

# ***Pine River Watershed Landscape Stewardship Plan***

---

## **Appendix**

***Cass SWCD***

***Cass County Environmental Services***

***Crow Wing SWCD***

***Crow Wing County Environmental Services***

***Crow Wing County Board of Commissioners***

***Pine River Watershed Alliance***

***Whitefish Area Property Owners Association***





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## Project Partners

This section provides an overview of the people involved with the development of the Pine River Landscape Stewardship Plan.

### Pine River LSP Planning Team

The Pine River Landscape Stewardship Plan development involved several people representing different interests. The following list includes planning team members arranged 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
Kelly Condiff	Cass SWCD/Environmental Services Department
Melissa Barrick	Crow Wing SWCD
Gary Griffin	Crow Wing County Environmental Services
Jake Frie	Crow Wing County Environmental Services
Paul Thiede	Crow Wing County Board of Commissioners
Alex Brothen	MN DNR Forestry
Heather Baird	MN DNR Fisheries
Chris Pence	Board of Water and Soil Resources
Ron Meyer	Pine River Watershed Alliance
Steve Roe	Pine River Watershed Alliance
Jeff Laurel	Whitefish Area Property Owners Association

### Staff Supporting the Pine 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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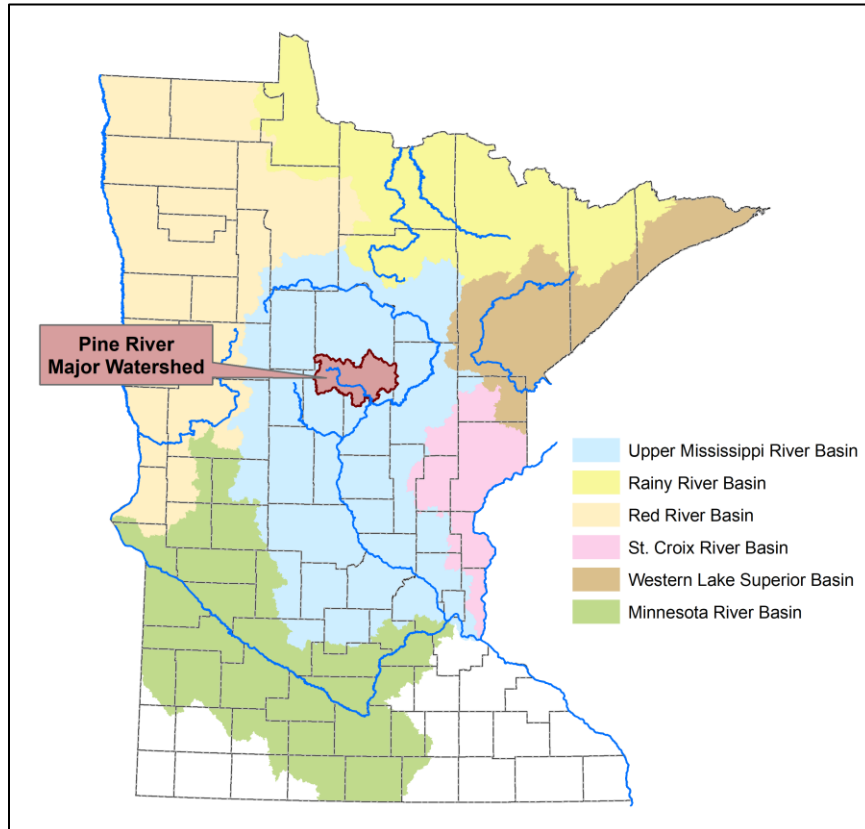
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## Pine River Resource Inventory (HUC 8)

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

**Figure 1. Location of the Pine River Major Watershed.**



## Geography

Figure 2. Geomorphological landforms.

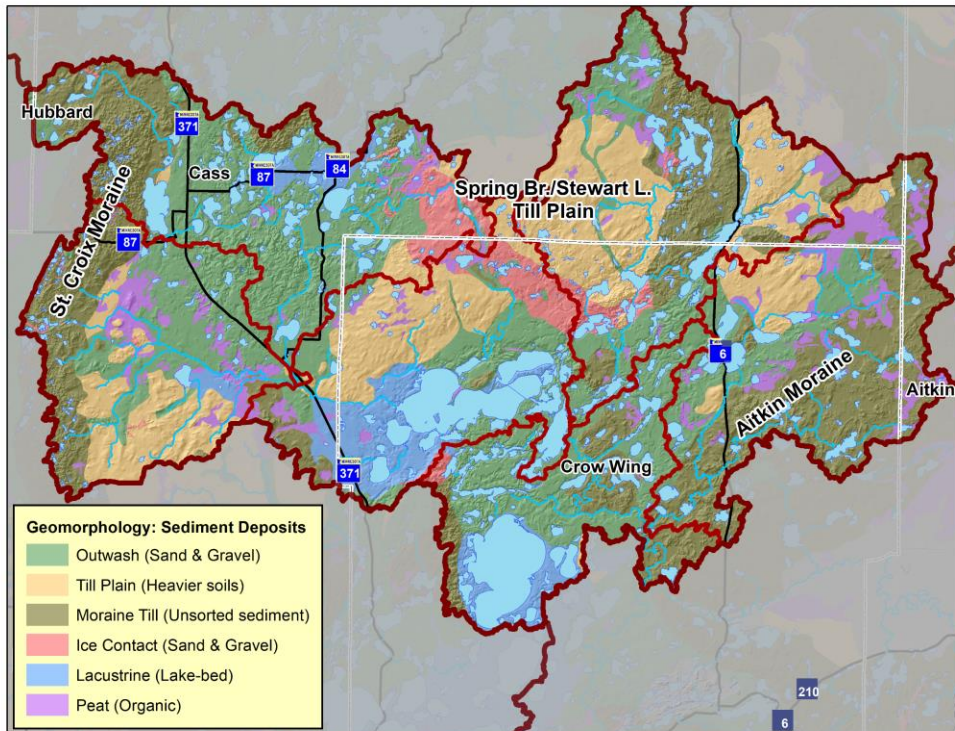


Figure 3. Elevation.

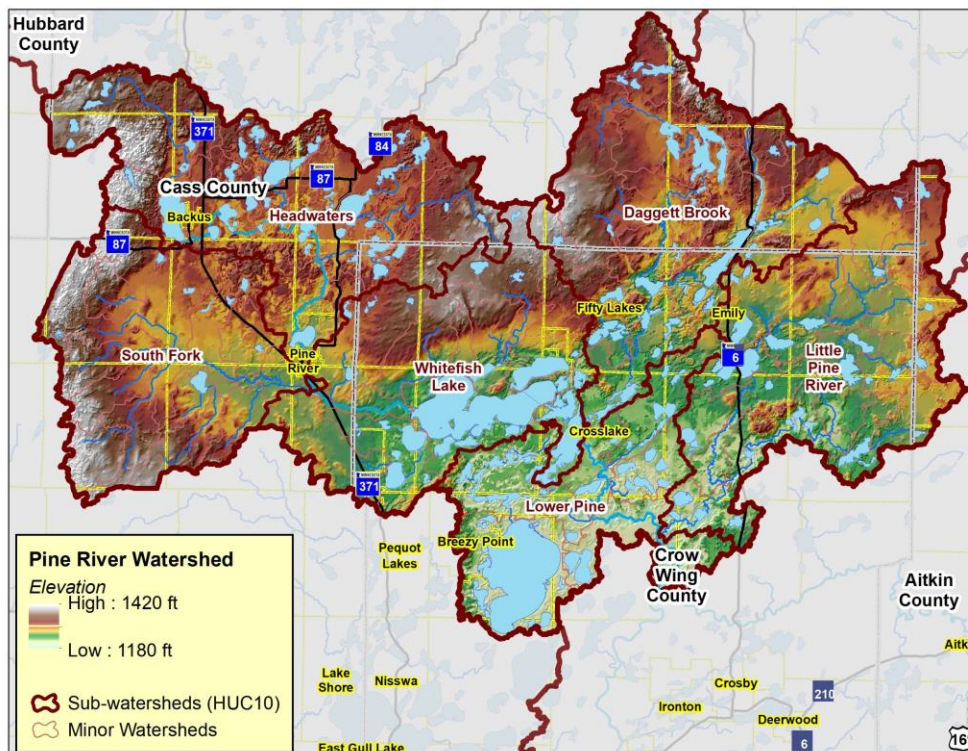




Figure 4. Ecological subsections.

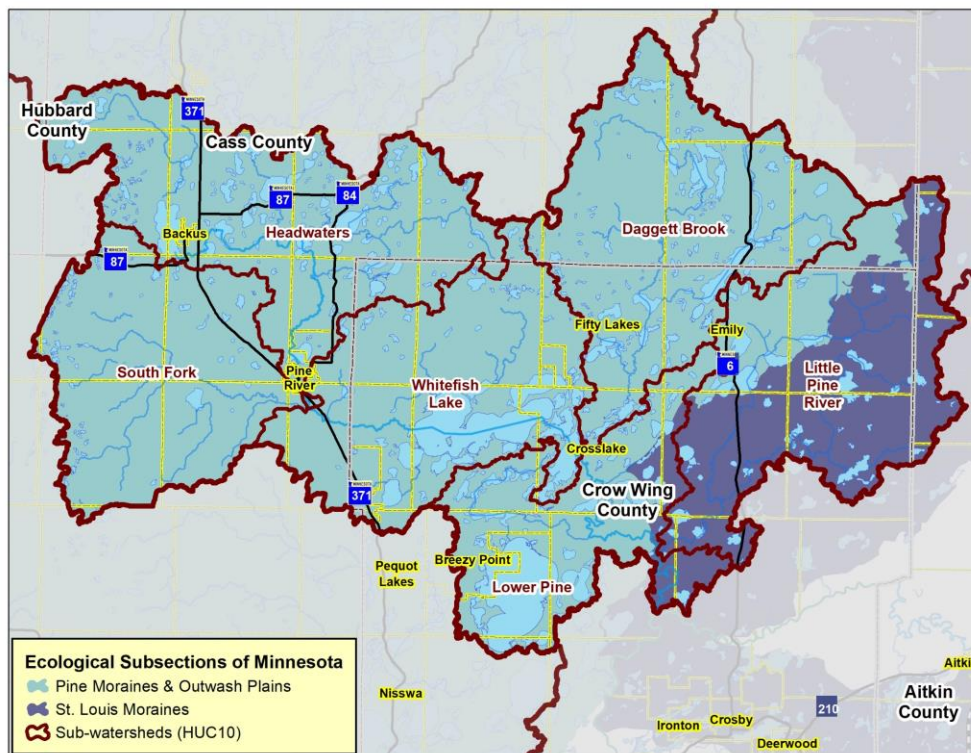
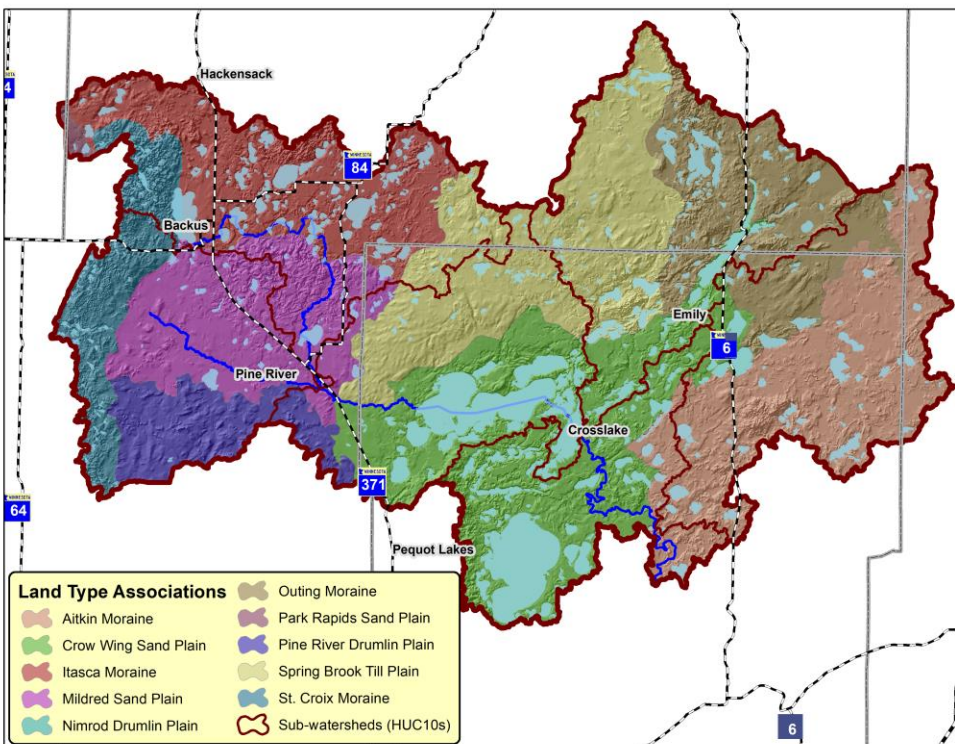


Figure 5. Land type associations.



## Forest Cover and Composition

Figure 6. Historic vegetation cover, Marschner.

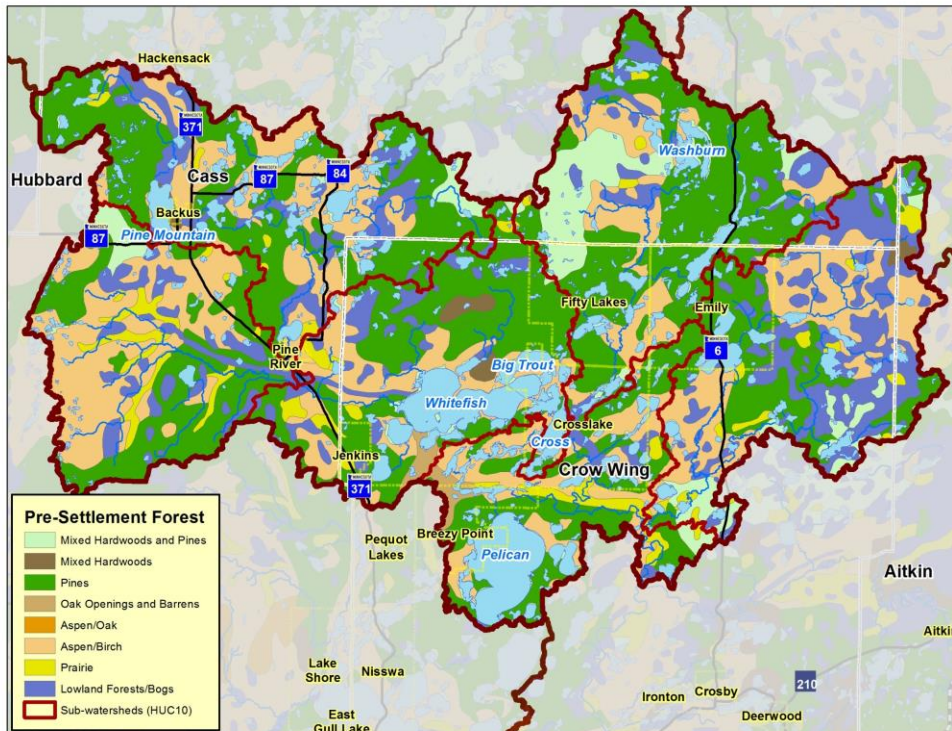


Figure 7. Historic vegetation class, MnDOT (VegMod).

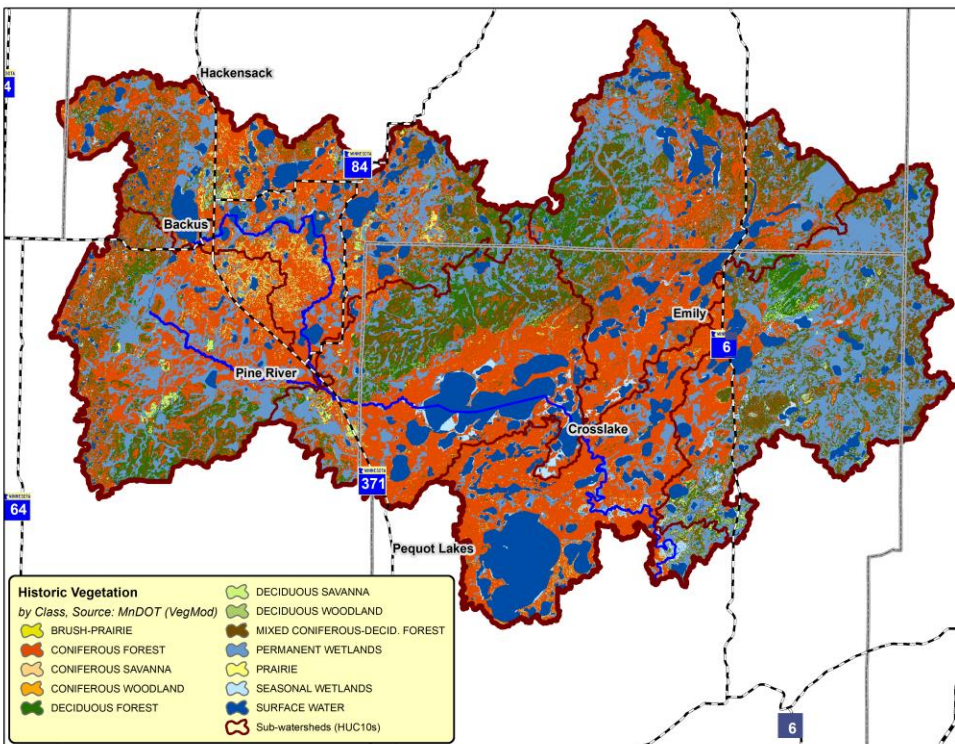




Figure 8. Historic vegetation type, MnDOT (VegMod).

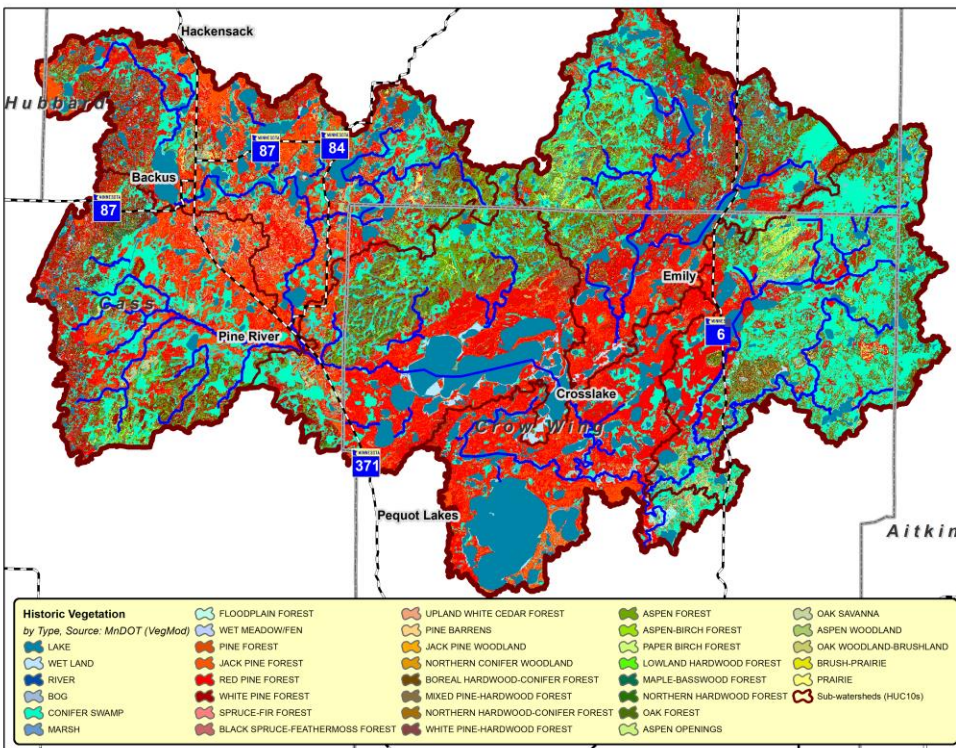


Figure 9. Current land cover.

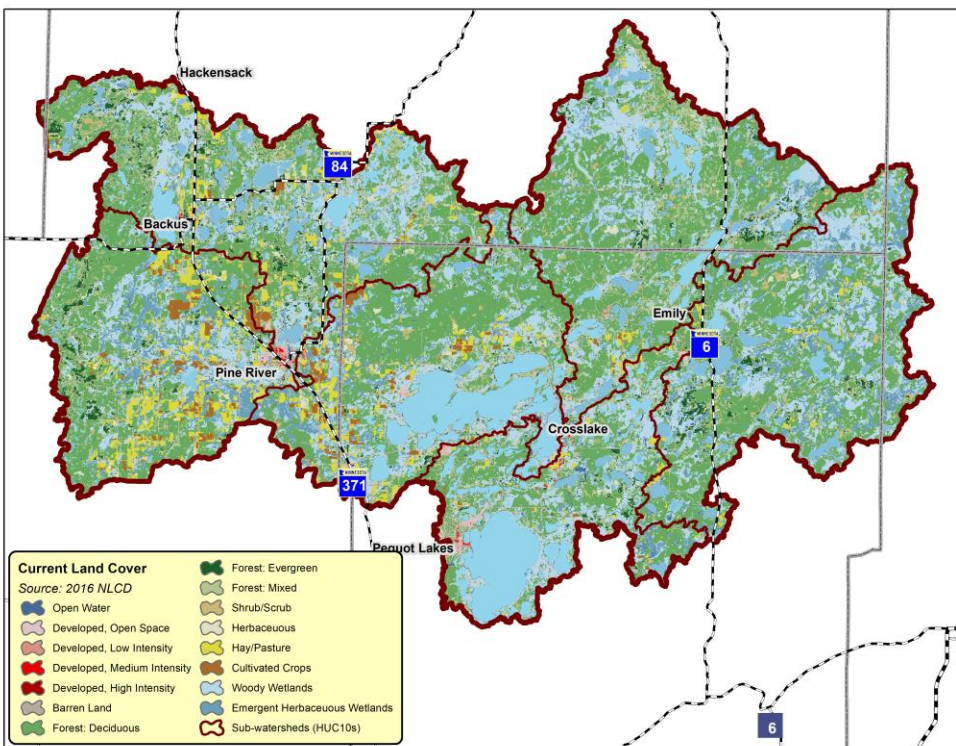




Figure 10. Current vegetation and areas of historic forest loss.

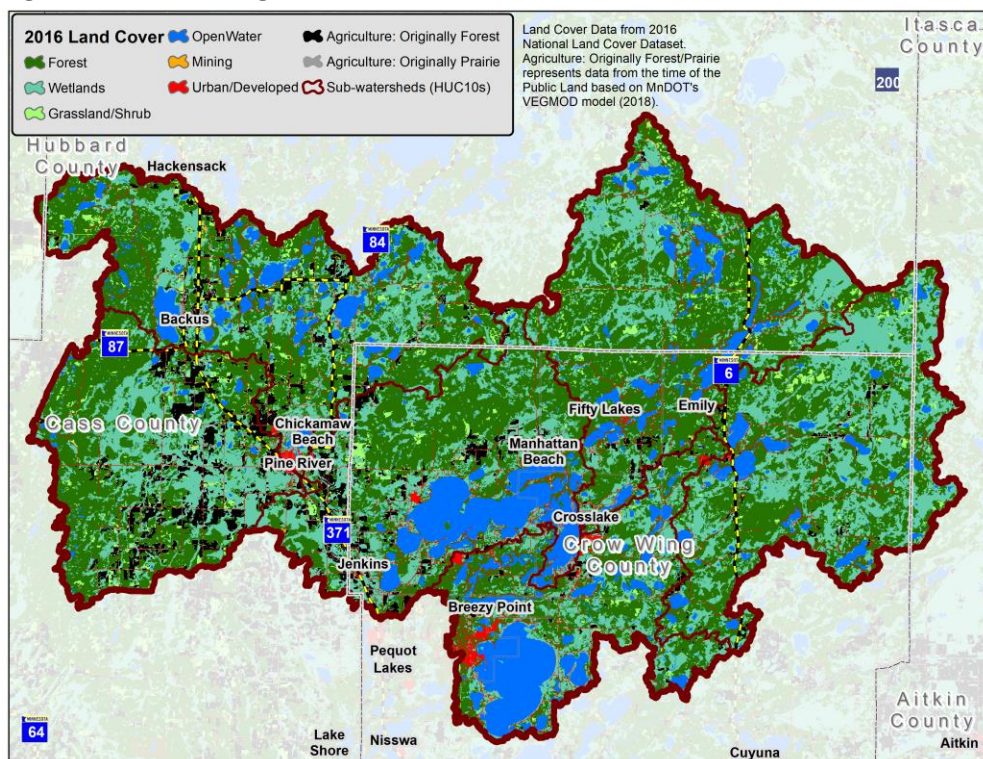


Figure 11. Potential native plant community systems.

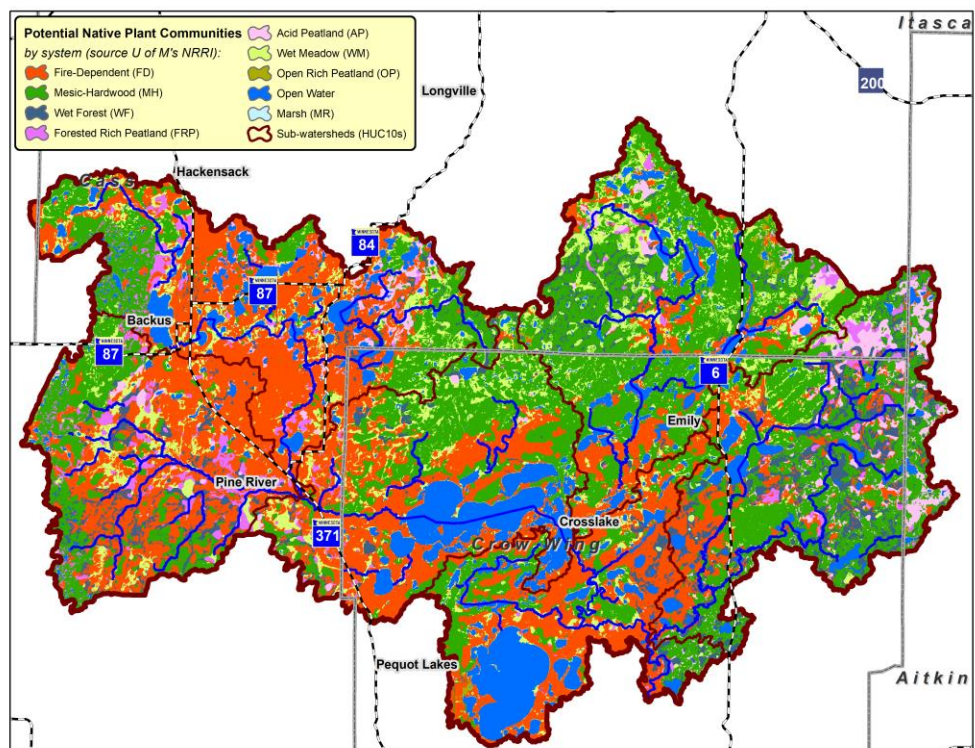


Figure 12. Change in aspen abundance.

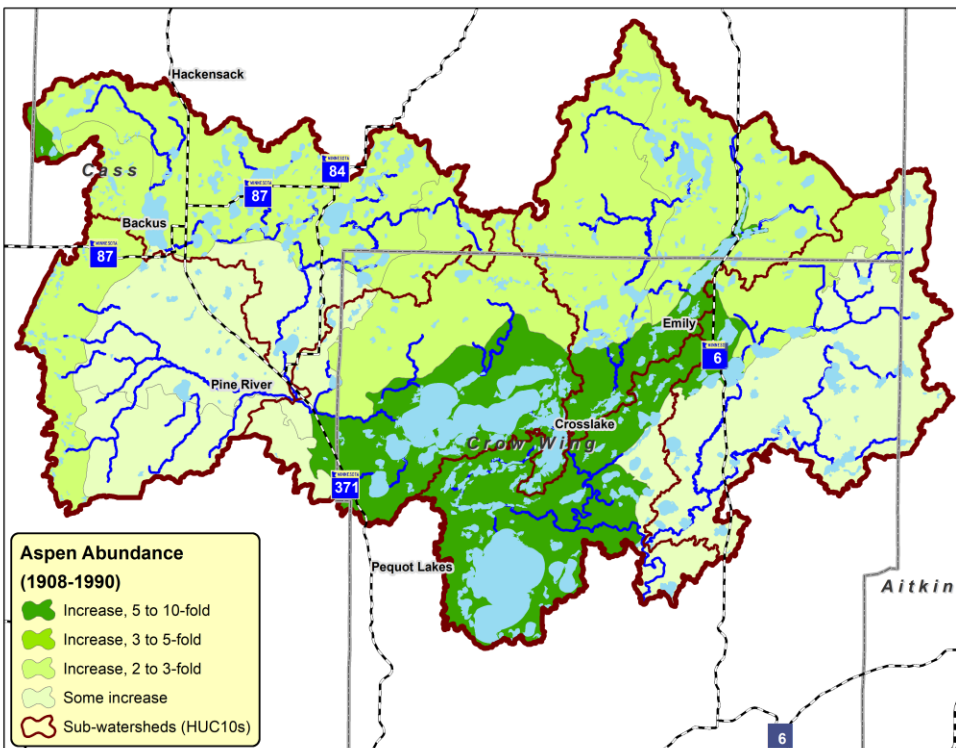


Figure 13. Change in red oak abundance.

