

# Celebrating Wetlands

Please join the Lewis  
Creek Association for  
our 2023 Annual  
Celebration!

Sunday, October 15th



**Wetland Functions and Values ; Flood Resiliency and Restoration  
Presented by Zapata Courage, District Wetland Ecologist  
VT DEC Wetlands Program**

- Wetland ID
- Wetland Functions and Values
- Wetland Restoration



P. Brian Machanic; NaturesEyeStudio



UVM Students

# Wetland Identification: Three (3) Parameters



**Hydrology:** presence  
of water



**Hydrophytic  
Vegetation  
(water-loving)**



**Hydric Soils:** soils  
showing evidence of  
water presence-low  
oxygen

# Wetland Hydrology

**Criteria:** Inundation or saturation to within soil surface for at least 5% of growing season in most years

**~2 weeks in VT**

- ☞ Primary indicator examples: actual observation of **surface water**, soil saturation, **high ground water table**, algal mat, oxidized root channels, hydrogen sulfide odor, or **inundation visible on aerial imagery**.
- ☞ Secondary indicator examples: water-stained leaves, **stunted or stressed plants**, geomorphic position, **drainage patterns**



# Wetland Soil



Hydric mineral soils have gray colors with orange/red mottling



Hydric organic soils are very dark, almost black



# Wetlands Types

- Forested swamps
- Scrub/Shrub wetlands
- Emergent marshes
- Bogs & Fens
- Seeps
- Vernal pools
- Wet meadows



# Vermont's Wetlands Provide



**10 Wetland Functions & Values**

# Buffer Zone

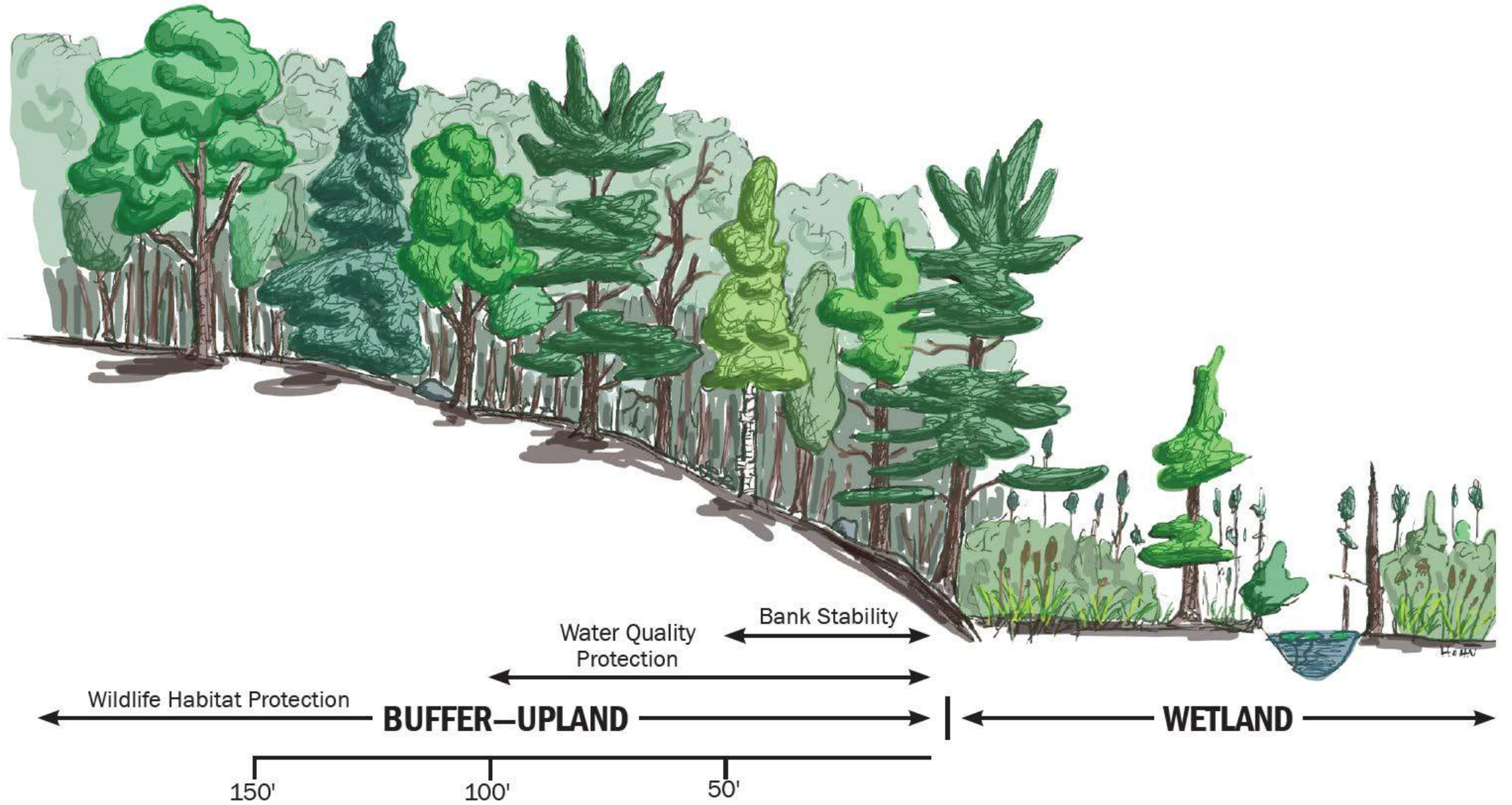
Area of upland around a wetland which provides protection to function and value

## Buffer Functions:

- Filters pollution/nutrients
- Protects water quality
- Increases wildlife habitat
- Prevents the spread of invasive species
- Protects against other disturbances









Wood Frogs rely on *vernal pools* for breeding, due to these pools being temporary and therefore lacks predators such as fish.

Wood Frog  
(state-wide)

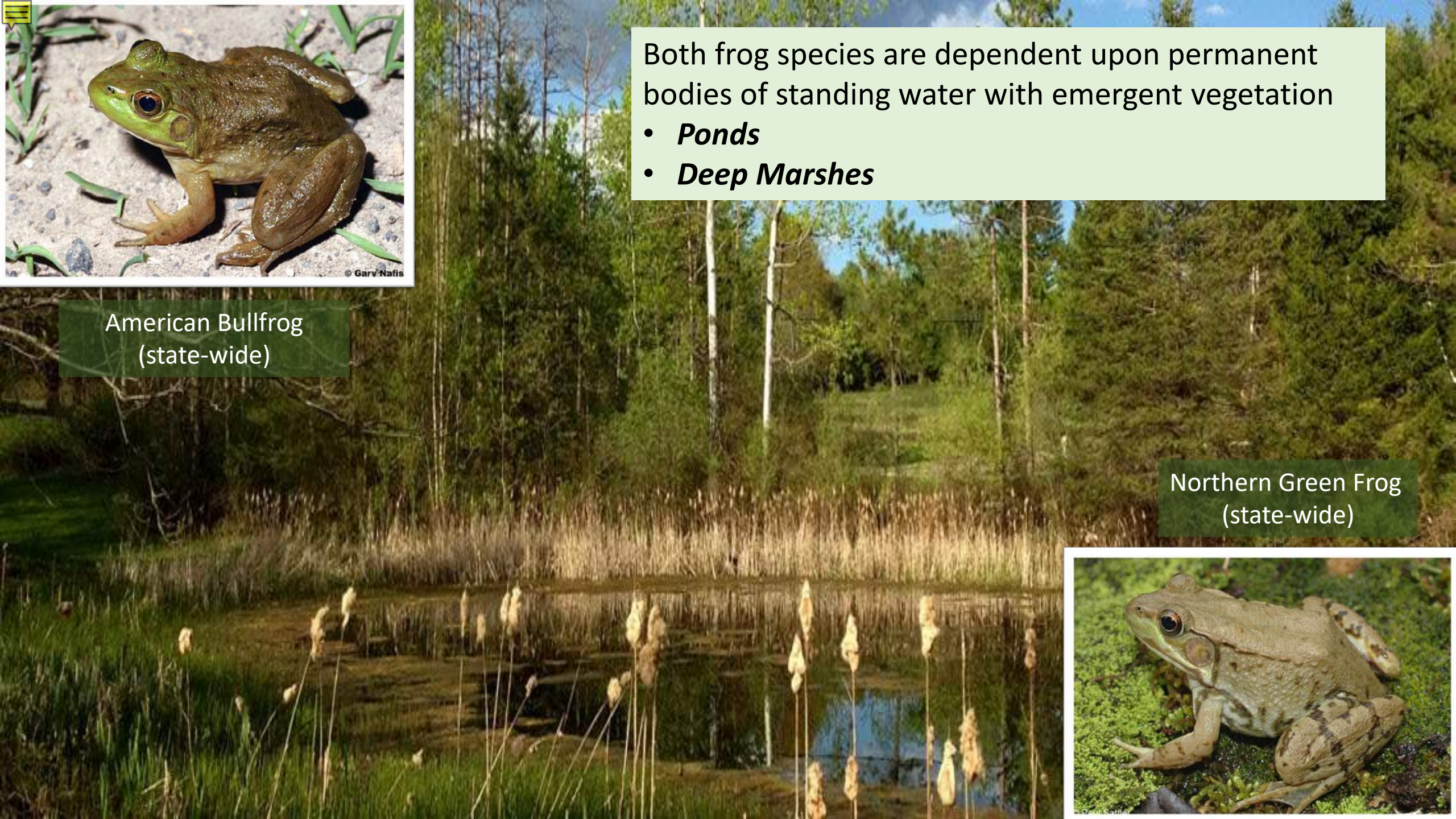




American Bullfrog  
(state-wide)

Both frog species are dependent upon permanent bodies of standing water with emergent vegetation

- *Ponds*
- *Deep Marshes*



Northern Green Frog  
(state-wide)





Pickerel Frog  
(state-wide)

- Pickerel frogs often rely on *beaver ponds*
- Mink frogs need *ponds and deep marshes*



Mink Frog  
(north central-  
northeastern)





American Toad  
(state-wide)

Both toad species congregate to breed in **shallow, grassy areas within wetlands**, farm ponds, floodplain pools, lakes, and even ditches!



