Rapid Ecological Assessment of Gillett Pond, Richmond, VT

Maria Dunlavey

Field Naturalist Program

Department of Plant Biology

University of Vermont

Sponsored by the Richmond Land Trust and Friends of Gillett Pond

Table of Contents

Appendices

Introduction

Gillett Pond, located in Richmond and Huntington, Vermont, is the current subject of a fundraising effort to replace its aging dam. In the last four years, the Richmond Land Trust has acquired the pond and much of the land surrounding it and drawn up plans to replace the dam. If successful, these efforts will result in a water level rise of approximately one foot, and a pond that persists for at least another 100 years.

It won't be the first time Gillett Pond has starred in a story about water levels. Its history going back to glacial times has been one of lakes and dams. Water has shaped, and been shaped by, Gillett Pond and the communities surrounding it — human and ecological — for thousands of years.

On September 14, 2017, the Richmond Land Trust and Friends of Gillett Pond engaged the University of Vermont (UVM) Field Naturalist Program to conduct a rapid ecological assessment of the Gillett Pond parcel, with an eye toward changing water levels and their impact on the pond and surrounding communities. This report presents the results of that effort.

Context: History & Landscape

Gillett Pond occupies a narrow valley between the Green Mountains, to the east, and their foothills to the west, at an elevation of 720 feet above sea level. It is approximately 30 acres in size, and is drained to the northwest by Johns Brook, which drains to the Huntington River, and then to the Winooski. The pond itself can be divided into three arms: the north arm, the south arm, and the downstream or northwest arm, where the dam is located.

Geologic History

The slopes surrounding Gillett Pond are dominated by outcrops of the Underhill Formation, the predominant regional bedrock (Ratcliffe et al. 2011). This schist unit was deposited as mud in the ancient Iapetus Ocean and metamorphosed by the intense heat and pressure of the continental collisions that built the Green Mountains. Today, it is a resistant, somewhat acidic bedrock whose appearance is dominated by its aligned planes of mica, though it also contains layers of quartzite and dolostone.

Underhill Formation exposed on the north shore of the pond.

Over the hundreds of millions of years since the formation of the Green Mountains, they have been worn down by erosion of all varieties to expose the highly metamorphosed rocks at their core. Most recently, a cycle of glacial advances and retreats has overrun the entire state of Vermont in a mile-thick sheet of ice. During the most recent of these retreats, Gillett Pond valley played a key role (Larsen 1987; Wright, Springston, and Van Hoesen 2015).

As the ice sheet retreated out of the Green Mountains, it left huge volumes of meltwater behind it. In many areas, this meltwater could run easily down existing river valleys to the Atlantic, but in the Winooski watershed, it was cut off — the glacier still blocked its outlet to the Champlain Valley, and then to the St. Lawrence to the north. Instead of following its modern course, glacial meltwater pooled into an immense lake until it found the next lowest outlet, which served as its temporary dam until the ice retreated far enough to reveal another one.

Geologists in Vermont have documented a whole series of these outlets, each corresponding to its own particular lake level, like a series of bathtub rings across the landscape. For a while, the ice sheet blocked off even the Gillett Pond Valley, and water pooling behind it escaped toward the Connecticut River Valley. Once the glacier had retreated past Johns Brook, though, the way was open for a new outlet.

Escaping lakewater rushed in a torrent through the Gillett Pond valley, making its way south and then out to the Champlain Valley through Huntington. Once lake levels stabilized, the valley acted for a time as the new dam, defining a water level known as Glacial Lake Mansfield. It didn't last long, on the scale of geologic time, but it persisted long enough to leave traces all around the Winooski River Valley. Once the ice sheet retreated far enough, the Huntington River became the lake's new outlet, and then, eventually, the Winooski River itself.

Human History

Since that time, the lake has had a quiet few millennia, at least as far as our knowledge is concerned. It likely underwent a succession of vegetation types and use by Native American tribes. Beavers have almost certainly played a long role in its history, damming and redamming the stream through the quiet mountain valley. Our direct knowledge of its history, though, begins at European settlement, with its namesake: Asa Gillett.

A detailed report on the history of Gillett Pond was prepared in 2016 by the UVM Consulting Archaeology Program, and is only summarized briefly here (Kenny and Quinn 2016). Asa Gillett first settled in the valley in 1790, and by the 1830s, his family was using a dammed pond to operate a sawmill on Johns Brook, and to provide ice in the winter. Gillett Pond is visible on maps dating to the 1850s, and a possible former mill site was located slightly downstream of the existing dam by the UVM group. The current dam structure was built in 1903 by the Richmond Light & Power Company, a short-lived hydroelectric operation, which abandoned Gillett Pond by 1910.

From 1910 until the 1950s, the dam was left largely unmaintained, aside from reported plugging of holes by the local beaver population (Friends of Gillett Pond & Richmond Land Trust 2017). (This population was presumably resurgent in the 1940s and '50s, after being extirpated from Vermont for the duration of the early 20th century.) In the 1950s, the land surrounding the pond was acquired by a local Girl Scout troop, whose camp is still located across the road from the dam. In 2013, the Girl Scouts requested a state inspection of the dam, which indicated that it was at risk of failure. In light of this, the Girl Scouts began plans to remove the dam and drain the pond, prompting a swell of local support to save Gillett Pond. For decades, the pond has been a centerpiece of local outdoor recreation, as the only publicly accessible body of still water in Huntington and Richmond (Friends of Gillett Pond & Richmond Land Trust 2017).

Efforts to save Gillett Pond resulted in its purchase by the Richmond Land Trust, along with much of the land along its shoreline, in 2014. Together with Friends of Gillett Pond, the Richmond Land Trust is now fundraising for the replacement of the dam.

Current state of the Gillett Pond dam.

Terrestrial Ecology

Gillett Pond is located in a steep-sided, wooded valley, with extensive bedrock exposure slopes generally exceeding 30%. The natural communities of the Richmond Land Trust (RLT) parcel and surrounding areas were mapped remotely by Arrowwood Environmental (Arrowwood) in 2013, as part of a larger Natural Resource Inventory of Bolton, Richmond, Huntington, and Jericho (Arrowwood Environmental 2013).

I planned my terrestrial field reconnaissance based on Arrowwood's natural communities designations. Within the Richmond Land Trust parcel, they mapped the west shore of the pond, including the northern point, as Hemlock-Northern Hardwood Forest. They mapped the east shore of the pond as predominantly Northern Hardwood Forest, with an area of Hemlock Forest. My findings are presented below. Plants and animals are referred to by their common names; for scientific names, see the species lists presented in Appendices A and B.

West Shore: Hemlock-Northern Hardwood Forest

The west shore of the pond is dominated by Hemlock-Northern Hardwood Forest, with notable signs of somewhat enriched soils, which I interpreted as the result of downslope movement. The overstory is dominated by eastern hemlock, sugar maple, yellow birch, and white ash, with some red maple, paper birch, bigtooth aspen, black cherry, red oak, basswood, and red pine. Regeneration in this area appears to be dominated by sugar maple, eastern hemlock, American beech, yellow birch, red oak, white ash, and striped maple.

Understory plants in this area are highly variable, with some rich site indicators such as maidenhair fern, jack-in-the-pulpit, and doll's eyes. Other understory plants are more typical of a Hemlock-Northern Hardwood Forest, including Canada mayflower, wild sarsaparilla, partridgeberry, and Indian pipe.

