# **Comparing LANDFIRE 2014 and Remap vegetation data to Wisconsin’s local land cover data**

David Kolodziejski and Megan Sebasky

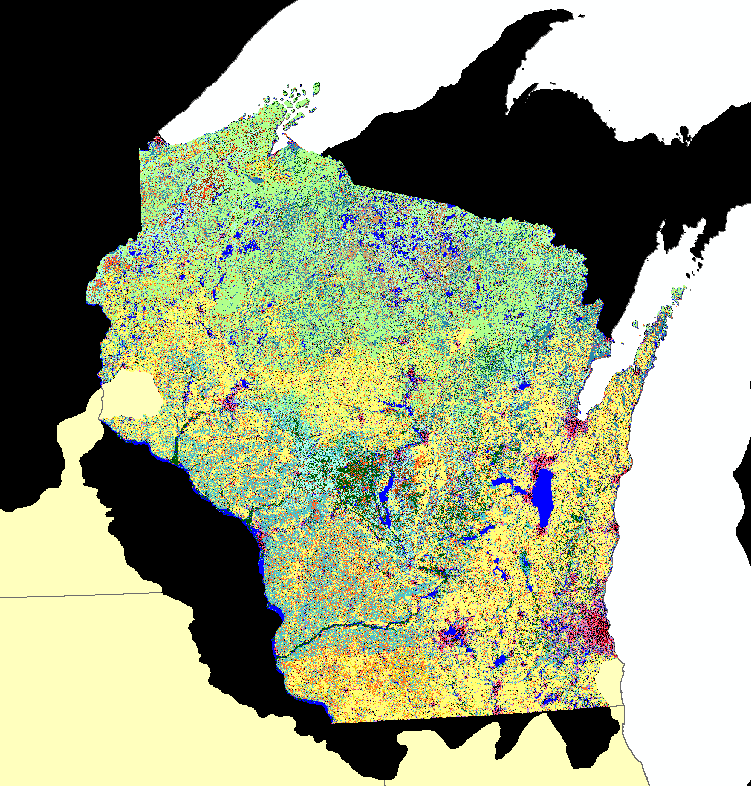
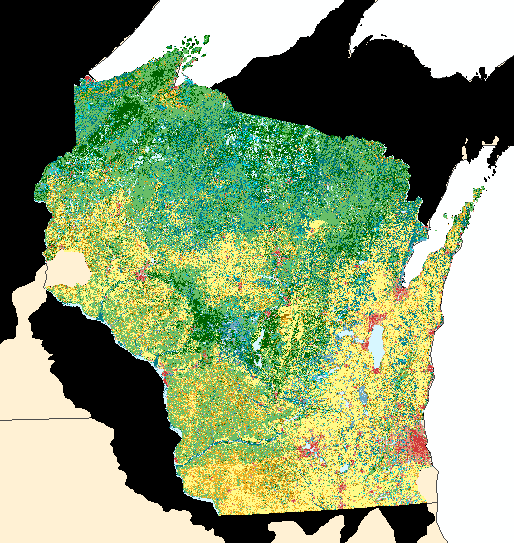
## Overview

This report revisits and re-creates many of the graphs that are included in the *“**[Lake State LF Issues Document](https://drive.google.com/file/d/1MVT-kKY8uqWbDb08I0TuPaS6Y05k2F6F/view?usp=sharing)”* by Robert Ziel and Megan Sebasky comparing LANDFIRE (LF) 2014 vegetation with the state of Wisconsin’s 30m2 landcover dataset, [Wiscland 2.0](https://dnr.wi.gov/maps/WISCLAND.html).These graphs were recreated by using the [Vegetation Production Unit](https://www.landfire.gov/documents/LF_Remap_Production_by_Product.pdf) (VPU) 10 new Remap vegetation data shared by the LANDFIRE Vegetation Team. VPU 10 was clipped to Wisconsin (Figure 1), and Wiscland 2.0 was clipped to VPU 10 (Figure 2) to properly conduct the comparisons.

This document recreates the graphs from the following comparisons to assess the Remap data quality:

* Existing Vegetation Type (EVT) Distribution Summary (LF 2014, Wiscland 2.0, and LF Remap on a single graph)
* Northern Hardwoods EVT Distribution Summary
* Wiscland 2.0 Cover and EVT Barrens Summary *(Note: Existing Vegetation Cover (EVC) is not available and was excluded from the comparison)*
* EVT Distribution by wetlands and uplands

Note: Comparisons utilizing the US Tree Atlas Database and SSURGO were excluded from this comparison.