Fowler's Toad  
(southern Connecticut River valley)





***Floodplains*** for breeding



**Northern Leopard Frog  
(Champlain Valley)**



***Wet meadows*** for foraging



***Permanent water*** for overwintering





Gray Treefrog  
(common in lowlands; absent  
at higher elevations)

Both frog species are dependent on ***emergent marshes*** with abundant vegetation for breeding



Spring Peeper  
(State-wide)











VT's wetland "dinosaurs"  
Snapping Turtle  
& other turtle species



**Northern Watersnake**



**Young Common Five-lined Skink**



**Spotted Salamander**



**Spiny Softshell Turtle**



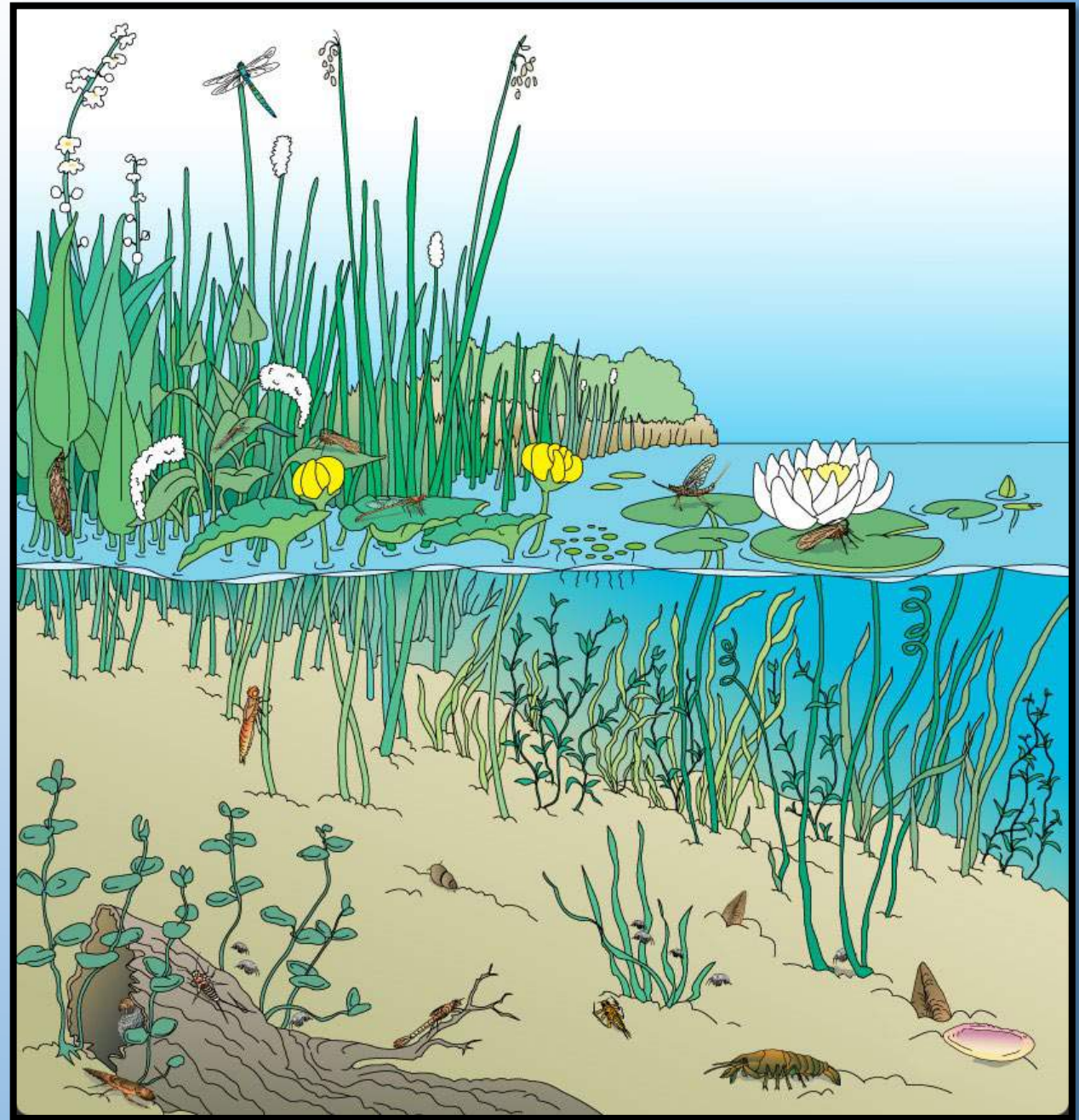




VT Land Trust  
Photo by: Allaire Diamond



# Littoral Zone-Lake





Wetlands provide nursery areas, feeding and refuge areas, and even for the brook trout, wetlands provide cold water recharge and overhanging wetland vegetation along streams help to keep water temps cooler.



# VERMONT BIRDS



A Folding Pocket Guide to Familiar Species



## WATERBIRDS

 Common Loon <i>Colinus h. h. h.</i> To 16 in. (41 cm)	 Wooded Green Heron <i>Butorides virescens</i> To 18 in. (46 cm)
 Crested Grebe <i>Podiceps cornutus</i> To 21 in. (53 cm)	 American Black Duck <i>Anas platyrhynchos</i> To 24 in. (61 cm)
 Canada Goose <i>Branta canadensis</i> To 48 in. (122 cm)	 Mallard Duck <i>Anas platyrhynchos</i> To 32 in. (81 cm)
 Blue-winged Teal <i>Anas cyanoptera</i> To 14 in. (35 cm)	 Northern Pintail <i>Anas platyrhynchos</i> To 24 in. (61 cm)
 Green-winged Teal <i>Anas cyanoptera</i> To 14 in. (35 cm)	 Cinnamon Teal <i>Anas cyanoptera</i> To 14 in. (35 cm)
 Common Goldeneye <i>Buceo clangula</i> To 24 in. (61 cm)	 Red-throated Loon <i>Colinus h. h. h.</i> To 16 in. (41 cm)
 Ring-billed Gull <i>Larus delawarensis</i> To 20 in. (51 cm)	 Common Ring-billed Gull <i>Larus delawarensis</i> To 20 in. (51 cm)

## NEARSHORE & WADING BIRDS

 Double-crested Cormorant <i>Phalacrocorax auritus</i> To 3 ft. (91 cm)	 Green Heron <i>Butorides virescens</i> To 22 in. (56 cm)	 Great Blue Heron <i>Ardea herodias</i> To 4.5 ft. (1.4 m)
 Black-crowned Night-Heron <i>Nycticorax nycticorax</i> To 26 in. (66 cm)	 Kildeer <i>Chordeiles macularia</i> To 12 in. (30 cm)	 Spotted Sandpiper <i>Actitis macularia</i> To 8 in. (20 cm)
 Common Gallinule <i>Gallinula galeata</i> To 14 in. (35 cm)	 Wilson's Snipe <i>Gallinago delicata</i> To 12 in. (30 cm)	 Upland Sandpiper <i>Actitis hypoleucos</i> To 12 in. (30 cm)
 American Woodcock <i>Scolopax minor</i> To 12 in. (30 cm)	 Great Black-backed Gull <i>Larus marinus</i> To 32 in. (81 cm)	 Herring Gull <i>Larus argentatus</i> To 26 in. (66 cm)
 Ring-billed Gull <i>Larus delawarensis</i> To 20 in. (51 cm)	 Common Tern <i>Sterna hirundo</i> To 15 in. (38 cm)	 Black Tern <i>Chelidon nigricans</i> To 10 in. (25 cm)