The soils in this area are mapped by the Chittenden County Soil Survey as Adams and Windsor loamy sands, which are derived from old lake beaches, deltas, and terraces (Allen 1974). My field observations bore this out. Similarly to other locations on the property, soils consisted of loamy sand intermingled with larger rocks. On the west shore, however, these large clasts were more rounded than on the north or east shores, suggesting that they have been transported by water. I hypothesize that deposits on the west side of the pond represent a terrace left by the outflow of Glacial Lake Mansfield through the Gillett Pond notch.

My soil pit, located in a hemlock-dominated stand without notable rich site indicators, contained a thin O horizon, an A horizon with a pH of 4.5, a poorly developed E horizon with a pH of 4.5, and a yellowish-brown B horizon with a pH of 5. This is a fairly typical soil profile for a forest

dominated by hemlock, whose needles have a strong acidifying effect. My soil pit did not reach the C horizon.

Additional Observations

The west shore of the pond is the most readily accessible for human use. A Girl Scout camp located across the road appears to use a small trail down to a fire pit and floating dock located alongside the pond. The southern portion of the west shore consists only of a narrow band of vegetation between the pond and the road, and is predominantly characterized by roadside herbs.

North Shore: Hemlock Forest

I define the "north shore" as the area between the pond's northern and western arms. Like the west shore, this area was mapped by Arrowwood as Hemlock-Northern Hardwood Forest. In visiting the area, however, I found that it is dominated by eastern hemlock, which comprises more than 75% of the canopy. It is therefore better described as a Hemlock Forest.

In addition to hemlock, canopy trees in this area include red spruce, paper birch, yellow birch, and American beech. Notable regenerating species include red spruce and eastern hemlock. In many areas, the understory is sparse to nonexistent. Where present, characteristic species include shining clubmoss, ground pine, whorled wood-aster, partridgeberry, and Canada mayflower.

The northern shore is characterized by steep cliffs dropping off rapidly to the shoreline of the pond. At the tops of these cliffs, the Hemlock Forest understory takes on a different character and is dominated by moss, wintergreen, and lowbush blueberry.

The band below the cliffs varies in character, with some areas still dominated by hemlock and others by richer forest communities, as seen on the east shore (see below). I observed these areas from the water but did not visit them on foot.

Soils on the north shore are mapped as Lyman-Marlow complex: steeply sloping, glacial till-derived soils that predominate in the Green Mountains. I found the soil in a hemlock-dominated area of the north shore to consist of sandy loam with frequent angular clasts. It had thin O and A horizons (~0.5") and a thin but well developed E horizon (~0.5") overlying a B horizon that was deep orange in color. The A and E horizons both had a pH of 4.5, while the B horizon had a pH of 6. My soil pit did not reach the C horizon.

East Shore

The east shore of the pond is its steepest and most inaccessible, rising abruptly from the water to a plateau above, a difference of approximately 500 feet. This area was mapped by Arrowwood as predominantly Northern Hardwood Forest, with an area of Hemlock Forest in a broad north-facing concavity in the slope. In addition to these community types, the Vermont Agency of Natural

Resources identifies a band of low-elevation acidic cliffs along the east shore of the pond as a "rare" physical landscape.

The property line cuts diagonally up the slope from its corner on the north arm of the pond to the plateau at its southeast corner. While I explored both the "Northern Hardwood" and "Hemlock Forest" areas of the east shore, I did not go as far as the southeast corner. My findings are discussed below.

Cliffs

The cliffs along the east side of the pond, like all of the bedrock in the area, are made up of schist of the Underhill Formation. In this area, the Underhill Formation strikes north-south, with the result that cliff-forming layers are oriented at an angle to the shore of the pond. Cliffs generally present themselves as a stair-stepping band along the hillslope, rather than as a sheer face. Most are wet, with plant growth including bulblet fern, whorled wood-aster, and liverworts. If given their own natural community designation, they would likely be considered Temperate Acidic Cliffs; however, they are present in very small and intermittent patches. Their significance in this discussion is primarily as a division between the natural community types above and below them.

Cliff on the east shore of Gillett Pond.

Rich Northern Hardwood Forest

The area below the cliffs along the east shore of the pond is characterized by a band of pronounced enrichment, likely the result of downslope movement. This area displays considerable variation, but is dominated by sugar maple, yellow birch, and white ash, with additional overstory trees including basswood, eastern hemlock, and hop-hornbeam. Understory rich site indicators include seersucker sedge, blue-stemmed goldenrod, blue cohosh, pale touch-me-not, jack-in-the-pulpit, doll's eyes, trillium, marginal wood fern, and maidenhair fern.

A soil pit I dug near the base of the slope supports the hypothesis that enrichment is the result of downslope movement. The soil was similar in texture to those of the Lyman-Marlow complex higher on the slope and on the north shore of the pond, but was characterized by a thicker A horizon (~2.25") and a more neutral pH, ranging from 6 to 6.5. In addition, two buried A horizons were evident within the upper 10 inches of the soil profile, indicating at least two separate downslope movement events.

Northern Hardwood Forest

The area above the cliffs on the east side of the pond is, as mapped by Arrowwood, a classic northern hardwood forest. Its overstory is dominated by sugar maple, American beech, yellow birch, paper birch, eastern hemlock, and white ash, with some red oak and bigtooth aspen. Understory plants are typical of a northern hardwood forest, including Christmas fern, shining clubmoss, intermediate fern, Indian cucumber root, and hobblebush. However, some rich site indicators are sporadically present, including maidenhair fern and blue-stemmed goldenrod.

The soil in this area is a sandy loam with abundant angular clasts. It consists of a one-inch O horizon, thin A and E horizons (~0.5" each) with pHs of 4.5 and 5, and an orange B horizon with a pH increasing from 5 to 5.5 with depth. Like the north shore, it is mapped as Lyman-Marlow complex.

Hemlock-Northern Hardwood Forest

The area mapped by Arrowwood as a Hemlock Forest would be more accurately classified as a Hemlock-Northern Hardwood Forest. While some areas of dense hemlock are present, it overall represents no more than 50% of the canopy, which it shares with sugar maple, white ash, yellow birch, and American beech. The understory is never fully excluded, and includes wild sarsaparilla, intermediate wood fern, shining clubmoss, Indian cucumber root, and bluebead lily.

I was not able to ascertain whether the Rich Northern Hardwood Forest band continues below the Hemlock-Northern Hardwood Forest on the east shore. However, I observed pale touch-me-not on the lower slopes of this area from the water, suggesting that the band of enrichment does continue.

Additional Observations

Mass Wasting

The steep slope of the east shore appears to favor downslope movement, both in the form of steady colluvial creep and in larger mass wasting events. Near the property's northeast corner, I observed a recent debris flow scar, characterized by uprooted trees and large rocks. Where this chute meets the pond, a hummocky debris flow deposit is present, now overgrown with shoreline vegetation. LiDAR hillshade imagery reveals several such deposits along the east shore of the pond, suggesting that mass wasting events play a role in the overall disturbance regime of the pond's eastern shore.

Debris flow scar on the east shore of Gillett Pond.

Terrestrial Wildlife

Over the course of my fieldwork, I observed several bird species making use of the terrestrial portion of the property, including black-capped chickadee, white-breasted nuthatch, American goldfinch, blue jay, American crow, common raven, and scarlet tanager. Bob Low and others have kept an extensive list of breeding birds at Gillett Pond based on an annual count in late July. For the full list, see Appendix B.

In addition to bird species, I observed signs of white-tailed deer and beaver, but did not encounter any mammalian wildlife. According to Bob Low and Aaron Worthley, mammals observed in the Gillett Pond area also include moose, bear, bobcat, fisher, ermine, mink, and otter.

