# Forests, Water and People

## Drinking water supply and forest lands in Michigan

USDA Forest Service
**Northeastern Area**
State and Private Forestry

## Project Description

In the Northeast and Midwest United States, forests are critically important to the supply of clean drinking water. Protecting and managing forests in source watersheds is an essential part of future strategies for providing clean safe drinking water that citizens can afford. The Forests, Water and People analysis identified private forests that are most important for drinking water supply and most in need of protection from development pressure. This fact sheet gives the results of the analysis for the State of Michigan. For more detailed description of methods, and results for the Northeast and Midwest United States, see the **full report**.

## The Process

Through a 4 step GIS-based overlay analysis, four indices were developed for each watershed (see Figure 1).

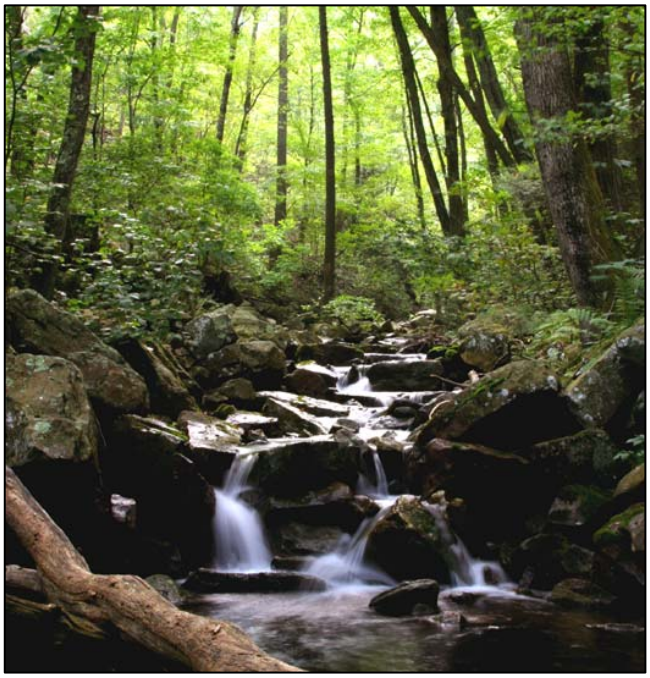
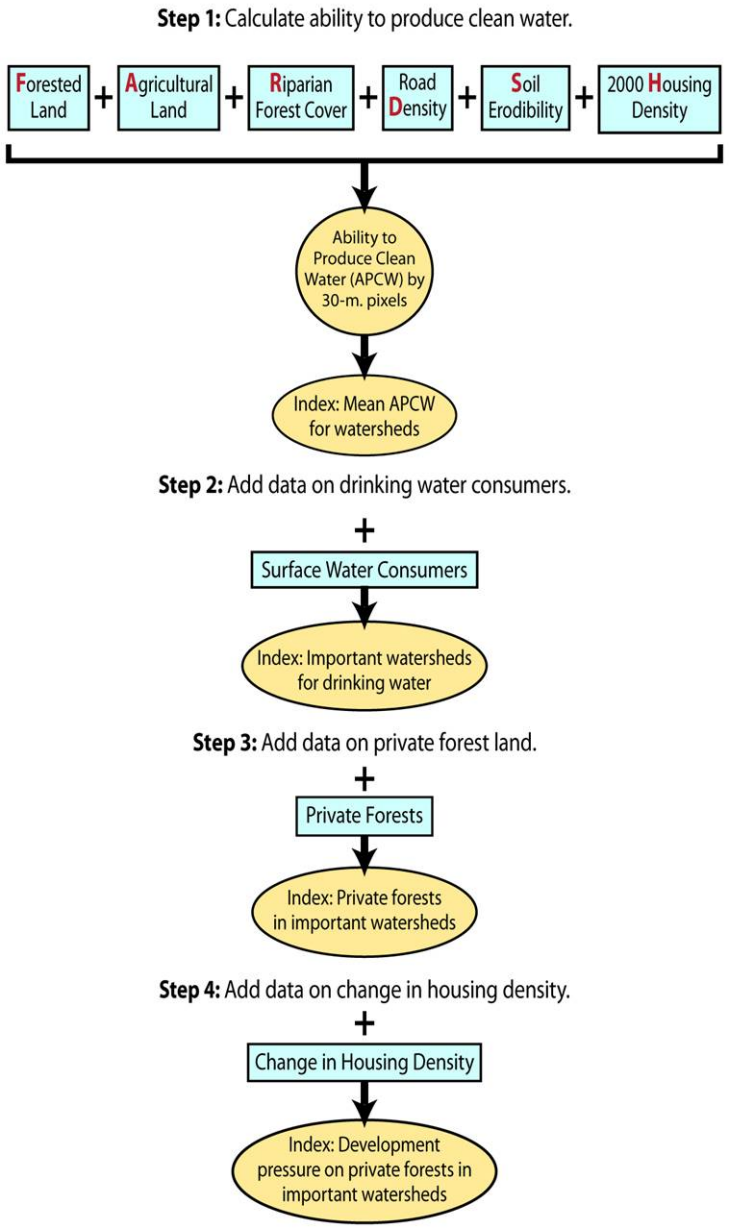


Photo by Michael Land.

