Redeye River Watershed Landscape Stewardship Plan

Appendix

East Otter Tail SWCD Wadena SWCD Wadena NRCS Houston Engineering

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 Redeye River Landscape Stewardship Plan.

Redeye River LSP Planning Team

The Redeye River 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
Anne Oldakowski	Wadena and East Otter Tail SWCD
Darren Newville	Wadena and East Otter Tail SWCD
Ben Underhill	Wadena and East Otter Tail SWCD
Ivan Reinke	Wadena NRCS
Pete Waller	Board of Water and Soil Resources
Jeff Hrubes	Board of Water and Soil Resources
Moriya Rufer	Houston Engineering Inc.

Staff Supporting the Redeye River 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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This section lists documents referenced in the Redeye River Landscape Stewardship Plan or otherwise used in its development.

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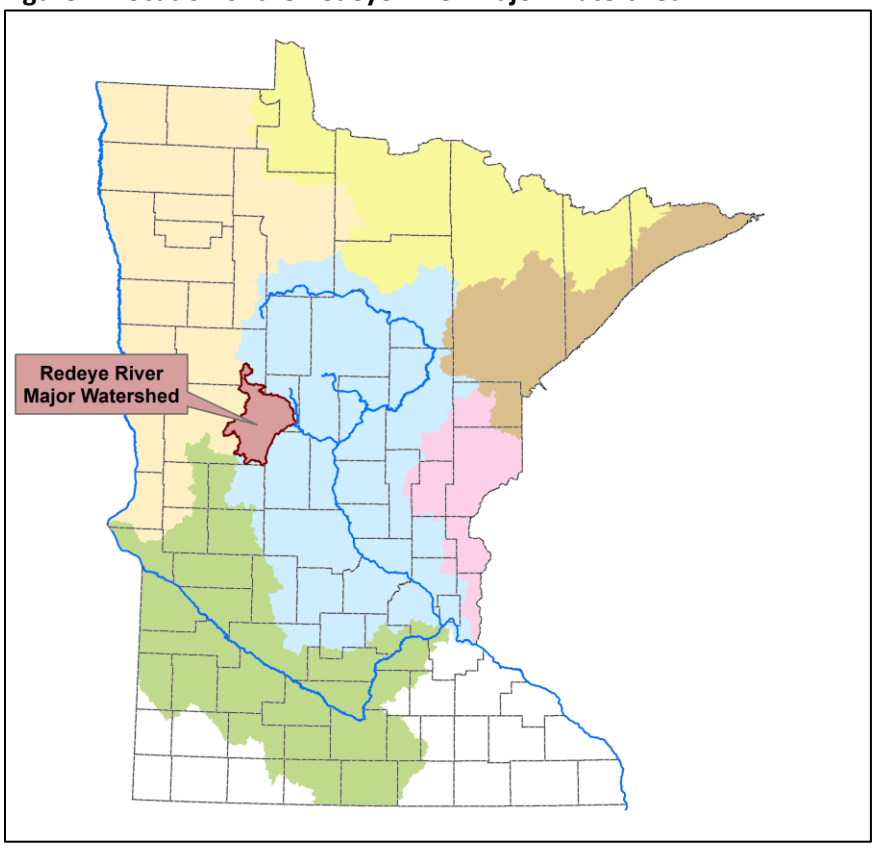
Redeye River Resource Inventory (HUC 8)

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

Figure 1. Location of the Redeye River Major Watershed.



Geography

Figure 2. Geomorphological landforms.

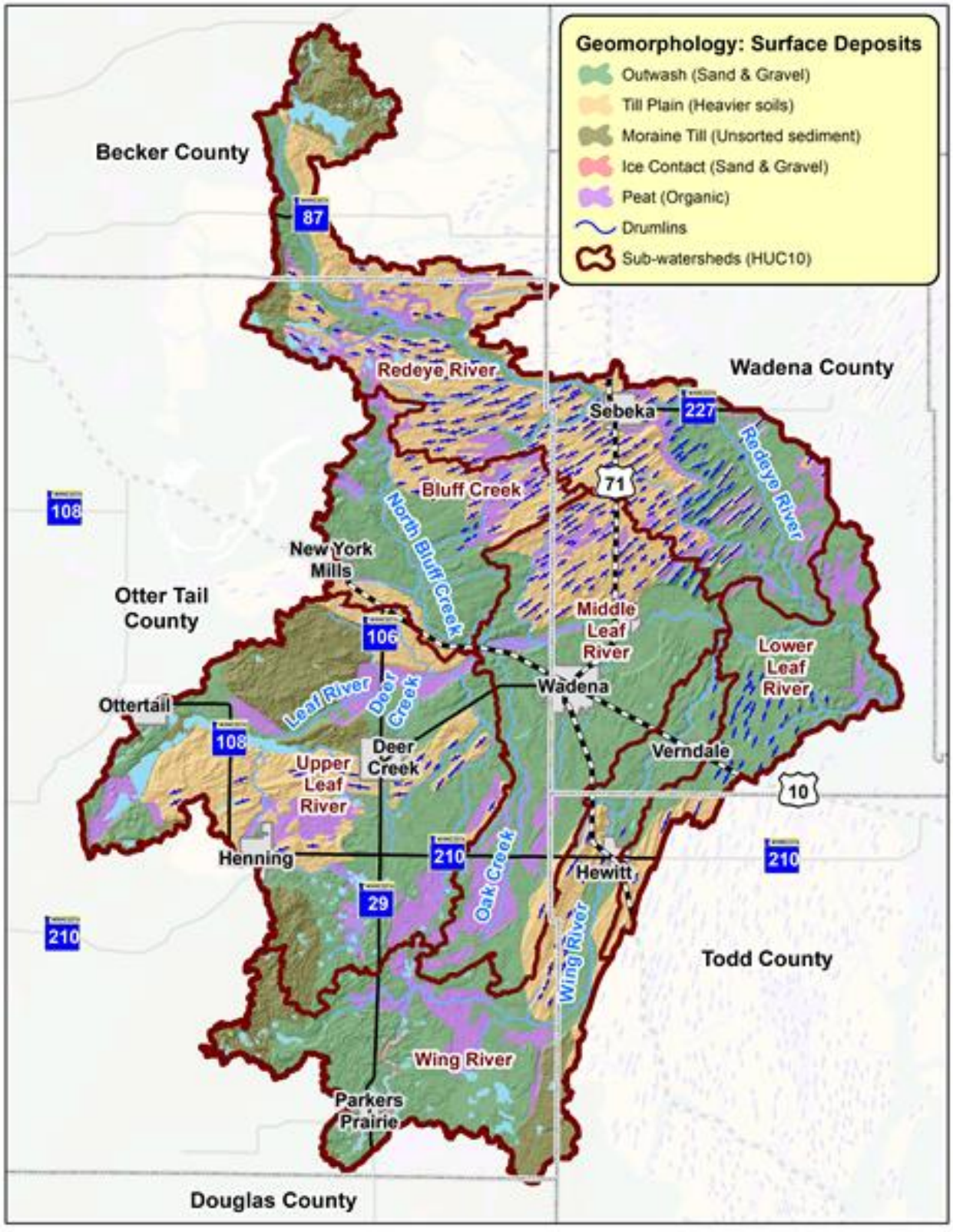


Figure 3. Elevation.

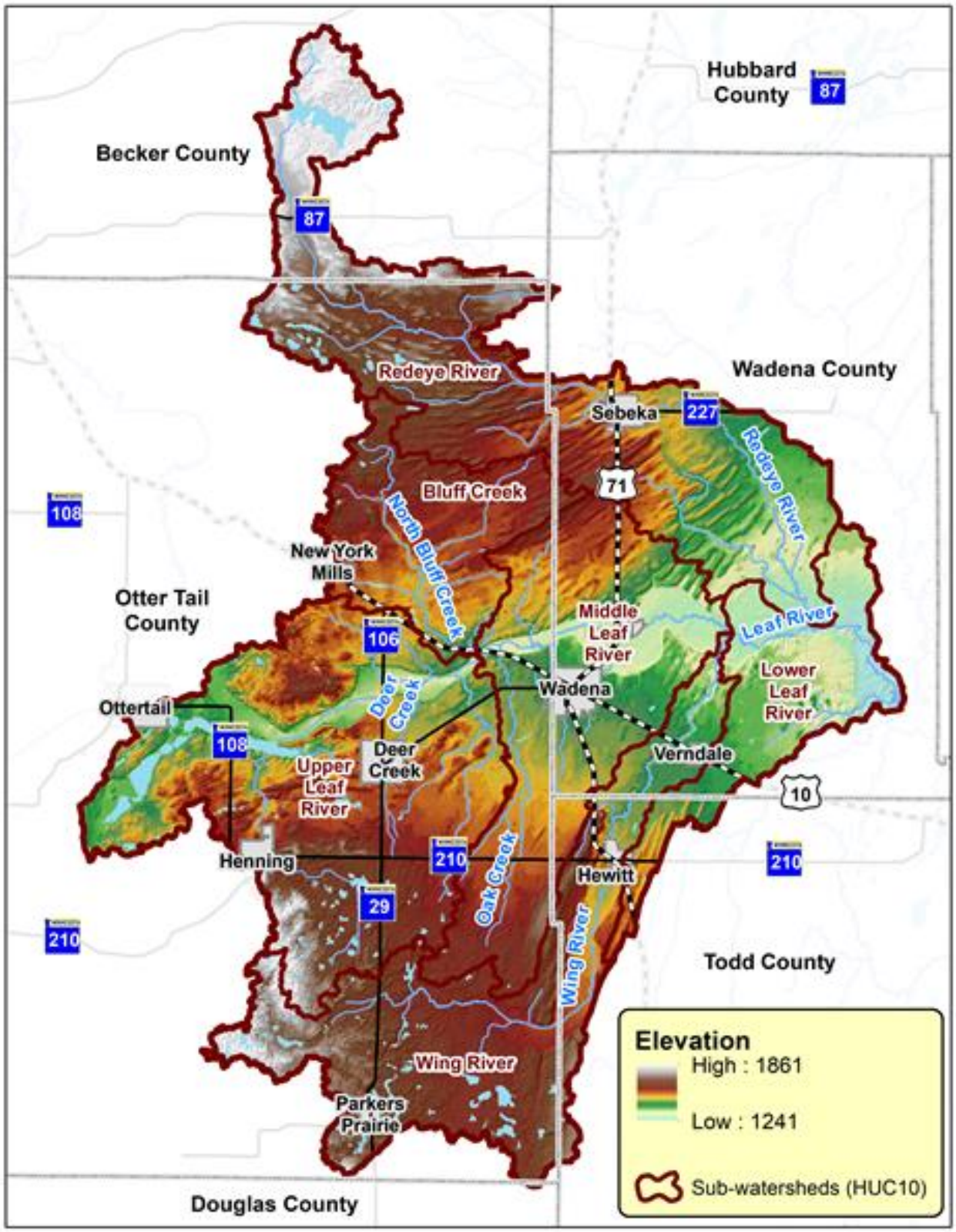


Figure 4. Ecological subsections.

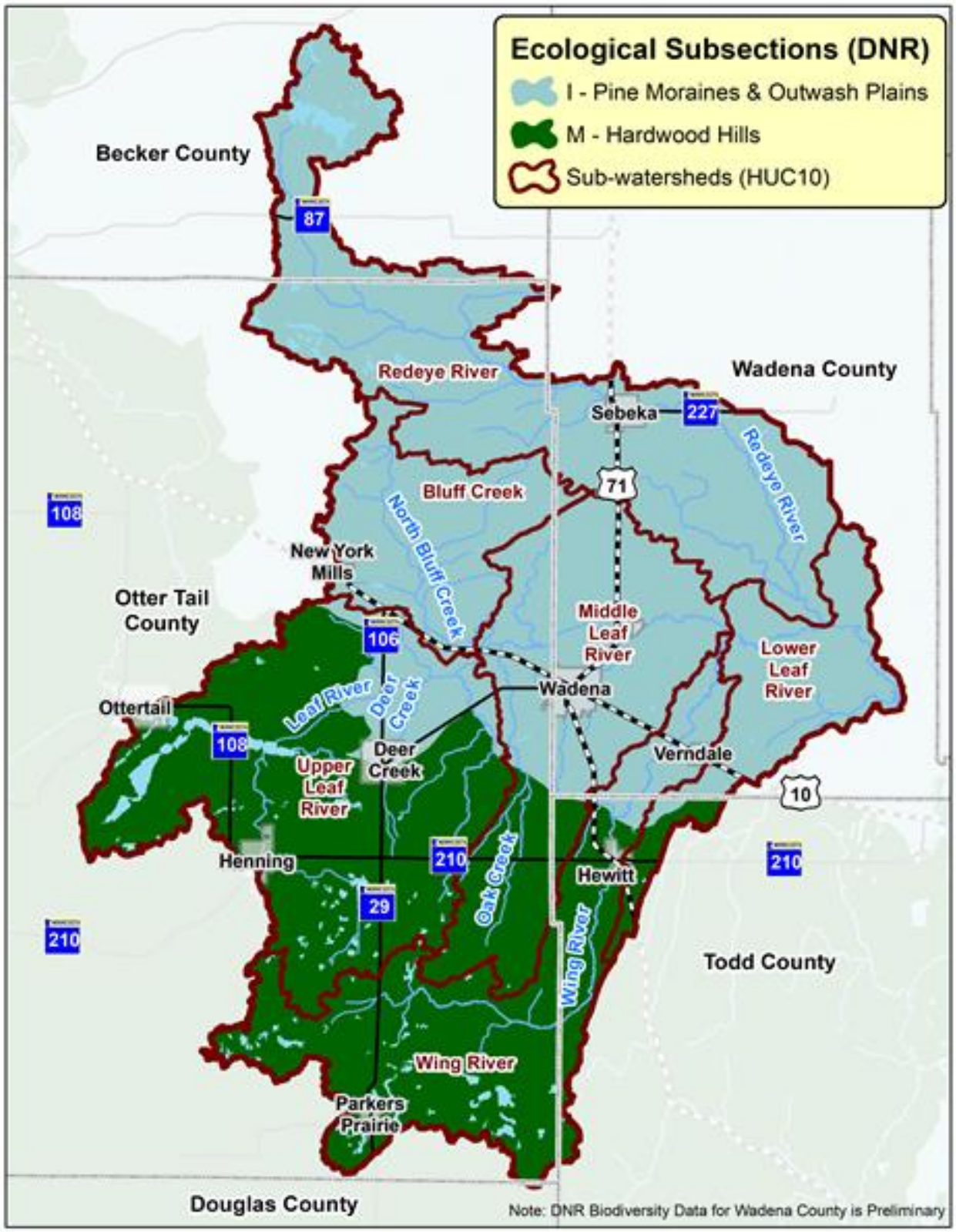
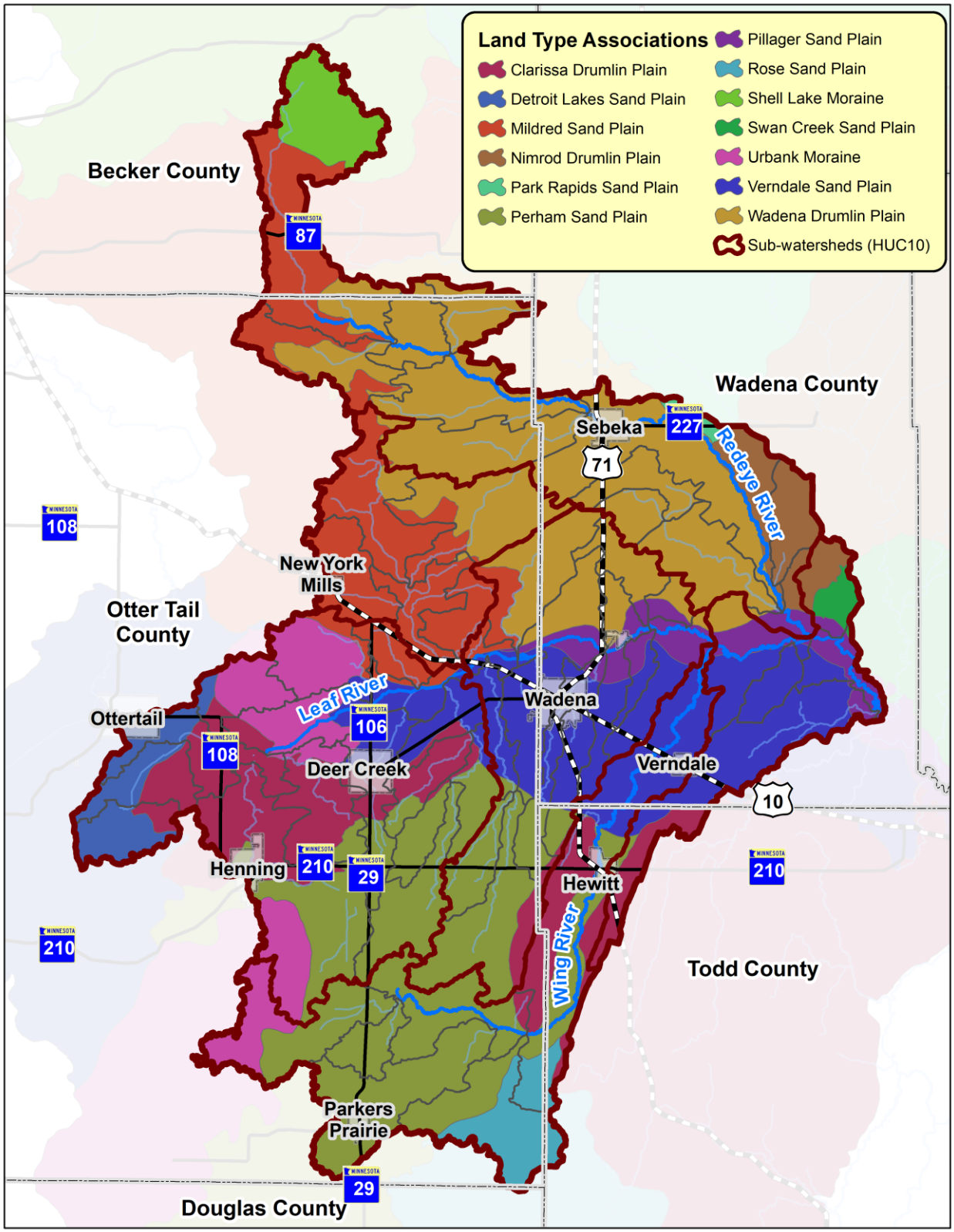


Figure 5. Land type associations.



Forest Cover and Composition

Figure 6. Historic vegetation cover, Marschner.

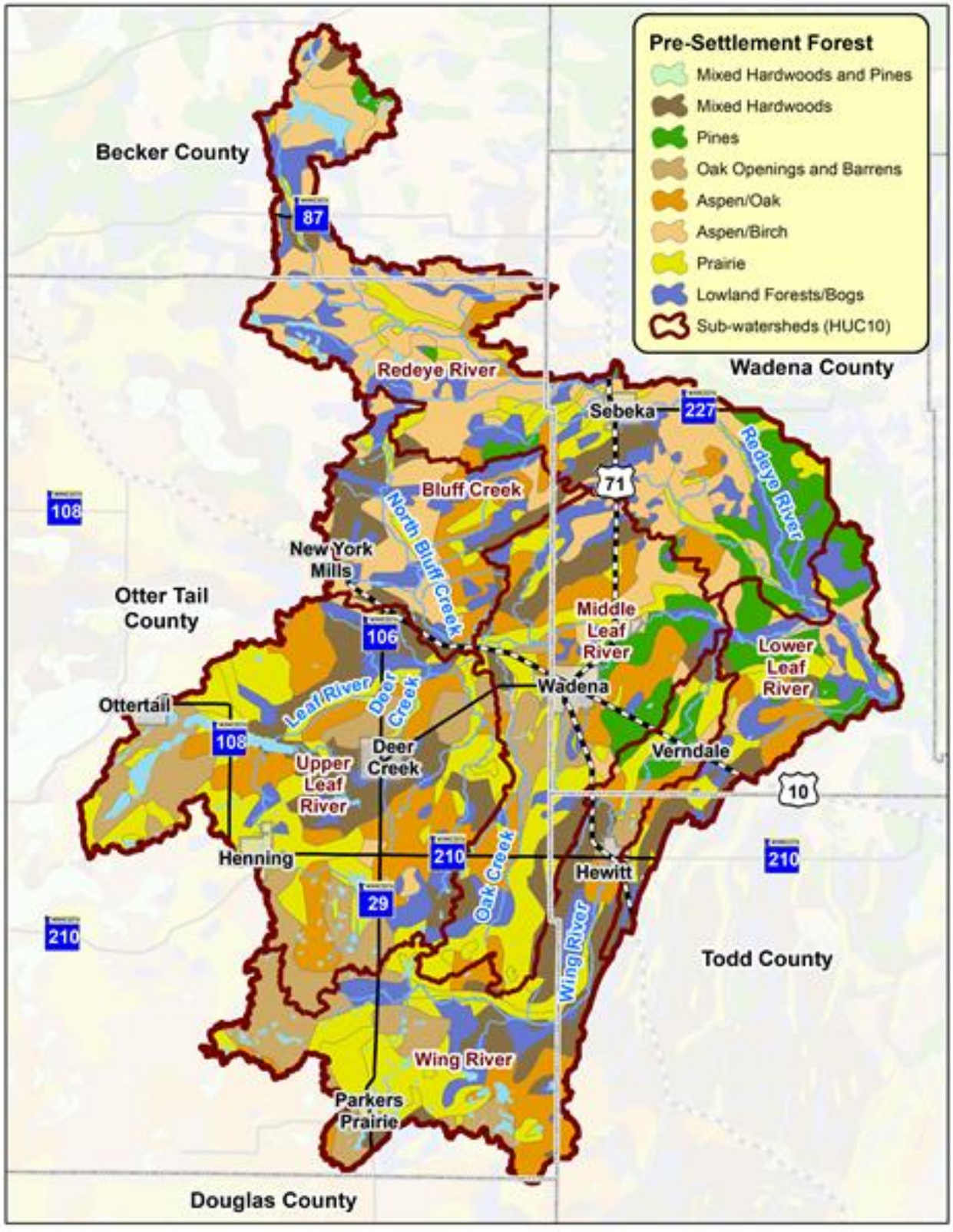


Figure 7. Historic vegetation class, MnDOT (VegMod).

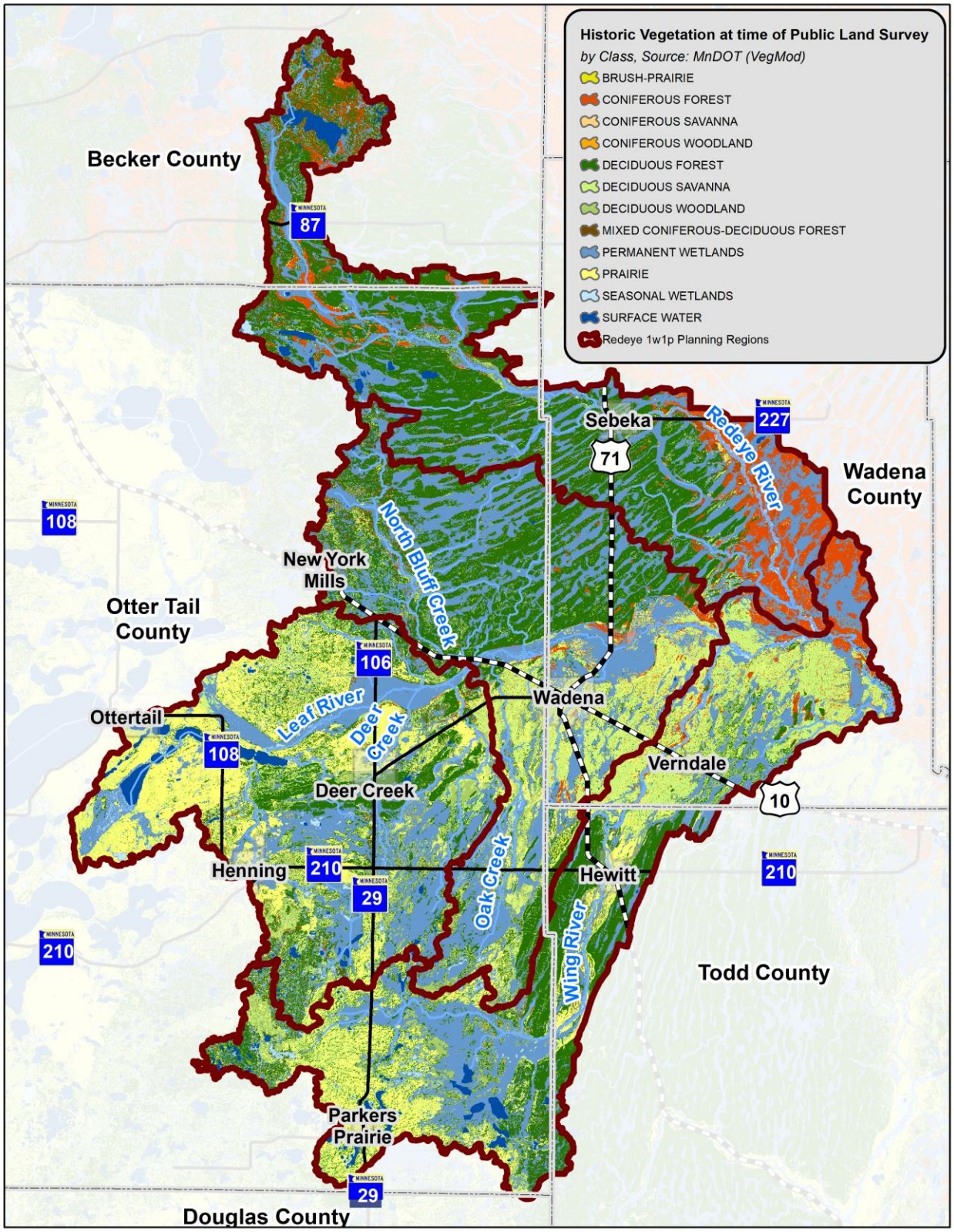


Figure 8. Land cover, 2013.

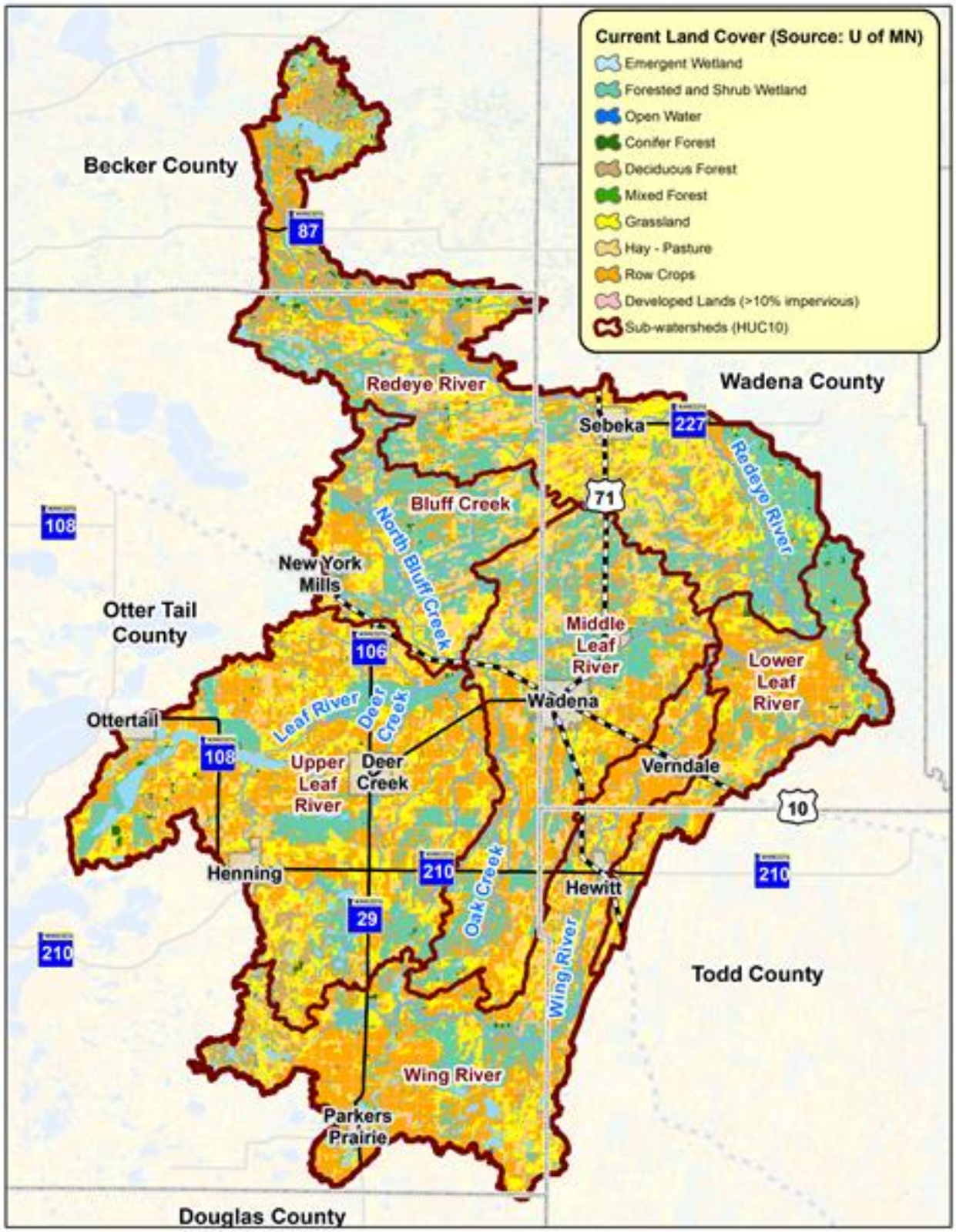


Figure 9. Current vegetation and areas of historic forest loss.