Gillett Pond is located within an extensive forest network that provides key habitat for mammal species requiring large ranges. The availability of water also makes it an important resource for mammals, birds, and other species.

Aquatic Ecology

Gillett Pond is a shallow pond with a surface area of approximately 30 acres. Over most of its extent, its water depth is less than 5 feet. It is considered a mesotrophic lake and supports large populations of aquatic plants, amphibians, insects, and warm-water fish.

The Vermont Department of Environmental Conservation (DEC) prepares ecological scorecards for inland lakes throughout the state, ranking each lake based on its nutrient trend, shore and lake habitat, mercury pollution, and invasive species (Vermont Department of Environmental Conservation 2015). In 2015, Gillett Pond ranked as "good" (the highest score) in the nutrient trend, habitat, and invasive species categories, and "fair" in the mercury pollution category, which is based on a statistical model of airborne mercury pollution risk throughout New Hampshire and Vermont.

Plants characterizing the aquatic community of Gillett Pond include common cattail, bur-reed, ribbonleaf and bigleaf pondweed, pond-lily, spike-rush, water horsetail, and bladderwort (see Appendix A).

Closed gentian on the shoreline of Gillett Pond.

The shoreline plant communities of the pond vary by location. Most of the pond's shore descends steeply into the water, and in many locations little to no shoreline community is present. The major exceptions are at the ends of the pond's north and south arms. To the south, the pond is bordered by a shallow emergent marsh that grades into an alder swamp (Arrowwood Environmental 2013). To the north, the pond shallows gradually into a narrow valley. Vegetation there appears to be characteristic of a shallow emergent marsh, but I was not able to explore it directly. Both of these

areas lie outside the Richmond Land Trust property, and the southern end of the pond lies across the town line in Huntington.

A few smaller areas of gently sloping shoreline are present along the west arm of the pond and on the numerous small debris flow deposits that jut into the pond from its east shore. Plants characterizing these areas include bur-reed, common cattail, closed gentian, purple-stemmed aster, small white aster, nodding bur marigold, Joe Pye weed, boneset, goldenrod, arrow-leaved tearthumb, and royal fern.

Beavers have long been active in Gillett Pond, and are credited with filling holes in the dam during its long period of human neglect (Friends of Gillett Pond & Richmond Land Trust 2017). Several beaver lodges are visible along the shores of the pond, including one that appears active, but the highest levels of beaver activity appear to be in the alder swamp to the south of the pond. Other mammals reported to use the pond by Aaron Worthley and Bob Low include otter and mink.

Painted turtle at Gillett Pond.

Fish, reptiles, and amphibians observed in the pond included chain pickerel, painted turtle, eastern newt, and several unidentified frogs. In addition, Bob Low and Aaron Worthley have reported sightings of bullfrog, snapping turtle, brown bullhead, yellow perch, and northern pike. They also

report observations of eastern floater, a native freshwater mussel, and *Pectinella magnifica*, a freshwater bryozoan.

Birds sighted using the pond habitat included belted kingfisher, great blue heron, mallard, wood duck, and Canada goose. A full list of breeding birds at the pond has been kept by Bob Low since 2002 and is included in Appendix B. Of these, the great blue heron is ranked as "S3S4B" in Vermont, indicating that breeding populations may be vulnerable (Vermont Natural Heritage Inventory 2017). The north arm of the pond in particular provides excellent habitat for great blue heron and wood ducks.

Wally Jenkins has kept an odonate species list at Gillett Pond since 2012 (Jenkins 2017). He has recorded 37 species of dragonflies and damselflies, including the Vesper bluet, a record for Chittenden County, and the Lilypad Clubtail, which is ranked as S3S4 (may be vulnerable) in the state of Vermont (Vermont Natural Heritage Inventory 2017).

Water Level Rise

The planned replacement of the Gillett Pond dam will result in a water level rise of approximately one foot (Friends of Gillett Pond & Richmond Land Trust 2017; Worthley 2017). Part of my objective in completing this ecological assessment is to discuss possible impacts of this water level rise, and to recommend monitoring strategies to assess these impacts.

A rise of one foot should represent a fairly minor change for most of the pond. Its steeply sloping shoreline will not be modified much by this increase; indeed, former water lines visible on several boulders along the shoreline show that water levels have historically been approximately a foot higher than they are today. That said, the raising of the water level will have a significant impact on the extent of the pond at the end of its north and south arms (see Map 1). In the case of the south arm of the pond, this is likely to eventually result in the wetland natural communities that now border the pond migrating southward. The area currently mapped as a shallow emergent marsh will become part of the pond, and a portion of the alder swamp beyond will likely transition into shallow emergent marsh. Current ecological conditions on the north arm of the pond are less well documented, but a similar transition is likely to take place there. Because this assessment focused on the Richmond Land Trust parcel, I did not conduct a detailed investigation of current conditions in either area.

Rock showing former water levels at Gillett Pond.

Within the Richmond Land Trust parcel, as discussed above, areas of gently sloping shoreline communities include a portion of the pond's west arm and a series of small debris flow deposits along the pond's eastern shoreline. These areas present opportunities to monitor the effects of changing water levels on the pond's shoreline plant communities; the debris flow deposits, in particular, could be used as replicates in a scientific study. One strategy for monitoring vegetation change would be to establish transects from dry land into the pond, and conduct annual surveys along these transects. Dryland start points could be marked permanently with rebar, and the azimuth of each transect recorded so as to be replicable from year to year. This strategy offers some

flexibility, depending on the expertise of the observer. A less experienced observer could mark the boundaries of vegetation zones, noting characteristic plants, while a more confident botanist could use line-point intercept monitoring to generate detailed vegetation data. Ideally, monitoring would occur at the same time every year, starting prior to dam replacement activities.

The pond's diverse odonate fauna also presents an excellent monitoring opportunity. Dragonflies and damselflies spend the beginnings of their lives as aquatic invertebrates before emerging as adults to mate, feed, and lay eggs. During both phases of their lives, they depend on other aquatic insects as a food source, and they benefit from diverse aquatic habitats and abundant emergent vegetation. Adult dragonflies are colorful and charismatic, and offer an opportunity to engage the public in monitoring efforts. For example, an expert-led annual dragonfly count, modeled after events like the Christmas Bird Count and the North American Butterfly Association's Butterfly Count Program, would both engage the public and result in diversity data over time.

Odonate identification to species can be an exacting endeavor, and one that may not hold the attention of younger participants. A monitoring and engagement strategy more suited to children might be to assess aquatic macroinvertebrates in the pond. Macroinvertebrates include the larvae of dragonflies and damselflies among other insects that dwell in aquatic vegetation, and they are easy to sample, observe, and identify to order. In my experience, most children (and, for that matter, adults) know little to nothing about predaceous diving beetles, giant water bugs, et al., and are fascinated to observe their behavior. Aquatic macroinvertebrates are considered excellent bioindicators of water quality, and are widely used to assess water quality in streams.

Existing formal and informal biodiversity monitoring projects, including Bob Low's breeding bird list and Wally Jenkins and Aaron Worthley's crowd-sourced amphibian monitoring project, can also be continued into the future. If practicable, I recommend using a citizen science website such as iNaturalist or eBird to keep track of this data, and encouraging others to upload their sightings of birds, etc. as well.

Finally, of course, monitoring must include regular measurements of water level. I recommend installing a water level gauge prior to the dam replacement project and engaging neighbors as citizen scientists to check it regularly.

