

Setting Floristic Quality Assessment Benchmarks for Inland Wetland Plant Community Condition Across Wisconsin: Establishing a Reference Wetland Network

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Ryan O'Connor, Kevin Doyle

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Photo: Pat Trochlell (WDNR Bureau of Watershed Management), Kevin Doyle (WDNR Bureau of Natural Heritage Conservation), and Tom Bernthal (WDNR Bureau of Water Quality) survey a high-quality southern sedge meadow at Goose Lake Drumlins State Natural Area, Dane Co., Wisconsin. Photo by Ryan O'Connor.

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Contact for Further Information

Ryan O'Connor
Bureau of Natural Heritage Conservation
Wisconsin Department of Natural Resources
101 S. Webster Street
PO Box 7921
Madison, WI 53707-7921
608- 266-7714
Ryan.OConnor@Wisconsin.gov

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Introduction and Background

From 2013-2017, the WNDR Bureau of Natural Heritage Conservation, WNDR Bureau of Water Quality and WNDR Bureau of Watershed Management conducted joint field work and data analysis to select and survey a reference wetland network. The survey data has contributed to a larger project: the “Wetland Floristic Quality Assessment Benchmarks Survey” designed to establish thresholds to define plant community condition tiers for Wisconsin’s wetlands using Floristic Quality Assessment metrics. Candidate sites for the reference wetland network were identified from the State Natural Areas (SNA), Natural Heritage Inventory (NHI), and wetland monitoring programs with the goal of identifying “least disturbed” wetlands to serve as ecological reference areas.

We assessed the condition of inland wetland plant communities utilizing a standardized framework to evaluate wetland condition and function. Floristic quality surveys were conducted on “least disturbed” wetlands throughout the state, stratified by NHI natural community type and Omernik Level III Ecoregions. These floristic quality surveys of least disturbed wetlands were paralleled by surveys of “most disturbed” wetlands conducted by the WNDR Water Quality Bureau and the Lake Superior Research Institute (LRSI) to establish datasets from which thresholds along a condition gradient could be set. The methodology utilizes timed-meander plant surveys with percent cover estimation to generate FQA response metrics, specifically a cover-weighted Mean C. This report summarizes the surveys of least disturbed wetlands and the establishment of a proposed reference wetland network stratified by plant community type and Omernik Level III Ecoregion.

Methods

To select potential candidate sites for a reference wetland network, known high-quality natural community element occurrences (EOs) within SNAs were selected for initial screening. Highly ranked wetland communities were defined as EOs with an existing ecological integrity rank of excellent or good (EO rank of A or B) were selected; EOs with an existing ecological integrity rank of fair or poor (EO rank of C or D) were excluded. Selection of candidate sites was stratified by Omernik Level III Ecoregion, and included all natural communities that occurred in that Ecoregion that had a minimum of 5 high-quality EOs meeting the criteria above. Natural communities that did not meet these criteria because they were at the edge of their range, were extremely rare, or were highly degraded region-wide were excluded from the analysis. In some cases, the existing SNA network was lacking in high-quality natural communities within a given Ecoregion. In these cases, the criteria were expanded to include other sites containing existing high-quality community EOs. For each natural wetland community that occurred in a given Ecoregion, a minimum of 10 sites were selected for survey. For each natural community survey site, draft Assessment Areas (AAs) were identified in GIS using existing EO data, previous survey maps, and current digital aerial photos.

Field surveys were conducted within each AA, and consisted of a timed-meander plant survey in which all vascular plant species occurring within the AA were identified to species, to the greatest extent possible. Species that could not be identified in the field were collected for later identification in the lab. The percent aerial cover as well as the relative abundance (a measure of frequency) was estimated for each plant species within the AA. Cover-weighted Mean C was calculated for each AA based on each species Coefficient of Conservatism and its relative percent aerial cover. Standard Operating Procedures (SOP) for these methods are outlined in the Timed-meander Sampling Protocol for Wetland Floristic Quality Assessment (WNDR 2017).

A Disturbance Factor Checklist was completed in the field for each AA independent of the timed-meander survey. Each AA was assigned an overall disturbance score as well as a plant community condition assessment score based on hydrologic, soil, and vegetation alterations, non-native invasive species cover, and for forested wetlands, forest maturity (Tables 1 and 2).

Table 1. Reference Wetland Overall Disturbance Score Definitions.

Score	Disturbance Score Description
1	Non-disturbed (Very few alterations, none greater than low intensity)
2	Minimal (Small number of alterations of low intensity, none greater than moderate intensity)
3	Moderate (Alterations of mostly low and moderate intensity, no high intensity alterations)
4	Major (Many alterations, including at least one of high intensity)
5	Severe (Many alterations, including multiple high intensity ones)

Table 2. Reference Wetland Plant Community Condition Assessment Score Definitions.

Score	Plant Community Condition Assessment Score Description
1	Natural structure and function of plant community maintained
2	Minimal changes in structure and function
3	Evident changes in structure and minimal changes in function
4	Moderate change in structure and minimal changes in function
5	Major changes in structure and moderate changes in function
6	Severe changes in structure and function

Following the completion of field surveys in all Ecoregions, sites for a proposed Reference Wetland Network were selected from all surveys based on the Overall Disturbance Score and Plant Community Condition Assessment Score for each AA (Table 3). Sites were selected if they were non-disturbed (overall Disturbance Score of 1) and had the natural structure and function of the plant community maintained or minimal changes in structure and function (Plant Community Condition Assessment of 1 or 2). Sites that were minimally disturbed (Disturbance Score of 2) were also considered for the Reference Network if they were within State Natural Areas or were located within an existing high-quality EO. In some special cases, sites were selected that were the best examples of natural communities remaining in the Ecoregion and within an SNA and/or within a high-quality EO but did not meet the criteria above. Such sites were considered for the proposed Reference Network if they were a) moderately disturbed (Disturbance Score of 3) with minimal changes in structure and function (Habitat Quality score of 2) or b) minimally disturbed (Disturbance Score of 2) with evident changes in structure and minimal changes in function (Habitat Quality score of 3). Examples of situations fitting these criteria included forested wetlands impacted by Emerald Ash Borer (EAB) that had clear changes in structure, but were still considered

only minimally disturbed and Calcareous Fens that had moderate levels of invasive species cover on the margin of the AA.

Table 3. Criteria used for selecting sites for a proposed Reference Wetland Network.

Overall Disturbance Score	Plant Community Condition Assessment Score	Reference Network Eligibility
1	1 or 2	Yes
2	2	Yes, if on SNA or within existing high-quality EO
2	3	Yes, if on SNA or within existing high-quality EO and site is among best remaining in Ecoregion
3	2	Yes, if on SNA or within existing high-quality EO and site is among best remaining in Ecoregion
3 or higher	3 or higher	No

All field data was entered into the Natural Heritage Inventory Ecology database (see Appendix A for a sample report from this database). Where applicable, EO data and the spatial extent of high-quality communities were also updated in the NHI information system (Biotics and associated data products and platforms).