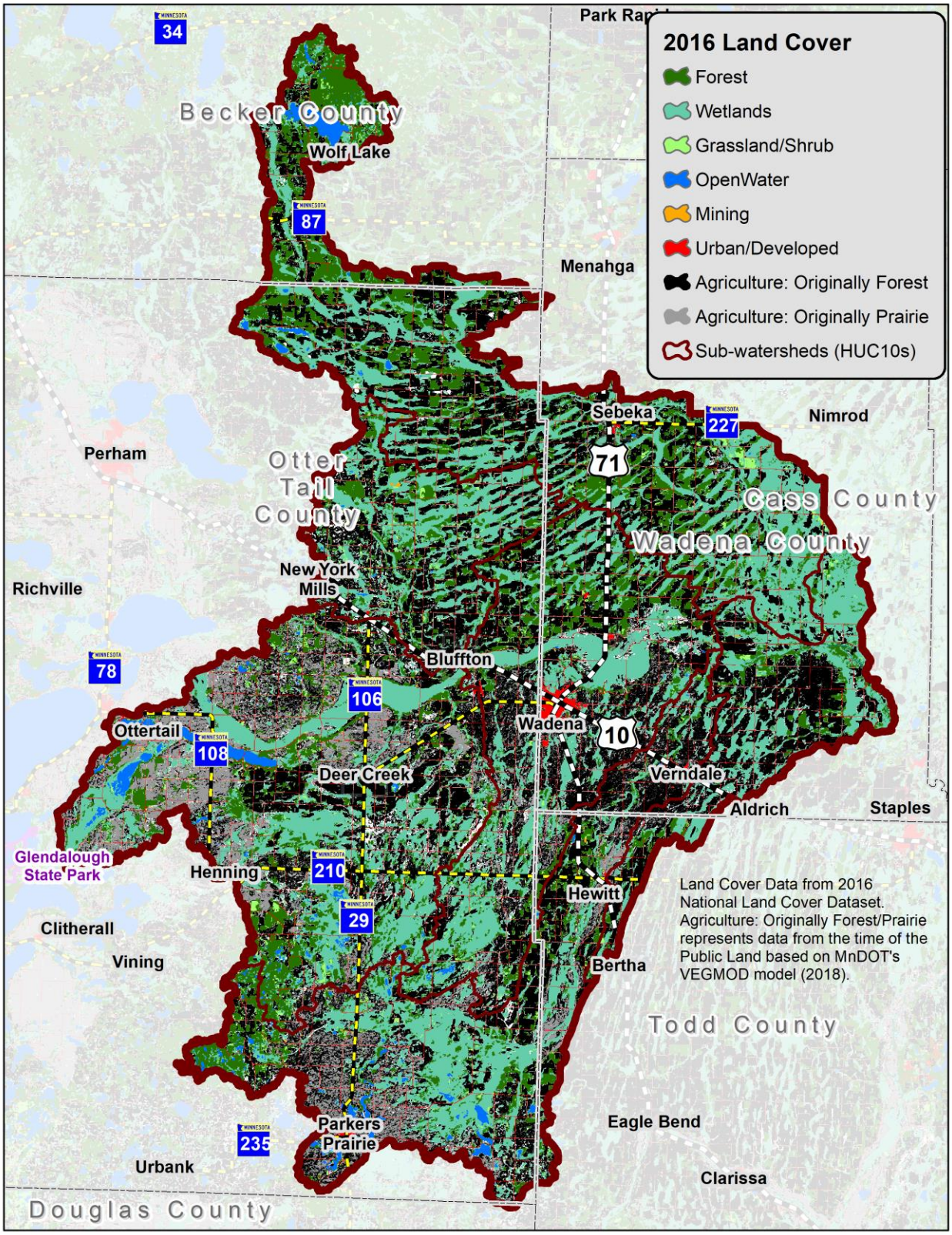


Figure 10. Potential native plant community systems.

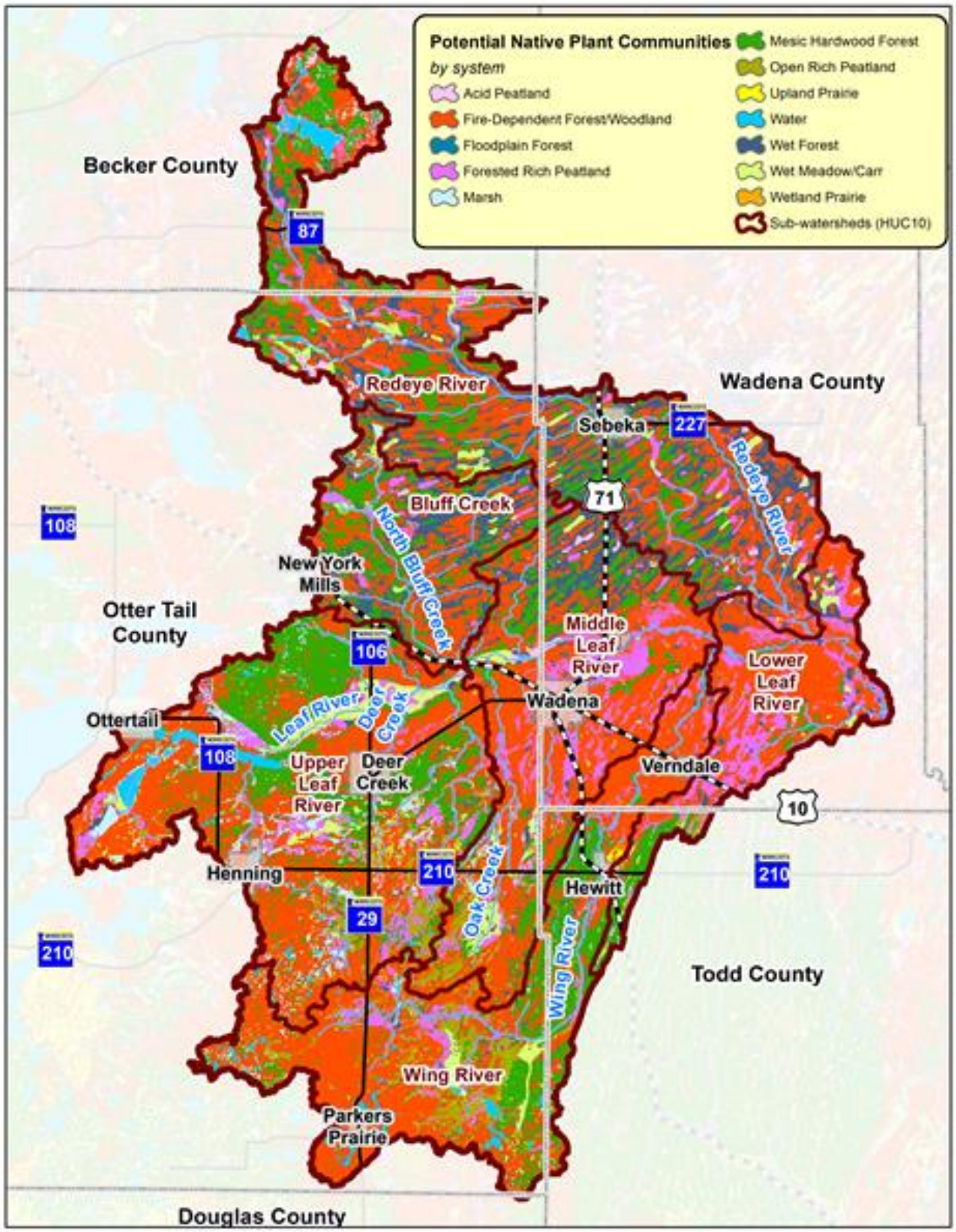


Figure 11. Change in aspen abundance.

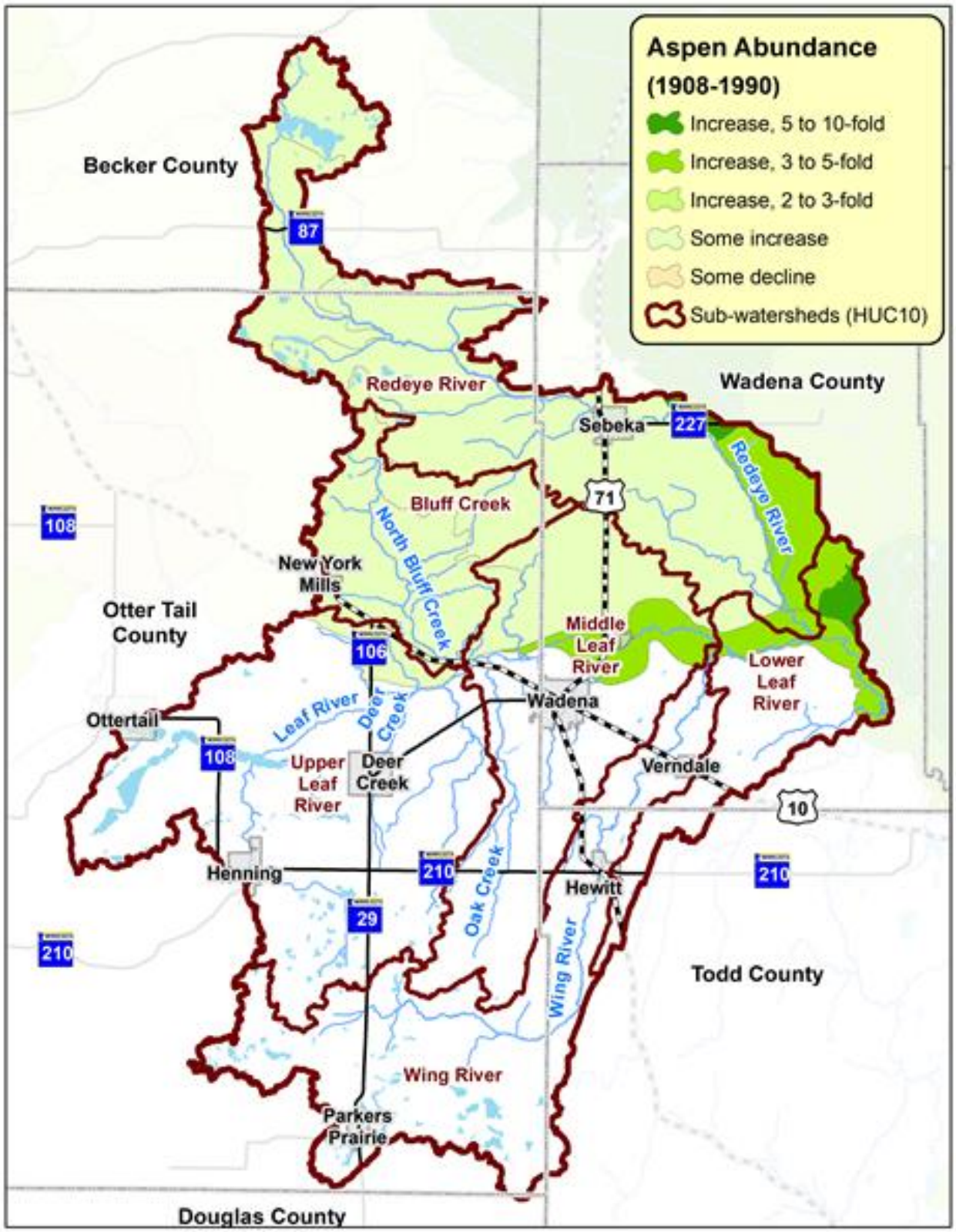


Figure 12. Change in red oak abundance.

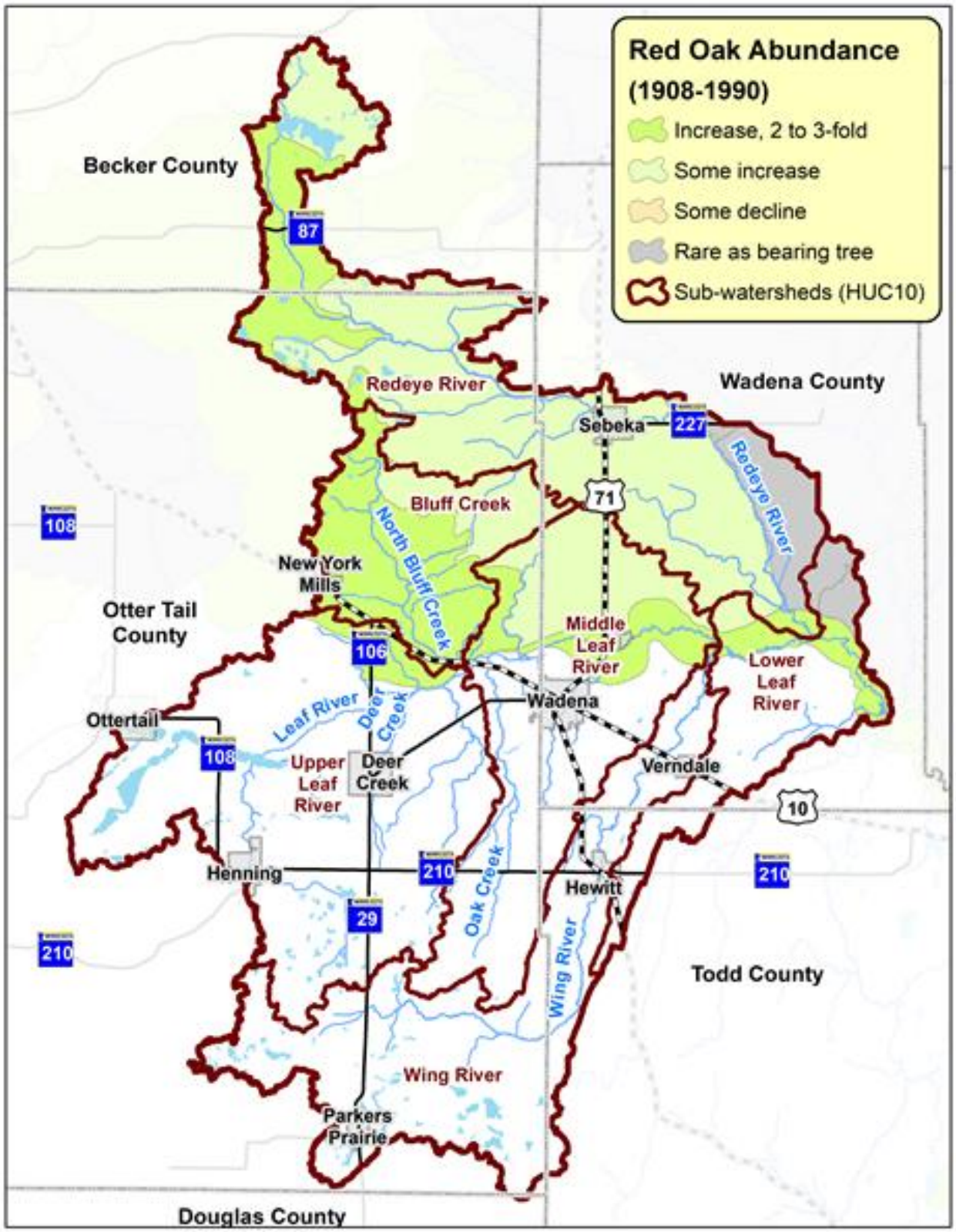


Figure 13. Change in white pine abundance.

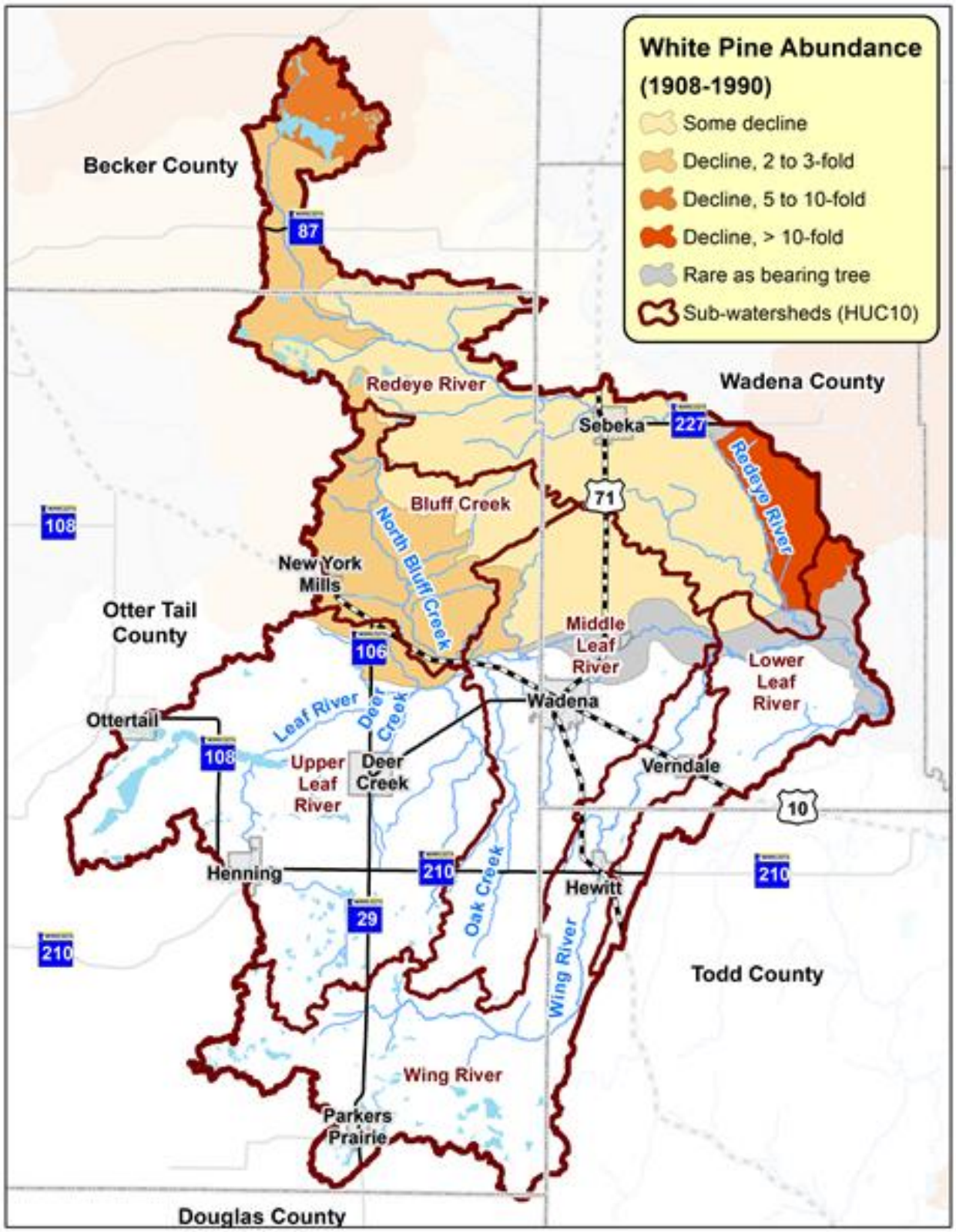


Figure 14. Potential white pine recovery areas.

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Figure 15. Lakes of phosphorus sensitivity significance.

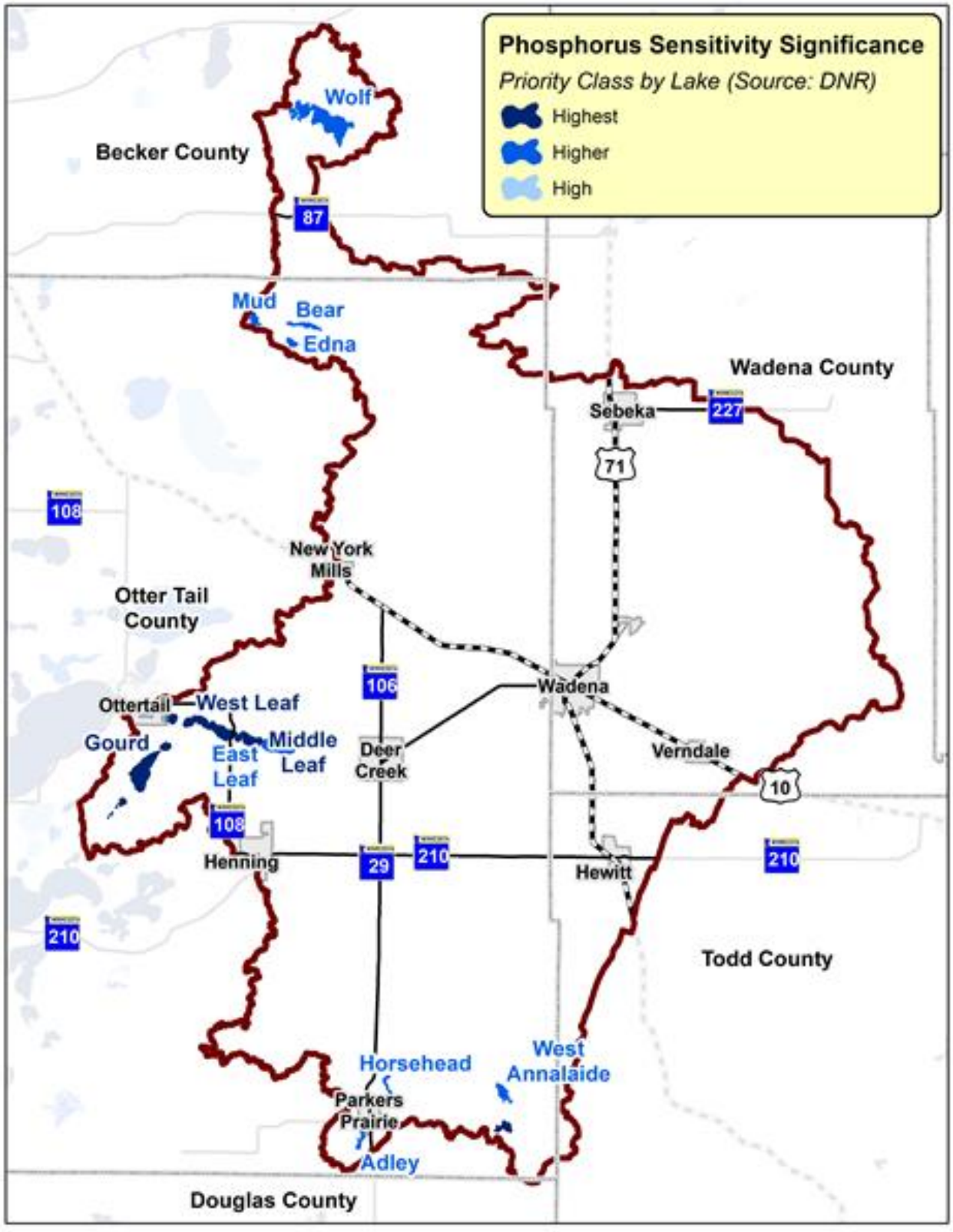

Figure 16. Lakes of biological significance.

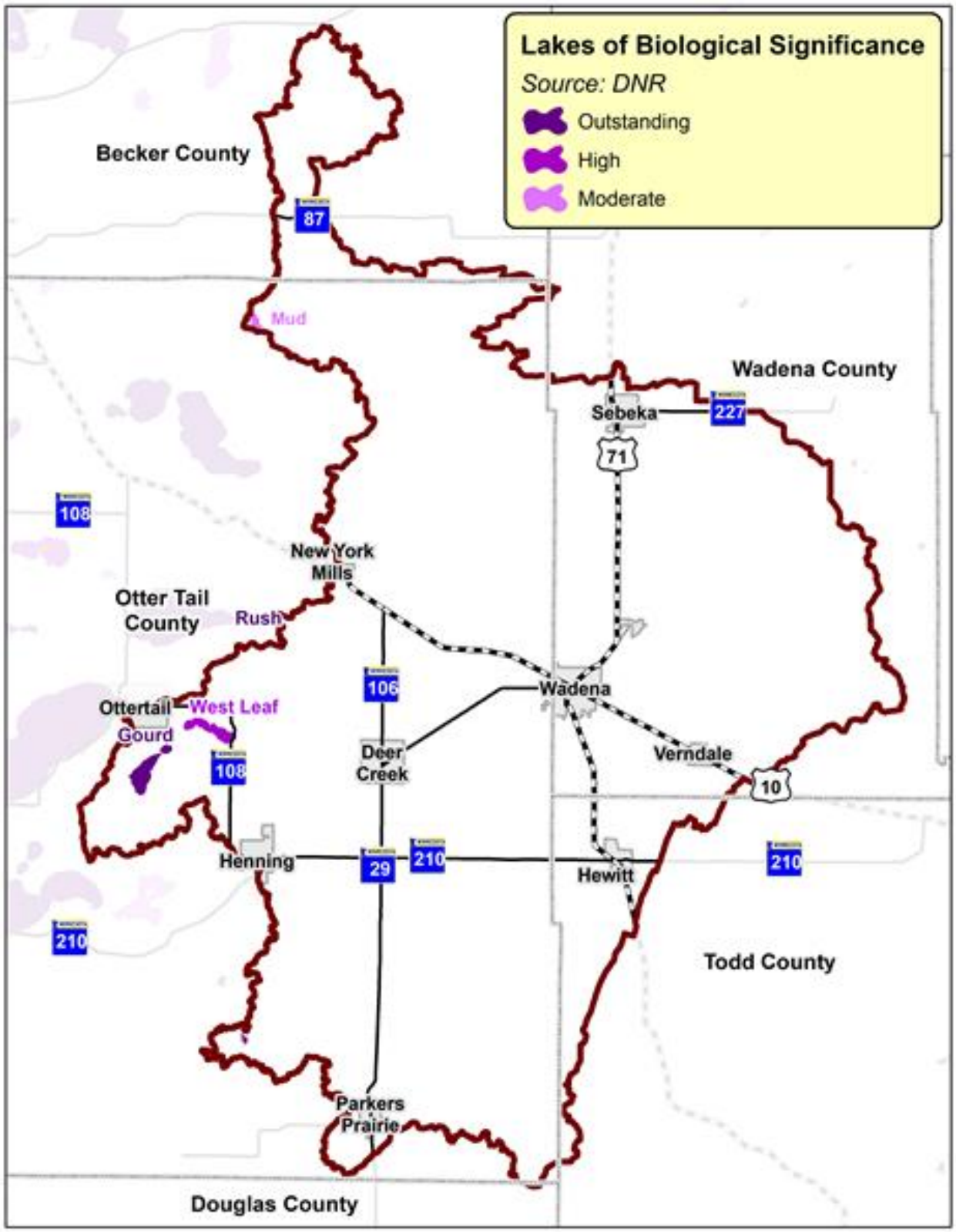

Figure 17. Wild rice and shallow lakes.

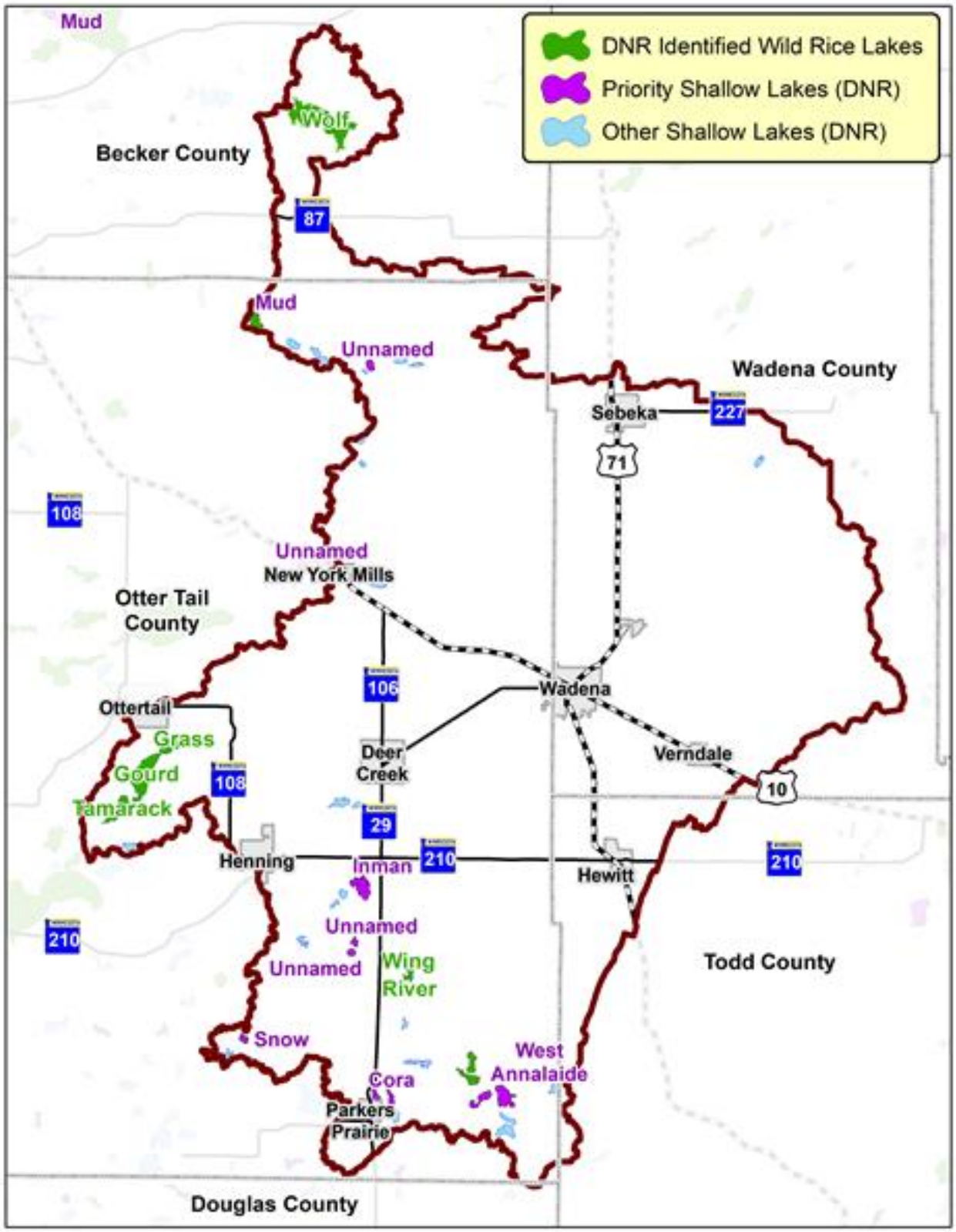

Figure 18. Designated trout streams and tributaries.