The presence of a Girl Scout camp across the street from the pond presents an opportunity to engage the next generation in service through citizen science. Partnerships with the Girl Scouts could focus on anything from water level measurements to in-depth ecological monitoring projects, depending on interest.

Conclusion

Gillett Pond is an ecological treasure, with its wild, undeveloped shorelines and diverse aquatic and terrestrial flora and fauna. The upcoming dam replacement project and resulting water level rise is likely to have limited impacts on its plant and animal communities. However, opportunities to monitor the pond's biodiversity and plant communities during this transition may provide new information about the effects of these changes, as well as engaging the public in ecological science and a renewed sense of place.

Species recorded on the Gillett Pond parcel that are ranked as rare or uncommon (S3 and above) include a dragonfly, the lilypad clubtail *(Arigomphus furcifer,* ranked S3S4); three birds, the great blue heron *(Ardea herodias,* ranked S3S4B), common raven *(Corvus corax,* ranked S3), and red-tailed hawk *(Buteo jamaicensis,* ranked S3S4B).

References

Allen, George W. 1974. "Soil Survey of Chittenden County, Vermont." United States Department of Agriculture Soil Conservation Service.

Arrowwood Environmental. 2013. "Science to Action: Four Town Natural Resources Inventory, Bolton, Huntington, Jericho, and Richmond."

Friends of Gillett Pond & Richmond Land Trust. 2017. "Application to the Huntington Conservation Fund to Support the Cost of Replacing the Gillett Pond Dam."

Jenkins, Wally. Letter to Maria Dunlavey. 2017, September 14.

Kenny, Kate, and Catherine A. Quinn. 2016. "Historic Resources Review of the Gillett Pond Dam Replacement Project, Richmond, Chittenden County, Vermont." 1014. University of Vermont Consulting Archaeology Program.

Larsen, Frederick D. 1987. "History of Glacial Lakes in the Dog River Valley, Central Vermont." In *New England Intercollegiate Geological Conference Guidebook*, edited by David S. Westerman, 213–37.

Ratcliffe, Nicholas M., Rolfe S. Stanley, Marjorie H. Gale, Peter J. Thompson, and Gregory J. Walsh. 2011. "Bedrock Geologic Map of of Vermont." U.S. Geological Survey.

Vermont Department of Environmental Conservation. 2015. "Vermont Inland Lakes Score Card."

Vermont Natural Heritage Inventory. 2017. "Rare and Uncommon Animals of Vermont."

Worthley, Aaron. 2017. "Gillett Pond- Conceptual Water Levels, Richmond & Huntington, Vt." Arrowwood Environmental.

Wright, Stephen F., George E. Springston, and John G. Van Hoesen. 2015. "Ice Retreat and Readvance across the Green Mountain Foothills: Bolton and Jericho, Vermont." In *New York State Geological Association Guidebook*.

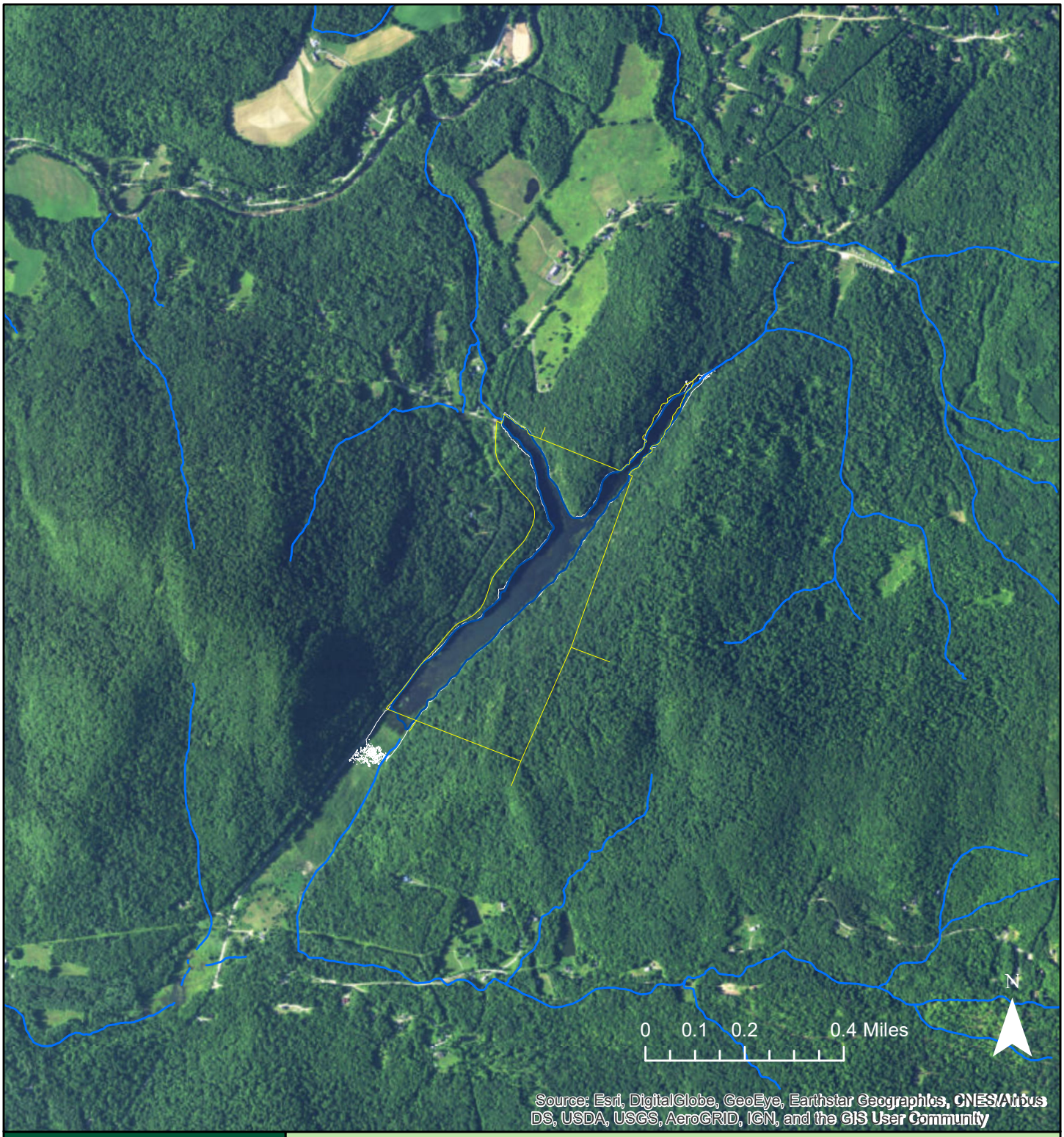
Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 1: Study Site

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.