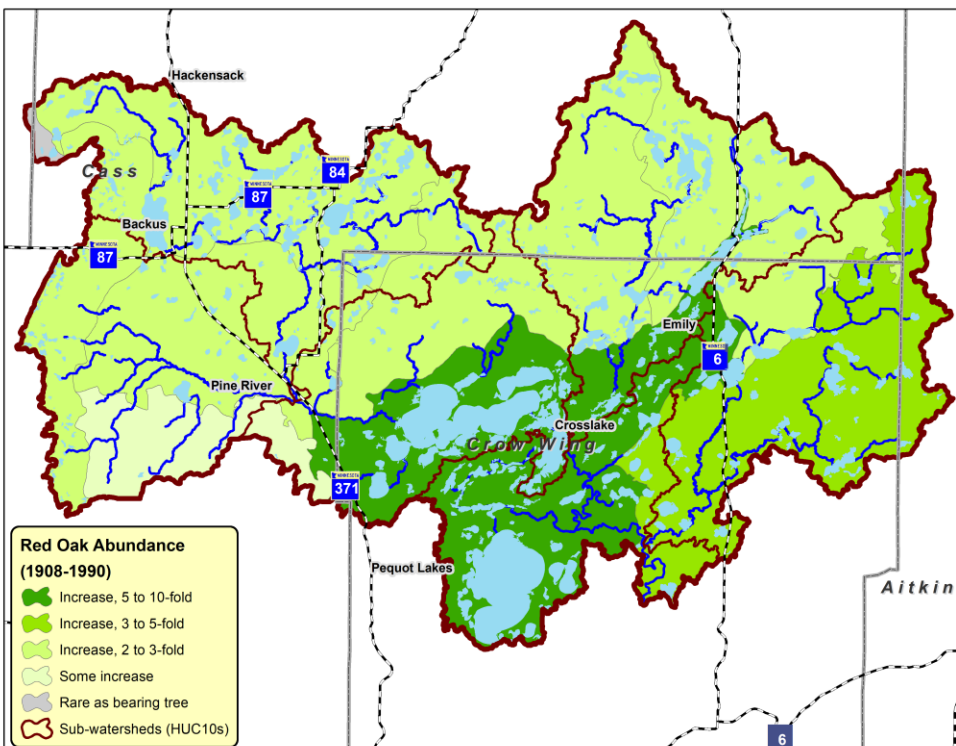




Figure 14. Change in white pine abundance.

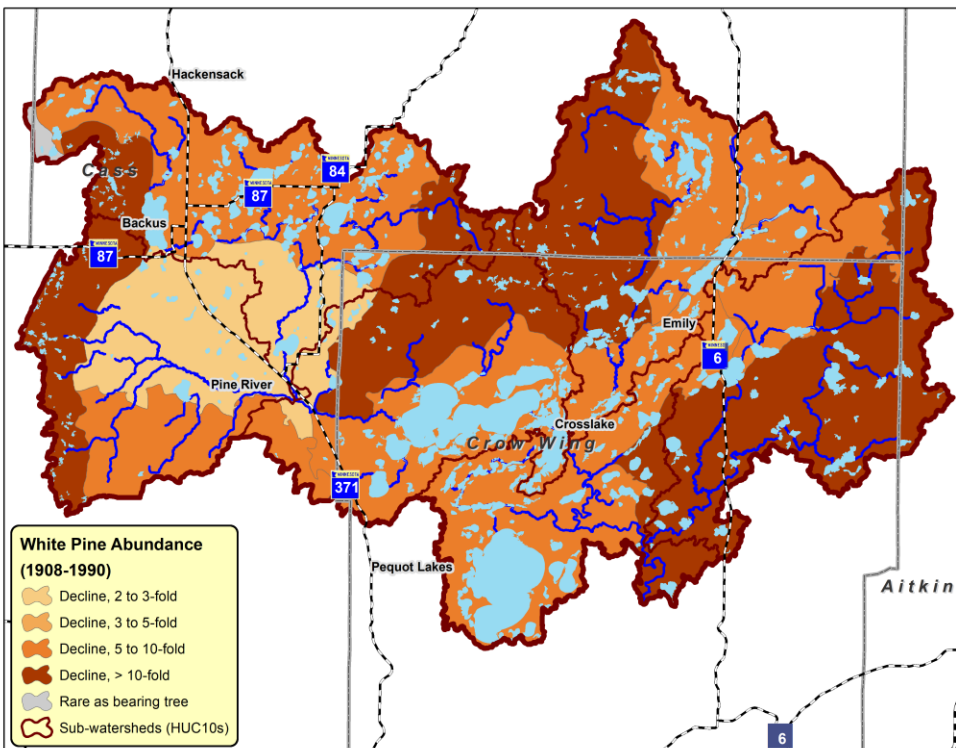
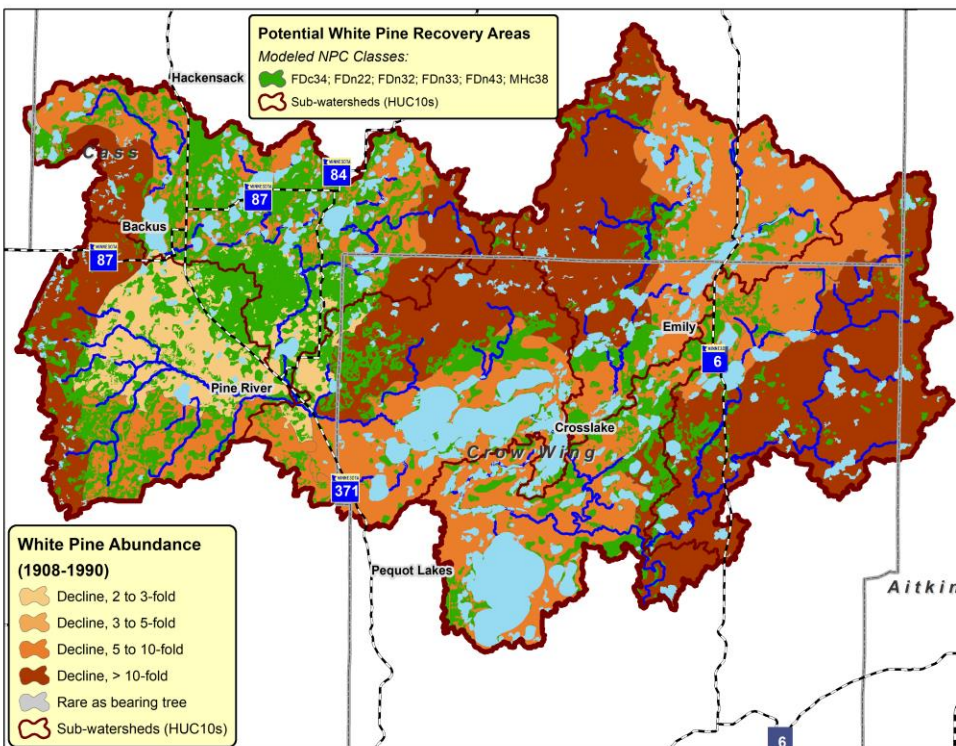


Figure 15. Potential white pine recovery areas.



## Lakes and Streams

Figure 16. Lakes of phosphorus sensitivity significance.

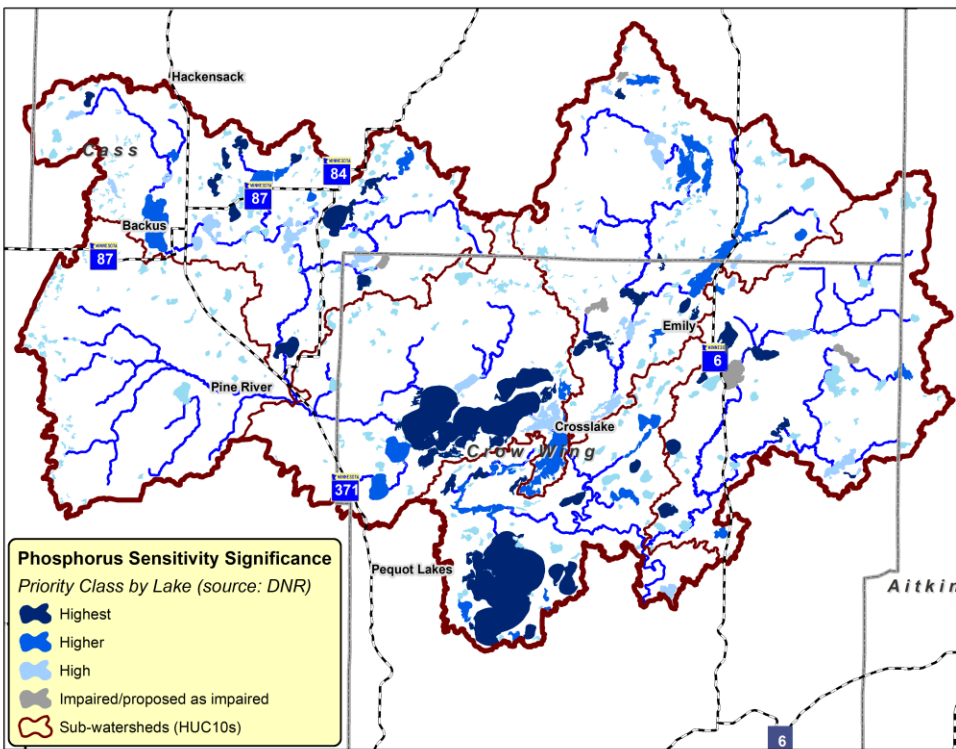


Figure 17. Lakes of biological significance.

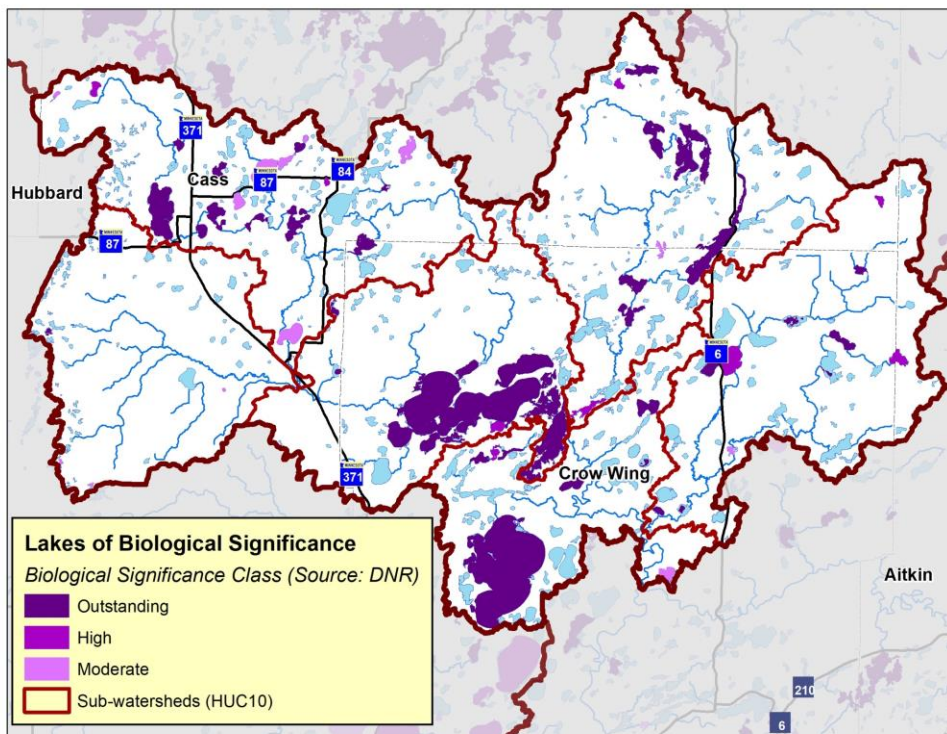


Figure 18. Wild rice, cisco refuge, and trout lakes.

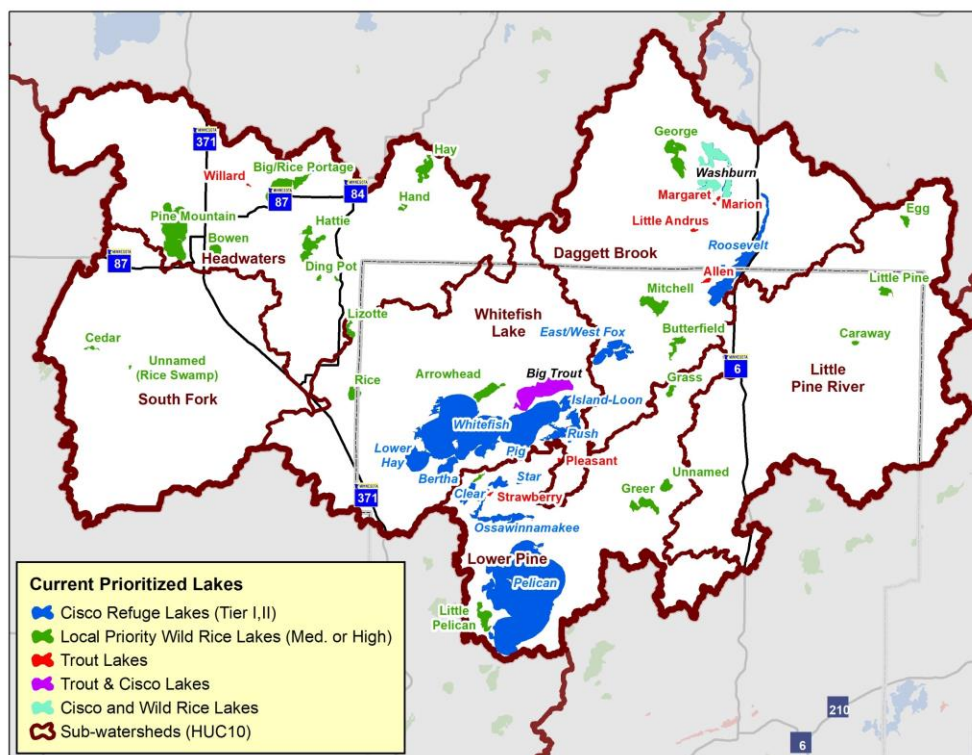


Figure 19. Lake benefit: cost assessment.

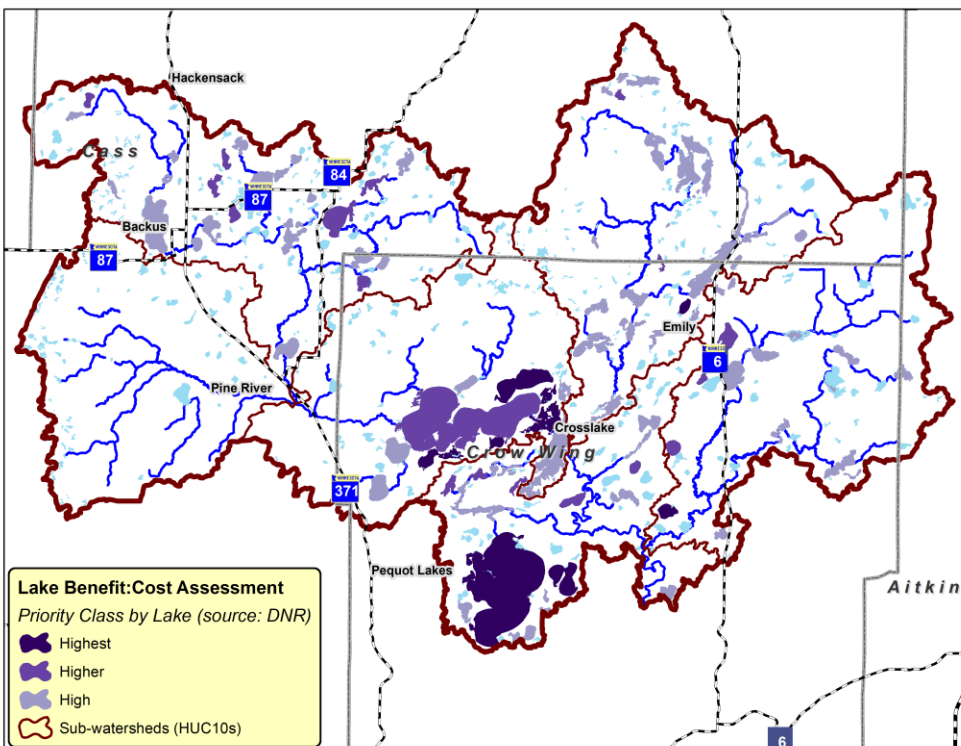




Figure 20. Non-mercury impaired lakes and streams.

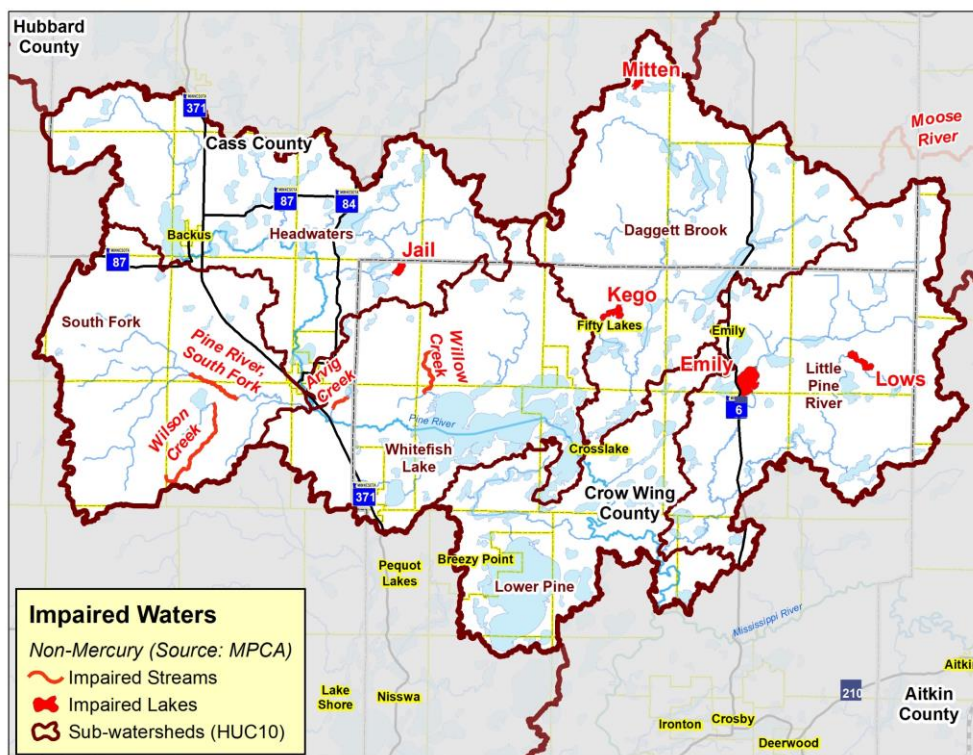


Figure 21. Lakes which are nearly to or barely over their total daily maximum load (TMDL).

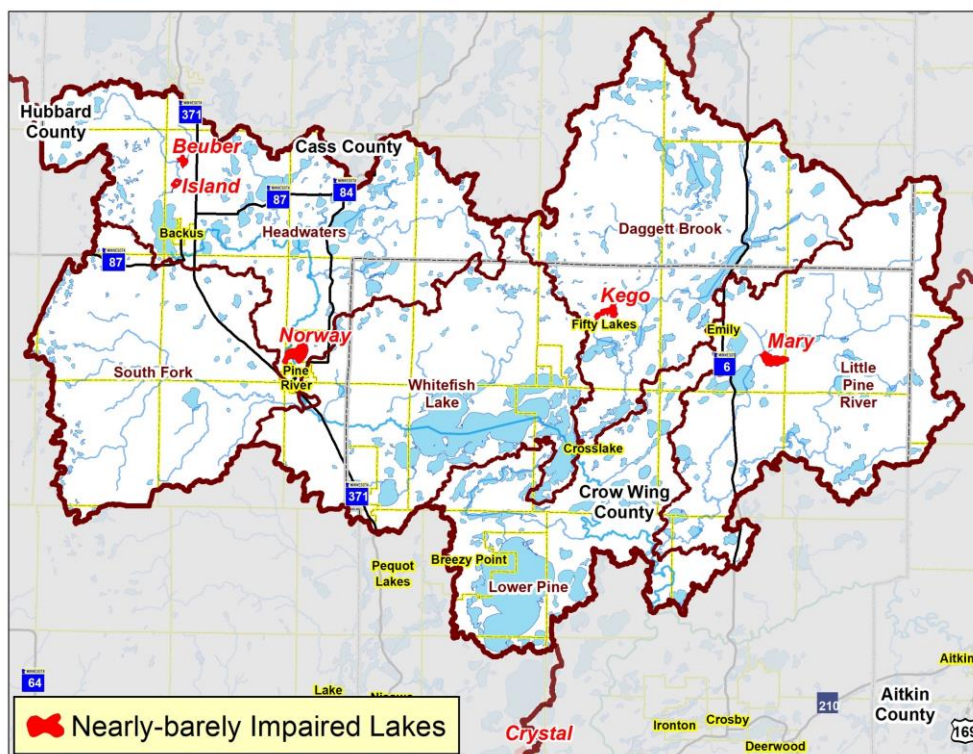


Figure 22. Highly sensitive shorelines.

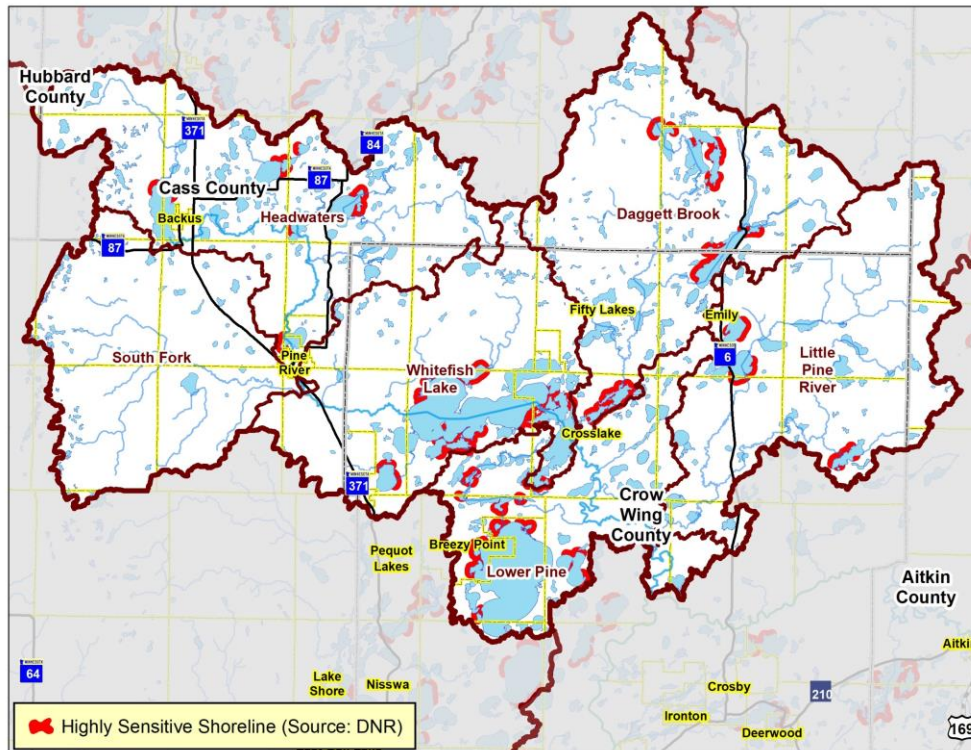
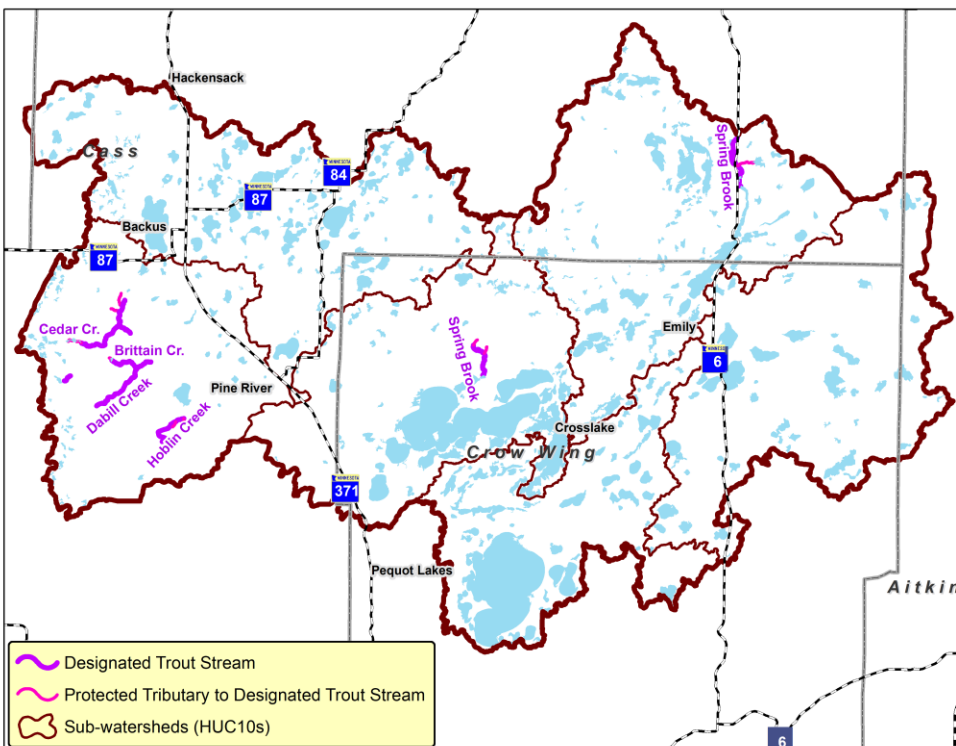


Figure 23. Designated trout streams and tributaries.





## Forest and Watershed Disturbance

Figure 24. Forest disturbance areas by year.

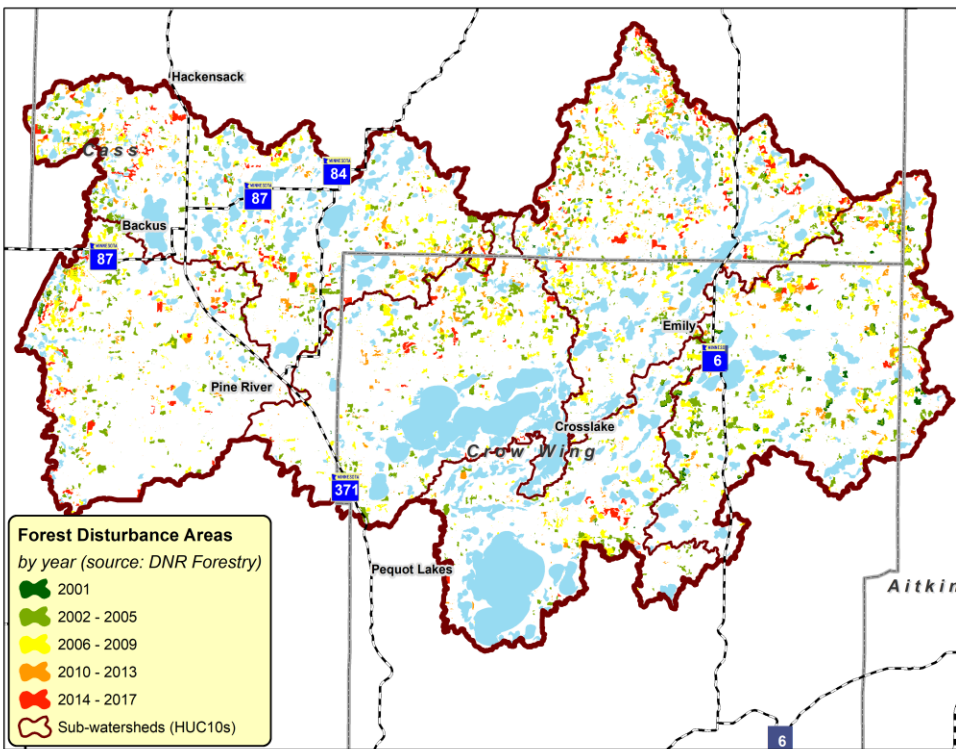


Figure 25. Forest disturbance levels by minor watershed (HUC 14).

