Wisconsin Section of the American Water Resources Association Annual Meeting
Managing Wisconsin's Urban Water Resources

March 7, 2013

Regional Water Supply Planning in Southeastern Wisconsin

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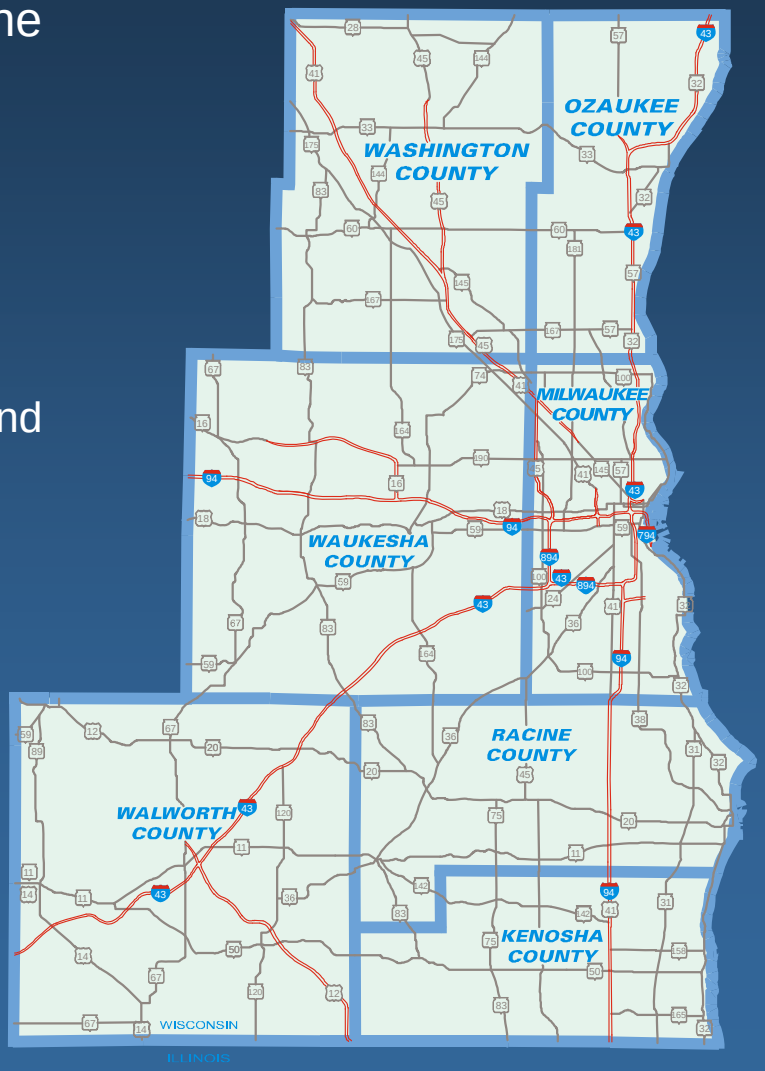
#209931

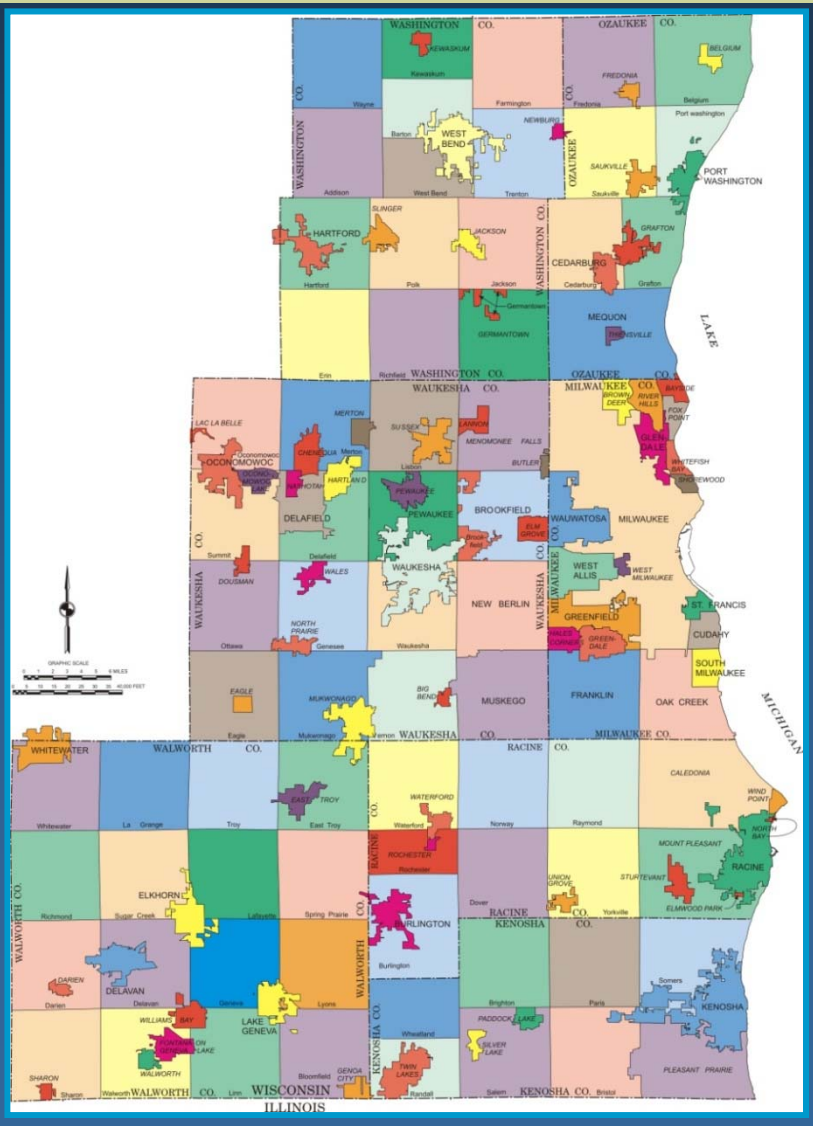
Southeastern Wisconsin Regional Planning Commission (SEWRPC)

- Official areawide public planning agency for the seven county Region
- Created in 1960 under State legislation
- Purpose:
  - Consider and address physical development and infrastructure problems that extend beyond municipal and county boundaries.
  - Prepare regionwide advisory long-range plans.
    - Land Use
    - Transportation
    - Water Quality Management
    - Flooding Management
    - Parks and Open Space
    - Environmental Corridors
    - Natural Areas
    - Water Supply



Southeastern Wisconsin Regional Planning Commission (SEWRPC)

- Southeastern Wisconsin Region
  - 154 general purpose units of government
    - 7 counties
    - 29 cities
    - 61 villages
    - 57 towns
  - 4 urbanized areas
    - Milwaukee
    - Racine
    - Kenosha
    - Round Lake Beach
  - Relationship to State
    - 5% – Area
    - 35 – 40% – Population, Employment, Economic Value



Regional Water Supply Plan Background

A Cooperative Program…

SE Wisconsin Water Utilities

USGS science for a changing world

Southeastern Wisconsin Regional Planning Commission

Seven Southeastern Wisconsin Counties

WISCONSIN DEPT. OF NATURAL RESOURCES

UNIVERSITY of WISCONSIN UWMILWAUKEE

UW Extension Wisconsin Geological and Natural History Survey

Background

Regional Water Supply Planning Program

Three Elements (Coordinated With And Designed To Complement Local Actions)

1. Conduct Basic Groundwater Inventories (Completed in 2001 With Partners—WGNHS and WDNR)
2. Collect Additional Inventory Data and Develop Regional Aquifer Simulation Model (Completed in 2005 with Partners—USGS, WGNHS, UW-Milwaukee, WDNR, and SE Wisconsin Water Utilities)
3. Prepare Regional Water Supply System Plan (Partners Include USGS, WGNHS, UW-Milwaukee, and WDNR)

Planning Report No. 52, “A Regional Water Supply Plan for Southeastern Wisconsin,” December 2010

Regional Water Supply Plan Reports

- Technical Report No. 43, “State of the Art of Water Supply Practices” (Ruekert & Mielke)
- Technical Report No. 44, “Water Supply Law Report” (Boardman, Suhr, Curry & Field)
- Technical Report No. 46, “Groundwater Budget Indices and Their Use in Assessing Water Supply Plans for Southeastern Wisconsin” (Doug Cherkauer, UW-Milwaukee)
- Technical Report No. 47, “Groundwater Recharge in Southeastern Wisconsin Estimated by a GIS-Based Water Balance Model” (David Hart, Peter Schoephoester, Ken Bradbury, WG&NHS, UWEX)
- Technical Report No. 48, “Shallow Groundwater Sustainability Analysis Demonstration for the Southeastern Wisconsin Region” (Ken Bradbury, WG&NHS, UWEX and Todd Rayne, Hamilton College)
- Planning Report No. 52, “A Regional Water Supply Plan for Southeastern Wisconsin”
  - Adopted and published in December 2010

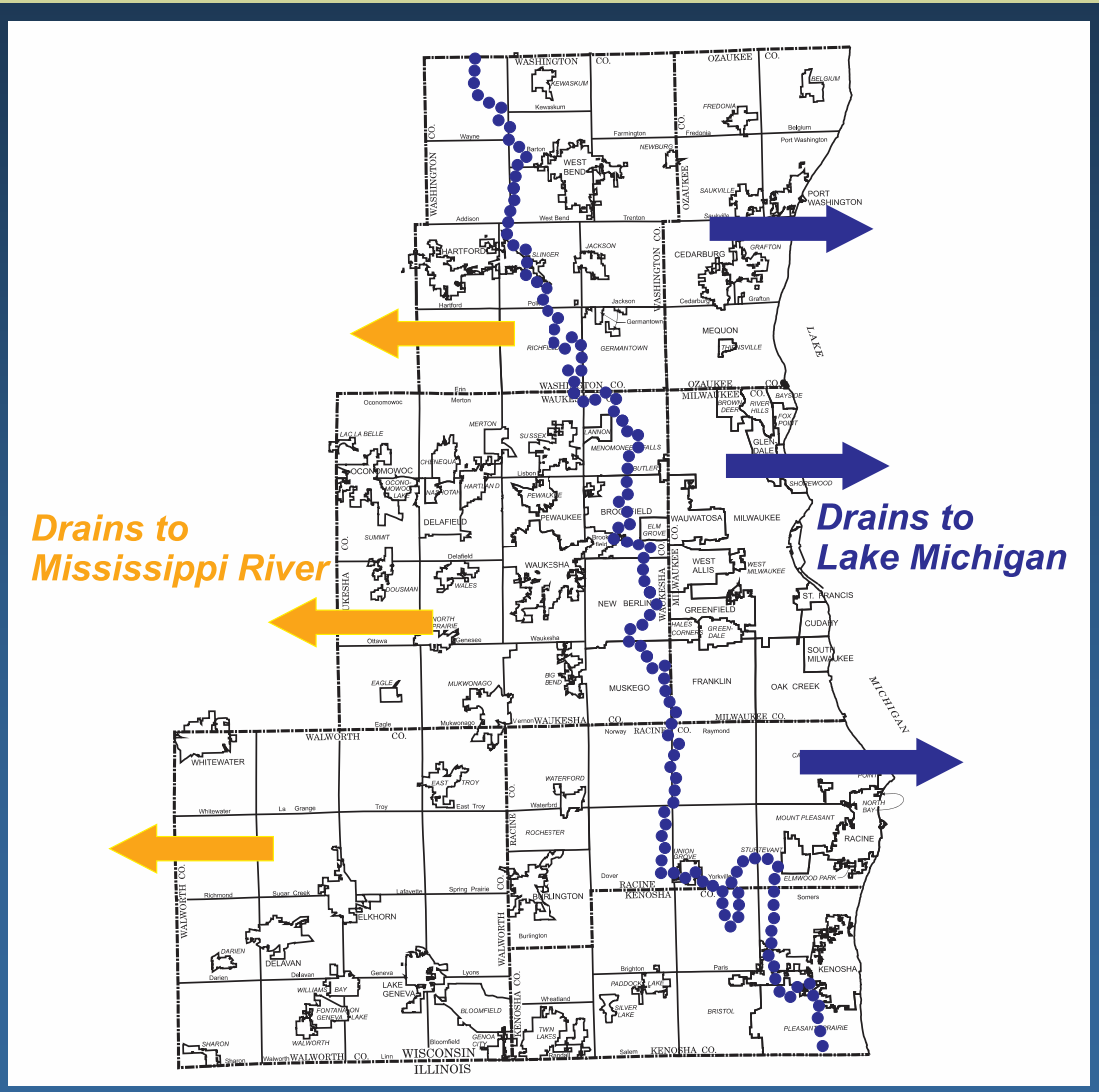
Regional Water Supply Plan Chapters

- Chapter I - Introduction and Background
- Chapter II - Description of the Study Area
- Chapter III - Existing Water Supply Conditions in the Region
- Chapter IV - Anticipated Growth and Change Affecting Water Supply in the Region
- Chapter V - Planning Objectives, Principles, and Standards
- Chapter VI - Summary of Water Supply Law as Applied to Southeastern Wisconsin
- Chapter VII - Water Supply Problems Identification and Issues to be Addressed
- Chapter VIII - Alternative Plans: Description and Evaluation
- Chapter IX – Alternative Plan Comparative Evaluation and Selection of a Composite Plan for Further Consideration
- Chapter X - Recommended Water Supply System Plan
- Chapter XI - Plan Implementation
- Chapter XII - Summary and Conclusions

