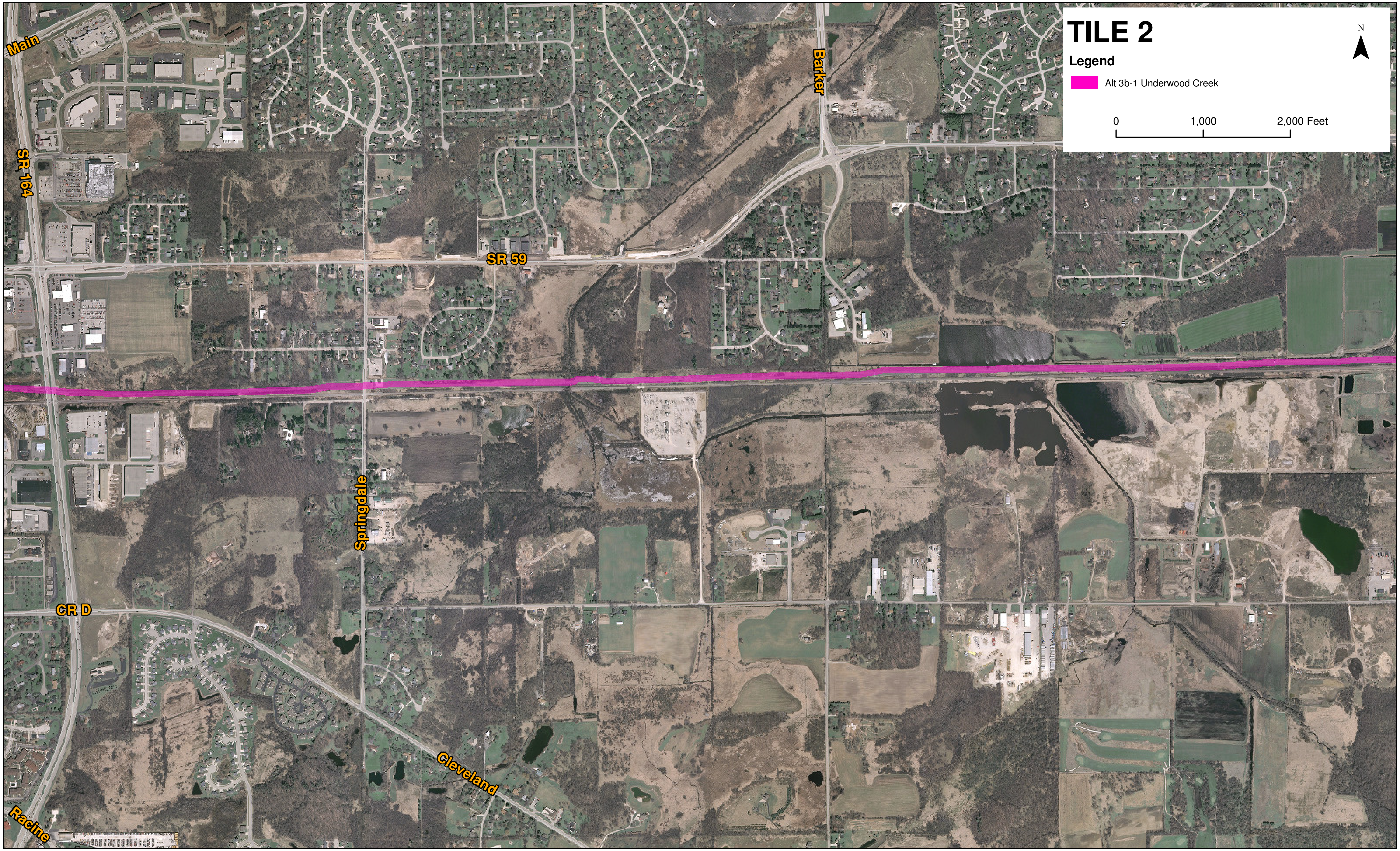
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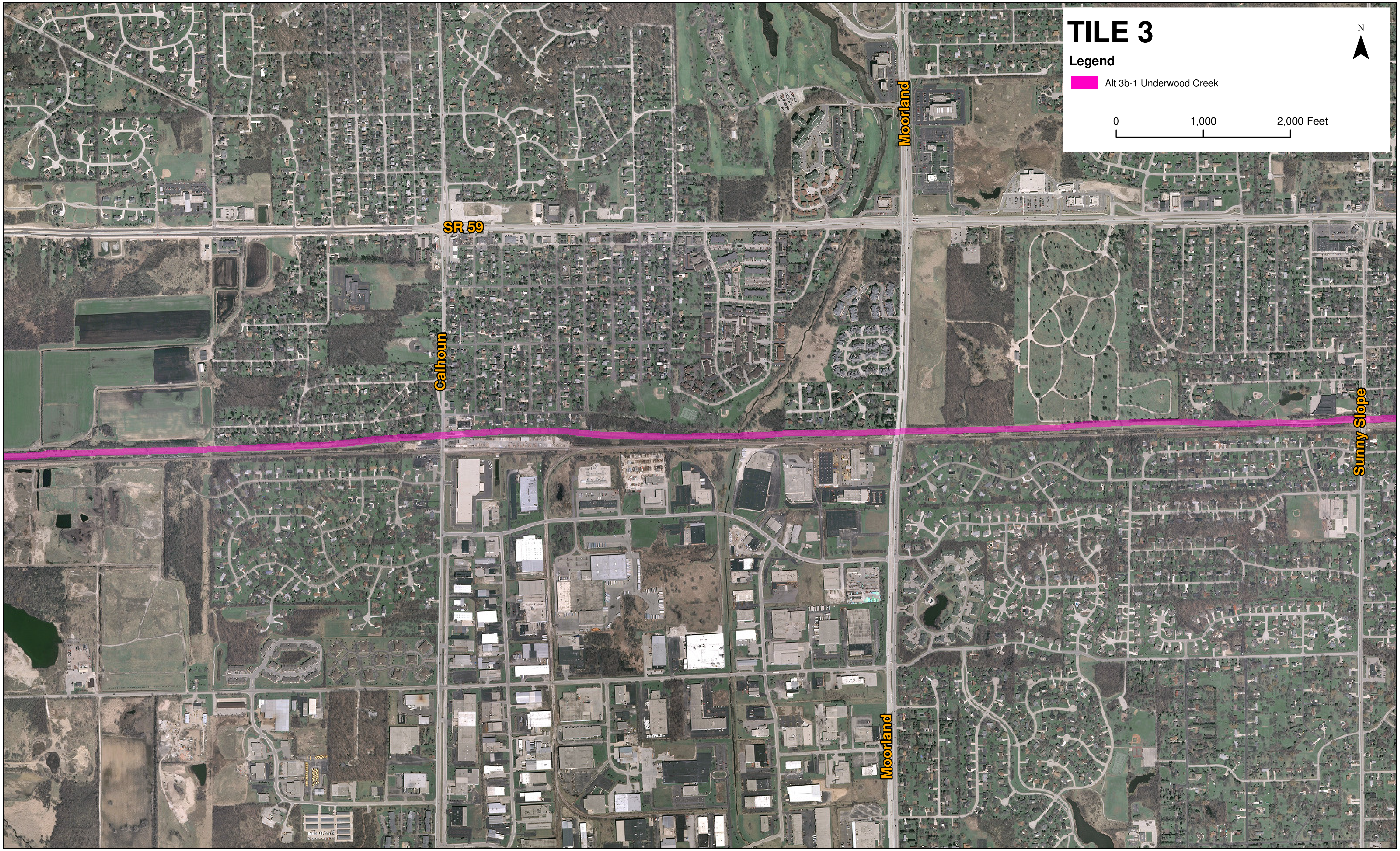
SR 59
Barker
Springdale
CR D
Cleveland
Racine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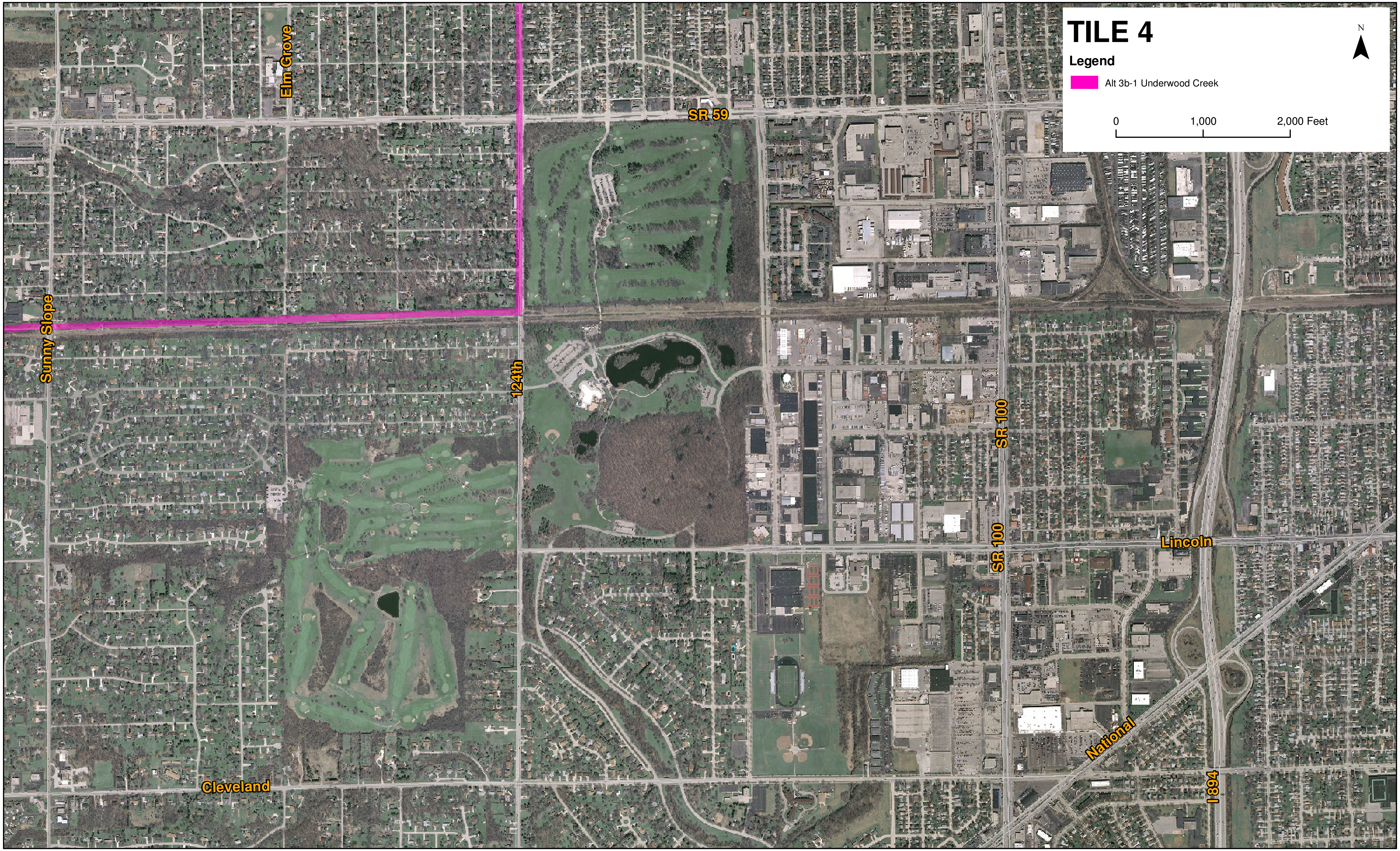
Moorland
Moorland
Sunny Slope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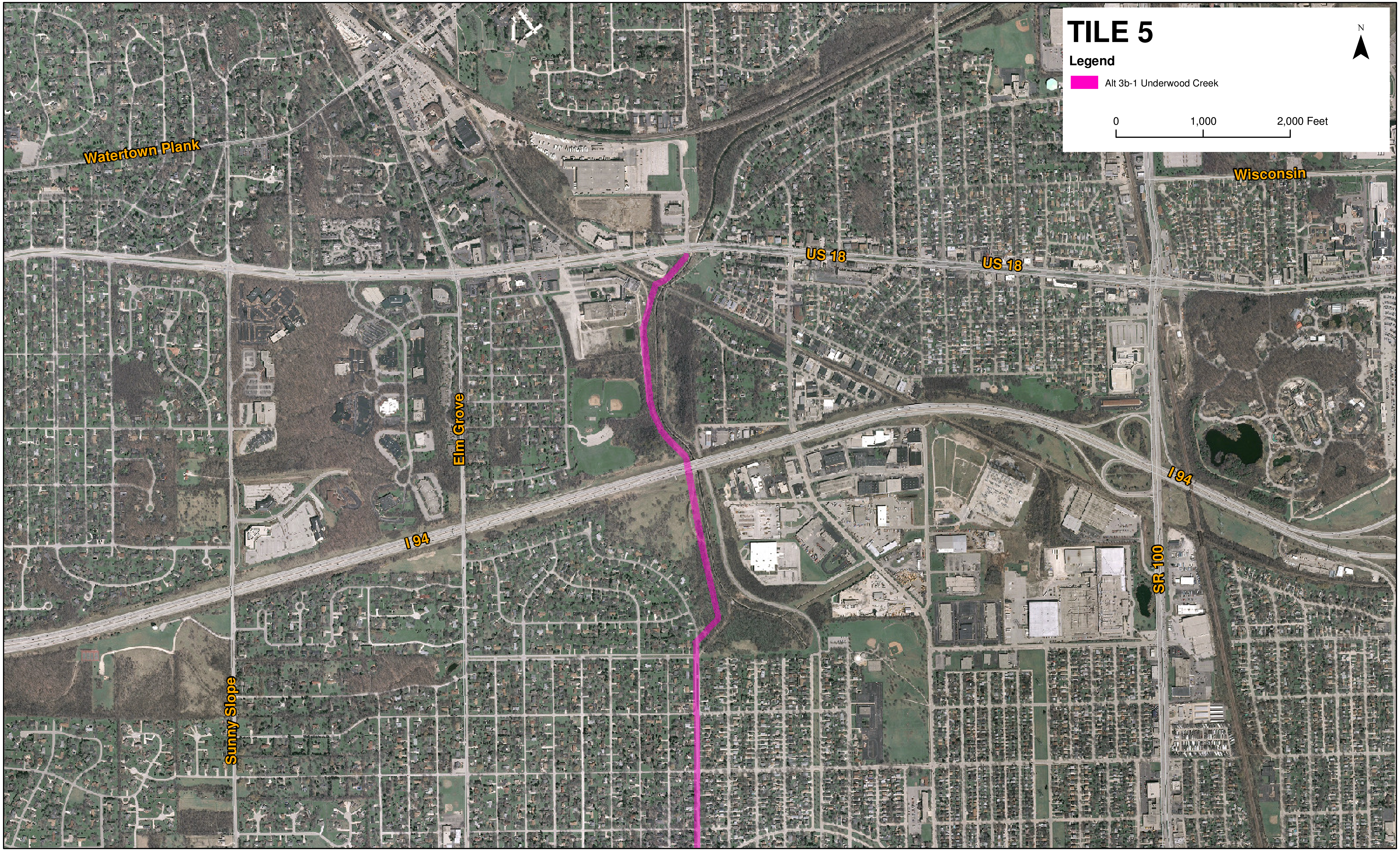
SR 100
Lincoln
National
Cleveland
I 894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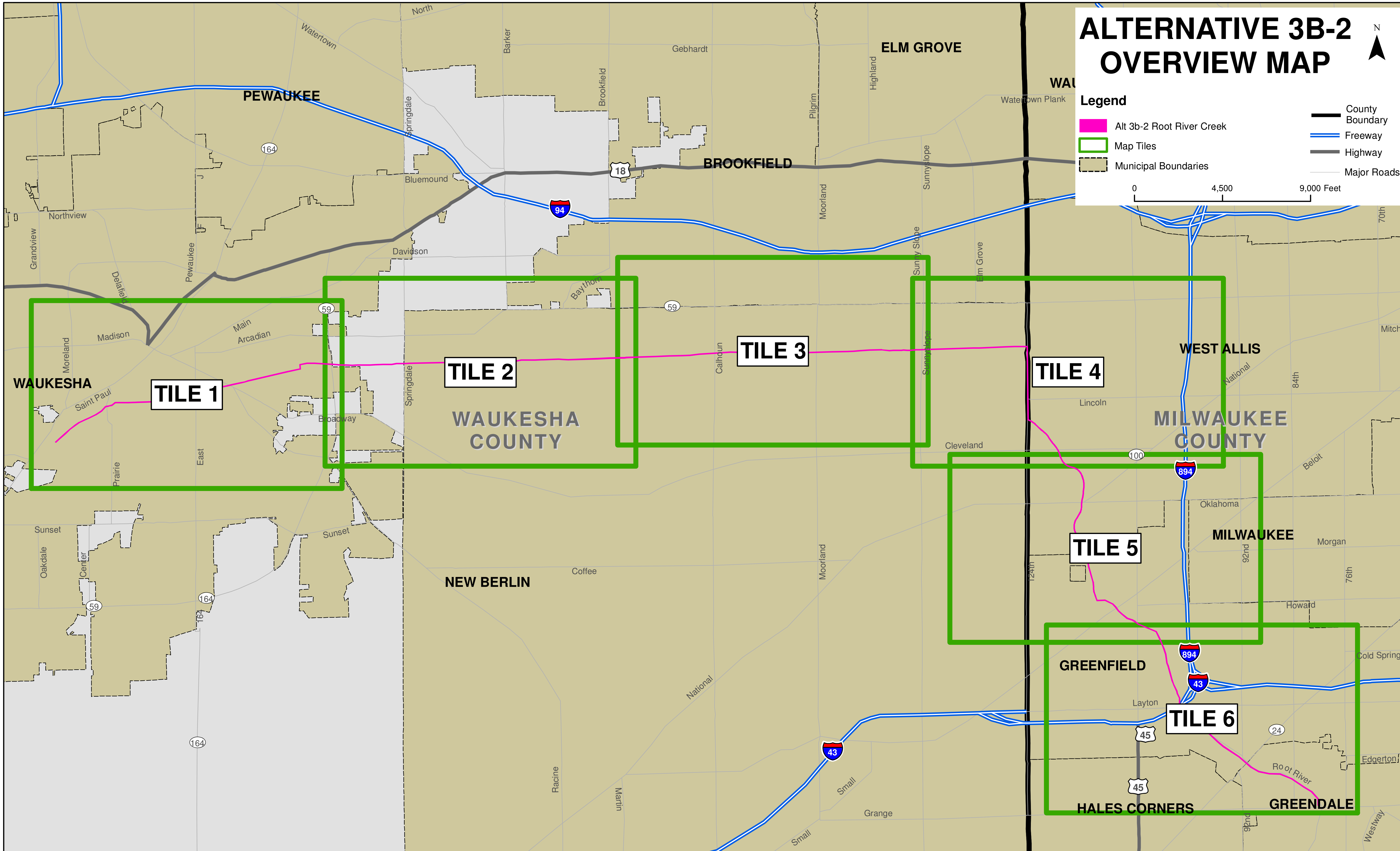
I 94
SR 100
Sunny Slope



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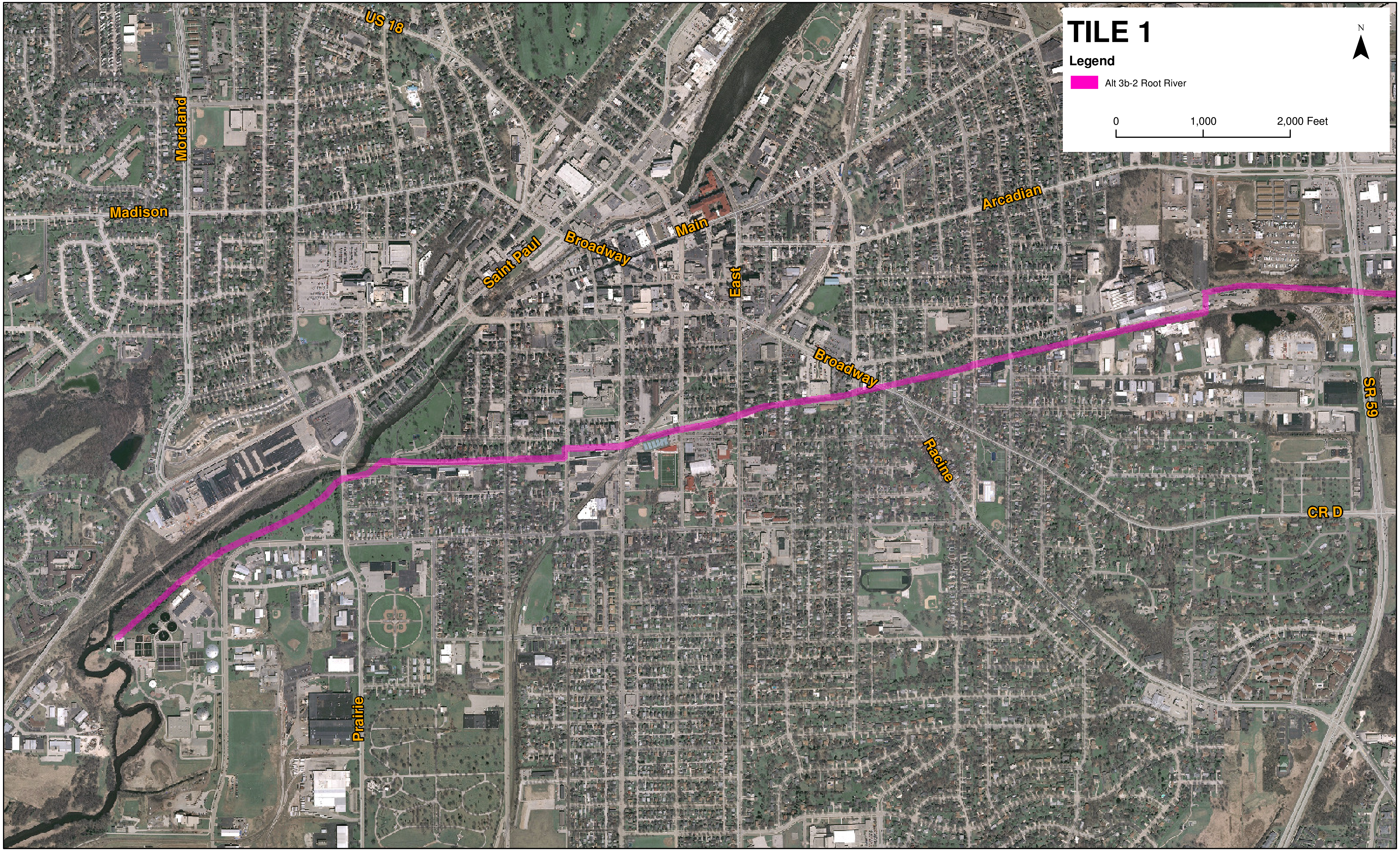
Municipal Boundaries
County Boundary
Freeway
Highway
Major Roads
0
4,500
9,000 Feet
TILE 1
TILE 2
TILE 3
TILE 4
TILE 5
TILE 6
WAUKESHA
PEWAUKEE
ELM GROVE
BROOKFIELD
WAUKESHA COUNTY
MILWAUKEE COUNTY
WEST ALLIS
MILWAUKEE
NEW BERLIN
GREENFIELD
HALES CORNERS
GREENDALE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0
1,000
2,000 Feet
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Moreland
Madison
Saint Paul
Broadway
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Broadway
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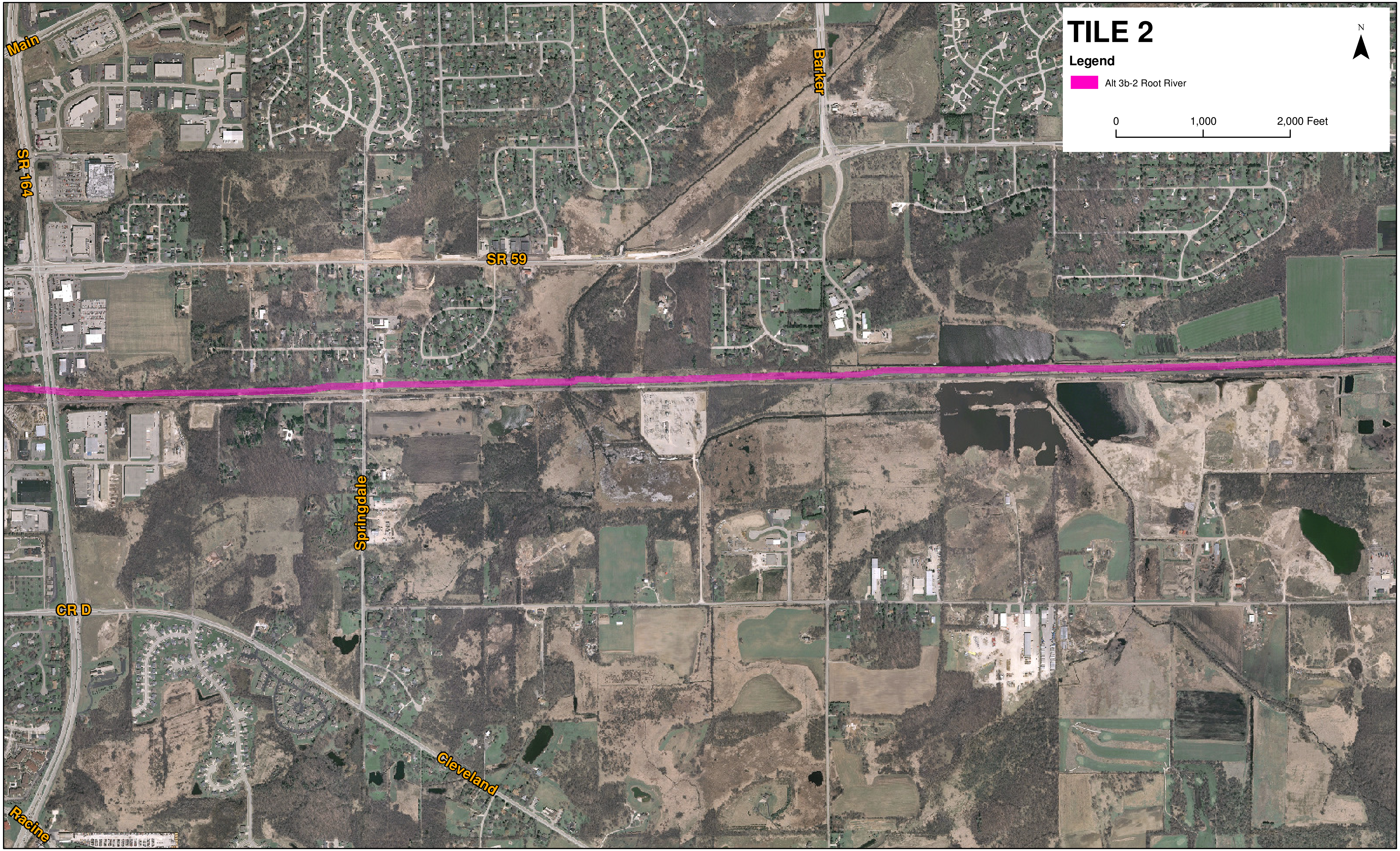
SR 59
CR D
Prairie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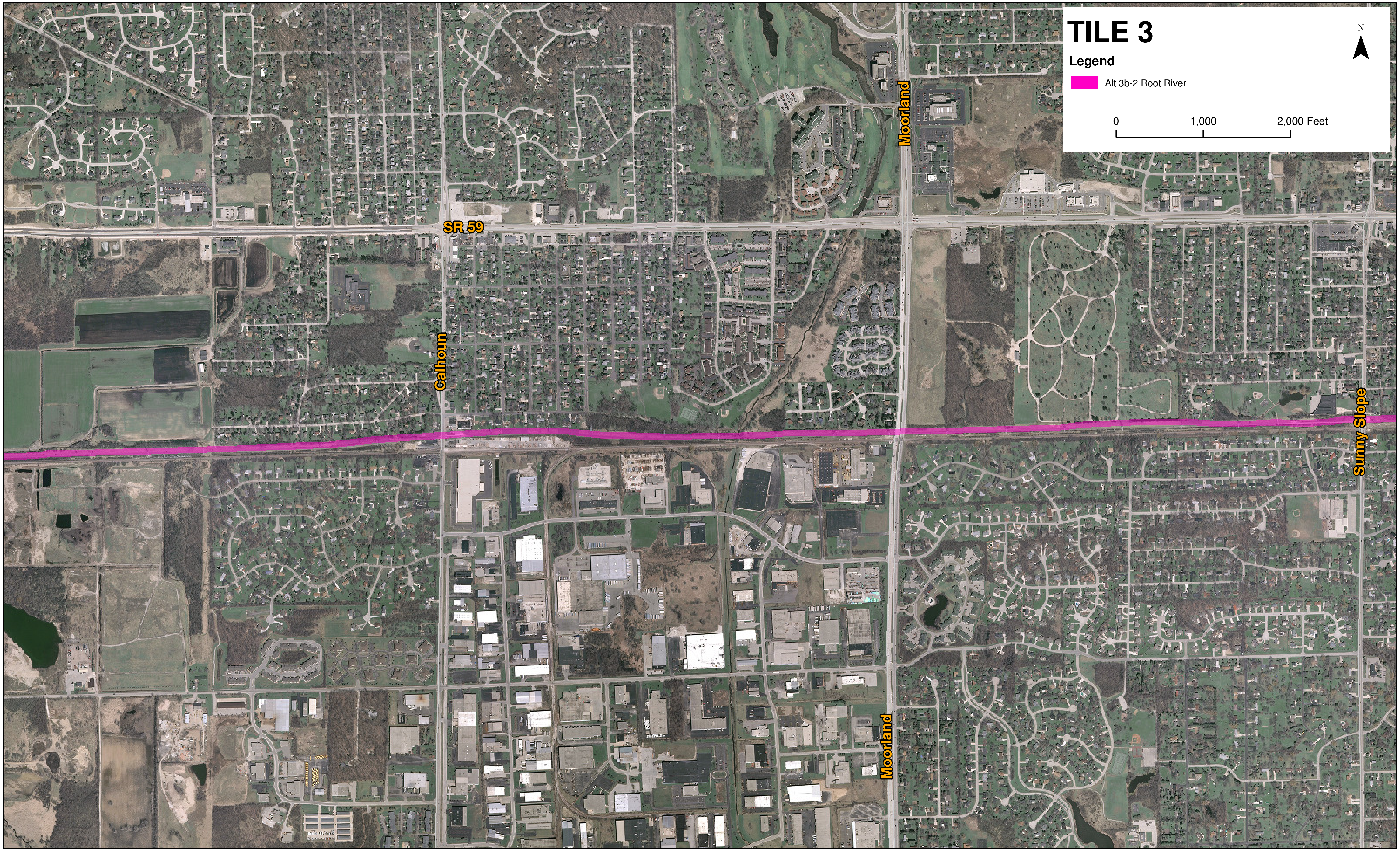
Main
SR 164
SR 59
Barker
Springdale
CR D
Cleveland
Racine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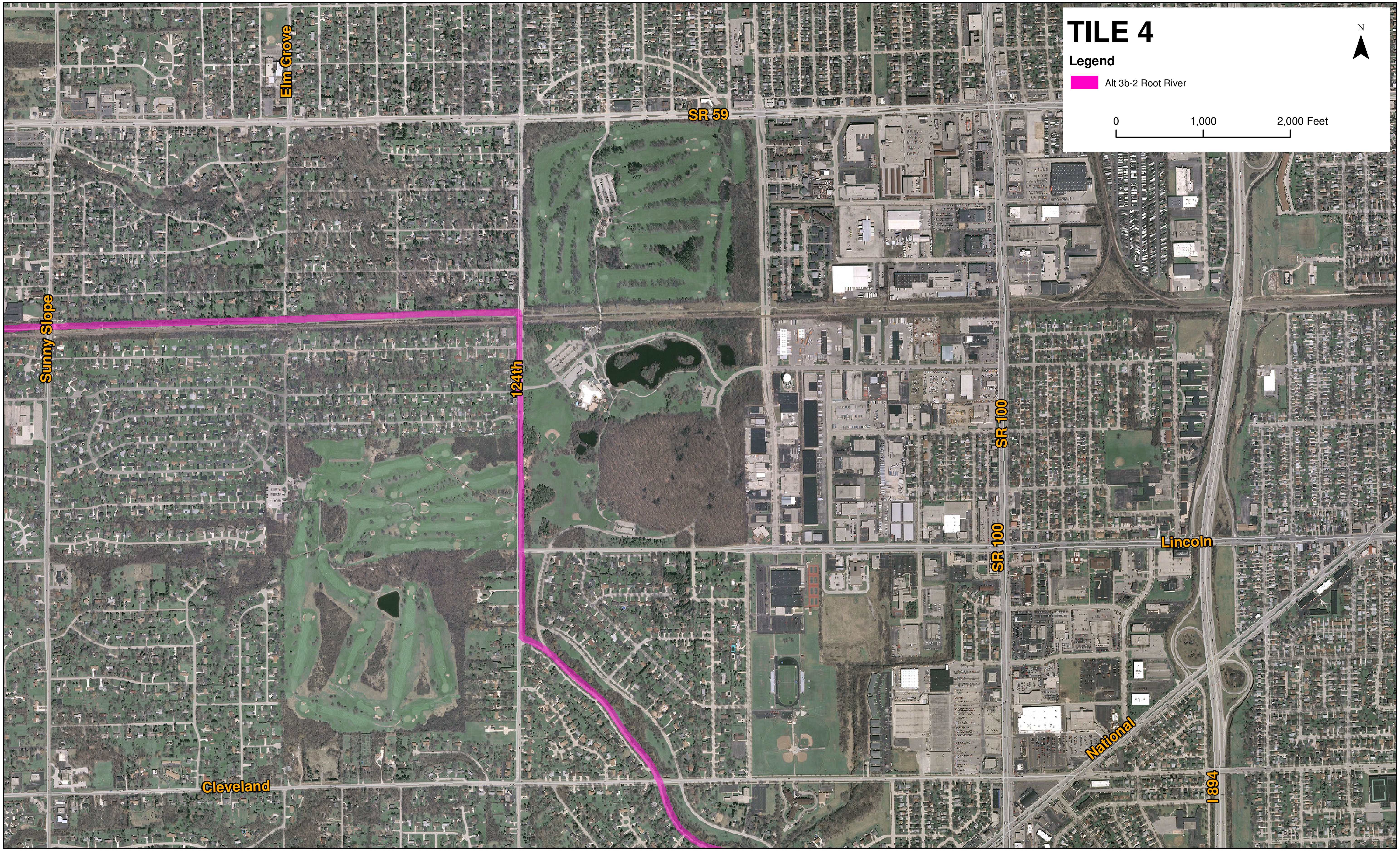
SR 59
Moorland
Calhoun
Sunny Slope
Moorland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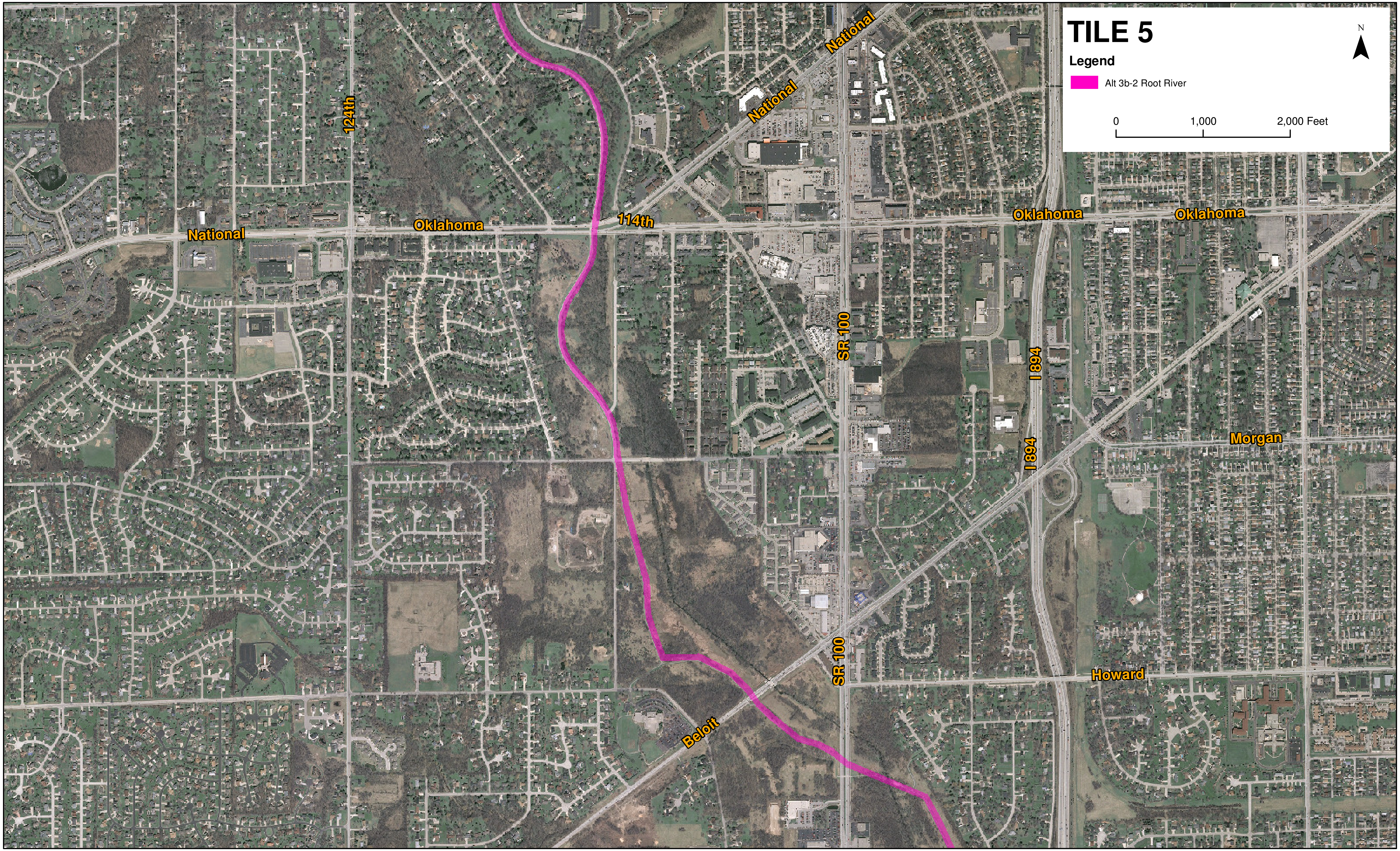
Lincoln
National
I 894
Cleveland



