Mississippi Headwaters Watershed Landscape Stewardship Plan

Appendix

Beltrami Environmental Services *Beltrami SWCD* *Cass Environmental Services*

Clearwater SWCD *Hubbard SWCD* *Itasca SWCD* *NRCS* *TSA 8*

DEPARTMENT OF NATURAL RESOURCES

BOARD OF WATER AND SOIL RESOURCES

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Project Partners

This section provides an overview of the people involved with the development of the Mississippi Headwaters Landscape Stewardship Plan.

Mississippi Headwaters LSP Planning Team

The Mississippi Headwaters Landscape Stewardship Plan development involved several people representing different interests. The following list includes planning tam members arraigned alphabetically by last name. In addition to those on this list, there were many others who supported the effort in various ways.

Team Member	Organization
Brent Rud	Beltrami Environmental Services
Shane Foley	Beltrami SWCD
Zachrie Gutknecht	Beltrami SWCD
Chester Powell	Clearwater SWCD
John Ringle	Cass Environmental Services
William Lee	Hubbard SWCD
Andy Arens	Itasca SWCD
Travis Doeden	NRCS
Nate Brandt	NRCS
Brent Mason	MN DNR
Mike Bates	MN DNR
Mitch Lundeen	TSA 8
Curtiss Hunt	Landowner
Robert Thompson	Landowner

Staff Supporting the Mississippi Headwaters LSP Development

Board of Water and Soil Resources
- Lindberg Ekola, Forest Stewardship Planning Coordinator
- Dan Steward, Watershed/Private Forest Management Program Coordinator

Independent Contractors
- David Henkel-Johnson, plan writer
- Mitch Brinks, GIS support

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Bibliography

This section lists documents referenced in the Mississippi Headwaters Landscape Stewardship Plan or otherwise used in its development.

C. Arnold and C. Gibbons. 1996. *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator*, Journal of the American Planning Association, 62:2, 243-258. Available online at: https://www.tandfonline.com/doi/abs/10.1080/01944369608975688.

E.S. Verry. 2016. *The Hydrology of Minor Watersheds*. Ellen River Partners, Inc. Grand Rapids, Minnesota.

M. Barnes, A. Todd, R. Lilja, and P. Barten. 2008. *Forests, Water, and People: Drinking water supply and forest lands in Minnesota.* United Stated Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. Newton Square, Pennsylvania.

Minnesota Forest Resource Council. 2017. *North Central Landscape Forest Resources Plan*. Minnesota Forest Resource Council, St. Paul, Minnesota. Available online at https://mn.gov/frc/docs/NC_Landscape_Plan.pdf.

Minnesota Pollution Control Agency. 2018. *Mississippi River Headwaters Watershed Restoration and Protection Strategy Report*. Minnesota Pollution Control Agency, St. Paul, Minnesota. Available online at https://www.pca.state.mn.us/water/watersheds/Mississippi-river-headwaters

P. Jacobson, T. Cross, D. Dustin and M. Duval. 2017. *A Fish Habitat Conservation Framework for Minnesota Lakes*, Fisheries, 41:6, 302-317. Available online at https://www.researchgate.net/publication/303745823_A_Fish_Habitat_Conservation_Framework_for_Minnesota_Lakes.

T. Brown, P. Meysembourg, G. Host. 2015. *Geospatial Modeling of Native Plant Communities of Minnesota's Laurentian Mixed Forest*. NRRI Technical Report NRRI/TR-2013/28, University of Minnesota Duluth. Duluth, Minnesota. Available online at http://conservancy.umn.edu/handle/11299/187333.

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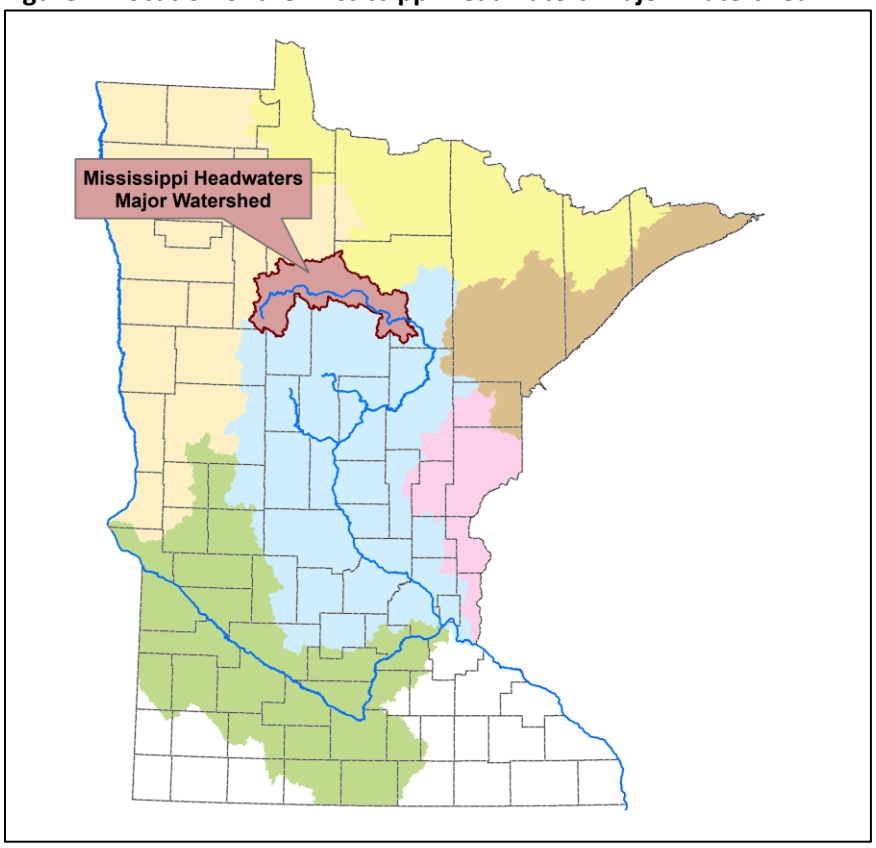
Mississippi Headwaters Resource Inventory (HUC 8)

The purpose of this section is to provide major watershed-scale (HUC 8) geographic data as a reference for the Mississippi Headwaters Landscape Stewardship Plan. Included in this section are maps regarding forest management topics for the Mississippi Headwaters Major Watershed.

Figure 1. Location of the Mississippi Headwaters Major Watershed.



Geography

Figure 2. Geomorphological landforms.

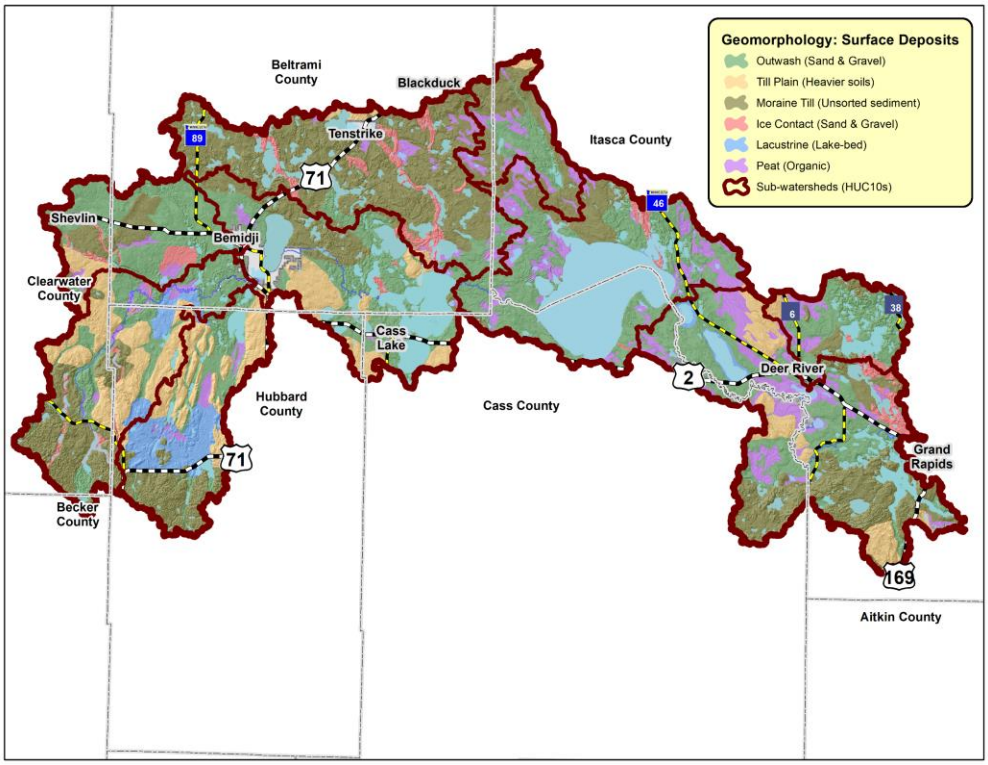


Figure 3. Elevation.

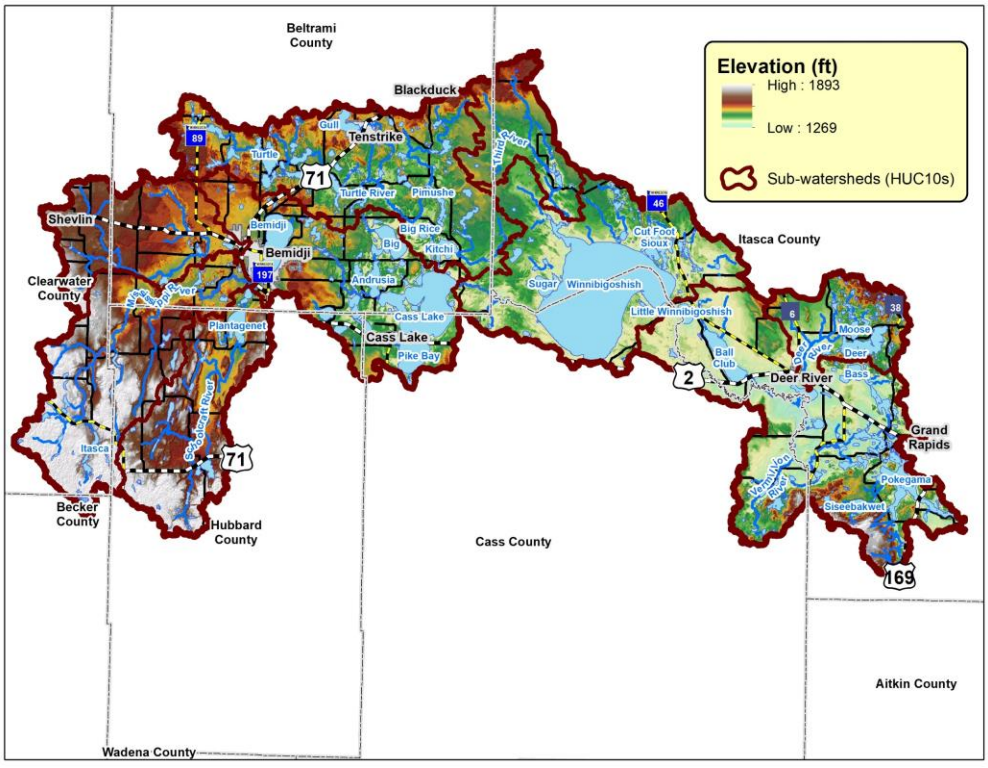


Figure 4. Ecological subsections.

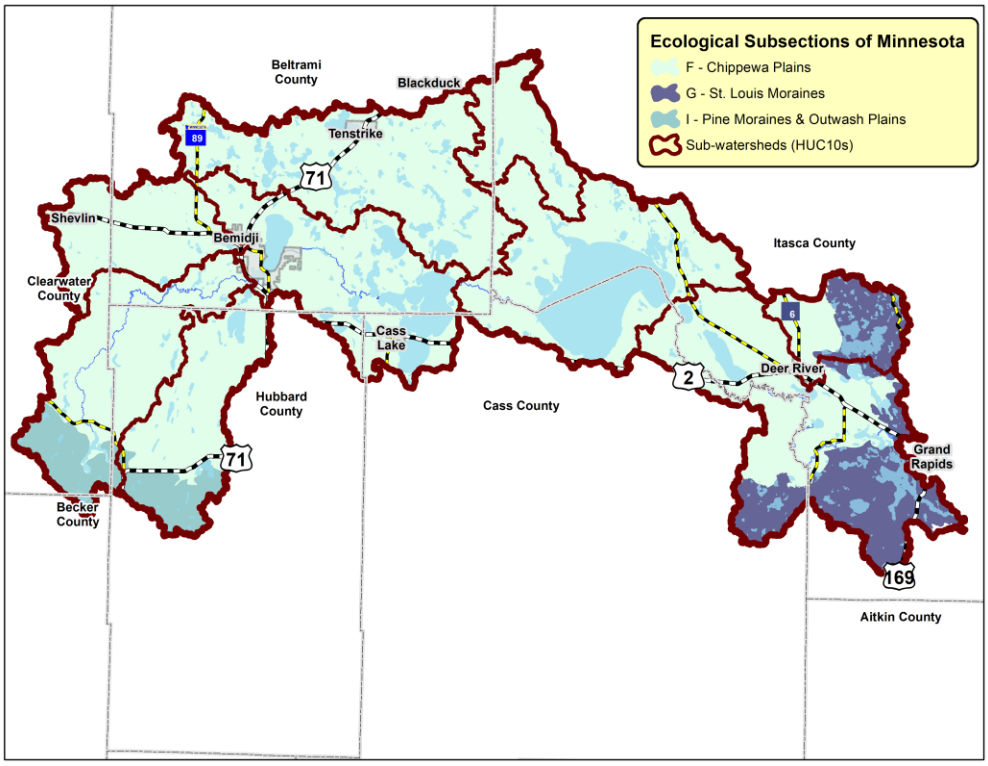
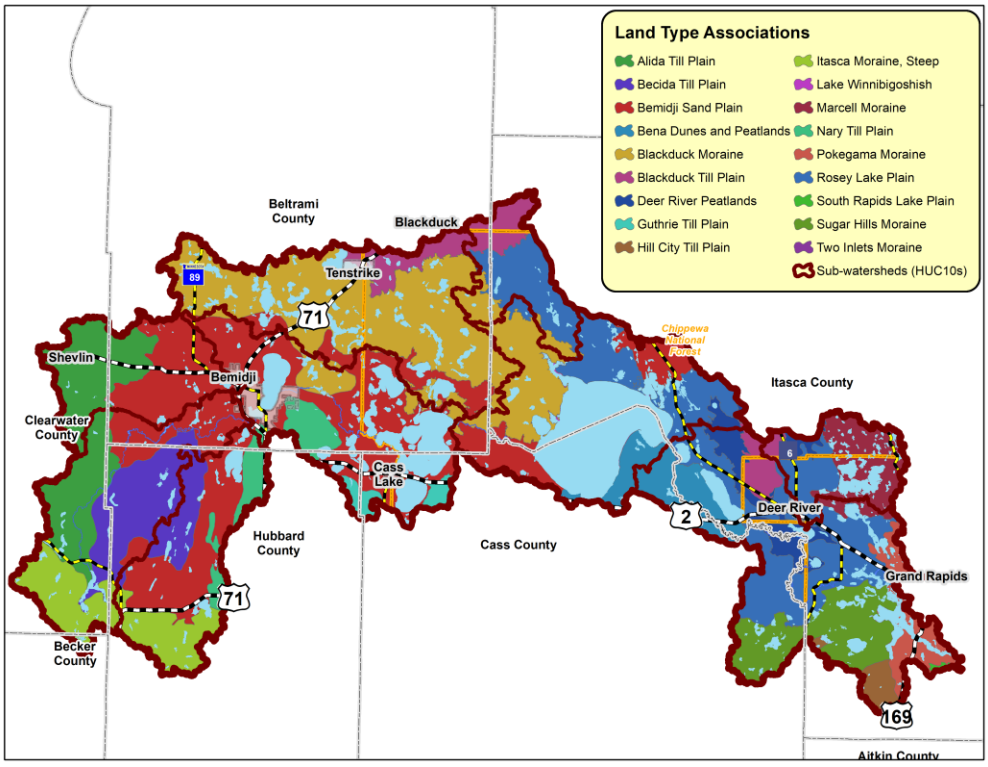


Figure 5. Land type associations.



Forest Cover and Composition

Figure 6. Historic vegetation cover, Marschner.

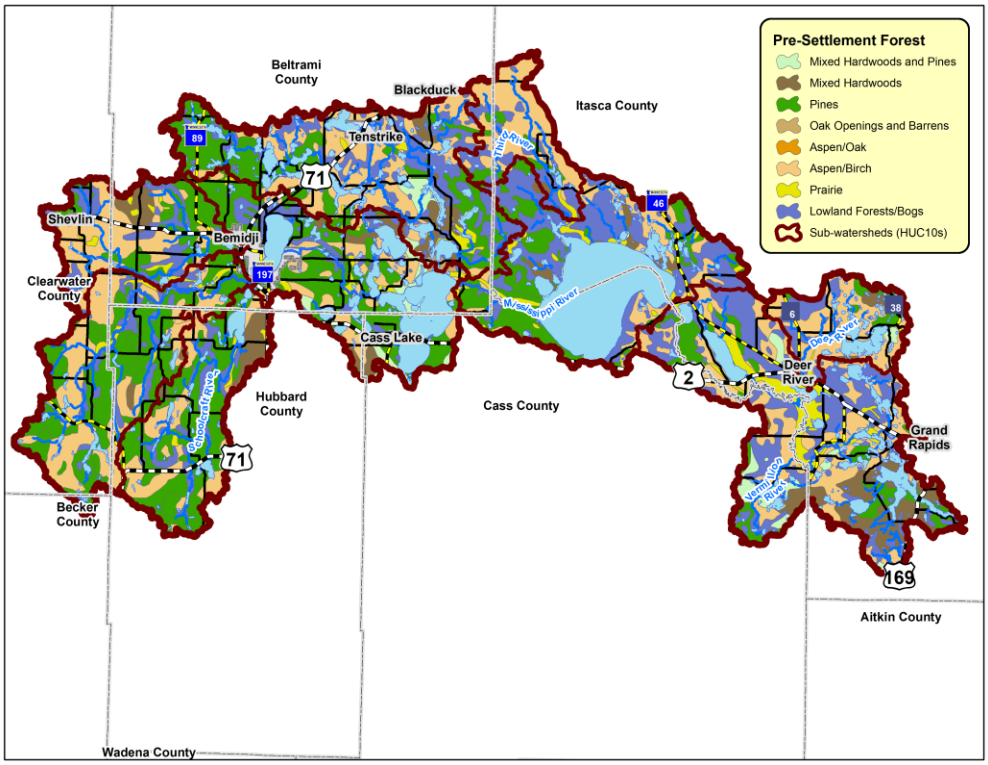


Figure 7. Historic vegetation class, MnDOT (VegMod).

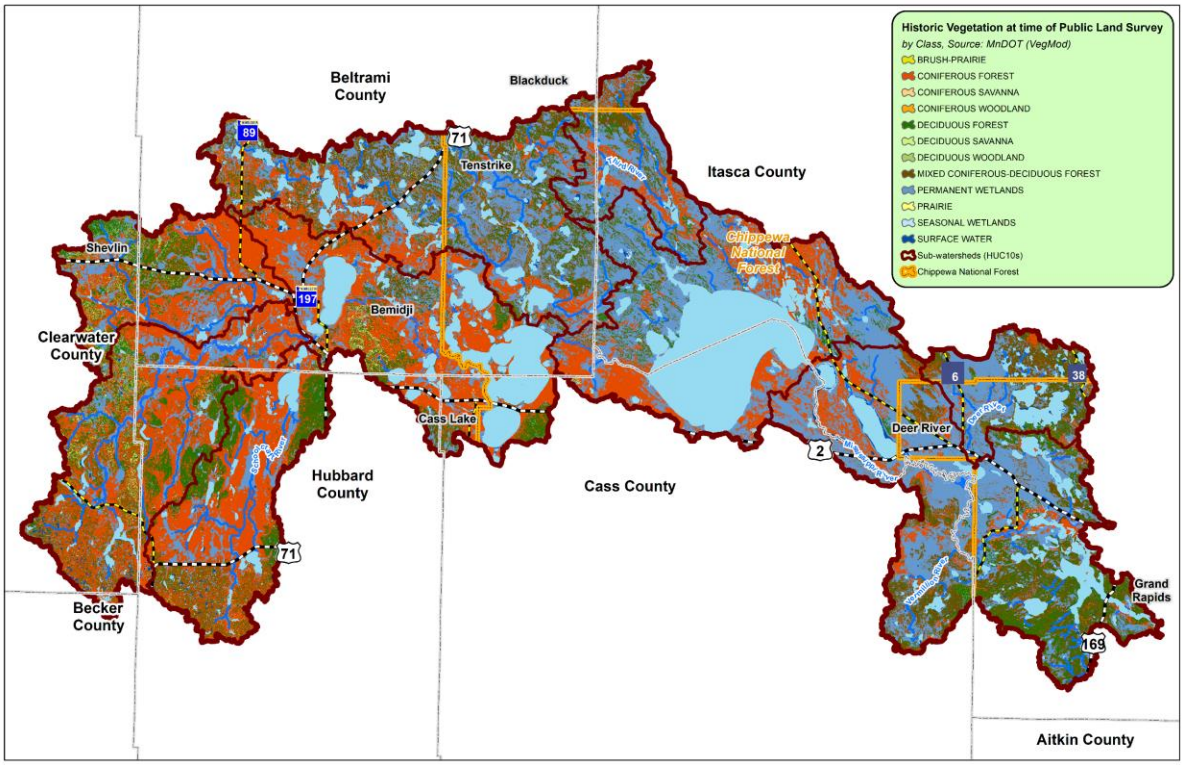


Figure 8. Historic vegetation type, MnDOT (VegMod).

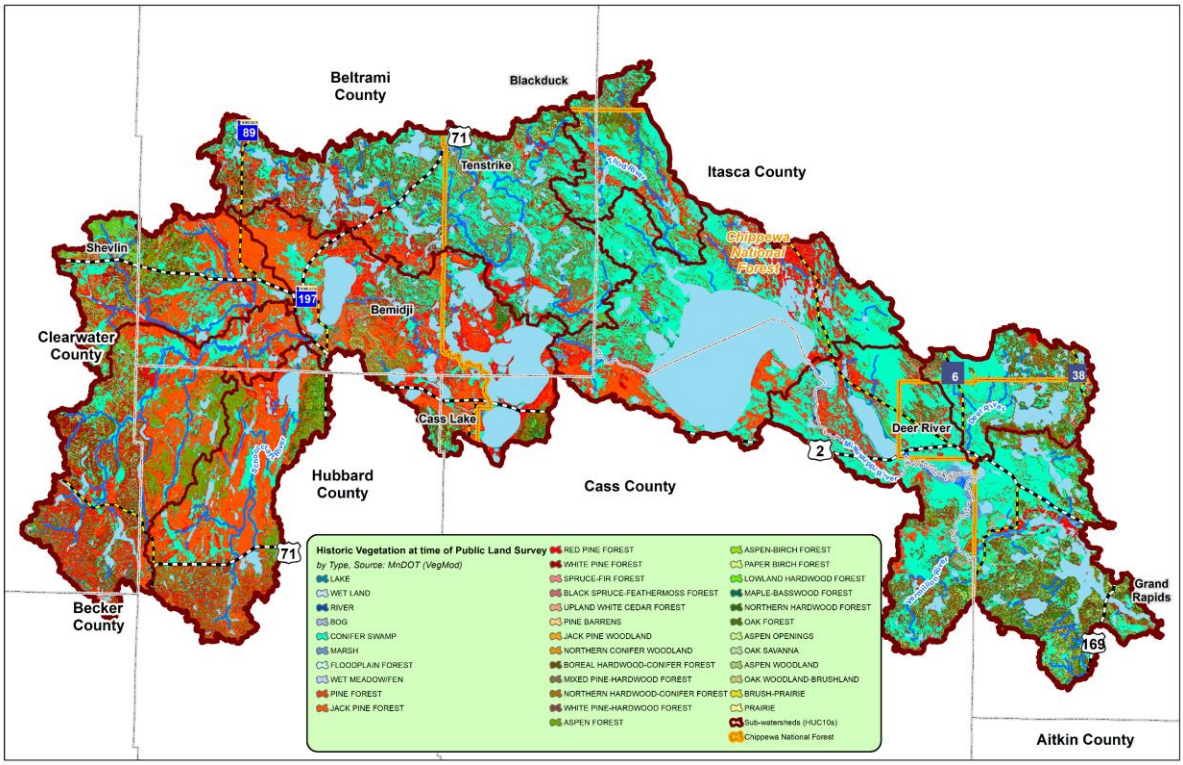


Figure 9. Land cover, 2013.

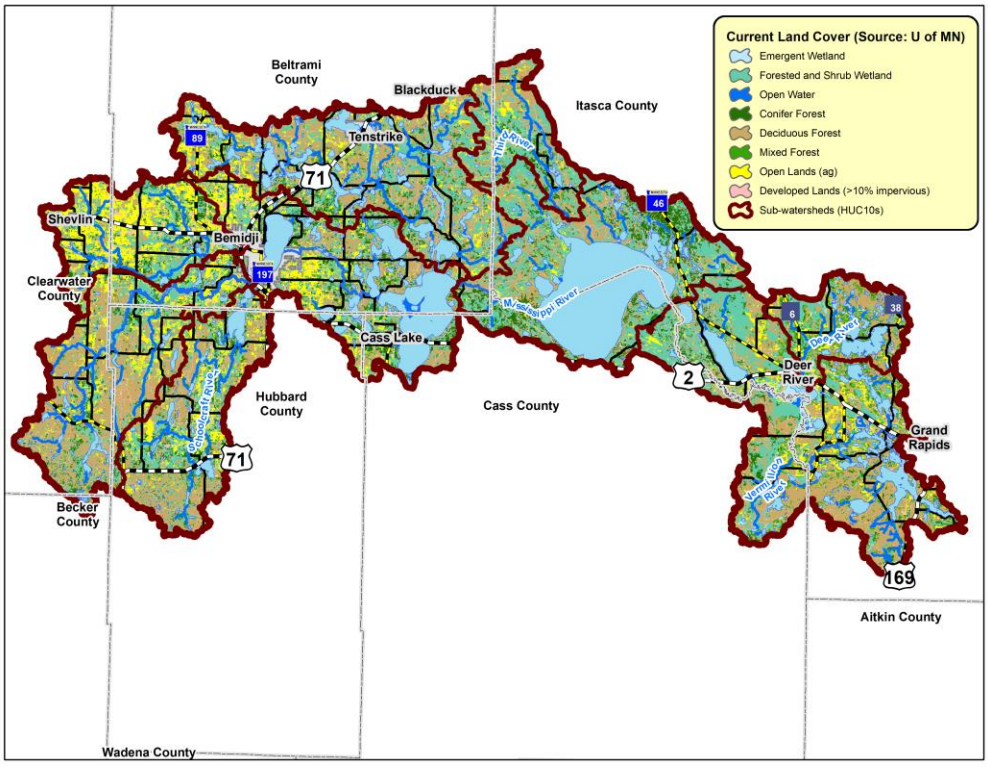


Figure 10. Current vegetation and areas of historic forest loss.

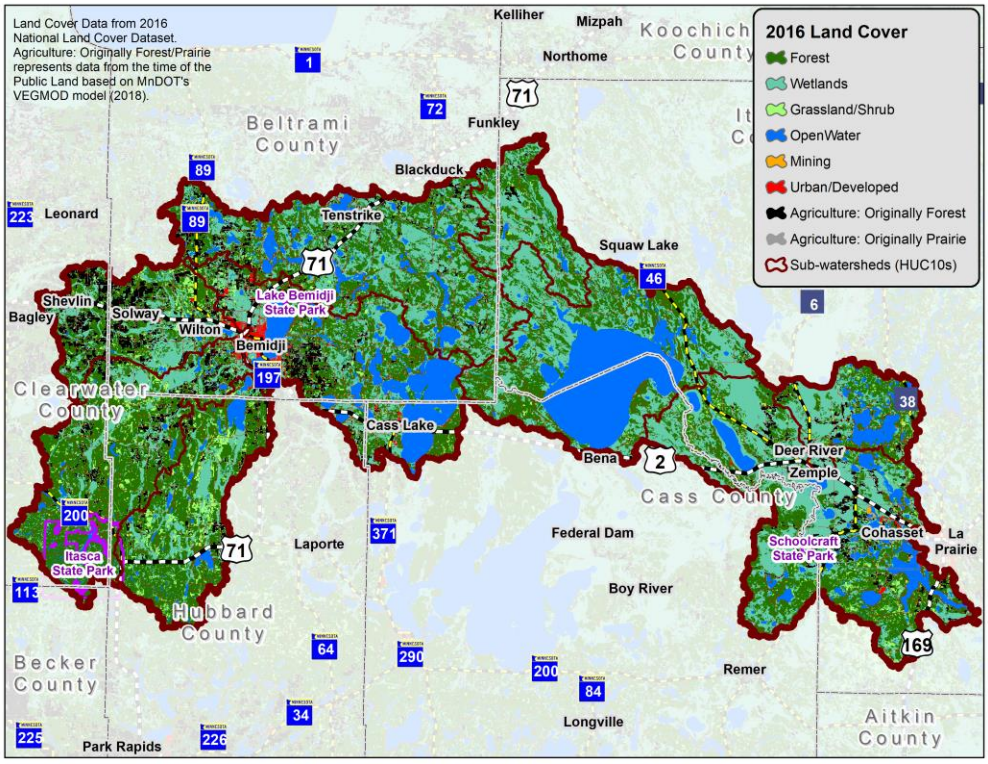


Figure 11. Potential native plant community systems.

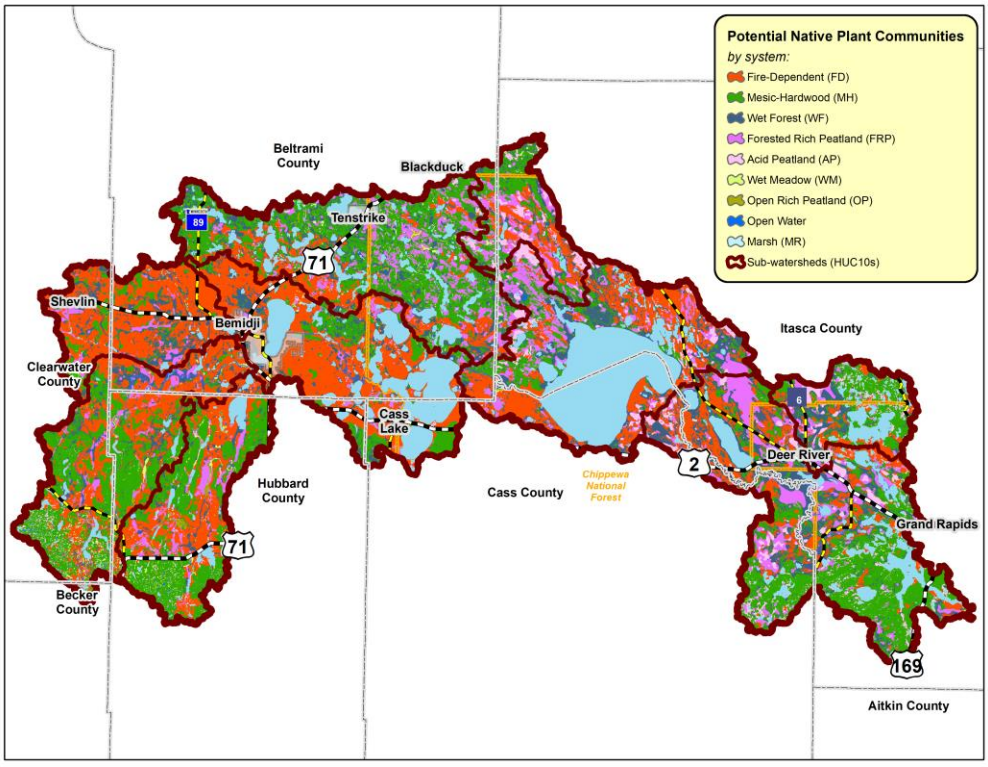


Figure 12. Change in aspen abundance.

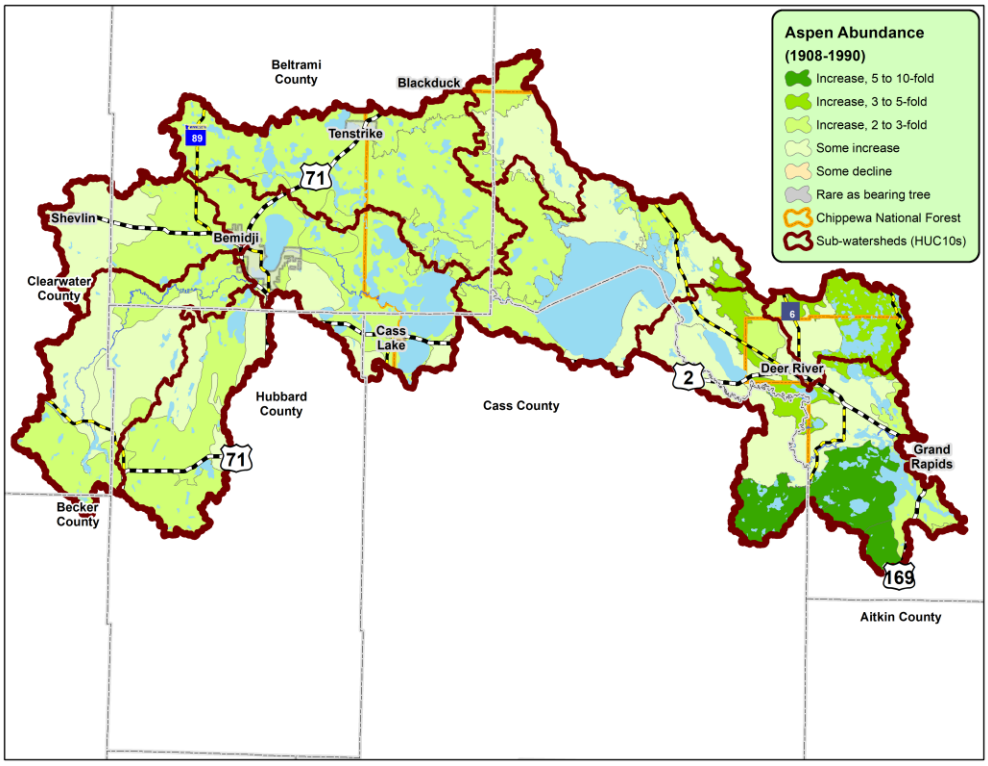


Figure 13. Change in red oak abundance.

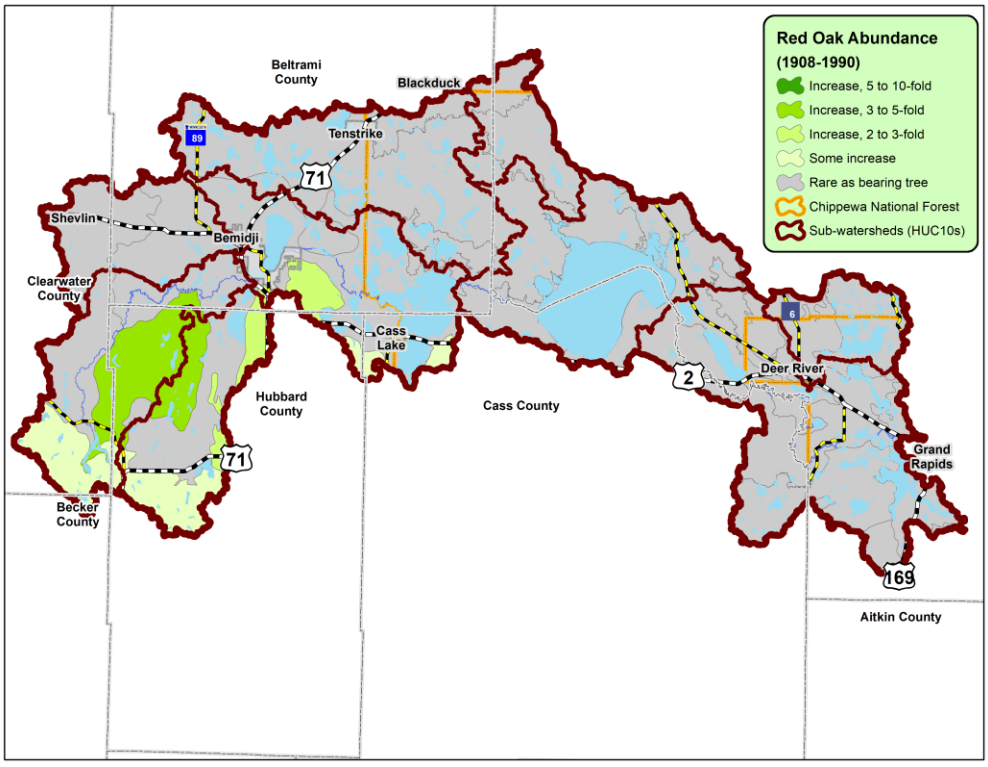


Figure 14. Change in white pine abundance.

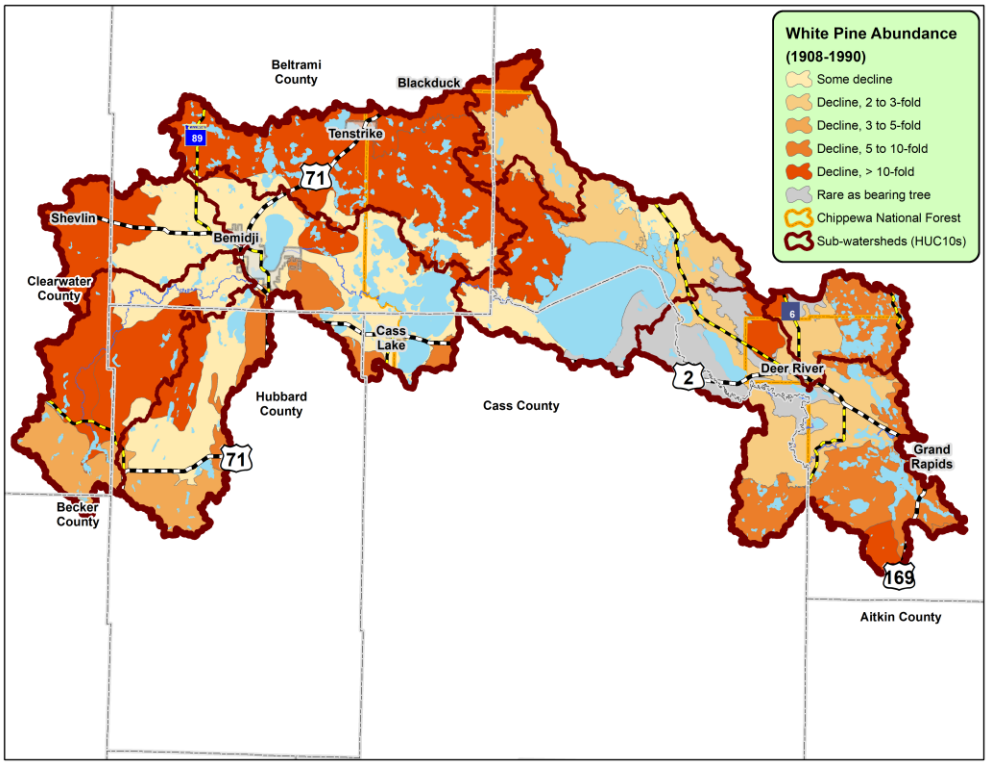


Figure 15. Potential white pine recovery areas.

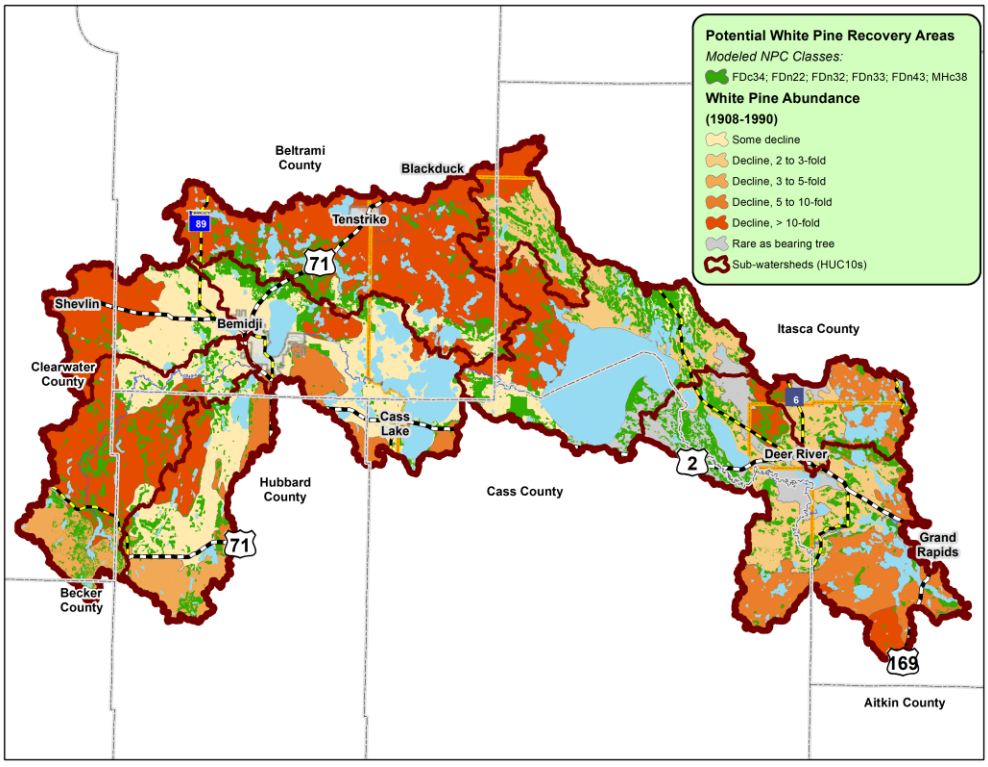


Figure 16. Potential white pine recovery areas and public/tribal lands.