Results

Of a total of 1,012 surveyed Assessment Areas, 416 were selected for the proposed Reference Network, stratified by Omernik Level III Ecoregions. Of the Reference Network, 213 AAs (51%) were located within SNAs, while the remaining 203 were located in other high-quality sites.

Wetland Floristic Quality Surveys 2012 - 2017

Reference Wetland Network

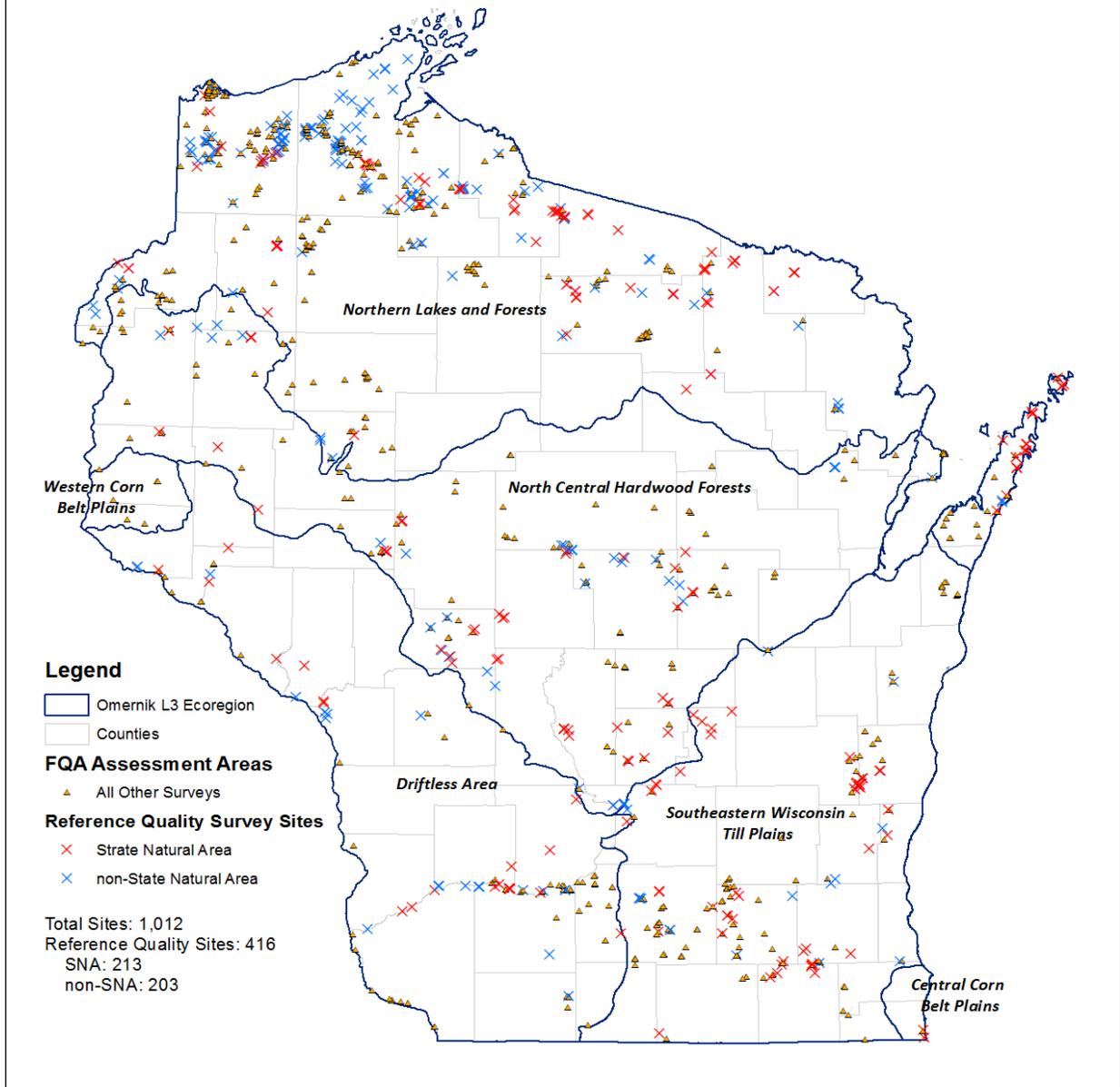


Figure 1. Map of Wisconsin's proposed Reference Wetland Network.

Tables 4-7 list the proposed reference wetland sites for each ecoregion, at the end of this report.

Table 4. Northern Lakes and Forests Ecoregion	p. 9-14
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The SNA network was widely utilized in the overall Benchmarks Survey, with a total of 139 SNAs surveyed for a total of 248 AAs. Most these were surveyed by Natural Heritage Conservation, wetland program and Wisconsin State Herbarium staff (111), with the remainder surveyed by LSRI. In total, NHC staff surveyed a total of 236 AAs, of which 194 were selected for the proposed Reference Network. Species lists for all AAs surveyed by NHC are presented in Appendix B. This dataset contains over 12,000 records, thus, due to size constraints, this information is only presented in digital form. In order to protect the sensitivity of rare species locations, the dataset does not include rare species listed and tracked by the Wisconsin Natural Heritage Inventory as endangered, threatened, or special concern.

Conclusions

Use of Natural Heritage Data

This project produced the most comprehensive network of wetland reference areas by ecoregion in Wisconsin, using objective, quantitative methods. To our knowledge, it is also the most comprehensive use of natural heritage data (e.g., plant community EOs) for an objective, repeatable floristic quality survey in the state. It highlights both the importance of high-quality natural heritage data for the development of metrics for plant communities as well as the opportunity for the refinement of metrics where needed in the future. Where gaps exist in the reference network, the reference selection criteria serve as a foundation to expand or refine the network for particular communities in particular ecoregions.

Utility of Wisconsin's SNA Network

This project also demonstrates the utility of Wisconsin's SNA network, the oldest and largest in the nation. To our knowledge, this project is the most extensive use of SNAs to establish an ecological reference network using quantitative wetland vegetation surveys. It was a more rigorous and comprehensive study of wetland communities than John Curtis's Plant Ecology Lab studies that form the foundation of the Vegetation of Wisconsin, the first statewide plant community classification in the Midwest. While Curtis covered a greater suite of communities, including upland forests, prairies, and primary communities (i.e., dunes, cliffs, etc.), this project was more thorough and quantitative in assessing groundlayer vegetation (surveys conducted by expert botanists with virtually all taxa identified to species including sedges, and percent cover estimated for all species rather than simply frequency of occurrence), and, for many communities, resulted in a higher sample size based on a more refined wetland community classification.