Regional Water Supply Planning Advisory Committee

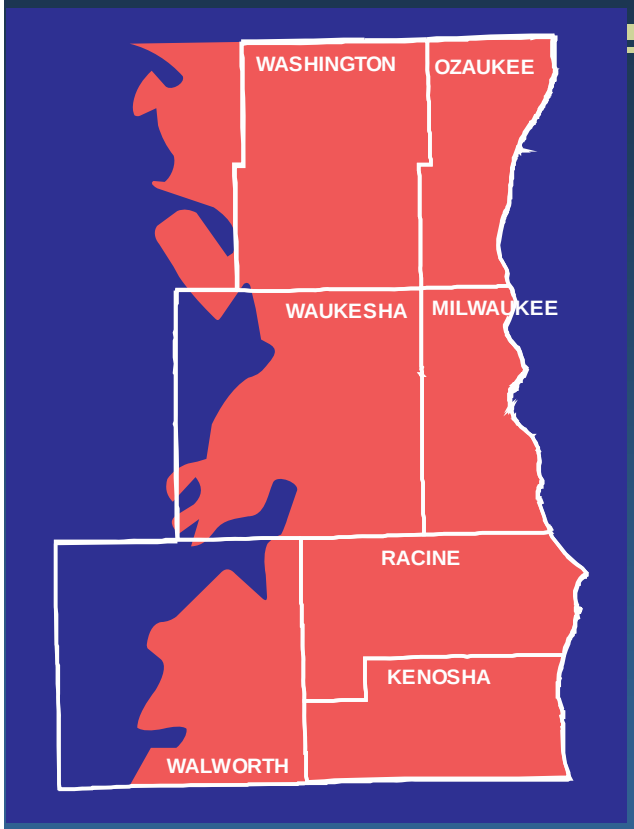
Dr. Kurt W. Bauer Chairman	Executive Director Emeritus, Southeastern Wisconsin Regional Planning Commission
Robert P. Biebel Secretary	Special Projects Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Julie A. Anderson	Director of Planning and Development, Racine County
Kenneth R. Bradbury	Hydrogeologist/Professor, Wisconsin Geological and Natural History Survey
Thomas J. Bunker	Representative, Water and Wastewater Utility, City of Racine
Douglas S. Cherkauer	Professor of Hydrogeology , University of Wisconsin—Milwaukee
Lisa Conley	Representative, Town and Country Resource and Development, Inc.
Michael P. Cotter	Director, Walworth county Land Use and Resource Management Department
Charles A. Czarkowski	Regional Water Program Expert, Wisconsin Department of Natural Resources, Southeastern Wisconsin Region
Daniel S. Duchniak	General Manager, Waukesha Water Utility, City of Waukesha
Charles P. Dunning	Hydrologist, U.S. Geological Survey
Franklyn A. Ericson	Director, Worldwide Safety, Health, Environment and Quality Operations, S. C. Johnson & Son, Inc.
David Ewig	Water Superintendent, City of Port Washington
Thomas M. Grisa	Director Public Works, City of Brookfield
Jeffrey A. Helmuth	Hydrogeologist Program Coordinator, Wisconsin Department of Natural Resources, Madison
Andrew A. Holschbach	Land Conservation Director, Ozaukee County
James Kell	Water Utility Superintendent, City of West Bend
Eric J. Kiefer	Manager, North Shore Water Commission
Thomas J. Krueger	Water and Wastewater Utility Director, Village of Grafton
Carrie M. Lewis	Superintendent, Milwaukee Water Works, City of Milwaukee
Mark Lurvey	Agricultural Business Operator, Lurvey Turf Nursery
J. Scott Mathie	Director of Government Affairs, Metropolitan Builders Association of Greater Milwaukee
George E. Melcher	Director of Planning and Development, Kenosha County
Paul E. Mueller	Administrator, Washington County Planning and Parks Department
Jeffrey Musche	Administrator/Clerk, Town of Lisbon
Michael P. Rau	President, City Water, LLC
Dale R. Shaver	Director, Waukesha County Department of Parks and Land Use
Edward St. Peter	General Manager, Water Utility, City of Kenosha
James Surfus	Senior Environmental Engineer, MillerCoors, LLC
Jack Takerian	Director, Milwaukee County Department of Transportation and Public Works
Daniel S. Winkler	Director of Public Works and Utilities, City of Lake Geneva
Steven N. Yttri	General Manager, Water and Sewer Utility, City of Oak Creek

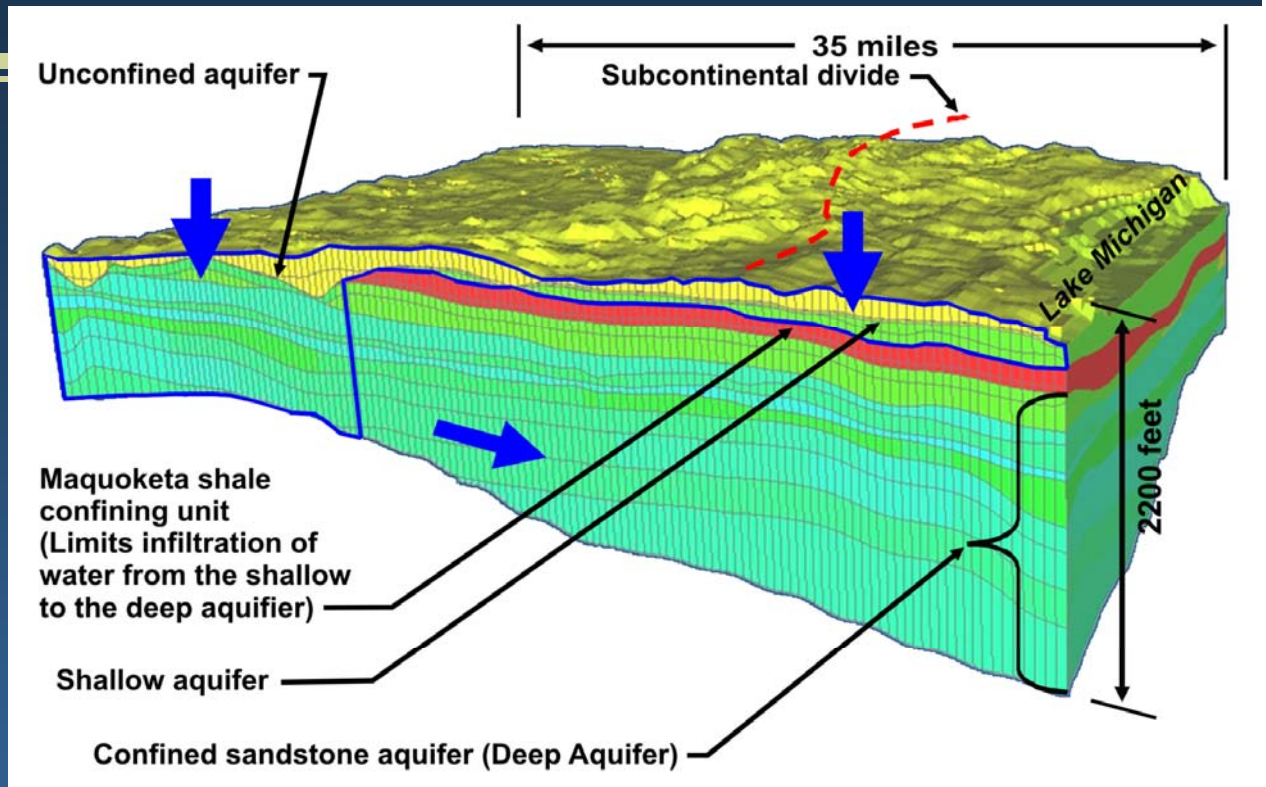
Subcontinental Divide



Background

General Hydrogeology of Southeast Wisconsin





Private residential wells are generally in the shallow aquifer and 100 to 300 feet deep. Most municipal wells are 200 to 800 feet deep with some up to 2,200 feet deep, and are in both the shallow and deep aquifer.

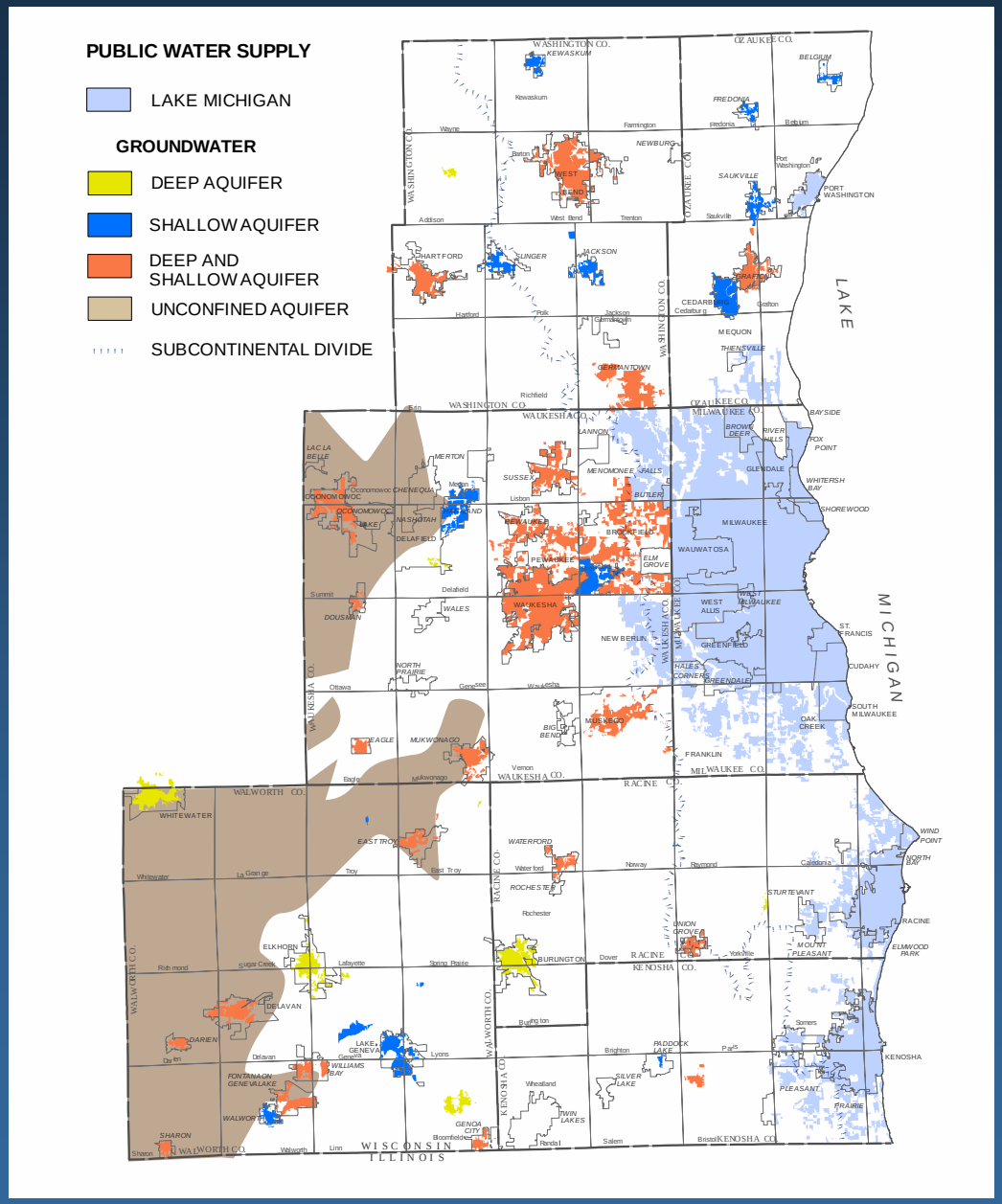
Source: USGS.

Background

Objective – To assess whether the water supply for this Region can sustain existing and planned population and development.

Experience to Date

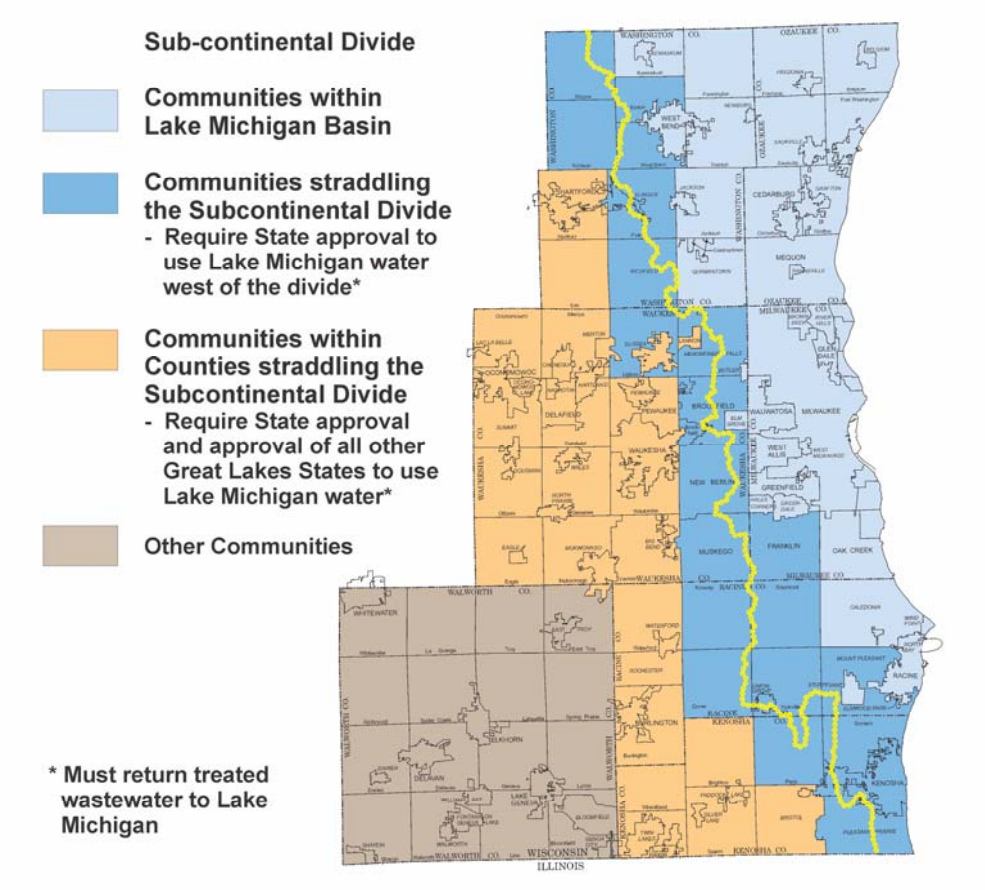
- **Current water supply (290 mgd)**
  - **Lake Michigan – 9 plants (28 systems) serving 1.2 million people (210 mgd-72%)**
  - **Groundwater – 50 systems serving 400,000 people (55 mgd-19%)**
  - **Groundwater – individual wells serving 350,000 people (25 mgd-9%)**
- **Groundwater deep aquifer – historic 4 to 5 feet annual drawdown and some radium and dissolved solids problems.**
- **Groundwater shallow aquifer – some isolated seasonal supply problems and quality issues.**
- **Lake Michigan water – existing treatment plants operating at less than 50 percent of capacity.**