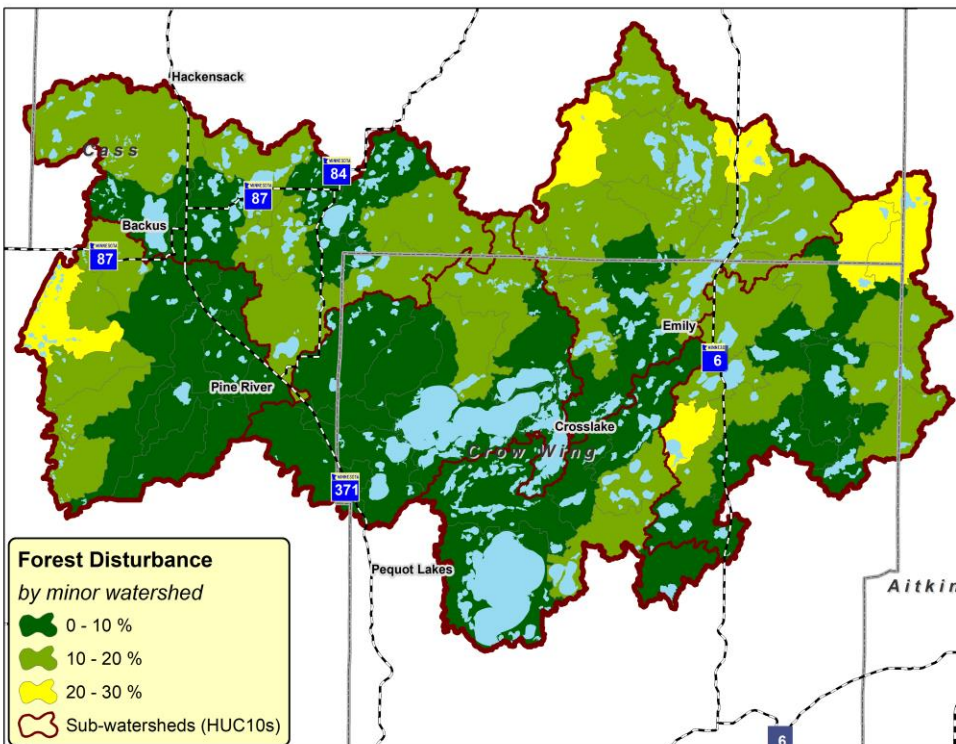


Figure 26. Average annual forest disturbance levels by minor watershed.

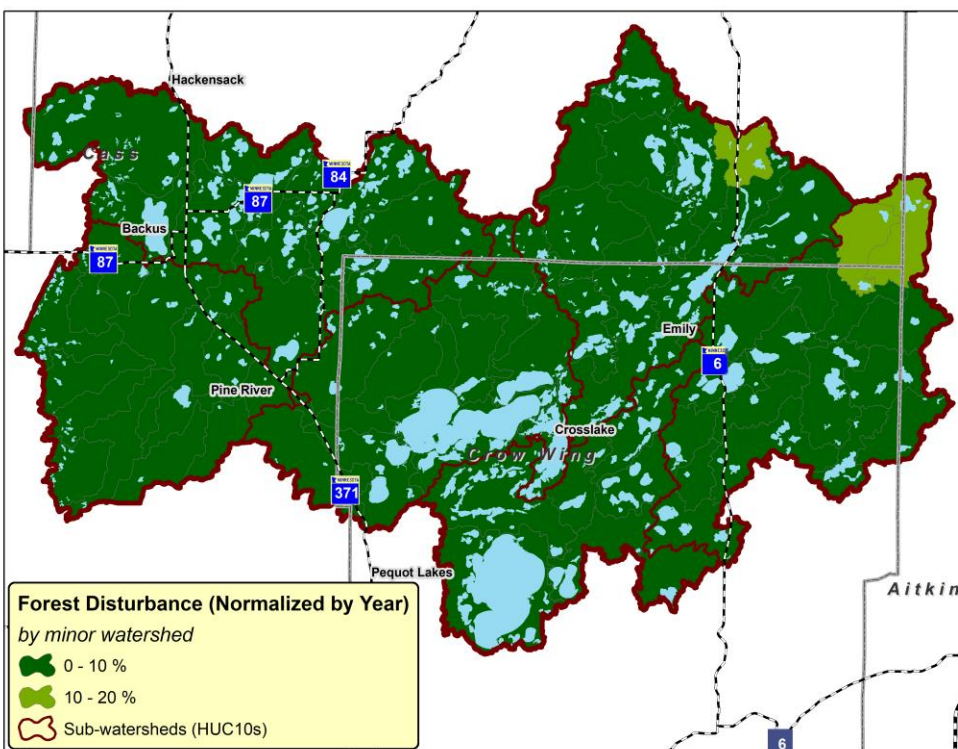
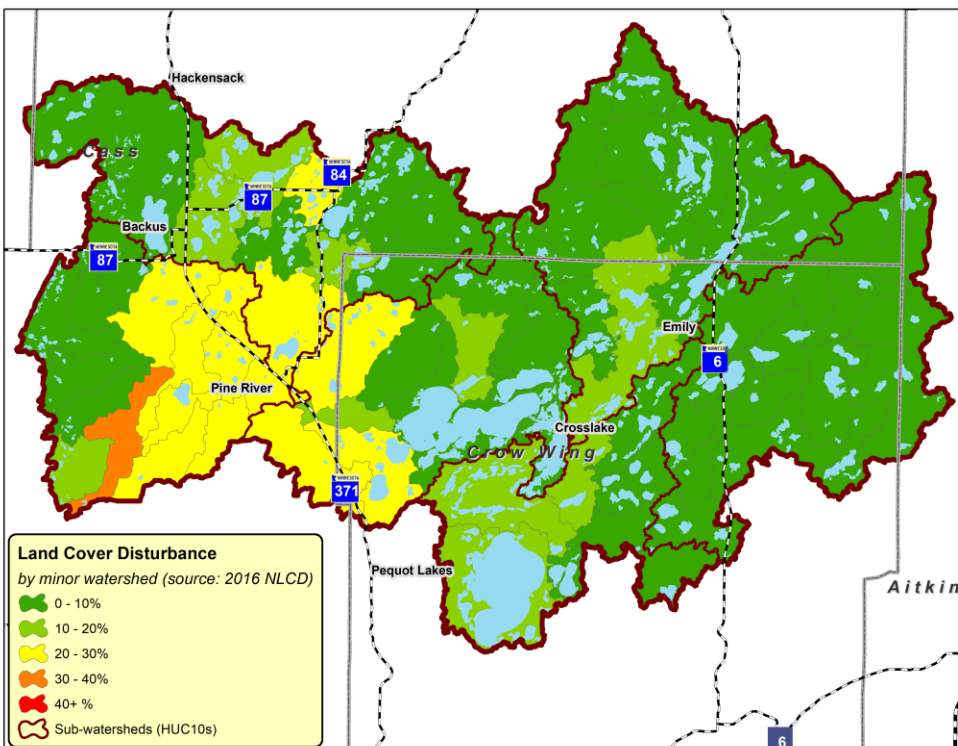


Figure 27. Disturbed land cover by catchment (DNR level 8).



## Protection

Figure 28. Protected lands.

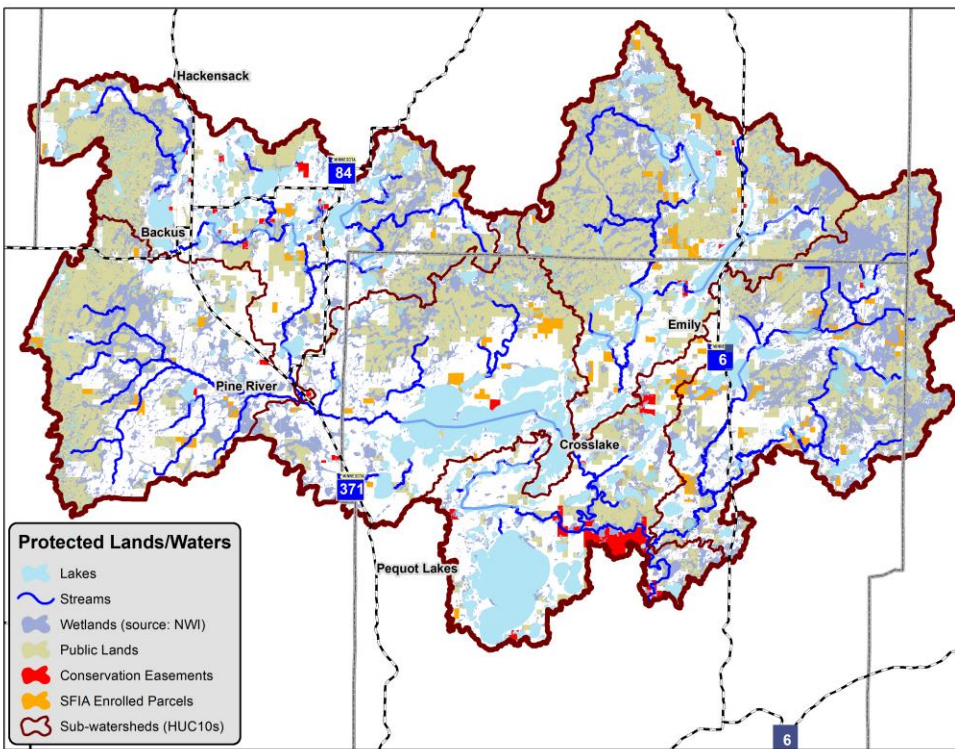


Figure 29. Subwatershed (HUC 10) protection levels.

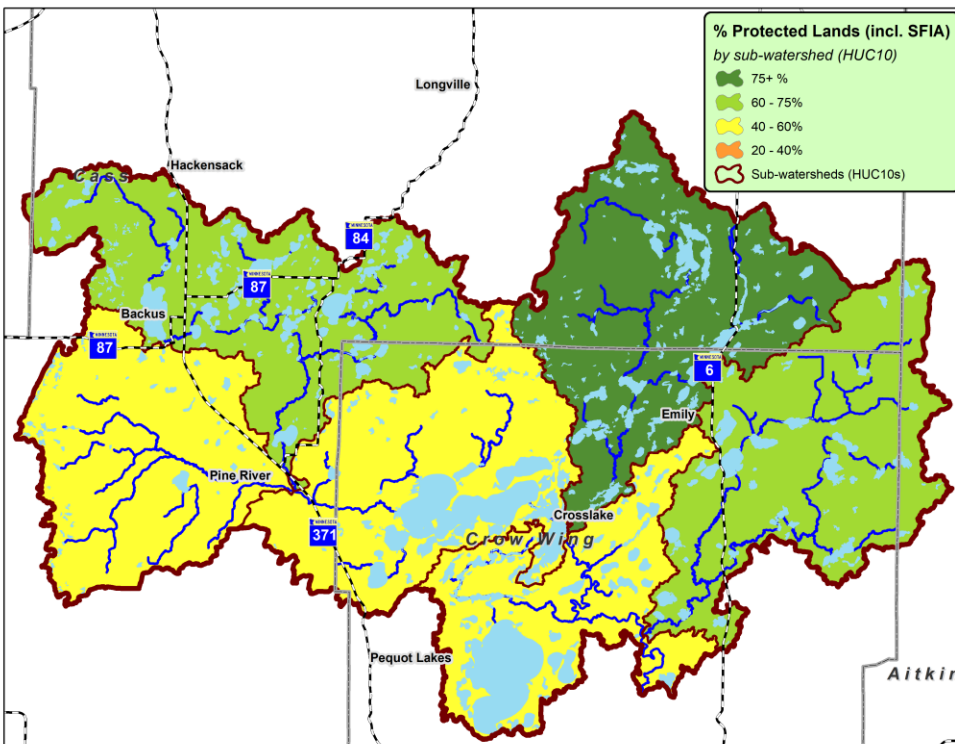




Figure 30. Minor watershed (HUC 14) protection levels.

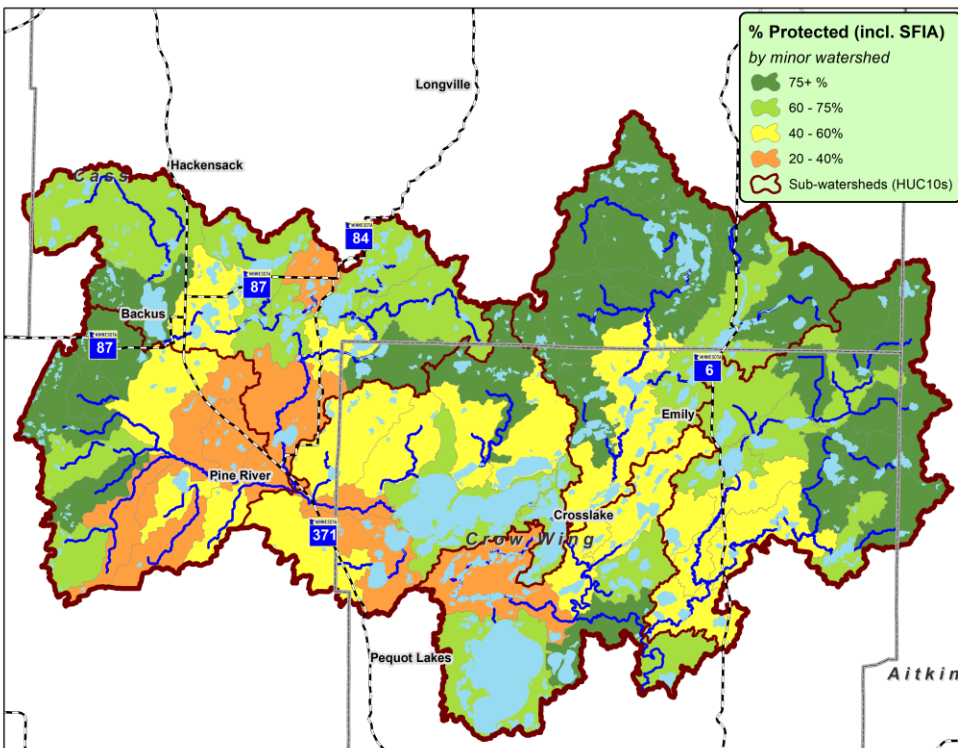


Figure 31. Parcels with the potential to protect.

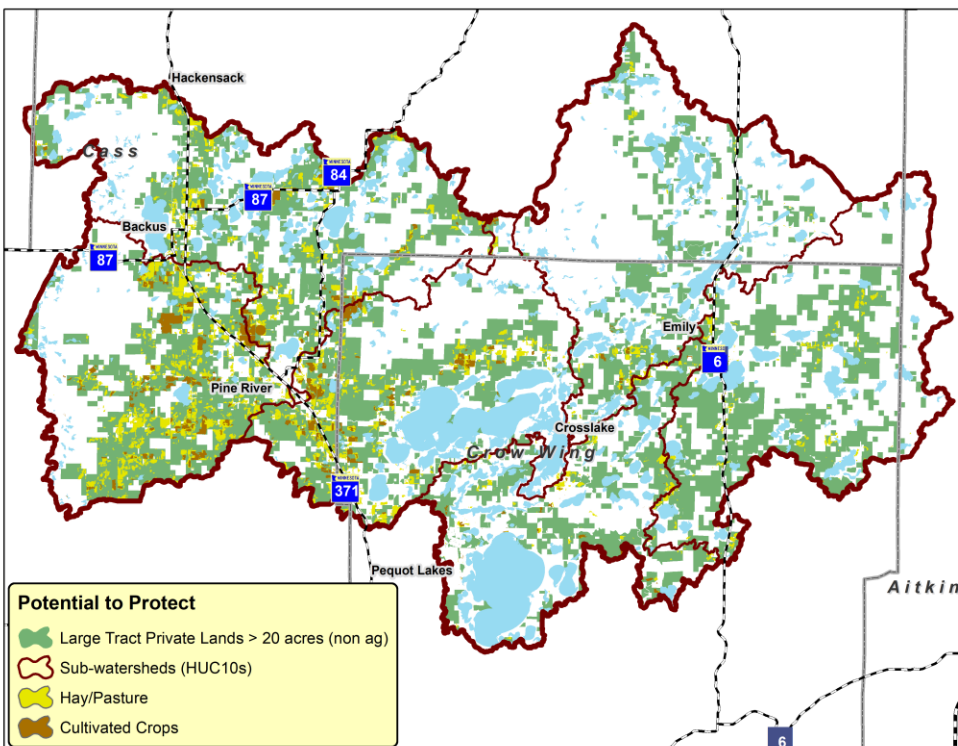
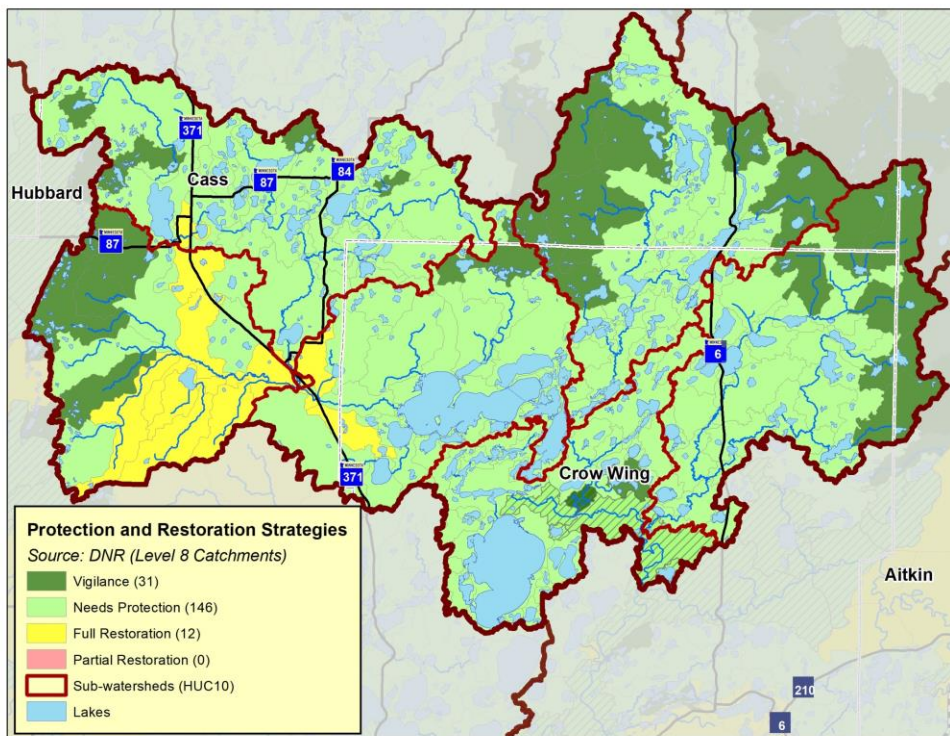


Figure 32. Protection/restoration classifications.



## Conservation Priorities

Figure 33. Lessard-Sams Outdoor Heritage Council priorities.

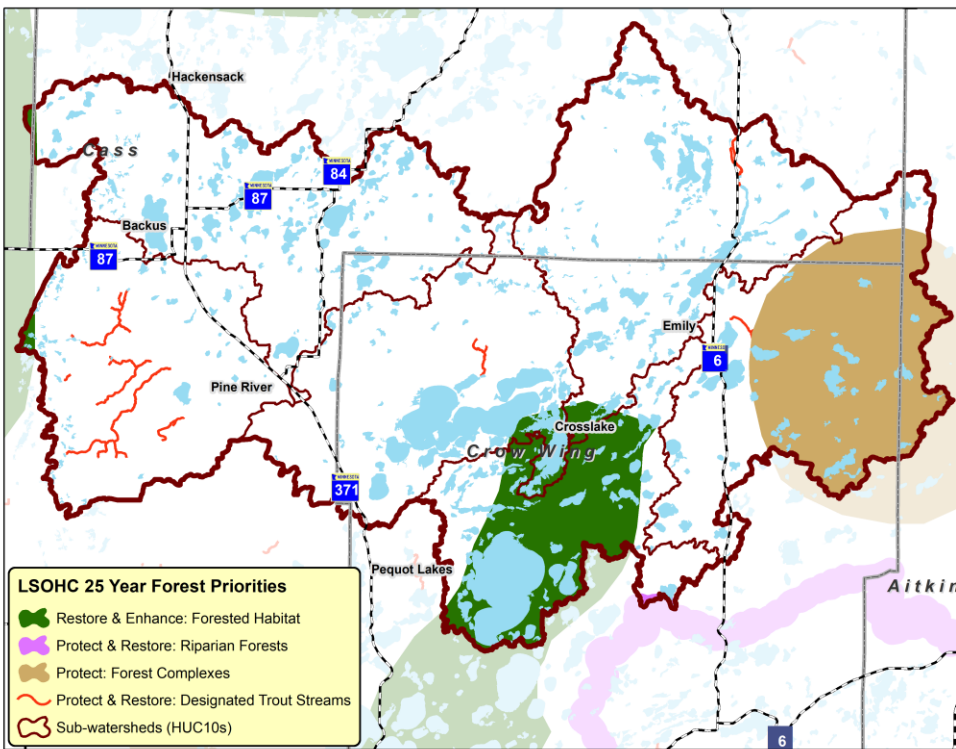


Figure 34. DNR Wildlife Action Network rankings.

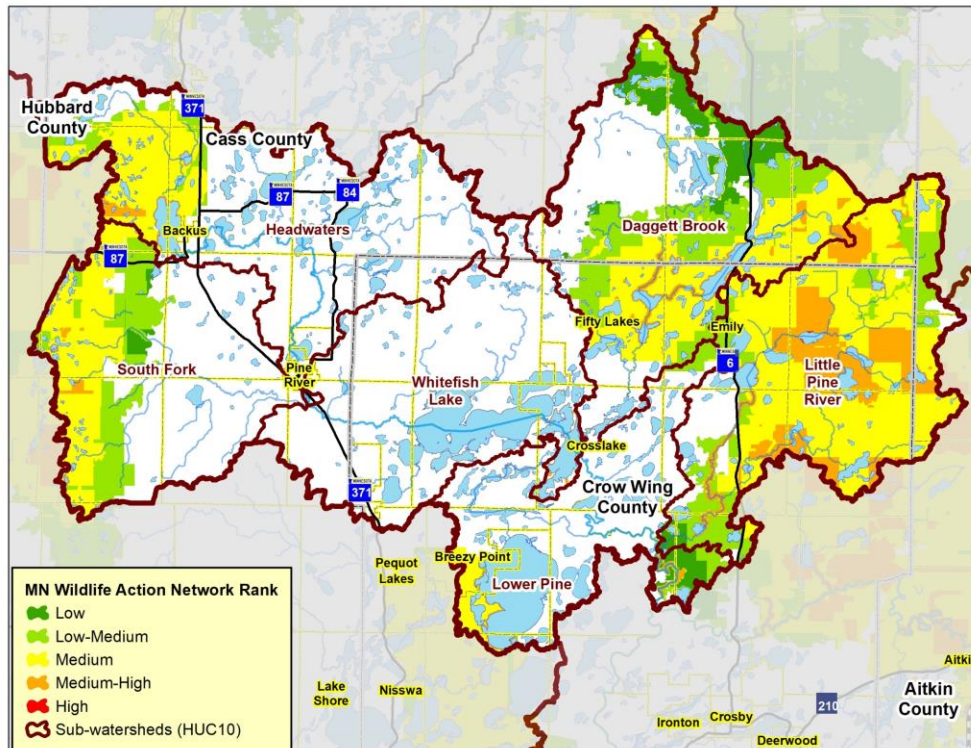




Figure 35. Minnesota Biological Survey (DNR) sites of biological significance.

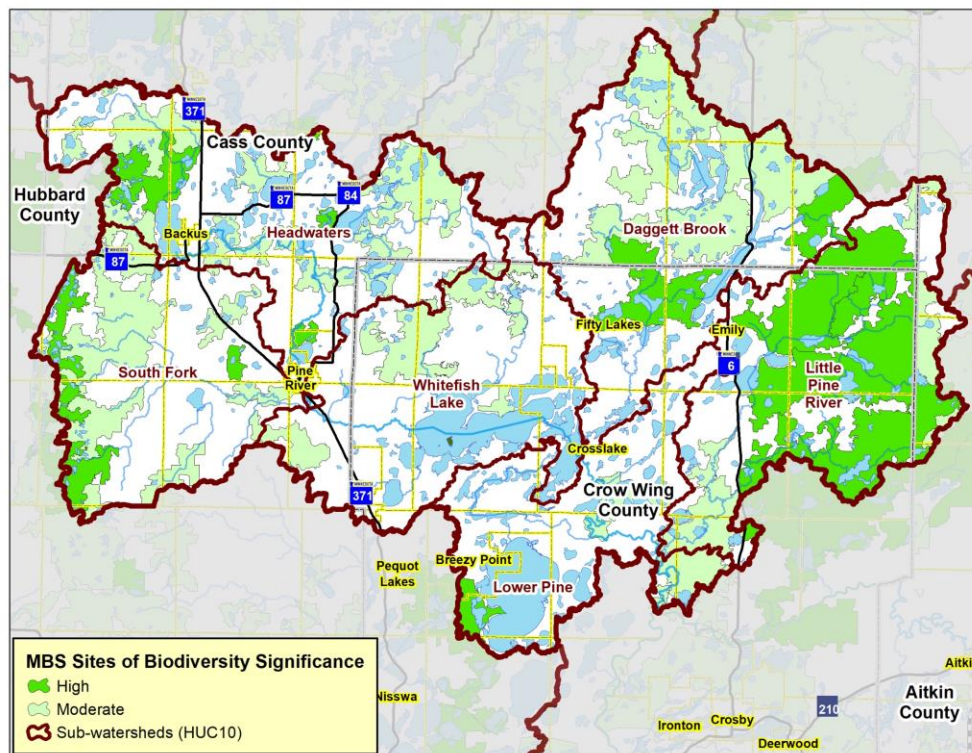


Figure 36. DNR Forests for the Future composite scores.

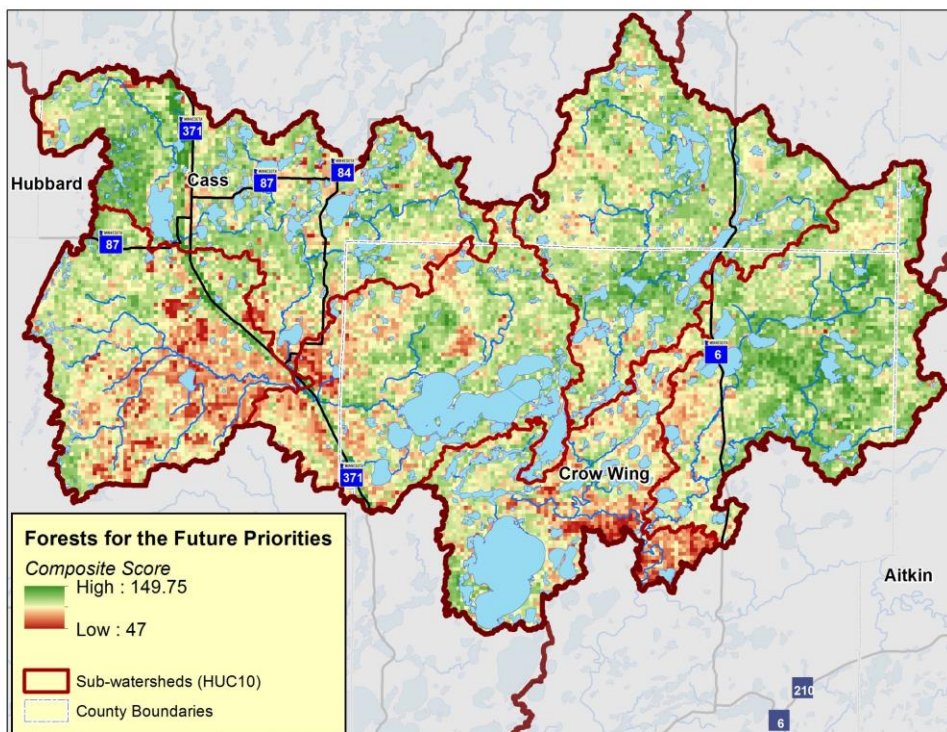
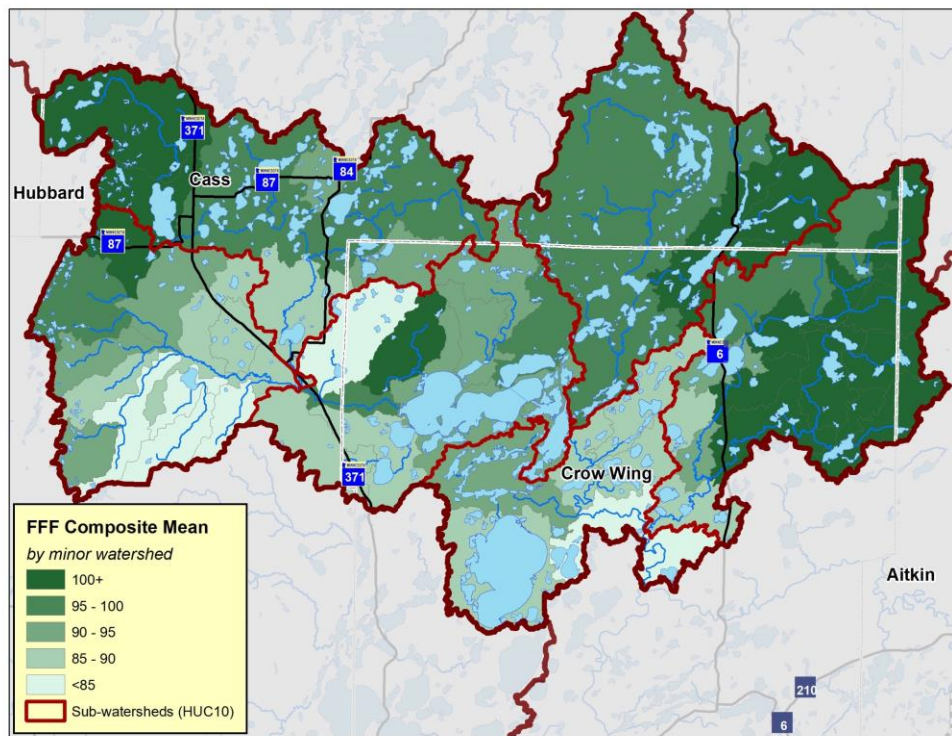


Figure 37. DNR Forests for the Future composite scores by minor watershed (HUC 14).





## Land Value

Figure 38. Total property values by minor watershed (HUC 14).