Benefits to Individual Wetland Sites and Long-term Monitoring

In addition to achieving the broad goal of a reference network of wetland plant communities, the project created a robust, current knowledge base for hundreds of individual wetland sites and resulted in updated EO information in the NHI information system. For sites not visited during the project, the field sampling protocol provides a framework for reevaluating previously identified high-quality sites that need field verification and standardized evaluation. The reference network and initial data also establish the foundation for long-term monitoring at individual sites for all aspects of environmental change, including succession due to fire suppression, the spread and impacts of invasive plants and animals (including Emerald Ash Borer), extreme precipitation events and droughts, nutrient enrichment, and groundwater withdrawals, as well as monitoring the effectiveness of ongoing management to combat these stressors. As such, the reference network helps fulfill a strategic goal for long-term monitoring within the SNA program.

Objective Measures of Wetland Quality and Condition

Within natural heritage programs, plant community condition assessments have historically been based on the best professional judgement of experienced field ecologists, and incorporated into a given element occurrence's EO rank. The EO rank is a measure of ecological integrity, and is a function of condition, size, and landscape context. Although different ecologists often agree on a given site's condition rank, the criteria used to evaluate a site are often somewhat subjective and difficult to communicate to novice ecologists, consultants, and policy makers. The results of the larger benchmark project, which will establish weighted Mean C thresholds for condition tiers, have potential to standardize and add more objectivity to the assessment of EO condition ranks for natural heritage programs, not only in Wisconsin but also for neighboring states. The results could also be integrated into NatureServe's Ecological Integrity Assessments (the development of which was also partially funded by the EPA) which is being utilized by federal agencies in monitoring wetland restoration.

Improved Understanding of Wetland Community Composition

The reference wetland network will also improve the state of knowledge of species composition of plant communities in different ecoregions of Wisconsin. Species composition, relative frequency and percent cover are crucial for understanding and correctly classifying plant communities, not only for general inventory but also for establishing restoration targets and species planting lists for wetland restorations, including those done for compensatory mitigation purposes.

Partnerships

Finally, this project demonstrated the power of partnerships, particularly among the DNR Bureaus of Water Quality, Watershed Management and Natural Heritage Conservation, along with the State Herbarium. The project leveraged the expertise of these groups, while also building bridges with other non-governmental organizations (NGOs) and private landowners who graciously participated in the project by allowing their properties to be surveyed and considered for the reference network.

Tables 4-7 follow.

Table 4. Proposed Reference Wetland Network for Northern Lakes and Forests Ecoregion

Site Name	Community Type	County	Short SiteID	Reference Class
AT_REF_02	Alder Thicket	Ashland	NL002	non-SNA
AT_REF_193	Alder Thicket	Ashland	NL091	non-SNA
B105_A244	Alder Thicket	Ashland	NL403	non-SNA
AT_REF_33	Alder Thicket	Bayfield	NL064	non-SNA
C163_A263	Alder Thicket	Chippewa	NL331	non-SNA
AT_13_11	Alder Thicket	Douglas	NL158	non-SNA
AT_IMP_214	Alder Thicket	Douglas	NL068	SNA
AT_REF_101	Alder Thicket	Douglas	NL039	non-SNA
AT_REF_106	Alder Thicket	Douglas	NL040	non-SNA
AT_REF_18	Alder Thicket	Douglas	NL010	non-SNA
AT_REF_15	Alder Thicket	Iron	NL022	non-SNA
AT_REF_16	Alder Thicket	Iron	NL023	non-SNA
Caroline Lake Alder Thicket	Alder Thicket	Iron	NL460	SNA
DuPage Lake Alder Thicket 1	Alder Thicket	Iron	NL473	SNA
DuPage Lake Alder Thicket 2	Alder Thicket	Iron	NL471	SNA
Toy Lake Swamp Alder Thicket 2	Alder Thicket	Iron	NL467	SNA
Hunting River Alder Thicket	Alder Thicket	Langlade	NL489	SNA
Rice Lake Alder Thicket	Alder Thicket	Oneida	NL484	SNA
Toy Lake Swamp Alder Thicket 1	Alder Thicket	Vilas	NL469	SNA
BSS_13_33	Black Spruce Swamp	Ashland	NL136	non-SNA
B706_A029	Black Spruce Swamp	Bayfield	NL410	non-SNA
BSS_13_05	Black Spruce Swamp	Bayfield	NL210	non-SNA
BSS_13_06	Black Spruce Swamp	Bayfield	NL149	non-SNA
BSS_13_20	Black Spruce Swamp	Bayfield	NL175	non-SNA
BSS_13_21	Black Spruce Swamp	Bayfield	NL161	non-SNA
BSS_13_306	Black Spruce Swamp	Bayfield	NL147	non-SNA
BSS_13_321	Black Spruce Swamp	Bayfield	NL171	non-SNA
BSS_13_350	Black Spruce Swamp	Bayfield	NL211	non-SNA
BSS_13_351	Black Spruce Swamp	Bayfield	NL212	non-SNA
C790	Black Spruce Swamp	Burnett	NL407	non-SNA
A707	Black Spruce Swamp	Douglas	NL390	non-SNA
BSS_13_02	Black Spruce Swamp	Douglas	NL117	non-SNA
BSS_13_300	Black Spruce Swamp	Douglas	NL114	non-SNA
BSS_13_301	Black Spruce Swamp	Douglas	NL115	non-SNA
BSS_13_302	Black Spruce Swamp	Douglas	NL116	non-SNA
BSS_13_303	Black Spruce Swamp	Douglas	NL118	non-SNA
BSS_13_305	Black Spruce Swamp	Douglas	NL129	non-SNA
BSS_13_330	Black Spruce Swamp	Douglas	NL195	non-SNA