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2,000 Feet
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National
National
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124th
Oklahoma
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Oklahoma
Oklahoma
SR 100
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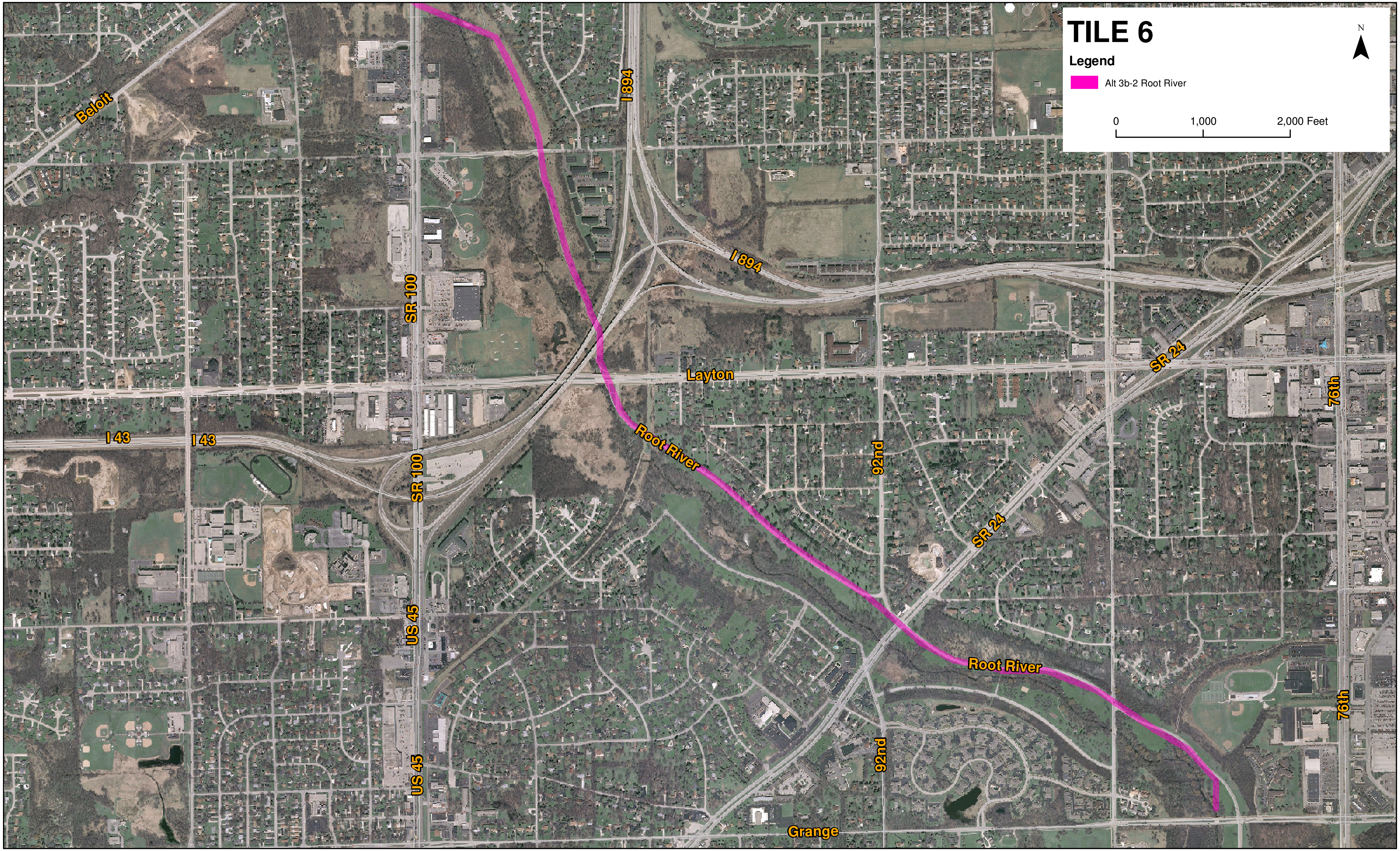
I 894
Morgan
SR 100
Howard
Beloit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1,000
2,000 Feet
Beloit
I 894
I 894
SR 100
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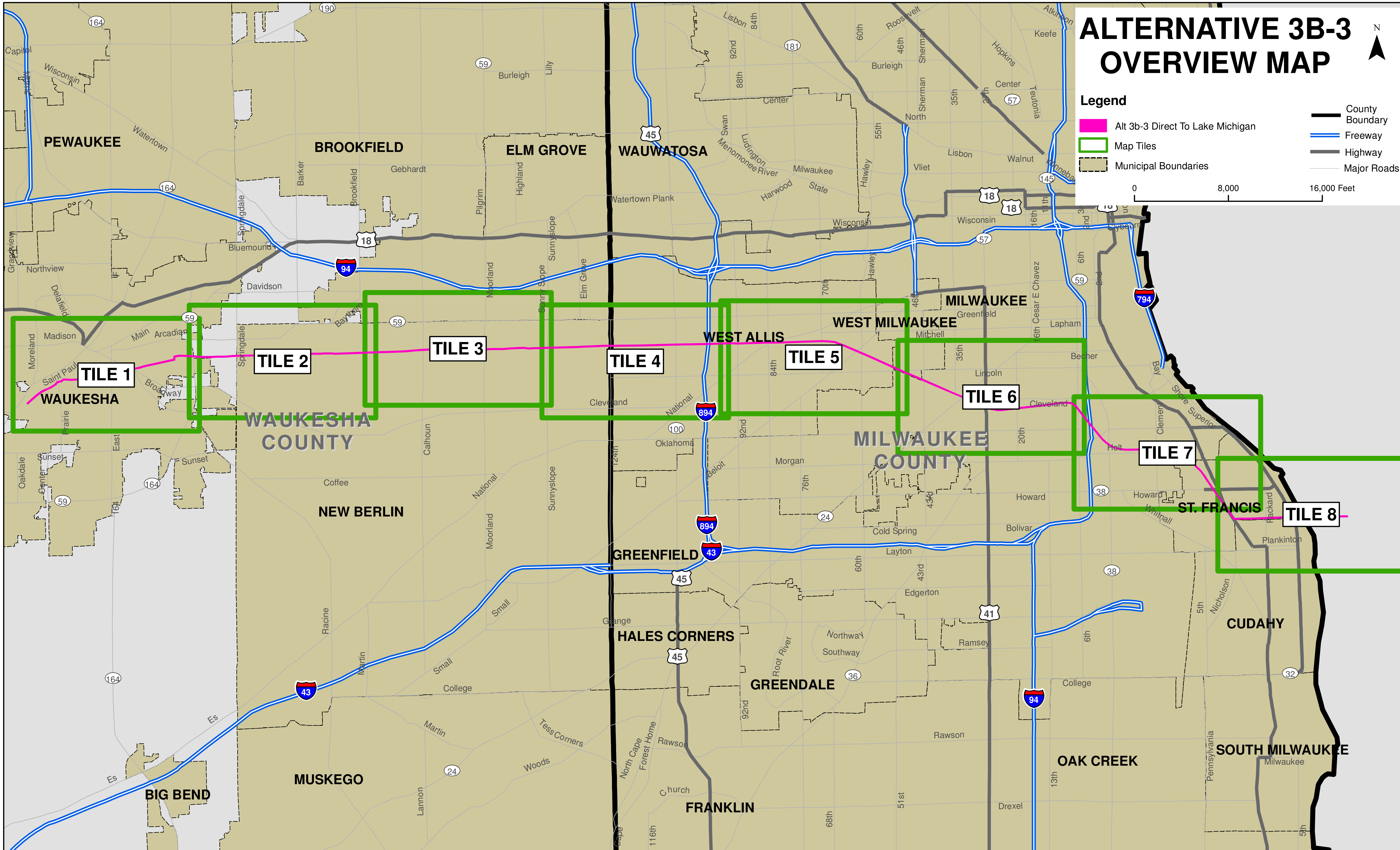
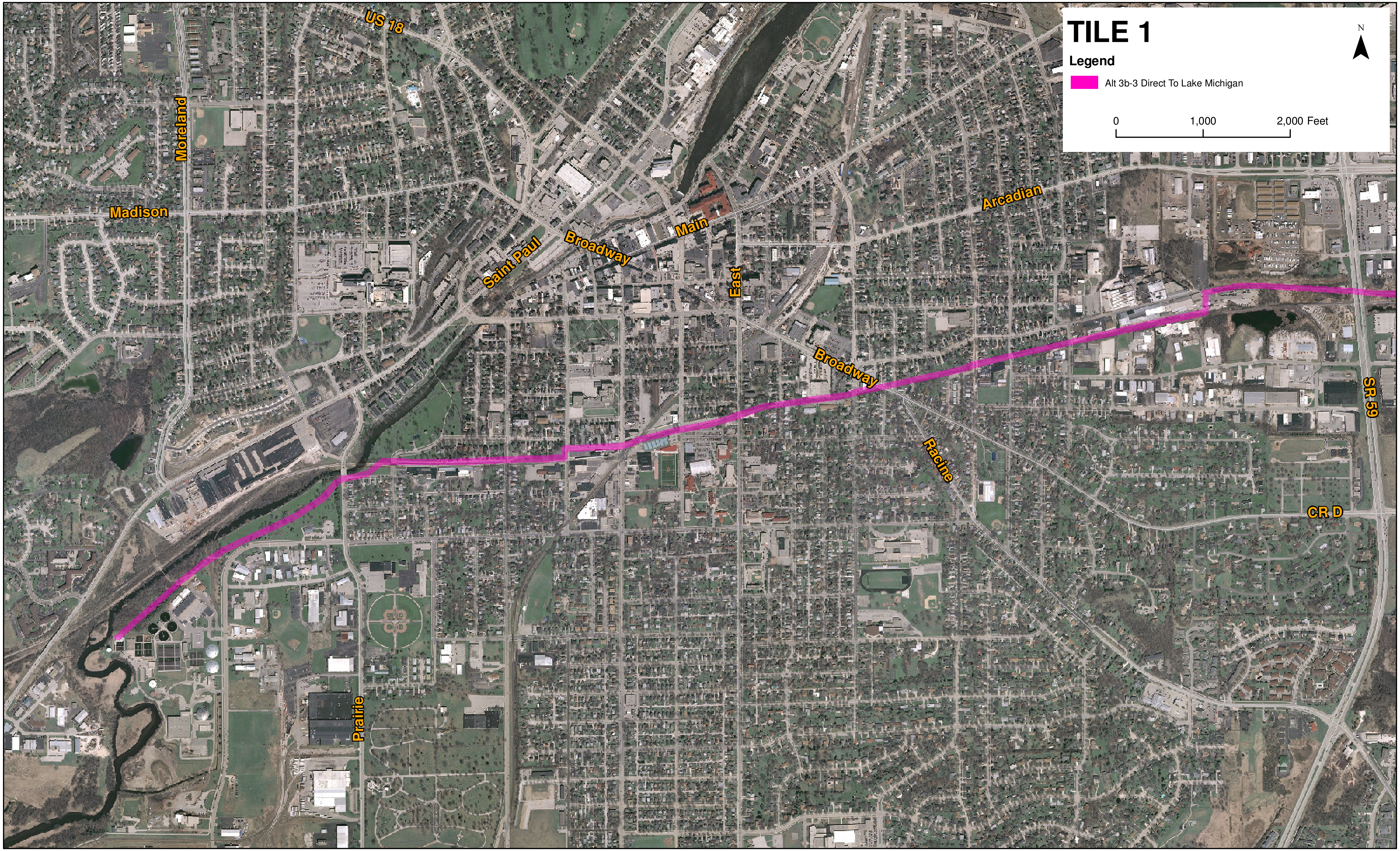
Layton
SR 24
SR 24
76th
76th
I 43
I 43
Root River
Root River
92nd
92nd
US 45
US 45
Grange



ALTERNATIVE 3B-3
OVERVIEW MAP
Legend
Alt 3b-3 Direct To Lake Michigan
Map Tiles
Municipal Boundaries
County Boundary
Freeway
Highway
Major Roads
0
8,000
16,000 Feet
N
TILE 1
TILE 2
TILE 3
TILE 4
TILE 5
TILE 6
TILE 7
TILE 8
PEWAUKEE
BROOKFIELD
ELM GROVE
WAUWATOSA
MILWAUKEE
WEST MILWAUKEE
WEST ALLIS
WAUKESHA
WAUKESHA COUNTY
MILWAUKEE COUNTY
NEW BERLIN
GREENFIELD
HALES CORNERS
GREENDALE
ST. FRANCIS
CUDAHY
OAK CREEK
SOUTH MILWAUKEE
MUSKEGO
BIG BEND
FRANKLIN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Madison
Saint Paul
Broadway
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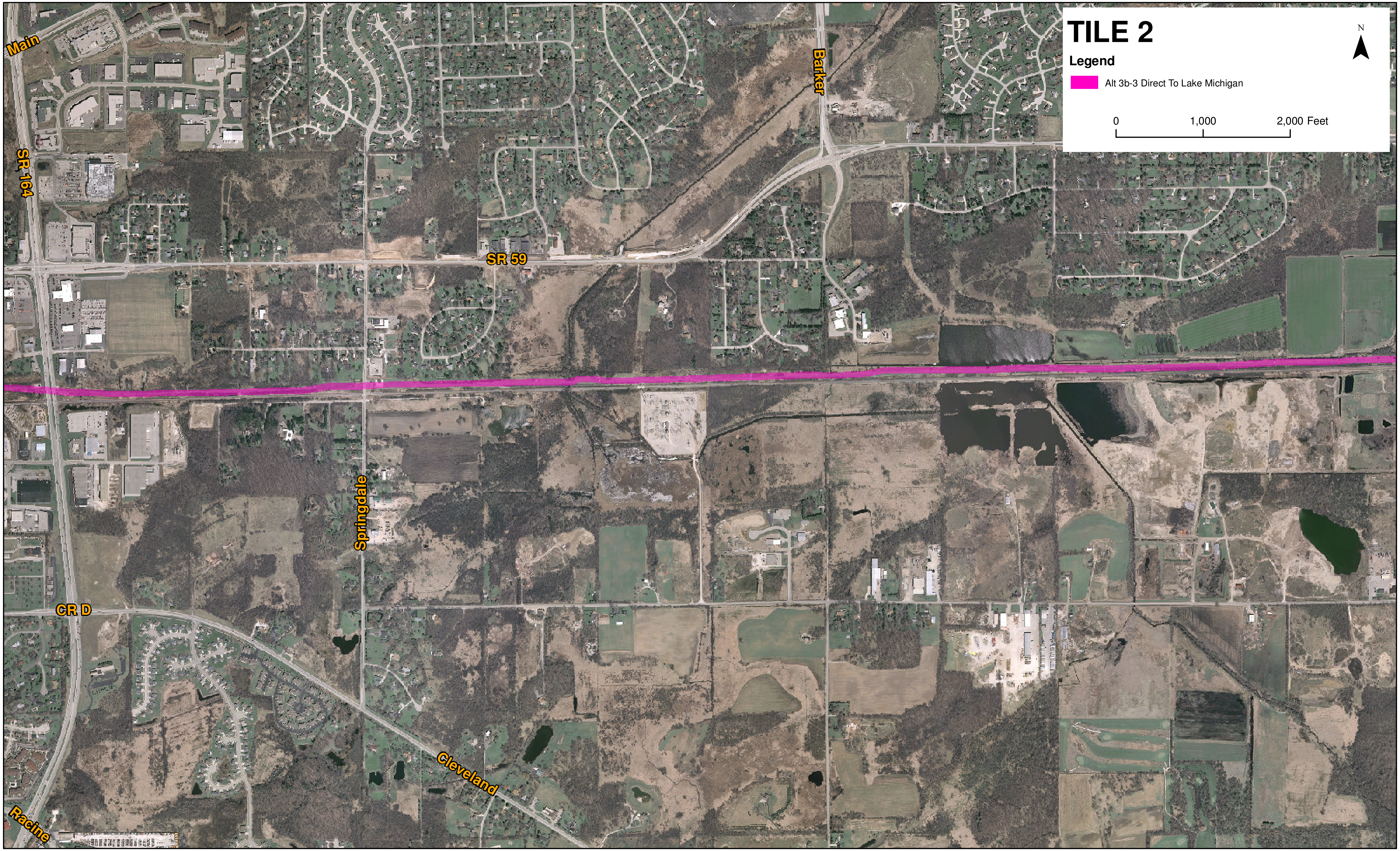
SR 59
CR D
Prairie



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2,000 Feet
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SR 164
SR 59
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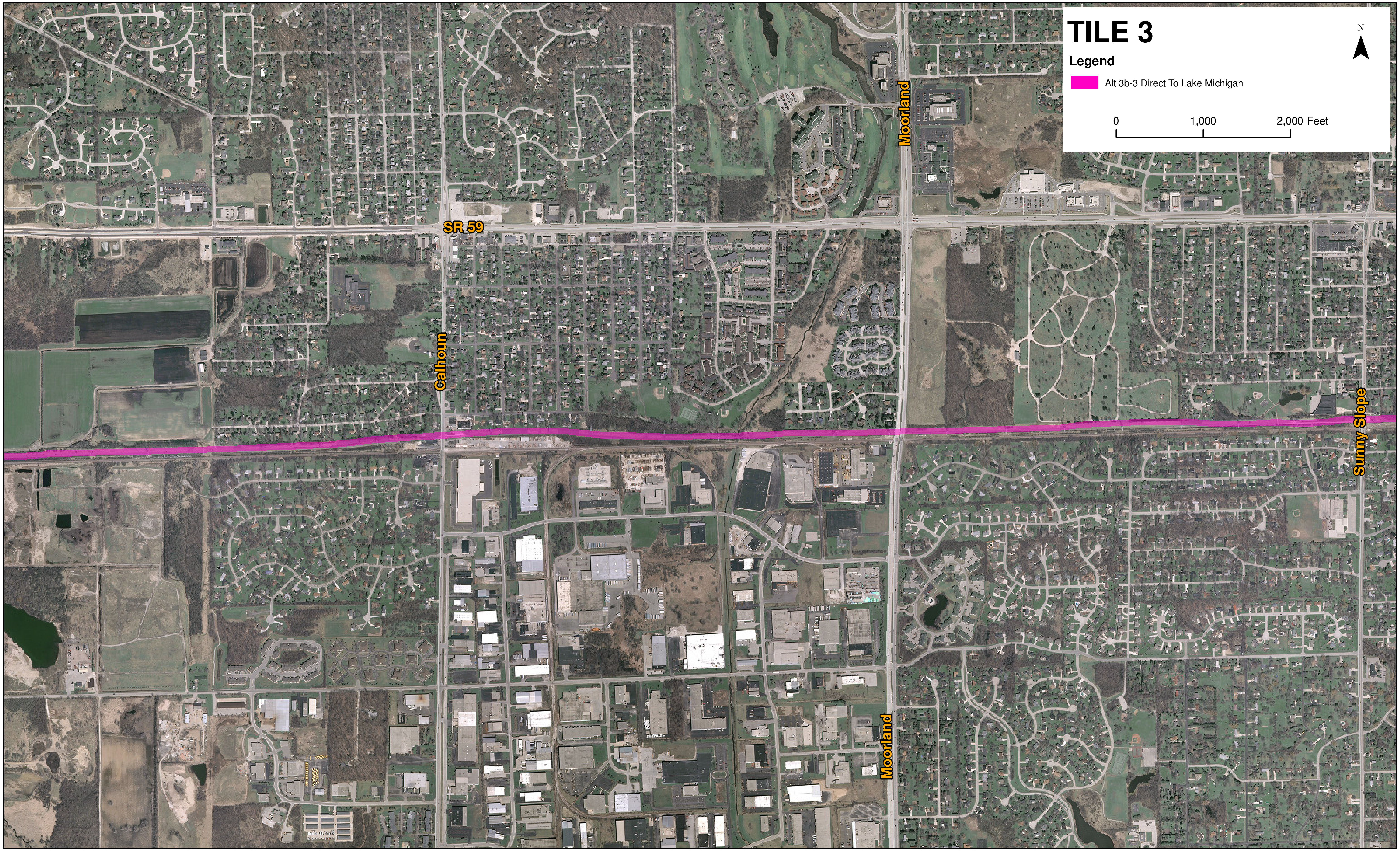
Springdale
CR D
Cleveland
Racine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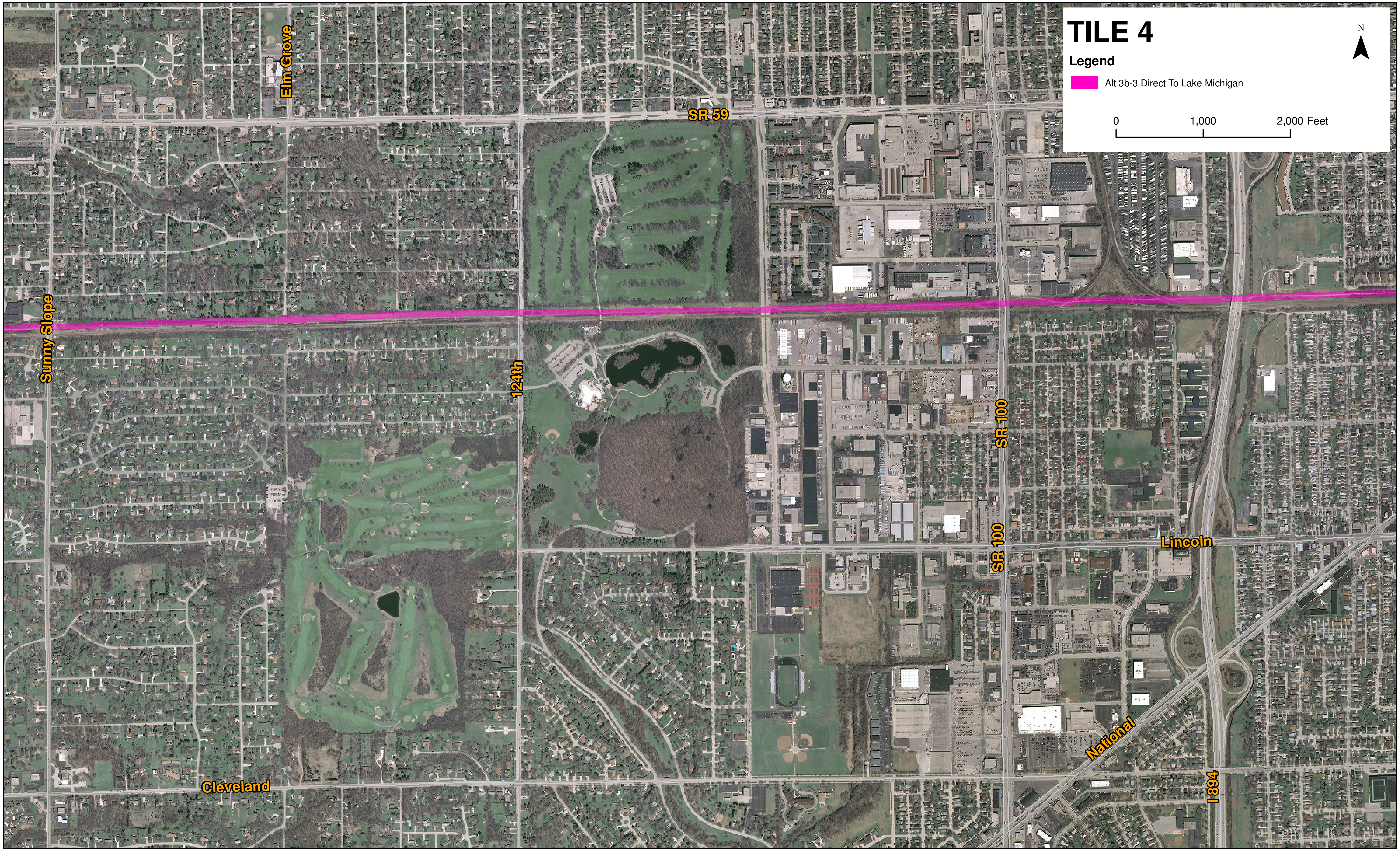
Moorland
Moorland
Sunny Slope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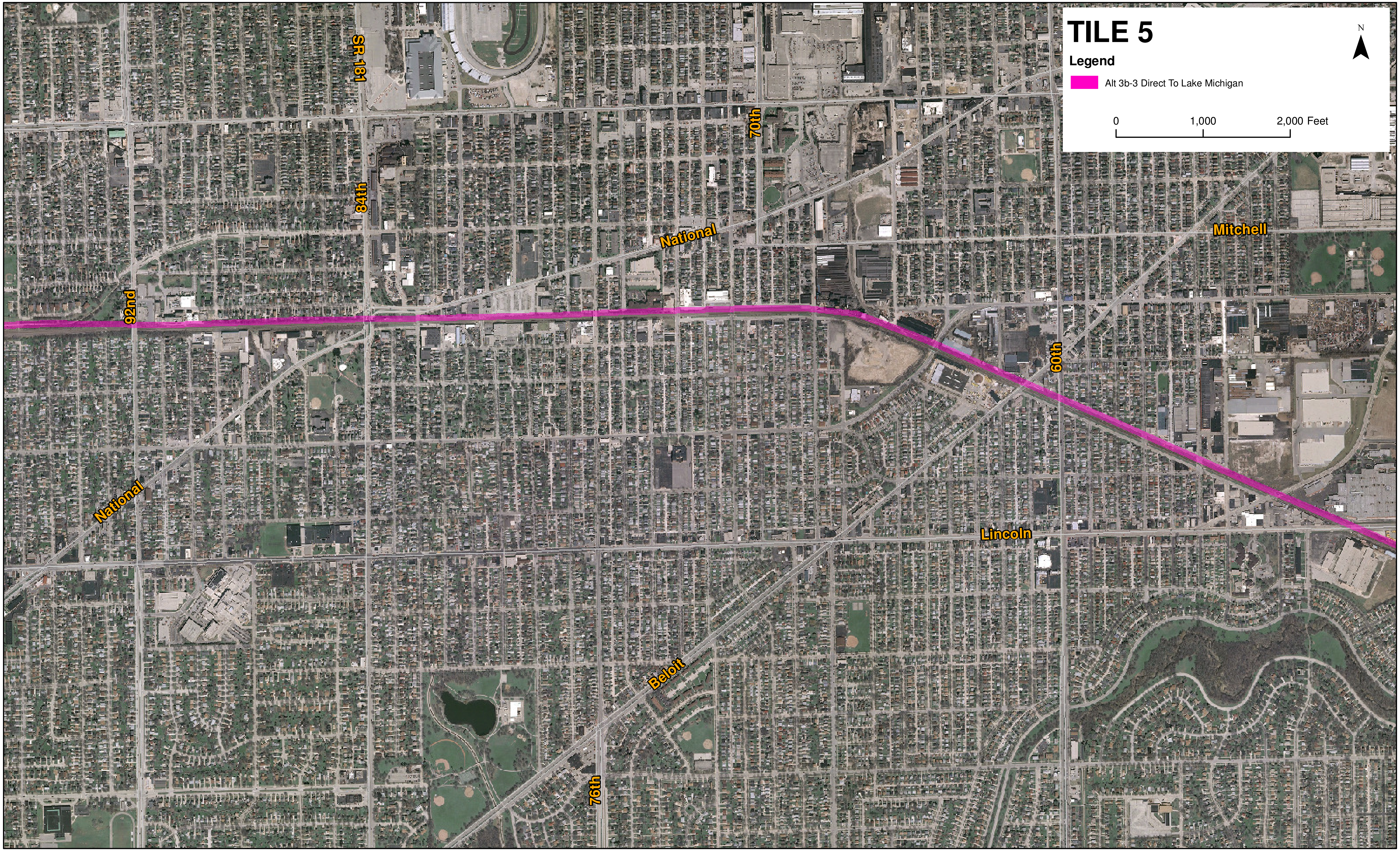
Elm Grove
Sunny Slope
124th
SR 100
SR 100
Lincoln
National
Cleveland
I 894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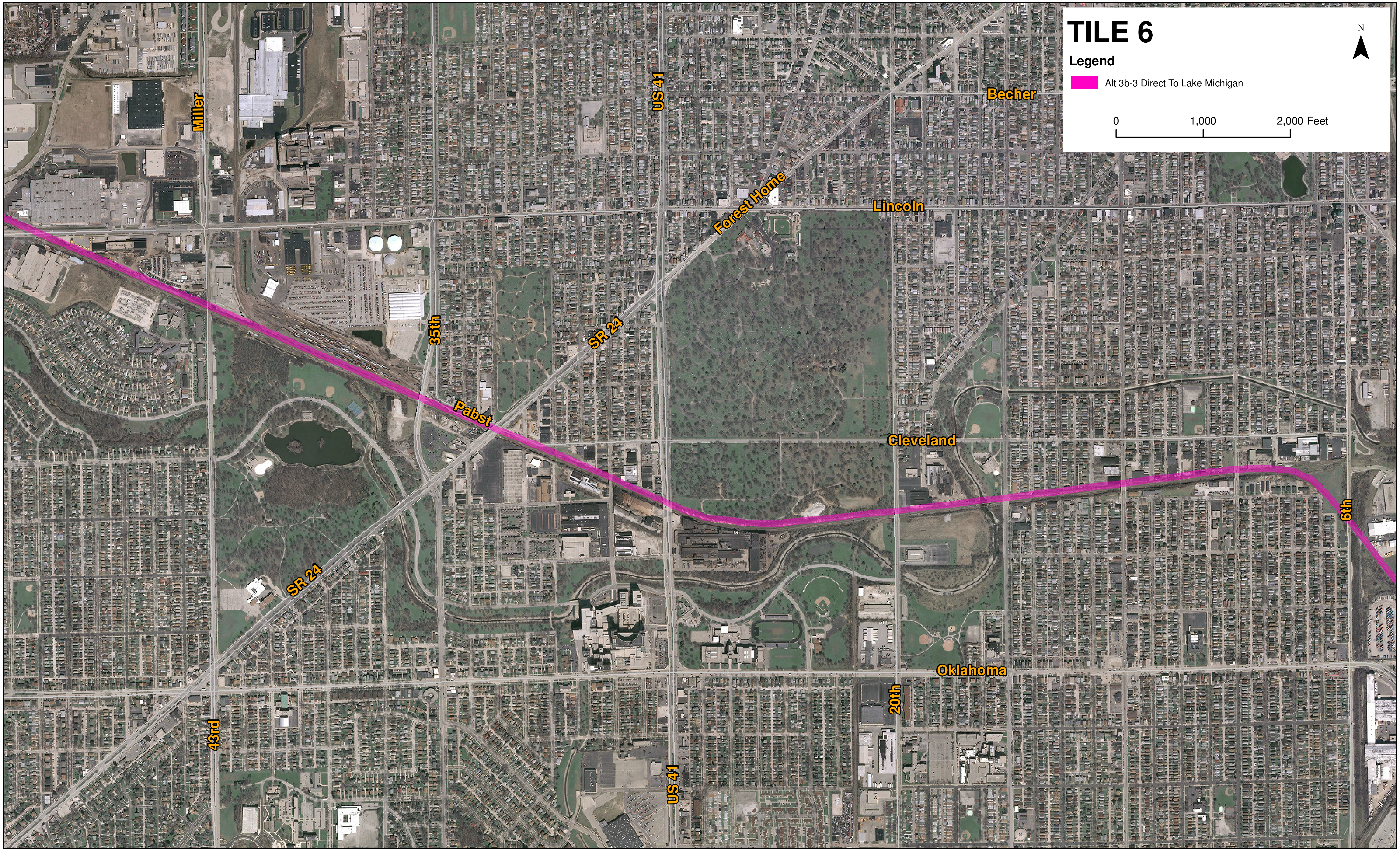
84th
National
Mitchell
92nd
60th
National
Lincoln
Beloit
76th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2,000 Feet
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Forest Home
Lincoln
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Oklahoma
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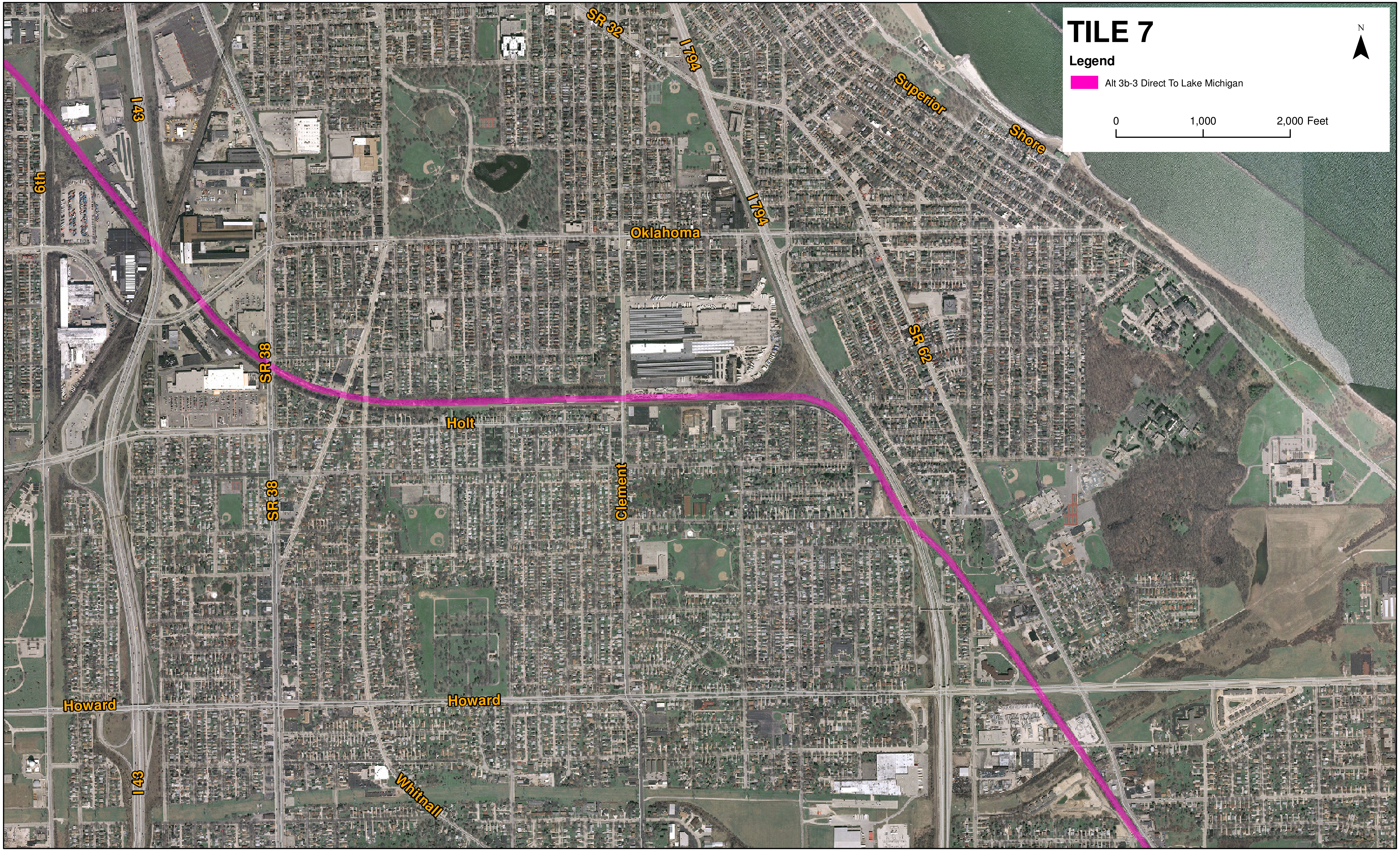
43rd
US 41



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2,000 Feet
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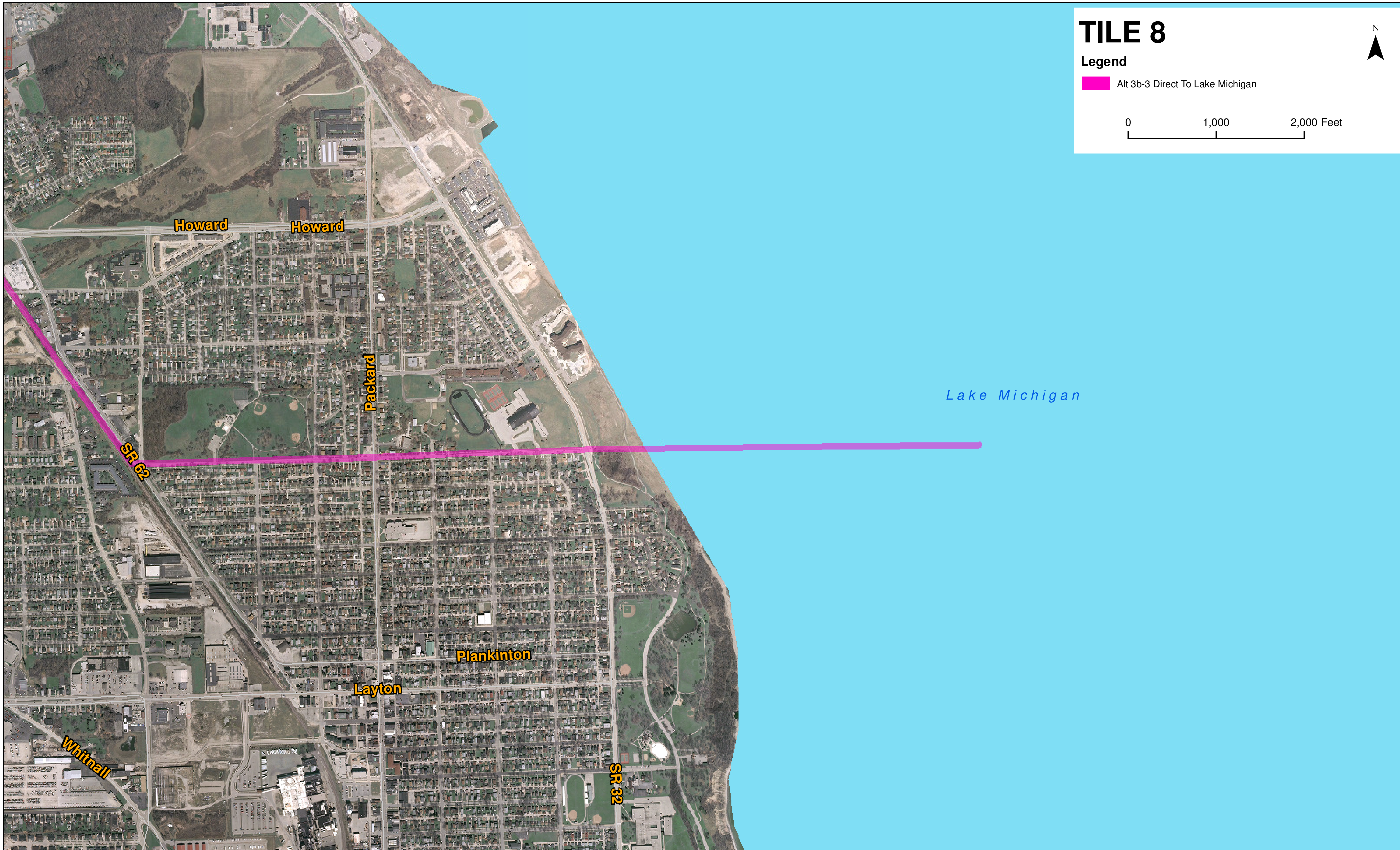
I 794
Superior
Shore
I 43
6th
Oklahoma
SR 38
SR 62
Holt
Clement
Howard
Whitnall



TILE 8
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0
1,000
2,000 Feet
N
Lake Michigan
Howard
Howard
Packard
SR 62
Plankinton
Layton
Whitnall
SR 32

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Chapter 2

Water Use and Quality

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CHAPTER 2

Water Use and Quality

2.1 Introduction

This chapter contains information necessary to identify and quantify the construction and operational impacts of the supply and return flow alternatives on water use and quality.

2.2 Groundwater Resources

2.2.1 Existing Resources

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 alternatives. Data for the aquifers present are provided by county where available from published reports. Groundwater quality data are provided on a regional basis and should be considered summary data.

Potential impacts to the aquifers present near the supply and return flow alternatives being considered can be divided in to two categories: temporary construction-related impacts and long-term operational impacts. Construction impacts to shallow aquifers as a result of the construction and placement of a 36-inch water main from the new water treatment plants to the City and pipelines from 8 to 20 inches in diameter in the well field to the water treatment plant at shallow depths of generally less than 10 feet 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 once construction has been completed.

Long-term impacts related to the operation of the supply or return flow alternatives may involve long-term water withdrawal from deep and shallow aquifers and from alluvial soils adjacent to the Fox River or replenishment of the deep aquifer system if a Lake Michigan water supply source is approved. Similarly, return flow alternatives will result in the discharge of treated water to Underwood Creek or Root River, which ultimately drains to Lake Michigan, or discharge directly to Lake Michigan itself.

The U.S. Environmental Protection Agency (EPA) designates sole-source aquifers as part of their Wellhead Protection Program. There are no designated sole-source aquifers in the State of Wisconsin (EPA, 2010a).

2.2.1.1 Aquifers and Existing Use

The major aquifers in Waukesha and Milwaukee counties are the Quaternary and Late Tertiary unconsolidated sand and gravel aquifer, Silurian-Devonian dolomite aquifer, and Cambrian-Ordovician sandstone aquifer. Historical use of the aquifers is discussed in Application Section 3, “Waukesha Water Supply Sources.”

Shallow Aquifer. The unconsolidated sand-and-gravel aquifer is not continuous but consists of lenses and layers of sand and gravel interspersed with other fine-grained or other low-permeability deposits. Therefore, 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. Additional information in Section 3 of the Application, "Shallow Aquifer," describes how the aquifer known locally at the Troy Bedrock Valley Aquifer is used for water supply. Additional information on water quality in the shallow aquifer is found in Application Section 3, "Shallow Troy Bedrock Valley Aquifer."

Fox River Alluvium. The Fox River Alluvium, geology under and around the Fox River, consists of sands and gravels as well as clay layers. The geology varies spatially based upon past geologic activity and river geomorphic processes. The Fox River Alluvium may in some locations be connected with the shallow aquifer system. Wells designed to access river alluvium water typically draw water from the river and from adjacent shallow aquifers. Current water supply wells have not been sited to specifically tap the Fox River Alluvium as a water supply source to avoid treatment to surface water regulations. Potential water quality considerations of groundwater under the influence of surface water are discussed in Application Section 4, "Water Supply Alternative 2: Shallow Aquifer and Fox River Alluvium."

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 the dolomite aquifer and the Maquoketa shale. Due to the thickness of the sandstone aquifer, large water quantities can be produced from wells within the aquifer. Near Waukesha, recharge of this aquifer occurs further west where the Maquoketa shale does not exist. Exhibits 3-2 and 3-3 of the Application illustrate the constraints limiting recharge of the deep aquifer.

The City of Waukesha's groundwater supply has radium levels up to three times the United States Environmental Protection Agency's (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. 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. Additional information on deep aquifer water quality is found in Application Section 3, "Deep Aquifer Groundwater Quality."

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

Additional information in Application Section 3, "Deep Aquifer," describes water quality and quantity problems the county is facing, such as historical drawdowns of over 500 to 600 feet, current declining levels of 5 to 9 feet per year, and decreasing water quality.

Springs. Springs are known to exist in Waukesha County. The Wisconsin Geological and Natural History Survey maintains an inventory of springs. This inventory was consulted and multiple springs exist near the groundwater alternative area (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 for at least 80 percent of the time.

2.2.1.2 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 (BRR) oversees the Remediation and Redevelopment (RR) Program and has a Web-based mapping system, RR Sites Map,[1] which contains information about contaminated properties and other activities related to the investigation and cleanup of contaminated soil or groundwater in Wisconsin. The WDNR BRR RR Sites Map Geographic Information System (GIS) registry layers contain groundwater contamination sites and groundwater and soil contamination sites. Based on information obtained from the WDNR GIS Registry, there appears to be two closed (cleaned up) groundwater-contamination sites and three closed (cleaned up) groundwater- and soil-contamination sites along the routes for the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium alternatives; one open groundwater-contamination site and four closed groundwater- and soil-contamination sites along the Lake Michigan—Milwaukee Supply; only three closed groundwater and soil contamination sites along the Oak Creek supply alternative; one closed groundwater and soil contamination site along the Racine supply alternative; one closed groundwater-contamination site and four closed groundwater- and soil-contamination sites along the Underwood Creek to Lake Michigan alternative; four closed groundwater and soil contamination sites; and five closed groundwater contamination sites and 14 closed groundwater and soil contamination sites along the return flow direct to Lake Michigan (WDNR, 2010b).

According to the WDNR's online BRR 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). Owing to the significant number of ERP and LUST sites within the counties of the supply and return flow alternatives, there is a potential that contaminated groundwater could be encountered during construction and operation activities. For final design, the City will work with WDNR to appropriately manage crossing any contaminated-groundwater areas. If groundwater contamination is encountered during construction or operation activities, the City will work with the appropriate agencies to handle it appropriately.

