Ducks Unlimited
Vermont
In Lieu Fee Program

Status, Trends and Program Improvements 2011 T0 2019

Submitted To:
United States Army Corps of Engineers and
The Interagency Review Team

DATE: MARCH 31, 2020

New England District
11 Lincoln Street
Room 210
Essex Junction, VT 05452

New England District
Regulatory Division
696 Virginia Road
Concord, MA 01742-2751

Table of Contents

1. Executive Summary 3
2. Introduction 3
3. Operation of DU-VT-ILF 4
4. In-Lieu Fee Payments Received 6
5. Status and Trends of Program Objectives 10
6. Mitigation Sites and Objectives in Four Service Areas: 11
7. Summary of Program Improvements 29
Program Infrastructure Investments 29
Efficiency Improvements 29
DU VT Site Evaluation Criteria Update 29
Continued Improvements to Wetland Map Products in Vermont 31
References 32

List of Tables

Table 1. Summary of Payments by Service Area and Associated Impacts 6
Table 2. Duren Mountain Swamp Credit Generation Table 13
Table 3. Three Mile Bridge Road Credit Generation Table 19
Table 4. Draft Willoughby Lake Road Credit Generation Table 25

List of Figures

Figure 1. Service Areas for the DU-VT-ILF Program 5
Figure 2. Credit Sales by Project Type and Service Area (2011–2019) 6
Figure 3. Credit Sales, by Service Area (2011-2019) 7
Figure 4. Permitted Wetland Impacts by Service Area and Wetland Type (2011-2019). 8
Figure 5. Duren Mountain Swamp Site Map 14
Figure 6. Three Mile Bridge Road Site Map 20
Figure 7. Willoughby Lake Road Site Map 26
Figure 8. Modeled Wetland Locations for the State of Vermont 30
Figure 9 VHB, UVM, DU Wetland Mapping Project Area for 2020. 31

List of Appendices

Appendix A: Species List

1. Executive Summary

Ducks Unlimited's (DU) mission focuses on protecting and restoring wetland resources critical to sustaining North America's waterfowl populations. DU utilizes a scientific approach to prioritize its' conservation and mitigation activities. At a high-level, DU's conservation priorities are identified by a team of international biologists made up of waterfowl and conservation experts spanning government, academia, and NGO sectors as described in the North American Waterfowl Management Plan (NAWAMP; United States Fish and Wildlife Service 1986, 2012). NAWMP and DU's applied internal version of this plan, identifies portions of Vermont as priority landscapes for waterfowl conservation. Further, the northeastern United States and adjacent Canada support an estimated 7.6 million breeding waterfowl, 2.7 million wintering waterfowl, and four to five million migrating waterfowl can be found within the Atlantic flyway. Providing a high-quality compensatory mitigation option in New England is therefore a priority for Ducks Unlimited.

The Ducks Unlimited, Inc. Vermont In-lieu Fee Program (DU-VT-ILF Program) began on January 6, 2011. The Service Areas (SA's) established within the DU-VT-ILF Program align with the Vermont Department of Environmental Conservation's basin planning efforts and other resource conservation strategies within Vermont. Additionally, DU has developed a suite of GIS-planning tools to aid in the identification of wetland restoration and protection opportunities within these Service Areas. DU's tools are based largely on similar past efforts to identify and prioritize sites suitable for mitigation banking in New York and Pennsylvania (e.g., Hunter et al. 2012, Raney et al. 2017, Raney and Leopold 2018), and the underlying processes developed in these GIS tools are feeding into collaborative efforts to update wetland maps within the State of Vermont. DU's top-down prioritization of landscapes and significant wetland features within those landscapes enables DU to identify priority areas for wetland conservation and mitigation activities on a watershed-scale. These capabilities are described further in Section 7.

From 2012 to 2019, the DU-VT-ILF Program has been used to mitigate for 48 permitted wetland impacts. Funds from these impacts have been used to reestablish, rehabilitate, and preserve aquatic resources and the associated upland buffers. The program has collected $4,426,830.18 for permitted impacts through 2019 (including administrative fees), contributing to three mitigation projects, protection of 565.24-acres and reestablishment or rehabilitation of 71.28-acres of wetland habitat. As a result of ongoing ILF projects, Vermonters will gain passive recreational opportunities at ILF sites, thereby forwarding DU's conservation mission, and improving hunting access in the State.

2. Introduction

The DU-VT ILF Program consists of four service areas used for compensatory mitigation for unavoidable impacts to waters of the United States in the State of Vermont and parts of New York. Permits are required by the U.S. Army Corps of Engineers ("Corps") through the Clean Water Act ("CWA") Section 404 for discharge of dredge or fill materials within "waters of the U.S."; through the Rivers and Harbors Act Section 10 for structures or work in or affecting navigable water of the U.S.; and by the Vermont Department of Environmental Conservation ("DEC") under section 8.5 of the Vermont Wetland Rules. These regulatory agencies require that

aquatic resource functions and services lost due to permitted impacts be replaced through compensatory mitigation after addressing avoidance and minimization of impacts. The DU-VT-ILF Program provides a compensatory mitigation option to permit applicants under the Corps and DEC permit programs, including as a potential option for compensation for secondary impacts, for possible use by the Corps for Civil Works projects, and as an option for resolution of enforcement cases.

The goals of the ILF Program are to: provide an alternative to permittee-responsible compensatory mitigation that will effectively replace functions and services lost through permitted impacts, provide a compensatory mitigation option for Corps Civil Works projects and function as an option for resolution of enforcement cases, minimize temporal loss of wetland functions and services, satisfy mitigation bank requirements specified in 33 CFR Part 332, provide projects to meet current and expected demand for credits, and to achieve ecological success on a watershed basis by providing appropriate wetland types and functions and by integrating other conservation goals and objectives when possible.

3. Operation of DU-VT-ILF

The ILF Program Instrument set guidelines, standards, and responsibilities for the use, operation, and maintenance of the ILF program. The Program operates in four service areas that are defined by the major river basin watersheds composed of 6-digit hydrologic unit codes (HUC) (Figure 1). These service areas include:

- Connecticut River (Upper – HUC 010801 and Lower – HUC 010802)
- St. Francois (HUC – 011100)
- Richelieu (HUC – 020100)
- Upper Hudson (HUC – 020200)

These four river basins are congruent with DEC's basin planning efforts and other resource conservation strategies within Vermont. These service areas were also chosen because the scale is appropriate to ensure that the projects selected will effectively compensate for adverse environmental impacts across the entire service area. Service areas may include more than one project depending on the number of impacts permitted and the subsequent number of required compensatory mitigation acres. DU provides compensatory mitigation for permitted impacts within the same geographic service area in which the impacts occur, unless the district engineer has agreed to an exemption. Individual projects are proposed for specific service areas in project-specific mitigation plans. Each project will be approved as an amendment to this instrument by going through the process outlined in 33 CFR 332.8(d) or 33 CFR 33.28(g)(2).

The ILF Program allows permit applicants to pay into the program to transfer all liability for the wetland mitigation. DU assumes all legal responsibility for satisfying the mitigation requirements of the Corps/state permit or other action for which fees have been accepted. DU assumes the responsibility for all aspects of mitigation, including but not limited to, the identification and selection of sites, property rights acquisition, mitigation plan design and development, construction, monitoring, preservation, and long-term management and maintenance of the required mitigation until the project from which credits were purchased is closed or responsibility is transferred.