Background—continued

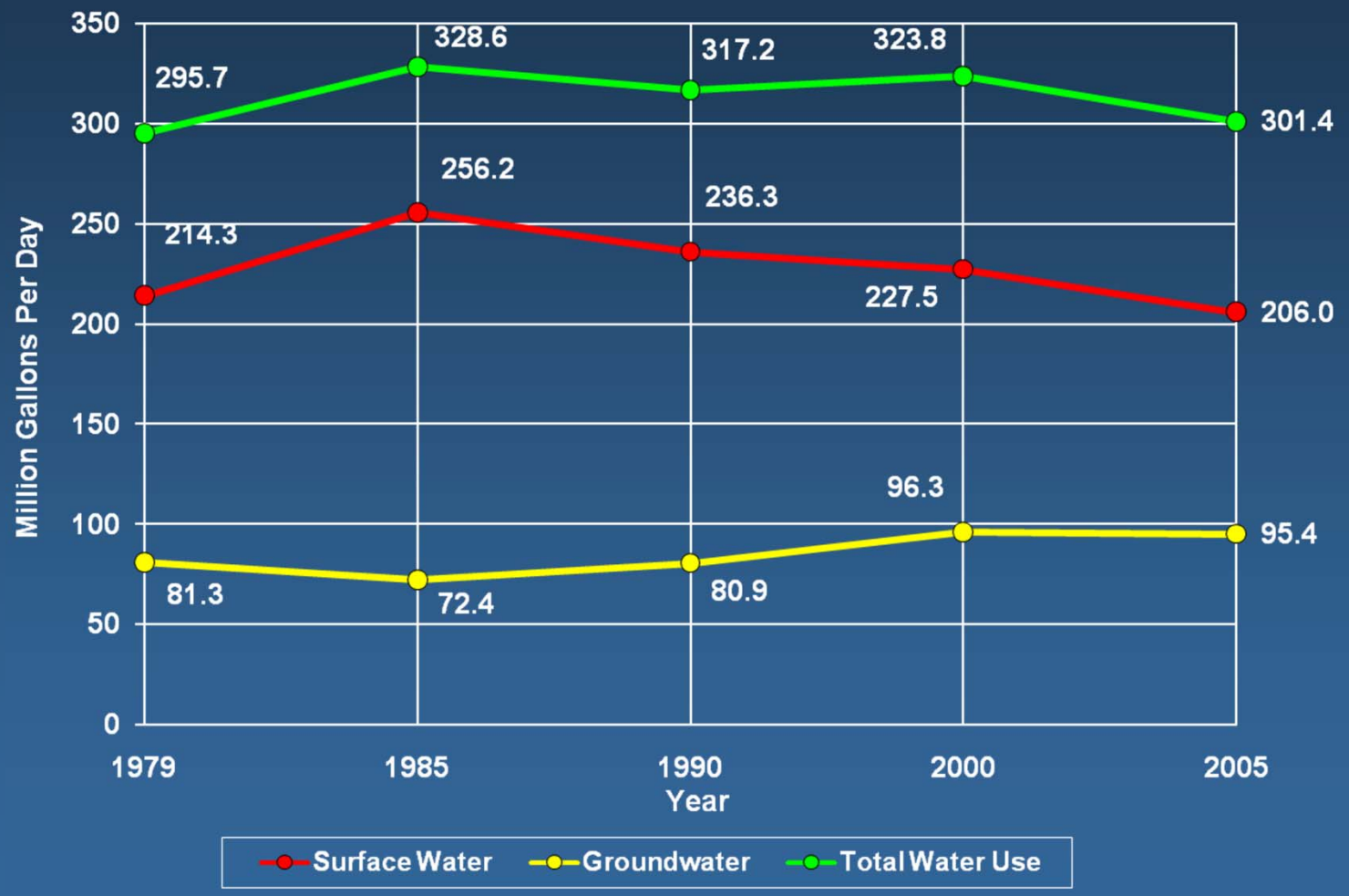
Scope of Study

- Forecast future water use demand in the Region.
- Consider potential of water conservation to reduce future demand.
- Identify groundwater recharge areas which should be protected from development.
- Assess potential for shallow groundwater recharge through infiltration of stormwater runoff and treatment plant effluent.
- Consider potential alternative sources of supply
  - Shallow groundwater
  - Lake Michigan water replacing groundwater east of the subcontinental divide.
  - Lake Michigan water replacing groundwater in "straddling communities" which already have "return flow"
  - Lake Michigan water replacing groundwater in "straddling communities" and "communities in straddling counties" and providing for "return flow".
- Estimate costs and impacts of alternatives
  - Groundwater-Surface Water Interdependence and Impacts
- Identify any development constraints necessary to assure water supply sustainability; consider amending regional land use plan if necessary



Background

Trends in Water Use for the Region: 1979-2005 (in Million Gallons Per Day)*



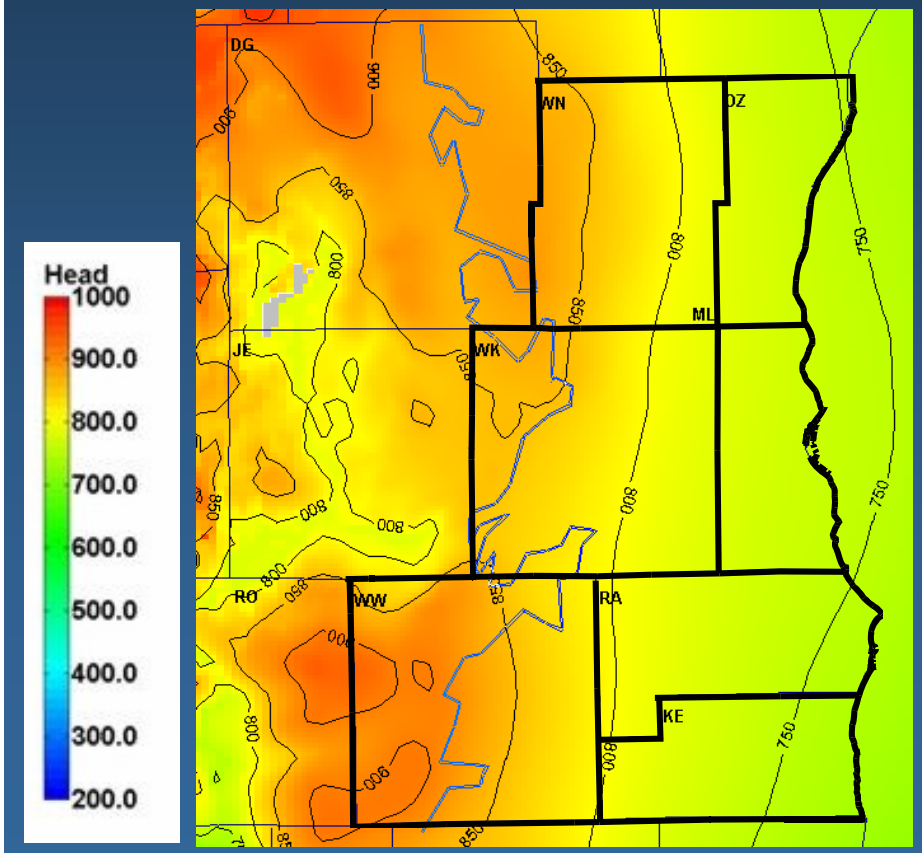
Source: USGS

* Excludes thermoelectric power generation uses

Background

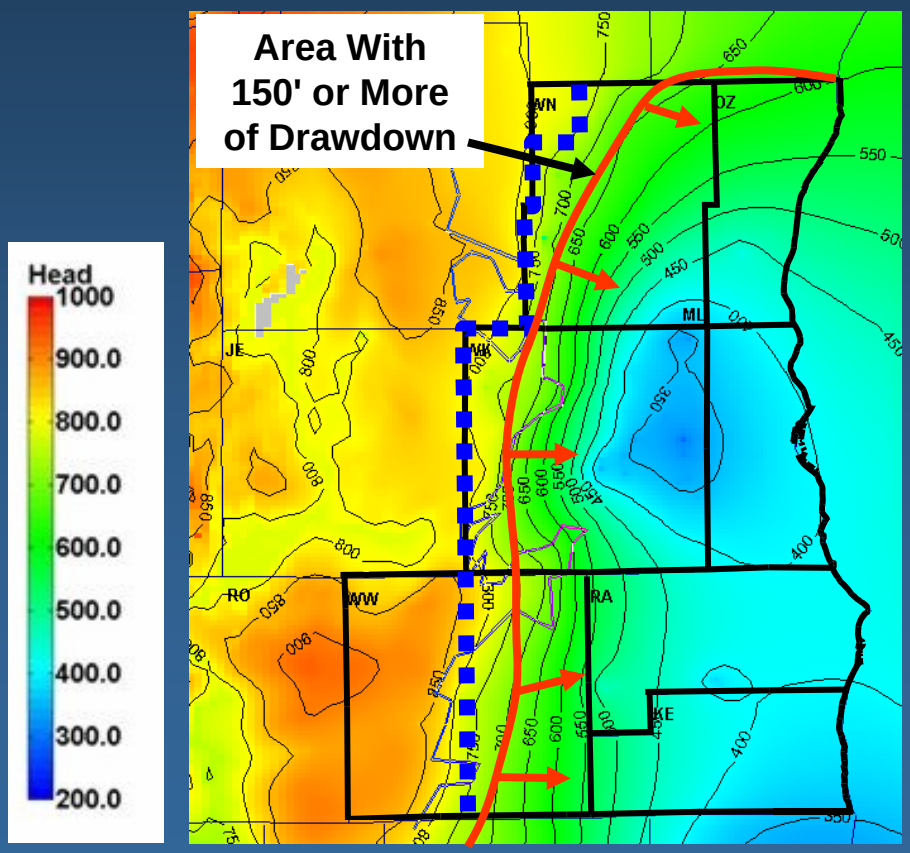
Deep Sandstone Aquifer Drawdown

Pre-1864



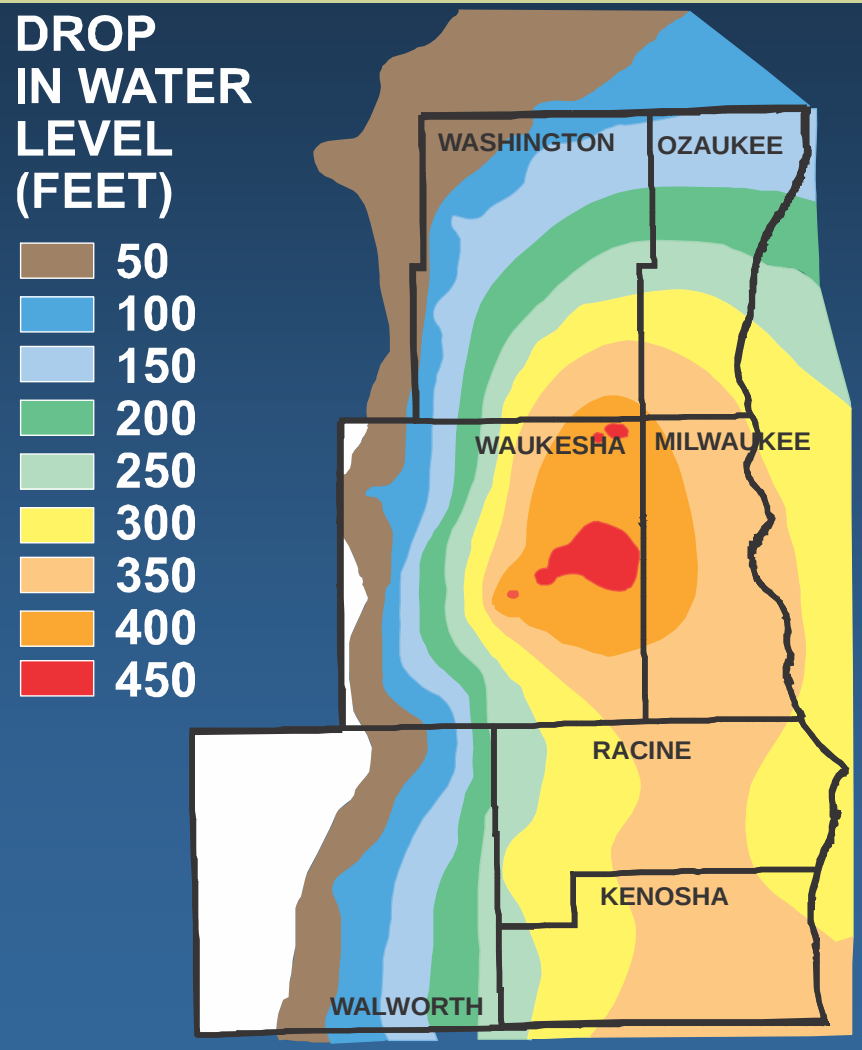
Water Levels in the Sandstone Aquifer
(feet above sea level)

2000



Water Levels in the Sandstone Aquifer
(feet above sea level)

Deep Aquifer Drawdown: Year 2000



Source: Wisconsin Geological and Natural History Survey.