2.2.2 Impacts and Mitigation

Environmental effects on groundwater for each of the water supply and return flow alternatives could occur either from the construction process or from operation and maintenance. The potential impacts from operation and maintenance vary depending upon

[1] http://www.dnr.state.wi.us/org/aw/rr/gis/.

the specific water supply alternative and are described individually below. The potential construction impacts are consistent for all alternatives and are described in this section.

Construction of a new water main or return flow pipe will all involve the installation of 8- to 36-inch water main pipe at shallow depths of generally less than 10 feet and will not require any long-term water withdrawal or discharges. Therefore, impacts to groundwater sources as a result of construction activities will be limited.

Potential groundwater impacts from heavy equipment fuel, lubrication oil, or hydraulic oil spills as a result of the construction of any of the alternatives will be minimized by implementing best management practices (BMPs) for storing such materials, refueling equipment, developing and implementing a spill prevention plan, and cleaning up of any lost materials that may present a danger to the aquifer. Preventative 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 one 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. As a result, the construction of a preferred supply and return flow alternative is not anticipated 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 fluid spills and coordinate the development of appropriate BMPs to protect important resources.

2.2.2.1 Water Supply Alternatives

Deep and Shallow Aquifers. The Deep and Shallow Aquifers supply alternative is entirely within Waukesha County. The aquifers used for water supply with this alternative include the Quaternary and Late Tertiary unconsolidated sand-and gravel-aquifer (shallow aquifer) and the Cambrian-Ordovician sandstone aquifer (deep aquifer). Water withdrawals between these two aquifers are described in detail in Section 4 of the Application.

As discussed in the Application, long-term water withdrawal from the deep and shallow aquifers and from alluvial soils adjacent to the Fox River in Waukesha County will result in a continued draw down of the aquifer levels and increased treatment of the water to ensure a safe drinking water supply. This drawdown of the deep aquifer will continue to cause water to migrate toward Waukesha County away from Lake Michigan, as the aquifers attempt to fill the cone of depression in the deep aquifer from nearby aquifer sources.

A groundwater model was developed to simulate the groundwater flow and capacity of shallow aquifer used in this alternative. Deep aquifer modeling was not conducted because that aquifer is currently used by the City of Waukesha and the performance is well known. The detailed results can be found in Appendix O, Groundwater Modeling, of the Application. The results indicate a maximum groundwater drawdown of about 50 feet. Groundwater impacts to surface waters and other natural resources are described in Chapter 2.3, Surface Water Resources, and Chapter 2.4, Wetlands.

Groundwater flows to the Fox River are eliminated and flow from the Fox River is reduced for a total change of 2.4 mgd in this reach of the river. Groundwater reductions to three cold water trout streams (Pebble Brook, Pebble Creek, and Mill Brook) also occur. For example, groundwater baseflow to Pebble Brook would be reduced by 61 percent, Pebble Creek would be reduced by 9 percent, and Mill Book would be reduced by 29 percent. The largest reduction of groundwater flow to a trout stream is 2.1 mgd from Pebble Brook.

The spatial extent over which groundwater drawdown of 5 feet or greater and of 1 foot or greater is shown in the figures at the end of this section. Within this groundwater drawdown footprint, several springs are known to exist. Maps depicting the Wisconsin Geological and Natural History Service spring inventory were reviewed and compared to the groundwater drawdown to see which springs may be affected (WGNHS, 2010). Figures at the end of the Chapter show the spring locations. The 1-foot drawdown affects 7 springs that range in known flow rate from 5 to 50 gallons per minute (gpm) (0.11 cfs).

Additional details on the specific impacts from operation of this groundwater supply alternative is provided in Application Section 3, "Need for a New Water Supply"; Section 4, "Water Supply Alternatives"; and in the Groundwater Modeling Results in Appendix O of the Application.

Shallow Aquifer and Fox River Alluvium—Waukesha County. The Shallow Aquifer and Fox River Alluvium alternative is entirely within Waukesha County. The aquifer used for this water supply alternative is the Quaternary and Late Tertiary unconsolidated sand-and-gravel aquifer (shallow aquifer) and alluvium under and around the Fox River. Water withdrawal from this aquifer is described in detail in Section 4 of the Application. Under this alternative, the deep aquifer would no longer be used. No longer using the deep aquifer will result in a beneficial partial rebound of the deep aquifer groundwater level because no more pumping would be occurring from the City of Waukesha.

A groundwater model was developed to simulate the groundwater flow and capacity of shallow aquifer used in this alternative. The detailed results can be found in Appendix O, Groundwater Modeling, of the Application. Under this alternative, more water is pumped out of the shallow aquifer because the deep aquifer is no longer used as a source of water supply. The results indicate a maximum groundwater drawdown of about 105 feet. Groundwater impacts to surface waters and other natural resources are described in Chapter 2.3, Surface Water Resources, and Chapter 2.4, Wetlands.

Groundwater flows to the Fox River are eliminated and flow from the Fox River is reduced for a total change of 5.9 mgd in this reach of the river. Groundwater reductions to three cold water trout streams (Pebble Brook, Pebble Creek, and Mill Brook) also occur. For example, groundwater baseflow to Pebble Brook would be reduced by 58 percent, Pebble Creek would be reduced by 23 percent, and Mill Book would be reduced by 30 percent. The largest reduction of groundwater flow to a trout stream is 2.0 mgd from Pebble Brook. Groundwater flow reduction to Mill Brook is roughly the same, and flow reduction to Pebble Creek increases under this alternative as compared to the Deep and Shallow Aquifers alternative.

The spatial extent over which groundwater drawdown of 5 feet or greater and of 1 foot or greater is shown in the figures at the end of this Chapter. Within this groundwater drawdown footprint, several springs are known to exist. Maps depicting the Wisconsin Geological and Natural History Service spring inventory were reviewed and compared to the groundwater drawdown to see which springs may be affected (WGNHS, 2010). Figures at the end of the Chapter show the spring locations. The 1-foot drawdown affects 12 springs that range in known flow rate from 0 at the time of survey to 50 gallons per minute (gpm) (0.11 cfs).

Additional details on the specific impacts from operation of this groundwater supply alternative is provided in Application Section 3, "Need for a New Water Supply"; Section 4, "Water Supply Alternatives"; and in the Groundwater Modeling Results in Appendix O of the Application.

Lake Michigan–Milwaukee Supply. Withdrawal from Lake Michigan for the Lake Michigan–Milwaukee Supply alternative would mean withdrawal of surface waters from Lake Michigan and therefore would not involve groundwater withdrawals, except for the emergency purposes described in Application Section 4. As a result, no adverse impacts to groundwater aquifers would occur. Under any Lake Michigan supply alternative, the deep aquifer would no longer be used. No longer using the deep aquifer would have the benefit of a partial rebound of the deep aquifer groundwater level because there would be no more pumping by the City of Waukesha.

Due to the volume of water present, withdrawal from Lake Michigan with return flow will result in an insignificant change in lake water levels and therefore is not anticipated to result in adverse affects to regional aquifer supplies that are influenced by Lake Michigan.

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

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

2.2.2.2 Return Flow Alternatives

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

Root River to Lake Michigan. The Root River to Lake Michigan return flow alternative will have the same effects on regional groundwater resources as the Underwood Creek return flow alternative.

Direct to Lake Michigan. The Direct to Lake Michigan return flow alternative impacts to groundwater are expected to be insignificant because the alternative will result in an insignificant change in lake water levels and therefore is not anticipated to result in adverse affects to regional aquifer supplies that are influence by Lake Michigan.

2.3 Surface Water Resources

2.3.1 Existing Resources

Surface waters within the affected environment are summarized below. The types of information included within each of these affected environments vary because the effects the various water supply and return flow alternatives 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 discharges do not occur within any of the alternatives.

According to the Wisconsin Administrative Code (WAC), Chapter NR 102 Water Quality Standards for Wisconsin Surface Waters, Wisconsin categorizes surface waters into one of five fishery “use” subcategories (WDNR, 2010d). Stream use is determined by the 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 are, by default, classified as warm water sport fisheries and are considered WWSF or WWFF waters (WDNR, 2010e).

According to Wisconsin NR Code 102.10 and 102.11, no Outstanding Resource Waters or Exceptional Resource Waters (ERWs) are located along the proposed supply or return flow alternatives. Genesee Creek in Waukesha County west of Vernon Marsh is listed as an Exceptional Resource Water upstream of State Highway 59, but this area is outside of the influence of the project and 1-foot groundwater drawdown.

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.”

2.3.1.1 Fox River

The Fox River will be affected by all the water supply alternatives considered. 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. Two of the water supply alternatives include pumping from shallow wells near the Fox River which may change baseflows in the 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 from 1963 to 2009.[2] The Fox River is designated by the WDNR as a WWSF, which includes the following uses: fish and aquatic life, recreation, public health and welfare, and fish consumption.

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.[3]

Just downstream of the City of Waukesha are several perennial Fox River tributaries, including Genesee Creek, Mill Brook, Brandy Brook, Pebble Creek, Pebble Brook, Mill Creek, and Spring Creek, all of which are listed as supporting cold water communities. The Fox River is on the 303(d) list for fish consumption advisories due to PCBs. 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).

2.3.1.2 Pebble Brook

Pebble Brook will only potentially be affected by the alternatives that pump shallow groundwater that may otherwise flow into Pebble Brook. Pebble Brook is not affected by the Lake Michigan water supply and return flow alternatives.

Pebble Brook is a narrow 9-mile-long perennial trout stream located in southeastern Waukesha County. It is a tributary to the Fox River south of the City of Waukesha. The WDNR has classified Pebble Brook as a Cold water fishery. Cold water fisheries are classified by NR102(04)(3) as surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species. Cold water streams receive much of their flow from groundwater entering the stream which enables their temperature to remain cold. Pebble Brook is not listed for use impairments (WDNR, 2002a).

2.3.1.3 Pebble Creek

Pebble Creek will only potentially be affected by the alternatives that pump shallow groundwater that may otherwise flow into Pebble Creek. Pebble Creek is not affected by the Lake Michigan water supply and return flow alternatives.

Pebble Creek is a narrow, 6-mile-long perennial trout stream in southeastern Waukesha County. It is a tributary to the Fox River south of the City of Waukesha. The WDNR has classified Pebble Creek as a Cold water fishery. Cold water fisheries are classified by NR102(04)(3) as surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species. Cold water streams receive much of their flow from groundwater entering the stream which enables their temperature to remain cold.

Use impairments to Pebble Creek include unspecified non-point-source contamination, sedimentation, and beaver dams. These impairments result in a loss of habitat within the waterway and water temperature fluctuations (WDNR, 2002a).

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

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

2.3.1.4 Mill Brook

Mill Brook will only potentially be affected by the alternatives that pump shallow groundwater that may otherwise flow into Mill Brook. Mill Brook is not affected by the Lake Michigan water supply and return flow alternatives.

Mill Brook is a narrow, 5-mile-long perennial trout stream in southeastern Waukesha County. It is a tributary to the Fox River south of the City of Waukesha. The WDNR has classified Mill Brook as a Cold water fishery. Cold water fisheries are classified by NR102(04)(3) as surface waters capable of supporting a community of cold water fish and other aquatic life or serving as a spawning area for cold water fish species. Cold water streams receive much of their flow from groundwater entering the stream which enables their temperature to remain cold.

Use impairments to Mill Brook include construction erosion, unspecified non-point-source contamination, sedimentation, and beaver dams. These impairments result in water temperature fluctuations (WDNR, 2002a).

2.3.1.5 Underwood Creek and Menomonee River

Underwood Creek and the Menomonee River will only be affected by the Lake Michigan water supply alternatives for return flow to Underwood Creek. The groundwater supply alternatives do not affect Underwood Creek or the Menomonee River.

Underwood Creek is a tributary stream to the Menomonee River, which in turn ultimately flows to Lake Michigan. Discharge of return flows 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. All of Underwood Creek, except for 2,400-foot=long reach that was rehabilitated in 2009 to a natural channel, is concrete lined. Future concrete channel rehabilitation of additional sections of the stream has been proposed. 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. Underwood Creek also has a variance in Milwaukee County for dissolved oxygen and fecal coliform.[4] 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.[5]

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).[6] 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.[7]

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[4] NR 104.06(2) Water Quality Standards for Wisconsin Surface Waters.

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

[6] NR 104.06(2) Water Quality Standards for Wisconsin Surface Waters.

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

A reach of Underwood Creek upstream of the discharge in Waukesha County is proposed to be included on the 2010 303(d) list for fecal coliform as a recreational restriction.[8] The last 2.67 miles of the Menomonee River is proposed to be 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.

Water quality information is gathered by a number of organizations in the Underwood Creek and Menomonee River watersheds. The USGS and the Milwaukee Metropolitan Sewerage District (MMSD) have obtained water quality data and the Southeastern Wisconsin Regional Planning Commission (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.[9] 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 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.[10]

There are no numeric phosphorus water quality standards in Wisconsin, but a planning guideline of 0.1 mg/L was used in SEWRPC's Regional Water Quality Management Plan Update. 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.[11]

The USGS water quality sampling occurred at USGS gage 04087088 on Underwood Creek at Wauwatosa with data obtained from February 2004 through August 2005.[12] Dissolved oxygen, phosphorus, and fecal coliform concentration ranges are included in Table 2-1.

TABLE 2-1
Underwood Creek Water Quality Data (USGS 2004, 2005)
City of Waukesha Water Supply

Parameter	Dissolved Oxygen (mg/L)	Phosphorus of Unfiltered Water (mg/L as P)	Fecal Coliform (Counts/100 mL)
Number of samples	12	12	12
Minimum	8.3	0.020	120
Maximum	14.2	0.350	16,000
Mean	11.8	0.114	3,018

8 http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html accessed January 19, 2010.
9 WDNR NR 102.04(4).
10 WDNR NR 102.06.
11 SEWRPC. 2008. *A Regional Water Supply Plan for Southeastern Wisconsin.* Planning Report No. 52.
12 http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087088 accessed February 2010.

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.[13] Dissolved oxygen, phosphorus, and fecal coliform concentration ranges are included in Table 2-2.

TABLE 2-2
Menomonee River Water Quality Data (USGS 1991–1993, 2004–2009)
City of Waukesha Water Supply

Parameter	Dissolved Oxygen (mg/L)	Phosphorus of Unfiltered Water (mg/L as P)	Fecal Coliform (counts/100 mL)
Number of samples	429	380	47
Minimum	7.5	0.020	10
Maximum	16.0	1.400	800,000
Mean	11.7	0.228	21,793

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

The MMSD (2008) water quality sampling produced a report Underwood Creek Water Quality Baseline Report. Generally, eight samples were taken each year 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 2-3.

TABLE 2-3
MMSD Underwood Creek 2003–2005 Average Water Quality Range
City of Waukesha Water Supply

Dissolved Oxygen (mg/L)	Phosphorus (mg/L)	Fecal Coliform (counts/100 mL)
11.8 to 17.8	0.102 to 0.203	1,915 to 23,677

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 below for three points closest to the proposed return flow location (SEWRPC, 2007, Appendix N).

TABLE 2-4
Average Water Quality Data Downstream of Underwood Creek Return Flow Location
City of Waukesha Water Supply

Dissolved Oxygen (mg/L)	Phosphorus (mg/L)	Fecal Coliform Summer Season Geometric Mean (Count/100 mL)	Total Suspended Solids (mg/L)
11.0 to 11.1	0.066 to 0.111	351 to 496	15.6 to 16.8

Underwood Creek and Menomonee River Fisheries and Habitat. Fisheries and habitat information for Underwood Creek and the Menomonee River is summarized in Section 5 of the Application and reiterated here. Game and nongame fish species are regulated and protected under state and federal legislation, including the Fish and Wildlife Conservation

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

Act of 1980 (16 USC 2901-2911) and the Fish and Wildlife Coordination Act of 1958 (16 USC 661 et seq.).

Underwood Creek, along with the Menomonee River, is a WWSF, with an imbalance in number and type of species, which 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, in terms of relative quality based on the presence of specific macroinvertebrates. Fish and macroinvertebrate communities are summarized in Appendix L of the Application.

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.

Additional summary background information on flood control projects, geomorphology, and flow for Underwood Creek is included in Section 5, “Return Flow,” of the Application Document.

2.3.1.6 Root River

Root River will only be affected by the Lake Michigan water supply alternatives for return flow to the Root River and by Lake Michigan water supply or return flow pipeline alignments that cross the Root River. The groundwater supply alternatives do not affect the Root River.

The Root River flows through parts of Milwaukee and Racine counties, and into Lake Michigan at Racine, Wisconsin. The river has more natural channel (e.g., natural bottom substrate and vegetated river banks) than does Underwood Creek, and it has a mixture of land uses between its headwaters and Lake Michigan. The headwaters of the Root River are heavily urbanized, the middle reaches are primarily agriculture and lower density development, and the lower parts of the watershed near Lake Michigan are heavily urbanized.

The Root River is classified for WDNR fish and aquatic life standards and is a WWSF community (WDNR, 2002b). At the USGS Fox River stream gage 04087214 in the City of Greenfield close to the return flow location, the average annual stream flow is 17.5 cfs

(11.3 mgd) over the period of record from 2004 to 2009.[14] The Root River at the potential discharge location is on the 303(d) list for low dissolved oxygen with reported causes from sediment and phosphorus.[15] In addition, the last roughly 6 miles of the Root River upstream of Lake Michigan is on the 303(d) list for PCBs. These listings were all made in 1998.[16]

Water quality information is gathered by a number of organizations in the Root River watershed. The USGS has 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.[17]

There are no numeric phosphorus water quality standards in Wisconsin, but a planning guideline of 0.1 mg/L was used in SEWRPC's Regional Water Quality Management Plan Update. 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.[18]

The USGS water quality sampling occurred at USGS gage 04087214 on the Root River at Grange Avenue in Greenfield, with data obtained from 2004 through 2009.[19] Dissolved oxygen, phosphorus, and fecal coliform concentration ranges are included in Table 2-5.

Water quality in the Root River was extensively studied in SEWRPC's *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 below for three points closest to the proposed return flow location (SEWRPC, 2007, pp. 200–214).

TABLE 2-5
Average Water Quality Data Downstream of Root River Return Flow Location
City of Waukesha Water Supply

Parameter	Dissolved Oxygen (mg/L)	Phosphorus of Unfiltered Water (mg/L as P)	Fecal Coliform (counts/100 mL)
Number of Samples	21	12	13
Minimum	2.5	0.03	110
Maximum	20.3	0.16	7,500
Mean	8.5	0.11	1,395

Root River Fisheries and Habitat. Fisheries and habitat information for Underwood Creek and the Menomonee River is summarized in Section 5 of the Application and reiterated here.

Fishery data for in the Root River watershed show that 10 new species have been identified, but 10 of 64 recorded species have not been observed since 1986 (SEWRPC, 2007, pp. 200–214).

[14] http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087214 accessed April, 2010.
[15] http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html accessed January 19, 2010.
[16] http://dnr.wi.gov/org/water/wm/wqs/303d/303d.html accessed January 19, 2010.
[17] WDNR NR 102.04(4).
[18] SEWRPC. 2008.
[19] http://waterdata.usgs.gov/wi/nwis/rt, gage number 04087120 accessed February, 2010.

The most recent fishery surveys, conducted in 2004 and 2007 by the USGS, identified 17 species in the Root River near the proposed return flow location. Some of the new species were observed in reaches of the Root River between the confluence with Lake Michigan and the first dam, suggesting that Lake Michigan's fish community may be influencing the fish community of the lower reaches of the watershed. The Root River is a warm-water habitat, where the balance of fish species indicates a fair quality fishery overall in the watershed that is higher in quality than that of the Menomonee River watershed. Macroinvertebrate data collected within the Root River watershed suggest that the river is dominated by species tolerant of a low-quality habitat. Most species within the fish and macroinvertebrate communities generally indicate fair habitat quality.

With the potential presence of one state-listed endangered and three state-listed threatened fish species, there appear to be areas of good quality within parts of the watershed, but there is also impairment because of the agricultural and urban development. The Root River watershed has relatively few streambed and bank modifications, with less than 1 percent of the stream channel observed being in conduit and none lined with concrete. Although habitat conditions in the Root River are fair to good, habitat could be improved by providing more or higher quality habitat.

2.3.1.7 Lake Michigan

Lake Michigan will only be affected by the Lake Michigan water supply alternatives for return flow to Underwood Creek. The groundwater supply alternatives do not affect Underwood Creek or the Menomonee River.

Lake Michigan is bordered by four states and connected through the other Great Lakes to the other four 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.[20]

TABLE 2-6
Average Water Quality Data at Select Locations in Lake Michigan near the Greater Milwaukee Watersheds
City of Waukesha Water Supply

Dissolved Oxygen (mg/L)	Phosphorus (mg/L)	Fecal Coliform Summer Season Geometric Mean (Count/100 mL)	Total Suspended Solids (mg/L)
9.6 to 11.5	0.062 to 0.087	603 to 770	10.3 to 19.4

Lake Michigan Water Quality. SEWRPC and the MMSD have been measuring water quality in the Greater Milwaukee area since the 1960s (SEWRPC, 2007, p. 149). Notable 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.

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

- 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 one year.

Annual pollutant loadings to Lake Michigan from the Greater Milwaukee watersheds have been documented in SEWRPC's *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds* (2007). The average annual loadings for select parameters are included below:

- 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).

Nearshore Lake Michigan Fisheries and Habitat. In recent years, nuisance algae (cladophora) growth has been observed along the Lake Michigan shoreline. The algae grows underwater attached to rocks and is dislodged by waves and then washes up on shore. The rotting algae creates 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 from changes in water clarity and phosphorous availability brought on by the prevalence of invasive zebra and quagga mussels.[21]

The Milwaukee Harbor estuary is designated a Great Lakes Area of Concern (AOC) due to legacy contaminants present and other impairments. The Milwaukee Harbor suffers from urban stresses similar to those that the other 42 AOCs throughout the Great Lakes experience from highly urban areas. The priorities of the Milwaukee AOC 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.[22]

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 portions of the Milwaukee, Menomonee, and Kinnickinnic Rivers, which achieve full fish and aquatic life standards (SEWRPC, 2007, p. 205).

2.3.1.8 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 summarized below.

[21] http://www.dnr.state.wi.us/ORG/water/greatlakes/cladophora/. Accessed March 3, 2010.
[22] http://www.epa.gov/glnpo/aoc/milwaukee.html. Accessed March 3, 2010.

2.3.2 Impacts and Mitigation

An assessment of the environmental effects for the water supply alternatives, and associated return flow for the Lake Michigan alternative, was completed and is discussed below for the affected environments.

2.3.2.1 Flow and Geomorphology

Impacts to flow and geomorphology to the surface waters potentially affected by the water supply and return flow alternatives are discussed below. Impacts to flow were assessed for potential changes to the existing flow within the surface water, to the surface water, or away from the surface water (e.g., baseflow changes within a creek). Where flow data exist to make numerical comparisons between alternatives, the impacts are quantified. However, where flow data are limited, such as on an ungauged creek like Mill Brook, qualitative assessments of impacts are discussed.

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 each water supply and return flow alternative 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.

Deep and Shallow Aquifers Water Supply. The shallow groundwater pumping with this alternative causes a drawdown in the aquifer and intercepts groundwater flow to surface waters. This potential surface water flow change from pumping the shallow aquifer has been documented by prior studies and groundwater modeling for this specific alternative.

SEWRPC identified adverse impacts from baseflow reduction to the Fox River. For a similar water supply alternative mixing deep and shallow groundwater sources, SEWRPC identified parts of the Fox River could experience a baseflow decrease greater than 10 percent.[23] A subsequent study estimated significant baseflow reductions near Waukesha when only 3.9 mgd of shallow groundwater was pumped and artificial recharge was used.[24]

The shallow groundwater pumping in this alternative causes a drawdown in the aquifer and intercepts groundwater flow to the Fox River. Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to the river could reduce significantly. For example, compared to the base scenario, groundwater baseflow to the river would be reversed, where groundwater pumping in this alternative is expected to draw water away from the Fox River. In the base scenario, groundwater flow *to the river* is estimate to be about 1.7 mgd in the study area. By implementing the groundwater pumping in this alternative, 0.7 mgd of groundwater would be withdrawn *from* the Fox River. This results in a 2.4 mgd flow reduction in groundwater baseflow to the river.

Because the WWTP discharges to the Fox River upstream of most of the affected areas of the river, this baseflow reduction is not anticipated to have significant adverse impacts between

[23] SEWRPC. 2008. Planning Report on Regional Water Supply Plan for Southeastern Wisconsin, Preliminary Draft.
[24] Cherkauer. 2009.

the WWTP discharge and the downstream extent of the groundwater drawdown (groundwater drawdown maps shown in Appendix O). However, the groundwater pumping will have an adverse impact on the flow in the Fox River downstream of the areas affected by the groundwater drawdown (downstream of the Vernon Marsh) because 2.4 mgd baseflow is removed from the Fox River (i.e., 2.4 mgd would be continuously intercepted between groundwater pumping and the WWTP and therefore would be removed from the flow in the river in the downstream reaches).

Geomorphic changes with reduced baseflows could result in a smaller channel over time but because channel stability is less associated with baseflow and more influenced by larger channel-forming flows generally in the 1- to 2-year return period flow range, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. The 2.4 mgd is only about 3 percent of the 71 mgd annual average flow in the river and even less than the channel-forming flow rate. The baseflow reductions from groundwater pumping will reduce flow in the river, but it is not expected to have a significant adverse impact to the flow in the river because the flow is small compared to the river flow, and flow in the Fox River includes baseflow along upstream segments of the river, other tributaries, and two WWTPs upstream of Waukesha.

Shallow Aquifer and Fox River Alluvium Water Supply. The shallow groundwater pumping with this alternative causes a drawdown in the aquifer and intercepts groundwater flow to the Fox River. This potential habitat impact from pumping the shallow aquifer has been documented by prior studies and groundwater modeling for this specific alternative.

Similarly to the Deep and Shallow Aquifer alternative, groundwater is pumped from the shallow aquifer and baseflow reduction impacts to the Fox River are expected. The baseflow reduction impacts to the Fox River would be expected to be more or similar to those documented in previous studies by SEWRPC and Cherkaur as described under the Deep and Shallow Aquifers alternative.

Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to the river could reduce significantly. For example, compared to the base scenario, groundwater baseflow to the river would be reversed, where groundwater pumping in this alternative is expected to draw water away from the Fox River. In the base scenario, groundwater flow *to the river* is estimate to be about 1.7 mgd in the study area. By implementing the groundwater pumping in this alternative, 4.2 mgd of groundwater would be withdrawn *from* the Fox River. This results in a 5.9 mgd flow reduction in groundwater baseflow to the river.

Because the WWTP discharges to the Fox River upstream of most of the affected areas of the river, this baseflow reduction is not anticipated to have significant adverse impacts between the WWTP discharge and the downstream extent of the groundwater drawdown (groundwater drawdown maps shown in Appendix O). However, the groundwater pumping will have an adverse impact on the flow in the Fox River downstream of the areas affected by the groundwater drawdown (downstream of the Vernon Marsh) because 5.9 mgd baseflow is removed from the Fox River (i.e., 5.9 mgd would be continuously intercepted between groundwater pumping and the WWTP and therefore would be removed from the flow in the river in the downstream reaches).

Geomorphic changes with reduced baseflows could result in a smaller channel over time but because channel stability is less associated with baseflow and more influenced by larger channel-forming flows generally in the 1- to 2-year return period flow range, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. The 5.9 mgd is about 8 percent of the 71 mgd annual average flow in the river and even less than the channel-forming flow rate. The baseflow reductions from groundwater pumping will reduce flow in the river, but it is not expected to have a significant adverse impact to the flow in the river because the flow is small compared to the river flow, and flow in the Fox River includes baseflow along upstream segments of the river, other tributaries, and two WWTPs upstream of Waukesha.

Lake Michigan Water Supply. A Lake Michigan water supply, regardless of its supply location from Milwaukee, Oak Creek, or Racine, will not adversely affect the Fox River with respect to geomorphology. This is because groundwater pumping would stop. 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 at least partially restored to conditions similar to pre-well conditions, by allowing the groundwater to contribute more baseflow to the river. This will improve the baseflow under current shallow groundwater pumping conditions and will have the greatest benefit in the future when projected water demands are greater.

A Lake Michigan supply will affect the Fox River the same, regardless of the return flow location to Underwood Creek, Root River or direct to Lake Michigan. 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.

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 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 alternative.

A study by the USGS and University of Milwaukee reports that wastewater flow from Sussex, Brookfield and Waukesha contributes 40 percent of the total Fox River flow during annual low flows.[25] The City of Waukesha's average annual WWTP flow is about 10 mgd, or 50 percent of the WWTP flow from the three 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 flow is estimated. Baseflow 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.

Because of 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

[25] 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.

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 was 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 be expected to have a significant adverse affect on the flow or geomorphic conditions in the river. In addition, during times when the Fox River has these higher flows, the Waukesha WWTP effluent will likely exceed the maximum return flow rate as discussed in Section 5 of the Application, and WWTP effluent will return flow to the Lake Michigan basin and discharge to the Fox River. During these times, the impact to the Fox River will be even less because the WWTP would continue to supplement the Fox River flows.

Return Flow Alternatives. Because a Lake Michigan supply will require return flow, any impacts to the Fox River are assigned to the Lake Michigan water supply alternatives. Impacts with return flow alternatives are compared to Lake Michigan tributaries and are described in the sections below discussing Lake Michigan tributary watersheds in detail.

2.3.2.2 Pebble Brook, Pebble Creek, and Mill Brook

Deep and Shallow Aquifers Water Supply. The shallow groundwater pumping in this alternative causes a drawdown in the aquifer and intercepts groundwater flow to these cold water streams. Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to these cold water streams could reduce significantly. For example, groundwater baseflow to Pebble Brook would be reduced by 61 percent, Pebble Creek would be reduced by 9 percent, and Mill Book would be reduced by 29 percent. Geomorphic changes with reduced baseflows could result in a smaller channel over time. Because channel stability is less associated with baseflow and more influenced by larger channel-forming flows generally in the 1- to 2-year return period flow range, baseflow reduction is not expected to cause a significant change in channel stability from what currently exists. The baseflow reductions could however, have a significant adverse impact to the flow in the channels (especially Pebble Brook because of its 61 percent baseflow reduction) during low flow periods when groundwater baseflow accounts for most of the flow in the channels.

Shallow Aquifer and Fox River Alluvium Water Supply. The shallow groundwater pumping in this alternative causes a drawdown in the aquifer and intercepts groundwater flow to these cold water streams. Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to these cold water streams could reduce significantly, and greater than the Deep and Shallow Aquifer alternative. For example, groundwater baseflow to Pebble Brook would be reduced by 58 percent, Pebble Creek would be reduced by 23 percent, and Mill Book would be reduced by 30 percent. Geomorphic changes with reduced baseflows could result in a smaller channel over time. Because channel stability is less associated with baseflow and more influenced by larger channel forming flows generally in the 1- to 2-year return period flow range, baseflow reduction is not expected to cause a significant change in channel stability from what exists. The baseflow reductions could however, have a significant adverse impact to the flow in the channels during low flow periods when groundwater baseflow accounts for most of the flow in the channels.

Lake Michigan Water Supply and Return Flow. There is no shallow groundwater pumping with this alternative and consequently the cold water streams are not affected with these alternatives.

Underwood Creek and Menomonee River. The flow and geomorphology in Underwood Creek and the Menomonee River will only be affected by a Lake Michigan water supply with return flow to Underwood Creek. All of the other water supply and return flow alternatives will not affect these watercourses. As described in the background information on Underwood Creek and the Menomonee River, 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) over the period of record for the Menomonee River.

A detailed analysis of the flow and geomorphic conditions is included in Section 5 and Appendixes G and L of the Application. In summary, return flow to Underwood Creek will increase the flow in the creek and river downstream of the return flow location. Underwood Creek experiences periods of no-flow and therefore a return flow could constitute 100 percent of the creek flow during these times. During less frequent flow events, such as a 2-year flow, a return flow is less than 2 percent of the creek flow and even less than the river flow. Due to the small percentage of return flow in the creek and river, a return flow will not adversely impact the flow or geomorphic conditions in either watercourse. Instead, the return flow 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.

Root River. The flow and geomorphology in the Root River will only be affected by a Lake Michigan water supply with return flow to the Root River. All of the other water supply and return flow alternatives will not affect this watercourse. As described in the background information on the Fox River, the average annual stream flow is 17.5 cfs (11.3 mgd) over the period of record.

A more detailed analysis of the flow and geomorphic conditions is included in Section 5 of the Application. In summary, return flow to the Root River is expected to have a similar insignificant impact as return flow to Underwood Creek. Similar to Underwood Creek, flow in the Root River sometimes is very low, and the functional habitat in the river is limited by the river flow. Augmentation of the return flow would eliminate the very low flow periods. Because the return flow rate is small compared to the higher flows in the river, return flow is not expected to affect the geomorphic stability of the river. For example, a return flow is about 5 percent of the 2-year river flow near the discharge location, and about 2.2 percent at the next reach about 1.3 miles downstream of the return flow outfall location.[26] These are similar to the Underwood Creek flow, where a detailed evaluation concluded that the return flow would not affect the geomorphic stability of the rehabilitated parts of the creek. A recent sediment transport study of the Root River concluded that the river stability is relatively insensitive to changes in flows because of the erosion resistance of the channel boundary materials, the relatively flat channel gradient, and the presence of a functional floodplain.[27] For these reasons, a return flow will not adversely impact the flow or geomorphic conditions in the

[26] MMSD. *Root River Sediment Transport Planning Study.* May 4, 2007. Hydraulics Technical Memorandum 3. HEC-RAS model from enclosed CD.

[27] MMSD. *Root River Sediment Transport Planning Study.* May 4, 2007. Hydraulics Technical Memorandum 6. Page 1.

river. Instead, the return flow will benefit Root River flow during low-flow periods because the return flow will provide additional baseflow in the river.

Lake Michigan. Impacts to Lake Michigan for each water supply and return flow alternative are discussed below.

Deep and Shallow Aquifers Water Supply. This water supply alternative will have an impact to the flow within Lake Michigan because increased pumping of the deep aquifer will continue to draw groundwater from under Lake Michigan. Because this water supply alternative includes discharging the water to the Fox River through the City of Waukesha WWTP, this volume of water is lost from the Great Lakes Basin. The volume from the Lake Michigan basin is considered to have no adverse impact. This alternative is not expected to affect the geomorphology of Lake Michigan.

Shallow Aquifer and Fox River Alluvium Water Supply. This water supply alternative will stop pumping of the deep aquifer for the City of Waukesha and consequently some minor decrease in groundwater flow away from Lake Michigan will occur. This will have a small benefit to the Lake Michigan basin. There is no adverse impact on the flow or geomorphology of Lake Michigan with this alternative.

Lake Michigan Supply and Return Flow. Flow within Lake Michigan will not be affected by a Lake Michigan water supply or return flow alternative. This is because the City of Waukesha has a goal of returning 100 percent of the withdrawn water. Details of how the City plans to accomplish this are included in Section 5 of the Application.

The geomorphology of Lake Michigan will not be adversely affected by the Lake Michigan water supply alternative because regardless of a Milwaukee, Oak Creek or Racine supply, the supply will utilize existing treatment plant intakes in the Lake and no construction is expected to occur within the Lake for a water supply.

The geomorphology of the Lake will not be affected by the return flow alternatives except for a return flow directly to Lake Michigan. For this return flow alternative, an outfall will be required on the bottom of the Lake to provide an offshore discharge. The pipe in the Lake will change the Lake substrate composition along the pipe alignment. The area in Lake Michigan affected by the pipeline is summarized in the land use changes documented in Section 7 of this ER and is expected to have a minor adverse impact to the Lake's geomorphology.

2.3.2.3 Flooding

Flooding is a concern in each urbanized community, and especially in southeastern Wisconsin where extensive flood mitigation projects have been constructed, and more are planned. The water supply and return flow alternatives were evaluated based on their impact to flooding along affected surface water resources. A summary of the analysis is discussed below for each water resource.

Fox River. Impacts to the Fox River for each water supply and return flow alternative are discussed below.

Deep and Shallow Aquifer Water Supply. The Deep and Shallow Aquifers supply alternative will not affect flooding on the Fox River because there are no floodplain changes and this alternative would continue to use the existing City of Waukesha WWTP for the discharge of treated wastewater. This alternative has a number of above ground structures. The buildings associated with this alternative will be located outside the regulatory floodplain, so they will not be damaged by the 100-year return period flood.

Shallow Aquifer and Fox River Alluvium Water Supply. The Shallow Aquifer and Fox River Alluvium supply alternative will also not affect the Fox River flooding for the same reasons discussed for the Deep and Shallow Aquifer alternative. This alternative has a number of aboveground structures. The buildings associated with this alternative will be located outside the regulatory floodplain, so they will not be damaged by the 100-year return period flood.

Lake Michigan Water Supply and Return Flow. A Lake Michigan water supply from either the City of Milwaukee, Oak Creek or Racine will not affect flooding on the Fox River. This is because Lake Michigan is in a different watershed.

The return flow to either Underwood Creek, Root River or directly to Lake Michigan will not affect flooding on the Fox River. As discussed in Section 5 of the Application, return flow to the Lake Michigan basin will 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 will maintain the same flow in the Fox River during flooding events as the groundwater supply alternatives. Therefore, a Lake Michigan water supply with the return flow as described in Section 5 of the Application will not adversely change flooding on the Fox River.

This alternative has two small aboveground pump stations, one for water from a Lake Michigan water supplier and one at the existing Waukesha WWTP for return flow. These pump stations will be located and designed so there is no damage from the 100-year return period flood.

Pebble Brook, Pebble Creek and Mill Brook. None of the water supply or return flow alternatives impact flooding on these watercourses because flows do not increase to these watercourses.

Underwood Creek, Menomonee River, and Root River. The groundwater supply alternatives will not affect flooding in these watercourses because the water supply and discharge from the Waukesha WWTP will not be located in these watersheds under those water supply alternatives. A Lake Michigan water supply, regardless of a City of Milwaukee, Oak Creek, or Racine supply will not affect flooding in these watercourses because the water intake at each location is within Lake Michigan.

The return flow to any of the watercourses will not affect flooding or the floodplain delineations. As discussed in Section 5 of the Application, return flow to Underwood Creek (Menomonee River) or Root River will be temporarily paused during flooding events that threaten personal or public property.

Lake Michigan. The groundwater supply alternatives will not affect flooding in these watercourses because the water supply and discharge from the Waukesha WWTP will not be located in these watercourse watersheds. A Lake Michigan water supply and return flow, regardless of supply and return flow locations, will not affect flooding in the Lake 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, which eliminates flooding impacts in the lake.

2.3.2.4 Aquatic Habitat

Aquatic habitat in the surface water resources will be affected as a result of the water supply and return flow alternatives. The impacts are generally beneficial for the surface waters in the Lake Michigan basin but the surface waters in the Fox River watershed generally have a minor adverse impact.

The pipeline alignments water body crossings that could cause temporary construction impacts to aquatic habitat are listed below in Table 2-7. During the design phase, 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. Example techniques that could be used are included in Appendix 2-A, Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques.

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 normally live in these areas may be displaced during construction. However, this habitat alteration will be relatively insignificant because of the small area affected at each crossing location and stream bank restoration techniques will be designed to promote regrowth of riparian vegetation.

The aquatic habitat impacts resulting from the operations (i.e., post-construction) of each water supply and return flow alternative is described below.

Fox River. Aquatic habitat impacts to the Fox River for each water supply and return flow alternative 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.

Deep and Shallow Aquifers Water Supply. Baseflow reductions to the Fox River are expected for this alternative water supply because of the shallow groundwater pumping. The City of Waukesha WWTP will continue to discharge treated wastewater to the Fox River. The WWTP discharges are larger than the baseflow reduction, so the WWTP discharges are expected to partially supplement the baseflow reduction caused by the pumping. However, as discussed above in the Flow and Geomorphology section, the groundwater pumping will reduce the volume of water in the Fox River compared to current conditions because the groundwater pumping draws baseflow from the river. Because there is less flow in the river for this alternative, there will be less aquatic habitat. The Deep and Shallow Aquifers supply alternative will not have significant adverse impacts on the aquatic habitat in the Fox River, but minor adverse impacts are possible from the flow reduction.

Shallow Aquifer and Fox River Alluvium Water Supply. The Shallow Aquifer and Fox River Alluvium alternative has greater reductions to Fox River baseflow. This alternative would continue to use the existing City of Waukesha WWTP for the discharge of treated wastewater. The WWTP discharges are larger than the baseflow reduction, so the WWTP discharges are expected to partially supplement the baseflow reduction caused by the groundwater pumping. However, as discussed above in the Flow and Geomorphology section, the groundwater pumping will reduce the volume of water in the Fox River compared to current conditions because the groundwater pumping draws baseflow from the river. Because there is less flow in the river for this alternative, there will be less aquatic habitat. The Shallow Aquifer and Fox River Alluvium supply alternative will not have significant adverse impacts on the aquatic habitat in the Fox River, but minor adverse impacts are possible.

Lake Michigan Water Supply. A Lake Michigan water supply from either Milwaukee, Oak Creek, or Racine will have an effect on the aquatic habitat in the Fox River. As discussed in Section 5 of the Application, flow from the City of Waukesha WWTP will be returned to the Lake Michigan basin with a Lake Michigan supply. The return flow will generally be to the Lake Michigan basin, but there will be times when WWTP flow is discharged 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. As discussed above, the City of Waukesha WWTP contributes about 25 percent of the Fox River flow during annual low flow conditions. This reduction in flow and aquatic habitat will have a minor adverse impact on the river during annual low flow conditions.*Return Flow Alternatives.* Because a Lake Michigan supply will require return flow, any impacts to the Fox River are assigned to the Lake Michigan water supply alternatives. Impacts with return flow alternatives are compared to Lake Michigan tributaries and are described in the sections below discussing Lake Michigan tributary watersheds in detail.

