Natural Resource Inventory Report

Town-owned Parcel in Gill, MA, along Hoe Shop Rd.

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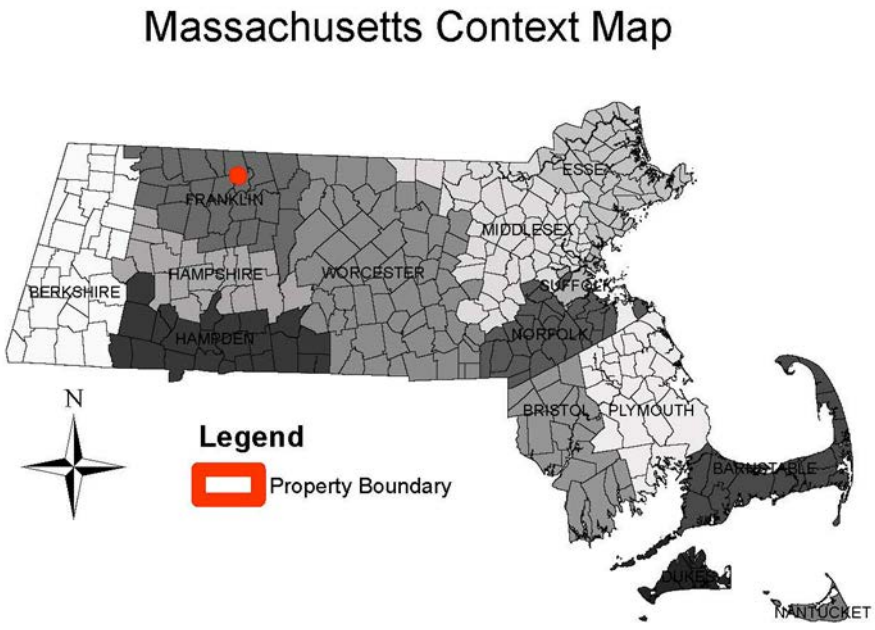
Introduction & Goals

The town of Gill owns a 160 acre property on Hoe Shop Road. The goals for the property as discussed on Tuesday February, 12th 2013 with Ray Purington and members of the Town Forest Committee, including input from Chris Polatin and the Gill Conservation Commission, have been suggested for the purposes of the town of Gill. Goals includes: wildlife survey, forest inventory, wetland survey, invasive species survey, and recreation and forestry opportunities. In order to help Gill achieve these goals, we developed a natural resource inventory to inform their decisions. In order to do this, we broke into groups based on our knowledge, interest and experience. Specifically, the groups include watershed context, wetland and riparian area survey, wetland wildlife habitat evaluation, invasive species analysis, wildlife survey, bird survey, and forest inventory. Other information in this report includes: land use history, landscape context, geology, soils and site suitability for recreation, log landings and forestry equipment. The report is broken up into these areas of focus and includes recommendations based on the goals articulated by the town and guided by the data gathered. These recommendations can be found at the end of each section. This natural resource inventory is meant guide future conservation steps that can be taken to improve and conserve the natural resources on the property.

Land Use History

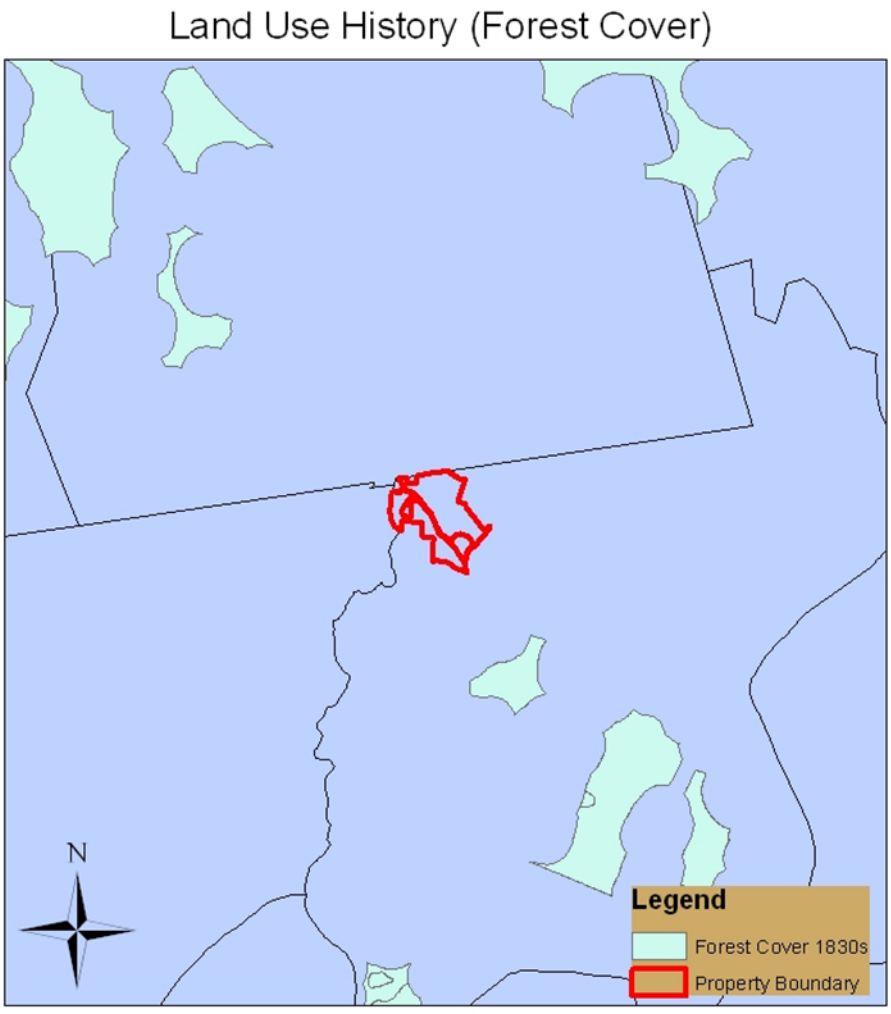


Forests cover more than 60% of Massachusetts, making it the 8th most forested state by percent of forest cover. However, this state has not always been this forested. European settlement in the 18th century removed much of New England's forests, along with wildlife, due to forest clearing, hunting and trapping. New England's wilderness rapidly transformed into a domesticated rural landscape. Within this century, up to 80% of the landscape was cleared for pasture, tillage, orchards and buildings. Whatever woodlands that were left were used for frequent cuttings for lumber and fuel. However, in the mid-1800s, abandoned pastures and fields due to a decline in farming led to the regrowth of forests, and white pines became the dominant species. As white

pines became more and more dominant, they became marketable in the use of 'box boards' for shipping containers. The succession of mixed hardwoods arose due to the clear cutting of the 'old field' white pines. This resulted in much diverse forest types, such as red oak, red maple, white ash, birches, and black cherry, which provided a vast range of habitats for a variety of different wildlife. As these forests continue to grow and mature all over New England, the remaining stonewalls serve as a reminder of the land use history. Now, 70% of the forests in Massachusetts are privately owned, mostly by families and individuals while 19% are owned by the state of Massachusetts.

Western Massachusetts was originally settled by Native American societies. However, in 1635, the first European explorers of who were English Puritans, ventured from the Massachusetts Bay Colony settlement of Boston to the modern site of Metro Center Springfield, Massachusetts. They continued to establish a permanent colony here after being lured by the promise of a 'great river' and New England's most fertile farmland. The Connecticut River Valley consisted of most of Massachusetts' early agricultural settlement since it had and still has New England's most productive farmland. The ancient Lake Hitchcock and the semi-regular flooding Connecticut River provide deposits of fine sediments for these productive farmlands.

Zooming in 95 miles northwest of Boston, 36 miles north of Springfield, and 7 miles east of Greenfield lies the town of Gill. The 1,620 residents populating this town mostly live in single family homes. Gill, which was discovered in 1793, was originally part of Deerfield, discovered in 1753. The district of Greenfield was also a part of this area. The establishment of Deerfield and neighboring settlements were due to Captain William Turner and his troops' victory against the Native Americans that were camped near the Connecticut River falls. The



Turner Falls River running through Gill, which separates is from Greenfield, was named after Captain William Turner. The Town of Gill lies in a wide, irregular bend of the Connecticut River. Its first town meeting was held on December 18, 1793 and was named in honor of Moses Gill, a member of Massachusetts's Executive Council. Moses Gill later became lieutenant governor in 1794 and acting governor in 1799. When Gill died in 1800, the state was left without a governor nor acting governor acting governor for the first and only time in history.

The specific property in Gill being analyzed for a local land inventory consists of 160 acres. These 160 acres of land are filled with esker deposits which are made up of the gravel deposited by meltwater from retreating and decaying glacier ice sheets. The Fall River runs through this property while a road splits the property into two. This land allows for forestry, hunting and fishing, but does not allow for hazardous waste, vehicles nor construction. There is one remaining house on the property, since the other house was knocked down a while back.

Works Cited

"Forest Resources of Massachusetts" handout. Compiled by Paul Catanzaro

"Landscape History of Central New England." Harvard Forest. Harvard University , n.d. Web. <http://harvardforest.fas.harvard.edu/diorama-series/landscape-history-central-new-englan>.

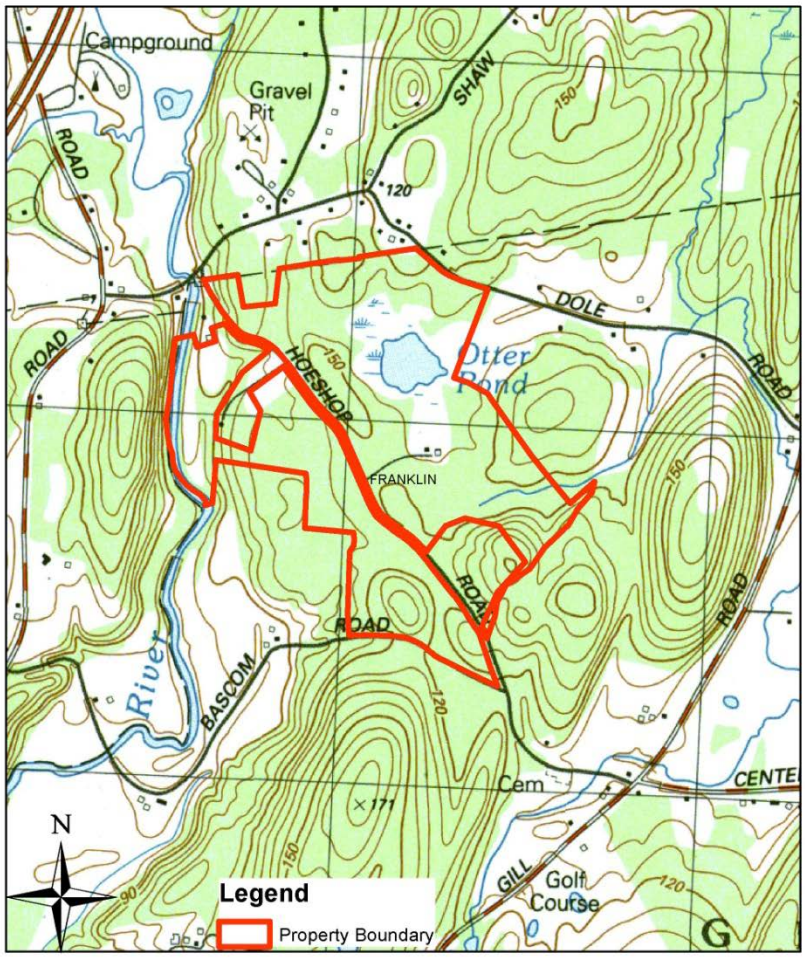
"Official Website of the Town of Gill." Gill, Massachusetts . Town of Gill, n.d. Web. http://www.gillmass.org/about.php

Landuse Context

As of 2005, the town of Gill contains 539 acres of developed land and 6,263 acres of natural land. Agricultural land makes up about 1,693 acres while 308 acres make up the town's open, recreational land, of mostly golf courses. The town of Gill's open water consists of 667 acres. 5.7% of Gill's land is developed while 66.1% makes up the town's natural land. Gill's 17.9% in agriculture puts the town in 8th compared to the rest of the 351 towns and cities in Massachusetts. Gill is made up of a total of 9,474 acres and 15 square miles, ranking them 255 out of 351.

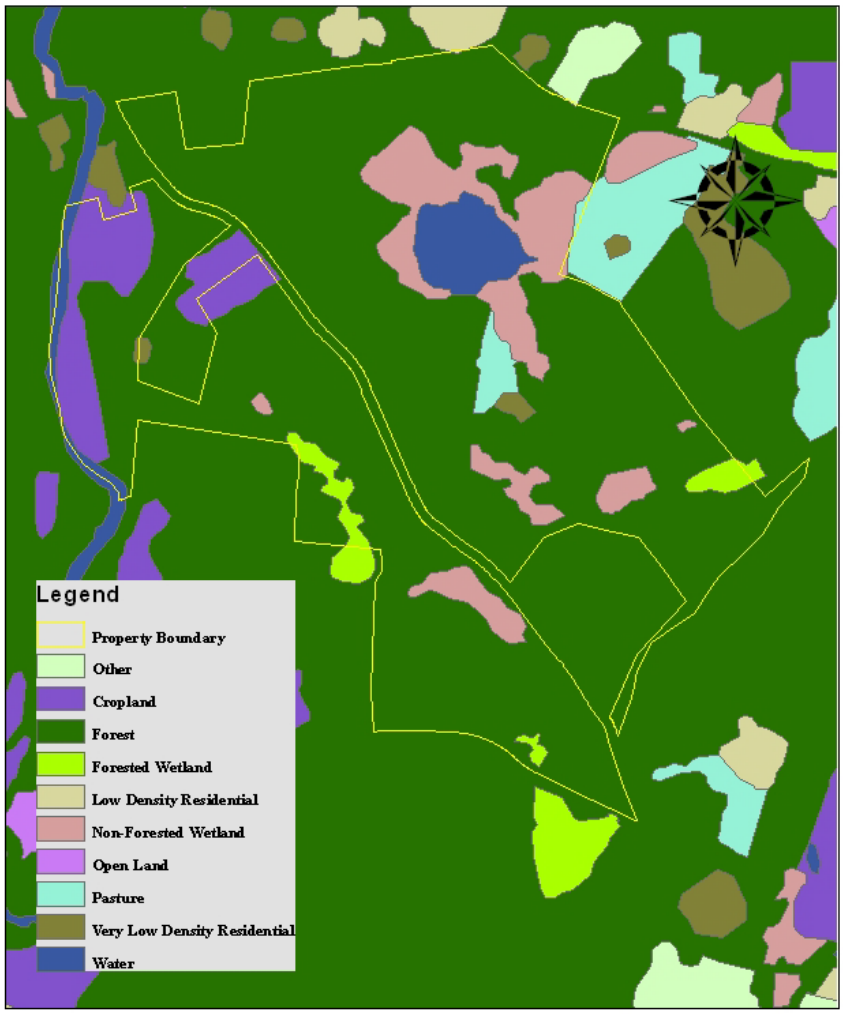
There have been a few changes in land use between 1999 and 2005. The acres of natural land converted to developed land have been estimated to be around 41, meaning that there are 3 acres of development per square mile. In addition, there was a 5.5% increase in the amount of homes built between 1999 and 2005. Due to this increase, the average living area of new homes is now around 1,966. Gill's population in 2000 was 1,362, putting them in the 313th most populated town and city in Massachusetts. Their estimated population for 2007 was 1,379, bumping them up to 314 out of 351. The total acres and square miles remained the same.