## IN CELESTIAL

 Sharp-shinned Hawk <i>Accipiter striatus</i> To 14 in. (35 cm)	 Cooper's Hawk <i>Accipiter cooperii</i> To 20 in. (51 cm)	 Northern Goshawk <i>Accipiter gentilis</i> To 27 in. (69 cm)
 Red-shouldered Hawk <i>Buteo lineatus</i> To 22 in. (56 cm)	 Broad-winged Hawk <i>Buteo platypterus</i> To 19 in. (48 cm)	 Red-tailed Hawk <i>Buteo jamaicensis</i> To 25 in. (64 cm)
 American Kestrel <i>Falco sparverius</i> To 12 in. (30 cm)	 Bald Eagle <i>Haliaeetus leucocephalus</i> To 48 in. (122 cm)	 Peregrine Falcon <i>Falco peregrinus</i> To 20 in. (51 cm)
 Eastern Screech-Owl <i>Screech owl</i> To 9 in. (23 cm)	 Great Horned Owl <i>Bubo virginianus</i> To 25 in. (64 cm)	 Barred Owl <i>Strix varia</i> To 2 ft. (60 cm)

## BIRDS OF PREY

 Turkey Vulture <i>Cathartes aura</i> To 32 in. (81 cm)	 Ogry <i>Bubo virginianus</i> To 2 ft. (60 cm)	 Northern Harrier <i>Circus cyaneus</i> To 22 in. (56 cm)
 Sharp-shinned Hawk <i>Accipiter striatus</i> To 14 in. (35 cm)	 Cooper's Hawk <i>Accipiter cooperii</i> To 20 in. (51 cm)	 Northern Goshawk <i>Accipiter gentilis</i> To 27 in. (69 cm)
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The West Rutland Marsh is more than a boardwalk, it is more than the birds that find sanctuary in the marsh, it is more than the marsh itself, it is an interdependent community of plants, animals and soils, and the waters that sustain them and we the people with our awesome potential to affect change.



Yellow Warbler

Yellow Warbler is one of the many species that uses the marsh for nesting.

Marv Elliot



**More than 1/3** of North American bird species use wetlands for breeding, nesting, as a source of drinking water and for shelter, social interactions and rearing their young.

**80%** of US threatened or endangered bird species rely on wetlands.



**Snow geese gathering at Dead Creek, Addison VT**







Photo: Enrique R. Aguirre Aves/Alamy

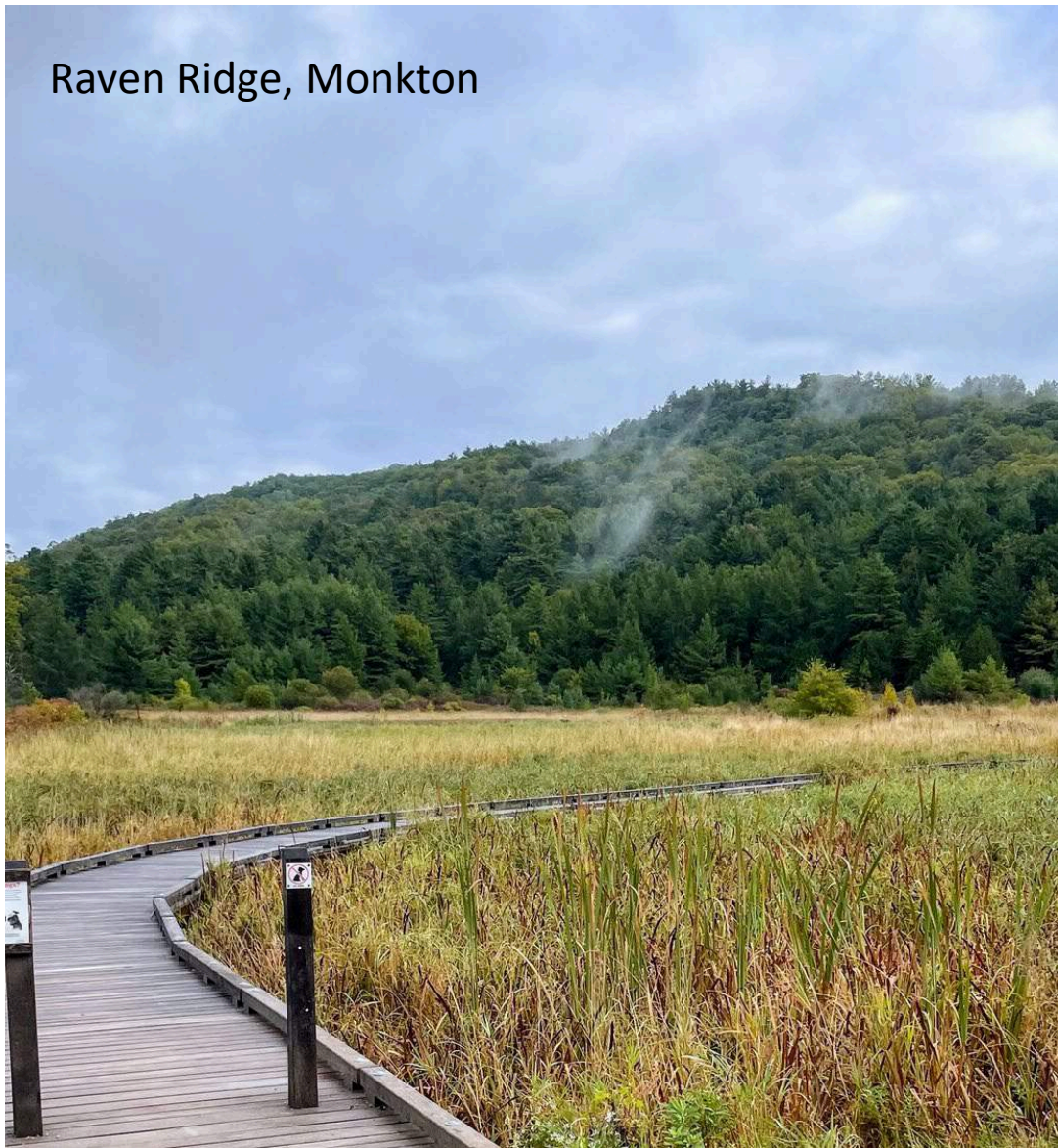
By Charlie Hancock, forester and VLT trustee



Fairlee Town Forest: the site of the beaver pond when an abandoned beaver dam gave way on May 23, 2016.  
(Lynne Fitzhugh photograph)



Raven Ridge, Monkton







**Wetlands host 31% of the world's plants.  
Over 50% of Vermont's plant species are found in wetlands.**

**Sandbar Wetlands, Class I protection  
Colchester / Milton, VT**






Experience the unusual and rare natural history of this plant community first-hand, without impacting its fragile ecology.