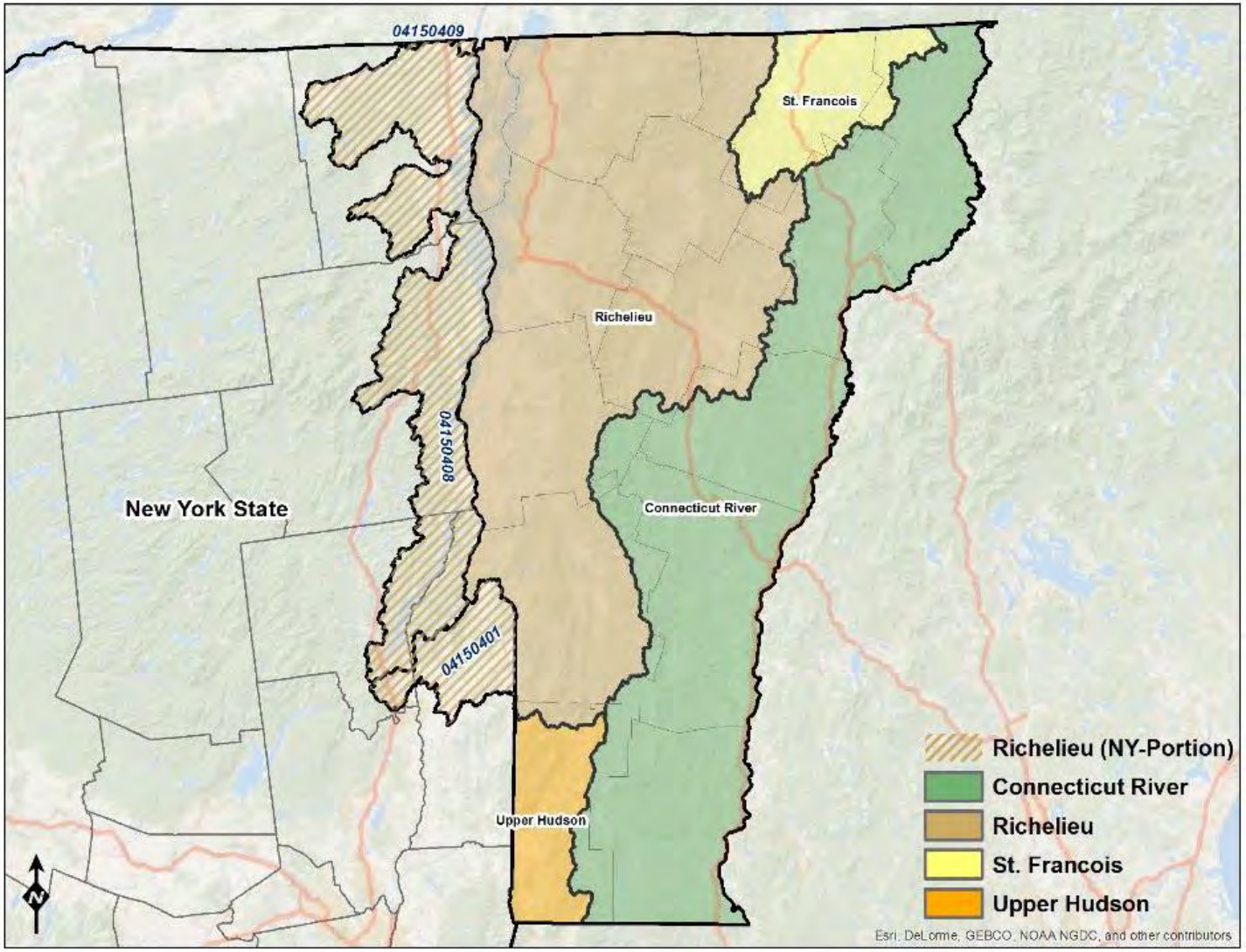


Figure 1. Service Areas for the DU-VT-ILF Program.

The Instrument was amended to provide the Corps with the discretion to utilize the Vermont ILF program for Impacts within the New York portion of the Richelieu Service Area. Associated NY impacts are satisfied in the Vermont portion of the Richelieu Service Area.

4. In-Lieu Fee Payments Received

The ILF Program has received 48 payments from permitted wetland and stream impacts that required compensatory mitigation from January 6, 2011 to December 31, 2019, totaling 35.14 credits for $3,760,397.03 (Table 1, Figure 2). The permitted activities that required the largest amount of mitigation were transportation, commercial, and energy projects.

Table 1. Summary of Payments by Service Area and Associated Impacts

Service Area	Permits Issued	Payment (Excludes Administrative Fee)	Total Credits Sold	Total Wetland Impacts
Connecticut River	7	$312,013.69	3.31	3.96
Richelieu	35	$2,557,673.31	22.67	52.45
St. Francois	4	$771,271.97	8.08	42.94
Upper Hudson	2	$119,438.06	1.08	9.94
Total	**48**	**$3,760,397.03**	**35.14**	**110.22**

Credit pricing was adjusted in February 2019, the Sponsor with Corps approval can now update pricing based on updated cost data while bypassing a formal instrument amendment.

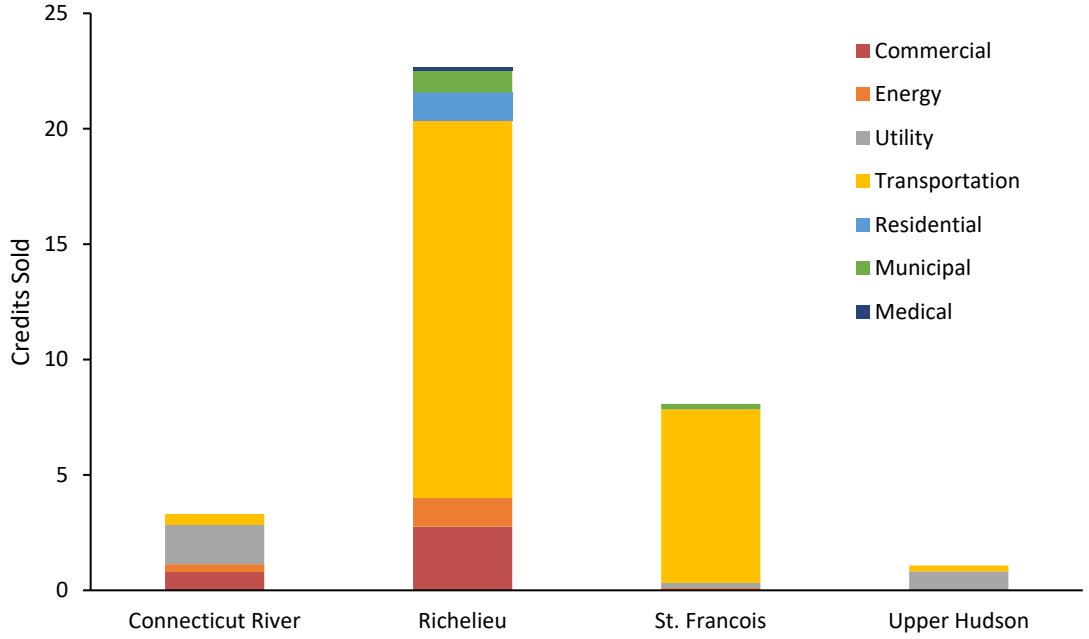


Figure 2. Credit Sales by Project Type and Service Area (2011–2019)

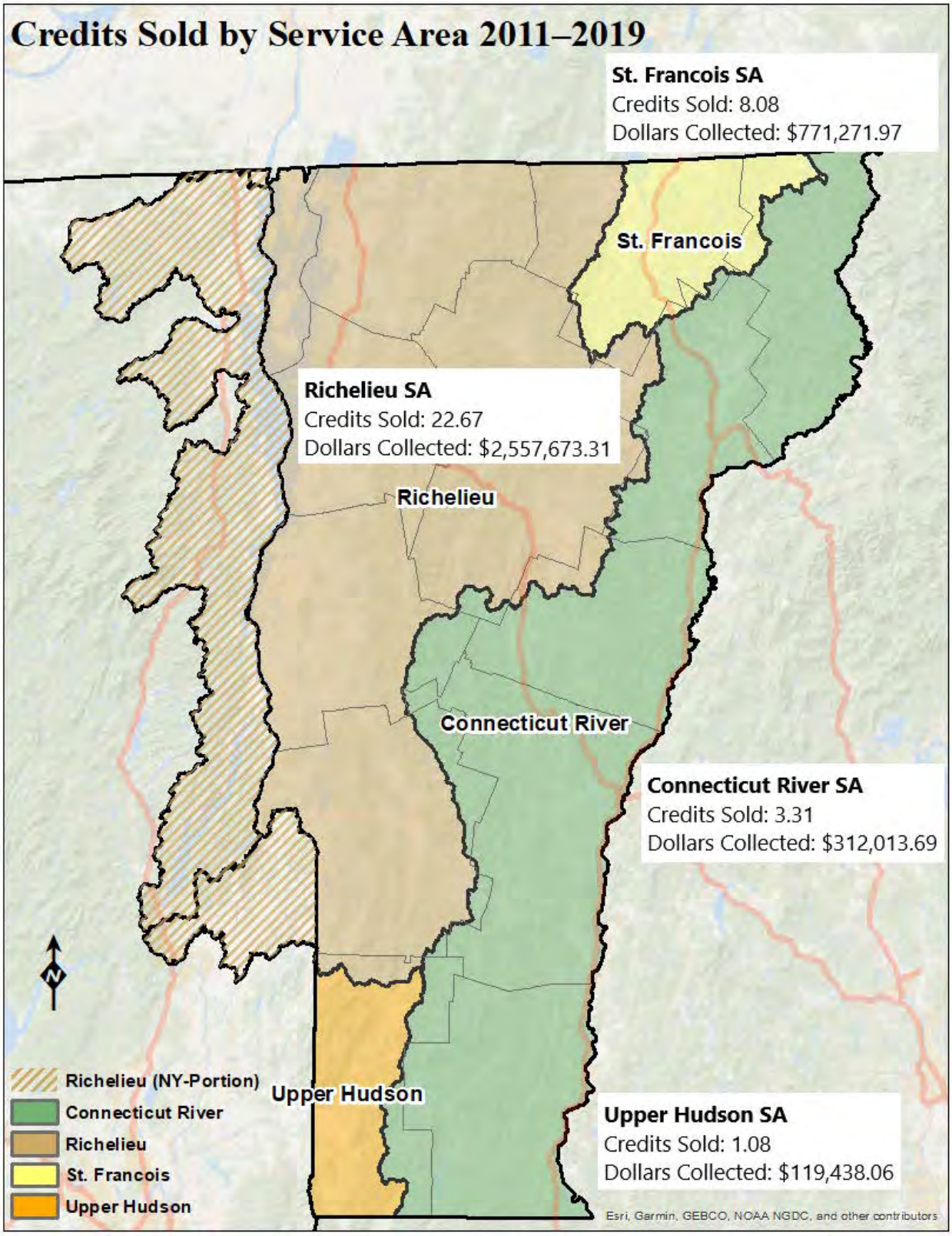


Figure 3. Credit Sales, by Service Area (2011-2019)
Excludes Administrative Fees.