Site Name	Community Type	County	Short SiteID	Reference Class
BSS_13_331	Black Spruce Swamp	Douglas	NL205	non-SNA
BSS_13_332	Black Spruce Swamp	Douglas	NL206	non-SNA
Grandma Lake Black Spruce Swamp	Black Spruce Swamp	Florence	NL275	SNA
Alvin Creek Black Spruce Swamp	Black Spruce Swamp	Forest	NL283	SNA
Echo Lake Black Spruce Swamp	Black Spruce Swamp	Forest	NL267	SNA
Scott Lake and Shelp Lake Black Spruce Swamp	Black Spruce Swamp	Forest	NL255	SNA
BSS_13_34	Black Spruce Swamp	Iron	NL231	non-SNA
DuPage Lake Black Spruce Swamp	Black Spruce Swamp	Iron	NL470	SNA
A729	Black Spruce Swamp	Oneida	NL364	non-SNA
C771_A821	Black Spruce Swamp	Oneida	NL421	non-SNA
C721_A620	Black Spruce Swamp	Vilas	NL371	non-SNA
C775	Black Spruce Swamp	Washburn	NL502	SNA
Grandma Lake Boreal Rich Fen	Boreal Rich Fen	Florence	NL274	SNA
Swamp Creek Fen Boreal Rich Fen	Boreal Rich Fen	Langlade	NL491	SNA
Rice Creek Boreal Rich Fen	Boreal Rich Fen	Vilas	NL480	SNA
SWM_13_14	Emergent Marsh	Bayfield	NL153	non-SNA
SWM_13_19	Emergent Marsh	Bayfield	NL154	non-SNA
SWM_13_201	Emergent Marsh	Bayfield	NL174	non-SNA
C453	Emergent Marsh	Burnett	NL412	SNA
C462	Emergent Marsh	Burnett	NL413	SNA
SWM_13_10	Emergent Marsh	Douglas	NL218	non-SNA
SWM_13_204	Emergent Marsh	Douglas	NL246	non-SNA
C411	Emergent Marsh	Marinette	NL307	non-SNA
B401	Emergent Marsh	Washburn	NL463	SNA
C495	Emergent Marsh	Washburn	NL500	SNA
MK_13_12	Muskeg	Ashland	NL137	non-SNA
MK_13_101	Muskeg	Bayfield	NL250	non-SNA
MK_13_102	Muskeg	Bayfield	NL251	non-SNA
MK_13_14	Muskeg	Bayfield	NL201	non-SNA
MK_13_15	Muskeg	Bayfield	NL208	non-SNA
MK_13_18	Muskeg	Bayfield	NL186	non-SNA
MK_13_20	Muskeg	Bayfield	NL166	non-SNA
MK_13_29	Muskeg	Bayfield	NL192	non-SNA
B609	Muskeg	Douglas	NL343	SNA
B610	Muskeg	Douglas	NL338	SNA
MK_13_33	Muskeg	Douglas	NL196	non-SNA
MK_13_34	Muskeg	Douglas	NL217	non-SNA
MK_13_35	Muskeg	Douglas	NL197	non-SNA
MK_13_36	Muskeg	Douglas	NL202	non-SNA
MK_13_41	Muskeg	Douglas	NL132	non-SNA

Site Name	Community Type	County	Short SiteID	Reference Class
MK_13_42	Muskeg	Douglas	NL142	non-SNA
C617_A417	Muskeg	Forest	NL366	non-SNA
MK_13_03	Muskeg	Iron	NL159	non-SNA
MK_13_05	Muskeg	Iron	NL232	non-SNA
MK_13_06	Muskeg	Iron	NL233	non-SNA
MK_13_110	Muskeg	Iron	NL163	non-SNA
C627_A627	Muskeg	Oneida	NL419	SNA
A613	Muskeg	Vilas	NL361	non-SNA
C635	Muskeg	Vilas	NL428	non-SNA
C660	Muskeg	Washburn	NL501	SNA
B901	Northern Hardwood Swamp	Ashland	NL399	non-SNA
Chequamegon Hardwoods Hardwood Swamp	Northern Hardwood Swamp	Ashland	NL451	SNA
English Lake Hemlocks Hardwood Swamp	Northern Hardwood Swamp	Ashland	NL452	SNA
Spider Lake Hardwood Swamp	Northern Hardwood Swamp	Ashland	NL458	SNA
BAS_13_02	Northern Hardwood Swamp	Bayfield	NL199	non-SNA
BAS_13_10	Northern Hardwood Swamp	Bayfield	NL240	non-SNA
BAS_13_16	Northern Hardwood Swamp	Bayfield	NL277	SNA
C001	Northern Hardwood Swamp	Chippewa	NL339	SNA
B903	Northern Hardwood Swamp	Douglas	NL335	SNA
C966	Northern Hardwood Swamp	Douglas	NL505	SNA
Caroline Lake Hardwood Swamp	Northern Hardwood Swamp	Iron	NL461	SNA
Moose Lake Hardwood Swamp	Northern Hardwood Swamp	Iron	NL466	SNA
C950	Northern Hardwood Swamp	Oneida	NL426	SNA
A043	Northern Hardwood Swamp	Sawyer	NL298	non-SNA
A325	Northern Sedge Meadow	Ashland	NL401	non-SNA
McCarthy Northern Sedge Meadow	Northern Sedge Meadow	Ashland	NL457	SNA
NSM_IMP_01	Northern Sedge Meadow	Ashland	NL007	non-SNA
NSM_REF_101	Northern Sedge Meadow	Ashland	NL003	non-SNA
NSM_REF_102	Northern Sedge Meadow	Ashland	NL004	non-SNA
NSM_IMP_209	Northern Sedge Meadow	Bayfield	NL034	non-SNA
NSM_REF_08	Northern Sedge Meadow	Bayfield	NL109	non-SNA
C360	Northern Sedge Meadow	Burnett	NL416	non-SNA
C361	Northern Sedge Meadow	Burnett	NL417	non-SNA
NSM_IMP_206	Northern Sedge Meadow	Douglas	NL053	non-SNA
NSM_REF_07	Northern Sedge Meadow	Douglas	NL076	non-SNA
NSM_REF_104	Northern Sedge Meadow	Douglas	NL029	SNA
NSM_REF_120	Northern Sedge Meadow	Douglas	NL071	non-SNA
NSM_REF_180	Northern Sedge Meadow	Douglas	NL110	non-SNA
Kieper Creek Northern Sedge Meadow	Northern Sedge Meadow	Florence	NL272	SNA