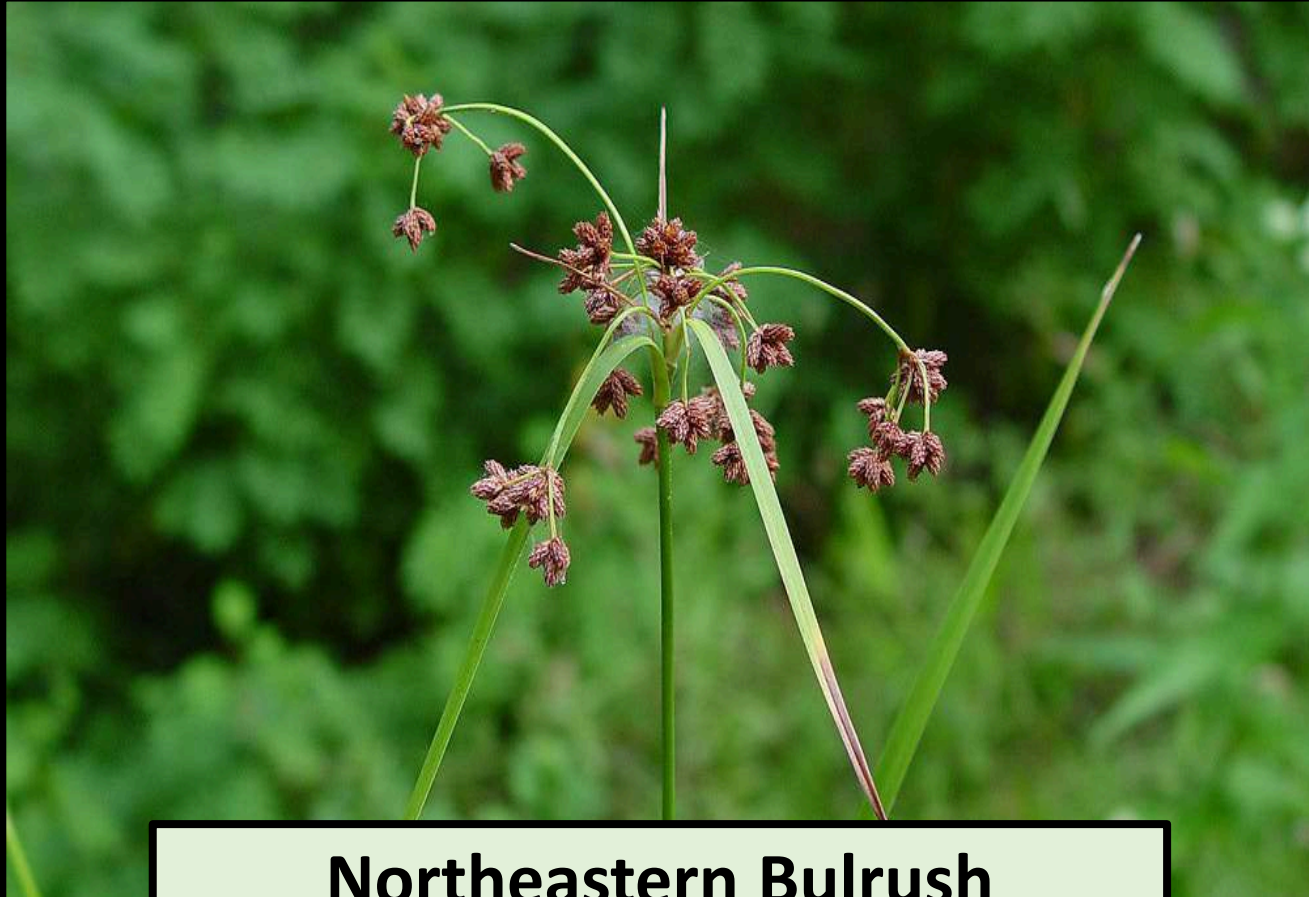




A photograph of a wetland area with a dense forest of tall, thin evergreen trees in the background. The foreground is filled with numerous white, fluffy flowers on green stems, likely bog plants. The sky is blue with scattered white clouds.

**43%** of rare, threatened, and endangered species  
in the U.S rely on wetlands for survival

Yellow Bogs, Lewis, VT



## Northeastern Bulrush

- Federally endangered
- G3 = “Globally vulnerable”
- Vermont: found in beaver-influenced wetlands

## New England Distribution

Adapted from [BONAP](#) data

### Native

■ county documented







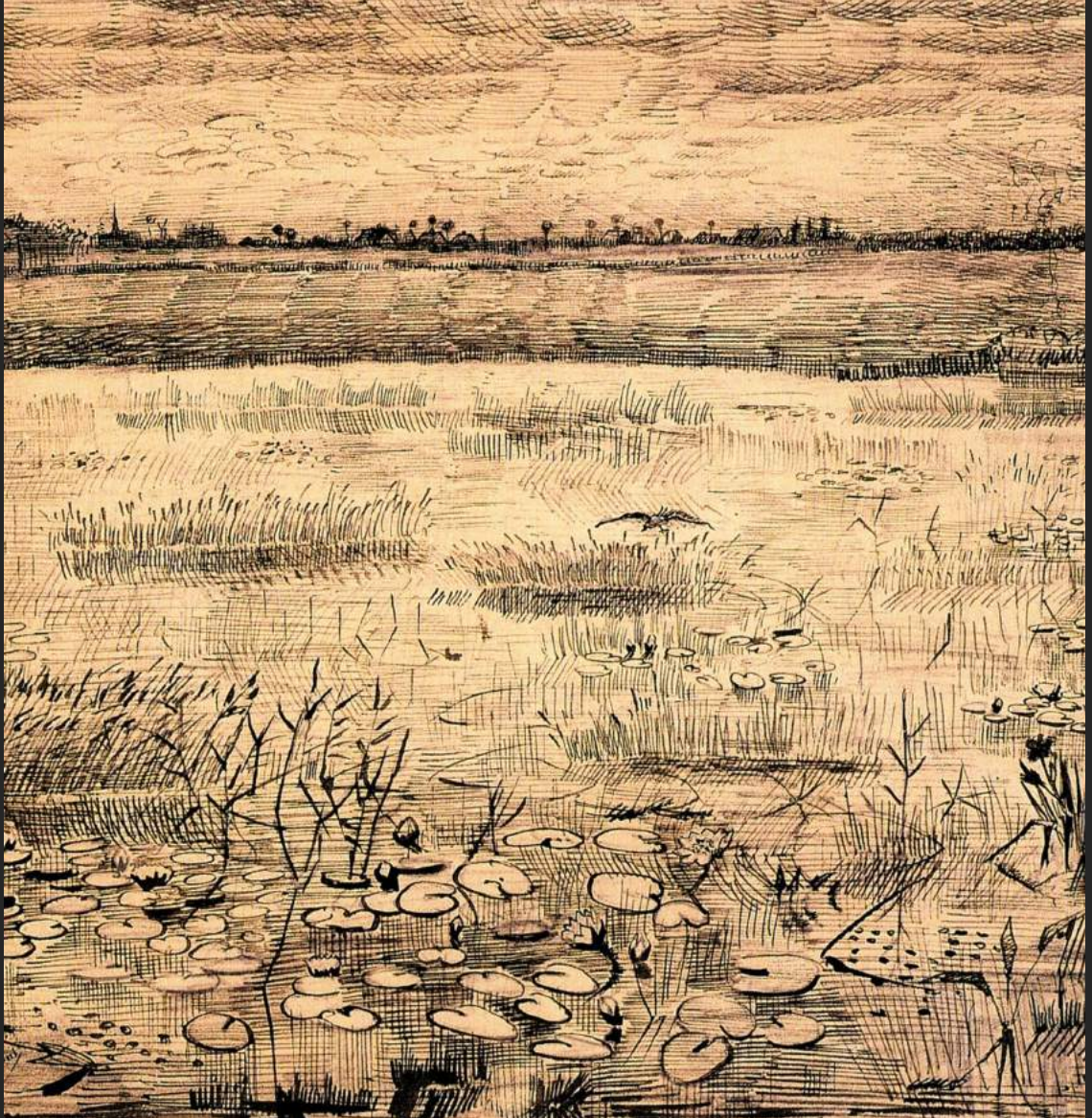


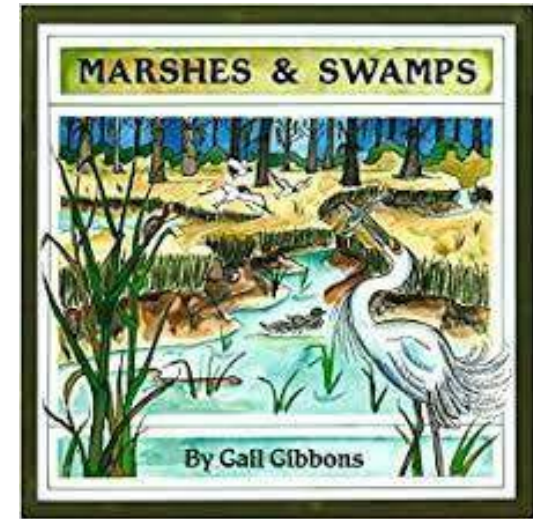
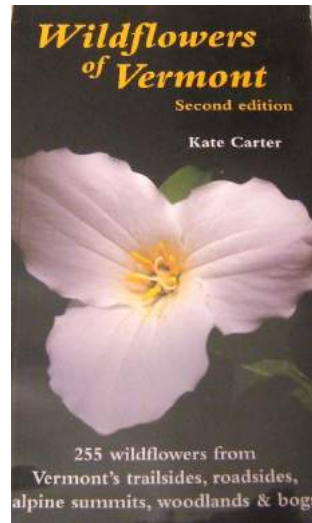
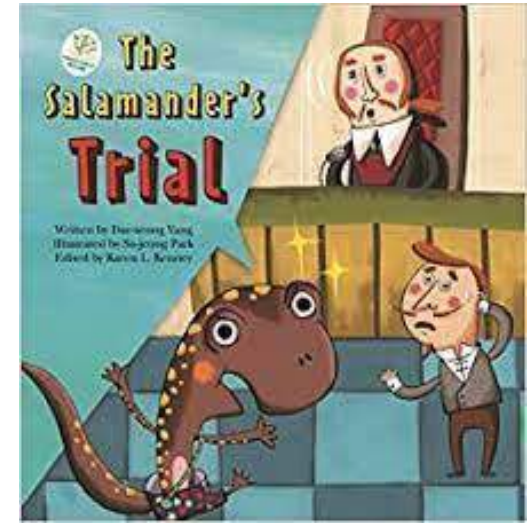
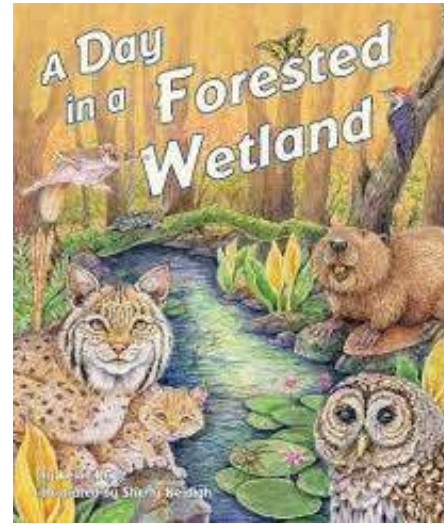
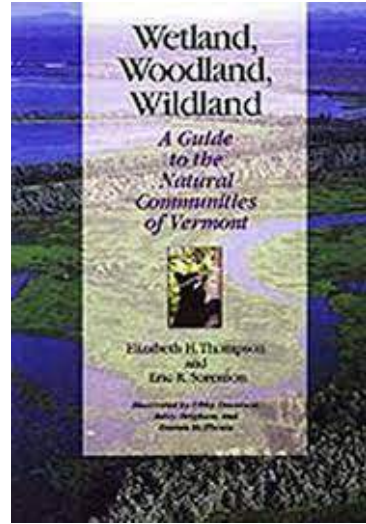
POTTERY ART FOR YOUR TABLE INSPIRED BY NATURE