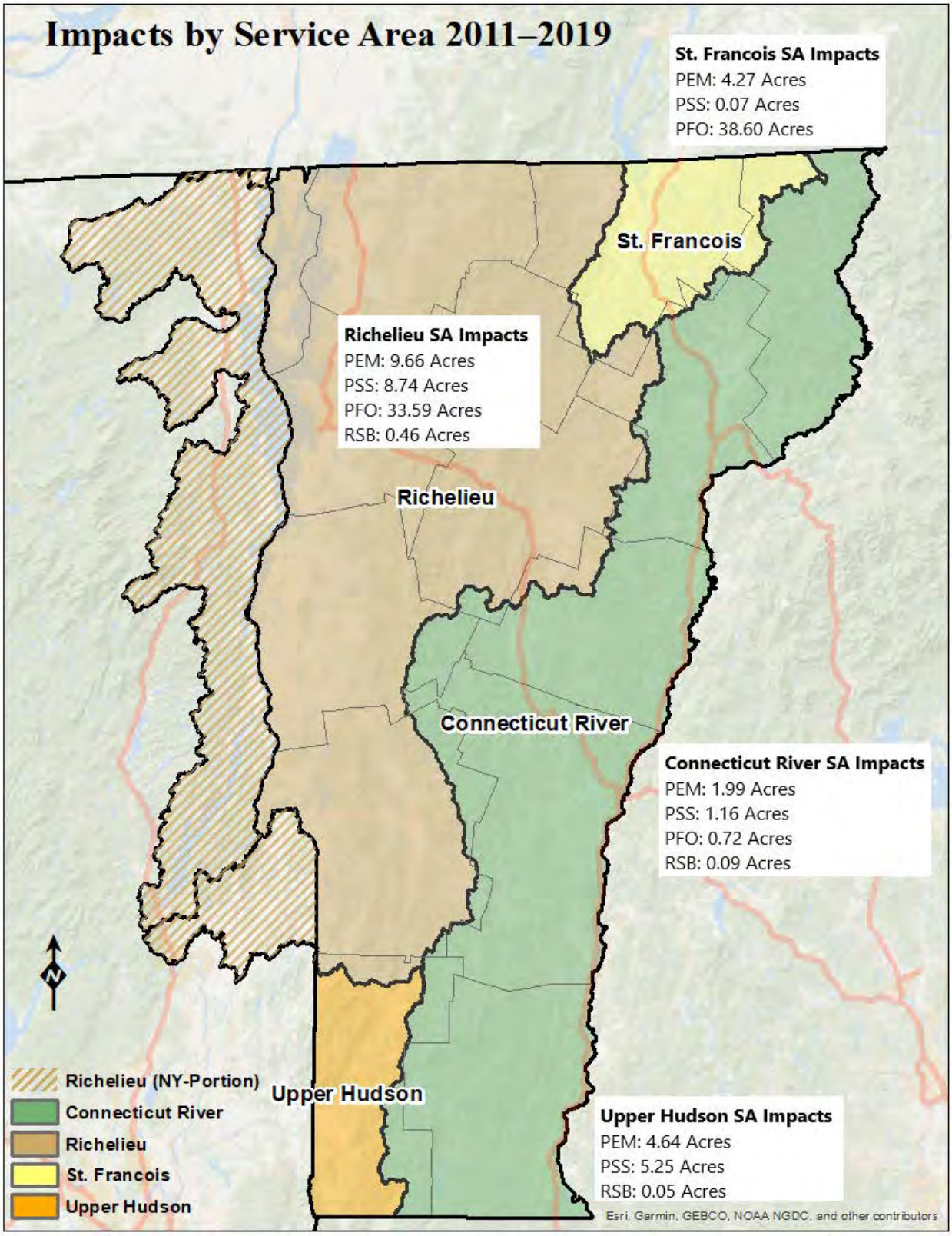


Figure 4. Permitted Wetland Impacts by Service Area and Wetland Type (2011-2019). *Includes temporary impacts.*

Connecticut River Service Area

The Connecticut River Service Area (SA) is situated in the eastern part of Vermont. The SA contains 41% of the land area in Vermont. The watershed has extensive forest, however, dams, river dredging, and floodplain agricultural activity have altered the natural floodplain function. Population density is low in this watershed, and development threats to wetlands are relatively low. Since the inception of the DU-VT-ILF Program in 2011, there have been only seven permitted wetland impacts that have used ILF, these resulted in 3.04 acres of permanent impact and 0.92 acres of temporary wetland loss, including impacts to palustrine forested, scrub/shrub, emergent wetlands and streams. Five of the seven permitted impacts that required ILF occurred in 2016, with only been one permitted impact since.

Richelieu Service Area

The Richelieu SA includes the Lake Champlain Basin in northwestern Vermont. The SA contains 56% of the land area in Vermont. Several of Vermont's largest population centers, including Burlington, are located in this SA. Impacts and threats to wetlands are greater in this SA than any other in Vermont. There have been 35 permitted impacts in this service area that required ILF, impacting a total of 52.45 acres of wetlands, including palustrine forested, scrub/shrub, emergent wetlands and streams. Seven impacts requiring ILF in this watershed were permitted in 2019, and demand remains higher here than in other service areas.

St. Francois Service Area

The St. Francois SA drains to Lake Memphremagog on the border between southern Quebec and northern Vermont. There have been four permitted wetland impacts requiring ILF, resulting in 8.08 credits, including impacts to palustrine emergent, scrub/shrub, and forested wetlands. The large majority of impacts requiring ILF have been to forested wetlands. The most recent permitted impact requiring ILF was in 2017.

Upper Hudson Service Area

The Upper Hudson SA is in the southwest corner of Vermont. It is part of the larger Hudson River Watershed that extends into parts of New York, Massachusetts, Connecticut, and New Jersey. Since 2011, there have been only two impacts requiring ILF, totaling 1.08 credits. The first credit sale was for 0.26 credits in 2015, and the second credit sale was 0.82 credits in 2018. This service area is small, consists of mountainous areas, has a high percentage of protected lands, and low overall development pressure. The ILF program has a proposed an instrument amendment to enable credits to be more readily transferred to adjacent service areas to facilitate project implementation. The 1.08 credits sold, pending instrument amendment, and USACE approval, are likely to be bolstered with a transfer of funds from the Richelieu service area so a critical mass of funds are available to advance a project.

5. Status and Trends of Program Objectives

The status of goals and objectives for the DU-VT ILF Program are as follows:

- Provide an alternative to permittee-responsible compensatory mitigation that will effectively replace functions and services lost through permitted impacts.
- Provide a compensatory mitigation option for Corps Civil Works projects, and function as an option for resolution of enforcement cases.
- Minimize the temporal loss of wetland functions and services by gaining approval of mitigation sites in advance of mitigation needs as funds allow.
- Create a program that has a level of accountability commensurate with mitigation banks as specified in 33 CFR Part 332.
- Provide projects to meet current and expected demand for credits.
- Achieve ecological success on a watershed basis by providing wetland types and functions that are appropriate, (e.g., identification of vulnerable wetlands in the watershed, stressors, ecological restoration opportunities, and priority conservation areas) to the service area and by integrating ILF Program projects with other conservation goals and objectives, whenever possible.

The DU-VT ILF Program has provided mitigation services both as an alternative to permittee-responsible mitigation and as an option for enforcement cases. Wetland functions and services that have been lost through permitted acts have and will continue to be replaced by the program. Although there has been some temporal loss of wetlands, as is consistent with any ILF program, strong efforts have been made to minimize these impacts. Current mitigation projects provide or will provide excess mitigation that can satisfy future wetland impacts, thus limiting future temporal loss. Additionally, efforts are already underway in the Richelieu Service Area to locate a second mitigation site.

The DU-VT-ILF Program currently has two approved mitigation projects, and third secured site in the planning stage. These mitigation projects are further described in Section 6.