Local Context and Topography Map



The town of Gill's overall protected land consists of 882 acres, putting them in 282 out of the 351 towns and cities in Massachusetts. These protected lands are owned by a mix of public and private ownerships. The privately owned agricultural land, except for one parcel, is protected by the Agricultural Preservation Restriction (APR) Program. These restrictions are held by the Massachusetts Department of Agricultural Resources. One parcel is under a Conservation Restriction (CR). The privately owned forested land is protected by conservation restrictions. These restrictions are also held by the Massachusetts Department of Agricultural Resources. The publically owned open space in Gill is owned by the Department of Conservation and Recreation and by the Department of Fish and Game. There are 176 acres of quasi-publicly owned permanently protected open space accounting for about 2½ percent of the total amount of open space with some level of protection. This land is owned by The Nature Conservancy, the Connecticut River Watershed Council, or Mount Grace Land Conservation Trust.

The amount of land protected between 1999 and 2005 includes 516 acres. 20.1% of BioMap Core acres are protected while 1.5% of Living Waters Core are protected. The BioMap Core Habitat layer shows the best habitat for rare species and natural communities in Massachusetts. This layer was made by the Natural Heritage and Endagered Species Program in 2001. In addition, the Living Waters project produced by the same program was made in 2003. This shows the areas that are important for conservation of aquatic resources. These aquatic resources include lakes, ponds, rivers, and streams that are crucial for the protection of freshwater biodiversity in Massachusetts. In comparison, 6.3% makes up the amount of unprotected Living Waters CSW (critical supporting watersheds) that are developed. The protected supporting landscape consists of about 1.8%. The percent of natural land in Gill that is protected is 10.0% while 13.9% makes up the amount of agricultural land that is protected.



The ecological integrity of an area is its ability to support its plants and animals and the natural processes needed to sustain them over a long period of time. Gill's index of ecological integrity in 1971 was 0.44, which was around 4,138 acres. This fell to 0.36, 3,369 acres, in 2005. This makes up an 18.6% loss in ecological integrity during that time period. The ecological impacts of development were measured by running a model used to assess the ecological integrity of lands and waters across all of Massachusetts. This model, the Conservation and Assessment Prioritization System, shows that by conserving intact areas of high ecological integrity, most species and ecological processes can also be conserved. For generating clear results, the index of ecological integrity takes eight factors into account: habitat loss; microclimate alterations; impacts from domestic predators such as cats and dogs; impacts from edge predators such as raccoons, blue jays, and

cowbirds; nonnative invasive plants; nonnative invasive earthworms; connectedness of the landscape; and similarity of each point to the surrounding landscape.

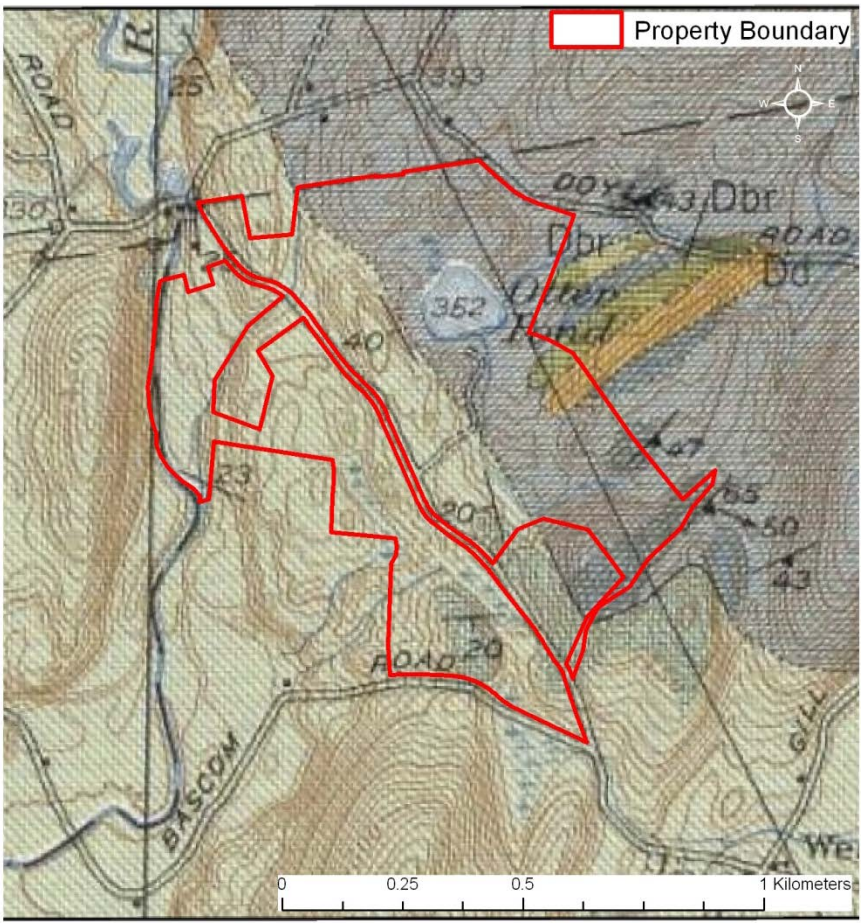
The property itself is made up of Pine and mixed hardwoods in general. The Falls River runs through this property, while it is cut in half by a road. Walking across the road is necessary in reaching the property's two cut parts. There were two existing houses located on this property; however one house was torn down, leaving only one remaining house on the property. A stone wall was found in stand 4, providing evidence that agriculture was indeed a part of this landscape. Abandoned fields are found located along the stone wall and are assumed to be found within the rest of the property, as well. The specific land itself is pretty similar to its surrounding property, which contains lots of forested lands made up of the same Pine and mixed hardwoods in general. In contrast, houses are found on the surrounding land, which makes this specific property unique in that aspect.

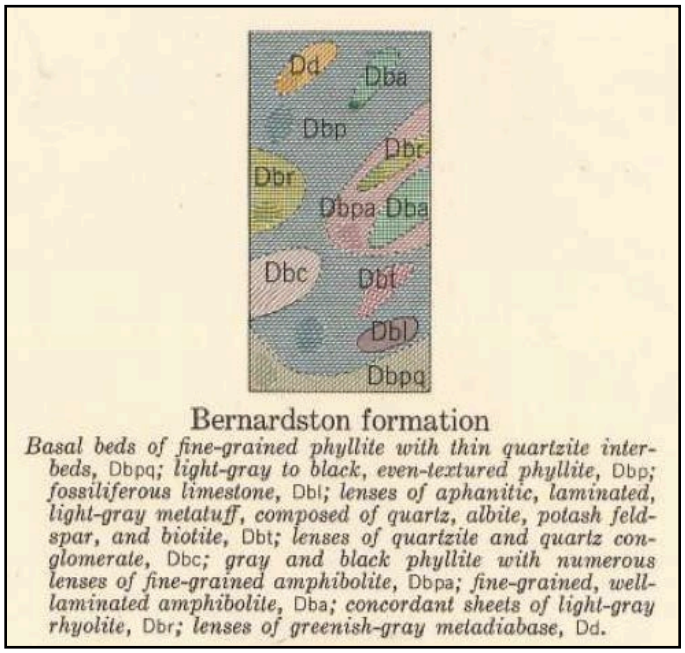
Works Cited

"Mass Audubon; Protecting the Nature of Massachusetts." Losing Ground; Statistics for the Town of Gill . Mass Audubon, n.d. Web. <http://www.massaudubon.org/losingground/stats.php?areaid=106>.

"Town of Gill 2011 Open Space and Recreation Plan." . Gill Open Space and Recreation Committee and Franklin Regional Council of Governments Planning Department , n.d. Web. 2 May 2013. <http://www.gillmass.org/pdfs/OpenSpace/Gill-OSRP-2011-FINAL.pdf>

Geology





Bernardston formation

Basal beds of fine-grained phyllite with thin quartzite interbeds, Dbpq*; light-gray to black, even-textured phyllite,* Dbp*; fossiliferous limestone,* Dbl*; lenses of aphanitic, laminated, light-gray metatuff, composed of quartz, albite, potash feldspar, and biotite,* Dbt*; lenses of quartzite and quartz conglomerate,* Dbc*; gray and black phyllite with numerous lenses of fine-grained amphibolite,* Dbpa*; fine-grained, well-laminated amphibolite,* Dba*; concordant sheets of light-gray rhyolite,* Dbr*; lenses of greenish-gray metadiabase,* Dd.

Sugarloaf formation

Red or gray arkose, grading laterally and vertically into coarse arkosic conglomerate.

The Geology on the West parcel is entirely Sugarloaf formation, a Red of gray arkose, grading laterally and vertically into coarse arkosic conglomerate. The East parcel includes Sugarloaf formation but also includes Bernardston Formation, a light-gray to black, even-textured phyllite; concordant sheets of light-grey rhyolite; lenses of greenish-gray metadiabase.

The Sugarloaf Formation includes all sedimentary strata in the Deerfield basin below the Deerfield Basalt or its projected horizon, consisting of coarse-grained, locally conglomeratic arkose interbedded with siltstone and sandstone (Stratigraphic Notes 1985).

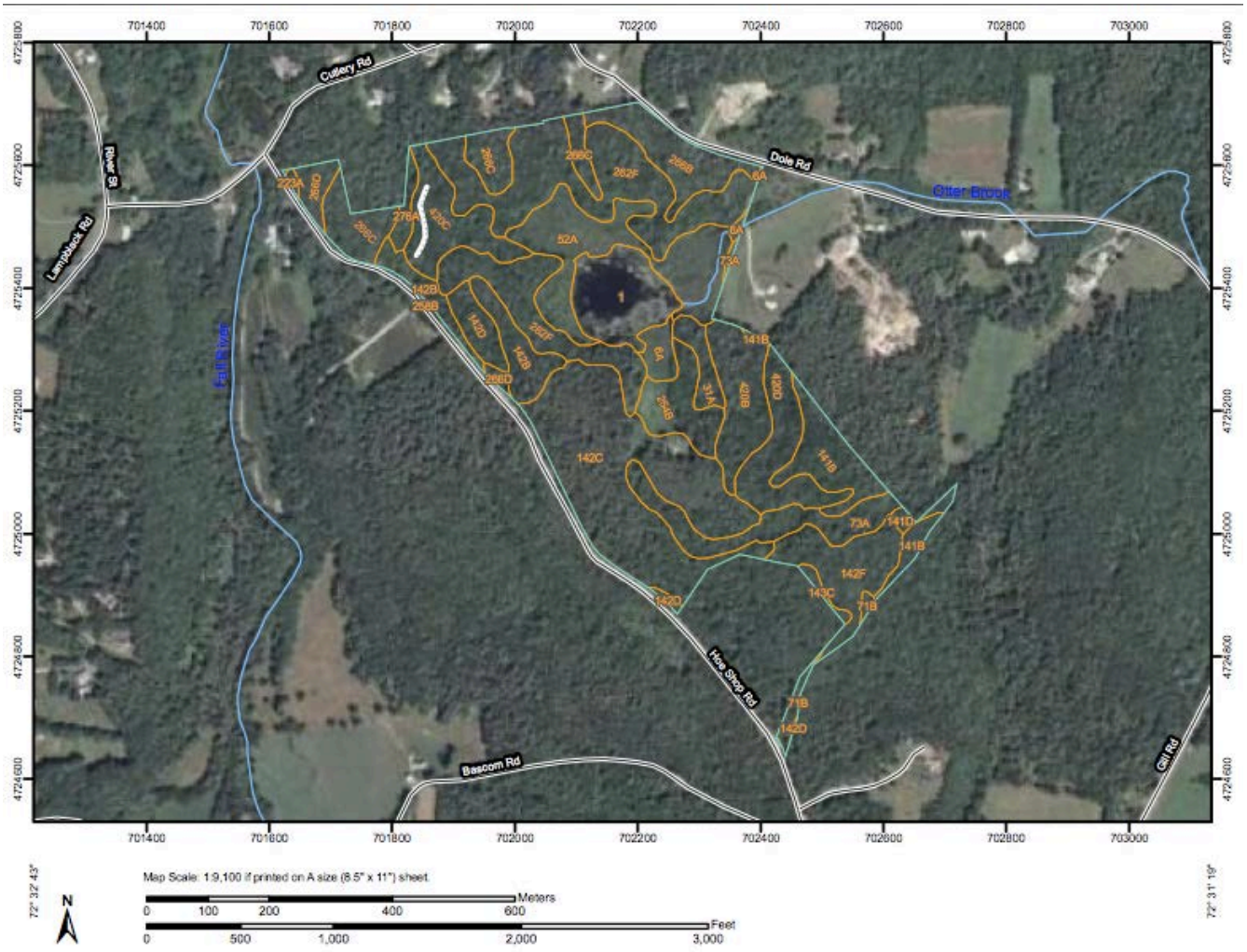
Bernardston Formation spreads over Bernardston and Vernon to the North where it connects with open sea, and to the South to the Connecticut basin as far a Belchertown. Composed of Leydon and source deposits derived quartzite pebbles that have been altered into thick quartzite beds and newly formed mica (Emerson 1917).