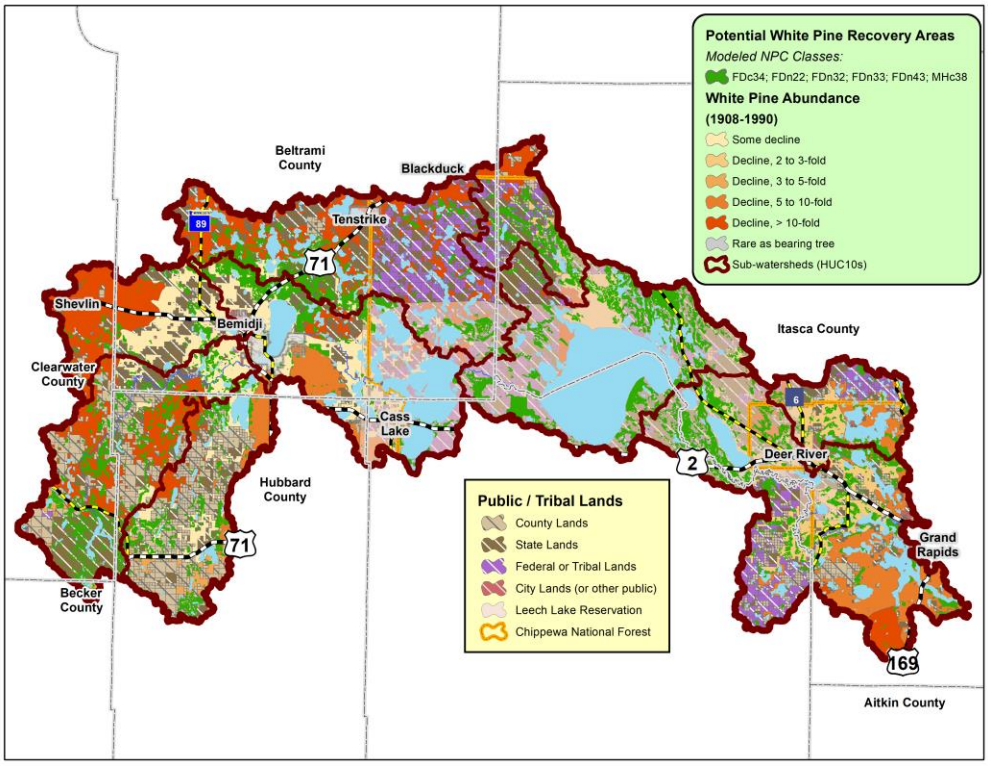
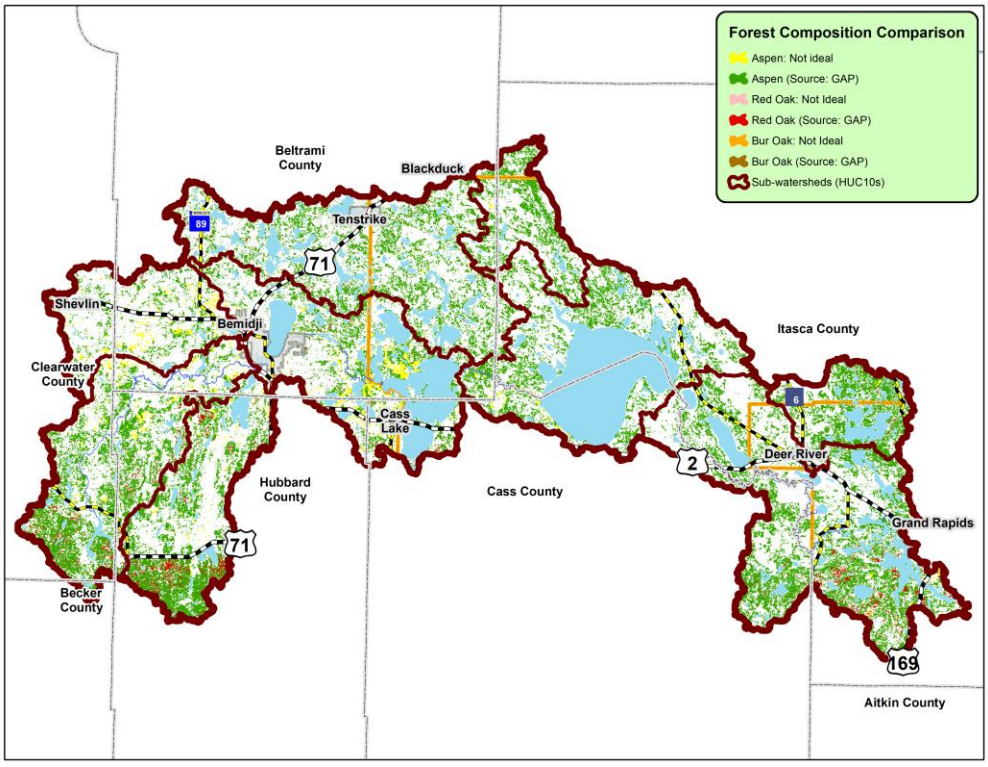


Figure 17. Comparison of common GAP cover types to potential NPC tree species suitability.



Lakes and Streams

Figure 18. Lakes.

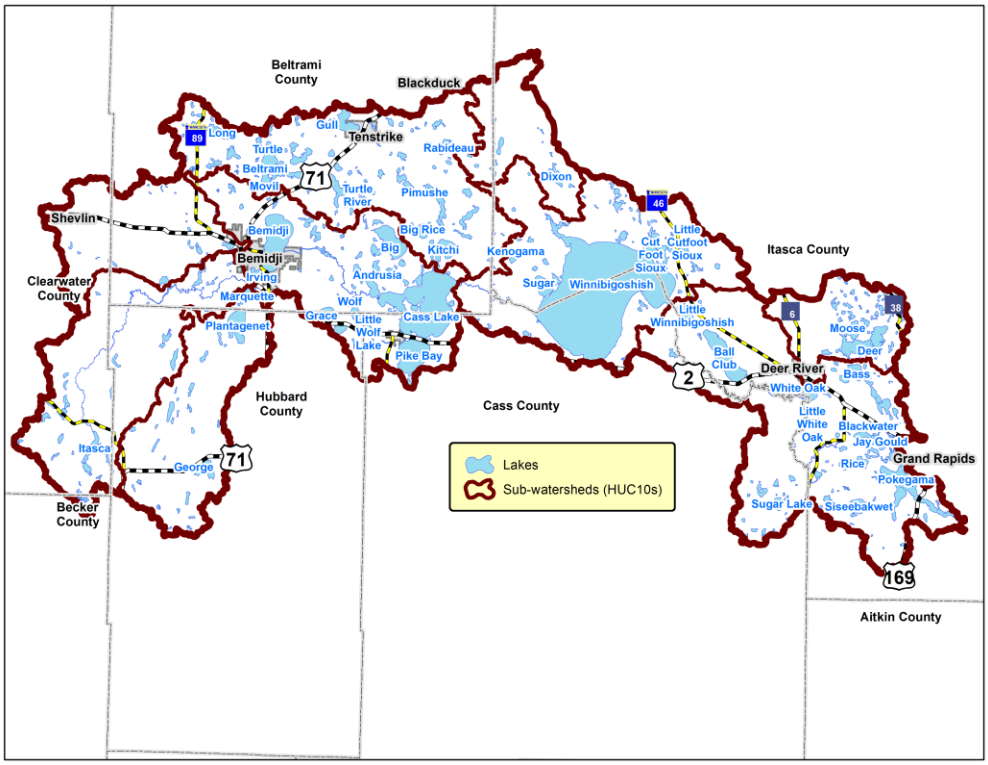


Figure 19. Water quality trends, MPCA data.

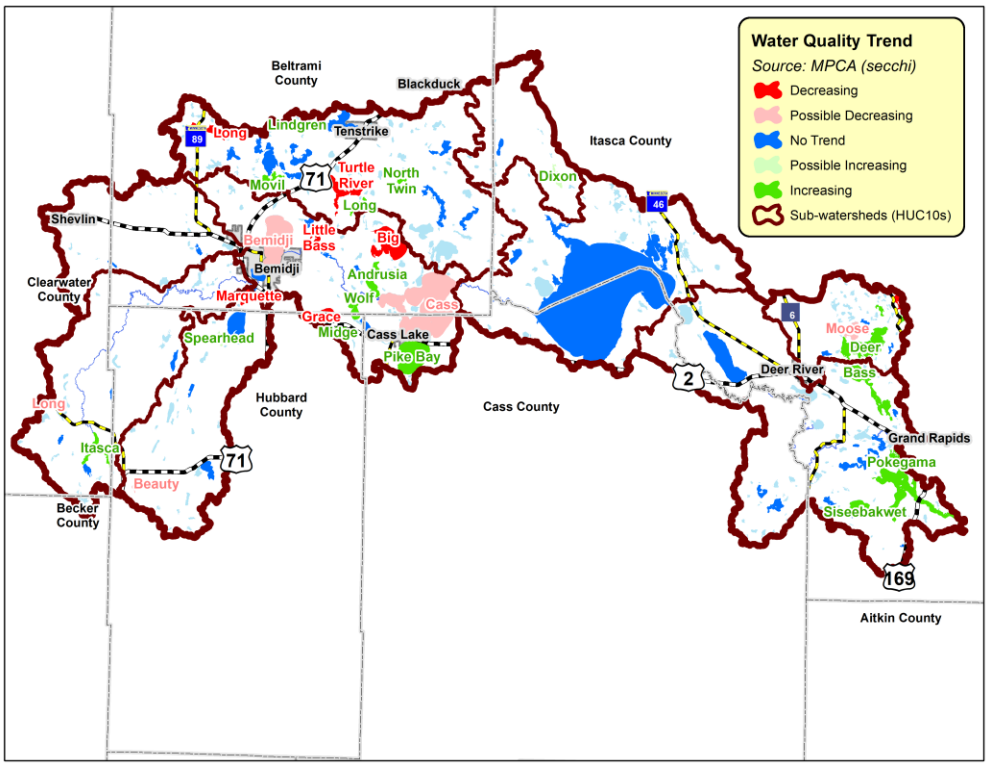


Figure 20. Water quality trends, RMB Environmental Laboratories data.

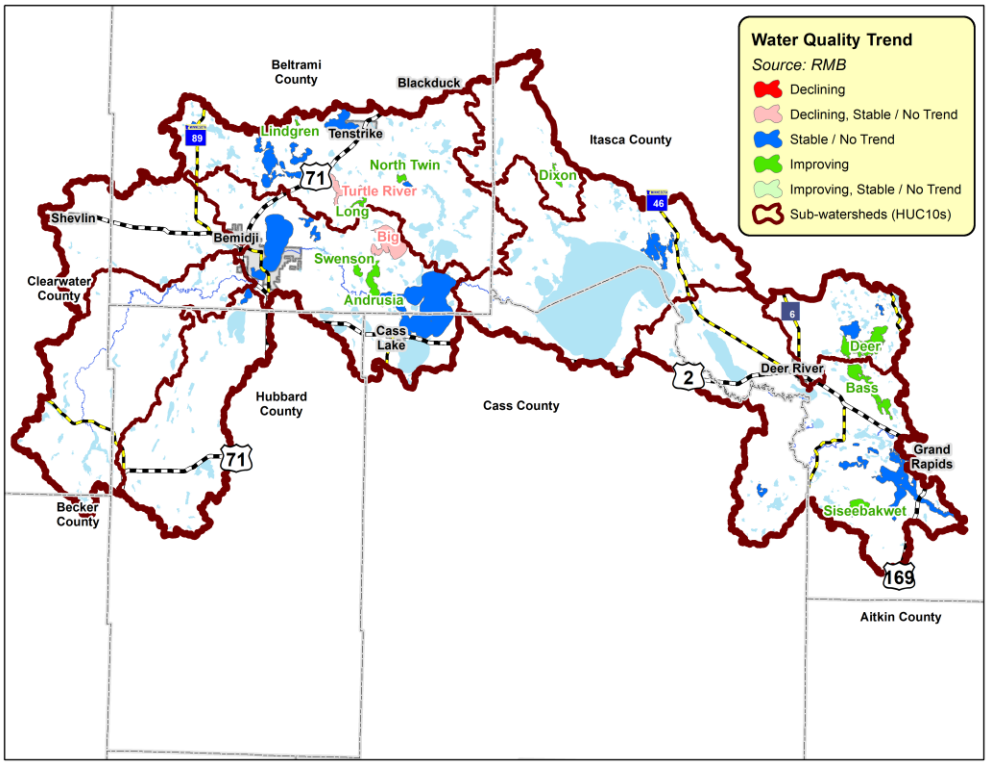


Figure 21. Nutrient impaired lakes.

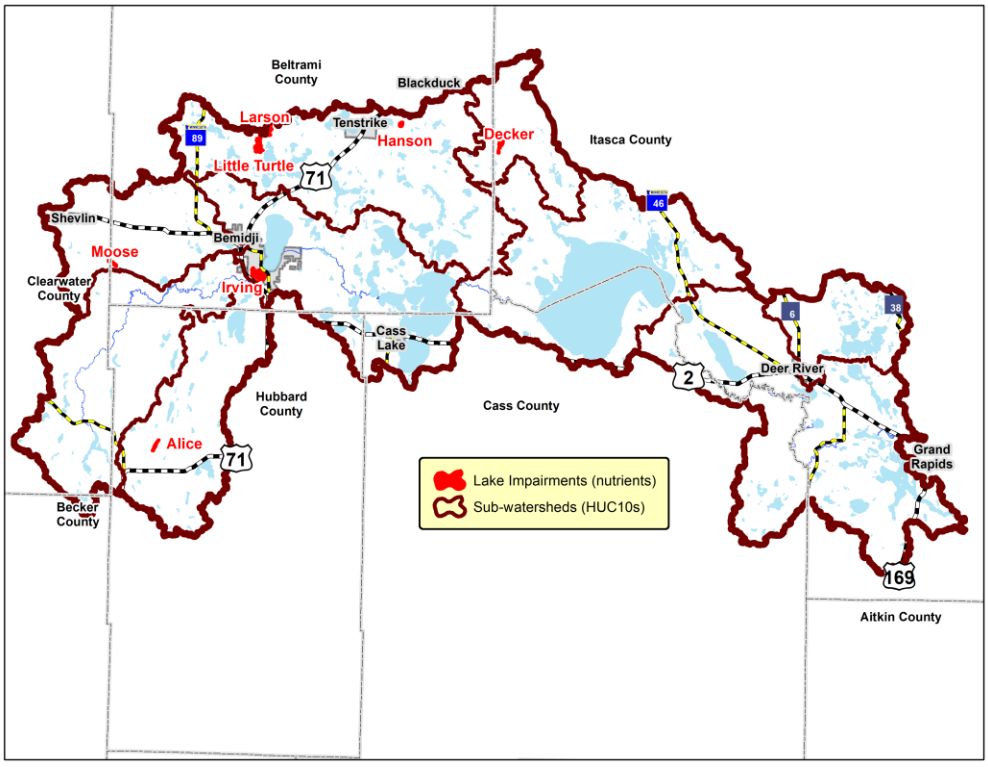


Figure 22. Lakes of phosphorus sensitivity significance.

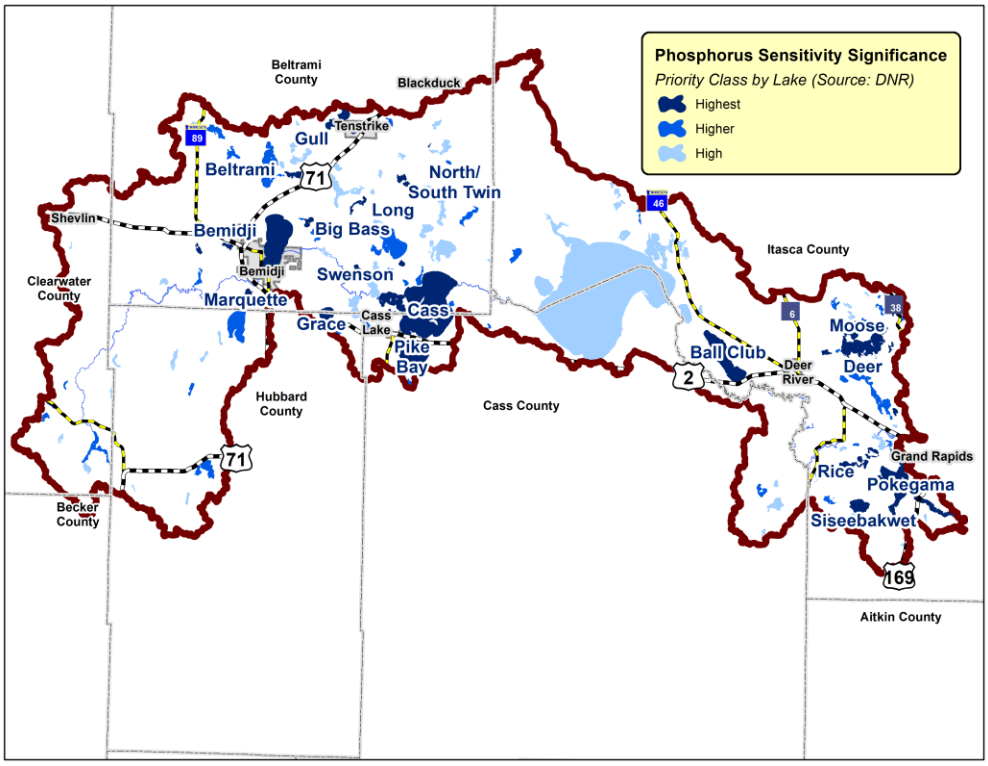


Figure 23. Lakes of biological significance.

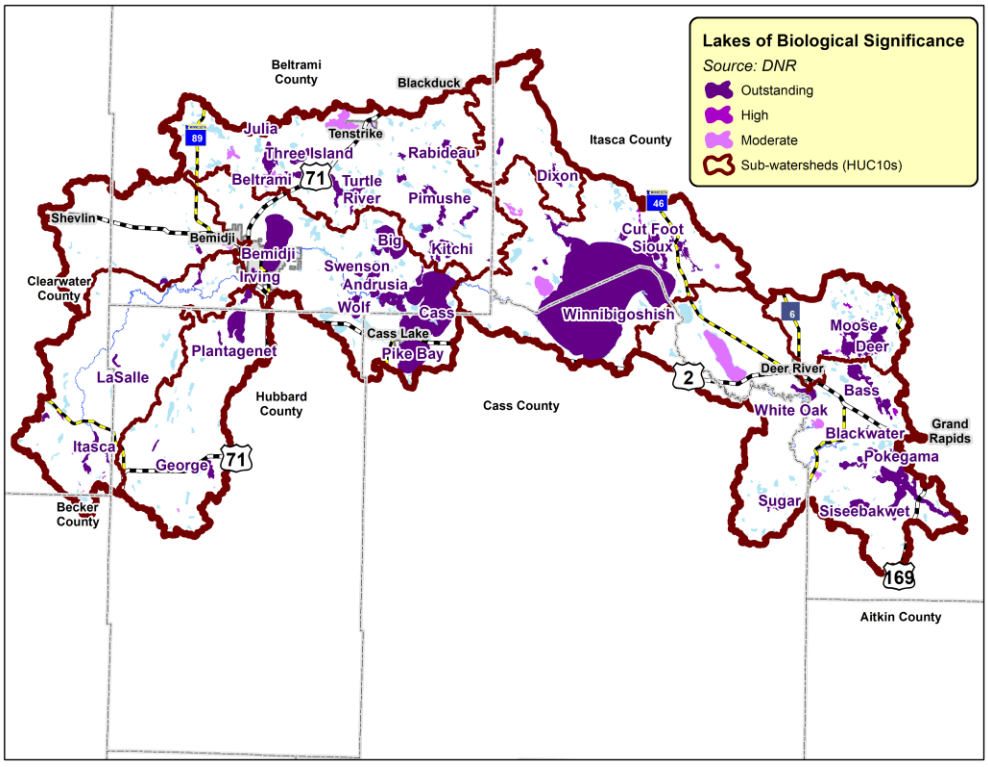


Figure 24. Wild rice, cisco refuge, and trout lakes.

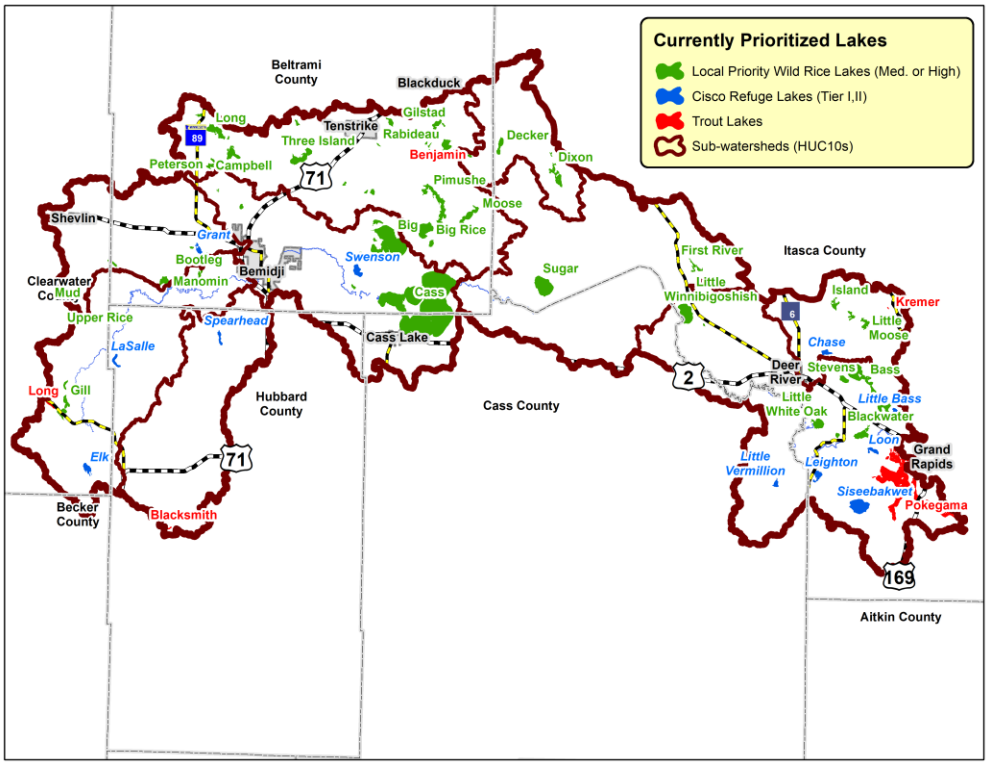
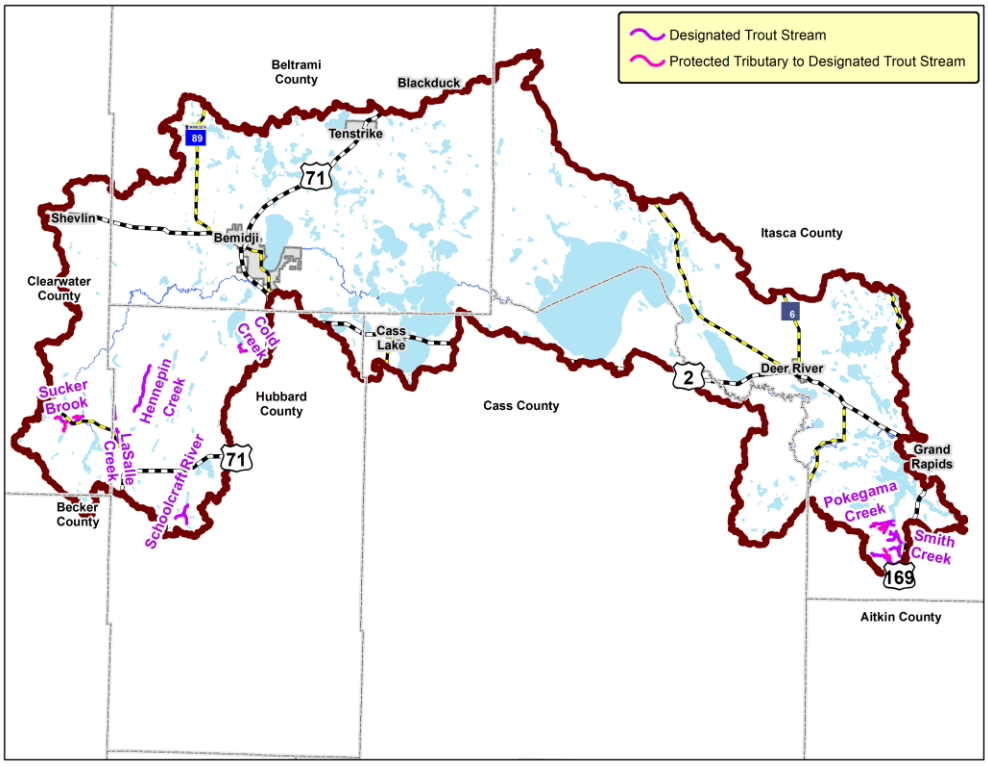


Figure 25. Designated trout streams and tributaries.



Forest and Watershed Disturbance

Figure 26. Forest disturbance areas by year.

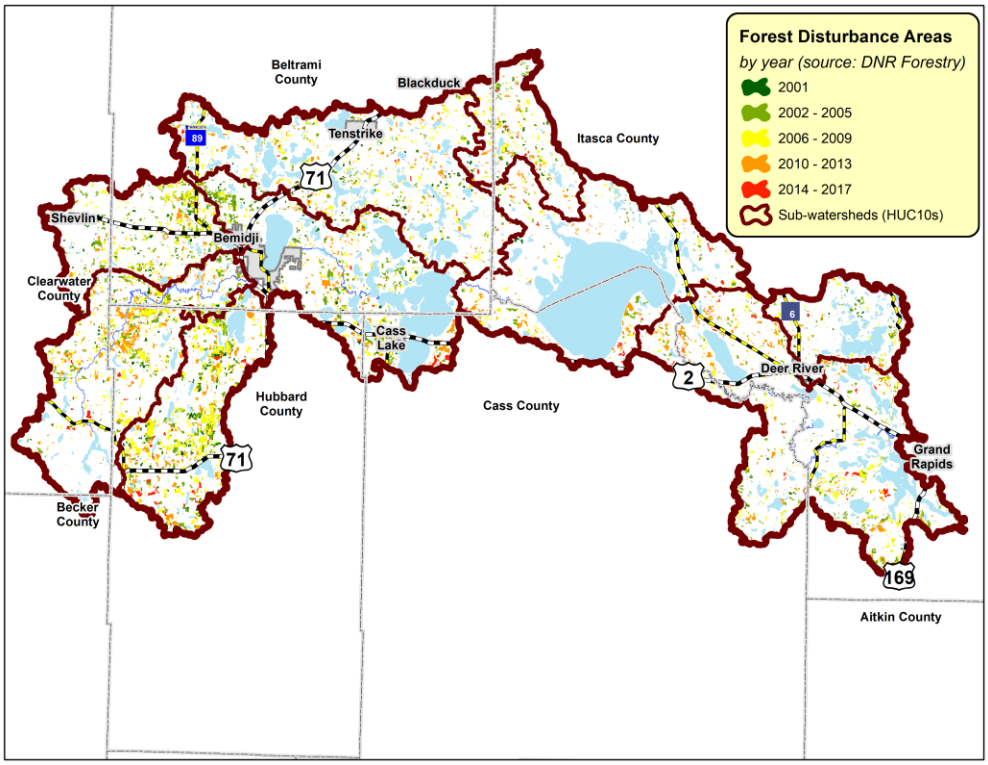


Figure 27. Forest disturbance levels by minor watershed (HUC 14).

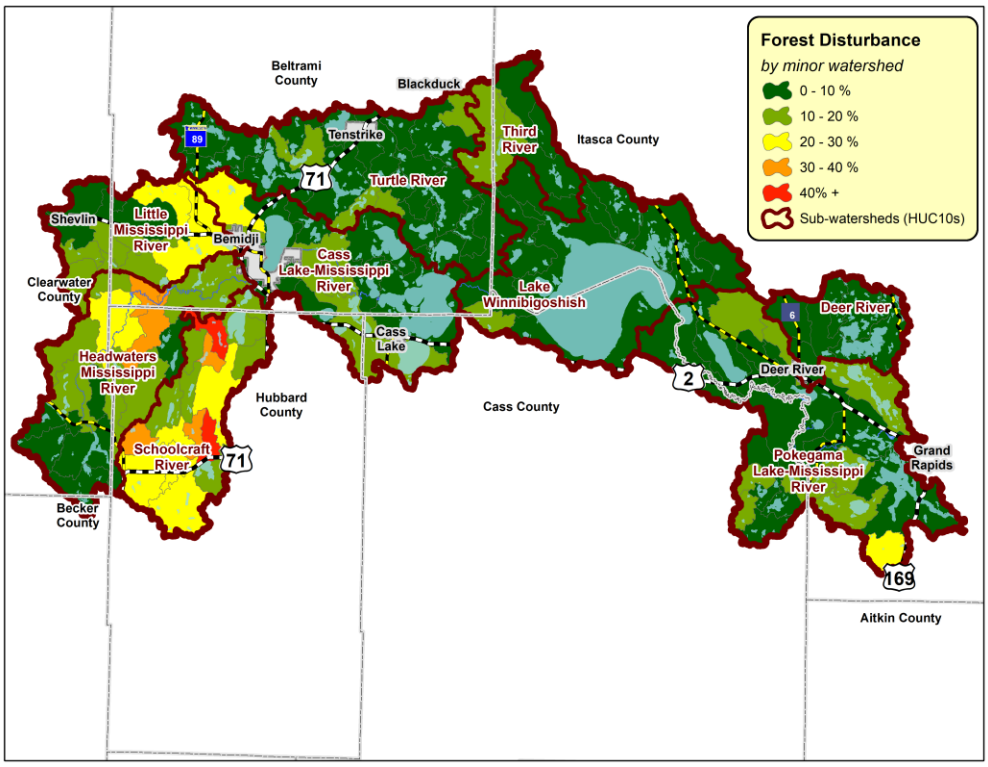


Figure 28. Average annual forest disturbance levels by minor watershed.

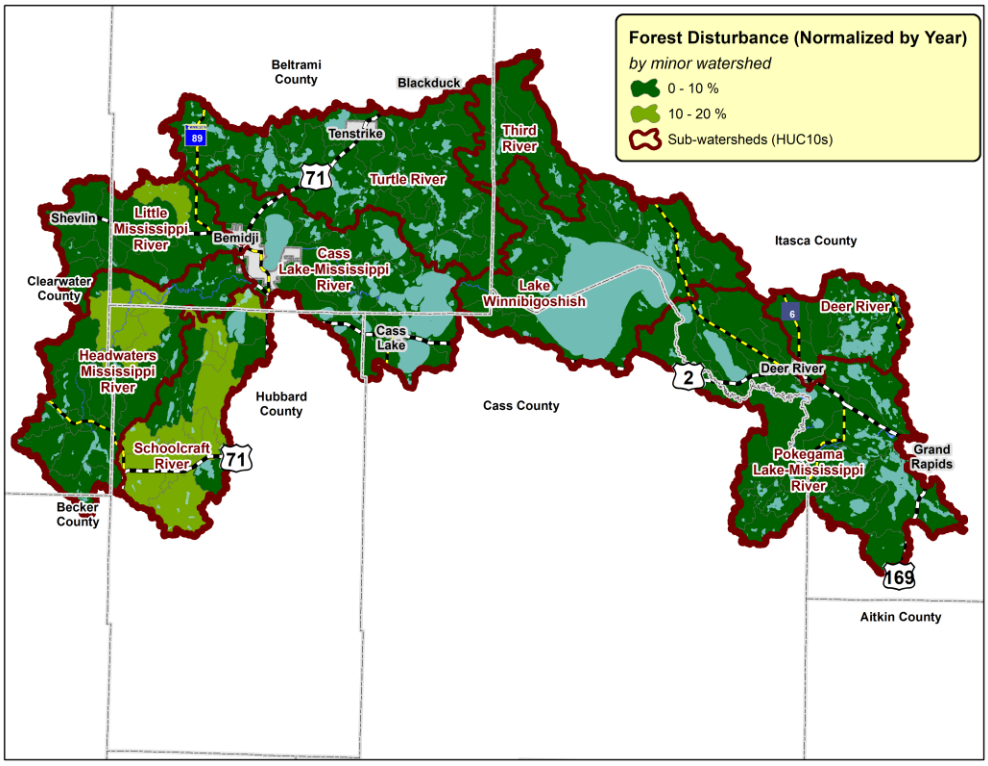
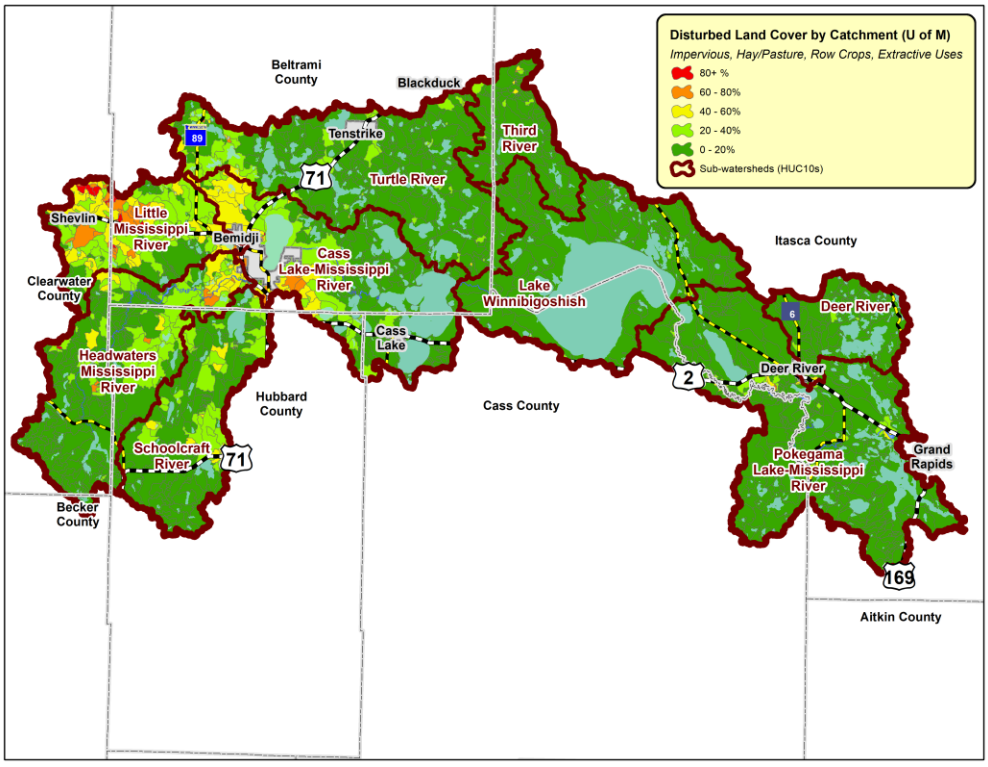


Figure 29. Disturbed land cover by catchment (DNR level 8).



Protection

Figure 30. Protected lands.

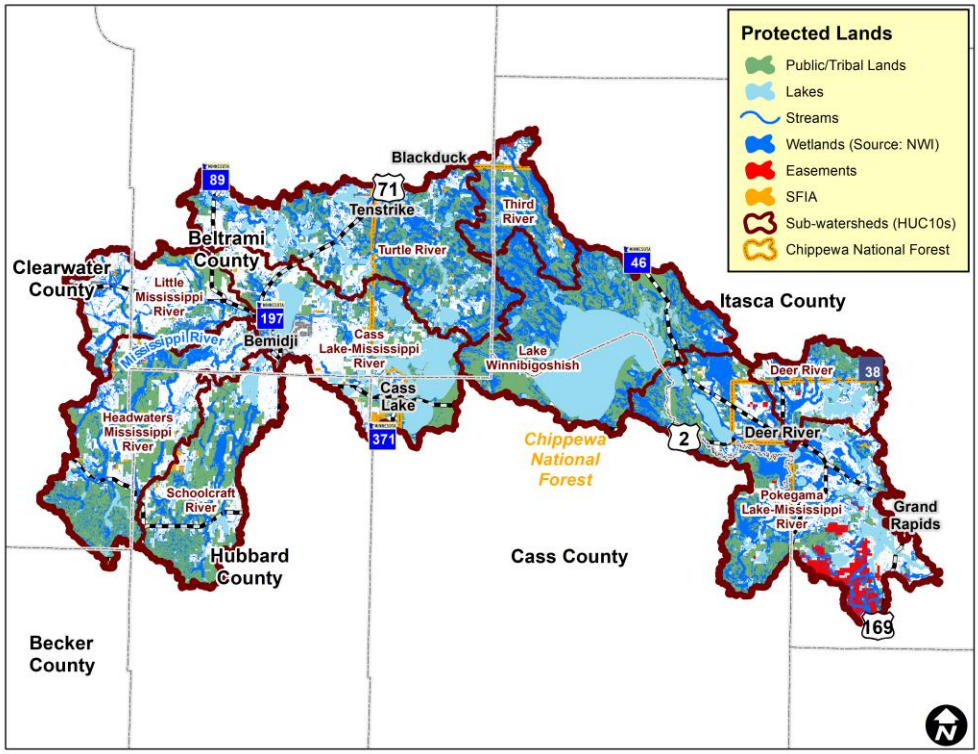


Figure 31. Public and tribal land ownership.

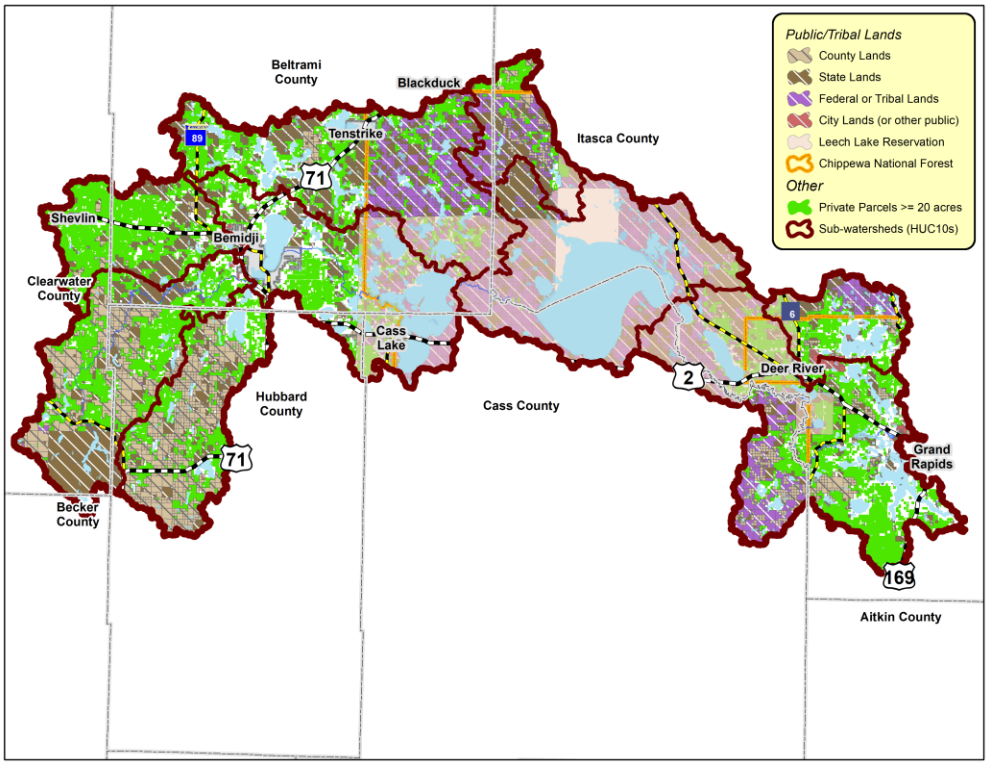


Figure 32. Subwatershed (HUC 10) protection levels.

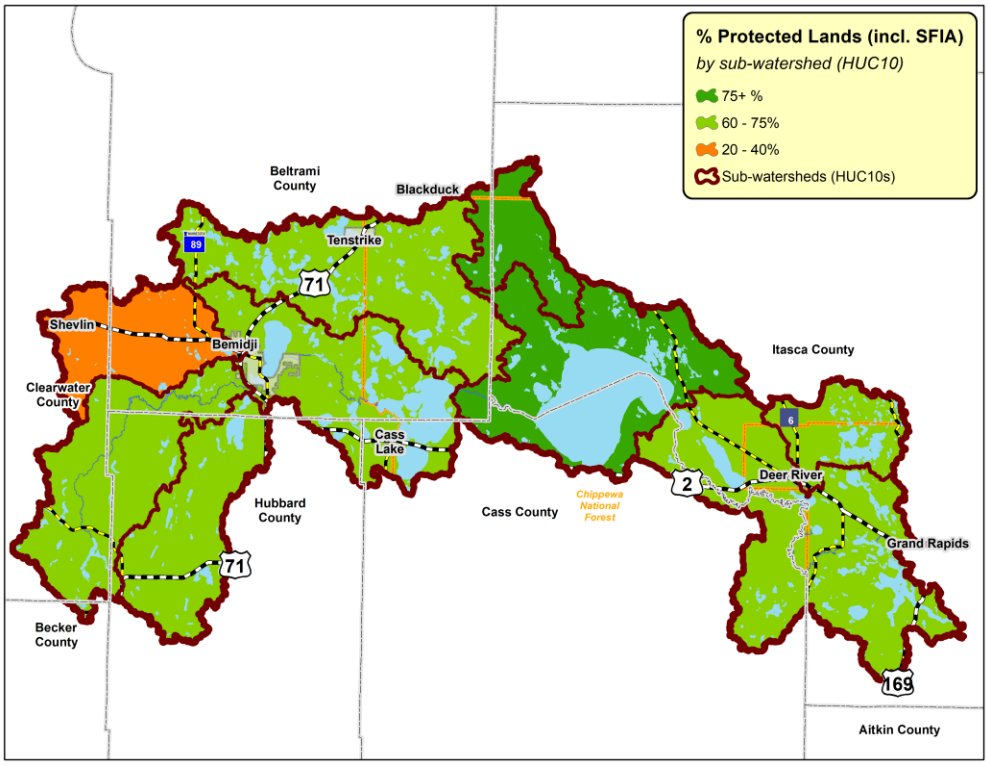


Figure 33. Minor watershed (HUC 14) protection levels.