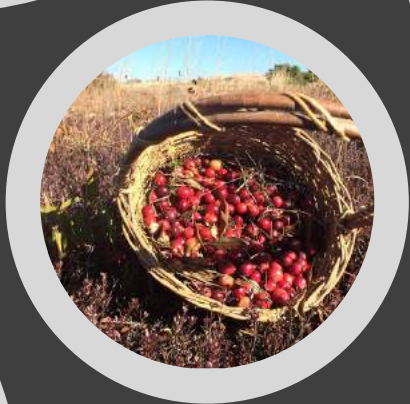












Non-profits

Wildlife Managers

Private Consulting

Educators: summer camp to college professors

Resiliency Planners

Biologist/Ecologist

Policy and Regulators

### Wetland Jobs Board



The Association State Wetland Managers (ASWM) works hard to keep wetland professionals informed about jobs, fellowships, and internships. If you have a wetland related job you would like to share, please submit this form.

Research

Plant and Soil Scientists

Engineers

GIS-mapping

Restoration

Landscape Design

Hydrologists

#### MISSISSIPPI

EPA Harmful Algal Blooms Research Opportunity  
(Posted 2/22/21)  
U.S. Environmental Protection Agency  
Duluth, MN  
Reference CodeEPA-ORD-CCTE-GLTED-2021-04  
Apply by May 26, 2021  
[More Information Here](#)

#### NEW JERSEY

Coastal Science Specialist - temporary  
(Posted 3/25/21)  
The Nature Conservancy  
Delmont, NJ  
Search Job ID: 49563  
Open until filled  
[More Information Here](#)

#### OREGON

Southern Field Operations Manager  
(Posted 3/17/21)  
Oregon Department of State Lands  
Salem, OR  
Req: 60593  
Apply by April 7, 2021  
[More Information Here](#)

#### TENNESSEE

Post-Doctoral Research Associate - Ecology & Evolutionary Biology  
(Posted 3/18/21)  
Department of Ecology and Evolutionary Biology  
University of Tennessee  
Knoxville, TN  
Job No.:21000000FB  
[More Information Here](#)

#### VIRGINIA

Wetlands Biologist  
(Posted 3/16/21)  
Virginia Department of Wildlife Resources  
Charles City, VA  
Position No.: 00442  
Apply by April 2, 2021  
[More Information Here](#)

#### MISSOURI

Post Doctoral Research Associate - Water Related Field  
(Posted 3/22/21)  
Water Institute at Saint Louis University  
St. Louis, MO  
Job No. 2021-02285  
Apply by April 1, 2021  
[More Information Here](#)

#### NEW MEXICO

Water Resources Scientist  
(Posted 3/18/21)  
Tetra Tech  
Albuquerque, NM  
[More Information Here](#)

#### OREGON

Ecological Education Program Director  
(Posted 3/22/21)  
Institute for Applied Ecology  
Corvallis, OR  
Apply by April 5, 2021  
[More Information Here](#)

#### TEXAS

Postdoctoral Scholar - Climate Change Research  
(Posted 3/26/21)  
Kelitt Lab  
University of Texas at Austin  
[More Information Here](#)

#### VIRGINIA

Senior Strategic Policy Advisor  
(Posted 3/17/21)  
The Nature Conservancy  
Arlington, VA (Negotiable)  
Job ID: 49420  
Open until filled.  
[More Information Here](#)

#### MONTANA

Farm Bill Biologist II  
(Posted 3/25/21)  
Pheasants Forever and Quail Forever Inc.  
Chester, MT  
Requisition ID: 1778  
Apply by April 15, 2021  
[More Information Here](#)

#### NEW YORK

Ecological Field Specialist  
(Posted 3/25/21)  
Suffolk County Water Authority  
Oakdale, NY  
[More Information Here](#)

#### PENNSYLVANIA

Postdoctoral Scholar of Aquatic Biodiversity  
(Posted 3/4/21)  
Cardinale Lab  
Pennsylvania State University  
University Park, PA  
REQ\_0000010920  
Applications are due by April 5, 2021  
[More Information Here](#)

#### UTAH

BLM Wetland (Lentic) Monitoring Lead and Field Technician  
(Posted 1/22/21)  
Colorado Natural Heritage Program/Colorado State University  
Salt Lake City, UT  
Apply by April 30, 2021  
[More Information Here](#)

#### VIRGINIA

Compliance and Regulatory Specialist  
(Posted 3/18/21)  
Wetland Studies and Solutions, Inc.  
Richmond, VA  
Requisition Number: 108346  
[More Information Here](#)

#### NEW JERSEY

Environmental/Wetland Scientist  
(Posted 1/22/21)  
Langan  
Parsippany, NJ  
Apply by April 23, 2021  
[More Information Here](#)

#### OREGON

Eastern Region Watershed Manager (Principal Executive/Manager E)  
(Posted 2/18/21)  
Oregon Department of Environmental Quality  
Department: Eastern Region - Water Quality  
Bend, OR  
REQ-58874  
Apply by March 10, 2021  
[More Information Here](#)

#### PENNSYLVANIA

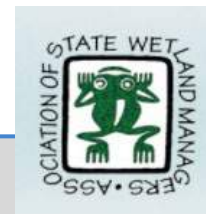
Assistant Professor of Aquatic Ecology  
(Posted 3/8/21)  
Department of Ecosystem Science and Management  
Pennsylvania State University  
University Park, PA  
Req. 0000011074  
Apply by April 16, 2021  
[More Information Here](#)

#### VERMONT

Environmental Technician II - Temporary  
(Posted 3/19/21)  
Vermont Department of Environmental Conservation  
Montpelier, VT  
Req. ID: 12866  
Apply by April 8, 2021  
[More Information Here](#)

#### WASHINGTON

Natural Resource Technician Seasonal  
(Posted 3/18/21)  
Skagit River System Cooperative  
LaConner, WA  
Apply by April 5, 2021  
[More Information Here](#)





# Education & Research in Natural Sciences

Weller, C. M., Watzin, M. C., & Wang, D. (1996). Role of wetlands in reducing phosphorus loading to surface water in eight watersheds in the Lake Champlain Basin. *Environmental Management*, 20(5), 731-739.



Examples

Woltemade, C. J. (2000). Ability of restored wetlands to reduce nitrogen and phosphorus concentrations in agricultural drainage water. *Journal of Soil and Water Conservation*, 55(3), 303-309.