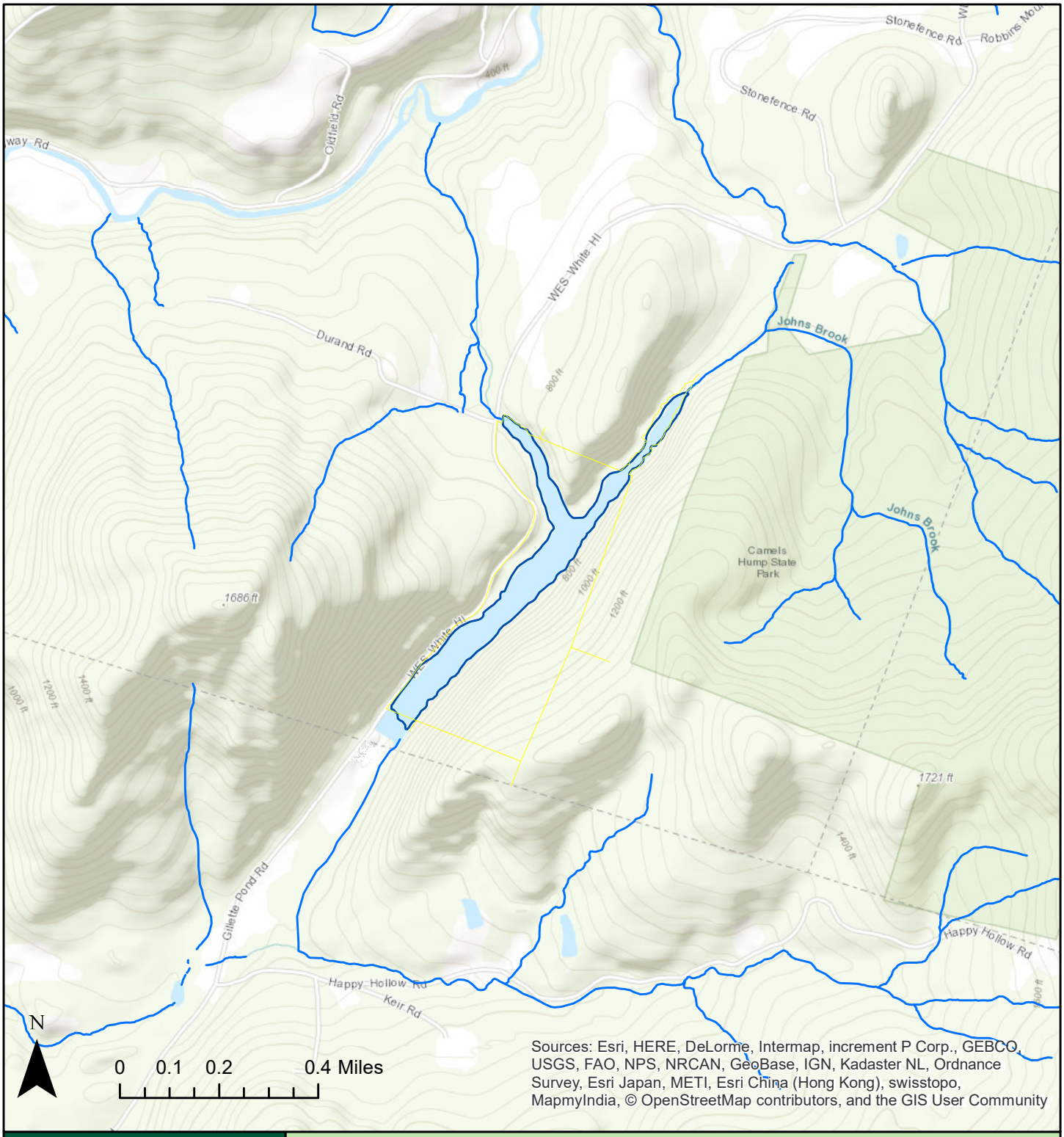
Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 2: Landscape Context

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.



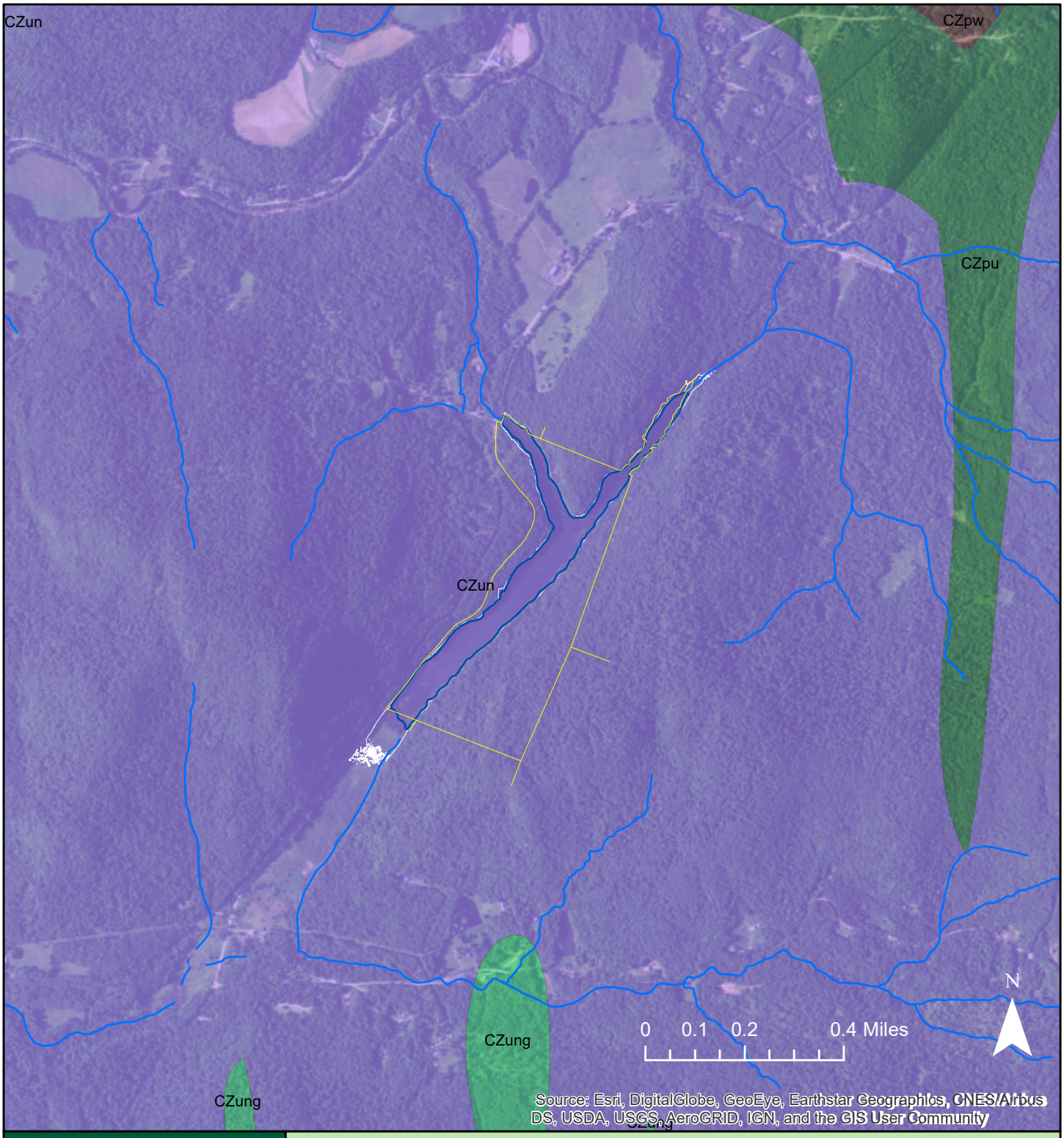
Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 3: Topography

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.



Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 4: Bedrock Geology

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

CZun	Underhill Formation
CZung	Underhill Formation, greenstone and amphibolite member
CZpu	Pinnacle Formation, undivided
CZpw	Pinnacle Formation, metawacke member

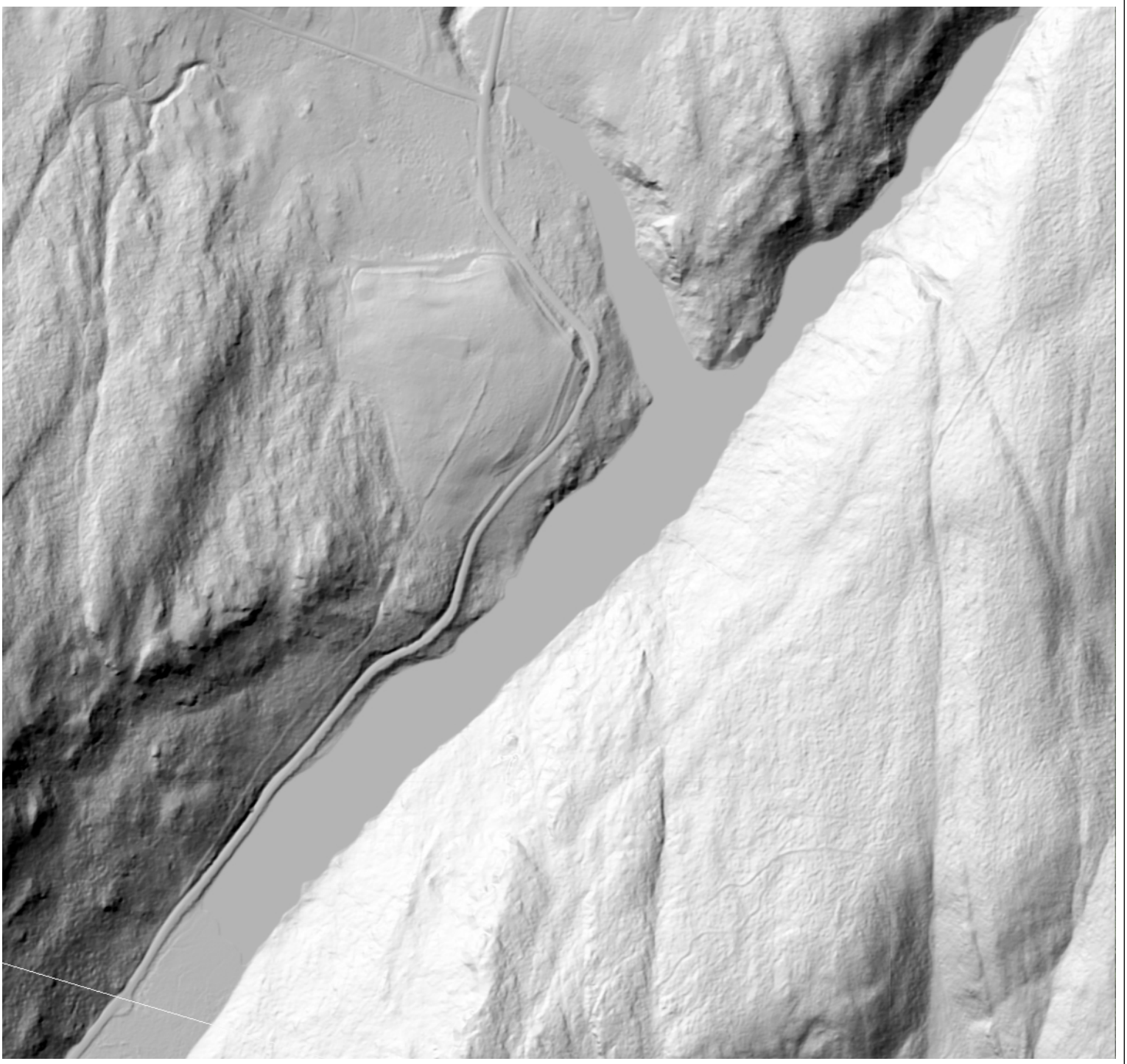
Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.

VERMONT

Map 5. LiDAR Imagery

Vermont Agency of Natural Resources

vermont.gov



LEGEND

Town Boundary

NOTES

Map created using ANR GIS mapping techology.

1: 6,839

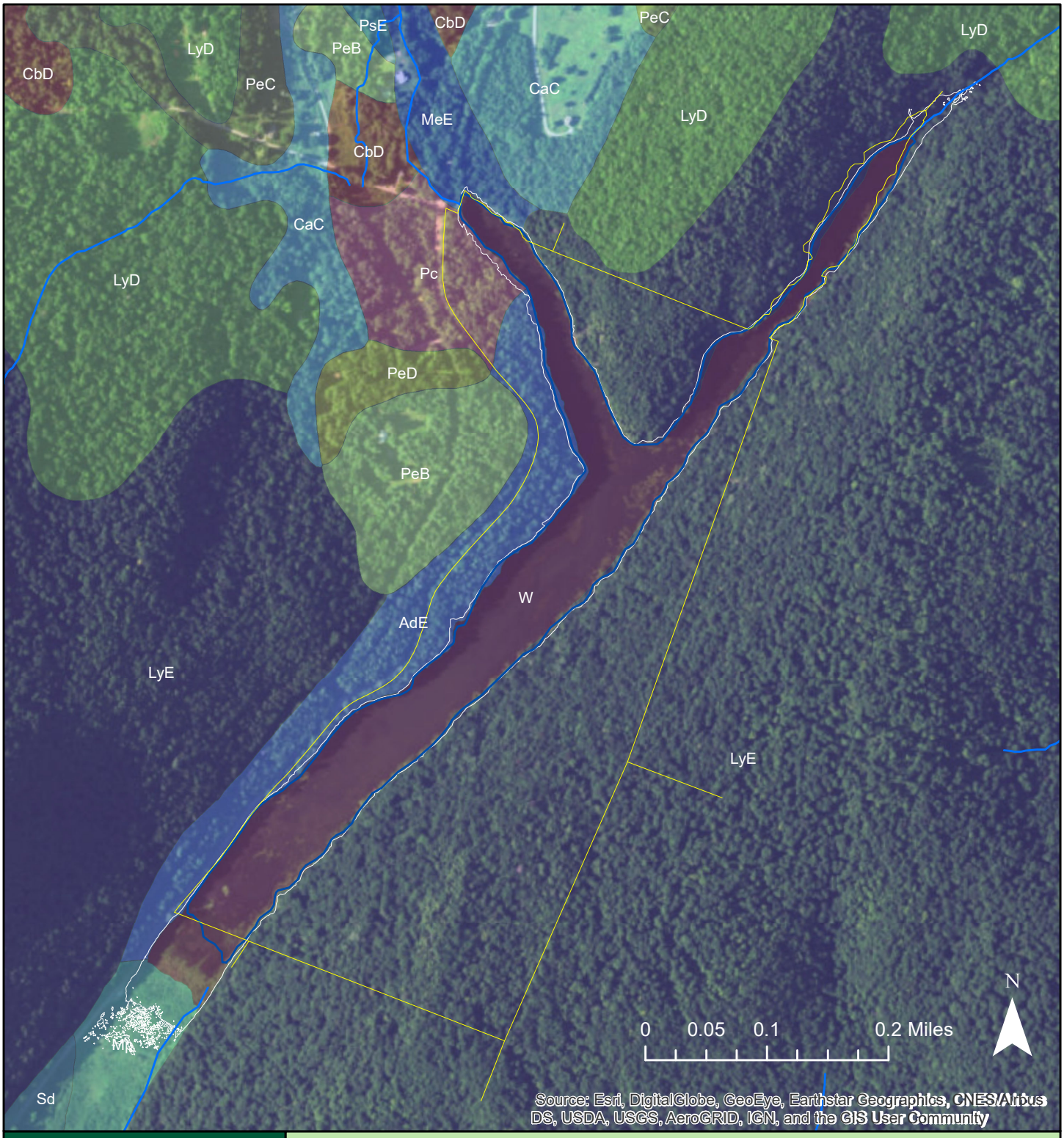
September 17, 2017

347.0 0 174.00 347.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

1" = 570 Ft. 1cm = 68 Meters

THIS MAP IS NOT TO BE USED FOR NAVIGATION



Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 6: Soils

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

LyE	Lyman-Marlow complex, 30 to 60 percent slopes, very rocky
AdE	Adams and Windsor loamy sands, 30 to 60 percent slopes
Pc	Peacham mucky peat, 0 to 3 percent slopes
W	water

Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.