The primary focus of every mitigation project identified by Ducks Unlimited is ecological success. Ducks Unlimited has implemented new site evaluation criteria (described in program improvements section) that enables quick desktop review of possible projects to ensure restoration potential of projects. Ducks Unlimited also reviews proximity of potential projects to conserved lands to prioritize creation of larger blocks of conserved area. Additionally, conservation planning and priority areas of partner organizations are considered. Some planning tools used include the Vermont Conservation Design Tool and Vermont Natural Heritage Inventory, among others that help us target high priority conservation projects (Vermont Fish and Wildlife Department 2016, Sorenson and Zaino 2018). All Ducks Unlimited projects incorporate appropriate wetland cover types based on present and historic site conditions as well as wetland cover impacts in each service area. These efforts have resulted in high quality mitigation sites that provide a wide range of ecological functions. The diverse biological communities found on DU mitigation sites in Vermont illustrate the ecological quality of the mitigation projects. To date 307 species of plants, fish, and wildlife have been identified on DU mitigation sites in Vermont (Appendix B). Many more are likely present, including under-sampled groups such as invertebrates.

6. Mitigation Sites and Objectives in Four Service Areas:

Connecticut River Service Area

Duren Mountain Swamp Mitigation Site

The Duren Mountain Swamp Mitigation Site has been approved by the Corps. The primary goal of this Site was to preserve biologically significant wetland features and adjacent terrestrial habitats near the Connecticut River.

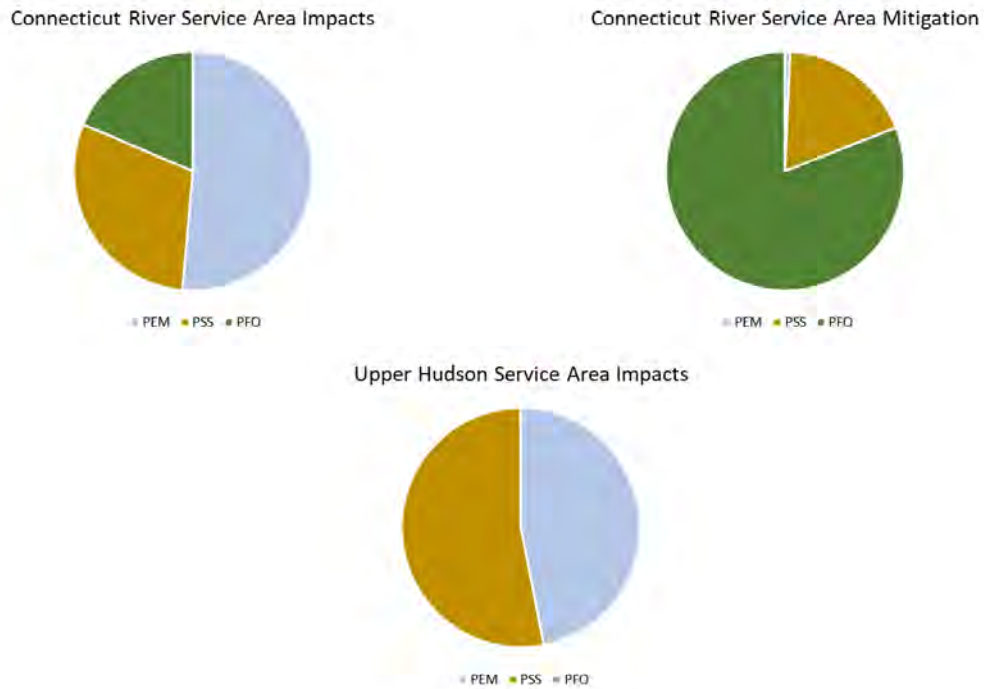
More specifically this project:

- Preserves wetland habitat, including a northern white cedar swamp, a rare wetland type and ecological community in Vermont, and habitat for at least one rare plant species
- Preserves flood attenuation capacity
- Preserves habitat for big game including moose and black bear
- Preserves a wildlife connective corridor
- Preserves upland buffer on the site to preserve water quality in the Connecticut River watershed
- Preserves a large interior forest block
- Provide recreational opportunities for hiking, wildlife viewing, and hunting

The Site is located directly to the west of Route 102 approximately 2.6 miles north of US Route 2 in, Guildhall in Essex County, Vermont as shown in Figure 5. It is within an area with a high density of protected properties and is a connecting parcel between existing Vermont Land Trust Easements. Several agencies and conservation partners have identified this area as a priority for protection. The Site falls within the Atlantic Coast Joint Venture (ACJV) Atlantic Northern Forest Bird Conservation Region's (BCR-14) Connecticut River Waterfowl Focus Area and is identified as a high priority landscape for conservation of waterfowl species (Dettmers 2006). The Vermont Conservation Design Tool developed by the Vermont Fish and Wildlife Department identifies this area as a high priority riparian wildlife connectivity corridor and a priority interior forest block (Sorenson and Zaino 2018). Similarly, The Nature Conservancy's (TNC) habitat connectivity tools also identified this area as a wildlife connective corridor. TNC owns over 11,000 acres in the Northern Connecticut River Watershed in Vermont and New Hampshire portions, so this site adds to protection efforts in the Watershed.

Species of greatest conservation need (black bear, moose, bobcat, snowshoe hare) and the rare plant species *Platanthera huronensis* (S3) have been identified at this site. Protection of intact, large wetland areas such as those present at this site is one of the strategies identified in The Vermont's 2010-2020 Moose Management Plan (VT Big Game Management Plan 2009). In addition to providing excellent wildlife habitat, the site contains a northern white cedar swamp identified by the Vermont Natural Heritage Inventory (VNHI) as a state-vulnerable (S-3), globally uncommon (G-4) community (Vermont Fish and Wildlife Department 2016). According to VNHI, this is a "site of ecological significance" and a "classic example of a seepage swamp". These communities are also rare in the Northeast, and commonly support rare plant species (Podniesinski and Leopold 1998; Scanga et al 2009, Raney et al. 2014, Vermont Fish and Wildlife Department 2016).

The mitigation site is 183.74 acres and when all protection requirements are met (property transferred to long-term owner, and conservation easement filed), will produce 11.12 credits (Table 2). A total of 183.3 acres of wetland habitat and associated upland buffers are being preserved at the site. 3.31 credits have been sold in the Connecticut River Service Area. It is anticipated that this site will be able to meet mitigation demand for a few years based on demand. The Site will be transferred to the Northeast Wilderness Trust for long-term ownership and will be open to the public for passive recreation including hunting. Ducks Unlimited will retain a permanent conservation easement on the property to ensure its status as a protected area is being upheld.



Percentage of impact area and mitigation activity area by habitat type (palustrine emergent, palustrine scrub/shrub, and palustrine forested) in the Connecticut River Service Area and Upper Hudson Service Area. This site preserves more palustrine forested wetlands and less palustrine emergent wetlands relative to wetland impacts in these service areas. Future mitigation will incorporate palustrine emergent wetlands to a greater extent.

Table 2. Duren Mountain Swamp Credit Generation Table

Mitigation Activity	Description	Acres	Ratio (Acres: Credits)	Credits
PEM Preservation	Preservation of Aquatic Resources	0.46	**20:1**	0.02
PSS Preservation		11.80		0.59
PFO Preservation		51.99		2.60
Pond Preservation		2.03		0.10
Upland Buffer Preservation	Preservation of Upland Buffer	117.11	**15:1**	7.81
	Total	**183.39**		**11.12**

Figure 5. Duren Mountain Swamp Site Map
The site lies to the West of the Connecticut River.

Diverse, globally rare northern white cedar swamp at Duren Mountain Swamp. August 2018.

Bobcats are one of the species that benefit from the long-term protection of the Duren Mountain Swamp Mitigation Site

Many moose, a species of greatest conservation need in Vermont, use the Duren Mountain Swamp Mitigation Site throughout the year

Richelieu Service Area

Three Mile Bridge Road Mitigation Site

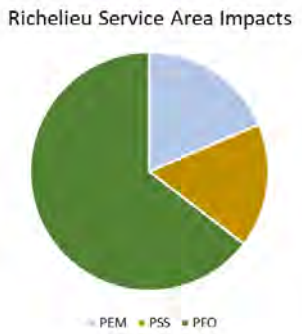
The overall goal of this compensatory wetland mitigation project is to re-establish, rehabilitate, and protect wetlands and associated upland buffers to compensate for the impacts to wetlands in the Lake Champlain – Richelieu River Basin. The mitigation site is on a 137.95-acre parcel owned by Wetlands America Trust, Inc. The Site is accessed from Three Mile Bridge Road and lies at the junction of Otter Creek and the Middlebury River in the Town of Middlebury, Addison County, VT (Figure 6).