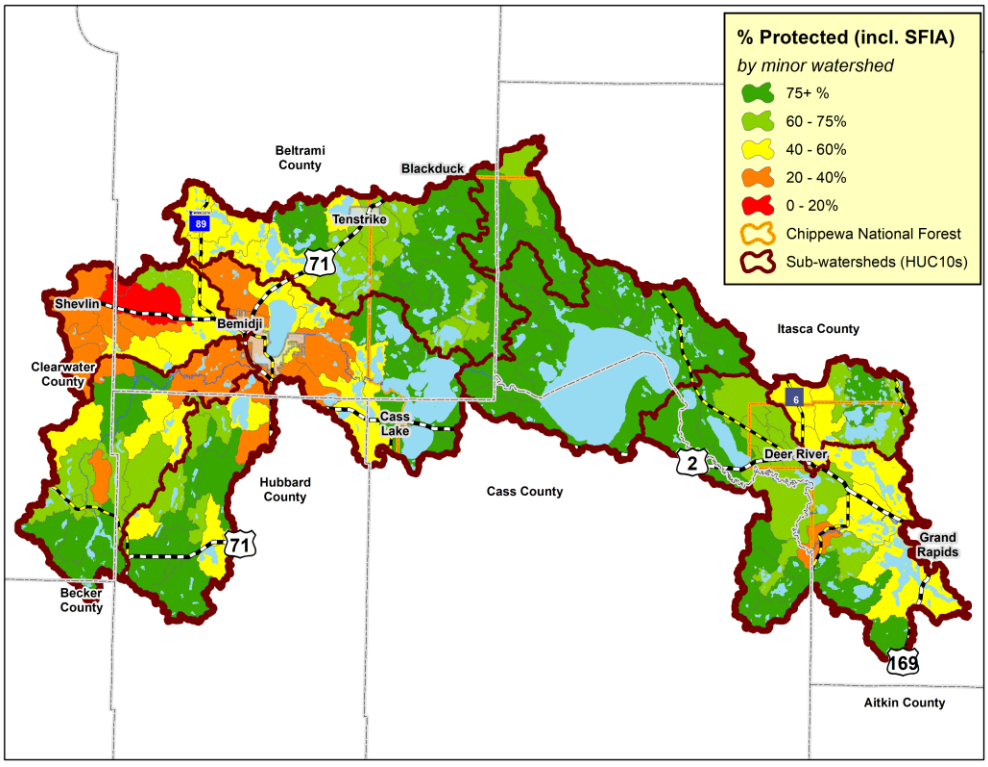


Figure 34. Parcels with the potential to protect.

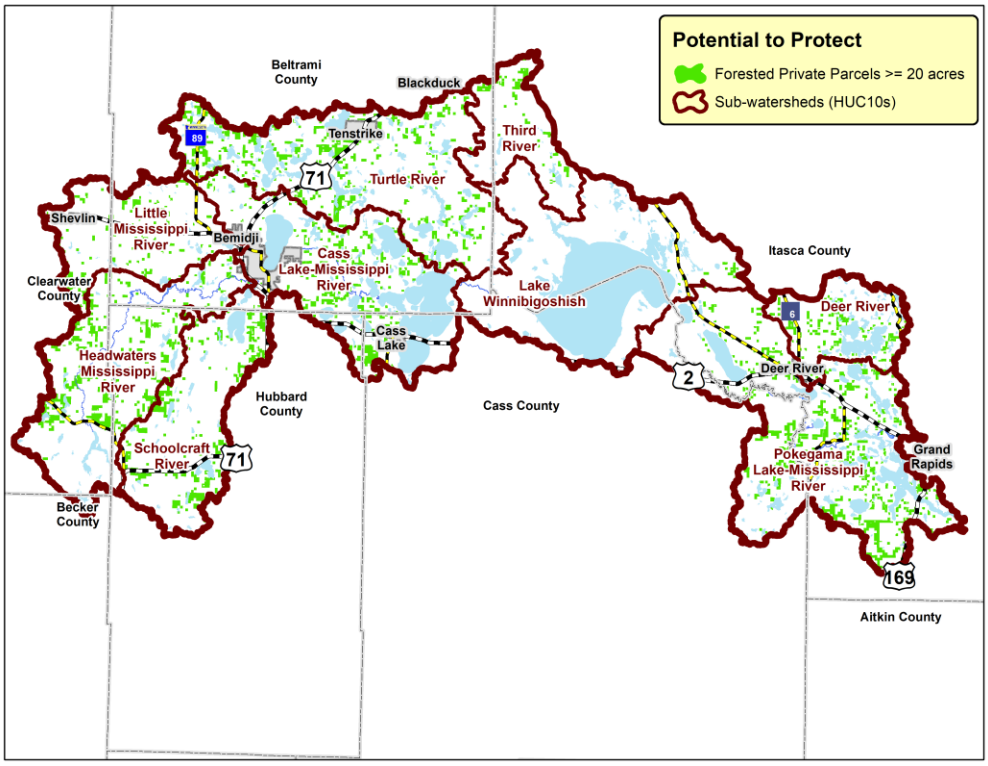


Figure 35. Potential to protect by minor watershed (HUC 14).

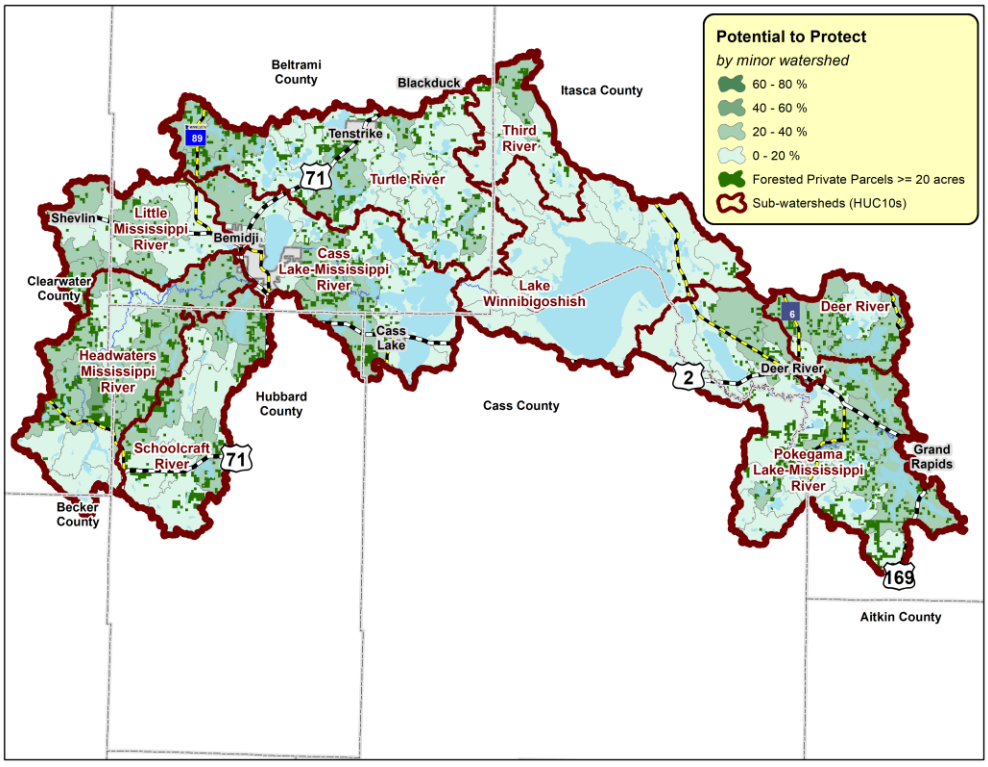
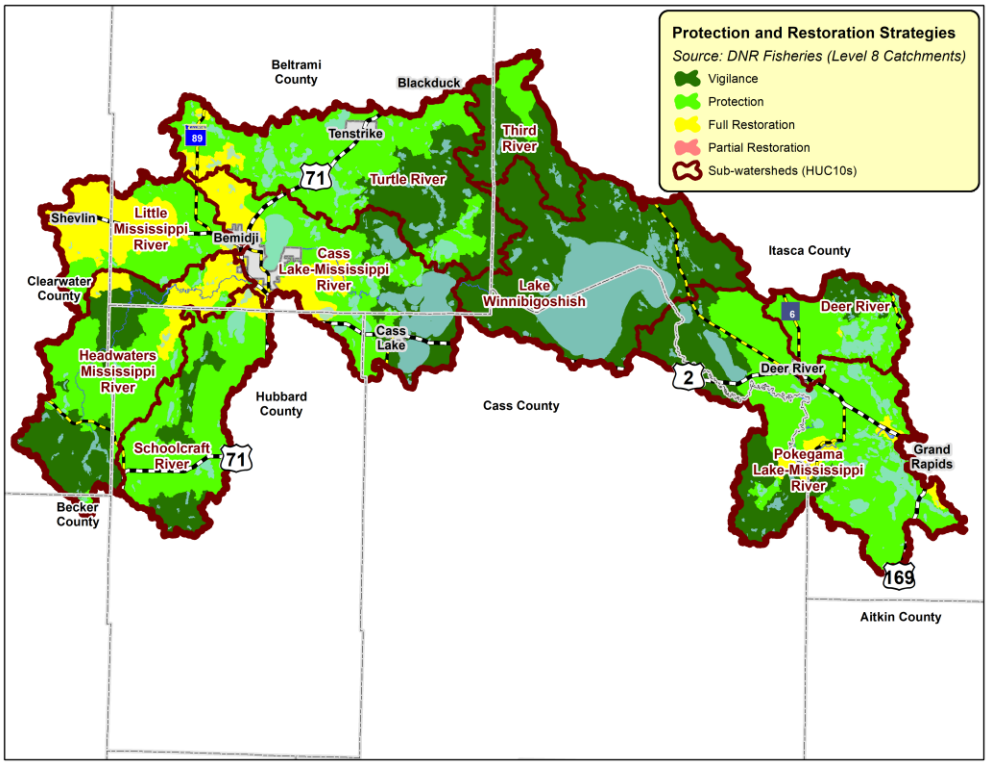


Figure 36. Protection/restoration classifications.



Conservation Priorities

Figure 37. Lessard-Sams Outdoor Heritage Council priorities.

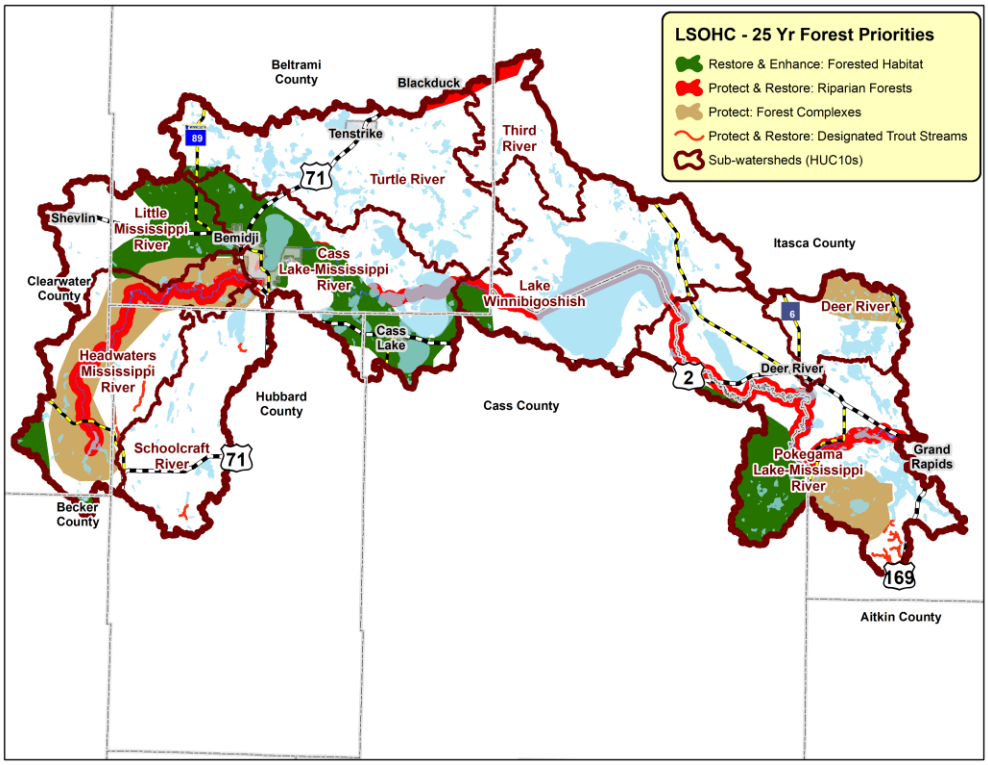


Figure 38. DNR Wildlife Action Network rankings.

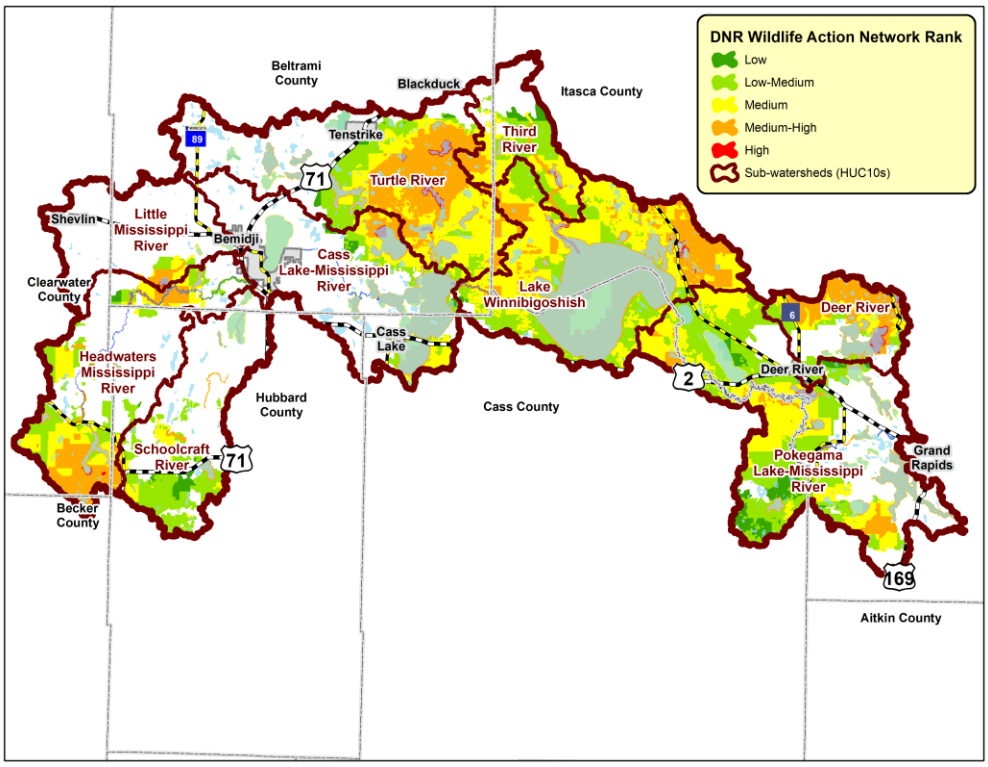


Figure 39. DNR Forests for the Future composite scores.

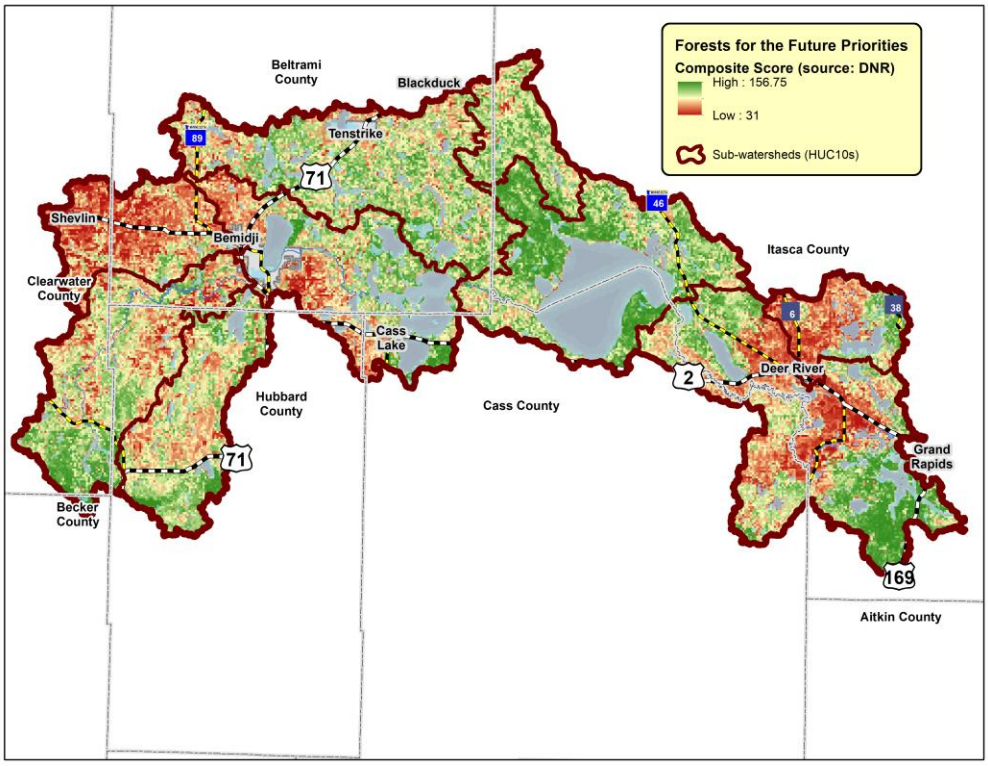


Figure 40. DNR Forests for the Future composite scores by minor watershed (HUC 14).

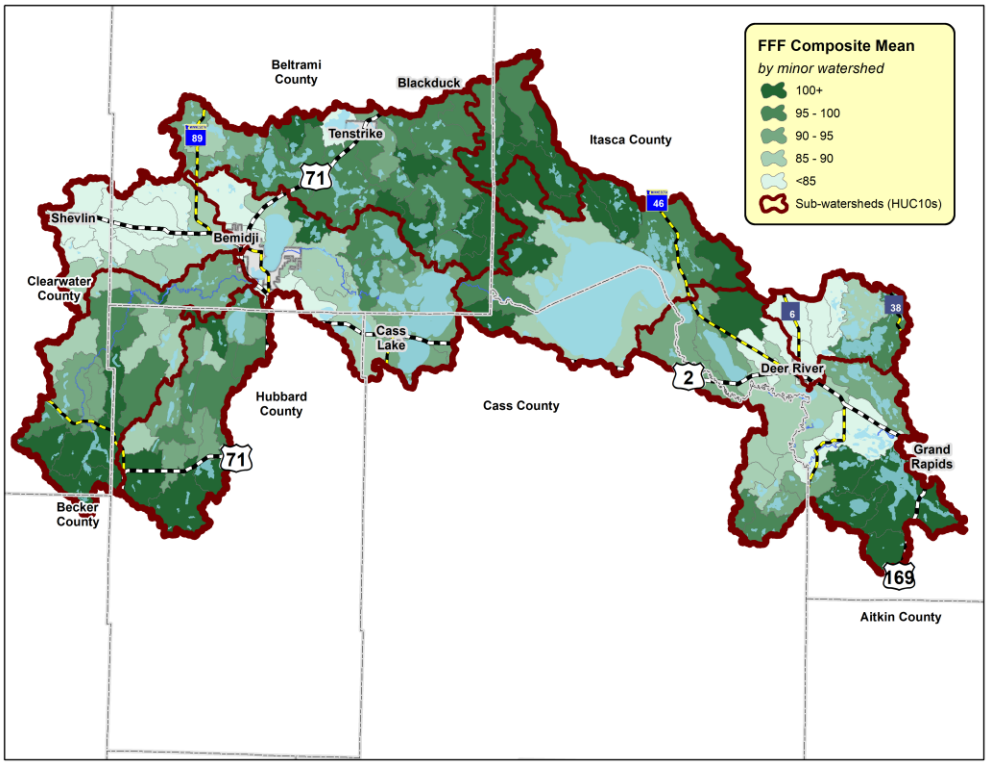
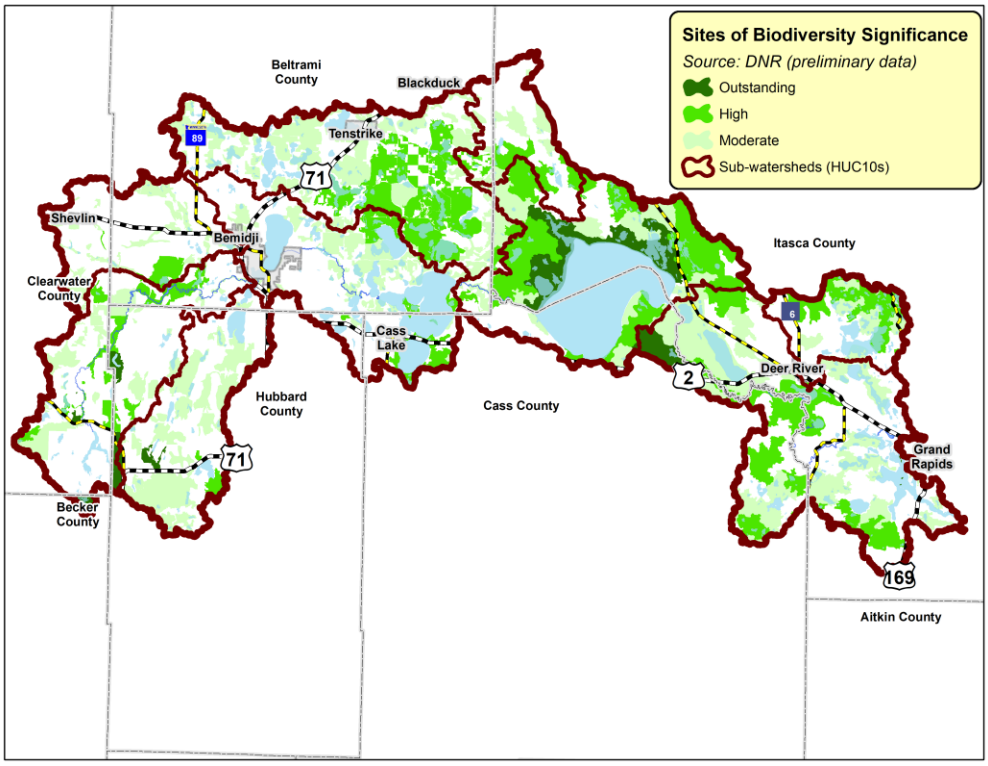


Figure 41. Minnesota Biological Survey (DNR) sites of biological significance.



Land Value

Figure 42. Total property values by minor watershed (HUC 14).

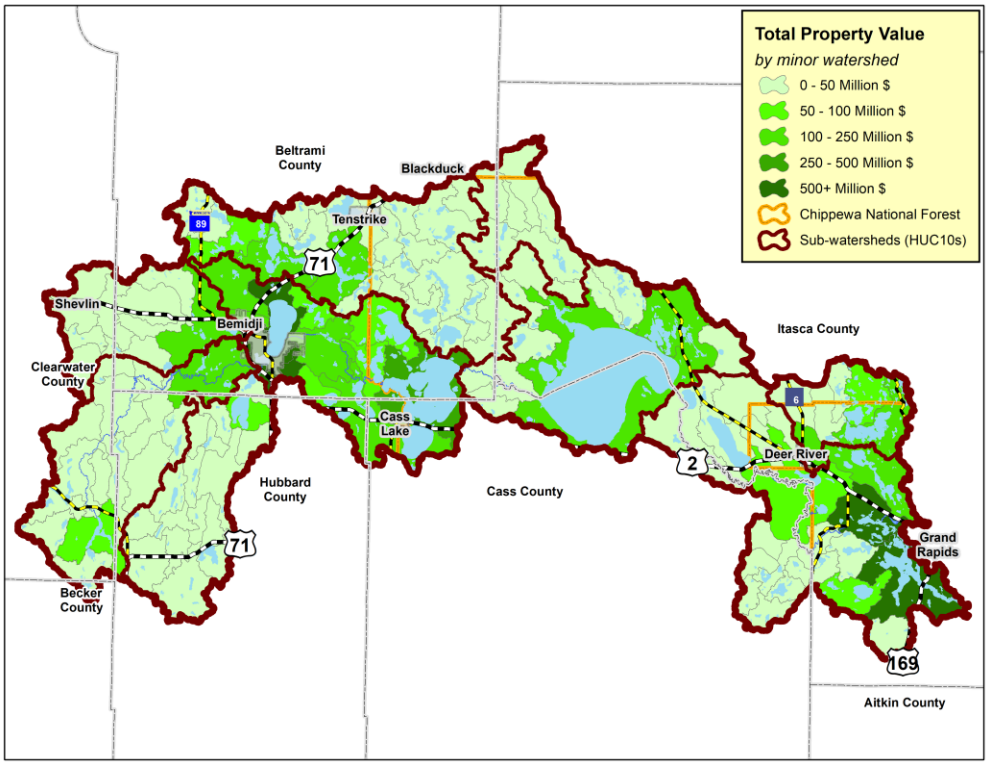


Figure 43. Large tract property values by minor watershed (HUC 14).

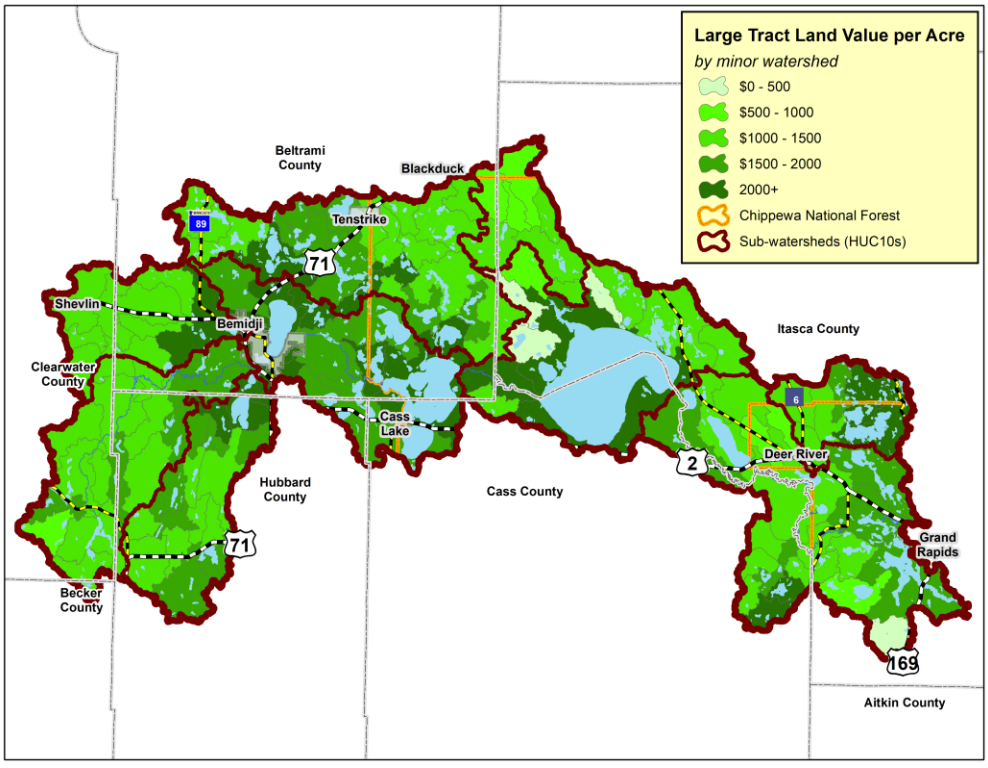
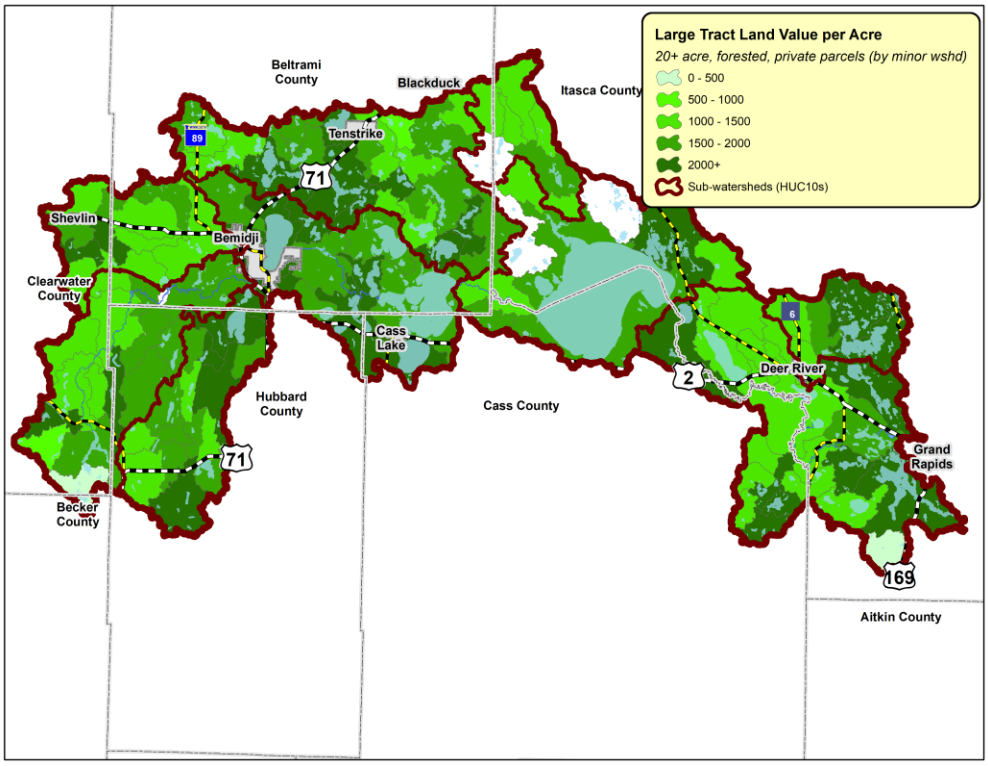


Figure 44. Large forested tract property values by minor watershed (HUC 14).



Population and Development Growth

Figure 45. Population change, 2000-2010.

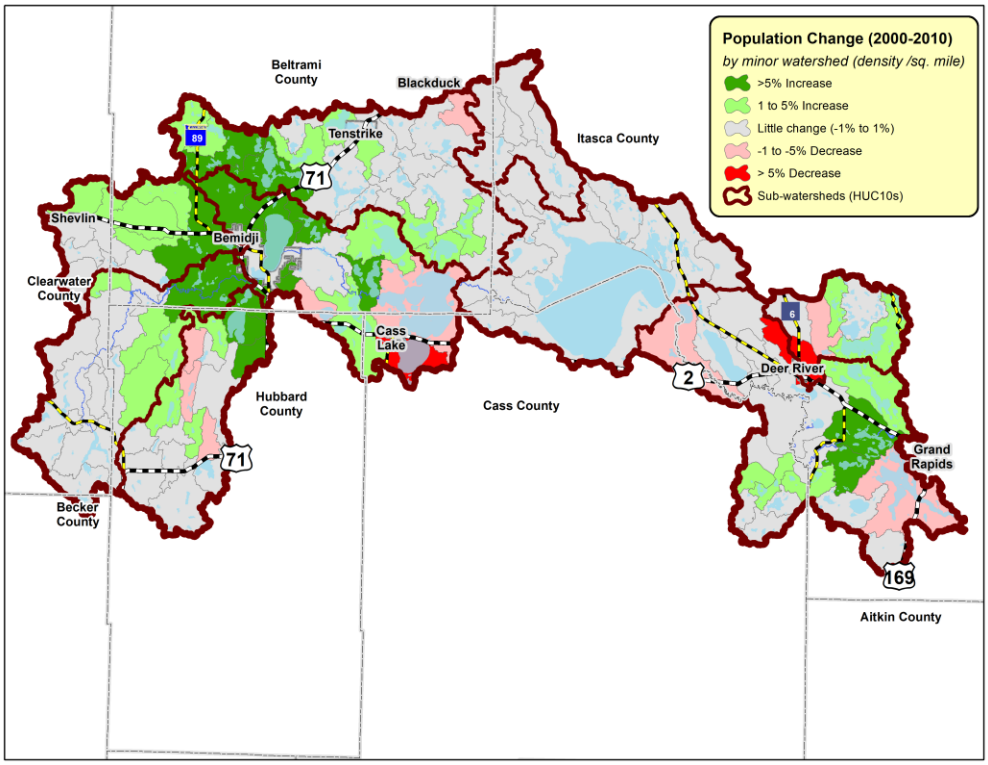
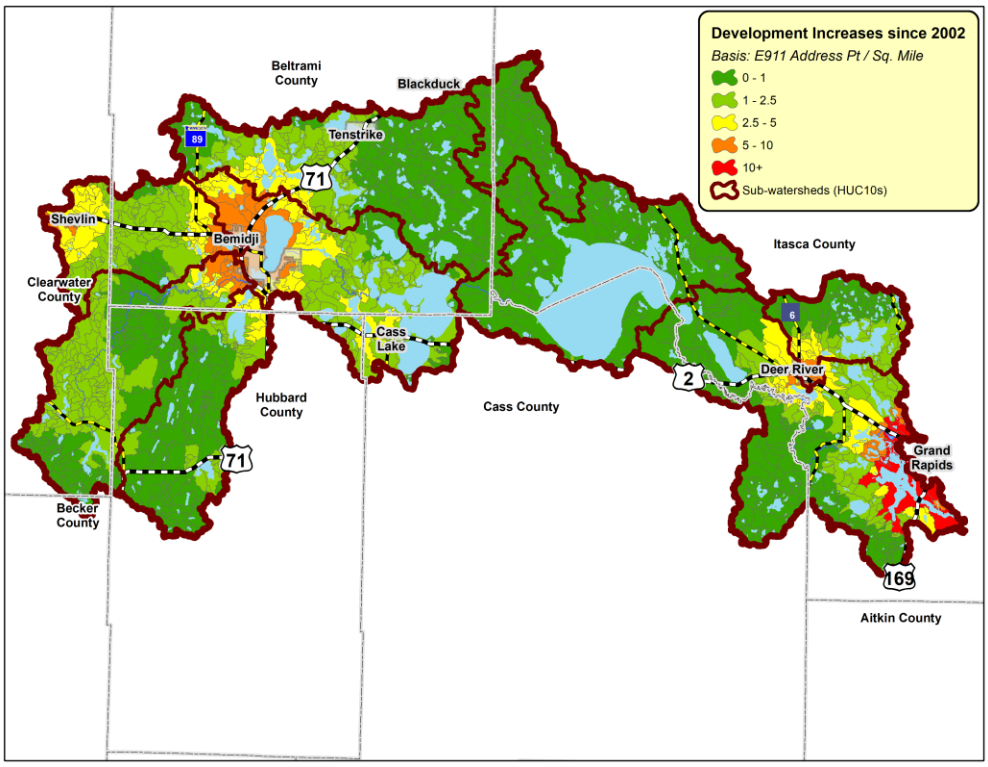


Figure 46. Development increases since 2002.



Growth – Roads – Zoning (GRZ)

Figure 47. Total GRZ scores.

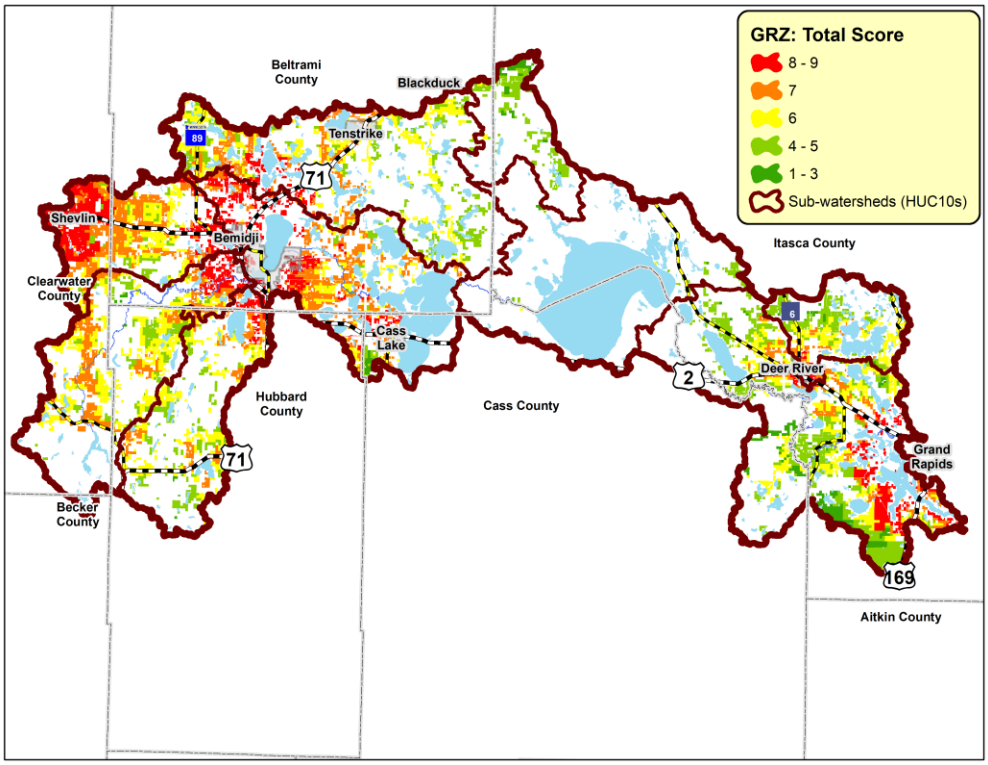


Figure 48. GRZ development scores.

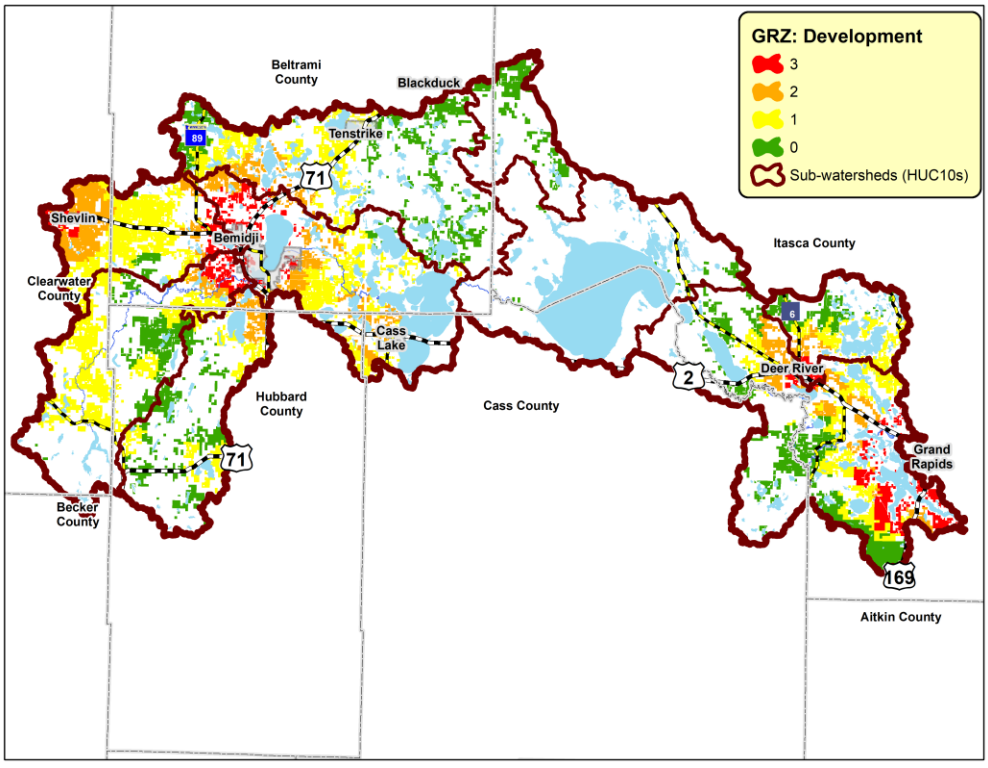


Figure 49. GRZ roads scores.