*Figure 2: Wiscland 2.0 clipped to VPU 10 (Black)*

*Figure 1: LF Remap VPU 10 (Black) clipped to Wisconsin*

## Wiscland 2.0 Dataset Summary

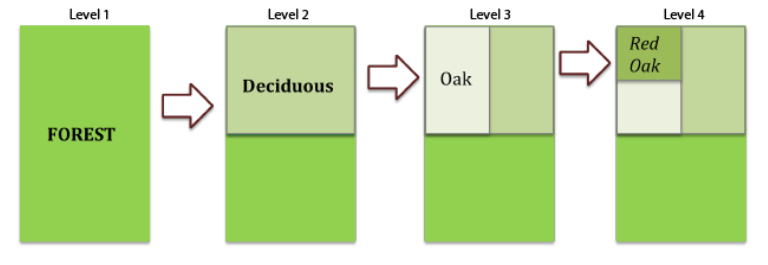
In the Lake States, there are a variety of mapping alternatives based on resource management objectives. Planning for timber and wildlife objectives demand detailed cover maps. Prominent among these efforts is the Wiscland 2 Land Cover project, completed in 2016. It is a statewide classification delivered at the same pixel resolution as LANDFIRE (30m²), making it suitable for comparative analysis, keeping in mind the difference in the suggested use scale. Like LANDFIRE, Wiscland 2 was created with a supervised classification approach, using ground-truthed plots to train the classification of Landsat imagery. There are a few key takeaways to keep in mind when using this dataset:

1. This product represents the land cover as modeled using imagery acquired between 2010 and 2014.
2. While the land cover is represented at a 30m² resolution, the smallest feature represented in the map is approximately two acres (nine pixels) in size. Therefore, the map is trained using point-and-based data but is validated at or above two-acre MMU.
3. Additional information, including the methodology, results, and discussion of the Wiscland 2.0 Land Cover project can be located [here](https://p.widencdn.net/8ghipa/Wiscland_2_User_Guide_September_2016).

### Accuracy Assessment

The Wiscland 2.0 dataset is a detailed landcover dataset that provides an in-depth classification schema (ranging from Level 1 – 4) from the most generalized level (Level 1) to the most detailed level within the project’s constraints (Level 4). Figure 3 provides a good example of the classification scheme within the Wiscland dataset. Once each classification level was completed, the land cover data gets cross-referenced by plot/ground truth data to access the spatial accuracy of the produced product. Each classification gets graded on four different categories of accuracy: Precision, Recall, F-Score, and Area Under the Receiver Operator Curve (AUC). For our purposes, the best metric to use for identifying accuracy is the AUC. The AUC metric considers the balance between true positives (correctly classified) and false positives (commissions) to measure how well the classification model discriminates between the class under consideration and the other land cover classes. The AUC measure is more relevant in assessing the performance of the model than indicating the types of error in the map. A high AUC signifies a good model selection given the training data. Each section in this document will provide the AUC metric of each landcover classification to provide additional insight on the validity of the Wiscland 2.0 dataset.

The Wiscland data, user guide, and accuracy assessment can be found [here](https://data-wi-dnr.opendata.arcgis.com/search?q=wiscland).



*Figure 3: Example of Wiscland Classification Schema from the* [*Wiscland 2.0 User Guide*](https://p.widencdn.net/8ghipa/Wiscland_2_User_Guide_September_2016)

# Existing Vegetation Distribution Summary:

This graph (Figure 4) highlights the differences between LF 2014 and Wiscland 2.0 (as [in LF Issues document](https://drive.google.com/file/d/139w-s7BWviMPdSK2wOxCsXF2Kb52Rmbi/view?usp=sharing)) and adds how those metrics change in the upcoming LF Remap (purple). The classification of EVTs and Wiscland land cover types into the below classes is provided in the appendix of this document (slight changes made from the LF Issues document). This summary is by total acreage, not a pixel-by-pixel assessment.

The grouping of EVTs and Wiscland2 cover types into comparable associations requires some subjective decisions. For example, the EVT barrens are grouped with forests (pine, oak, and mixed) here while at least 25% of those areas are substantially open. The Wiscland2 Central Hardwoods type is grouped with Other Upland Deciduous while at least some of its area could be applied to both Northern Hardwoods and Oak types.

*Figure 4:*

# Northern Hardwoods EVT Distribution Summary:

The over-mapping of Northern Hardwood Forests is a large concern in the Lake States especially in terms of the fire behavior difference between this vegetation type and the ones that are primarily mis-mapped (e.g. oak, aspen, pine). Over 9 million acres of Northern Hardwoods are mapped throughout Wisconsin in LF 2014, while the Wiscland 2.0 dataset only identifies 2.7 million acres of this vegetation type. In LANDFIRE Remap, the total acreage of Northern Hardwoods EVT classes dropped to 6.5 million, a 28% reduction from LF 2014.

For the Wiscland data for this analysis, three Level 4 Land Cover types were identified as Northern Hardwoods: Sugar Maple, Other Northern Hardwoods, and Red Maple (Table 1). The former two classes combined have high spatial accuracy (AUC=0.88, Table 1). Red Maple was not classified as Northern Hardwoods in the Wiscland Level 3 hierarchy but remains its own class and has an AUC of 0.62. This was due to its binomial nature and difficultly of discerning between upland and lowland classifications. However, it is most commonly confused with the Northern Hardwoods classification, which we combine together, therefore increasing the accuracy. For this analysis, we classified Red Maple as a Northern Hardwood due to LANDFIRE’s definition of the LANDFIRE EVTs and the similarity in fire behavior among these forest types.