Works Cited

Balk, Robert. (1956). Geology Map of the Massachusetts Portion of Bernardston Quadrangle Massachusetts-Vermont Bedrock Geology

Emerson. K.B. (1917). Geology of Massachusetts and Rhode Island. U.S. Government Printing Office

Stratigraphic Notes. (1984). U.S. Geological Survey Bulletin : 1605-A. Supt of Docs, no.: 19.3:1605-A

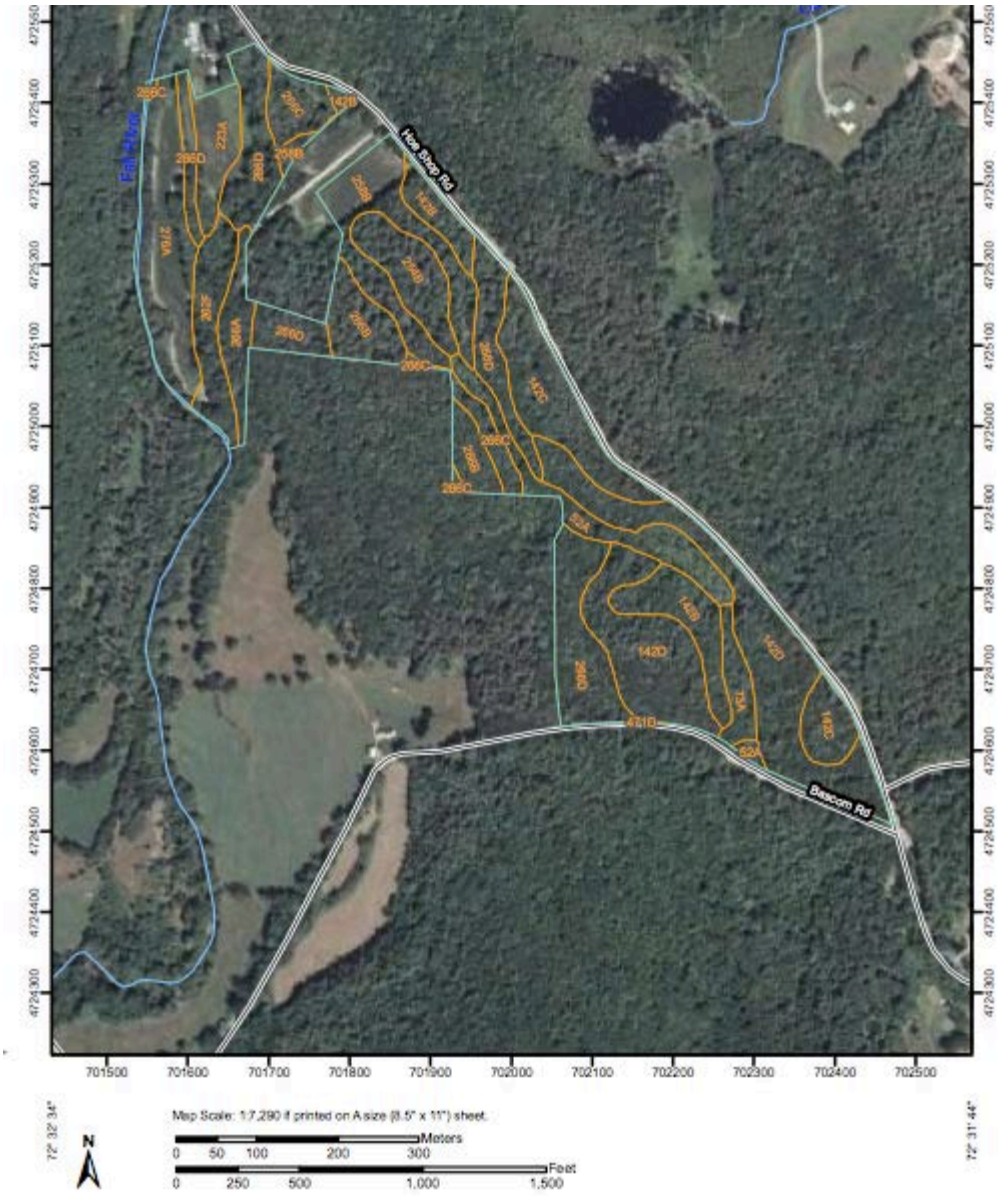


Soils

The soils on the Hoe Shop Road Property. Some soils are exclusive to one side, either West or East, of the property compared to the plot as a whole, and some are described as being on both sides, West and East. The separation of West to East is Hoe Shop Road. Other soils have special characteristics based upon the context of the land type on the surface.

Freetown Woody peat, 0 to 1 percent slopes (52A). Parent material is organic matter. More than 80 inches to bedrock, very poorly drained soils. Depth to water table about 0 to 2 inches. *Hydrologic soil group: C/D. These soils are those that exist in and or around wetland areas on the property. Found on both sides of property.

Cardigan-Kearsarge complex, very rocky (142 B-F). Slopes between 3 and 8 percent are somewhat excessively drained and are 10 go 20 inches to lithic bedrock, while from 8 to 60 percent slope are well drained and are 20 to 40 inches to lithic bedrock. Parent material is loamy superglacial till derived from phyllite and or schist. Depth to water table more than 80 inches. *Hydrologic soil group: C. Found on both sides of property.



Amostown fine sandy loam, 3 to 8 percent slopes (258B). Parent material is loamy glaciaiofluvial deposits over glaciolacustrine deposits. More than 80 inches to bed rock, moderately well drained. Depth to water about 13 to 17 inches. *Hydrologic soil group: C/D. This soil is found on the West side of Hoe Shop Road. Found only on West side of property only.

Warwick channery fine sandy loam, slopes ranging from 0 to 25 percent (266 A-D). Parent Material is sandy gravelly glaciofluvial deposits derived from phyllite. More than 80 inches to bedrock, somewhat excessively drained. Depth to water table more than 80 inches. *Hydrologic soil group: A. Found on both sides of property

Quonset fine sandy loam, 25 to 45 percent slopes (262F). Parent material is sandy gravelly glaciofluvial deposits derived from phyllite. More than 80 inches to bedrock, poorly drained. Depth to water table more than 80 inches. *Hydrologic soil group: A. Found on both sides of property.

Canton fine sandy loam slopes ranging from 3 to 25 percent (420B-D). Parent material is loamy supraglacial till derived from gneiss and or schist over sandy till derived from gneiss and or schist. 18 to 36 inches to strongly contrasting textural stratification, well drained. Depth to water table more than 80 inches. *Hydrologic soil group: A. Found only on East side of property.

*Hydrologic Soil grouping rates refer to soils runoff potential. The soils properties that influence its potential are those that affect the minimum rate of water infiltration a bare soil during periods after prolonged wetting when the soil is not frozen. Properties include: depth to a seasonal high water table, the infiltration rate, and depth to a layer that significantly restricts the downward movement of water (i.e. bedrock). The slope and the kind of plant cover are **not** considered but are separate factors
in predicting runoff.

Map Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	5.2	3.239875389
6A	Scarboro mucky sandy loam, 0 to 2 percent slopes	1.3	0.809968847
31A	Walpole fine sandy loam, 0 to 3 percent slopes	1.4	0.872274143
52A	Freetown woody peat, 0 to 1 percent slopes	11.7	7.289719626
71B	Ridgebury gravelly fine sandy loam, 0 to 5 percent slopes, extremely stony	0.2	0.124610592
73A	Whitman very stony mucky fine sandy loam,0 to 3 percent slopes, extremely stony	5.9	3.676012461
141B	Dutchess-Cardigan complex, 3 to 8 percent slopes	4.5	2.803738318
141D	Dutchess-Cardigan complex, 15 to 25 percent slopes	0.5	0.31152648
142B	Cardigan-Kearsarge complex, 3 to 8 percent slopes, very rocky	7.7	4.797507788
142C	Cardigan-Kearsarge complex, 8 to 15 percent slopes, very rocky	23.3	14.51713396
142D	Cardigan-Kearsarge complex, 15 to 25percent	14	8.722741433

	slopes, very rocky		
142F	Cardigan-Kearsarge complex, 25 to 60 percent slopes, very rocky	4.9	3.052959502
143C	Kearsarge-Cardigan-Rock outcrop complex, 8 to 15 percent slopes	0.4	0.249221184
223A	Scio silt loam, 0 to 3 percent slopes	2	1.246105919
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	5.8	3.613707165
258B	Amostown fine sandy loam, 3 to 8 percent slopes	4.9	3.052959502
262F	Quonset fine sandy loam, 25 to 45 percent slopes	20	12.46105919
266A	Warwick channery fine sandy loam, 0 to 3 percent slopes	1.5	0.934579439
266B	Warwick channery fine sandy loam, 3 to 8 percent slopes	6.9	4.299065421
266C	Warwick channery fine sandy loam, 8 to 15 percent slopes	7.3	4.548286604
266D	Warwick channery fine sandy loam, 15 to 25 percent slopes	11.4	7.102803738
276A	Ninigret very fine sandy loam, 0 to 3 percent slopes	6.2	3.862928349
420B	Canton fine sandy loam, 3 to 8 percent slopes	4.5	2.803738318
420C	Canton fine sandy loam, 8 to 15 percent slopes	4.4	2.741433022
420D	Canton fine sandy loam, 15 to 25 percent slopes	4.5	2.803738318
471D	Dutchess channery silt loam, 15 to 25 percent slopes, very stony	0.1	0.062305296
		160.5	100

Works Cited

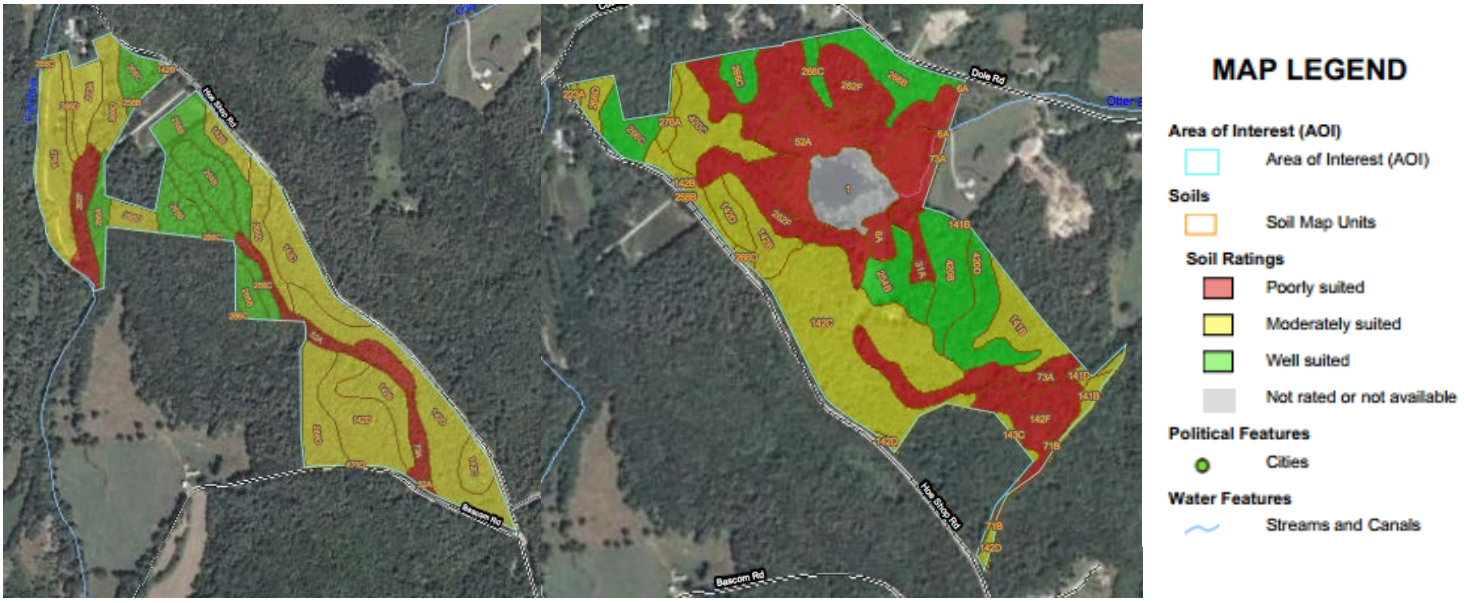
Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. (March 2013) Available online at http://websoilsurvey.nrcs.usda.gov/.

Site Suitability

Harvesting Equipment Operability

Suitability Rating is based on slope, rock fragments on the surface, plasticity index (the range of moisture content within which the soil remains plastic), content of sand, the unified classification of the soil, depth to water table, and ponding when using standard rubber-tire skidders and bulldozers for harvesting and transporting.

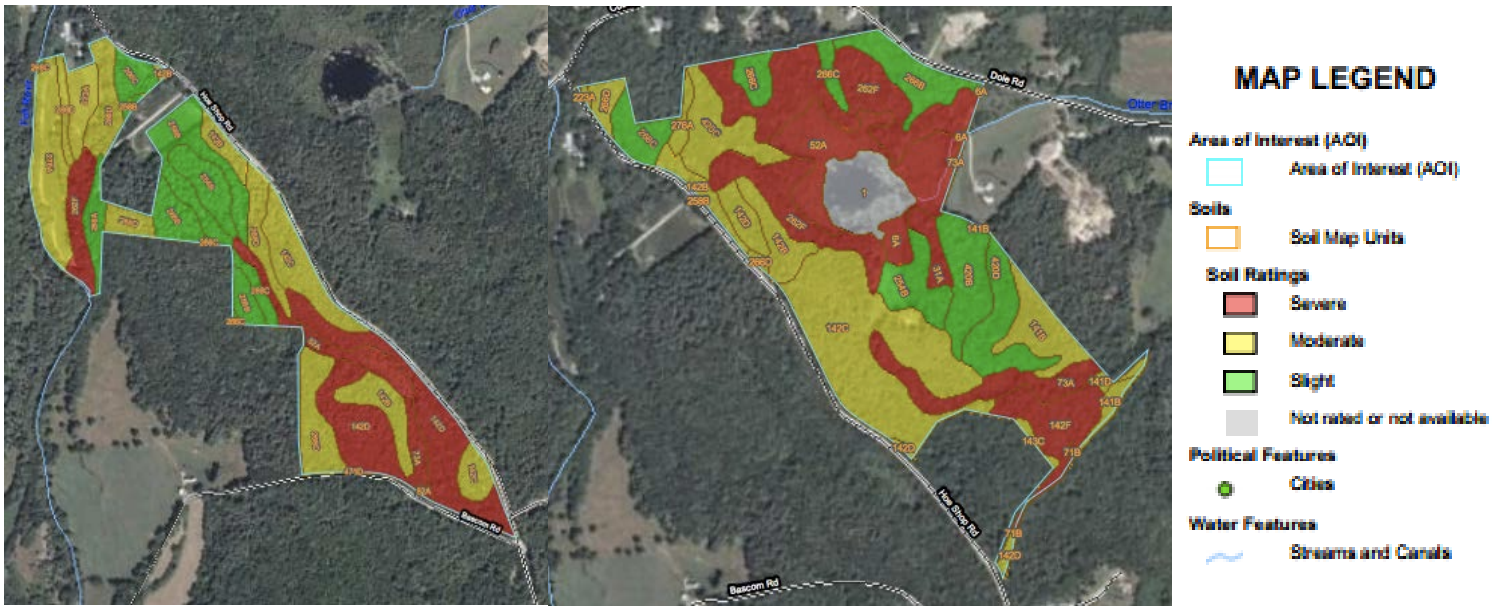
Much of the area is unsuitable or moderately suited. These areas are those that are around Otter Pond, and along the wet areas. Some areas that are suitable are the area that runs along Dole Road, another area South of Otter Pond and a large area abutting one of the building parcels on the East side of Hoe Shop Road.