Pebble Brook, Pebble Creek and Mill Brook. Aquatic habitat impacts to Pebble Brook, Pebble Creek, and Mill Brook for each water supply and return flow alternative are discussed below.

Deep and Shallow Aquifers Water Supply. The shallow groundwater pumping with this alternative causes a drawdown in the aquifer and intercepts groundwater flow to these cold water streams. This potential habitat impact from pumping the shallow aquifer has been documented by prior studies and groundwater modeling for this specific alternative.

SEWRPC identified adverse impacts from baseflow reduction to Pebble Brook and Pebble Creek. For a similar water supply alternative mixing deep and shallow groundwater sources, SEWRPC identified parts of Pebble Creek could experience a baseflow decrease greater than 25 percent.[28] A subsequent study estimated significant baseflow reductions near Waukesha when only 3.9 mgd of shallow groundwater was pumped and artificial recharge was used.[29]

Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to these cold water streams could reduce significantly. For example, groundwater baseflow to Pebble Brook would be reduced by 61 percent, Pebble Creek would be reduced by 9 percent, and Mill Book would be reduced by 29 percent. Baseflow reductions will reduce the quantity and amount of time habitat is available in these channels.

The baseflow reductions could have a significant adverse impact to aquatic habitat in the channels (especially Pebble Brook because of its 61 percent baseflow reduction) during low flow periods when groundwater baseflow is the majority of the flow in the channels. During

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[28] SEWRPC. 2008. Planning Report on Regional Water Supply Plan for Southeastern Wisconsin, Preliminary Draft.
[29] Cherkauer. 2009.

higher flow periods, the baseflow reduction is not anticipated to have a significant adverse impact because the reduction in baseflow is a very small percentage of the flood flow rate in the channels. Because these baseflow reduction numbers represent steady state average conditions, actual baseflow percent reduction will be greater during droughts when water demand is higher and stream baseflows are lower.

Shallow Aquifer and Fox River Alluvium Water Supply. The shallow groundwater pumping with this alternative causes a drawdown in the aquifer and intercepts groundwater flow to these cold water streams. This potential habitat impact from pumping the shallow aquifer has been documented by prior studies and groundwater modeling for this specific alternative.

Similarly to the Deep and Shallow Aquifer alternative, groundwater is pumped from the shallow aquifer and baseflow reduction impacts to cold water streams are expected. The baseflow reduction impacts to cold water streams would be expected to be more or similar to those documented in previous studies by SEWRPC and Cherkaur as described under the Deep and Shallow Aquifer alternative.

Detailed groundwater modeling (Appendix O of the Application) of this alternative found average groundwater baseflows to these cold water streams could reduce significantly, and greater than the Deep and Shallow Aquifer alternative. For example, groundwater baseflow to Pebble Brook would be reduced by 58 percent, Pebble Creek would be reduced by 23 percent, and Mill Book would be reduced by 30 percent. Baseflow reductions will reduce the quantity and amount of time habitat is available in these channels.

The baseflow reductions could have a significant adverse impact to aquatic habitat in all three channels during low flow periods when groundwater baseflow is the majority of the flow in the channels. During higher flow periods, the baseflow reduction is not anticipated to have a significant adverse impact because the reduction in baseflow is a very small percentage of the flood flow rate in the channels. Because these baseflow reduction numbers represent steady state average conditions, actual baseflow percent reduction will be greater during droughts when water demand is higher and stream baseflows are lower.

Lake Michigan Water Supply and Return Flow. There is no shallow groundwater pumping with this alternative and consequently these cold water streams are not affected by these alternatives.

Underwood Creek and Menomonee River. None of the water supply alternatives will affect the aquatic habitat in Underwood Creek and the Menomonee River. The aquatic habitat in these watercourses will only be affected with a return flow discharge location to Underwood Creek. As discussed in Section 5 and Appendix L of the Application, a return flow to Underwood Creek is expected to improve the aquatic habitat in Underwood Creek and the Menomonee River. The greatest benefits will occur during low flow conditions in the creek and river, when the return flow contributes the greatest portion of flow. A summary of the habitat improvements to the creek and river discussed in detail in Appendix L includes:

- The habitat of dominant fish and macroinvertebrates could be improved with additional flow, especially in the rehabilitated segment of the creek and during periods when the creek flows are low (baseflow flow conditions).
- Underwood Creek often experiences extended periods when there is no flow in the creek because of ice or dry conditions when there is little precipitation. At those times,

return flow would provide the greatest habitat improvement because periods of no flow could be eliminated.

- During baseflow and low flow periods, 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.
- 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 (e.g., gravel) sediment habitat.
- Most of the creek is concrete lined, but the areas that have already been rehabilitated or that will be rehabilitated in the future will benefit the most from additional flow.
- When creek flow is high (e.g., flow events greater than a 2-year flow), return flow is a small portion of the total creek flow. During these times, return flow is not expected to have a significant effect on the creek habitat.
- Return flow influence on the larger Menomonee River is expected to benefit the habitat downstream of its confluence with Underwood Creek for the same reasons. Because the return flow will be a smaller percentage of the total river flow, it will improve fish passage, submerged habitat, and embeddedness to a lesser degree. When river flows are high, return flow is not expected to have a significant effect on river habitat because it will be a very small percentage of the total river flow.

A return flow to Underwood Creek and Menomonee River will have a beneficial effect on the aquatic habitat, especially during low flow conditions in the creek and river.

Root River. None of the water supply alternatives will affect the aquatic habitat in the Root River. The aquatic habitat will only be affected with a return flow discharge location to the Root River. As discussed in Section 5 of the Application, a return flow to Underwood Creek is expected to improve the aquatic habitat, similar to an Underwood Creek discharge location. The greatest benefits will occur during low flow conditions in the river, when the return flow contributes the greatest portion of flow. The same as an Underwood Creek return flow, a return flow to the Root River will have a beneficial effect on the aquatic habitat, especially during low flow conditions in the river.

Lake Michigan. None of the water supply alternatives will affect the aquatic habitat in Lake Michigan. The aquatic habitat will only be affected with a return flow discharge location direct to Lake Michigan because this return flow alternative includes construction of a pipeline in Lake Michigan to provide an offshore discharge (as discussed in Section 5 of the Application). The pipeline within Lake Michigan will likely change the bottom substrate of the lake along the alignment from natural substrate. This change in natural substrate for the pipeline alignment is expected to have a minor adverse impact on the Lake Michigan aquatic habitat.

2.3.2.5 Water Quality

Water quality environmental effects will occur both during construction as well 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 impact of 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 stream banks and rights-of-way from pipeline construction. Impact severity is a function of sediment load, particle size, stream bank 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.

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 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 best management practices as described in Appendix 2-A, "Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques."

Operational and maintenance effects on water quality are described below for each water supply and return flow alternative.

Deep and Shallow Aquifers Water Supply. The Deep and Shallow Aquifers supply alternative includes new aboveground impacts to over 30 acres (see Table 7-1) that will produce stormwater pollution runoff from previously undeveloped land. The increased runoff will have stormwater water quality impacts that drain to the Fox River. The runoff will be managed to meet the WDNR's stormwater quality management requirements for new development NR 151 *Runoff Management* (WDNR, 2010g) as well as local stormwater management requirements.

Operational and maintenance effects on water quality are associated with WWTP discharge to the Fox River for this groundwater supply alternative. Existing WWTP permit limits from the WDNR and performance for many water quality parameters has been documented in Appendix H of the Application. 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 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. Residential water softening would continue with the groundwater alternatives. 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 for all discharge location alternatives.

The groundwater draw down will also effect baseflow in Pebble Brook, Pebble Creek, and Mill Brook, three cold water streams south of Waukesha tributary to the Fox River as described above in Aquatic Habitat. Lower baseflows in these cold water streams will lead to warmer temperatures and potential temperature impairment. Pebble Creek is already listed for water temperature fluctuation and this impairment would be expected to worsen.

Shallow Aquifer and Fox River Alluvium Water Supply. The Shallow Aquifer and Fox River Alluvium supply alternative includes new aboveground impacts to over 50 acres (see Table 7-1), which will produce stormwater pollution runoff from previously undeveloped land. The increased runoff will have stormwater water quality impacts that drain to the Fox River. The runoff will be managed to meet the WDNR's stormwater quality management requirements for new development NR 151 *Runoff Management* as well as local stormwater management requirements.

This groundwater water supply alternative continues WWTP discharge to the Fox River. The Waukesha WWTP meets permit requirements currently, so no change in the plant permit limits is expected with a switch in water sources. The same approach to permit allowances for discharge to the Fox River as currently occurs would be expected with this water supply alternative.

The groundwater draw down will also effect baseflow in Pebble Brook, Pebble Creek, and Mill Brook, three cold water streams south of Waukesha tributary to the Fox River as described above in Aquatic Habitat. Lower baseflows in these cold water streams will lead to warmer temperatures and potential temperature impairment. Pebble Creek is already listed for water temperature fluctuation and this impairment would be expected to worsen.

Lake Michigan–Milwaukee Supply, –Oak Creek Supply, and –Racine Water Supply. 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. All Lake Michigan supply options will also include return flow water quality impacts, which are described below.

Underwood Creek–Lake Michigan, Root River–Lake Michigan, and Direct-to-Lake-Michigan Return Flow Alternatives. All water returned to the Lake Michigan watershed, will meet WDNR water quality permit requirements. All return flow alternatives are assumed to share in common expected effluent limits for the purpose of this analysis. A summary of proposed discharge limits from the WDNR and a comparison to historical Waukesha WWTP performance are detailed in Application Section 5, "Water Quality." 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.

While the groundwater alternatives would continue the need for water softening, 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 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 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.

Flow from all return flow alternatives ultimately ends up in Lake Michigan. Consequently, the findings for all return flow alternatives with respect to Lake Michigan water quality inputs are the same and are listed here prior to discussing individual alternatives. 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 H 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 is considering new phosphorus regulations that could require more stringent phosphorus discharge limitations.

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

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 303(d) listings or proposed 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).

Subsequent modeling of the Menomonee River also 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 H 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 these water bodies is summarized in Section 5 of the Application with additional detailed information in Appendix H to the Application.

The Root River to Lake Michigan return flow alternative considered water quality changes to the Root River. The 303(d) listings in the Root River should not be exacerbated with return flow. Near the potential discharge location, the Root River was originally listed for low dissolved oxygen from sediment and phosphorus in 1998. However, more recent SEWRPC water quality modeling found that dissolved oxygen concentrations met the standard between 95 and 100 percent of the time for the 11-year period of record analyzed (SEWRPC, 2007, Appendix N). No or little change in dissolved oxygen standard compliance would be expected with return flow to the Root River because historical WWTP performance has produced a BOD concentration less than 2 mg/L on average as described in Appendix H of the Application.

The Root River PCB 303(d) listing in the 6 miles of the river upstream of Lake Michigan will not be exacerbated because this chemical is not found in the return flow. Water quality analysis for this water body is summarized in Section 5 of the Application.

The Direct to Lake Michigan return flow alternative has the same water quality affects as those listed for the other return flow alternatives.

2.3.3 Perennial and Intermittent Surface Water Crossings

All water supply alternatives have pipelines that cross surface waters. The extents of the surface water crossings are listed in Tables 2-7 to 2-9 for each alternative. Please see Chapter 1 for figures associated with each of the alternatives. All of these crossings will have temporary impacts during construction. Once the construction is complete, the surface water crossing will be restored. Operational and maintenance impacts are expected to be negligible.

TABLE 2-7
Water Body Crossings
City of Waukesha Water Supply

Alternative	Water Body/ Stream No.	Water Body Name	Water Body Type	Approximate Crossing Width (ft)	Crossing Area (acres)	Fisheries Classification[a]
Supply						
Deep and Shallow Aquifers	3	Fox River	Perennial	139.4	0.24	WWSF
	2855	Unnamed	Intermittent/ephemeral	17.4	0.03	—
	2931	Pebble Brook	Perennial	46.5	0.08	Unknown
	2973	Unnamed	Intermittent/ephemeral	11.6	0.02	—
Shallow Aquifer and Fox River Alluvium	3	Fox River	Perennial	342.7	0.59	WWSF
	2855	Unnamed	Intermittent/ephemeral	17.4	0.03	—
	2931	Pebble Brook	Perennial	46.5	0.08	Unknown
	2973	Unnamed	Intermittent/ephemeral	11.6	0.02	—
Lake Michigan—Milwaukee Supply	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—Oak Creek Supply	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	—

TABLE 2-7
Water Body Crossings
City of Waukesha Water Supply

Alternative	Water Body/ Stream No.	Water Body Name	Water Body Type	Approximate Crossing Width (ft)	Crossing Area (acres)	Fisheries Classification[a]
Lake Michigan—Racine Supply	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
	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						
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	
Root River to Lake Michigan	1845	Poplar Creek	Perennial	—	0.03	Unknown
	3052	Unnamed	Intermittent/ephemeral	—	0.01	—
	3054	Unnamed	Intermittent/ephemeral	—	0.08	—

TABLE 2-7
Water Body Crossings
City of Waukesha Water Supply

Alternative	Water Body/ Stream No.	Water Body Name	Water Body Type	Approximate Crossing Width (ft)	Crossing Area (acres)	Fisheries Classification[a]
	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
	4887	North Branch Root River	—	93.3	0.04	—
	5985	North Branch Root River	—	42.8	0.03	—
	21136	Deer Creek	—	77.4	0.02	—
	22799	North Branch Root River	—	496.2	0.16	—
Direct to Lake Michigan	1845	Poplar Creek	Perennial	—	0.03	Unknown
	3052	Unnamed	Intermittent/ephemeral	—	0.01	—
	3054	Unnamed	Intermittent/ephemeral	—	0.08	—
	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
	5428	Lake Michigan	Lake	—	6.24	—
	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 waterbody.

TABLE 2-8
Summary of Acres of Water Body Crossings
City of Waukesha Water Supply

Name	Deep and Shallow Wells	Shallow Aquifer and Fox River Alluvium	Lake Michigan–Milwaukee Supply	Lake Michigan-Oak Creek Supply	Lake Michigan–Racine Supply	Underwood Creek to Lake Michigan	Root River to Lake Michigan	Direct To Lake Michigan
Deer Creek	—	—	0.02	0.02	—	0.02	0.02	0.02
Lake Michigan	—	—	—	—	—	—	—	6.24
Muskego Drainage Canal	—	—	—	—	0.51	—	—	—
Fox River	0.24	0.59	—	—	—	—	—	—
Pebble Brook	0.08	0.08	—	—	—	—	—	—
Poplar Creek	—	—	0.03	0.03	1.12	0.03	0.03	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	0.04	0.04	0.01	0.01	0.72	0.11	0.10	0.10
Grand Total	**0.36**	**0.71**	**0.06**	**0.06**	**2.35**	**0.16**	**0.15**	**6.39**

TABLE 2-9
Summary of Number of Water Body Crossings
City of Waukesha Water Supply

Alt 1 Deep and Shallow Wells	Alt 2 Shallow Aquifer and Fox River Alluvium	Alt 3a-1 Milwaukee	Alt 3a-2 Oak Creek	Alt 3a-3 Racine	Alt 3b-1 Underwood Creek	Alt 3b-2 Root River	Alt 3b-3 Direct To Lake Michigan
4	4	8	11	16	9	11	9

The City will minimize construction impacts to surface waters during construction. The specific practices for individual surface water crossings will be developed once the final pipeline alternative has been selected. Then the City will work with applicable federal, state, and local stakeholder agencies to select the construction measures and mitigation plans necessary on a case by case basis to minimize impacts to local surface water resources to the extent feasible.

Typical pipeline construction surface-water-crossing BMPs are included in Appendix 2-A.

2.4 Wetlands

Most wetlands are classified as "waters of the United States," which 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.

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, described below.

- *Hydrophytic vegetation.* The prevalent vegetation must consist of plants adapted to life in hydric soils. These species, due to 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.

2.4.1 Existing Resources

Wetlands crossed by the supply and return flow alternatives, located at the proposed aboveground structures (including well houses and water treatment plant), and affected by groundwater drawdown were identified from the 2005 Wetlands Inventory provided by

SEWRPC and WDNR (2005) to produce the an accurate and comprehensive desktop wetlands inventory.

Wetlands affected by groundwater pumping were determined from groundwater modeling results. Groundwater modeling is documented in Appendix O of the Application. The impact to wetlands from a 5 foot or greater and 1 foot or greater groundwater drawdown is shown in the figures at the end of this Chapter. Because a wetland is designated by the type of plants, hydrology, and soil type, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. Table 2-10 lists the total wetlands affected by various groundwater drawdown depths for each groundwater supply alternative.

TABLE 2-10
Wetland Impacts from Groundwater Drawdown (Acres)
City of Waukesha Water Supply

	Emergent or Wet Meadow	Filled or Drained Wetland	Flats or Unvegetated Wet Soil	Foreste d	Open Water & Aquatic Bed	Scrub/ Shrub	Grand Total
Deep and Shallow Aquifers 5 foot or greater groundwater drawdown	240.6	1.8	12.1	307.5	11.1	419.0	992.1
Deep and Shallow Aquifers 1 foot or greater groundwater drawdown	710.2	11.3	50.5	932.2	88.6	1,294.4	3,087.2
Shallow Aquifer and Fox River Alluvium 5 foot or greater groundwater drawdown	475.0	2.4	30.4	547.9	37.0	871.3	1,964.0
Shallow Aquifer and Fox River Alluvium 1 foot or greater groundwater drawdown	1,079.2	12.5	74.5	1,278.7	103.4	1,558.2	4,106.5

Table 2-11 lists the wetlands crossed by the supply and return flow alternatives. Please see Chapter 1 for figures associated with each of the alternatives. There is some overlap between the wetlands potentially affected by groundwater drawdown and wetlands only affected by supply and return flow route alternative pipeline or aboveground structure construction. Consequently, only wetlands affected by the pipeline or aboveground structure construction are listed in Table 2-11.

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.

2.4.2 Impacts and Mitigation

A discussion regarding wetland crossing acreages associated with each of the alternatives has been included below and is summarized in Table 2-11. Additional analysis on the significance of wetland acreages affected for each alternative in comparison to other land use types crossed can be found in ER Chapter 7, "Land Use." Potential wetlands impacts are described in terms of temporary construction and operational impacts. Pipeline construction impacts to wetlands are expected to be temporary in nature while operational impacts are expected to be ongoing permanent impacts. Operational impacts are subdivided into aboveground structure impacts and impacts from groundwater level drawdown.

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
Supply				
Deep and Shallow Aquifers	7963	Emergent/wet meadow	556.9	1.60
	7982	Emergent/wet meadow	597.2	1.83
	8111	Flats/unvegetated wet soil	—	0.01
	8122	Scrub/shrub	—	0.13
	8129	Scrub/shrub	474.7	1.34
	8146	Scrub/shrub	872.4	1.50
	8178	Scrub/shrub	480.3	0.83
	8197	Scrub/shrub	526.8	0.71
	8246	Scrub/shrub	—	0.07
	8263	Scrub/shrub	283.3	0.58
	8315	Forested	—	0.02
	8325	Forested	—	0.02
	8392	Forested	—	0.84
	8395	Forested	235.7	0.40
	8399	Forested	611.9	0.95
	8401	Forested	—	0.01
Shallow Aquifer and Fox River Alluvium	7963	Emergent/wet meadow	556.9	1.60
	7982	Emergent/wet meadow	597.2	1.83
	8044	Emergent/wet meadow	—	0.52
	8089	Emergent/wet meadow	58.6	0.28
	8111	Flats/unvegetated wet soil	—	0.01
	8122	Scrub/shrub	—	0.13
	8129	Scrub/shrub	474.7	1.34
	8146	Scrub/shrub	872.4	1.50
	8178	Scrub/shrub	480.3	0.83
	8179	Scrub/shrub	45.8	0.31
	8184	Scrub/shrub	220.8	1.09
	8197	Scrub/shrub	526.8	0.71
	8246	Scrub/shrub	—	0.07
	8249	Scrub/shrub	—	0.11
	8263	Scrub/shrub	283.3	0.58

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	8266	Scrub/shrub	—	0.15
	8303	Forested	782.9	1.34
	8315	Forested	—	0.02
	8324	Forested	—	1.23
	8325	Forested	902.8	2.06
	8392	Forested	—	0.84
	8395	Forested	235.7	0.40
	8399	Forested	611.9	0.95
	8401	Forested	248.5	1.59
	8402	Forested	213.5	2.42
Lake Michigan—Milwaukee Supply	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	1286.9	2.53
	11973	Forested	—	0.002
	12645	Forested	—	0.02
	12650	Forested	—	0.15
	12660	Forested	—	0.01

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
Lake Michigan—Oak Creek Supply	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
	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

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	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
	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—Racine Supply	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

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	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
	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

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	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
	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

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	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				
Underwood Creek to Lake Michigan	6807	Emergent/wet meadow	187.0	0.30
	6934	Forested	20.0	0.04
	6937	Forested	1380.9	2.52
	7003	Forested	—	0.05
	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	1454.2	2.38
Root River to Lake Michigan	7962	Emergent/wet meadow	—	1.38
	7970	Emergent/wet meadow	—	0.00
	8015	Emergent/wet meadow	—	0.17

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
	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
	11029	Emergent/wet meadow	—	0.01
	11030	Emergent/wet meadow	90.5	0.11
	11031	Emergent/wet meadow	175.3	0.30
	11047	Emergent/wet meadow	—	0.18
	11433	Scrub/shrub	114.5	0.20
	11638	Scrub/shrub	14.5	0.04
	11672	Scrub/shrub	—	0.10
	11794	Forested	—	0.00
	11796	Forested	15.3	0.03
	11799	Forested	2261.4	3.58
	11970	Forested	—	0.01
	11972	Forested	503.7	0.92
	12578	Forested	304.8	0.52
	12581	Forested	—	0.22
	12585	Forested	82.7	0.13
	12587	Forested	—	0.00
	12645	Forested	—	0.72
	12650	Forested	284.7	0.69
	12656	Forested	—	0.25
	12660	Forested	—	0.28

TABLE 2-11
Wetland Crossings
City of Waukesha Water Supply

Alternative	Wetland No.	Wetland Type	Crossing Width (ft)	Crossing Area (acres)
Direct to Lake Michigan	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
	10321	Filled/drained wetland	121.6	0.13
	11046	Emergent/wet meadow	270.9	0.45
	11053	Emergent/wet meadow	—	0.19
	11054	Emergent/wet meadow	—	0.10
	11676	Scrub/shrub	—	0.01
	12613	Forested	—	0.08
	12627	Forested	—	0.08
	12628	Forested	—	0.01
	12643	Forested	193.6	0.32

2.4.2.1 Supply Alternatives

Deep and Shallow Aquifers. Two palustrine emergent (PEM) wetlands, seven palustrine scrub-shrub (PSS) wetlands, six palustrine forested (PFO) wetlands, and one flats/unvegetated wetlands are located along this alternative and affected by the pipeline construction or aboveground structures. As shown in Table 2-12, this supply route may affect 10.83 acres of wetlands. The breakdown of temporary and potential permanent impacts are described below, where permanent aboveground structures are discussed.

TABLE 2-12
Summary of Wetland Types Impacted (Acres)
City of Waukesha Water Supply

	Emergent or Wet Meadow	Flats or Unvegetated Wet Soil	Forested	Scrub/ Shrub	Filled or Drained Wetland	Open Water	Grand Total
Deep and Shallow Aquifers	3.42	0.01	2.24	5.16	—	—-	10.83
Shallow Aquifer and Fox River Alluvium	4.22	0.01	10.85	6.81	—-	—-	21.88
Lake Michigan-Milwaukee Supply	0.83	—-	3.9	14.82	—-	—-	19.55
Lake Michigan-Oak Creek Supply	2.91	—-	5.86	4.39	—-	0.06	13.22
Lake Michigan-Racine Supply	15.8	4.57	6.85	22.36	0.66	1.62	51.85
Underwood Creek to Lake Michigan	1.42	—-	5.11	7.32	—-	—-	13.85
Root River to Lake Michigan	2.22	—-	7.48	2.66	—-	0.01	12.37
Direct To Lake Michigan	2.36	—-	0.6	2.33	0.13	0.01	5.43

Note: Not all impacts are permanent. Permanent versus temporary construction impacts are discussed below.

The groundwater drawdown from pumping provides significant additional operational impacts as shown in Table 2-10. Nearly 1,000 acres of wetlands experience a 5 foot or greater groundwater drawdown. A 1-foot or greater groundwater drawdown occurs for over 3,000 wetland acres.

Because a wetland is designated by the type of plants, hydrology, and soil type, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. Species change, habitat change, or destruction of habitat could occur when the groundwater level is lowered below what is needed for plant species that have colonized areas based upon current groundwater levels. Vernal pool habitat is also very susceptible to changes in water depth and lowering groundwater levels could reduce the occurrence or duration of this seasonal habitat where it exists within the groundwater drawdown zone.

Shallow Aquifer and Fox River Alluvium. Four PEM, 11 PSS, and nine PFO wetlands are located along this alternative and affected by the pipeline construction or aboveground structures. As shown in Table 2-12, this supply route may affect 21.88 acres of wetlands. The breakdown of temporary and potential permanent impacts is described below, where permanent aboveground structures are discussed.

The groundwater drawdown provides significant additional operational impacts, as shown in Table 2-10. Nearly 2,000 acres of wetlands experience a 5-foot or greater groundwater drawdown. A 1-foot or greater groundwater drawdown occurs for over 4,000 wetland acres. The same potential habitat changes from groundwater drawdown described for the Deep and Shallow Aquifer alternative also apply to this alternative.

Lake Michigan–Milwaukee Supply. Four PEM, 11 PSS, and 11 PFO wetlands are located along this alternative and affected by the pipeline construction. As shown in Table 2-12, this supply route may affect 19.55 acres of wetlands; however, all impacts will be temporary in nature.

Lake Michigan–Oak Creek Supply. Twelve PEM, 21 PSS, 20 PFO, and three open-water wetlands are located along this alternative and affected by the pipeline construction. As shown in

Table 2-12, this supply route may affect 13.22 acres of wetlands; however, all impacts will be temporary in nature.

Lake Michigan–Racine Supply. Twenty-nine PEM, 29 PSS, 16 PFO, 4 filled/drained, 8 flat/unvegetated soil, and 6 open-water wetlands are located along this alternative and affected by the pipeline construction. As shown in Table 2-12, this supply route may affect 51.85 acres of wetlands; however, all impacts will be temporary in nature.

2.4.2.2 Return Flow Alternatives

Underwood Creek to Lake Michigan. Five PEM, 10 PSS, and six PFO wetlands are located along this alternative and affected by the pipeline construction. As shown in Table 2-12, this return flow alternative may affect 13.85 acres of wetlands, but all impacts will be temporary in nature.

Root River to Lake Michigan. Eight PEM, 13 PSS, 15 PFO, and one open-water wetland are located along this alternative and affected by the pipeline construction. As shown in Table 2-12, this return flow alternative may affect 12.37 acres of wetlands; however, all impacts will be temporary in nature.

Direct to Lake Michigan. Seven PEM, 11 PSS, six PFO wetlands, one open-water wetland, and one filled/drained wetland are located along this alternative and affected by the pipeline construction. As shown in Table 2-12, this return flow alternative may affect 5.43 acres of wetlands; however, all impacts will be temporary in nature.

2.4.2.3 Aboveground Structures

Aboveground structures associated with the various alternatives represent potential permanent impacts to wetland resources. Permanent structures that may be necessary, depending on the final alternative selected, include, but are not limited to, pump houses, access roads, and water treatment plants. Preliminary siting of aboveground resources has been completed and is associated primarily with the Deep and Shallow Aquifers alternative and the Shallow Aquifer and Fox River Alluvium alternative. The potential permanent impacts to wetland resources for these two alternatives are included below. The remaining pipeline alternatives have minimal aboveground structures.

Deep and Shallow Aquifers. Of the 10.83 acres of wetlands potentially temporarily affected by this alternative, 6.31 acres, or 58 percent, are affected by the 11 proposed well houses and corresponding access roads. No wetland impacts are anticipated as a result of the proposed water treatment plant for this alternative.

Shallow Aquifer and Fox River Alluvium. This alternative would affect 21.88 acres of wetlands, of which 17.26 acres are the result of the 15 proposed well houses. Approximately 0.11 acre will be as a result of the proposed water treatment plant.

2.4.2.4 Mitigation

Based on the results of the groundwater modeling study completed (Appendix O to the Application), approximately 1,000 to 2,000 acres of wetlands could be affected by a 5-foot groundwater drawdown, depending upon the groundwater water supply alternative. For 1 foot of drawdown, approximately 3,000 to 4,000 wetland acres could be affected. As described in the groundwater modeling results in Appendix O to the Application, an alternative groundwater well location option, which involved altering and adding well locations to spread them farther apart to reduce the potential environmental impacts, was analyzed for the Shallow Aquifer and Fox River Alluvium alternative. A review of the modeling drawdown for that alternative (see Section 4 of the Application and the figures in this chapter) indicated the 5-foot drawdown would reduce the wetland impact to 1,783 acres and the 1-foot drawdown would reduce the wetland impact to 4,063 acres. The wetland impacts from this variation only reduced the impacts from the base case 1 to 9 percent. As a result, it appears that any shallow groundwater supply alternative in the Troy Bedrock aquifer near the City of Waukesha will result in potentially significant impacts.

The construction for supply and return flow pipeline alternatives are co-located with existing infrastructure to the greatest extent feasible in order to minimize wetland impacts by utilizing previously disturbed land and reducing habitat fragmentation. The Deep and Shallow Aquifers and Shallow and Fox River Alluvium alternatives will require impacts to previously undisturbed wetland areas due to the need to drill wells in rural, undeveloped locations. With the exception of proposed aboveground structures and groundwater drawdown, construction impacts will be temporary in nature.

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.

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FIGURE 2-1 SHALLOW AQUIFER WITH FOX RIVER ALLUVIUM ONE FOOT DRAWDOWN AREA