For LANDFIRE data, we will be focusing on Laurentian-Acadian Northern Hardwood Forests and North-Central Interior Maple Basswood as they make up 99% of the area of all generally defined Northern Hardwoods throughout Wisconsin. The following graph identifies how the spatial distribution (pixel-by-pixel) of these LANDFIRE Northern Hardwood EVTs compares with broad vegetation groupings from Wiscland based on LF 2014 and LF Remap. *Note, in the graph below the total sum of Northern Hardwoods acreage within LF 2014 and LF Remap is an aggregation of the total acres of Laurentian-Acadian Northern Hardwood Forests and North-Central Interior Maple Basswood only. Percentages are included to better compare how LANDFIRE Northern Hardwoods compare within the Wiscland 2.0 dataset.*

**In LANDFIRE 2014, only 28% of these Northern Hardwoods** EVTs were identified as similar northern hardwood types within the Wiscland 2.0 dataset. Fortunately, the **correlation between the EVT Northern Hardwoods and Wiscland has increased slightly to 36% in the LF Remap.** However, there is still room for improvement. In LF 2014, approximately 33% of all Laurentian-Acadian Northern Hardwood Forests and North-Central Interior Maple Basswood (3,072,716 acres) EVTs were classified within Oak or Aspen/Birch classification in the Wiscland 2.0 (Figure 5). Even though the overall acreage of Northern Hardwoods has decreased in LF Remap, the percentage classified as Oak or Aspen/Birch in Wiscland 2.0 increased to 37% (2,436,107 acres Figure 6). From conversations with ecologists from NatureServe, Aspen/Birch and Northern Red Oaks are often identified as Northern Hardwoods (Laurentian-Acadian Hardwood Forest) in the [Natural Vegetation Classification](http://usnvc.org/data-standard/natural-vegetation-classification/) (NVC). For Aspen/Birch specifically, they are grouped into Northern Hardwoods NVC because they represent a successional stage of this ecosystem. However, in the EVT classification based on Ecological Systems, there is a separate Aspen/Birch class (“Boreal Aspen-Birch Forest” in 2014 and “Laurentian-Acadian Sub-boreal Aspen-Birch Forest” in Remap), but we see little of this EVT mapped in Wisconsin (Figure 4). It is still possible that some of the EVT misclassifications of Aspen/Birch relates to the reasoning behind the NVC in that they represent a successional stage of Northern Hardwoods and potentially other classes.

#### Table 1: Wiscland 2.0 Northern Hardwoods Accuracy Assessment

|  |  |  |  |
| --- | --- | --- | --- |
| **Wiscland Level 4 Land Cover** | **Wiscland Level 3 Land Cover** | **Cover Type Group** | **Level 3 Accuracy Assessment (AUC)** |
| Sugar Maple | N. Hardwoods | N. Hardwoods | **0.88** |
| Other Northern Hardwoods |
| Red Maple\* | Red Maple | N. Hardwoods | **0.62** |

*Figure 6*

**Acres (per Thousand)**

### Barrens Existing Vegetation Types (EVT) and Wiscland 2.0 Comparison:

|  |  |  |
| --- | --- | --- |
| **Cover Type Group** | **Wiscland Level 2 Land Cover** | **Level 2 (or 1) Accuracy Assessment (AUC)** |
| Other Upland Conifer | Coniferous Forest | **0.91** |
| Pine |
| Aspen/Birch | Broad-leaved Deciduous Forest | **0.92** |
| N. Hardwoods |
| Oak |
| Other Upland Deciduous |
| Wetland Conifer Forest | Wetland (Split between Emergent/Wet Meadow, Lowland Scrub/Shrub, and Forested Wetland | **0.95 in Level 1** |
| Wetland Deciduous Forest |
| Wetland Mixed Forest |
| Wetland Grass/Shrub |

In the Lake States Issues document, we discuss issues with the Barrens EVT classifications, particularly that these areas generally have more than 40% tree cover as identified by LANDFIRE Existing Vegetation Cover (EVC) and are commonly identified as forested types in Wiscland. While we do not have the Remap EVC dataset to comment on yet, the spatial distribution of Barrens EVTs in comparison to Wiscland is presented here.