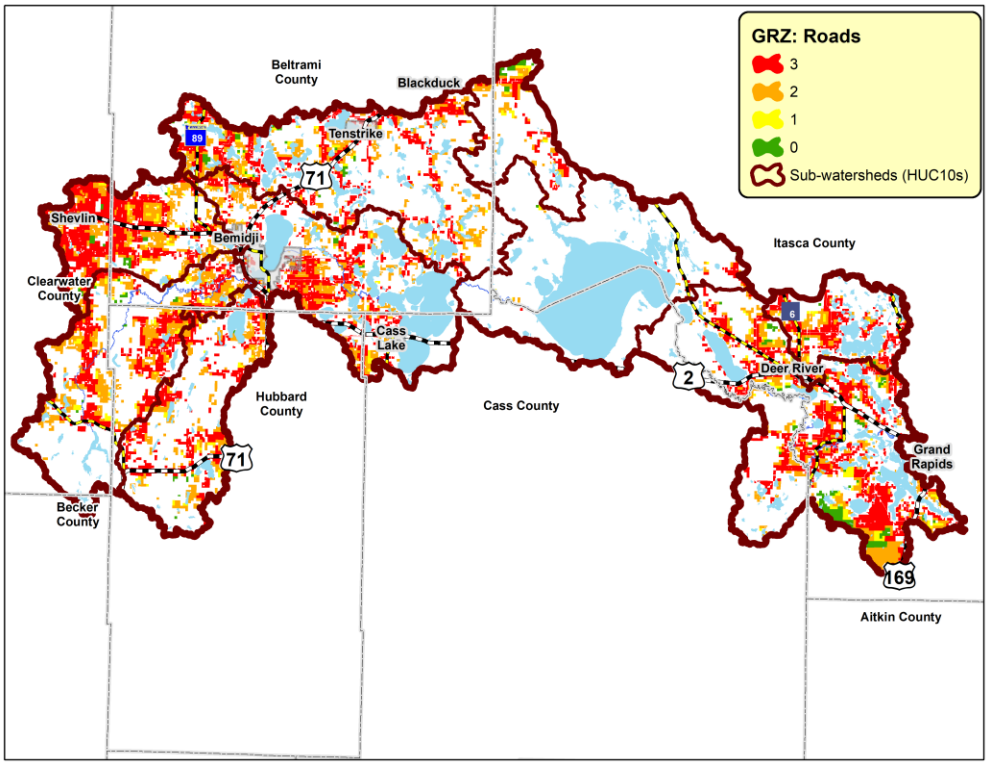
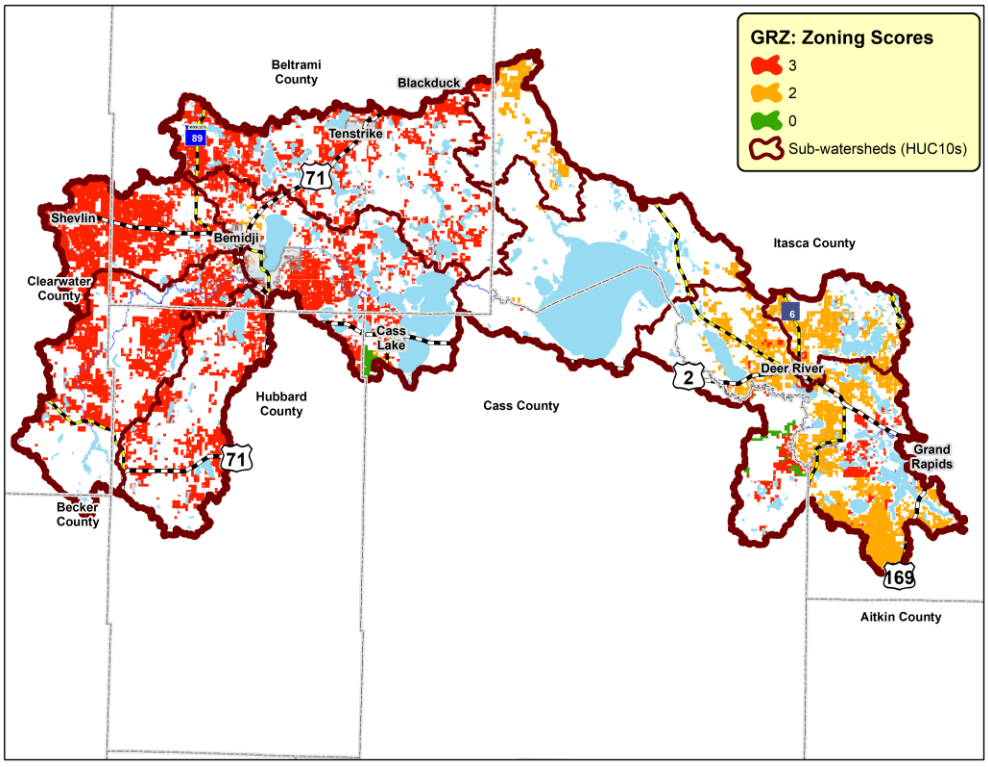


Figure 50. GRZ zoning scores.



Other

Figure 51. Priority PFM focus areas.

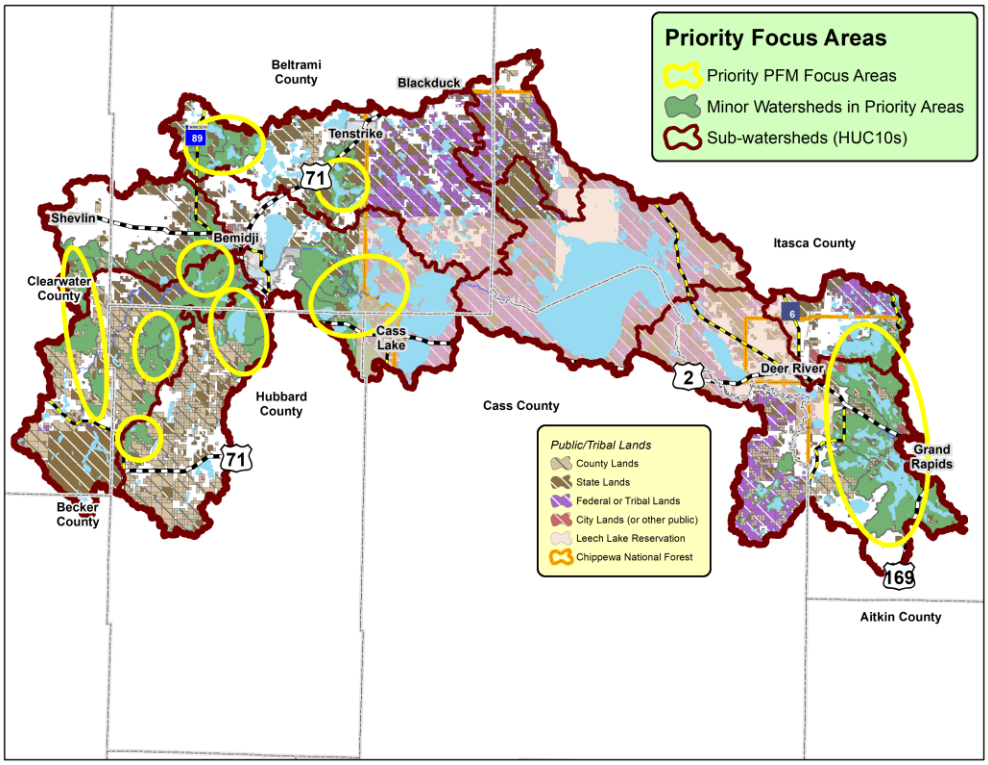


Figure 52. Current forest stewardship plan areas.

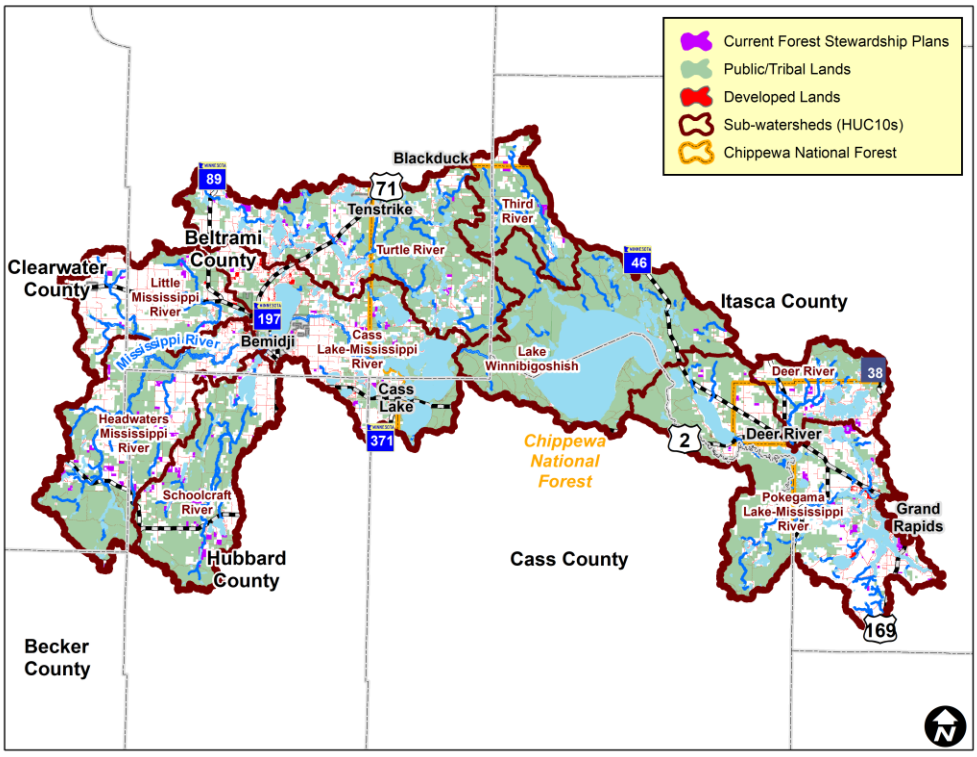
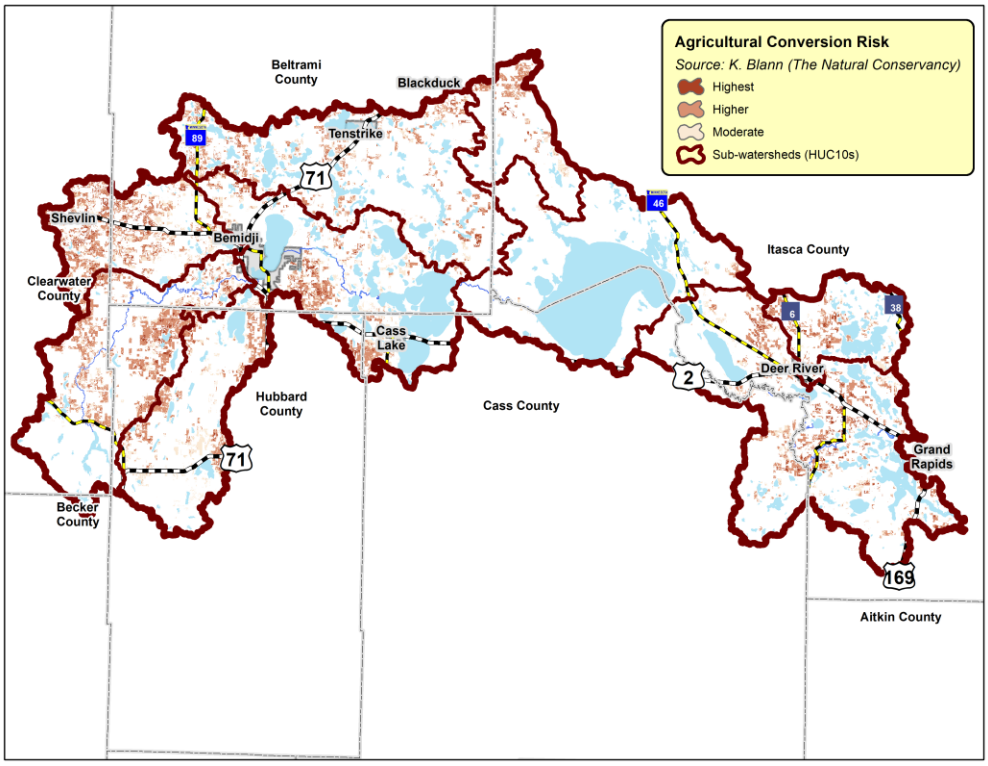


Figure 53. Agricultural conversion risk areas.



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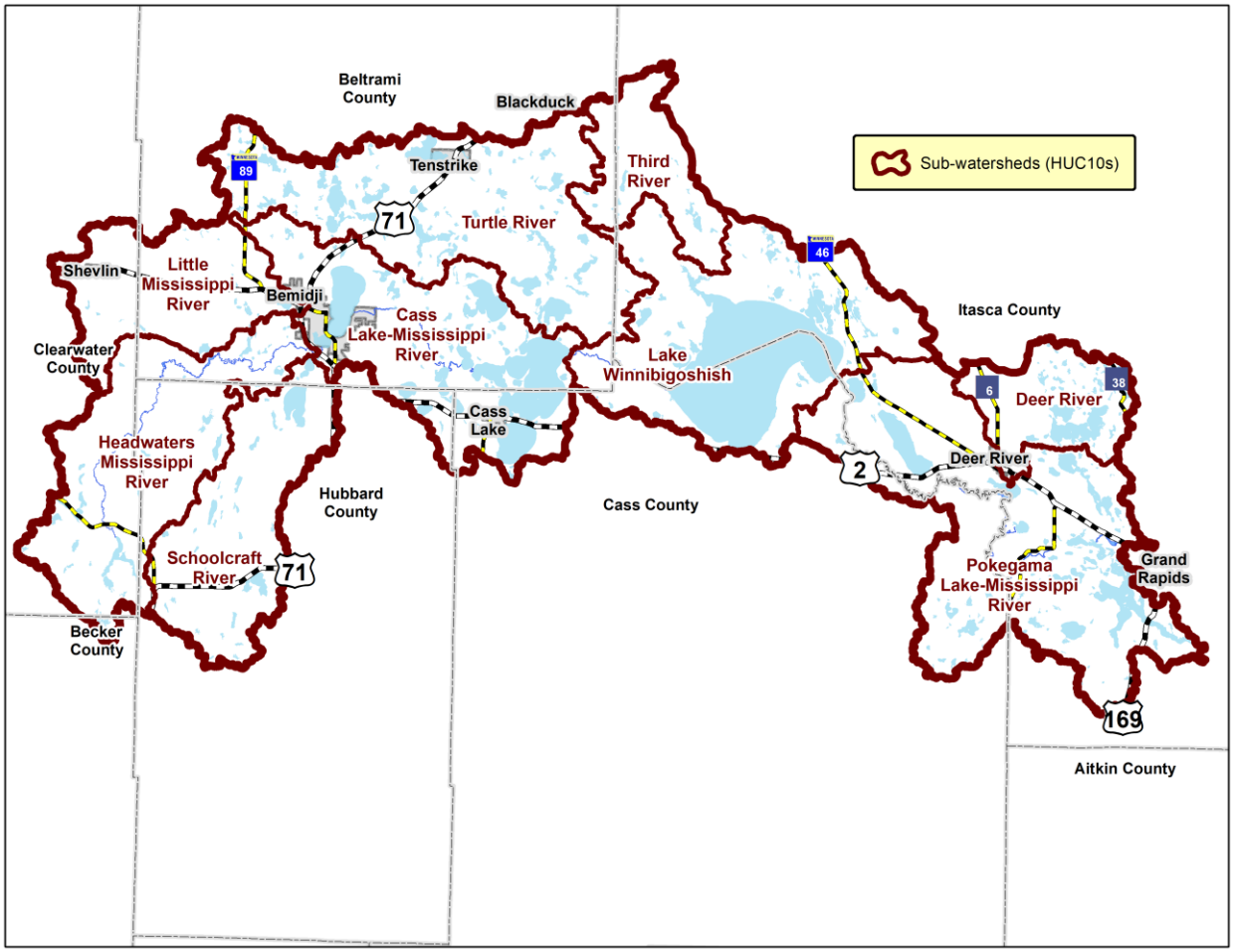
Subwatershed Analyses (HUC 10)

Developing water resource protection strategies within a watershed context is a logical, scientific approach because it acknowledges what landowners have known for years: that upstream activities affect those downstream. The question becomes at what scale is appropriate? Watersheds are classified at many scales, from region and basin scales down to smaller watershed and sub-watersheds, including minor watersheds and catchments. The Mississippi Headwaters Major Watershed is divided into 9 smaller or "sub" watershed units (HUC10 scale) as shown in the map below. Within each of these HUC10 sub-watersheds, are 6 to 22 minor watersheds, which are on average are 10,156 acres (15.9 sq. miles). Although major watersheds can be analyzed and modeled, it is difficult to implement since they typically cross municipal, county, and/or state boundaries.



The minor watershed is a sub-watershed unit of the HUC12 unit, which is a sub-watershed of the HUC10 unit. "The character of the minor watersheds drives the character of larger watersheds" (Sandy Verry, 2016). Implementation is also easier since many minor watersheds are within a single jurisdiction, focused on one or two primary surface water resources, and strategies can be better targeted and designed for optimal success and cost efficiencies. Each of the 121 minor watersheds are unique in their amount of protection, quality forest and water resources, and risk factors. These minor watersheds are highlighted in the following sections, which are organized by the HUC10 subwatershed unit. These HUC10 subwatersheds are summarized in the table below and on the following pages:

Subwatershed Characteristics

Below is a summary of the subwatershed and forest characteristics of the Mississippi Headwaters Major Watershed by subwatershed (HUC10):

Table 1. Subwatershed characteristics and indices of quality and risk.

	Headwaters - Miss River	Little Mississippi River	Schoolcraft River	Cass Lake - Mississippi River	Turtle River	Lake Winnibigosh-ish	Third River	Deer River	Pokegama Lake - Mississippi River
# of minor wshds	16	11	17	12	22	10	7	6	20
% forest cover	50%	24%	45%	27%	42%	30%	42%	49%	46%
% protected	67%	39%	70%	61%	72%	94%	83%	65%	73%
Potential to protect	22%	30%	19%	14%	17%	1%	11%	21%	15%
Land use disturbance	20%	43%	19%	23%	16%	7%	12%	12%	13%
# of lakes	39	20	31	62	95	54	14	44	89
Avg. lake size (ac)	147	77	217	686	248	1,226	107	199	293
Geomorphology	Moraine / Till Plan	Outwash	Moraine / Till Plain / Lacustrine	Outwash / Till Plain / Moraine	Moraine	Outwash	Moraine / Outwash	Outwash	Moraine / Outwash
Primary land cover	Open Lands, Forest	Open Lands	Open Lands, Forest	Open Lands, Forest, Lakes	Forest, Lakes	Forest, Lakes, Wetlands	Forest, Wetlands	Forest, Lakes	Forest, Lakes
Primary land uses	Forest, Pasture	Forest, Pasture	Forest, Pasture	Development / Ag	Forests, Development	Abundant Public/Tribal Lands	Abundant Public/Tribal Lands	Forest, Development	Forest, Development
Lake or stream based	Lake & Stream	Stream	Lake & Stream	Lake	Lake	Lake & Stream	Lake & Stream	Lake & Stream	Lake & Stream
Quality	Forests, Lakes/ Streams	Forests, Lakes/ Streams	Forests, Lakes/ Streams	Forests, Lakes/ Streams	Forests, Lakes	Forests, Lakes/ Streams	Forests, Lakes/ Streams	Forests, Large Lakes	Forests, Lakes
Risks	Development near Bemidji, some ag	Ag	Development near Bemidji, some ag	Development	Development	Low Risk (> 75% Protection)	Low Risk (> 75% Protection)	Development	Development (lower part)
Total acres needed for protection goal	12,339	5,517	5,902	21,939	5,999	0	0	5,383	3,921
Cost to achieve protection goal	$12,835,991	$5,595,175	$7,012,893	$27,970,225	$6,556,182	$0	$0	$6,318,176	$3,992,335
Avg. land value (20+ acre, private parcels)	$1,361	$1,274	$1,854	$2,143	$1,536	$1,864	$1,021	$1,806	$1,287
Avg. RAQ score	3.0	2.1	3.0	2.8	4.2	6.0	3.8	4.3	3.8
Other				Declining water quality trends	High amount of private land				

Table 2. Composite Forests for the Future (FFF) scores and potential native plant communities.

Name	FFF score (composite mean)	Fire-Dependent		Mesic Hardwood		Acid & Forested Rich Peatland		Floodplain & Wet Forest		Open wetlands (Marsh, Open Peatland, Wet Meadow)	
Headwaters-Mississippi River	97.1	53,258	36%	58,601	40%	10,143	5%	15,821	11%	4,839	2%
Little Mississippi River	80.5	55,263	62%	10,891	12%	4,735	5%	15,624	18%	941	1%
Schoolcraft River	97.6	34,139	31%	47,950	44%	9,938	7%	6,995	6%	4,008	2%
Cass Lake-Mississippi River	89.3	72,661	46%	21,633	14%	5,386	3%	18,032	11%	504	0%
Turtle River	97.4	27,768	15%	80,614	43%	28,660	13%	29,491	16%	2,208	1%
Lake Winnibigoshish	96.4	47,467	25%	20,511	11%	31,767	11%	27,346	14%	356	0%
Third River	101.7	11,315	20%	18,826	33%	17,420	19%	7,752	14%	331	0%
Deer River	85.3	7,339	13%	19,566	35%	11,247	7%	9,528	17%	39	0%
Pokegama Lake-Mississippi River	93.5	42,230	18%	76,669	33%	45,676	13%	45,134	19%	282	0%
Total (or avg for FFF)	**93.6**	**351,440**	**29%**	**355,261**	**29%**	**164,971**	**9%**	**175,723**	**14%**	**13,508**	**1%**

Lake Characteristics

Below is a summary of the lake characteristics of the Mississippi Headwaters Major Watershed by subwatershed (HUC10). More information on the lakes will be detailed in the individual subwatershed sections to follow.

Figure 54. Lake size distribution.

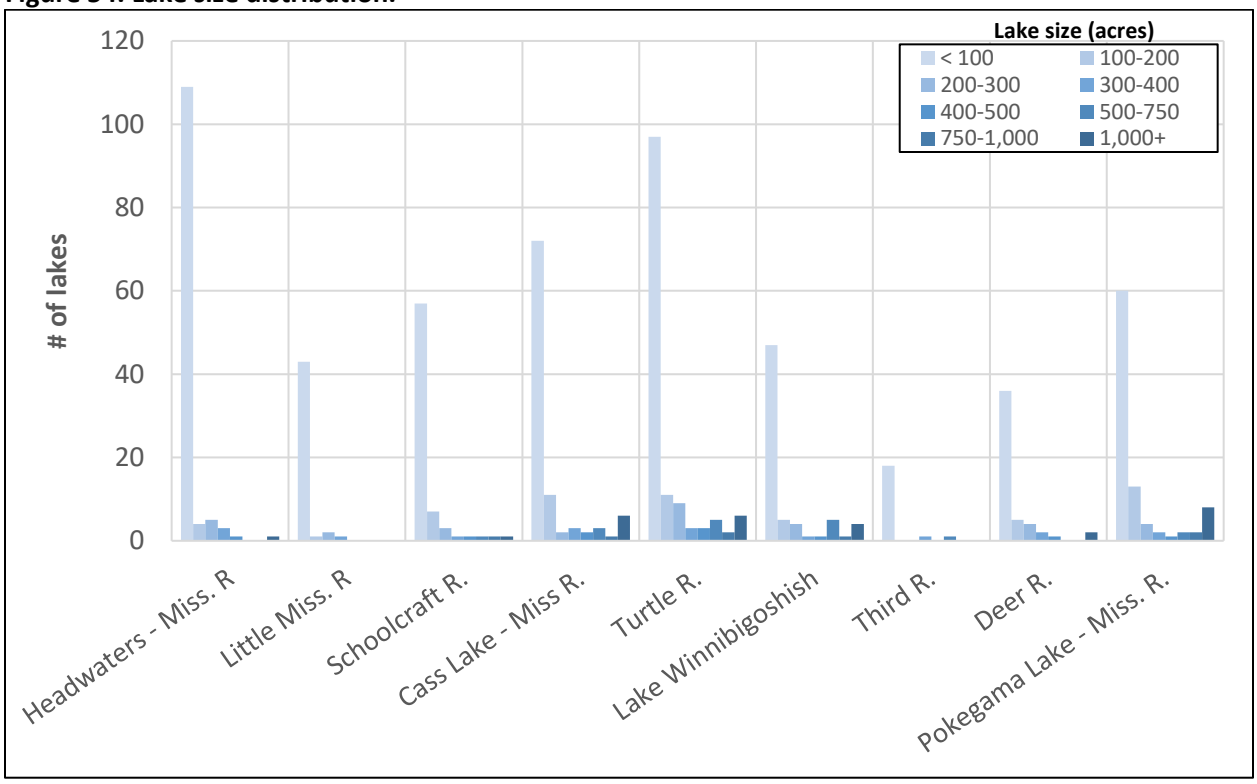


Table 3. Priority and at-risk lake estimates.

	Lakes of phosphorous sensitivity significance			Lake of biodiversity significance			Lake water quality trends			Outstanding water resources			
Name	**High**	**Higher**	**Highest**	**Moderate**	**High**	**Outstanding**	**Improving**	**Declining**	**Stable**	**Cisco/ tullibee**	**Trout**	**Priority wild rice**	**Priority shallow**
Headwaters – Miss. R.	5	4	2	5	2	7			4	2		7	7
Little Miss. R.	1	1	2	1		2			1	1		4	3
Schoolcraft R.	6	3	2	3		5		1	4	1	2	7	9
Cass Lake – Miss. R.	4	10	9			10	4	1	10	1		4	11
Turtle R.	12	8	10	4		16	3	3	11		1	18	17
Lake Winnibigoshish	5	6	1	3	1	7			2			21	13
Third R.	1					2			1			6	4
Deer R.	6	8	5	2	2	4	1	1	5	1	1	2	
Pokegama Lake – Miss. R.	10	8	8	3	1	8	2		9	5	1	19	8
Totals	**50**	**48**	**39**	**21**	**6**	**61**	**10**	**6**	**47**	**11**	**5**	**88**	**72**

Subwatershed No. 1
Headwaters-Mississippi River (HUC 701010102)

Description

The Headwaters - Mississippi River Subwatershed drains 139 square miles of Clearwater, Hubbard, Beltrami, and Becker counties. It is the headwaters to the Mississippi River and receives water from the Little Mississippi River Subwatershed. The subwatershed is orientated in a southwest to northeast direction, with the headwaters located in the southwestern end and the outlet in the northeastern end and to the west of the city of Bemidji. The Headwaters – Mississippi River Subwatershed is heavily forested, although agriculture is common near the downstream (northeastern) end of the subwatershed.

Geography

The southwestern portion of this subwatershed is a high, hummocky end moraine deposited by the Wadena lobe during the last glaciation. It is within this deposit that Lake Itasca, and the beginnings of the Mississippi River, is located. The Mississippi River then flows north out of the high elevation and follows a ribbon of outwash on either side of which is till plain from the Itasca Moraine. Toward the end of the watershed the narrow outwash channel broadens into an outwash plain where the river is less constrained by changes in relief and allowed to meander through the landscape.

Figure 55. Geomorphological landforms.

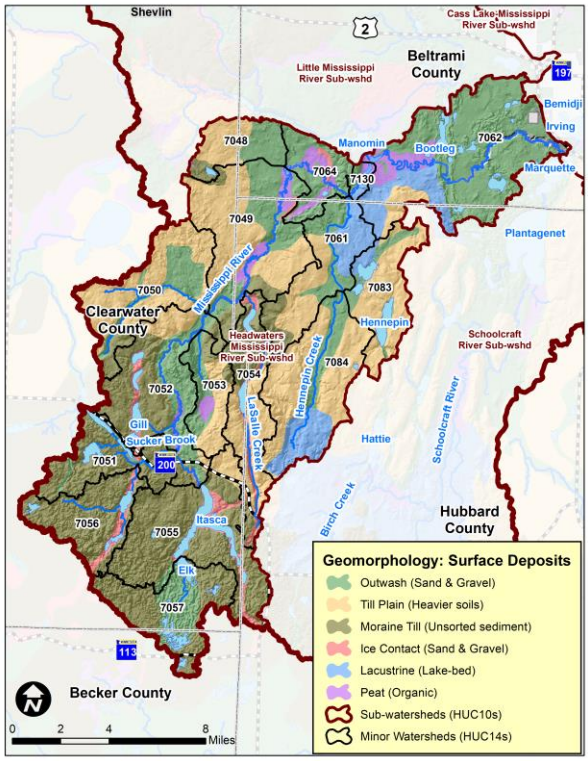
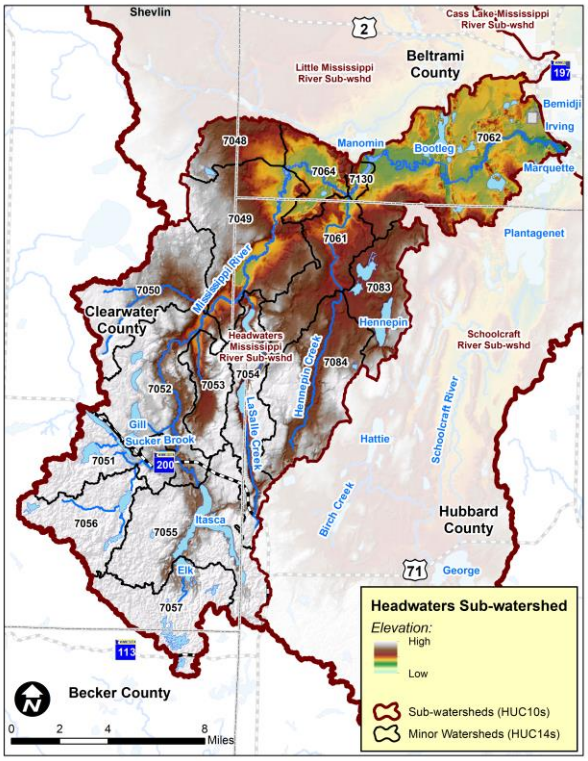


Figure 56. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Headwaters – Mississippi River Subwatershed was dominated by conifers, mainly jack and red pine. Scattered patches of aspen occurred on the Itasca Moraine near the headwaters as well as on the till plain near the middle of the subwatershed. In the lowland areas conifer swamps were the primary vegetation type. Today the forest remains largely intact, although about 20% of the

subwatershed area has been converted to development or agriculture. The fragmentation is most obvious around the outskirts of Bemidji near the northeastern end of the subwatershed. The current forest composition is mostly an aspen/birch cover type, although larger stands of pines are present on the Bemidji Sand Plain LTA in the northern part of the subwatershed and some patches of northern hardwoods occur on the Itasca Moraine near the southern border.

Estimates of the potential native plant communities (NPCs) indicate fire-dependent communities can be supported on the outwash that occur along the Mississippi River and Hennepin Creek valleys, as well as on the outwash plain and lacustrine deposits in the northeast third of the subwatershed. Conversely, the potential for mesic hardwoods is greater on the moraine till and till plain deposits

Figure 57. Historic vegetation class.

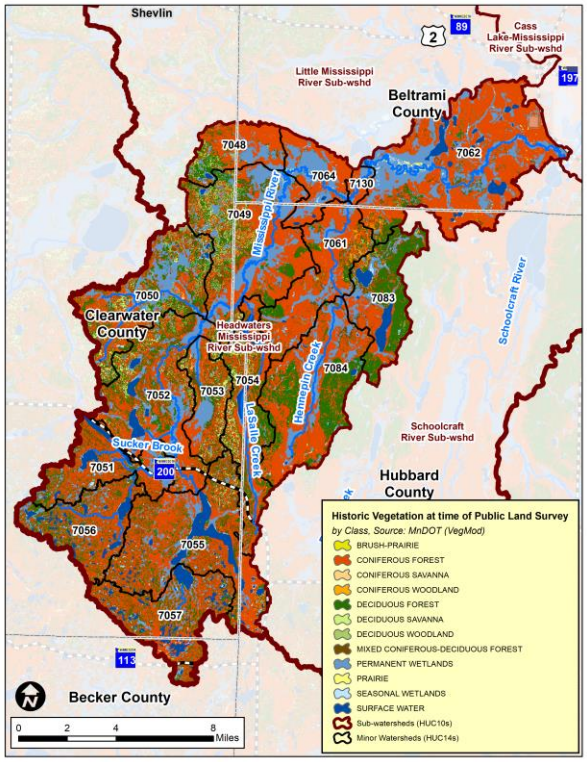


Figure 58. Land cover, 2013.

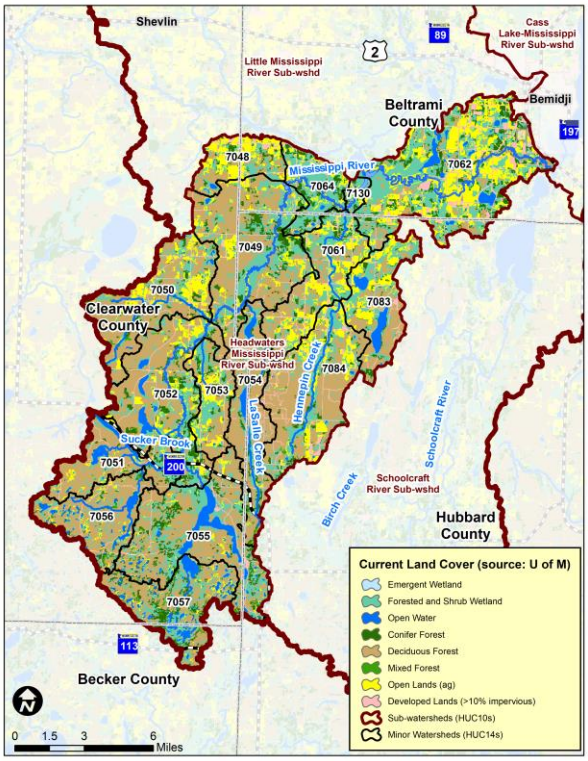
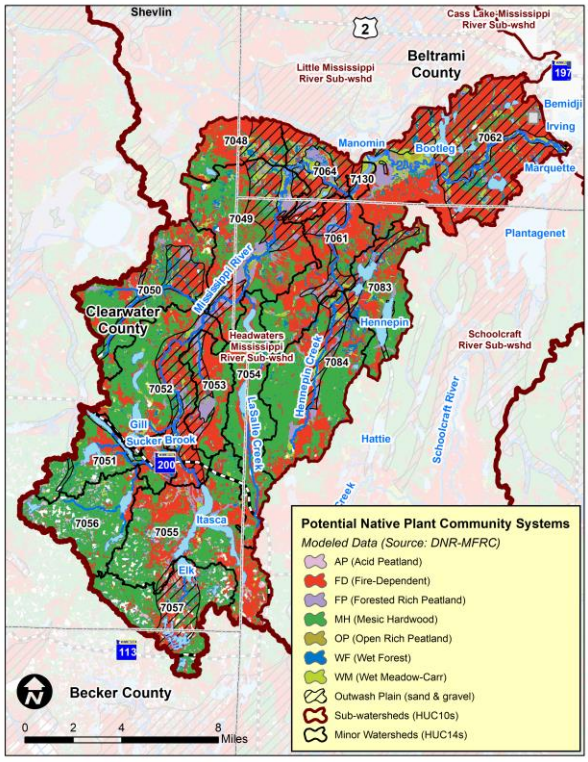


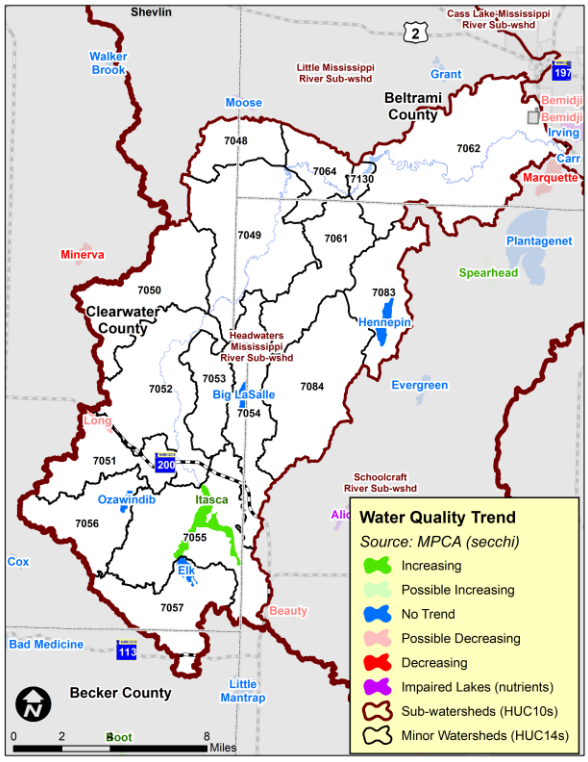
Figure 59. Potential native plant community systems.



Water Resources Summary

Compared to other subwatersheds in the Mississippi Headwaters Major Watershed, the Headwaters-Mississippi Subwatershed has a higher density of streams (.48 miles/mile^2) and more miles of trout stream (15.1 miles). As for lakes, this subwatershed has a high density of small lakes, ponds, and wetlands in the hills towards the head of the watershed, and several somewhat larger lakes elsewhere. Of the lakes with available water quality data most are stable with one (Lake Itasca) increasing. This subwatershed also boasts nine lakes of high or outstanding biodiversity significance, as well as two cisco refuge lakes, seven priority wild rice lakes, and seven priority shallow lakes.

Figure 60. Water quality trends.



Protection Status

67% of the Headwaters - Mississippi River Subwatershed is currently protected, mostly by county lands as well as Itasca State Park. Generally, there is less protection in the northeastern portion of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 12,339 acres need to be protected at an estimated cost of $12,835,991. Fortunately, nearly 33,000 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7050, 7052, 7053, 7061, 7062, 7083, and 7084.

Figure 61. Protected lands.

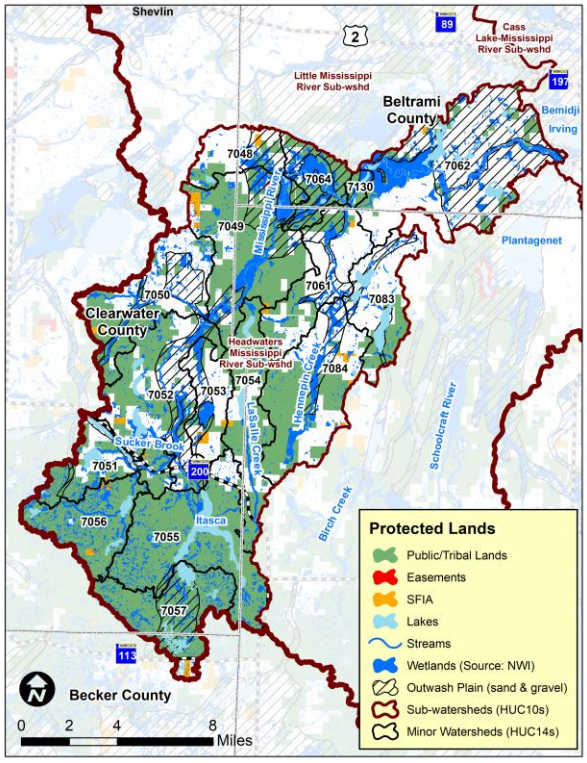
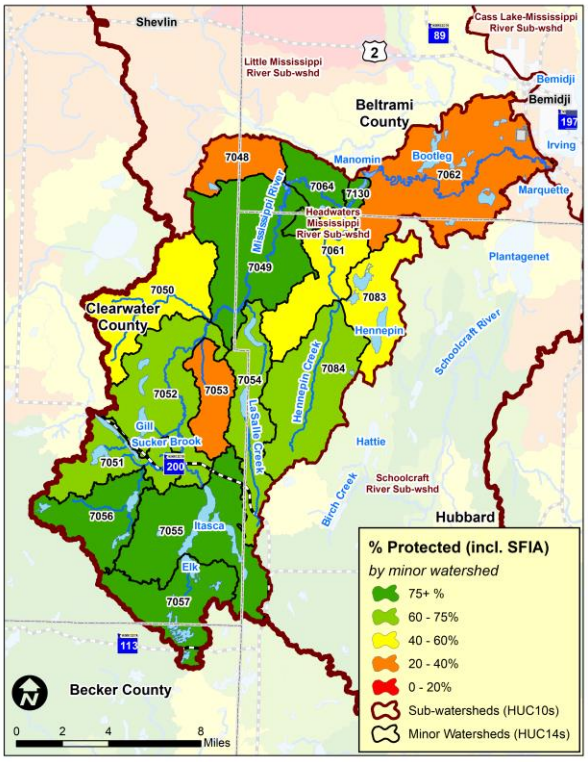


Figure 62. Minor watershed protection levels.



Subwatershed No. 2
Little Mississippi River (HUC 701010101)

Description

The Little Mississippi River Subwatershed drains 139 square miles of southern Clearwater and Beltrami counties and is a tributary to the Headwaters – Mississippi River Subwatershed. It is located to the west of the city of Bemidji and its shape is about twice as wide (east to west) and it is tall (north to south). The dominant land use in the central and western portions is agriculture, while forests are more common near its eastern end. The Little Mississippi River Subwatershed's rivers and streams converge in Manomin/Rice Lake in the south-central portion of the subwatershed before flowing into Mississippi River.

Geography

The Little Mississippi River Subwatershed is largely covered by an outwash deposit, although an area of moraine till from the Itasca Moraine is present near the center of the subwatershed. The landscape is level to gently rolling, and is relatively high in elevation when compared to other subwatersheds within the Mississippi Headwaters Major Waters.

Figure 63. Geomorphological landforms.

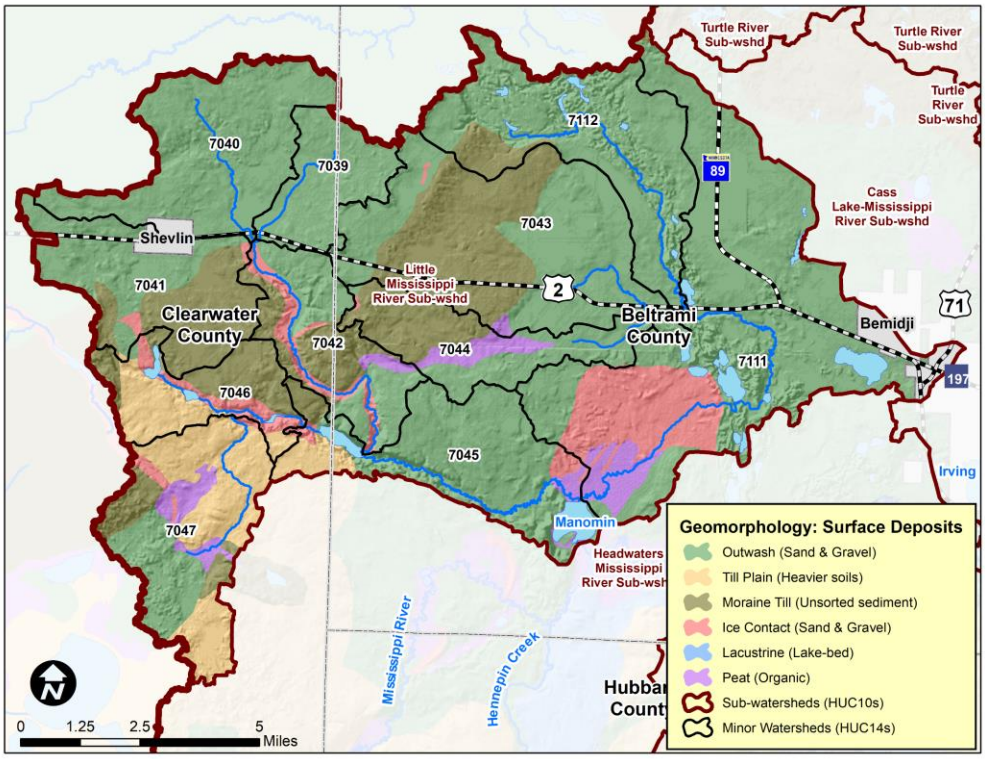
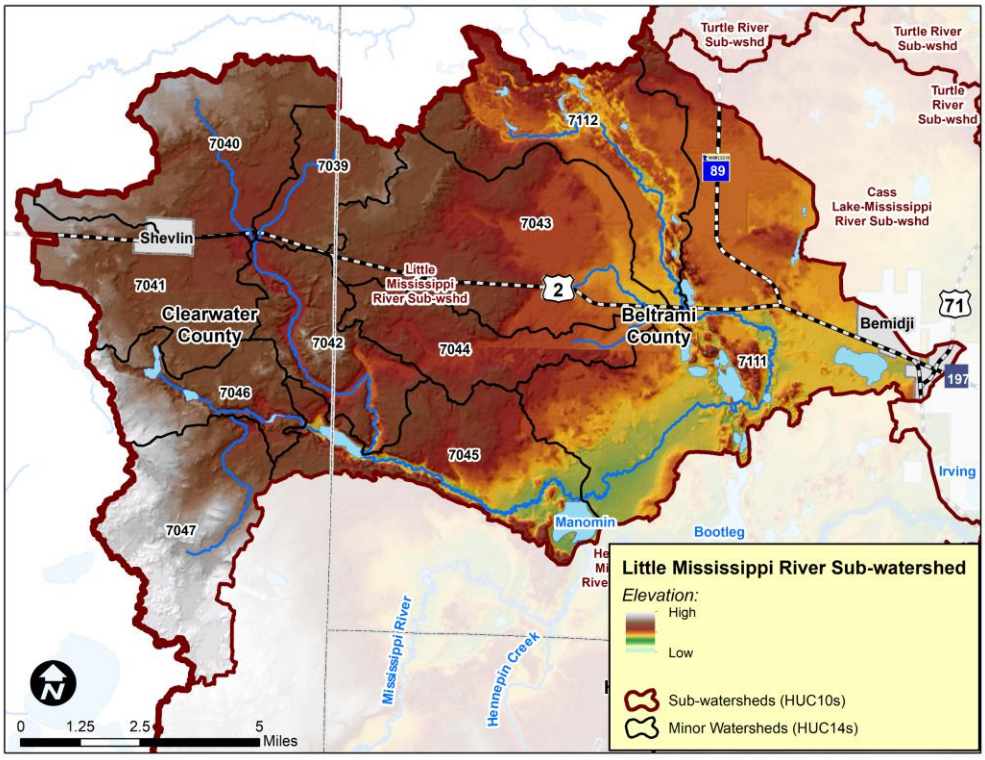


Figure 64. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Little Mississippi River Subwatershed was dominated by jack pine and red pine forests, particularly on the outwash plains. Aspen forests were also present, although were mostly on the moraine till deposits. The lowland vegetation was mainly conifer swamps. Over the past 100+ years most of the former forest land was converted into agriculture (i.e. pasture/hay and row crops), particularly in the central and western portions of the subwatershed. The remaining forest is split between aspen/birch and pine cover types, with the pine forests being more concentrated in the northeastern portion of the subwatershed.