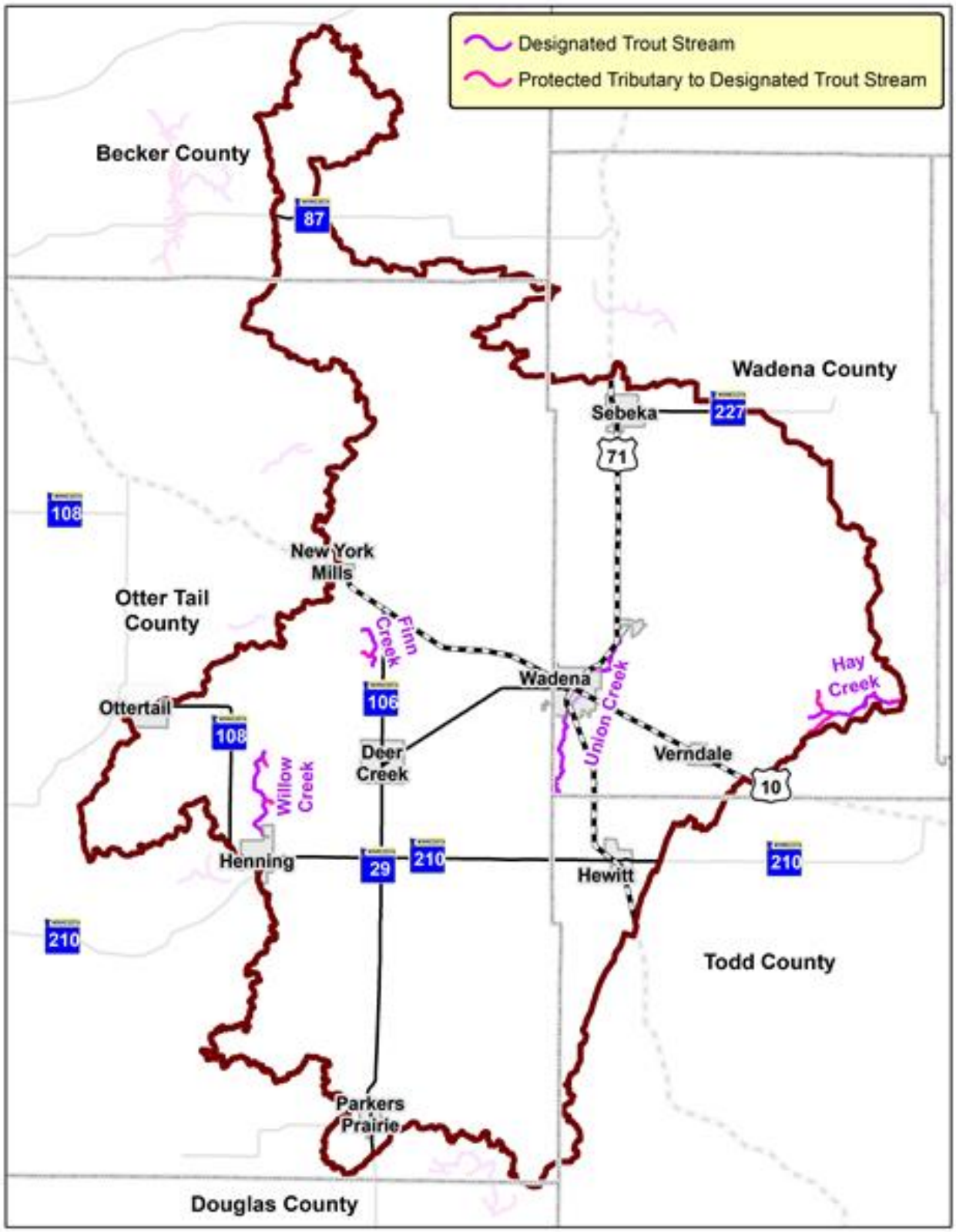

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Figure 19. Forest disturbance areas by year.

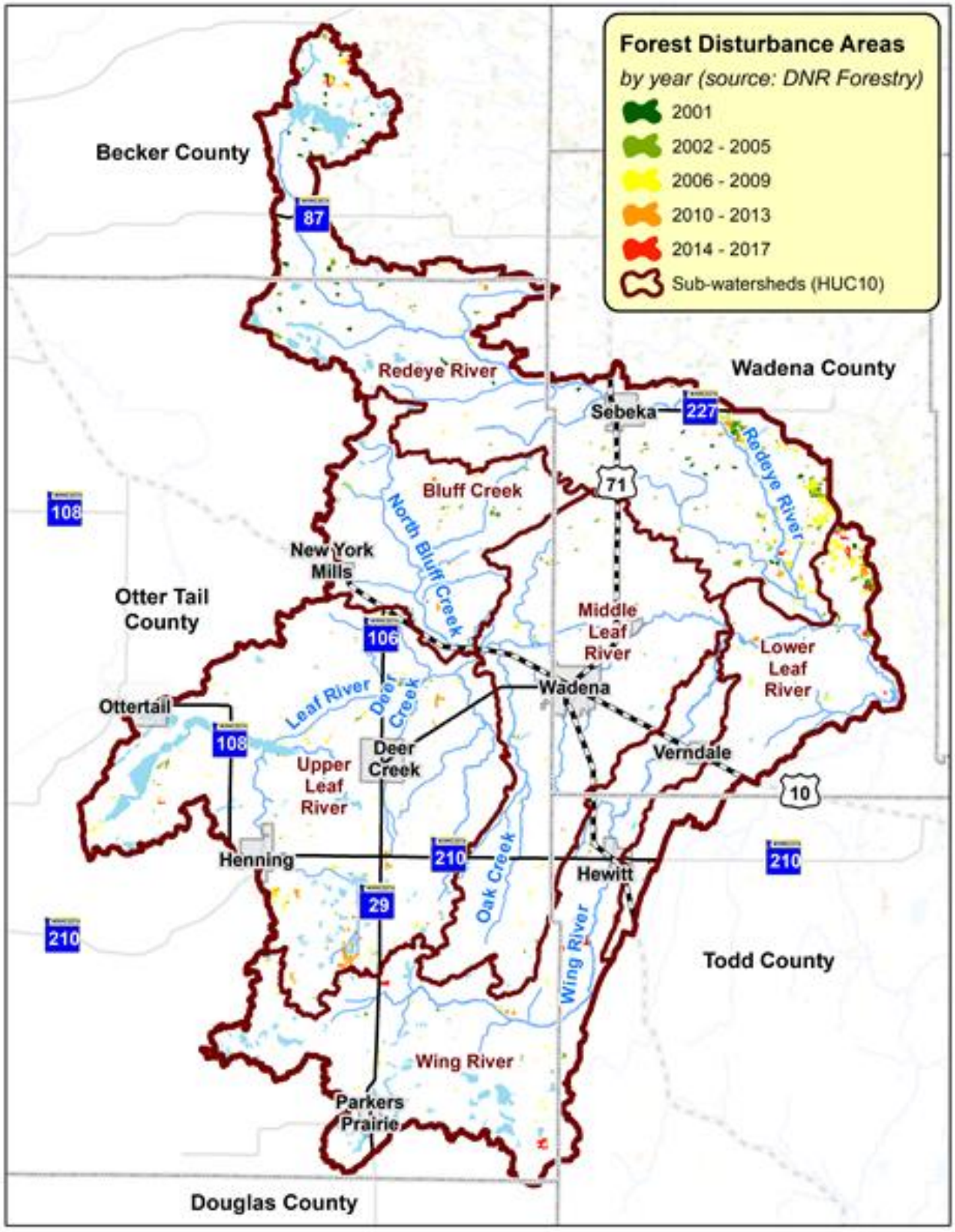


Figure 20. Forest disturbance levels by minor watershed (HUC 14).

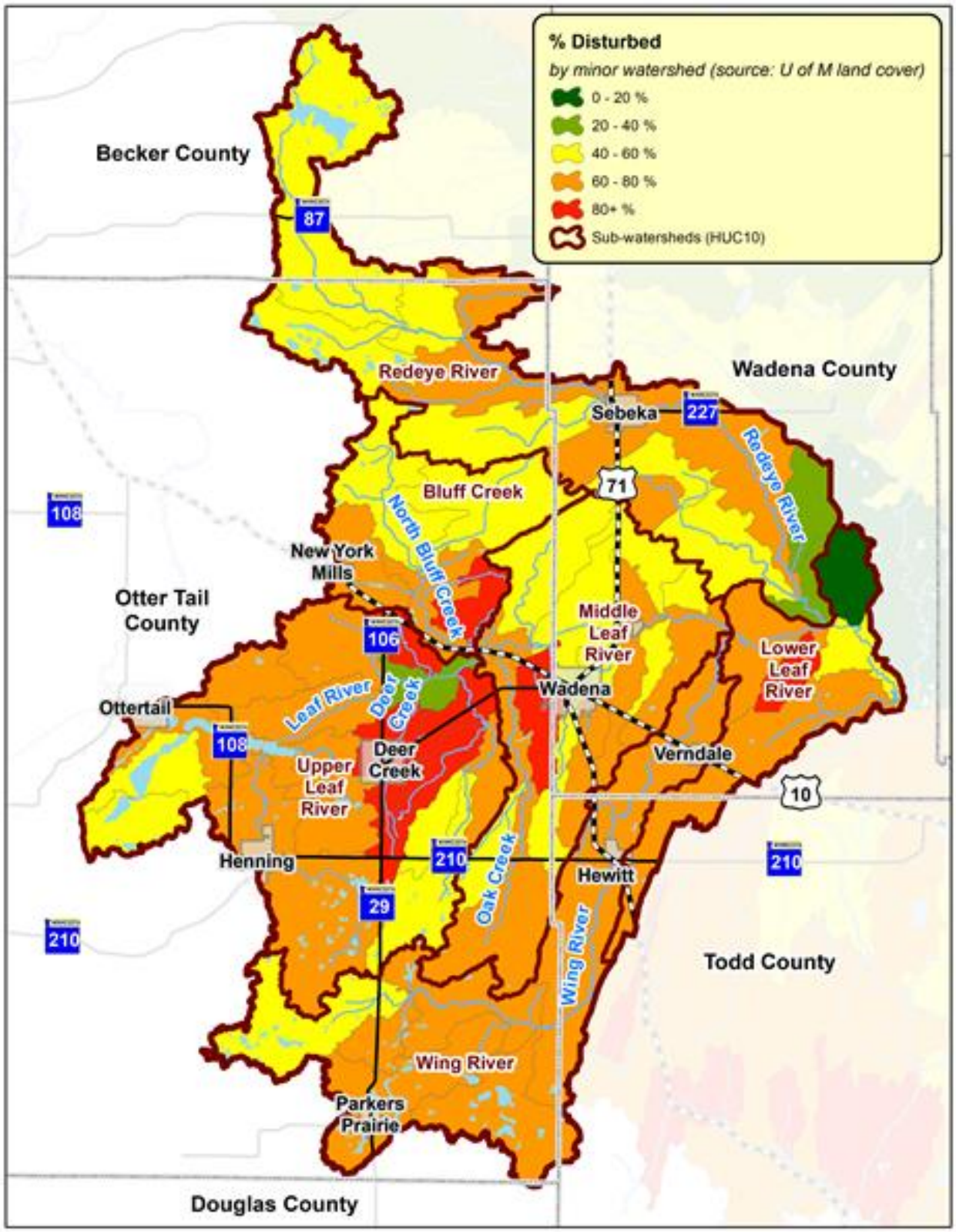
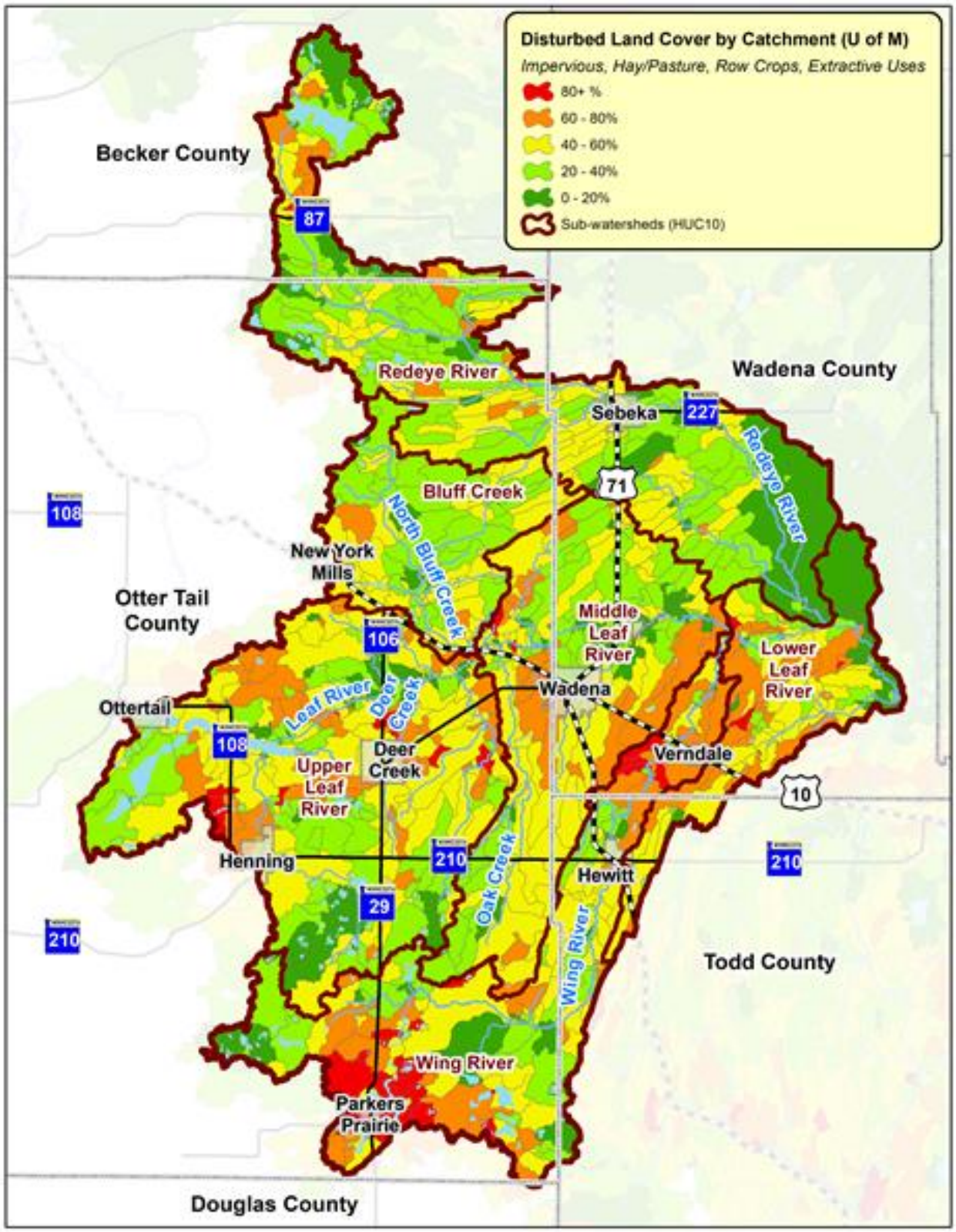


Figure 21. Disturbed land cover by catchment (DNR level 8).



Protection

Figure 22. Protected lands.

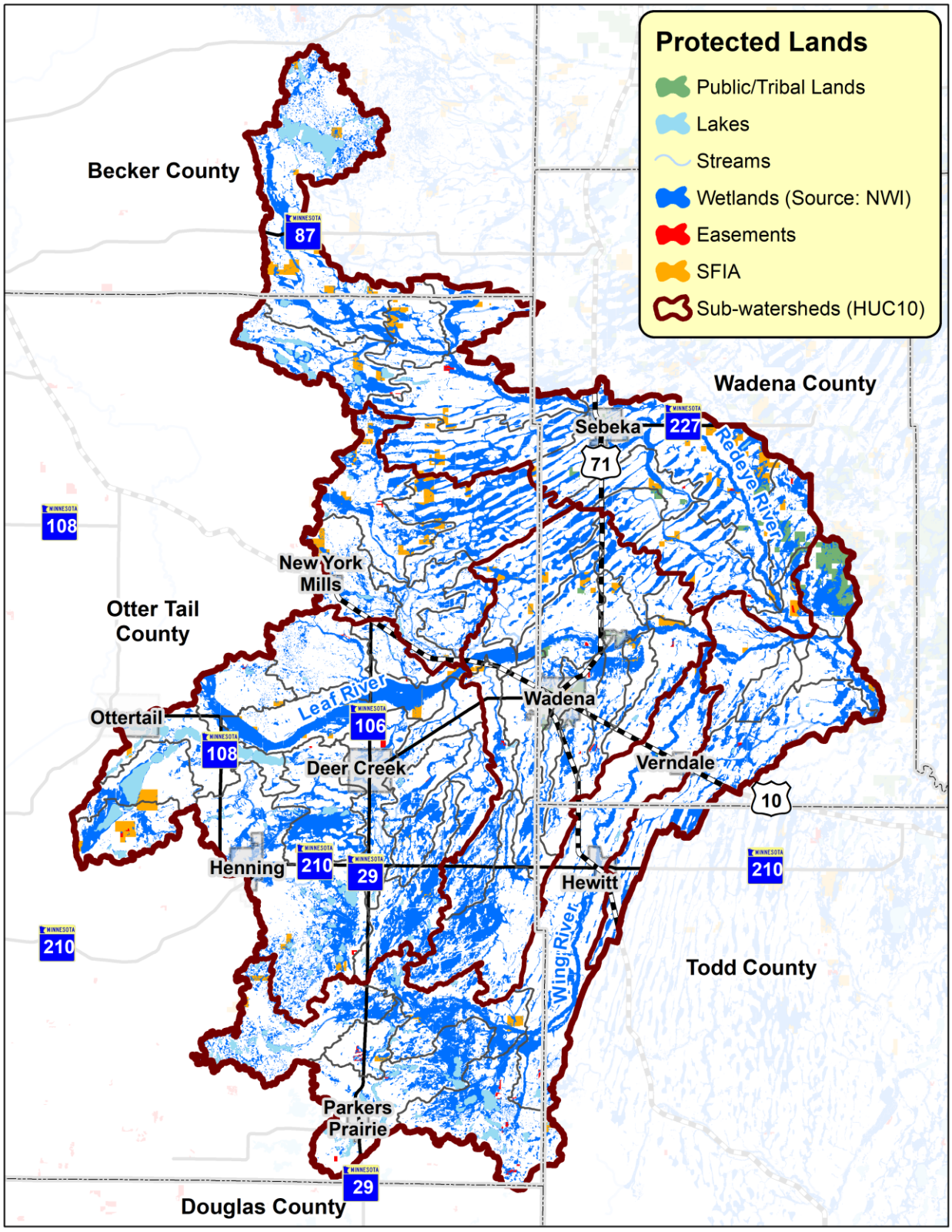


Figure 23. Public and tribal land ownership.

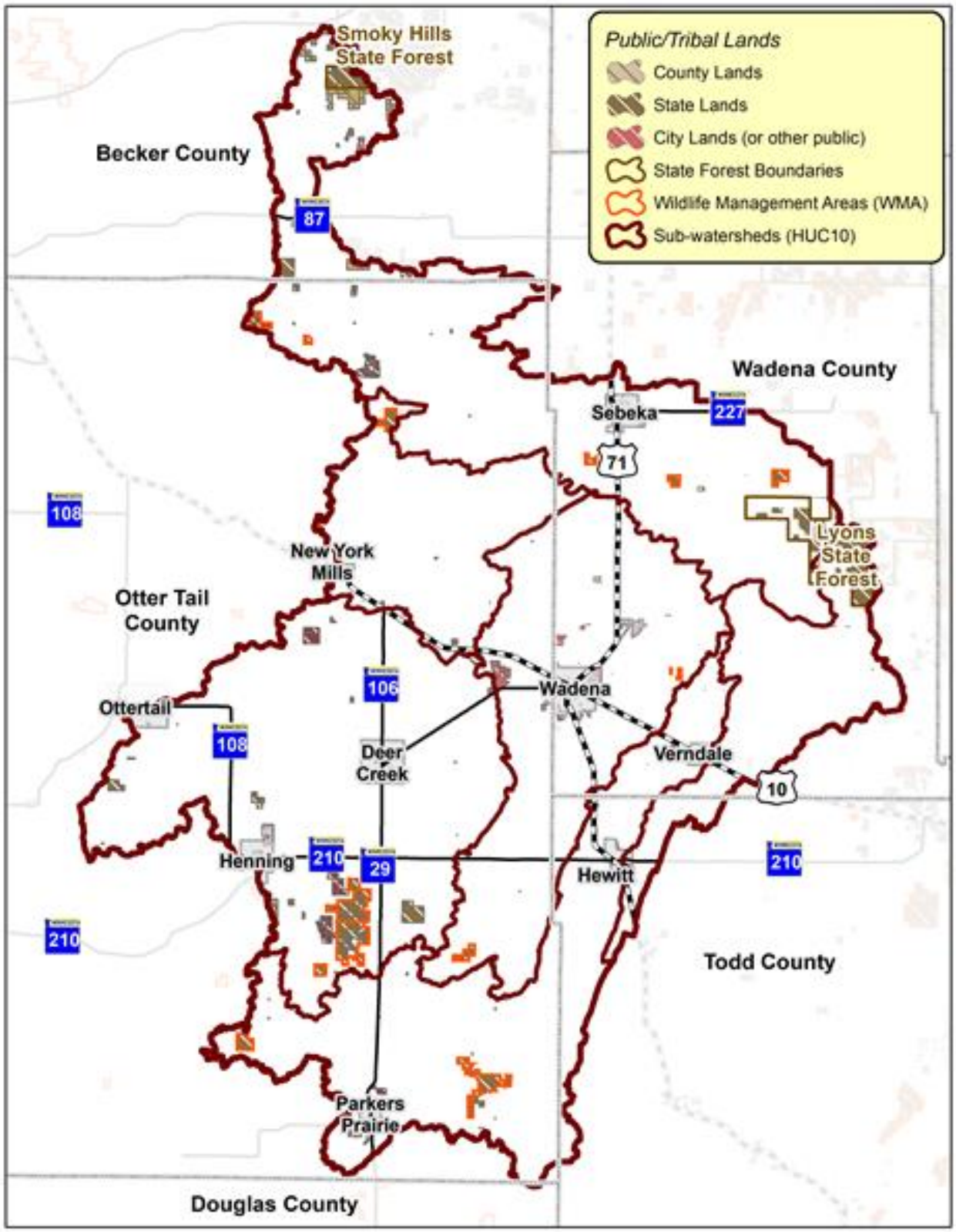


Figure 24. Subwatershed (HUC 10) protection levels.

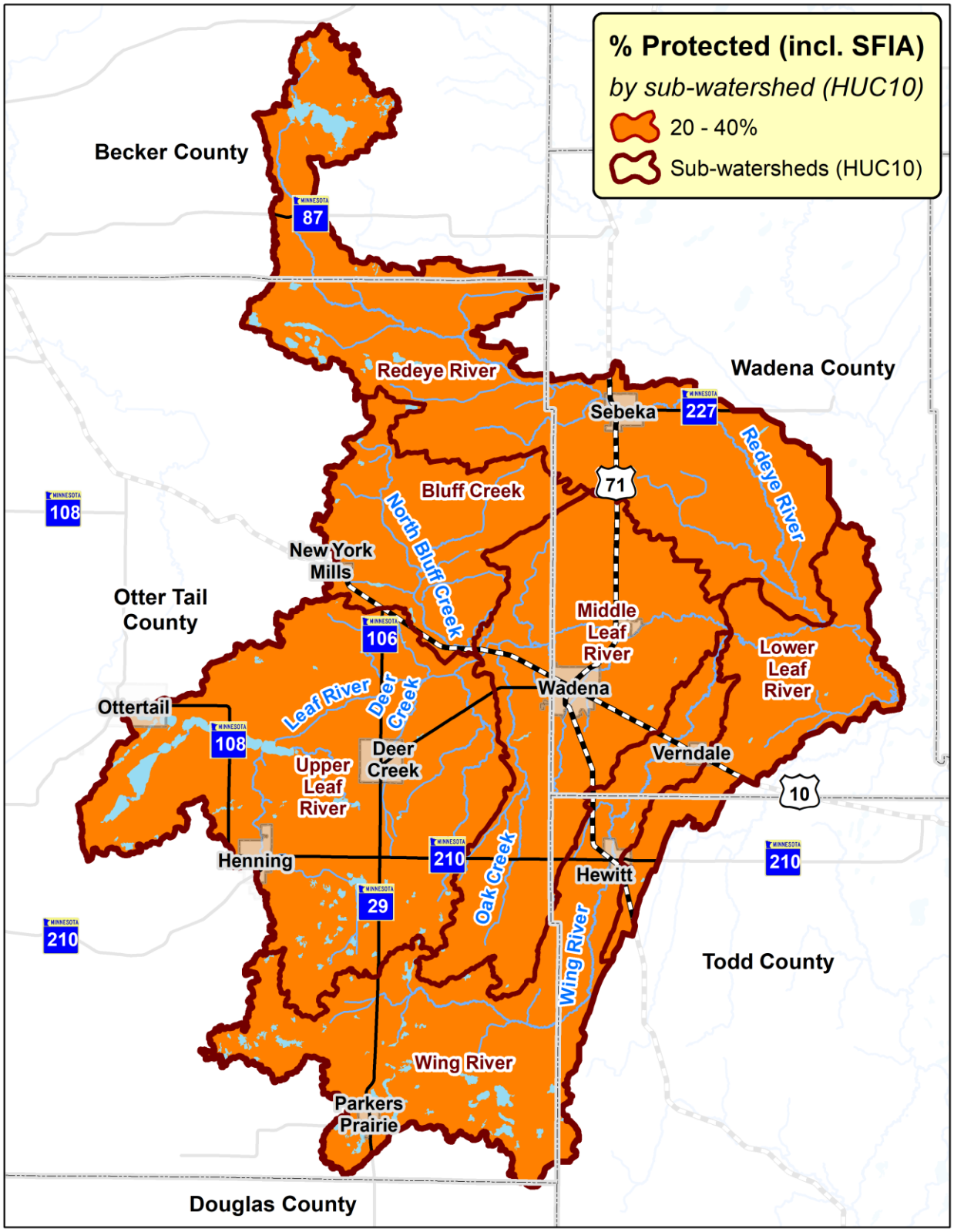


Figure 25. Minor watershed (HUC 14) protection levels.