The overall acreage of all Barrens EVTs has dropped substantially throughout Wisconsin between LANDFIRE 2014 (956,441 acres) and LANDFIRE Remap (278,523 acres). This decrease is somewhat expected due to the inability to maintain Barrens ecosystems with fire suppression as they are converted to forests. For this summary, we will be focusing on **Laurentian** Barrens EVTs (four in LF 2014 and three in LF Remap) as they provide a reasonable representation of this classification (87% in LF 2014 and 71% in LF Remap). Amongst these Laurentian Barrens EVTs, there was a decrease of 75% between LF 2014 and LF Remap (834,405 acres in LF 2014 vs. 205,532 acres in LF Remap). The graphs below identify how the spatial distribution (pixel-by-pixel) of Laurentian Barrens Types within LANDFIRE 2014 and Remap compare with general cover classifications in the Wiscland data. These correspond to Wiscland Level 2 classifications and all have high accuracy (0.91-0.95, Table 2).

Although the overall acreage of Laurentian Barrens EVTs has decreased, the spatial distribution between these EVT Barrens has worsened from LF 2014 in comparison to the Wiscland dataset. In the original analysis (using LF 2014 data) located in the [Lake State Issues Document](https://drive.google.com/file/d/139w-s7BWviMPdSK2wOxCsXF2Kb52Rmbi/view?usp=sharing) (Figure 7), approximately 23% of all Laurentian Oak Barrens were classified as conifer in Wiscland 2.0 and 18% of all Laurentian Pine Barrens were classified as deciduous. Unfortunately, the mis-mapping of these Laurentian Barrens has not improved in LF Remap where 26% of Laurentian Oak Barrens are now classified as conifer and 25% Laurentian Pine Barrens were classified as deciduous within the Wiscland 2.0 dataset (Figure 8).

A notable improvement between LF 2014 and LF Remap is the substantial decrease in Laurentian Barrens classified as wetland in the Wiscland 2.0 dataset. In our original analysis, over 125 thousand acres of Laurentian Barrens were classified as wetland with the majority belonging to the Laurentian Oak Barrens EVT (48%). In LF Remap, only 14 thousand acres are classified as wetland within Wiscland with the majority of these EVTs being Laurentian Pine Barrens. This is encouraging to see as we typically expect Barrens to be mapped in upland landscapes.

#### Table 2: Accuracy Assessment (AUC) of Conifer, Deciduous, and Wetland Landcover Types in Wiscland 2.0

*Figure 7*

*Figure 8*

## Wetland EVT Distribution Summary:

Wetland communities have large importance on the landscape as they can drastically influence fire behavior as particular types can experience severe fire activity but those same types and others may also act as barriers to fire spread. Overall, the acreage of all Wetland Vegetation Types has increased substantially between LANDFIRE versions, from 2.9 million acres in LF 2014 to 5.4 million acres in LF Remap. It is crucial to accurately identify the spatial distribution of these communities in order to accurately predict fire behavior and identify potential high areas of risk and concern. [The Lake States Issues Document](https://drive.google.com/file/d/1MVT-kKY8uqWbDb08I0TuPaS6Y05k2F6F/view?usp=sharing) previously identified that approximately 25% of all Wetland Vegetation Types in LF 2014 were misclassified as Upland in the Wiscland 2.0 Dataset. Even though these vegetation types almost doubled in acreage, it does not appear that the accuracy of wetland types has improved in the LANDFIRE Remap as 27% (1.6 million acres) of Wetland Vegetation Types are misclassified as upland in comparison to the Wiscland 2.0 dataset.

For this analysis, we sorted Wiscland vegetation cover types based on 15 classes categorized as Wetland or Upland and conducted a pixel-by-pixel analysis to determine how well LANDFIRE wetland EVTs coincide within the Wiscland 2.0 dataset. Because we are attempting to distinguish between general Upland and Lowland classifications, it is appropriate to use the Level 1 Accuracy assessment to provide a better indication of the validity of the dataset. The table below identifies all the various level 1 land cover classifications that reside within the Wiscland 2.0 dataset, determines whether they are upland of wetland, and provides their AUC accuracy metric.

Across the Wisconsin landscape, several changes have occurred between the spatial distribution of LANDFIRE EVTs within these wetland communities. In LF 2014, Wisconsin wetlands were predominately composed of Laurentian-Acadian Lowland Systems (47%) and Boreal Acidic Peatland Systems (29%). However, the distribution of these wetland systems has changed in LF Remap where 49% are composed of Laurentian-Acadian Lowland Systems but only 17% reflect Boreal Acidic Peatland Systems. For simplicity, the figures on the following pages depict how all the EVTs within Boreal Acidic Peatland Systems (two in both 2014 and Remap) and Laurentian Acadian Lowland Types (eight in 2014 and seven in Remap) are distributed throughout Wiscland general cover types between LF 2014 (Figure 8) and LF Remap (Figure 9). These systems account for 70% (~ 2 million acres) of all Wetlands in LF 2014 and 67% (~3.6 million acres) in LF Remap.