An objective of the Site was to return agricultural fields to floodplain forest and improve water quality in two important streams. Reed canary grass control was performed in a fallow agricultural field to the north of Three Mile Bridge Road during June of 2018. This control involved the combination of herbicide (glyphosate) application and disking, followed up by a second herbicide application and broadcast seeding of broad-leaf hydrophytes; graminoids will be seeded in during 2019. Observations made during the fall of 2018 indicate a decrease in the abundance of reed canary grass and an increase in the diversity of native hydrophytes within the treated area. Future monitoring will determine if adaptive management to control reed canary grass is needed.

Construction to the south of Three Mile Bridge Road was completed in August of 2018. Approximately 29.4 acres of palustrine forested (PFO) and 28.5 acres of palustrine scrub-shrub (PSS) communities were planted to restore floodplain functioning and to improve wildlife habitat.

It is estimated the site will produce 22.81 credits when all performance standards are met. Through 2019, 22.67 credits have been sold in the Richelieu Service Area. Efforts are underway to secure a second mitigation site.

The Site will be transferred to the State of Vermont as an addition to their Wildlife Management Areas. It will be open to the public, providing access for passive recreation including hunting and fishing. Middlebury College has already been utilizing the property for a natural laboratory for its biology classes.



Relative percentage of the area of mitigation activities and impacts by habitat type (Palustrine emergent, palustrine scrub/shrub, and palustrine forested) in the Richelieu Service Area. The ratio of delivered wetland mitigation habitat types closely approximates the ratio of habitat type impacts.

Table 3. Three Mile Bridge Road Credit Generation Table

Habitat Type	Acreage	Ratio	Credit Generation
PEM Reestablishment	0.34	2:1	0.17
PEM Rehabilitation	5.16	10:1	0.52
PSS Reestablishment	1.71	2:1	0.86
PSS Rehabilitation	26.87	3:1	8.96
PFO Reestablishment	5.29	3:1	1.76
PFO Rehabilitation	31.91	5:1	6.38
Wetland Preservation	63.14	15:1	4.21
Upland Buffer Preservation	3.23	15:1	0.22
Wetland Impact	0.27	1:1	-0.27
Total	**137.92**		**22.81**

Figure 6. Three Mile Bridge Road Site Map

Earthwork was completed in August 2018 at the Three Mile Bridge Road site to help restore hydrology in the Middlebury River and Otter Creek floodplain.

Seeding and planting of hydrophytic plant species was conducted to restore the plant community of the mitigation site. Native plant species, such as spotted Joe-pye weed (*Eutrochium maculatum*), have thrived post-restoration.

Mallards, northern shovelers, common mergansers, and wood ducks are utilizing constructed and preserved aquatic resources at Three Mile Bridge. Here a breeding mallard pair was photographed in May 2019.

St. Francois Service Area

Willoughby Lake Road Mitigation Site

The Willoughby Lake Road Mitigation Site was acquired in 2019. This large 243.6-acre site provides the opportunity to preserve significant acreage, and to provide wetland compensation. The primary goal of the Willoughby Lake Road ILF Site (hereafter: Site) is to provide wetland reestablishment, rehabilitation, and preservation to compensate for wetland loss.

More specifically this Site provides an opportunity to:

- Mitigate for wetland impacts through wetland reestablishment, rehabilitation, and preservation
- Reestablish, rehabilitate, and preserve habitat for a wide range of species
- Preserve and improve flood attenuation capacity
- Preserve a wildlife connective corridor
- Preserve upland buffer on the Site to preserve water quality in the watershed, specifically to Lord Brook, a tributary to the nearby Willoughby River
- Potentially provide recreational opportunities for hunting
- Potentially provide educational and research opportunities for universities

The ILF Site is located directly to the north of Vermont Route 16 (Willoughby Lake Road) at the intersection with Hunt Lane in the town of Barton in Orleans County. This Site was selected because of its unique potential to reestablish a forested wetland community adjacent to Lord Brook, a tributary of the Willoughby River. The Willoughby River has the potential to be given an Outstanding Resource Waters (ORW) designation by the State of Vermont. During initial Site inspections, evidence of clearing and drainage for agriculture indicated suitable conditions for reestablishing wetland acreage. The Site is 243.60-acres and lies within the larger 243.90-acre property protected by WAT (Figure 6). A conservation easement encompassing the 243.60-acre Site will be established to permanently protect natural areas on this property.

The Site lies within close proximity to other protected areas, such as the Willoughby Falls Wildlife Management Area, Willoughby State Forest, local recreational areas, and several Vermont Land Trust Easements. Lord Brook, a tributary of the Willoughby River, also flows through the western side of the property. The Willoughby River is clear, cold-water trout stream fed by nearby Lake Willoughby. Lake Willoughby is an important recreational area in NE Vermont and has an extensive trail system on protected lands. The Barton Town Forest is located to the southwest of the property, immediately across the road from the property. The close proximity to other protected areas, as well as biologically significant aquatic resources emphasizes the importance of restoring and protecting this Site. The Site will protect an important buffer that maintains functioning of features including streams hydrologically connected to the Willoughby River.

Based on the proximity of this Site to both the Willoughby River and Lake Willoughby, restoring wetlands on this Site would likely support seasonal use by many waterfowl species including American black ducks, mallards, and wood ducks. This Site also contains forested wetlands that are important resources worthy of protection, especially because these wetlands protect water quality in sensitive riparian areas. Additionally, a portion of wetland impacts that this Site will mitigate for are forested wetland impacts, making protection of existing forested wetlands an important aspect of the Site.

The mitigation site is 243.60 acres and is projected to produce 23.12 credits in two phases of work (Table 4). A total of 243.60 acres of wetland habitat and associated upland buffers will be preserved on the mitigation site. A total of 8.08 credits have been sold in the St. Francois Service Area. The credit production on the mitigation site will satisfy all outstanding credits sold in the St. Francois Service Area.

Relative percentage of the area of mitigation activities and impacts by habitat type (Palustrine emergent, palustrine scrub/shrub, and palustrine forested) in the St. Francois Service Area. The ratio of delivered wetland mitigation habitat types is comparable to the ratio of habitat type impacts.

Table 4. Draft Willoughby Lake Road Credit Generation Table

Mitigation Activity	Ratio (Acres: Credits)	Acres	Credits Generated
	Phase 1		
PEM/Upland Mosaic Preservation	15:1	10.18	0.68
Upland Buffer Preservation	15:1	65.34	4.36
Wetland Preservation	15:1	89.59	5.97
PEM Re-establishment	2:1	1.32	0.66
PFO Re-establishment	2:1	5.27	2.64
Upland Buffer Rehabilitation	10:1	26.94	2.69
		Subtotal	**17.00**
	Phase 2		
PEM Re-establishment	2:1	2.47	1.24
PSS Re-establishment	2:1	1.08	0.54
PFO Re-establishment	2:1	0.6	0.3
PFO/Upland Mosaic Re-establishment	7:1	10.23	1.46
PFO Rehabilitation	10:1	2.6	0.26
Upland Buffer Rehabilitation	10:1	20.63	2.06
Upland Buffer Preservation	15:1	2.86	0.19
Wetland Preservation	15:1	1.03	0.07
	Phase 2 Total	**41.50**	**6.12**
		Total all phases:	**23.12**

A final credit production table will be available with final plan submission.