*"Water, in all its uses and permutations, is by far the most valuable commodity that comes from the forest land that we manage, assist others to manage, and/or regulate."*
*Policy Statement, National Association of State Foresters*

**Figure 1.** *Nine layers of GIS data (boxes) were combined in stepwise fashion, to produce four indices (ovals) of watershed importance for drinking water supplies and the need for private forest management to protect those supplies.*



# Michigan Results

## Highlights

- Michigan's Upper Peninsula watersheds scored above average in each step of the analysis, with the highest scores in step 1. The State contains large protected forest areas in the north and the Upper Peninsula, a large percent of privately owned forest (66 percent), and high development pressure.
- Those Michigan watersheds that ranked highest in their ability to produce clean water (step 1) are located in the Upper Peninsula, and in the northern part of the State. Sixteen watersheds in the Upper Peninsula (or one-quarter of all the State's watersheds) tied for the highest score in step 1.
- In the ability of watersheds to provide drinking water to the most people (step 2), several Michigan watersheds scored above average, particularly those in the Upper Peninsula. The scores were not as high as in other parts of the study area due to the fact that many areas of Michigan get their drinking water from ground water supplies, which are not included in this study. The Detroit, Flint, and Huron watersheds scored the highest.
- In the ability of watersheds to provide drinking water on private lands (step 3), all of the watersheds of the Upper Peninsula and many of the northern Michigan watersheds scored above average because the State has 66 percent privately owned forest land. The highest scoring watershed is the Michigamme, followed by a tie score between Thunder Bay, Brule, Cedar-Ford, and Tacoosh-Whitefish watersheds.
- Most of Michigan's watersheds scored above average in step 4, which ranked watersheds based on their development pressure and land ownership status (private lands ranked higher because they are subject to conversion). The two highest scoring watersheds were the Pine and Huron watersheds. These watersheds averaged in the top sixteen percent of the study area's watersheds.

**Table 1.** Watershed results for Michigan

| Watershed Name | Hydrologic Unit Code | Mean APCW for watersheds | Surface drinking water consumers | % private forest in watershed | % watershed with housing density increase | Index: Development pressure on private forests important for drinking water supply Score (Step 4) | Rank (Step 4) |
|---|---|---|---|---|---|---|---|
| Pine | 04080202 | 6 of 10 | 32,560 | 35 % | 21 % | 28 of 40 | 88 of 540 |
| Huron | 04090005 | 5 of 10 | 114,,000 | 32 % | 19 % | 28 of 40 | 88 of 540 |
| Cheboygan | 04070004 | 9 of 10 | 0 | 49 % | 21 % | 27 of 40 | 109 of 540 |
| Keweenaw Peninsula | 04020103 | 10 of 10 | 0 | 84 % | 5 % | 27 of 40 | 109 of 540 |
| Thunder Bay | 04070006 | 9 of 10 | 0 | 64 % | 12 % | 27 of 40 | 109 of 540 |
| Betsie-Platte | 04060104 | 8 of 10 | 0 | 49 % | 26 % | 26 of 40 | 126 of 540 |
| Boardman-Charlevoix | 04060105 | 8 of 10 | 0 | 49 % | 29 % | 26 of 40 | 126 of 540 |
| Flint | 04080204 | 5 of 10 | 124,943 | 25 % | 12 % | 26 of 40 | 126 of 540 |
| Manistee | 04060103 | 9 of 10 | 0 | 40 % | 19 % | 26 of 40 | 126 of 540 |
| Pere Marquette-White | 04060101 | 8 of 10 | 0 | 44 % | 20 % | 26 of 40 | 126 of 540 |
| Michigamme | 04030107 | 10 of 10 | 0 | 74 % | 3 % | 25 of 40 | 148 of 540 |
| Muskegon | 04060102 | 7 of 10 | 0 | 44 % | 23 % | 25 of 40 | 148 of 540 |
| Au Gres-Rifle | 04080101 | 8 of 10 | 0 | 51 % | 12 % | 25 of 40 | 148 of 540 |
| Tittabawassee | 04080201 | 7 of 10 | 0 | 45 % | 24 % | 25 of 40 | 148 of 540 |
| Dead-Kelsey | 04020105 | 10 of 10 | 0 | 87 % | 3 % | 25 of 40 | 148 of 540 |
| Upper Wisconsin | 07070001 | 10 of 10 | 0 | 56 % | 6 % | 25 of 40 | 148 of 540 |
| Detroit | 04090004 | 4 of 10 | 975,810 | 20 % | 9 % | 25 of 40 | 148 of 540 |
| Tacoosh-Whitefish | 04030111 | 10 of 10 | 0 | 51 % | 7 % | 25 of 40 | 148 of 540 |
| Cedar-Ford | 04030109 | 10 of 10 | 0 | 59 % | 4 % | 24 of 40 | 169 of 540 |
| Lone Lake-Ocqueoc | 04070003 | 9 of 10 | 0 | 57 % | 6 % | 24 of 40 | 169 of 540 |
| St. Joseph | 04100003 | 2 of 10 | 250,000 | 15 % | 17 % | 23 of 40 | 199 of 540 |
| Menominee | 04030108 | 9 of 10 | 0 | 50 % | 6 % | 23 of 40 | 199 of 540 |
| Black | 04070005 | 9 of 10 | 0 | 37 % | 10 % | 23 of 40 | 199 of 540 |
| Flambeau | 07050002 | 10 of 10 | 0 | 45 % | 4 % | 23 of 40 | 199 of 540 |
| Escanaba | 04030110 | 10 of 10 | 0 | 49 % | 3 % | 23 of 40 | 199 of 540 |
| Thornapple | 04050007 | 6 of 10 | 0 | 27 % | 30 % | 22 of 40 | 229 of 540 |
| Black-Presque Isle | 04020101 | 10 of 10 | 0 | 56 % | 2 % | 22 of 40 | 229 of 540 |
| Lower Grand | 04050006 | 6 of 10 | 0 | 30 % | 26 % | 22 of 40 | 229 of 540 |