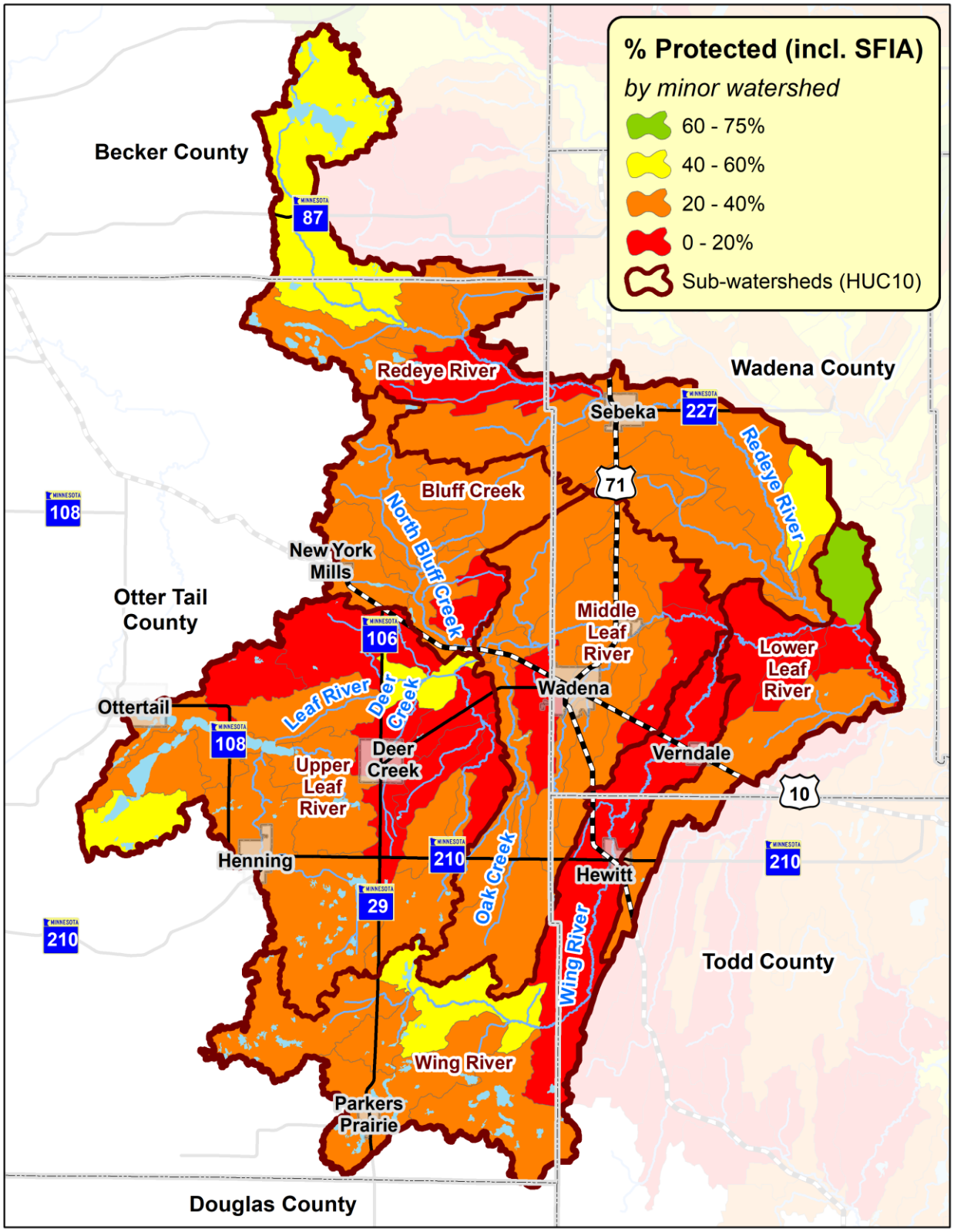


Figure 26. Parcels with the potential to protect.

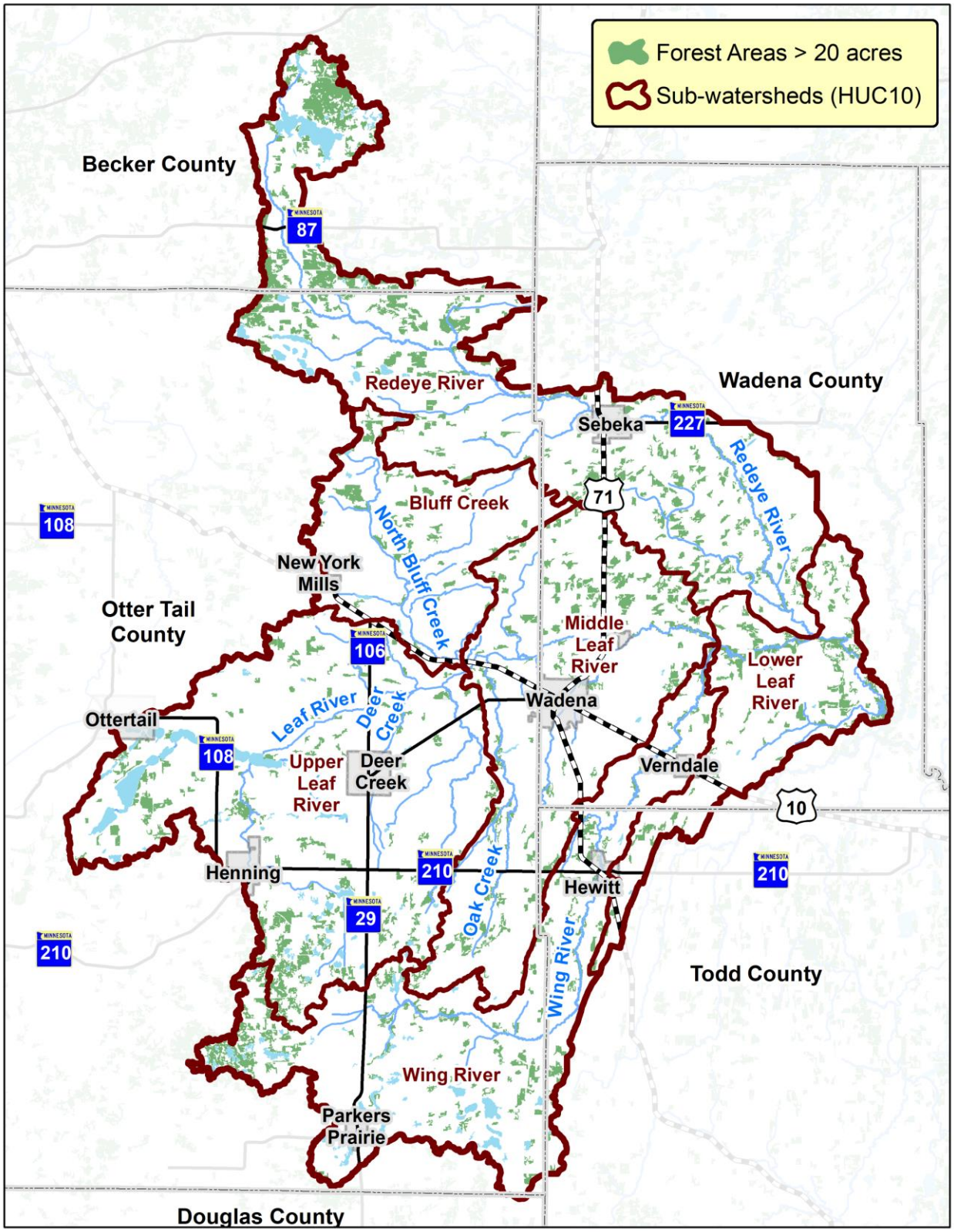


Figure 27. Potential to protect by minor watershed (HUC 14).

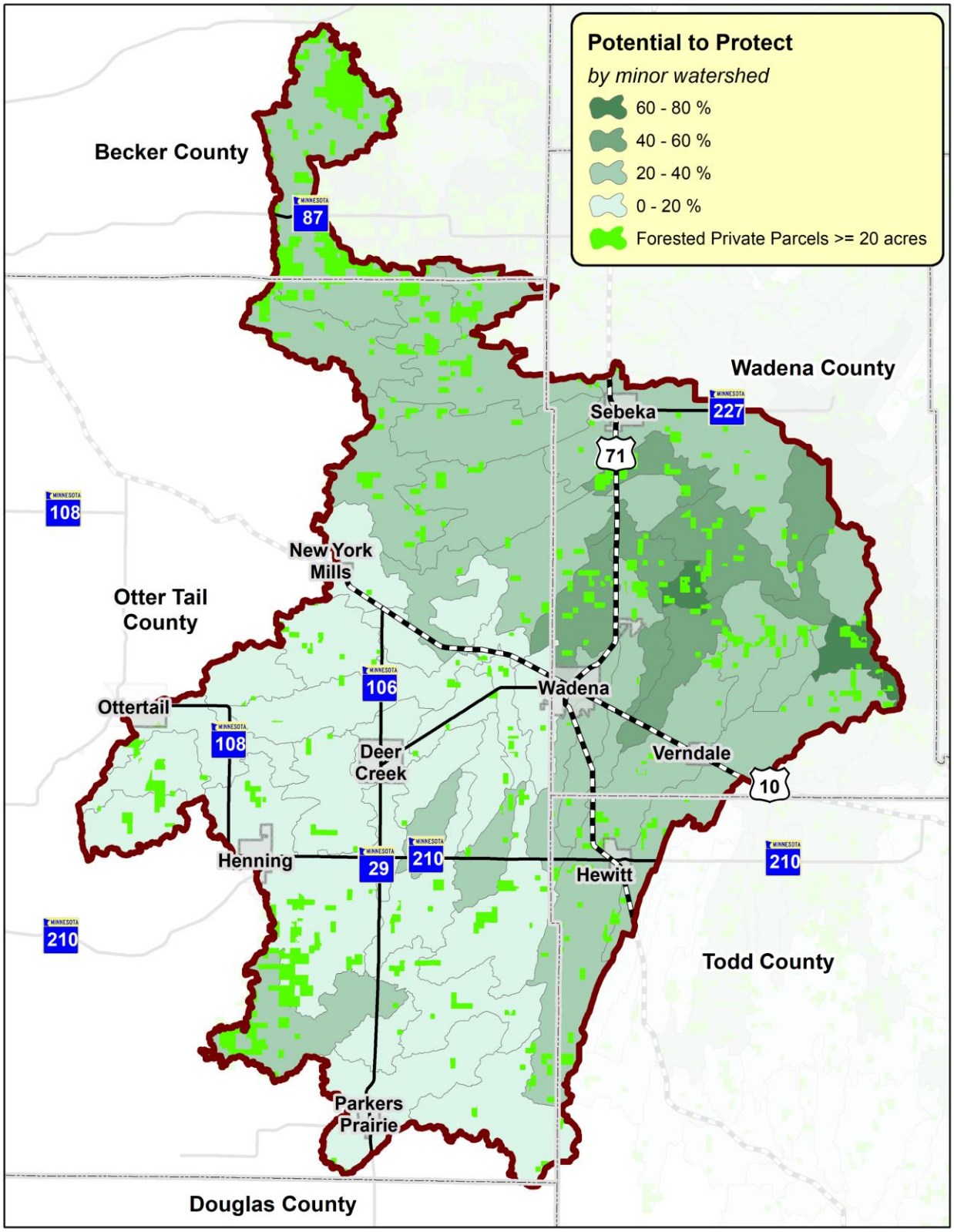


Figure 28. Protection/restoration classifications.

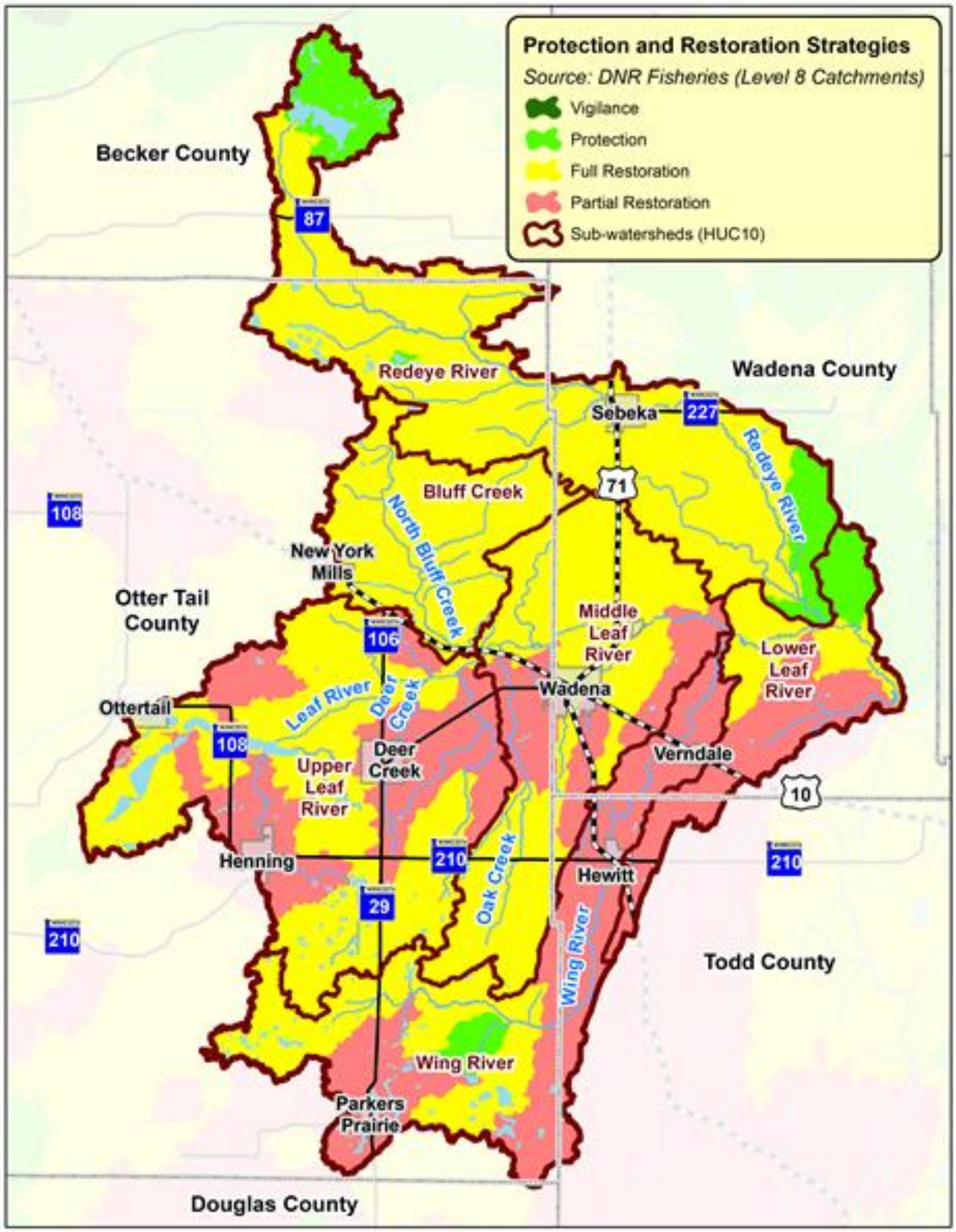


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Figure 29. Lessard-Sams Outdoor Heritage Council priorities.

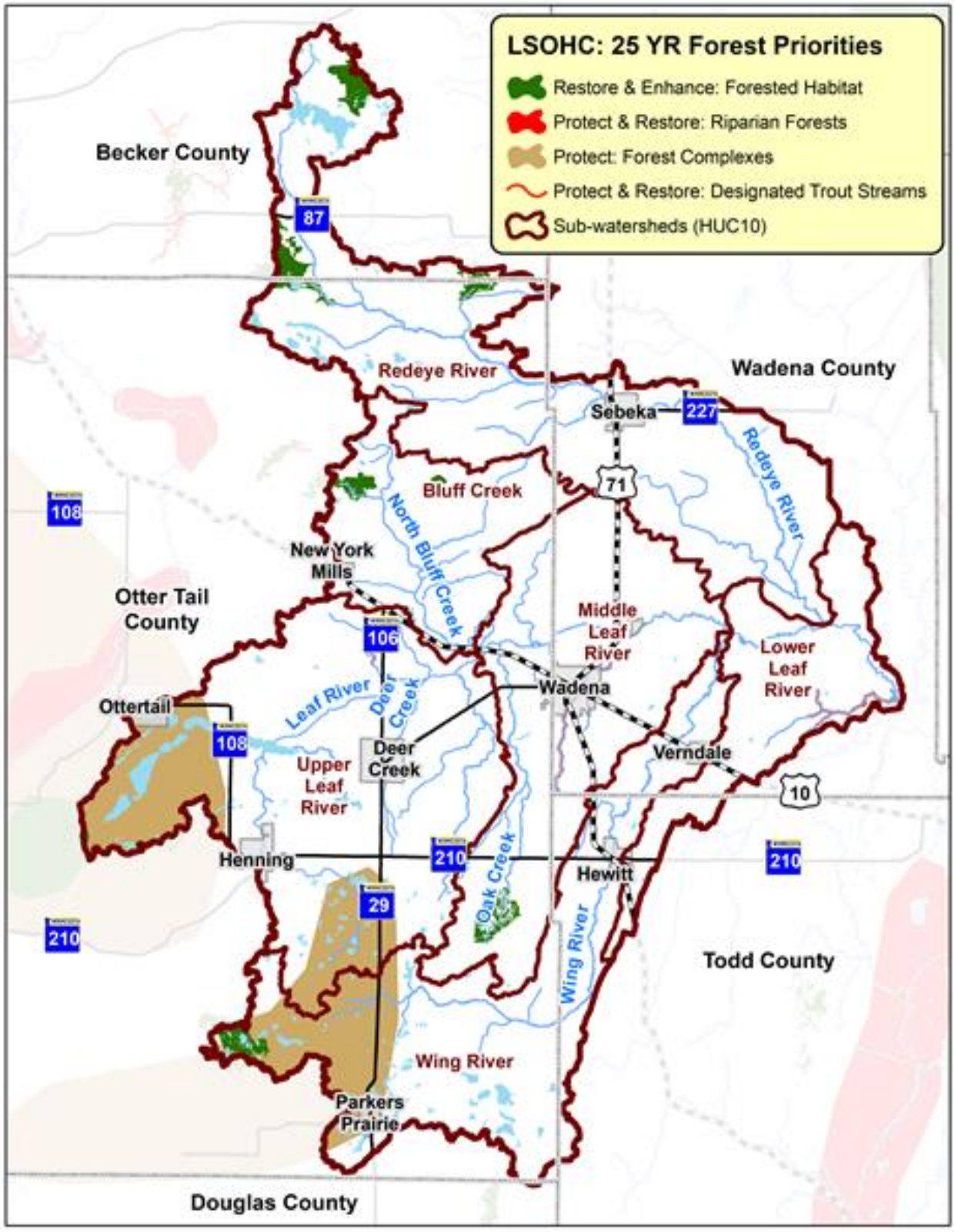


Figure 30. DNR Wildlife Action Network rankings.

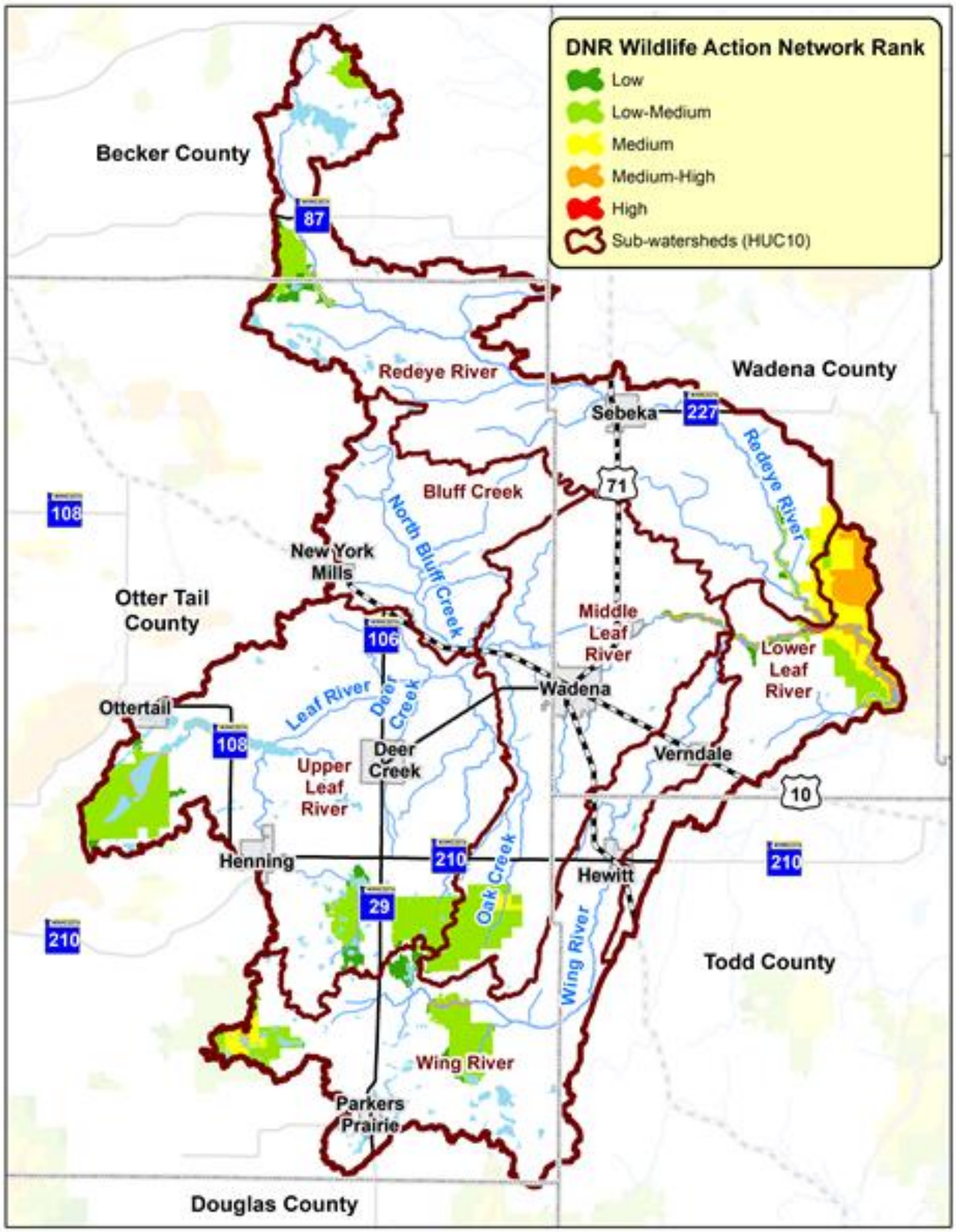


Figure 31. DNR Forests for the Future composite scores.

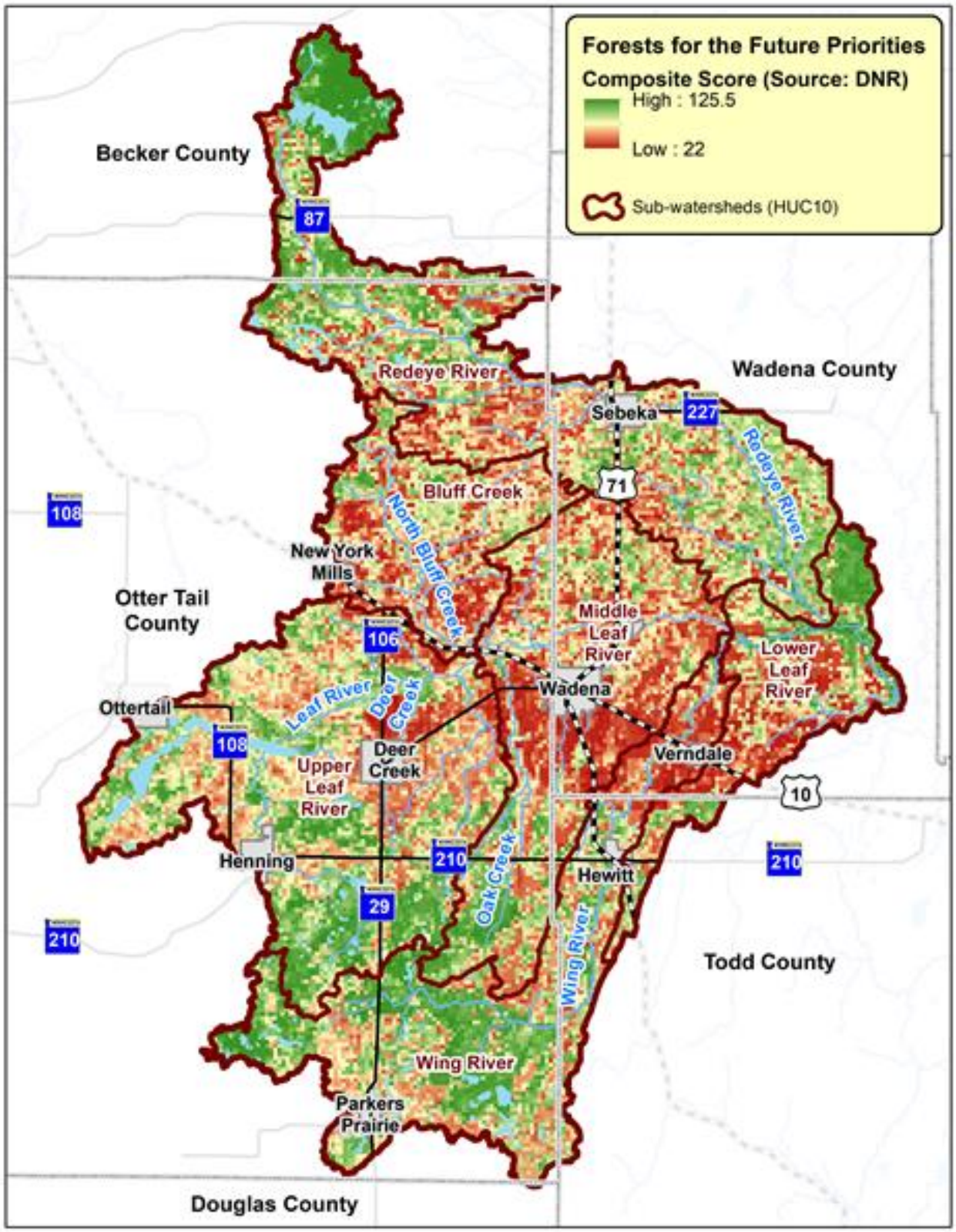


Figure 32. DNR Forests for the Future composite scores by minor watershed (HUC 14).