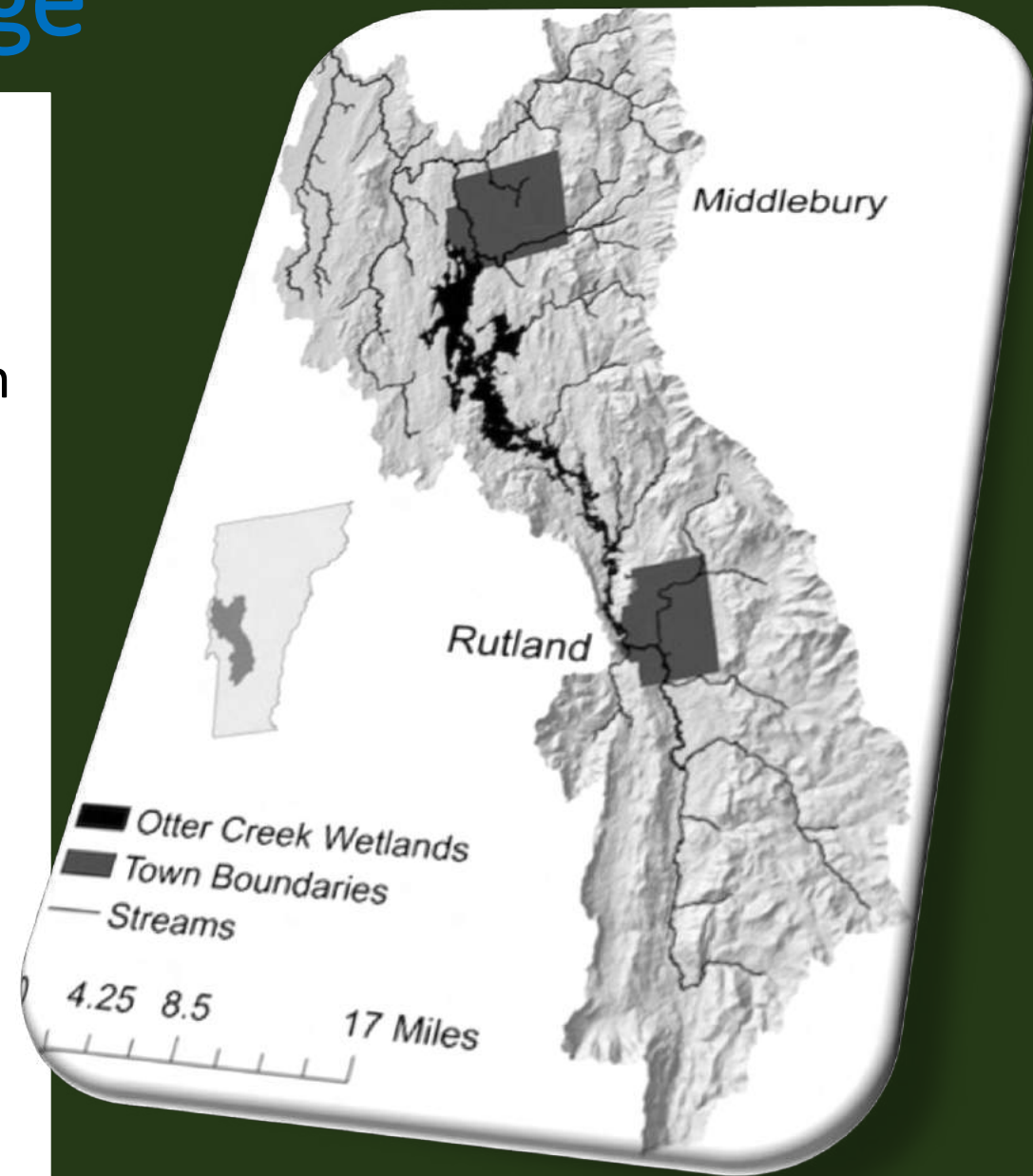
# Flood & Storm Water Storage

## University of Vermont Studies

Wetlands & floodplains protected Middlebury from as much as **\$1.8 million in flood damage** during Tropical Storm Irene.

**AND**

Researchers analyzed 10 flood events to estimate the economic value of the Otter Creek floodplain/wetlands near Middlebury. They found the natural barrier **saves the town up to 78%** of potential damages, or between \$126,000 to \$450,000 per year on average.





# Wetlands

## Phosphorus Removal and Carbon Sequestration

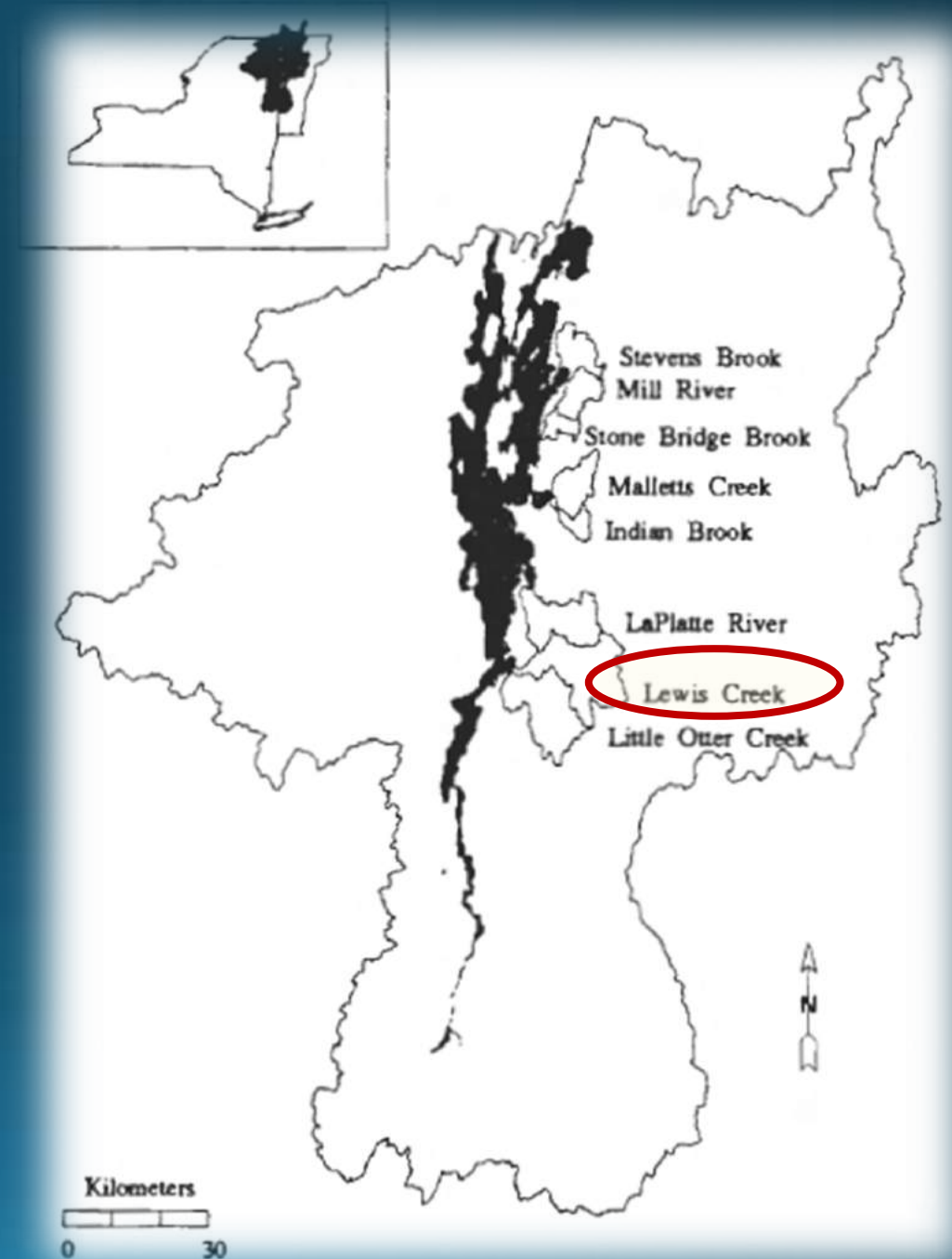
- **Wetlands can't provide this function if they are degraded or overwhelmed.**



# Phosphorus Removal

- UVM study on 8 watersheds in the Lake Champlain basin indicated that riparian wetlands higher up in rural watersheds were strongly correlated with phosphorus reduction.
- Protecting and Restoring riparian wetlands in rural landscapes should reduce significant levels of phosphorus reaching Lake Champlain.

Weller, C. M., Watzin, M. C., & Wang, D. (1996). Role of wetlands in reducing phosphorus loading to surface water in eight watersheds in the Lake Champlain Basin. *Environmental Management*, 20(5), 731-739.



# Phosphorus Removal

- Large wetlands can remove up to 43% of phosphorus from drainage water.
- The larger the wetland is in size in relation to the size of the watershed, the more phosphorus removal.