| Watershed Name | Hydrologic Unit Code | Mean APCW for watersheds | Surface drinking water consumers | % private forest in watershed | % watershed with housing density increase | Index: Development pressure on private forests important for drinking water supply Score (Step 4) | Rank (Step 4) |
|---|---|---|---|---|---|---|---|
| Au Sable | 04070007 | 9 of 10 | 0 | 32 % | 9 % | 22 of 40 | 229 of 540 |
| Brule | 04030106 | 10 of 10 | 0 | 52 % | 2 % | 22 of 40 | 229 of 540 |
| Sturgeon | 04020104 | 10 of 10 | 0 | 49 % | 2 % | 22 of 40 | 229 of 540 |
| Fishdam-Sturgeon | 04030112 | 10 of 10 | 0 | 36 % | 3 % | 22 of 40 | 229 of 540 |
| Betsy-Chocolay | 04020201 | 10 of 10 | 0 | 49 % | 3 % | 22 of 40 | 229 of 540 |
| Kalamazoo | 04050003 | 6 of 10 | 0 | 31 % | 22 % | 22 of 40 | 229 of 540 |
| St. Marys | 04070001 | 7 of 10 | 0 | 53 % | 4 % | 22 of 40 | 229 of 540 |
| Brevoort-Millecoquins | 04060107 | 10 of 10 | 0 | 44 % | 2 % | 22 of 40 | 229 of 540 |
| Black-Macatawa | 04050002 | 5 of 10 | 0 | 33 % | 19 % | 21 of 40 | 264 of 540 |
| Lake St. Clair | 04090002 | 1 of 10 | 11,848 | 23 % | 13 % | 21 of 40 | 264 of 540 |
| Bad-Montreal | 04010302 | 9 of 10 | 0 | 52 % | 1 % | 21 of 40 | 264 of 540 |
| Carp-Pine | 04070002 | 10 of 10 | 0 | 27 % | 3 % | 20 of 40 | 289 of 540 |
| Raisin | 04100002 | 3 of 10 | 26,504 | 16 % | 17 % | 20 of 40 | 289 of 540 |
| Tahquamenon | 04020202 | 10 of 10 | 0 | 39 % | 1 % | 19 of 40 | 320 of 540 |
| Clinton | 04090003 | 4 of 10 | 0 | 29 % | 14 % | 19 of 40 | 320 of 540 |
| Manistique | 04060106 | 10 of 10 | 3,874 | 26 % | 2 % | 19 of 40 | 320 of 540 |
| St. Joseph | 04050001 | 4 of 10 | 0 | 21 % | 18 % | 19 of 40 | 320 of 540 |
| Upper Grand | 04050004 | 5 of 10 | 0 | 25 % | 15 % | 19 of 40 | 320 of 540 |
| Kawkawlin-Pine | 04080102 | 5 of 10 | 0 | 28 % | 12 % | 19 of 40 | 320 of 540 |
| St. Clair | 04090001 | 4 of 10 | 4,652 | 22 % | 16 % | 19 of 40 | 320 of 540 |
| Waiska | 04020203 | 8 of 10 | 0 | 32 % | 3 % | 18 of 40 | 337 of 540 |
| Ontonagan | 04020102 | 10 of 10 | 0 | 34 % | 1 % | 18 of 40 | 337 of 540 |
| Little Calumet-Galien | 04040001 | 3 of 10 | 0 | 31 % | 11 % | 17 of 40 | 352 of 540 |
| Shiawassee | 04080203 | 4 of 10 | 0 | 22 % | 10 % | 17 of 40 | 352 of 540 |
| Cass | 04080205 | 5 of 10 | 0 | 25 % | 9 % | 17 of 40 | 352 of 540 |
| Maple | 04050005 | 4 of 10 | 0 | 14 % | 17 % | 17 of 40 | 352 of 540 |
| Tiffin | 04100006 | 1 of 10 | 22,144 | 12 % | 9 % | 16 of 40 | 380 of 540 |
| Kankakee | 07120001 | 3 of 10 | 43,789 | 10 % | 7 % | 16 of 40 | 380 of 540 |
| Ottawa-Stony | 04100001 | 1 of 10 | 995 | 16 % | 13 % | 15 of 40 | 394 of 540 |
| Birch-Willow | 04080104 | 2 of 10 | 0 | 16 % | 5 % | 12 of 40 | 442 of 540 |
| Saginaw | 04080206 | 2 of 10 | 0 | 6 % | 7 % | 12 of 40 | 442 of 540 |
| Pigeon-Wiscoggin | 04080103 | 2 of 10 | 0 | 8 % | 4 % | 10 of 40 | 465 of 540 |