Even though Laurentian-Acadian Lowland Systems experienced little change in percent composition of wetland acres between datasets (47% in 2014 and 49% in Remap) there are concerns involving the spatial accuracy across the Wisconsin landscape, especially regarding the potential misclassification of upland systems as wetlands. The Laurentian Acadian Alkaline Conifer-Hardwood Swamp EVT (split between forest and shrubland in LF 2014) increased substantially between LANDFIRE datasets; increasing from 660 thousand acres in LF 2014 to 2.3 million acres in LF Remap. However, 700 thousand acres of this EVT are classified as Upland in Wiscland 2.0 and accounts for 44% of the 1.6 million total wetland acres that are misclassified (Table 3). The table below (Table 3) Identifies the top 10 LF Remap Wetland EVTs that are classified as Upland in the Wiscland 2.0 dataset and accounts for 93% (in acres) of all identified wetland misclassifications.

Overall, there is a high level of confidence surrounding the distribution of general Upland and Wetland cover types within the Wiscland 2.0 dataset (Table 4). Within this dataset, Wetland cover types have a highly confident AUC value of 0.95 and, with the exception of Shrubland, Upland types (identifies as Grassland, Forest, and Shrubland) are all generally mapped with high confidence as well. These results further validate the need to improve upon the accuracy of Wetlands within LANDFIRE as 27% (1.6 million acres) of Wetland EVT acres are being inappropriate mapped as Upland in comparison to the highly accurate land cover dataset in Wiscland 2.0.

#### Table 3: Top 10 LANDFIRE Remap Wetland EVTs that are Classified as Upland in Wiscland 2.0

|  |  |  |
| --- | --- | --- |
| **LF Remap EVTs** | **Sum of Wetland Acres misclassified as Upland** | **Percent of total area of wetlands misclassified as uplands** |
| Laurentian-Acadian Alkaline Conifer-Hardwood Swamp | 694,364 | 45% |
| Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen | 210,537 | 14% |
| North-Central Interior and Appalachian Rich Swamp | 175,733 | 11% |
| North-Central Interior Floodplain Forest | 69,755 | 4% |
| North-Central Interior and Appalachian Acidic Peatland Woodland | 59,630 | 4% |
| Northern & Central Native Ruderal Flooded & Swamp Forest | 57,939 | 4% |
| Northern & Central Ruderal Wet Meadow & Marsh | 52,487 | 3% |
| Eastern Cool Temperate Developed Ruderal Mixed Forested Wetland | 50,609 | 3% |
| Laurentian-Acadian Wet Meadow | 37,435 | 2% |
| North-Central Interior Freshwater Marsh | 35,987 | 2% |

#### Table 4: Level 1 Land Cover Accuracy Assessment within Wiscland 2.0

|  |  |  |  |
| --- | --- | --- | --- |
| **Wiscland Vegetation Cover Type Group** | **Wiscland Level 1 Land Cover Classification** | **Upland or Wetland?** | **Level 1 Accuracy Assessment (AUC)** |
| Aspen/Birch | Forest | Upland | **0.95** |
| Mixed Forest |
| N. Hardwoods |
| Oak |
| Other Upland Conifer |
| Pine |
| Other Upland Deciduous |
| Grass | Grassland | **0.96** |
| Shrub | Shrubland | **0.53** |
| Wetland Conifer Forest | Wetland | Wetland | **0.95** |
| Wetland Deciduous Forest |
| Wetland Grass/Shrub |
| Wetland Mixed Forest |
| *Agriculture* | *N/A* | *Upland* | *N/A* |
| *Non-Burnable* | *Urban/Developed, Open Water, Barren* | *(0.99, 0.99, 0.85)* |

*Note: Wiscland didn’t perform and an accurate assessment on Agriculture because data for this type was extracted through the* [*National Agriculture Statistic Service (NASS) Crop Data Layer (CDL).*](https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php) *Non-Burnable Vegetation Cover Type Group is a culmination of Developed, Open Water, and Barren land cover types and, for simplicity purposes, classified as upland but are aware that this may be considered wetland in other areas as well.*