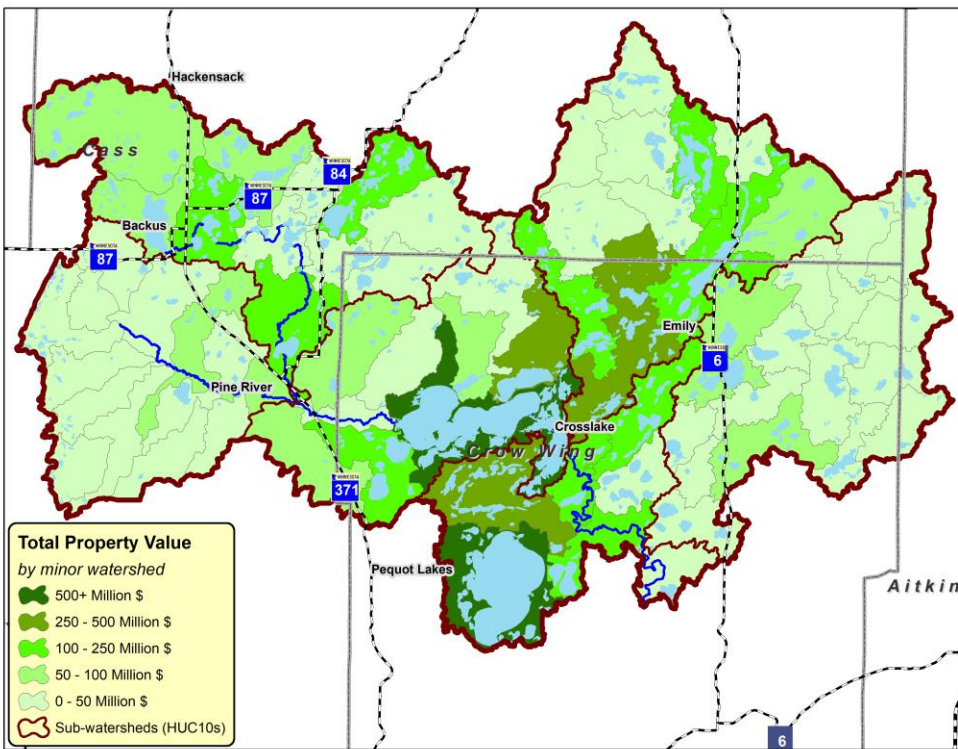


Figure 39. Large tract property values by minor watershed (HUC 14).

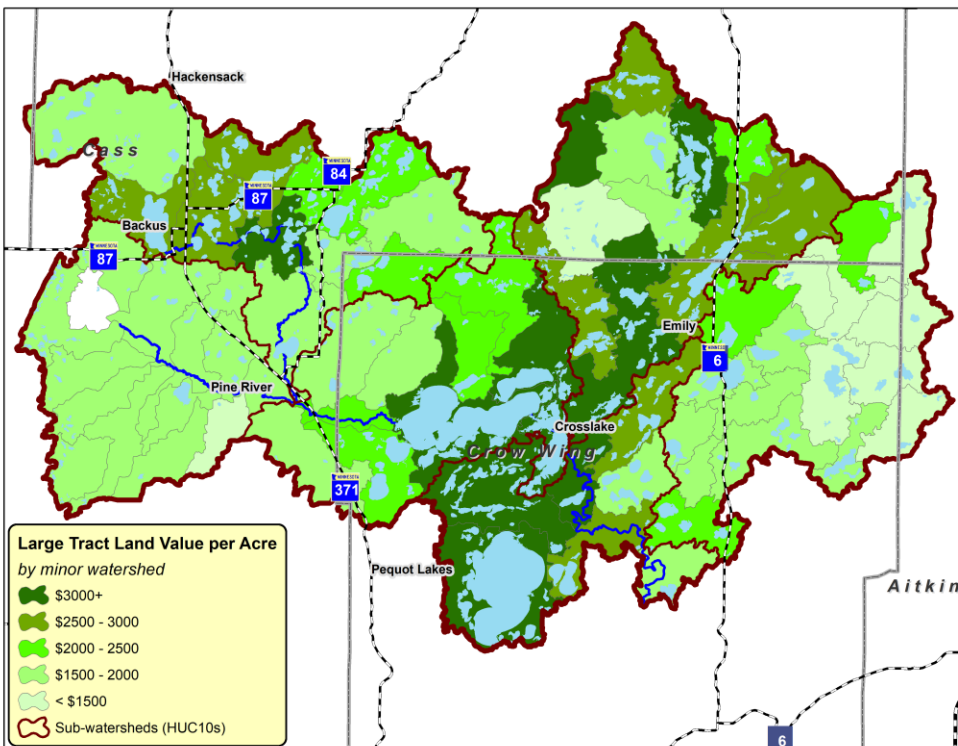
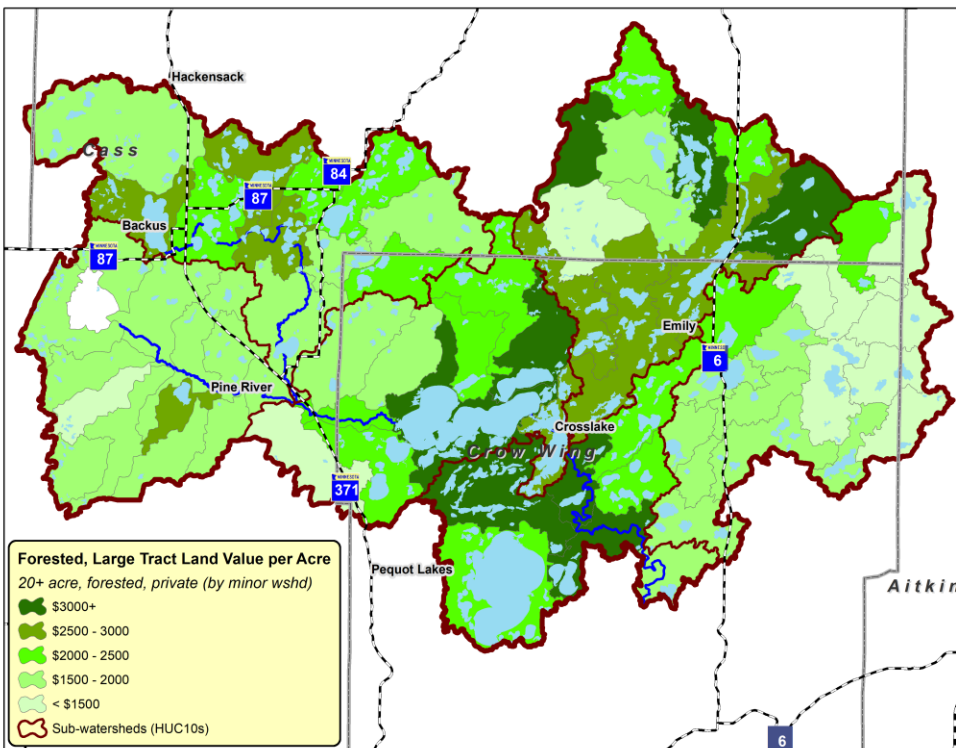


Figure 40. Large forested tract property values by minor watershed (HUC 14).



## Population, Development, Roads, and Zoning

Figure 41. Population change, 2000-2010.

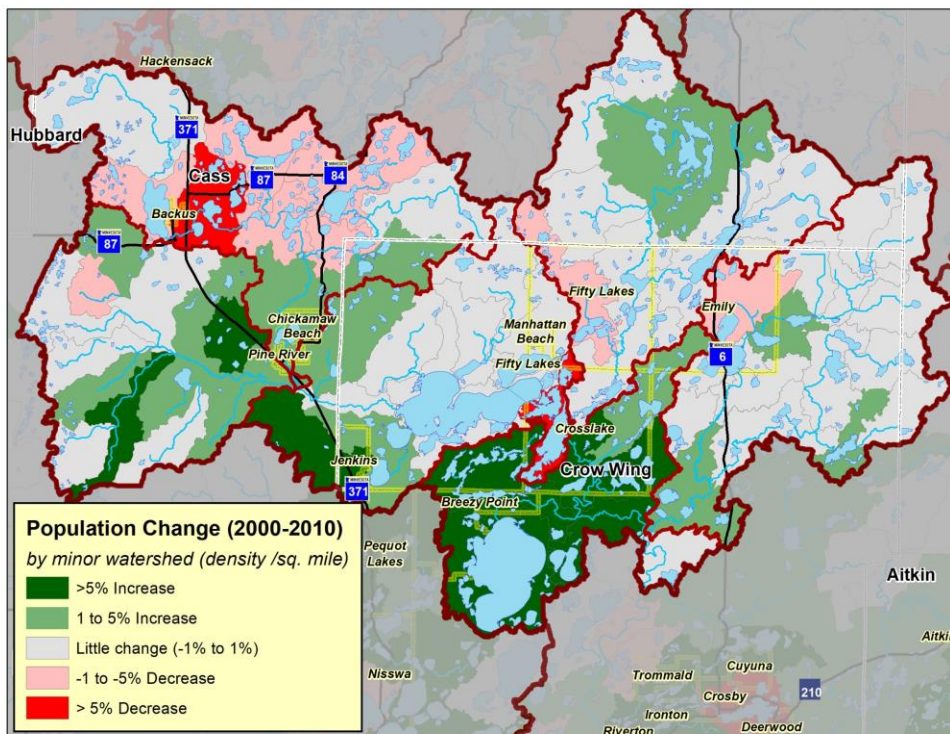


Figure 42. Current development density, 2017.

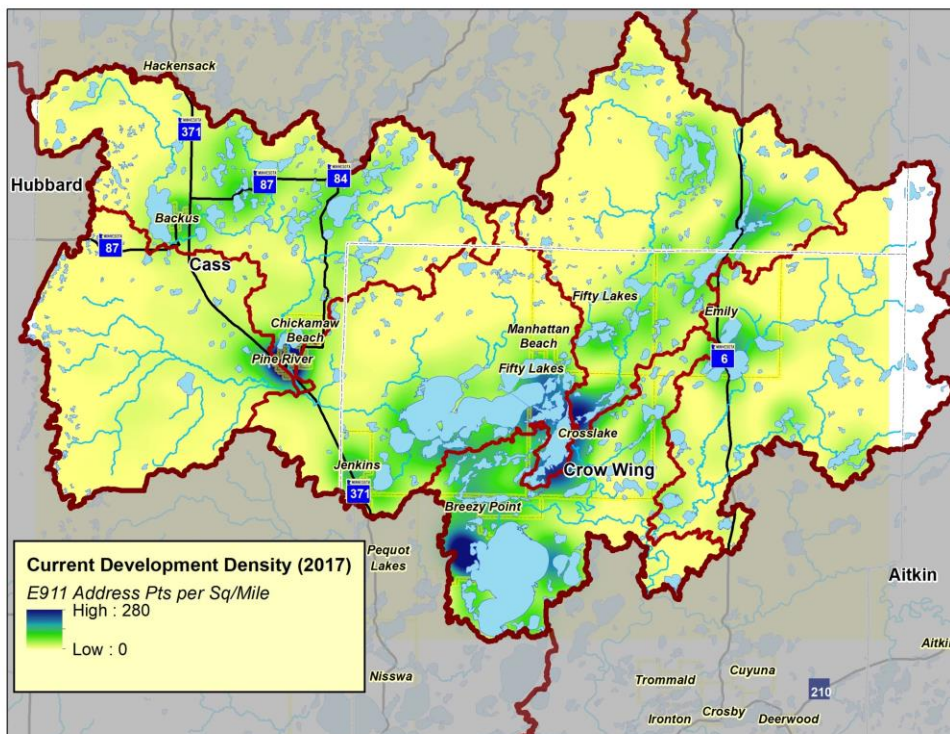




Figure 43. Development increases, 1998-2017

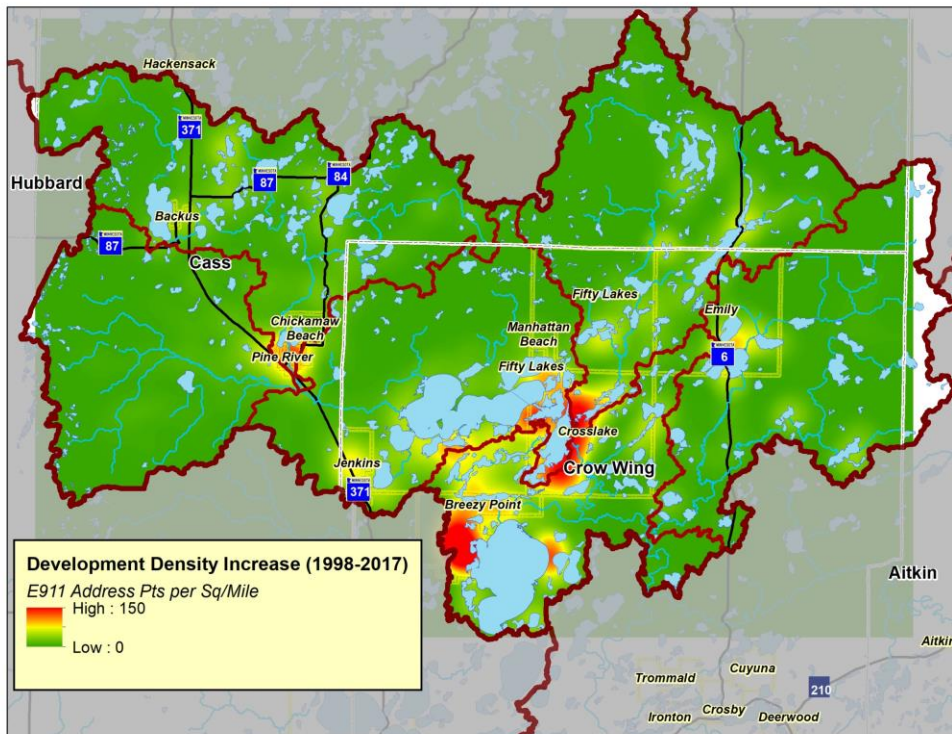


Figure 44. Road miles density by minor watershed (HUC 14).

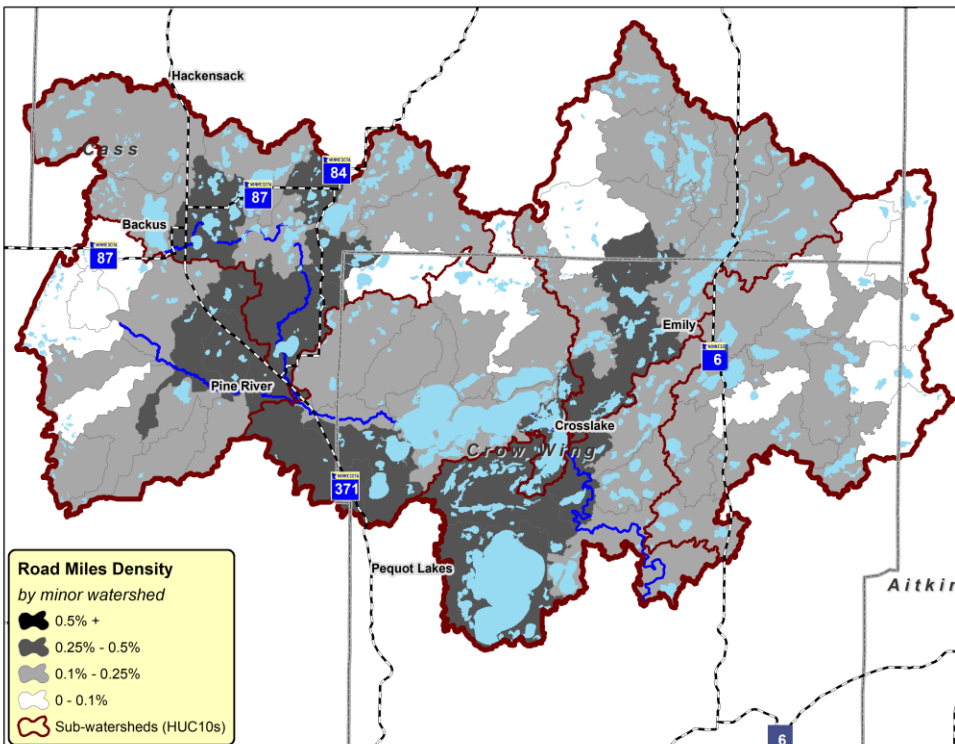
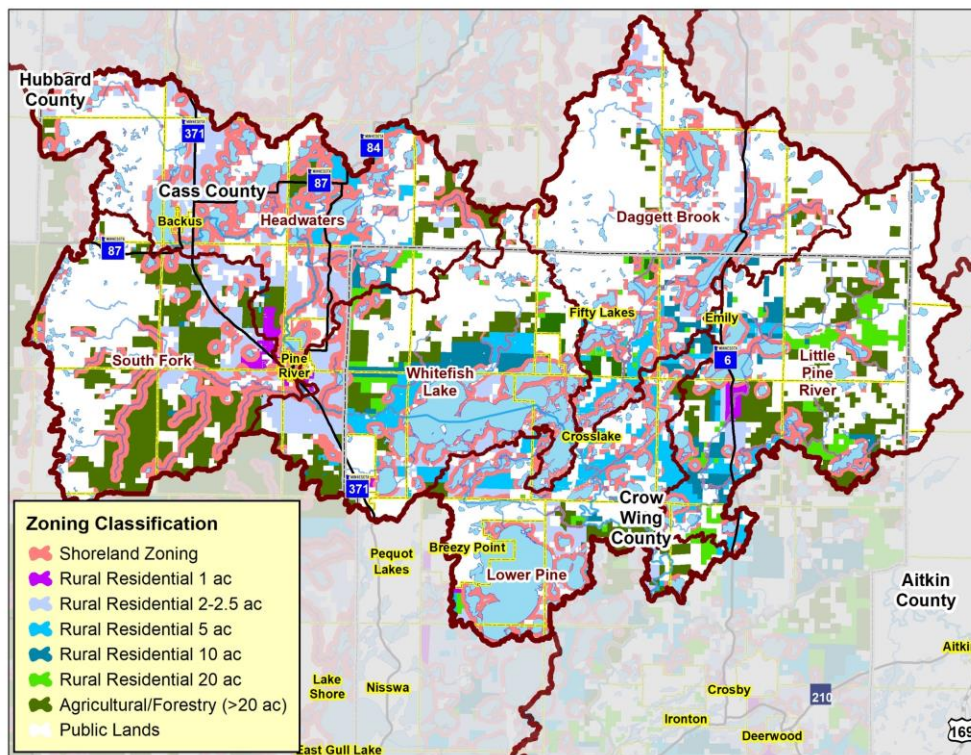


Figure 45. Zoning classification.





## Risk Models

Figure 46. Agricultural conversion risk areas.

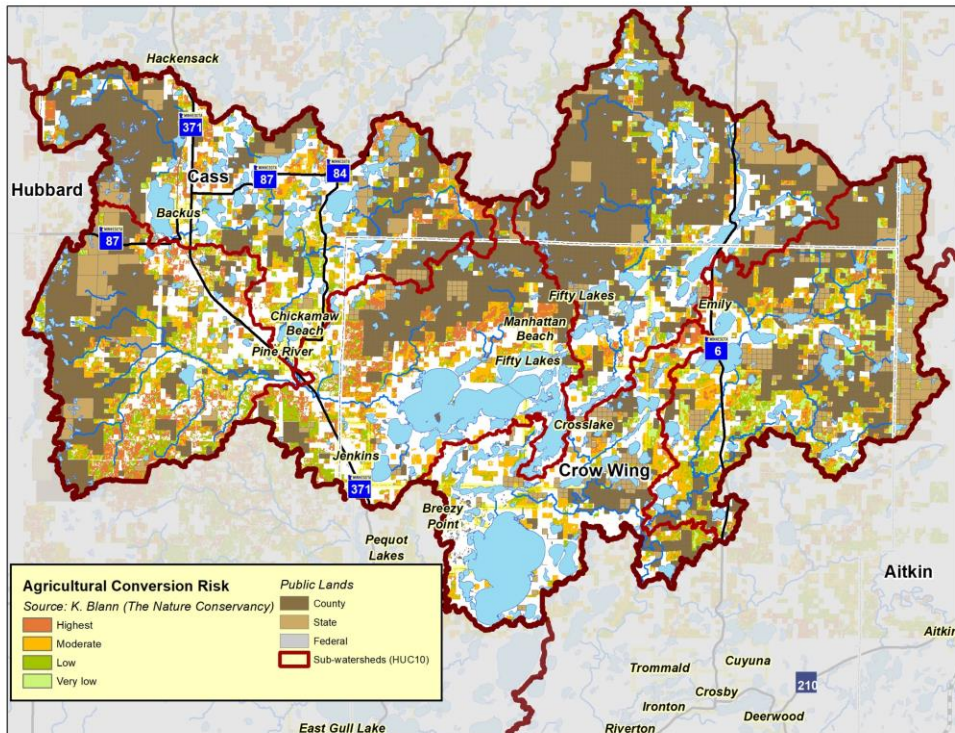
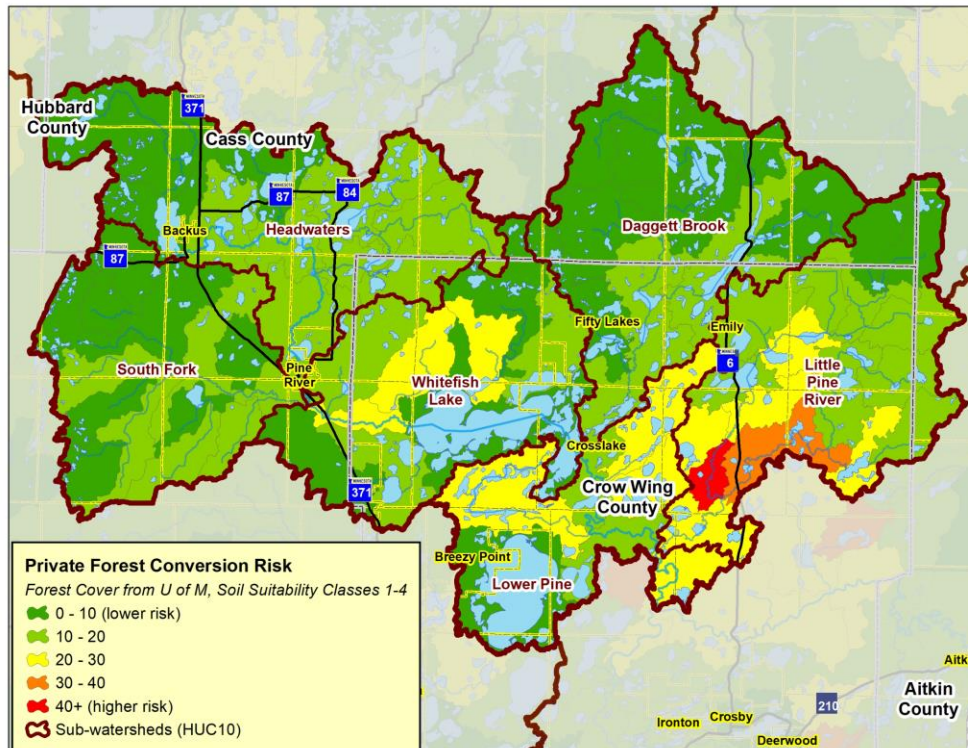


Figure 47. Private forest land conversion risk areas.



## Other

Figure 48. Land ownership.

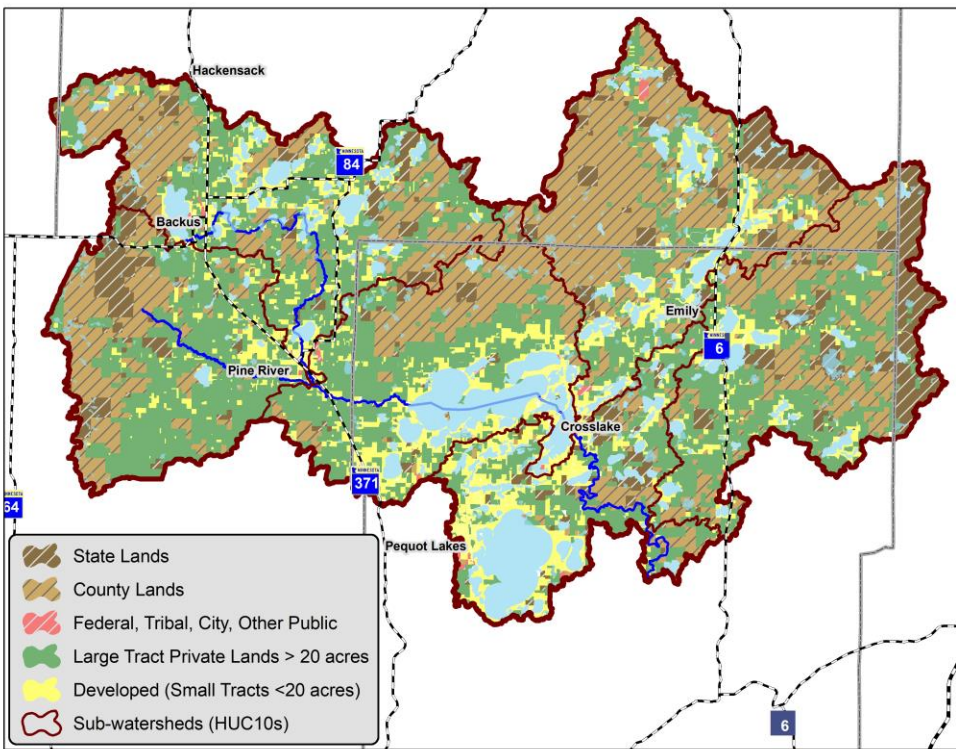
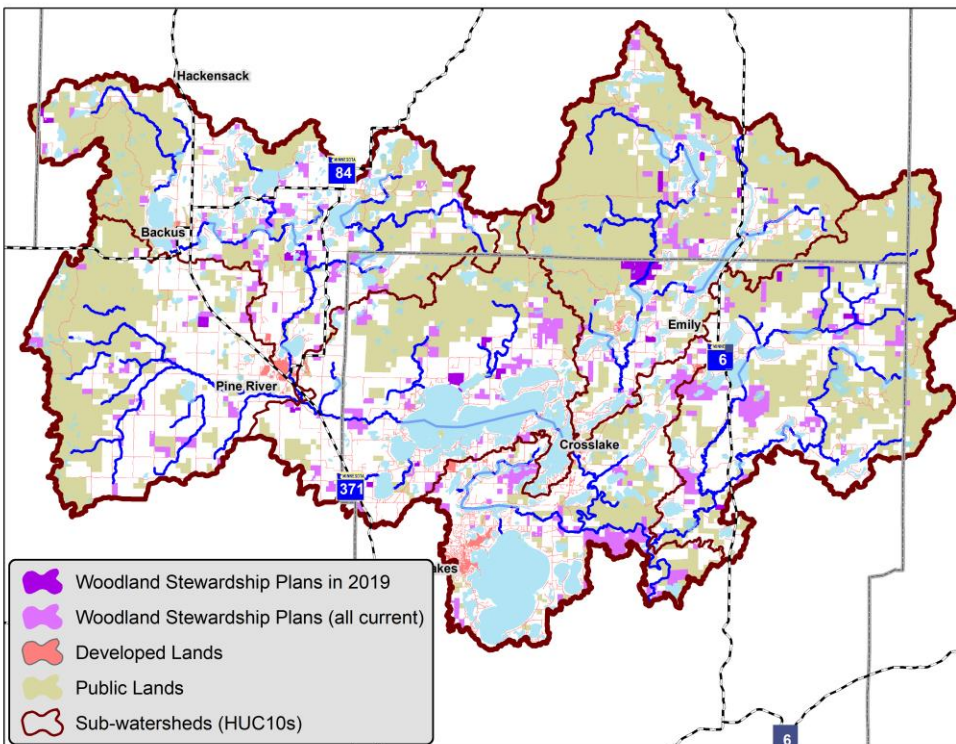


Figure 49. Current forest stewardship plan areas.