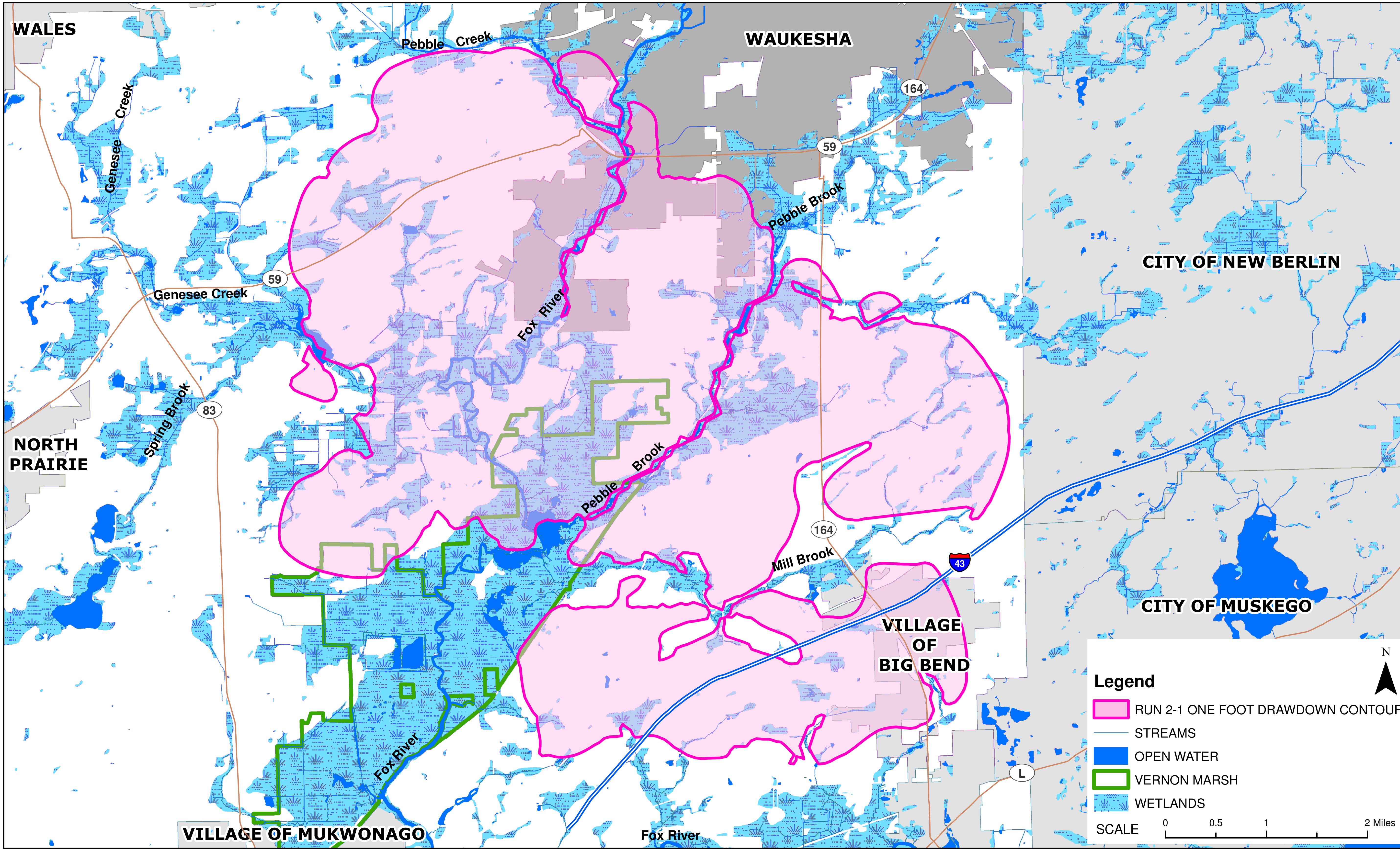


FIGURE 2-2 SHALLOW AQUIFER WITH FOX RIVER ALLUVIUM FIVE FOOT DRAWDOWN AREA

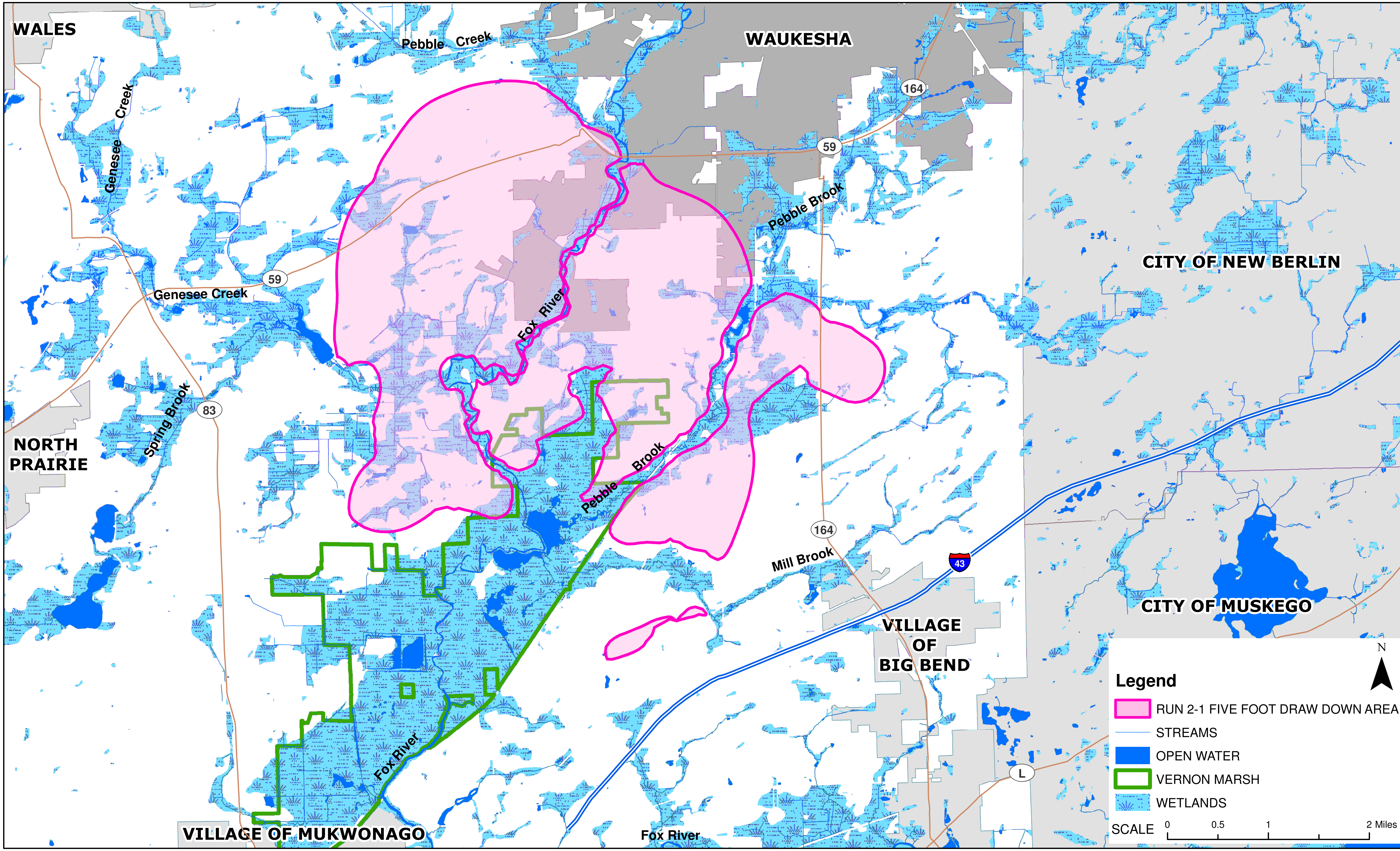


FIGURE 2-3 DEEP AND SHALLOW AQUIFERS ONE FOOT DRAWDOWN AREA

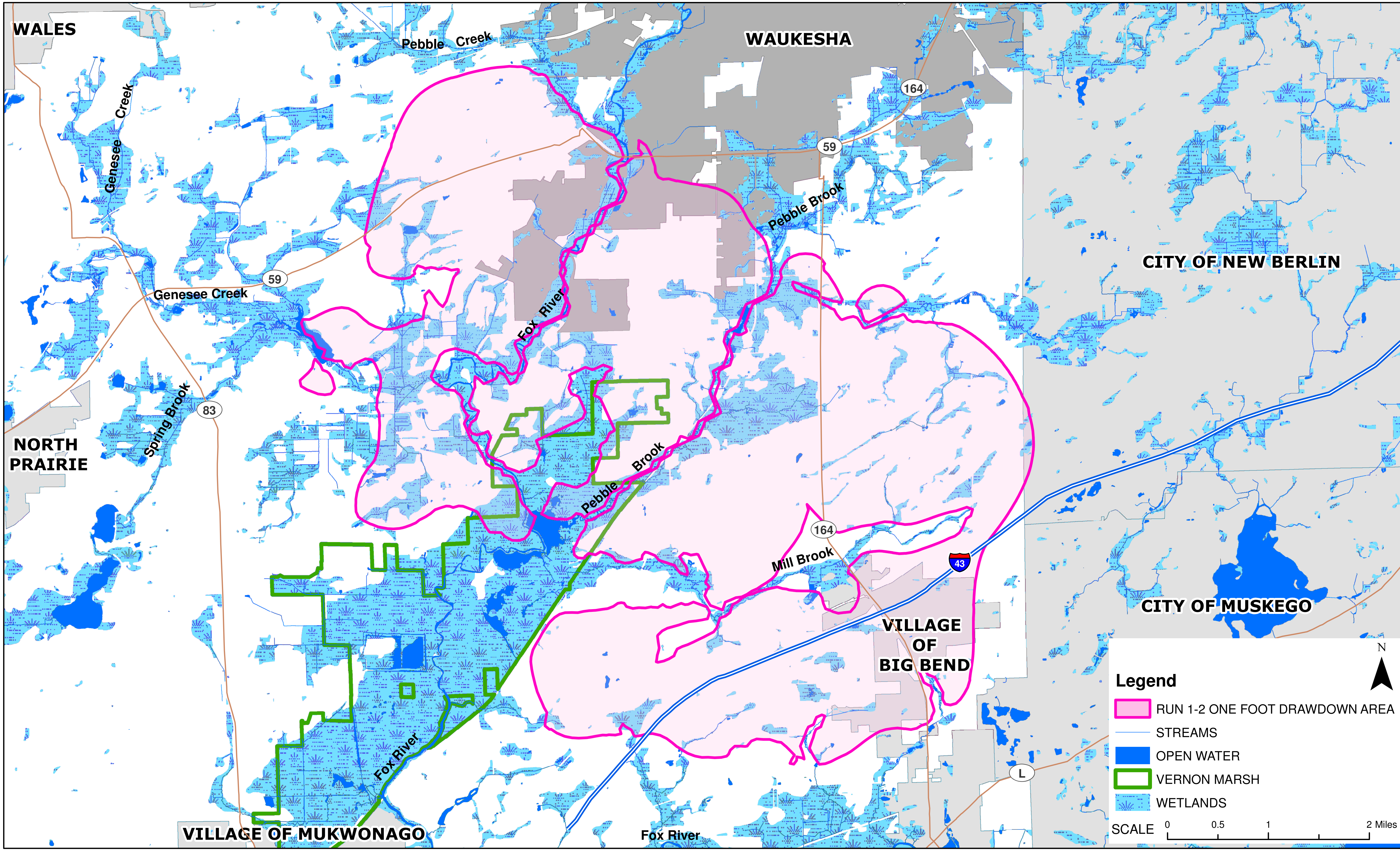


FIGURE 2-4 DEEP AND SHALLOW AQUIFERS
FIVE FOOT DRAWDOWN AREA

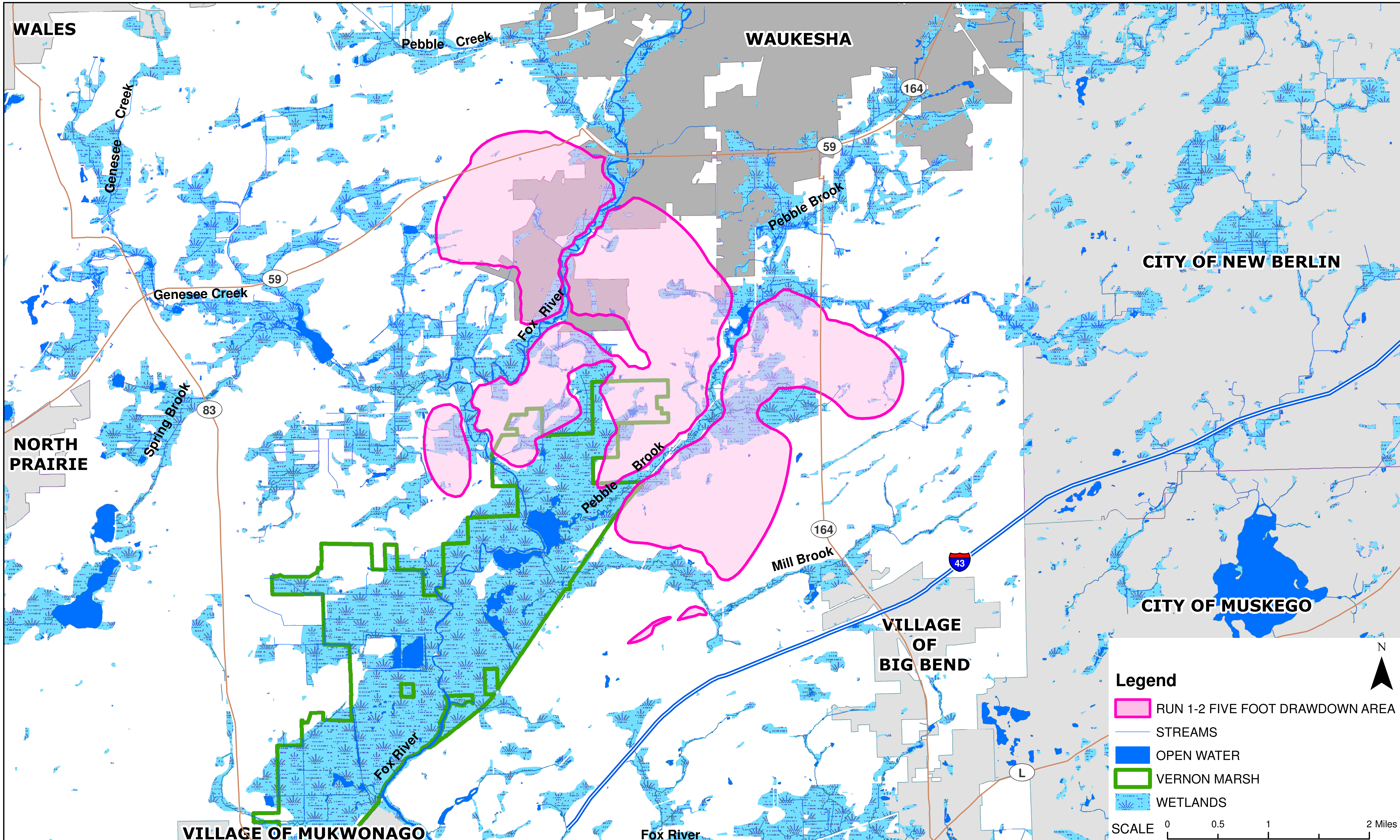


FIGURE 2-5 SHALLOW AQUIFER WITH FOX RIVER ALLUVIUM ONE FOOT DRAWDOWN AREA AND SPRINGS

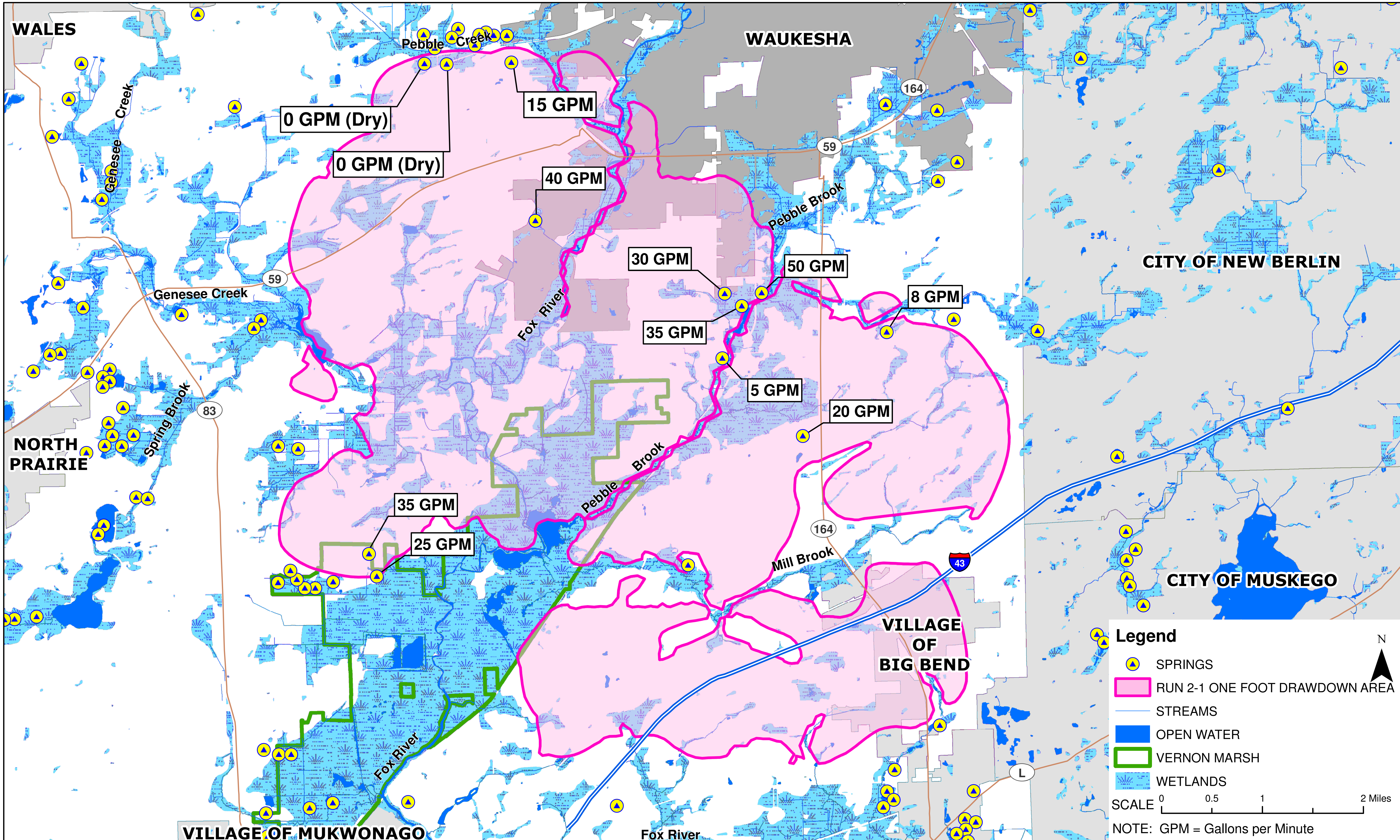
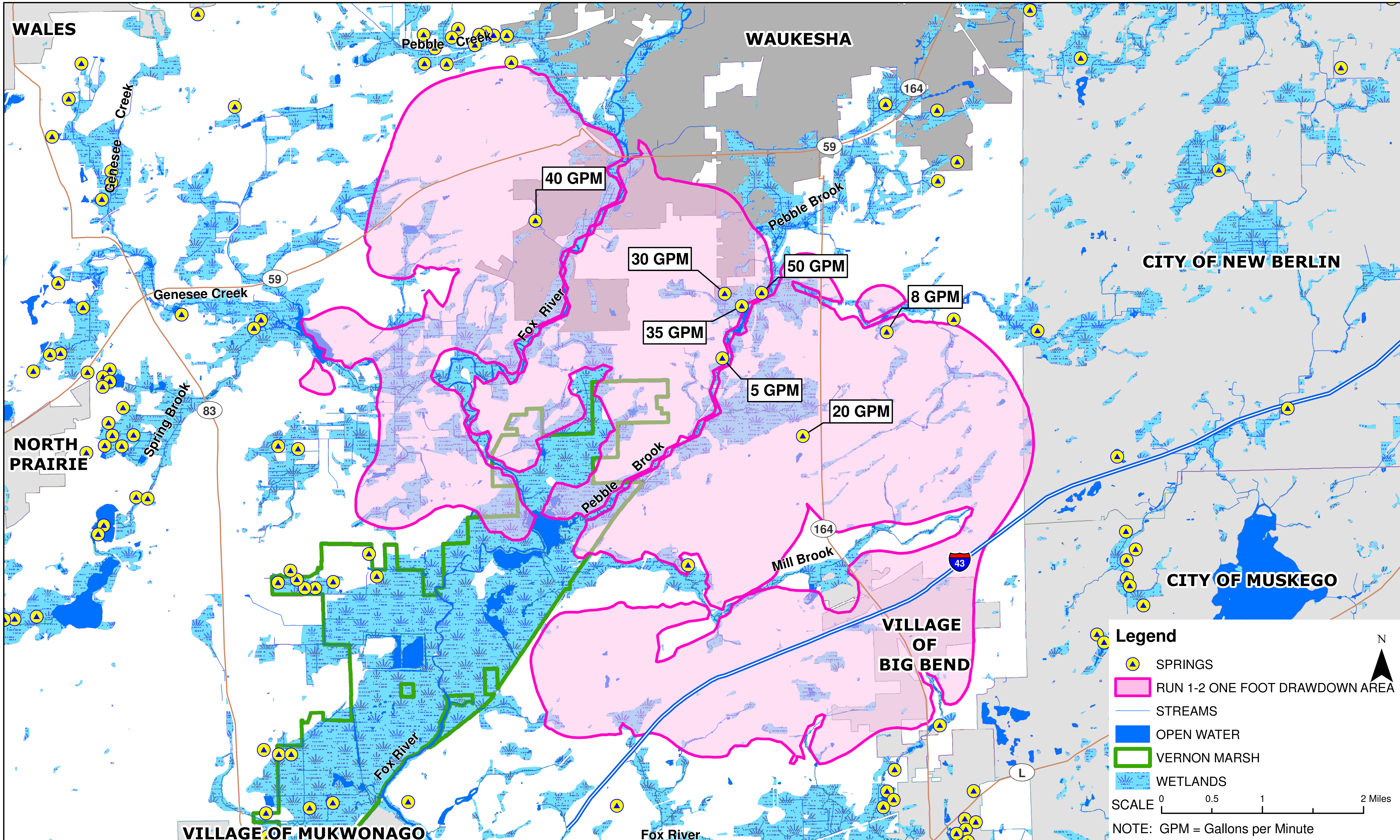


FIGURE 2-6 DEEP AND SHALLOW AQUIFERS ONE FOOT DRAWDOWN AREA AND SPRINGS



Appendix 2-A

Example Wetland and Waterway Pipeline Construction Crossing Impact Minimization Techniques

APPDENDIX 2-A

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.

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Vegetation and Wildlife Resources

CHAPTER 3

Vegetation and Wildlife Resources

3.1 Introduction

This section describes existing fish and wildlife resources, plant communities, sensitive species, special status species and habitats that may be directly or indirectly affected by the supply and return flow alternatives being evaluated. It considers anticipated impacts related to construction and operation. Information was derived from two principal sources: communication with federal and state agencies and published and unpublished natural resources data pertaining to the regional area. Due to the preliminary nature of the project, field surveys on the proposed corridor options have not yet been completed. A field review will be completed to delineate wetlands and survey habitats within proposed construction workspaces once a final supply and return flow route has been chosen. Based on the field review, measures will be taken to mitigate any identified impacts to vegetation and wildlife resources.

3.2 Wildlife Resources

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); and 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.

3.2.1 Existing Resources

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. A aerial view of the alternative alignments is shown with the figures in ER Chapter 1. The wildlife habitats along the proposed workspace fall into four categories and several subcategories:

- *Open Unforested Areas* affected by the supply and return flow alternatives 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* affected by the supply and return route options 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 aboveground structures anticipated with the project as shown in the figures in ER Chapter 1. While impacts to forested riparian areas and wetlands may occur as a result of pipeline installation, these impacts are temporary in nature and will 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 resource concern.

- *Aquatic Areas* affected by the supply and return route options consist generally of streams and wetlands from pipeline construction and return flow receiving waters which includes Lake Michigan tributaries and Lake Michigan. Aquatic areas can provide habitat to a diverse wildlife population, and a number of common species (beaver, muskrat, herons, etc.) are dependent on aquatic habitat for food and shelter. Some animals and birds (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. Aquatic habitat is discussed further in ER Chapter 2.

- *Developed Areas* affected by the Project generally consist of residential, commercial, and industrial land, and active recreational parks. These areas generally consist of asphalt and concrete surfaces, maintained turf grass, and landscape trees and shrubs. In general, these areas provide poor wildlife habitat. However, several opportunistic species (raccoon, opossum, squirrel, American crow, American robin, European starling, common grackle, various sparrows, etc.) have adapted well and thrive in urban and suburban settings.

3.2.2 Significant Habitat: Vernon Wildlife Area

Significant wildlife habitats typically include state game refuges, wildlife management areas, National Wildlife Refuges, and other unique or sensitive areas. A single state wildlife management area, Vernon Wildlife Area (VWA), is located within the proposed construction workspace for the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives. VWA is a 4,655-acre property in eastern Waukesha County consisting of wetlands and flowages associated with the Fox River and including a calcareous fen in the southern portion of the property. Adjacent uplands are dominated by grassland habitats with interspersed areas of limited hardwoods. The VWA provides significant wildlife habitat, especially for migrating and nesting waterfowl (WDNR, 2010d).

3.2.3 Construction and Operation Impacts and Mitigation

3.2.3.1 Impacts Outside of Vernon Wildlife Area

In general, impacts to wildlife resources as a result of constructing new supply and return flow water mains are anticipated to 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 disturbance will likely cause the temporary displacement of more mobile wildlife from the construction workspace 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 colonize postconstruction habitats. Because the pipeline routes follow previously disturbed areas including streets and alleys, bike paths, active and abandoned railroad corridors, utility corridors, and city and county lands, no permanent or long-term impacts to wildlife resources are anticipated other than those associated with permanent above ground structures predominantly associated with the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives (see Chapter 7, Table 7-1). Plans will accommodate general and site-specific protective measures for any sensitive wildlife habitat and species identified during the course of construction. Seasonal timing to account for reproductive and migratory patterns will be coordinated with state and federal agencies, as necessary.

Siting for the supply and return flow alternatives was chosen to minimize the overall land use impact by utilizing land already in use as 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.

3.2.3.2 Impacts to Vernon Wildlife Area (VWA)

A total of 1.25 acres of the VWA would be affected by the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives if either were constructed as currently proposed (see ER Chapter 7, Table 7-5). These impacts would consist of temporary, construction-type impacts.

In addition, due to the volume of water proposed to be withdrawn from the deep and shallow aquifers for the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium alternatives, there is the potential for a drawdown of the groundwater table within the VWA. Groundwater modeling shows groundwater level drawdown associated with these alternatives and is discussed in Appendix O to the Application. The groundwater drawdown relative to the VWA is shown in ER Chapter 2 figures.

Groundwater drawdowns were compared for overlap to the VWA. The Deep and Shallow Aquifers alternative has a 5 foot or greater depth of groundwater drawdown affecting 291 acres, or a 1 foot or greater depth of groundwater drawdown affecting 609 acres. This level of groundwater drawdown is a significant impact upon the VWA habitat because much of the VWA is wetland and this level of drawdown could result in habitat type change. Wetland impacts are described in ER Chapter 2.4.

The Shallow Aquifer and Fox River Alluvium alternative has a 5 foot or greater depth of groundwater drawdown affecting 343 acres, or a 1 foot or greater depth of groundwater drawdown affecting 1,106 acres. This level of groundwater drawdown is a significant impact upon the VWA habitat because much of the VWA is wetland and this level of drawdown could result in habitat type change. Wetland impacts are described in ER Chapter 2.4.

The Lake Michigan water supply and return flow alternatives do not affect the VWA.

3.3 Vegetation

The figures in Chapter 1 show an aerial view of the alternative alignments which portray the land use and general vegetation along the routes for each alternative. Table 7-2 in ER Chapter 7, Land Use, provides a comprehensive breakdown of land use affected by each of the supply and return flow alternatives. (Note that there may be differences between land use types discussed in Chapter 7 and the vegetation and habitat types discussed here, in Chapter 3.)

3.3.1 Existing Resources

U.S. Department of Agriculture's *Descriptions of the Ecoregions of the United States* (USDA, 1995) describes a hierarchical classification system for ecological units on national and regional scales. Areas of the country 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:

3.3.1.1 Humid Temperate Domain

The climate of the Humid Temperate Domain, located in the middle latitudes (30° to 60°N), is 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 these 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).

3.3.1.2 Hot Continental Division

The Hot Continental Division is characterized by hot summers and cool winters. In the warmer sections of the Hot Continental Division, the frost-free, or growing, season continues for 5 to 6 months and in the colder sections only 3 to 5 months. 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 quickly develops, but 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.

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

3.3.1.3 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, owing to lower precipitation, the province also supports the oak-hickory association. The Eastern Broadleaf Forest in the northern states, such as Wisconsin, also supports the maple-basswood association (USDA, 2010).

3.3.2 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 alternatives.

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 alternatives. The pipeline alignments follow previously disturbed areas including streets and alleys, bike paths, active and abandoned railroad corridors, utility corridors, and city and county lands, so few, if any impacts to Natural Communities are expected. Any project alignment impacts to these Natural Communities will be coordinated with the appropriate state and federal agencies and will be avoided and minimized. Potential Natural Communities include:

- Southern Dry Mesic Forest
- Southern Mesic Forest
- Mesic Prairie
- Wet Prairie
- Emergent Marsh
- Southern Sedge Meadow
- Calcareous Fen
- Shrub-Carr
- Northern Wet Forest
- Floodplain Forest
- Springs and Spring Runs

3.3.3 Construction and Operation Impacts and Mitigation

The City has selected pipeline routes to primarily follow areas that have already been developed or disturbed to minimize impacts to vegetation communities of special concern. The City will work with regulatory agencies to identify specific locations where vegetation communities of special concern exist and to minimize and mitigate impacts. The majority of the project footprint for all alternatives is associated with pipeline construction, the impacts of which will primarily be temporary during construction.

Operational impacts are associated both with above ground structures which are predominantly associated with the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives and groundwater drawdown which is only associated with the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives. The operational impacts from groundwater drawdown from pumping are described above under Chapter 3.2 Wildlife Resources. The Lake Michigan water supply and return flow alternatives have insignificant operational surface impacts. The temporary construction and operational surface impacts are summarized in Chapter 7, Table 7-1.

Construction will necessitate removing surface vegetation from workspaces. The ground surface will be graded to facilitate pipeline installation and to allow safe operation of equipment. During grading, the root systems of herbs, shrubs, and small trees will be disturbed.

Vegetation removal can increase wind and water erosion of exposed soil. It can also increase soil temperature and allow greater light penetration into fringing woodland where new workspace is cleared in forested areas. Changes in light and temperature regimes may influence the species profile of plant communities within and adjacent to the workspace. The City will minimize soil erosion by adherence to BMPs.

Most impacts to vegetation are expected to be minor and short-term. In open areas with herbaceous cover, recolonization of disturbed ground by annual and perennial species is characteristically rapid and occurs within one growing season. Where necessary, the City will develop area-specific revegetation and restoration plans in consultation with the appropriate federal, state, and local agencies.

Clearing of woody shrubs and trees will have more significant, long-term impacts because shrubs and trees take longer to regrow than herbaceous vegetation. During recolonization, a shrub- or tree-dominated community will evolve through several successional stages before assuming its original profile.

Tree removal will be minimized to the extent practicable and replanting will be in accordance with local, state, and federal agency requirements. Woody shrubs and trees will be allowed to regrow in previously forested areas, but the permanent pipeline maintenance corridor will be maintained with low vegetative cover to facilitate access and inspection of the water main. Mechanical methods, such as a brush hog, will be used as necessary to keep the maintenance corridor clear of excessive woody vegetation.

Table 8-2 shows the potential acreage of various land use affected along the proposed workspace. Further details are provided in ER Chapter 7, Land Use.

3.4 Endangered and Threatened Species

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 United States and that protection of these species and their habitats is required. The Act protects fish, wildlife, plants, and invertebrates that are federally listed as endangered or threatened.

A federally endangered species is any species that is in danger of extinction throughout all or a significant portion of its range, with exceptions for certain insect pests. A federally threatened species is any species that is likely to become endangered in the foreseeable future throughout all or a significant portion 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. In addition to protection of individual species, 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 this 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 about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this 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 the 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.

3.4.1 Existing Resources

3.4.1.1 Federally Listed Species

According to correspondence from the USFWS (2010), no federally listed threatened or endangered species occur within the vicinity of the supply and return flow alternatives being evaluated. Since construction is not proposed until midyear 2013, the City is planning to consult with the USFWS in spring 2013 to verify that no new federally listed species have been identified within the selected supply and return flow construction workspace.

3.4.1.2 State-Listed Species

The City initiated consultation with WDNR Office of Energy, which assumes responsibility for endangered resources review of utility projects and works closely with the Bureau of Endangered Resources to implement the WDNR's endangered resources protection policies and regulations. WDNR (2010c) identified multiple listed species as potentially occurring within the vicinity of the proposed supply and return flow alternatives. A summary of the listed species associated with each of the supply and return flow alternatives is included in the following tables 3-1 through 3-7.

Consultation with SEWRPC was also conducted by the City at the request of the WDNR to inquire about any threatened or endangered species or species of concern information SEWRPC may have available. The information from SEWRPC is available in several reports on a watershed basis and is consistent with information on listed species received from the WDNR. However, a recent SEWRPC report, Community Assistance Planning Report No. 284, Pebble Creek Watershed Protection Plan documented the presence of a state threatened species, the Longear Sunfish (*Lepomis megalotis)* in 1999-2005 surveys in Pebble Creek. As discussed in Chapter 2.3.2.2, base groundwater flows to Pebble Creek could be significantly affected by the Deep and Shallow Aquifer and Shallow Aquifer and Fox River Alluvium alternatives and as a result, these alternatives have the potential to adversely impact habitats for documented listed species. Other species were found in Pebble Creek or at the confluence with the Fox River that are species of special concern in Wisconsin. However, the historical presence of these species in the watershed does not indicate the species occur in the alternative corridor.

Due to the preliminary nature of the project, no field surveys have been completed at this time. Once a final water supplier has been negotiated and a return flow location have been approved, field surveys will be completed to along the selected route to confirm the presence or absence of the species listed by the WDNR.

3.4.2 Construction and Operation Impacts and Mitigation

Based on the consultation response from USFWS (2010), no impacts to federally listed species or critical habitat are anticipated. However, USFWS does state 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 reinitiate consultation with the USFWS to comply with their request and to prevent impacts to federally listed species or critical habitat.

The City has selected pipeline routes to primarily follow areas that have already been developed or disturbed to minimize impacts to endangered and threatened species. The City will work with regulatory agencies to identify specific locations where such species may potentially be impacted and take measure to to minimize impacts. The majority of the project footprint for all alternatives is associated with pipeline construction, the impacts of which will primarily be temporary during construction.

Operational impacts are associated both with above ground structures which are predominantly associated with the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives and groundwater drawdown which is only associated with the Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium supply alternatives. The Lake Michigan water supply and return flow alternatives have insignificant operational surface impacts. The temporary construction and operational surface impacts are summarized in Chapter 7, Table 7-1.

The City is currently coordinating with the WDNR to conduct a habitat assessment at locations along alternative infrastructure alignments in the summer of 2010. The information gained from the habitat assessment will be shared with the WDNR. Once a final water supplier has been negotiated and a return flow location have been approved, field surveys will be completed to confirm the presence or absence of the species listed by the

WDNR. The City will continue to 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 it is feasible
- Stage construction to limit disturbance during sensitive time periods
- Conduct temporary removal by an approved scientist following established protocols

3.5 References

SEWRPC (Southeastern Wisconsin Regional Planning Commission). 2008. Community Assistance Planning Report No. 284, Pebble Creek Watershed Protection Plan.

SEWRPC (Southeastern Wisconsin Regional Planning Commission). 2007. Water Quality Conditions and Sources of Pollution in the Greater Milwaukee Watersheds. Technical Report No. 39.

USDA (U.S. Department of Agriculture). 1995. Descriptions of the Ecoregions the United States. Compiled by R. G. Baily.

USDA (U.S. Department of Agriculture). 2010. USDA Humid Temperate Domain. http://www.fs.fed.us/land/ecosysmgmt/index.html. Accessed Feb. 25, 2010.

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WDNR (Wisconsin Department of Natural Resources). 2010d. Vernon Wildlife Area. http://www.dnr.state.wi.us/org/land/wildlife/wildlife_areas/vernon.htm. Accessed February 25, 2010.

TABLE 3-1
Lake Michigan—Milwaukee Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat	—	Southern dry-mesic forest	N/A	—	5/1/1992 9/3/1997 5/23/2002
	—	Bird Rookery	NA	-—	NA
	—	Southern mesic forest	N/A	—	2/8/1988
Plants	*Asclepias purpurascens*	Purple milkweed	E	—	7/13/1912
	Astragalus neglectus	Cooper's milkvetch	E	—	6/22/1939
	Carex crus-corvi	Ravenfoot sedge	E	—	6/22/1988
	Carex lupuliformis	False hop sedge	E	—	7/22/1988 1995
	Conioselinum chinense	Hemlock parsley	E	—	8/25/1897
	Platanthera leucophaea	Prairie white-fringed orchid	E	T	7/9/1890
	Erigenia bulbosa	Harbinger-of-spring	E	—	4/25/1897
	Prenanthes aspera	Rough rattlesnake root	E	—	1845
	Cypripedium arietinum	Ram's-head lady's slipper	T	—	6/1897
	Cypripedium candidum	Small white lady's slipper	T	—	1850
	Aster furcatus	Forked aster	T	—	6/7/1999
	Cacalia muehlenbergii	Great Indian plantain	SC	—	7/1/1937
	Lithospermum latifolium	American gromwell	SC	—	5/29/1976 4/30/1992 5/11/1992
	Platanthera hookeri	Hooker orchid	SC	—	7/9/1899

TABLE 3-1
Lake Michigan—Milwaukee Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Scutellaria ovata	Heart-leaved skullcap	SC	—	5/12/1980 8/1/2000
	Trillium recurvatum	Reflexed trillium	SC	—	5/28/2000 5/23/2002
	Calamagrostis stricta	Slim-stem small reedgrass	SC	—	6/30/1940
	Carex tenuiflora	Sparse-flowered sedge	SC	—	6/3/1882
	Cypripedium parviflorum	Northern yellow lady's slipper	SC	—	6/3/1932
	Liatris spicata	Marsh blazing star	SC	—	9/1875
	Thalictrum revolutum	Waxleaf meadowrue	SC	—	8/8/1933 6/30/1940
	Triglochin maritime	Common bog arrow-grass	SC	—	1800s
	Ptelea trifoliate	Wafer-ash	SC	—	10/3/2000
	Viburnum prunifolium	Smooth black-haw	SC	—	12/2/1999
	Platanthera dilatata	Leafy white orchid	SC	—	7/1884
Reptiles & Amphibians	*Acris crepitans*	Northern cricket frog	E	—	5/10/1946 5/1/1955
	Thamnophis butleri	Butler's gartersnake	T	—	7/13/2007 10/23/2007 6/2008 10/23/2008

TABLE 3-1
Lake Michigan—Milwaukee Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Emydoidea blandingii	Blanding's turtle	T	—	5/3/1988 6/26/1996 2002
	Lithobates catesbeianus	American bullfrog	SC	—	7/20/1988
Fish	*Luxilus chrysocephalus*	Striped shiner	E	—	1920
	Lythrurus umbratilis	Redfin shiner	T	—	7/11/1924
	Clinostomus elongates	Redside dace	SC	—	3/20/1910
	Erimyzon sucetta	Lake chubsucker	SC	—	3/29/1977 5/10/1979
Insects	*Pompeius verna*	Little glassy wing	SC	—	7/12/1988
	Archilestes grandis	Great spreadwing	SC	—	9/20/1984
Crustaceans	*Procambarus gracilis*	Prairie crayfish	SC	—	3/28/1910 5/11/1970

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected).

TABLE 3-2
Lake Michigan—Oak Creek Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat	—	Southern dry mesic forest	N/A	—	6/11/1991 5/1/1992 9/30/1997 7/24/2001 5/23/2002 5/1/2003
	—	Southern mesic forest	N/A	—	2/8/1988 6/16/1991 6/22/1995 7/29/1999
	—	Mesic prairie	N/A	—	8/17/1992
	—	Wet prairie	N/A	—	7/1985
	—	Emergent marsh	N/A	—	7/1985
	—	Southern sedge meadow	N/A	—	7/1985
	—	Calcareous fen	N/A	—	9/9/1991
	—	Shrub-carr	N/A	—	7/1985
	—	Northern wet forest	N/A	—	7/1985
	—	Floodplain forest	N/A	—	6/2/1995
	—	Springs and spring runs (hard)	N/A	—	7/1985
Plants	*Asclepias purpurascens*	Purple milkweed	E	—	8/20/1905 7/13/1912 7/4/1928

TABLE 3-2
Lake Michigan—Oak Creek Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Solidago caesia	Bluestem goldenrod	E	—	9/16/1991 8/30/2000 6/4/2003 9/20/2003
	Platanthera leucophaea	Prairie white-fringed orchid	E	T	7/9/1890
	Carex lupuliformis	False hop sedge	E	—	1995 5/1/2003
	Carex crus-corvi	Ravenfoot sedge	E	—	6/22/1988
	Trisetum melicoides	Purple false oats	E	—	8/4/1940
	Astragalus neglectus	Cooper’s milkvetch	E	—	6/22/1939
	Conioselinum chinense	Hemlock parsley	E	—	8/25/1897
	Erigenia bulbosa	Harbinger-of-spring	E	—	4/25/1897
	Prenanthes aspera	Rough rattlesnake root	E	—	1845
	Aster furcatus	Forked aster	T	—	5/1/1992 1997
	Tofieldia glutinosa	Sticky false-asphodel	T	—	7/31/2003
	Cypripedium arietinum	Ram’s-head lady’s slipper	T	—	6/1897
	Cypripedium candidum	Small white lady’s slipper	T	—	1850
	Scutellaria ovata	Heart-leaved skullcap	SC	—	5/12/1980 8/1/2000
	Carex tenuiflora	Sparse-flowered sedge	SC	—	6/3/1882
	Cacalia muehlenbergii	Great Indian plantain	SC	—	7/1/1937
	Medeola virginiana	Indian cucumber-root	SC	—	6/6/1908
	Platanthera hookeri	Hooker orchid	SC	—	7/9/1899

TABLE 3-2
Lake Michigan—Oak Creek Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Trillium recurvatum	Reflexed trillium	SC	—	5/18/1941 5/11/1992 4/30/1999 5/28/2000 7/11/2000 5/23/2002 5/1/2003
	Viburnum prunifolium	Smooth black-haw	SC	—	9/16/1991 4/26/2000 7/11/2000 5/1/2003
	Cypripedium parviflorum	Northern yellow lady's slipper	SC	—	5/30/1889 7/9/1890 6/3/1932
	Liatris spicata	Marsh blazing star	SC	—	9/1875
	Epilobium strictum	Downy willow-herb	SC	—	8/19/1983
	Triglochin maritime	Common bog arrow-grass	SC	—	1800s
	Platanthera dilatata	Leafy white orchid	SC	—	7/1884
	Glycyrrhiza lepidota	Wild licorice	SC	—	8/13/1940
	Thalictrum revolutum	Waxleaf meadowrue	SC	—	6/30/1940 7/5/1963 6/15/2000
	Lithospermum latifolium	American gromwell	SC	—	5/27/1897 5/29/1976 4/30/1992 5/11/1992

TABLE 3-2
Lake Michigan—Oak Creek Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					10/19/2005
	Calamagrostis stricta	Slim-stem small reedgrass	SC	—	6/30/1940
	Cakile lacustris	American sea-rocket	SC	—	7/26/1975
	Cypripedium reginae	Showy lady's slipper	SC	—	6/17/1939
	Equisetum variegatum	Variegated horsetail	SC	—	6/30/1995
	Gentianopsis procera	Lesser fringed gentian	SC	—	9/22/2000
	Solidago ohioensis	Ohio goldenrod	SC	—	10/20/2000
	Triglochin palustris	Slender bog arrow-grass	SC	—	8/11/1981
	Ptelea trifoliata	Wafer-ash	SC	—	10/3/2000
Birds	*Sterna forsteri*	Forster's tern	E	—	2004
	Nycticorax nyticorax	Black-crowned night heron	SC	—	1962
	Pandion haliaetus	Osprey	SC	—	5/2008
	Spiza Americana	Dickissel	SC	—	7/7/2000
Reptiles & Amphibians	*Acris crepitans*	Northern cricket frog	E	—	5/10/1946 5/1/1955
	Thamnophis butleri	Butler's gartersnake	T	—	7/14/2006 5/14/2007 7/13/2007 10/23/2007 4/2008 6/2008 10/23/2008
	Emydoidea blandingii	Blanding's turtle	T	—	5/3/1988 6/4/1996

TABLE 3-2
Lake Michigan—Oak Creek Supply: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					5/9/2000 2002
	Lithobates catesbeianus	American bullfrog	SC	—	7/20/1988
Fish	*Luxilus chrysocephalus*	Striped shiner	E	—	1920
	Lythrurus umbratilis	Redfin shiner	T	—	7/11/1974
	Lepomis megalotis	Longear sunfish	T	—	4/4/2000
	Etheostoma microperca	Least darter	SC	—	7/11/1924
	Erimyzon sucetta	Lake chubsucker	SC	—	3/29/1977 5/10/1979
Insects	*Somatochlora ensigera*	Lemon-faced emerald	SC	—	6/25/1978
	Pompeius verna	Little glassy wing	SC	—	7/12/1988
Crustaceans	*Procambarus gracilis*	Prairie crayfish	SC	—	5/11/1970 8/7/1982

[a]E, Endangered; T, Threatened; SC, Spaecies of Concern (not legally protected).

TABLE 3-3
Underwood Creek Return: State-Listed Endangered and Threatened Species, Natural Heritage Inventory Data—WDNR
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat	—	Southern dry-mesic forest	N/A	—	9/30/1997 10/9/1998 5/23/2002
	—	Southern mesic forest	N/A	—	2/8/1988 4/28/1993
	—	Floodplain forest	N/A	—	5/23/1992
	—	Southern sedge meadow	N/A	—	9/26/1990
	—	Mesic prairie	N/A	—	7/26/2002
Plants	*Asclepias purpurascens*	Purple milkweed	E	—	7/13/1912
	Astragalus neglectus	Cooper's milkvetch	E	—	6/22/1939
	Carex crus-corvi	Ravenfoot sedge	E	—	6/22/1988
	Carex lupuliformis	False hop sedge	E	—	1995
	Conioselinum chinense	Hemlock parsley	E	—	8/25/1897
	Platanthera leucophaea	Prairie white-fringed orchid	E	T	7/9/1890
	Erigenia bulbosa	Harbinger-of-spring	E	—	4/25/1897
	Prenanthes aspera	Rough rattlesnake root	E	—	1845
	Cypripedium arietinum	Ram's-head lady's slipper	T	—	6/1897
	Aster furcatus	Forked aster	T	—	1997
	Cypripedium candidum	Small white lady's slipper	T	—	1850
	Cacalia muehlenbergii	Great Indian plantain	SC	—	7/1/1937
	Lithospermum latifolium	American gromwell	SC	—	5/27/1897 5/29/1976 4/30/1992 4/28/1993

TABLE 3-3
Underwood Creek Return: State-Listed Endangered and Threatened Species, Natural Heritage Inventory Data—WDNR
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Platanthera hookeri	Hooker orchid	SC	—	7/9/1899
	Scutellaria ovata	Heart-leaved skullcap	SC	—	5/12/1980 8/1/2000
	Trillium recurvatum	Reflexed trillium	SC	—	5/12/2002 5/23/2002
	Calamagrostis stricta	Slim-stem small reedgrass	SC	—	6/30/1940
	Carex tenuiflora	Sparse-flowered sedge	SC	—	6/3/1882
	Cypripedium parviflorum	Northern yellow lady's slipper	SC	—	6/3/1932 8/11/1992
	Liatris spicata	Marsh blazing star	SC	—	9/1875
	Thalictrum revolutum	Waxleaf meadowrue	SC	—	6/30/1940
	Triglochin maritime	Common bog arrow-grass	SC	—	1800s
	Platanthera dilatata	Leafy white orchid	SC	—	7/1884
	Calylophus serrulatus	Yellow evening primose	SC	—	7/26/2002
	Thaspium trifoliatum	Purple meadow parsnip	SC	—	5/30/1930
	Jeffersonia diphylla	Twinleaf	SC	—	4/28/1993
Birds	*Nycticorax nycticorax*	Black-crowned night heron	SC	—	1974
Reptiles & Amphibians	*Acris crepitans*	Northern cricket frog	E	—	5/10/1946 5/1/1955
	Thamnophis butleri	Butler's gartersnake	T	—	7/2007 10/23/2007 2008
	Emydoidea blandingii	Blanding's turtle	T	—	5/3/1988

TABLE 3-3
Underwood Creek Return: State-Listed Endangered and Threatened Species, Natural Heritage Inventory Data—WDNR
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					6/26/1996
	Lithobates catesbeianus	American bullfrog	SC	—	7/20/1988
Fish	*Luxilus chrysocephalus*	Stride shiner	E	—	1920
	Lythrurus umbratilis	Redfin shiner	T	—	7/11/1924
	Etheostoma microperca	Least darter	SC	—	11/17/1901
	Erimyzon sucetta	Lake chubsucker	SC	—	3/29/1977
	Clinostomus elongates	Redside dace	SC	—	11/17/1901
Insects	*Pompeius verna*	Little glassy wing	SC	—	7/12/1988
Crustaceans	*Procambarus gracilis*	Prairie crayfish	SC	—	5/11/1970

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected).

TABLE 3-4
Direct to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat	—	Calcareous fen	NA		9/9/1991
	—	Southern dry mesic forest	N/A	—	5/14/1991
	—	Southern mesic forest	N/A	—	9/9/1991
	—	Springs and spring runs (hard)	N/A	—	7/1985
Plants	*Asclepias purpurascens*	Purple milkweed	E	—	8/20/1905 7/13/1912 7/4/1928
	Aster furcatus	Forked aster	T	—	8/19/2001 1997
	Astragalus neglectus	Cooper's milkvetch	E	—	6/22/1939
	Cacalia muehlenbergii	Great Indian plantain	SC	—	7/1/1937
	Cakile lacustris	American sea-rocket	SC	—	1950s?
	Calamagrostis stricta	Slim-stem small reedgrass	SC	—	6/30/1940
	Carex tenuiflora	Sparse-flowered sedge	SC	—	6/3/1882
	Conioselinum chinense	Hemlock parsley	E	—	8/25/1897
	Cypripedium arietinum	Ram's-head lady's slipper	T	—	6/1897
	Cypripedium candidum	Small white lady's slipper	T	—	1850
	Cypripedium parviflorum	Northern yellow lady's slipper	SC	—	5/30/1889 7/9/1890 6/3/1932
	Cypripedium reginae	Showy lady's slipper	SC	—	6/17/1939
	Equisetum variegatum	Variegated horsetail	SC	—	6/30/1995

TABLE 3-4
Direct to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Erigenia bulbosa	Harbinger-of-spring	E	—	1850 1920
	Euphorbia polygonifolia	Seaside Spurge	SC		1872
	Gentianopsis procera	Lesser fringed gentian	SC	—	9/9/1991
	Glycyrrhiza lepidota	Wild licorice	SC	—	8/19/1940
	Liatris spicata	Marsh blazing star	SC	—	9/1875 1872
	Lithospermum latifolium	American gromwell	SC	—	5/27/1897
	Medeola virginiana	Indian cucumber-root	SC	—	6/6/1908
	Penstemon hirsutus	Hairy Beardtongue	SC		6/18/1939
	Platanthera dilatata	Leafy white orchis	SC	—	7/1884
	Platanthera hookeri	Hooker orchis	SC	—	7/9/1899
	Platanthera leucophaea	Prairie white-fringed orchid	E	T	7/9/1890
	Solidago caesia	Bluestem goldenrod	E	—	9/20/1872 9/25/2001 12/10/2000
	Solidago ohioensis	Ohio goldenrod	SC	—	9/20/1975 9/9/1991
	Thalictrum revolutum	Waxleaf meadowrue	SC	—	8/8/1933 6/30/1940
	Tofieldia glutinosa	Sticky false-asphodel	T	—	6/30/1995
	Triglochin maritime	Common bog arrow-grass	SC	—	1800s

TABLE 3-4
Direct to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Triglochin palustris	Slender bog arrow-grass	SC	—	8/11/1981
	Trillium recurvatum	Reflexed trillium	SC	—	5/14/1991 1846 5/23/1945 5/17/1963 5/28/2000 5/11/1938
	Trisetum melicoides	Purple false oats	E	—	8/4/1940
Birds	*Spiza Americana*	Dickissel	SC	—	2/8/2000
Reptiles & Amphibians	*Acris crepitans*	Northern cricket frog	E	—	5/10/1946 5/1/1955
	Thamnophis butleri	Butler's gartersnake	T	—	10/25/1915 4/14/1910 2003 5/14/2007 10/10/1938 10/18/1987
	Emydoidea blandingii	Blanding's turtle	T	—	5/3/1988 6/4/1996 5/9/2000 2002
	Lithobates catesbeianus	American bullfrog	SC	—	7/20/1988
Fish	*Luxilus chrysocephalus*	Striped shiner	E	—	3/2/1910

TABLE 3-4
Direct to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Lythrurus umbratilis	Redfin shiner	T	—	7/11/1974
	Moxostoma valenciennesi	Greater Redhorse	T		9/13/1996
	Fundulus diaphanus	Banded Killfish	SC	—	4/20/1902
	Pompeius verna	Little glassy wing	SC	—	7/12/1988
Crustaceans	*Procambarus gracilis*	Prairie crayfish	SC	—	3/28/1910 5/2/1910 7/9/1983 2/7/1982 7/11/1982 7/8/1982

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected).