## Average or total value for all watersheds listed in Table 1

| | | |
|---|---|---|
| Mean APCW for watersheds: | 6.9 | of 10 |
| Important watersheds for drinking water composite score: | 8.8 | of 20 |
| Private forests in important watersheds composite score: | 14.5 | of 30 |
| Development pressure on private forests in important watersheds composite score: | 21.6 | of 40 |
| Forested Land (acres): | 24,512,265.3 | |
| Private Forest (acres): | 16,175,379.7 | |
| Private Forest Land under Development Pressure by 2030 (acres): | 2,225,629.1 | |
| (% private forest land): | 13.8% | |

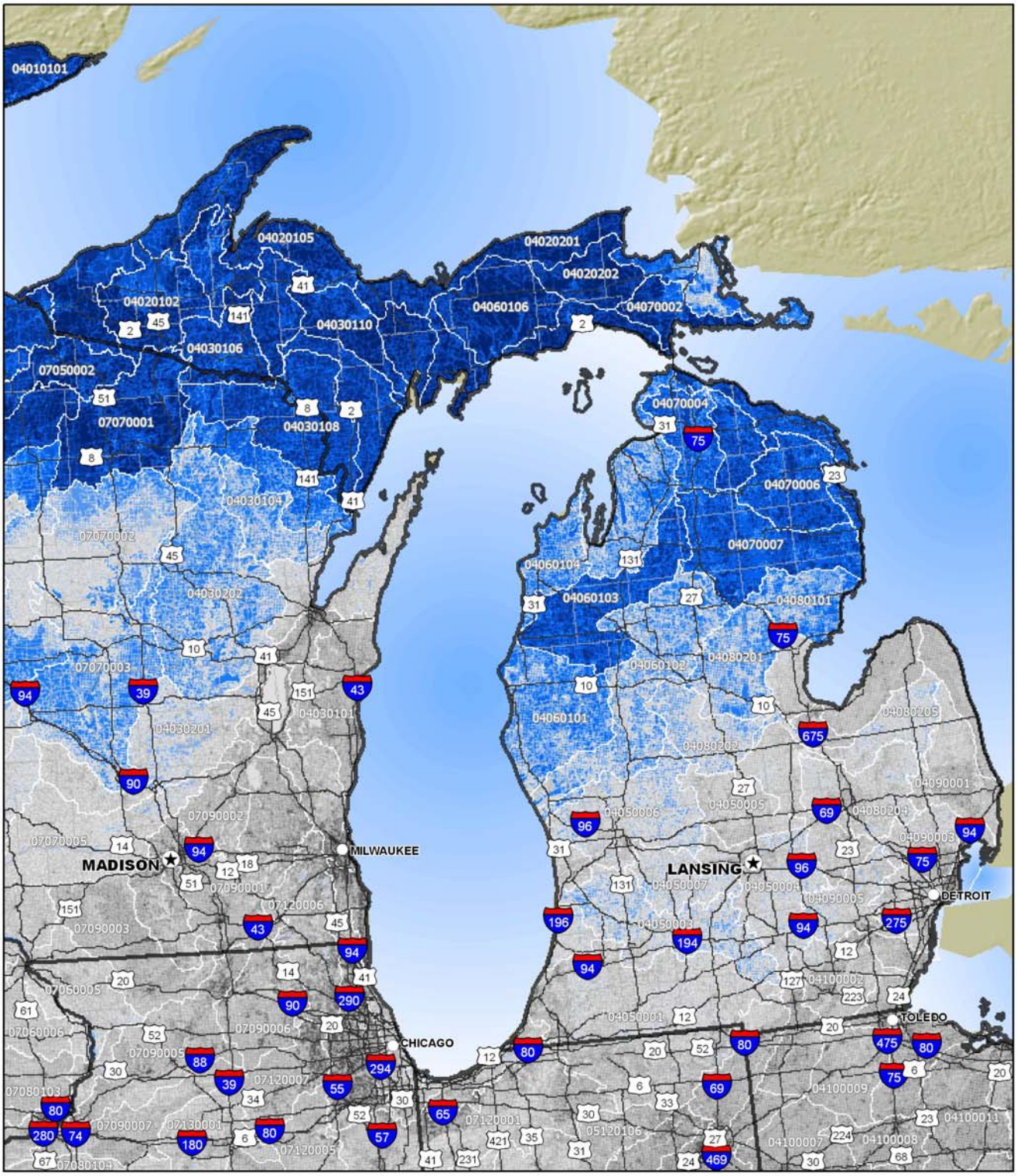
Note: If a watershed fell partially in Michigan, the whole watershed was considered for this project. State results reflect the total acreage for all watersheds that impact that State (this may account for a higher acreage figure than if only lands within State boundaries were considered).