## Figure 8: LANDFIRE 2014 Laurentian-Acadian Lowland & Boreal Acidic Peatland EVTs and Wiscland 2.0 Cover Types

**~28% of the Laurentian-Acadian and Boreal Acidic Peatland EVTs are classified within Upland Classification**

## Figure 9: LANDFIRE Remap Laurentian-Acadian Lowland & Boreal Acidic Peatland EVTs and Wiscland 2.0 Cover Types

**~27% of the Laurentian-Acadian and Boreal Acidic Peatland EVTs are classified within Upland Classification**

## Appendix:

### Cover Type Groupings for LANDFIRE 2014 and LANDFIRE Remap

|  |  |
| --- | --- |
| **EVT Name** | **Cover Type Group** |
| Eastern Warm Temperate Pasture and Hayland | Ag |
| Eastern Cool Temperate Fallow/Idle Cropland | Ag |
| Eastern Cool Temperate Row Crop | Ag |
| Eastern Cool Temperate Pasture and Hayland | Ag |
| Eastern Cool Temperate Close Grown Crop | Ag |
| Eastern Cool Temperate Wheat | Ag |
| Eastern Cool Temperate Row Crop - Close Grown Crop | Ag |
| Eastern Cool Temperate Orchard | Ag |
| Eastern Cool Temperate Bush fruit and berries | Ag |
| Eastern Cool Temperate Vineyard | Ag |
| Eastern Warm Temperate Row Crop | Ag |
| Eastern Warm Temperate Close Grown Crop | Ag |
| Eastern Warm Temperate Wheat | Ag |
| Laurentian-Acadian Sub-boreal Aspen-Birch Forest | Aspen/Birch |
| Boreal Aspen-Birch Forest | Aspen-Birch |
| Developed-Roads | Developed |
| Developed-Low Intensity | Developed |
| Developed-Medium Intensity | Developed |
| Developed-High Intensity | Developed |
| Barren | Developed |
| Quarries-Strip Mines-Gravel Pits | Developed |
| Quarries-Strip Mines-Gravel Pits-Well and Wind Pads | Developed |
| Eastern Cool Temperate Developed Ruderal Grassland | Grass |
| Eastern Cool Temperate Urban Herbaceous | Grass |
| North-Central Interior Sand and Gravel Tallgrass Prairie | Grass |
| Paleozoic Plateau Bluff and Talus Herbaceous | Grass |
| Eastern Cool Temperate Undeveloped Ruderal Grassland | Grass |
| Recently Logged-Herb and Grass Cover | Grass |
| Central Tallgrass Prairie | Grass |
| Recently Burned-Herb and Grass Cover | Grass |
| Modified/Managed Northern Tallgrass Grassland | Grass |
| North-Central Oak Barrens Herbaceous | Grass |
| Introduced Upland Vegetation-Perennial Grassland and Forbland | Grass |
| Northern Tallgrass Prairie | Grass |
| Recently Disturbed Other-Herb and Grass Cover | Grass |
| Great Lakes Alvar | Grass |
| Great Lakes Dune Grassland | Grass |
| Northern & Central Ruderal Meadow | Grass |
| Paleozoic Plateau Bluff and Talus Woodland | Mixed Forest |
| Boreal Hardwood Forest | Mixed Forest |
| Boreal White Spruce-Fir-Hardwood Forest | Mixed Forest |
| Laurentian-Acadian Northern Pine-Oak Forest | Mixed Forest |
| Laurentian-Acadian Pine-Hemlock-Hardwood Forest | Mixed Forest |
| Eastern Cool Temperate Urban Mixed Forest | Mixed Forest |
| Laurentian Pine-Oak Barrens | Mixed Forest |
| Great Lakes Wooded Dune and Swale | Mixed Forest |
| Eastern Cool Temperate Developed Ruderal Mixed Forest | Mixed Forest |
| Ruderal Forest-Northern and Central Hardwood and Conifer | Mixed Forest |
| Eastern Cool Temperate Undeveloped Ruderal Mixed Forest | Mixed Forest |
| Central Interior Highlands Dry Acidic Glade and Barrens | Mixed Forest |
| Central Interior Highlands Calcareous Glade and Barrens Woodland | Mixed Forest |
| Recently Logged-Tree Cover | Mixed Forest |
| Recently Burned-Tree Cover | Mixed Forest |
| Recently Disturbed Other-Tree Cover | Mixed Forest |
| Laurentian-Acadian Northern Pine-(Oak) Forest | Mixed Forest |
| Northern & Central Native Ruderal Forest | Mixed Forest |
| Laurentian-Acadian Northern Hardwoods Forest | N. Hardwoods |
| North-Central Interior Maple-Basswood Forest | N. Hardwoods |
| Laurentian-Acadian Hardwood Forest | N. Hardwoods |
| North-Central Interior Beech-Maple Forest | N. Hardwoods |
| Western Cool Temperate Aquaculture | N/A |
| Eastern Cool Temperate Aquaculture | N/A |
| Great Lakes Alkaline Rocky Shore and Cliff | N/A |
| Great Lakes Dune | N/A |
| Laurentian-Acadian Acidic Cliff and Talus | N/A |
| Laurentian-Acadian Calcareous Cliff and Talus | N/A |
| North-Central Interior Dry-Mesic Oak Forest and Woodland | Oak |
| North-Central Interior Dry Oak Forest and Woodland | Oak |
| Laurentian Oak Barrens | Oak |
| Laurentian-Acadian Northern Oak Forest | Oak |
| North-Central Oak Barrens Woodland | Oak |
| North-Central Interior Oak Savanna | Oak |
| Open Water | Open Water |
| Introduced Upland Vegetation-Treed | Other Upland Conifer |
| Boreal White Spruce-Fir Forest | Other Upland Conifer |
| Eastern Cool Temperate Urban Evergreen Forest | Other Upland Conifer |
| Eastern Cool Temperate Developed Ruderal Evergreen Forest | Other Upland Conifer |
| Eastern Cool Temperate Undeveloped Ruderal Evergreen Forest | Other Upland Conifer |
| Laurentian-Acadian Sub-boreal Mesic Balsam Fir-Spruce Forest | Other Upland Conifer |
| Laurentian Acidic Rocky Outcrop Woodland | Other Upland Conifer |
| Northeastern North American Temperate Forest Plantation | Other Upland Conifer |
| Eastern Cool Temperate Developed Ruderal Deciduous Forest | Other Upland Deciduous |
| Eastern Cool Temperate Urban Deciduous Forest | Other Upland Deciduous |