Rapid Ecological Assessment Gillett Pond Richmond, VT

Map 7: Natural Communities

Legend

- Current Water Level
- Proposed Water Level
- Streams
- Property Lines

NH	Northern Hardwood Forest
HNH	Hemlock-Northern Hardwood Forest
HF	Hemlock Forest
SEM	Shallow Emergent Marsh
AS	Alder Swamp

Natural community mapping by Science to Action.

Completed by Maria Dunlavey in partial fulfillment of the graduation requirements of the UVM Field Naturalist Program. Map prepared by Maria Dunlavey using data provided by Aaron Worthley (Arrowwood Environmental) and VCGI.

APPENDIX A

Species Observed by Maria Dunlavey, 9/14/17 and 9/16/17

PLANTS

West Shore: Hemlock-Northern Hardwood Forest

Red maple	*Acer rubrum*
White ash	*Fraxinus americana*
Basswood	*Tilia americana*
Dogwood	*Cornus* sp.
Jack-in-the-pulpit	*Arisaema triphyllum*
Sugar maple	*Acer saccharum*
Red oak	*Quercus rubra*
Eastern hemlock	*Tsuga canadensis*
Hay-scented fern	*Dennstaedtia punctilobula*
Lady fern	*Athyria filix-femina*
New York fern	*Parathelypteris novaboracensis*
Maidenhair fern	*Adiantum pedatum*
Interrupted fern	*Osmunda claytoniana*
Goldenrod	*Solidago* sp.
Raspberry	*Rubus* sp.
Virginia creeper	*Parthenocissus quinquefolia*
Doll's eyes	*Actaea pachypoda*
Bluebead lily	*Clintonia borealis*
Partridgeberry	*Mitchella repens*
American beech	*Fagus grandifolia*
Witch hazel	*Hamamelis virginia*
Marginal wood fern	*Dryopteris marginalis*
Wild sarsaparilla	*Aralia nudicaulis*
Ground pine	*Dendrolycopodium obscurum*
Indian pipe	*Monotropa uniflora*
Striped maple	*Acer pensylvanicum*
Paper birch	*Betula papyrifera*
Intermediate wood fern	*Dryopteris intermedia*
Canada mayflower	*Maianthemum canadense*
Sensitive fern	*Onoclea sensibilis*
Long beech fern	*Phegopteris connectilis*
Bracken	*Pteridium aquilinum*
Yellow birch	*Betula alleghaniensis*
Red pine	*Pinus resinosa*
White pine	*Pinus strobus*
Black cherry	*Prunus serotina*
Bigtooth aspen	*Populus grandidentata*

Christmas fern	*Polystichum acrostichoides*
American hog peanut	*Amphicarpaea bracteata*

North Shore: Hemlock Forest

Eastern hemlock	*Tsuga canadensis*
Red spruce	*Picea rubra*
Paper birch	*Betula papyrifera*
Yellow birch	*Betula alleghaniensis*
American beech	*Fagus grandifolia*
Striped maple	*Acer pensylvanicum*
Red oak	*Quercus rubra*
Wintergreen	*Gaultheria procumbens*
Lowbush blueberry	*Vaccinium angustifolium*
Whorled wood-aster	*Oclemena acuminata*
Ground pine	*Dendrolycopodium obscurum*
Shining clubmoss	*Huperzia lucidula*
Canada mayflower	*Maianthemum canadense*
Polypody	*Polypodium* sp.
Partridgeberry	*Mitchella repens*

East Shore: Rich Northern Hardwood Forest

Yellow birch	*Betula alleghaniensis*
Sugar maple	*Acer saccharum*
Eastern hemlock	*Tsuga canadensis*
Hop-hornbeam	*Ostrya virginiana*
Basswood	*Tilia americana*
Maidenhair fern	*Adiantum pedatum*
Lady fern	*Athyria filix-femina*
Spotted touch-me-not	*Impatiens capensis*
Pale touch-me-not	*Impatiens pallida*
Raspberry	*Rubus* sp.
White ash	*Fraxinus americana*
Hobblebush	*Viburnum lantanoides*
Trillium	*Trillium* sp.
Shining clubmoss	*Huperzia lucidula*
Marginal wood fern	*Dryopteris marginalis*
Blue cohosh	*Caulophyllum thalictroides*
Blue-stemmed goldenrod	*Solidago caesia*
Seersucker sedge	*Carex plantaginea*
Jack-in-the-pulpit	*Arisaema triphyllum*
Rose twisted-stalk	*Streptopus lanceolatus*
Paper birch	*Betula papyrifera*
Striped maple	*Acer pensylvanicum*

Doll's eyes	*Actaea pachypoda*
Polypody	*Polypodium* sp.

East Shore: Cliffs

Bulblet fern	*Cystopteris bulbifera*
Liverworts	Marchantiophyta
Whorled wood-aster	*Oclemena acuminata*

East Shore: Northern Hardwood Forest

Yellow birch	*Betula alleghaniensis*
Paper birch	*Betula papyrifera*
Sugar maple	*Acer saccharum*
American beech	*Fagus grandifolia*
Eastern hemlock	*Tsuga canadensis*
White ash	*Fraxinus americana*
Red oak	*Quercus rubra*
Bigtooth aspen	*Populus grandidentata*
Christmas fern	*Polystichum acrostichoides*
Shining clubmoss	*Huperzia lucidula*
Intermediate wood fern	*Dryopteris intermedia*
Wild sarsaparilla	*Aralia nudicaulis*
Hobblebush	*Viburnum lantanoides*
Maidenhair fern	*Adiantum pedatum*
Blue-stemmed goldenrod	*Solidago caesia*
Indian cucumber root	*Medeola virginiana*

East Shore: Hemlock-Northern Hardwood Forest

Eastern hemlock	*Tsuga canadensis*
Sugar maple	*Acer saccharum*
White ash	*Fraxinus americana*
Yellow birch	*Betula alleghaniensis*
American beech	*Fagus grandifolia*
Wild sarsaparilla	*Aralia nudicaulis*
Intermediate wood fern	*Dryopteris intermedia*
Shining clubmoss	*Huperzia lucidula*
Indian cucumber root	*Medeola virginiana*
Bluebead lily	*Clintonia borealis*

Shoreline Plants

Royal fern	*Osmunda regalis*
Common cattail	*Typha latifolia*
Bur-reed	*Sparganium* sp.
Closed gentian	*Gentiana clausa*

Purple-stemmed aster	*Symphyotrichum puniceum*		
Nodding bur marigold	*Bidens cernua*		
Small white aster	*Symphyotrichum racemosum*		
Joe Pye weed	*Eutrochium maculatum*		
Boneset	*Eupatorium perfoliatum*		
Goldenrod	*Solidago* sp.		
Arrow-leaved tearthumb	*Persicaria sagittata*		