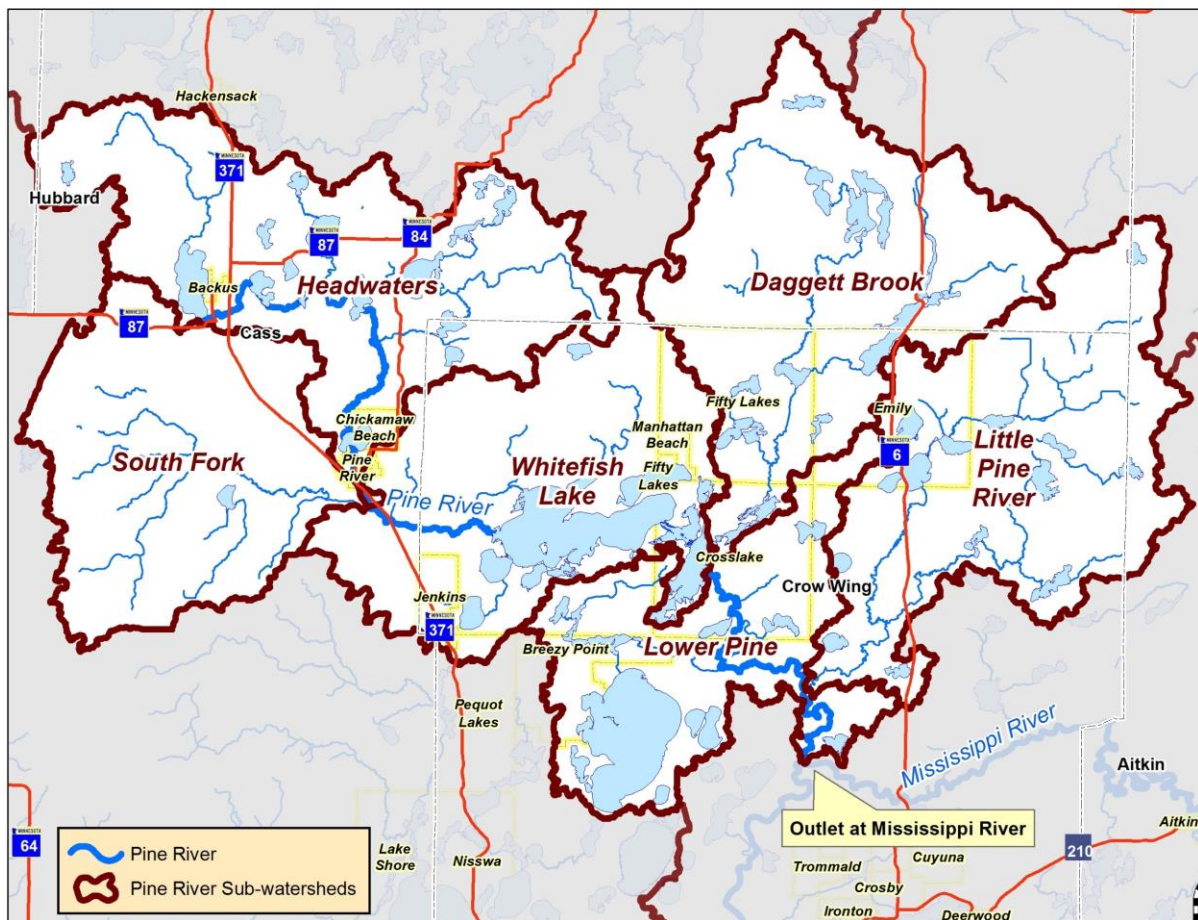


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## Subwatershed Analyses (HUC 10)

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 subwatersheds, including minor watersheds and catchments. The Pine 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 subwatersheds, are 7 to 17 minor watersheds, which are on average are 7,259 acres (11.3 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 subwatershed unit of the HUC12 unit, which is a subwatershed 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 69 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 Pine River Major Watershed by subwatershed (HUC10):

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

	Headwaters Pine River	South Fork Pine River	Daggett Brook	Whitefish Lake	Little Pine River	Lower Pine River
# of minor wshds	11	13	11	10	17	7
% upland forest & woody wetland cover	69%	65%	79%	58%	74%	60%
% protected	62%	57%	79%	56%	71%	58%
Land use disturbance	13%	19%	5%	14%	4%	10%
# of lakes	143	70	125	60	48	68
Geomorphology	St. Croix Moraine / Outwash	Till Plain (South), Outwash (North), Moraine (West)	Till Plain (+ some moraine-based till)	Till Plain, Outwash, Lacustrine (Lake-bed)	Till (largely moraine-based)	Outwash + some moraine till
Primary land cover	Mixed Conifer-Hardwood Forest with Abundant Lakes	Mixed Conifer-Hardwood Forest, Hay / Pasture	Mesic-Hardwood Forest / Wetlands	Mixed Conifer-Hardwood Forest / Hay Pasture / Row Crops	Mesic-Hardwood Forest / Wetlands	Mixed Conifer and Mesic-Hardwood Forest
Lake or stream based	Lake & Stream	Stream	Lake	Lake	Lake & Stream	Lake
Quality	Numerous small-medium sizes lakes with abundant fish and wildlife (+ wild rice)	High Quality Hardwood Forests on Moraine	High Quality Lakes (all sizes) & Forests	Very High Quality Lakes	High Terrestrial Biodiversity & Forests for the Future Scores	Numerous small to mid-size high quality lakes
Risks	Development of remaining large tracts or conversion to open lands	Grazing	Development	Residential Development, Grazing	Development	Residential Development
Avg. land value (20+ acre, private lands)	\$806	\$736	\$513	\$947	\$528	\$953
Acres needed for protection goal	12,478	5,560	0	7,846	3,509	10,658
Cost to achieve protection goal	\$10,902,928	\$4,741,584	\$0	\$7,187,603	\$2,773,642	\$9,782,726
Avg. RAQ score	3.6	3.4	4.6	2.5	4.4	3.4

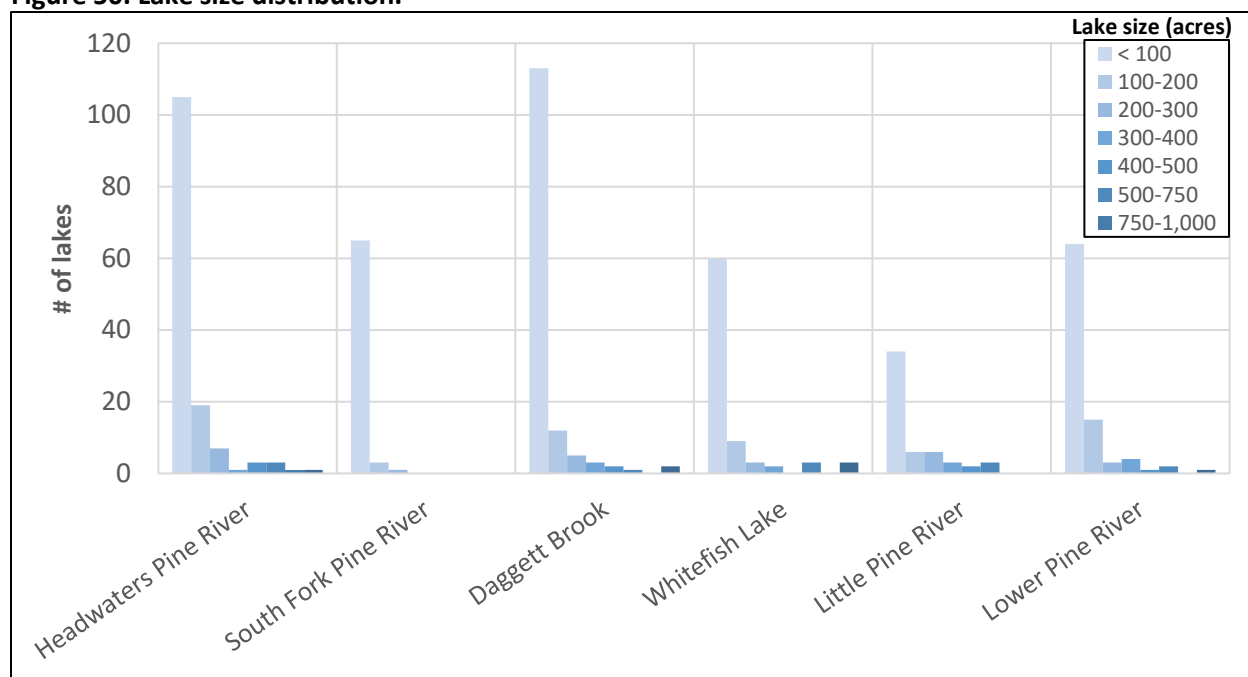
**Table 2. Composite Forests for the Future (FFF) scores and potential native plant communities.**

Name	FFF score (composite mean)	Fire-Dependent		Mesic Hardwood		Acid & Forested Rich Peatland		Floodplain & Wet Forest		Open wetlands (Marsh, Open Peatland, Wet Meadow)	
Headwaters Pine River	97.73	40,504	42%	23,229	24%	6,701	7%	2,346	2%	11,504	12%
South Fork Pine River	90.08	32,993	45%	18,402	25%	7,132	10%	6,879	9%	7,288	10%
Daggett Brook	98.65	12,368	13%	50,851	53%	3,669	4%	3,657	4%	15,717	16%
Whitefish Lake	91.74	30,400	36%	24,601	29%	1,446	2%	2,344	3%	9,873	12%
Little Pine River	100.78	13,795	15%	39,652	44%	11,891	13%	16,820	19%	2,856	3%
Lower Pine River	86.09	25,672	42%	13,171	22%	532	1%	2,327	4%	4,817	8%
<b>Total (or avg for FFF)</b>	<b>94.2</b>	<b>155,732</b>	<b>31%</b>	<b>169,905</b>	<b>34%</b>	<b>31,369</b>	<b>6%</b>	<b>34,372</b>	<b>7%</b>	<b>52,055</b>	<b>10%</b>

### Lake Characteristics

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

**Figure 50. Lake size distribution.**



**Table 3. Priority and at-risk lake estimates.**

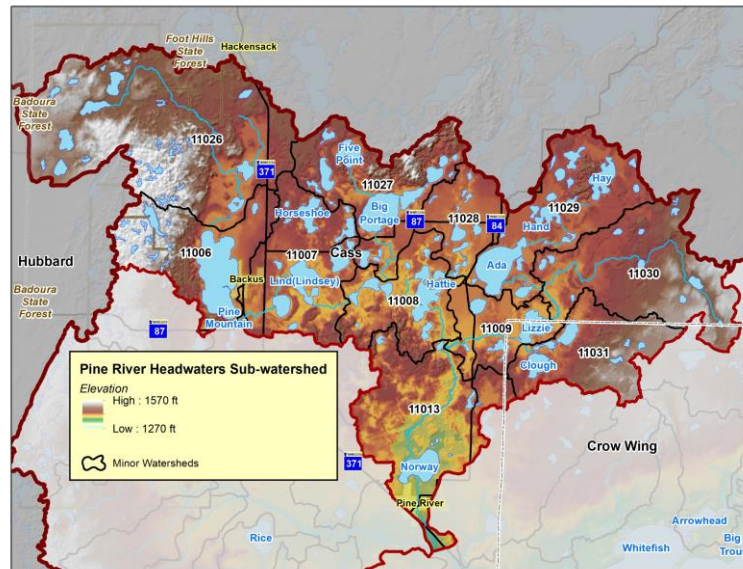
Name	Lakes of phosphorous sensitivity significance			Lake of biodiversity significance			Lake water quality trends			Outstanding water resources		
	High	Higher	Highest	Moderate	High	Outstanding	Improving	Declining	Stable	Cisco/ tullibee	Local priority wild rice	State priority wild rice
Headwaters Pine River	8	10	4	6	2	10	6	3	7	1	8	7
South Fork Pine River	0	1	0	3	0	1	0	0	1	0	2	0
Daggett Brook	14	7	3	3	2	6	5	8	8	4	4	3
Whitefish Lake	3	3	8	0	1	12	2	7	3	7	3	2
Little Pine River	4	5	5	1	3	7	1	4	2	0	3	3
Lower Pine River	2	13	7	1	1	6	12	0	5	5	5	0
<b>Totals</b>	<b>31</b>	<b>39</b>	<b>27</b>	<b>14</b>	<b>9</b>	<b>42</b>	<b>26</b>	<b>22</b>	<b>26</b>	<b>17</b>	<b>25</b>	<b>15</b>

## Subwatershed No. 1 Headwaters Pine River (HUC 701010501)

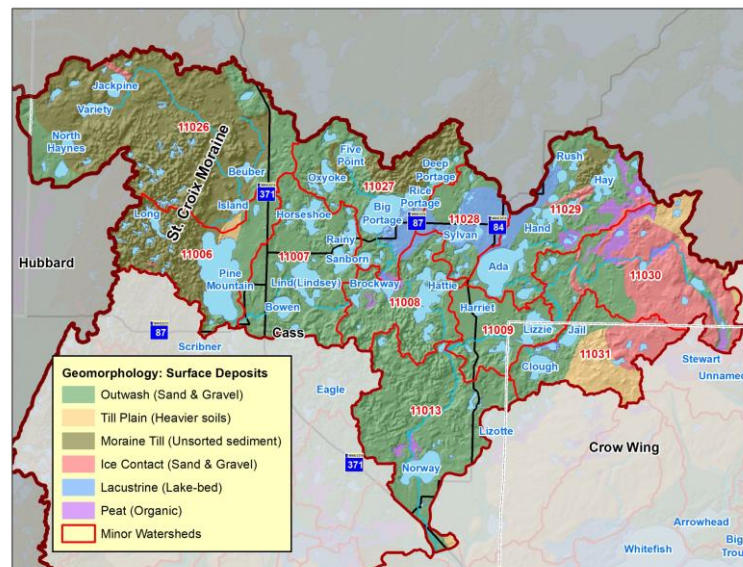
### Description

The Headwaters Subwatershed of the Pine River Major Watershed includes the drainage area above the confluence of the Pine River with the South Fork of the Pine River (which is a separate subwatershed that enters from the west). There are numerous lakes in this subwatershed, many of which the Pine River flows through as it makes its way out of Pine Mountain Lake and meanders toward the City of Pine River. In fact, it has the highest number of lakes compared to the other 5 subwatersheds, many of which are outstanding resources. It has over 40% forest cover and is 60% protected. The following maps highlight the key forest and water resources of this subwatershed.

**Figure 51. Elevation.**



**Figure 52. Geomorphological landforms.**





## Past, Current, and Potential Future Forest Conditions

The historic and current forest maps show the changes in forest composition over the past several hundred years in this subwatershed. Of particular note is the decline in the amount of pine forest communities. Despite this decline, the Potential Native Plant Communities Systems map shows that the potential is there for pines to return as the pine-dominated “Fire-Dependent” forest community resides largely in the sandy, outwash plain which comprises much of the subwatershed. The “Fire Dependent” potential NPC community makes up 45% of all potential NPCs in the subwatershed, with the “Mesic-Hardwood” community making up 31% and “Wet meadow-carr” at 13%.

Figure 53. Historic vegetation cover.

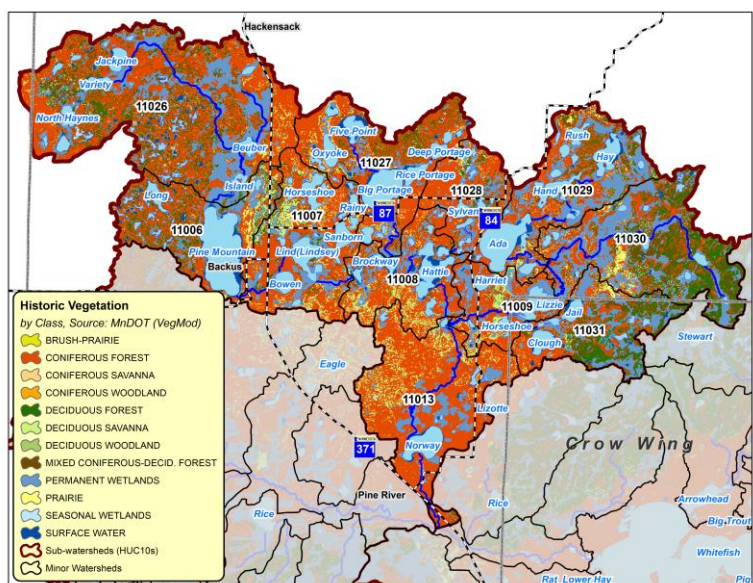


Figure 54. Current land cover.

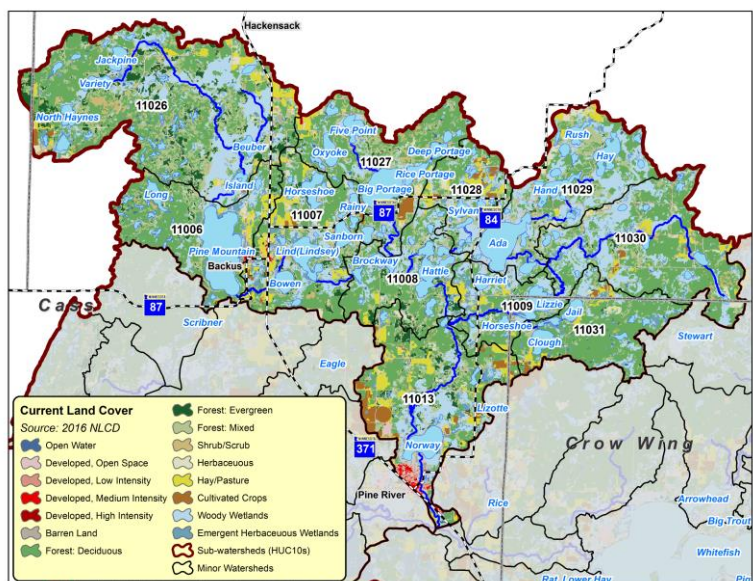
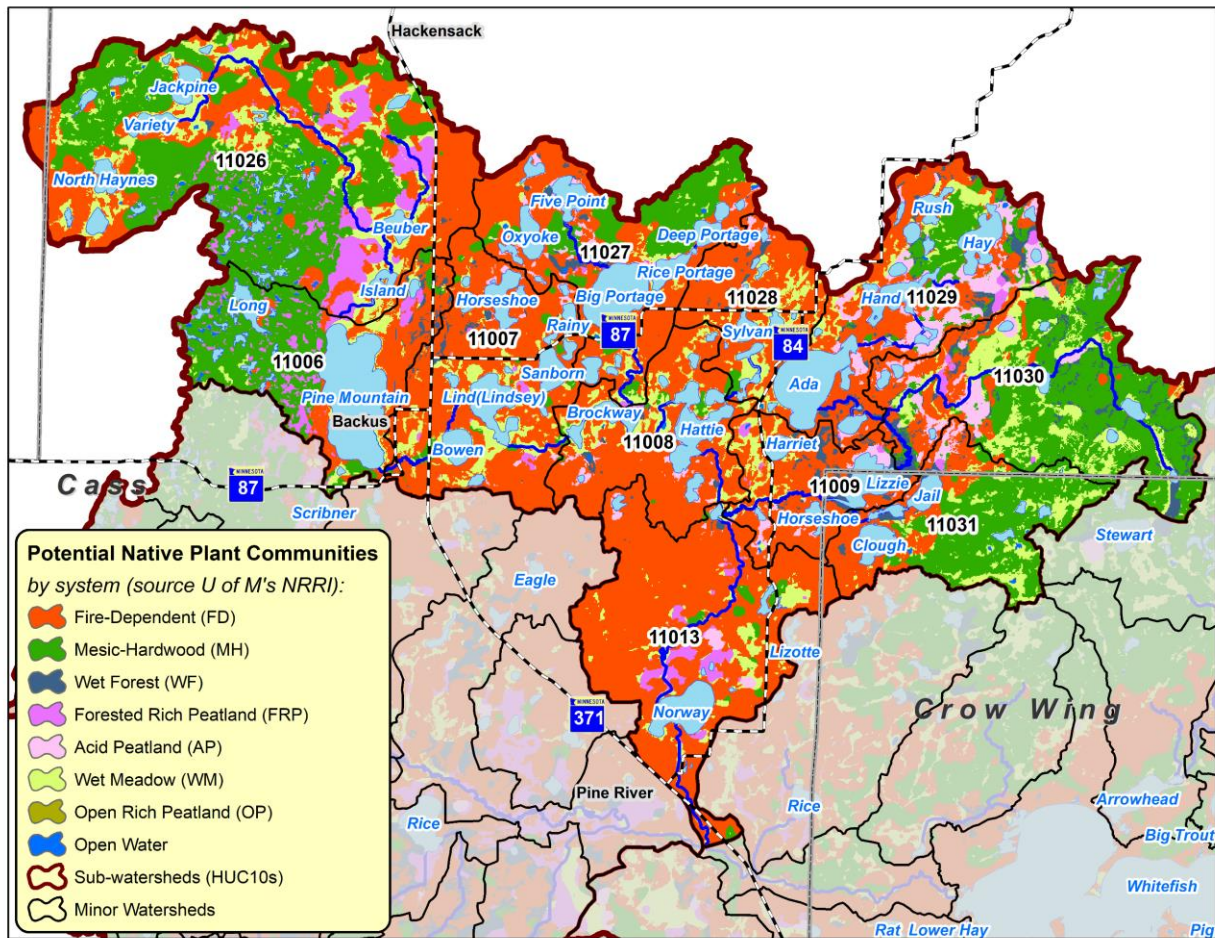


Figure 55. Potential native plant communities.









“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands. The map below shows the percentage by minor watershed. The upper reaches of the watershed, where the topography is steeper and where it was less desirable for development or agriculture have the most public lands, which (along with lakes) make up the highest percentage of “protected” lands.

The map displays the Crow Wing National Wildlife Refuge area, highlighting various protected lands and watersheds. A legend in the bottom left corner defines the symbols used:

- Protected Lands:**
  - Public Lands (Yellow shaded area)
  - Conservation Easements (Red outline)
  - SFIA Enrolled Parcels (Orange outline)
- Water Features:**
  - Lakes (Blue shaded area)
  - Streams (Blue line)
  - NWI Wetlands (Blue wavy line)
  - Minor Watersheds (Yellow outline)
  - Sub-watersheds (HUC10s) (Red outline)

The map includes numerous place names and numerical identifiers, such as 11026, 11027, 11028, 11029, 11030, 11031, 11006, 11007, 11008, 11009, 11010, 11011, 11012, 11013, 11014, 11015, 11016, 11017, 11018, 11019, 11020, 11021, 11022, 11023, 11024, 11025, 11026, 11027, 11028, 11029, 11030, 11031, 11032, 11033, 11034, 11035, 11036, 11037, 11038, 11039, 11040, 11041, 11042, 11043, 11044, 11045, 11046, 11047, 11048, 11049, 11050, 11051, 11052, 11053, 11054, 11055, 11056, 11057, 11058, 11059, 11060, 11061, 11062, 11063, 11064, 11065, 11066, 11067, 11068, 11069, 11070, 11071, 11072, 11073, 11074, 11075, 11076, 11077, 11078, 11079, 11080, 11081, 11082, 11083, 11084, 11085, 11086, 11087, 11088, 11089, 11090, 11091, 11092, 11093, 11094, 11095, 11096, 11097, 11098, 11099, 11100, 11101, 11102, 11103, 11104, 11105, 11106, 11107, 11108, 11109, 11110, 11111, 11112, 11113, 11114, 11115, 11116, 11117, 11118, 11119, 11120, 11121, 11122, 11123, 11124, 11125, 11126, 11127, 11128, 11129, 11130, 11131, 11132, 11133, 11134, 11135, 11136, 11137, 11138, 11139, 11140, 11141, 11142, 11143, 11144, 11145, 11146, 11147, 11148, 11149, 11150, 11151, 11152, 11153, 11154, 11155, 11156, 11157, 11158, 11159, 11160, 11161, 11162, 11163, 11164, 11165, 11166, 11167, 11168, 11169, 11170, 11171, 11172, 11173, 11174, 11175, 11176, 11177, 11178, 11179, 11180, 11181, 11182, 11183, 11184, 11185, 11186, 11187, 11188, 11189, 11190, 11191, 11192, 11193, 11194, 11195, 11196, 11197, 11198, 11199, 11200, 11201, 11202, 11203, 11204, 11205, 11206, 11207, 11208, 11209, 11210, 11211, 11212, 11213, 11214, 11215, 11216, 11217, 11218, 11219, 11220, 11221, 11222, 11223, 11224, 11225, 11226, 11227, 11228, 11229, 11230, 11231, 11232, 11233, 11234, 11235, 11236, 11237, 11238, 11239, 11240, 11241, 11242, 11243, 11244, 11245, 11246, 11247, 11248, 11249, 11250, 11251, 11252, 11253, 11254, 11255, 11256, 11257, 11258, 11259, 11260, 11261, 11262, 11263, 11264, 11265, 11266, 11267, 11268, 11269, 11270, 11271, 11272, 11273, 11274, 11275, 11276, 11277, 11278, 11279, 11280, 11281, 11282, 11283, 11284, 11285, 11286, 11287, 11288, 11289, 11290, 11291, 11292, 11293, 11294, 11295, 11296, 11297, 11298, 11299, 11300, 11301, 11302, 11303, 11304, 11305, 11306, 11307, 11308, 11309, 11310, 11311, 11312, 11313, 11314, 11315, 11316, 11317, 11318, 11319, 11320, 11321, 11322, 11323, 11324, 11325, 11326, 11327, 11328, 11329, 11330, 11331, 11332, 11333, 11334, 11335, 11336, 11337, 11338, 11339, 11340, 11341, 11342, 11343, 11344, 11345, 11346, 11347, 11348, 11349, 11350, 11351, 11352, 11353, 11354, 11355, 11356, 11357, 11358, 11359, 11360, 11361, 11362, 11363, 11364, 11365, 11366, 11367, 11368, 11369, 11370, 11371, 11372, 11373, 11374, 11375, 11376, 11377, 11378, 11379, 11380, 11381, 11382, 11383, 11384, 11385, 11386, 11387, 11388, 11389, 11390, 11391, 11392, 11393, 11394, 11395, 11396, 11397, 11398, 11399, 11400, 11401, 11402, 11403, 11404, 11405, 11406, 11407, 11408, 11409, 11410, 11411, 11412, 11413, 11414, 11415, 11416, 11417, 11418, 11419, 11420, 11421, 11422, 11423, 11424, 11425, 11426, 11427, 11428, 11429, 11430, 11431, 11432, 11433, 11434, 11435, 11436, 11437, 11438, 11439, 11440, 11441, 11442, 11443, 11444, 11445, 11446, 11447, 11448, 11449, 11450, 11451, 11452, 11453, 11454, 11455, 11456, 11457, 11458, 11459, 11460, 11461, 11462, 11463, 11464, 11465, 11466, 11467, 11468, 11469, 11470, 11471, 11472, 11473, 11474, 11475, 11476, 11477, 11478, 11479, 11480, 11481, 11482, 11483, 11484, 11485, 11486, 11487, 11488, 11489, 11490, 11491, 11492, 11493, 11494, 11495, 11496, 11497, 11498, 11499, 11500, 11501, 11502, 11503, 11504, 11505, 11506, 11507, 11508, 11509, 11510, 11511, 11512, 11513, 11514, 11515, 11516, 11517, 11518, 11519, 11520, 11521, 11522, 11523, 11524, 11525, 11526, 11527, 11528, 11529, 11530, 11531, 11532, 11533, 11534, 11535, 11536, 11537, 11538, 11539, 11540, 11541, 11542, 11543, 11544, 11545, 11546, 11547, 11548, 11549, 11550, 11551, 1

**% Protected (incl. SFIA)**  
by minor watershed

- 75+ %
- 60 - 75%
- 40 - 60%
- 20 - 40%

Sub-watersheds (HUC10s)

Minor Watersheds

## Subwatershed No. 2 South Fork Pine River (HUC 701010502)

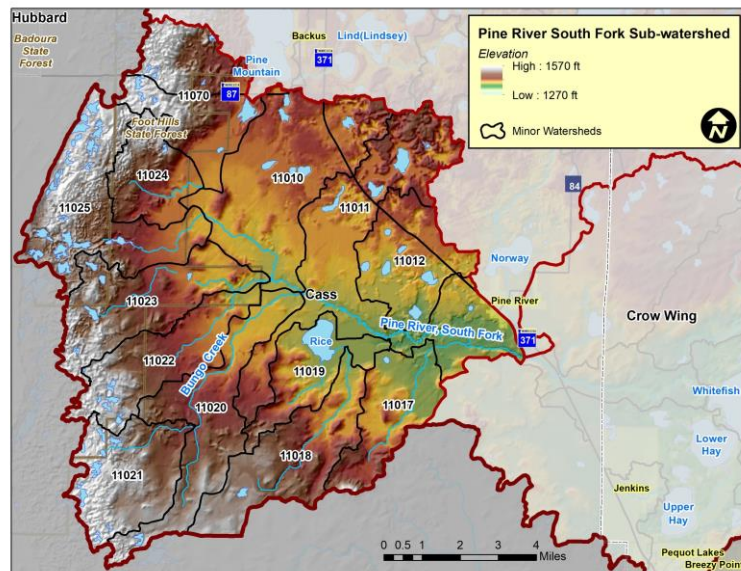
### Description

The South Fork of the Pine River Major Watershed includes the drainage area west of the confluence of the Pine River with the South Fork of the Pine River. There are few lakes in this subwatershed. It has the highest percentage of land converted from forest / prairie to agriculture (17.2% disturbance) of all of the subwatersheds in the Pine River Watershed. Because of the agricultural nature of this subwatershed, it also has the lowest percentage of forest cover (35.8%). Due to the public lands in the headwaters at the edge of the watershed, it does have 56.8% protected lands. The following maps and highlight the key forest and water resources of this subwatershed.

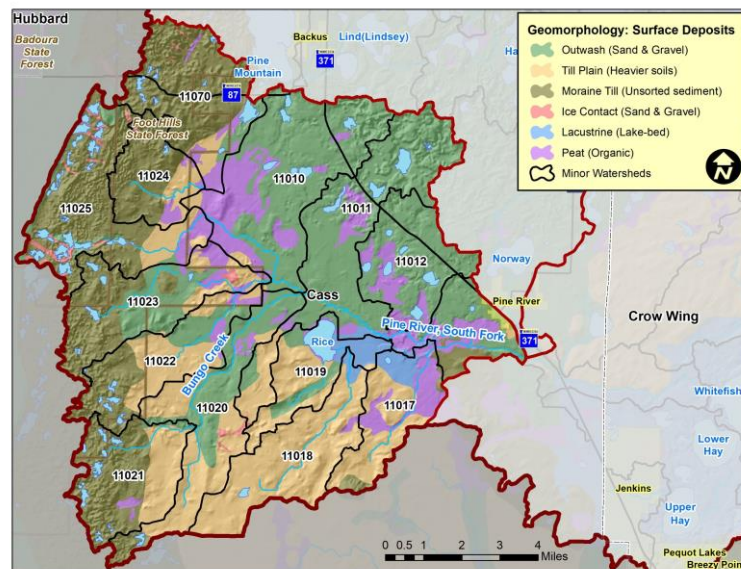
### Geography

Just like the headwater subwatershed, the hills of the St. Croix moraine dominate the far upper reaches of this subwatershed. This area is mostly public land and part of the Foot Hills State Forest. There is a relatively abrupt transition from the forested foot hills of the moraine down to the flatter till plain in the southern part and the outwash plain in the northern part. This largely agricultural area has numerous tributaries to the South Fork, including Bungo Cr., Behler Cr., Dabill Cr., Miller Cr., and Cedar Creek.