Log Landing

Suitability Rating is based on slope, rock fragments on the surface, plasticity index, contend of sand, the Unified classification of of the soil, depth to water table, and ponding when using standard rubber-tire skidders and bulldozers for harvesting and transporting.

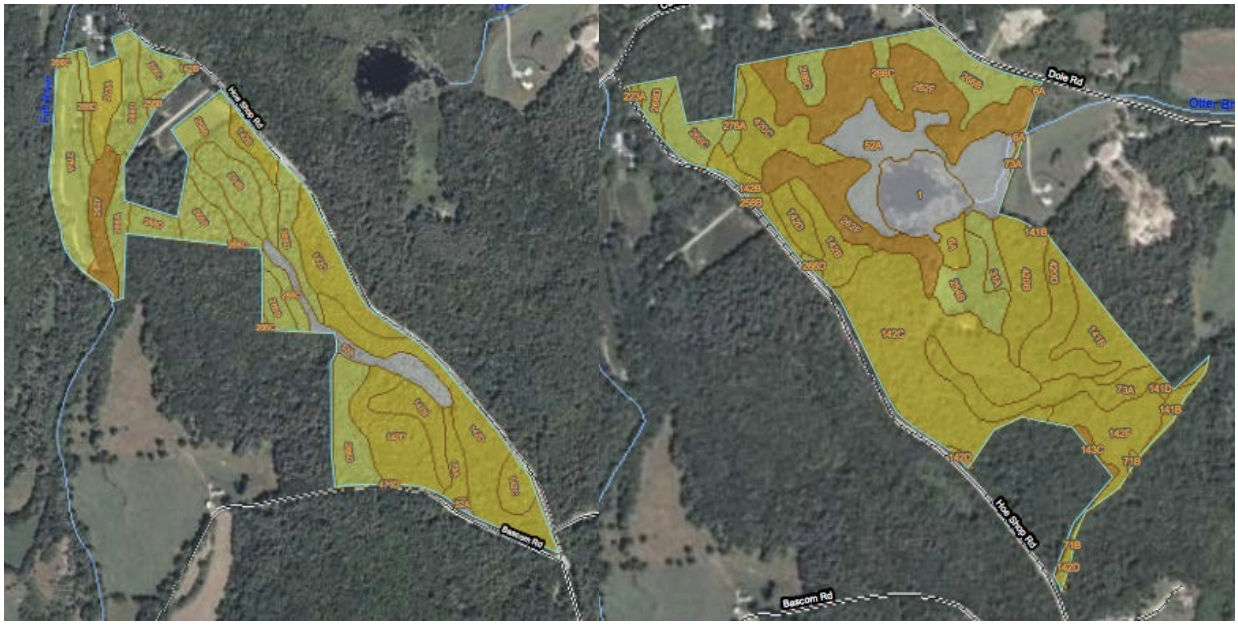
Areas suitable and practical for a log landing would ideally be near a road for loading trucks. There are two areas that have no significant limitations to construction activities: Northern most reach of property that abuts Dole Road (4.0 acres), West of that area abutting Hoe Shop Road (4.8 acres).



Tails and Paths

Much of the area is not rated through the USGS report. Especially around the wetlands, there is no available information. The Quonset fine sandy loam is the soil that is very limited, (20.2 acres) while the other classes are somewhat limited to not limited.

Soil Chemistry



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- Ultra acid (ph < 3.5)
- Extremely acid (pH 3.5 - 4.4)
- Very strongly acid (pH 4.5 - 5.0)
- Strongly acid (pH 5.1 - 5.5)
- Moderately acid (pH 5.6 - 6.0)
- Slightly acid (pH 6.1 - 6.5)
- Neutral (pH 6.6 - 7.3)
- Slightly alkaline (pH 7.4 - 7.8)
- Moderately alkaline (pH 7.9 - 8.4)
- Strongly alkaline (pH 8.5 - 9.0)
- Very strongly alkaline (pH > 9.0)
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

pH

Areas without rating are small and include freetown wood peat around Otter pond and on the East side of Hoe Shop Road by the long wetland. The soils are acidic on the site ranging from 4.8 to 5.9pH. This is indicative to the vegetation that is found on the site: white pine, American beech & red oak.

Watershed Context

This property borders the Fall River, a tributary of the Connecticut River and part of the larger Connecticut River Watershed, which extends from Vermont down to Rhode Island and the Long Island sound. The Connecticut River watershed supports many wildlife and fish species, including some threatened species. It provides drinking water, hydroelectric power, and recreation to human populations that live in the region. The northern reaches of the watershed are less populated with nearby lands dominated by farms and forests. In the south, on the other hand, more densely populated cities create a larger influence on the rivers' ecosystems. For fish that are diadromous, this means there are many barriers to overcome in order move between the marine environment in the south and, in the case of anadromous fish, to optimal spawning habitat in northern high quality tributaries such as the Fall River.

The Fall River is a 10.2 mile long tributary that joins the Connecticut River just above the town of Turners Falls. The Massachusetts Division of Watershed Management (MA DWM) sampled the fish community upstream of Bascom Rd in Gill in 2003. They found seven fish species including blacknose dace, slimy sculpin, longnose dace, Atlantic salmon, brook trout, creek chub, and pumpkinseed. While many of these species are considered pollution tolerant, a concurrent habitat assessment scored this section of the Fall River as "optimal" habitat, the best score out of six stations sampled in the Connecticut River Watershed. Presence of slimy sculpin, brook trout and Atlantic salmon, which are heat intolerant species, allowed the river to be classified as a Cold Water Fishery (Connecticut River Watershed [PC1] Water Quality Assessment Report 2003). Concerns in this section of the Fall River, according to DWM, include abbreviated, "marginal" riparian zones due to farming fields along the river, and bank vegetative protection and bank stability.

High gradient, high velocity streams, tend to erode vertically creating a steep-sided, deep channel. This section of the Fall River is a higher gradient stream, so some bank erosion is expected at times of higher flow, particularly in the spring. However, excessive siltation and eroded sediments negatively affect fish habitat, a problem that is occurring in many rivers in the country. Waters that have high concentrations of suspended material due to erosion tend to have lower concentrations of dissolved oxygen, an essential factor for the survival of fish and other stream biota. Increased sediments in the water increase turbidity which limits the amount of light that penetrates the water column and reduces photosynthesis and plant production. When sediments settle onto spawning substrates (cobble and gravel for trout and other cold water fish), egg and larval

mortality increase. Production of aquatic insects and invertebrates can also be reduced by excessive sediments, which then limits food for fish species.

Riparian zones along rivers are important because they help to prevent many of the aforementioned problems. In riparian zones, root systems of vegetation along river banks stabilize soils to reduce erosion, they contain canopy trees that help maintain shade and cool temperatures in the water, and they aid in filtering out runoff of sewage, agricultural nutrients, herbicides and pesticides, and other chemicals of human sources. Thus, it is important to consider the land around the river when evaluating the state and value of the river itself.

Until about 10 years ago, the Fall River supported migration runs of blueback herring (Slater 2013). The river is sometimes stocked with recreational fishes including rainbow trout. The last stocking of Atlantic salmon will occur in the spring of 2013. The Salmon Stocking program was impacted by the 2011 storms associated with Hurricane Irene and has otherwise been largely unsuccessful is re-establishing salmon (Slater 2013). While some juveniles may be seen in the Connecticut and Fall River in the next year, it is expected that natural reproduction will not occur and salmon will disappear from the system in the near future.

Wetlands are lands in the transition zone between terrestrial and aquatic systems. They are either covered in water or are saturated with water at least part of the year. Rivers and ponds without deepwater habitats are also considered wetlands. Wetlands on the conservation land are typical of inland New England, the majority of them being forested or shrub-dominated wetlands. In general, they can be expected to support a variety of amphibians and reptiles, waterfowl, birds of prey, small mammals, and larger animals such as deer, bear, and coyote. Otter pond may support warmer water fish species such as bluegill and pumpkinseed.

A portion of the western boundary of the property is bordered by the Fall River. This part of the property contains one small stream and another smaller seasonal, spring fed stream that join together and feed into the Fall River. The larger stream is labeled just “brook” on the assessors map. The west tract of the property has two relatively large wetlands, which were surveyed and two smaller wetlands, which were not surveyed. In the Eastern tract lie Otter Pond and its adjacent wetlands, which will be referred to as the Otter Pond complex. To the southeast of the pond are three more relatively large wetlands, which were surveyed, and one smaller wetland, which was not surveyed.

Wetlands and Riparian Area Survey Methods

We surveyed the riparian area long the Fall River and the Otter Pond and surrounding wetland using the Detailed Wildlife Habitat Evaluation produced by the Massachusetts Department of Environmental Protection Wetland and Waterways Program (2006). A copy of this evaluation and field data form can be found in appendix A. First, we quickly walked each of the survey areas noticing as much wildlife sign and potential habitat as possible. At the end of the initial surveys, we took some general field notes about the area. Then, we went back to each site a second time, and using the standardized field data form, we completed the habitat evaluation (the second evaluation generally took from several hours to half a day). This was done by filling out each of the sections on the field data form as completely as possible. Data collected included: dominant plant species; important habitat features such as number of trees, standing dead trees and cavities; presence of burrows, covers, perches, denning and nesting habitat; connectivity and habitat continuity with adjoining habits; and signs of habitat degradation. When the survey was complete for each area, we compiled a written interpretation and summary of the reports, found below, to make it comprehensible to the public.

For the riparian area survey, noted the size of the buffer zone, bank vegetative protection and bank stability as these were concerns mentioned in the DWM 2003 Water Quality Assessment Report. As we surveyed the Fall River and riparian area, we also used a field data form called the Citizens Qualitative Habitat Evaluation Index (found in appendix B), developed by the Ohio Evironmental Protection Agency, as it serves a quick way to take notes on the characteristics of a river and produces a rough estimate of habitat quality. This is a form that could be used to repeat a river survey in the future to compare habitat quality in relative terms over time. Notes taken using this form are described below in the Fall River discussion.

Additionally, we visited each of the smaller wetlands on the property using the wetlands maps from the Massachusetts GIS website. We classified each of these wetlands using the Cowardin Classification System and noted interesting features and points of concern. The Cowardin system classifies wetlands hierarchically from general Systems and Subsystems to more specific Classes, Subclasses and Dominance Types. The major Systems are the palustrine(the marine (ocean and adjacent shores), estuarine (brackish waters and estuaries), riverine (rivers), and lacustrine (lakes) systems. For example, the Fall River would be classified in the following manner:

System: Riverine
Subsystem: Upper Perennial *(high gradient, swift, year-round flow)*
Class: Unconsolidated Bottom *(25% or more cover of particles smaller than stones)*
Subclass: Cobble-Gravel *(majority of substrate that covers the bottom)*

Dominance Type: Caddisfly *(dominant plant or animal species)*

Classifying wetlands helps us to understand the physical nature of the wetlands, the environmental conditions that help create and control them, and the plants and wildlife we can expect to see throughout the year. It can also help us to understand the functions and values wetlands provide. For instance, a certain type of wetland may have a high capacity for storage of flood waters and another might do an excellent job of filtering waste or toxic materials out of the water, while another might provide habitat for an endangered migratory bird.

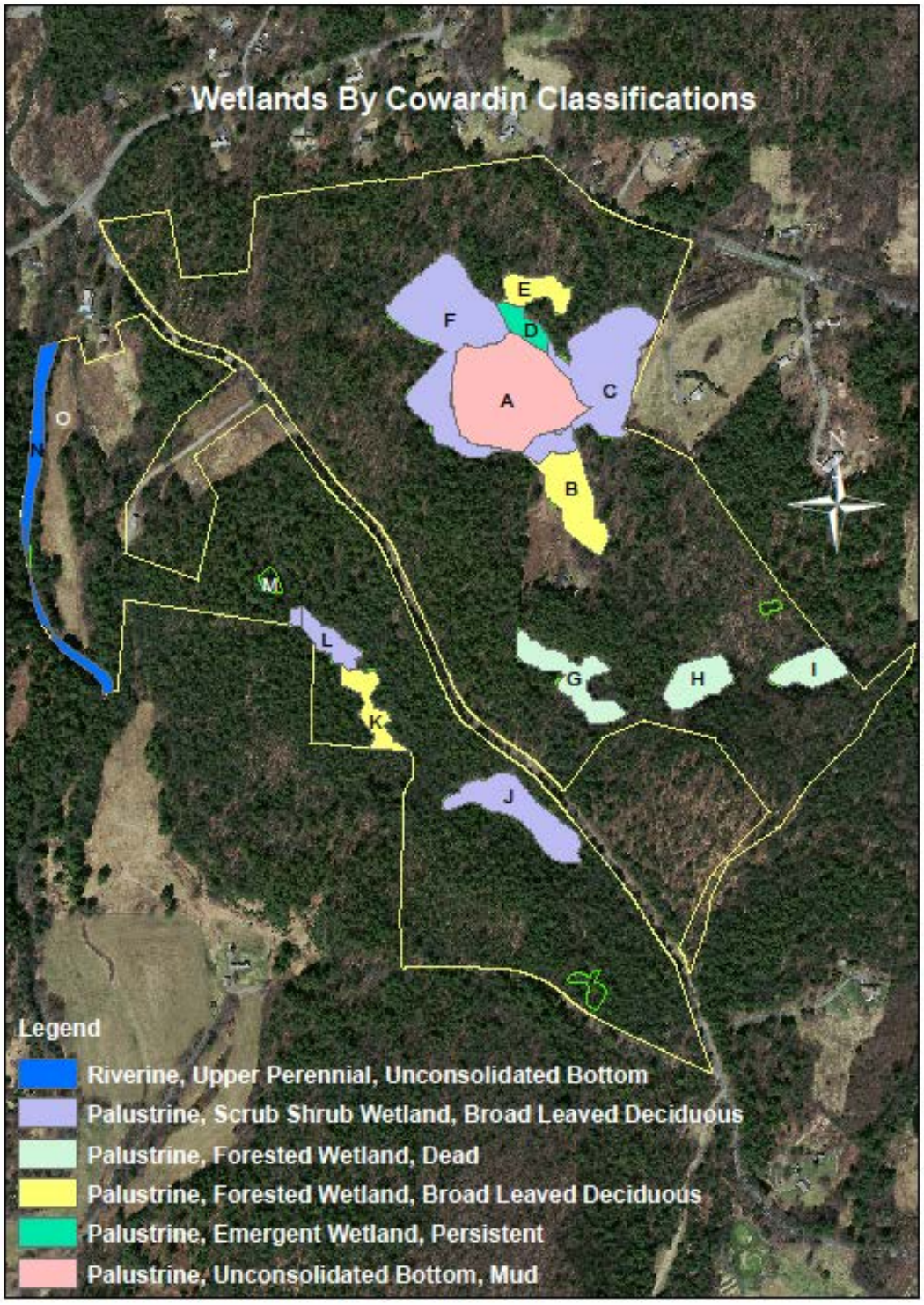
All of the wetlands visited were classified using the Cowardin system and a map was created labeling to show each of the different wetland types. This map can be found on the following page. The colors represent the distinct Cowardin Classifications and the letters are assigned to make discussion of the areas easier.