Site Name	Community Type	County	Short SiteID	Reference Class
Alvin Creek Northern Sedge Meadow	Northern Sedge Meadow	Forest	NL281	SNA
Echo Lake Northern Sedge Meadow	Northern Sedge Meadow	Forest	NL265	SNA
Moose Lake Northern Sedge Meadow	Northern Sedge Meadow	Iron	NL465	SNA
NSM_REF_140	Northern Sedge Meadow	Iron	NL088	non-SNA
Springstead Landing NSM	Northern Sedge Meadow	Iron	NL455	non-SNA
Peshtigo River NSM	Northern Sedge Meadow	Marinette	NL508	non-SNA
Rainbow Wetlands Sedge Meadow	Northern Sedge Meadow	Oneida	NL482	SNA
Rice Lake Northern Sedge Meadow	Northern Sedge Meadow	Oneida	NL483	SNA
Squirrel River Pines Sedge Meadow	Northern Sedge Meadow	Oneida	NL477	SNA
Tomahawk River Pines Sedge Meadow	Northern Sedge Meadow	Oneida	NL475	SNA
A321	Northern Sedge Meadow	Price	NL442	non-SNA
Nixon Lake Northern Sedge Meadow	Northern Sedge Meadow	Vilas	NL478	SNA
C370	Northern Sedge Meadow	Washburn	NL498	SNA
C371	Northern Sedge Meadow	Washburn	NL499	SNA
Kentuck Lake Northern Tamarack Swamp	Northern Tamarack Swamp	Vilas	NL264	SNA
CS_13_411	Northern Wet-mesic Forest	Ashland	NL180	non-SNA
CS_13_412	Northern Wet-mesic Forest	Ashland	NL181	non-SNA
CS_13_440	Northern Wet-mesic Forest	Ashland	NL235	non-SNA
CS_13_441	Northern Wet-mesic Forest	Ashland	NL236	non-SNA
McCarthy Northern Wet-mesic Forest	Northern Wet-mesic Forest	Ashland	NL456	SNA
CS_13_476	Northern Wet-mesic Forest	Bayfield	NL241	non-SNA
C850	Northern Wet-mesic Forest	Burnett	NL414	SNA
C883	Northern Wet-mesic Forest	Douglas	NL504	SNA
CS_13_400	Northern Wet-mesic Forest	Douglas	NL130	SNA
CS_13_401	Northern Wet-mesic Forest	Douglas	NL131	SNA
CS_13_404	Northern Wet-mesic Forest	Douglas	NL141	non-SNA
CS_13_490	Northern Wet-mesic Forest	Douglas	NL259	SNA
CS_13_491	Northern Wet-mesic Forest	Douglas	NL260	non-SNA
CS_13_492	Northern Wet-mesic Forest	Douglas	NL261	SNA
CS_13_495	Northern Wet-mesic Forest	Douglas	NL286	non-SNA
CS_13_496	Northern Wet-mesic Forest	Douglas	NL287	SNA
CS_13_497	Northern Wet-mesic Forest	Douglas	NL288	SNA
Kieper Creek Northern Wet-mesic Forest	Northern Wet-mesic Forest	Florence	NL273	SNA
Echo Lake Northern Wet-mesic Forest	Northern Wet-mesic Forest	Forest	NL266	SNA
Scott Lake and Shelp Lake NWMF	Northern Wet-mesic Forest	Forest	NL254	SNA
Caroline Lake Northern Wet-mesic Forest	Northern Wet-mesic Forest	Iron	NL459	SNA
Moose Lake Northern Wet-mesic Forest	Northern Wet-mesic Forest	Iron	NL464	SNA

Site Name	Community Type	County	Short SiteID	Reference Class
Swamp Creek Fen Northern Wet-mesic Forest	Northern Wet-mesic Forest	Langlade	NL490	SNA
C822_A722	Northern Wet-mesic Forest	Marinette	NL305	non-SNA
C890	Northern Wet-mesic Forest	Oneida	NL425	SNA
C866	Northern Wet-mesic Forest	Vilas	NL449	SNA
Rice Creek Northern Wet-mesic Forest	Northern Wet-mesic Forest	Vilas	NL479	SNA
Toy Lake Swamp Northern Wet-mesic Forest	Northern Wet-mesic Forest	Vilas	NL468	SNA
OB_IMP_101	Open Bog	Ashland	NL008	non-SNA
OB_REF_03	Open Bog	Ashland	NL005	non-SNA
OB_13_04	Open Bog	Bayfield	NL209	non-SNA
OB_13_07	Open Bog	Bayfield	NL148	non-SNA
OB_13_22	Open Bog	Bayfield	NL167	non-SNA
OB_13_500	Open Bog	Bayfield	NL213	non-SNA
OB_13_510	Open Bog	Bayfield	NL203	non-SNA
OB_13_565	Open Bog	Bayfield	NL284	non-SNA
OB_IMP_02	Open Bog	Bayfield	NL014	non-SNA
OB_IMP_03	Open Bog	Bayfield	NL015	non-SNA
OB_IMP_06	Open Bog	Bayfield	NL089	non-SNA
OB_IMP_08	Open Bog	Bayfield	NL090	non-SNA
OB_IMP_110	Open Bog	Bayfield	NL065	non-SNA
OB_IMP_114	Open Bog	Bayfield	NL077	non-SNA
OB_IMP_13	Open Bog	Bayfield	NL067	non-SNA
OB_REF_09	Open Bog	Bayfield	NL016	non-SNA
OB_REF_10	Open Bog	Bayfield	NL020	non-SNA
OB_REF_103	Open Bog	Bayfield	NL028	non-SNA
OB_REF_112	Open Bog	Bayfield	NL078	non-SNA
OB_REF_113	Open Bog	Bayfield	NL079	non-SNA
OB_13_511	Open Bog	Douglas	NL173	non-SNA
OB_REF_04	Open Bog	Douglas	NL047	non-SNA
OB_REF_07	Open Bog	Douglas	NL057	non-SNA
OB_REF_102	Open Bog	Douglas	NL030	non-SNA
OB_REF_108	Open Bog	Douglas	NL058	non-SNA
OB_REF_11	Open Bog	Douglas	NL050	non-SNA
OB_REF_120	Open Bog	Douglas	NL072	non-SNA
OB_REF_229	Open Bog	Douglas	NL054	non-SNA
A510	Open Bog	Forest	NL367	non-SNA
C511	Open Bog	Marinette	NL308	non-SNA
A539	Open Bog	Oneida	NL443	non-SNA
A522	Open Bog	Vilas	NL360	non-SNA
C546	Open Bog	Vilas	NL427	non-SNA

Site Name	Community Type	County	Short SiteID	Reference Class
Alvin Creek Poor Fen	Poor Fen	Forest	NL282	SNA
Scott Lake and Shelp Lake Poor Fen	Poor Fen	Forest	NL256	SNA
Indian Creek Poor Fen	Poor Fen	Oneida	NL481	non-SNA
SC_REF_02	Shrub-carr	Bayfield	NL094	SNA
SC_REF_03	Shrub-carr	Bayfield	NL095	SNA
SC_REF_04	Shrub-carr	Bayfield	NL096	SNA
SC_REF_150	Shrub-carr	Bayfield	NL097	SNA
SC_REF_151	Shrub-carr	Bayfield	NL098	SNA
SC_REF_152	Shrub-carr	Bayfield	NL099	SNA
C261	Shrub-carr	Burnett	NL418	non-SNA
SC_REF_101	Shrub-carr	Douglas	NL059	non-SNA
DuPage Lake Shrub-carr	Shrub-carr	Iron	NL472	SNA
Turtle-Flambeau Shrub-carr	Shrub-carr	Iron	NL454	SNA
Squirrel River Pines Shrub-carr	Shrub-carr	Oneida	NL476	SNA
Tomahawk River Pines Shrub-carr	Shrub-carr	Oneida	NL474	SNA
C268	Shrub-carr	Washburn	NL493	non-SNA