Estimates of the potential native plant communities (NPCs) indicate that the majority of the subwatershed has the potential to support fire-dependent communities, especially on the outwash deposits.

Figure 65. Historic vegetation class.

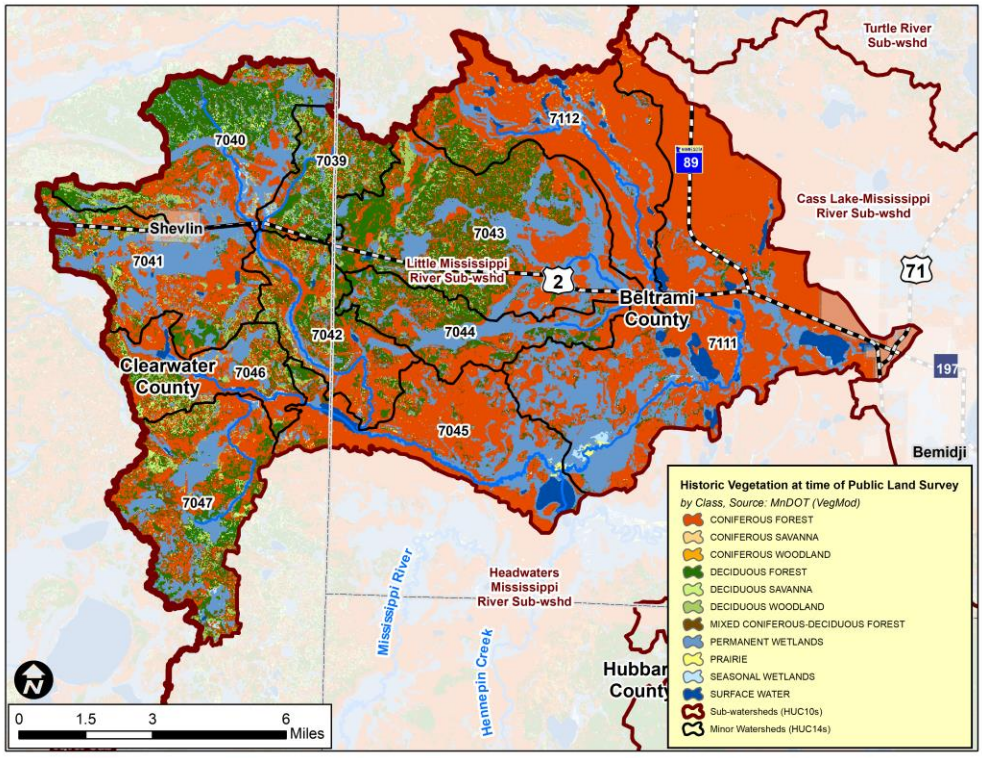


Figure 66. Land cover, 2013.

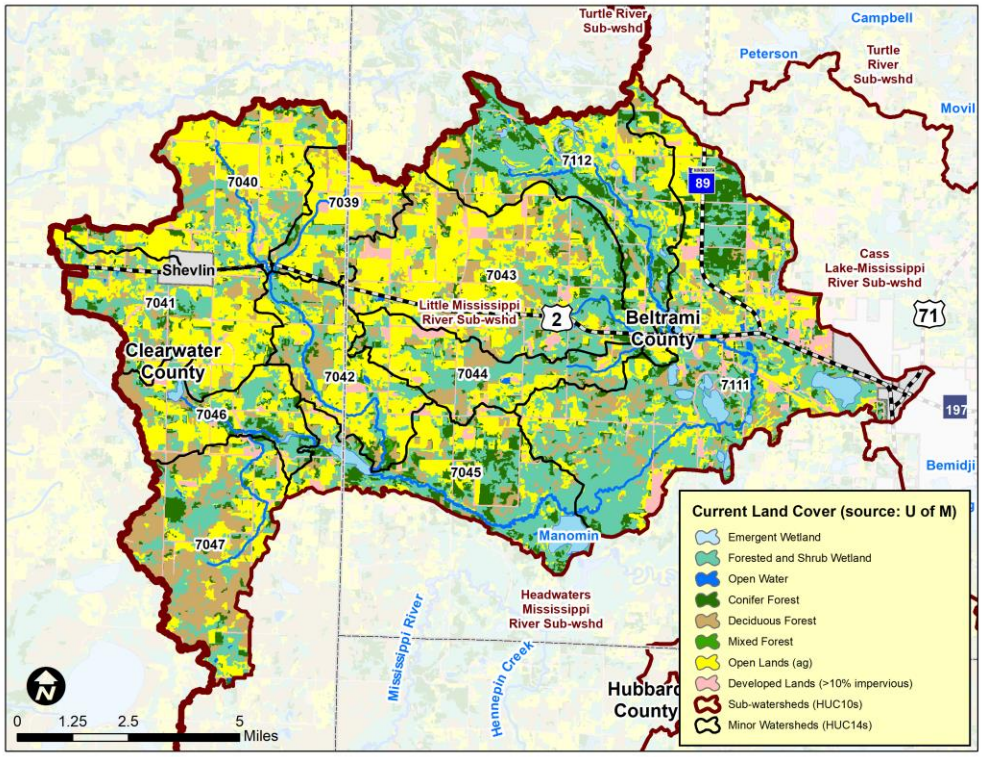
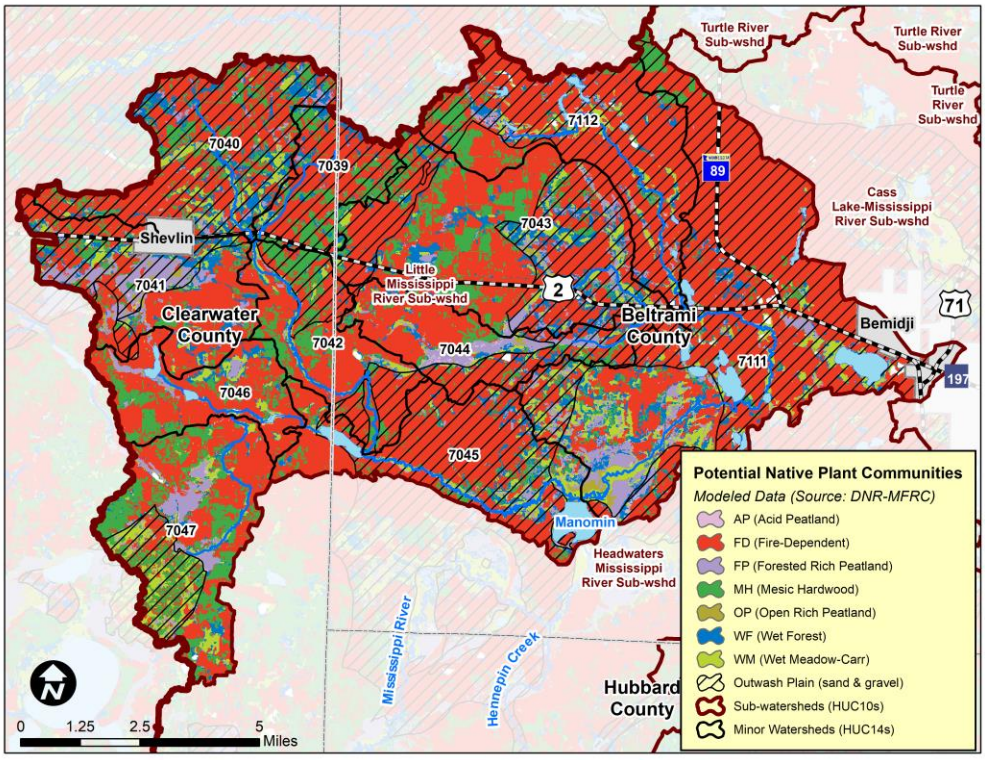


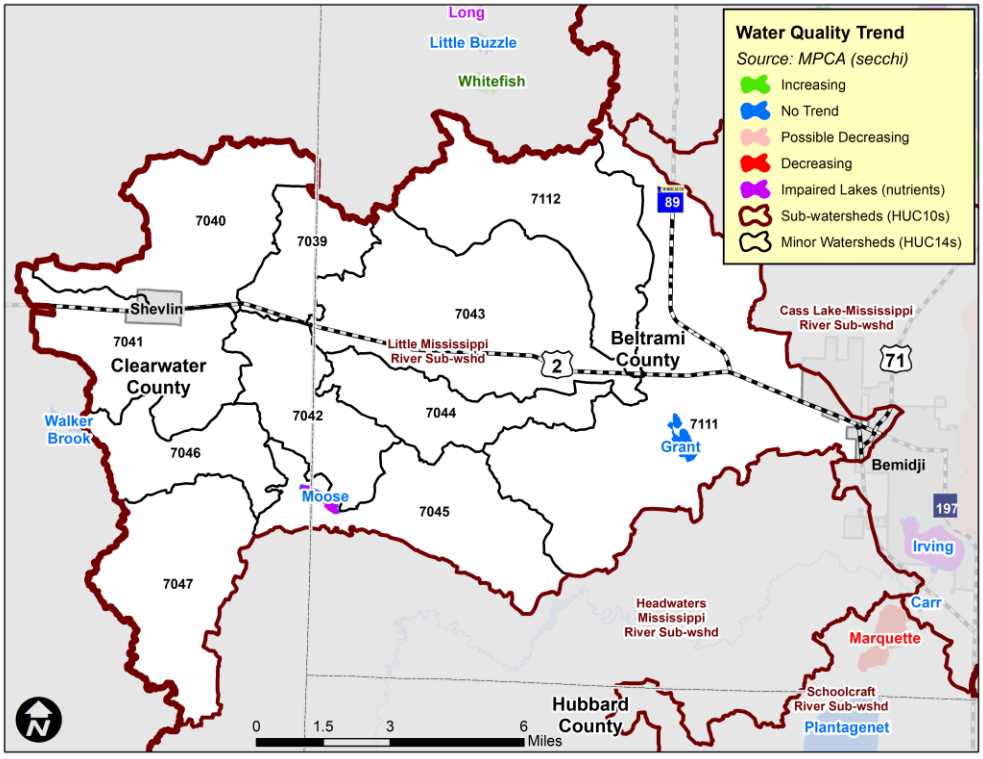
Figure 67. Potential native plant community systems.



Water Resources Summary

The Little Mississippi River Subwatershed is primarily a stream-based watershed with relatively few lakes. Of the lakes with available water quality data one (Grant Lake) is stable, and another (Moose Lake) is impaired with nutrients. This subwatershed also has two lakes of outstanding biodiversity significance, as well as one cisco refuge lake, four priority wild rice lakes, and three priority shallow lakes.

Figure 68. Water quality trends.



Protection Status

39% of the Little Mississippi River Subwatershed is currently protected, mostly by wetlands and county lands. Generally, there is less protection in the central and western portions of the subwatershed than in other areas. To reach the subwatershed protection goal of 45% an additional 5,517 acres need to be protected at an estimated cost of $5,595,175. Fortunately, 26,800 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7045, 7046, and 7047.

Figure 69. Protected lands.

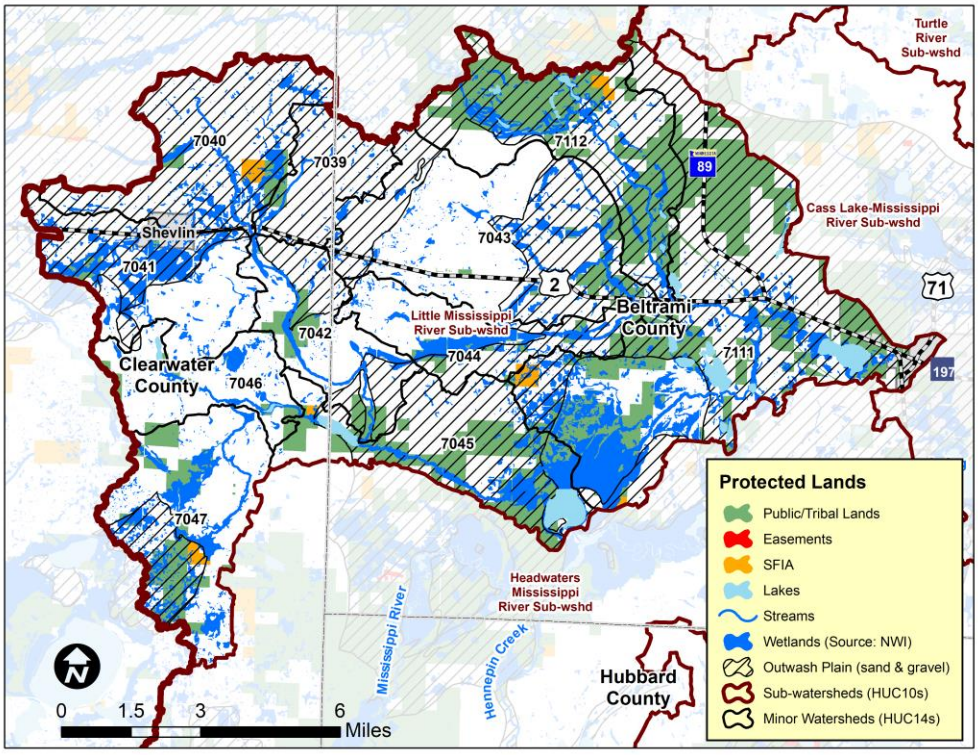
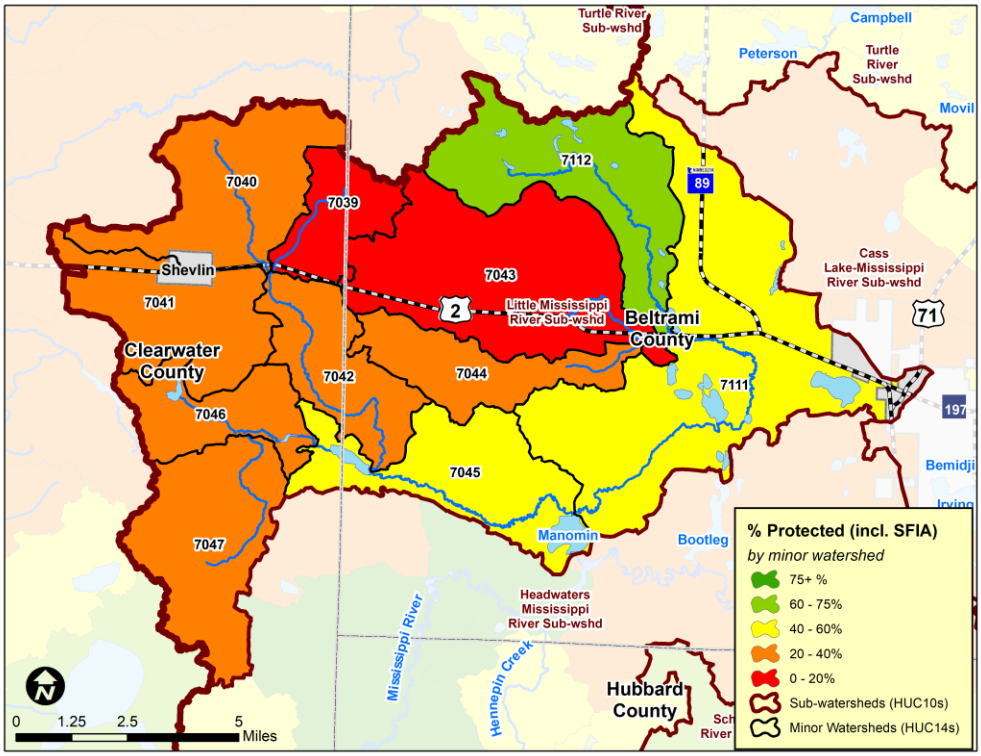


Figure 70. Minor watershed protection levels.



Subwatershed No. 3
Schoolcraft River (HUC 701010103)

Description

The Schoolcraft River Subwatershed drains 171 square miles of Hubbard and Beltrami counties and is a tributary to the Cass Lake – Mississippi River Subwatershed. It is located just to the south of the city of Bemidji and its shape is relatively long and narrow with the Schoolcraft River running through the middle of it. The headwaters to the Schoolcraft River is located near its southern end, and the outlet is in Lake Marquette at the subwatershed's northern end. The subwatershed's dominant land uses are forests and wetlands with a few pockets of agriculture.

Geography

The geography of the Schoolcraft River Subwatershed is remarkably similar to the Mississippi Headwaters Subwatershed. Its beginnings are in the high, hummocky, and lake-pocketed hills of the Itasca Moraine. The Schoolcraft river runs out of these hills and flows north first through a glacial lake-bed, and then a channel of outwash with till plain on either side. One notable feature of this subwatershed is that there is a strong north-south orientation of streams and ridges that were clearly influenced by the advance and retreat of the Wadena lobe.

Figure 71. Geomorphological landforms.

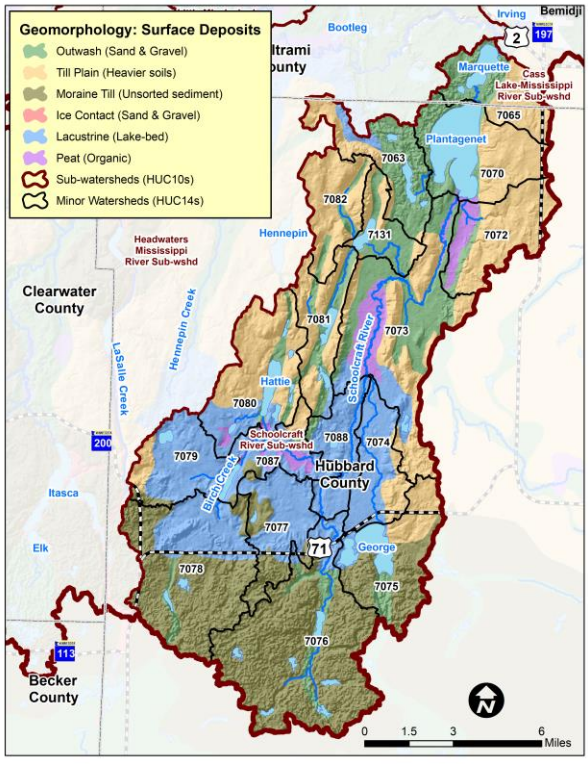
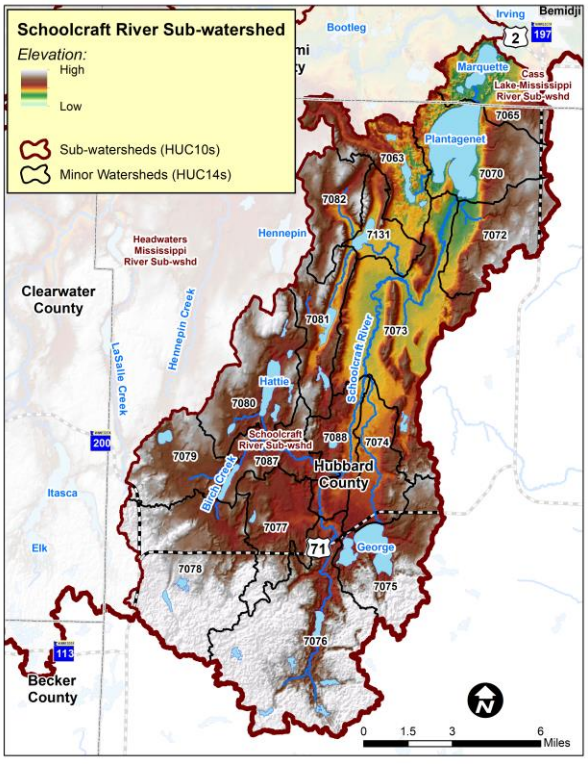


Figure 72. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Schoolcraft River Subwatershed were mostly forests of jack and red pine on the outwash and moraine till deposits, aspen on the till plains, and conifer swamps in the lowland areas. Today the forest remains largely intact, although about 23% of the subwatershed area has been converted to development or agriculture. The fragmentation is most obvious around the outskirts of

Bemidji near the northern tip of the subwatershed. The current forest composition is mostly an aspen/birch cover type, although larger stands of pines are present on the Bemidji Sand Plain LTA near the center of the subwatershed. Lowland forests of spruce/fir are also scattered through the subwatershed.

Estimates of the potential native plant communities (NPCs) indicate that mesic hardwood forests can be supported on the Itasca Moraine near the southern end of the subwatershed as well as the till plains, while fire-depended forests are largely limited to the outwash and lacustrine deposits.

Figure 73. Historic vegetation class.

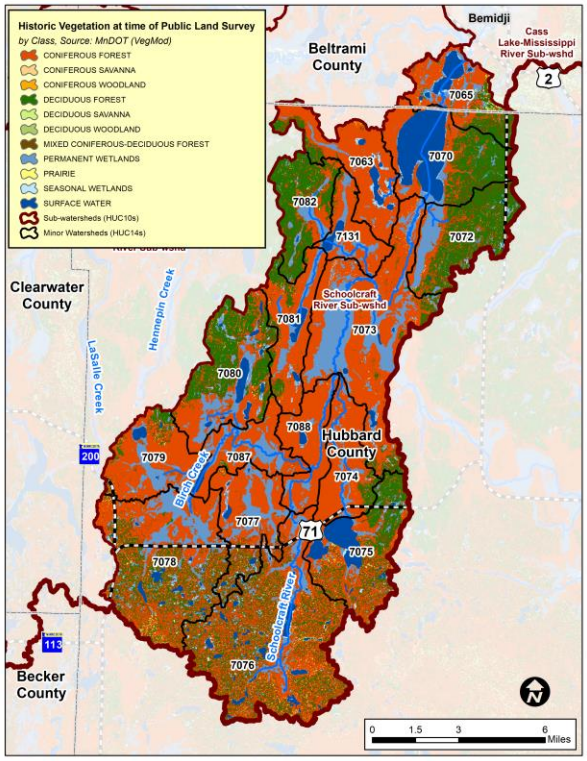


Figure 74. Land cover, 2013.

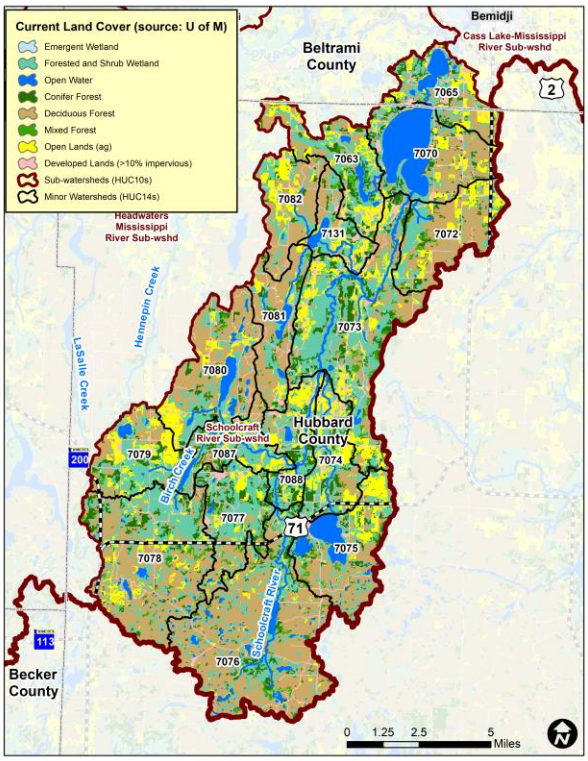
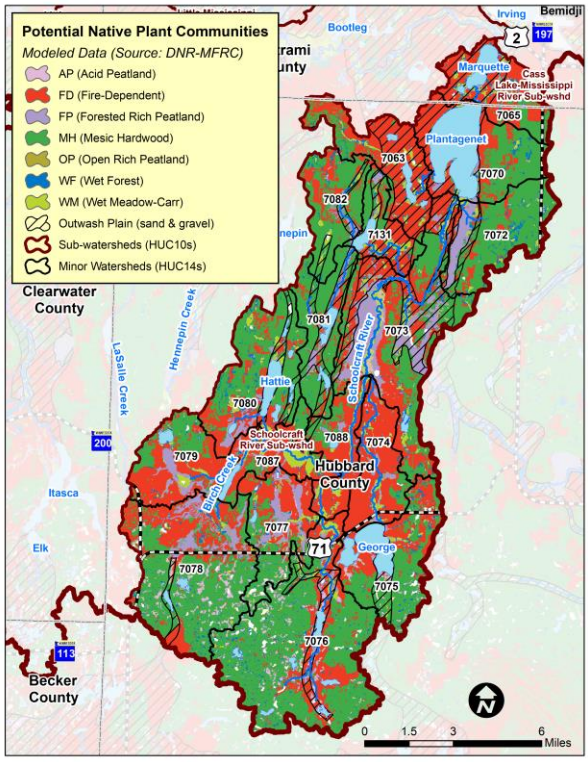


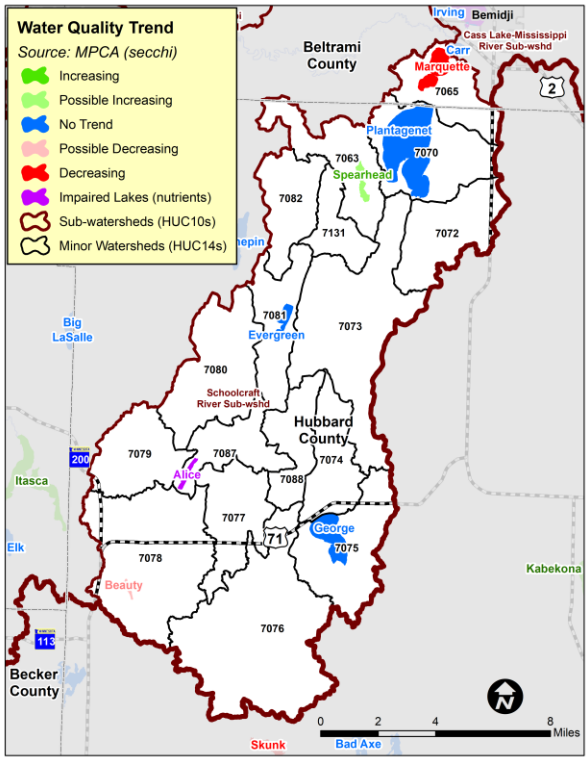
Figure 75. Potential native plant community systems.



Water Resources Summary

The Schoolcraft River Subwatershed is similar to the Headwaters – Mississippi River Subwatershed in that it has many smaller lakes in the hummocky Itasca Moraine at the southern end of the watershed, and fewer – but larger – lakes elsewhere. Of the lakes with available water quality data one is improving, four are stable, one is declining, and one (Alice) is impaired. This subwatershed also has five lakes of outstanding biodiversity significance, as well as one cisco refuge lake, two trout lakes, seven priority wild rice lakes, and nine priority shallow lakes.

Figure 76. Water quality trends.



Protection Status

70% of the Schoolcraft River Subwatershed is currently protected, mostly by county lands as well as the Paul Bunyan State Forest. Generally, there is less protection in the northeastern portion of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 5,902 acres need to be protected at an estimated cost of $7,012,893. Fortunately, over 21,000 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7063, 7065, 7070, 7072, and 7079.

Figure 77. Protected lands.

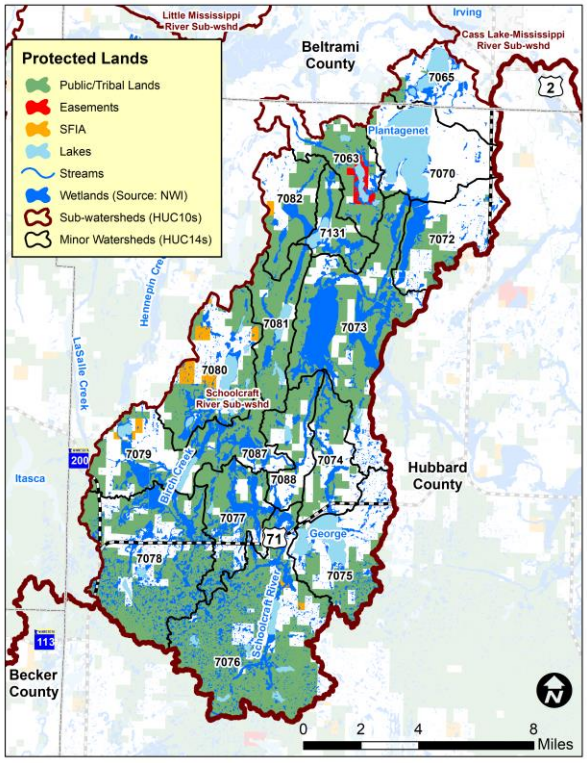
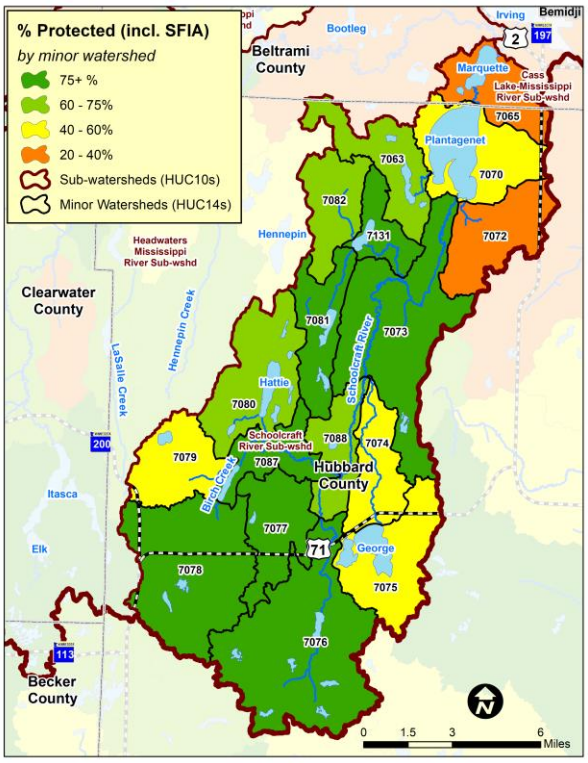


Figure 78. Minor watershed protection levels.



Subwatershed No. 4
Cass Lake-Mississippi River (HUC 701010105)

Description

The Cass Lake - Mississippi River Subwatershed drains 247 square miles of Beltrami, Cass, and Hubbard counties and receives water from the Headwaters – Mississippi River, Schoolcraft River, and Turtle River subwatersheds. It is also home to the city of Bemidji, which is known as 'The First City on the Mississippi' and is the most important regional center in the Mississippi Headwaters Major Watershed. The subwatershed has a roughly teardrop shape with the point on the northwestern end and the rounded belly on the southeastern end. The inlet to the Cass Lake – Mississippi River Subwatershed is located at the convergence of the Mississippi River with the Schoolcraft River. From there the Mississippi River runs north past the city of Bemidji, and through Lake Bemidji, then flows southeast into Cass Lake before exiting the subwatershed from an outlet in the northeastern corner of Cass Lake. Land cover in this subwatershed is largely forests, wetlands, or open water with some areas of agriculture and development.

Geography

The majority of the Cass Lake – Mississippi River Subwatershed is covered by a low-lying outwash plain that holds many of the large lakes which characterize this subwatershed. The areas of higher elevation are till plains and a portion of the Sugar Hills Moraine near Lake Bemidji.

Figure 79. Geomorphological landforms.

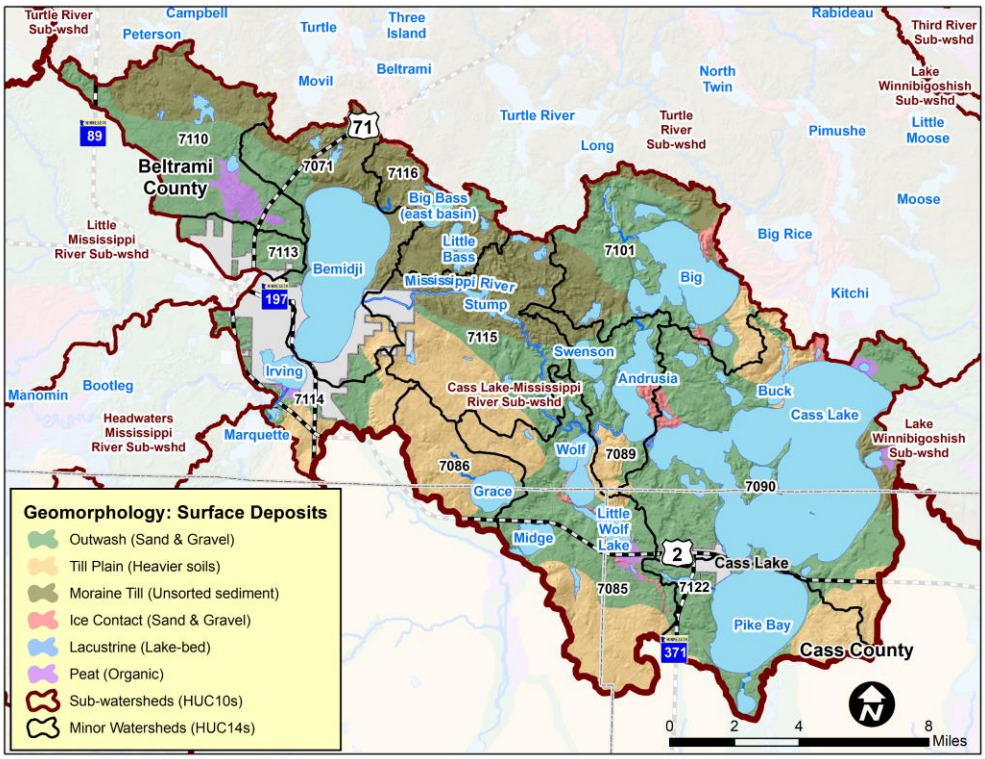
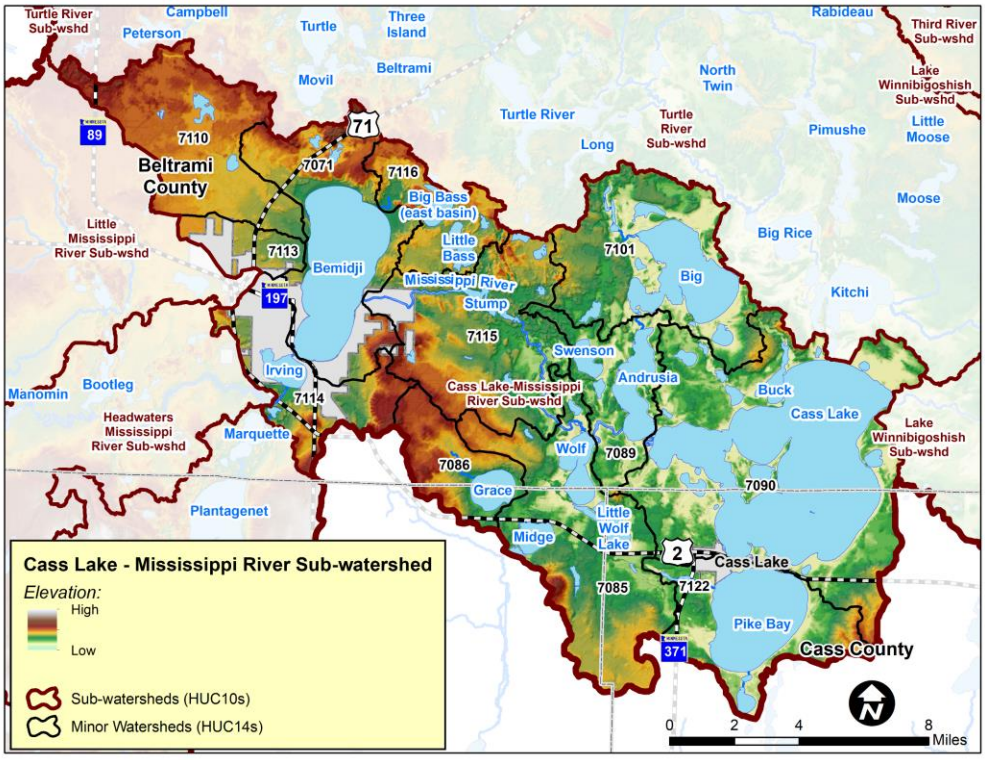


Figure 80. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation of the Cass Lake – Mississippi River Subwatershed was mainly jack pine and red pine in the uplands along with some aspen on the till plains, and conifer swamps in the lowlands. Today much of the upland forest in the western half of the subwatershed was converted to agriculture or urban development around the city of Bemidji. The composition of the remaining forest is mostly an aspen/birch cover type with patches of pine forest scattered throughout the subwatershed.

Estimates of the potential native plant communities indicate that fire-dependent forests can be supported across most of the landscape, while mesic hardwood forests are limited to the till plain deposits.

Figure 81. Historic vegetation class.

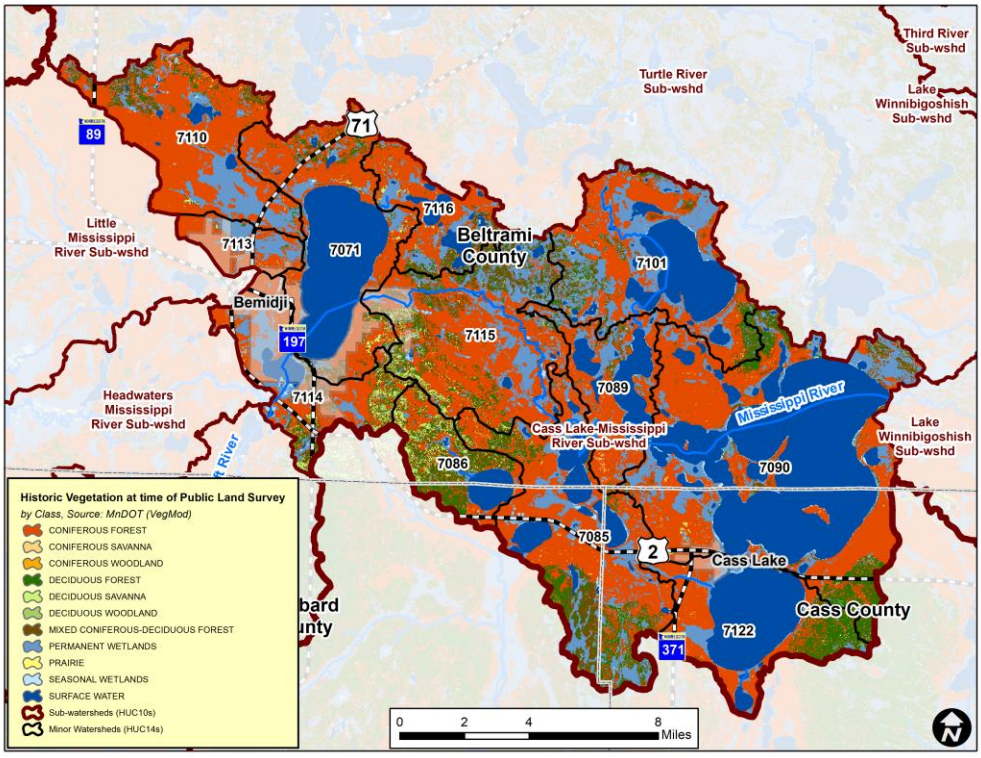


Figure 82. Land cover, 2013.