Otter Pond Complex

A view of Otter Pond in early spring

We surveyed Otter Pond using the aforementioned Wetlands Wildlife Habitat Evaluation. While there were several different types of wetlands, we used one form for the entire Otter Pond and adjacent wetlands complex. Then, we classified all of the wetland types in the complex and took individual notes of observations

within each. We used this information to create a wetlands map that highlights the distinct wetland types (see Elyse's map). Otter Pond and its wetlands are described below.



Under the Cowardin Classification System, Otter Pond and its adjacent wetlands are part of the Palustrine System, which includes wetlands that are commonly called marshes, swamps, bogs, fens, and prairies as well as smaller water bodies such as ponds. Wetlands in the complex were of the classes unconsolidated bottom, forested wetland, scrub-shrub wetland, and emergent wetland. These wetlands and their classification are further described below.

Area A: Otter Pond. Otter Pond is located on the East Tract of the conservation land. The pond itself is about 300 ft across with an area of approximately 63,000 m^2Size, depth. It is classified as an unconsolidated, mud bottom wetland. Seen on the pond on 4/10/13 were: two male and female pairs of wood ducks, two males and one female ring-billed duck, five Canada geese, and a painted turtle.

Dense shrubs in area E

Area B. This is mostly a forested, broad leaved deciduous, red maple-dominated wetland with shrubs dominating on the pond's border. It is bordered to the west by a small grassland. Moss dominates the ground cover on the eastern side where a mud bottom stream runs toward the pond.

Area C. A scrub-shrub,broad leaved deciduous wetland. An outflow of the pond with a deep channel but low velocity flows eastward out of the pond. There is a cattail bed in this area near the pond's edge. The northeastern side of this area is more open and contains more emergent vegetation and fewer shrubs than the rest of the area. Spring peepers were heard calling here.

Area D. This is an area of persistent emergent wetland with a cattail bed and grasses. There is also a bed of invasive phragmites.

Area E. This area lies to the north and north west of the pond. It is the area of the densest shrubs. At least three different species of frogs were heard calling here, dominated by spring peepers.

Dead forested wetland, area I

Otter Pond Associated Wetlands

In the height of the hydrological season, wetlands G, H, and I are connected by running water flowing westward. Water flows out of area G into Otter Pond via a small stream. There is a culvert in this stream at the Gravel

Road crossing. The amount of water flowing between these wetlands is not enough to pass fish and the connection is probably only seasonal.

Area G. This is a dead, forested wetland that drains at least part of the year through a stream into Otter pond. The upland areas around the wetland are conifer dominated. There were wood frogs and many spring peepers calling here.

Area H. This is a dead, forested wetland with less vegetation and a greater percentage of dead trees than seen in area F. Few spring peepers were heard here. Three wood ducks were seen in the wetland.

Area I. This is a dead, forested wetland. Grey tree frogs were heard calling here.

Fall River and Riparian Area

Fall River, area N

Area N: Fall River. This is a 1,600ft long section of the Fall River. It is classified as a riverine, upper perennial, unconsolidated, cobble-gravel wetland. This river section is on average approximately 45ft wide with the deepest pools being about waist deep. It has a variety of flow types, including very fast, fast, moderate and slow flow that would allow for a number of macro invertebrate and fish species to use the area. It has riffles and runs that are at least knee deep and fast, adding to the quality of habitat. Smothering and silting on the bottom, signs of excessive erosion, were not observed. The water was clear and would not be considered turbid at the time we observed it. The gravel-cobble substrates are ideal for cold water fish spawning areas, while the larger rocks help to create riffles and areas for cover. Fish cover is abundant throughout this section of the river and includes the following features: large and fine underwater tree roots, downed trees, logs and branches, shallow slow areas for small fish, water plants, undercut banks, and overhanging shrubs and small trees. This portion of the

Bank erosion along Fall River

river can be considered mostly unaltered, lacking significant man-made changes. Out of 110 points on the Citizens Habitat Evaluation Index, the river in area N scored 96 points, rating it high quality.

Unidentified fry were observed in a slow, shallow area of the river as well as in the stream that drains into the river. Caddisflies were observed in abundance in the river.

Area O: Riparian Area and Upland. The width of the forested riparian area along the eastern bank of the Fall River averages 40-50ft before it becomes field. The western bank of the river, in the town of Bernardston is uninterrupted forest and is very steep. Some erosion is occurring on banks on the Gill side of the river, however, there are several large areas of bank erosion on the Bernardston side.

Other Wetlands

Areas K & L. The northern end of this approximately 80,000 sq. ft. wetland is a shrub-scrub broad leaved deciduous wetland, called area L. It is contiguous with wetland K. Mountain laurel is abundant. Area K is a forested wetland at the. It is red maple dominant with mountain laurel, sphagnum moss and skunk cabbage abundant. Sphagnum hummocks could provide habitat for four-toed salamanders.

Forested wetland, area K

Area J. This is a scrub-shrub wetland with many standing dead trees. A barred owl was heard calling here.

Area M. This small wetland is listed as a potential vernal pool on the Massachusetts wetlands maps. It was not surveyed.

Wetland Wildlife Habitat Evaluation

Food plants: hard mast and berry producers. The Otter Pond complex has abundant hard mast and fruit and berry producing trees and shrubs which provide food for many wildlife species. Blueberries are particularly abundant along the northern and eastern side of Otter Pond from areas F to C. Area O contains hard mast producing trees. Bear scat, full of seeds, was found along the bank of the Fall River.

Standing dead trees in area G.

Live or dead trees > 30 dbh (diameter at breast height). Large trees provide large cavities, whether or not they currently have cavities, they may provide habitat as cavities form in the future. They can serve as dens or food caching sites for large wildlife species, including black bear, otter, fisher, mink, and raccoon. They may be used by nesting wood ducks, hooded mergansers and barred owls. Both wood ducks and barred owls were observed in the Otter Pond area. These taller dead trees near water may also provide perches for birds of prey. There were approximately 20 trees >30" dbh in the riparian area along the river.

Standing dead trees. The Otter Pond complex has many standing dead trees from 6in. diameter at breast height (DBH) 24in. However, the greatest number and density of standing dead trees are found in the dead forested wetlands in areas G, H, and I. These three wetlands were likely created by beaver impoundment and they can currently offer a tremendous amount of habitat to wildlife species. Wood ducks, for example will nest in large cavities (often found in large standing dead trees) up to a half a mile away from open water. Indeed, wood ducks were observed both in Otter Pond and in area H. Standing dead trees were also abundant in area J. Along the Fall River riparian area, some standing dead trees of varying sizes were observed.

Tree cavities. Small cavities provide habitat for tree swallows, saw whet owls, screech owls, bluebirds and other songbirds. Larger cavities are sufficient for hooded mergansers, wood ducks, common goldeneye, common merganser, barred owls, mink, raccoon and fisher.

Small mammal burrows. Small mammal burrows were observed throughout the Otter Pond complex as well as along the Fall River in area O.

Dense herbaceous cover. Some areas of dense herbaceous cover and large woody debris were present in the Otter Pond complex that would support voles, small mammals, amphibians and reptiles. The grassland adjacent to area B likely supports many small mammals. A Northern water snake was observed at the edge of the grassland. Dense herbaceous cover is also abundant in area O, upland of the river.

Northern Water

Rocks, crevices, logs, tree roots, or hummocks under the water's surface. Turtles, snakes, and frogs benefit from rocks, crevices, logs tree roots and hummocks under the water's surface that can be found in abundance in the wetlands adjacent to the pond. These features are present at Otter Pond and along the Fall River.

Rocks, crevices, logs, overhanging branches, or hummocks at, or within 1 m above, the water's surface. This provides basking sites for frogs, water snakes, and turtles and cover for wood ducks. A painted turtle was observed basking on a log near the northern edge of Otter Pond in area A. Along the waters' edge, green herons, mink, and raccoons will use these types of structures to access the pond for foraging. Rocks, crevices, logs and overhanging branches were present along the Fall River.

Live or dead standing vegetation overhanging water or offering good visibility of open water. Birds that hunt for fish or insects use this kind of habitat. These include osprey, kingfisher, flycatchers and cedar waxwings. The trees along the banks of the Fall River are good sites for kingfishers, flycatchers and cedar waxwings.

Depressions that may serve as seasonal (vernal/autumnal) pools. These are important breeding areas for amphibians. Spotted turtles, wood ducks and many invertebrates rely on vernal pool habitat. Areas H and M were listed on the Massachusetts GIS wetlands map as potential vernal pools. While we did not have enough time or information on the site to confirm the status, we did hear wood frogs (a vernal pool obligate) calling in area G during breeding season. Areas G, H, and I all contain a significant amount of standing water in the spring season. We did not visit area M.

Standing water present at least part of the growing season. As standing water is present around Otter Pong during the growing season, the complex is suitable for use by breeding and non-breeding amphibians, turtles, and foraging waterfowl. However, amphibian breeding may be limited by the presence of fish in the pond.

Large/medium flat rocks within a stream. These rocks provide habitat for stream salamanders. Some large and medium flat rocks were present in the Fall River, but high velocity may deter some salamanders from using them as cover.

Flat rocks and logs on banks or within streambeds. Logs on banks, which provide nesting habitat for northern dusky salamanders, were present along the Fall River.

Top: Japanese knotweed emerging in spring.
Bottom: Partially blocked culvert in area C.

Undercut or overhanging banks. Undercut banks provide cover for small mammals and small mammal predators such as mink and weasel. Some areas of undercut bank were present along the Fall River.

Habitat continuity and connectivity. Otter pond is part of a wetland complex that is at least 10 acres in size that includes, scrub-shrub, forested, and emergent wetlands, and vernal pools. Diversity of wetlands in an area means that the needs of many wildlife species at different life stages can be met within a small area. Collectively, these wetlands provide habitat for a broader range of species than a stand-alone, single class of wetland would. In addition, the wetlands and this conservation land in general have numerous connectors to adjoining natural habitats.

Habitat degradation. Section D has a bed of invasive phragmites growing in it. The banks of the Fall River have several colonizations of the invasive Japanese knotweed.

There are culverts inhibiting the natural inflow (out of Area G) and outflow (in Area C) of the pond. When we visited, the outflow culvert was partially blocked by debris (see picture). The abutter on the east side of the pond mows the lawn right up to the property boundary, which likely does not extend far into the hydric area of the wetland, but the reduced vegetation may cause an increased flow of lawn care products or fertilizers into the wetland.

Horse-riding was observed on small paths along the Otter Pong wetland perimeter. At this small scale (3 riders observed on one day), horses are not likely to be a threat to the wetland. However, large numbers of horses or frequent trail rides can lead to increased nutrients from feces running into the wetlands. Excessive horses riding, like intense hiking pressure and ATV use, can also lead to soil erosion which destroys habitat and leads to increased sedimentation into aquatic systems, impacting aquatic organisms.

Wetland and River Management Recommendations

Invasive species. Two invasive plant species were positively identified during the wetland surveys. Japanese knotweed was present in many places along the bank of the Fall River. Phragmites was present in area D of the Otter Pond complex. We recommend exploring the options available to remove these plants and contain the invasion. Removal will ensure that the integrity and diversity of the ecosystems is maintained. Once invasives are removed or otherwise controlled, the area should be monitored for regeneration and new invasions.

Erosion. We recommend that the banks of the Fall River be periodically monitored for excessive erosion. If it becomes clear that the banks are eroding to a large degree, tree and shrub plantings could be done in the riparian zone to help stabilize banks. In areas where erosion is prevalent, it is common practice to keep walking trails back away from the edge of the bank so as not to further disturb vegetation and contribute to erosion. This may be something to consider when permanent trails are created for public use.

Culverts. The culvert at the outflow of Otter Pond (area C) was partially blocked by debris at our visit. If it became fully dammed it could wash out the driveway leading to the private property to the east. While this culvert alters the natural flow of the stream out of the pond, it is not clear that removing it would have a significant impact on wildlife as the stream is unlikely to support fish. This might be a matter to explore further in the future. We would recommend keeping this culvert free of debris.

While it is not often the case in reality, the Massachusetts Division of Ecological Restoration recommends that culverts span the stream and banks to at least 1.2 times bankfull width (the width of the bank when it carries its maximum amount of water). The culvert at the gravel road is narrower than the ideal. This culvert could be replaced with a wider one or could be removed if vehicle access via the gravel road is no longer necessary. We recommend that you consult the Massachusetts Stream Crossings Handbook for more information on culverts.

Recent beaver activity in area C

Things to consider

Vernal Pools. If certification of vernal pools on the property is desired, a new online system developed by the Massachusetts Natural Heritage and Endangered Species Program could be used by volunteers to complete the task. It is located at this web address: http://www.mass.gov/dfwele/dfw/nhesp/vernal_pools/vernal_pool_cert.htm. The areas that are potential vernal pools are areas H and M as well as G, where wood frogs were heard calling during the breeding season.

Beavers. Beavers play an important role in shaping wetland ecosystems. The nature of beavers is to chew trees that eventually fall down and dam up a wetland, causing it to flood and create better denning and feeding habitat for the beavers. Beaver dams sometimes cause large areas of land bordering a wetland to flood, which can lead to conflict with humans when roads and personal property are washed out.