Table 5. Proposed Reference Wetland Network for Northern Central Hardwood Forest Ecoregion

Site Name	Community Type	County	Short SiteID	Reference Class
Blue Swamp SNA AT	Alder Thicket	Clark	NC162	SNA
Big Beaver SNA	Alder Thicket	Dunn	NC179	SNA
Pea Creek SNA AT	Alder Thicket	Eau Claire	NC187	SNA
Dewey Marsh Alder Thicket	Alder Thicket	Portage	NC152	non-SNA
Hulbert Creek Woods Alder Thicket	Alder Thicket	Sauk	NC112	non-SNA
Mead Alder Thicket	Alder Thicket	Wood	NC155	non-SNA
Mead WA	Alder Thicket	Wood	NC020	non-SNA
NCHF-30	Black Spruce Swamp	Barron	NC191	non-SNA
Blue Swamp SNA BS/TS	Black Spruce Swamp	Clark	NC163	SNA
NCHF-23	Black Spruce Swamp	Clark	NC184	non-SNA
Spaulding Fen Black Spruce Swamp	Black Spruce Swamp	Jackson	NC149	SNA
Kingston Pines Black Spruce Swamp	Black Spruce Swamp	Juneau	NC139	SNA
Tula Lake BS/TS	Black Spruce Swamp	Polk	NC209	SNA
Dewey Marsh Black Spruce Swamp	Black Spruce Swamp	Portage	NC153	non-SNA
Mead Black Spruce Swamp	Black Spruce Swamp	Wood	NC156	SNA
Big Marsh Boreal Rich Fen	Boreal Rich Fen	Door	NC130	SNA
Coffey Swamp Boreal Rich Fen	Boreal Rich Fen	Door	NC133	SNA
Dunes Lake Boreal Rich Fen	Boreal Rich Fen	Door	NC120	non-SNA
Kellner Fen Boreal Rich Fen	Boreal Rich Fen	Door	NC136	SNA
Pickernel Pond Boreal Rich Fen	Boreal Rich Fen	Door	NC135	SNA
Summerton Bog Calcareous Fen	Calcareous Fen	Marquette	NC110	SNA
Bass Lake Calcareous Fen	Calcareous Fen	Waushara	NC114	SNA
Quincy Bluff and Wetlands Central Poor Fen	Central Poor Fen	Adams	NC060	SNA
Sohlberg Silver Lake Central Poor Fen	Central Poor Fen	Adams	NC067	SNA
Black River SF	Central Poor Fen	Jackson	NC069	non-SNA
Black River SF- Waterbury Rd	Central Poor Fen	Jackson	NC074	non-SNA
Ketchum Creek Central Poor Fen	Central Poor Fen	Jackson	NC143	SNA
Spaulding Fen Central Poor Fen	Central Poor Fen	Jackson	NC150	SNA
Starlight Wetland Central Poor BSS	Central Poor Fen	Jackson	NC144	SNA
Starlight Wetland Central Poor Fen	Central Poor Fen	Jackson	NC145	non-SNA
Blueberry Swamp Central Poor Fen	Central Poor Fen	Juneau	NC138	non-SNA
Kingston Pines Central Poor Fen	Central Poor Fen	Juneau	NC140	SNA
Hiles Wetland Central Poor Fen	Central Poor Fen	Wood	NC147	SNA
Hiles Wetlands Central Poor Fen 2	Central Poor Fen	Wood	NC148	SNA
Big Marsh Emergent Marsh	Emergent Marsh	Door	NC131	SNA
Little Marsh Emergent Marsh	Emergent Marsh	Door	NC132	SNA
Muddy Creek SNA	Emergent Marsh	Dunn	NC182	SNA

Site Name	Community Type	County	Short SiteID	Reference Class
NCHF-17	Emergent Marsh	Eau Claire	NC174	non-SNA
Skunk Lake	Emergent Marsh	Portage	NC033	non-SNA
Pine Island EM	Emergent Marsh	Sauk	NC006	non-SNA
Myklebust Lake Emergent Marsh	Emergent Marsh	Waupaca	NC107	SNA
Skunk Lake Emergent Marsh	Emergent Marsh	Waupaca	NC108	SNA
Lewiston Marsh	Floodplain Forest	Columbia	NC004	non-SNA
Bear Lake SNA MK	Muskeg	Barron	NC201	SNA
NCHF-48	Muskeg	Burnett	NC206	non-SNA
NCHF-55	Muskeg	Polk	NC213	non-SNA
NCHF-41	Muskeg	Washburn	NC199	non-SNA
NCHF-29	Northern Hardwood Swamp	Chippewa	NC186	non-SNA
NCHF-44	Northern Hardwood Swamp	Chippewa	NC203	non-SNA
NCHF-10	Northern Hardwood Swamp	St Croix	NC167	SNA
Iola Trout-Nace Creek	Northern Hardwood Swamp	Waupaca	NC032	non-SNA
Jackson Creek Hardwood Swamp	Northern Hardwood Swamp	Waupaca	NC159	SNA
Mead WA NHS	Northern Hardwood Swamp	Wood	NC024	non-SNA
NCHF-37	Northern Sedge Meadow	Barron	NC194	non-SNA
Blue Swamp SNA NSM	Northern Sedge Meadow	Clark	NC164	SNA
Dunes Lake Northern Sedge Meadow	Northern Sedge Meadow	Door	NC121	non-SNA
Kangaroo Lake NSM	Northern Sedge Meadow	Door	NC117	SNA
Mink River Northern Sedge Meadow	Northern Sedge Meadow	Door	NC125	SNA
Mud Lake Cedar Swamp	Northern Sedge Meadow	Door	NC127	SNA
Mud Lake Northern Sedge Meadow	Northern Sedge Meadow	Door	NC128	SNA
Peninsula SP	Northern Sedge Meadow	Door	NC055	SNA
PeaCreekSNA NSM	Northern Sedge Meadow	Eau Claire	NC188	SNA
Mead WA NSM	Northern Sedge Meadow	Marathon	NC022	non-SNA
Dewey Marsh NSM	Northern Sedge Meadow	Portage	NC154	SNA
Pine Island SSM	Northern Sedge Meadow	Sauk	NC002	non-SNA
Mead Northern Sedge Meadow	Northern Sedge Meadow	Wood	NC157	SNA
Sohlberg Silver Lake Tamarack Poor Swamp	Northern Tamarack Swamp	Adams	NC061	SNA
Washburn Marsh Tamarack Swamp	Northern Tamarack Swamp	Jackson	NC141	SNA
Warrens	Northern Tamarack Swamp	Monroe	NC075	non-SNA
Oconto County Forest NTS	Northern Tamarack Swamp	Oconto	NC059	non-SNA
Hiles Wetlands Tamarack Poor Swamp	Northern Tamarack Swamp	Wood	NC146	SNA
Kangaroo Lake Cedar Swamp	Northern Wet-mesic Forest	Door	NC116	SNA
Meridian Park Cedar Swamp	Northern Wet-mesic Forest	Door	NC118	SNA
Meridian Park NSM	Northern Wet-mesic Forest	Door	NC119	SNA
Mink River Cedar Swamp	Northern Wet-mesic Forest	Door	NC124	SNA
Ridges Sanctuary Cedar Swamp	Northern Wet-mesic Forest	Door	NC129	SNA
Shivering Sands Cedar Swamp	Northern Wet-mesic Forest	Door	NC123	SNA