**Table 1. Summary of case study wetland characteristics and performance.**

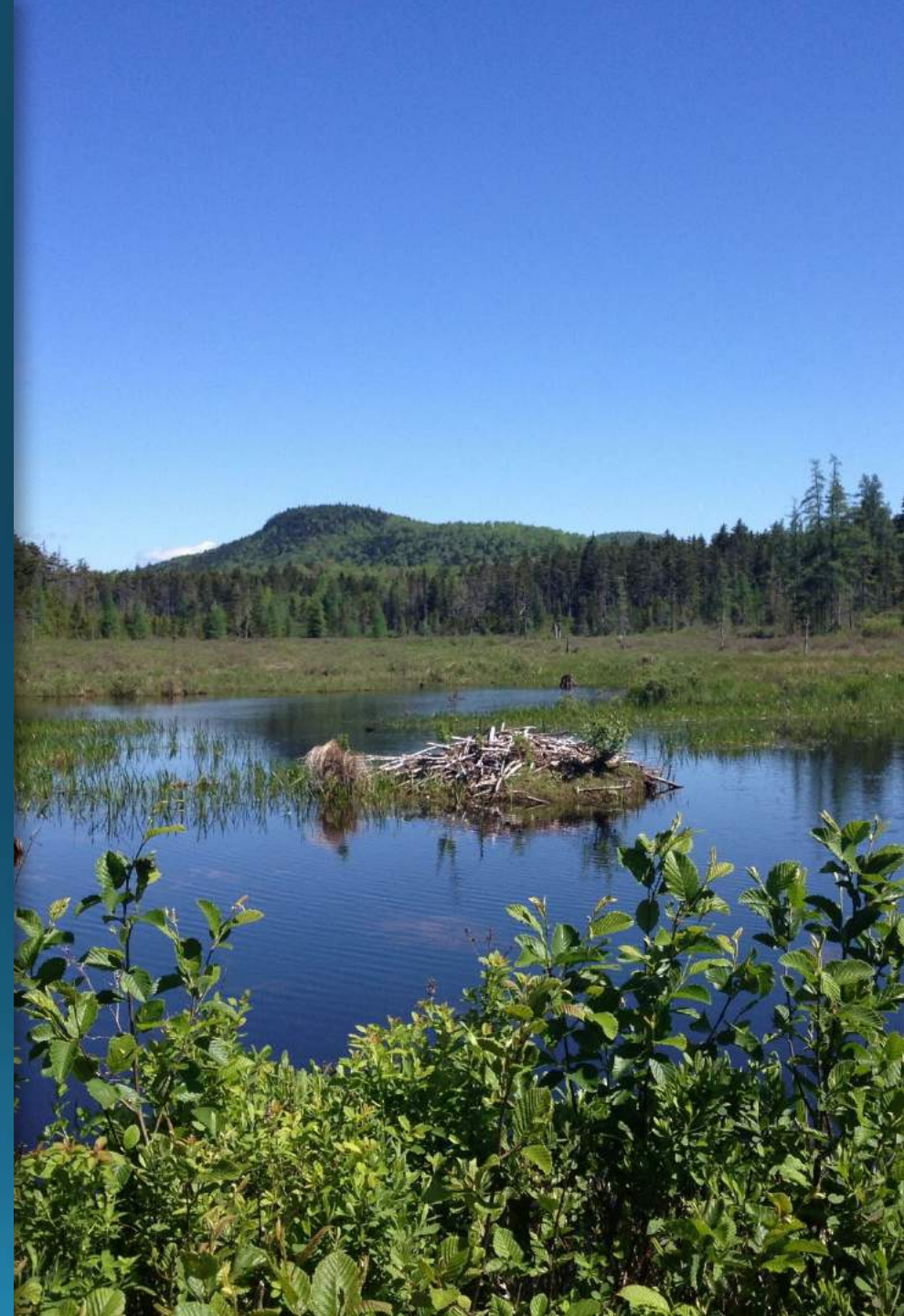
Site	Wetland area (ha)	Wetland to watershed area ratio	Nitrate-nitrogen reduction (%)	Phosphorus reduction (%)
MD coastal plain	0.4 - 3.7	1 : 5 to 1 : 25	68	43
Embarras R., IL	0.6 - 0.8	1 : 32 to 1 : 33	36 - 45	20
Snyder, IA	0.23	1 : 115	20 - 85	n.a.
Bear Creek, IA	0.03	1 : 180	70 - 80*	n.a.

\* Reflects low flow conditions only. Notable exceptions occurred during large runoff events when residence times were reduced.

Woltemade, C. J. (2000). Ability of restored wetlands to reduce nitrogen and phosphorus concentrations in agricultural drainage water. *Journal of Soil and Water Conservation*, 55(3), 303-309.

# Carbon Sequestration

- All intact wetlands are “carbon sinks” – sequestering carbon
- Wetland drainage and degradation can release stored carbon as methane and reduce ability to sequester
- Restoration and conservation can improve carbon storage across the landscape





## Ahead of the Storm Sites



### 14 Hinesburg Town Garage & Beecher Hill Brook Floodplain Restoration

The brook had historically been constricted to a narrow area by berms and Town Garage buildings and was eroding.

- Town Garage buildings were moved out of the floodplain area, and a new garage was built.
- Log and rock weirs were added to the stream to raise the level of the stream.
- Berms and sediment were removed from next to the brook, to allow the brook to access the floodplain.
- Over 400 trees were planted in spring 2020.
- Swale improvements and filter strips were added, along with stormwater ponds, to minimize run-off from the Town Garage/CSWD site.





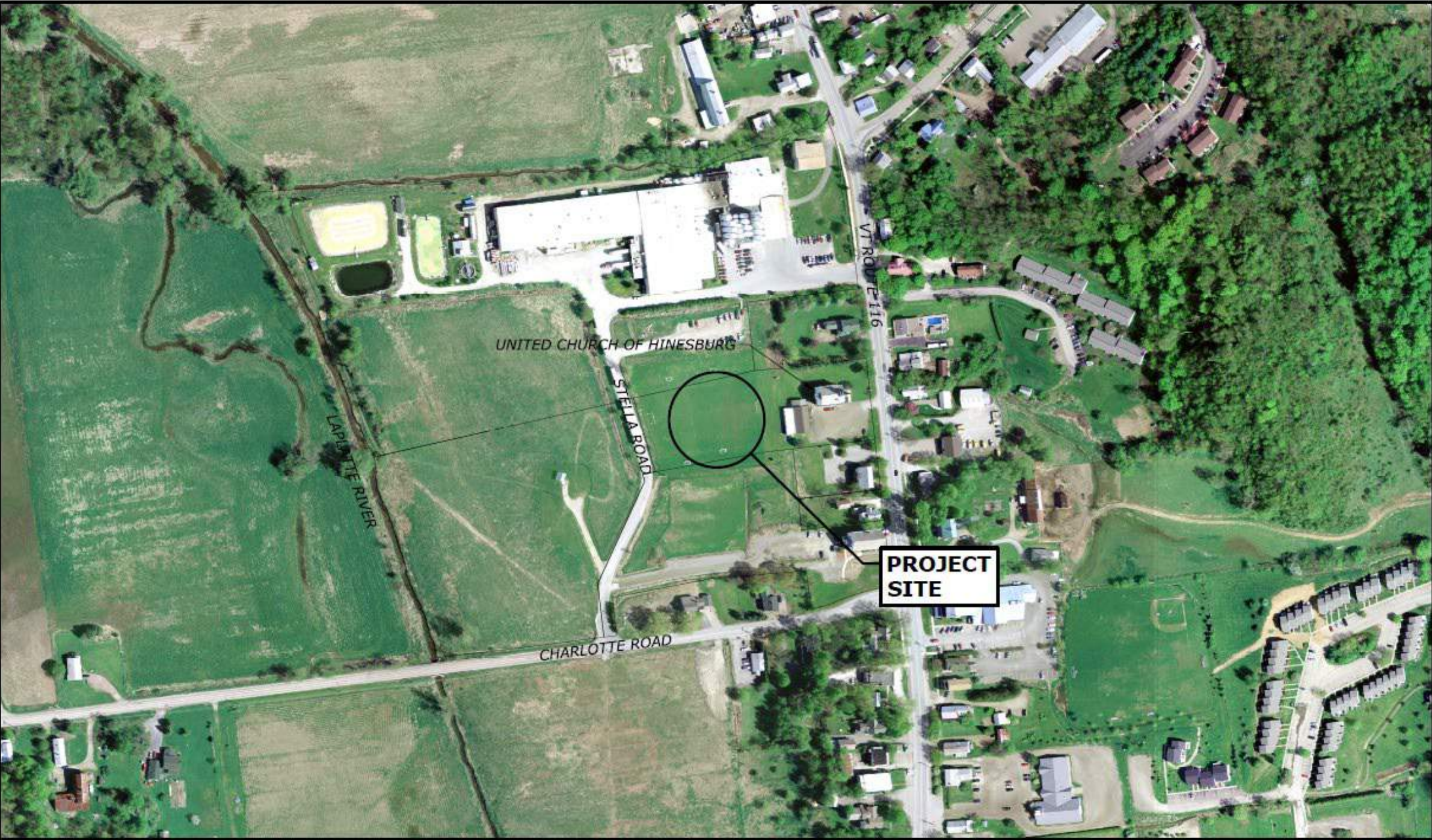


## Floodplain Access and Revegetation

Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.