## Maps

The following maps depict the results of each step in the Forests, Water and People analysis. Each watershed is labeled with the eight-digit HUC and the watershed composite score for the analysis step. (Note: the APCW, 30-m. pixel view does not have a watershed score)

All of the maps were produced by Rebecca Whitney Lilja, Office of Knowledge Management, Northeastern Area State and Private Forestry.

## Ability to Produce Clean Water (APCW) (Step 1), 30-m View - Michigan




### STEP 1 COMPOSITE SCORE, 30-m VIEW

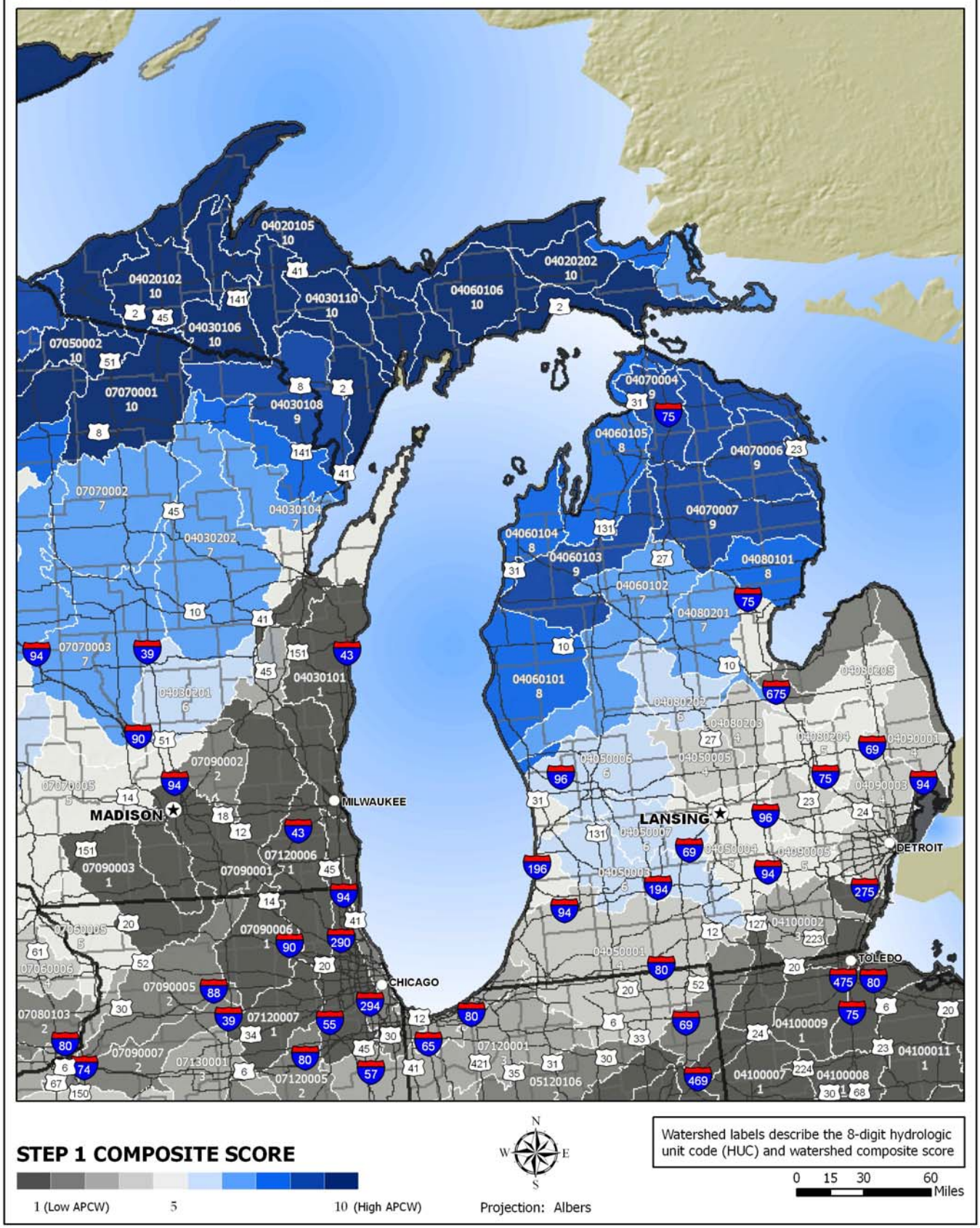
6 (Low APCW) 10 15 20 24 (High APCW)

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC)

0 15 30 60 Miles

## Mean Ability to Produce Clean Water (APCW) by Watershed (Step 1, Continued) - Michigan




### STEP 1 COMPOSITE SCORE

1 (Low APCW) 5 10 (High APCW)