Site Name	Community Type	County	Short SiteID	Reference Class
Turtle Lake	Northern Wet-mesic Forest	Oconto	NC066	non-SNA
Flume Creek Cedars NWMF	Northern Wet-mesic Forest	Portage	NC158	SNA
Little Wolf River	Northern Wet-mesic Forest	Portage	NC028	non-SNA
Bear Lake SNA OB	Open Bog	Barron	NC192	SNA
PeaCreekSNA OB	Open Bog	Eau Claire	NC189	SNA
Washburn Marsh Open Bog	Open Bog	Jackson	NC142	non-SNA
Mead WA	Open Bog	Marathon	NC021	non-SNA
Oconto County Forest Bog	Open Bog	Oconto	NC058	non-SNA
Tula Lake OB	Open Bog	Polk	NC210	SNA
Comstock Bog Meadow NSM	Poor Fen	Marquette	NC214	SNA
Myklebust Lake Poor Fen	Poor Fen	Waupaca	NC106	SNA
Lewiston Marsh	Shrub-carr	Columbia	NC100	non-SNA
Mink River Shrub-carr	Shrub-carr	Door	NC126	SNA
Lawrence Creek SF&WA	Shrub-carr	Marquette	NC099	SNA
Dewey Marsh	Shrub-carr	Portage	NC088	non-SNA
Paul Olsen WA	Shrub-carr	Portage	NC093	non-SNA
Bass Lake	Shrub-carr	Waushara	NC001	SNA
Quincy Bluff and Wetlands SSM	Southern Sedge Meadow	Adams	NC005	SNA
Page Creek Wetlands SSM	Southern Sedge Meadow	Marquette	NC109	SNA
Summerton Bog Southern Sedge Meadow	Southern Sedge Meadow	Marquette	NC111	SNA
Scandinavia	Southern Sedge Meadow	Waupaca	NC036	non-SNA
Lunch Creek Wetlands Sedge Meadow	Southern Sedge Meadow	Waushara	NC215	SNA

Table 6. Proposed Reference Wetland Network for Driftless Area and Western Corn Belt Plains

Site Name	Community Type	County	Short SiteID	Reference Class
Lost Lake Alder Thicket	Alder Thicket	Columbia	DA063	SNA
Long Sedge Pines Alder Thicket	Alder Thicket	Monroe	DA095	non-SNA
Honey Creek Alder Thicket	Alder Thicket	Sauk	DA068	SNA
Mirror Lake Alder Thicket	Alder Thicket	Sauk	DA064	SNA
Stump Lake EM	Emergent Marsh	Buffalo	DA104	non-SNA
Whites and Big Cat Slough EM	Emergent Marsh	Grant	DA082	non-SNA
Woodman Lake - Dead Lake EM	Emergent Marsh	Grant	DA079	SNA
Avoca EM	Emergent Marsh	Iowa	DA078	SNA
Goodwiler-Kendall EM	Emergent Marsh	Iowa	DA081	non-SNA
Black River Bottoms EM	Emergent Marsh	La Crosse	DA097	non-SNA
Lake Onalaska EM	Emergent Marsh	La Crosse	DA094	non-SNA
Van Loon EM	Emergent Marsh	La Crosse	DA102	SNA
Pierce County Islands EM	Emergent Marsh	Pierce	DA105	non-SNA
Rush River EM	Emergent Marsh	Pierce	DA021	SNA
Gotham EM	Emergent Marsh	Richland	DA073	SNA
Lower Lake EM	Emergent Marsh	Richland	DA084	non-SNA
Smith Slough EM 1	Emergent Marsh	Richland	DA077	SNA
Smith Slough EM 2	Emergent Marsh	Richland	DA075	SNA
Trempealeau Mountain EM	Emergent Marsh	Trempealeau	DA098	non-SNA
Tiffany Bottoms FPF	Floodplain Forest	Buffalo	DA103	SNA
Wauzeka Bottoms FPF	Floodplain Forest	Crawford	DA083	SNA
Weniger Island FPF	Floodplain Forest	Crawford	DA088	non-SNA
Tower Hill Bottoms FPF	Floodplain Forest	Iowa	DA065	SNA
Van Loon FPF	Floodplain Forest	La Crosse	DA101	SNA
Nine Mile Island FPF	Floodplain Forest	Pepin	DA106	SNA
Bay City FPF	Floodplain Forest	Pierce	DA022	non-SNA
Smith Slough FPF	Floodplain Forest	Richland	DA074	SNA
Trumble Island FPF	Floodplain Forest	Richland	DA089	SNA
Blue Mounds Ck Bottoms Shrub-carr	Shrub-carr	Iowa	DA070	non-SNA
Black River Bottoms Shrub-carr	Shrub-carr	La Crosse	DA096	non-SNA
Smith Slough Shrub-carr	Shrub-carr	Richland	DA076	SNA
Bakkens Pond Alder Thicket	Shrub-carr	Sauk	DA051	non-SNA
Tower Hill Area Shrub-carr	Shrub-carr	Sauk	DA029	non-SNA
Trempealeau River SSM	Southern Sedge Meadow	Buffalo	DA100	SNA
Sugar River Wetlands SSM	Southern Sedge Meadow	Dane	DA062	SNA
Blue Mounds Creek Bottoms SSM	Southern Sedge Meadow	Iowa	DA069	non-SNA
Dodge Branch SSM	Southern Sedge Meadow	Iowa	DA061	non-SNA

Site Name	Community Type	County	Short SiteID	Reference Class
Goodwiler-Kendall SSM	Southern Sedge Meadow	Iowa	DA080	non-SNA
Argyle Marsh SSM	Southern Sedge Meadow	Lafayette	DA107	non-SNA
Bear Creek SSM	Southern Sedge Meadow	Richland	DA060	SNA
Lower Lake SSM	Southern Sedge Meadow	Richland	DA085	non-SNA
Tamarack Creek SSM	Southern Sedge Meadow	Trempealeau	DA099	SNA