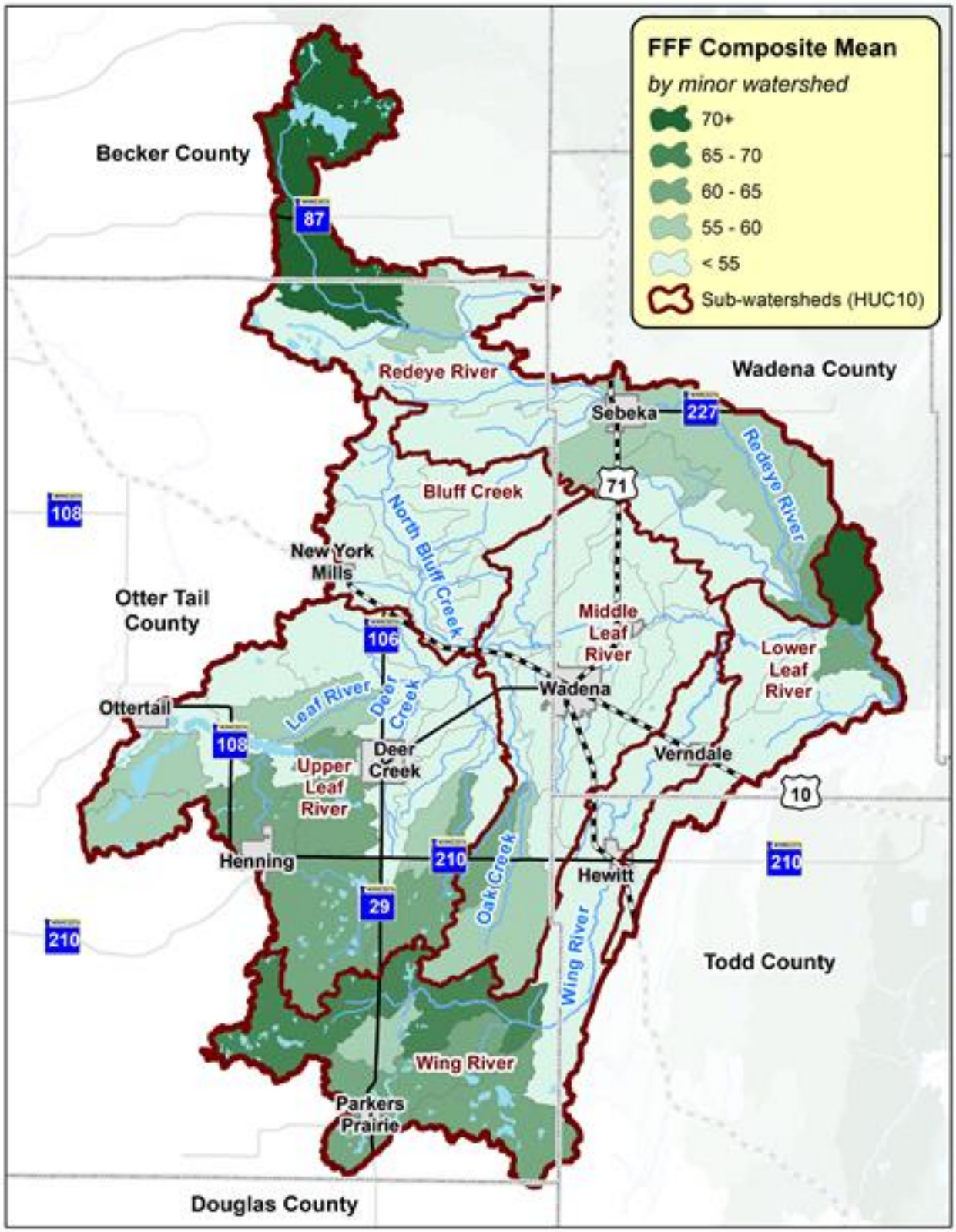
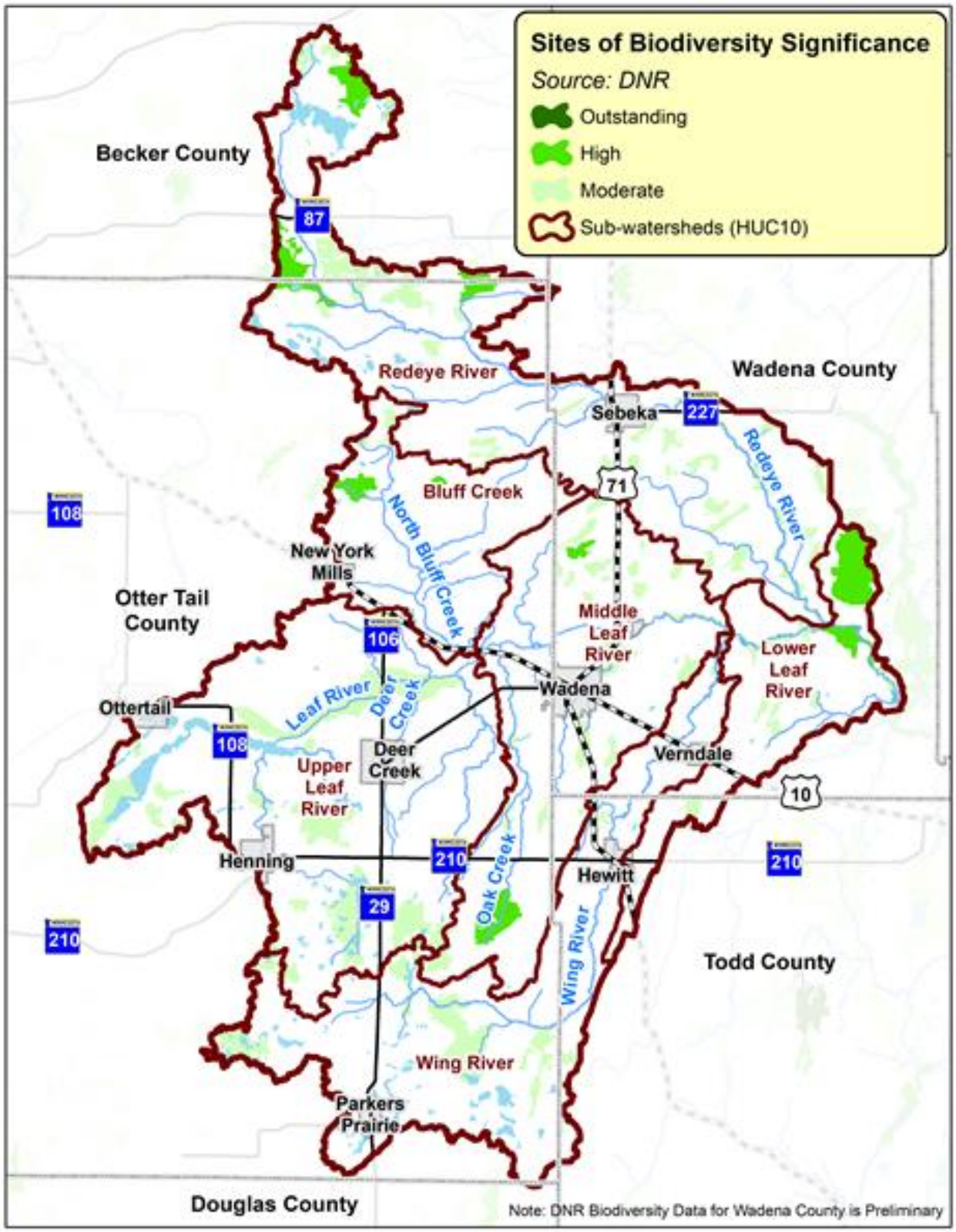
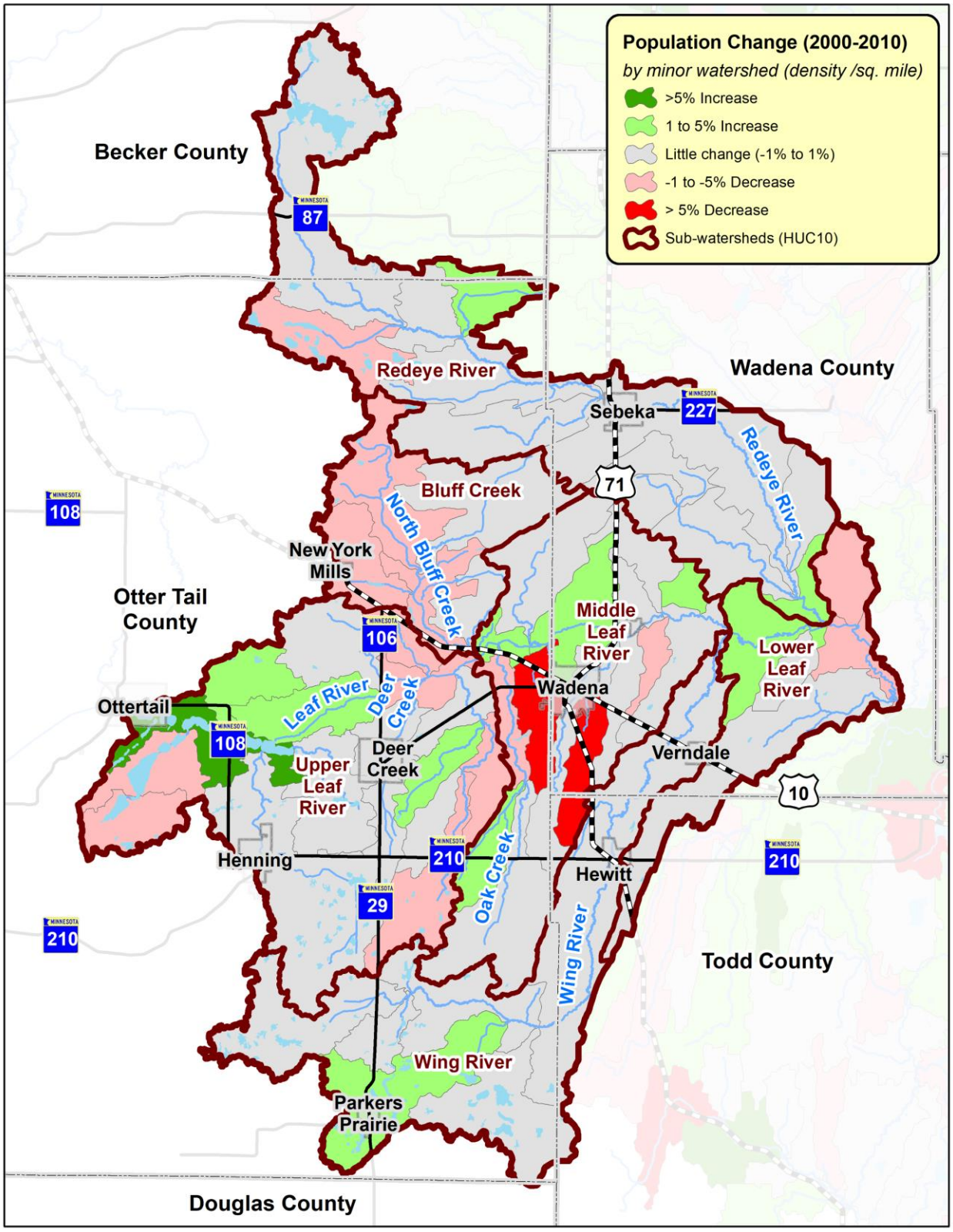


Figure 33. Minnesota Biological Survey (DNR) sites of biological significance.



Population and Development Growth

Figure 34. Population change, 2000-2010.



Other

Figure 35. Priority PFM focus areas.

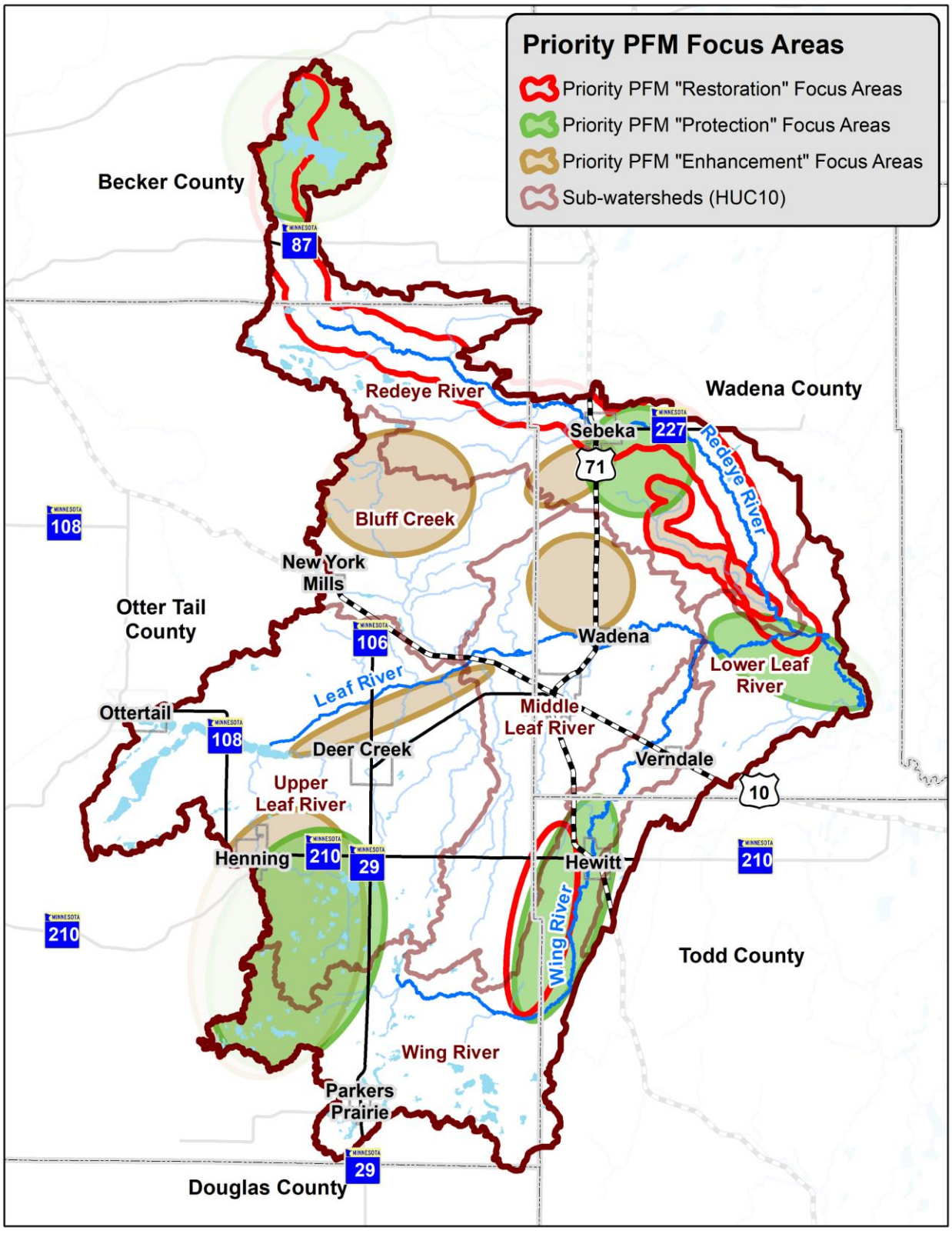


Figure 36. Current forest stewardship plan areas.

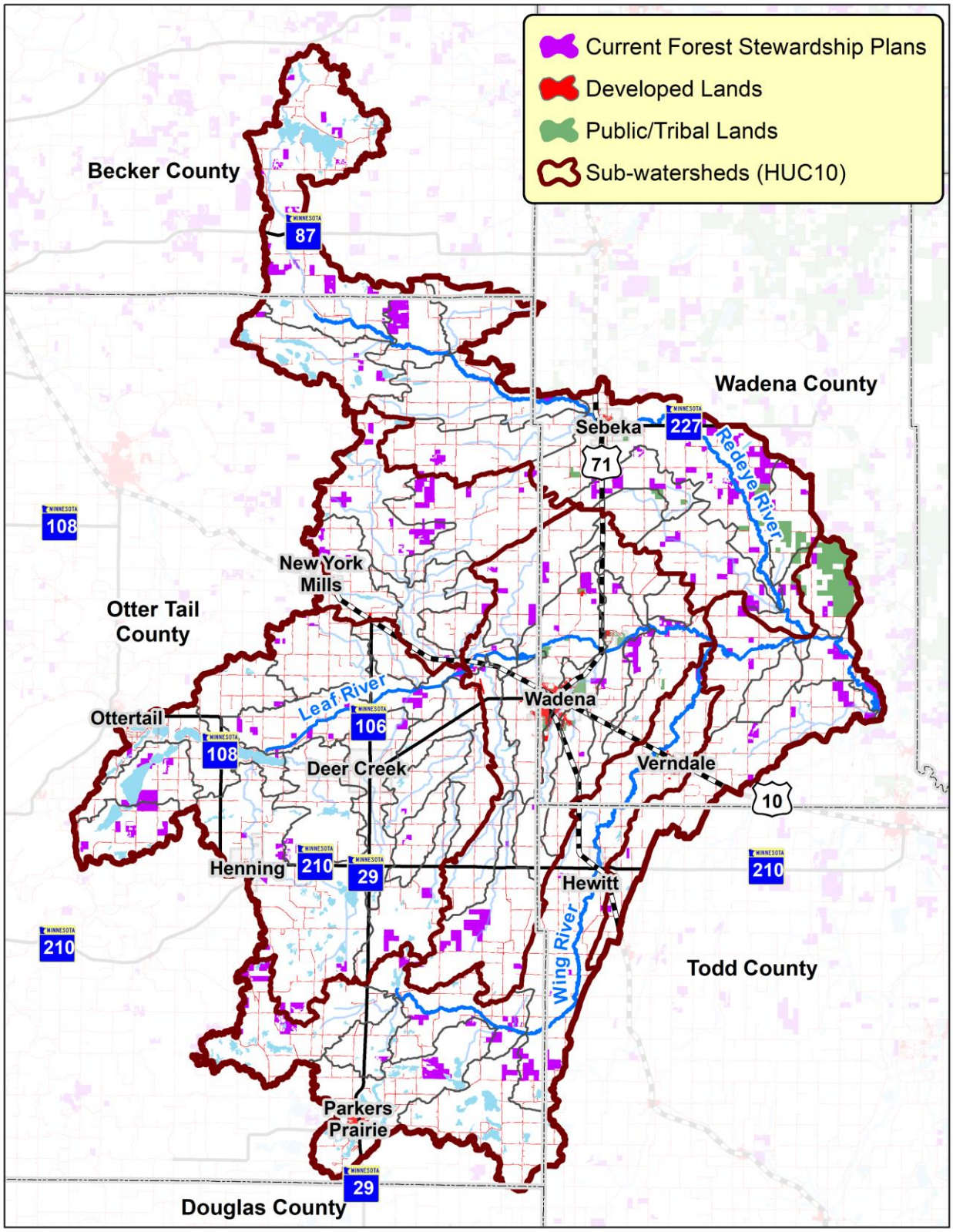
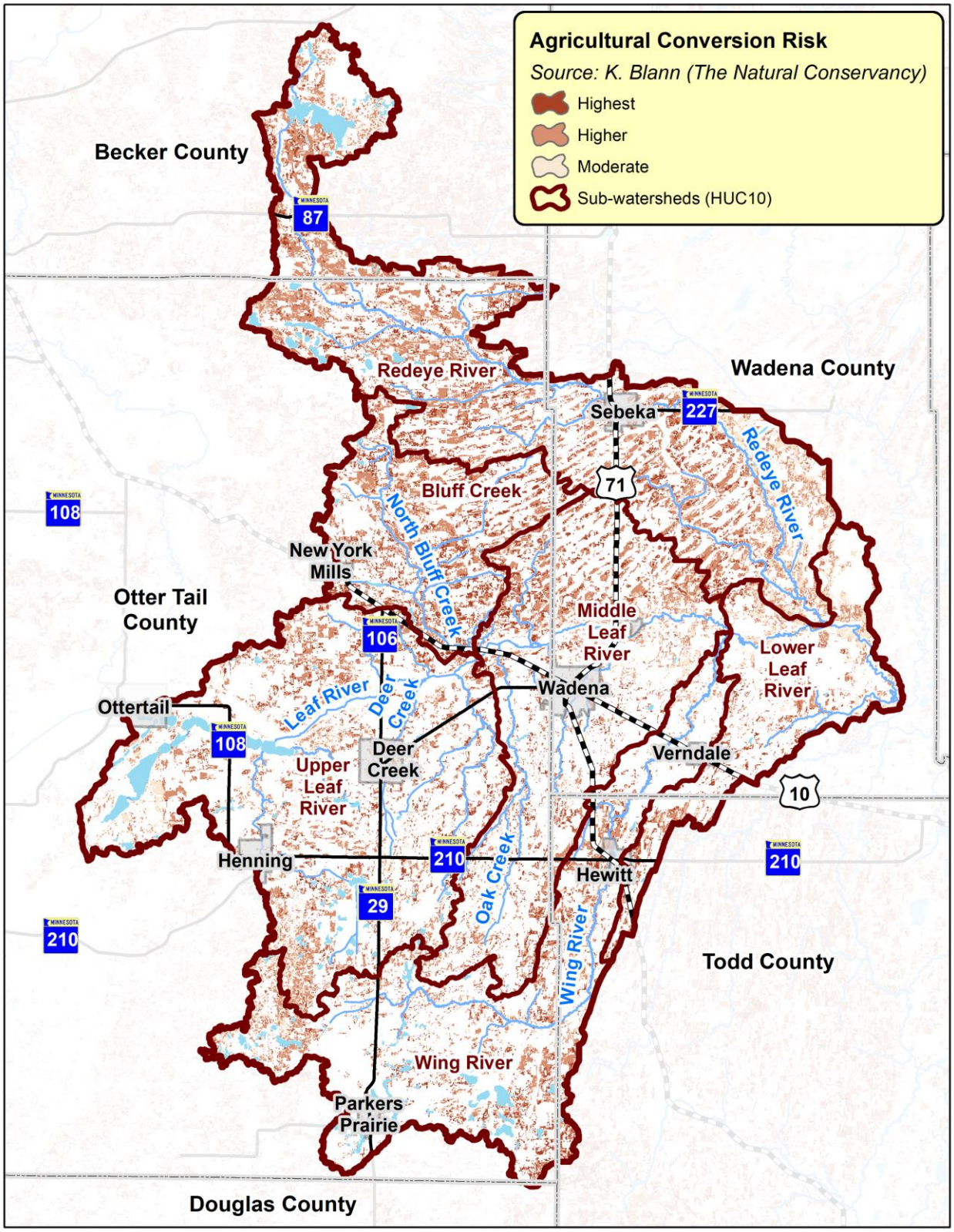


Figure 37. Agricultural conversion risk areas.



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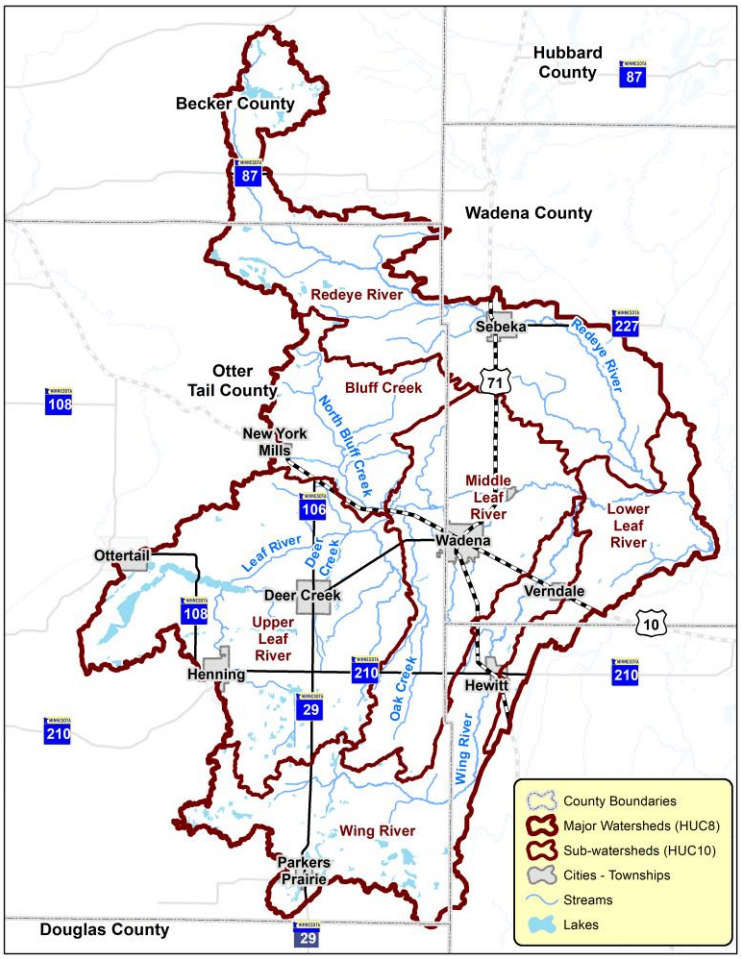
Subwatershed Analyses (HUC 10)

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 Redeye River Major Watershed is divided into 6 smaller or "sub" watershed units (HUC10 scale) as shown in the map below. Within each of these HUC10 sub-watersheds, are 5 to 16 minor watersheds, which are on average are 9,863 acres (15.4 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 58 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 Redeye River Major Watershed by subwatershed (HUC10):

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

	Upper Leaf River	Bluff Creek	Middle Leaf River	Wing River	Redeye River	Lower Leaf River
# of minor wshds	**16**	**5**	**14**	**6**	**12**	**5**
% forest cover	12%	10%	14%	15%	21%	17%
% protected	29%	30%	27%	26%	33%	27%
Potential to protect	5%	3%	7%	7%	14%	8%
Land use disturbance	69%	56%	62%	71%	53%	62%
# of lakes	57	8	7	58	33	3
Avg. lake size	106	40	25	65	109	17
Geomorphology	Moraine / till plain / outwash	Till plain (+ drumlins) / outwash	Till plain (+ drumlins) / outwash	Outwash	Till plain (+ drumlins) / outwash	Outwash
Primary land cover	Open lands / deciduous forest	Open lands / deciduous forest	Open lands / deciduous forest	Open lands / deciduous forest	Open lands / deciduous forest (+ some pines)	Open lands / deciduous forest (+ some pines)
Lake or stream based	Lake & stream	Stream	Stream	Lake & stream	Lake & stream	Stream
Quality	Surface water, forests/habitat, groundwater	Surface water, forests/habitat, groundwater	Surface water, forests/habitat, groundwater	Surface water, forests/habitat, groundwater	Surface water, forests/habitat, groundwater	Forests/habitat
Risks	Ag: animal & crops, impairments	Ag: animal & crops, impairments	Ag: animal & crops, impairments	Ag: animal & crops, impairments	Ag: animal & crops, impairments	Ag: animal & crops, impairments
Avg. land value (20+ acre, private lands)	$1,369	$1,235	$1,156	$1,367	$1,130	$1,182
Acres needed for goal	9,653	3,460	6,929	11,360	15,898	4,580
Cost to achieve goal	$10,144,376	$3,477,368	$6,639,101	$11,822,825	$15,747,376	$4,481,791
Avg. RAQ score	2.4	2.3	2.5	2.9	2.7	2.4

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

Name	FFF score (composite mean)	Fire-Dependent		Mesic Hardwood		Acid Peatland		Forested Rich Peatland		Flooplain Forest		Wet Forest	
Upper Leaf River	55.8	67,260	48%	32,763	23%	421	0%	11,482	8%	0	0%	3,157	2%
Bluff Creek	47.9	20,219	41%	11,250	23%	240	0%	2,367	5%	0	0%	13,766	28%
Middle Leaf River	48.7	51,197	53%	11,705	12%	771	1%	14,059	15%	2	0%	10,652	11%
Wing Ringer	58.9	56,695	56%	17,591	17%	2	0%	7,033	7%	58	0%	2,630	3%
Redeye River	58.2	62,219	45%	25,934	19%	4,364	3%	5,919	4%	22	0%	34,145	25%
Lower Leaf River	52.7	25,720	56%	4,880	11%	262	1%	10,334	22%	6	0%	3,033	7%
Total (or avg for FFF)	54.8	283,309	50%	104,123	18%	6,061	1%	51,193	9%	88	0%	67,384	12%

Lake Characteristics

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

Figure 38. Lake size distribution.

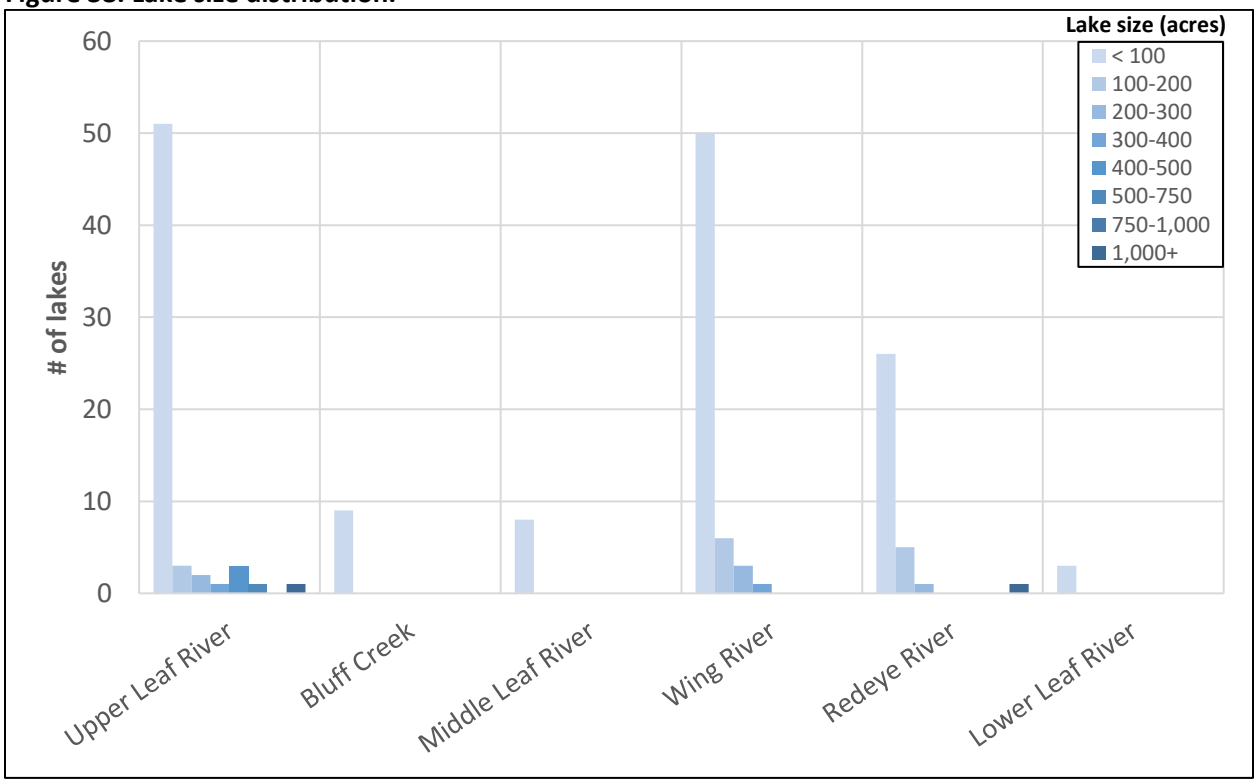


Table 3. Priority and at-risk lake estimates.

	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**	**Priority wild rice**	**Priority shallow**
Upper Leaf River	1	1	5		1	1		1	2	3	3
Bluff Creek											
Middle Leaf River											
Wing River	1	2	1			1				3	7
Redeye River	1	3		1						2	2
Lower Leaf River											
Totals	**3**	**6**	**6**	**1**	**1**	**2**		**1**	**2**	**8**	**12**

Subwatershed No. 1
Upper Leaf River (HUC 701010701)

Description

The Upper Leaf River Subwatershed drains 219 square miles of Otter Tail County and is the headwaters to the Leaf River. It is near the western edge of the Redeye River Major Watershed and its primary land use is agriculture. The Leaf River has its beginnings in a chain of lakes on the Subwatersheds western side, and from there flows east and picks up water from numerous other streams along the way. The subwatershed's outlet is where the Leaf River is joined by Bluff Creek near the town of Bluffton.

Figure 39. Elevation.

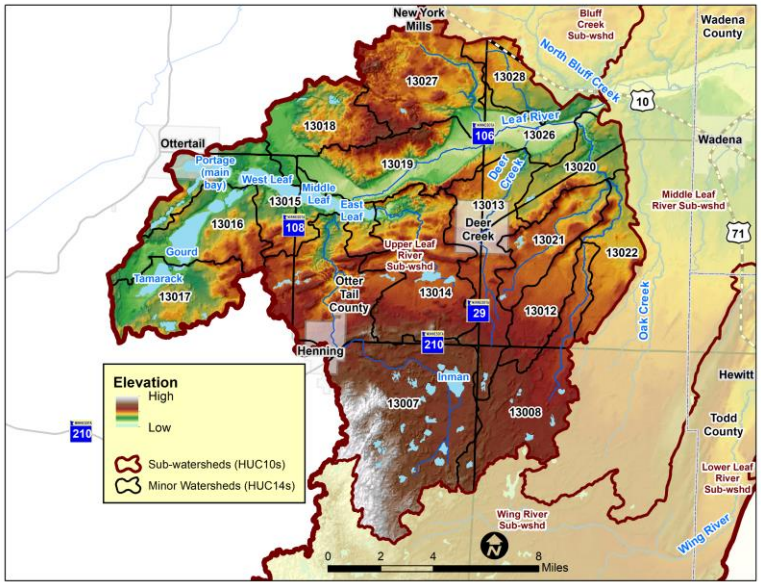
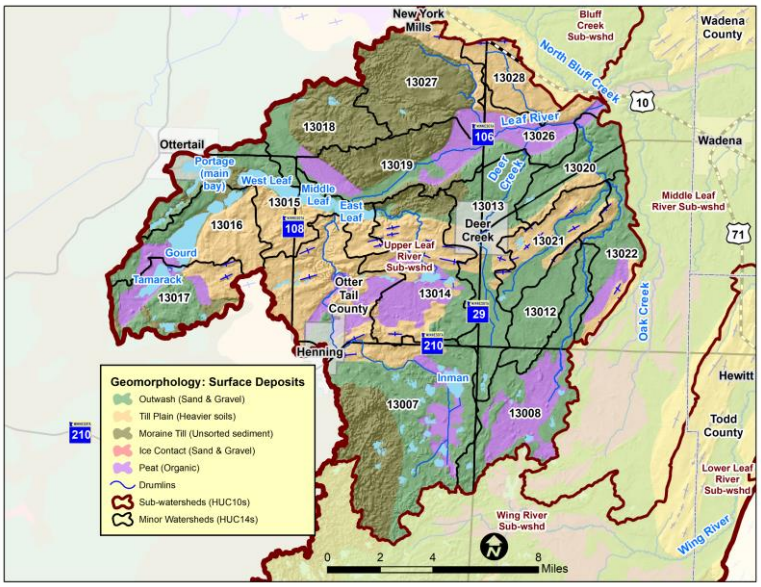


Figure 40. Geomorphological landforms.