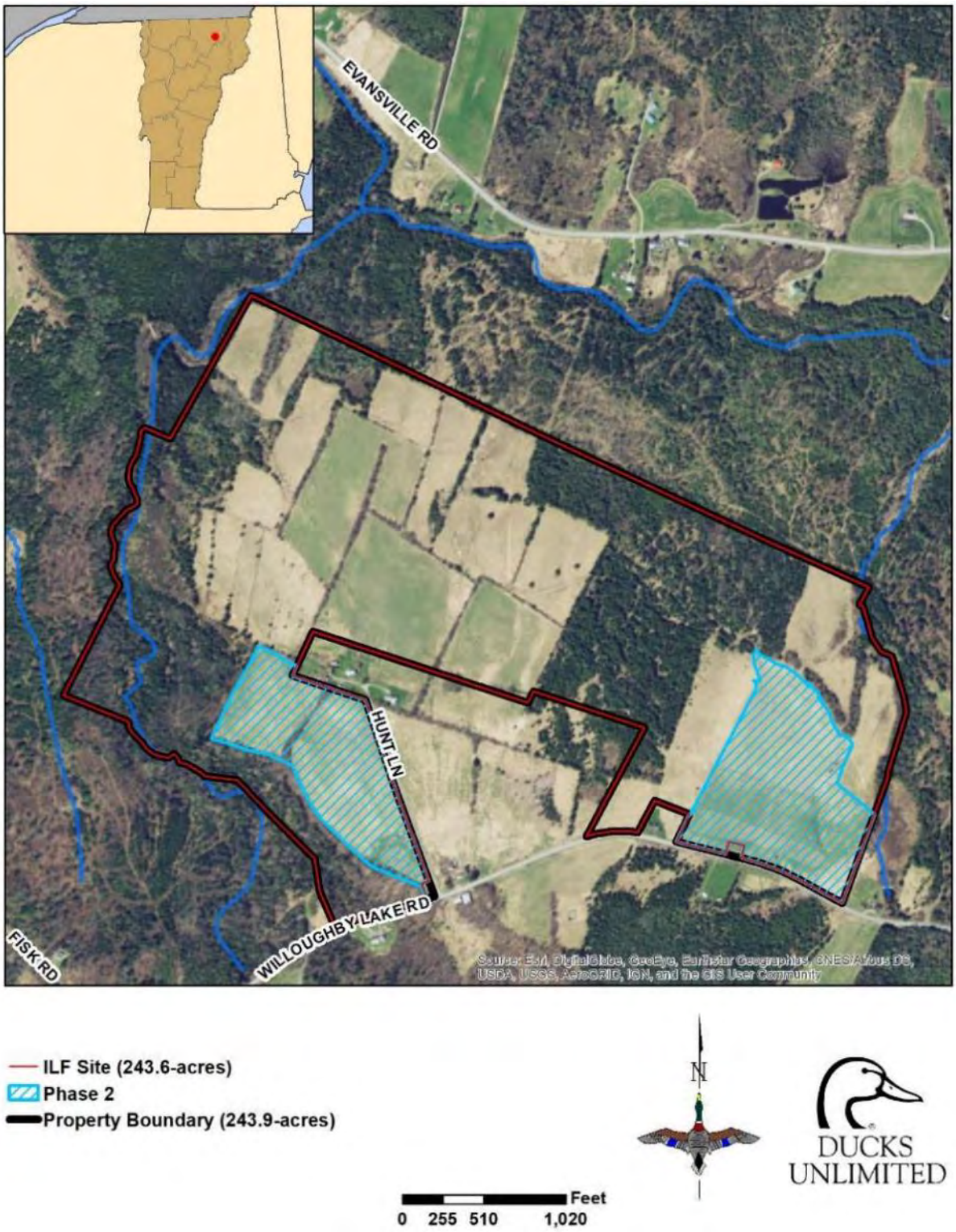


Figure 7. Willoughby Lake Road Site Map

The 243.60-acre Site is owned by Wetlands America Trust (WAT). WAT is a wholly owned subsidiary of Ducks Unlimited. Phase 2 areas are shown in light blue hashing, all other areas within the red site boundary are included in phase 1. It is anticipated this site will meet continuing mitigation demand in the St. Francois SA.

Large forested wetlands like this northern white cedar swamp were delineated at the site. Restoration activities will target forested wetland rehabilitation and reestablishment, in addition to some emergent and scrub/shrub wetland rehabilitation and reestablishment.

Lord Brook flows along the western edge of the mitigation site, and it will benefit from restoration and long-term protection of the site.

Upper Hudson Service Area

To date only 1.08 credits have been sold in this SA. This amount of funding is insufficient to support a full mitigation project. An instrument amendment request has been submitted that would enable movement of funds to bolster funds available in this watershed.

7. Summary of Program Improvements

Program Infrastructure Investments

Ducks Unlimited has established and staffed the DU North Atlantic Office in Syracuse New York (NAO), improved GIS site identification targeting tools, and taking steps to improve internal operating efficiencies. In addition to dedicated program staff and engineering support, DU's Great Lakes Atlantic Regional Office also hired a full-time real estate specialist to perform land acquisition in the region and specifically to provide support to the ILF program. This specialist's presence has also advanced long-term stewardship arrangements for ILF projects.

Efficiency Improvements

Since program inception, advances in cloud-based computing applications have enabled real-time file-sharing facilitating faster site planning. DU has taken full advantage of these advancements in the ILF program, with staff working collaboratively in real time on mitigation documents. These increases in efficiency reduce lag time in resource replacement.

DU VT Site Evaluation Criteria Update

In 2018, the DU VT ILF program overhauled its state-wide GIS tools. Layers in this GIS database now include: SSURGO soils, topographic wetness index, transportation features, municipal boundaries, tax parcels, existing wetlands, easements, and partner organization conservation prioritization and habitat connectivity tools.

DU staff have also used modeling techniques to map wetland locations and their potential restoration opportunities comprehensively for the State of Vermont, using an approach described previously by Hunter et al. 2012, Raney et al. 2017, and Raney and Leopold 2018. The approach predicted wetland distribution based on relationships between known wetland sites and environmental variables (terrain, climate, and soil facets). This approach able to identify potentially restorable wetlands because it is not sensitive to fine-scale ditching and drainage efforts (Raney and Leopold 2018). The modeling technique used was honed during previous New York and Pennsylvania projects, greatly reducing development costs for Vermont. These tools were developed using ILF administrative funds. The modeled wetland distribution tool is shown in Figure 8. Since development of these expanded GIS tools, the DU VT ILF program has been able to better screen candidate sites and has had more productive site reviews with the Wetland Interagency Review Team (IRT).

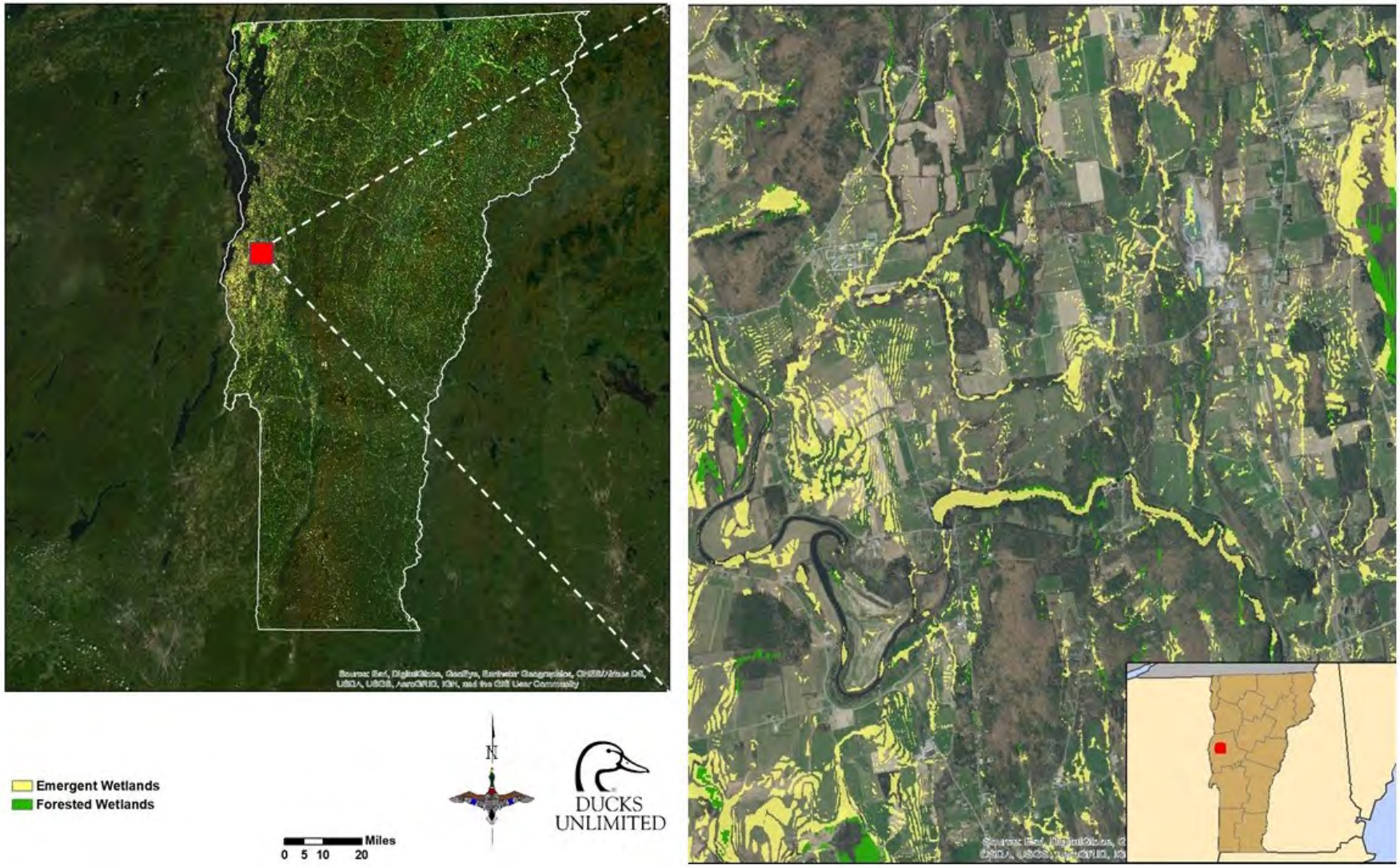


Figure 8. Modeled Wetland Locations for the State of Vermont

Modeled wetlands can be accessed as an ArcGIS map package here: https://www.dropbox.com/s/x28docyn95pr6zy/DU_Vermont. Questions regarding this tool can be directed to the Vermont ILF program point of contact: Dr. Patrick A. Raney praney@ducks.org.