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Elements Considered in Alternative Plans

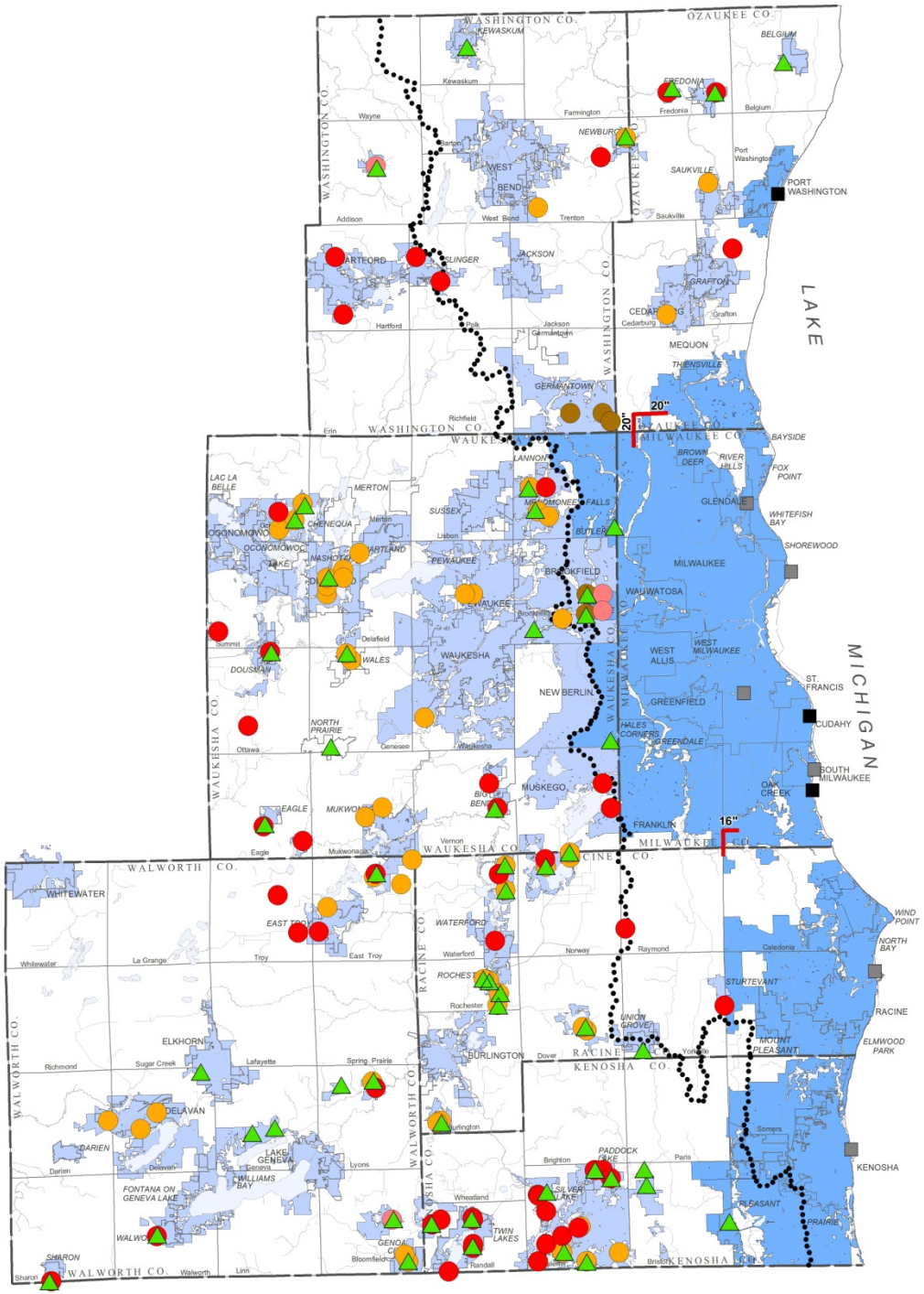
- Water conservation.
- Groundwater recharge area protection.
- Enhanced recharge of shallow aquifer by stormwater management practices.
- Enhanced recharge of shallow aquifer by injection of highly treated sewage treatment plant effluent.
- Recharge of the deep aquifer by injection of treated Lake Michigan surface water
- Continued reliance on deep aquifer water with treatment as needed.
- Continued and increased reliance on shallow aquifer water.
- Extension of Lake Michigan supply to selected communities east of the divide.
- Extension of Lake Michigan supply to selected communities straddling the divide with current return flow.
- Extension of Lake Michigan supply to areas west of the divide with return flow. (City of Waukesha only under plan recommendation.)

Alternative Plans: Year 2035

- Alternative Plan No. 1: Existing Trends and Committed Actions
- Alternative Plan No. 2: Limited Expansion of Lake Michigan and Shallow Groundwater Aquifer Supplies
- Alternative Plan No. 3: Limited Expansion of Lake Michigan and Shallow Groundwater Aquifer Supplies with Groundwater Recharge
- Alternative Plan No. 4: Alternative Plan No. 2 with Further Expansion of Lake Michigan Supply

Regional Water Supply Plan
Alternative Plan 1–Design Year 2035 Forecast Conditions Under Existing Trends and Committed Actions

- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN: 2035
- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING GROUND WATER: 2035
- EXISTING MUNICIPAL WATER TREATMENT PLANT NEEDING NO EXPANSION
- EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
- PLANNED MUNICIPAL WELL (SHALLOW AQUIFER)
- PLANNED MUNICIPAL WELL (DEEP AQUIFER)
- PLANNED MUNICIPAL WELL AND RESERVOIR STORAGE FACILITY (SHALLOW AQUIFER)
- PLANNED MUNICIPAL WELL AND RESERVOIR STORAGE FACILITY (DEEP AQUIFER)
- PLANNED MUNICIPAL WATER STORAGE FACILITY
- PLANNED WATER TRANSMISSION MAIN
- SUBCONTINENTAL DIVIDE



- Existing 2007 water supply facilities
- Enhanced local water conservation programs
- Continued reliance on groundwater sources to meet 2035 demand (light blue)
- Continued reliance on Lake Michigan water sources for all areas now served, meeting 2035 demand (dark blue)
- Recharge of groundwater in areas of new development to the extent required by State law
- Continued reliance on private wells for residential areas (about 180,000 persons) plus selected agricultural, irrigation, and industrial uses

Regional Water Supply Plan
Alternative Plan 2–Limited Expansion of Lake Michigan Supply

- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN: 2035
- AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER ALTERNATIVE PLANS 2 AND 3 COMPARED TO ALTERNATIVE PLAN 1: 2035
- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING GROUND WATER: 2035
- EXISTING MUNICIPAL WATER TREATMENT PLANT NEEDING NO EXPANSION
- EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
- PLANNED MUNICIPAL WELL (SHALLOW AQUIFER)
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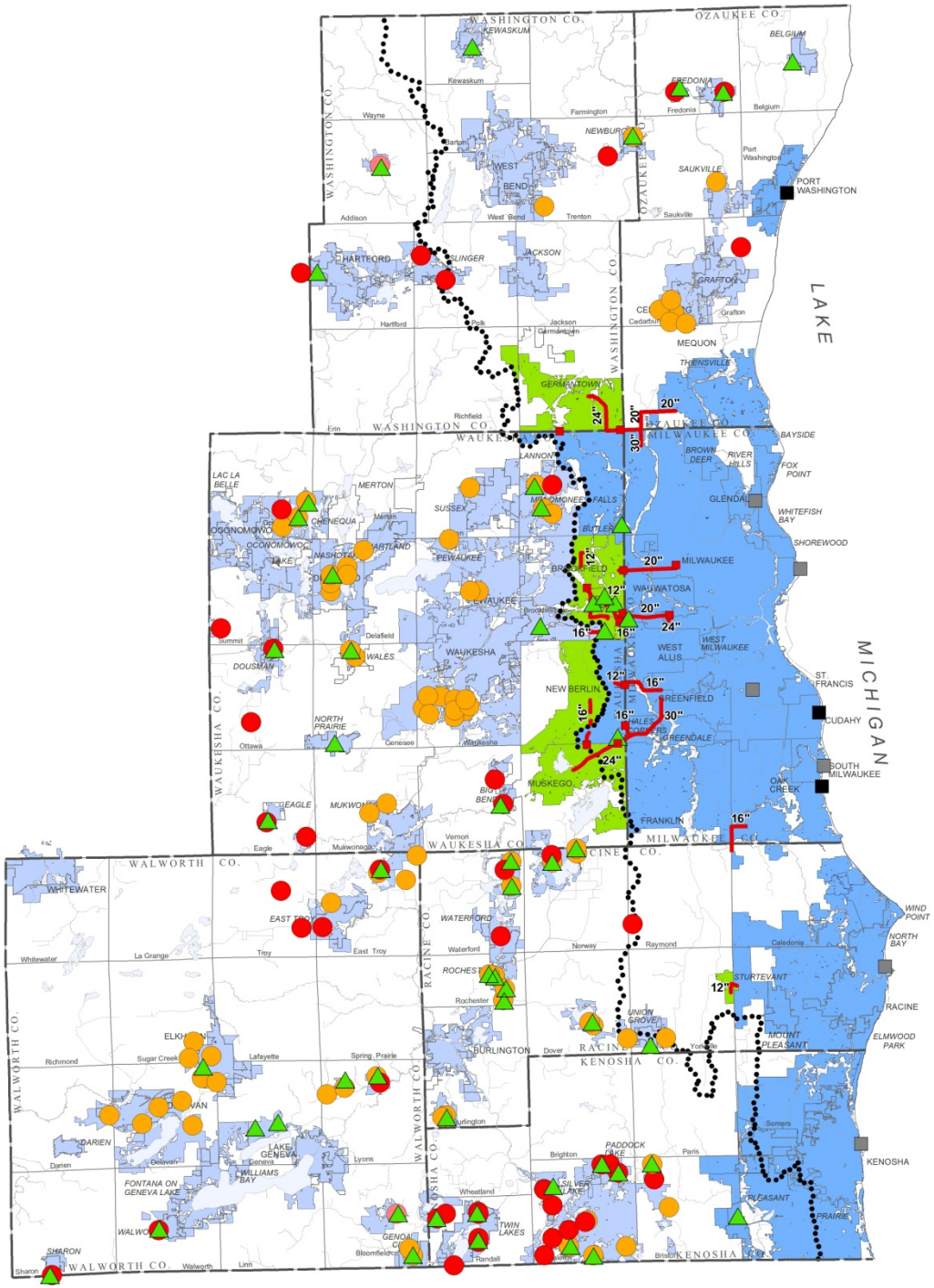
- PLANNED MUNICIPAL WATER STORAGE FACILITY
- PLANNED NEW OR MODIFIED MUNICIPAL PUMP OR METERING STATION
- PLANNED WATER TRANSMISSION MAIN
- SUBCONTINENTAL DIVIDE



- Includes most aspects of Alternative Plan 1, but converts certain areas to Lake Michigan supply
  - 4 areas east of the subcontinental divide (Germantown, Elm Grove, Brookfield-east, and Yorkville) all with existing return flow (green)
  - 2 areas west of the divide (New Berlin-central, Muskego) both straddling communities with existing return flow (green)
  - Includes conversion of selected treated deep aquifer sources to shallow aquifer sources

Regional Water Supply Plan
Alternative Plan 3–Groundwater Recharge

SHALLOW AQUIFER RECHARGE FACILITIES

RAINFALL INFILTRATION FACILITIES (MILLION GALLONS PER YEAR)

- 0.1 - 5.0
- 5.1 - 10.0
- 10.1 - 15.0
- 15.1 - 20.0
- 20.1 - 25.0

WASTEWATER TREATMENT PLANT EFFLUENT INFILTRATION FACILITIES (MILLION GALLONS PER YEAR)

- 146
- 584
- 1,460
- 1,825

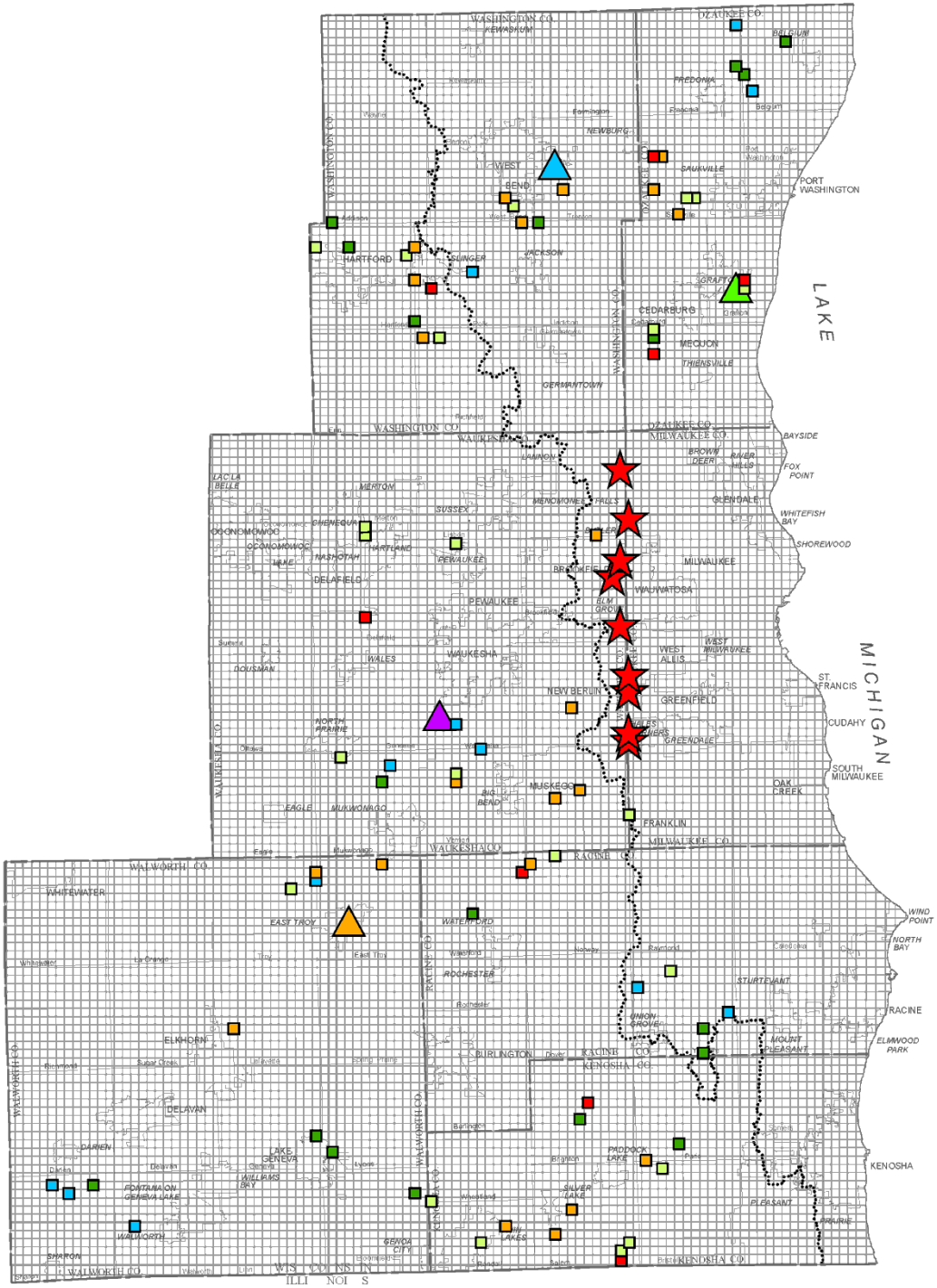
DEEP AQUIFER RECHARGE FACILITIES

INJECTION WELLS (MILLION GALLONS PER YEAR)