Geography

The Upper Leaf River Subwatershed has a diverse geography and landforms including moraines, till plains, outwash plains, and peat deposits. The morainal deposits to the north and south of the Leaf River are associated with the Urbank Moraine LTA and are higher and more rugged than the surround landscape. The areas covered by till plains to the south of the Leaf River is a rolling landscape dominated by drumlins. The outwash plains are more level that the other landforms and are characterized by sand and gravel soils.

Past, Current, and Potential Future Forest Conditions

The historical vegetation of the Upper Leaf River Subwatershed was estimated to be a mix of prairie, oak savanna, and deciduous forest in the uplands, while the lowlands were split between conifer swamp and marsh. The deciduous forest component was largely either oak forest, maple-basswood, or aspen forest types. Today most of the upland vegetation has been converted to agriculture, and the remaining forest exists as fragmented stands and the occasional larger patch of cover. The composition of the remaining forest is primarily in the aspen/birch forest type group, along with scattered stands of the maple/beech/birch forest type group.

Estimates of the potential native plant communities (NPCs) indicate that most of the upland area has the potential to support fire-dependent NPCs, although there is good potential for mesic hardwood NPCs on the moraine till deposits to the north of the Leaf River. The lowlands may support a mix of forested rich peatland, marsh, wet meadow, or open rich peatland NPCs.

Figure 41. Historic vegetation cover, Marschner.

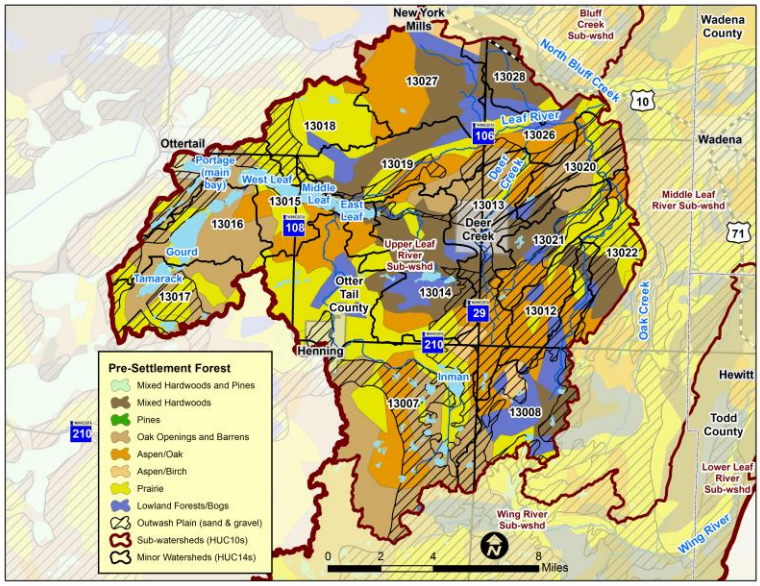


Figure 42. Land cover, 2013.

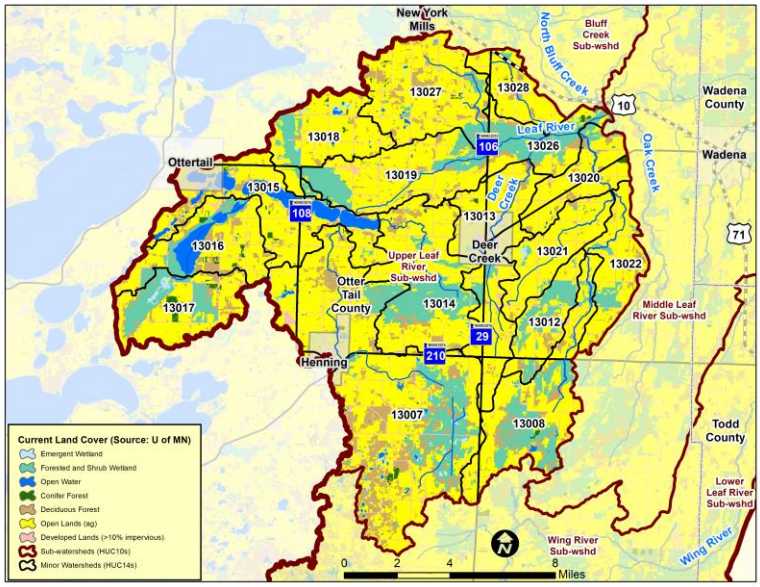
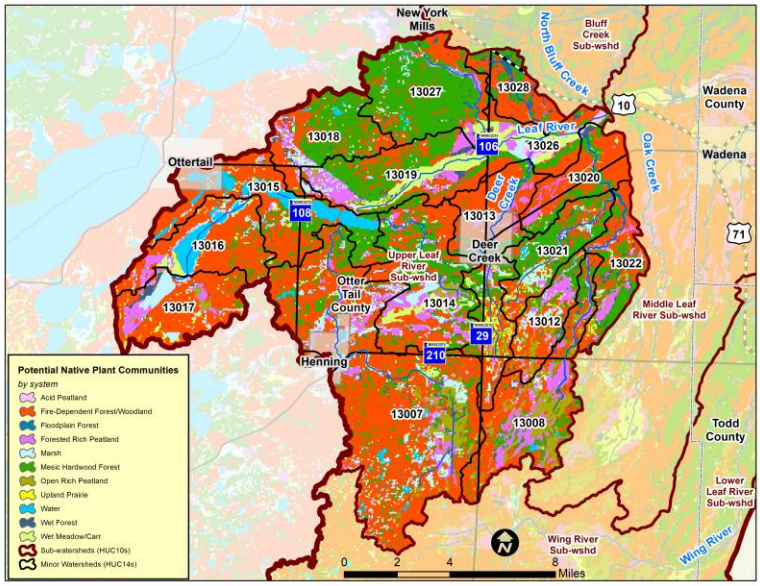


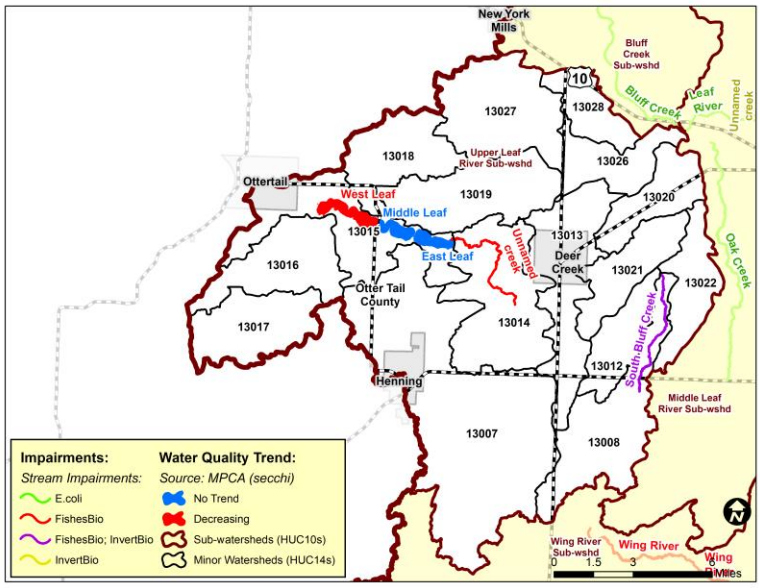
Figure 43. Potential native plant communities.



Water Resources Summary

The Upper Leaf River Subwatershed is the headwaters to the Leaf River, and home to several other streams and lakes. Of the lakes with available water quality data, 1 is declining and 2 are stable. This subwatershed also has 2 lakes of high or outstanding biodiversity significance, as well as 3 priority wild rice lakes and 3 priority shallow lakes. Additionally, the Upper Leaf River Subwatershed contains 67 miles of streams, including 10 miles of trout streams, 13 miles of which are impaired by fish or invertebrate bioassessments.

Figure 44. Water quality trends.



Protection Status

31% of the Upper Leaf River Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 41% an additional 13,343 acres need to be protected at an estimated cost of $13,913,025. Fortunately, over 30,000 acres have the potential to protect, although the Redeye River Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed # 13007.

Figure 45. Protected lands.

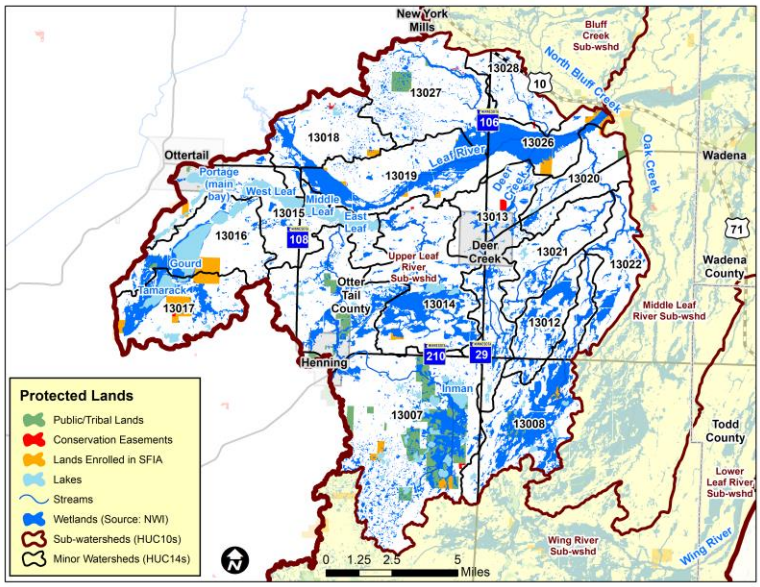
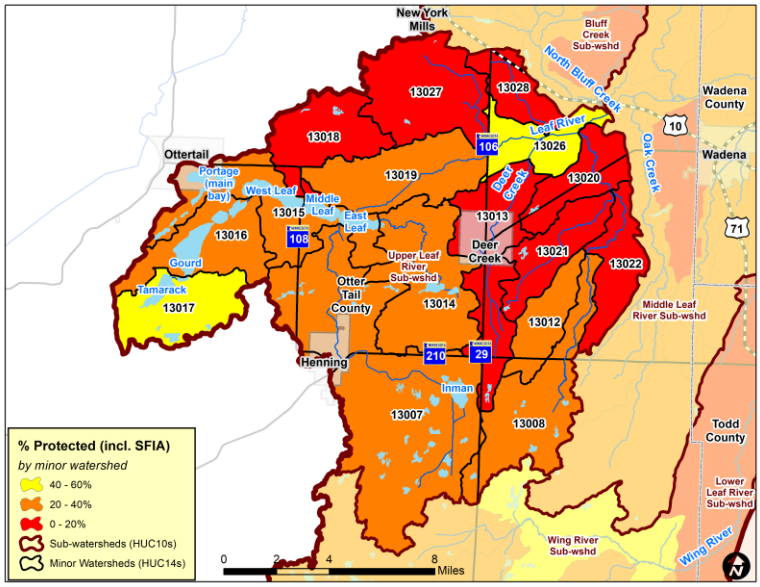


Figure 46. Minor watershed protection levels.

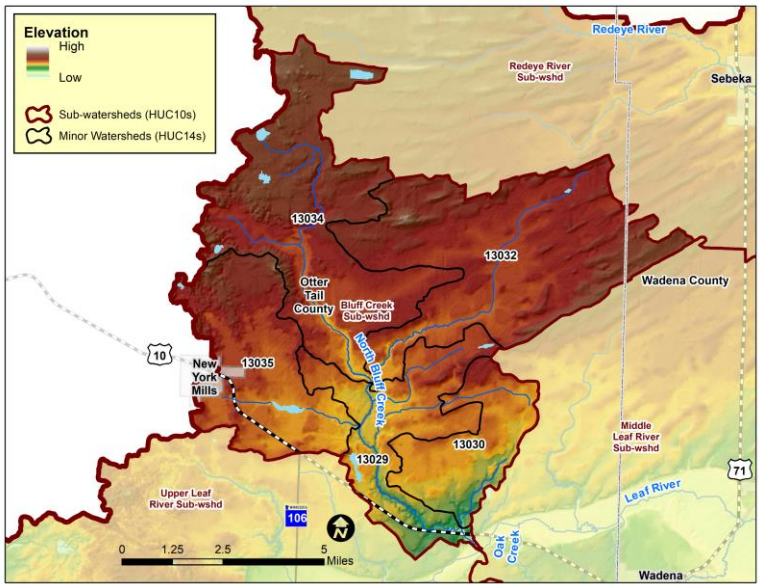


Subwatershed No. 2
Bluff Creek (HUC 701010702)

Description

The Bluff Creek Subwatershed is a tributary watershed to the Leaf River and drains 77 square miles of Otter Tail and Wadena counties. It is located near the western side of the Redeye River Major Watershed and just above the Upper Leaf River Subwatershed. The primary land use in the Bluff Creek Subwatershed is agriculture, although about a third of the subwatershed is also covered by wetlands. The headwaters to Bluff Creek are in the northern part of the subwatershed and from there it flows south and picks up water from numerous other streams along the way. The subwatershed's outlet is where the Bluff Creek flows into the Leaf River near the town of Bluffton.

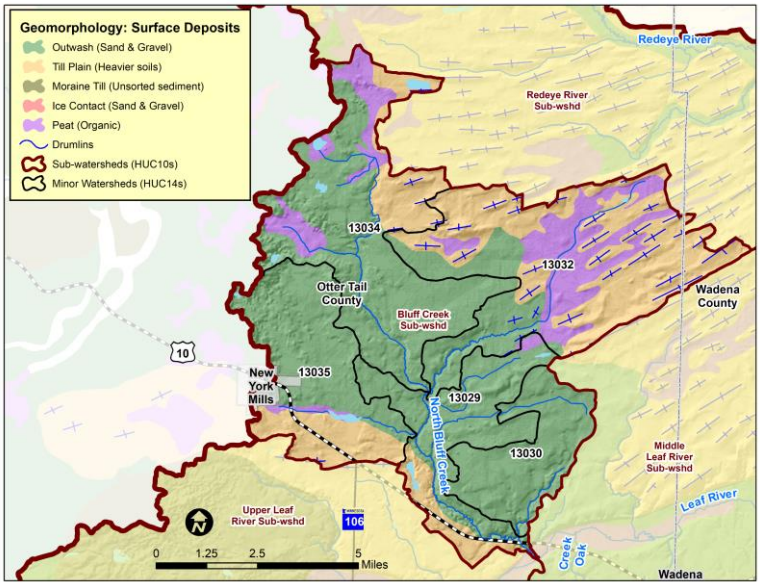
Figure 47. Elevation.



Geography

The western two-thirds of the subwatershed is a landscape dominated by rolling to steep terrain and sandy soils. The landforms were deposited by melt-water flowing from the Rainy and Wadena Lobe glaciers. The eastern one-third is a rolling drumlin field formed by the Wadena Lobe glacier.

Figure 48. Geomorphological landforms.



Past, Current, and Potential Future Forest Conditions

The historical vegetation of the Bluff Creek Subwatershed was estimated to be a mix of aspen, oak, or maple-basswood forest in the uplands, while the lowlands were conifer swamps or marsh. The lowland vegetation types were especially common in the area between the drumlins. Today most of the upland vegetation has been converted to agriculture, and the remaining forest exists as fragmented stands and the occasional larger patch of cover. The composition of the remaining forest is primarily in the aspen/birch forest type group.

Estimates of the potential native plant communities (NPCs) indicate that most of the upland area has the potential to support fire-dependent NPCs, although some areas may better support mesic hardwood NPCs. The lowlands have good potential for wet forest NPCs.

Figure 49. Historic vegetation cover, Marschner.

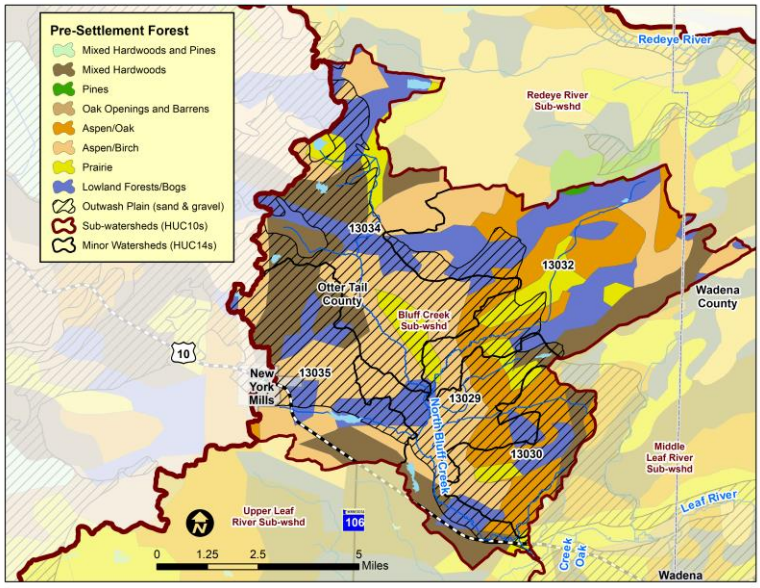


Figure 50. Land cover, 2013.

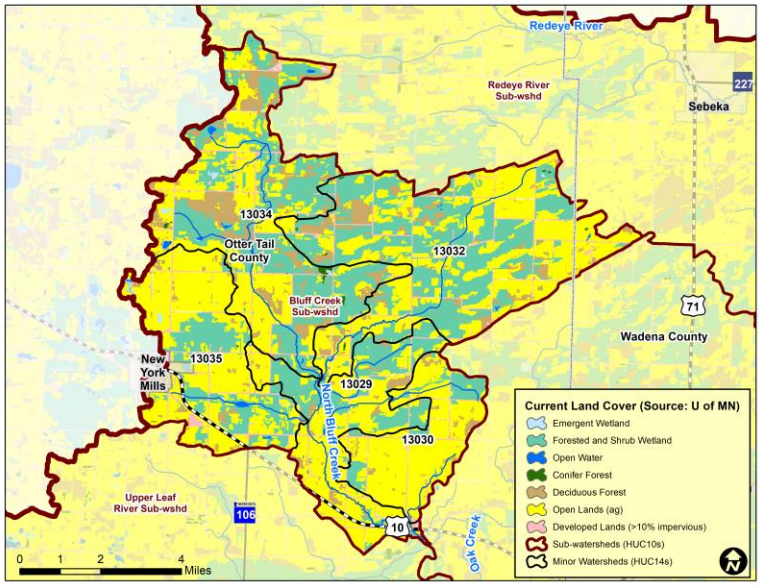
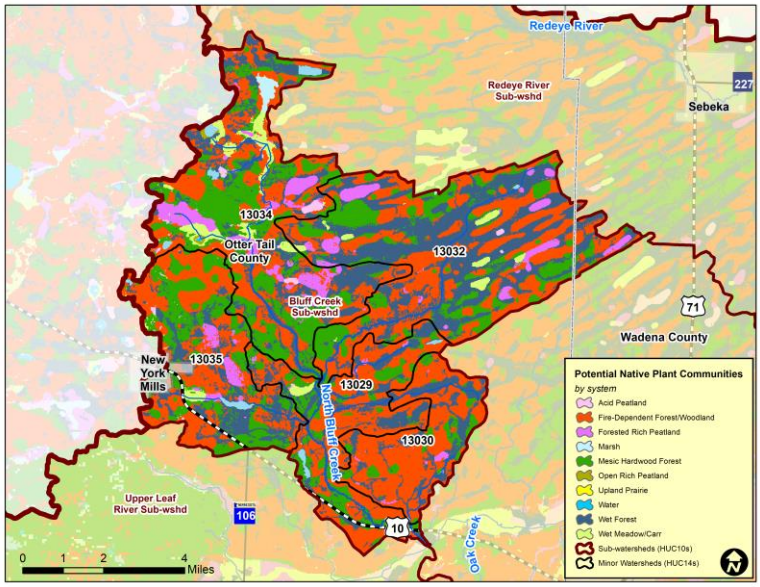


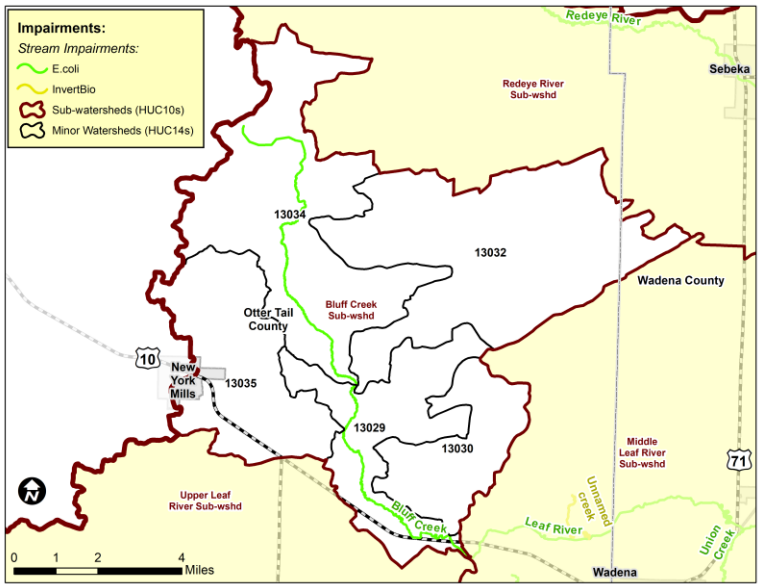
Figure 51. Potential native plant communities.



Water Resources Summary

The Bluff Creek Subwatershed is a stream-based watershed with relatively few lakes. It is home to Bluff Creek as its name implies, as well as a few other smaller streams. The Bluff Creek Subwatershed contains 38 miles of streams, 18 miles of which are impaired by E-coli.

Figure 52. Water quality trends.



Protection Status

32% of the Bluff Creek Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 42% an additional 5,011 acres need to be protected at an estimated cost of $5,023,214. Fortunately, nearly 9,000 acres have the potential to protect. The Redeye River Landscape Stewardship Committee did not prioritize any minor watershed in this subwatershed for protection efforts.

Figure 53. Protected lands.

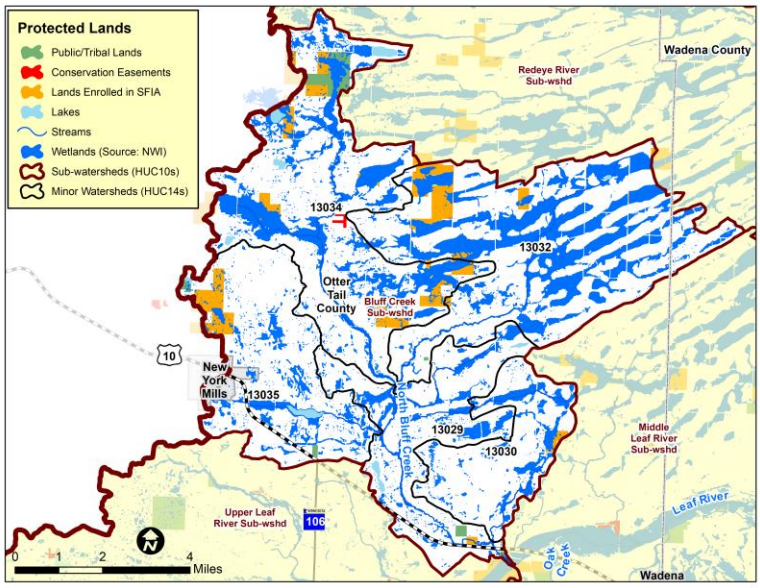
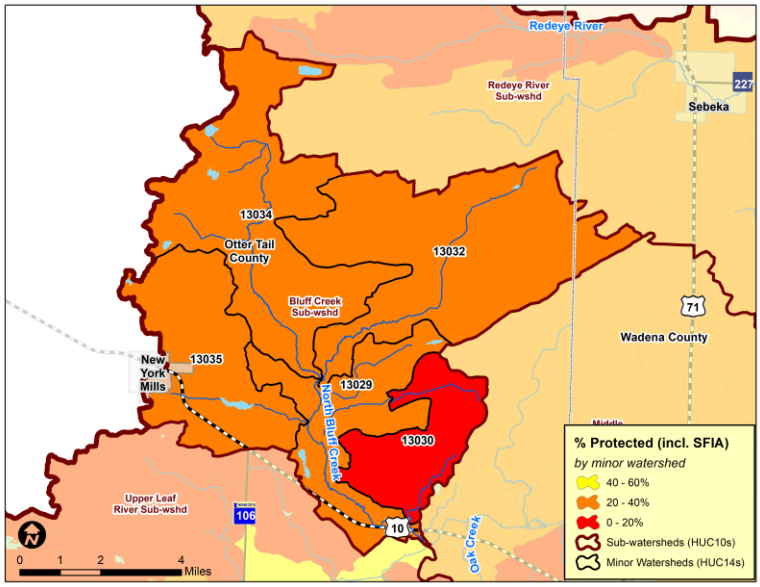


Figure 54. Minor watershed protection levels.

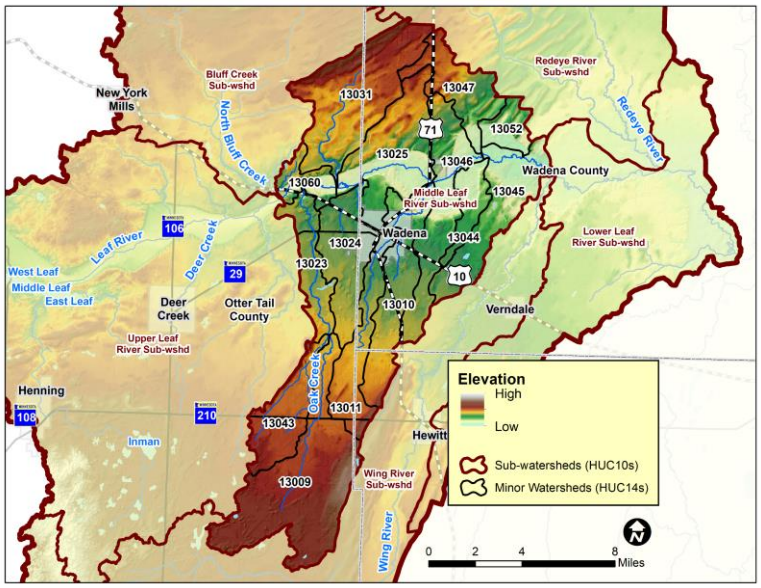


Subwatershed No. 3
Middle Leaf River (HUC 701010703)

Description

The Middle Leaf River drains 150 square miles of Wadena, Otter Tail, and Todd counties. It also receives water from the Upper Leaf River and Bluff Creek Subwatersheds. The Middle Leaf River Subwatershed is located at the center of the Redeye River Major Watershed and its primary land use is agriculture, although about a quarter of the subwatershed is covered by wetlands. The inlet to the subwatershed is on its western border where the Leaf River and Bluff Creek meet. From there it flows east and picks up water from several other streams along the way. Its outlet is its eastern border where it meets the Wing River.

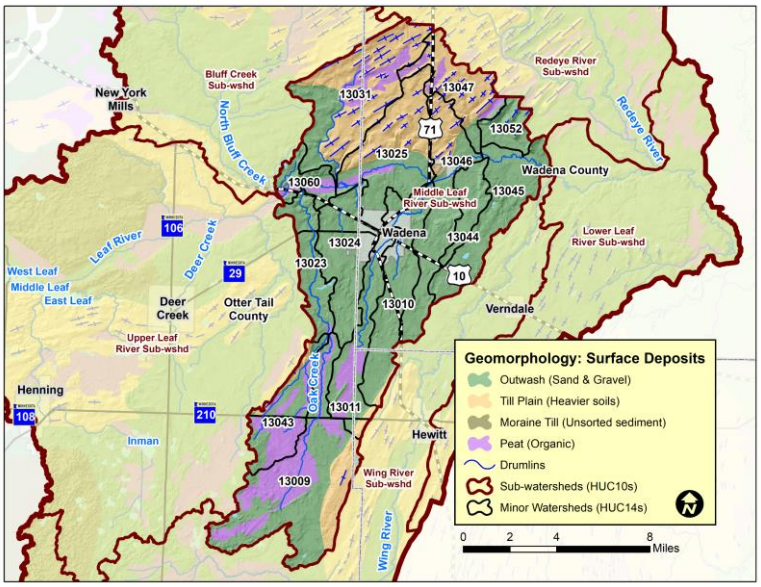
Figure 55. Elevation.



Geography

The majority of the landscape is nearly level to rolling outwash plain. North of the Leaf River is the Wadena Drumlin Plain LTA, which is characterized rolling drumlin field formed by the Wadena Lobe glacier. The soil parent material in the drumlin field is sandy loam till with a hardpan

Figure 56. Geomorphological landforms.