***Reduce Flooding Risk & Improve Water Quality-Hollow Brook in Starksboro***



UNITED CHURCH OF HINESBURG

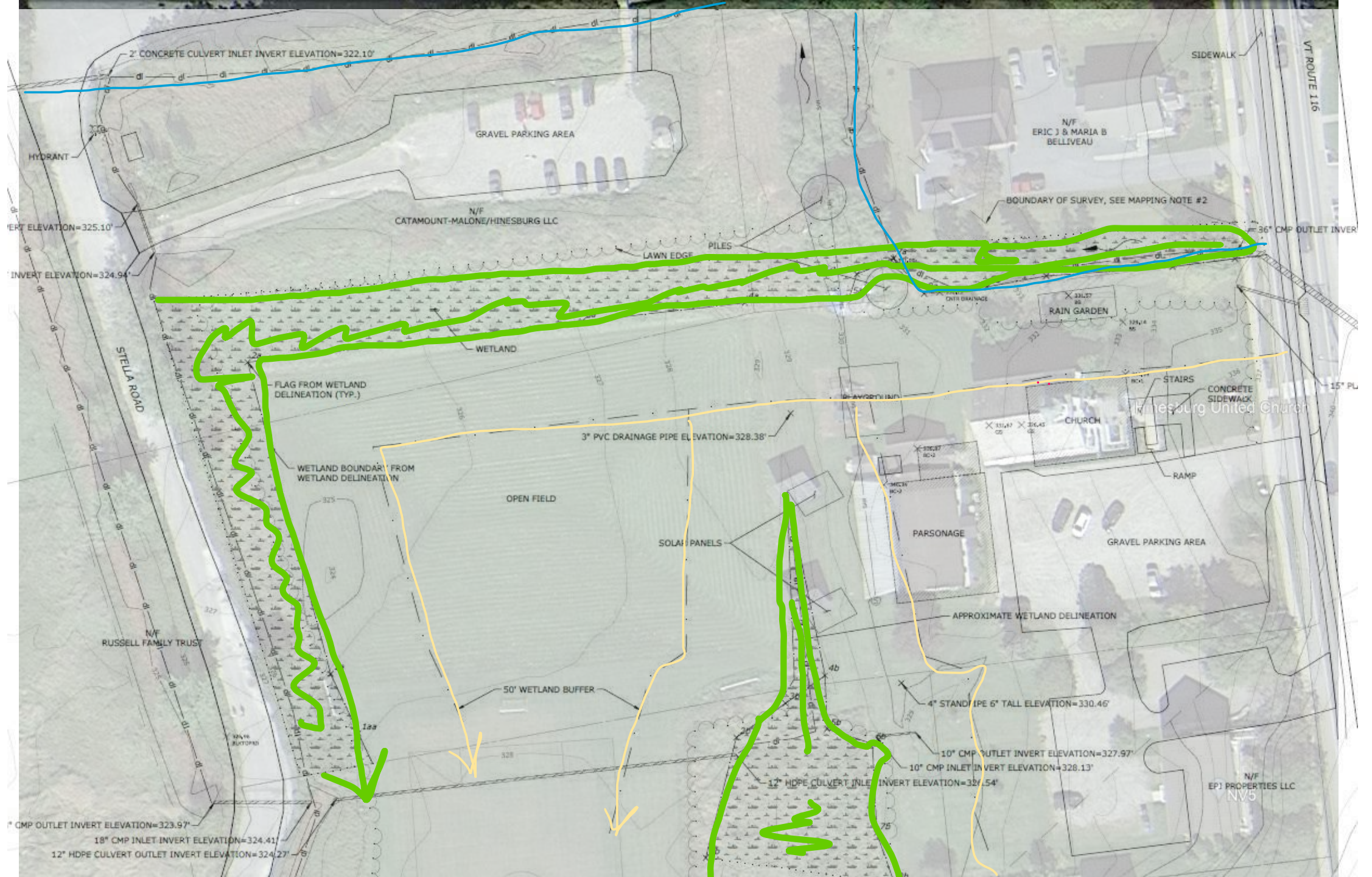
STELLA ROAD

VT ROUTE 116

CHARLOTTE ROAD

LAPORTE RIVER

**PROJECT SITE**



2" CONCRETE CULVERT INLET INVERT ELEVATION=322.10'

GRAVEL PARKING AREA

N/F CATAMOUNT-MALONE/HINESBURG LLC

N/F ERIC J & MARIA B BELLIVEAU

BOUNDARY OF SURVEY, SEE MAPPING NOTE #2

SIDEWALK

VT ROUTE 116

HYDRANT

VERT ELEVATION=325.10'

INVERT ELEVATION=324.94'

36" CMP OUTLET INVERT

STELLA ROAD

WETLAND

FLAG FROM WETLAND DELINEATION (TYP.)

WETLAND BOUNDARY FROM WETLAND DELINEATION

3" PVC DRAINAGE PIPE ELEVATION=328.38'

OPEN FIELD

SOLAR PANELS

PARSONAGE

CHURCH

Hinesburg United Church

CONCRETE SIDEWALK

GRAVEL PARKING AREA

N/F RUSSELL FAMILY TRUST

50' WETLAND BUFFER

APPROXIMATE WETLAND DELINEATION

4" STANDPIPE 6' TALL ELEVATION=330.46'

10" CMP OUTLET INVERT ELEVATION=327.97'

10" CMP INLET INVERT ELEVATION=328.13'

12" HDPE CULVERT INLET INVERT ELEVATION=327.54'

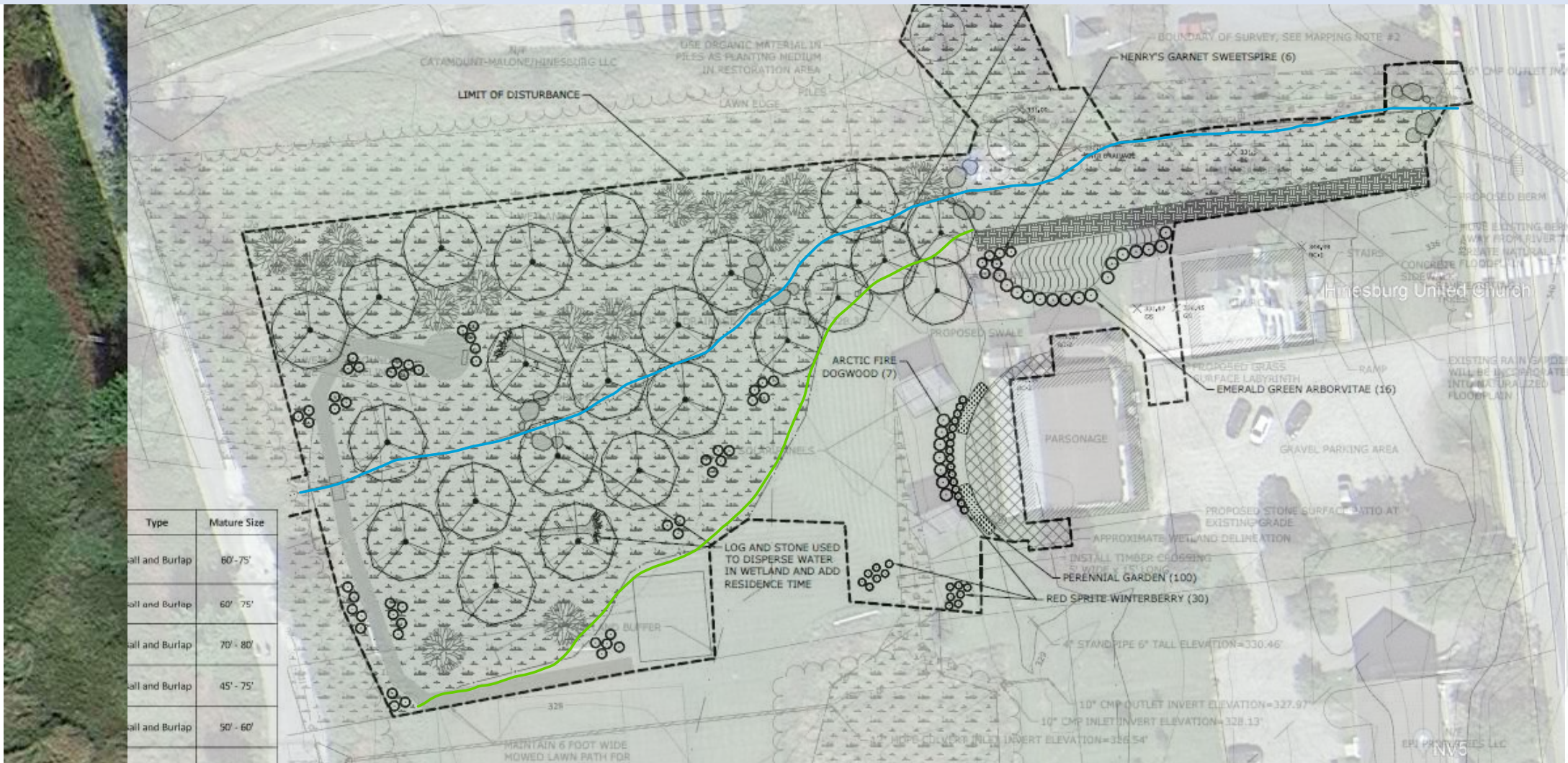
N/F EPI PROPERTIES LLC

18" CMP OUTLET INVERT ELEVATION=323.97'

18" CMP INLET INVERT ELEVATION=324.41'

12" HDPE CULVERT OUTLET INVERT ELEVATION=324.27'

- Plow, harrow, and rototill Compacted surface multiple times to Create rough ground surface
- Retain shallow organic soils on top
- Grade to create positive drainage to Naturalized channel
- Grade shallow 6" deep by 20' wide Sinuous flow path



Restore mowed lawn to naturalized wetland ~1.0 acre



2014  
1 year post restoration



2017  
3 years post restoration



2011 pre-restoration








Wetlands reduce flooding, enhance water quality, and support diverse habitats.

- Conserving and restoring wetlands can lead to cost savings when compared to man-made infrastructure solutions.
- This study found that every dollar invested in land conservation by the State of VT returns \$9 in economic value of natural goods and services.
- Broken down into land cover type; wetland conservation has the highest level of a return on investment per acre.

# Vermont's return on investment in land conservation



Based on existing research, The Trust for Public Land determined the natural goods and services provided and estimated their values for each land cover type (2018).

An aerial photograph of a river valley during autumn. The river flows through the center, surrounded by dense forests with trees in various shades of green, yellow, orange, and red. A layer of mist or fog hangs over the valley, and sunlight filters through the trees, creating a warm, golden glow. The overall scene is serene and scenic.

Congratulations on the projects that Lewis  
Creek Association has been initiating.

Any Questions?