**Figure 59. Elevation.**



**Figure 60. Geomorphological landforms.**





## Past, Current, and Potential Future Forest Conditions

As is typical in the Pine River Watershed, a comparison of the historic and current forest maps show the shift from a pine-dominated forested landscape to the modern hardwoods-dominated forested landscape. In addition, the influx of agriculture in the flatter, more well drained portions of the subwatershed is readily visible with hay/pasture lands more common south of the South Fork of the Pine River while row crops are more common to the north as shown in the “Current Forest” map below. Another reason for the agriculture in this subwatershed is the fact that there was some native prairie present, which would have been easier for the early European settlers to farm than the forested lands.

The South Fork of the Pine River subwatershed has the 2nd lowest Forests for the Future Composite score (90.1), which is a sum of the ecological, economic, and recreational values of the forests.

As in the Headwaters subwatershed, the Potential Native Plant Communities (NPC) Systems map on the follow page shows that the potential is there for pines to return as the pine-dominated “Fire-Dependent” forest community generally coincides with the sandy, outwash plain which comprises much of the northern part of the subwatershed. However, competition with agricultural uses, rather than the change in forest composition, may be the largest challenge to overcome in that area. The “Fire Dependent” potential NPC community makes up 45% of all potential NPCs in the subwatershed, with the “Mesic-Hardwood” making up 26% and “Wet meadow-carr” at 12%.

Figure 61. Current land cover.

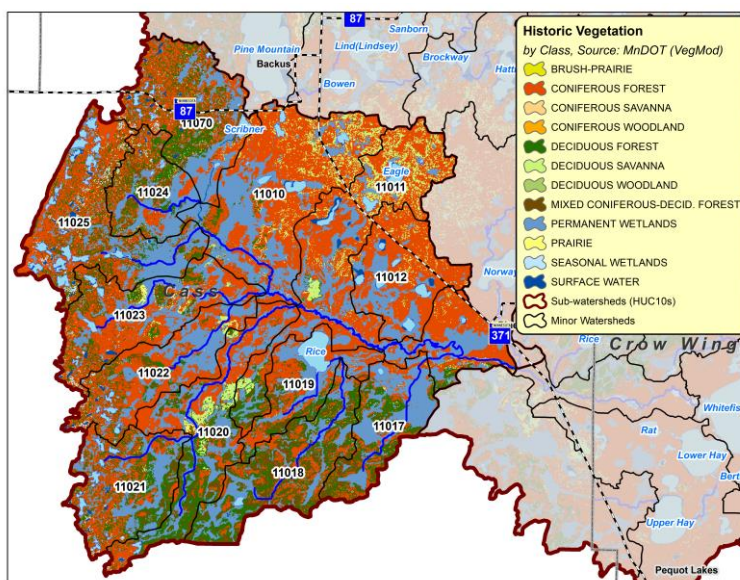


Figure 62. Historic vegetation cover.

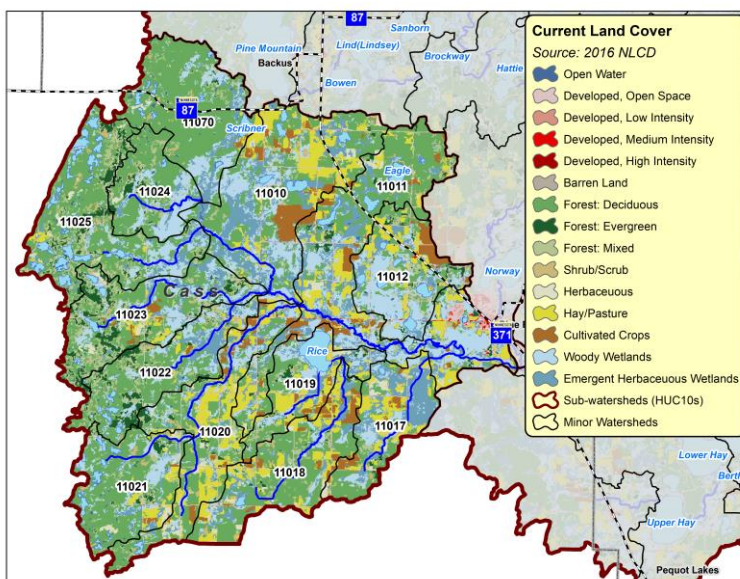
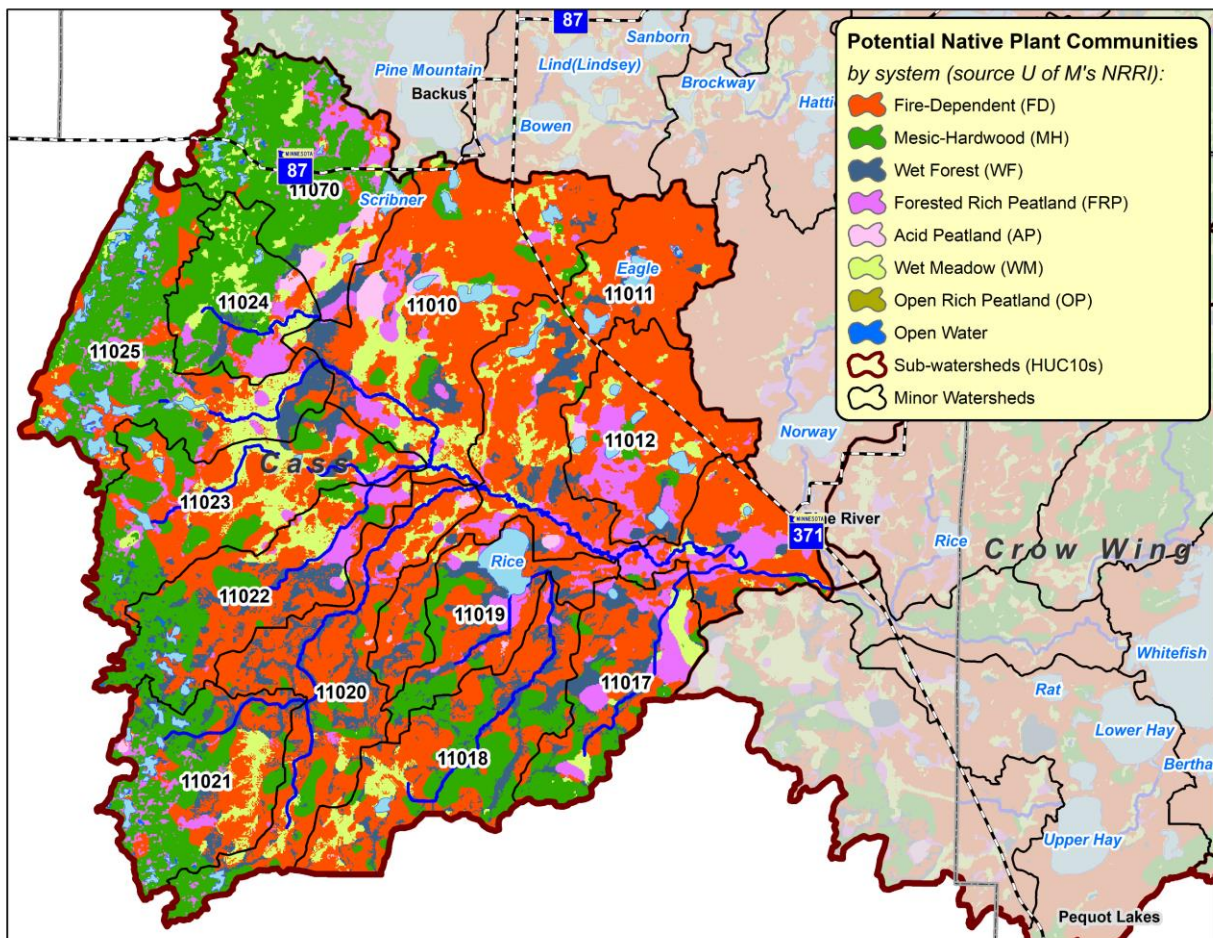




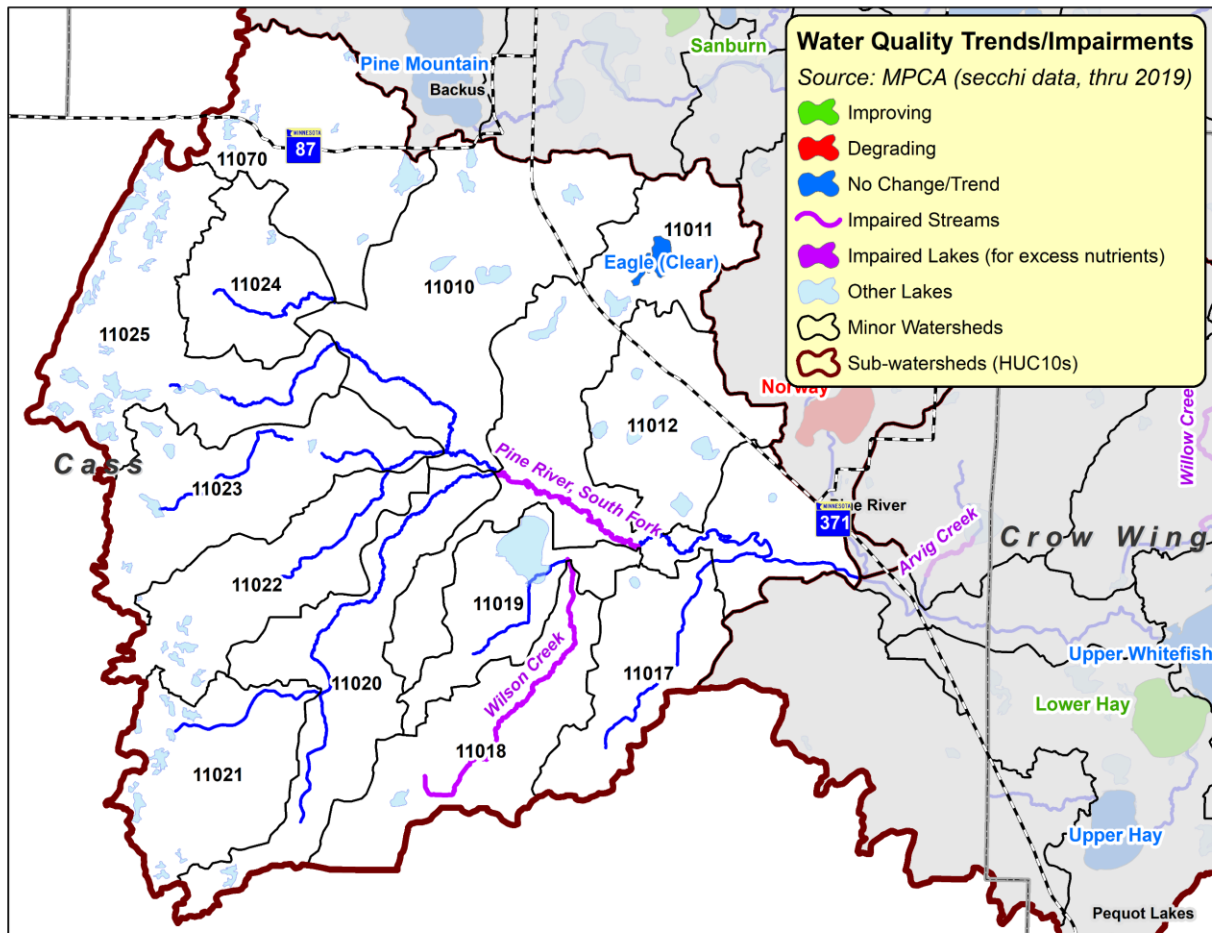
Figure 63. Potential native plant communities.



## Water Resources Summary

The map below shows that most of the subwatershed's water resources are streams. Most of the lakes in the subwatershed are smaller, natural environment lakes. Therefore, only one had any water quality data for which water quality trends could be established (Eagle L.: stable). According to MPCA's WRAPS document, the only impaired resources are Wilson Creek (biological: bugs) and a portion of the South Fork of the Pine River (biological: fish) from Bungo Cr. to Hoblin Cr. as shown on the map below. The cause of these impairments is reported to be increased bedded sediment and a lack of physical habitat.

Figure 64. Water quality trends.

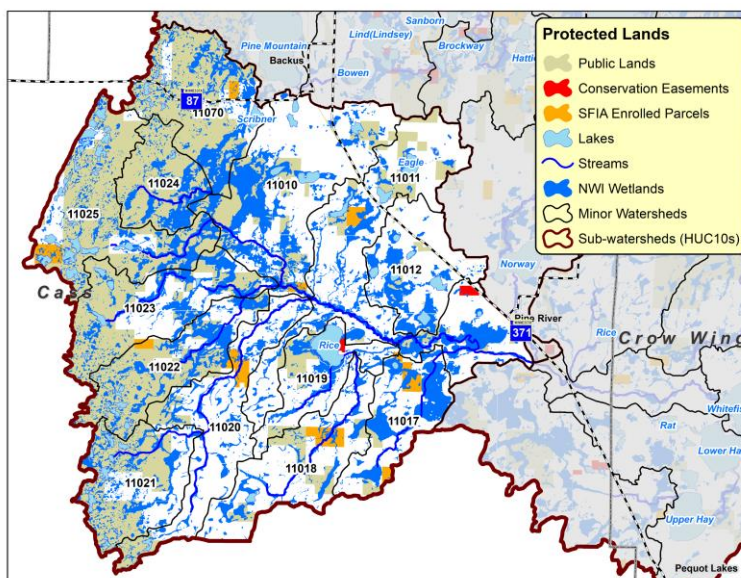


## Protection Status

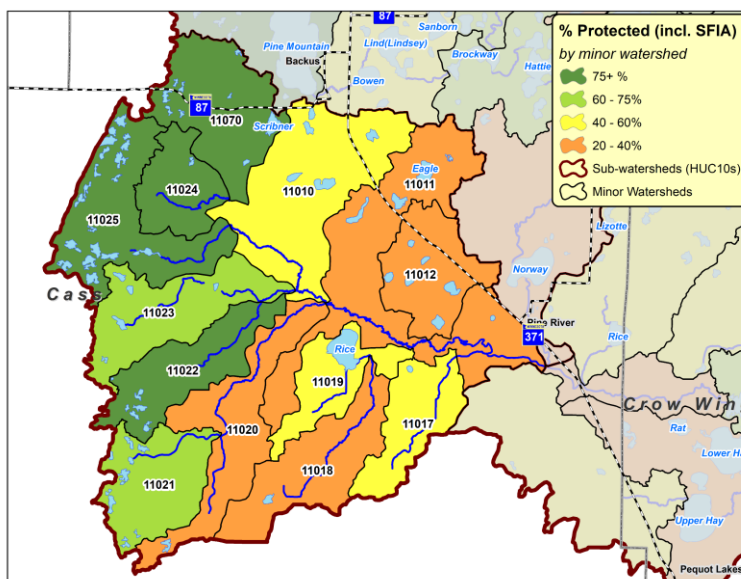
“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands. As with the Headwaters Subwatershed, the upper reaches of the watershed on the moraine, where the topography is steeper and where it was less desirable for development or agriculture have the most public lands, which make up the highest portion of “protected” lands, (now largely making up the Foot Hills State Forest). A small amount of forest land is also enrolled in SFIA.

The map to the right shows the distribution and percentage of protected lands by minor watershed. The lack of protected lands in the eastern portion of the subwatershed coincides with the location of abundant, privately-held agricultural lands.

**Figure 65. Protected lands.**



**Figure 66. Minor watershed protection levels.**





## Subwatershed No. 3 Daggett Brook (HUC 701010503)

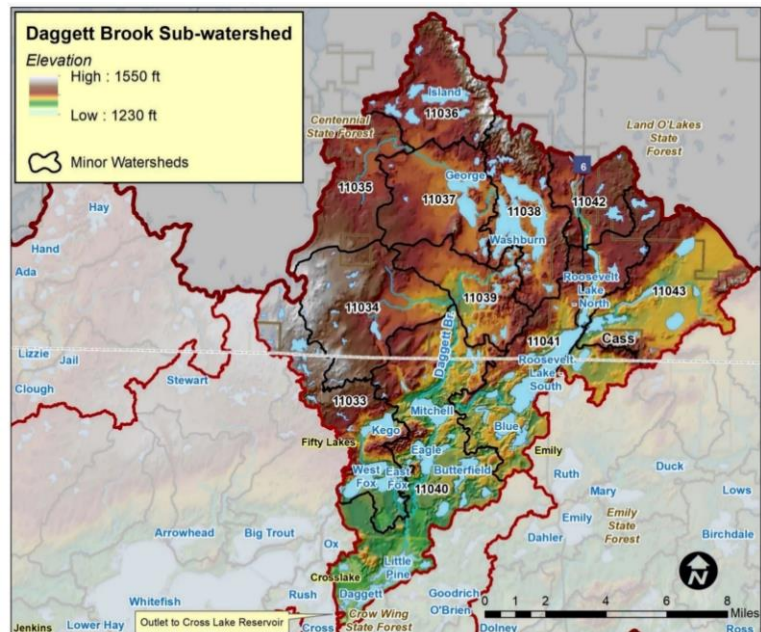
### Description

The Daggett Brook subwatershed is a large subwatershed that drains south into Little Pine and Daggett lakes, which are connected to the Whitefish Chain of Lakes because of the Crosslake dam. It has the highest percentage of both forested lands and protected lands and very low land disturbance (3.6%). It is second only to the Headwaters subwatershed in the number of lakes. The following maps highlight the key forest and water resources of this subwatershed.

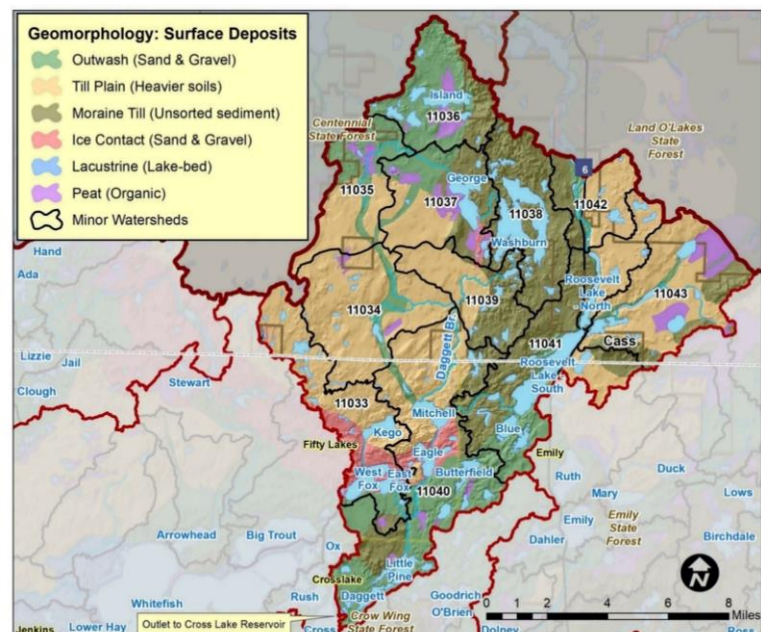
### Geography

As shown in both the elevation and geomorphology maps to the right, the Stewart Lake Till Plain is the dominant feature in much of the northern part of the subwatershed, with the exception of the moraine soils that extend through the area with Roosevelt, Washburn, and George lakes. Most of the lakes present are in the moraine till and ice contact sediments.

**Figure 67. Elevation.**



**Figure 68. Geomorphological landforms.**



## Past, Current, and Potential Future Forest Conditions

This subwatershed shows perhaps the most striking contrast between the historic and current forest. Much of the historic forest consisted of pines or a mix of hardwoods and pines. Few large tracts of pine remain in today's forested landscape.

The Daggett Brook subwatershed has the second highest Forests for the Future (FFF) Composite score (98.7), which is a sum of the ecological, economic, and recreational values of the forests.

As with the Little Pine subwatershed, little outwash plain is present in the Daggett Brook subwatershed. The predominant potential native plant community (NPC) system type is "Mesic Hardwood," which makes up 55% of all potential NPC communities as shown in the map on the following page. The "Fire-Dependent" potential NPC community makes up only 19% with "Wet meadow-carr" at 17%.

Figure 69. Historic vegetation cover.

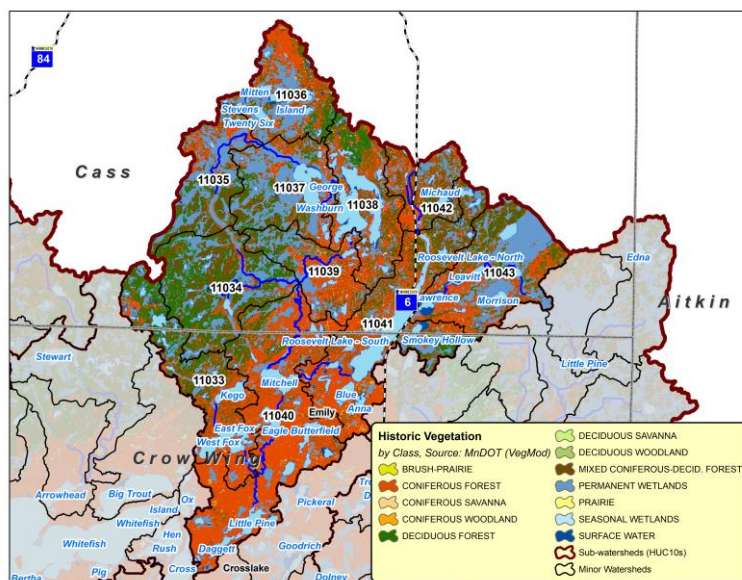


Figure 70. Current land cover.

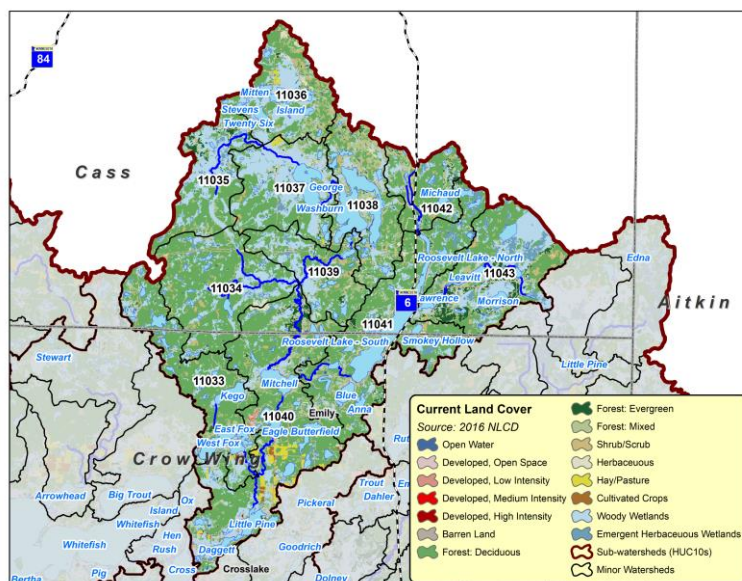
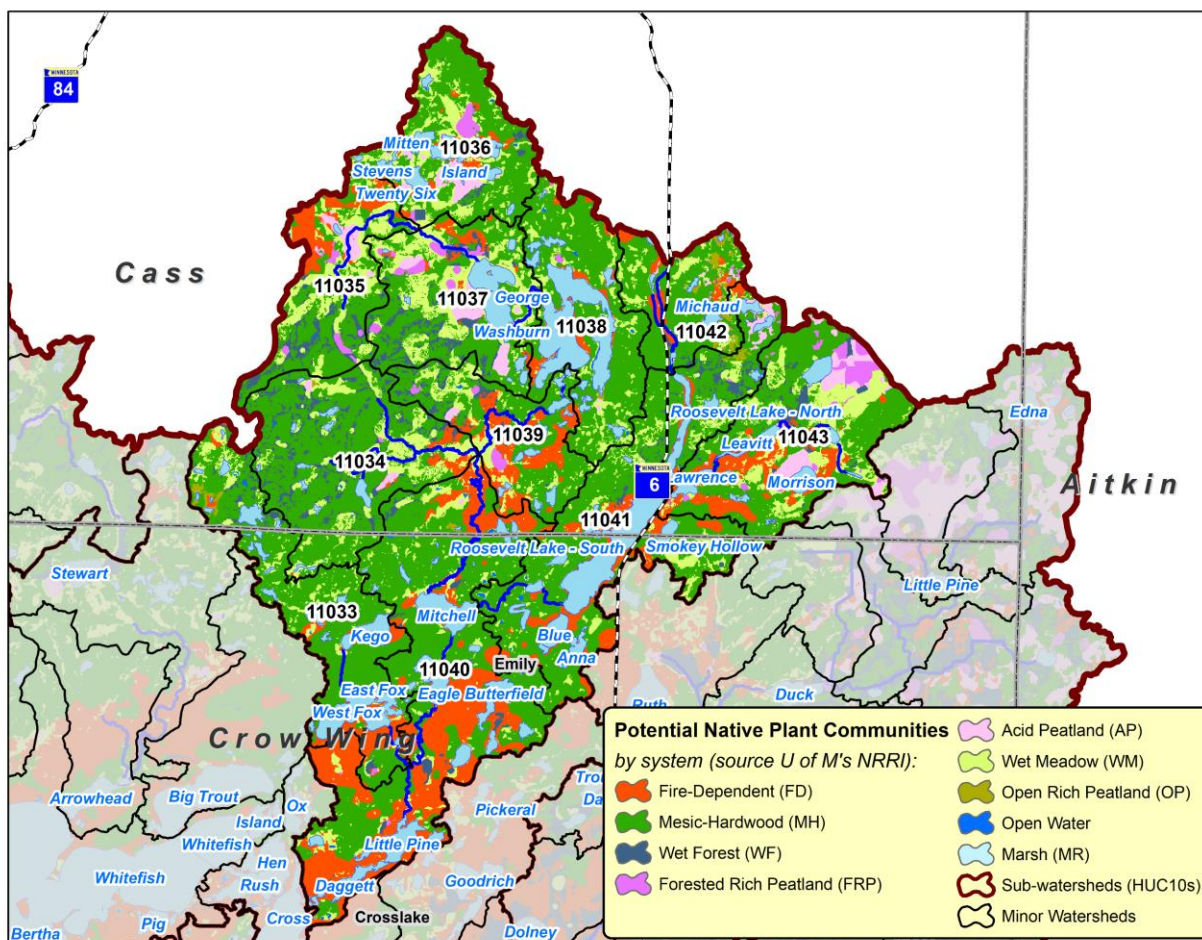




Figure 71. Potential native plant communities.





The Daggett Brook subwatershed has the 2nd highest number of lakes, most of which are less than 100 acres in size. There are 8 with declining trends, 5 with improving trends, and 8 with stable trends. The only 2 water resources that are impaired are Kego and Mitten. Outstanding resources consist of 8 lakes of high or outstanding biological significance, 4 cisco/tullibee lakes, and 4 local prioritized wild rice lakes. Washburn, Roosevelt, Mitchell, Eagle, East/West Fox, and Daggett/Little Pine Lakes are the significant large, recreational lakes in this subwatershed.

**Water Quality Trends/Impairments**  
Source: MPCA (secchi data, thru 2019)

- Improving
- Degrading
- No Change/Trend
- Impaired Lakes (for excess nutrients)
- Other Lakes
- Minor Watersheds
- Sub-watersheds (HUC10s)

## Protection Status

“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands. Like the other subwatersheds, the upper reaches of the watershed, where the topography is steeper and where it was less desirable for development or agriculture have the most public lands, which make up the highest portion of “protected” lands. The public land that dominates the Stewart Lake Till Plain is plainly visible in the northwestern portion of the subwatershed. The map below shows the percentage of protected lands by minor watershed.

Figure 73. Protected lands.