- 365

SUBCONTINENTAL DIVIDE

- Includes all aspects of Alternative Plan 2
- Enhancement of rainfall infiltration over 4.0 square miles of open space through bioengineering; sites to be selected
- Protection of most significant groundwater recharge areas through public purchase if necessary
- Recharge of groundwater for new development beyond the requirements of current State law
- Redirection of wastewater treatment plant effluent to shallow aquifer after enhanced treatment at 4 demonstration locations
- Recharge deep aquifer with treated Lake Michigan water



Regional Water Supply Plan
Alternative Plan 4–Further Expansion of Lake Michigan Supply

- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN: 2035
- AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER ALTERNATIVE PLAN 4 COMPARED TO ALTERNATIVE PLAN 1: 2035
- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING GROUND WATER: 2035
- EXISTING MUNICIPAL WATER TREATMENT PLANT NEEDING NO EXPANSION
- EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
- EXISTING MUNICIPAL WASTEWATER TREATMENT PLANT
- PLANNED MUNICIPAL WELL (SHALLOW AQUIFER)
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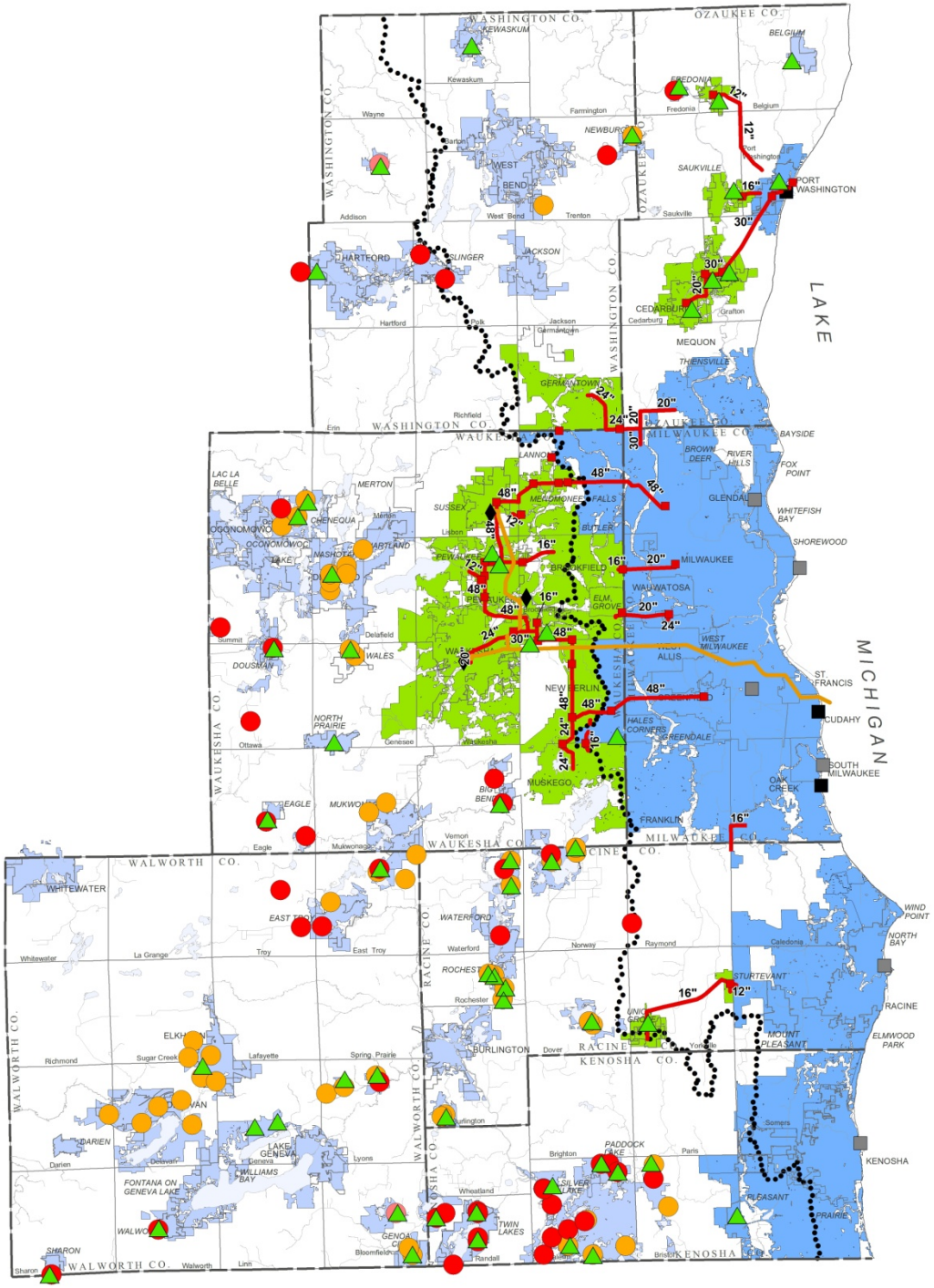
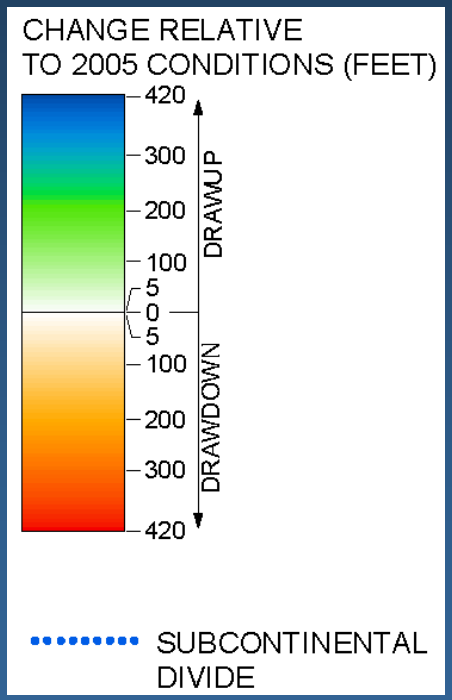
- PLANNED MUNICIPAL WELL AND RESERVOIR STORAGE FACILITY (SHALLOW AQUIFER)
- PLANNED MUNICIPAL WELL AND RESERVOIR STORAGE FACILITY (DEEP AQUIFER)
- PLANNED MUNICIPAL WATER STORAGE FACILITY
- PLANNED NEW OR MODIFIED MUNICIPAL PUMP OR METERING STATION
- PLANNED WATER TRANSMISSION MAIN
- PLANNED WATER RETURN-FLOW PIPELINE
- SUBCONTINENTAL DIVIDE



- Includes all aspects of Alternative Plan 2 but with conversion of selected additional areas to Lake Michigan supply all with return flow components
  - 4 areas east of the subcontinental divide (Cedarburg, Grafton, Fredonia, Saukville) (green)
  - 4 areas in communities which straddle the divide (Brookfield-west, Menomonee Falls-west, Brookfield-Town, Union Grove) (green)
  - 9 areas which are in communities west of the divide within a straddling county (Pewaukee-City, Pewaukee-Village, Sussex, portion of the Town of Lisbon, Lannon, Waukesha-City, portions of the Towns of Waukesha, Genessee, and Delafield) (green)

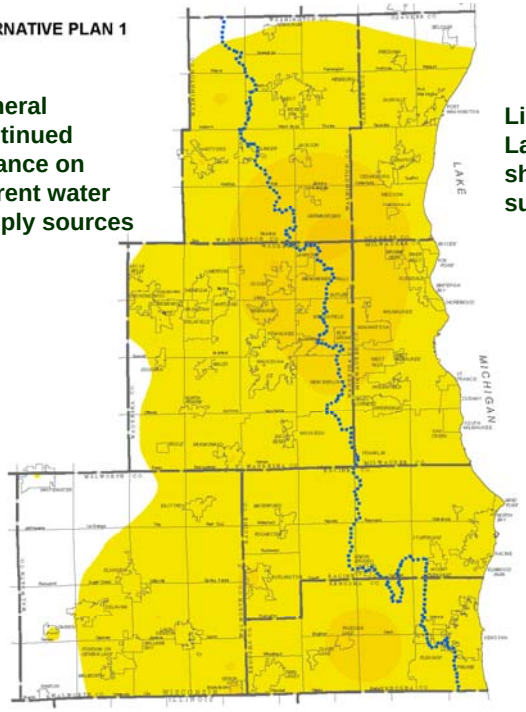
Evaluation of Four Alternative Plans

Deep Aquifer Conditions Associated with Alternative Water Supply Plans



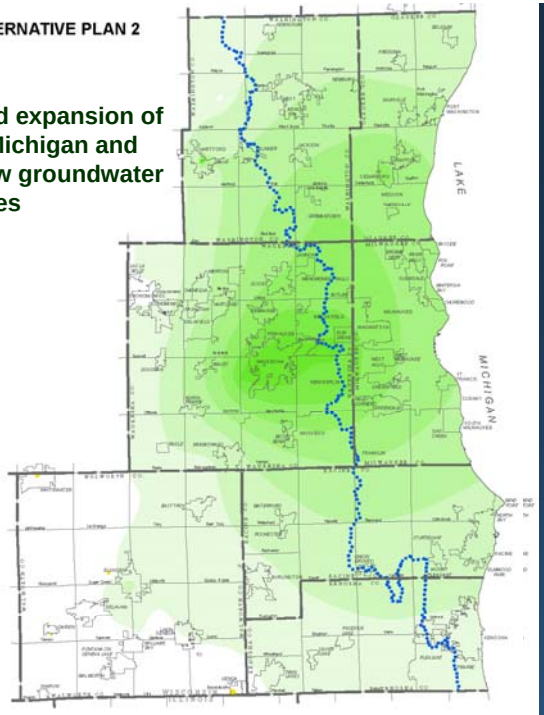
ALTERNATIVE PLAN 1

General continued reliance on current water supply sources



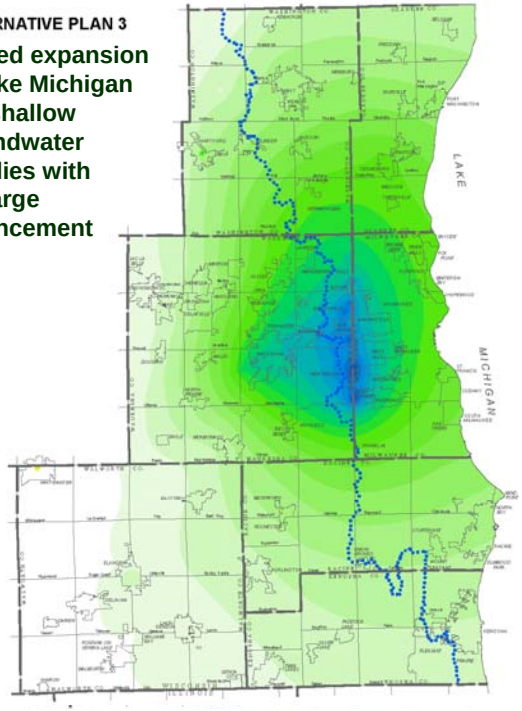
ALTERNATIVE PLAN 2

Limited expansion of Lake Michigan and shallow groundwater supplies



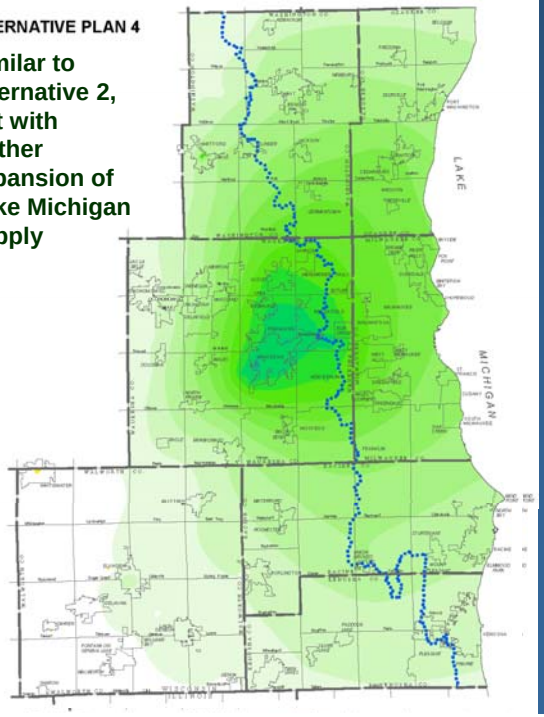
ALTERNATIVE PLAN 3

Limited expansion of Lake Michigan and shallow groundwater supplies with recharge enhancement



ALTERNATIVE PLAN 4

Similar to Alternative 2, but with further expansion of Lake Michigan supply



Four Alternative Plans

Test and Evaluation Results-Summary

	Capital Costs	Annual Operating and Maintenance Cost	Equivalent Annual Cost	Deep Aquifer Impact	Shallow Aquifer Impact	Surface Water Impact
Alternative Plan 1	$172 million	$5.4million	$11.6 million	Significant slowdown in the drawdown of the deep aquifer	Localized impact around community wells	4.5% reduction in groundwater derived baseflow
Alternative Plan 2	$254 million	$5.8 million gross -$0.7 million net*	$11.1 million	Drawup in the deep aquifer	Localized impact around community wells	5.3% reduction in groundwater derived baseflow
Alternative Plan 3	$403 million	$11.8 million gross $5.3 million net*	$17.8 million	Drawup in the deep aquifer	Localized impact around community wells	1.7% reduction in groundwater derived baseflow
Alternative Plan 4	$472 million	$7.3 million gross -$14.4 million net**	$14.5 million	Drawup in the deep aquifer	Localized impact around community wells	0.7% reduction in groundwater derived baseflow

*Includes a credit of $6.5 million for reduced household water softening costs.