TABLE 3-5
Deep and Shallow Wells & Shallow Aquifer and Fox River Alluvium - State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat/Other	—	Bird Rookery	SC	—	1994
	—	Calcerous Fen	NA	—	9/10/1992
	—	Emergent Marsh	N/A	—	5/30/1992
	—	Mesic Prairie	N/A	—	7/26/2002
	—	Southern dry forest	N/A	—	4/30/1992
	—	Southern dry-mesic forest	N/A	—	4/30/1992
	—	Southern mesic forest	N/A	—	4/29/1992
Plants	*Agrimonia parviflora*	Swamp Agrimony	SC	—	6/3/1882 1999
	Asclepias Purpurascens	Purple Milkweed	E	—	4/7/1928
	Aster furcatus	Forked aster	T	—	6/8/1999 8/18/1998
	Cacalia tuberosa	Prairie Indian plantain	T	—	7/25/1925
	Carex Crawei	Crawe Sedge	SC	—	1852
	Cypripedium candidum	Small White Lady's Slipper	T	—	6/9/1997 6/10/1898 5/31/1948
	Cypripedium parviflorum	Northern yellow lady's slipper	SC	—	8/11/1982
	Gentiana alba	Yellow Gentain	T	—	8/30/1938
	Gentianopsis procera	Lesser Fringed Gentain	SC	—	9/10/1992
	Jeffersonia diphylla	Twinleaf	SC	—	1852

TABLE 3-5
Deep and Shallow Wells & Shallow Aquifer and Fox River Alluvium - State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					6/24/1930
	Liatris spicata	Marsh blazing star	SC	—	7/8/1933 10/8/1897
	Myriophyllum farewelii	Farwell's Water-milfoil	SC	—	5/31/1931
	Polygala cruciata	Crossleaf Milkwort	SC	—	8/1875
	Prenanthes aspera	Rough rattlesnake root	E	—	1845
	Ptelea trifoliata	Wafer ash	SC	—	9/10/1992
	Solidago ohioensis	Ohio Goldenrod	SC	—	8/30/1928 9/10/1992 6/9/1997
	Thaspium trifoliatum var. flavum	Purple Meadow-Parsnip	SC	—	5/30/1930
Reptiles & Amphibians	*Acris crepitans*	Northern cricket frog	E	—	5/1/1955
	Emydoidea blandingii	Blanding's turtle	T	—	5/1993
	Thamnophis butleri	Butler's gartersnake	T	—	4/5/1955 4/17/1998 6/7/2007 2/10/2007 10/2007 2004 2003 4/17/1998

TABLE 3-5
Deep and Shallow Wells & Shallow Aquifer and Fox River Alluvium - State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Fish and Mussels	*Alasmidonta marginata*	Elktoe	SC	—	8/15/2001
	Alasmidonta virdis	Slippershell Mussel	T	—	8/15/2001
	Erimyzon sucetta	Lake chubsucker	SC	—	11/7/1978 7/13/1978
	Lepomis megalotis	Longear Sunfish	T	—	3/10/1996
	Luxilus chrysocephalus	Striped shiner	E	—	1920
Birds	*Chlidonias niger*	Black tern	SC	—	5/30/1992
	Gallinula Chloropus	Common Moorhen	SC	—	5/30/1992
Mammals	*Spermophilus frankilinii*	Franklin's ground Squirrel	SC	—	1980

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected).

TABLE 3-6
Root River to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat	—	Mesic Prairie	N/A	—	7/26/2002
	—	Southern Dry Mesic Forest	N/A	—	5/14/1991 6/11/1991 5/1/1992 5/23/2002
	—	Southern Mesic Forest	N/A	—	2/8/1988
Plants	*Asclepias purpurascens*	Purple Milkweed	E		8/20/1905 7/13/1912
	Aster furcatus	Forked Aster	T	—	5/1/1992
	Astragalus neglectus	Cooper's Milkvetch	E	—	6/22/1939
	Cacalia muehlenbergii	Great Indian Plantain	SC	—	7/1/1937
	Calamagrostis stricta	Slim-stem Small reedgrass	SC	—	6/30/1940
	Carex lupuliformis	False Hop Sedge	E	—	1995
	Carex tenuiflora	Sparse-flowered Sedge	SC	—	6/3/1882
	Conioselinum chinense	Hemlock parsley	E	—	8/25/1897
	Cypripedium arietinum	Ram's-head Lady's slipper	T	—	6/1897
	Cypripedium parviflorum	Northern Yellow Lady's slipper	SC	—	6/3/1932 8/11/1992
	Liatris spicata	Marsh Blazing Star	SC	—	9/1875
	Lithospermum latifolium	American Gromwell	SC	—	5/27/1897 6/11/1991 4/30/1992 5/11/1992
	Platanthera dilatata	Leafy white orchid	SC	—	7/1884

TABLE 3-6
Root River to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Platanthera hookeri	Hooker orchid	SC	—	7/9/1899
	Platanthera leucophaea	Prairie white-fringed orchid	E	T	7/9/1890
	Prenanthes aspera	Rough Rattlesnake-root	E	—	1845
	Ptelea trifoliata	Wafer-ash	SC	—	10/3/2000
	Scutellaria ovata	Heart-leaved skullcap	SC	—	8/1/2000
	Solidago caesia	Bluestem goldenrod	E	—	9/20/2003
	Thalictrum revolutum	Waxleaf Meadowrue	SC	—	8/8/1933 6/30/1940
	Triglochin maritime	Common Bog Arrow-grass	SC	—	1800s
	Trillium recurvatum	Reflexed Trillium	SC	—	1846 5/18/1941 5/23/1944 5/23/1945 5/14/1991 5/1/1992 5/28/2000 5/12/2002 5/23/2002
	Viburnum prunifolium	Smooth black-haw	SC	—	6/11/1991
Birds	*Spiza Americana*	Dickcissel	SC	—	7/7/2000
Reptiles & Amphibians	*Acris crepitans*	Northern Cricket Frog	E	—	5/10/1946 5/1/1955
	Emydoidea blandingii	Blanding's Turtle	T	—	5/3/1988 5/9/2000
	Lithobates catesbeianus	American Bullfrog	SC	—	7/20/1988

TABLE 3-6
Root River to Lake Michigan: State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Thamnophis butleri	Butler's Gartersnake	T	—	4/5/1955 2003 6/30/2003 10/2003 2004 7/13/2006 7/18/2006 5/14/2007 6/7/2007 6/13/2007 7/2007 10/2/2007 2008 6/2008
Fish	*Luxilus chrysocephalus*	Striped shiner	E	—	1920
	Lythrurus umbratilis	Redfin shiner	T	—	7/11/1924
	Lepomis megalotis	Longear sunfish	T	—	4/4/2000
	Etheostoma microperca	Least darter	SC	—	7/11/1924
	Erimyzon sucetta	Lake chubsucker	SC	—	5/10/1979
Insects	*Pompeius verna*	Little Glassy Wing	SC	—	7/12/1988
Crustaceans	*Procambarus gracilis*	Prairie Crayfish	SC	—	3/28/1910 5/11/1970

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected).

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
Habitat		Bird Rookery	SC	—	10/18/1991
					6/16/1905
		Calcareous Fen	NA	—	8/11/1993
					10/2/1992
		Emergent Marsh	NA	—	3/9/1985
		Floodplain Forest	NA	—	5/6/1993
					7/22/1991
					10/1/1991
					12/11/1993
					7/1985
					7/10/1991
					7/1976
		Lake--Oxbow	NA	—	7/1976
		Mesic Prairie	NA	—	7/19/1991
		Northern Wet Forest	NA	—	6/19/1992
		Southern Dry Forest	NA	—	4/30/1993
		Southern Dry-mesic Forest	NA	—	10/7/1991
					10/2/1991

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					5/20/1991
					4/1999
					9/30/1997
		Southern Mesic Forest	NA	—	7/1976
					10/7/1991
					10/1/1991
					5/8/1992
					7/1976
					5/20/1991
					5/18/2004
					4/29/1992
					2/8/1988
		Stream--Slow, Hard, Warm	NA	—	7/1985
Plants	*Adlumia fungosa*	Climbing Fumitory	SC	—	1861?
	Arethusa bulbosa	Swamp-pink	SC	—	6/13/1888
	Asclepias purpurascens	Purple Milkweed	E	—	7/19/1879
					7/4/1928
					8/20/1905
	Asclepias sullivantii	Prairie Milkweed	T	—	6/14/1905

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					9/1880
	Aster furcatus	Forked Aster	T	—	6/12/1905
					9/10/1992
					8/29/1990
	Cacalia muehlenbergii	Great Indian-plantain	SC	—	6/16/1905
	Cacalia tuberosa	Prairie Indian Plantain	T	—	7/1995
					7/30/1898
	Calamintha arkansana	Low Calamint	SC	—	10/3/1891
	Carex crawei	Crawe Sedge	SC	—	6/15/1901
					1/25/1905
	Carex crus-corvi	Ravenfoot Sedge	E	—	9/9/1996
	Carex formosa	Handsome Sedge	T	—	1980s
	Carex lupuliformis	False Hop Sedge	E	—	6/12/1905
	Carex richardsonii	Richardson Sedge	SC	—	6/12/1901
	Carex tenuiflora	Sparse-flowered Sedge	SC	—	7/1/1932
	Cirsium hillii	Hill's Thistle	T	—	8/17/1897
	Cypripedium candidum	Small White Lady's-slipper	T	—	6/1876

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Cypripedium parviflorum var. makasin	Northern Yellow Lady's-slipper	SC	—	5/23/1897 3/14/1905 5/30/1889 5/7/1938 6/3/1932
	Cypripedium reginae	Showy Lady's-slipper	SC	—	3/17/1905
	Deschampsia cespitosa	Tufted Hairgrass	SC	—	6/30/1900
	Echinacea pallida	Pale-purple Coneflower	T	—	6/9/1905
	Etheostoma microperca	Least Darter	SC	—	7/10/1924
	Festuca paradoxa	Cluster Fescue	SC	—	1930s?
	Fraxinus quadrangulata	Blue Ash	T	—	7/9/1995
	Gentiana alba	Yellow Gentian	T	—	8/1992
	Gentianopsis procera	Lesser Fringed Gentian	SC	—	5/9/1897 9/28/1968
	Jeffersonia diphylla	Twinleaf	SC	—	6/24/1930
	Liatris spicata	Marsh Blazing Star	SC	—	9/5/1990 6/12/1905
	Lithospermum latifolium	American Gromwell	SC	—	5/8/1992

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					10/2/1991
					5/29/1976
					10/21/2000
					12/11/1993
	Medeola virginiana	Indian Cucumber-root	SC	—	6/6/1908
	Pandion haliaetus	Osprey	SC	—	6/30/1905
	Panicum wilcoxianum	Wilcox Panic Grass	SC	—	7/23/1944
	Parthenium integrifolium	American Fever-few	T	—	9/25/1900
					6/12/1905
	Plantago cordata	Heart-leaved Plantain	E	—	7/17/2002
	Platanthera leucophaea	Prairie White-fringed Orchid	E	—	7/9/1980
	Polystichum acrostichoides	Christmas Fern	SC	—	1861?
	Prenanthes aspera	Rough Rattlesnake-root	E	—	1/18/1905
	Ptelea trifoliata	Wafer-ash	SC	—	10/17/ 1940
					7/6/1966
	Ranunculus cymbalaria	Seaside Crowfoot	T	—	7/1/1898
					8/1878
	Scutellaria ovata	Heart-leaved Skullcap	SC	—	5/24/2000

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
	Solidago caesia	Bluestem Goldenrod	E	—	10/21/2000
					10/18/1991
					9/10/1992
					9/25/2001
	Solidago ohioensis	Ohio Goldenrod	SC	—	9/5/1990
					6/12/1905
					9/13/1991
					10/2/1992
					8/30/1928
					9/13/1991
					10/2/1992
					9/10/1992
	Thalictrum revolutum	Waxleaf Meadowrue	SC	—	7/6/1906
					9/5/1990
					6/12/1905
	Tofieldia glutinosa	Sticky False-asphodel	T	—	7/2/1898
	Tomanthera auriculata	Earleaf Foxglove	SC	—	8/18/1900
	Triglochin maritima	Common Bog Arrow-grass	SC	—	1800s
	Trillium recurvatum	Reflexed Trillium	SC	—	5/6/1993

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					6/3/1991
					5/24/2000
					6/6/1991
					10/1/1991
					4/6/1962
					5/20/1991
					8/18/2004
					5/14/1933
					5/12/1980
					5/10/1988
					5/15/2001
					5/20/1990
					6/15/1960
					4/28/1998
	Viburnum prunifolium	Smooth Black-haw	SC	—	5/6/1993
					5/8/1992
					12/11/1993
					5/24/2000
					10/2/1991
					9/1/1985

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					10/1/1991
					5/25/1992
					10/7/1991
					7/22/1998
Reptiles & Amphibians	*Emydoidea blandingii*	Blanding's Turtle	T	—	7/1/1989
					5/3/2006
	Thamnophis butleri	Butler's Gartersnake	T	—	6/26/1905
					10/2/2010
					4/5/1955
					6/7/2005
					7/2007
					6/13/2006
					6/30/2003
					4/5/1955
					7/13/2007
	Regina septemvittata	Queensnake	E	—	8/21/1971
	Acris crepitans	Northern Cricket Frog	E	—	5/1/1955
Birds	*Haliaeetus leucocephalus*	Bald Eagle	SC	R	5/2008
	Nycticorax nycticorax	Black-crowned Night-heron	SC	—	1950s

TABLE 3-7
Lake Michigan - Racine; State-Listed Endangered and Threatened Species and Communities
City of Waukesha Water Supply

Species Group	Scientific Name	Common Name	State Status[a]	Federal Status[a]	Date Last Observed
					5/15/1905
	Buteo lineatus	Red-shouldered Hawk	T	—	4/1982
	Bartramia longicauda	Upland Sandpiper	SC		6/10/1987
Fish and Mussels	*Fundulus diaphanus*	Banded Killifish	SC	—	6/20/1995
					7/11/1978
					11/9/1978
	Opsopoeodus emiliae	Pugnose Minnow	SC	—	6/26/1995
	Notropis anogenus	Pugnose Shiner	T	—	10/8/1971
	Luxilus chrysocephalus	Striped Shiner	E	—	7/12/1978
	Erimyzon sucetta	Lake Chubsucker	SC	—	7/11/1978
					3/29/1977
	Lythrurus umbratilis	Redfin Shiner	T	—	7/11//1924
					7/10/1924
	Lepomis megalotis	Longear Sunfish	T	—	1/9/1900
					7/10/1924
					11/9/1978

[a]E, Endangered; T, Threatened; SC, Species of Concern (not legally protected); R, Recovery

Appendix 3-A

Volume 1: Public Agency Correspondence

CH2M HILL
135 S. 84th Street
Suite 325
Milwaukee, WI 53214
Tel 414-272-2426
Fax 414-272-4408

January 12, 2010

Shari Koslowsky
Office of Energy SS/7
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921
Phone: (608) 261-4382

Subject: Threatened and Endangered Species Review Request
City of Waukesha Municipal Water Supply – Lake Michigan Diversion

Dear Ms. Koslowsky:

On behalf of the City of Waukesha (the City), CH2M HILL is requesting your verification that no threatened, endangered, proposed or candidate species, and/or unique habitats or natural areas exist in locations where infrastructure associated with obtaining a new water source for the City may be located. As requested by the Wisconsin DNR, the City is completing an environmental report that is evaluating the impacts of several alternatives to meet the current and future water supply needs of the City. These water supply alternatives include expanding existing groundwater sources, developing new groundwater sources, and obtaining and returning Lake Michigan water. This review will assist the City with evaluating the impacts of each alternative.

All of the proposed areas that may be impacted by water supply alternatives are located in the Counties of Waukesha, Milwaukee, or Racine, Wisconsin. The township, range, and section data for each proposed route is provided in tabular format in Attachment 1, which is included with this letter for your convenience. Attachment 2 is a map depicting the quarter sections from Attachment 1 that intersect with the alternatives.

CH2M HILL is requesting your concurrence that no state protected resources will be affected by or is located within one (1) mile of the water supply alternatives described above.

Because we are evaluating and comparing the alternatives, it is important that the potential impacts be identified for each alternative. We respectfully request that if potential impacts are identified in your review, that you please indicate which alignment ID <u>and</u> quarter section is impacted.

If you have any questions regarding this request or need additional information, please do not hesitate to contact me at (414) 272-2426, ext. 40356. Thank you.

Sincerely,

CH2M HILL

Corey Wilcox

Corey Wilcox
Associate Scientist

Attachments:
(1) Tables 1 – 3. Township, Range, and Section Data for Water Supply Alternatives
(2) Map Depicting Quarter-Sections Impacted by Proposed Water Supply Alternatives

Cc: Mark Mittag/CH2M HILL
Brent Brown/CH2M HILL

TABLE 2A – 2D – TRS Data

TABLE 2A

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RB	06	19	01	2
RB	06	19	01	3
RB	06	19	02	3
RB	06	19	02	4
RB	06	19	03	3
RB	06	19	03	4
RB	06	19	04	4
RB	06	19	09	1
RB	06	19	01	1
RB	06	19	01	4
RB	06	20	01	1
RB	06	20	01	2
RB	06	20	01	3
RB	06	20	01	4
RB	06	20	02	1
RB	06	20	02	2
RB	06	20	02	3
RB	06	20	02	4
RB	06	20	03	1
RB	06	20	03	2
RB	06	20	03	3
RB	06	20	03	4
RB	06	20	04	1
RB	06	20	04	2
RB	06	20	04	3
RB	06	20	04	4
RB	06	20	05	1
RB	06	20	05	2
RB	06	20	05	3
RB	06	20	05	4
RB	06	20	06	1
RB	06	20	06	2

TABLE 2A

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RB	06	20	06	3
RB	06	20	06	4

TABLE 2B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RLM	06	21	02	3
RLM	06	21	02	4
RLM	06	21	03	1
RLM	06	21	03	2
RLM	06	21	03	3
RLM	06	21	03	4
RLM	06	21	04	1
RLM	06	21	04	2
RLM	06	21	04	3
RLM	06	21	04	4
RLM	06	21	05	1
RLM	06	21	05	2
RLM	06	21	05	3
RLM	06	21	05	4
RLM	06	21	06	1
RLM	06	21	06	4
RLM	06	21	11	1
RLM	06	21	12	1
RLM	06	21	12	2
RLM	06	21	12	4
RLM	06	22	07	3
RLM	06	22	07	4
RLM	06	22	08	3
RLM	06	22	08	4
RLM	06	22	15	2
RLM	06	22	15	3

TABLE 2B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RLM	06	22	15	4
RLM	06	22	16	1
RLM	06	22	16	2
RLM	06	22	17	1
RLM	06	22	22	1
RLM	06	22	23	1
RLM	06	22	23	2
RLM	06	22	23	3
RLM	06	22	23	4
RLM	06	22	24	2
RLM	06	22	24	3
RLM	06	20	01	1
RLM	06	20	01	4
RLM	06	21	06	2
RLM	06	21	06	3

TABLE 2C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RRG	06	20	12	1
RRG	06	21	06	3
RRG	06	21	07	2
RRG	06	21	07	3
RRG	06	21	07	4
RRG	06	21	18	1
RRG	06	21	18	2
RRG	06	21	18	3
RRG	06	21	18	4
RRG	06	21	19	1
RRG	06	21	20	2
RRG	06	21	20	3
RRG	06	21	28	2

TABLE 2C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RRG	06	21	28	3
RRG	06	21	28	4
RRG	06	21	29	1
RRG	06	21	29	2
RRG	06	21	29	4
RRG	06	20	01	4

TABLE 2D

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RUB	06	21	06	2
RUB	07	20	25	4
RUB	07	20	36	1
RUB	07	20	36	4
RUB	07	21	31	2
RUB	07	21	31	3
RUB	06	20	01	1

TABLE 3A – 3F – TRS Data

TABLE 3A

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SSWF	05	19	04	1
SSWF	05	19	04	2
SSWF	06	19	28	3
SSWF	06	19	28	4
SSWF	06	19	33	1
SSWF	06	19	33	2
SSWF	06	19	33	3
SSWF	06	19	33	4

TABLE 3B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SAWTP	06	19	29	3
SAWTP	06	19	32	2

TABLE 3C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
VMWTPHR	06	19	01	1
VMWTPHR	06	19	01	4
VMWTPHR	06	19	13	1
VMWTPHR	06	19	13	4
VMWTPHR	06	19	20	3
VMWTPHR	06	19	20	4
VMWTPHR	06	19	21	3
VMWTPHR	06	19	21	4
VMWTPHR	06	19	22	3
VMWTPHR	06	19	22	4
VMWTPHR	06	19	23	3
VMWTPHR	06	19	23	4

TABLE 3C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
VMWTPHR	06	19	24	1
VMWTPHR	06	19	24	2
VMWTPHR	06	19	24	3
VMWTPHR	06	19	24	4
VMWTPHR	06	19	25	1
VMWTPHR	06	19	25	2
VMWTPHR	06	19	26	1
VMWTPHR	06	19	26	2
VMWTPHR	06	19	27	1
VMWTPHR	06	19	27	2
VMWTPHR	06	19	28	1
VMWTPHR	06	19	28	2
VMWTPHR	06	19	29	1
VMWTPHR	06	19	29	2
VMWTPHR	06	19	29	3
VMWTPHR	06	20	06	1
VMWTPHR	06	20	06	2
VMWTPHR	06	20	06	3
VMWTPHR	06	20	06	4
VMWTPHR	06	20	07	1
VMWTPHR	06	20	07	3
VMWTPHR	06	20	07	4
VMWTPHR	06	20	18	2
VMWTPHR	06	20	18	3
VMWTPHR	06	19	36	4

TABLE 3D

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SWSWF	06	19	29	1
SWSWF	06	19	29	2

TABLE 3D

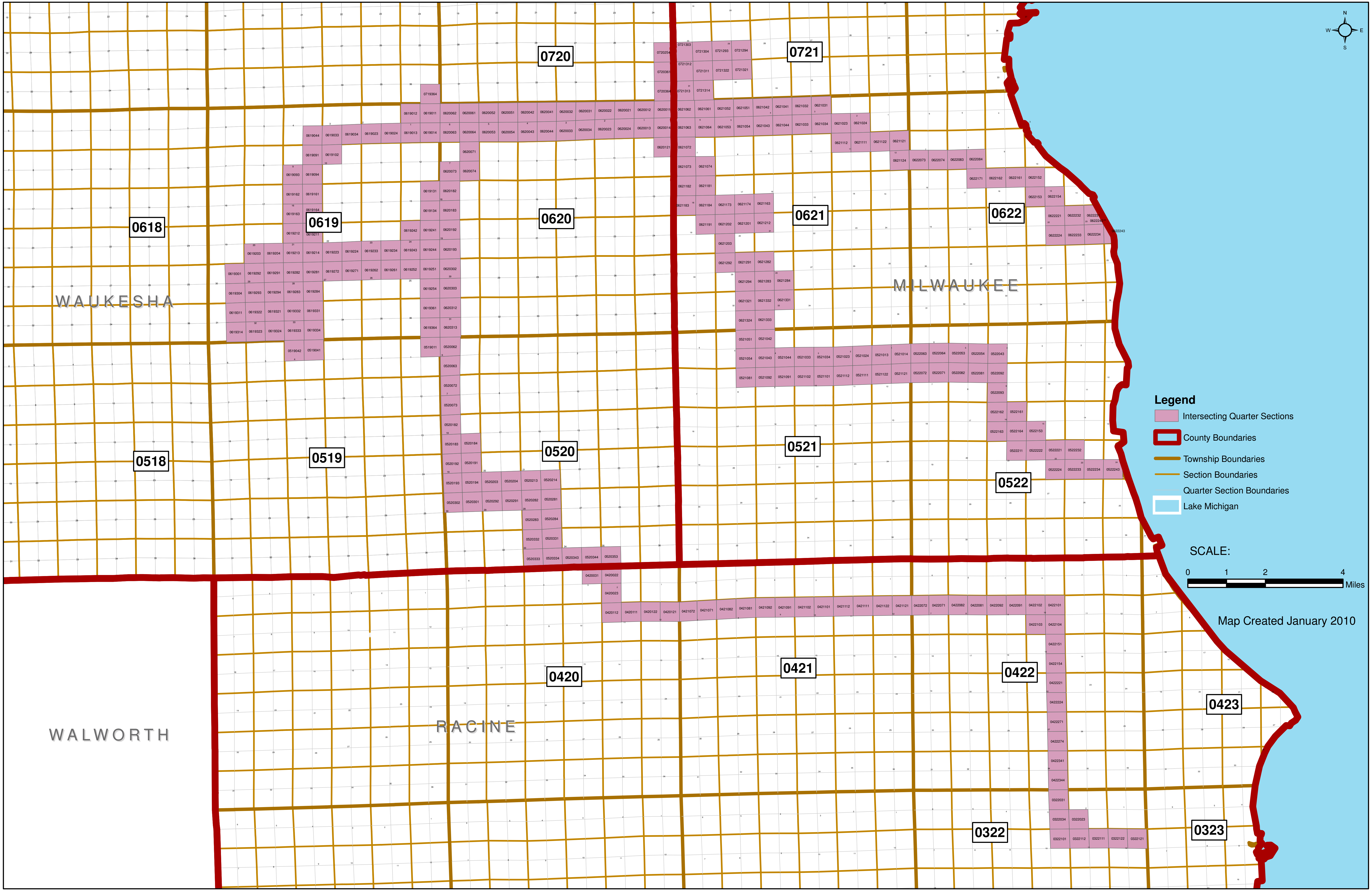
ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SWSWF	06	19	29	3
SWSWF	06	19	29	4
SWSWF	06	19	30	1
SWSWF	06	19	30	4
SWSWF	06	19	31	1
SWSWF	06	19	32	1
SWSWF	06	19	32	2

TABLE 3E

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
WTPSWWTP	06	19	09	1
WTPSWWTP	06	19	09	3
WTPSWWTP	06	19	09	4
WTPSWWTP	06	19	10	2
WTPSWWTP	06	19	16	1
WTPSWWTP	06	19	16	2
WTPSWWTP	06	19	16	3
WTPSWWTP	06	19	16	4
WTPSWWTP	06	19	20	3
WTPSWWTP	06	19	20	4
WTPSWWTP	06	19	21	1
WTPSWWTP	06	19	21	2
WTPSWWTP	06	19	21	3
WTPSWWTP	06	19	21	4
WTPSWWTP	06	19	28	1
WTPSWWTP	06	19	28	2
WTPSWWTP	06	19	29	1
WTPSWWTP	06	19	29	2
WTPSWWTP	06	19	29	3

TABLE 3F

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
WWURLLS	06	19	29	3
WWURLLS	06	19	29	4
WWURLLS	06	19	30	4
WWURLLS	06	19	31	1
WWURLLS	06	19	31	4
WWURLLS	06	19	32	1
WWURLLS	06	19	32	2
WWURLLS	06	19	32	3
WWURLLS	06	19	32	4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0721
0618
0619
0620
0621
0622
WAUKESHA
MILWAUKEE
0518
0519
0520
0521
0522
0420
0421
0422
0423
WALWORTH
RACINE
0322
0323
Legend
Intersecting Quarter Sections
County Boundaries
Township Boundaries
Section Boundaries
Quarter Section Boundaries
Lake Michigan
SCALE:
0 1 2 4
Miles
Map Created January 2010

CH2M HILL
135 S. 84th Street
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Milwaukee, WI 53214
Tel 414-272-2426
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January 13, 2010

Ms. Louise Clemency
Ecological Services Office – Green Bay
U.S. Fish and Wildlife Service
2661 Scott Tower Drive
New Franken, WI 54229
Phone: (920) 866-1717

Subject: Threatened and Endangered Species Review Request
City of Waukesha, Wisconsin Application for Lake Michigan Water Supply

Dear Ms. Clemency:

On behalf of the City of Waukesha (the City), CH2M HILL is requesting your verification that no threatened, endangered, proposed or candidate species, and/or unique habitats or natural areas exist in locations where infrastructure associated with obtaining a new water source for the City may be located. As requested by the Wisconsin DNR, the City is completing an environmental report that is evaluating the impacts of several alternatives to meet the current and future water supply needs of the City. These water supply alternatives include expanding existing groundwater sources, developing new groundwater sources, and obtaining and returning Lake Michigan water. This review will assist the City with evaluating the impacts of each alternative.

All of the proposed areas that may be impacted by water supply alternatives are located in the Counties of Waukesha, Milwaukee, or Racine, Wisconsin. The township, range, and section data for each proposed route is provided in tabular format in Attachment 1, which is included with this letter for your convenience. Attachment 2 is a map depicting the quarter sections from Attachment 1 that intersect with the alternatives.

CH2M HILL reviewed the online U.S. Fish and Wildlife Service (USFWS), Midwest Region's *County Distribution of Federally-listed Endangered, Threatened, Proposed, and Candidate Species* list for the state of Wisconsin, and found that no species are listed for either Milwaukee or Racine County. However, there is one threatened species listed for Waukesha County: the eastern prairie fringed orchid (*Platanthera leucophaea*). According to the USFWS, the eastern prairie fringed orchid typically occurs in wet grassland habitats.

CH2M HILL is requesting your concurrence that no federally protected resources will be affected by or is located within one (1) mile of the water supply alternatives described above.

Because we are evaluating and comparing the alternatives, it is important that the potential impacts be identified for each alternative. We respectfully request that if potential impacts are identified in your review, that you please indicate which alignment ID and quarter section is impacted.

If you have any questions regarding this request or need additional information, please do not hesitate to contact me at (414) 272-2426, ext. 40356. Thank you.

Sincerely,

CH2M HILL

Corey Wilcox

Corey Wilcox
Associate Scientist

Attachments:
(1) Tables 1 – 3. Township, Range, and Section Data for Water Supply Alternatives
(2) Map Depicting Quarter-Sections Impacted by Proposed Water Supply Alternatives

Cc: Mark Mittag/CH2M HILL
Brent Brown/CH2M HILL

TABLE 1A – 1H – TRS Data

TABLE 1A

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
MS	06	21	17	3
MS	06	21	17	4
MS	06	21	20	1
MS	06	20	01	4
MS	06	20	12	1
MS	06	21	06	3
MS	06	21	07	2
MS	06	21	07	3
MS	06	21	18	1
MS	06	21	18	2
MS	06	21	18	3
MS	06	21	18	4
MS	06	21	19	1
MS	06	21	20	2

TABLE 1B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
OCS	05	21	01	3
OCS	05	21	01	4
OCS	05	21	02	3
OCS	05	21	02	4
OCS	05	21	03	3
OCS	05	21	03	4
OCS	05	21	04	2
OCS	05	21	04	3
OCS	05	21	04	4
OCS	05	21	05	1
OCS	05	21	05	4
OCS	05	21	08	1
OCS	05	21	09	1

TABLE 1B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
OCS	05	21	09	2
OCS	05	21	10	1
OCS	05	21	10	2
OCS	05	21	11	1
OCS	05	21	11	2
OCS	05	21	12	1
OCS	05	21	12	2
OCS	05	22	04	3
OCS	05	22	05	3
OCS	05	22	05	4
OCS	05	22	06	3
OCS	05	22	06	4
OCS	05	22	07	1
OCS	05	22	07	2
OCS	05	22	08	1
OCS	05	22	08	2
OCS	05	22	09	2
OCS	05	22	09	3
OCS	05	22	15	3
OCS	05	22	16	1
OCS	05	22	16	2
OCS	05	22	16	4
OCS	05	22	21	1
OCS	05	22	22	1
OCS	05	22	22	2
OCS	05	22	22	4
OCS	05	22	23	2
OCS	05	22	23	3
OCS	05	22	23	4
OCS	06	21	32	1
OCS	06	21	32	4
OCS	06	21	33	2
OCS	06	21	33	3

TABLE 1B

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
OCS	06	20	01	4
OCS	06	20	12	1
OCS	06	21	06	3
OCS	06	21	07	2
OCS	06	21	07	3
OCS	06	21	18	1
OCS	06	21	18	2
OCS	06	21	18	3
OCS	06	21	18	4
OCS	06	21	19	1
OCS	06	21	20	2
OCS	06	21	20	3
OCS	06	21	28	3
OCS	06	21	29	1
OCS	06	21	29	2
OCS	06	21	29	4

TABLE 1C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RS	03	22	03	1
RS	03	22	03	4
RS	03	22	10	1
RS	03	22	11	1
RS	03	22	11	2
RS	03	22	12	1
RS	03	22	12	2
RS	04	20	02	2
RS	04	20	02	3
RS	04	20	03	1
RS	04	20	11	1
RS	04	20	11	2

TABLE 1C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RS	04	20	12	1
RS	04	20	12	2
RS	04	21	07	1
RS	04	21	07	2
RS	04	21	08	1
RS	04	21	08	2
RS	04	21	09	1
RS	04	21	09	2
RS	04	21	10	1
RS	04	21	10	2
RS	04	21	11	1
RS	04	21	11	2
RS	04	21	12	1
RS	04	21	12	2
RS	04	22	07	1
RS	04	22	07	2
RS	04	22	08	1
RS	04	22	08	2
RS	04	22	09	1
RS	04	22	09	2
RS	04	22	10	1
RS	04	22	10	2
RS	04	22	10	4
RS	04	22	15	1
RS	04	22	15	4
RS	04	22	22	1
RS	04	22	22	4
RS	04	22	27	1
RS	04	22	27	4
RS	04	22	34	1
RS	04	22	34	4
RS	05	19	01	1
RS	05	20	06	2

TABLE 1C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RS	05	20	06	3
RS	05	20	07	2
RS	05	20	07	3
RS	05	20	18	2
RS	05	20	18	3
RS	05	20	18	4
RS	05	20	19	1
RS	05	20	19	2
RS	05	20	19	3
RS	05	20	19	4
RS	05	20	20	3
RS	05	20	20	4
RS	05	20	21	3
RS	05	20	21	4
RS	05	20	28	1
RS	05	20	28	2
RS	05	20	28	3
RS	05	20	28	4
RS	05	20	29	1
RS	05	20	29	2
RS	05	20	30	1
RS	05	20	30	2
RS	05	20	33	1
RS	05	20	33	2
RS	05	20	33	3
RS	05	20	33	4
RS	05	20	34	3
RS	05	20	34	4
RS	05	20	35	3
RS	06	19	24	1
RS	06	19	24	4
RS	06	19	25	1
RS	06	19	25	4

TABLE 1C

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
RS	06	19	36	1
RS	06	19	36	4
RS	06	20	19	2
RS	06	20	19	3
RS	06	20	30	2
RS	06	20	30	3
RS	06	20	31	2
RS	06	20	31	3

TABLE 1D

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SB	06	20	01	1
SB	06	20	01	2
SB	06	20	01	3
SB	06	20	01	4
SB	06	20	02	1
SB	06	20	02	2
SB	06	20	02	3
SB	06	20	02	4
SB	06	20	03	1
SB	06	20	03	2
SB	06	20	03	3
SB	06	20	03	4
SB	06	20	04	1
SB	06	20	04	2
SB	06	20	04	3
SB	06	20	04	4
SB	06	20	05	1
SB	06	20	05	2
SB	06	20	05	3
SB	06	20	05	4

TABLE 1D

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SB	06	20	06	1
SB	06	20	06	4

TABLE 1E

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SNEWHR	06	19	01	1
SNEWHR	06	19	01	4
SNEWHR	06	20	06	1
SNEWHR	06	20	06	2
SNEWHR	06	20	06	3
SNEWHR	07	19	36	4
SNEWHR	06	20	06	4

TABLE 1F

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
SSEWHT	06	19	13	4
SSEWHT	06	20	06	4
SSEWHT	06	20	07	1
SSEWHT	06	20	07	3
SSEWHT	06	20	07	4
SSEWHT	06	20	18	2
SSEWHT	06	20	18	3

TABLE 1G

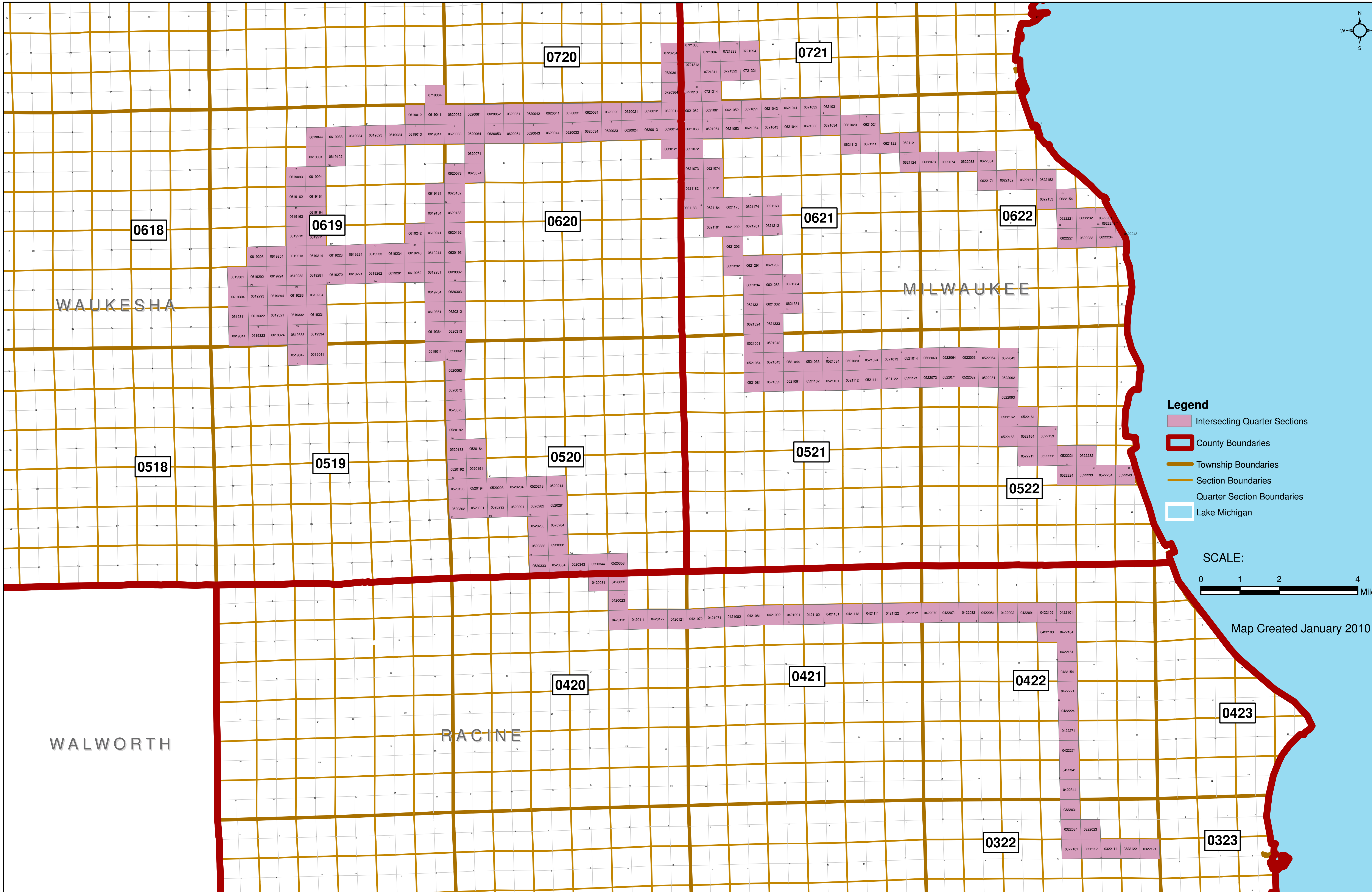
ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
EVSWS	06	19	28	3
EVSWS	06	19	28	4

TABLE 1G

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
EVSWS	06	19	29	3
EVSWS	06	19	29	4
EVSWS	06	19	32	1
EVSWS	06	19	32	2
EVSWS	06	19	33	1
EVSWS	06	19	33	2

TABLE 1H

ALIGNMENT	TWN	RNG	SEC	QUARTER_SEC_ID
MSZ	06	21	06	2
MSZ	07	21	29	3
MSZ	07	21	29	4
MSZ	07	21	30	4
MSZ	07	21	31	1
MSZ	07	21	31	2
MSZ	07	21	31	3
MSZ	07	21	31	4
MSZ	07	21	32	1
MSZ	07	21	32	2



0720
0721
0618
0619
0620
0621
0622
WAUKESHA
MILWAUKEE
0518
0519
0520
0521
0522
0420
0421
0422
0423
WALWORTH
RACINE
0322
0323
Legend
Intersecting Quarter Sections
County Boundaries
Township Boundaries
Section Boundaries
Quarter Section Boundaries
Lake Michigan
SCALE:
0
1
2
4
Miles
Map Created January 2010

CH2MHILL TRANSMITTAL

To: Wisconsin Dept. of Natural Resources
Office of Energy, OE/7
101 S. Webster S., P.O. Box 7921
Madison, WI 53707-7921

From: Corey Wilcox
135 S. 84th Street, Suite 325
Milwaukee, WI 53076

Attn: Shari Koslowsky

Date: January 20, 2010

Re: City of Waukesha, Wisconsin- Application for Lake Michigan Water Supply

We Are Sending You:

Attached
Shop Drawings
Prints
Copy of letter

Method of shipment:

Under separate cover via
Documents
Specifications
Other:

Tracings
Catalogs

Quantity	Description
1	CD containing shapefiles of the alternative routes being evaluated

If the material received is not as listed, please notify us at once.