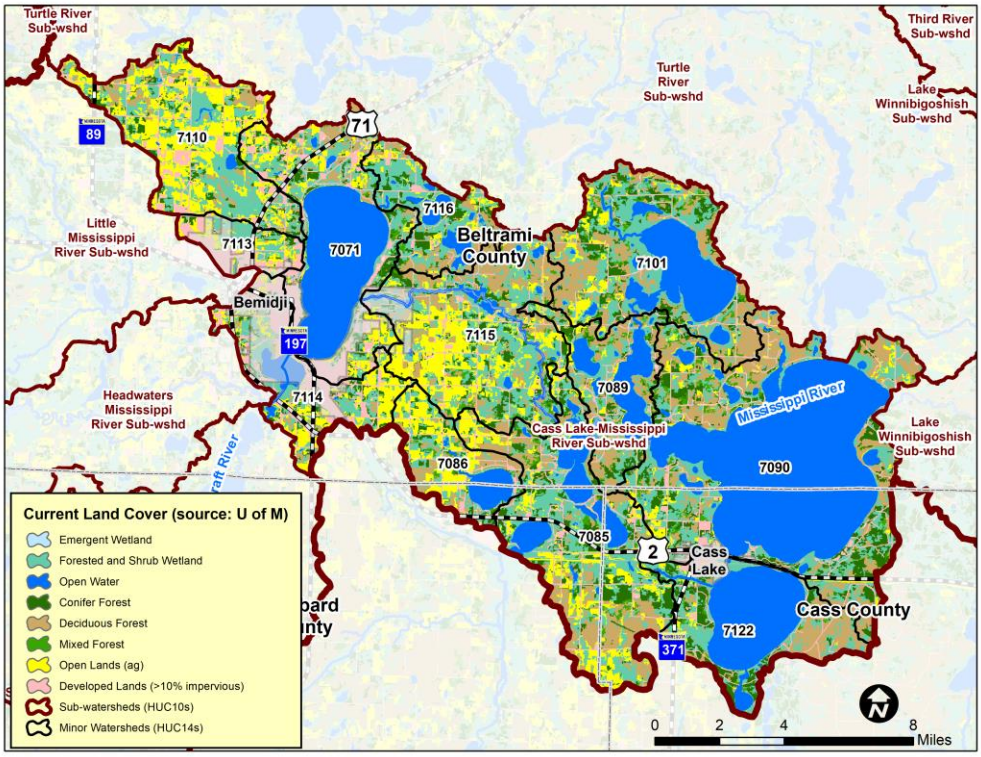
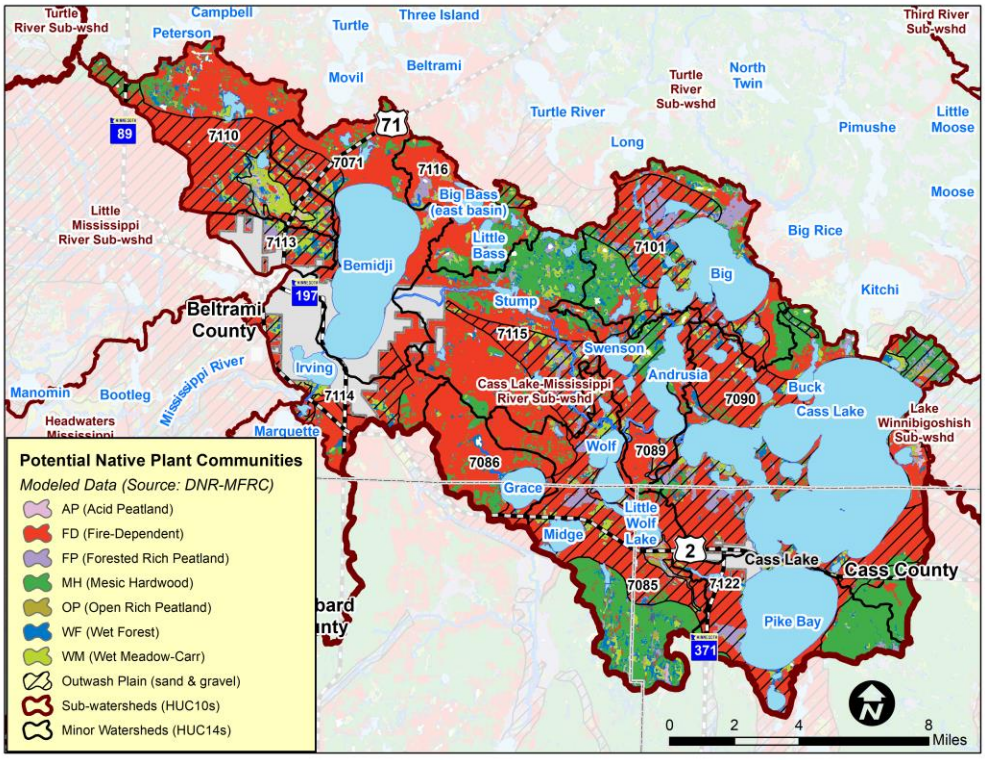


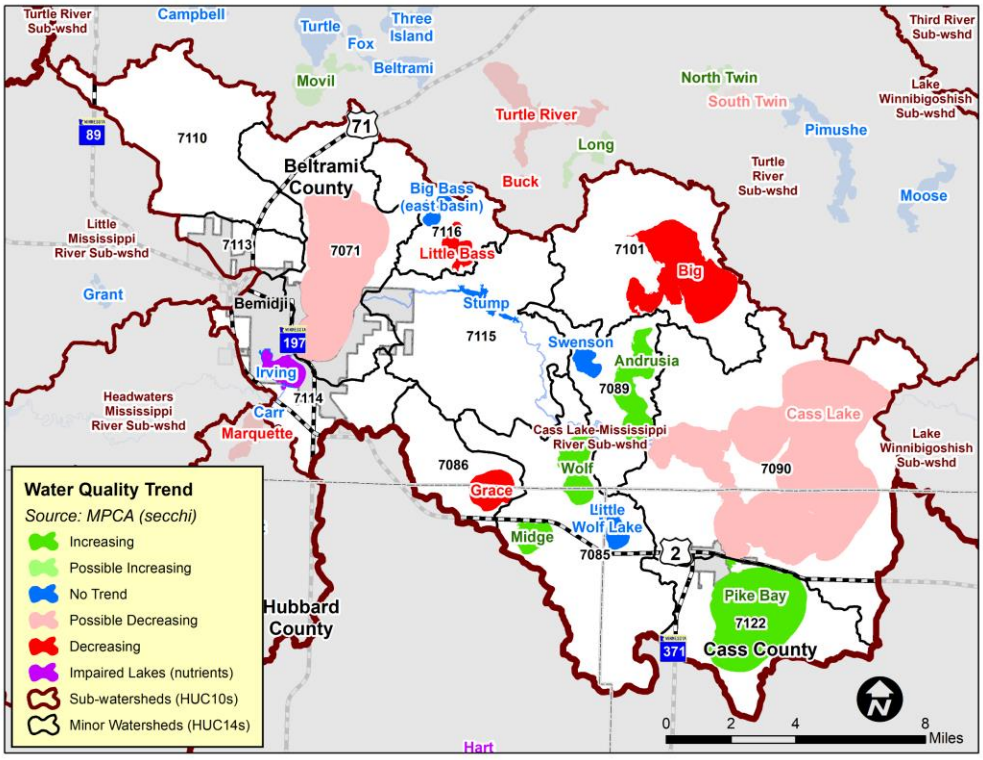
Figure 83. Potential native plant community systems.



Water Resources Summary

The Cass Lake – Mississippi River Subwatershed is rich in lakes, both large and small, which collectively make up 27% of the subwatershed area. Of the lakes with available water quality data four are improving, seven are stable, three are declining, and one (Irving) is impaired. This subwatershed also has 11 lakes of outstanding biodiversity, as well as one cisco lake, one trout lake, five priority wild rice lakes, and 11 priority shallow lakes.

Figure 84. Water quality trends.



Protection Status

61% of the Cass Lake - Mississippi River Subwatershed is currently protected, mostly by public waters, county lands, and the Chippewa National Forest. Generally, there is more protection in the eastern third of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 21,939 acres need to be protected at an estimated cost of $27,970,225. Reaching this goal will be a challenge given that number of acres to reach the protection goal is close to the same amount that have the potential to protect. The Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7085, 7086, 7089, and 7115.

Figure 85. Protected lands.

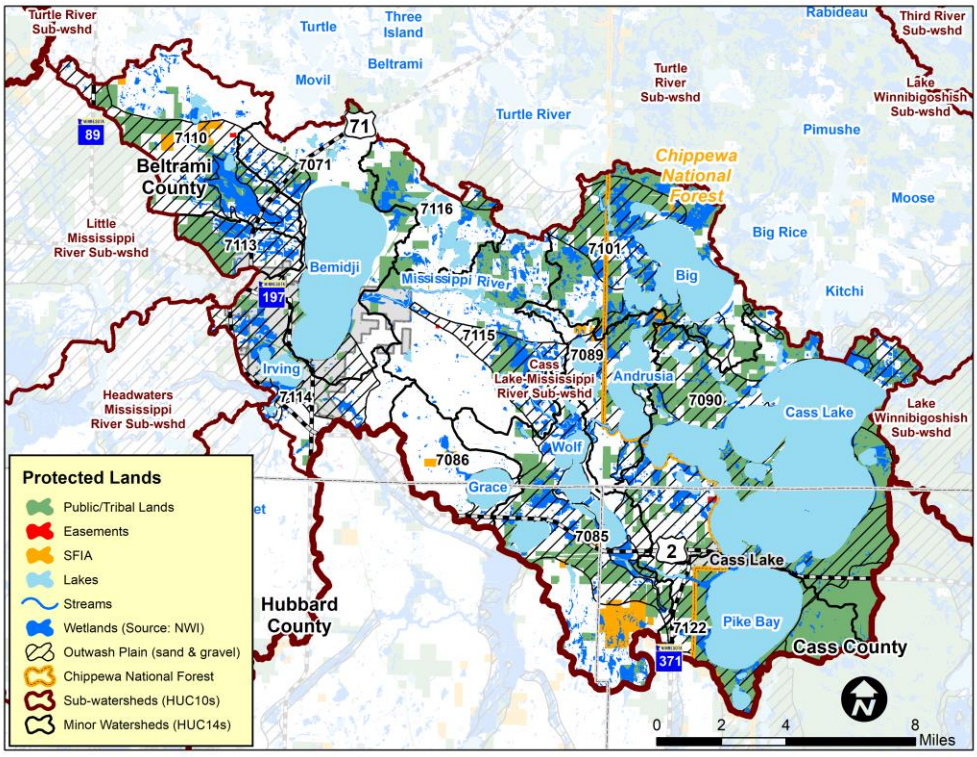
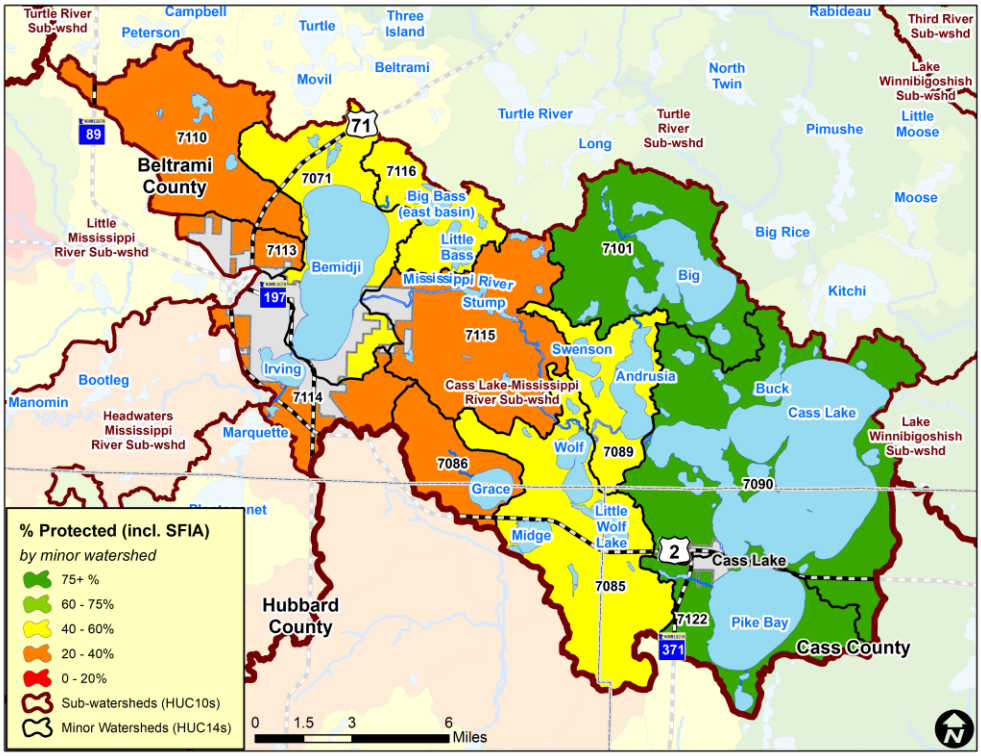


Figure 86. Minor watershed protection levels.



Subwatershed No. 5
Turtle River (HUC 701010104)

Description

The Turtle River Subwatershed drains 294 square miles of southern Beltrami and Itasca counties and is a tributary to Cass Lake – Mississippi River Subwatershed. It is roughly shaped like a triangle with the headwaters located along its northern border. The outlet to the subwatershed is located in its southern corner where the waters of the Turtle River Subwatershed flow into Cass Lake. The land cover is mostly forests, wetlands, and open water, although some areas of agriculture do occur near the subwatershed's western and north-central borders.

Geography

The Turtle River Subwatershed is bounded by high elevation on its southwest and northern borders, out of which many of its streams flower to converge with the many lakes in the subwatershed. The Turtle River Subwatershed, along with the Third River Subwatershed to its east, are unique in among all the subwatersheds in the Mississippi Headwaters Major Watershed in that the majority of its area is covered by moraine till with only small portions of outwash, till plain, peat, and ice contact deposits scattered throughout.

Figure 87. Geomorphological landforms.

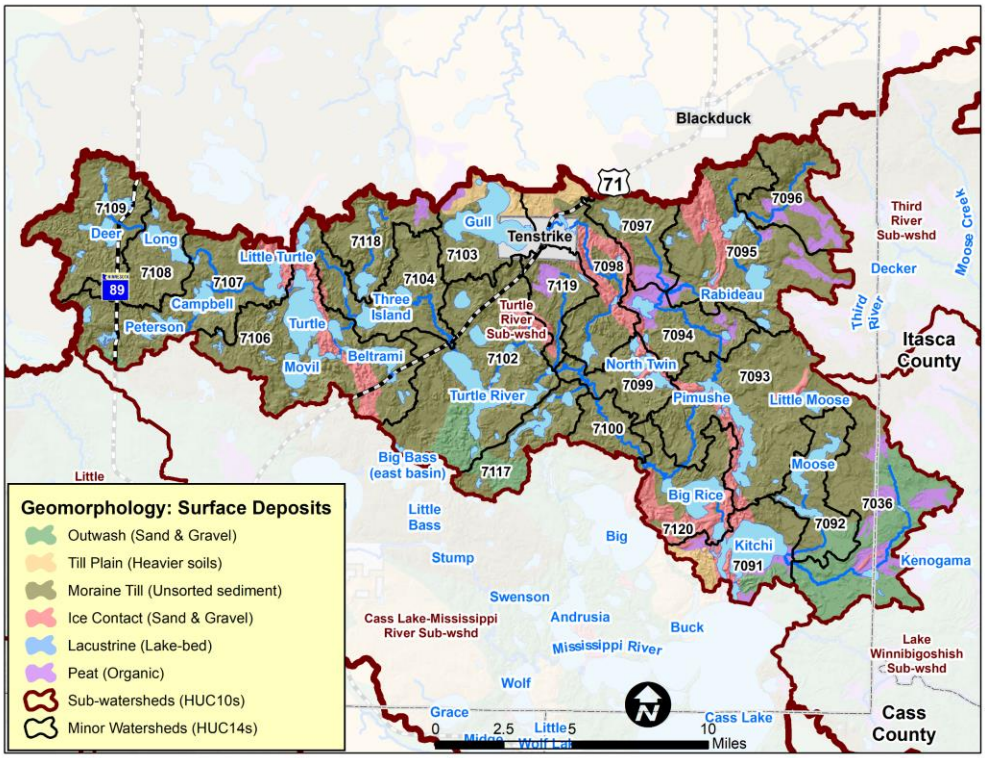
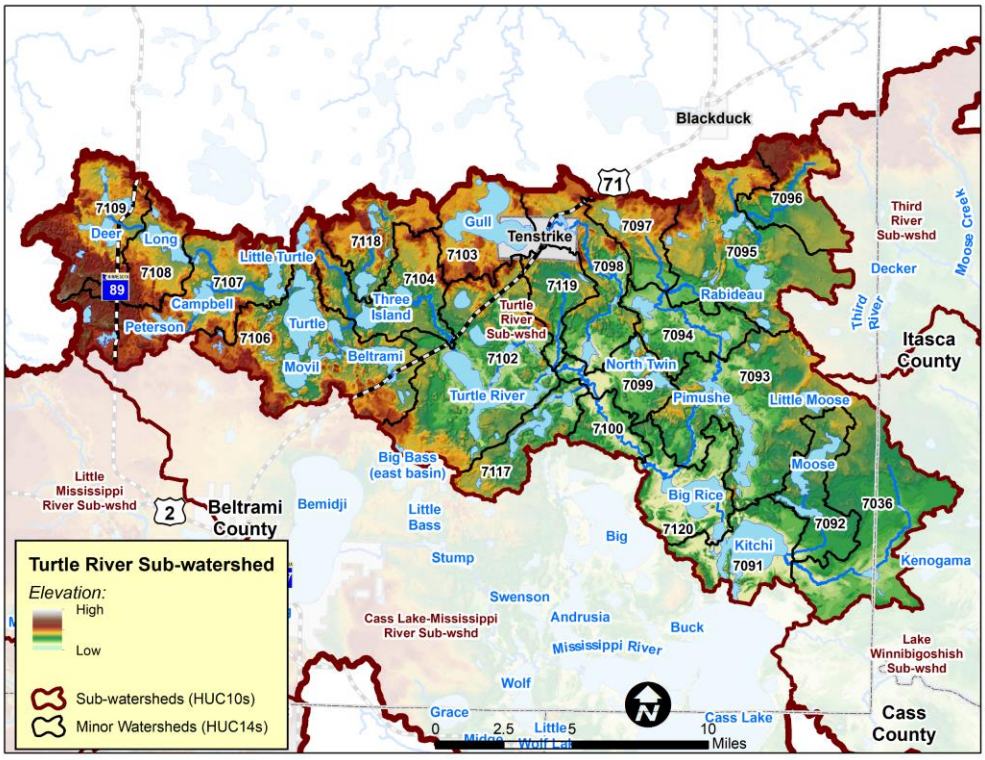


Figure 88. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Turtle River Subwatershed was largely conifer swamps and northern hardwoods, as well as pines along its southern border. Today the forest remains mostly intact, although about 16% of the subwatershed has been converted to agriculture or development. The fragmentation is most obvious towards the western end of the watershed. The current forest is mostly aspen/birch, although some northern hardwoods and pines are present towards the western half of the subwatershed while the eastern half also has some spruce/fir forests in the lowlands.

Estimates of the potential native plant communities (NPCs) indicate that mesic hardwoods can be supported on the uplands in most areas of the forest, except along the southern border where fire-dependent forests are more likely to occur. The lowlands are generally more likely to support wet forests or forested rich peatlands and only a small likelihood of other lowland NPCs.

Figure 89. Historic vegetation class.

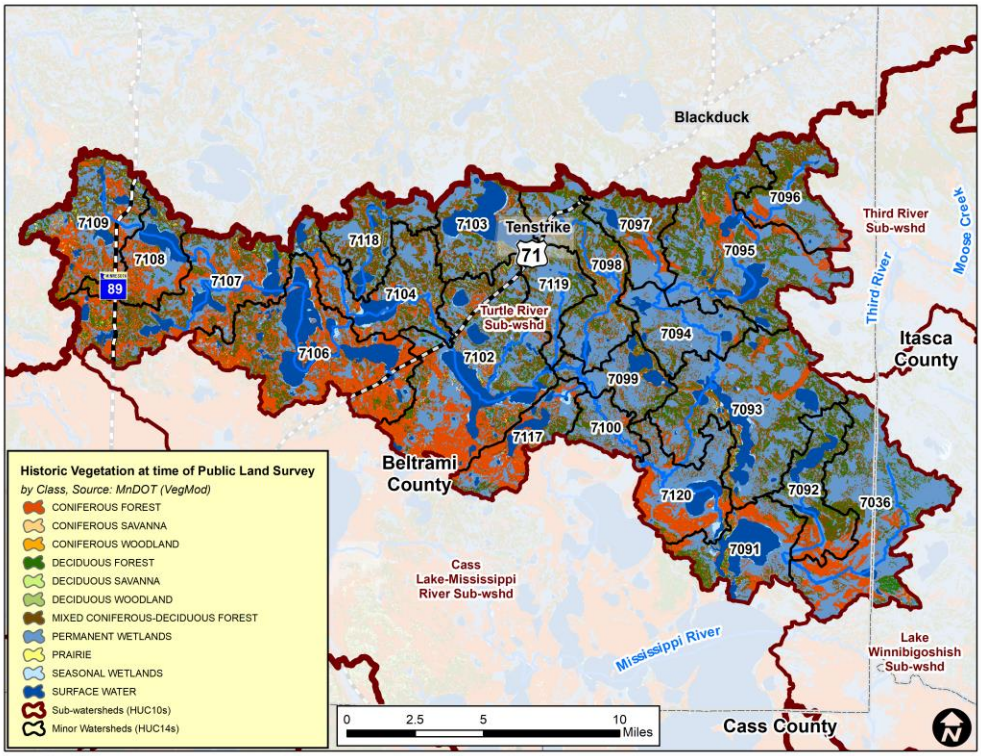


Figure 90. Land cover, 2013.

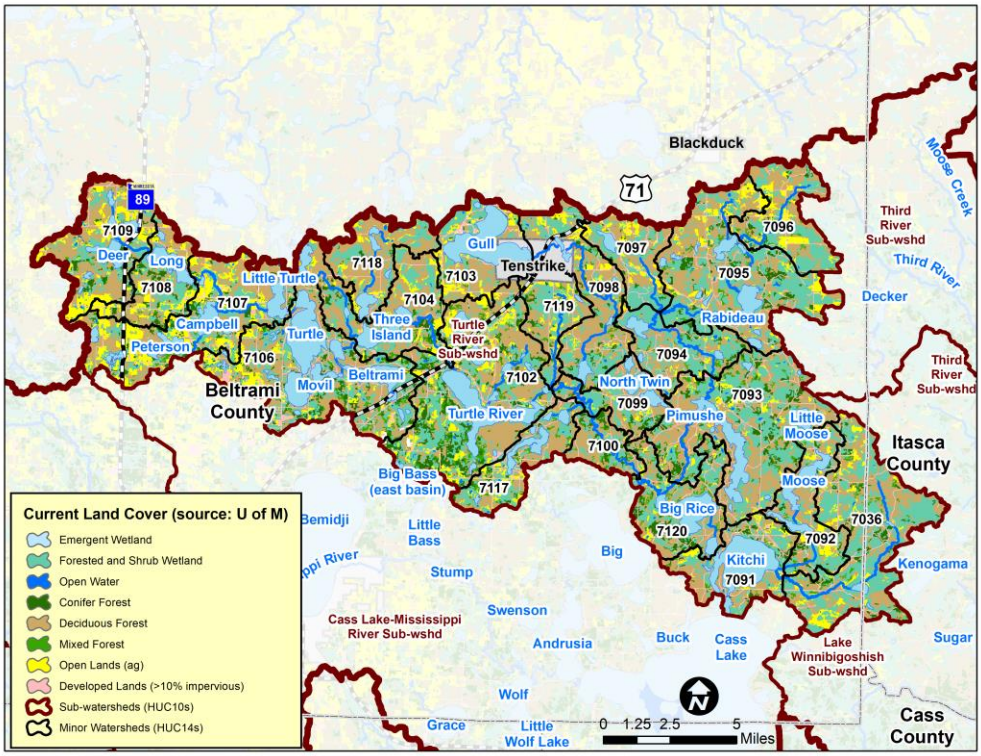
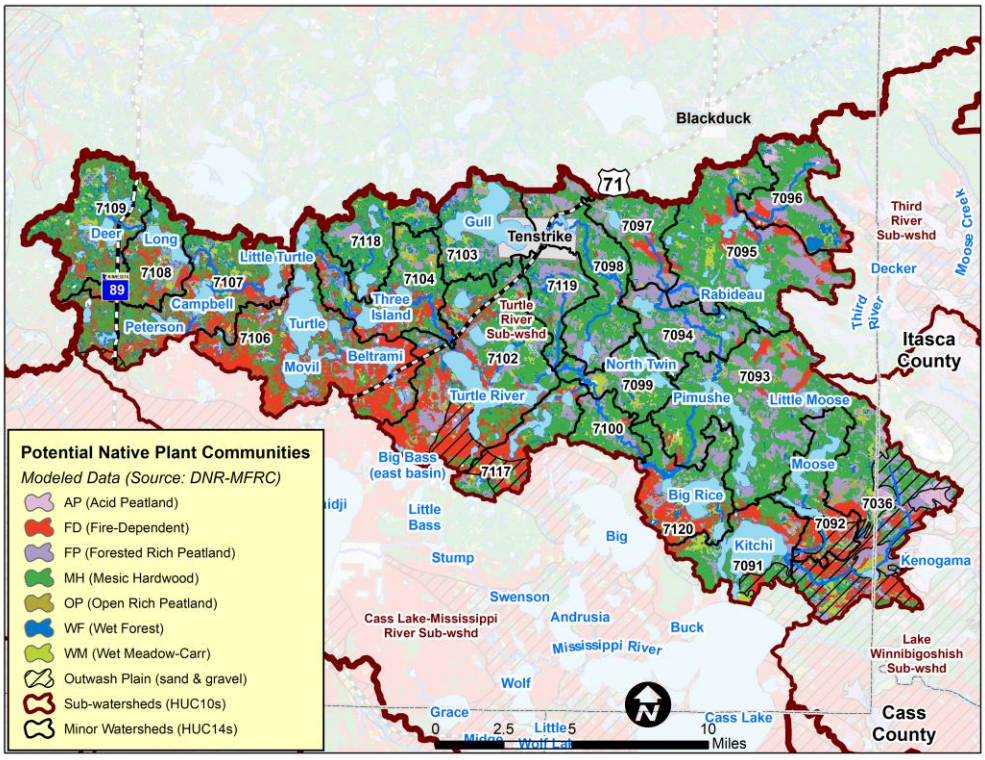


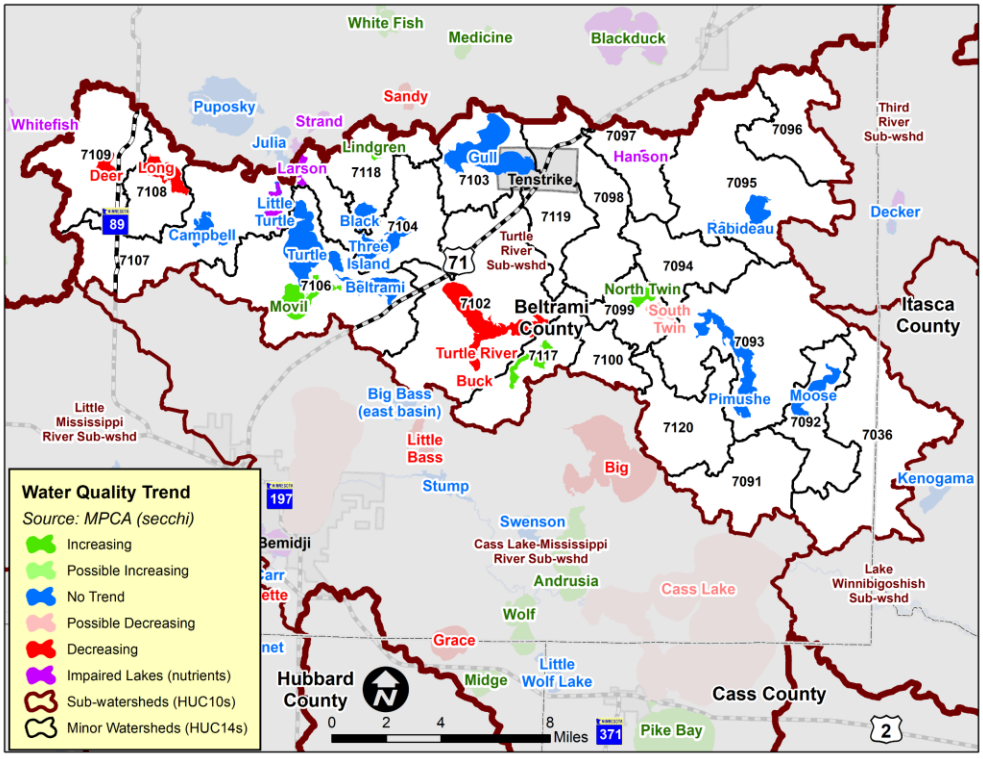
Figure 91. Potential native plant community systems.



Water Resources Summary

The Turtle River Subwatershed is particularly rich in water resources and has 95 lakes, which is more than any other subwatershed in the Mississippi Headwaters Major Watershed. Of the lakes that have available water quality data, four are improving, 10 are stable, four are declining, and two are impaired with nutrients. This subwatershed also has 17 lakes of outstanding biodiversity significance, as well as 20 priority wild rice lakes and 18 priority shallow lakes.

Figure 92. Water quality trends.



Protection Status

72% of the Turtle River Subwatershed is currently protected, mostly by a mix of county lands, state forests, and the Chippewa National Forest. Generally, there is less protection in the western portion of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 5,999 acres need to be protected at an estimated cost of $6,556,182. Fortunately, over 32,500 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7102, 7107, and 7108.

Figure 93. Protected lands.

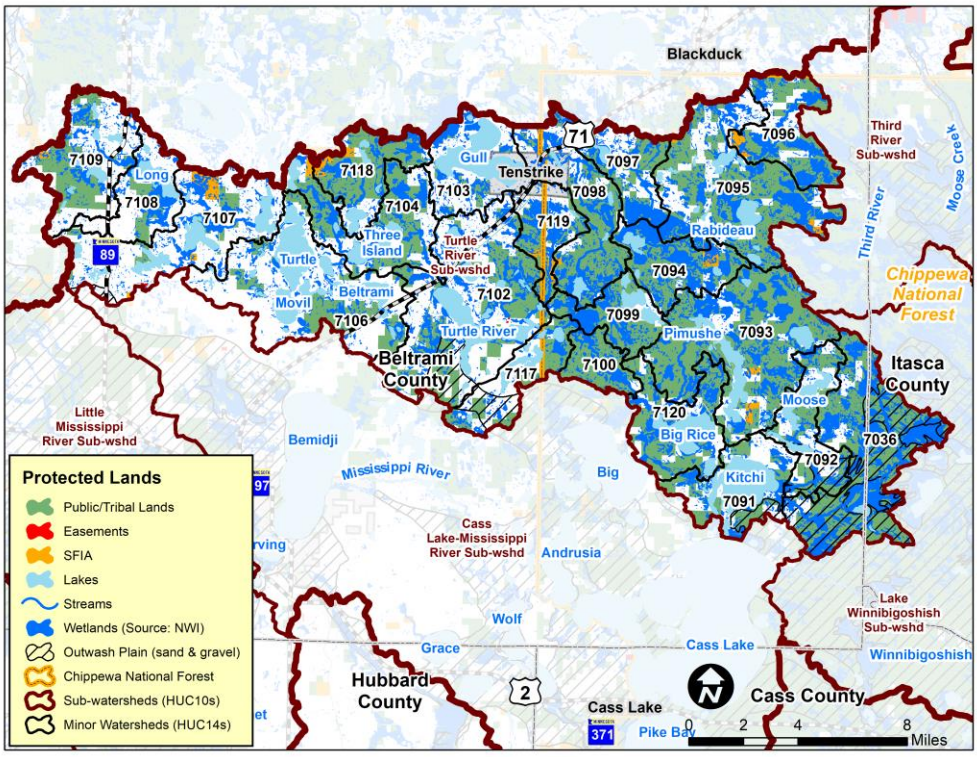
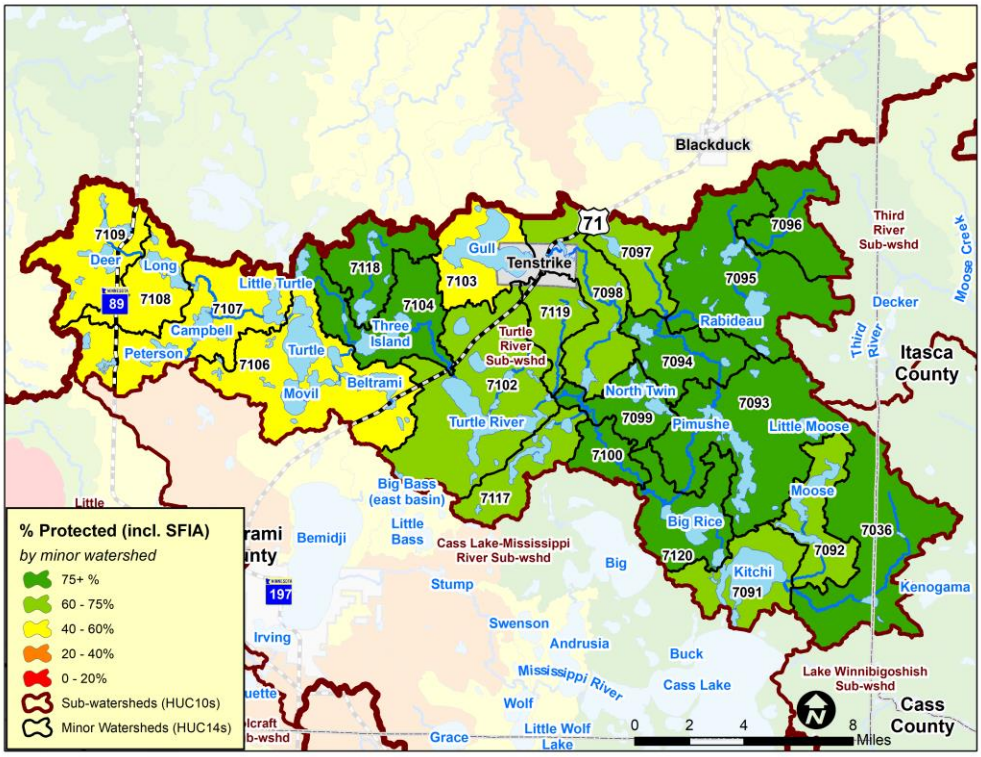


Figure 94. Minor watershed protection levels.



Subwatershed No. 6
Lake Winnibigoshish (HUC 701010107)

Description

The Lake Winnibigoshish Subwatershed is located near the center of the Mississippi Headwaters Major Watershed where is drains 298 square miles of Itasca, Cass, and Beltrami counties. It also receives water from the Cass Lake – Mississippi River and Third River subwatersheds. The subwatershed's defining feature is Lake Winnibigoshish, which is among the most famous fishing lakes in Minnesota and the largest lake in the major watershed. Land cover in the Lake Winnibigoshish Subwatershed is largely undisturbed and split between open water, wetlands, and forest cover. The outlet to the subwatershed is the Lake Winnibigoshish Dam on the eastern end of Lake Winnibigoshish.

Geography

Most of the Lake Winnibigoshish Subwatershed is within a low and level outwash plain with extensive swamps and bogs.

Figure 95. Geomorphological landforms.

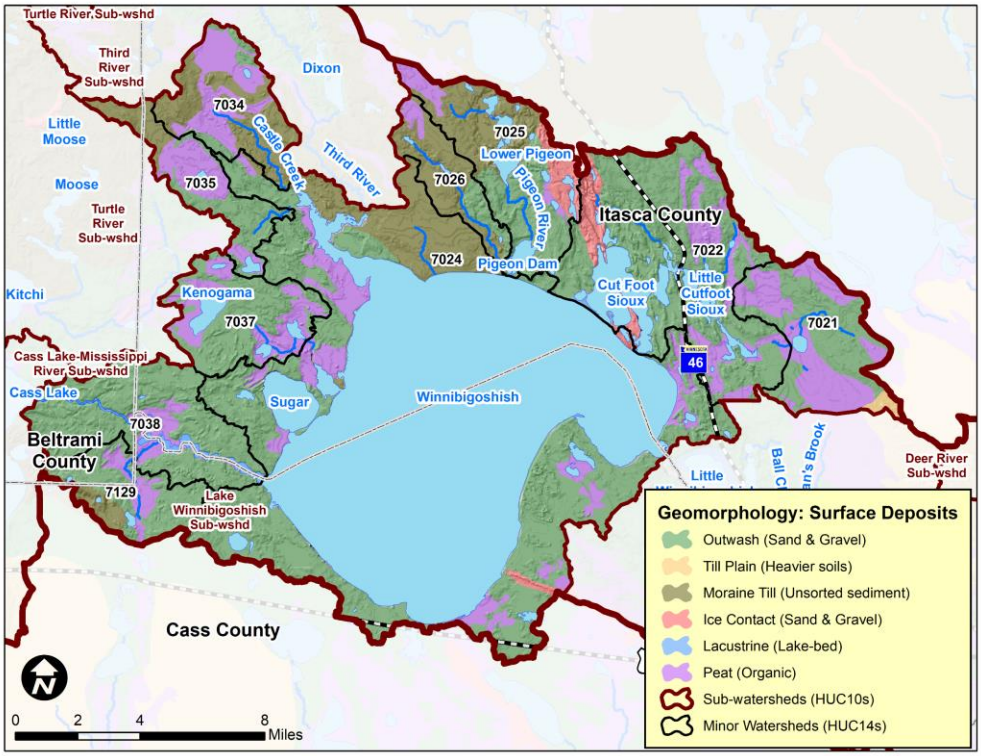
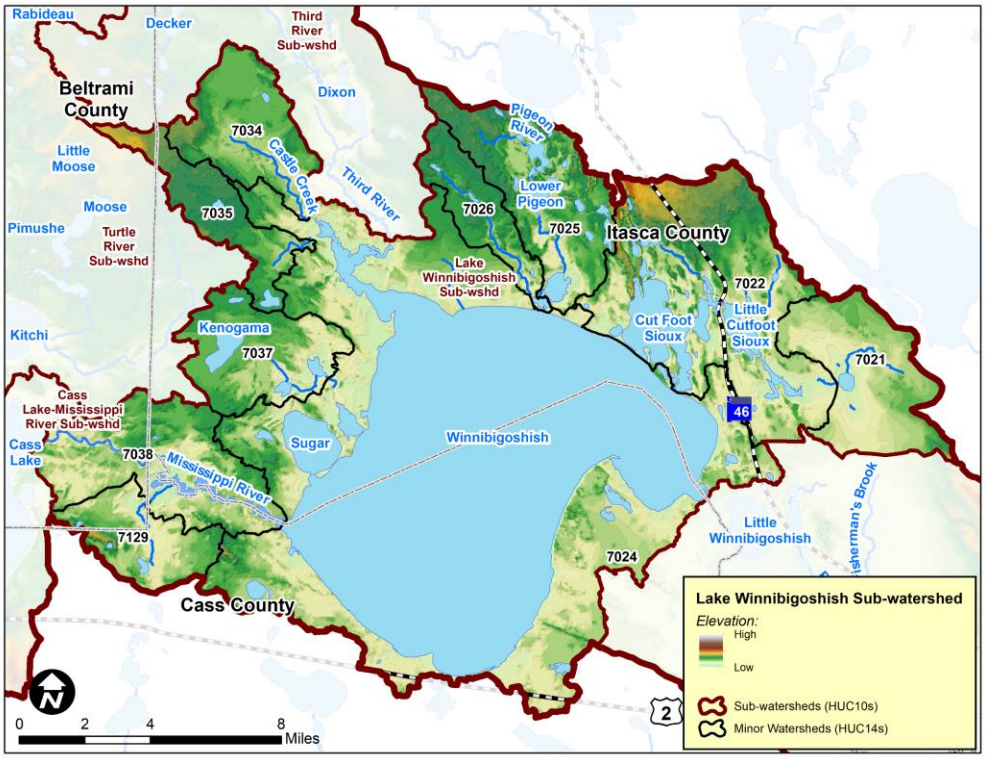


Figure 96. Elevation.



Past, Current, and Potential Future Forest Conditions

The Lake Winnibigoshish Subwatershed has abundant wetland areas, which historically were conifer swamps. The upland forest was mostly red and jack pine, and small amounts of aspen and northern hardwoods on upland patches among the large wetland areas in the subwatershed. Thanks to protection by the Chippewa National Forest the forest remains largely intact and retains a larger conifer component than other subwatersheds in the Mississippi Headwaters Major Watershed. A large pine forest is present to the northeast of Lake Winnibigoshish as well as in scattered patched to the south and west of the lake. The rest of the upland forests are aspen/birch while the lowland forests are spruce/fir.

Estimates of the potential native plant communities indicate that fire-dependent forest may be supported on most of the upland areas in the subwatershed, except for the area to the northwest of the lake where mesic hardwoods may be better suited. The extensive wetland areas are more likely to support wet forest, forested rich peatland, and some acid peatland communities.

Figure 97. Historic vegetation class.

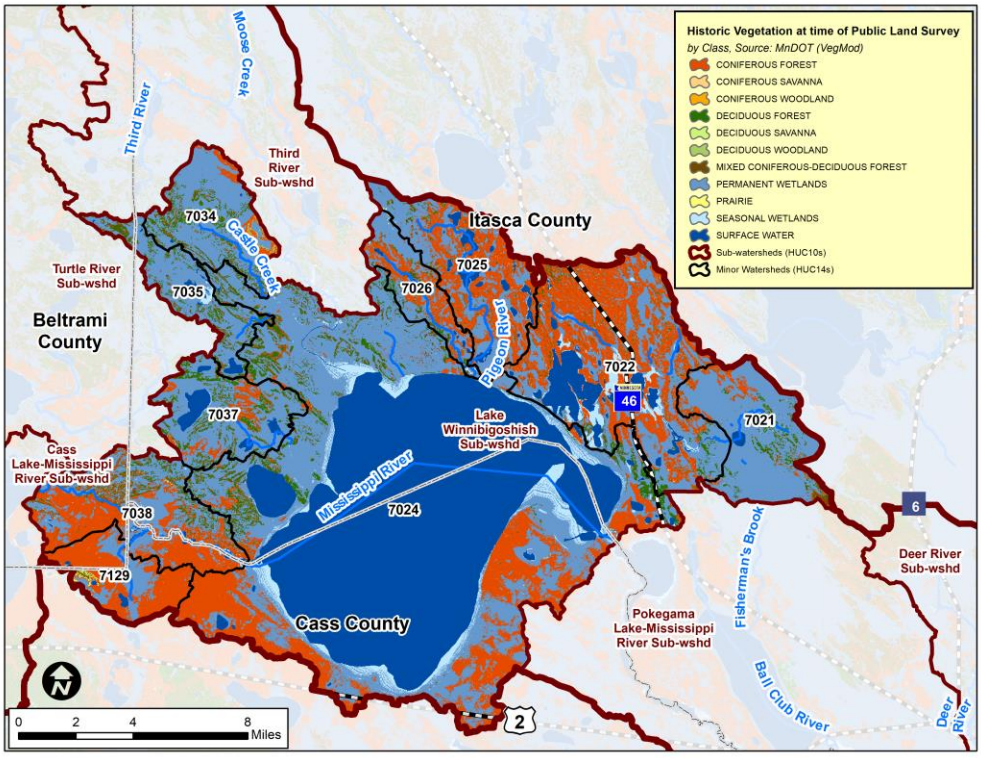


Figure 98. Land cover, 2013.