| Eastern Cool Temperate Undeveloped Ruderal Deciduous Forest | Other Upland Deciduous |
| North-Central Interior Quartzite Glade | Other Upland Deciduous |
| Laurentian-Acadian Pine-Hemlock Forest | Pine |
| Managed Tree Plantation-Northern and Central Hardwood and Conifer Plantation Group | Pine |
| Laurentian-Acadian Northern Pine Forest | Pine |
| Laurentian Pine Barrens | Pine |
| Boreal Jack Pine-Black Spruce Forest | Pine |
| Laurentian-Acadian Sub-boreal Dry-Mesic Pine-Black Spruce Forest | Pine |
| Laurentian Jack Pine-Red Pine Forest | Pine |
| Laurentian-Acadian Sub-boreal Dry-Mesic Pine-Black Spruce-Hardwood Forest | Pine |
| Eastern Cool Temperate Urban Shrubland | Shrub |
| Eastern Cool Temperate Developed Ruderal Shrubland | Shrub |
| Laurentian Shrubland Barrens | Shrub |
| Great Lakes Alvar Shrubland | Shrub |
| Eastern Cool Temperate Undeveloped Ruderal Shrubland | Shrub |
| North-Central Interior Sand and Gravel Shrubland | Shrub |
| Modified/Managed Northern Tallgrass Shrubland | Shrub |
| Recently Logged-Shrub Cover | Shrub |
| Recently Burned-Shrub Cover | Shrub |
| Recently Disturbed Other-Shrub Cover | Shrub |
| Northern & Central Ruderal Shrubland | Shrub |
| Laurentian Acidic Rocky Outcrop Shrubland | Shrub |
| Central Interior Acidic Cliff and Talus | Sparsely Vegetated |
| Laurentian-Acadian Lakeshore Beach | Sparsely Vegetated |
| Boreal Acidic Peatland Forest | Wetland Conifer Forest |
| Boreal-Laurentian Conifer Acidic Swamp and Treed Poor Fen | Wetland Conifer Forest |
| North-Central Interior and Appalachian Acidic Peatland Woodland | Wetland Conifer Forest |
| Central Interior and Appalachian Swamp Forest | Wetland Deciduous Forest |
| Laurentian-Acadian Floodplain Forest | Wetland Deciduous Forest |
| Eastern Boreal Floodplain Woodland | Wetland Deciduous Forest |
| Central Interior and Appalachian Floodplain Forest | Wetland Deciduous Forest |
| North-Central Interior Wet Flatwoods | Wetland Deciduous Forest |
| North-Central Interior and Appalachian Rich Swamp | Wetland Deciduous Forest |
| North-Central Interior Floodplain Forest | Wetland Deciduous Forest |
| Central Interior and Appalachian Herbaceous Wetlands | Wetland Grass/Shrub |
| Laurentian-Acadian Herbaceous Wetlands | Wetland Grass/Shrub |
| Boreal Acidic Peatland Shrubland | Wetland Grass/Shrub |
| Boreal Acidic Peatland Herbaceous | Wetland Grass/Shrub |
| Central Interior and Appalachian Swamp Shrubland | Wetland Grass/Shrub |
| Laurentian-Acadian Shrub Wetlands | Wetland Grass/Shrub |
| Central Interior and Appalachian Shrub Wetlands | Wetland Grass/Shrub |
| Central Interior and Appalachian Floodplain Shrubland | Wetland Grass/Shrub |
| Laurentian-Acadian Floodplain Herbaceous | Wetland Grass/Shrub |
| Eastern Boreal Floodplain Shrubland | Wetland Grass/Shrub |
| Great Lakes Coastal Marsh Herbaceous | Wetland Grass/Shrub |
| Central Interior and Appalachian Floodplain Herbaceous | Wetland Grass/Shrub |
| Laurentian-Acadian Floodplain Shrubland | Wetland Grass/Shrub |
| Great Lakes Coastal Marsh Shrubland | Wetland Grass/Shrub |
| Eastern Great Plains Wet Meadow-Prairie-Marsh | Wetland Grass/Shrub |
| Great Plains Prairie Pothole | Wetland Grass/Shrub |
| Eastern Boreal Floodplain Herbaceous | Wetland Grass/Shrub |
| Central Interior and Appalachian Riparian Shrubland | Wetland Grass/Shrub |
| Central Interior and Appalachian Riparian Herbaceous | Wetland Grass/Shrub |
| Eastern Cool Temperate Developed Ruderal Shrub Wetland | Wetland Grass/Shrub |
| Eastern Cool Temperate Developed Ruderal Herbaceous Wetland | Wetland Grass/Shrub |
| Boreal-Laurentian Bog | Wetland Grass/Shrub |
| Boreal-Laurentian-Acadian Acidic Basin Fen | Wetland Grass/Shrub |
| Laurentian-Acadian Alkaline Fen | Wetland Grass/Shrub |
| Laurentian-Acadian Freshwater Marsh | Wetland Grass/Shrub |
| Laurentian-Acadian Wet Meadow | Wetland Grass/Shrub |
| North-Central Interior Freshwater Marsh | Wetland Grass/Shrub |
| North-Central Interior Shrub Alkaline Fen | Wetland Grass/Shrub |
| North-Central Interior Shrub Swamp | Wetland Grass/Shrub |
| Northern Great Lakes Coastal Marsh | Wetland Grass/Shrub |
| Northern Great Lakes Interdunal Wetland | Wetland Grass/Shrub |
| Northern & Central Ruderal Wet Meadow & Marsh | Wetland Grass/Shrub |
| Laurentian-Acadian Shrub Swamp | Wetland Grass/Shrub |
| North-Central Interior and Appalachian Acidic Peatland Shrubland | Wetland Grass/Shrub |
| North-Central Interior Floodplain Shrubland | Wetland Grass/Shrub |
| North-Central Interior Graminoid Alkaline Fen | Wetland Grass/Shrub |
| North-Central Interior Wet Meadow | Wetland Grass/Shrub |
| Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Shrubland | Wetland Mixed Forest |
| Central Interior and Appalachian Riparian Forest | Wetland Mixed Forest |
| Laurentian-Acadian Alkaline Conifer-Hardwood Swamp Forest | Wetland Mixed Forest |
| Laurentian-Acadian Forested Wetlands | Wetland Mixed Forest |
| Laurentian-Acadian Alkaline Conifer-Hardwood Swamp | Wetland Mixed Forest |
| Eastern Cool Temperate Developed Ruderal Mixed Forested Wetland | Wetland Mixed Forest |
| Northern & Central Native Ruderal Flooded & Swamp Forest | Wetland Mixed Forest |