**Includes a credit of $21.7 million for reduced water softening costs.

Regional Water Supply Plan
Subalternative 1 to the Composite Plan:

- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN: 2035
- AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER COMPOSITE SUBALTERNATIVE 1 PLAN: 2035
- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING GROUND WATER: 2035
- PLANNED MUNICIPAL WELL (SHALLOW AQUIFER)
- PLANNED MUNICIPAL WELL (DEEP AQUIFER)
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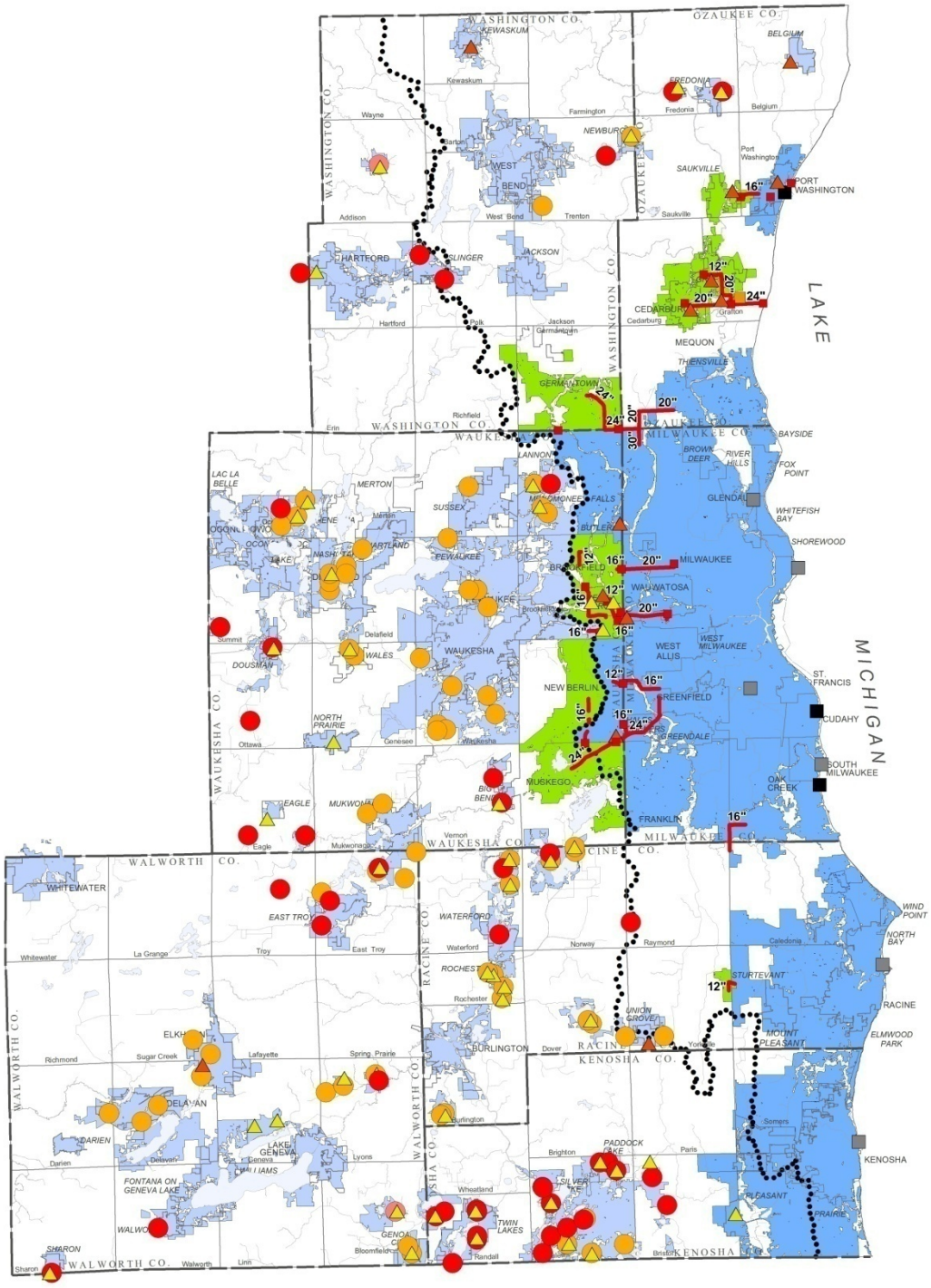
- EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
- PLANNED NEW MUNICIPAL WATER TREATMENT PLANT
- PLANNED NEW OR MODIFIED MUNICIPAL PUMP OR METERING STATION
- PLANNED MUNICIPAL ELEVATED TANK
- PLANNED MUNICIPAL REPUMP RESERVOIR
- PLANNED WATER TRANSMISSION MAIN
- SUBCONTINENTAL DIVIDE



- Enhanced local conservation programs
- Conversion of selected areas with current return flow to Lake Michigan supply
- Conversion of selected groundwater supply from deep to shallow aquifer supply
- Enhancement of rainfall infiltration over 2.0 square miles of open space through bioengineering
- Continued reliance on private wells for selected residential areas (about 180,000 persons plus selected agricultural, irrigation, and industrial uses)

Regional Water Supply Plan
Subalternative 2 to the Composite Plan: (Preliminary Recommended Water Supply Plan)

- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN: 2035
- AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER COMPOSITE SUBALTERNATIVE 2 PLAN: 2035
- AREAS SERVED BY MUNICIPAL WATER UTILITIES PROVIDING GROUND WATER: 2035
- PLANNED MUNICIPAL WELL (SHALLOW AQUIFER)
- PLANNED MUNICIPAL WELL (DEEP AQUIFER)
- PLANNED MUNICIPAL WELL AND RESERVOIR STORAGE FACILITY (SHALLOW AQUIFER)
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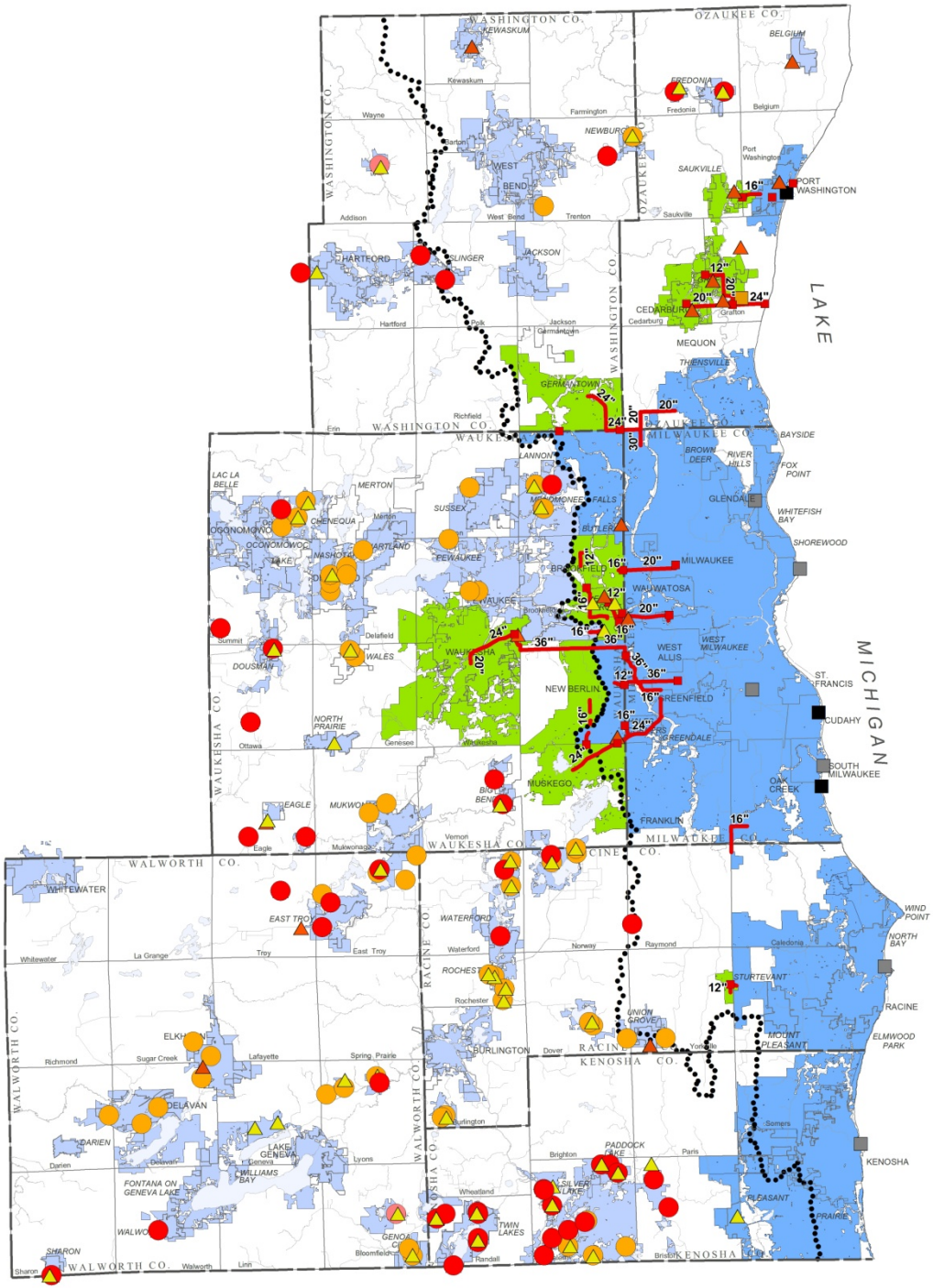
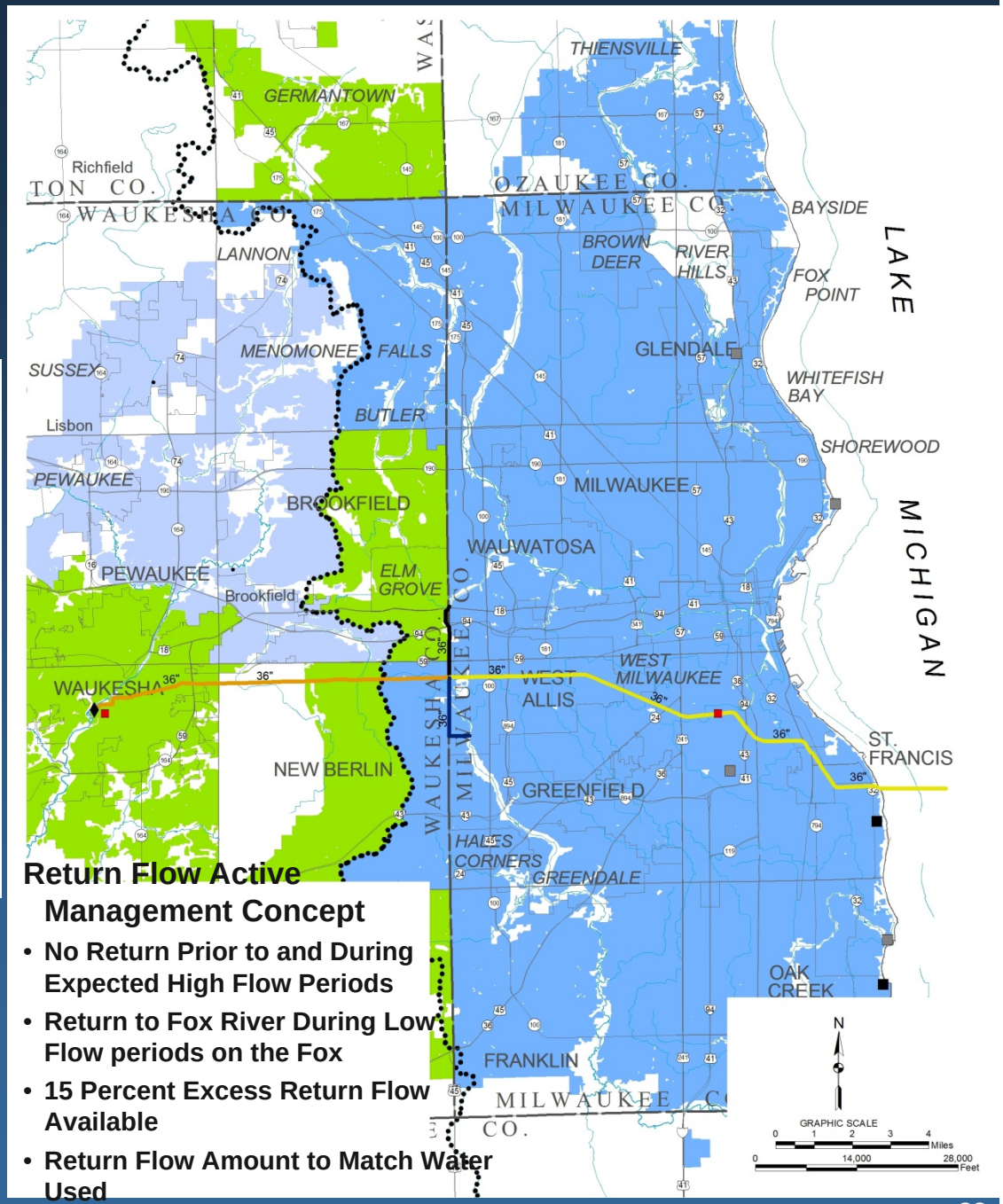
- PLANNED MUNICIPAL ELEVATED TANK
- PLANNED MUNICIPAL REPUMP RESERVOIR
- PLANNED WATER TRANSMISSION MAIN
- SUBCONTINENTAL DIVIDE