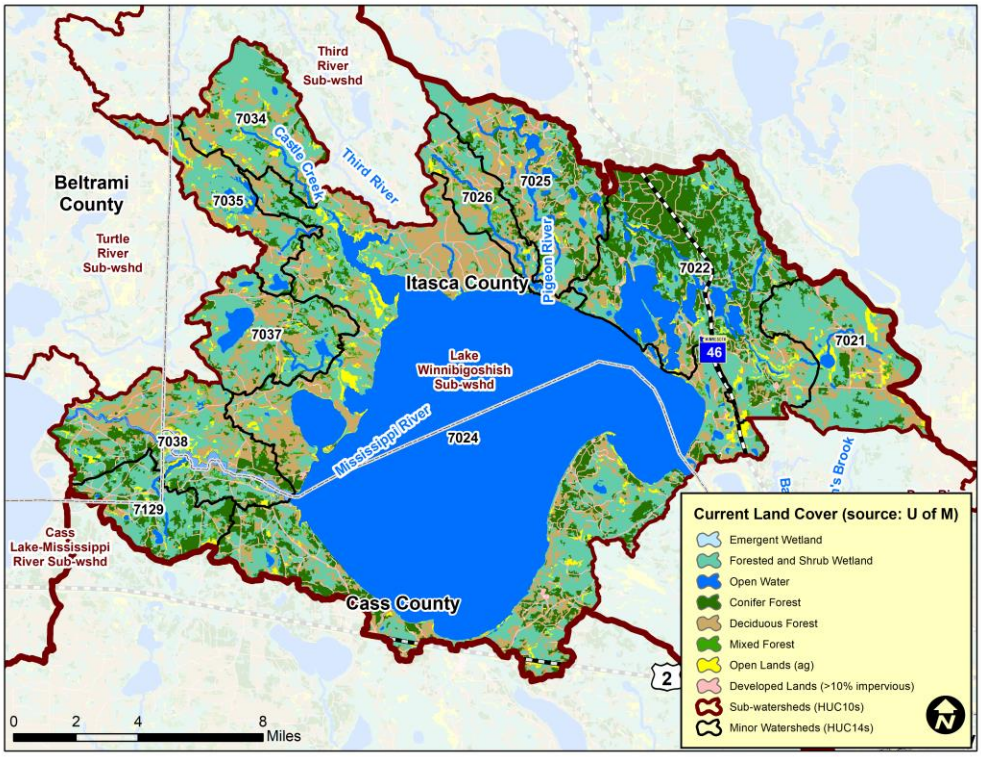
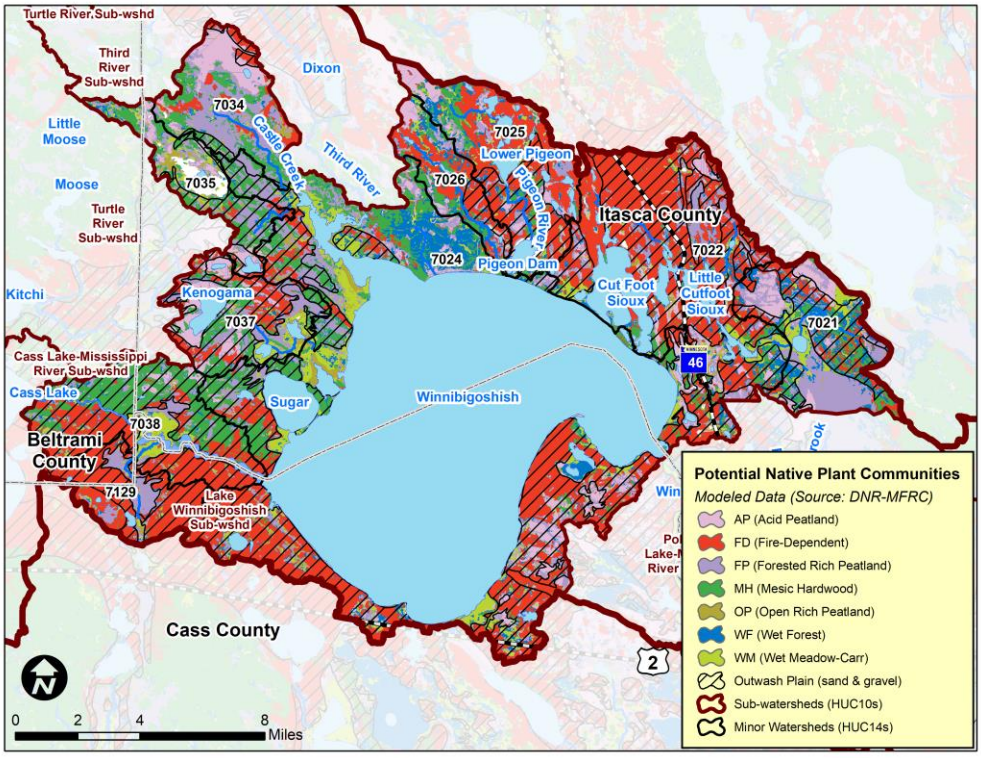


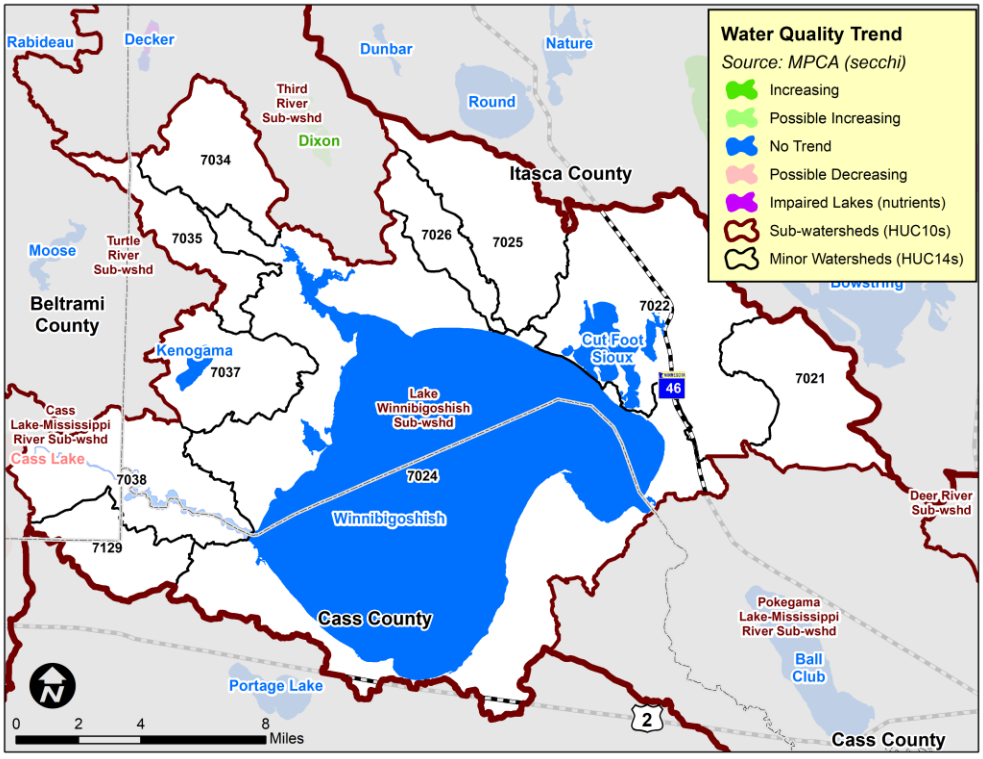
Figure 99. Potential native plant community systems.



Water Resources Summary

Compared to other subwatersheds in the Mississippi Headwaters Major Watershed the Lake Winnibigoshish Subwatershed does not have the most lakes, but it does have the greatest amount of open water with over 67,000 acres or about 35% of the subwatershed area. Of the three lakes that have available water quality data, all are stable. This subwatershed also has nine lakes of high or outstanding biodiversity significance, as well as 23 priority wild rice lakes and 13 priority shallow lakes.

Figure 100. Water quality trends.



Protection Status

94% of the Lake Winnibigoshish Subwatershed is currently protected, mostly by public waters and the Chippewa National Forest. This exceeds the subwatershed protection goal of 75%, and therefore the Lake Winnibigoshish Subwatershed is a low priority for forest land protection.

Figure 101. Protected lands.

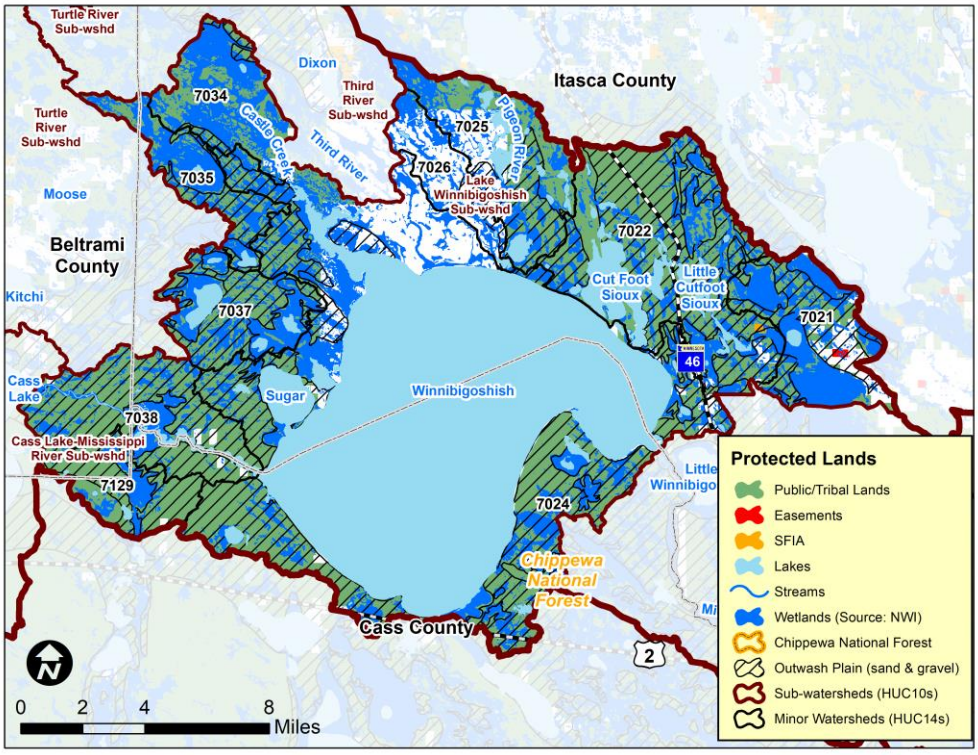
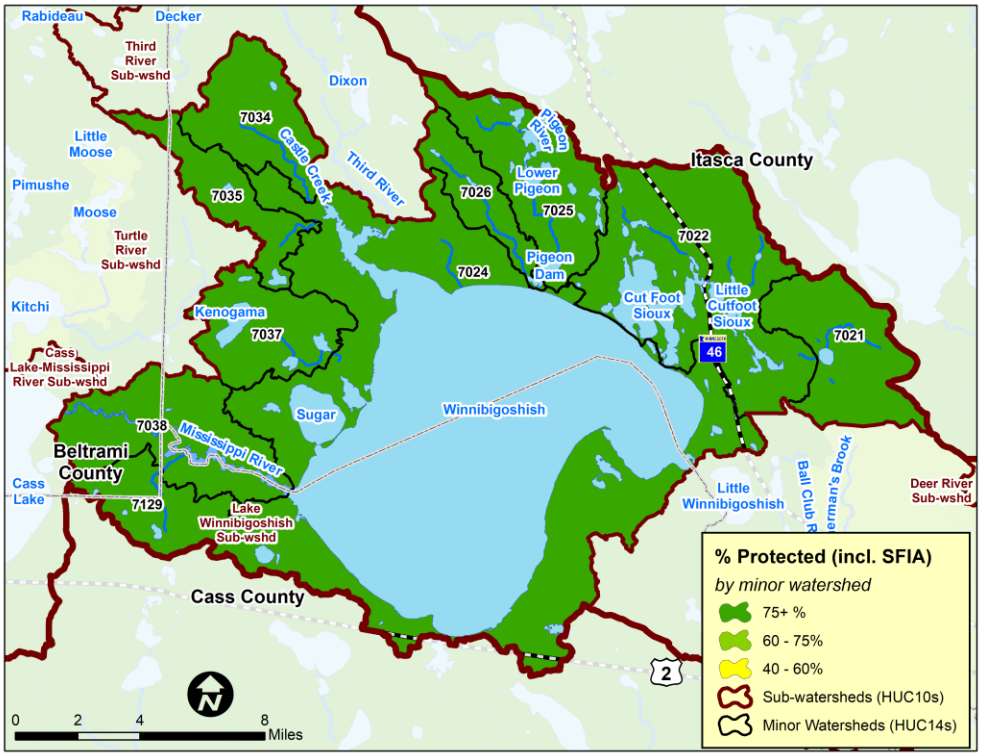


Figure 102. Minor watershed protection levels.



Subwatershed No. 7
Third River (HUC 701010106)

Description

The Third River Subwatershed drains 89 square miles of Beltrami and Itasca counties and is a tributary to the Lake Winnibigoshish Subwatershed. It has an irregular shape and most of the water flows in a southeast direction via Moose Creek and the Third River. The landcover is principally forest and wetlands with minor amounts of agriculture. The outlet to the Third River Subwatershed is located at the southeastern corner of the subwatershed where the Third River flows into a bay on the northern side of Lake Winnibigoshish.

Geography

The Third River Subwatershed, like the Turtle River Subwatershed to its west, is one of the few subwatersheds in the Mississippi Headwaters Majors Watershed that is largely covered by moraine till. However, elongated bands of peat are dispersed throughout the subwatershed and the center is an outwash plain that holds a large portion of the Third River. A notable characteristic of this subwatershed is that it was strongly influenced by the passing of the Des Moines Lobe of the Laurentide Ice Sheet – most of the ridges, streams, and basins of peat are orientated along a northwest-southeast axis.

Figure 103. Geomorphological landforms.

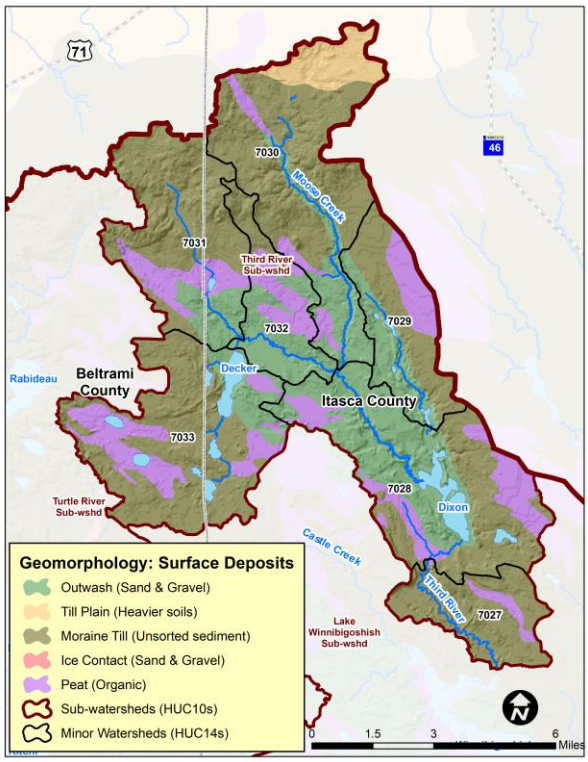
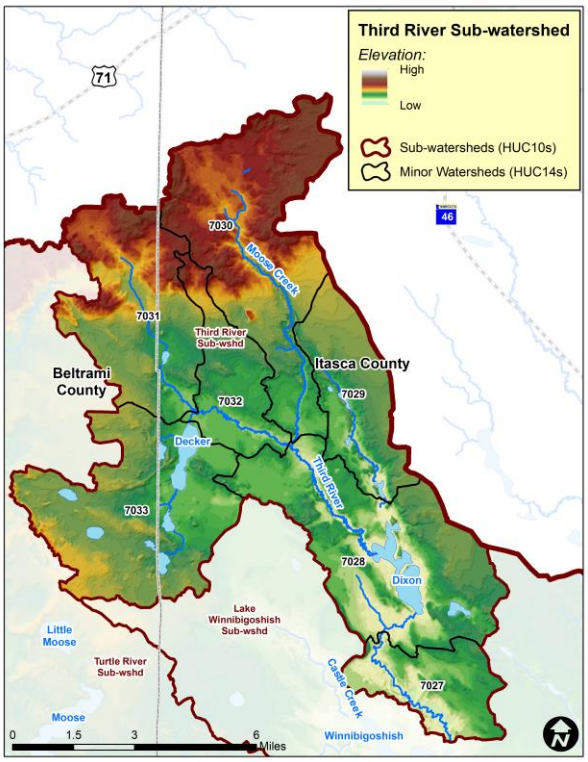


Figure 104. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Third River Subwatershed was mostly conifer swamps in the wetland areas, and northern hardwoods and pines in the uplands. Today the forest remains mostly intact, although the composition has shifted so that most of the forest is in the aspen/birch or spruce/fir cover type, the latter of which are mainly in the wetland areas.

Estimates of the potential native plant communities indicate that fire-dependent forests are most likely supported on the outwash deposits towards the center of the subwatershed, while mesic hardwoods may be better suited to the moraine till deposits. The wetland areas can likely support wet forest, acid peatland, or forested rich peatlands depending on the local conditions.

Figure 105. Historic vegetation class.

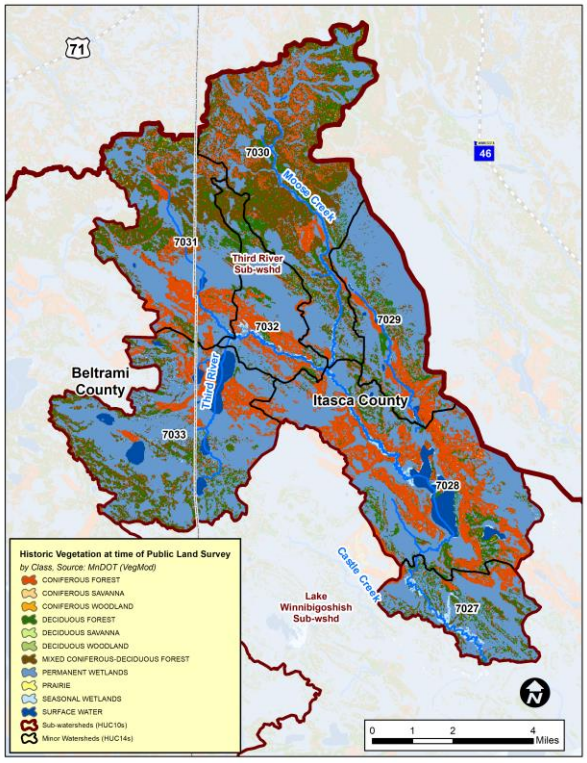


Figure 106. Land cover, 2013.

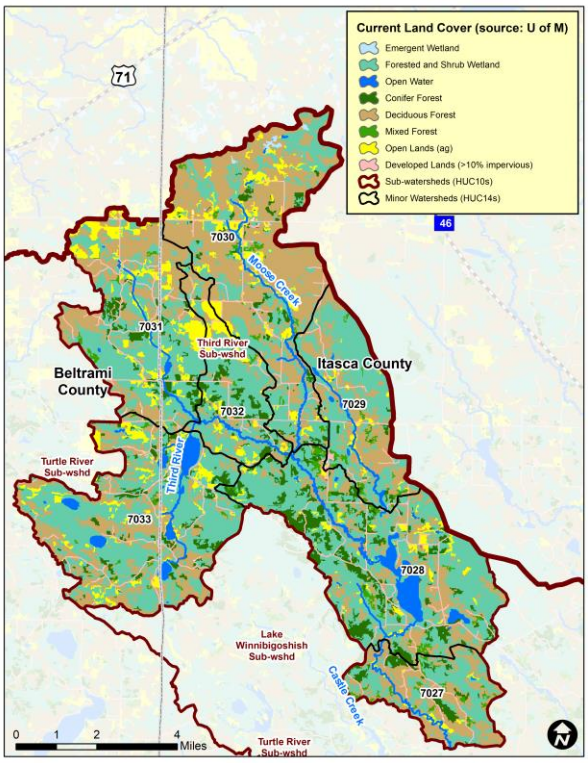
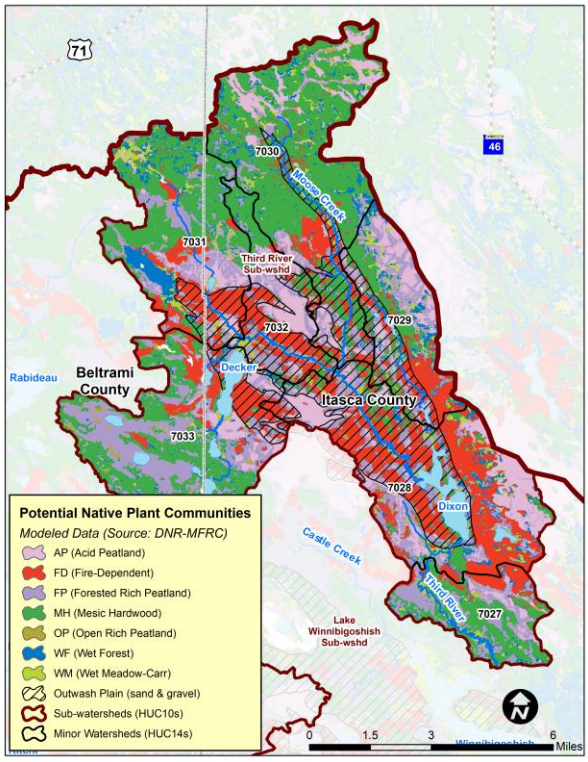


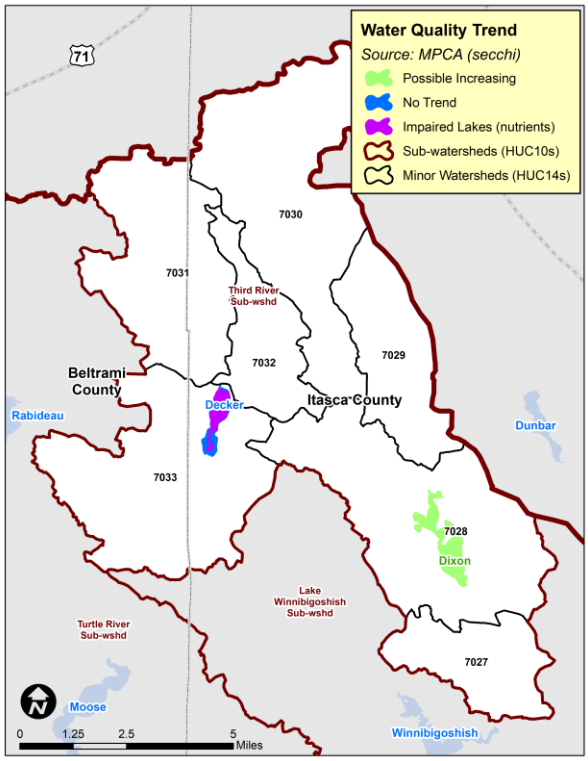
Figure 107. Potential native plant community systems.



Water Resources Summary

The Third River Subwatershed is a stream-based watershed with relatively few lakes, but the highest stream density 0.58 miles/mile^2, which is the highest density of all the subwatersheds in the Mississippi Headwaters Major Watershed. Of the lakes that has available water lake data one (Dixon Lake) is improving and one (Decker Lake) is impaired with nutrients. This subwatershed also has two lakes of outstanding biodiversity, as well as six priority wild rice lakes and four priority shallow lakes.

Figure 108. Water quality trends.



Protection Status

82% of the Third River Subwatershed is currently protected, mostly by the Chippewa National Forest and the Blackduck State Forest. This exceeds the subwatershed protection goal of 75%, and therefore the Third River Subwatershed is a low priority for forest land protection.

Figure 109. Protected lands.

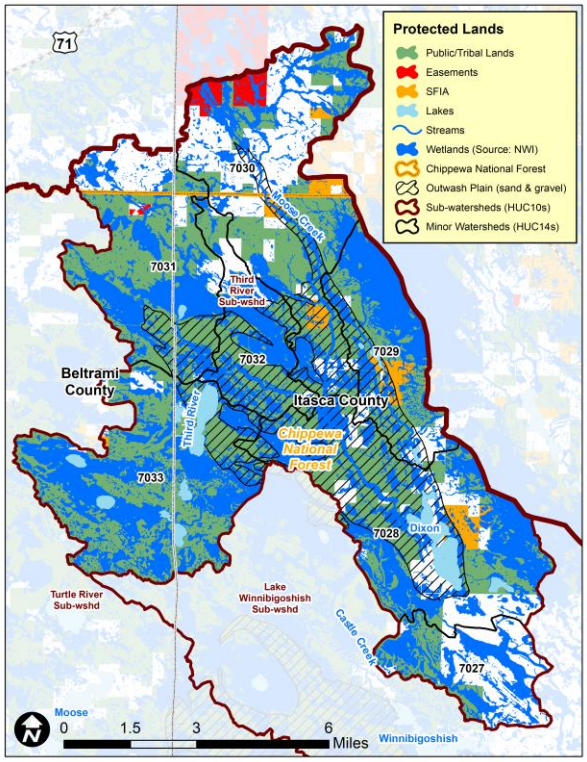
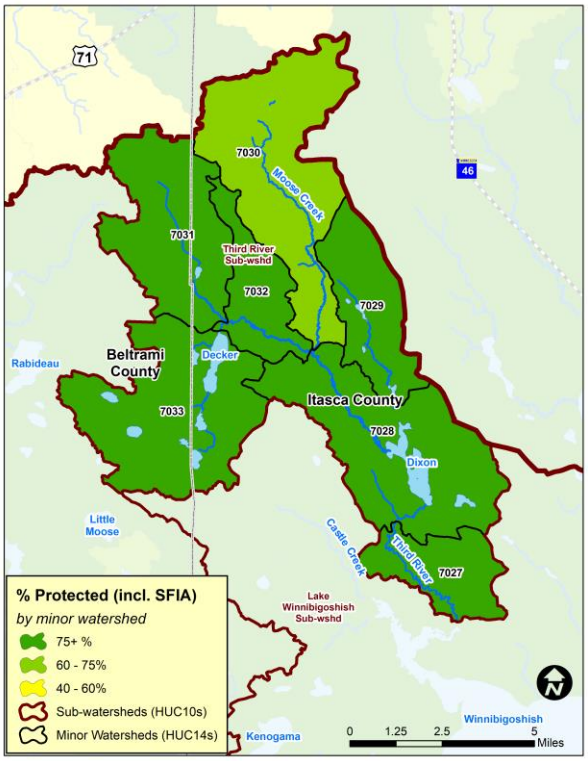


Figure 110. Minor watershed protection levels.



Subwatershed No. 8
Deer River (HUC 701010108)

Description

The Deer River Subwatershed drains 87 square miles of Itasca County and is a tributary to the Pokegama Lake - Mississippi River Subwatershed. It has an irregular shape and the landcover is mostly forests, wetlands, and open water with small amounts of agriculture located in its western half. The outlet to the subwatershed is in the subwatershed's southwestern corner by the town of Deer River, where the actual Deer River flows into White Oak Lake and the Mississippi River beyond.

Geography

The Deer River Subwatershed has two distinct geographical regions – a low, level, and wetland-rich lake plain in the western portion, and a high, rugged landscape of end moraines and pitted outwash plains in the eastern portion. The eastern half also contains nearly all the lakes in this subwatershed, which are drained by a network of streams that converge into the Deer River.

Figure 111. Geomorphological landforms.

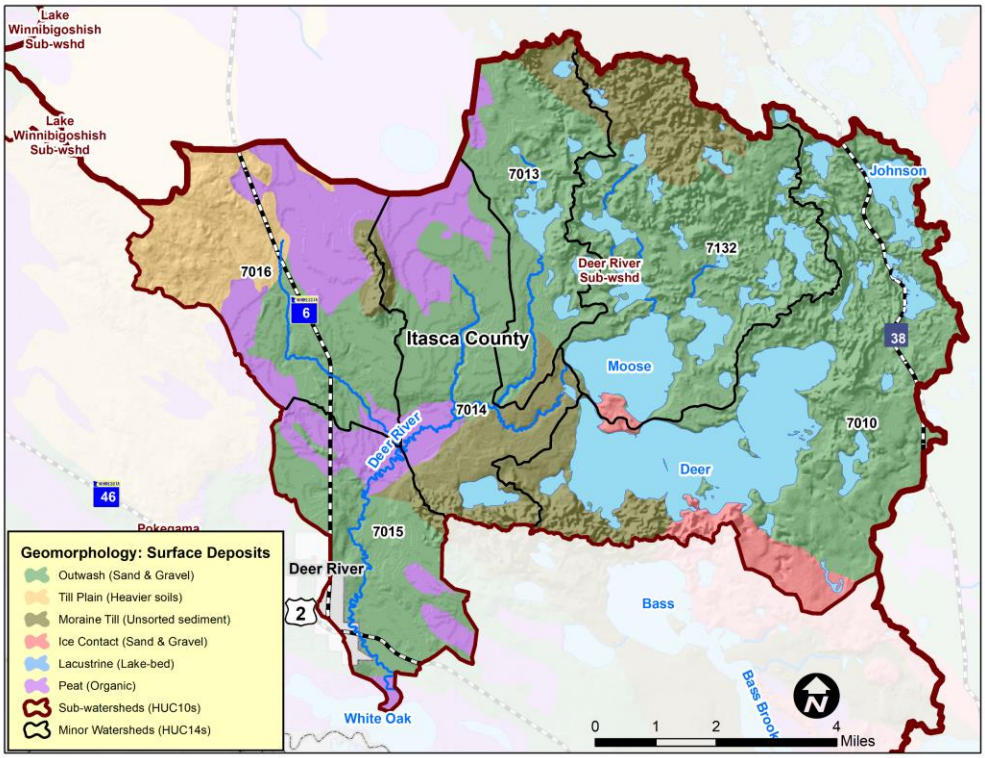
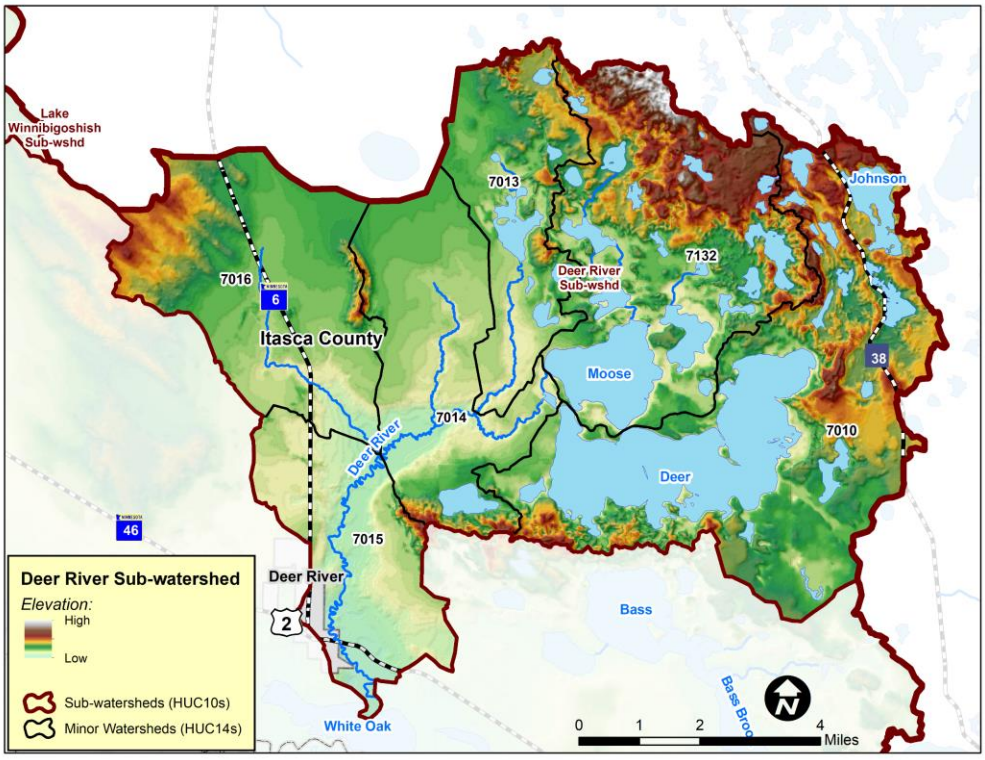


Figure 112. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Deer River Subwatershed was primarily a mix of northern hardwoods and conifers in the uplands and conifer swamps in the wetlands. Today the forest remains mostly intact, albeit more fragmented, with about 12% of the subwatershed area having been converted to development or agriculture. The current forest composition is mostly an aspen/birch cover type in the uplands and spruce/fir in the lowlands.

Estimates of the potential native plant communities (NPCs) indicate that the upland NPCs are more likely to occur in the eastern half of the subwatershed while the lowland NPCs are more likely in the western half among the relatively low and level area around the Deer River and its tributaries. Within the uplands, the potential for mesic hardwoods are greater than the fire-dependent forests, which has a somewhat patchy distribution. Within the lowlands, there is significant potential for both wet forest and peatland NPCs.

Figure 113. Historic vegetation class.

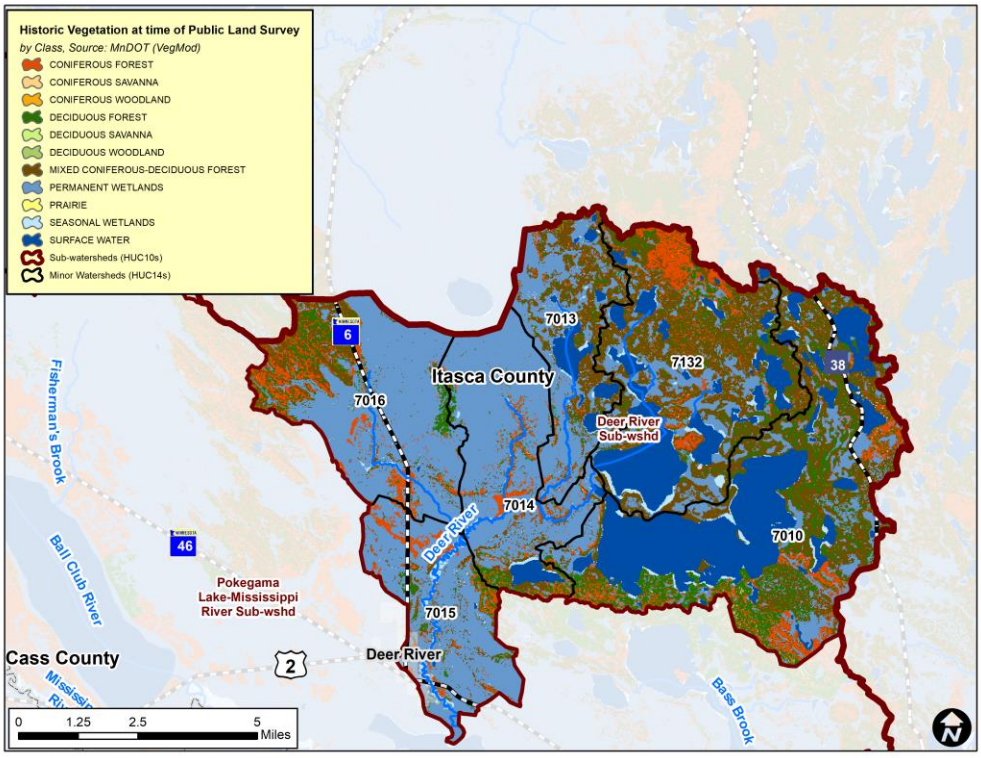


Figure 114. Land cover, 2013.

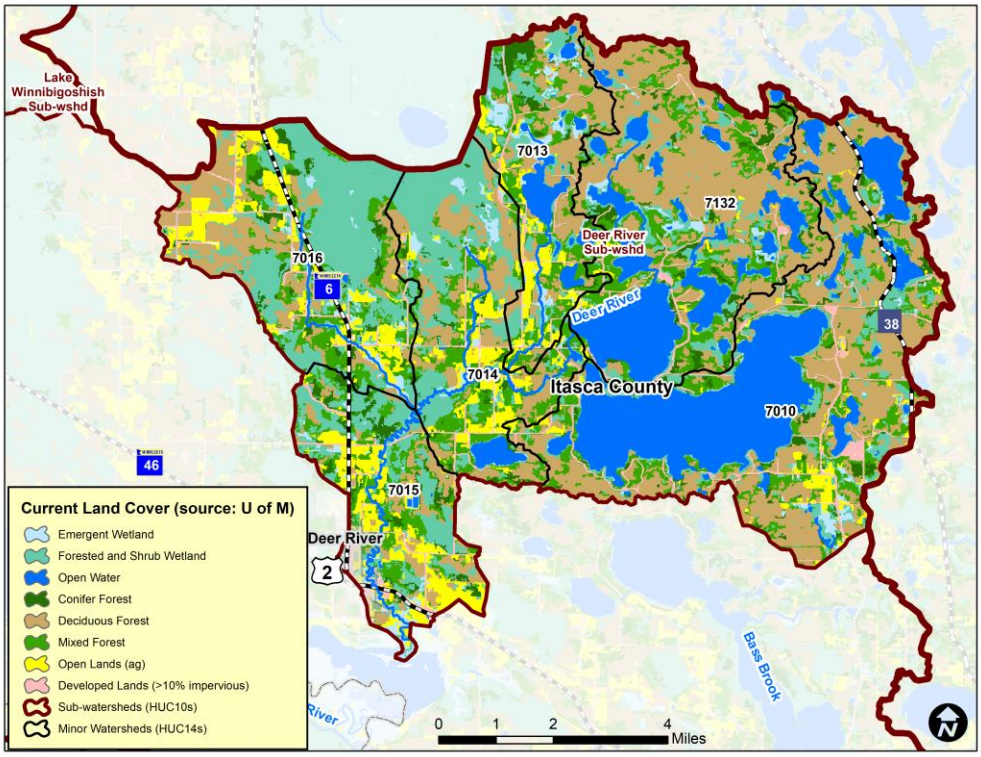
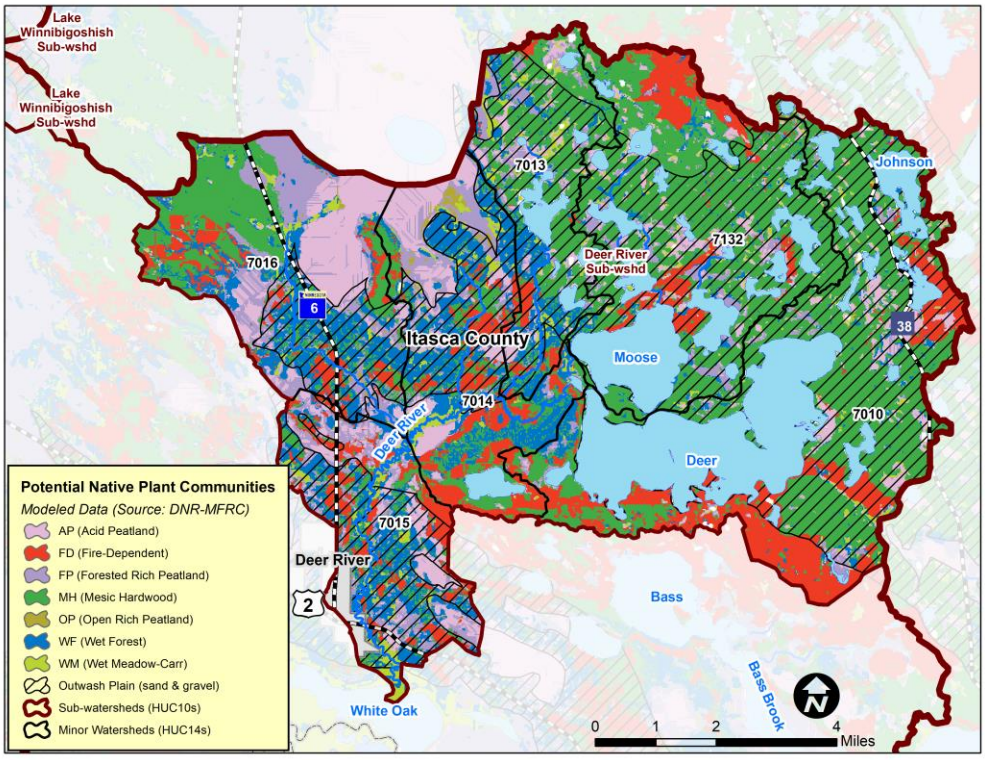


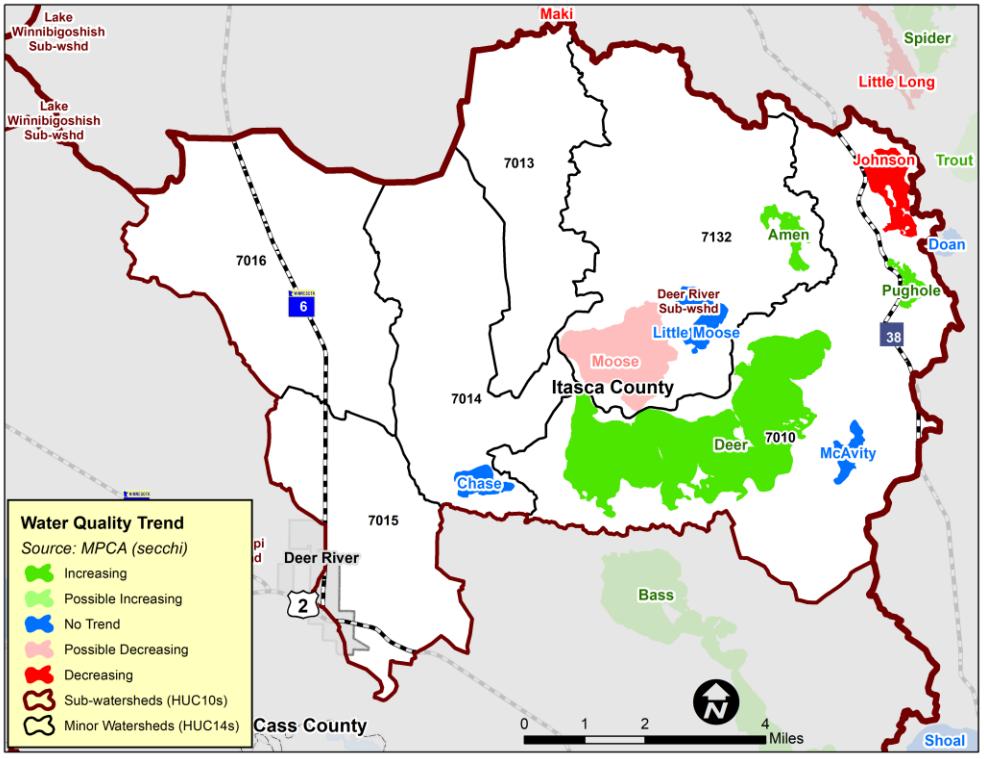
Figure 115. Potential native plant community systems.