Continued Improvements to Wetland Map Products in Vermont

Ducks Unlimited continues to partner with academic, private sector, and our regulatory partners to produce higher accuracy, wetland mapping in the State of Vermont. In 2020, DU will be assisting the State of Vermont, VHB and the University of Vermont's Spatial Analysis Laboratory with updated wetland mapping from LiDAR, high resolution imagery, and the aforementioned wetland modeling techniques to produce accurate wetland maps for the Otter Creek and Black-Ottauquechee watersheds (Figure 9). While this effort will not be a function of the VT ILF Program, datasets and techniques developed in the ILF program will be used in this more comprehensive wetland mapping effort thereby lowering mapping costs for the State of Vermont.

Figure 9 VHB, UVM, DU Wetland Mapping Project Area for 2020.

References

Big Game Management Plan 2010-2020: Creating a Road Map for the Future (2009) – Moose Management, Chapter 3. Vermont Fish and Wildlife Department http://www.vtfishandwildlife.com/moose-study.html.

Dettmers R (2006) A blueprint for the design and delivery of bird conservation in the Atlantic northern forest. United States Fish and Wildlife Service. Department of the Interior, Washington, D.C., USA.

Fernández-Pascual E, Jiménez-Alfaro B, Hájek M, et al (2015) Soil thermal buffer and regeneration niche may favour calcareous fen resilience to climate change. Folia Geobotanica 50:293–301. doi: 10.1007/s12224-015-9223-y

Forsyth JL, Forsythe JL (1974) Geologic conditions essential for the perpetuation of cedar bog, Champaign County, Ohio. The Ohio Journal of Science 74:116–125.

Keddy PA (2010) Wetland ecology, principles and conservation. Cambridge University Press, New York, USA

Podniesinski GS, Leopold DJ (1998) Plant community development and peat stratigraphy in forested fens in response to ground-water flow systems. Wetlands 18:409–430.

Raney PA, Fridley JD, Leopold DJ (2014) Characterizing microclimate and plant community variation in wetlands. Wetlands. doi: 10.1007/s13157-013-0481-2

Raney PA, Leopold DJ, Dovciak M, Beier CM (2016) Hydrologic position mediates sensitivity of tree growth to climate: Groundwater subsidies provide a thermal buffer effect in wetlands. Forest Ecology and Management. doi: 10.1016/j.foreco.2016.08.004

Scanga SE, Leopold DJ, Shannon SS (2009) Population Ecology of the Rare Wetland Plant.

Sorenson E, Engstrom B, Lapin M, Popp R, Parren S. (1998) Northern white cedar swamps and red maple-northern white cedar swamps of Vermont: some sites of ecological significance. Nongame and Natural Heritage Program, Vermont Fish and Wildlife Department. Waterbury, VT.

Sorenson E, Zaino R (2018) Vermont conservation design: summary report for landscapes, natural communities, habitats, and species. Vermont Fish and Wildlife Department. Montpelier, VT.

United States Fish and Wildlife Service. 1986. North American Waterfowl Management Plan. Department of the Interior, Washington, D.C., USA.

United States Fish and Wildlife Service. 2012. North American Waterfowl Management Plan. Department of the Interior, Washington, D.C., USA.

Vermont Fish and Wildlife Department (2016) Synonymy of Vermont Natural Community Types with National Vegetation Classification Associations Natural Heritage Inventory.

Vermont Wildlife Action Plan Team (2015) Vermont Wildlife Action Plan 2015. Vermont Fish and Wildlife Department. Montpelier, VT. http://www.vtfishandwildlife.com

White D, Fennessy S (2005) Modeling the suitability of wetland restoration potential at the watershed scale. Ecological Engineering 24:359–377.

Appendix A. Wildlife and Plant Species Identified on ILF Projects.

Species	common name	Conservation Status	Notes
	plants		
Abies balsamea	balsam fir		
Acer negundo	box elder		
Acer pennsylvanicum	striped maple		
Acer rubrum	red maple		
Acer saccharum	sugar maple		
Acer spicatum	mountain maple		
Achillea millefolium	yarrow		
Acorus americanus	sweet flag		
Agrostis scabra	rough bent grass		
Alisma subcordatum	water plantain		
Alnus incana	speckled alder		
Anthoxanthum odoratum	sweet vernal grass		
Aralia nudicaulis	wild sarsparilla		
Arisaema triphyllum	Jack-in-the-pulpit		
Asclepias syriaca	common milkweed		
Bazzania trilobata	greater whipwort		
Betula alleghaniensis	yellow birch		
Betula papyrifera	paper birch		
Bidens cernua	nodding beggartick		
Bidens frondosa	devil's beggartick		
Botrychium virginianum	rattlesnake fern		
Carex comosa	bristly sedge		
Carex comosa	bearded sedge		
Carex crinita	fringed sedge		
Carex flava	yellow-green sedge		
Carex grayi	Gray's sedge		
Carex gynandra	nodding sedge		
Carex intumescens	bladder sedge		
Carex lacustris	lakeshore sedge		
Carex lupulina	hop sedge		
Carex lurida	shallow sedge		
Carex rostrata	swollen beaked sedge		
Carex scoparia	pointed broom sedge		
Carex stricta	tussock sedge		
Carex trisperma	three-seeded sedge		
Carex vulpinoidea	fox sedge		
Carpinus caroliniana	American hornbeam		
Cephalanthus occidentalis	buttonbush		
Chamaenerion angustifolium	fireweed		
Chelone glabra	white turtlehead		

Species	common name	Conservation Status	Notes
Circaea alpina	enchanter's nightshade		
Cirsium arvense	Canada thistle		
Clematis virginiana	woodbine		
Clintonia borealis	blue-bead lily		
Convulvulus arvensis	bindweed		
Coptis groenlandica	threeleaf goldthread		
Cornus amomum	silky dogwood		
Cornus canadensis	creeping dogwood		
Cornus racemosa	gray dogwood		
Cornus sericea	red-osier dogwood		
Corylus cornuta	beaked hazelnut		
Crotalaria sagittalis	rattlebox	MP SGCN	
Cyperus esculentus	yellow nutsedge		
Cypripedium acaule	pink lady's slipper		
Dactylis glomerata	orchardgrass		
Dennstaedtia punctilobula	hayscented fern		
Dryopteris carthusiana	spinulose wood fern		
Dryopteris cristata	crested wood fern		
Dryopteris intermedia	intermediate wood fern		
Dryopteris intermedia	evergreen wood fern		
Echinochloa muricata	barnyard grass		
Eleocharis obtusa	blunt spikerush		
Eleocharis palustris	common spike-rush		
Epilobium sp.	willowherb		
Epipactis helleborine	weed orchid		
Equisetum arvense	field horsetail		
Equisetum fluviatile	water horsetail		
Eragrostis hypnoides	teal love grass		
Eriophorum vaginatum	tussock cottongrass		
Eupatorium perfoliatum	boneset		
Eupatorium serotinum	white boneset		
Eurybia divaricata	wood aster		
Euthamia graminifolia	grass leaved goldenrod		
Euthamia graminifolia	flat-top goldentop		
Eutrochium maculatum	Joe Pye Weed		
Eutrochium maculatum	spotted joe pye weed		
Fagus grandifolia	American beech		
Festuca rubra	red fescue		
Fragaria vesca	wild strawberry		
Fragaria virginiana	Virginia strawberry		
Frangula alnus	glossy buckthorn		
Fraxinus nigra	black ash		

Species	common name	Conservation Status	Notes
Fraxinus pennsylvanica	green ash		
Galium aparine	stickywilly		
Galium mollugo	false baby's breath		
Galium tinctorium	stiff marsh bedstraw		
Geranium maculatum	spotted crane's-bill		
Glyceria canadensis	rattlesnake mannagrass		
Glyceria striata	fowl manna grass		
Gymnocarpium dryopteris	oak fern		
Hylocomnium splendens	stair-step moss		
Ilex mucronata	mountain holly		
Ilex verticillata	winterberry		
Impatiens capensis	jewelweed		
Iris versicolor	blue flag		
Juncus alpinoarticulatus	northern green rush		
Juncus articulatus	joint-leaf rush		
Juncus canadensis	Canadian rush		
Juncus effusus	soft rush		
Juncus tenuis	poverty rush		
Krigia virginica	Virginia dwarf-dandelion		
Larix laricina	tamarack		
Leersia oryzoides	rice cutgrass		
Lemna minor	duckweed		
Leucanthemum vulgare	ox-eye daisy		
Linnaea borealis	twinflower		
Lobelia inflata	Indian tobacco		
Lolium perenne	perennial ryegrass		
Lonicera oblongifolia	swamp honeysuckle		
Luzula acuminata	hairy wood rush		
Lychnis flos-cuculi	ragged-robin		
Lycopodium sp.	clubmoss		
Lycopus americanus	American water horehound		
Lysimachia terrestris	swamp candles		
Maianthemum canadense	Canada mayflower		
Maianthemum racemosum	false Solomon's-seal		
Maianthemum stellatum	star-flowered lily-of-the-valley		
Maianthemum trifolium	three-leaf Solomon's-seal		
Medeola virginiana	Indian cucumber-root		
Melilotus officinalis	yellow sweet clover		
Mimulus ringens	monkey flower		
Mitchella repens	partridgeberry		
Mitella nuda	naked bishop's cap		
Mnium cuspidatum	toothed plagiomnium moss		