Otter Pond and nearby wetlands show signs of past and present beaver activity. At our visit, the pond had three beaver dens within it, though it was not clear how many of these were inhabited. In the west side of the pond in area F, many stumps and trees felled by beavers were present. On the opposite side of the pond, in the north section of area C, there was sign of recent beaver activity in the form of felled and chewed trees. The three dead forested wetlands were most likely created by a beaver damming up a small stream, causing depressed areas to flood and trees to die off. This created some highly valuable habitat features including a vernal pool and significant habitat for cavity nesting birds, including wood duck, and other animals.

Beavers are unlikely to be a threat to human property in this area unless they dam up the area near the culvert in area C and cause the road to wash out. Our view is that beavers are an important part of this wetland and should be allowed to naturally carry out their activities unless a real threat to private property becomes apparent.

Conclusion

The wetlands on this conservation land provide a diverse range of habitat that can support a large variety of New England wildlife species. Overall, the wetlands and river are of high quality and are in very good condition, showing few signs of disturbance. These wetlands can provide numerous opportunities for education and wildlife viewing, however, care should be taken to minimize any human impacts on the natural ecosystem.

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Methods for Wildlife Survey

To better prepare ourselves for what kind of wildlife to expect to possibly find on the Gill property, we first looked through the *New England Wildlife book; Habitat, Natural History, and Distribution* by DeGraaf and

Yamasaki. After compiling a short list of common birds, mammals, reptiles and amphibians, which could be found on the property, we began to think of ways to best detect what really is on the property.

In order to evaluate what animals use this property, we have decided to use track boxes, camera traps, and tracking. Track boxes area a small rectangular box big enough to allow a raccoon size animal to walk in. It has an opening on one side and metal mesh on the other. Cocoa powder was sprinkled in the front at the entrance of the box and sticky paper was placed towards the end near the mesh. Chicken gizzards were placed in the inside of the box near the mesh. This way, as the animal walks into the box to get the chicken gizzards, its paws get covered in cocoa powder and the prints will show up on the sticky paper. The camera traps (fig. 1) are small digital cameras that are able to take color photographs in the day time and at night using a hidden flash. They are strapped to a tree about knee high off the ground and a lure is smeared about 5ft in front of it to attract animals. The locations for placement of track boxes and camera traps where selected at random, though keeping in mind the different habitats on the property.

We placed two track boxes out at the same time in different location and would move them to a new location once a week, changing the sticky paper every time. The track boxes contained cocoa powder at the entrance followed by a sheet of sticky paper (where the paw prints will be collected) and at the end of the box chicken gizzards to attract the animals. We then analyzed the prints on the sticky paper using the *Mammal Tracks and Scat; Life-Size Tracking Guide* by Levine and Mitchell. Using the track boxes we were able to detect the medium to small size animals (mainly mammals) that were passing through the location of where the box was at the time. A record was kept of the GPS location where the track boxes were placed, type of environment of the location, the date they were place and moved, and the different prints seen.

To view possible larger mammals and birds that may be using the property, we used four camera traps and moved their location about every 14 days. The cameras were secured to a tree and “Badland Bob’s” lure was smeared about three to four feet in front of the camera (on tree branches and/ or ground). We made sure that there were no overhanging branches or small trees in front of the camera that would cause the camera to be set off without any wildlife present. The batteries were checked every time the cameras were moved. Before moving the camera, we downloaded the pictures that were taken from that particular spot and reset the memory card. A record was kept of the GPS locations of each camera, the environment type and condition, the date the camera was placed and removed, and the wildlife that was seen and at what time.

At every visit to the property, we searched for tracks, scats, and other signs of wildlife (such as remains of a meal, feathers, clutches of fur, and marks on trees). We would then examine what we saw and record it along with the location. We also would take a photograph for better analyzation and confirmation with fellow group mates.

To get a better understanding of what mammals actually use the property, we compiled the data collected and analyzed it. We searched for which animal was seen most often and when and which animals

were rare. We also took into account possible errors that could have occurred or seasonal conditions that would skew our data. We then compared our findings to what we expected to find.

Results

Using the program NEWild we were able to input the forest and wetland habitats that we have determined for this area and the program determined which animals we would most likely find in each habitat type. The program suggested (insert results here)

There was some success in capturing wildlife using camera traps. There was a wide range of animals using the area such as opossums, raccoons, white tailed deer, coyotes, squirrels, and skunks. We also detected people and dogs using the property. Deer were seen at almost every location, but they were seen more often in areas near wetland. Raccoons, opossum, and one skunk were seen mainly in the forested dry area of the forest, on an escar and near a road. Coyotes were spotted at the edge of the field and forest (near Otter Pond). People were seen walking with their dogs in the area near and around the pond. It is possible that due to the weather (severe snow storm and heavy rains that occurred during placement) could have decreased the number of species captured on the camera. Also it is suggested that camera traps are set up and left in one place for 21 days to achieve maximum number of different species that use the area. Out cameras stayed up for only 14 days which may have caused us to capture less wildlife. We believe that if cameras were set up again at these locations for at least 21 days and closer to spring, in the summer, or early fall, one would be able to see a larger variety of species and get a better understanding of which animals prefer to use which type of habitat.

Unfortunately, we did not receive the same range of results using the track boxes. Out of the all track box placement only one site, near the stream in the forested wetland, captured tracks of a raccoon. The other trials either had smeared tracks that could not be identified or no tracks at all. We are not sure exactly why we received such little data, if it was due to the weather (damp weather could have affected the stickiness of the paper) or the cocoa powder that was used (animals may not like the scent of cocoa). We would suggest trying to use the track boxes again, but maybe during a dryer season.

At every visit we would take not of different scats or signs of wildlife. White tail deer scat was the most abundant on the Gill Property, mainly in the wetland across from the field that is adjacent to Otter Pond. In that area there was a lot of hemlock trees, several patches of where the deer rested were seen cleared in the snow (fig.3). At the entrance of the forest opposite the side of the shed an owl pellet was discovered. There was also a sitting of possible small bear scat by the edge of the river. By the forested wetland two large patches of deer hair were found, suggesting that a coyote could have captured a small deer and consumed it leaving the remains. Another deer remain was a deer skull (fig 4) located by the edge of Otter Pond. By tracking method alone, we could say with confidence that there is a large deer population on the property. It, however, does not seem to be

large enough to effect the vegetation. However this we would be able to better determine in late spring and summer.

Having a better knowledge of the different kinds of habitats on the property and using NEWild as a guideline of what species may be most often present where; it would be interesting and more beneficial to repeat the wildlife assessment. We would suggest repeating setting up camera traps in different habitats types for at least 21 days. We would also suggest creating transect lines for tracking, for better results. Overall, we can say that this property has the potential to house and sustain a variety of animal species.

Fig 1. Jessie setting up a camera trap

Fig 2. Photograph of Coyote

Fig 3. Raccoon

Fig 4. Area used by deer

Fig 5. Deer skull found by Otter Pond

Bird Survey

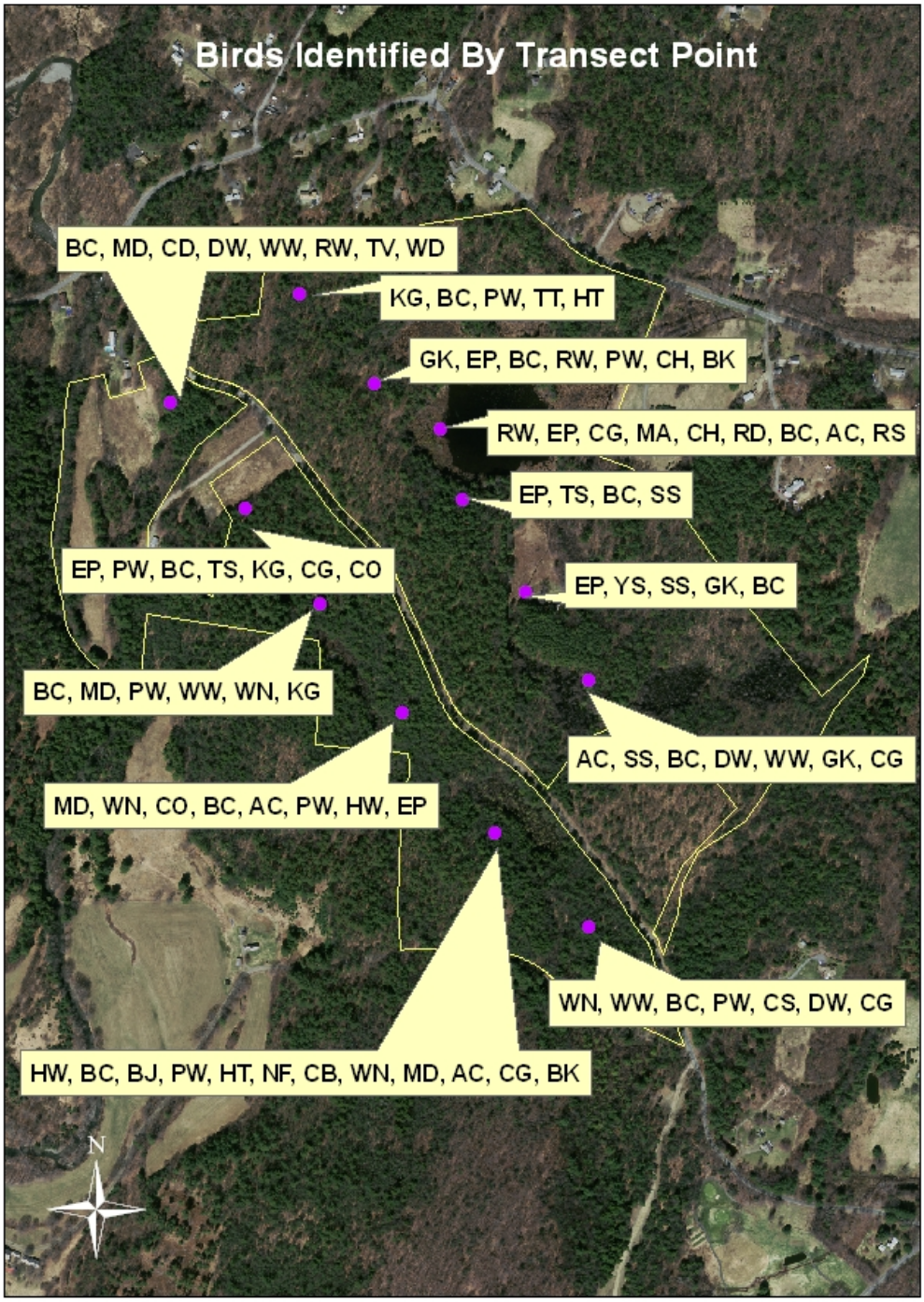
Population index was assessed with GPS information on pre-determined surveying points to allow for possible future population monitoring. We conducted a random stratified sampling strategy, based twelve transect points evenly distributed on the two sides of the property, trying to include different habitats including forested, wetland, open field, and open water.

- The entirety of the survey was carried out before noon in mid-April.
- The survey was taken along two pre-determined transects, that attempted to intersect as many different habitats as possible.
- The count duration for each point count was eight minutes, along each point on the point transect.

The aim was to record all birds identified by sight or sound with an estimate of distance when first detected. We replicated a point count data form used by the USDA and Forest Service.

The species we determined to be present on the land are as follows; White breasted Nuthatch, Winter Wren, Black Capped Chickadee, Palm Warbler, Chipping Sparrow, Downy Woodpecker, Canada Goose, Hairy Woodpecker, Blue Jay, Hermit Thrush, Northern Flicker, Cowbird, Mourning Dove, American Crow, Common Grackle, Eastern Phebee, Kinglet, Tree Swallow, Cardinal, Tufted Titmouse, Golden Crown Kinglet, Barred Owl, Coopers Hawk, Belted Kingfisher, Red Winged Black Bird, Turkey Vulture, Wood Duck, Mallard, Green Winged Teal Duck, Roughed Wing Swallow, Song Sparrow, and Yellow Bellied Sapsucker.

WN = White Breasted Nuthatch	WW = Winter Wren	BC = Black Capped Chickadee	PW = Palm Warbler
CS = Chipping Sparrow	DW = Downy Woodpecker	CG = Canada Goose	HW = Hairy Woodpecker
BJ = Blue Jay	HT = Hermit Thrush	NF = Northern Flicker	CB = Cowbird
MD = Mourning Dove	AC = American Crow	CO = Common Grackle	EP = Eastern Phebee
KG = Kinglet	TS = Tree Swallow	CD = Cardinal	TT = Tufted Titmouse
GK = Golden Crown Kinglet	CH = Coopers Hawk	BK = Belted Kingfisher	RW = Red Winged Black Bird
TV = Turkey Vulture	WD = Wood Duck	MA = Mallard	SS = Song Sparrow
GD =Green Winged Teal Duck	RS = Roughed Wing Swallow	YS = Yellow Bellied Sapsucker	