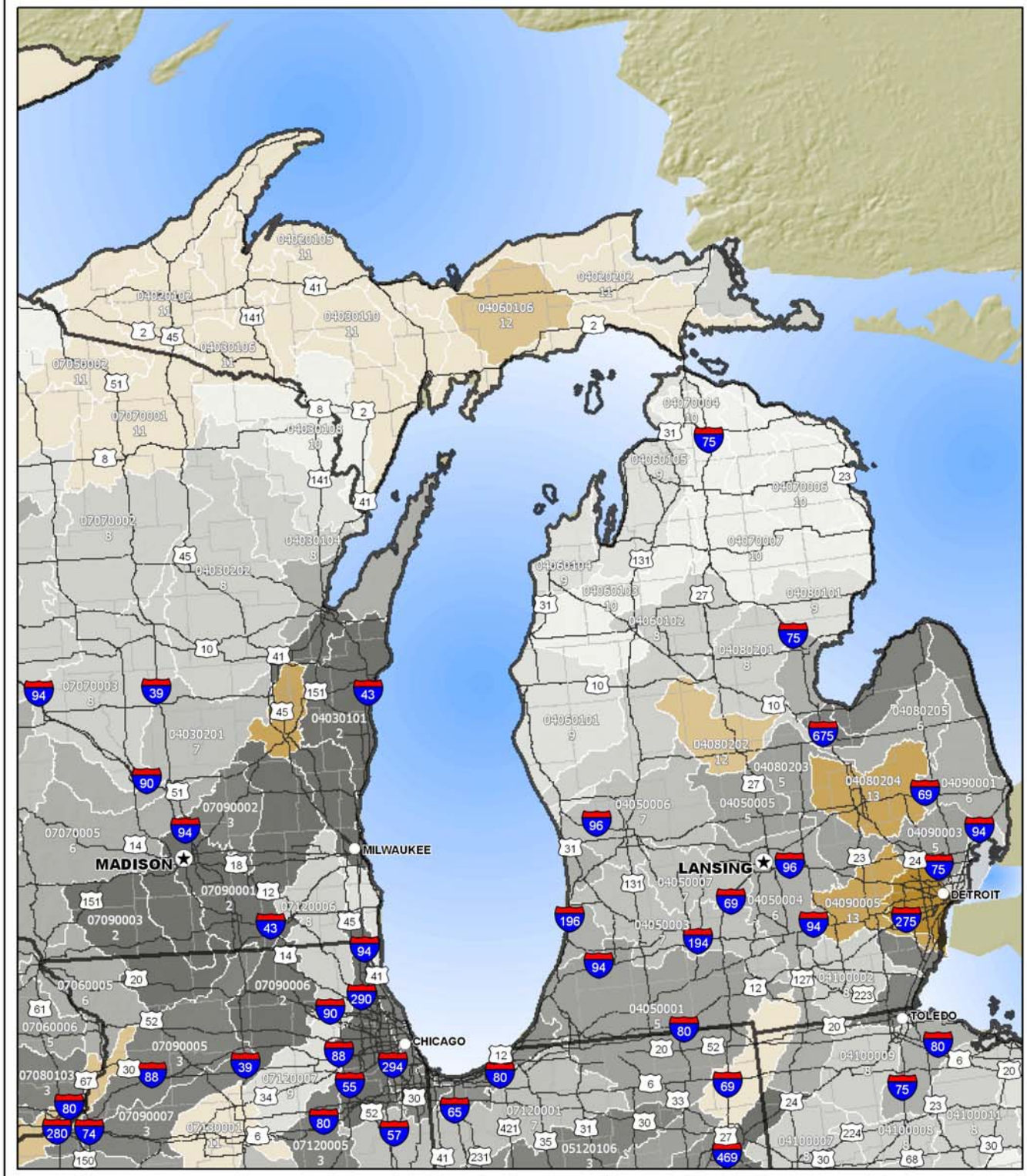
N W E S

Projection: Albers

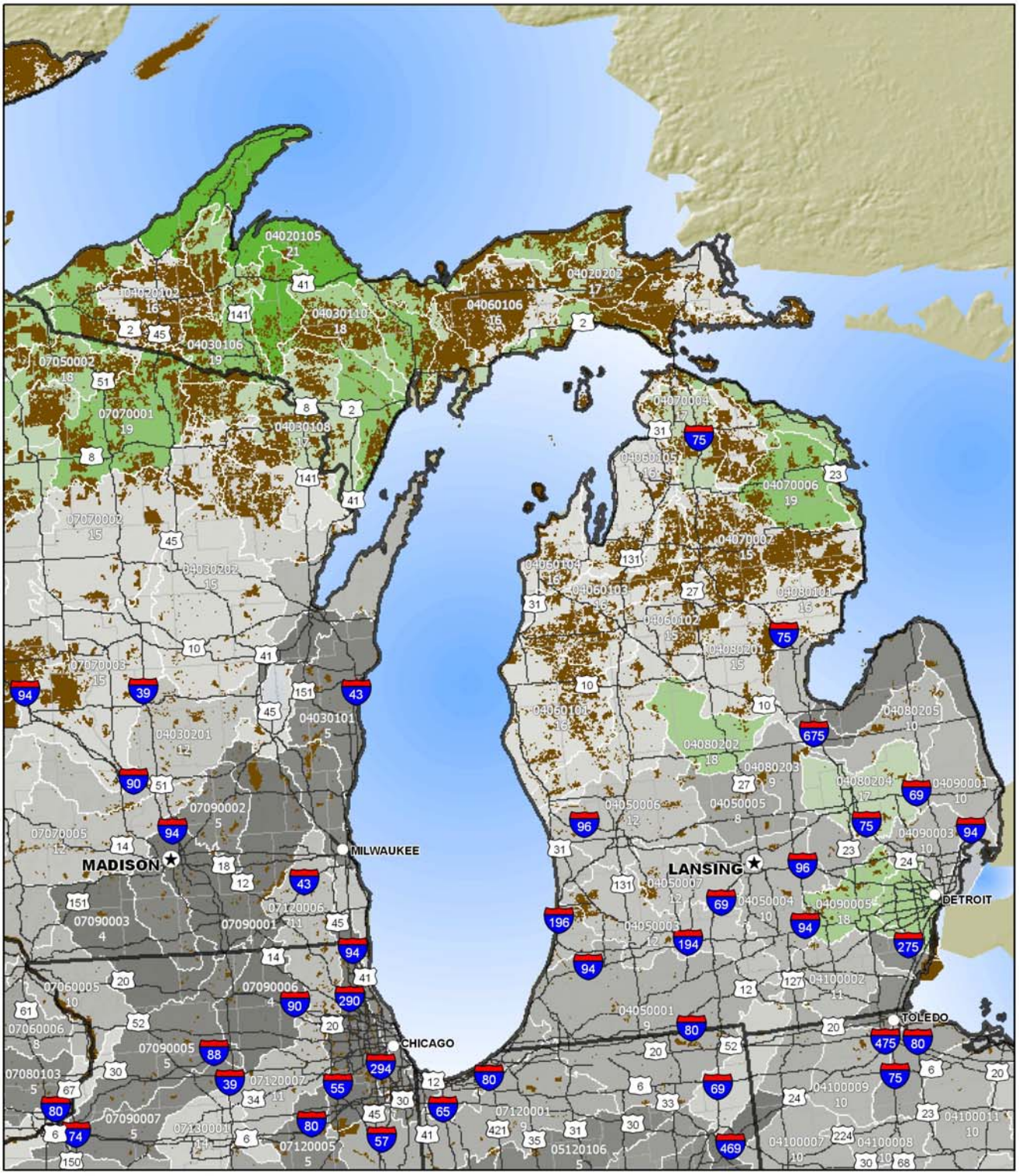
Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles

## Importance of watersheds for drinking water supply (Step 2) - Michigan



## Importance of watersheds and private forest for drinking water supply (Step 3) - Michigan




**STEP 3 COMPOSITE SCORE**

3 5 10 15 20 25 29

(Low APCW; Small number of water consumers; and Low % private forest)

(High APCW; Large number of water consumers; and High % private forest)