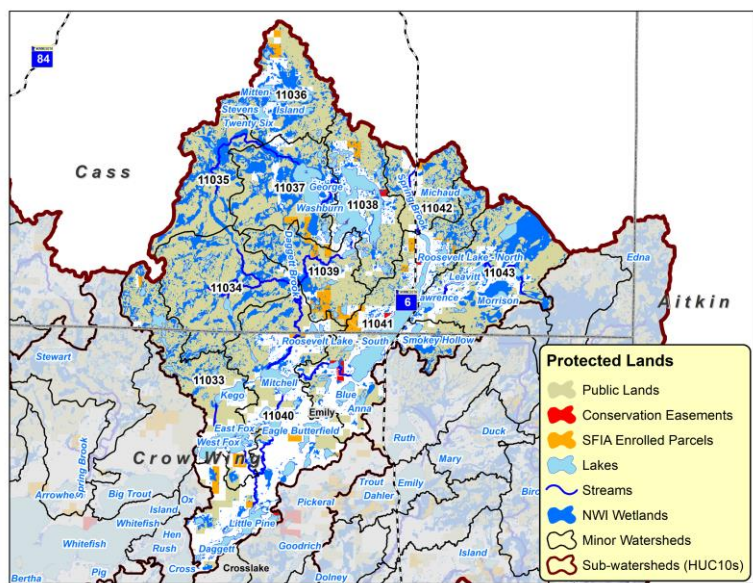
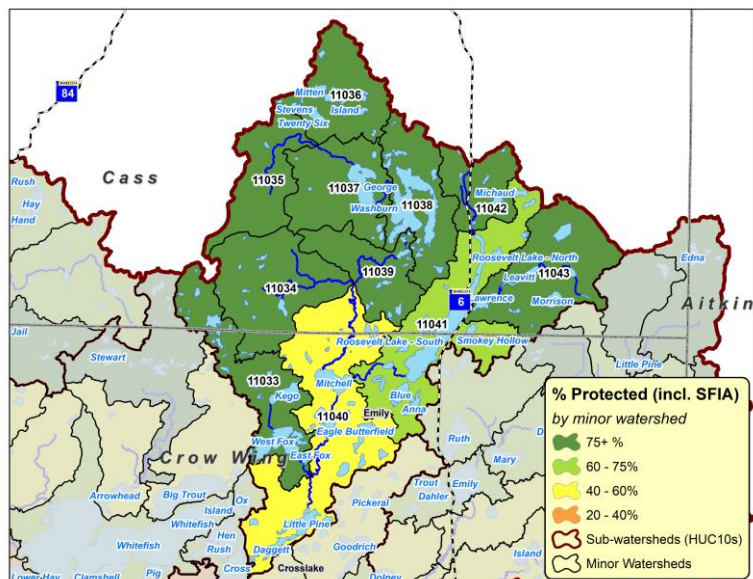


Figure 74. Minor watershed protection levels.



## Subwatershed No. 4 Whitefish Lake (HUC 701010504)

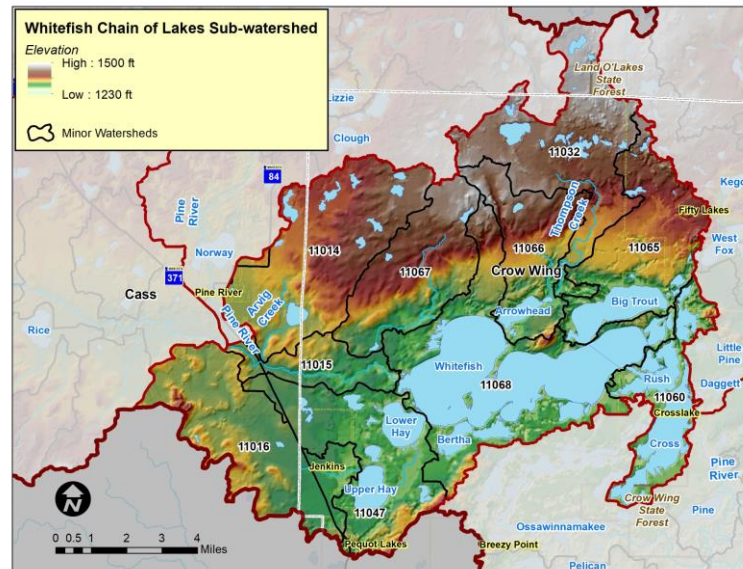
### Description

Below the confluence of the main stem of the Pine River and the South Fork of the Pine River (just south of Pine River) is the Whitefish Chain of Lakes subwatershed. There is only a 4-5 mile stretch of the river in this subwatershed, which is a scenic, forested stretch that extends from the confluence down through a number of series of small rapids to Upper Whitefish Lake. The rest of the subwatershed is largely dominated by the Whitefish Chain of Lakes, a very large, high-quality, and economically important lake chain in north-central MN, including lakes like Whitefish, Big Trout, and Cross. Although much of the lakes in the chain are deep-water recreational lakes, there are plenty of smaller bays and lakes with outstanding biological diversity and unique features (such as wild rice). Due to the amount of shoreline (which is mostly private), the subwatershed has the highest land and building values but the lowest amount of protected lands at 53.2%. The percentage of land converted from forest to development or other human uses is 13.0%. Just under 40% of the subwatershed is forested.

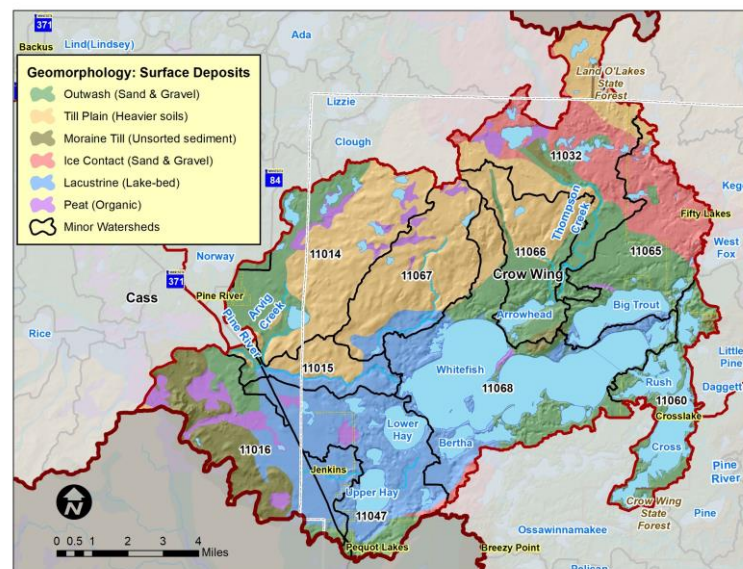
### Geography

There is a very large till plain in the northern portion of this subwatershed that extends north into the Leech Lake Major Watershed as well. It is shown by the darker colors on the elevation map (top of page) and by the tan color in the geomorphology map above. Over 50 large lakes are found at the edge of this large geomorphic feature, which is several hundred feet higher in elevation and comprised of heavier, less well-drained soils, fewer (and smaller) lakes, and large wetland complexes.

**Figure 75. Elevation.**



**Figure 76. Geomorphological landforms.**





## Past, Current, and Potential Future Forest Conditions

Although still forested, most of the till plain has transitioned from a pine-dominated landscape to a hardwoods-dominated landscape. Some of the original pines are still present in small patches around the Whitefish Chain of Lake and elsewhere on the outwash plain. As with it's neighbor to the west (the South Fork of the Pine River), portions of the wetern part of this subwatershed have been converted to agricultural uses.

The Whitefish Chain of Lakes subwatershed has the 3rd lowest Forests for the Future Composite score (91.7, just above the South Fork of the Pine River which was at 90.1), which is a sum of the ecological, economic, and recreational values of the forests.

The Potential Native Plant Communities (NPC) map on the follow page shows that the Stewart Lake Till Plain in the northern part of the subwatershed is best suited for hardwood species and not pines, which are best suited for the sandier areas in the rest of the subwatershed. The pine-dominated “Fire Dependent” potential NPC community makes up 47% of all potential NPCs in the subwatershed, with the “Mesic-Hardwood” making up 34% and “Wet meadow-carr” at 12%.

Figure 77. Historic vegetation cover.

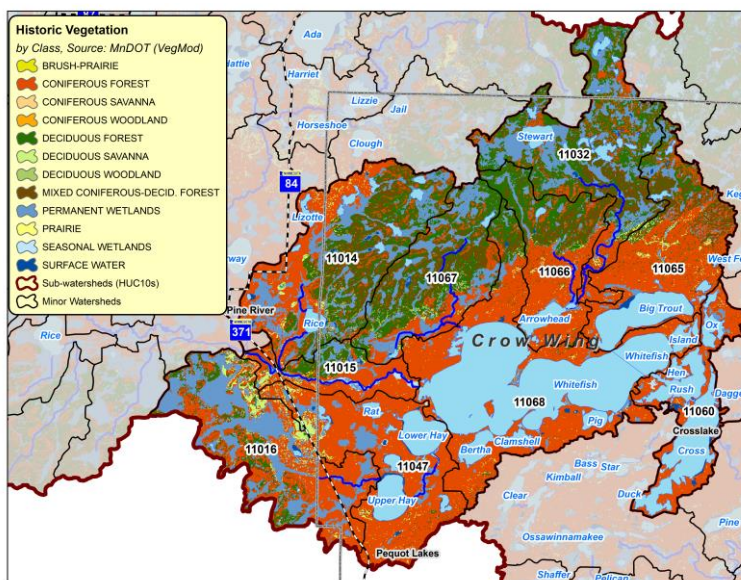
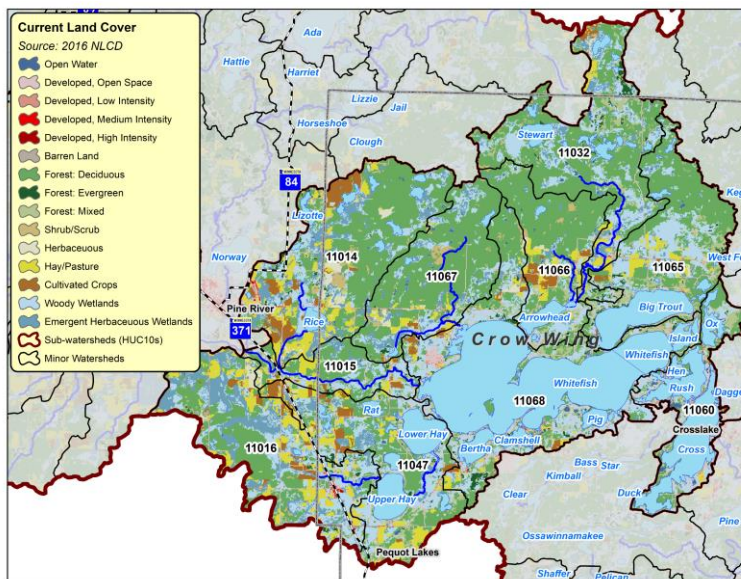
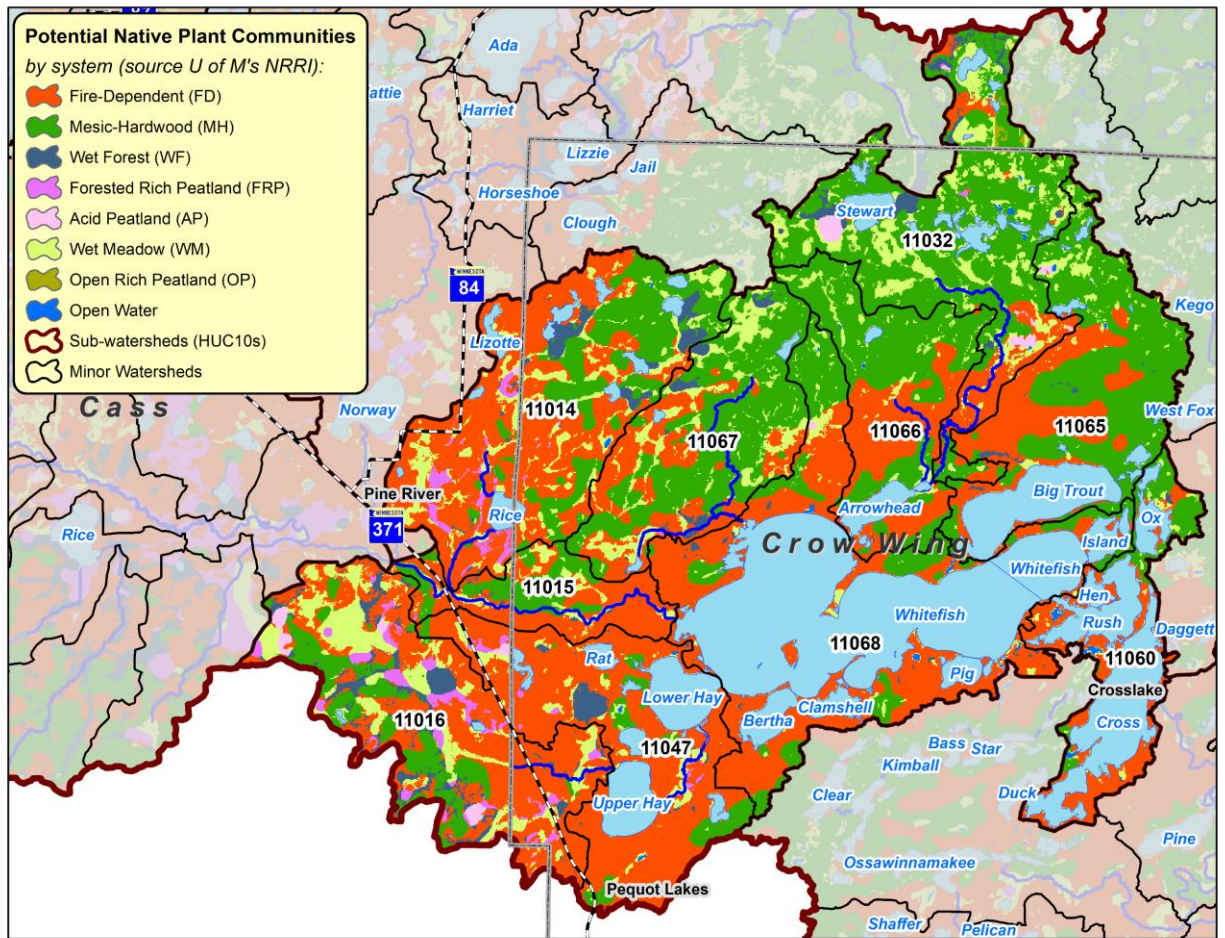


Figure 78. Current land cover.



**Figure 79. Potential native plant communities.**



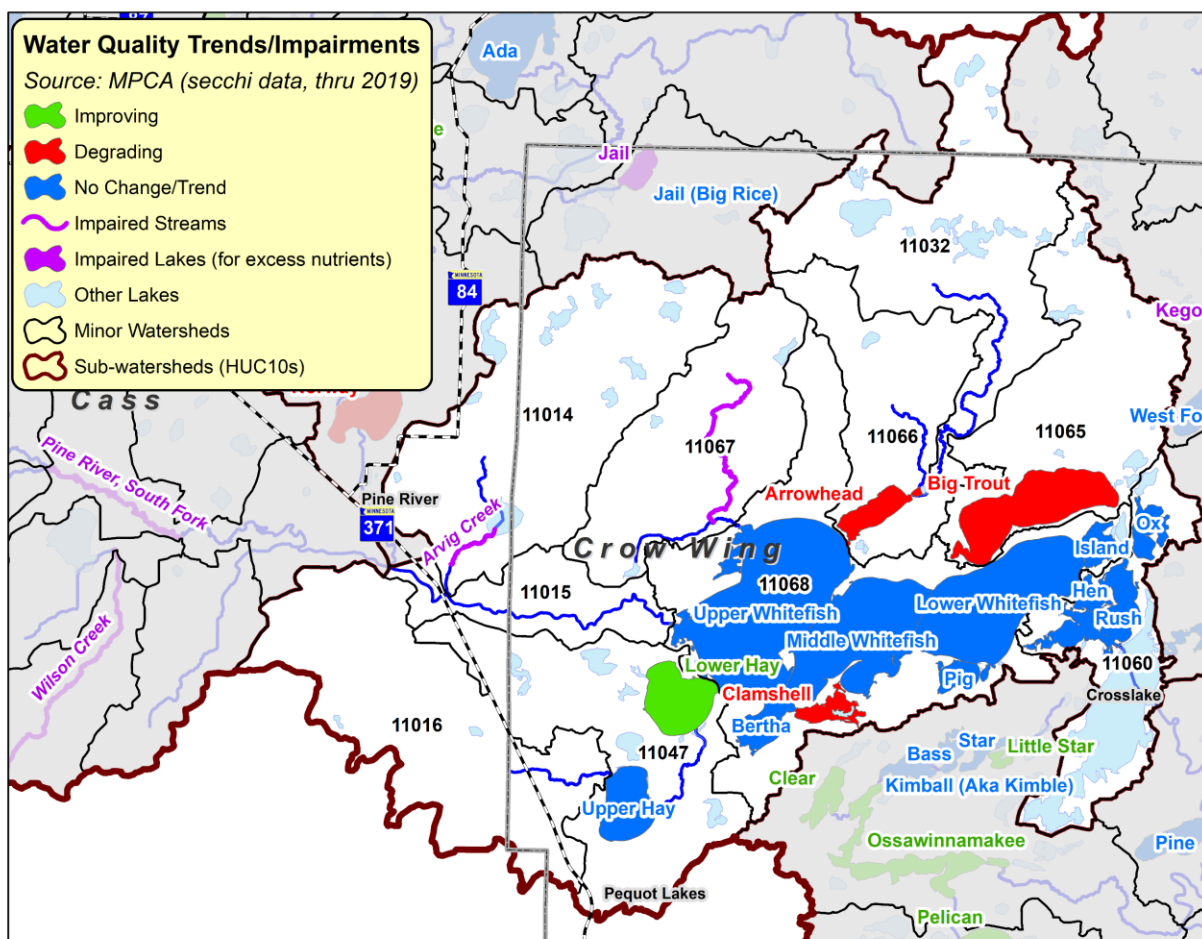


## Water Resources Summary

Lakes dominate the southern, sandy portion of this subwatershed. Many of the lakes in the Whitefish Chain became connected as part of the installation of the dam at the outlet of the Pine River (and this subwatershed) from Cross Lake.

Water quality is generally good across the chain, but the trend varies and there is concern over the declining trend on Whitefish and Big Trout lakes. Arvig Creek (tributary to the Pine River) and Willow Creek (tributary to Whitefish lake) are the only two impaired water resources, which have biological impairments due to habitat alteration resulting from livestock grazing near and into the streams (Source: WRAPS). 14 of the lakes in this subwatershed have high (3), higher (3), or highest (8) sensitivity to phosphorus loading according to the DNR. 12 Lakes have outstanding biological significance. There are also 7 cisco / tullibee lakes and 3 local priority wild rice lakes.

Figure 80. Water quality trends.



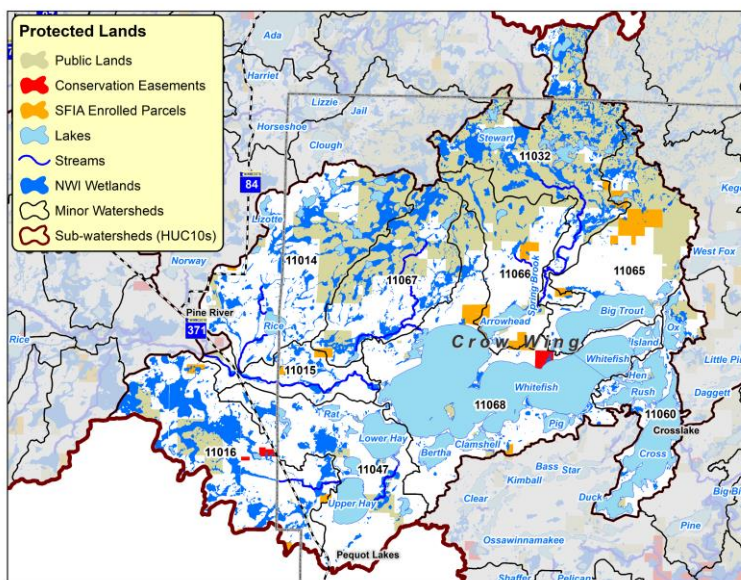


## Protection Status

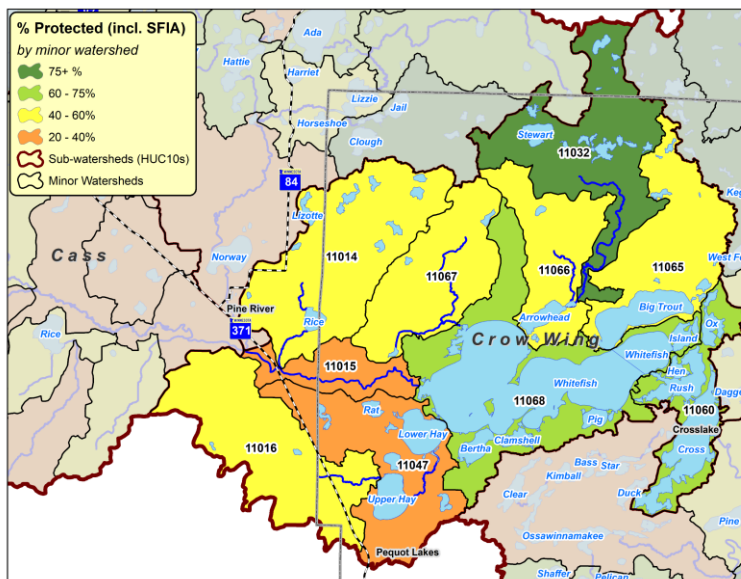
“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands in the Whitefish Chain of Lakes subwatershed. Just as with the St. Croix moraine to the west, the upper reaches of this subwatershed (the “Stewart Lake Till Plain”) where the topography is steeper and where it was less desirable for development and more difficult for agriculture have the most public lands. Many of the public lands in this portion of the watershed are tax-forfeited lands where early settlers likely tried to farm but decided to move elsewhere after experiencing soils and geomorphic conditions.

The map to the right shows the percentage of these lands by minor watershed. As with the South Fork of the Pine River subwatershed, the lack of protected lands in the western portion of the subwatershed coincides with the location of abundant, privately-held agricultural lands. The relatively high percentage of protection in the Whitefish Lake minor watershed is largely due to the amount of public waters.

**Figure 81. Protected lands.**



**Figure 82. Minor watershed protection levels.**



## Subwatershed No. 5

### Little Pine River (HUC 701010505)

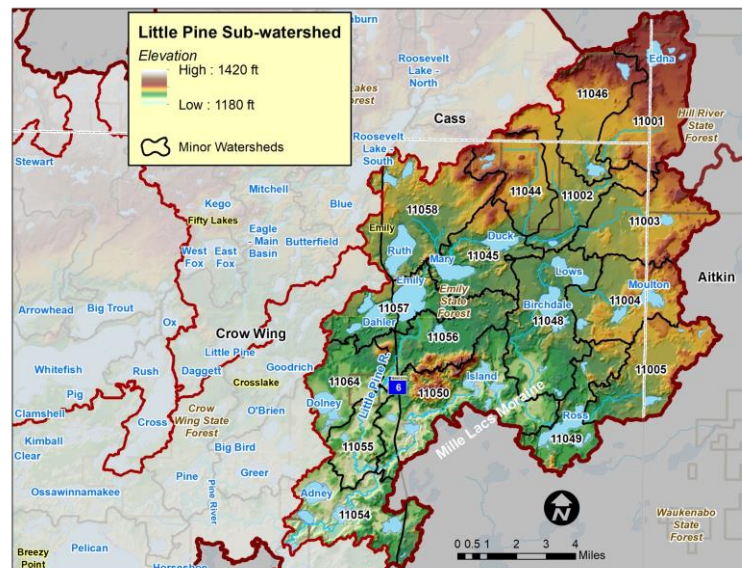
#### Description

The Little Pine River is one of the main tributaries to the Pine River and has its confluence with the Pine below the Crosslake dam, near the Pine's confluence with the Mississippi. It is one of the 3 largest subwatersheds (along with the Headwaters and Daggett Brook) with its headwaters in Aitkin County and flows southwest through a mix of larger lakes, wetlands, and rural forested areas. By several measures, the Little Pine River subwatershed has some of the highest quality forests in the Pine River major Watershed. Part of this is because it has the lowest disturbance level (3.6%) and the 2nd highest percentage of both forested cover (53%) and protected lands (71%). The following maps highlight the key forest and water resources of this subwatershed.

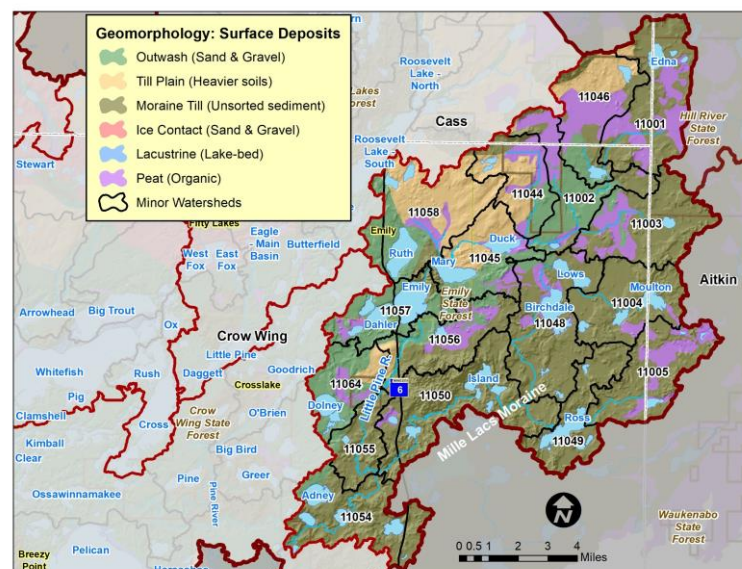
#### Geography

Much of the geomorphology of the subwatershed is made up of the Mille Lacs Moraine, which forms its eastern boundary. A mix of till and outwash plains comprise the remainder of the subwatershed.

**Figure 83. Elevation.**



**Figure 84. Geomorphological landforms.**





## Past, Current, and Potential Future Forest Conditions

Although a few areas in the Emily area still have stands of pine remaining, much of the forest landscape now consists of hardwoods as shown in the “Current Forest” map below. Because of the variety of soils (due to the geomorphic setting), the biodiversity of the area is quite high. The Little Pine subwatershed has by far the highest Forests for the Future (FFF) Composite score (100.8), which is a sum of the ecological, economic, and recreational values of the forests. It is the only subwatershed that has any minor watersheds with a top 25 FFF score statewide (#11048, #11002, 11044 all score in the top 25 in the *Ecological* Category).

Figure 85. Historic vegetation cover.