- Includes all aspects of subalternative 1 to the composite plan except:
  - The City of Waukesha water utility is converted to a Lake Michigan supply with a return flow component
  - The enhanced rainfall infiltration acreage is reduced from 2.0 to 1.7 square miles

Options 1 – 4 for Return Flow for Subalternative 2 to the Composite Plan: Return Flow Pipelines to Lake Michigan, Underwood Creek, and Root River

- AREAS SERVED BY PUBLIC WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN UNDER ALTERNATIVE PLAN 1: 2035
- AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER THE PRELIMINARY RECOMMENDED PLAN: 2035
- AREAS SERVED BY PUBLIC WATER UTILITIES PROVIDING GROUNDWATER: 2035
- EXISTING MUNICIPAL WATER TREATMENT PLANT NEEDING NO EXPANSION
- EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
- EXISTING MUNICIPAL WASTEWATER TREATMENT PLANT
- PLANNED NEW PUMPING STATION
- PLANNED WATER RETURN FLOW PIPELINE: OPTIONS 1, 2, 3, AND 4
- PLANNED WATER RETURN FLOW PIPELINE: OPTION 1
- PLANNED WATER RETURN FLOW PIPELINE: OPTION 2 AND 4
- PLANNED WATER RETURN FLOW PIPELINE: OPTION 3 AND 4
- SUBCONTINENTAL DIVIDE

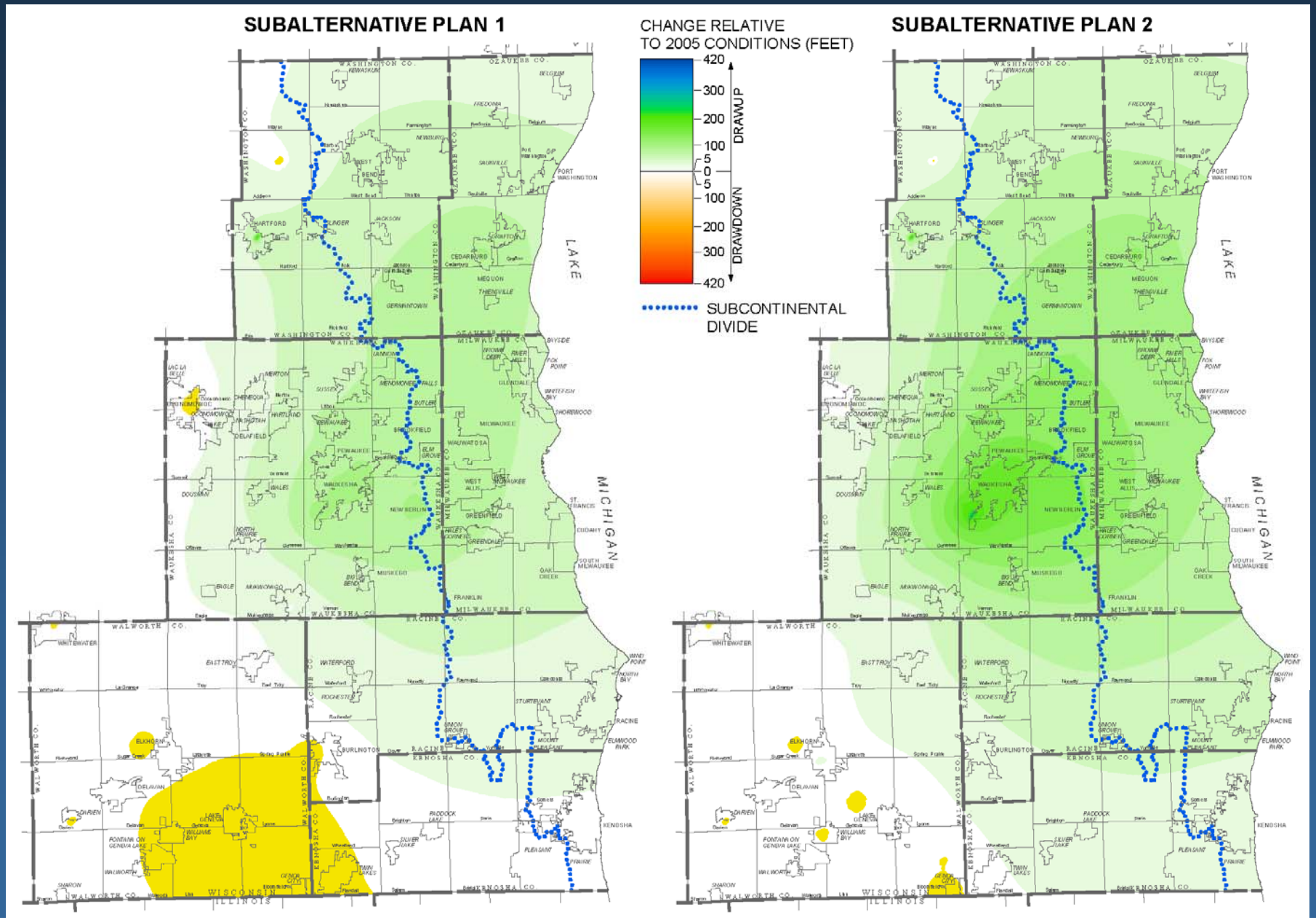


Return Flow Active Management Concept

- **No Return Prior to and During Expected High Flow Periods**
- **Return to Fox River During Low Flow periods on the Fox**
- **15 Percent Excess Return Flow Available**
- **Return Flow Amount to Match Water Used**

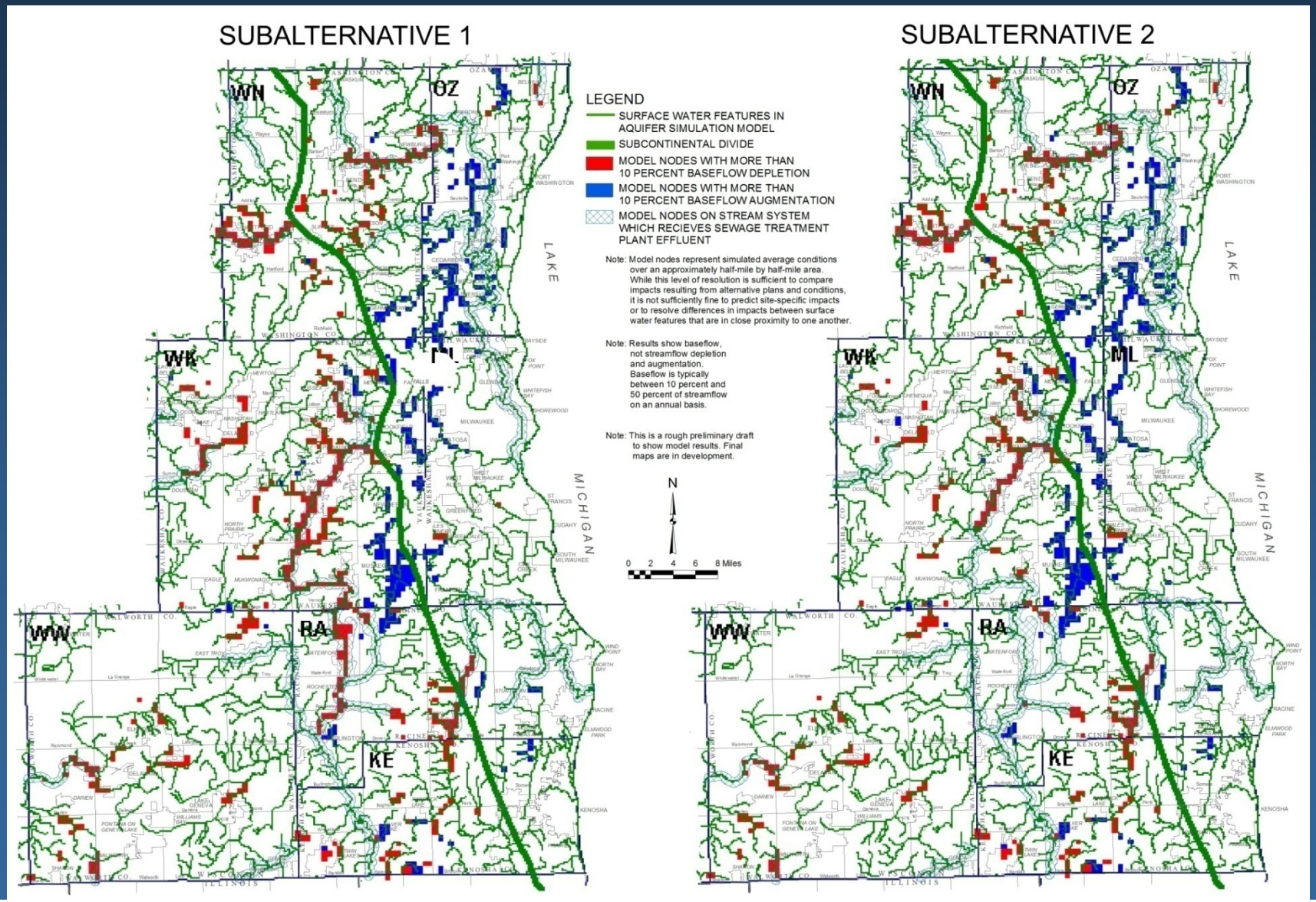
Evaluation of Subalternative Composite Plans

Deep Aquifer Conditions Associated with Subalternatives of the Composite Plan



Evaluation of Subalternative Composite Plans

Surface Water Impacts Associated with Subalternatives of the Composite Plan



Composite Plans

Test and Evaluation Results-Summary

	Capital Costs	Annual Operating and Maintenance Cost	Equivalent Annual Cost	Deep Aquifer Impact	Shallow Aquifer Impact	Surface Water Impact
Subalternative 1 Composite Plan	$297 million	$8.0 million gross -$1.4 million net*	$13.1 million	Drawup in the deep aquifer	Localized impact around community wells	3.4% reduction in groundwater derived baseflow
Subalternative 2 Composite Plan	$329 to 356 million	$8.0 to 8.5 million gross -$8.2 to 8.7 million net*	$8.5 to 10.8 million	Drawup in the deep aquifer	Localized impact around community wells	2.0% reduction in groundwater derived baseflow

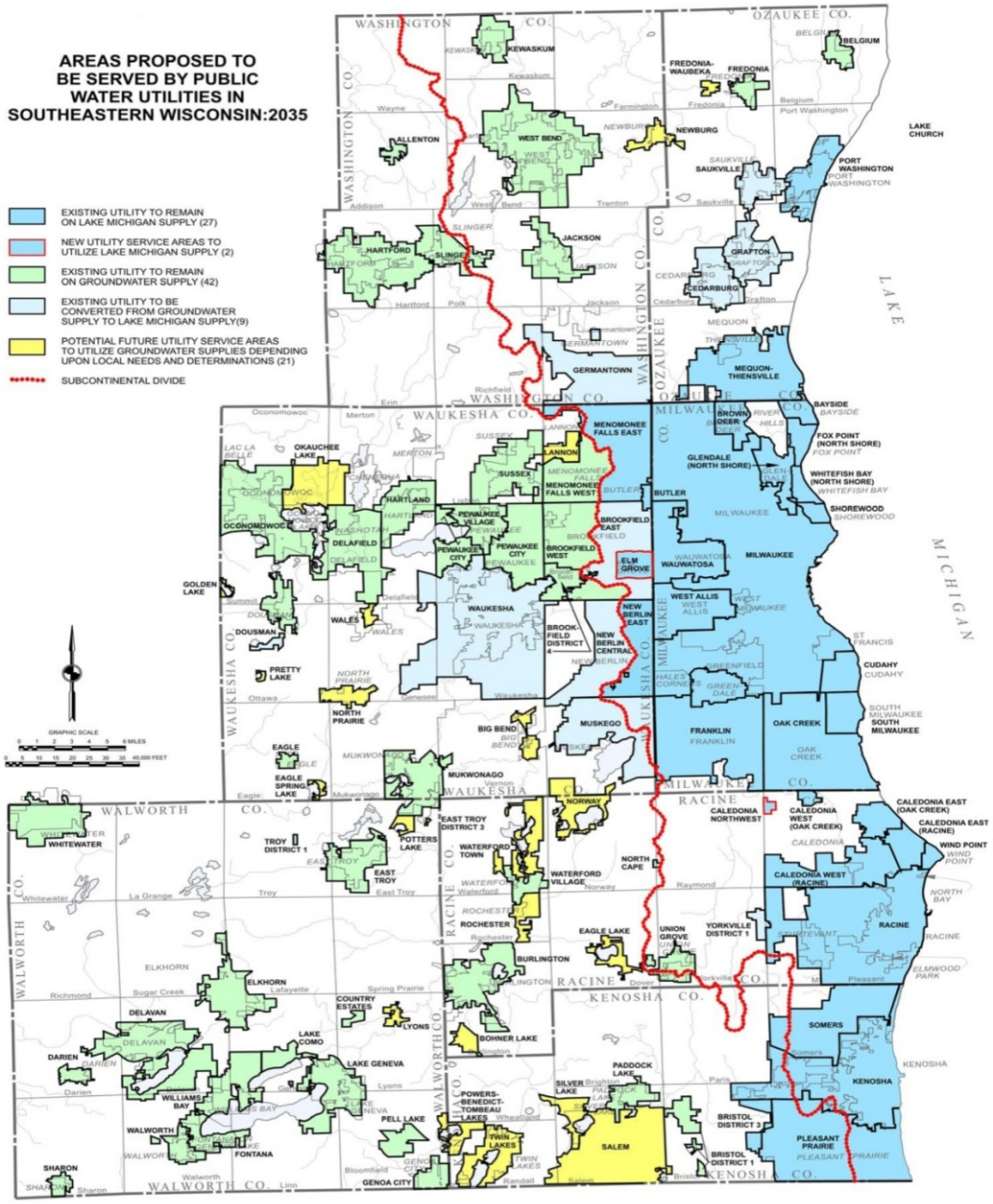
*Includes a credit of $9.4 million for reduced household water softening costs.