Table 7. Proposed Reference Wetland Network for Southeast Till Plains and Central Corn Belt Plains

Site Name	Community Type	County	Short Site ID	Reference Class
Cherokee Marsh Calcareous Fen	Calcareous Fen	Dane	SE001	SNA
Berlin Fen	Calcareous Fen	Green Lake	SE014	SNA
Fountain Creek Calcareous Fen	Calcareous Fen	Green Lake	SE182	SNA
Snake Creek Calcareous Fen	Calcareous Fen	Green Lake	SE181	SNA
Clover Valley Calcareous Fen	Calcareous Fen	Walworth	SE185	SNA
Lulu Lake RR Grade Calcareous Fen	Calcareous Fen	Walworth	SE008	SNA
Pickerel Lake Fen	Calcareous Fen	Walworth	SE135	SNA
French Creek Emergent Marsh	Emergent Marsh	Columbia	SE139	SNA
Dorn Creek EM	Emergent marsh	Dane	SE042	non-SNA
Bean Lake Emergent Marsh	Emergent Marsh	Jefferson	SE171	SNA
Crooked Lake EM	Emergent Marsh	Sheboygan	SE132	SNA
Lulu Lake Emergent Marsh	Emergent Marsh	Walworth	SE128	SNA
Loews Lake Emergent Marsh	Emergent Marsh	Washington	SE115	non-SNA
Rainbow Springs Marsh	Emergent Marsh	Waukesha	SE094	non-SNA
Levee Road Floodplain Forest	Floodplain Forest	Columbia	SE189	non-SNA
Kanow Park Rock River	Floodplain Forest	Jefferson	SE105	non-SNA
Root River Floodplain Forest AA2	Floodplain Forest	Milwaukee	SE125	non-SNA
Avon Bottoms West FPF	Floodplain Forest	Rock	SE180	SNA
Butler Lake NHS	Northern Hardwood Swamp	Sheboygan	SE144	SNA
Crooked Lake Hardwood Swamp 1	Northern Hardwood Swamp	Sheboygan	SE130	SNA
Crooked Lake Hardwood Swamp 2	Northern Hardwood Swamp	Sheboygan	SE176	SNA
Milwaukee River & Swamp NWMF	Northern Wet-mesic Forest	Fond du Lac	SE117	SNA
Mullet Creek White Cedar Swamp	Northern Wet-mesic Forest	Fond du Lac	SE173	SNA
Cedarburg Bog Cedar Swamp	Northern Wet-mesic Forest	Ozaukee	SE133	SNA
Nichols Creek Cedars & Springs NWMF	Northern Wet-mesic Forest	Sheboygan	SE119	SNA
Nichols Creek East Cedars	Northern Wet-mesic Forest	Sheboygan	SE120	SNA
Lower Mud Lake SC	Shrub-carr	Dane	SE037	non-SNA
Crooked Lake Shrub-carr	Shrub-carr	Fond du Lac	SE131	SNA
French Creek North Shrub Carr	Shrub-carr	Fond du Lac	SE141	SNA
Milwaukee River Tamarack SC	Shrub-carr	Fond du Lac	SE137	SNA
Bean Lake Shrub-carr	Shrub-carr	Jefferson	SE170	SNA
Mud Lake Shrub Carr	Shrub-carr	Jefferson	SE156	SNA
Butler Lake Shrub Carr	Shrub-carr	Sheboygan	SE143	SNA
Lulu Lake Shrub-carr	Shrub-carr	Walworth	SE129	SNA
Milwaukee River Tamarack SHS	Southern Hardwood Swamp	Fond du Lac	SE136	SNA
Collins Marsh SHS	Southern Hardwood Swamp	Manitowoc	SE174	non-SNA
Huiras Lake SHS	Southern Hardwood Swamp	Ozaukee	SE147	SNA

Site Name	Community Type	County	Short Site ID	Reference Class
Riveredge Nature Center SHS	Southern Hardwood Swamp	Ozaukee	SE172	non-SNA
Jackson Marsh SHS	Southern Hardwood Swamp	Washington	SE184	SNA
Martin's Woods SHS	Southern Hardwood Swamp	Waukesha	SE123	SNA
Rat River SHS1	Southern Hardwood Swamp	Winnebago	SE177	non-SNA
Lewiston Marsh	Southern Sedge Meadow	Columbia	SE015	non-SNA
Cherokee Marsh Sedge Meadow	Southern Sedge Meadow	Dane	SE002	SNA
Dorn Ck SSM	Southern Sedge Meadow	Dane	SE071	non-SNA
Dorn Creek LD SSM	Southern Sedge meadow	Dane	SE043	non-SNA
Goose Lake Southern Sedge Meadow	Southern Sedge Meadow	Dane	SE003	SNA
Lower Mud Lake SSM	Southern Sedge Meadow	Dane	SE035	non-SNA
Waubesa Wetlands SSM	Southern sedge meadow	Dane	SE111	SNA
Milwaukee River & Swamp SSM	Southern Sedge Meadow	Fond du Lac	SE118	SNA
White River Marsh Rustic Road SSM	Southern Sedge Meadow	Green Lake	SE012	SNA
Koshkonong WA SSM	Southern sedge meadow	Jefferson	SE044	non-SNA
Red Cedar Lake SSM	Southern Sedge Meadow	Jefferson	SE005	SNA
French Creek Fen North SSM	Southern Sedge Meadow	Marquette	SE140	SNA
Bluff Creek SSM	Southern Sedge Meadow	Walworth	SE154	SNA
Lulu Lake Southern Sedge Meadow	Southern Sedge Meadow	Walworth	SE009	SNA
Loews Lake SSM	Southern Sedge Meadow	Washington	SE114	non-SNA
Puchyan Prairie Wet-mesic Prairie	Wet-mesic Prairie	Green Lake	SE011	SNA
White River Wet-mesic Prairie	Wet-mesic Prairie	Green Lake	SE013	SNA
Faville Wet-mesic prairie	Wet-mesic Prairie	Jefferson	SE186	SNA
Paintbrush Wet-mesic Prairie	Wet-mesic Prairie	Jefferson	SE155	SNA
Snapper Wet-mesic prairie	Wet-mesic Prairie	Jefferson	SE187	SNA
Chiwaukee 116th Street WMP	Wet-mesic Prairie	Kenosha	SE148	SNA
Chiwaukee Carol Beach WMP	Wet-mesic Prairie	Kenosha	SE126	SNA
Young Prairie Wet-mesic prairie	Wet-mesic Prairie	Walworth	SE121	SNA
Kettle Moraine Low WMP	Wet-mesic Prairie	Waukesha	SE151	SNA
Scuppernong Wet-mesic Prairie	Wet-mesic Prairie	Waukesha	SE150	SNA