Shari,

As we discussed on the phone on Tuesday, Jan. 19, we would like your help in evaluating T/E concerns along the potential water supply and return options included in the January 12, 2010 letter sent to you via email. In order to help facilitate your review I have enclosed a CD containing shape files that show each of the routes currently being evaluated. Of the multiple routes being evaluated, we would prefer your review and comment on 4 in particular by close of business on Monday, January 25 in order to prepare for a public meeting on the project on January 26. These four routes are designated as:

Alt 1 Deep and Shallow Wells
Alt 2 Shallow Aquifer and Fox River Alluvium
Alt 3a-1 Milwaukee
Alt 3b-2 Underwood Creek

We understand you have a busy schedule and for the purposes of the January 26 public meeting we are only looking for a list of T/E species for each of the four routes listed above. A more detailed discussion on the specific impacts that may be anticipated can be provided as follow up material.

Thank you.

Corey Wilcox

Copy To:
Mark Mittag / CH2M HILL

CH2M HILL
135 S. 84th Street
Suite 325
Milwaukee, WI 53214
Tel 414-272-2426
Fax 414-272-4408

February 2, 2010

Ms. Jill Utrupp
Ecological Services Office – Green Bay
U.S. Fish and Wildlife Service
2661 Scott Tower Drive
New Franken, WI 54229

Subject: Environmental Review
City of Waukesha Municipal Water Supply – Lake Michigan Diversion

Dear Ms. Utrupp:

This letter is a follow-up to the initial threatened and endangered (T&E) species review request letter sent on January 13, 2010, and subsequent phone and email correspondence on January 21 and 26, 2010 regarding several alternatives being considered to meet future water supply needs of the City of Waukesha (City).

On behalf of the City, CH2M HILL is requesting a more detailed environmental impact review for the locations where the alternatives are proposed, to further identify and evaluate any potential impacts the alternatives may have on federal-listed species, federal-managed lands, and/or sensitive habitats. The township, range, and section data for each proposed alternative is provided in tabular format in Attachment 1, which is included with this letter for your convenience. In addition, a copy of the Draft Application for Lake Michigan Water Supply, which provides a explanation of the nature, location, and general impacts resulting from the proposed project, has been included (Attachment 2) to provide you with more detailed information regarding the proposed alternatives.

Due to the need to compare each of the alternatives, we would appreciate if you would provide a separate review and analysis of the potential impacts for each alternative. Accordingly, we respectfully request that you please indicate the corresponding alternative name and which section /quarter section(s) the resource may be present.

If you have any questions regarding this request or need additional information, please do not hesitate to contact me at (414) 272-2426, ext. 40356. Thank you.

Sincerely,

CH2M HILL

Corey Wilcox

Corey Wilcox
Associate Scientist

Attachments:
Tables 1 – 8. Township, Range, and Section Data for Proposed Water Supply and Return Alternatives

DRAFT Application Lake Michigan Water Supply

Cc: Mark Mittag/CH2M HILL
Brent Brown/CH2M HILL

CH2M HILL
135 S. 84th Street
Suite 325
Milwaukee, WI 53214
Tel 414-272-2426
Fax 414-272-4408

February 2, 2010

Shari Koslowsky
Office of Energy SS/7
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921

Subject: Environmental Review
City of Waukesha Municipal Water Supply – Lake Michigan Diversion

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This letter is a follow-up to the initial threatened and endangered (T&E) species review request letter sent on January 13, 2010, and subsequent phone and email correspondence on January 19, 2010 regarding several alternatives being considered to meet future water supply needs of the City of Waukesha (City).

On behalf of the City, CH2M HILL is requesting a more detailed environmental impact review for the locations where the alternatives are proposed, to further identify and evaluate any potential impacts the alternatives may have on state-listed species, state-managed lands, and/or sensitive habitats. The township, range, and section data for each proposed alternative is provided in tabular format in Attachment 1, which is included with this letter for your convenience. In addition, a copy of the Draft Application for Lake Michigan Water Supply, which provides a explanation of the nature, location, and general impacts resulting from the proposed project, has been included (Attachment 2) to provide you with more detailed information regarding the proposed alternatives.

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If you have any questions regarding this request or need additional information, please do not hesitate to contact me at (414) 272-2426, ext. 40356. Thank you.

Sincerely,

CH2M HILL

Corey Wilcox

Corey Wilcox
Associate Scientist

Attachments:
Tables 1 – 8. Township, Range, and Section Data for Proposed Water Supply and Return Alternatives

DRAFT Application Lake Michigan Water Supply

Cc: Mark Mittag/CH2M HILL
Brent Brown/CH2M HILL

TRS Data for Proposed Supply and Return Routes

TABLE 1
Alternative 1
Deep and Shallow Wells (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	16	2
06	19	16	1
06	19	15	2
06	19	15	1
06	19	16	3
06	19	16	4
06	19	30	4
06	19	29	3
06	19	29	4
06	19	28	3
06	19	28	4
06	19	03	3
06	19	03	4
07	19	35	3
07	19	35	4
07	19	36	3
07	19	36	4
06	19	09	3
06	19	09	4
06	19	10	3
06	19	10	4
06	19	09	1
06	19	10	2
06	19	10	1
06	19	03	2
06	19	03	1
06	19	02	2
06	19	02	1
06	19	31	1
06	19	32	2
06	19	32	1

TABLE 1
Alternative 1
Deep and Shallow Wells (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	33	2
06	19	33	1
06	19	31	4
06	19	32	3
06	19	32	4
06	19	33	3
06	19	33	4
06	19	29	2
06	19	29	1
06	19	28	2
06	19	28	1
06	19	20	3
06	19	20	4
06	19	21	3
06	19	21	4
06	19	21	2
06	19	21	1

TABLE 2
Alternative 2
Shallow Aquifer and Fox River Alluvium (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	16	2
06	19	16	1
06	19	15	2
06	19	15	1
06	19	16	3
06	19	16	4
06	19	30	4
06	19	29	3
06	19	29	4
06	19	28	3
06	19	28	4
06	19	03	3
06	19	03	4
07	19	35	3
07	19	35	4
07	19	36	3
07	19	36	4
06	19	09	3
06	19	09	4
06	19	10	3
06	19	10	4
06	19	09	1
06	19	10	2
06	19	10	1
06	19	03	2
06	19	03	1
06	19	02	2
06	19	02	1
06	19	31	1
06	19	32	2
06	19	32	1
06	19	33	2

TABLE 2
Alternative 2
Shallow Aquifer and Fox River Alluvium (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	33	1
06	19	31	4
06	19	32	3
06	19	32	4
06	19	33	3
06	19	33	4
06	19	30	1
06	19	29	2
06	19	29	1
06	19	28	2
06	19	28	1
06	19	20	3
06	19	20	4
06	19	21	3
06	19	21	4
06	19	21	2
06	19	21	1

TABLE 3
Alternative 3a-1
Milwaukee Supply

TWN	RNG	SEC	QUARTER_SEC_ID
06	21	06	2
06	21	06	3
06	21	07	1
06	21	07	2
06	21	07	3
06	21	07	4
06	21	14	3
06	21	15	3
06	21	15	4
06	21	16	3
06	21	16	4
06	21	17	3
06	21	17	4
06	21	18	1
06	21	18	2
06	21	18	3
06	21	18	4
06	21	19	1
06	21	19	2
06	21	20	1
06	21	20	2
06	21	21	1
06	21	21	2
06	21	22	1
06	21	22	2
06	21	23	2
06	20	06	3
06	20	06	4
06	20	05	3
06	20	05	4
06	20	04	3
06	20	04	4

TABLE 3
Alternative 3a-1
Milwaukee Supply

TWN	RNG	SEC	QUARTER_SEC_ID
06	20	03	3
06	20	03	4
06	20	02	3
06	20	02	4
06	20	01	3
06	20	01	4
06	19	01	4
07	19	36	4
06	20	10	1
06	20	11	2
06	20	11	1
06	20	12	2
06	20	12	1
06	19	01	1
06	20	06	2
06	20	06	1
06	20	05	2
06	20	05	1
06	20	04	2
06	20	04	1
06	20	03	2
06	20	03	1
06	20	02	2
06	20	02	1
06	20	01	2
06	20	01	1

TABLE 4
Alternative 3a-2
Oak Creek (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
05	21	01	3
05	21	01	4
05	21	02	3
05	21	02	4
05	21	03	3
05	21	03	4
05	21	04	2
05	21	04	3
05	21	04	4
05	21	05	1
05	21	05	4
05	21	08	1
05	21	09	1
05	21	09	2
05	21	10	1
05	21	10	2
05	21	11	1
05	21	11	2
05	21	12	1
05	21	12	2
05	22	04	3
05	22	05	3
05	22	05	4
05	22	06	3
05	22	06	4
05	22	07	1
05	22	07	2
05	22	08	1
05	22	08	2
05	22	09	2
05	22	09	3
05	22	15	3

TABLE 4
Alternative 3a-2
Oak Creek (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
05	22	16	1
05	22	16	2
05	22	16	3
05	22	16	4
05	22	21	1
05	22	22	1
05	22	22	2
05	22	22	4
05	22	23	2
05	22	23	3
05	22	23	4
05	22	24	3
06	20	01	4
06	20	12	1
06	21	06	3
06	21	07	2
06	21	07	3
06	21	18	1
06	21	18	2
06	21	18	3
06	21	18	4
06	21	19	1
06	21	20	2
06	21	20	3
06	21	28	3
06	21	29	1
06	21	29	2
06	21	29	4
06	21	32	1
06	21	32	4
06	21	33	2
06	21	33	3

TABLE 4
Alternative 3a-2
Oak Creek (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	20	01	1
06	20	01	2
06	20	01	3
06	20	01	4
06	20	02	1
06	20	02	2
06	20	02	3
06	20	02	4
06	20	03	1
06	20	03	2
06	20	03	3
06	20	03	4
06	20	04	1
06	20	04	2
06	20	04	3
06	20	04	4
06	20	05	1
06	20	05	2
06	20	05	3
06	20	05	4
06	20	06	1
06	20	06	4
06	19	01	1
06	19	01	4
06	20	06	1
06	20	06	2
06	20	06	3
06	20	06	4
07	19	36	4

TABLE 5
Alternative 3a-3
Racine (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
03	22	02	3
03	22	03	1
03	22	03	4
03	22	10	1
03	22	11	1
03	22	11	2
03	22	12	1
03	22	12	2
04	20	02	2
04	20	02	3
04	20	03	1
04	20	11	1
04	20	11	2
04	20	12	1
04	20	12	2
04	21	07	1
04	21	07	2
04	21	08	1
04	21	08	2
04	21	09	1
04	21	09	2
04	21	10	1
04	21	10	2
04	21	11	1
04	21	11	2
04	21	12	1
04	21	12	2
04	22	07	1
04	22	07	2
04	22	08	1
04	22	08	2
04	22	09	1

TABLE 5
Alternative 3a-3
Racine (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
04	22	09	2
04	22	10	1
04	22	10	2
04	22	10	3
04	22	10	4
04	22	15	1
04	22	15	4
04	22	22	1
04	22	22	4
04	22	27	1
04	22	27	4
04	22	34	1
04	22	34	4
05	19	01	1
05	20	06	2
05	20	06	3
05	20	07	2
05	20	07	3
05	20	18	2
05	20	18	3
05	20	18	4
05	20	19	1
05	20	19	2
05	20	19	3
05	20	19	4
05	20	20	3
05	20	20	4
05	20	21	3
05	20	21	4
05	20	28	1
05	20	28	2
05	20	28	3

TABLE 5
Alternative 3a-3
Racine (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
05	20	28	4
05	20	29	1
05	20	29	2
05	20	30	1
05	20	30	2
05	20	33	1
05	20	33	2
05	20	33	3
05	20	33	4
05	20	34	3
05	20	34	4
05	20	35	3
06	19	24	1
06	19	24	4
06	19	25	1
06	19	25	4
06	19	36	1
06	19	36	4
06	20	19	2
06	20	19	3
06	20	30	2
06	20	30	3
06	20	31	2
06	20	31	3
06	19	01	1
06	19	01	4
06	20	06	1
06	20	06	2
06	20	06	3
06	20	06	4
07	19	36	4
06	19	13	1

TABLE 5
Alternative 3a-3
Racine (Supply)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	13	4
06	20	06	4
06	20	07	1
06	20	07	3
06	20	07	4
06	20	18	2
06	20	18	3

TABLE 6
Alternative 3b-1
Underwood Creek (Return Route)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	01	1
06	19	01	2
06	19	01	3
06	19	01	4
06	19	02	3
06	19	02	4
06	19	03	3
06	19	03	4
06	19	04	4
06	19	09	1
06	19	10	2
06	20	01	1
06	20	01	2
06	20	01	3
06	20	01	4
06	20	02	1
06	20	02	2
06	20	02	3
06	20	02	4
06	20	03	1
06	20	03	2
06	20	03	3
06	20	03	4
06	20	04	1
06	20	04	2
06	20	04	3
06	20	04	4
06	20	05	1
06	20	05	2
06	20	05	3
06	20	05	4
06	20	06	1

TABLE 6
Alternative 3b-1
Underwood Creek (Return Route)

TWN	RNG	SEC	QUARTER_SEC_ID
06	20	06	2
06	20	06	3
06	20	06	4
06	20	01	1
06	21	06	2
07	20	25	4
07	20	36	1
07	20	36	4
07	21	30	3
07	21	31	2
07	21	31	3

TABLE 7
Alternative 3b-2
Root River (Return)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	01	1
06	19	01	2
06	19	01	3
06	19	01	4
06	19	02	3
06	19	02	4
06	19	03	3
06	19	03	4
06	19	04	4
06	19	09	1
06	19	10	2
06	20	01	1
06	20	01	2
06	20	01	3
06	20	01	4
06	20	02	1
06	20	02	2
06	20	02	3
06	20	02	4
06	20	03	1
06	20	03	2
06	20	03	3
06	20	03	4
06	20	04	1
06	20	04	2
06	20	04	3
06	20	04	4
06	20	05	1
06	20	05	2
06	20	05	3
06	20	05	4
06	20	06	1

TABLE 7
Alternative 3b-2
Root River (Return)

TWN	RNG	SEC	QUARTER_SEC_ID
06	20	06	2
06	20	06	3
06	20	06	4
06	20	01	4
06	20	12	1
06	21	06	3
06	21	07	2
06	21	07	3
06	21	07	4
06	21	18	1
06	21	18	2
06	21	18	3
06	21	18	4
06	21	19	1
06	21	20	2
06	21	20	3
06	21	28	2
06	21	28	3
06	21	28	4
06	21	29	1
06	21	29	2
06	21	29	4
06	21	33	1

TABLE 8
Alternative 3b-3
Direct to Lake Michigan (Return)

TWN	RNG	SEC	QUARTER_SEC_ID
06	19	01	1
06	19	01	2
06	19	01	3
06	19	01	4
06	19	02	3
06	19	02	4
06	19	03	3
06	19	03	4
06	19	04	4
06	19	09	1
06	19	10	2
06	20	01	1
06	20	01	2
06	20	01	3
06	20	01	4
06	20	02	1
06	20	02	2
06	20	02	3
06	20	02	4
06	20	03	1
06	20	03	2
06	20	03	3
06	20	03	4
06	20	04	1
06	20	04	2
06	20	04	3
06	20	04	4
06	20	05	1
06	20	05	2
06	20	05	3
06	20	05	4
06	20	06	1

TABLE 8
Alternative 3b-3
Direct to Lake Michigan (Return)

TWN	RNG	SEC	QUARTER_SEC_ID
06	20	06	2
06	20	06	3
06	20	06	4
06	20	01	1
06	20	01	4
06	21	02	3
06	21	02	4
06	21	03	1
06	21	03	2
06	21	03	3
06	21	03	4
06	21	04	1
06	21	04	2
06	21	04	3
06	21	04	4
06	21	05	1
06	21	05	2
06	21	05	3
06	21	05	4
06	21	06	1
06	21	06	2
06	21	06	3
06	21	06	4
06	21	11	1
06	21	11	2
06	21	12	1
06	21	12	2
06	21	12	4
06	22	07	3
06	22	07	4
06	22	08	3
06	22	08	4

TABLE 8
Alternative 3b-3
Direct to Lake Michigan (Return)

TWN	RNG	SEC	QUARTER_SEC_ID
06	22	15	2
06	22	15	3
06	22	15	4
06	22	16	1
06	22	16	2
06	22	17	1
06	22	22	1
06	22	22	4
06	22	23	1
06	22	23	2
06	22	23	3
06	22	23	4
06	22	24	2
06	22	24	3

CH2MHILL TRANSMITTAL

To: Office of Energy SS/7
Wisconsin DNR
101 S Webster Street - OE/7
P.O. Box 7921
Madison, WI 53707-7921

From: Corey Wilcox

135 South 84th Street
Suite 325
Milwaukee, WI 53214135 S. 84th
Street, Suite 325
Milwaukee, WI 53076

Attn: Shari Koslowsky

Date: March 19, 2010

Re: Environmental Review - City of Waukesha Municipal Water Supply – Lake Michigan Diversion

We Are Sending You: Method of shipment: FedEx

Attached	Under separate cover via	
Shop Drawings	Documents	Tracings
Prints	Specifications	Catalogs
Copy of letter	Other: CD containing Draft Application Document	

Quantity	Description
1	CD containing Aerial Photographs of the Supply and Return Flow Alternatives being evaluated as part of the Waukesha Water Utility- Lake Michigan Water Supply Application

If the material received is not as listed, please notify us at once.

Copy To: Mark Mittag/CH2M HILL

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Cultural Resources

CHAPTER 4

Cultural Resources

4.1. Introduction

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.

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 and are 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 and 2 surveys
- Shallow Aquifer and Fox River Alluvium: 10 sites and 2 surveys
- Lake Michigan—Milwaukee Supply: 5 sites and 6 surveys
- Lake Michigan—Oak Creek Supply: 11 sites and 11 surveys
- Lake Michigan—Racine Supply: 2 sites and 7 surveys

Return Flow Alternatives
- Underwood Creek to Lake Michigan: 6 sites and 7 surveys
- Root River to Lake Michigan: 9 sites and 2 surveys
- Direct to Lake Michigan: 17 sites and 7 surveys

4.2. Archaeological Sites

4.2.1. Supply Alternatives

4.2.1.1. Deep and Shallow Aquifers

According to the archival investigations, nine archaeological sites exist within 100 m (328 feet) of the centerline of this proposed supply route. Table 4-1 provides the locations and descriptions of these nine sites.

4.2.1.2. Shallow Aquifer and Fox River Alluvium

According to the archival investigations, 10 archaeological sites exist within 100 m (or 328 feet) of the centerline of this proposed supply route. Table 4-2 provides the locations and descriptions of these 10 sites.

4.2.1.3. Lake Michigan—Milwaukee Supply

According to the archival investigations, five archaeological sites exist within 100 m (328 feet) of the centerline of this proposed supply route. Table 4-3 provides the locations and descriptions of these five sites.

4.2.1.4. Lake Michigan Supply—Oak Creek

According to the archival investigations, 11 archaeological sites exist within 100 m (328 feet) of the centerline of this proposed supply route. Table 4-4 provides the locations and descriptions of these 11 sites.

4.2.1.5. Lake Michigan Supply—Racine

According to the archival investigations, two archaeological sites exist within 100 m (328 feet) of the centerline of this proposed supply route. Table 4-5 provides the locations and descriptions of these two sites.

TABLE 4-1
Archaeological Sites within 100 m of Centerline of a Supply Alternative: Deep and Shallow Aquifers[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.

[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 4-2
Archaeological Sites within 100 m of Centerline of a Supply Alternative: Shallow Aquifer and Fox River Alluvium[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.
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.	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 4-2
Archaeological Sites within 100 m of Centerline of a Supply Alternative: Shallow Aquifer and Fox River Alluvium[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.

[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 4-3
Archaeological Sites within 100 m of Centerline of a Supply Alternative: Lake Michigan—Milwaukee Supply[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Brown (1906a, 1916b, 1923a, 1924); Benchley (1981); Becker (1988); Herzfeld (1995); McMullen and Hammerberg (1998); Van Dyke (2007).

TABLE 4-4
Archaeological Sites within 100 m of Centerline of a Supply Alternative: Lake Michigan Supply—Oak Creek[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Jungblut (1903); *Milwaukee Sentinel* (1903); Brown (1906a, 1916b, 1923a, 1924); Milwaukee Newspaper (1922); Benchley et al. (1979); Penman (1979); Benchley (1981); Becker (1988); Keene (1995); McMullen and Hammerberg (1998); Van Dyke (2008).

TABLE 4-5
Archaeological Sites within 100 m of Centerline of Supply Alternative: Lake Michigan Supply—Racine [a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.

4.2.2. Return Flow Alternatives

4.2.2.1. Underwood Creek

According to the archival investigations, six archaeological sites exist within 100 m (328 feet) of the centerline of this proposed flow return route. Table 4-6 provides the locations and descriptions of these six sites.

TABLE 4-6
Archaeological Sites within 100 m of Centerline of a Flow Return Alternative: Underwood Creek [a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Dwelle (1836); Lapham (1855); Brown (1906a, 1906b, 1923a, 1923b, 1923c, 1925); Philips (1923); Becker (1988); Goldstein (1994); Sasso (1998).

4.2.2.2. Root River

According to the archival investigations, nine archaeological sites exist within 100 m (328 feet) of the centerline of this proposed flow return route. Table 4-7 provides the locations and descriptions of these nine sites.

TABLE 4-7
Archaeological Sites within 100 m of Centerline of a Flow Return Alternative: Root River[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.

[a]To protect cultural resources, section and quarter section locations have been omitted.
WHS, Wisconsin Historical Society.
Sources: Dwelle (1836); Lapham (1855b); Jungblut (1903); *Milwaukee Sentinel* (1903); Brown (1906a, 1906b, 1916b, 1923a, 1923b, 1923c, 1924, 1925); Philips (1923); Benchley (1981); Becker (1988); Goldstein (1994); McMullen and Hammerberg (1998); Sasso (1998); Van Dyke (2007).

4.2.2.3. Direct to Lake Michigan

According to the archival investigations, 17 archaeological sites exist within 100 m (328 feet) of the centerline of this proposed flow return route. Table 4-8 provides the locations and descriptions of these 17 sites.

TABLE 4-8
Archaeological Sites within 100 m of Centerline of a Flow Return Alternative: Direct to Lake Michigan[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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.

TABLE 4-8
Archaeological Sites within 100 m of Centerline of a Flow Return Alternative: Direct to Lake Michigan[a]
City of Waukesha Water Supply

Site Name	Township	Range	Description	Consultation Requirements
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.
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: Dwelle (1836); Lapham (1855a, 1855b); Jungblut (1903); Brown (1906a, 1906b, 1906d, 1908, 1916a, 1916c, 1916d, 1923b, 1923c, 1925); Philips (1923); Benchley et al. (1979); Gregory and Benchley (1980); Benchley (1981); Becker (1988); Goldstein (1994); Herzfeld (1995); Sasso (1998).

4.3. 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.

4.3.1. Supply Alternatives

4.3.1.1. Deep and Shallow Wells

Two previous surveys were conducted along this alternative in Waukesha County. Details of these past surveys are provided in Appendix 4A.

4.3.1.2. Shallow Aquifer and Fox River Alluvium

Two previous surveys were conducted along this alternative in Waukesha County. Details of these past surveys are provided in Appendix 4A.

4.3.1.3. Lake Michigan—Milwaukee Supply

Six previous surveys were conducted along this alternative in Milwaukee and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

4.3.1.4. Lake Michigan—Oak Creek Supply

Eleven previous surveys were conducted along this alternative in Milwaukee and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

4.3.1.5. Lake Michigan—Racine Supply

Seven previous surveys were conducted along this alternative in Racine and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

4.3.2. Return Flow Alternatives

4.3.2.1. Underwood Creek to Lake Michigan

Seven previous surveys were conducted along this alternative in Milwaukee and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

4.3.2.2. Root River to Lake Michigan

Two previous surveys were conducted along this alternative in Milwaukee and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

4.3.2.3. Direct to Lake Michigan

Seven previous surveys were conducted along this alternative in Milwaukee and Waukesha Counties. Details of these past surveys are provided in Appendix 4A.

For additional information, refer to archival investigation results provided by PSAAP, included as Appendix 4A.These findings contain archeologically sensitive and confidential information and are not intended for public release.

4.4. National Register of Historic Places

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).

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.

4.5. Impacts and Mitigation

The cultural resources affected environment is the cultural resources that exist within the area of potential effect of the alternatives. Regardless of the alternatives selected, the City will meet regulatory requirements regarding cultural resources during the design and construction phases 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 cultural resources.

4.6. 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.

4.7. Consultation with the State Historic Preservation Office and Cultural Resources Survey

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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Socioeconomic Environment

CHAPTER 5

Socioeconomic Environment

5.1 Introduction

This section describes socioeconomic resources that could be affected by the water supply and return flow alternatives described in Chapter 1 and also the potential impacts. Socioeconomic impacts associated with water supply result primarily from variations in supply quantity; supply quality; and cost of supply. Since all alternatives evaluated in the Application have comparable quantity, quality, and cost of potable water, the socioeconomic impacts among alternatives considered in this report are very similar.

The University of Wisconsin–Milwaukee prepared an evaluation of the socioeconomic implications of water supply alternatives in support of SEWRPCs regional water supply plan. Based on recommendations by SEWRPC's Environmental Justice Task Force, SEWRPC contracted with the University of Wisconsin–Milwaukee 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* (March 2010) has been released in draft form. 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 chapter summarizes the findings of the draft report.

5.2 Population

5.2.1 Existing Resources

Waukesha county population has more than doubled between 1960 and 2007. This growth is much greater than that in the region. whereas Waukesha accounted for only 10 percent of the regional population, it now represents almost 20 percent (Table 5-1). 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 Waukesha is expected to decline over the next 25, reaching a projection a total of 88,500 in 2035 (36 percent increase). The water supply needs for the City are based on these population projections.

TABLE 5-1
Waukesha and 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
Region	1,573,614	100.0	1,995,901	100.0	422,287	26.8

Source: US Census Bureau as reported in UW Milwaukee 2010

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 in the City over the period. The percent increase in nonwhites is similar to other that in communities in the region. The percent of Waukesha County nonwhite population is projected to almost double by 2035 to almost 17 percent of the total.

5.2.2 Impacts and Mitigation

The demand projections used to specify the water supply quantities for all sources (groundwater and Lake Michigan) were based 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 impact on population. Any sources also can support the projected increase in nonwhite population in the Waukesha. This is consistent with conclusions in the CED socioeconomic study, where planners and utilities managers reported that the water supply source will not affect population growth or distribution.

5.3 Economy

5.3.1 Existing Resources

The economy in Waukesha County also has grown over the last 20 years. Economic growth in Waukesha has been much greater than the overall region, increasing from nearly 5 percent of the total in 1960 to more than 22 percent in 2000 (Table 5-2). 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.

TABLE 5-2
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
Region	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 region is considered to be water-intensive, and thus potentially affected by water supply. However, many of the large industrial water users do not rely on municipal water but on private high-capacity groundwater wells. A review of the large businesses in Waukesha county indicates that there are no known major water-intensive businesses or industries using municipal supplies (UW Madison 2010).[1]

[1] University of Wisconsin Milwaukee, Center for Economic Development. 2010. Chapter 3, page 15.

5.3.2 Impacts and Mitigation

The projections of water demand take into account the increase in the Waukesha economy discussed above as it relates to the City's water supply service area (see Appendix xx in the Application). By serving the projected demand, water supply would not constrain or otherwise affect economic growth. The source of the supply does not affect the quantity, thus all supply source alternatives are similar with respect to quantity and do not impact the economy. Also the cost of all alternatives is similar, so there is no advantage to employment or other economic factors for one supply source over another.

The CED study found that the source of water is not a differentiating factor on development within a municipal service area.[2] The only exception to this view is related to perceptions surrounding groundwater quality. The study found some planners and utility managers in the region understood groundwater quality problems to be associated with contamination (particularly radium). There were no concerns expressed for surface water sources.

5.4 Energy Use

5.4.1 Existing Resources

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.

5.4.2 Impacts and Mitigation

As described in the Section 4 of the Application and summarized in Table 5-3, energy use would be substantially lower for the Lake Michigan water supply than either groundwater supply alternative. The return flow alternatives associated with the Lake Michigan supply have similar energy requirements.

TABLE 5- 3
Energy Use for Water Supply Alternatives

Alternative	Est. Annual Energy Usage (MWh)
Alt 1: Deep and Shallow Aquifer Water Supply	33,400
Alt 2: Shallow Aquifer and Fox River Alluvium Water Supply	20,500
Alt 3: Lake Michigan Water Supply with Return Flow	16,200
Return Flow to Underwood Creek	2,000
Return Flow to Root River	2,500
Return Flow Direct to Lake Michigan	2,700

5.5 References

University of Wisconsin Milwaukee, Center for Economic Development. 2010. http://www4.uwm.edu/ced/sewrpc/index.cfm

[2] University of Wisconsin Milwaukee, Center for Economic Development. 2010. Chapter 3, page 19.

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Chapter 6

Soils

CHAPTER 6

Soils

6.1 Introduction

This section provides information about soil conditions along the routes of the supply and return flow alternatives evaluated. Chapter 2 discusses geomorphology and channel stability. Consequently, this Chapter focuses upon soil productivity for agricultural production. Chapter 7, Land Use communicates additional information on how much of the alternative alignments support active agriculture. The water supply or return flow pipeline routes follow previously disturbed areas including streets and alleys, bike paths, active and abandoned railroad corridors, utility corridors, and city and county lands. As a result potential impacts to active agricultural areas are minimized.

6.2 Identification of Prime Farmland

6.2.1 Background and Methodology

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

6.2.2 Prime Farmland Soils

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 also available for these uses. 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. In general, 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, and either they do not flood frequently or they are protected from flooding. It may be, however, that not all of the areas designated as prime farmland are currently active agriculturally, but instead there may be locations that exhibit extensive historical disturbance due to development, such as residential or roadway construction. Based upon a review of current land use classifications, observations as to whether active agricultural areas are present is included for each water supply and return flow alternative and is discussed below.

6.3 Prime Farmland Soils

The soil series and associated descriptions were obtained through the SSURGO database (NRCS, 2009). Descriptions provided are based on information available at the county level for soil series. Specific information on soil characteristics and limitations for the supply and return flow alternatives are provided in Tables 6-1 through 6-8.

6.3.1 Supply Alternatives

6.3.1.1 Deep and Shallow Aquifers

The operational and maintenance impacts to soils are those that occur from the facilities which will permanently alter the land use, such as the water treatment plant (WTP), wells, and service roads. The WTP proposed for the Deep and Shallow Wells Alternative impacts 33.20 acres, of which all impacts prime farmland soils. The 11 well houses proposed for the Deep and Shallow Wells Proposed Alternative impact approximately 38.41 acres, of which 30.96 acres, or 80.6 percent, is prime farmland soils. Table 6-1 below includes these operational and maintenance impacts as well as those associated with pipeline construction, where agricultural use could continue after construction is completed.

While this alternative effects soil classified as prime agricultural land as listed in Table 6-1, current land use designated as active agriculture is much less as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural use currently exist on a majority of the remaining soil that is classified as prime farmland.

6.3.1.2 Shallow Aquifer and Fox River Alluvium

The operational and maintenance impacts to soils are those that occur from the facilities which will permanently alter the land use, such as the WTP, wells, and service roads. The WTP proposed for the Shallow Aquifer and Fox River Alluvium Alternative impacts approximately 14.74 acres, of which all is classified as prime farmland soils. The 15 well houses proposed for the Shallow Aquifer and Fox River Alluvium Alternative impact approximately 51.26 acres, of which 50.62 acres, or 99 percent, are designated as prime farmland soils. Table 6-2 below includes these operational and maintenance impacts, as well as those associated with pipeline construction where agricultural use could continue after construction is completed.

While this alternative effects soil classified as prime agricultural land as listed in Table 6-2 below, current land use designated as active agriculture is much less, as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural exist on a majority of the remaining soil that is classified as prime farmland.

6.3.1.3 Lake Michigan—Milwaukee Supply

While this alternative impacts soil classified as prime farmland, as listed in Table 6-3 below, there is no current land use designated as active agriculture, as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently occur on all of the remaining soil classified as prime farmland.

6.3.1.4 Lake Michigan Supply—Oak Creek

There are negligible facilities that alter the land use associated with this alternative. Any impacts to active agricultural lands would be from pipeline construction, which would all be temporary in nature and would allow agricultural activities to continue after construction is completed.

TABLE 6-1
Prime Farmlands Crossed by the Deep and Shallow Aquifers Supply Alternative
City of Waukesha Water Supply

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AzA	Aztalan loam, 0 to 2 percent slopes	4.55
CeB	Casco loam, 2 to 6 percent slopes	2.55
Dt	Drummer silt loam, gravelly substratum	1.42
FmA	--	11.24
FmB	Fox sandy loam, 1 to 6 percent slopes	1.10
FoA	Fox loam, 0 to 2 percent slopes	16.33
FoB	Fox loam, 2 to 6 percent slopes	1.77
FoC2	Fox loam, 6 to 12 percent slopes, eroded	0.33
FsA	Fox silt loam, 0 to 2 percent slopes	3.34
FsB	Fox silt loam, 2 to 6 percent slopes	0.76
HeA	Hebron loam, 0 to 2 percent slopes	3.88
HeB	Hebron loam, 2 to 6 percent slopes	0.86
HmB	Hochheim loam, 2 to 6 percent slopes	4.30
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	4.39
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	7.59
HtA	Houghton muck, 0 to 2 percent slopes	0.59
KeA	Kane silt loam, 1 to 3 percent slopes	3.29
LyB2	Lorenzo loam, 2 to 6 percent slopes, eroded	0.09
MgA	Martinton silt loam, 1 to 3 percent slopes	0.41
MmA	Matherton silt loam, 1 to 3 percent slopes	6.89
MoB	Mayville silt loam, 2 to 6 percent slopes	0.73
Na	Navan silt loam	2.74
Oc	Ogden muck	0.07
OmB	Oshtemo loamy sand, 1 to 6 percent slopes	9.68
Pa	Palms muck	3.59
Ph	Pella silt loam	4.09
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.12
Sm	Sebewa silt loam	1.23
ThB	Theresa silt loam, 2 to 6 percent slopes	2.69
WeA	Warsaw loam, 0 to 2 percent slopes	1.36
WeB	Warsaw loam, 2 to 6 percent slopes	21.24
WhA	Warsaw silt loam, 0 to 2 percent slopes	16.29
	Total	**139.53**

TABLE 6-2
Prime Farmlands Crossed by the Shallow Aquifer and Fox River Alluvium Alternative
City of Waukesha Water Supply

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AzA	Aztalan loam, 0 to 2 percent slopes	4.55
CeB	Casco loam, 2 to 6 percent slopes	2.55
Dt	Drummer silt loam, gravelly substratum	2.33
FmA	—	14.98
FmB	Fox sandy loam, 1 to 6 percent slopes	4.54
FoA	Fox loam, 0 to 2 percent slopes	25.47
FoB	Fox loam, 2 to 6 percent slopes	4.07
FoC2	Fox loam, 6 to 12 percent slopes, eroded	0.33
FsA	Fox silt loam, 0 to 2 percent slopes	3.34
FsB	Fox silt loam, 2 to 6 percent slopes	0.76
HeA	Hebron loam, 0 to 2 percent slopes	5.16
HeB	Hebron loam, 2 to 6 percent slopes	0.86
HmB	Hochheim loam, 2 to 6 percent slopes	4.31
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	5.05
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	7.59
HtA	Houghton muck, 0 to 2 percent slopes	4.21
KeA	Kane silt loam, 1 to 3 percent slopes	3.29
LyB2	Lorenzo loam, 2 to 6 percent slopes, eroded	0.09
MgA	Martinton silt loam, 1 to 3 percent slopes	0.41
MmA	Matherton silt loam, 1 to 3 percent slopes	9.61
MoB	Mayville silt loam, 2 to 6 percent slopes	0.73
MtA	Mequon silt loam, 1 to 3 percent slopes	0.00
Na	Navan silt loam	2.74
Oc	Ogden muck	0.07
OmB	Oshtemo loamy sand, 1 to 6 percent slopes	12.89
Pa	Palms muck	3.72
Ph	Pella silt loam	4.92
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.12
Sm	Sebewa silt loam	1.23
ThB	Theresa silt loam, 2 to 6 percent slopes	2.69
WeA	Warsaw loam, 0 to 2 percent slopes	1.36
WeB	Warsaw loam, 2 to 6 percent slopes	23.88
WhA	Warsaw silt loam, 0 to 2 percent slopes	16.29
Ww	Wet alluvial land	3.15
	Total	**177.29**

TABLE 6-3
Prime Farmlands Crossed by the Lake Michigan—Milwaukee Supply Alternative
City of Waukesha Water Supply

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
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**

TABLE 6-4
Prime Farmlands Crossed by the Lake Michigan—Oak Creek Supply Alternative
City of Waukesha Water Supply

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
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**

TABLE 6-5
Prime Farmlands Crossed by the Lake Michigan—Racine Supply Alternative
City of Waukesha Water Supply

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

TABLE 6-5
Prime Farmlands Crossed by the Lake Michigan—Racine Supply Alternative
City of Waukesha Water Supply

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
MgA	Martinton silt loam, 1 to 3 percent slopes	6.13
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**

TABLE 6-6
Prime Farmlands Crossed by the Underwood Creek to Lake Michigan Return Flow Alternative
City of Waukesha Water Supply

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**

TABLE 6-7
Prime Farmlands Crossed by the Root River to Lake Michigan Return Flow Alternative
City of Waukesha Water Supply

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	4.21
AzB	Aztalan loam, 2 to 6 percent slopes	0.85
CeB	Casco loam, 2 to 6 percent slopes	0.72
Dt	Drummer silt loam, gravelly substratum	15.71
FoA	Fox loam, 0 to 2 percent slopes	0.08
FsC2	Fox silt loam, 6 to 12 percent slopes, eroded	0.10
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	17.86
KeA	Kane silt loam, 1 to 3 percent slopes	0.66
LmB	Lamartine silt loam, 1 to 4 percent slopes	0.66
Lo	Lawson silt loam	9.97
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	5.99
MtA	Mequon silt loam, 1 to 3 percent slopes	13.65
Mzb	Montgomery silty clay loam	1.23
Na	Navan silt loam	0.04
Oc	Ogden muck	5.07
OuB	Ozaukee silt loam, 2 to 6 percent slopes	7.95
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	3.70
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.47
Ph	Pella silt loam	3.06
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.34
ShC2	Saylesville silt loam, 6 to 12 percent slopes, eroded	0.02
Sm	Sebewa silt loam	11.40
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	11.01
	Total	**136.13**

TABLE 6-8
Prime Farmlands Crossed by the Direct to Lake Michigan Return Flow Alternative
City of Waukesha Water Supply

Prime Farmland Soil Series	Soil Series Description	Acres Crossed
AsA	Ashkum silty clay loam, 0 to 3 percent slopes	4.21
CeB	Casco loam, 2 to 6 percent slopes	0.91
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	1.47
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	7.20
MtA	Mequon silt loam, 1 to 3 percent slopes	12.35
Mzb	Montgomery silty clay loam	1.23
MzfA	Mundelein silt loam, 1 to 3 percent slopes	1.05
Oc	Ogden muck	5.07
OuB	Ozaukee silt loam, 2 to 6 percent slopes	7.95
OuB2	Ozaukee silt loam, 2 to 6 percent slopes, eroded	3.13
OuC2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.40
Ph	Pella silt loam	3.06
PrA	Pistakee silt loam, 1 to 3 percent slopes	0.31
Sm	Sebewa silt loam	2.54
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	**93.41**

While this alternative effects soil classified as prime farmland, as listed in Table 6-4 below, current land use classified as active agricultural is much less, as shown in the Table 6-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently exist on a majority of the remaining soil classified as prime farmland.

6.3.1.5 Lake Michigan Supply—Racine

There are negligible facilities that alter the land use associated with this alternative. Any impacts to active agricultural lands would be from pipeline construction, which would all be temporary in nature and would allow agricultural activities to continue after construction is completed.

While this alternative effects soil classified as prime farmland, as listed in Table 6-5 below, current land use classified as active agricultural is much less, as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently exist on a majority of the remaining soil classified as prime farmland.

6.3.2 Return Flow Alternatives

6.3.2.1 Underwood Creek

While this alternative impacts soil classified as prime farmland, as listed in Table 6-6 below, there is no current land use designated as active agriculture as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently occur on all of the remaining soil classified as prime farmland.

6.3.2.2 Root River

While this alternative impacts soil classified as prime farmland, as listed in Table 6-7 below, there is no current land use designated as active agriculture, as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently occur on all of the remaining soil classified as prime farmland.

6.3.2.3 Direct to Lake Michigan

While this alternative impacts soil classified as prime farmland, as listed in Table 6-8 below, there is no current land use designated as active agriculture, as shown in the Table 7-2 (see Chapter 7 of this Environmental Report). Land uses other than agricultural currently occur on all of the remaining soil classified as prime farmland.

6.4 Construction and Operation Impacts and Mitigation

Construction will result in both short-term and permanent impacts to the soils within a given supply or return flow alternative corridor. Potential 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. However, these impacts will be mitigated by sustainable construction techniques and an aggressive re-vegetation program.