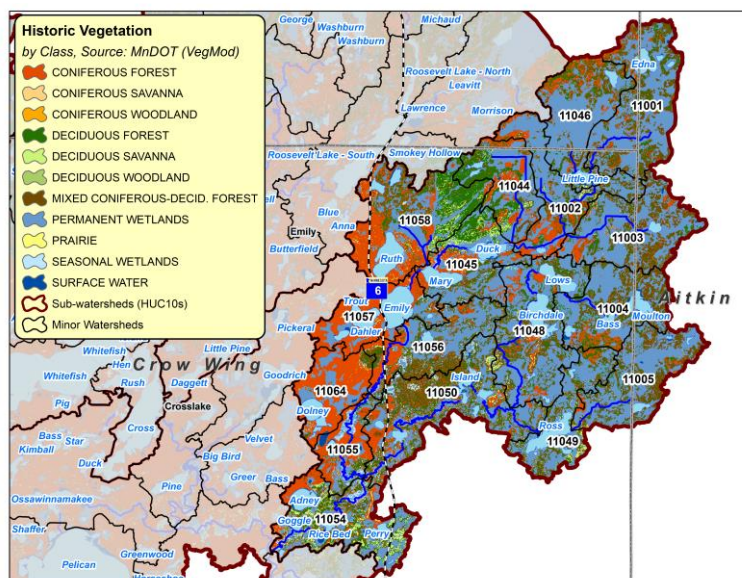
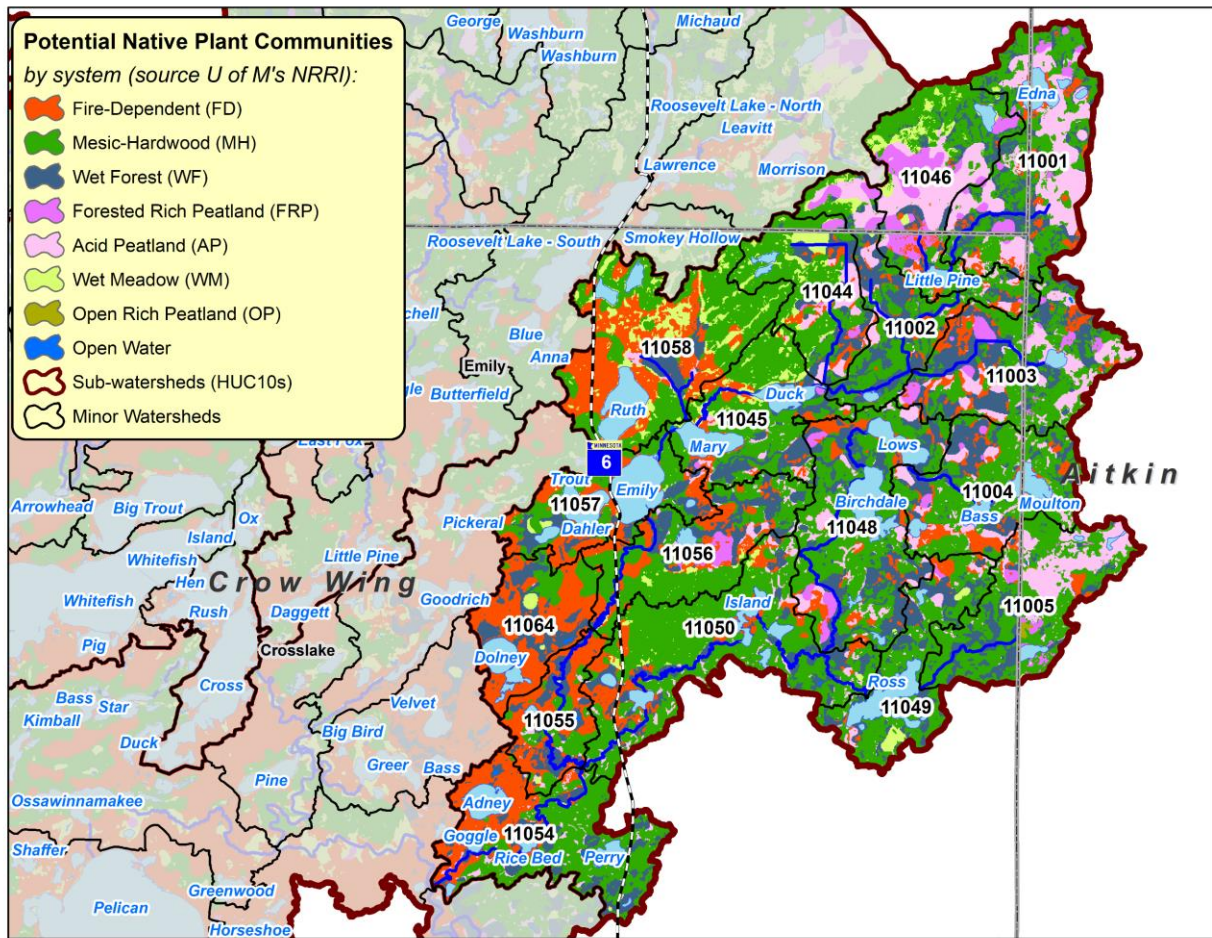




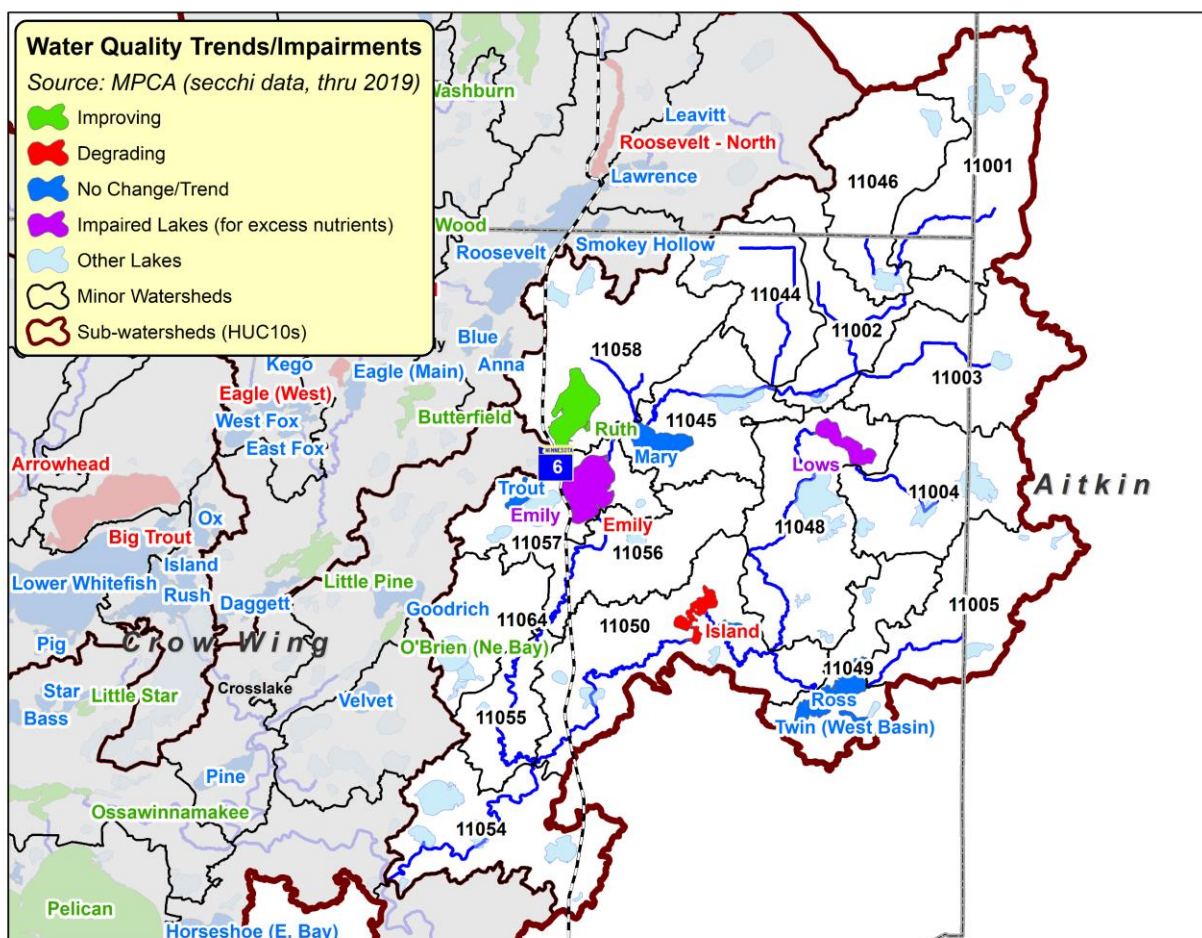
Figure 87. Potential native plant communities.



## Water Resources Summary

The Little Pine subwatershed has the smallest number of lakes of all six subwatersheds. This is largely due to the geomorphology (limited outwash, abundant moraine). There are 4 lakes with a declining trend in water quality, with 2 being impaired: Emily Lake and Lows Lake. Both of these lakes are shallow lakes. The impairment for Lows is being considered natural background and no TMDL is being prepared (Source: WRAPS). Many of the lakes in the subwatershed are shallow, wildlife lakes with the exception of the large recreational lakes like Ruth, Mary, and Emily. 10 lakes have high or outstanding aquatic biodiversity and 3 are locally prioritized wild rice lakes.

**Figure 88. Water quality trends.**



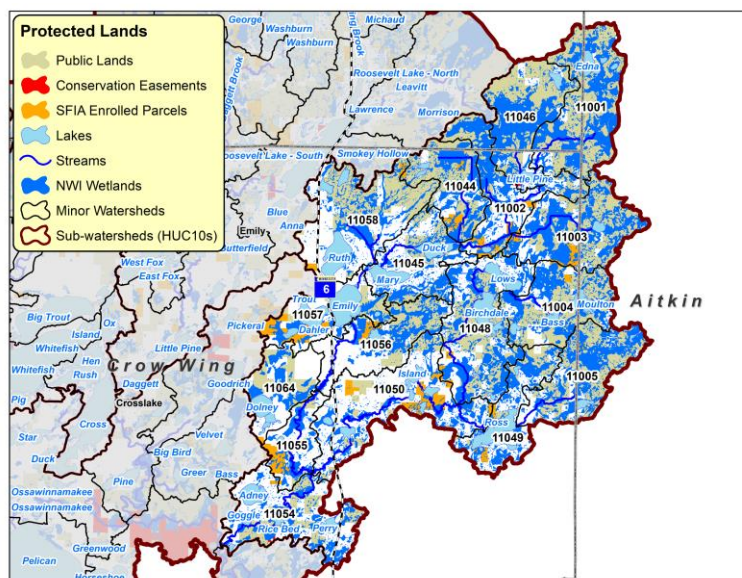


## Protection Status

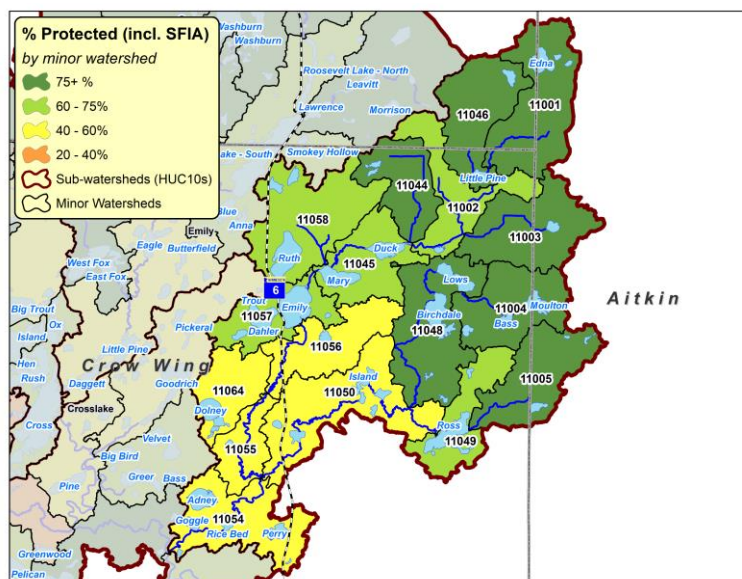
“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands. The upper reaches of the watershed, where the topography is steeper and where it was less desirable for development or agriculture have the most public lands, which make up the highest portion of “protected” lands.

The map below shows the percentage by minor watershed. In general, the minor watersheds surrounding the Little Pine River itself are fairly well protected (>50%). The headwaters are also well protected as those minors are mostly at or above 75%.

**Figure 89. Protected lands.**



**Figure 90. Minor watershed protection levels.**





## Subwatershed No. 6

### Lower Pine River (HUC 701010506)

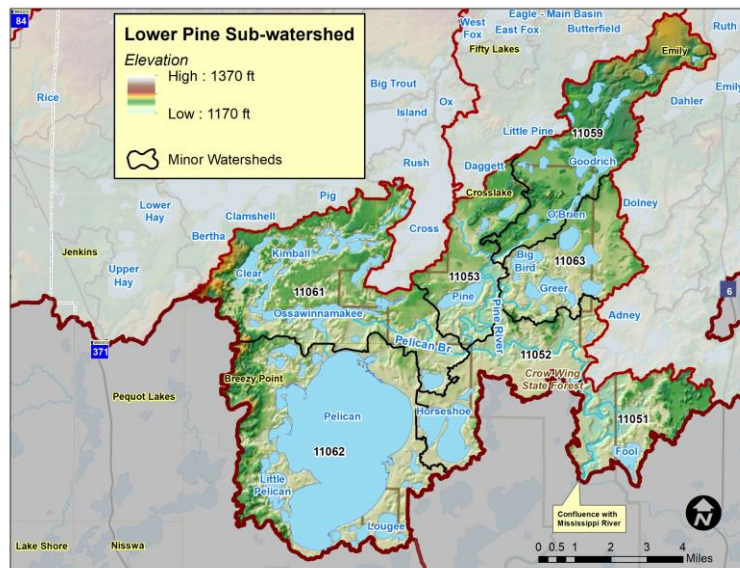
#### Description

The Lower Pine River subwatershed is the portion of the Pine River Major Watershed that starts just below the dam in the City of Crosslake and extends south and east to the confluence with the Mississippi River. As shown in the elevation profile to the lower right, the river drops quickly as it exits the Cross Lake reservoir and then winds its way more gradually down to the Mississippi. The Pelican Brook and the Little Pine River are the main tributaries to the Pine River along this stretch, which is generally very forested and well protected (56% overall in the subwatershed, but higher along much of the river itself, see Section ??). There are also numerous high-quality lakes in this subwatershed. Land use disturbance is low at 8%, with the percentage of forest cover at 40%. The following maps highlight the key forest and water resources of this subwatershed.

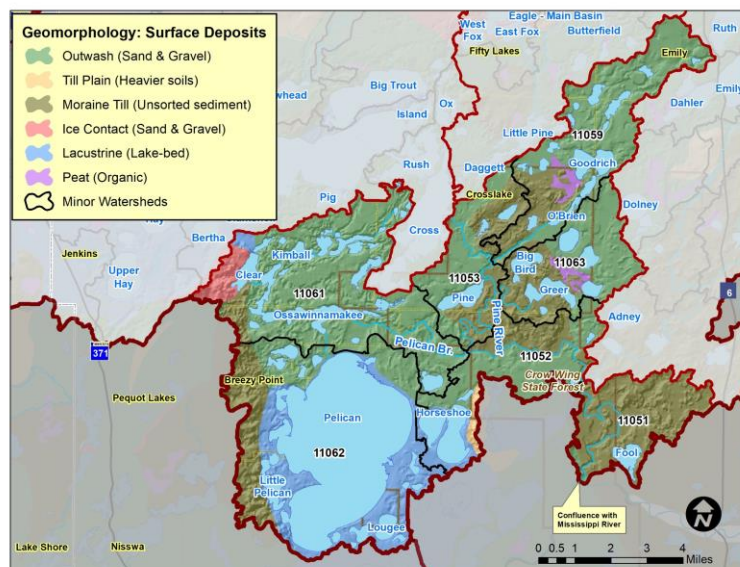
#### Geography

Most of this subwatershed lies in the sandy (and topographically flat) outwash plain, with some moraine till present along the edges. Pelican Lake sits in sandy lacustrine (lake-bed) sediment.

**Figure 91. Elevation.**



**Figure 92. Geomorphological landforms.**



## Past, Current, and Potential Future Forest Conditions

Because of the sandy outwash in this subwatershed, much of the historic and current forest is comprised of pine. Of all the subwatersheds, this one shows the most mixture of both hardwoods and pine (both past and present). In addition to shoreline development, some off-lake development has occurred in this subwatershed, especially in the cities of Breezy Point (NW side of Pelican Lake) and Crosslake. Very little agriculture exists in this subwatershed.

Despite having abundant forests, this subwatershed had the lowest Forests for the Future composite score of just 86.1, which is a sum of the ecological, economic, and recreational values of the forests.

The Potential Native Plant Communities (NPC) map on the following page shows the same patchwork of the “Fire-Dependent” (pines) and “Mesic-Hardwood” communities on the outwash plain that were shown in the historic forest and current forest maps. The moraine till areas that form the southeast and southwest boundaries of the subwatershed are more hardwood dominated on both the potential NPC map and the current forest map. Overall, the pine-dominated “Fire-Dependent” potential NPC community makes up 55% of all potential NPCs in the subwatershed (the highest among the 6 subwatersheds), with the “Mesic-Hardwood” making up 30% and “Wet meadow-carr” at 9%.

Figure 93. Historic vegetation cover.

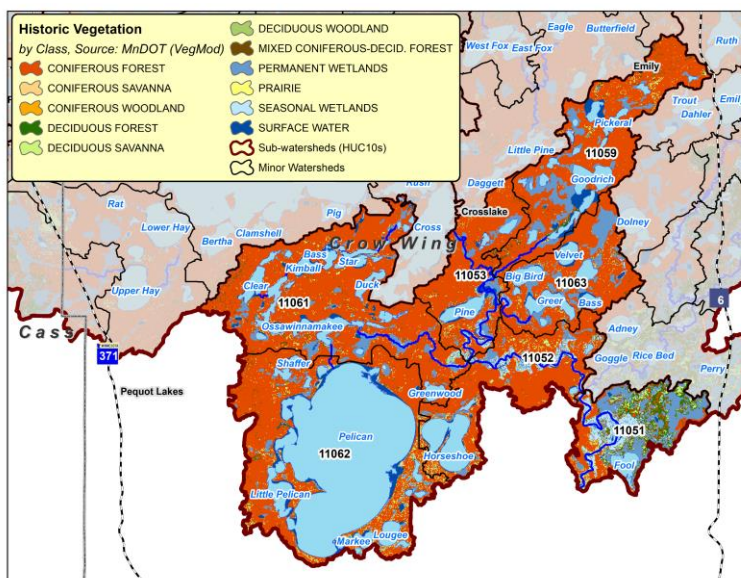
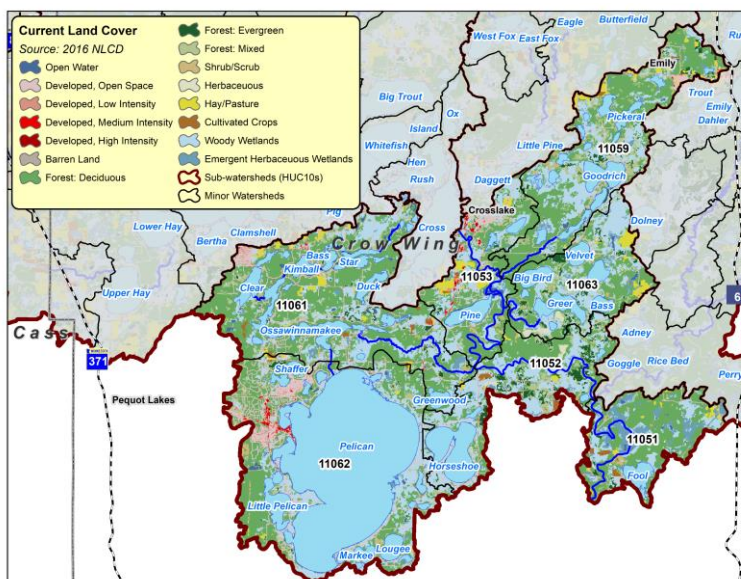


Figure 94. Current land cover.





Pine River Watershed Landscape Stewardship Plan - Appendix

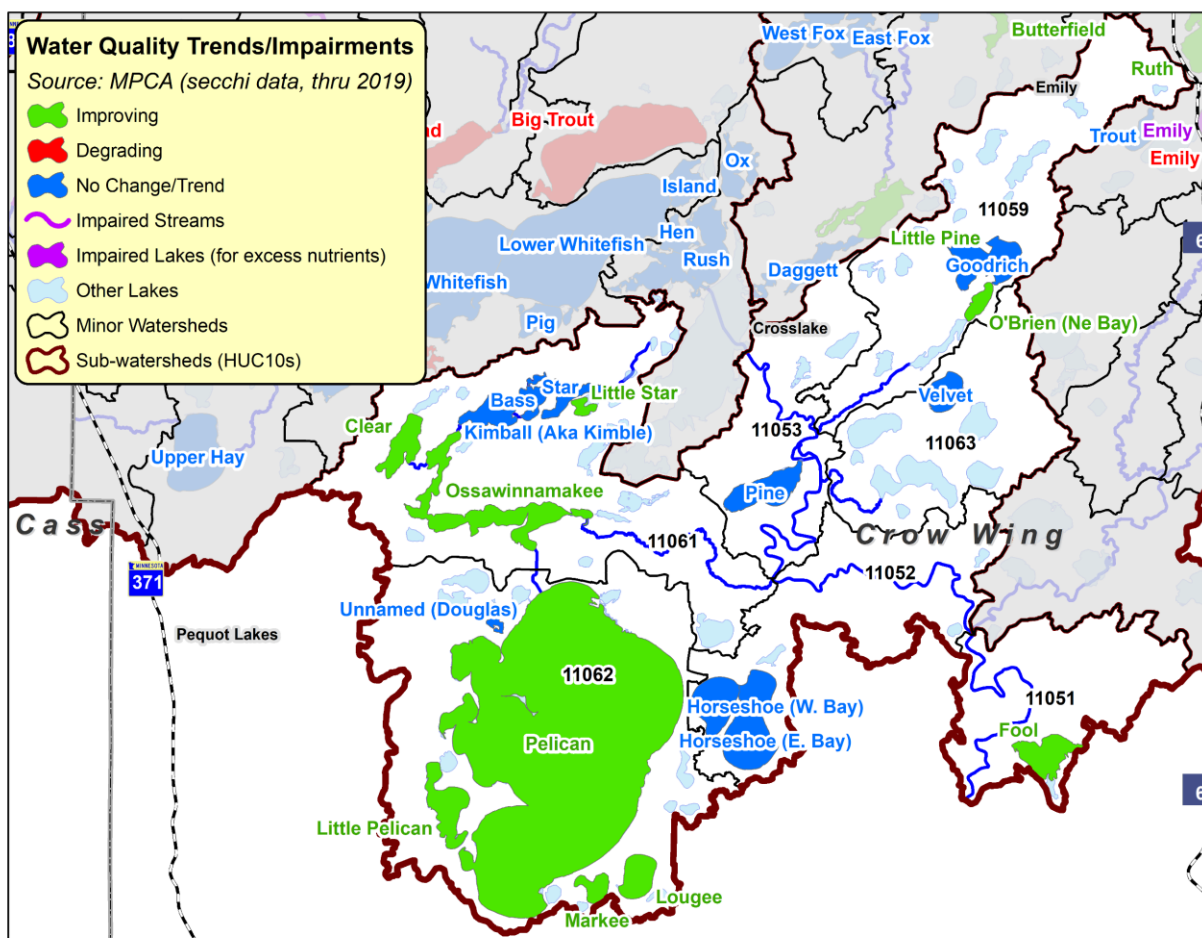




## Water Resources Summary

This subwatershed has some of the highest quality of water resources in the entire Pine River Major Watershed, with 12 lakes having an improving trend in water quality and none with a declining trend. There are no impairments. Pelican Lake, a deep, clear Oligotrophic lake, is the premeir lake in the subwatershed. Ossawinnamakee and the Horseshoe are the other large, high quality recreation lakes. There are a disproportionately high number of relatively small (100-200 acre), high quality lakes in this subwatershed, compared to the others and include lakes like Kimball, Bass, Star, Duck, Fawn, O'Brien, Big Bird, Velvet, and Young.

Figure 96. Water quality trends.

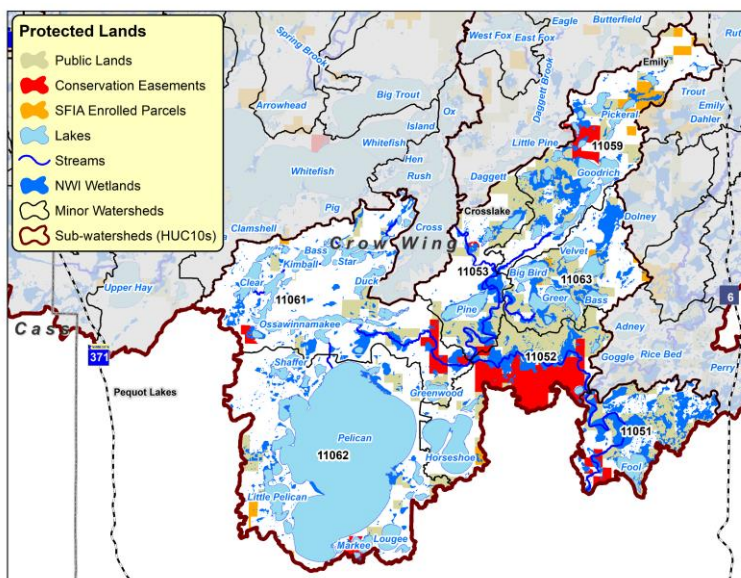


## Protection Status

“Protected” lands consist of public lands, public waters, permanent conservation easements, lands enrolled in SFIA, and wetlands. The map to the right shows the type and distribution of these “protected” lands. Much of the public lands in the central part of the subwatershed are part of the Crow Wing State Forest. The large block of easements along the Pine River is a result of the DNR’s Forest Legacy Program which worked with Potlatch to put easements on many of their lands in this subwatershed.

The map to the right shows the percentage by minor watershed. The relative lack of protected lands in the Ossawinnamakee minor watershed was highlighted in the 2013 Crow Wing County Local Water Management Plan as a focal point due to the risk these unprotected lands present to the abundant forest lands (<10% disturbance) and high quality waters. The primary risk factor is development, as the Ossawinnamakee minor watershed is right between two of the fastest growing areas in the County (the cities of Breezy Point and Crosslake.

Figure 97. Protected lands.



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# Ecological Pathway to Sustainable Forest Management

Below is the general sequence of concepts and products that were developed for and/or integrated into the 2<sup>nd</sup> 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](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](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](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](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](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](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](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](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](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](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](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](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](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](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](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](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](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](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](https://mn.gov/frc/docs/NC_Landscape_Plan.pdf))

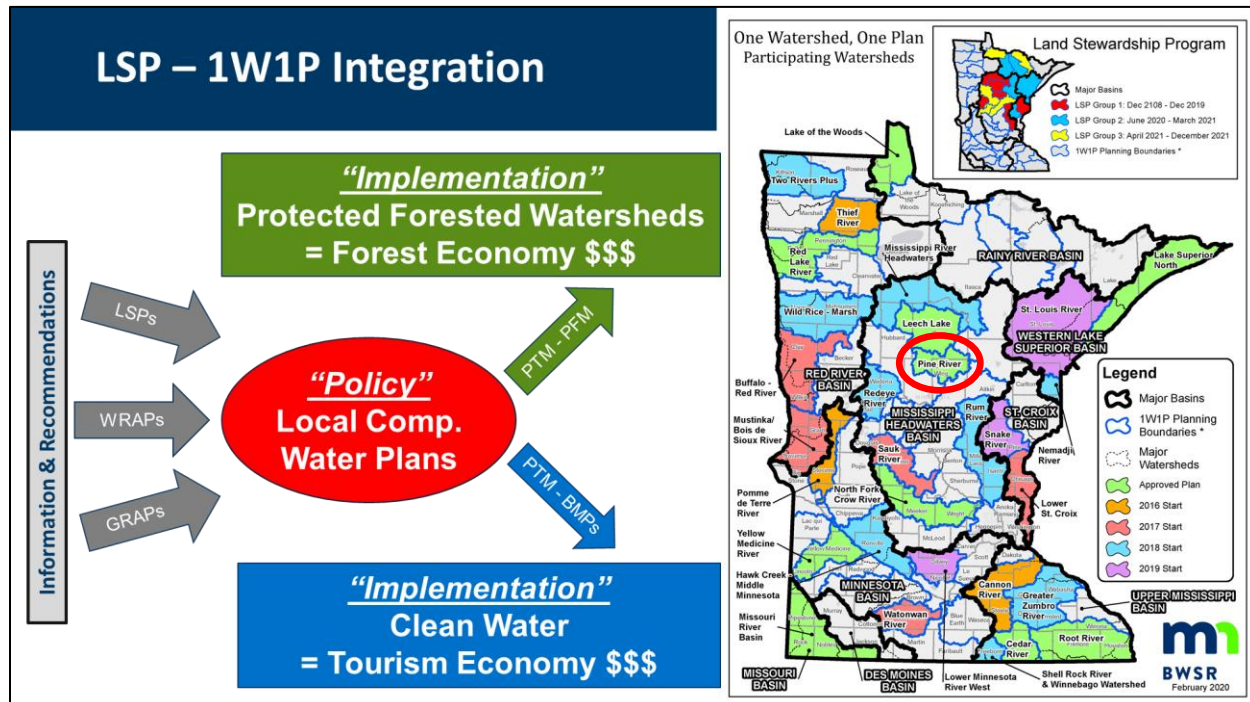
#### **6. Silvicultural Considerations**

- 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](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](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](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](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:

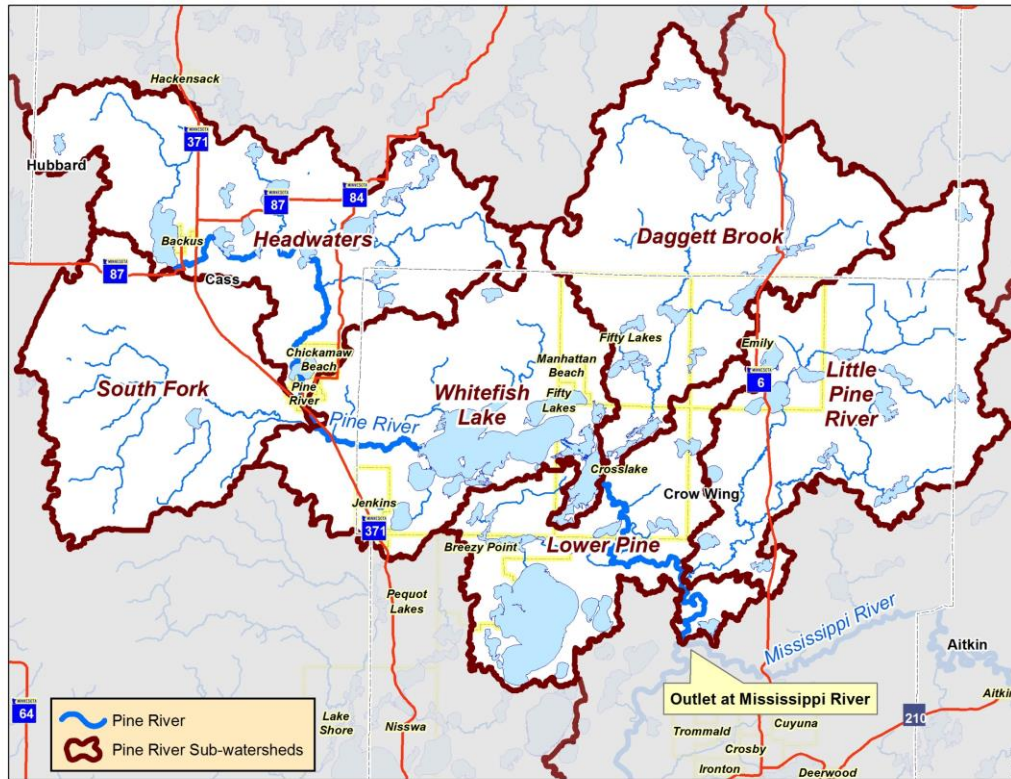
- Conserve Working Forest Lands.
- Protect Forests from Harm.
- Enhance Public Benefits from Trees and Forests.

“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 – Pine River Major Watershed



Subwd no.	Subwatershed name	HUC no.	Acres	No. of minors
1	Headwaters Pine River	701010501	95,510	11
2	South Fork Pine River	701010502	74,074	13
3	Daggett Brook	701010503	95,494	11
4	Whitefish Lake	701010504	83,980	10
5	Little Pine River	701010505	90,743	17
6	Lower Pine River	701010506	61,086	7
	<b>Totals</b>		<b>500,887</b>	<b>69</b>