Past, Current, and Potential Future Forest Conditions

The historical vegetation of the Middle Leaf River Subwatershed was estimated to be a mix of deciduous forest and oak savanna in the uplands, while the lowlands were split between conifer swamp and marsh. The deciduous forest component was largely either oak forest, maple-basswood, or aspen forest types. Today most of the upland vegetation has been converted to agriculture, and the remaining forest exists as fragmented stands and the occasional larger patch of cover. The composition of the remaining forest is primarily in the aspen/birch or maple/beech/birch forest type groups.

Estimates of the potential native plant communities (NPCs) indicate that most of the upland area has the potential to support fire-dependent NPCs. The lowlands north of the Leaf River are more likely to support wet forest NPCs, while lowlands south of the river are more likely to support forested rich peatland NPCs.

Figure 57. Historic vegetation cover, Marschner.

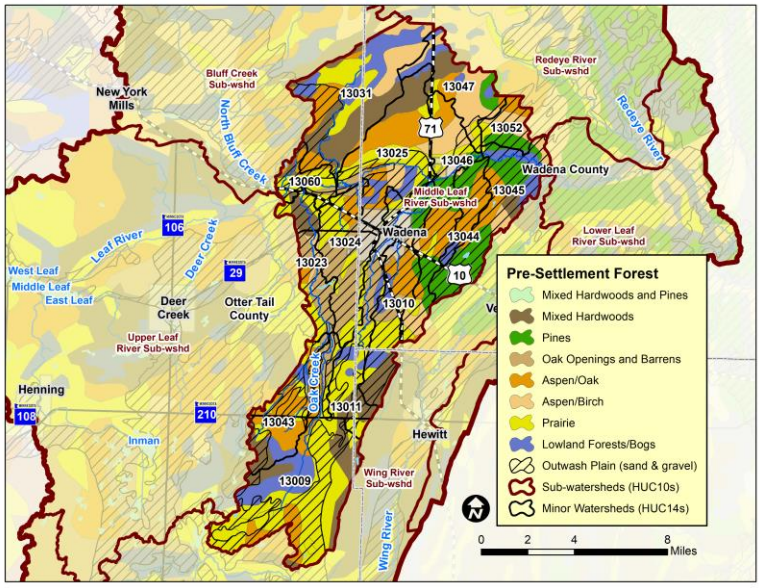


Figure 58. Land cover, 2013.

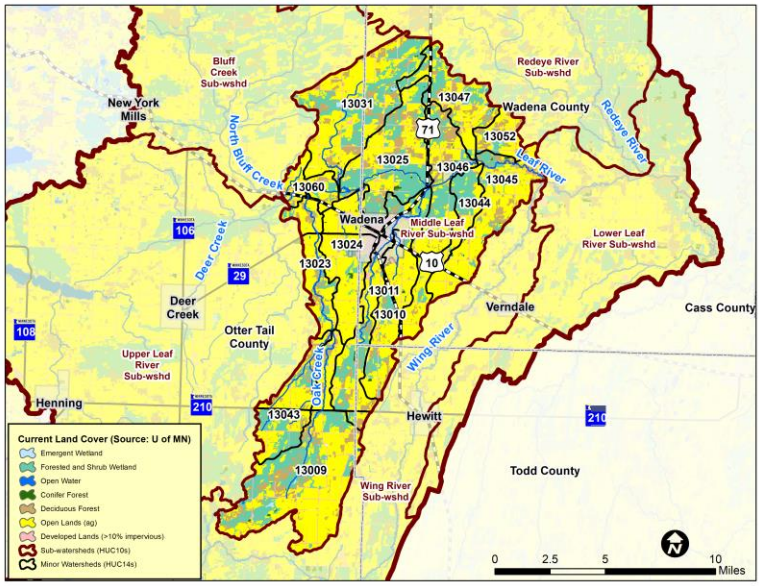
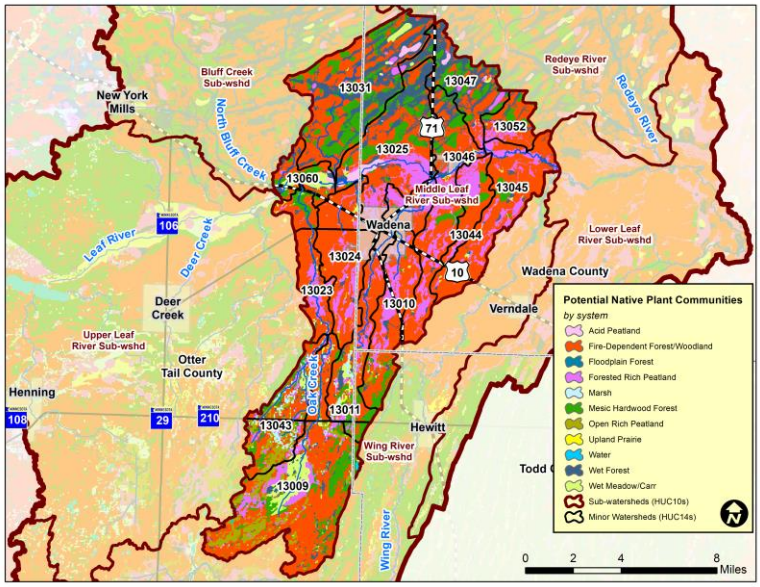


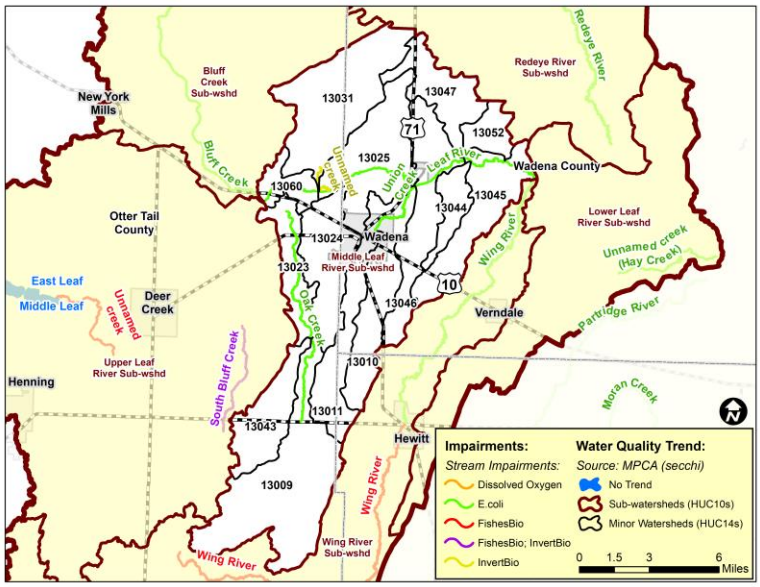
Figure 59. Potential native plant communities.



Water Resources Summary

The Middle Leaf River Subwatershed is a stream-based watershed with relatively few lakes. It is home to the middle reaches of the Leaf River as its name implies, as well as several other streams and a few small lakes. The Middle Leaf River Subwatershed contains 74 miles of streams, including 11 miles of trout streams, 39 miles of which are impaired by E-coli or invertebrate bioassessments.

Figure 60. Water quality trends.



Protection Status

28% of the Middle Leaf River Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 38% an additional 9,735 acres need to be protected at an estimated cost of $9,528,402. Fortunately, over 25,000 acres have the potential to protect. The Redeye River Landscape Stewardship Committee did not prioritize any minor watershed in this subwatershed for protection efforts.

Figure 61. Protected lands.

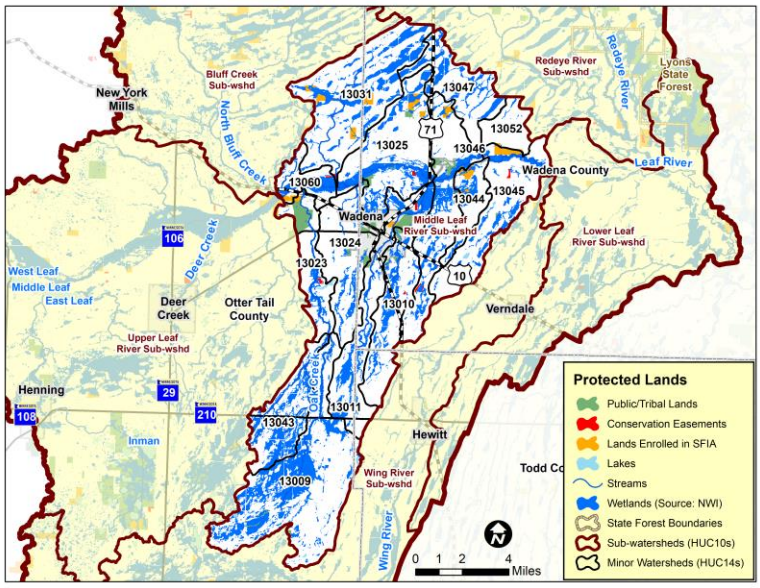
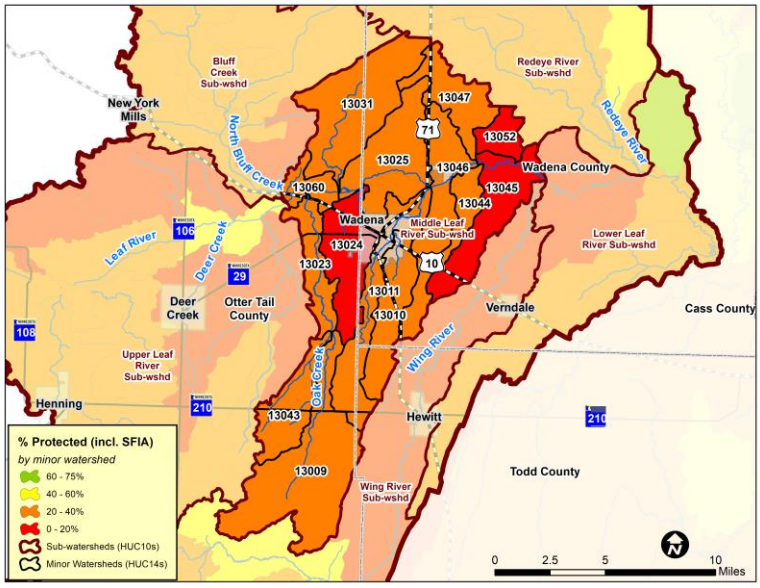


Figure 62. Minor watershed protection levels.

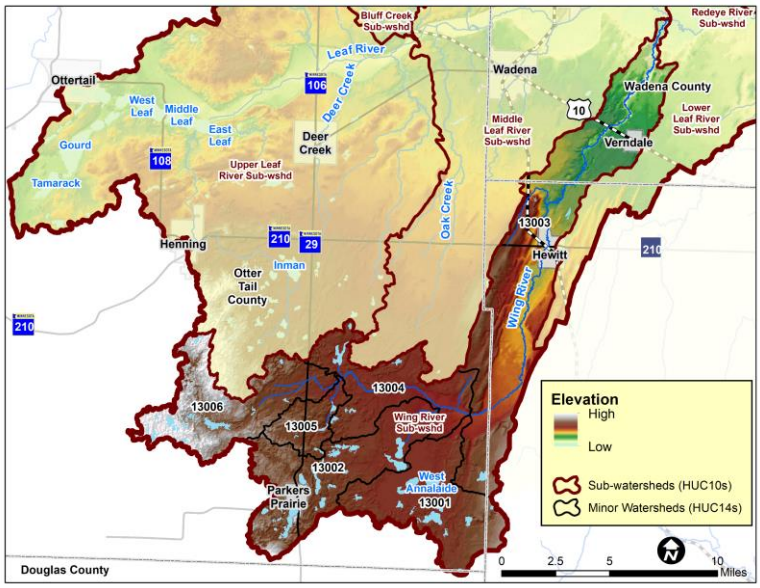


Subwatershed No. 4
Wing River (HUC 701010704)

Description

The Wing River Subwatershed is a tributary watershed to the Leaf River and drains 158 square miles of Otter Tail, Todd, and Wadena counties. It is located on the southern side of the Redeye River Major Watershed and its primary land use is agriculture. The headwaters to the Wing River are in the lower part of the subwatershed, which is also home to numerous small lakes. From its headwaters the Wing River flows east and then north, and its outlet is where it flows into the Leaf River at the subwatershed's northernmost tip.

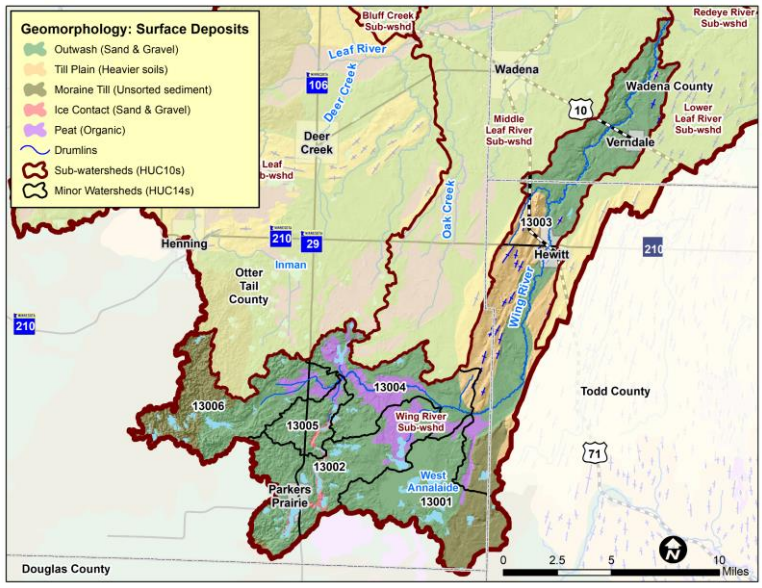
Figure 63. Elevation.



Geography

The majority of the Wing River Subwatershed is covered by a sandy outwash plain. Near the town of Hewitt is a till plain dominated by drumlins orientated in the northeast-southeast direction.

Figure 64. Geomorphological landforms.



Past, Current, and Potential Future Forest Conditions

The historical vegetation of the Wing River Subwatershed was estimated to be a mix of deciduous forest, oak savanna, and prairie in the uplands, while the lowlands were split between conifer swamp and marsh. The deciduous forest component was largely either oak forest, maple-basswood, or aspen forest types. Today most of the upland vegetation has been converted to agriculture, and the remaining forest exists as fragmented stands and the occasional larger patch of cover. The composition of the remaining forest is primarily in the maple/beech/birch, oak/hickory, or aspen/birch forest type groups.

Estimates of the potential native plant communities (NPCs) indicate that most of the upland area has the potential to support fire-dependent NPCs except on the till plain or moraine till deposits in the eastern half of the subwatershed where mesic hardwoods NPCs have greater potential. The lowlands may support open rich peatland or forested rich peatland NPCs.

Figure 65. Historic vegetation cover, Marschner.

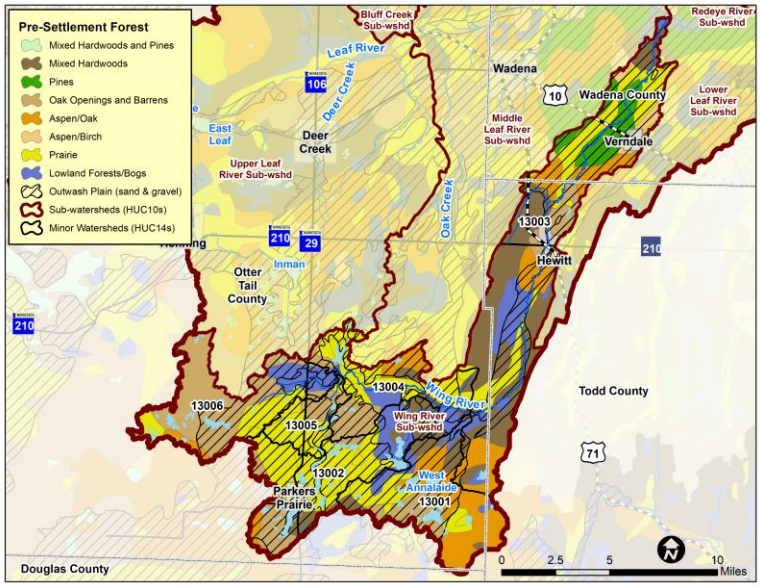


Figure 66. Land cover, 2013.

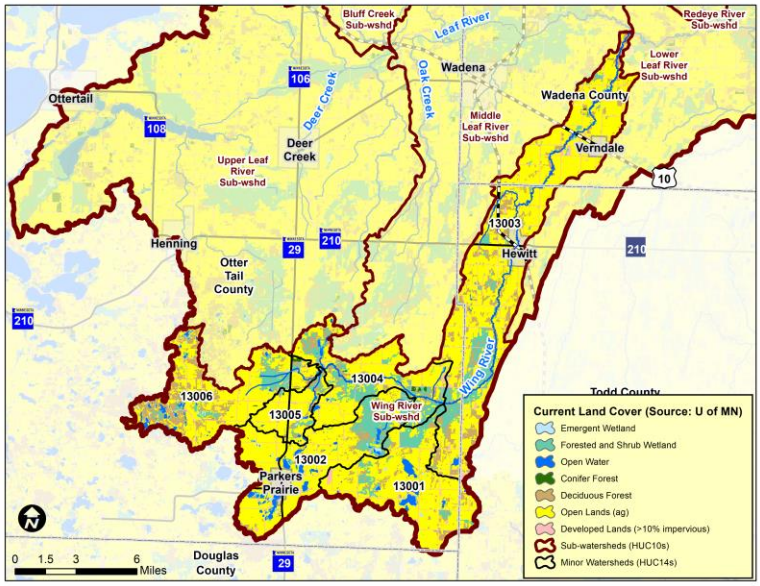
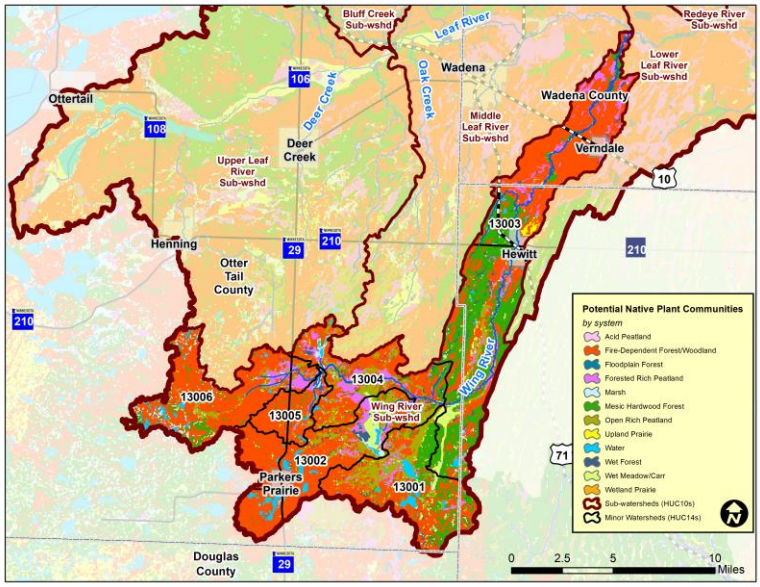


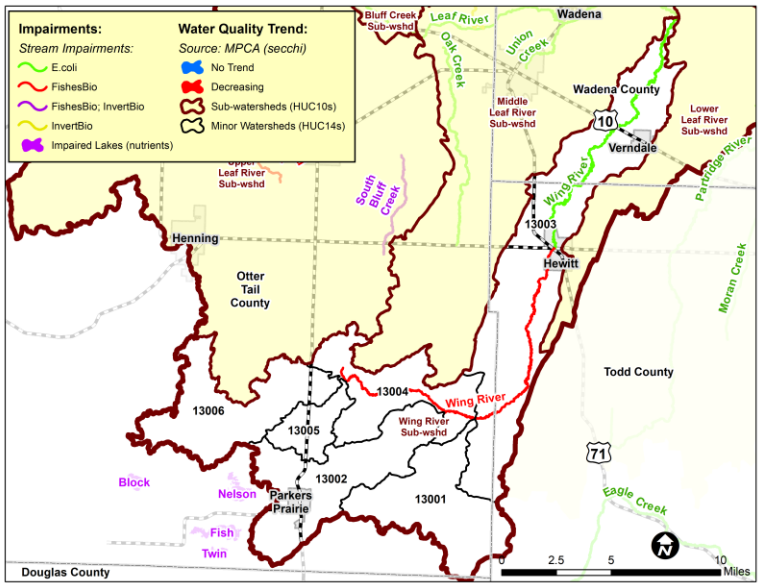
Figure 67. Potential native plant communities.



Water Resources Summary

The Wing River Subwatershed is home to the Wing River as its name implies, as well as several smaller streams and lakes near its headwaters. 3 of the lakes are priority wild rice lakes and 7 are priority shallow lakes. Additionally, the Wing River Subwatershed contains 59 miles of streams, 48 miles of which are impaired by E-coli or fish bioassessments.

Figure 68. Water quality trends.



Protection Status

28% of the Wing River Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 38% an additional 10,088 acres need to be protected at an estimated cost of $10,512,710. Fortunately, nearly 30,000 acres have the potential to protect, although the Redeye River Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 13003 and 13006.

Figure 69. Protected lands.

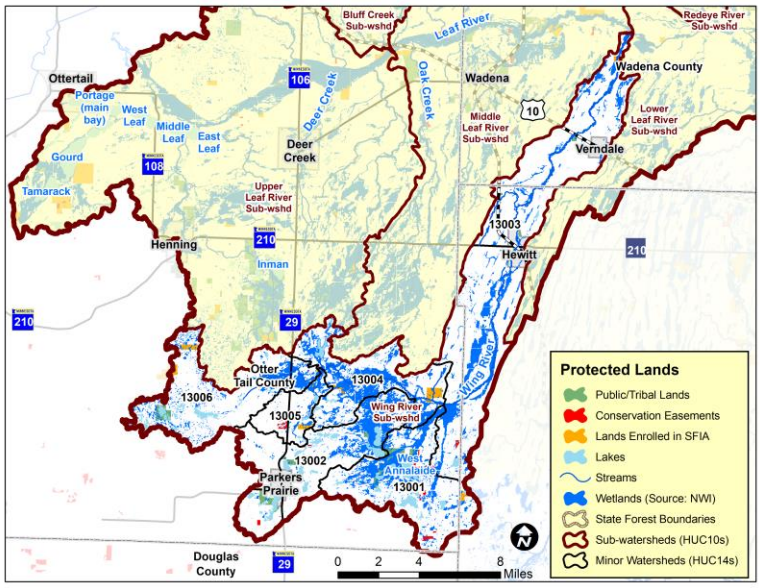
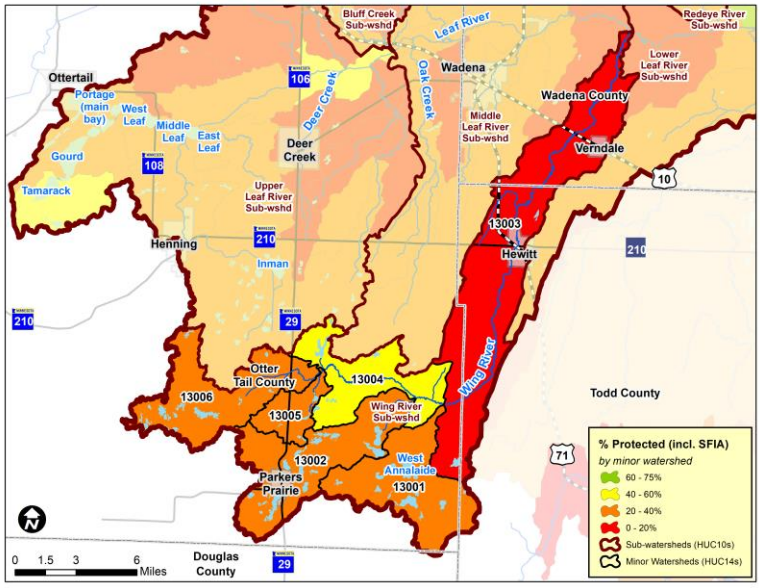


Figure 70. Minor watershed protection levels.

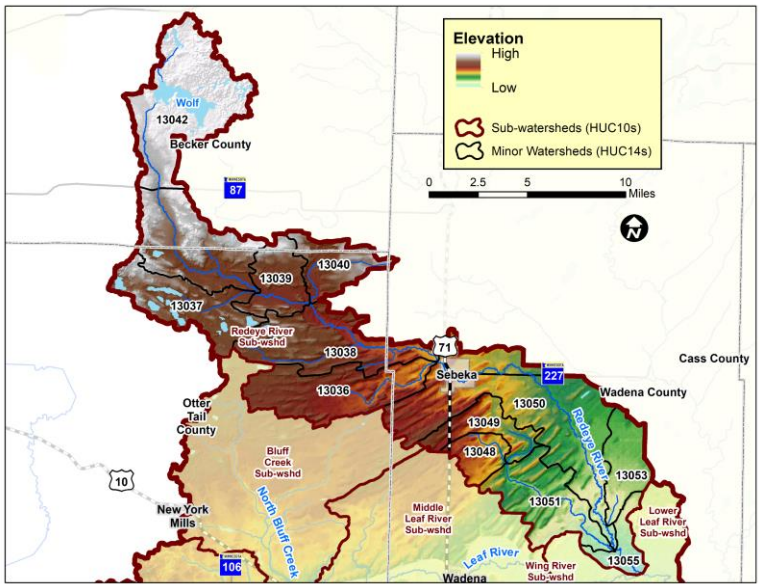


Subwatershed No. 5
Redeye River (HUC 701010705)

Description

The Redeye River Subwatershed is a tributary watershed to the Leaf River and drains 217 square miles of Wadena, Otter Tail, and Becker counties. The subwatershed is long and relatively narrow and is situated on the northern side of the Redeye River Major Watershed. Its landcover is split between agricultural land uses, wetlands, and forest. The headwaters to the Redeye River are located at the northern end of the watershed near the Smoky Hills State Forest, and from there it flows south and east before it merges with the Leaf River at its southeastern tip.

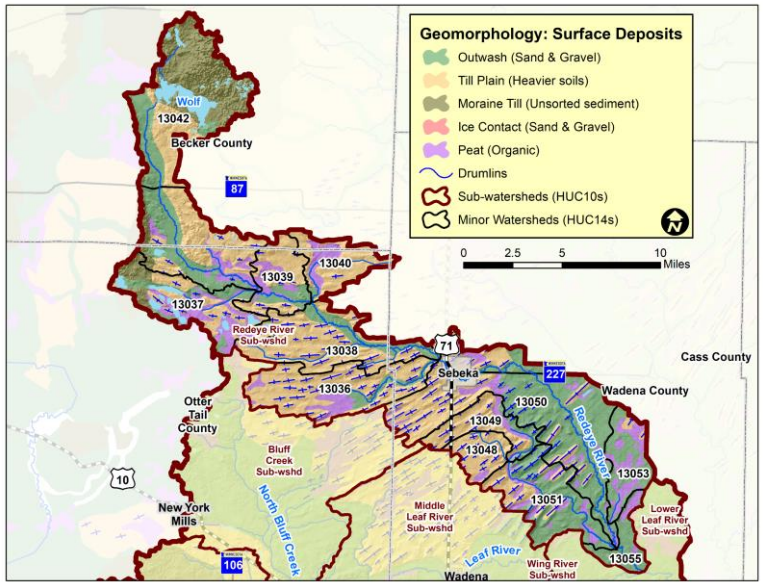
Figure 71. Elevation.



Geography

The Redeye River Subwatershed has varying geographical features from its headwaters to mouth. Near Wolf Lake in the northern end of the subwatershed is a hummocky end moraine with course loamy till. Around the middle reaches of the Redeye River is a rolling drumlin field formed by the Wadena Lobe glacier, although a corridor of outwash deposits follows the length of the river. Near the lower reaches of the Redeye River is a sandy outwash plain that is also dominated by drumlins.

Figure 72. Geomorphological landforms.



Past, Current, and Potential Future Forest Conditions

The historical vegetation in the uplands of the Redeye River Subwatershed was estimated to primarily be deciduous forests, except on the outwash plain near the lower reaches of the Redeye River where coniferous forests dominated. The deciduous forests were largely aspen, oak, or maple-basswood forest types, and the coniferous forests were either jack pine or red pine. The lowland vegetation types were mostly conifer swamps and marshes. Today a significant portion of the upland vegetation has been converted to agriculture, although the Redeye River subwatershed retains a larger percentage of its forest than the other subwatersheds in the major watershed. The composition of the remaining forest is primarily in the aspen/birch or maple/beech/birch forest type groups, expect near the lower reaches of the Redeye River where pine forests are the most common forest type groups.

Estimates of the potential native plant communities (NPCs) indicate that the upland area has the potential to support a mix of fire-dependent and mesic hardwood NPCs. The lowlands have good potential for wet forest NPCs and moderate potential for forested rich peatland, acid peatland, and wet meadow NPCs.

Figure 73. Historic vegetation cover, Marschner.