### Cover Type Groupings for Wiscland 2.0

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| **CLS\_DESC\_4** | **Cover Type Group** |
| Cash Grain | Ag |
| Continuous Corn | Ag |
| Dairy Rotation | Ag |
| Potato/Vegetable | Ag |
| Cranberries | Ag |
| Hay | Ag |
| Pasture | Ag |
| Aspen Forest | Aspen/Birch |
| Paper Birch | Aspen/Birch |
| Cool-season Grass | Grass |
| Warm-season Grass | Grass |
| Hemlock Hardwoods | Mixed Forest |
| Mixed Deciduous/Coniferous Forest | Mixed Forest |
| Sugar Maple | N. Hardwoods |
| Other Northern Hardwoods | N. Hardwoods |
| Red Maple | N. Hardwoods |
| Open Water | NB8 |
| Barren | NB9 |
| Red Oak | Oak |
| N. Pin Oak, Black Oak | Oak |
| White Oak, Burr Oak | Oak |
| Fir Spruce | Other Upland Conifer |
| Central Hardwoods | Other Upland Deciduous |
| Jack Pine | Pine |
| Red Pine | Pine |
| White Pine | Pine |
| Shrubland | Shrub |
| Developed, High Intensity | Urban/Developed |
| Developed, Low Intensity | Urban/Developed |
| White Cedar | Wetland Conifer Forest |
| Black Spruce | Wetland Conifer Forest |
| Tamarack | Wetland Conifer Forest |
| Other Coniferous Forested Wetland | Wetland Conifer Forest |
| Aspen Forested Wetland | Wetland Deciduous Forest |
| Silver Maple | Wetland Deciduous Forest |
| Other Bottomland Hardwoods | Wetland Deciduous Forest |
| Black Ash | Wetland Deciduous Forest |
| Other Swamp Hardwoods | Wetland Deciduous Forest |
| Reed Canary Grass | Wetland Grass/Shrub |
| Floating Aquatic Herbaceous Vegetation | Wetland Grass/Shrub |
| Cattails | Wetland Grass/Shrub |
| Other Emergent/Wet Meadow | Wetland Grass/Shrub |
| Buckthorn/Honeysuckle | Wetland Grass/Shrub |
| Other Broad-leaved Deciduous Scrub/Shrub | Wetland Grass/Shrub |
| Broad-leaved Evergreen Scrub/Shrub | Wetland Grass/Shrub |
| Needle-leaved Scrub/Shrub | Wetland Grass/Shrub |
| Mixed Deciduous/Coniferous Forested Wetland | Wetland Mixed Forest |