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Forest Inventory Methods

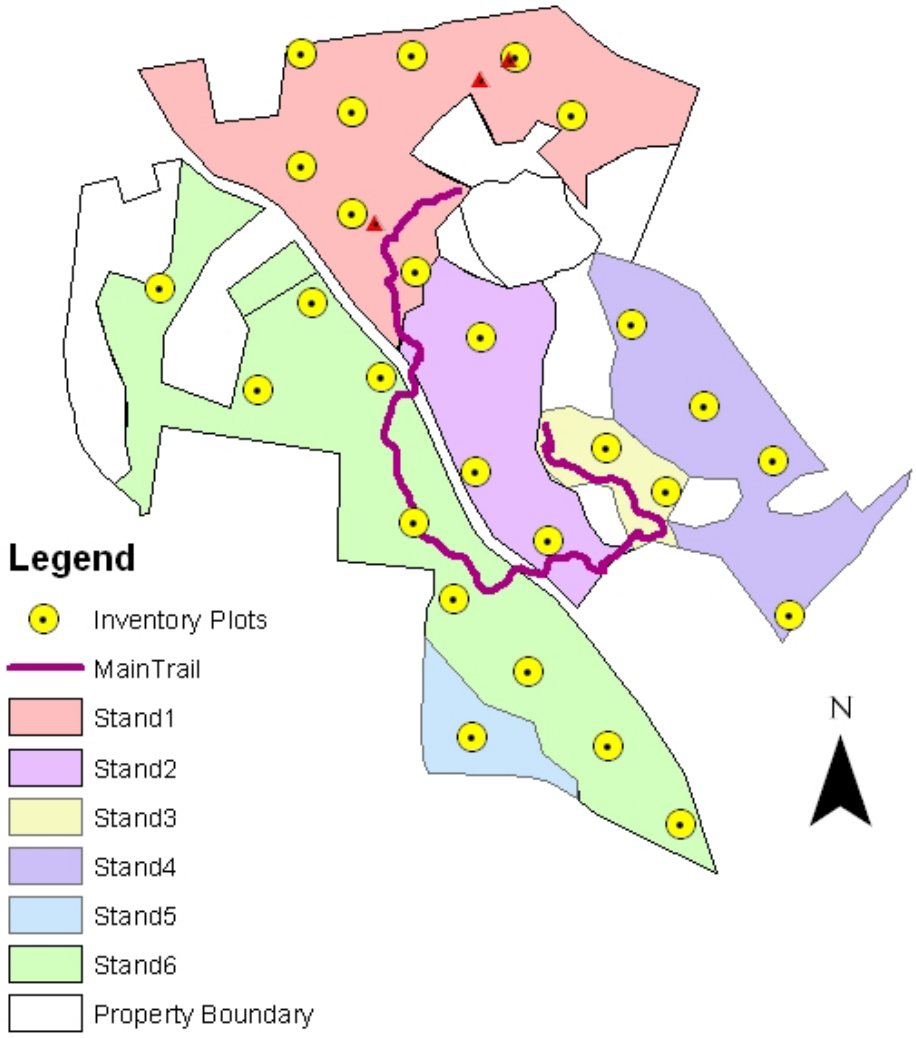
Overstory: We measured the overstory vegetation using a point sampling method. Within each stand we made evenly spaced plots using a grid overlay on our GPS unit, with cruise lines going at a bearing of 315 degrees. This bearing made our plots parallel to Hoe Shop Rd., allowing the most evenly distributed sampling points. We made this decision because there is little major topographic change (besides the eskers that are spread throughout the property) to influence our cruise line placement. Typically, the bearing of plot placement, also known as cruise lines, would be placed going upslope or downslope to capture the most environmental variation. At each plot we used a 10-factor prism to determine which trees were within the plot. We determined: the species, total height, Diameter at Breast Height, cavity presence, growing stock acceptability, living/dead status, and crown position of each tree within the plot. Comparing the heights and diameters of trees helped us to classify the age of the stand. Cavities are also significant for certain wildlife species, so we wanted to note any that we saw. We determined whether a tree was acceptable growing stock vs. unacceptable growing stock (these terms are defined in the analysis section) by looking at its form and branching structure. We also noted any presence of damage to trees by insects and pathogens. Lastly, the crown positions fell into the categories: suppressed, intermediate, co-dominant, and dominant. For each stand, we also determined the site index, which is defined below. We determined our site index for each stand using an increment borer to take a core sample of a co-dominant Eastern white pine. We then measured the height of the tree with a clinometer (a tool that uses geometry to calculate height from an angle). The chart below shows the number of plots per stand, along with what percent of the stand that represents. Refer to the "Stand Delineation" map below for stand locations.

Stand Number	Acreage	Number of Plots	% of Stand Inventoried
1	36.21	8	2%
2	16.66	3	2%
3	5.32	2	4%
4	21.08	4	2%
5	5.04	1	2%
6	45.4	9	2%

Regeneration: To measure regeneration, we counted the trees under 5" DBH within a 4 meter radius of our plot center. For these trees we only collected species and DBH information.

Ground species/non-tree inventory: To determine non-tree species density, we walked a transect of 100 feet, starting at plot center and moving in the direction of our next plot using a compass. We counted (tally method) all non-tree species within 2 feet of our path, paying special attention to the presence of invasive species. The transect method for ground species was suggested to us by a professional in invasive detection and removal, Chris Pollitan. We added a 6-inch buffer in order to cover more area and convert these transects into fixed area plots. This buffered method of sampling is also used for wildlife scat sampling. Because this transect is easily converted to a fixed area plot, we can analyze the data in the same way as a square or circular plot.

Coarse woody debris: In this inventory, we define coarse woody debris as any down and dead wood that is at least 3 inches in diameter and 3 feet in length. Along the same transects as the ground species, we measured the length of all coarse woody debris we crossed (no buffer in this case) and determined whether they were hardwood or softwood species. We also noted the species type when identifiable.

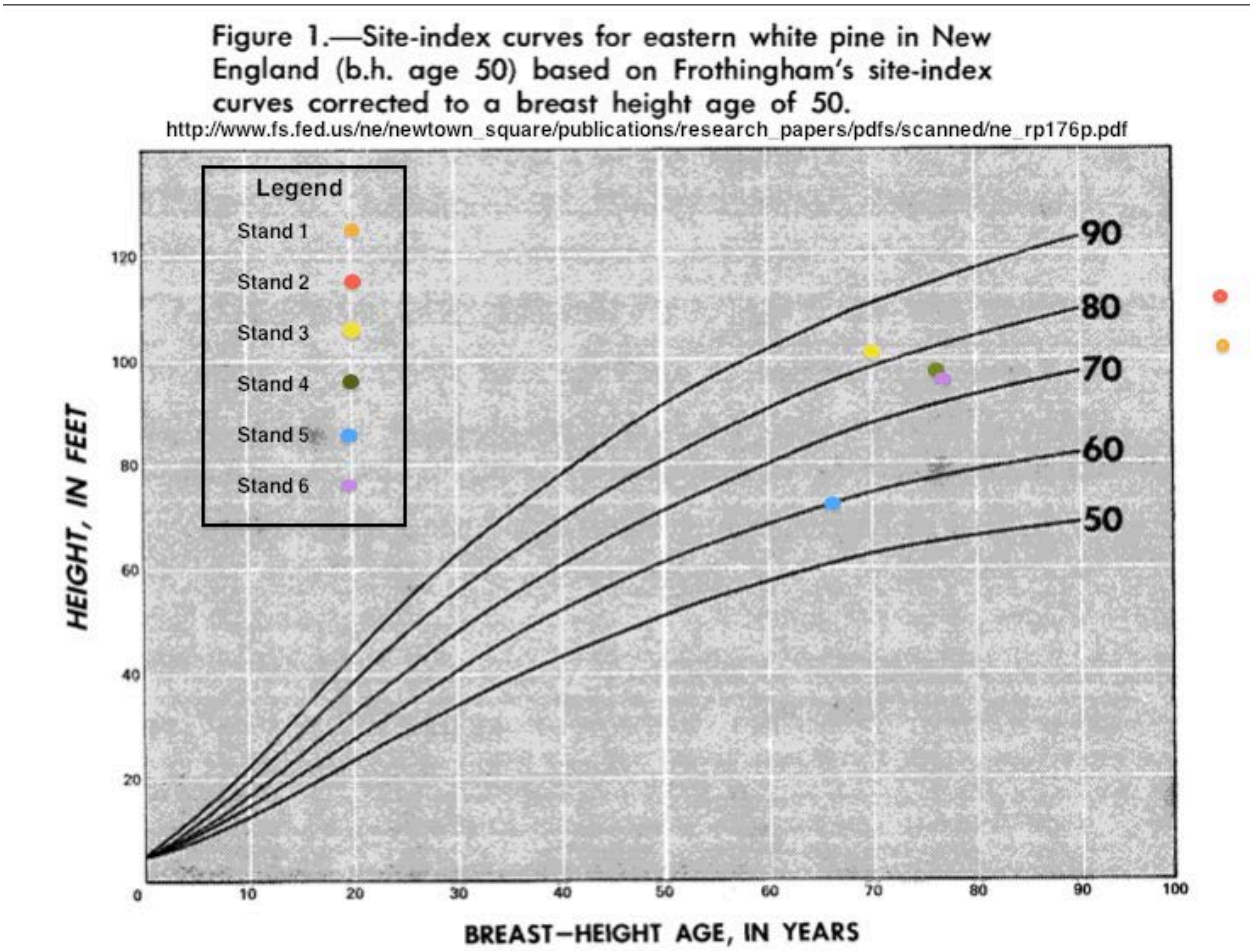


Stand Delineation

Stand	1	2	3	4	5	6
Stand Type	Oak – Northern pine	Oak – Northern pine	Eastern white pine (pure)	Oak – Northern hardwoods	Oak – Northern hardwoods	Bottomland mixed
Acres	36.2	16.7	5.3	21.1	5.0	45.4

Site Index

Site index is a measure of how well a species grows on a particular site. The number correlates with the height of a tree at age 50. Sites with taller 50-year-old trees than other sites have a higher site index, indicating that conditions are more favorable for tree growth. We plotted the values collected for this property onto a site index curve for New England. See below for the property's site index estimates.



Basal Area

Stand	1	2	3	4	5	6
Site Index	~ 70	~ 80	~ 82	~ 76	~ 60	~74

Basal area can be thought of as the bird's eye view of a tree that has been cut at breast height (4.5 feet above the ground). That circular area is measured in square feet for each tree and the measurements of all trees in a plot are combined to figure out the basal area per acre.

Stand	1	2	3	4	5	6
Basal Area (square feet/acre)	143.8	153.3	170	140	150	164.4

"Acceptable growing stock" (AGS) refers to trees that are straight and mostly free of knots/branches. "Unacceptable growing stock" (UGS) might include leaning trees, trees that are split/forked, or trees with low branches that would reduce the quality of timber produced. If we break up basal area/acre into AGS trees versus UGS trees, we see these values:

Stand	1	2	3	4	5	6
AGS Basal Area/acre	57.5	86.7	50	35	20	47.8
UGS Basal Area/acre	86.4	66.7	120	105	130	116.7

Density

The density of a natural stand can tell us a lot about the age of the trees within that stand. The more trees you have per acre, the more likely it is that those trees are younger because smaller trees require less space to grow. A stand full of mature trees is likely to be less dense due to natural competition and mortality of poorer adapted trees. Below you can see the values for density that we have calculated for this property.

Stand	1	2	3	4	5	6
Trees/acre	639.2	192.6	161.4	209.3	272.6	237.8
Total Trees	23,139	3216	855	4,416	1363	10,796

Stocking Guide

Using values of basal area/acre and trees/acre, we can determine how well "stocked" a particular stand it. This refers to ideal spacing to grow good timber trees. Representatives from the town of Gill expressed interest in forest management for this property's future, so the following diagram, taken from the Forest Service's web page, will estimate how well suited the stands are for growing timber at present.

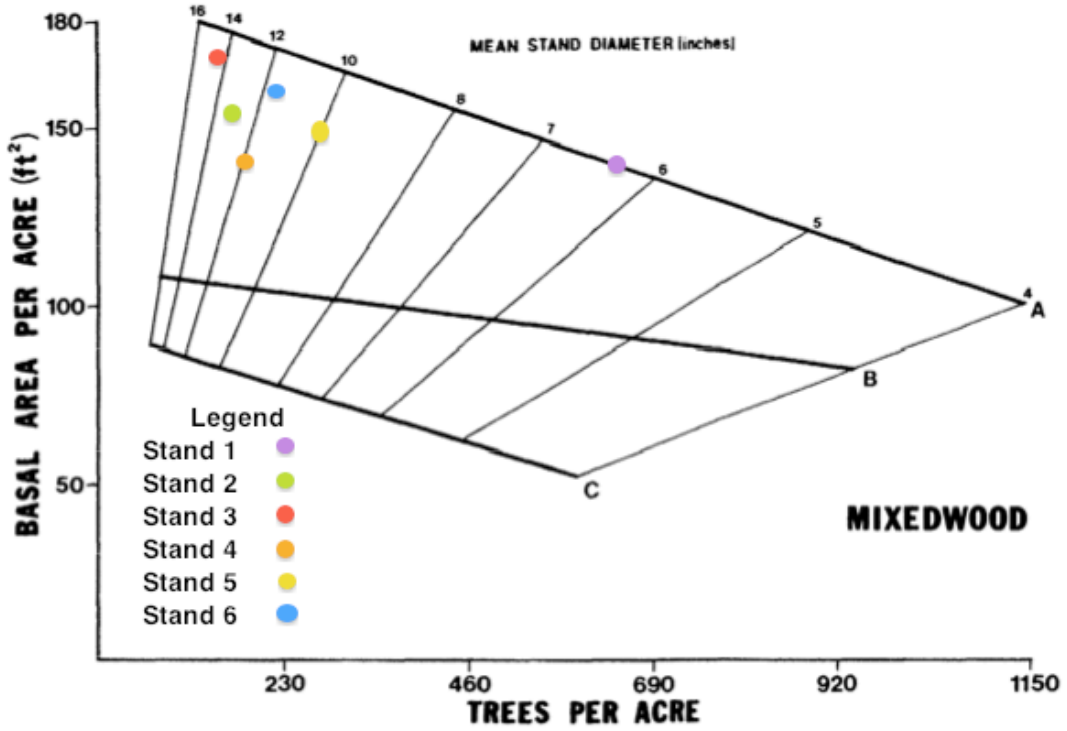


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Based on this diagram of mixed-wood stands, all of the stands on this property are well stocked and some over-stocked. The "B" line represents a low estimate for ideal stocking of timber trees, which gives trees enough sunlight and water to thrive, while still maintaining enough trees per acre to provide a full canopy. Having too few trees per acre can lead to trees with a lot of taper, which negatively affects timber quality. The "A" line is "fully stocked". A fully stocked stand typically contains many trees that are too crowded for maximum growth, due to competition for light, water, and nutrients. The Gill property falls towards the "A" line, which is reinforced by the proportion of Acceptable versus Unacceptable growing stock inventoried in the sample plots. One option for improvement might be to thin the stands to an appropriate stocking level.

Tree Diameter

The quadratic mean diameter is an "average" of stem diameter, which is calculated using the average *basal area* of the trees in an equation instead of the average *diameter*. This produces an estimate greater than or equal to the true average because basal area gives greater weight to the larger trees. Below you will see quadratic mean diameter per stand.

Stand	1	2	3	4	5	6
Quadratic Mean Diameter	6.4	12.1	13.9	11.1	10.0	11.3

Volume

Girard Form Class is a model of the measure of taper in the stem of a tree. The closer the value is to 100, the closer it resembles a perfect cylinder, and the further it is from 100, the more it resembles a cone. The total volume of a stand accounts for this form class, as well as the basal area and total height of each tree. Volume is measured in board feet, which are 12”x12”x1”. We have converted total volume per stand to cords of firewood (4’x4’x8’ piles) for easy visualization.