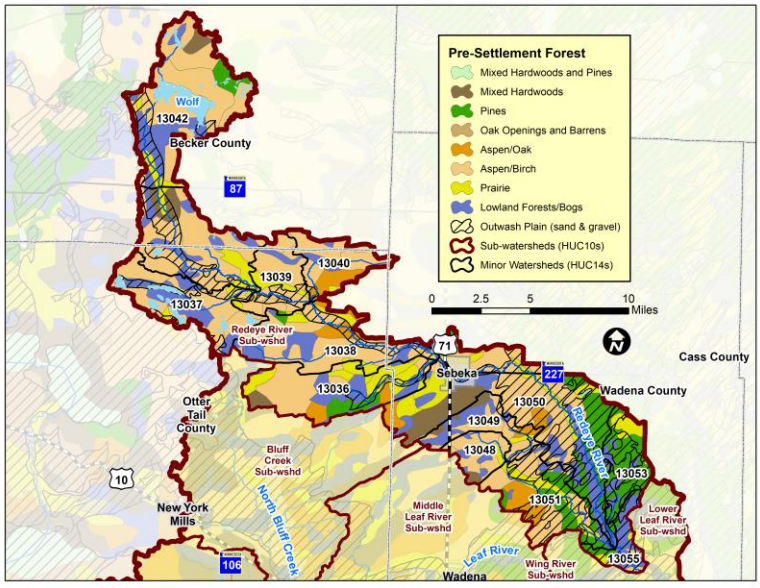


Figure 74. Land cover, 2013.

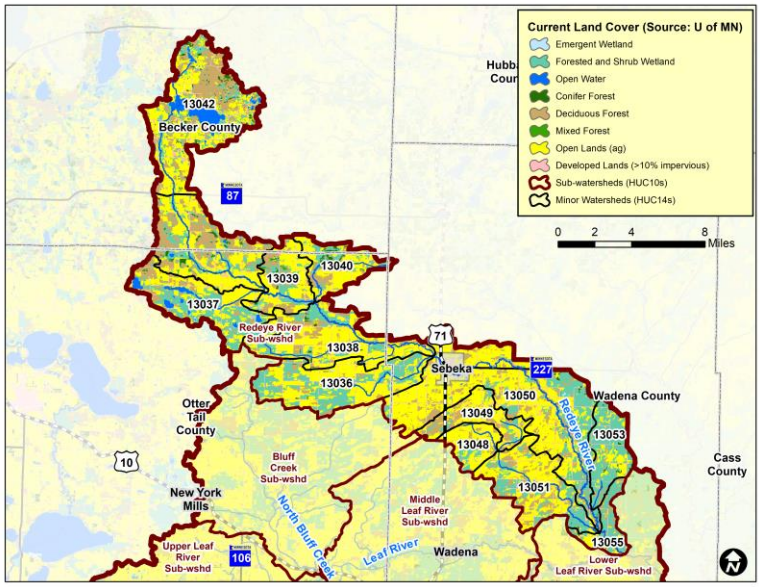
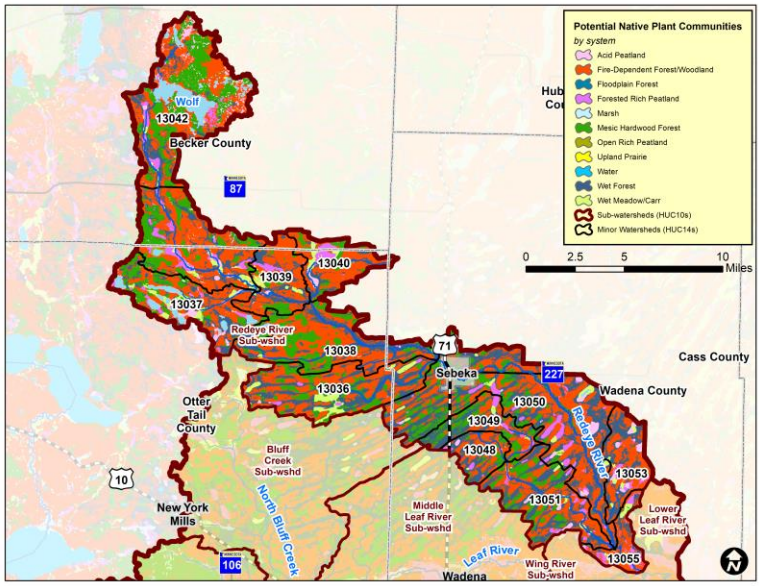


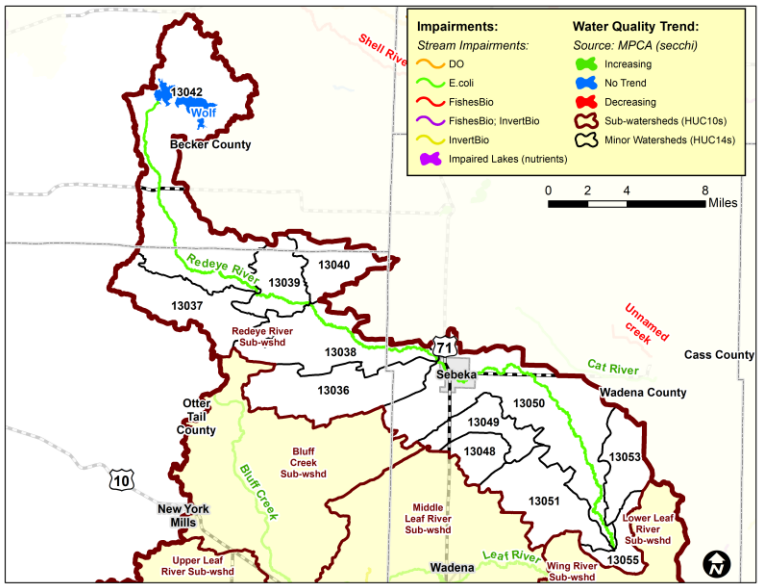
Figure 75. Potential native plant communities.



Water Resources Summary

The Redeye River Subwatershed is home to the Redeye River as its name implies, as well as several smaller streams and lakes. 2 of the lakes are priority wild rice lakes and 2 are priority shallow lakes. Additionally, the Redeye River Subwatershed contains 117 miles of streams, 63 miles of which are impaired by E-coli.

Figure 76. Water quality trends.



Protection Status

33% of the Redeye River Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 43% an additional 13,660 acres need to be protected at an estimated cost of $13,263,600. Fortunately, over 52,000 acres have the potential to protect, although the Redeye River Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 13042, 13048, 13049, and 13050.

Figure 77. Protected lands.

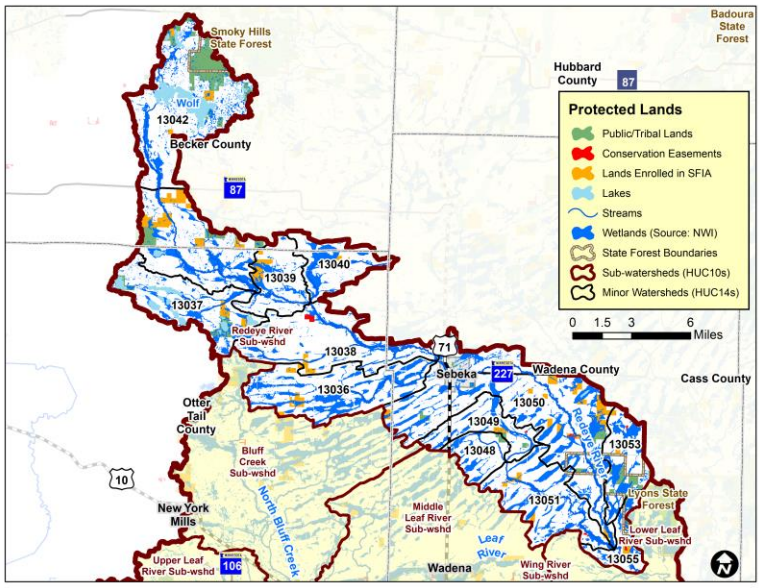
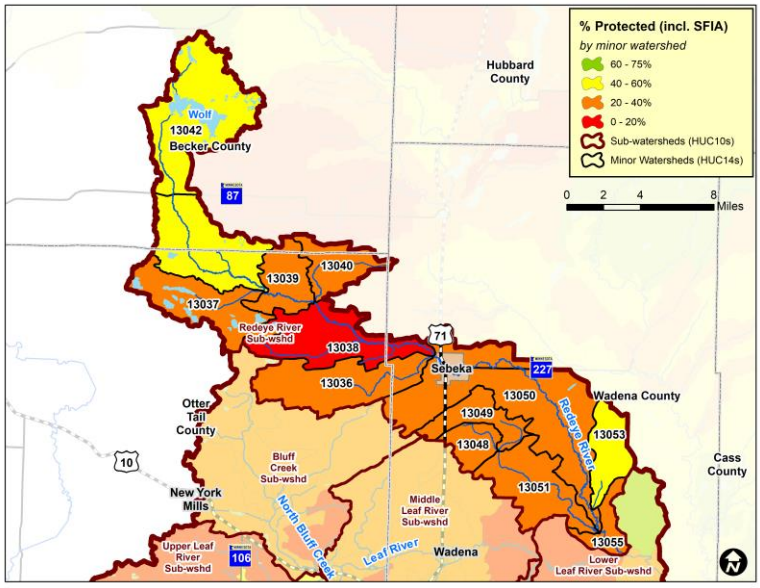


Figure 78. Minor watershed protection levels.



Subwatershed No. 6
Lower Leaf River (HUC 701010706)

Description

The Lower Leaf River Subwatershed drains 72 square miles of Wadena and Todd counties. It also receives water from the Middle Leaf Ring, Wing River, and Redeye River subwatersheds. The Lower Leaf River Subwatershed is on the eastern side of the Redeye River Major Watershed and its primary land use is agriculture. The inlet to the subwatershed is on its western border where the Leaf River and Wing River meet. From there it flows east and picks up water from several streams and rivers along the way, including the Redeye River. The outlet to the Lower Leaf River Subwatershed, and the entire Redeye River Major Watershed, is on the subwatershed's eastern border where the Leaf River flows into the Crow Wing River.

Figure 79. Elevation.

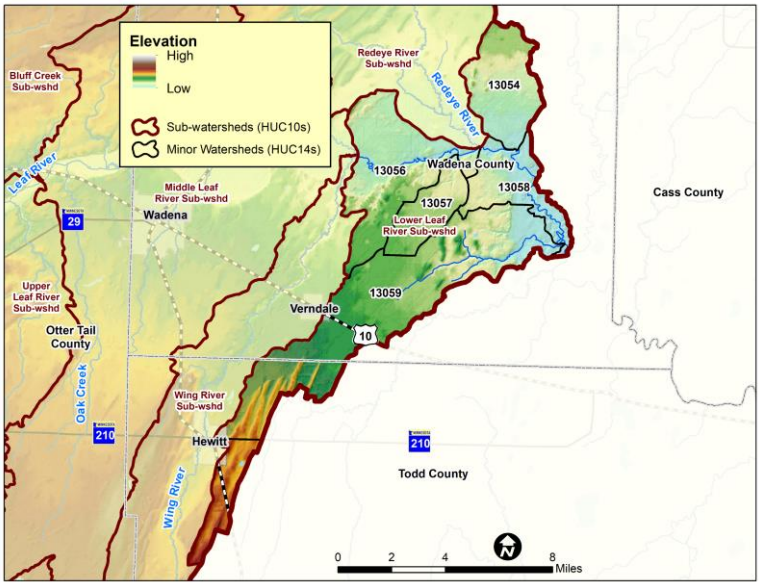
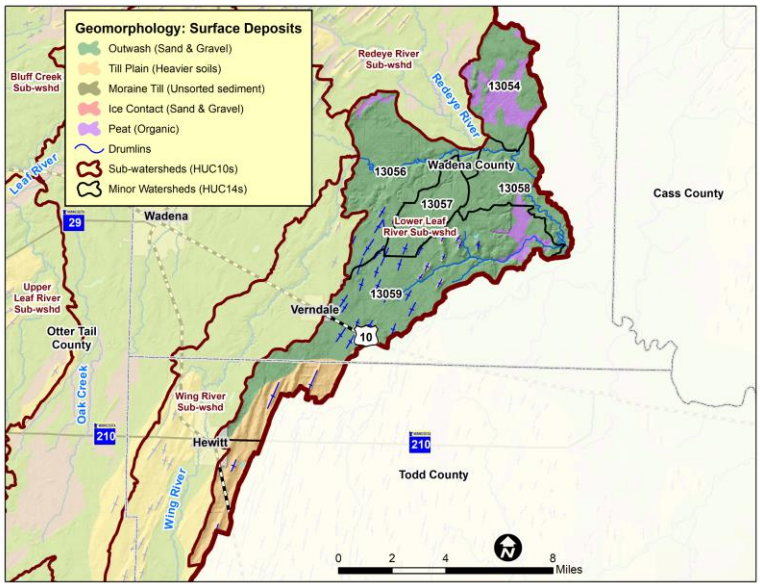


Figure 80. Geomorphological landforms.



Geography

The majority of the Lower Leaf River Subwatershed is covered by a level to rolling outwash plain. Drumlins are common on the outwash plain south of the Leaf River. Near the southern end of the subwatershed is a till plain deposit that is also dominated by drumlins.

Past, Current, and Potential Future Forest Conditions

The historical vegetation in the Lower Leaf River Subwatershed was estimated to be a mix of oak savanna, coniferous forests, and deciduous forests in the uplands, while the lowlands were conifer swamps and marshes. Oak savannas were especially common south of the Leaf River while coniferous forests of jack and red pine were found north of the river. Today most of the upland vegetation has been converted to agriculture, but larger patches of pine forest remain near the northern end of the subwatershed.

Estimates of the potential native plant communities (NPCs) indicate that most of the upland area has the potential to support fire-dependent NPCs, although mesic hardwood NPCs have good potential on the till plain deposits. The lowlands have good potential for forested rich peatland NPCs and moderate potential for wet forest and wet meadow NPCs.

Figure 81. Historic vegetation cover, Marschner.

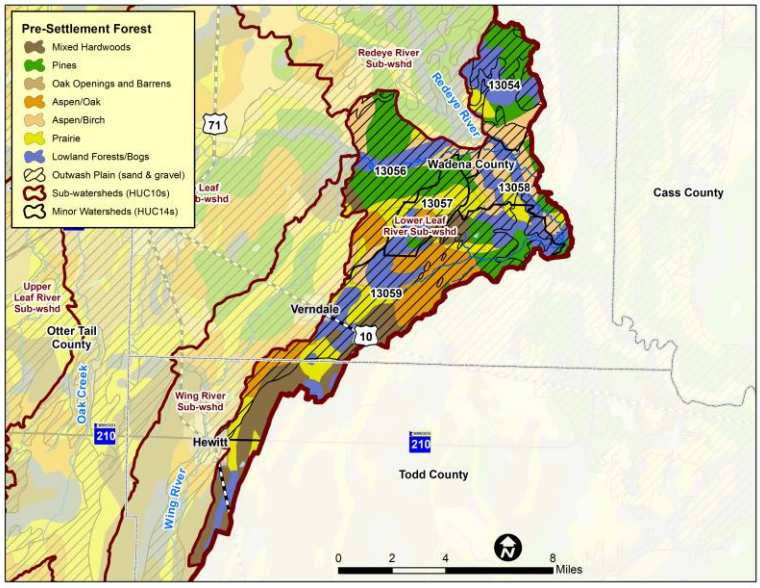


Figure 82. Land cover, 2013.

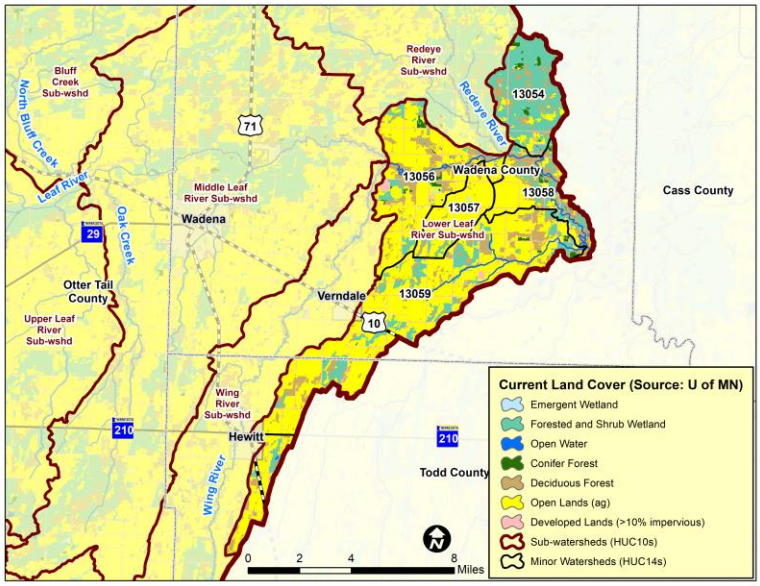
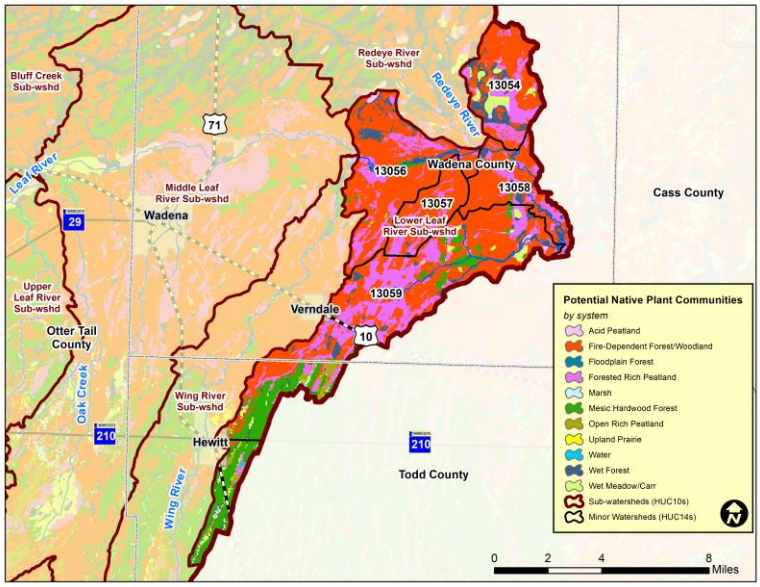


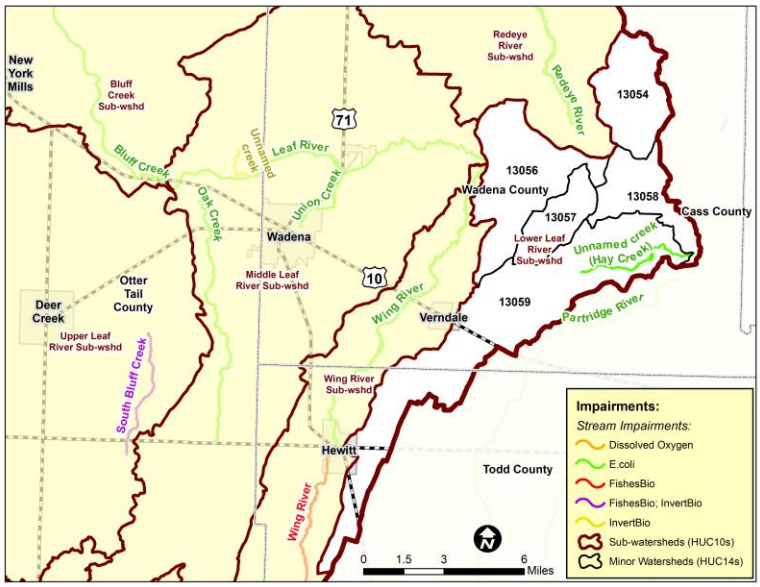
Figure 83. Potential native plant communities.



Water Resources Summary

The Lower Leaf River Subwatershed is a stream-based watershed with relatively few lakes. It is home to the lower reaches of the Leaf River as its name implies, as well as a few other smaller streams. The Lower Leaf River Subwatershed contains 19 miles of streams, including 9 miles of trout streams, 6 miles of which are impaired by E-coli.

Figure 84. Water quality trends.



Protection Status

27% of the Lower Leaf River Subwatershed is currently protected, mostly by wetlands. To reach the subwatershed protection goal of 37% an additional 4,605 acres need to be protected at an estimated cost of $4,543,393. Fortunately, over 16,000 acres have the potential to protect, although the Redeye River Landscape Stewardship Committee recommends prioritizing protection efforts on minor watershed #'s 13056, 13057, and 13058.

Figure 85. Protected lands.

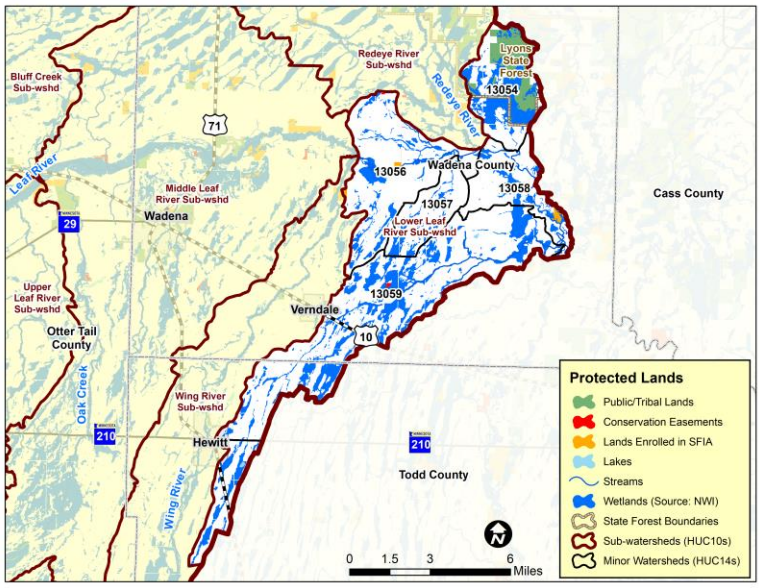
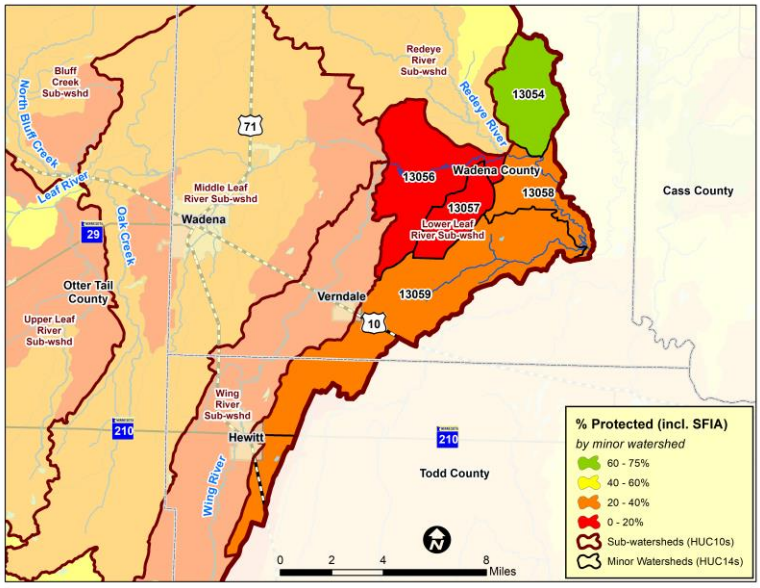


Figure 86. Minor watershed protection levels.



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Ecological Pathway to Sustainable Forest Management

Below is the general sequence of concepts and products that will be developed for and/or integrated into the 2nd generation West 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 Eastern Broadleaf Forest Province
b. DNR ECS website (http://www.dnr.state.mn.us/ecs/index.html)
c. West Central Landscape Conditions and Trends Report (TBD)
d. West Central Landscape Resource Atlas (TBD)
e. West Central Landscape Plan (TBD)

2. Native Plant Communities

a. Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province
b. DNR NPC website (http://www.dnr.state.mn.us/npc/index.html)
c. West Central Landscape Conditions and Trends Report (TBD)
d. West Central Landscape Resource Atlas (TBD)
e. West Central Landscape Plan - Appendix D (TBD)

3. Potential Native Plant Communities

a. 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)
b. GIS data source: https://data.nrri.umn.edu/data/dataset/npc-ebf-lmf
c. West Central Landscape Conditions and Trends Report (TBD)
d. West Central Landscape Resource Atlas (TBD)

4. Vegetation Management Framework Goals and Strategies

a. West Central Landscape Plan (TBD)

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. West Central Landscape Conditions and Trends Report (TBD)
h. West Central Landscape Plan – Appendix D (TBD)
i. West Central Landscape Plan (TBD)

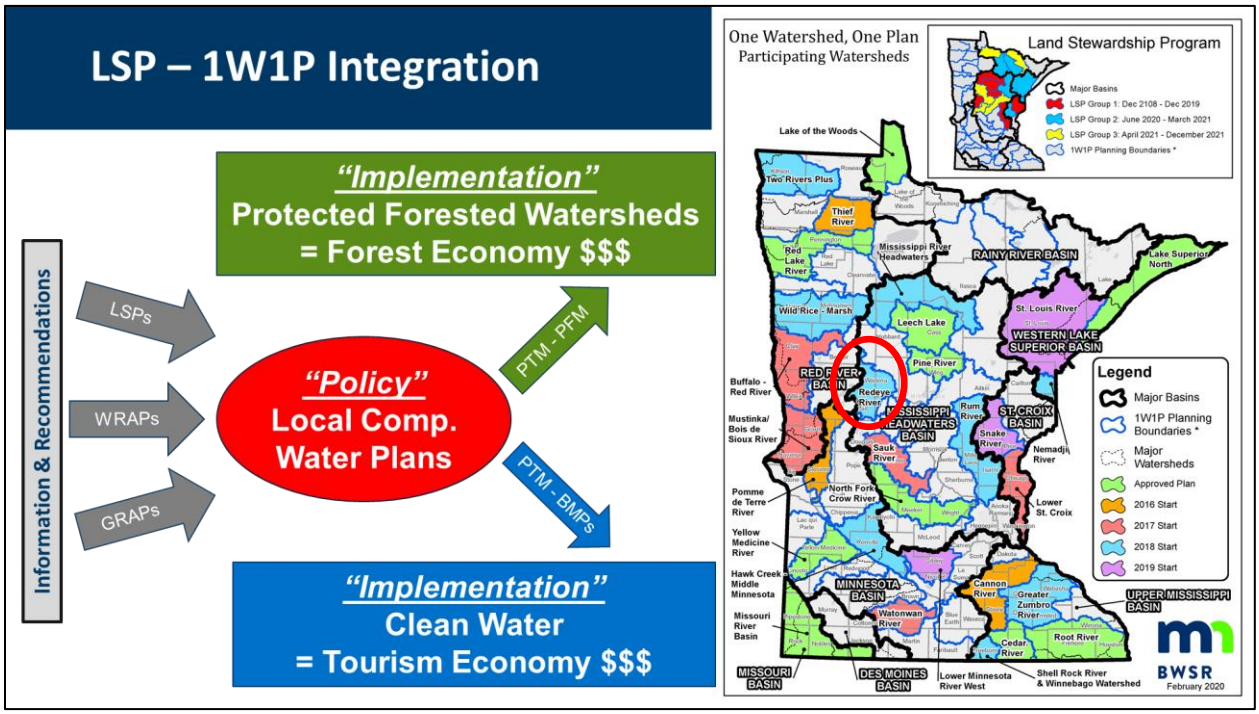
6. Silvicultural Considerations

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. West Central Landscape Plan - Appendix D (TBD)
e. West Central Landscape Plan - Appendix E (TBD)

8. 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

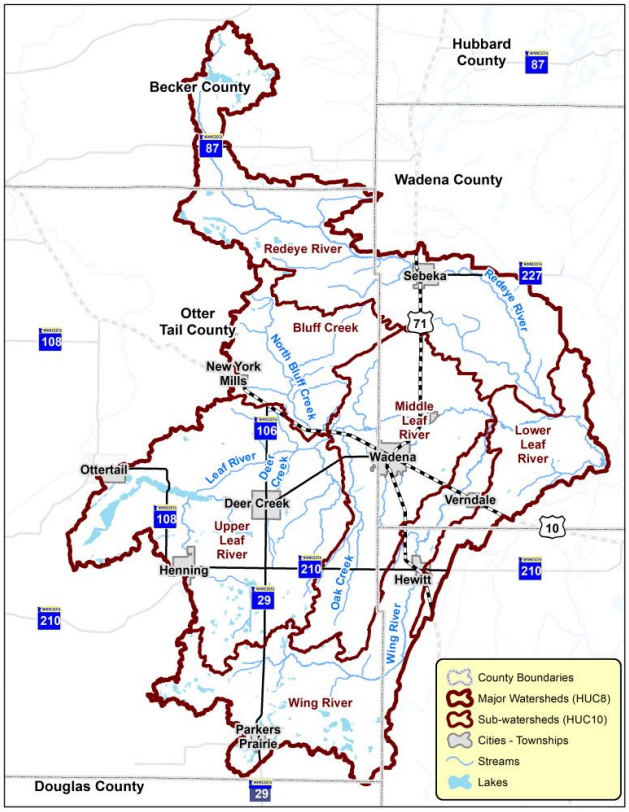


Note: Landscape stewardship plans (LSPs) like the MPCA Watershed Restoration and Protection Strategies (WRAPs) and the MDH Groundwater Restoration and Protection Strategies (GRAPs) provide an important information and relevant context from state water and forest resource programs to inform comprehensive 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 – Redeye River Major Watershed



Subwd no.	Subwatershed name	HUC no.	Acres	No. of minors
1	Upper Leaf River	701010701	140,218	16
2	Bluff Creek	701010702	49,307	5
3	Middle Leaf River	701010703	96,017	14
4	Wing River	701010704	101,220	6
5	Redeye River	701010705	139,171	12
6	Lower Leaf River	701010706	46,136	5
	Totals		**572,069**	**58**