Water Resources Summary

The Deer River Subwatershed has both a stream- and lake-based minor watersheds. The minor watersheds in its eastern half are lake-based while the minors in the western half are stream-based. Of the lakes that have available water quality data three are improving, four are stable, and one is declining. This subwatershed also has six lakes of high or outstanding biodiversity significance, as well as one cisco refuge lake, one trout lake, three priority wild rice lakes, and one priority shallow lake.

Figure 116. Water quality trends.



Protection Status

65% of the Deer River Subwatershed is currently protected, mostly by public waters, wetlands, and the Chippewa National Forest. Generally, there is less protection in the western portion of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 5,383 acres need to be protected at an estimated cost of $6,318,176. Fortunately, over 11,500 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed # 7010.

Figure 117.. Protected lands.

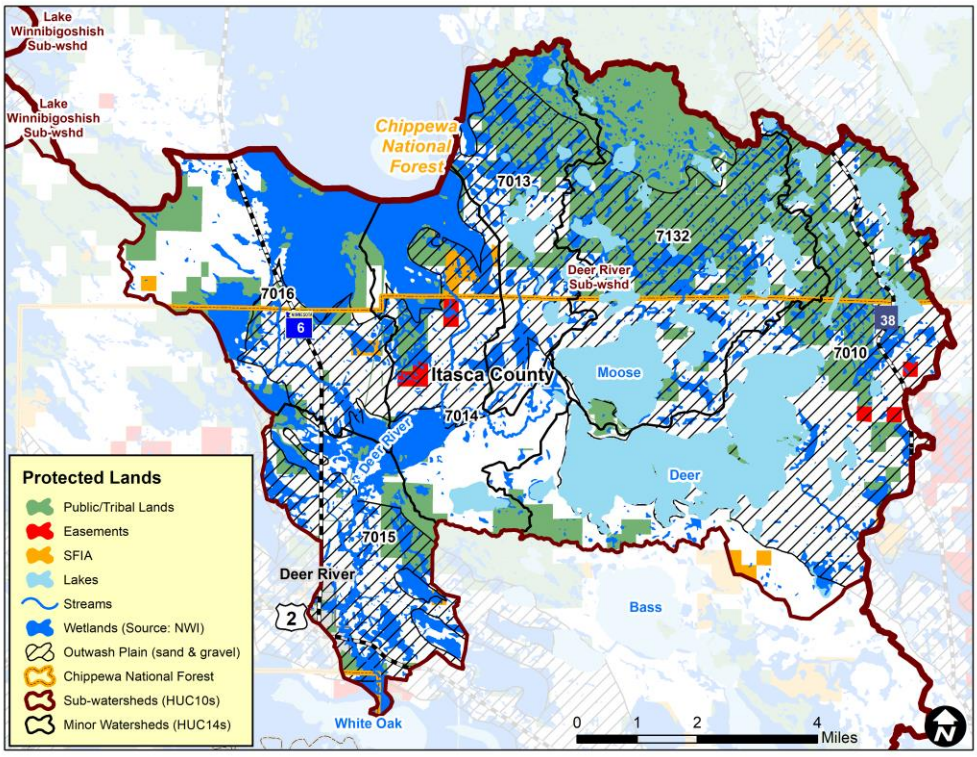
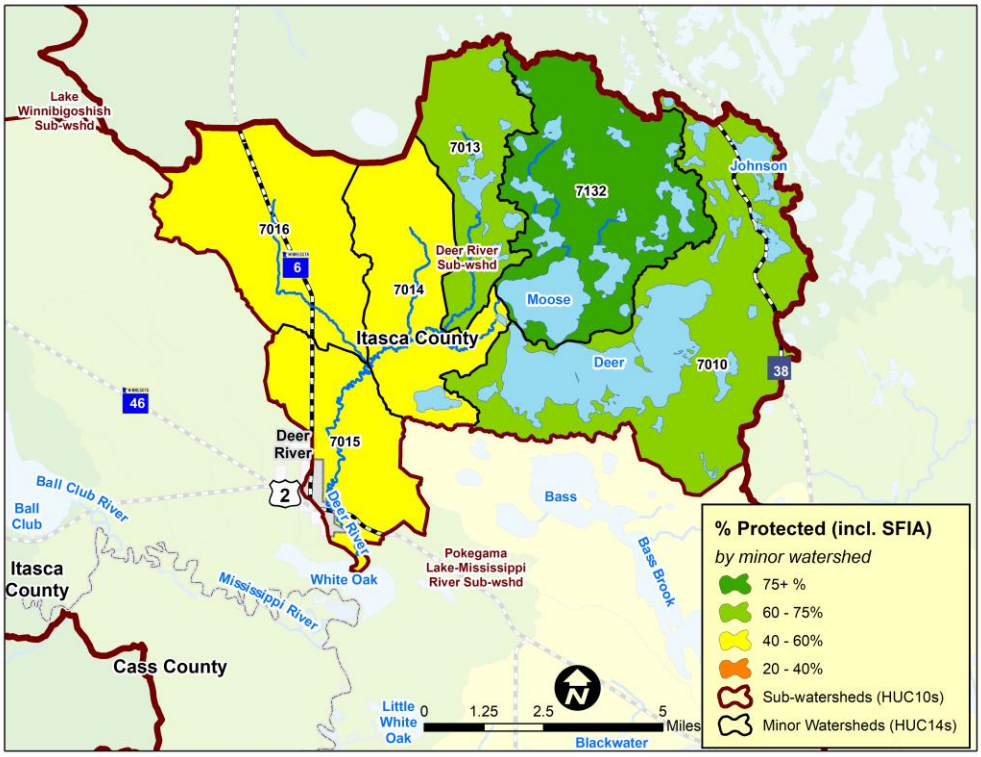


Figure 118. Minor watershed protection levels.



Subwatershed No. 9
Pokegama Lake-Mississippi River (HUC 701010109)

Description

The Pokegama Lake - Mississippi River Subwatershed is located to the west of Grand Rapids and drains 363 square miles of Itasca and Cass counties, making it the largest subwatershed in the Mississippi Headwaters Major Watershed. It also receives water from the Lake Winnibigoshish and Deer River subwatersheds. One of the defining features of this subwatershed is Pokegama Lake, which has high indicators of quality (wild rice, cisco, etc.) and is a very popular recreation lake. The landcover is principally forests, wetlands, and open water with some pockets of agriculture. The outlet to the Pokegama Lake - Mississippi River Subwatershed, and the entire Mississippi Headwaters Major Watershed, is on the subwatershed's eastern border where the Mississippi River flows into the Blandin Reservoir.

Geography

The Pokegama Lake – Mississippi River Subwatershed is one of the more geographically diverse subwatersheds in the Mississippi Headwaters Major Watershed. For most of its course in this subwatershed the Mississippi River flows through outwash plains with extensive peatlands and swamps and past till plain deposits near the town of Deer River. The rugged Sugar Hills Moraine lies in the southern part of the subwatershed and redirects the flow of the Mississippi River around its northern end before exiting the Mississippi Headwaters Major Watershed.

Figure 119. Geomorphological landforms.

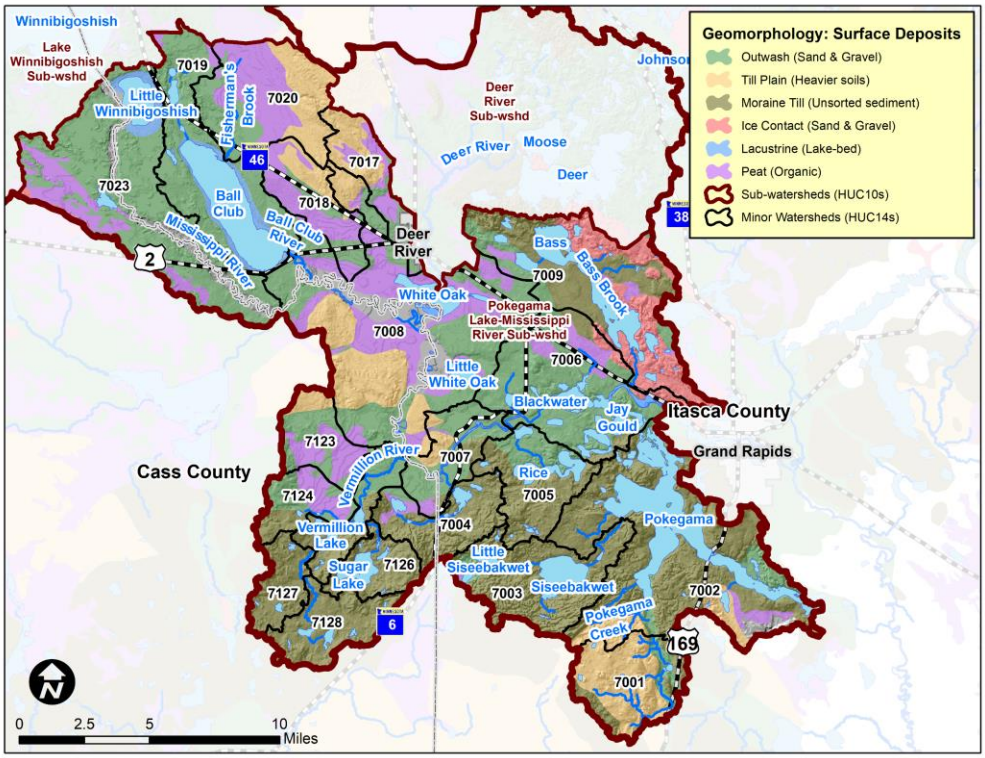
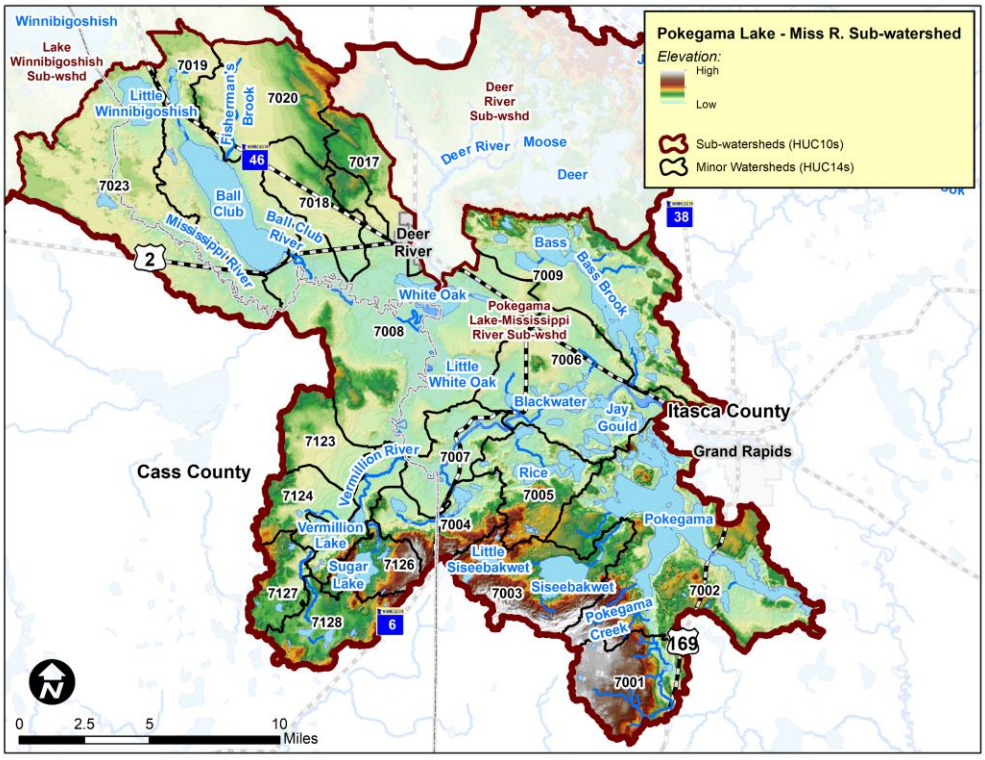


Figure 120. Elevation.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Pokegama Lake-Mississippi River Subwatershed was primarily conifer swamps in the lowlands and a mix of a mix of northern hardwoods and conifers in the uplands. Today most of the forest remains intact, although expanding development from the Grand Rapids in the eastern portion of the subwatershed is a concern. The current forest composition is mostly a spruce/fir cover type in the lowlands and aspen/birch in the uplands. Additionally, some pine forests are present near the beginning of the watershed near the northwestern border, and northern hardwoods may be found on the Sugar Hills Moraine in the southern third of the subwatershed.

Estimates of the potential native plant communities (NPCs) indicate that the mesic hardwoods can likely be supported on the Sugar Hills Moraine, while fire-dependent forests have more potential on the remaining uplands areas in the subwatershed. Within the lowlands, there is significant potential for both wet forest and peatland NPCs.

Figure 121. Historic vegetation class.

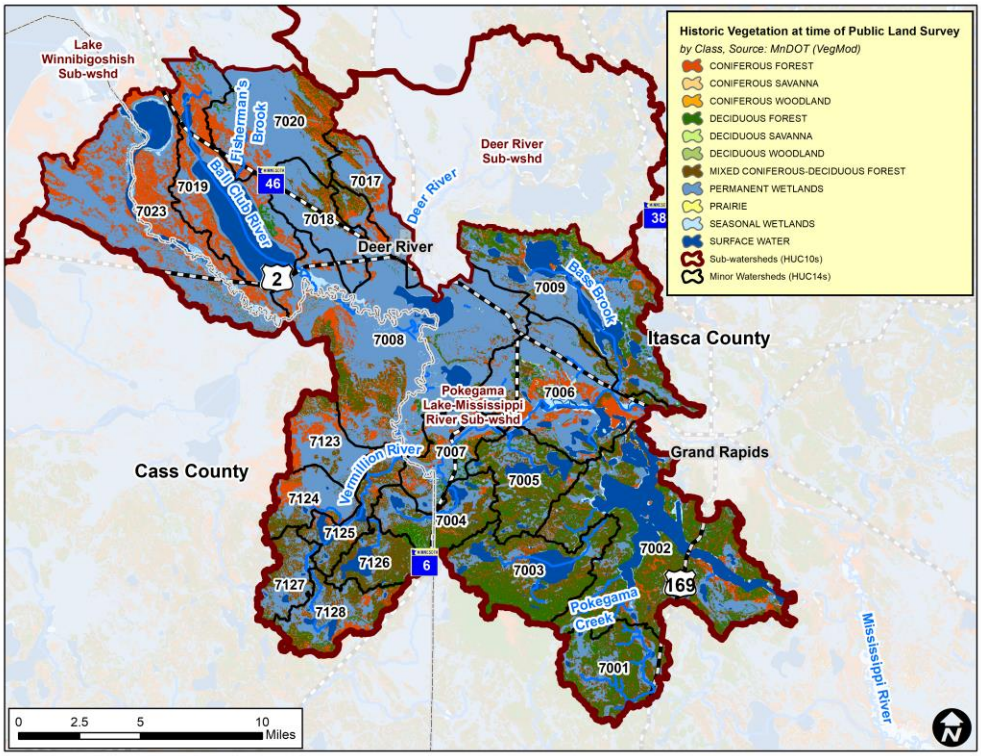


Figure 122. Land cover, 2013.

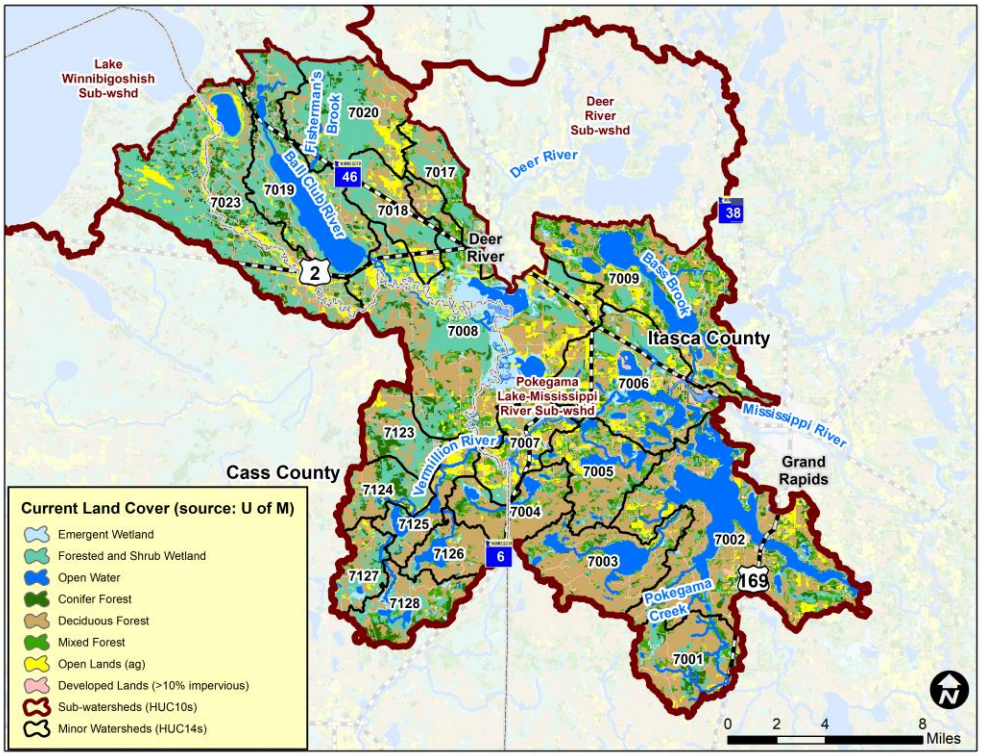
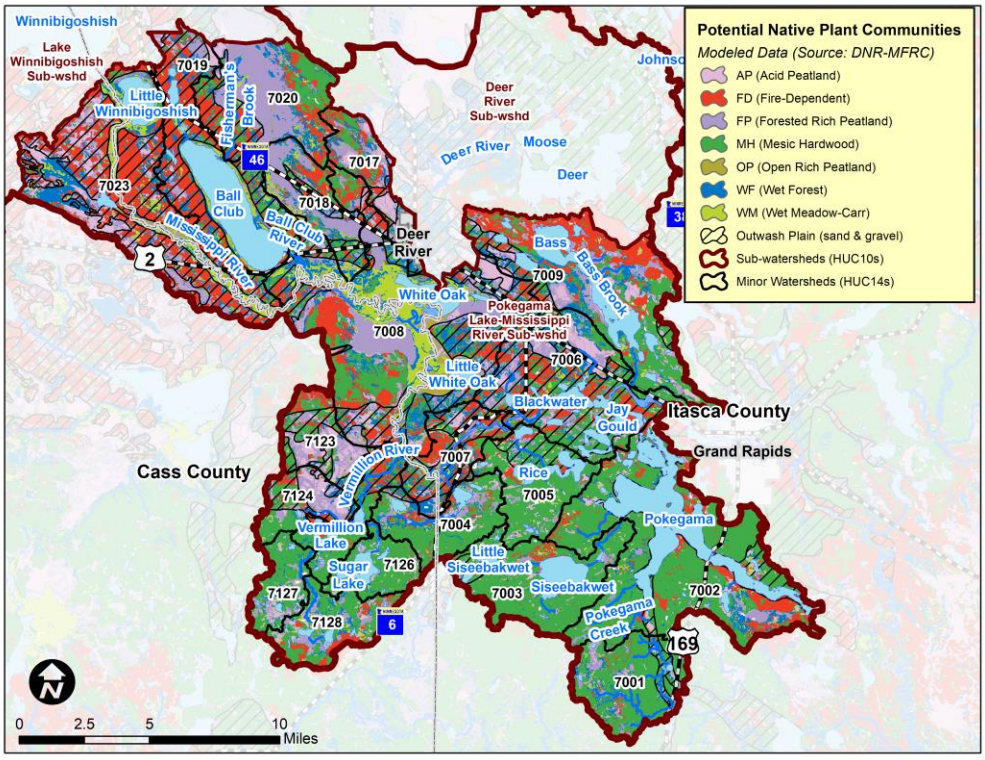


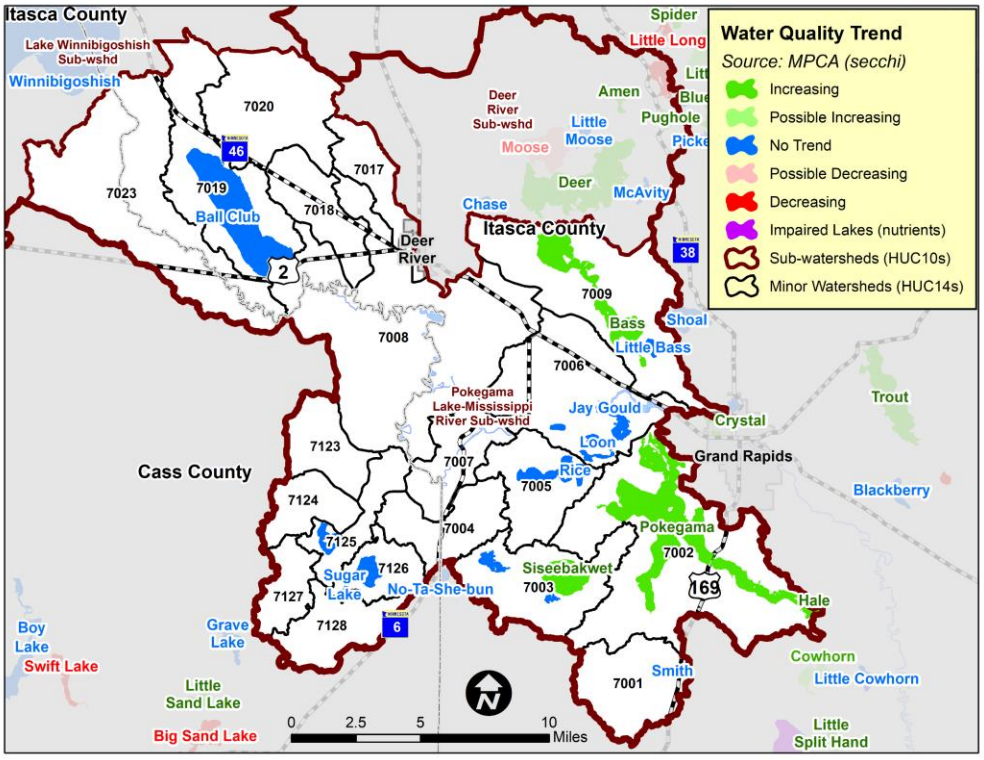
Figure 123. Potential native plant community systems.



Water Resources Summary

The Pokegama Lake - Mississippi River Subwatershed is both large in area and rich in lakes. Furthermore, it contains 20 miles of trout streams, which is more than any other subwatershed in the Mississippi Headwaters Major Watershed. Of the lakes with available water quality data three are improving and 11 are stable. This subwatershed also has nine lakes of high or outstanding biodiversity significance, as well as five cisco refuge lakes, one trout lake, 19 priority wild rice lakes, and eight priority shallow lakes.

Figure 124. Water quality trends.



Protection Status

73% of the Pokegama Lake - Mississippi River Subwatershed is currently protected, mostly by a mix of public lands, public waters, wetlands, and conservation easements held by Blandin. Generally, there is less protection in the eastern third of the subwatershed than in other areas. To reach the subwatershed protection goal of 75% an additional 3,921 acres need to be protected at an estimated cost of $3,992,335. Fortunately, nearly 36,000 acres have the potential to protect, although the Mississippi Headwaters Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 7002, 7005, 7006, 7009, and 7125.

Figure 125. Protected lands.

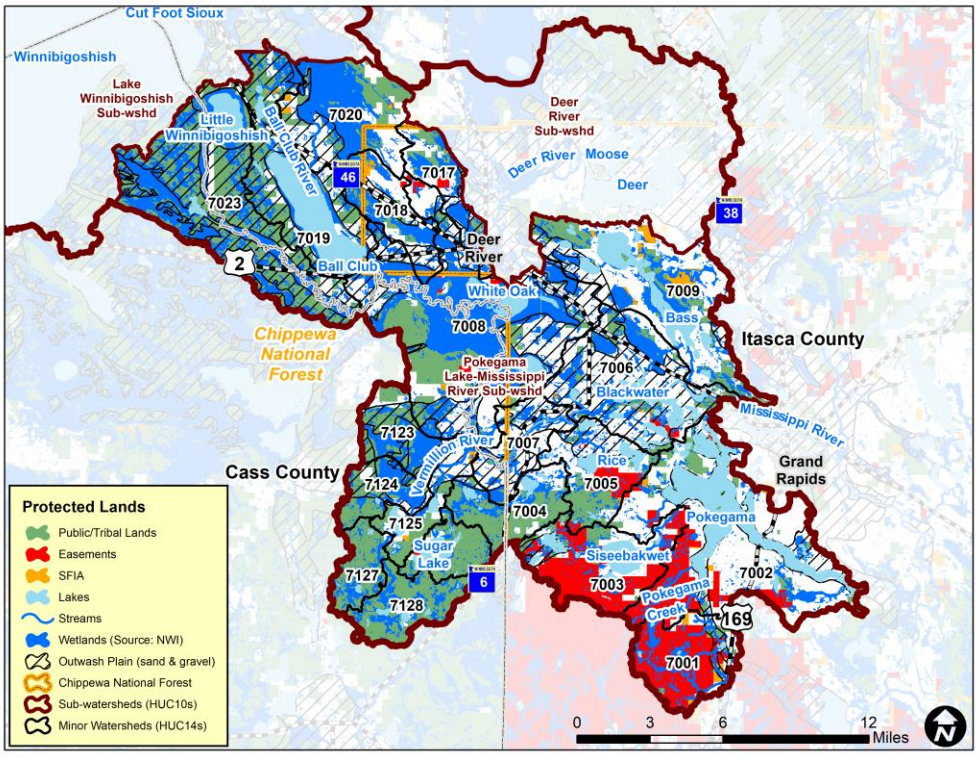
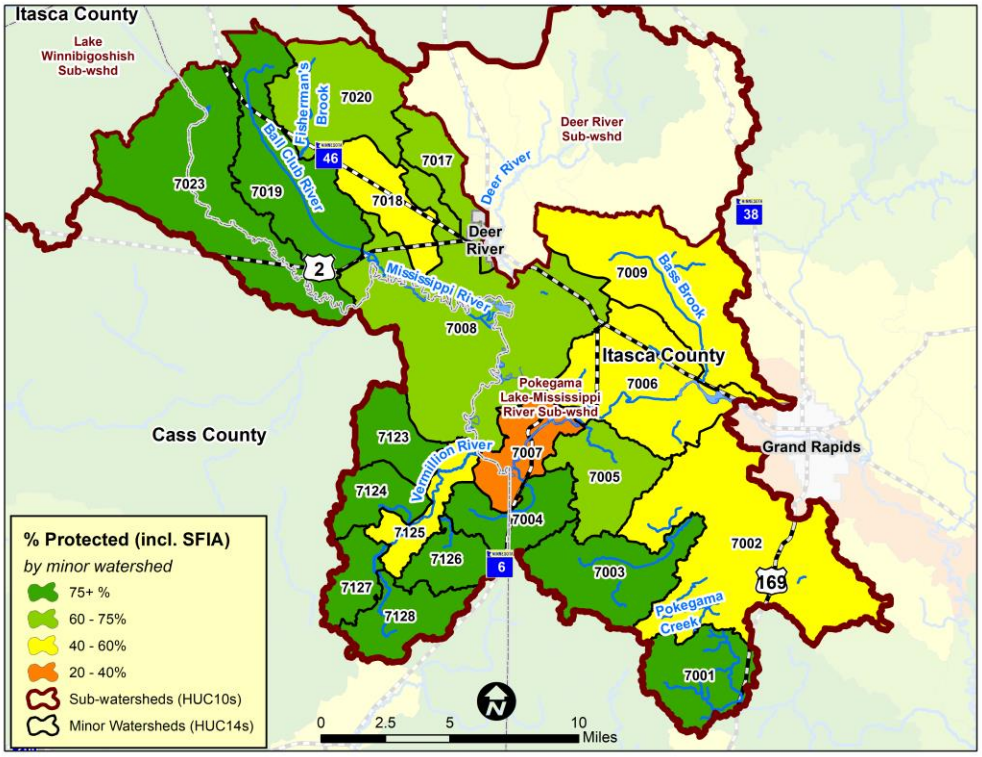


Figure 126. Minor watershed protection levels.



Ecological Pathway to Sustainable Forest Management

Below is the general sequence of concepts and products that were developed for and/or integrated into the 2nd generation North Central Landscape Plan as a suggested ecological pathway to help land managers and owners work from the landscape scale down to the site level when planning specific forest management activities.

1. Ecological Classification System

a. Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province
b. DNR ECS website (http://www.dnr.state.mn.us/ecs/index.html)
c. North Central Landscape Conditions and Trends Report (pp. 3.2-3.6) (https://mn.gov/frc/docs/north-central_Conditions&Trends_2017.pdf)
d. North Central Landscape Resource Atlas (pp. 37-41) (https://mn.gov/frc/docs/NC_Resource_Atlas_May2016.pdf)
e. North Central Landscape Plan (p. 3.2) (https://mn.gov/frc/docs/NC_Landscape_Plan.pdf)

2. Native Plant Communities

a. Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province
b. Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province
c. DNR NPC website (http://www.dnr.state.mn.us/npc/index.html)
d. North Central Landscape Conditions and Trends Report (pp. 3.7-3.8) (https://mn.gov/frc/docs/north-central_Conditions&Trends_2017.pdf)
e. North Central Landscape Resource Atlas (pp. 65-66) (https://mn.gov/frc/docs/NC_Resource_Atlas_May2016.pdf)
f. North Central Landscape Plan - Appendix D (https://mn.gov/frc/docs/NC_Landscape_Plan_Appendix.pdf)

3. Potential Native Plant Communities

a. Geospatial Modeling of Native Plant Communities of Minnesota's Laurentian Mixed Forest (http://mn.gov/frc/docs/NPC_Technical_Report_Final_Jan2013.pdf)
b. Mapping Potential Native Plant Communities of Minnesota's Laurentian Mixed Forest (http://mn.gov/frc/docs/Potential_Native_Plant_Communities_Summary_Final-Jan2014.pdf)
c. Potential Native Plant communities of Minnesota's Eastern Broadleaf Forest (https://data.nrri.umn.edu/data/dataset/cb6d64e5-fb67-4b05-b9cc-5bbebdb3568a/resource/43c8d895-709b-4b82-ae22-7dade35ac1df/download/nrri-tr-2019-01.pdf)
d. GIS data sources:
   - Laurentian Mixed Forest: http://data.nrri.umn.edu/data/dataset/nemn-pnpc
   - Laurentian Mixed Forest & Eastern Broadleaf Forest: https://data.nrri.umn.edu/data/dataset/npc-ebf-lmf
e. North Central Landscape Conditions and Trends Report (pp. 3.8-3.12) (https://mn.gov/frc/docs/north-central_Conditions&Trends_2017.pdf)
f. North Central Landscape Resource Atlas (pp. 69-92) (https://mn.gov/frc/docs/NC_Resource_Atlas_May2016.pdf)

4. **Vegetation Management Framework Goals and Strategies**

    a. North Central Landscape Plan – Section 7 (https://mn.gov/frc/docs/NC_Landscape_Plan.pdf)

5. **Climate Change Considerations and Strategies**

    a. Minnesota Forest Ecosystem Vulnerability Assessment and Synthesis: A Report from the Northwoods Climate Change Response Framework Project (http://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs133.pdf)
    b. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers (https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs87-2.pdf)
    c. Climate Change Field Guide for Northern Minnesota Forests: Site-level consideration and adaption (https://forestadaptation.org/sites/default/files/ClimateChangeFieldGuide_NMNForests_HiRes.pdf)
    d. Minnesota Private Landowner Climate Scorecard (https://forestadaptation.org/sites/default/files/KeepYourWoodsHealthyforTomorrow_MN.pdf)
    e. Climate Change Atlas (https://www.fs.fed.us/nrs/atlas/)
    f. NPC silviculture strategies for forest stand prescriptions (https://www.dnr.state.mn.us/forestry/ecs_silv/npc/index.html)
    g. North Central Landscape Conditions and Trends Report (pp. 3.21-3.25) (https://mn.gov/frc/docs/north-central_Conditions&Trends_2017.pdf)
    h. North Central Landscape Plan - Appendix D (https://mn.gov/frc/docs/NC_Landscape_Plan_Appendix.pdf)
    i. North Central Landscape Plan (pp. 4.9-10, 7.20-21) (https://mn.gov/frc/docs/NC_Landscape_Plan.pdf)

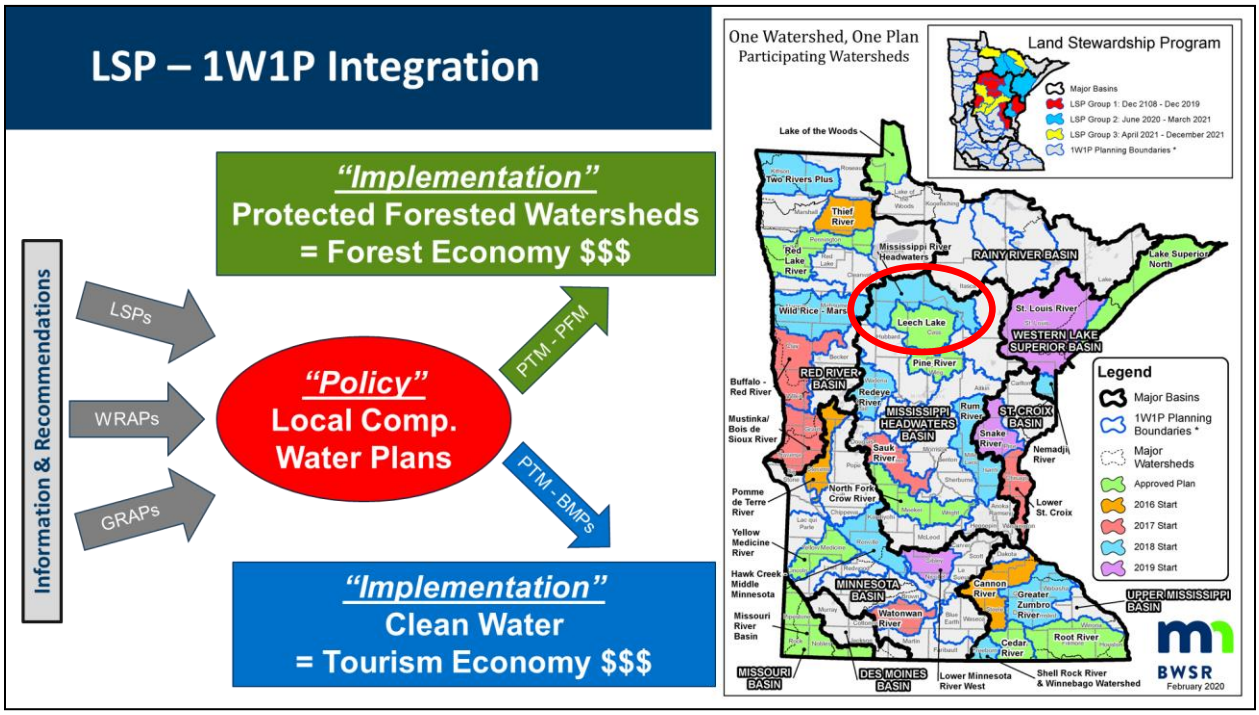
6. **Silvicultural Considerations**

    a. MN DNR Tree Suitability Table (http://files.dnr.state.mn.us/forestry/ecssilviculture/treetables.pdf)
    b. NPC silviculture strategies for forest stand prescriptions (https://www.dnr.state.mn.us/forestry/ecs_silv/npc/index.html)
    c. Great Lakes Silvicultural Library (https://silvlib.cfans.umn.edu/)
    d. North Central Landscape Plan - Appendix D (https://mn.gov/frc/docs/NC_Landscape_Plan_Appendix.pdf)
    e. North Central Landscape Plan - Appendix E (https://mn.gov/frc/docs/NC_Landscape_Plan_Appendix.pdf)

7. **Tatum Guides – in development**

    a. NPC silviculture strategies for forest stand prescriptions (https://www.dnr.state.mn.us/forestry/ecs_silv/npc/index.html)

Linking Forest & Water Planning and Implementation through LSPs and 1W1Ps

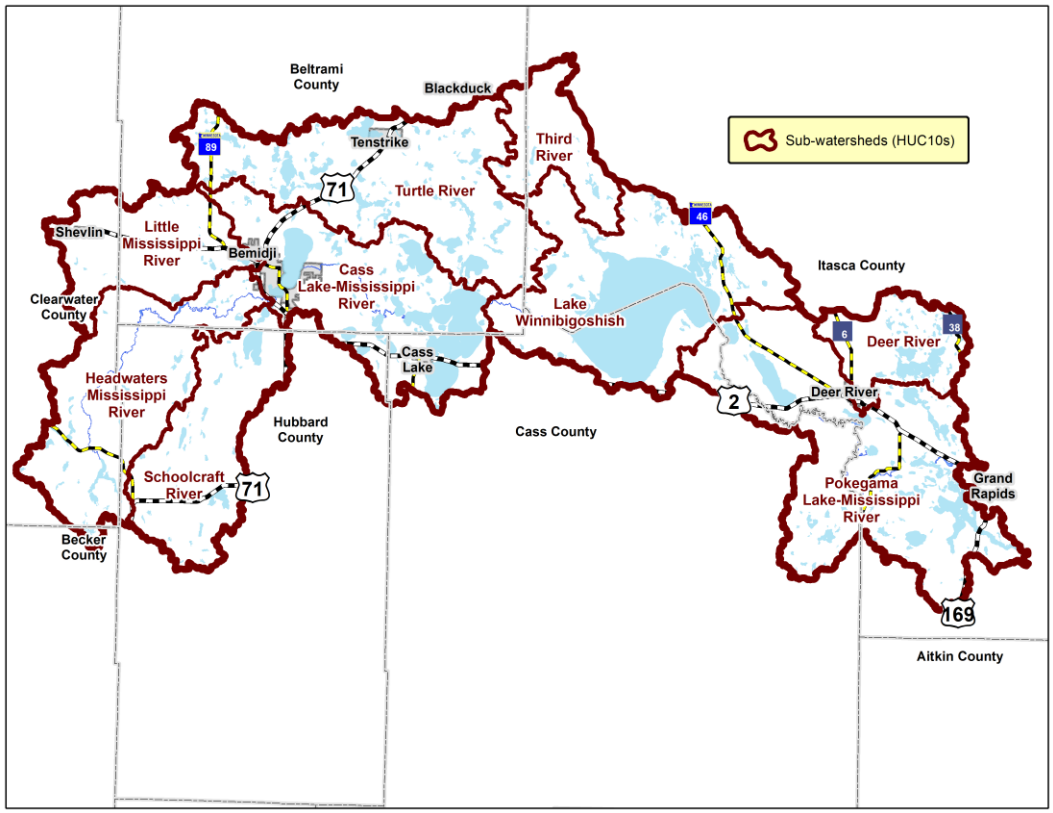


Note: Landscape stewardship plans (LSPs) like the MPCA Watershed Restoration and Protection Strategies (WRAPs) and the MDH Groundwater Restoration and Protection Strategies (GRAPs) provide an important information and relevant context from state water and forest resource programs to inform comprehensive local water management (1W1Ps) processes. Members of the 1W1P committees are encouraged to consider the recommendations in this document for incorporation into their plans. Through the integration of landscape stewardship plans and 1W1Ps, conservation professionals and landowners are working together to address the following national priorities from the USDA Forest Service:

- Conserve Working Forest Lands.
- Protect Forests from Harm.
- Enhance Public Benefits from Trees and Forests.

"A lake is the landscape's most beautiful and expressive feature.
It is Earth's eye;
looking into which the beholder measures the depth of his own nature."
- Henry David Thoreau

Index Information – Mississippi Headwaters Major Watershed



Subwd no.	Subwatershed name	HUC no.	Acres	No. of minors
1	Headwaters Mississippi River	701010102	148,213	16
2	Little Mississippi River	701010101	88,654	11
3	Schoolcraft River	701010103	109,631	17
4	Cass Lake-Mississippi River	701010105	158,269	12
5	Turtle River	701010104	188,297	22
6	Lake Winnibigoshish	701010107	190,894	10
7	Third River	701010106	56,811	7
8	Deer River	701010108	55,852.	6
9	Pokegama Lake-Mississippi River	701010109	232,267	20
	Totals		**1,228,889**	**121**