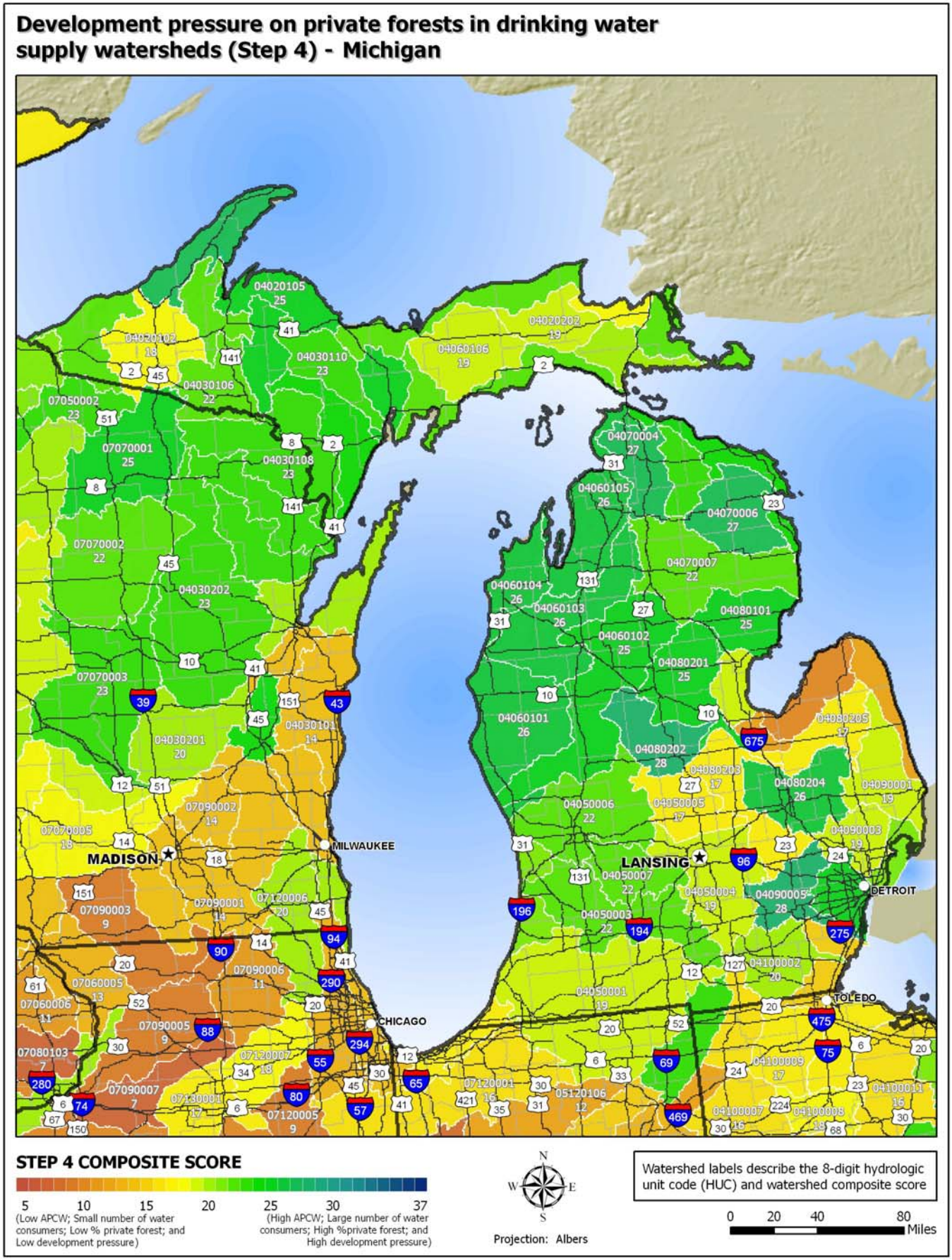
Protected Land

N W E S

Projection: Albers

Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score

0 15 30 60 Miles


Development pressure on private forests in drinking water supply watersheds (Step 4) - Michigan
MADISON
MILWAUKEE
CHICAGO
LANSING
DETROIT
TOLEDO
STEP 4 COMPOSITE SCORE
5 10 15 20 25 30 37
(Low APCW; Small number of water consumers; Low % private forest; and Low development pressure)
(High APCW; Large number of water consumers; High %private forest; and High development pressure)
N
W E
S
Projection: Albers
Watershed labels describe the 8-digit hydrologic unit code (HUC) and watershed composite score
0 20 40 80
Miles

## References

**Table 2.** Datasets used in the Forests, Water and People Analysis

| Attribute | Dataset | Source* |
|---|---|---|
| Forest land | 1992 National Landcover Dataset | U.S. Geological Survey 1999 |
| Agricultural land by watershed | 1992 National Landcover Dataset | U.S. Geological Survey 1999 |
| Riparian forest cover by watershed | 1:100,000-scale National Hydrography Dataset, buffered to 30 meters | Hatfield 2005 |
| Road density | 2002 Bureau of Transportation Statistics (BTS) Roads | U.S. Department of Transportation 2002 |
| Soil erodibility | STATSGO Soil Dataset, kffact | Miller and White 1998 |
| Housing density by watershed | Housing density in 2000 | Theobald 2004 |
| Surface drinking water consumers per unit area | Public Drinking Water System (PWS) Consumers by eight-digit HUC; City Drinking water consumers for New York City, Philadelphia, St. Louis, St. Paul, and Washington DC | U.S. Environmental Protection Agency 2005 |
| Private forest by watershed | Protected Areas Database, Version 4; Wisconsin Stewardship Data | Conservation Biology Institute 2006; U.S. Geological Survey, Upper Midwest Environmental Sciences Center 2005 |
| Development pressure per unit area | Housing density in 2000 and 2030 | Theobald 2004 |

*Note: See the **full report** for complete reference citations.

## Watershed Resources

**Northeastern Area Watershed—** http://www.na.fs.fed.us/watershed

**Forest-to-Faucet Partnership—**http://www.wetpartnership.org/index.html

**Trust for Public Land Source Water Stewardship Project—**http://www.tpl.org/

**Forests on the Edge—**http://www.fs.fed.us/openspace/fote/index.html

**American Water Works Association—Professional and Technical Resources—**
http://www.awwa.org/Resources/index.cfm?&navItemNumber=1416

**Source Water Collaborative—**http://www.protectdrinkingwater.org/

**Environmental Protection Agency—Surf Your Watershed—**http://cfpub.epa.gov/surf/locate/index.cfm

**Environmental Protection Agency—Safe Drinking Water Information System—**

http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html

This project was a collaborative effort between the Northeastern Area and Dr. Paul K. Barten, Associate Professor, University of Massachusetts-Amherst and Co-director of the Forest-to-Faucet Partnership.



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