Species	common name	Conservation Status	Notes
Monotropa uniflora	Indian pipe		
Myosotis scorpioides	true forget-me-not		
Nemopanthus mucronata	mountain holly		
Onoclea sensibilis	sensitive fern		
Osmunda claytoniana	interrupted fern		
Osmunda regalis	royal fern		
Osmundastrum cinnamomeum	cinnamon fern		
Oxalis acetosella	wood sorrel		
Oxalis montana	mountain woodsorrel		
Oxalis stricta	common wood sorrel		
Parthenocissus quinquefolia	Virginia creeper		
Penthorum sedoides	ditch stonecrop		
Persicaria lapathifolia	pale smartweed		
Persicaria pensylvancium	Pennsylvania smartweed		
Persicaria sagittatum	arrow-leaved tearthumb		
Phalaris arundinacea	reed canary grass		
Phleum pratense	common timothy		
Picea glauca	white spruce		
Picea rubens	red spruce		
Pilea pumila	Canadian clearweed		
Pinus strobus	eastern white pine		
Plantago lanceolata	narrow-leaf plantain		
Plantago major	broadleaf plantain		
Platanthera aquilonis	northern green orchid		
Platanthera huronensis	tall northern bog orchid	S3	
Platanthera lacera	ragged-fringed-orchid		
Polypodium virginianum	rock polypody		
Polystichum acrostichoides	Christmas fern		
Populus balsamifera	balsam poplar		
Populus tremuloides	quaking aspen		
Prunella vulgaris	common selfheal		
Prunus serotina	black cherry		
Quercus bicolor	swamp white oak		
Ranunculus acris	tall buttercup		
Rhynchospora alba	white beak sedge		
Ribes nigrum	blackcurrant		
Rubus pubescens	dwarf red blackberry		
Rumex crispus	curly dock		
Salix candida	sageleaf willow		
Salix nigra	black willow		
Salix sp.	willow		
Sambucus nigra	black elderberry		

Species	common name	Conservation Status	Notes
Scirpus atrovirens	green bulrush		
Scirpus cyperinus	woolgrass		
Securigea varia	Crown vetch		
Sinapis arvensis	wild mustard		
Solidago canadensis	Canada goldenrod		
Solidago patula	rough leaved goldenrod		
Solidago rugosa	wrinkleleaf goldenrod		
Sorbus americana	American mountain ash		
Sparganium eurycarpum	giant burreed		
Spergularia media	media sandspurry		
Sphagnum centrale	sphagnum		
Sphagnum sqarrosa	spiky bog moss		
Sphagnum warnstorfii	sphagnum		
Spiraea alba	white meadowsweet		
Spiraea tomentosa	rosy meadowsweet		
Spiranthes romanzoffiana	hooded ladies tresses		
Stellaria media	common chickweed		
Streptopus lanceolatus var. roseus	rose twisted-stalk		
Symphyotrichum ericoides	white heath American-aster		
Symphyotrichum novae-angliae	New England aster		
Symphyotrichum tradescantii	tradescant aster	MP SGCN	
Taraxacum officinale	common dandelion		
Thelypteris noveboracensis	New York fern		
Thelypteris palustris	eastern marsh fern		
Thuja occidentalis	northern white cedar		
Tiarella cordifolia	foamflower		
Tiarella cordifolia	heart-leaf foamflower		
Tilia americana	American basswood		
Triadenum virginicum	marsh St. John's wort		
Trientalis borealis	starflower		
Trifolium pratense	red clover		
Trifolium repens	white clover		
Trillium grandiflorum	white trillium		
Trillium undulatum	painted trillium		
Tsuga canadensis	eastern hemlock		
Tussilago farfara	coltsfoot		
Typha angustifolia	narrowleaf cattail		
Typha latifolia	broad-leaf cattail		
Typha X *glauca*	hybrid cattail		invasive
Ulmus americana	American elm		
Ulmus rubra	slippery elm		
Urtica dioica	stinging nettle		

Species	common name	Conservation Status	Notes
Vaccinium corymbosum	highbush blueberry		
Vaccinium myrtilloides	velvet-leaf blueberry		
Verbena hastata	blue vervain		
Verbena urticifolia	white vervain		
Viburnum dentatum	southern arrowwood		
Viburnum lentago	nannyberry		
Viburnum nuda var. cassinoides	withe-rod		
Vicia sativa	common vetch		
Viola spp.	violets		
Vitis riparia	riverbank wild grape		
	birds		
Agelaius phoeniceus	red-winged blackbird		
Aix sponsa	wood duck		
Anas carolinensis	green-winged teal		
Anas platyrhynchos	mallard		
Ardea herodias	great blue heron	MP SGCN	
Baeolophus bicolor	tufted titmouse		
Bombycilla cedrorum	cedar waxwing		
Bonasa umbellus	ruffed grouse	MP SGCN	
Buteo jamaicensis	red-tailed hawk		
Calidris minutilla	least sandpiper		
Cathartes aura	turkey vulture		
Colaptes auratus	northern flicker		
Contopus virens	eastern wood peewee		
Corvus brachyrhynchos	American crow		
Corvus corax	common raven		
Cyanocitta cristata	blue jay		
Dolichonyx oryzivorus	bobolink		
Dryocopus pileatus	pileated woodpecker		
Dumetella carolinensis	gray catbird		
Falco columbarius	merlin		
Falco peregrinus	peregrine falcon	MP SGCN	
Gallinago delicata	Wilson's snipe		
Geothlypis trichas	common yellowthroat		
Haliaeetus leucocephalus	bald eagle	HP SGCN	
Hirundo rustica	barn swallow		
Lophodytes cucullatus	hooded merganser		
Maleagris gallopavo	wild turkey		
Megaceryle alcyon	belted kingfisher		
Meleagris gallopavo	wild turkey		
Melospiza georgiana	swamp sparrow		
Melospiza melodia	song sparrow		

Species	common name	Conservation Status	Notes
Mergus merganser	common merganser		Breeding
Pandion haliaeatus	osprey		
Passerina cyanea	indigo bunting		
Phalaropus lobatus	red-necked phalarope		
Poecile atricapillus	black-capped chickadee		
Quiscalus quiscula	common grackle		
Sayornis phoebe	eastern phoebe		
Scolopax minor	American woodcock	MP SGCN	
Setophaga petechia	yellow warbler		
Sialia sialis	eastern bluebird		
Sitta carolinensis	white-breasted nuthatch		
Spatula clypeata	northern shoveler		
Sphyrapicus varius	yellow-bellied sapsucker		
Spinus tristis	American goldfinch		
Spizelloides arborea	American tree sparrow		
Tachycineta bicolor	tree swallow		
Tringa solitaria	solitary sandpiper		
Turdus migratorius	American robin		
Tyrannus tyrannus	eastern kingbird		
Zenaida macroura	mourning dove		
Zonotrichia albicollis	white-throated sparrow		
	mammals		
Alces alces	moose	MP SGCN	
Canis latrans	coyote		
Castor canadensis	American beaver		
Erethizon dorsatum	porcupine		
Lepus americanus	snowshoe hare	MP SGCN	
Lontra canadensis	North American river otter	MP SGCN	
Lynx rufus	bobcat	MP SGCN	
Odocoileus virginianus	white-tailed deer		
Peromyscus maniculatus	deer mouse		
Procyon lotor	raccoon		
Tamiasciurus hudsonicus	American red squirrel		
Ursus americana	American black bear	MP SGCN	
	reptiles/amphibians		
Bufo americanus	American toad		
Chrysemis picta	painted turtle		
Hyla versicolor	gray tree frog		
Lithobates pipiens	northern leopard frog		
Pseudoacoris crucifer	spring peeper		
Thamnophis sirtalis	common garter snake		
	fish		

Species	common name	Conservation Status	Notes
Ambloplites rupestris	rock bass		
Ameiurus nebulosus	brown bullhead		
Esox lucius	northern pike		
Esox masquinongy x Esox lucius	tiger muskie		
Lepomis macrochirus	bluegill		
Micropterus salmoides	largemouth bass		
Salmo trutta	brown trout		