Aquatic Plants

Bur-reed	*Sparganium* sp.		
Common cattail	*Typha latifolia*		
Bladderwort	*Utricularia* sp.		
Water horsetail	*Equisetum fluviatile*		
Rush	*Juncus* sp.		
Spike-rush	*Eleocharis* sp.		
Pond lily	*Nuphar* sp.		
Big-leaf pondweed	*Potamogeton amplifolius*		
Ribbonleaf pondweed	*Potamogeton epihydrus*		

ANIMALS

Birds

Great blue heron	*Ardea herodias*	S3S4B	breeding population may be vulnerable
Canada goose	*Branta canadensis*		
Wood duck	*Aix sponsa*		
Mallard	*Anas platyrhynchos*		
Wild turkey	*Meleagris gallopavo*		
Belted kingfisher	*Megaceryle alcyon*		
Downy woodpecker	*Picoides pubescens*		
Blue jay	*Cyanocitta cristata*		
American crow	*Corvus brachyrhynchos*		
Common raven	*Corvus corax*	S3	vulnerable
Black-capped chickadee	*Poecile atricapillus*		
White-breasted nuthatch	*Sitta carolinensis*		
Scarlet tanager	*Piranga olivacea*		

Amphibians

Wood frog	*Lithobates sylvaticus*		
Eastern newt	*Notophthalmus viridescens*		

Fish

Chain pickerel	*Esox niger*		

Reptiles

Painted turtle	*Chrysemys picta*

APPENDIX B

Animal species reported by Bob Low, Aaron Worthley, Wally Jenkins, & others.

Mammals			
American beaver	*Castor canadensis*		
Bobcat	*Lynx rufus*	SGCN	species of greatest conservation need
North American river otter	*Lontra canadensis*	SGCN	species of greatest conservation need
Ermine	*Mustela erminea*		
American mink	*Neovison vison*		
Fisher	*Pekania pennanti*		
American black bear	*Ursus americanus*		
Moose	*Alces americanus*	SGCN	species of greatest conservation need
White-tailed deer	*Odocoileous virginianus*		
Fish			
Yellow perch	*Perca flavescens*		
Brown bullhead	*Ameiurus nebulosus*		
Chain pickerel	*Esox niger*		
Northern pike	*Esox lucius*		
Other Invertebrates			
Eastern floater	*Pyganodon cataracta*		
Magnificent bryozoan	*Pectinella magnifica*		
Reptiles			
Painted turtle	*Chrysemys picta*		
Snapping turtle	*Chelydra serpentina*		
Amphibians			
Bull frog	*Lithobates catesbeianus*		
Spotted salamander	*Ambystoma maculatum*	SGCN	species of greatest conservation need
Wood frog	*Lithobates sylvaticus*		
Eastern newt	*Notophthalmus viridescens*		
Spring peeper	*Pseudacris crucifer*		
Birds (breeding)			
Great blue heron	*Ardea herodias*	S3S4B	breeding population may be vulnerable
Wood duck	*Aix sponsa*		
Mallard	*Anas platyrhynchos*		
Common merganser	*Mergus merganser*		
Broad-winged hawk	*Buteo platypterus*		
Red-tailed hawk	*Buteo jamaicensis*	S3S4B	breeding population may be vulnerable
Ruffed grouse	*Bonasa umbellus*		

Spotted sandpiper	*Actitis macularius*
Mourning dove	*Zenaida macroura*
Belted kingfisher	*Megaceryle alcyon*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Pileated woodpecker	*Dryocopus pileatus*
Yellow-bellied sapsucker	*Sphyrapicus varius*
Alder flycatcher	*Empidonax alnorum*
Eastern wood-pewee	*Contopus virens*
Eastern phoebe	*Sayornis phoebe*
Red-eyed vireo	*Vireo olivaceus*
Blue-headed vireo	*Vireo solitarius*
Blue jay	*Cyanocitta cristata*
American crow	*Corvus brachyrhynchos*
Barn swallow	*Hirundo rustica*
Tree swallow	*Tachycineta bicolor*
Black-capped chickadee	*Poecile atricapillus*
Tufted titmouse	*Baelophus bicolor*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia americana*
Winter wren	*Troglodytes hiemalis*
Hermit thrush	*Catharus guttatus*
Veery	*Catharus fuscescens*
Wood thrush	*Hylocichla mustelina*
American robin	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*
Cedar waxwing	*Bombycilla cedrorum*
American redstart	*Setophaga ruticilla*
Northern waterthrush	*Parkesia noveboracensis*
Black-and-white warbler	*Mniotilta varia*
Black-throated blue warbler	*Setophaga caerulescens*
Black-throated green warbler	*Setophaga virens*
Canada warbler	*Cardellina canadensis*
Common yellowthroat	*Geothlypis trichas*
Nashville warbler	*Oreothlypis ruficapilla*
Northern parula	*Setophaga americana*
Yellow-rumped warbler	*Setophaga coronata*
Louisiana waterthrush	*Parkesia motacilla*
Ovenbird	*Seiurus aurocapilla*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Scarlet tanager	*Piranga olivacea*
Indigo bunting	*Passerina cyanea*

Song sparrow	*Melospiza melodia*		
Swamp sparrow	*Melospiza georgiana*		
Dark-eyed junco	*Junco hyemalis*		
Red-winged blackbird	*Agelaius phoeniceus*		
Common grackle	*Quiscalus quiscula*		
American goldfinch	*Spinus tristis*		

Odonates

Canada Darner	*Aeshna canadensis*		
Lake Darner	*Aeshna eremita*		
Variable Darner	*Aeshna interrupta*		
Black-tipped Darner	*Aeshna tuberculifera*		
Shadow Darner	*Aeshna umbrosa*		
Common Green Darner	*Anax junius*		
Variable Dancer	*Argia fumipennis*		
Lilypad Clubtail	*Arigomphus furcifer*	S3S4	may be vulnerable
Springtime Darner	*Basiaeschna janata*		
Fawn Darner	*Boyeria vinosa*		
Aurora Damsel	*Chromagrion conditum*		
American Emerald	*Cordulia shurtleffi*		
Racket-tailed Emerald	*Dorocordulia libera*		
Black-shouldered Spinyleg	*Dromogomphus spinosus*		
Boreal Bluet	*Enallagma boreale*		
Marsh Bluet	*Enallagma ebrium*		
Skimming Bluet	*Enallagma geminatum*		
Hagen's Bluet	*Enallagma hageni*		
Orange Bluet	*Enallagma signatum*		
Vesper Bluet	*Enallagma vesperum*		
Common Baskettail	*Epitheca cynosura*		
Spiny Baskettail	*Epitheca spinigera*		
Lancet Clubtail	*Gomphus exilis*		
Dusky Clubtail	*Gomphus spicatus*		
Eastern Forktail	*Ischnura verticalis*		
Chalk-fronted Corporal	*Ladona Julia*		
Amber-winged Spreadwing	*Lestes eurinus*		
Elegant Spreadwing	*Lestes inaequalis*		
Slender Spreadwing	*Lestes rectangularis*		
Swamp Spreadwing	*Lestes vigilax*		
Slaty Skimmer	*Libellula incesta*		
Widow Skimmer	*Libellula luctuosa*		
Twelve-spotted Skimmer	*Libellula pulchella*		
Four-spotted Skimmer	*Libellula quadrimaculata*		
Blue Dasher	*Pachydiplax longipennis*		

Eastern Amberwing	*Perithemis tenera*
Common Whitetail	*Plathemis lydia*