**Includes a credit of $16.7 million for reduced water softening costs.

Summary of Recommended Plan

- Sources of supply
- Water conservation programs
- Groundwater recharge area protection
- Stormwater management practices
- Regulation of high capacity wells
- Enhanced rainfall infiltration systems in strategic locations

Sources of Supply Plan Component



Source: SEWRPC.

Sources of Supply Plan Component

SUMMARY OF WATER SUPPLY SOURCE RECOMMENDATIONS IN REGIONAL WATER SUPPLY PLAN FOR SOUTHEASTERN WISCONSIN

Utility Status	Water Supply Source	Number of Utilities	2035 Service Area Population	
			Number	Percent of Total
Existing–No Change in Supply Source	Lake Michigan	27	1,411,000	62
	Groundwater Including 2 utilities Partly served by Lake Michigan	42	383,000	17
	Subtotal	69	1,794,000	79
Existing–Convert from Groundwater to Lake Michigan	Lake Michigan	9	219,000	9
Potential New–Only if local conditions dictate a need and local initiative is undertaken	Lake Michigan	2	7,000	1
	Groundwater	21	78,000	3
	Subtotal	23	85,000	4
None–Private Water Supply	Groundwater	- -	178,000	8
Total	- -	101	2,276,000	100
Total by Supply Source	Lake Michigan	38	1,637,000	72
	Groundwater	63	639,000	28
	Total	101	2,276,000	100

Sources of Supply Plan Component

Regional Water Supply Plan
Lake Michigan Diversion Element

Fundamental reasons for recommending the additional areas be supplied with Lake Michigan waters.

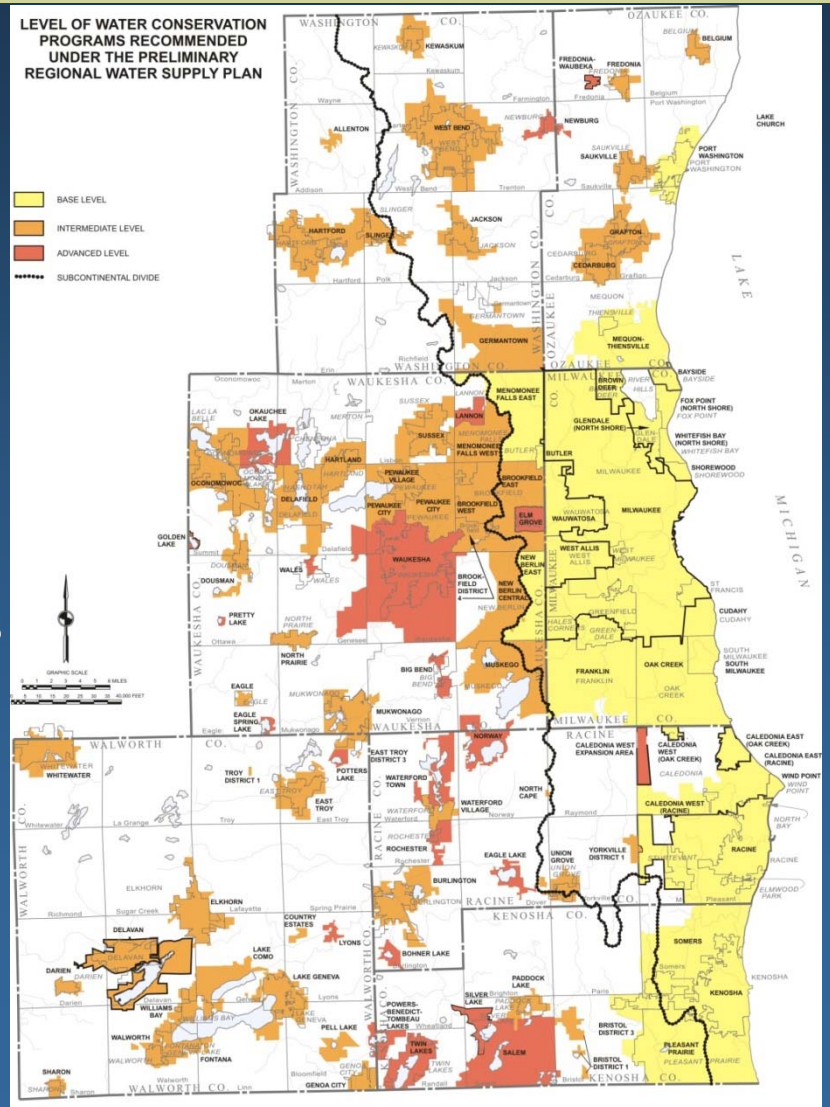
- **Reduction in chloride discharge.**
- **Favorable impacts on recovery of deep aquifer.**
- **Favorable environmental impacts on baseflows to surface waters.**
- **Ability to preserve groundwater for other uses, e.g., agriculture.**
- **Opportunity to use excess water production capacity at Lake Michigan water treatment plants.**

Water Conservation Program Plan Component

Base-Level Program: 24 Utilities

Intermediate-Level Program:
54 Utilities

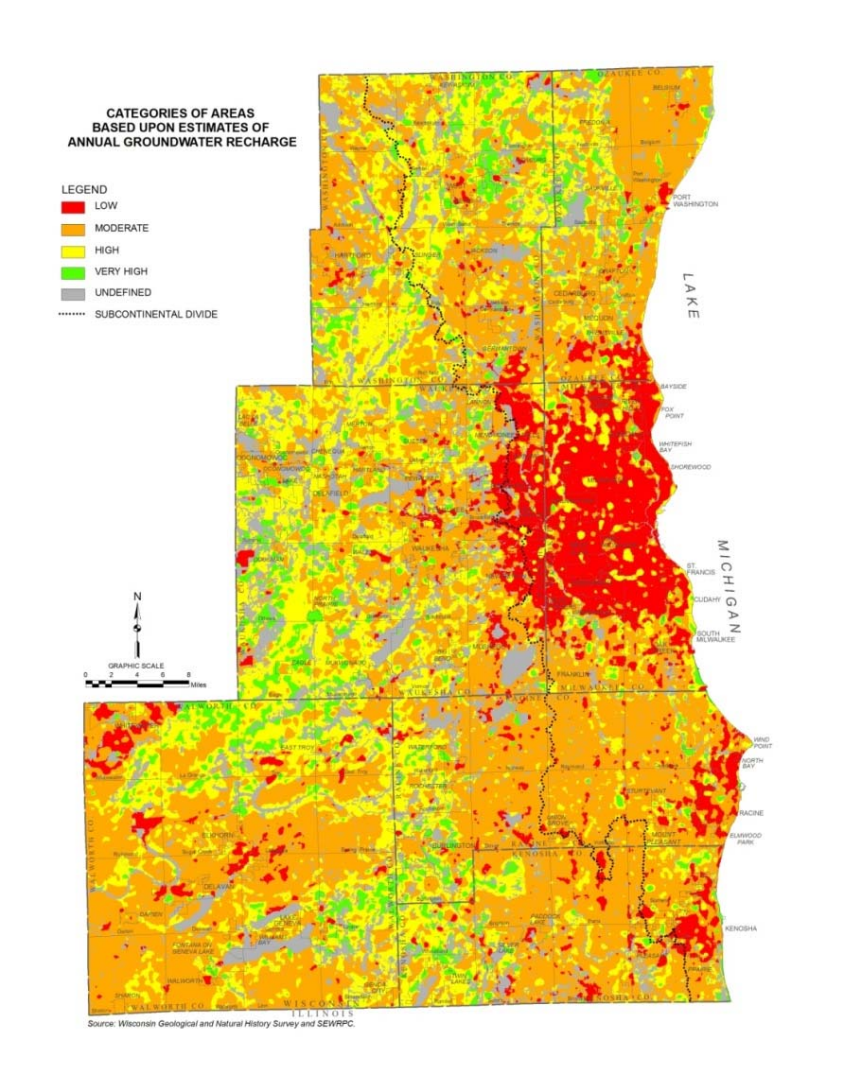
Advanced-Level Program:
23 Utilities and Potential New Utilities



Source: SEWRPC.

Groundwater Recharge Area Protection Plan Component

- The preservation of groundwater recharge areas found to have a high or very high recharge potential.
- About 74 percent of the highly rated and very highly rated recharge areas may be expected to be preserved by inclusion in the environmental corridors, isolated natural areas, and prime and other agricultural areas identified for preservation in the regional land use plan.
- Additional areas can be protected in medium or low density development areas by utilizing stormwater management practices designed to maintain the natural hydrology.
- Over time, consider expansion of environmental corridors to include selected areas with very high or high groundwater recharge potential



Stormwater Management Practices Plan Component

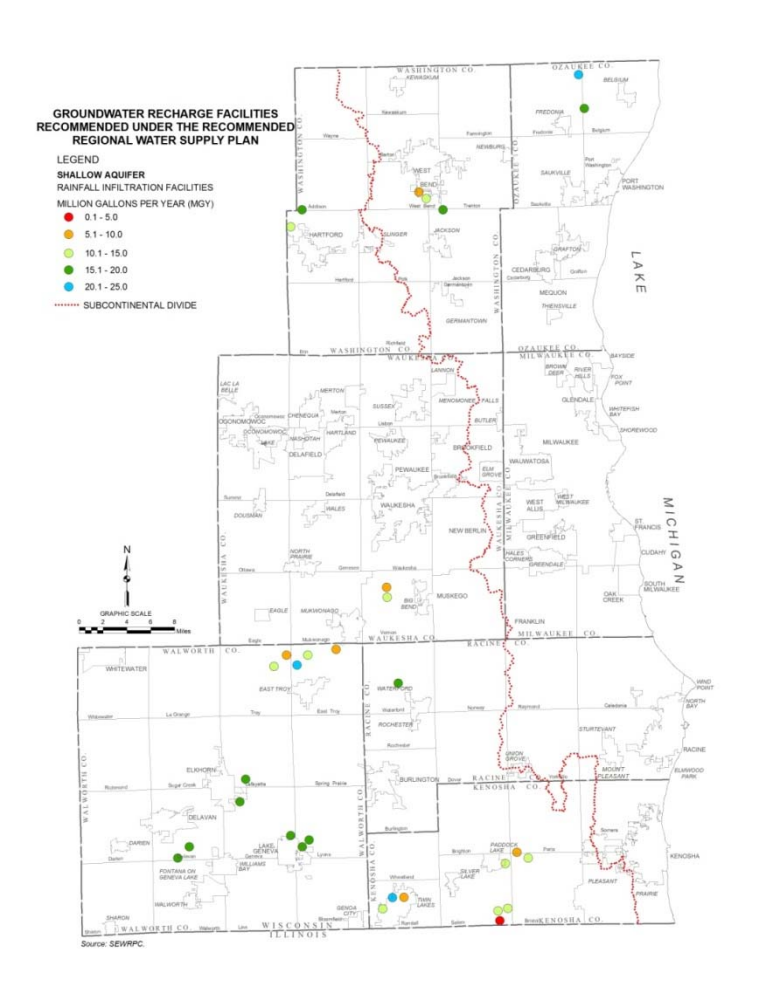
- Widespread implementation of state-of-the-art stormwater management practices, including application of treatment and infiltration systems.
  - Will largely be implemented through NR 151
- To the extent practicable maintain the natural recharge of areas committed to residential and selected nonresidential land use developments.

High Capacity Well Regulation Plan Component

- Recommends analyses and monitoring of the impacts of potential new wells on the shallow aquifer, existing wells, and surface waters.
  - Develop the necessary understanding of the hydrogeological system associated with each candidate well site.
  - Monitoring of water levels in the vicinity of potential new high-capacity wells in the shallow aquifer, to establish a baseline, including levels in private wells expected to be maintained.
  - Monitoring to continue during the test well phase of evaluation and during the operation of the well.

Enhanced Rainfall Infiltration Systems Plan Component

- Installation of enhanced rainfall infiltration systems in areas where evaluations conducted in conjunction with locating high-capacity wells in the shallow aquifer indicate probable reductions in base flow to nearby surface waterbodies or water levels in lakes or wetlands.
  - A variety of designs and methods are possible for these systems and the appropriate design will need to be determined on a case-by-case basis. The systems could be in the form of rain gardens, larger bioretention basins, infiltration ponds, infiltration ditches, and other systems.
  - A total of 32 of these rainfall infiltration systems are envisioned under the plan.



UWM-CED SocioEconomic Impact Analysis: Framework

- What impact would implementation of the regional water supply recommendations have on :
  - The overall distribution of population, including racial segregation patterns, in the Region?
  - The overall distribution of job locations in the Region?
  - The fiscal health and well-being of those communities in the Region wherein reside relatively large populations of low and moderate income families?
  - Housing and other land use patterns in the Region?

- To what extent would implementation of the regional water supply recommendations contribute to any failure of the plan to meet Federal regulations attendant to civil rights and environmental justice?