Because the pipeline routes follow previously disturbed areas including streets and alleys, bike paths, active and abandoned railroad corridors, utility corridors, and city and county lands few impacts occur to active agricultural lands even if the soil is classified as prime agricultural land. Expected impacts to active agricultural lands are listed in Chapter 7 Land Use, Table 7-2. As noted in Table 7-2, the Lake Michigan Supply – Milwaukee and all of the return flow alternatives cross lands classified as prime farmland, but they have no impacts on active agricultural lands.

However, if an alternative includes impacts to active agricultural lands, crop production may be lost within temporary workspaces if construction takes place during the growing season. Losses would be short-term in areas where no permanent aboveground structures or access roads are proposed as the land would be returned to production for the growing season following completion of construction. Topsoil will be carefully managed during construction to ensure that the productive capacity of the land would be retained after construction.

In addition to topsoil management, the land disturbed during construction would be restored as nearly as practicable to pre-construction conditions. The City would employ BMPs, such as topsoil segregation, sediment and erosion control measures, and proper site restoration, to minimize long-term impacts to construction areas. Further information regarding specific BMPs and restoration measures proposed to be used will be provided to the appropriate agency stakeholders during the design process. Operational impacts to prime farmland occur for the Deep and Shallow Wells and Shallow Aquifer and Fox River Alluvium alternatives due to above ground structures required for the project. Acreage impacts are listed in the above descriptions.

6.5 References

NRCS (Natural Resources Conservation Service). 2009. U.S. Department of Agriculture, NRCS, Soil Survey Geographic (SSURGO) Database. Available at http://soils.usda.gov/survey/geography/ssurgo/. Accessed January and February 2010.

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Chapter 7

Land Use, Recreation, and Aesthetics

CHAPTER 7

Land Use, Recreation, and Aesthetics

7.1. Introduction

This section addresses existing land uses within the supply and return flow alternatives that could be affected by construction or operation of the routes. It identifies sensitive land uses near the route, including residential areas, hospitals, public lands, recreation areas, and other similar special use areas.

7.2. Land Use

Table 7-1 summaries the total land impacts anticipated for the various supply and return flow alternatives.

TABLE 7-1
Summary of Land Acreage Impacts
City of Waukesha Water Supply

	Land Affected (acres)	
Alternative Name	**Overall[a]**	**During Operation[b]**
Supply Alternatives		
Deep and Shallow Wells pipeline alignment	121.11	*0*
Aboveground structures and access roads[c]	*31.49*	*31.49*
Deep and Shallow Wells (Total)	152.6	31.49
Shallow Aquifer and Fox River Alluvium pipeline alignment	134.51	*0*
Aboveground structures and access roads[c]	*56.19*	*56.19*
Shallow Aquifer and Fox River Alluvium (Total)	190.7	56.19
Lake Michigan—Milwaukee Supply	122.4[d]	0
Lake Michigan—Oak Creek	230.2 [d]	0
Lake Michigan—Racine	341.6 [d]	0
Return Flow Alternatives		
Underwood Creek to Lake Michigan	104.8	0 [e]
Root River to Lake Michigan	141.4	0[e]
Direct to Lake Michigan to Lake Michigan	206	0[e]

[a] Includes all areas impacted by the supply and return flow alternatives, both temporary and permanent.
[b] Includes land disturbed during construction that also will be regarded as permanent workspace, including new aboveground structures and new access roads .
[c] Includes new access roads (15 feet wide), well houses, and WTP.
[d] A pump station may be required from the water provider. If required, it will be constructed within a previously disturbed area.
[e] Aboveground structures may include only a single pump station which will be constructed within the existing Waukesha WWTP site, in a previously disturbed area.

Table 7-2 provides quantitative data for land use types affected by a combination of temporary construction impacts and operation impacts of the supply and return flow alternatives. 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 (SEWRPC, 2000, 2005). 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 as commercial or industrial.
- *Transportation and Communication Utilities.* Motor-vehicle-related freeways, expressways, streets, and truck terminals; off-street parking areas; rail-related track ROWs; 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.

As illustrated in Table 7-2, most of the land impacted by each of the individual supply and return flow alternatives is categorized as transportation and communication utilities, the majority of which is made up of the roadways impacted by the routes. This emphasizes the fact that the pipelines associated with this project primarily use existing public right-of-way or utility corridors. The second largest land use category impacted for some individual routes was agricultural lands. Even though the Lake Michigan Supply – Milwaukee and all of the return flow alternatives cross lands classified as prime farmland (Chapter 6, Soil), they have no impacts on active agricultural lands. Combined, transportation and communication utilities and agricultural lands account for 75 percent of the total area affected by the various supply and return flow alternatives.

Once a final alternative has been selected and constructed, land with temporary impacts from pipeline construction will be allowed to revert or will be restored to its prior existing use. Land use change during the operational phase of the project would almost exclusively occur for either of the Deep and Shallow Wells alternative or the Shallow Aquifer and Fox River Alluvium alternative due to the need for a new water treatment plant, new access roads, and aboveground structures with these alternatives.

TABLE 7-2
Land Use Impacts in Acres
City of Waukesha Water Supply

Route	Residential	Commercial & Industrial	Transportation & Communication/ Utilities	Government. & Institutional	Recreational Areas	Agricultural Lands	Open Lands	Woodlands	Surface Water	Wetlands	Total[a]
Supply Routes											
Deep and Shallow Wells	10.84	2.18	77.57	0.82	0.66	46.53	6.31	0.00	0.24	7.46	**152.61**
Shallow Aquifer and Fox River Alluvium	10.70	2.18	77.70	0.82	0.66	73.72	6.31	0.00	0.55	18.10	**190.74**
Lake Michigan—Milwaukee Supply[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—Oak Creek Supply[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—Racine Supply	9.31	4.24	33.85	0.04	3.75	213.05	30.70	7.74	0.26	38.67	**341.61**
Return Route											
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**
Root River to Lake Michigan[b]	1.61	2.31	92.18	0.92	9.14	0.00	19.68	1.18	0.17	14.23	**141.42**
Direct to Lake Michigan[b]	4.80	9.81	154.77	4.29	4.51	0.00	11.33	0.08	0.17	10.03[b]	**199.79[c]**

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

[c] Total does not include 6.2 acres of surface waters within Lake Michigan which were not included in the SEWRPC Digital Land Use Inventory.

7.2.1. Access Roads

Existing roads and highways would be used for primary access to the workspace along the supply and return flow alternatives, for both construction crews and delivery of pipe and equipment. Equipment would be moved across public roads that intersect the workspace 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 short-term construction period would have a similar effect as other construction activities on adjacent land uses.

The only new access roads proposed will be for the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium supply alternatives in Waukesha County. These new gravel access roads would be used for access to the well houses at the southern terminus of both supply routes, during both construction and operation.

No new access roads will be required for the various Lake Michigan supply alternatives or the return flow alternatives. Existing public or private roads will be used for these alternatives. Table 7-3 summarizes the number and acreages of proposed new access roads for each of the alternatives.

TABLE 7-3
Access Roads
City of Waukesha Water Supply

Alternative Name	Number of New Access Roads	Acreage Affected by New Access Road
Supply Alternatives		
Deep and Shallow Wells	2[a]	3.0[b]
Shallow Aquifer and Fox River Alluvium	3[a]	5.0[b]
Lake Michigan—Milwaukee Supply	None proposed[c]	—
Lake Michigan—Oak Creek	None proposed[c]	—
Lake Michigan—Racine	None proposed[c]	—
Return Flow Alternatives		
Underwood Creek to Lake Michigan	None proposed[c]	—
Root River to Lake Michigan	None proposed[c]	—
Direct to Lake Michigan	None proposed[c]	—

[a]Access will also include existing municipal roadways and trails

[b]Assumes access roads will be 15 feet wide, constructed only between well houses, and will not involve water body crossings.

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

7.2.2. Aboveground Structures

The supply and return flow alternatives will involve the construction of water main pipelines through Milwaukee, Racine, or Waukesha Counties, Wisconsin. Permanent impacts associated with aboveground structures will depend on the alternative(s) selected, and will include the construction of well houses, pump stations, and new water treatment plant (WTP) for the two shallow aquifer alternatives.

A summary of the proposed aboveground structures and acreages associated with each of the alternatives is depicted in Table 7-4. The above ground structures are primarily associated with the Deep and Shallow Aquifer and Shallow Aquifer and Fox River Alluvium alternatives. Lake Michigan water supply and return flow alternatives have an insignificant impact for above ground structures.

TABLE 7-4
Aboveground Structures
City of Waukesha Water Supply

Alternative Name	Description & Number of Structures	Acres
Supply Alternatives		
Deep and Shallow Aquifers	11 well houses	13.75
	WTP	14.74
Shallow Aquifer and Fox River Alluvium	15 well houses	17.99
	WTP	33.20[a]
Lake Michigan—Milwaukee Supply	None proposed[b]	—
Lake Michigan—Oak Creek	None proposed[b]	—
Lake Michigan—Racine	None proposed[b]	—
Return Flow Alternatives		
Underwood Creek to Lake Michigan	Pump Station[c]	—
Root River to Lake Michigan	Pump Station[c]	—
Direct to Lake Michigan	Pump Station[c]	—

[a] Includes the same 14.74 acres listed for the Deep and Shallow Aquifers alternative, plus additional 18.46 acres for more expansive plant needed for treatment of groundwater under the influence of surface water.
[b] A pump station may be required from the water provider. If required, it will be constructed within a previously disturbed area.
[c] Will be constructed within the existing Waukesha WWTP site, in a previously disturbed area.

7.3. Residential and Commercial Areas

7.3.1. Existing Residences and Buildings

No private residences would be affected by the supply and return flow alternatives being considered. A single private building is located within the proposed 75-foot-wide construction corridor for the Lake Michigan—Milwaukee, —Oak Creek, and —Racine supply alternatives. The building is located in Waukesha County near the terminus of the Lake Michigan supply alternatives and based on a review of aerial photography, appears to be used as a storage structure. The City will coordinate with the owner of the building further if the final alternative chosen is a Lake Michigan supply option. Appropriate mitigation measures will be taken to restore properties disturbed during construction.

7.4. Public Land, Recreation, and Other Designated Areas

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

A review of alternatives being evaluated was completed to identify Public or Conservation Land and Natural, Recreational, or Scenic Areas within 0.10 mile of the respective alternative alignments. 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
- 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

According to a review of Google Earth (Google Earth, 2009) and the SEWRPC Land Use Division and GIS Division , Park and Open Spaces Sites data (SEWRPC, 2005), no federally designated or managed Public or Conservation Land and Natural, Recreational, or Scenic Areas are impacted by the supply and return flow alternatives.

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 depending on which supply and return flow alternative is ultimately selected. Impacts to state and local resources can be divided 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 resulting from the project are anticipated to be short in duration and will be minimized by implementing BMPs designed to reduce impacts to sensitive resources. No permanent aboveground structures will be built within areas designated as state or local Public or Conservation Land and Natural, Recreational, or Scenic Areas and as a result, no permanent construction related impacts will occur.

Permanent impacts resulting from a potential drawdown of the groundwater table are only applicable to the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium Alternatives. The groundwater drawdown affects the Vernon Wildlife Area and is described in Chapter 2.4 Wetlands, and Chapter 3, Vegetation and Wildlife Resources .

Table 7-5 summarizes the Public or Conservation Land and Natural, Recreational, or Scenic Areas located within or adjacent to the proposed workspaces for the supply and return flow alternatives.

TABLE 7-5
Public or Conservation Lands within or Adjacent to the Alternatives
City of Waukesha Water Supply

Alternative Name	Name of Resource	Acres Within Proposed 75-ft Construction Workspace
***S*upply Alternatives**		
Deep and Shallow Aquifers	Vernon Marsh Wildlife Area	1.25
	American Legion Memorial Park	0.10
	Fox River Park	1.40
	Hillcrest Park	0.06
	Spring City Soccer Club Athletic Fields	0.72
Shallow Aquifer and Fox River Alluvium	Vernon Marsh Wildlife Area	1.25
	American Legion Memorial Park	0.10
	Fox River Park	1.41
	Hillcrest Park	0.06
	Spring City Soccer Club Athletic Fields	0.72
Lake Michigan—Milwaukee Supply	Greenfield Park	0.17
	Hillcrest Park	1.16
	New Berlin Golf Course	1.51
	Root River Parkway	21.28
Lake Michigan—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—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

TABLE 7-5
Public or Conservation Lands within or Adjacent to the Alternatives
City of Waukesha Water Supply

Alternative Name	Name of Resource	Acres Within Proposed 75-ft Construction Workspace
Return Flow Alternatives		
Underwood Creek	Bethesda Springs Park	0.30
	Carroll College athletic fields	0.28
	Fox River Sanctuary	2.48
	Greenfield Park	0.17
	Krueger Park (which becomes Rainbow Park on the south side of Interstate 94)	0.89
	Underwood Creek Parkway and Corridor	3.83
Root River	Bethesda Springs Park	0.30
	Carroll College athletic fields	0.28
	Fox River Sanctuary	2.48
	Greenfield Park	0.17
	New Berlin Hills Golf Course	1.00
	Root River Parkway	43.99
Direct to Lake Michigan	Bethesda Springs Park	0.30
	Carroll College athletic fields	0.28
	Fox River Sanctuary	2.48
	Greene Park	0.61
	Greenfield Park	0.64
	Kinnickinnic River Parkway	0.35
	Sheridan Park	0.60
	Saint Francis High School	0.49
	Saint Francis Property	0.30

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

7.4.2. Coastal Zone Management Areas

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

The Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium alternatives and their associated aboveground structures (well houses and WTP) are located entirely within Waukesha County and therefore will not impact a Coastal Zone Management Area.

The Direct to Lake Michigan return flow alternative is located within the designated Wisconsin Coastal Zone (DOA, 2010). If this alternative is utilized, the City will coordinate with the WDNR, USACE, and applicable agencies regarding avoidance and minimization of impacts to the Wisconsin Coastal Zone.

7.5. Agricultural Lands

Construction may result in a reduction of agricultural production if the alternative affects agricultural land. According to Table 7-2 in, the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium alternatives have permanent impacts on prime farmland soils. The Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium alternatives, Lake Michigan – Oak Creek, and Lake Michigan – Racine all have temporary construction agricultural impacts (Table 7-2) while the Lake Michigan- Milwaukee, and all the return flow alternatives have no agricultural land use impacts. Further discussion on impacts to prime farmland soils is included in Chapter 6, Soils.

7.6. Visual Resources

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 alternatives.

The aboveground structures (well houses and WTP for the Deep and Shallow Aquifers and Shallow Aquifer and Fox River Alluvium alternatives) would be located within primarily agricultural areas, with a small amount of wetlands and very limited residential areas (approximately 1.0 acre) impacted. None of the proposed aboveground structures is located in any visually sensitive areas.

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

7.7. References

DOA. 2010. State of Wisconsin, Department of Administration, Division of Intergovernmental Relations, Wisconsin Coastal Management Program. Available at: http://www.doa.state.wi.us/category.asp?linkcatid=648&linkid=65&locid=9. Accessed February 2010.

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SEWRPC (Southeast Wisconsin Regional Planning Commission). 2005. Land Use Division and GIS Division, Park and Open Space Sites data.

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CHAPTER 8

Comparison of Alternatives

This section compares impacts of the alternatives considered relative to each other. Impacts could result from construction (short term) or operation (long term).

8.1 Environmental Impact Category Description

Table 8-1 describes the level of impact (no adverse impact, minor adverse impact, etc.) for the various environmental resource categories reviewed in this ER. Each category has been detailed in previous sections of this report; this chapter compares the alternatives on the basis of these relative impact classifications. The text below describes the impacts of each alternative, and Table 8-2 summarizes the findings.

TABLE 8-1
Environmental Impact Category Description
City of Waukesha Water Supply

Category	No Adverse Impact	Minor Adverse Impact	Moderate Adverse Impact	Significant Adverse Impact
Groundwater Resources (Chapter 2)	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.	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.	Draw down of the deep aquifer continues and shallow aquifer draw down 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%.	Draw down of the deep aquifer continues or shallow aquifer draw down 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.
Flow and Geomorphology (Chapter 2)	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.	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.	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.	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.
Water Quality (Chapter 2)	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.	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.	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.	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 8-1
Environmental Impact Category Description
City of Waukesha Water Supply

Category	No Adverse Impact	Minor Adverse Impact	Moderate Adverse Impact	Significant Adverse Impact
Flooding (Chapter 2)	No increase in flooding depth for the 100-year return period storm.	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.	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.	Causes an increase in flooding depth of greater than 1.0 foot at buildings for the 100-year return period storm.
Aquatic Habitat (Chapter 2)	Temporary impacts from construction; neutral or improved habitat creation and frequency of availability from operation.	Reduced baseflow in warm water streams of up to 25%, causing habitat loss. Substrate change to Lake Michigan of fewer than 10 acres.	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.	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.
Wetlands (Chapter 2)	No temporary or operational impacts to existing wetlands greater than 0.1 acre.	Temporary construction impacts to wetlands. Operational impacts of greater than 0.1 acre but less than 5 acres of existing wetlands.	Operational impacts of greater than 5 but less than 10 acres of existing wetlands.	Operational impacts of more than 10 acres of existing wetlands.
Vegetation and Wildlife Resources (Chapter 3)	No long-term, operational impacts.	Operational impacts occur from new above ground structures to areas without special wildlife area protection. Groundwater drawdown to areas with special wildlife protection areas impact is less than 5 acres.	Groundwater drawdown to areas with special wildlife protection areas impact is greater than 5 but less than 10 acres.	Groundwater drawdown to areas with special wildlife protection areas impact is greater than 10 acres.
Cultural Resources (Chapter 4)	Cultural resources will be protected for all alternatives and thus the same for all alternatives. Any impacts to known cultural resources will follow applicable regularly requirements and will consequently be insignificant.	See No Adverse Impact definition.	See No Adverse Impact definition.	See No Adverse Impact definition.

TABLE 8-1
Environmental Impact Category Description
City of Waukesha Water Supply

Category	No Adverse Impact	Minor Adverse Impact	Moderate Adverse Impact	Significant Adverse Impact
Socioeconomics (Chapter 5)	Future growth planning in the City of Waukesha has not been contingent upon water supply source. Consequently, socioeconomic impacts are insignificant for all alternatives.	See Insignificant Impact definition.	See Insignificant Impact definition.	See Insignificant Impact definition.
Soils (Chapter 6)	No operational impacts and only temporary construction impacts.	Operational impacts are limited to soil types frequently found in the area.	Operational impacts occur to soil types infrequently occurring in the area.	Operational impacts occur to soil types rarely occurring in the area.
Land Use (Chapter 7)	Temporary construction impacts and operational impacts that result in land use changes already frequently occurring in the area.	Operational impacts result in land use changes to Public or Conservation Land and Natural, Recreational, or Scenic Areas less than 5 acres.	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.	Operational impacts result in land use changes to Public or Conservation Land and Natural, Recreational, or Scenic Areas greater than 50 acres.

8.2 Alternative Comparison

Each alternative is compared below for relative environmental impacts for each category in Table 8-1. Table 8-2 is a comparison summary of the impacts for each alternative.

8.2.1 Groundwater Resources

Please refer to Chapter 2.2.2 for detailed information on each alternative.

8.2.1.1 Deep and Shallow Aquifers

This alternative would reduce existing impacts to the deep aquifer because there would be less pumping of the deep aquifer and thus some rebound of the deep aquifer in the City of Waukesha over time. Increased pumping of the shallow aquifer, however, would decrease baseflow to various streams. Groundwater modeling of the alternative indicates that the Fox River would experience 2.4 mgd less flow. The reduction of baseflow to the Fox River from groundwater pumping would be a minor adverse impact.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would experience baseflow reduction from groundwater pumping, with a 61 percent reduction in Pebble Brook on average, and an even greater reduction during low flow conditions. The baseflow reduction to the cold water streams would be a significant adverse impact.

Groundwater pumping would reduce the groundwater level by 5 feet or more for nearly 1,000 wetland acres. Drawdown of 1 foot or greater would occur for over 3,000 wetland acres. Because a wetland is designated by the type of plants, hydrology, and soil, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. The groundwater drawdown to wetlands from groundwater pumping would be a significant adverse impact.

8.2.1.2 Shallow Aquifer and Fox River Alluvium

Impacts to the deep aquifer are further reduced with this alternative because there would be no pumping of the deep aquifer for the City of Waukesha water supply, which will lead to some rebound of the deep aquifer in the City of Waukesha over time. However, increased pumping from the shallow aquifer further decreases baseflow to various streams. Groundwater modeling of this alternative indicates that the Fox River would experience 5.9 mgd less flow. The baseflow reduction to the Fox River from groundwater pumping would be a minor adverse impact.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would also experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 58 percent on average, and an even greater reduction during low flow conditions. The baseflow reduction to the cold water streams would be a significant adverse impact.

Groundwater pumping would reduce the groundwater level by 5 feet or more for nearly 2,000 wetland acres. A 1-foot or greater groundwater drawdown would occur for over 4,000 wetland acres. Because a wetland is designated by the type of plants, hydrology, and soil, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. The groundwater drawdown to wetlands from groundwater pumping would be a significant adverse impact.

8.2.1.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

The Lake Michigan water supply alternatives 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 that are influenced by Lake Michigan. Lake Michigan water supply consequently produces no adverse impact on groundwater resources.

8.2.1.4 Return Flow—Underwood Creek to Lake Michigan

Due to the small change in this Lake Michigan tributary water depth with return flow, this alternative is not anticipate to result in adverse impacts to regional aquifer supplies that are influenced by a Lake Michigan tributary. Return flow to Underwood Creek consequently would produce no adverse impact on groundwater resources.

8.2.1.5 Return Flow—Root River to Lake Michigan

Due to the small change in this Lake Michigan tributary water depth with return flow, this alternative is not anticipate to result in adverse impacts to regional aquifer supplies that are influenced by a Lake Michigan tributary. Return flow to the Root River consequently would produce no adverse impact on groundwater resources.

8.2.1.6 Return Flow—Direct to Lake Michigan

Due to the volume of water present, withdrawal from Lake Michigan with return flow will result in an insignificant change in lake water levels and therefore is not anticipated to result in adverse effects to regional aquifer supplies that are influenced by Lake Michigan. Direct to Lake Michigan return flow consequently would produce no adverse impact on groundwater resources.

8.2.2 Flow and Geomorphology

Please refer to Chapter 2.3.2.1 for detailed information on each of these alternatives.

8.2.2.1 Deep and Shallow Aquifers

Impacts to the flow and geomorphology of surface water resources would occur from shallow groundwater pumping with this water supply alternative. Groundwater modeling of this alternative indicates that the Fox River would experience 2.4 mgd less flow. The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would also experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 61 percent on average and an even greater reduction during low flow conditions. Geomorphic changes with reduced baseflows could result in a smaller channel over time, but because channel stability is associated less with baseflow and influenced more by larger channel-forming flows, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. The baseflow reduction to surface waters from groundwater pumping would produce no adverse impact to geomorphology.

8.2.2.2 Shallow Aquifer and Fox River Alluvium

Impacts to the flow and geomorphology of surface water resources would occur from shallow groundwater pumping with this water supply alternative. Groundwater modeling of this alternative indicates the Fox River would experience 5.9 mgd less flow. The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would also experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 58 percent on average and an even greater reduction during low flow conditions. Geomorphic changes with reduced baseflows could result in a smaller channel over time, but because channel stability is associated less with baseflow and influenced more by larger channel-forming flows, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. The baseflow reduction to surface waters from groundwater pumping would produce no adverse impact to geomorphology.

8.2.2.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

The Lake Michigan water supply alternatives prevent the need for baseflow reduction from groundwater pumping. The flow and geomorphology changes to the environment are dependent upon only the return flow location. Consequently, the Lake Michigan water supply would produce no adverse impacts to flow and geomorphology.

8.2.2.4 Return Flow—Underwood Creek to Lake Michigan

Impacts to the flow and geomorphology of surface water resources occur with this return flow alternative. 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 influenced more by larger channel-forming flows, baseflow reduction is not expected to cause a significant change in channel stability from existing conditions. Consequently, flow and geomorphology changes to the Fox River are expected to have no adverse impact.

The flow that used to discharge to the Fox River instead increases baseflow in Underwood Creek and the Menomonee River. 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. Return flow to Underwood Creek consequently would produce no adverse impact on flow and geomorphology.

8.2.2.5 Return Flow—Root River to Lake Michigan

Impacts to the flow and geomorphology of surface water resources occur with this return flow alternative. The changes to the Fox River would be the same as those listed for the Underwood Creek return flow alternative.

The flow that used to discharge to the Fox River instead would increase baseflow in the Root River. A recent sediment transport study of the Root River concluded that the river stability is relatively insensitive to changes in flows because of the erosion resistance of the channel boundary materials, the relatively flat channel gradient, and the presence of a functional floodplain. Return flow to Root River consequently would produce no adverse impact on flow and geomorphology.

8.2.2.6 Return Flow—Direct to Lake Michigan

Impacts to the flow and geomorphology of surface water resources occur with this return flow alternative. The changes to the Fox River would be the same as those listed for the Underwood Creek return flow alternative.

The flow that used to discharge to the Fox River instead would discharge directly to Lake Michigan. To send the water directly into Lake Michigan, a new outfall would be required on the bottom of the Lake. The pipe in the Lake would change the Lake substrate composition along the pipe alignment. A total of 6.2 acres is estimated to be potentially affected. Return flow direct to Lake Michigan consequently would produce a minor adverse impact on geomorphology.

8.2.3 Flooding

Please refer to Chapter 2.3.2.2 for detailed information on each of these alternatives.

8.2.3.1 Deep and Shallow Aquifers

Flooding impacts would not change under this alternative, because flow would continue to be discharged to the Fox River. Consequently, groundwater pumping would produce no adverse impact to flooding.

8.2.3.2 Shallow Aquifer and Fox River Alluvium

Flooding impacts would not change under this alternative, because flow would continue to be discharged to the Fox River. Consequently, groundwater pumping would produce no adverse impact to flooding.

8.2.3.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

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

8.2.3.4 Return Flow—Underwood Creek, Root River, or Direct to Lake Michigan

The return flow to any location would not impact flooding. Return flow 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 the groundwater supply alternatives. Consequently, any return flow alternative would cause no adverse impact to flooding.

8.2.4 Aquatic Habitat

Please refer to Chapter 2.3.2.3 for detailed information on each of these alternatives.

8.2.4.1 Deep and Shallow Aquifers

Impacts to aquatic habitat would occur with this alternative because increased pumping of the shallow aquifer would decrease baseflow to various streams. Reduced baseflow can decrease the frequency and availability of aquatic habitat, including wetlands. Groundwater modeling of this alternative indicates the Fox River would experience 2.4 mgd less flow. The aquatic habitat change from baseflow reduction to the Fox River would be a minor adverse impact.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would also experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 61 percent on average, with an even greater reduction during low flow conditions. These baseflow reductions would decrease habitat in these streams. The baseflow reduction to the cold water streams would be a significant adverse impact to aquatic habitat.

8.2.4.2 Shallow Aquifer and Fox River Alluvium

Impacts to aquatic habitat would occur with this alternative because increased pumping of the shallow aquifer would decrease baseflow to various streams. Reduced baseflow can decrease the frequency and availability of aquatic habitat. Groundwater modeling of this alternative indicates the Fox River would experience 5.9 mgd less flow. The aquatic habitat change from baseflow reduction to the Fox River from would be a minor adverse impact.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would also experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 58 percent on average, with an even greater reduction during low flow conditions. These baseflow reductions would decrease habitat in these streams. The baseflow reduction to the cold water streams would be a significant adverse impact to aquatic habitat.

8.2.4.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

The Lake Michigan water supply alternatives would not change habitat in Lake Michigan or other surface water resources. Lake Michigan water supply consequently would produce no adverse impact on aquatic habitat.

8.2.4.4 Return Flow—Underwood Creek to Lake Michigan

Return flow to Underwood Creek would increase baseflow and consequently the quantity and availability of aquatic habitat. The greatest habitat benefits would occur during low flow conditions. Return flow to Underwood Creek consequently would improve the aquatic habitat and produce no adverse impact on aquatic habitat.

8.2.4.5 Return Flow—Root River to Lake Michigan

Return flow to the Root River would increase baseflow and consequently the quantity and availability of aquatic habitat. The greatest habitat benefits would occur during low flow conditions. Return flow to the Root River consequently would improve the aquatic habitat and produce no adverse impact on aquatic habitat.

8.2.4.6 Return Flow—Direct to Lake Michigan

Return flow directly to Lake Michigan would have no volume change in flow. Aquatic habitat changes to Lake Michigan with this alternative would occur only with the return flow pipeline on the bottom of Lake Michigan, which would change the bottom substrate. An estimated 6.2 acres could be affected by this alternative. A change in bottom substrate of this magnitude would be expected to have only a minor adverse impact.

8.2.5 Water Quality

Please refer to Chapter 2.3.2.4 for detailed information on each of these alternatives.

8.2.5.1 Deep and Shallow Aquifers

This alternative would maintain WWTP discharge to the Fox River as currently occurs. Discharge permit requirements are currently met and would be met under this future groundwater supply alternative. The existing WDNR discharge permit includes allowances for chloride and mercury. These allowances are expected to continue under this water supply source. Consequently, the water quality impacts to the Fox River are expected to be minor adverse impacts.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 61 percent on average, with an even greater reduction during low flow conditions. Lower baseflows in these cold water streams would lead to warmer temperatures and potential temperature impairment. Pebble Creek's water temperature already fluctuates, and this would be expected to worsen. The water quality impacts to the cold water streams are expected to be minor adverse impacts.

8.2.5.2 Shallow Aquifer and Fox River Alluvium

This alternative would maintain WWTP discharge to the Fox River as currently occurs. Impacts are expected to be the same to the Fox River as with the Deep and Shallow Aquifer alternative. Consequently, the water quality impacts to the Fox River would be expected to be minor adverse impacts.

The small cold water streams Pebble Brook, Pebble Creek, and Mill Brook would experience baseflow reduction from groundwater pumping, with Pebble Brook experiencing a baseflow reduction of 59 percent on average, with an even greater reduction during low flow conditions. Lower baseflows in these cold water streams would lead to warmer temperatures and potential temperature impairment. Pebble Creek's water temperature already fluctuates, and this would be expected to worsen. The water quality impacts to the cold water streams would be expected to be minor adverse impacts.

8.2.5.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

The Lake Michigan water supply alternatives 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, which would be necessary under both groundwater supply alternatives. 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.

8.2.5.4 Return Flow—Underwood Creek to Lake Michigan

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. Water quality modeling found water quality improved, continued to meet water quality standards, or did not cause higher algae growth. 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 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 is considering 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.

8.2.5.5 Return Flow—Root River to Lake Michigan

Return flow to the Root River would have the same impacts to the Fox River as described for return flow to Underwood Creek.

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

Water quality impacts to Lake Michigan would be the same as those described for return flow to Underwood Creek: minor adverse impacts.

8.2.5.6 Return Flow—Direct to Lake Michigan

Return flow directly to Lake Michigan would have the same impacts to the Fox River as described for return flow to Underwood Creek.

Water quality impacts to Lake Michigan would be the same as those described for return flow to Underwood Creek: minor adverse impacts.

8.2.6 Wetlands

Please refer to Chapter 2.4.2 for detailed information on each of these alternatives.

8.2.6.1 Deep and Shallow Aquifers

Temporary construction-related impacts to wetlands are associated with all alternatives. Consequently, this summary focuses upon operational impacts to wetlands from this alternative that occur from aboveground structures and groundwater drawdown.

A total of 6.31 acres of wetlands could be impacted from operational impacts associated with aboveground structures. This alternative would have a moderate adverse impact on wetlands from aboveground structures.

The groundwater-pumping operation would reduce the groundwater level by 5 feet or more for nearly 1,000 wetland acres. A 1-foot or greater groundwater drawdown would occur for over 3,000 wetland acres. Because a wetland is designated by the type of plants, hydrology, and soil, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. The groundwater drawdown to wetlands from groundwater pumping would be a significant adverse impact.

8.2.6.2 Shallow Aquifer and Fox River Alluvium

Temporary construction-related impacts to wetlands are associated with all alternatives. Consequently, this summary focuses upon operational impacts to wetlands from this alternative that occur from aboveground structures and groundwater drawdown.

A total of 17.26 acres of wetlands could be impacted from operational impacts associated with aboveground structures. This alternative would have a significant adverse impact on wetlands from aboveground structures.

The groundwater pumping would reduce the groundwater level by 5 feet or more for nearly 2,000 wetland acres. A 1-foot or greater groundwater drawdown would occur for over 4,000 wetland acres. Because a wetland is designated by the type of plants, hydrology, and soil, groundwater drawdown in wetlands can reduce or eliminate the hydrology element required to sustain wetland conditions. The groundwater drawdown to wetlands from groundwater pumping would be a significant adverse impact.

8.2.6.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

Temporary construction-related impacts to wetlands are associated with all alternatives. Consequently, this summary focuses upon operational impacts to wetlands from this alternative that would occur from aboveground structures. There would be no operational impacts to wetlands from aboveground structures associated with these alternatives. These alternatives would have only minor adverse impacts to wetlands from temporary construction impacts.

8.2.6.4 Return Flow—Underwood Creek, Root River, or Direct to Lake Michigan

Temporary construction-related impacts to wetlands are associated with all alternatives. Consequently, this summary focuses upon operational impacts to wetlands from this alternative that would occur from aboveground structures. There would be no operational impacts to wetlands from aboveground structures associated with these alternatives. These alternatives would have only minor adverse impacts to wetlands from temporary construction impacts.

8.2.7 Vegetation and Wildlife

Please refer to Chapters 3.2.3, 3.3.3, and 3.4.2 for detailed information on each of these alternatives. The City is currently coordinating with the WDNR to conduct a habitat assessment at locations along alternative infrastructure alignments in the summer of 2010. The information gained from the habitat assessment will be shared with the WDNR.

8.2.7.1 Deep and Shallow Aquifers

Temporary construction-related impacts to vegetation are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. The City will work closely with resource agencies to avoid, minimize, and mitigate impacts, if any, to threatened and endangered species. Consequently, this summary focuses upon operational impacts to vegetation and wildlife from this alternative that would occur from aboveground structures and groundwater drawdown.

The groundwater pumping operation reduces the groundwater level by 5 feet or more over 291 acres of the Vernon Wildlife Area (VWA). A 1-foot or greater groundwater drawdown over the VWA occurs for over 609 acres. This groundwater level drawdown could result in habitat type change in this specially regulated area. The groundwater drawdown to VWA regulated lands from groundwater pumping would be a significant adverse impact.

8.2.7.2 Shallow Aquifer and Fox River Alluvium

Temporary construction-related impacts to vegetation are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. The City will work closely with resource agencies to avoid, minimize, and mitigate impacts, if any, to threatened and endangered species. Consequently, this summary focuses upon operational impacts to vegetation and wildlife from this alternative that would occur from aboveground structures and groundwater drawdown.

The groundwater-pumping operation reduces the groundwater level by 5 feet or more over 343 acres of the VWA. A 1-foot or greater groundwater drawdown over the VWA would occur for over 1,106 acres. This groundwater level drawdown could result in habitat type change in this specially regulated area. The groundwater drawdown to VWA-regulated lands from groundwater pumping would be a significant adverse impact.

8.2.7.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

Temporary construction-related impacts to vegetation are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. The City will work closely with resource agencies to avoid, minimize, and mitigate impacts, if any, to threatened and endangered species. Consequently, this summary focuses upon operational impacts to vegetation and wildlife from this alternative that would occur from aboveground structures.

There would be no operational impacts to wildlife areas with these alternatives. Consequently, there would be no adverse impact to vegetation and wildlife with these alternatives.

8.2.7.4 Return Flow—Underwood Creek, Root River, or Direct to Lake Michigan

Temporary construction-related impacts to vegetation are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. The City will work closely with resource agencies to avoid, minimize, and mitigate impacts, if any, to threatened and endangered species. Consequently, this summary focuses upon operational impacts to vegetation and wildlife from this alternative that would occur from aboveground structures.

There would be no operational impacts to wildlife areas with these alternatives. Consequently, there would be no adverse impact to vegetation and wildlife with these alternatives.

8.2.8 Cultural Resources

Please refer to Chapter 4.5 for detailed information on each of these alternatives.

Regardless of the alternatives selected, the City will meet regulatory requirements regarding cultural resources during the design and construction phases to prevent any significant impacts and mitigate impacts to known or potential NRHP sites. During operation, there would be no ground disturbance and thus no impacts to cultural resources. Consequently, no adverse impacts to cultural resources are expected.

Because there would be no adverse impacts to cultural resources for any alternative, Table 8-2 does not include cultural resources in the comparison summary.

8.2.9 Socioeconomics

Please refer to Chapters 5.2.2, 5.3.2, and 5.4.2 for detailed information on each of these alternatives.

Regardless of the alternatives selected, socioeconomic impacts would be similar for all alternatives. A draft socioeconomic study of SEWRPC's Regional Water Supply concludes that given similar costs and quantity, the source of water is not a differentiating factor in development, population, economics, or other socioeconomic attributes within a municipal service area. Consequently, since all alternatives are capable of delivering the projected water demand at similar costs, there would be no adverse impact differences with population or land use and the associated economic outcomes that depend upon these factors with any alternative.

Energy use would be less with a Lake Michigan water supply and return flow pipeline than what is expected with the two groundwater supplies.

Because there are no adverse socioeconomic impacts differentiating the alternative, Table 8-2 does not include socioeconomics in the comparison summary.

8.2.10 Soils

Please refer to Chapter 6.4 for detailed information on each of these alternatives.

8.2.10.1 Deep and Shallow Aquifers

Temporary construction-related impacts to soils are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. Consequently, this summary focuses upon operational impacts to soils from this alternative that would occur from aboveground structures.

The aboveground structures would affect prime farmland soils. Prime farmland soil is commonly found in the project vicinity. The drinking water treatment plant (WTP) proposed for this alternative would impact 33.20 acres, all of which are prime farmland soils. The 11 well houses proposed would impact approximately 38.41 acres, of which 30.96 acres, or 80.6 percent, are prime farmland soils. These impacts would be limited to soil types frequently found in the area and consequently would be minor adverse impacts.

8.2.10.2 Shallow Aquifer and Fox River Alluvium

Temporary construction-related impacts to soils are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. Consequently, this summary focuses upon operational impacts to soils from this alternative that would occur from aboveground structures.

The aboveground structures would affect prime farmland soils. Prime farmland soil is commonly found in the project vicinity. The WTP proposed for this alternative would impact approximately 14.74 acres, of which all is classified as prime farmland soils. The 15 well houses proposed for this alternative would impact approximately 51.26 acres, of which 50.62 acres, or 99 percent, are designated prime farmland soils. These impacts would be limited to soil types frequently found in the area and consequently would be minor adverse impacts.

8.2.10.3 Lake Michigan—Milwaukee Supply, Oak Creek Supply, or Racine Supply

Temporary construction-related impacts to soils are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. Consequently, this summary focuses upon operational impacts to soils from this alternative that would occur from aboveground structures.

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

8.2.10.4 Return Flow—Underwood Creek, Root River, or Direct to Lake Michigan

Temporary construction-related impacts to soils are associated with all alternatives. All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to vegetation and species of concern. Consequently, this summary focuses upon operational impacts to soils from this alternative that would occur from aboveground structures.

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

8.2.11 Land Use

Please refer to Chapters 7.3, 7.4, and 7.6 for detailed information on each of these alternatives.

All alternatives have selected pipeline routes that focus primarily upon areas that have been already developed or disturbed to minimize impacts to existing Public or Conservation Land and Natural, Recreational, or Scenic Areas. These pipeline routes would be disturbed only temporarily during construction. No alternative would have ongoing operational impacts to these resources. Consequently, all alternatives are similar and would have no adverse operational impacts to public or conservation land or to natural, recreational, or scenic areas.

TABLE 8-2
Water Supply and Return Flow Alternative Environmental Impact Comparison Summary
City of Waukesha Water Supply

Water Supply Alternative	Groundwater Resources	Flow and Geomorphology	Flooding	Aquatic Habitat	Water Quality	Wetlands	Vegetation and Wildlife Resources	Soils	Land Use
Water Supply Alternatives									
Deep and shallow aquifers	Significant adverse impact	No adverse impact	No adverse impact	Significant adverse impact	Minor adverse impact	Significant adverse impact	Significant adverse impact	Minor adverse impact	No adverse impact
Shallow aquifer and Fox River alluvium	Significant adverse impact	No adverse impact	No adverse impact	Significant adverse impact	Minor adverse impact	Significant adverse impact	Significant adverse impact	Minor adverse impact	No adverse impact
Lake Michigan – Milwaukee	No adverse impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan – Oak Creek	No adverse impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Lake Michigan – Racine	No adverse impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact
Return Flow Alternatives									
Underwood Creek	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
Root River	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
Direct to Lake Michigan	No adverse impact	Minor adverse impact	No adverse impact	Minor adverse impact	Minor adverse impact	Minor adverse impact	No adverse impact	No adverse impact	No adverse impact

8.3 Conclusion

The Deep and Shallow Aquifers and the Shallow Aquifer and Fox River Alluvium alternatives would have significant adverse environmental impacts to natural resources. The Lake Michigan water supply and return flow alternatives would have only minor adverse environmental impacts to natural resources. Lake Michigan is the preferred water supply alternative as a result.

Of the return flow alternatives, the Underwood Creek and Root River alternatives both would have minor adverse impacts in two categories, whereas the Lake Michigan alternative would have minor adverse impacts in four categories. The costs of the Underwood Creek and Root River alternatives were compared, and the Underwood Creek alternative is the preferred return flow alternative.

Once a water supplier and return flow location have been reviewed and approved, the City will work with the regulatory agencies during final design to conduct any necessary field surveys, location refinements, mitigation planning, and to obtain required permits.