Stand	1	2	3	4	5	6
Board feet/acre	9,856	11,626	15,705	9,057	6,327	10,551
Total Volume	356,787.2	194,154.2	83,236.5	191,102.7	31,635	479,015.4
Cords of firewood	232	517	54	124	21	312

Species Composition

Each stand is defined by a unique species composition. This is influenced by a number of factors, including the land use history, soil conditions, slope aspect, and water availability. For instance, Eastern white pine is commonly referred to as an “old field species” because it is often the first species to inhabit abandoned agricultural land. White pine’s intolerance to shade and suitability for nutrient-poor sites make these events occur. Likewise, other species have conditions in which they thrive or struggle.

Species Composition by Percent Basal Area

Stand	**1**	**2**	**3**	**4**	**5**	**6**
Eastern white pine	39.1%	60.9%	88.2%	7.1%	20.0%	31.8%
Northern red oak	23.5%	17.4%	2.9%	29.6%	40.0%	12.2%
Red maple	12.2%	4.3%	2.9%	30.4%	33.3%	8.8%
Eastern hemlock	7.8%	10.9%	5.9%	-	6.7%	34.5%
Black birch	5.2%	2.2%	-	8.9%	-	7.4%
Shagbark hickory	4.3%	-	-	-	-	-
Pignut hickory	4.3%	-	-	-	-	-
White oak	2.6%	4.3%	-	3.6%	-	3.4%
Sugar	-	-	-	17.9%	-	-

maple						
Quaking aspen	-	-	-	1.8%	-	-
White ash	-	-	-	1.8%	-	-
Bigtooth aspen	-	-	-	-	-	.7%
Paper birch	-	-	-	-	-	.7%

The species composition can help us to depict overall site conditions and can also help us to make assumptions about the site's presence of wildlife, which we have included in our wildlife inventory section of this report.

Cruise Data Accuracy

Standard Deviation helps to depict the range and accuracy of our data. The empirical rule states that 68% of normally distributed data should fall within 1 standard deviation of the mean, 95% within 2 standard deviations, and 99.7% within 3 standard deviations. The higher the standard deviation, the more suspect we should be of our data because a larger range means it is less consistent, and therefore less conclusive overall. One way to decrease standard deviation is to take more sample plots. Forests are naturally diverse, though, so some variation is expected. Below you will find our standard deviation for the values of basal area.

Stand	1	2	3	4	5	6
Standard Deviation of Basal Area (square feet)	53	31	50	40	0	48

Due to time constraints, we were unable to sample the number of plots necessary to have more conclusive data. As it stands, many of our standard deviations are higher than they should be. Also, stand 5 only contained 1 plot, which creates the illusion of 0 deviation. Nonetheless, this inventory is still a fair estimate of the property's composition and can be used as an aid in future conservation planning within the property.

Understory

Woody plant species that reside under the main canopy compose the understory of a stand. In this layer of the forest, regeneration can be determined. The temperature regimes, light, water, and nutrients availability allotted to understory species is determined by the overstory and is not entirely representative of the overstory species. Regeneration is important to determine the potential of regrowth after a natural even, such as hurricanes or tornadoes, or after a silvicultural operation. When openings in the canopy occur from such disturbances, these species will be the ones to fill the gaps to become the future overstory. This layer is usually more diverse than the overstory but composes a much smaller biomass. These species commonly feed many species of

wildlife. For example, deer, raccoons, bears, and a variety of birds eat blueberries, a common understory species (Antos 2008).

Stand	1	2	3	4	5	6
Density (Stems per acre)	2,187.5	1500.0	*NA	3,650.0	*NA	700.0

*Not Applicable (NA): program used to calculate this data did not have sufficient data collection. The information came from stands having plot numbers less than or equal to two.

The density of each stand is variable. Stand 4 has the highest while stand 6 is the least dense (stands 3 and 5 cannot be accounted for). This leads to the conclusion, that stands with low densities of understory species have a more mature and closed canopy, while stands with high densities are in young open canopy stands. The stocking guide supports this.

Ground Cover

Herbaceous species that colonize the lowest level of the forest floor are known as ground cover species. These species include ferns, grasses, and wildflowers, among others. This is typically the most diverse layer in a forest ecosystem. In our report, because the data was collected in late winter into early spring, and many species had yet to germinate, our species composition is not entirely representative of the ground covers species diversity. The species we captured are mostly composed of evergreen species and upright perennials. Theses species are excellent indicators of the types of soils present. For example, Partridge be*rry* [*Michella repens*], favor acidic soils well drained soils.

We determined the presence or absence of species using the Jaccard's Similarity Coefficient which typically ranges from 0 to 1. Low values indicate little or no similarity: high diversity. Higher values indicate stronger similarity: low diversity. This measure gives more weight to species that are unique to each sample which indicates how diverse the stand is. Invasive ground cover species were not found in our plots.

Stand	1	2	3	4	5	6
Jaccard Similarity Coefficient	0.3157	0.5333	0.5000	0.2389	0.0000	0.2295
Range per Stand	0.0000-0.6667	0.5000-0.6000	0.5000-0.5000	0.0000-0.6074	0.0000-0.0000	0.0000-0.7500

The average Jaccard Coefficient for the six stands is 0.3029. This number is closer to zero than one, giving it little to no similarity, meaning the stands are relatively diverse.

Coarse Woody Debris

Coarse woody debris (CWD) is defined as downed limbs, and fallen or uprooted trees in various stages of decomposition. CWD is an important element in a forest habitat. It provides habitat and purpose for certain species, including insects, birds, amphibians, mammals and even other vegetation. CDW also adds organic matter that aids in water retention and recycles nutrient in the soil to be made available to other plant species.

Eastern Forest Species type, size and progression of decay is very is also very important. (Bottorff 2009). Suggested by the National Parks Services, U.S. Department of the Interior, for northeast temperate forests (NETF), states that most NETF do not have enough CWD. The National Park Service uses a model to determine adequate CWD levels by ratio of live tree volume to CWD volume which indicates that a healthy CWD volume is greater than 15% live tree volume. Levels between 5-15% reserve caution and require monitoring, while below 5% requires significant concern and is warrant to management practices (National Parks Service 2009).

Stand	1	2	3	4	5	6
CWD (cu. ft. per ac.)	468.59	296.69	1,478.78	215.05	0	623.19
Overstory (cu. ft. per ac.)	3,472	3,757	4,425	3,297	3,258	3,697
% CWD	11.89%	7.32%	25.05%	6.12%	0%	14.43%

On average, the property has 10.8% CWD. According to the National Parks Service, caution should be warranted and a monitoring is required to sustain healthy amounts of CWD. As can be seen in the table above, some stands are healthy, while others are in the caution zone. Specifically, stand 5 is small and only has a single plot. If a transect survey is to be conducted through this area in the future, CWD may be found. To increase CWD, large to medium trees should be felled, by cutting or pulling down, and left. This will also happen naturally if the stand is left undisturbed for several growing cycles.

Snags

Standing dead trees, also known as snags, play an important role in the forest ecosystem. Snags create important habitat for many vertebrates. The size of the trees and the cavities themselves is crucial in supporting a variety of species. The diameter of the tree ultimately determines the limitations of the species that can reside within. Some species, such as barred owl, require larger trees to nest in compared to smaller species, such as flying squirrels (Bottorff 2009). Using the same idea described by the National Parks Services, for CWD, They describe the importance of snags and its limited presence in NETF. Snags are measured by abundance and size within a plot of living trees. Healthy levels are considered greater than or equal to 10% standing trees are snags and are medium to large in size. Less then 10% raises caution and should be monitored, less than 5% raises significant concern and should be managed (National Parks Services 2009). Medium to Large in size is an arbitrary range, so all snags are included in the table below except for those with a DBH less than six inches.

Stand	1	2	3	4	5	6
Snags per acre	23.46	0	62.59	16.81	0	25.81
Living Stems per acre	639.2	192.6	161.4	209.3	272.6	237.8

% Snags	3.5%	0%	27.94%	7.43%	0%	9.79%

On average, the property has 8.11% snags per acre. According to the National Parks Service, this percentage raises caution and should be monitored. Stand 3 greatly affects the average and there are three stands that are of significant concern and will require management to increase snag percentage. To increase snags, a method called girdling can be conducted. Girdling is as practice that involves severing the conductive tissues (layer beneath the bark) of the tree which will lead to the trees death. This will create a snag that is still structurally sound enough to stand. It is suggested by the National Parks Service to choose trees for girdling that are of low vigor and are medium to large in size (2009).

Works Cited

Antos. J. A., 2008. Understory Plants in Temperate Forests. Department of Biology, University of Victoria, Canada. Vol. 1

Bottorff, J. 2009. Snags, Coarse Woody Debris, and Wildlife. Washing State Department of Natural Resources.

National Parks Services, Department of the Interior. 2009. Forest Health, Coarse Woody Debris and Snags.

Forest Recommendations

Our inventory results have led us to make a few management recommendations for this property. First, as mentioned in the stocking guide section, the property is quite crowded for ideal timber growth. We would recommend thinning any stands that might be harvested in the future, to give the remaining trees a chance to grow at their maximum potential.

We would also recommend looking at stand 2 in particular for management potential. This stand currently has the highest percentage of acceptable growing stock on the property and is comprised predominantly of white pine in the overstory. There are several large wildlife trees in the stand, which could be left standing, and the understory is fairly dense as well. This combination would be perfect for a shelterwood harvest, which could advance the succession of this forest to another desired habitat type or species composition. Lastly, this stand falls right along Hoe Shop Rd. and it bisected by an old driveway. This great accessibility, as well as the stand's lack of enclosed wetlands or extreme topography, makes stand 2 a great option for future management.

Invasive Species

Our surveys were done in April before most plants had the opportunity to leaf out, making identification more difficult, so we would recommend revisiting the forest to assess invasive threats during the summer months. However, two invasive plant species were positively identified during the wetland surveys. Phragmites is present on the banks of Otter Pond. This invasive reed is a perennial wetland grass that grow to 15 feet, the height that the phragmites on the property have currently achieved. Phragmites can degrade wetland area by

crowding out native plants and is unacceptable habitat for many native animal species. It can also create a fire hazard. The Phragmites is quite dense in area D of the pond however has not spread outside of that area. It would be ideal to preventatively eradicate it, as it is capable of rapid expansion into new territory once it has invaded a wetland area. Japanese knotweed is present in many places along the banks of the Fall River. Japanese knotweed is an herbaceous perennial that can grow to be ten feet tall, although the plants found along the river are about 6 feet tall. Currently, the plants are still sparsely distributed within the riparian zone, however these plants often form dense colonies that completely crowd out other herbaceous species so this is an excellent plant to eradicate as soon as possible after detection. As this is still an initial population, grubbing should be an effective means of removal. It is important to remove the entire plant including all roots and runners otherwise it will resprout.

The upland forest inventory did not find a presence of invasive plants. This study focused on sample plots though, so we do not suggest a complete absence of invasive upland species. Citizen scientists and volunteers are often the greatest asset to invasive species discovery and mitigation, so we encourage Gill town citizens to be active participants in this work.

Likewise, there were no observations of important pests and pathogens within the sample plots. Although these factors are constantly affecting forests, important invasive species, such as hemlock woolly adelgid, emerald ash borer, or Asian long-horned beetle, can be detrimental across the landscape. Therefore, it is important to know of their presence.

Conclusions

The Gill town forest inventory has shed some light on the different aspects of the property and its potential for the future. The contrasting uplands and wetlands provide diversity of habitat for different life stages of New England's wild fauna and flora. The property has great potential for future management, but should, as always, be executed with great caution to prevent any wetland or habitat disturbance.

The condition of the wetlands and river appear mostly undisturbed, but could be a great tool for educational purposes as well as restoration and invasive species control. Otter pond and its surrounding wetlands in particular provide opportunities for vernal pool protection and phragmites and knotweed removal, as well as native plant diversity in and around the wetlands.

The upland forest ecosystem on the property consists of 6 stands or forest types, all of which are healthy with adequate amounts of living and dead trees to provide habitat for wildlife and recycle essential soil nutrients. Management options could include specific species habitat conversion or simply improvements upon the current stands.

Overall, the property is in very good condition. It is a great asset to the citizens of Gill for their utilization, education, and restoration efforts.

Property Deed

2009 00012566
Bk: 5750 Pg: 129 Franklin County
Page: 1 of 3 09/17/2009 10:43 AM

Affected Premises

Hoe Shop Road
Gill, Massachusetts

QUITCLAIM DEED

FRANKLIN LAND TRUST, INC., a Massachusetts non-profit corporation with a place of business in Shelburne Falls, Franklin County, Massachusetts

for consideration of **ONE DOLLAR ($1.00)**, paid

grants to **THE INHABITANTS OF THE TOWN OF GILL,** of c/o Town Hall, 325 Main Road, Gill, Massachusetts 01354

with **QUITCLAIM COVENANTS,**

The land in Gill, Franklin County, Massachusetts, more particularly described on Exhibit A attached hereto and incorporated herein.

SUBJECT TO a Conservation Restriction recorded in Franklin County Registry of Deeds, Book 5709, Page 39.

Being a portion of the premises conveyed to the grantor herein by deed of Ronald P. Weiss and Greenfield Savings Bank as Trustees of the Acilio R. Sandri Irrevocable Grandchild's Trust for the Benefit of Jeffrey W. Sandri, Ronald P. Weiss and Greenfield Savings Bank as Trustees of the Acilio R. Sandri Irrevocable Grandchild's Trust for the Benefit of Lisa Lou Sandri, and Wendy Van Epps, dated May 8, 2009, and recorded in Franklin County Registry of Deeds, Book 5668, Page 193.

This conveyance does not represent all or substantially all of the assets of the corporation.

IN WITNESS WHEREOF, the said FRANKLIN LAND TRUST, INC., has caused its corporate seal to be hereto affixed and these presents to be signed in its name and behalf by Richard K. Hubbard, its Executive Director, this 16th day of September 2009.

FRANKLIN LAND TRUST, INC.

Witness

By: R. K. H.
Richard K. Hubbard
Its Executive Director

THE COMMONWEALTH OF MASSACHUSETTS

Franklin, ss.

On this 16th day of September, 2009, before me, the undersigned notary public, personally appeared Richard K. Hubbard, personally known to me to be the person whose name is signed on the within document, and acknowledged to me that he signed it voluntarily for its stated purpose, as Executive Director of Franklin Land Trust, Inc., a corporation.

BRANDON W. VICKERY
Notary Public
COMMONWEALTH OF MASSACHUSETTS
My Commission Expires
September 24, 2015

Notary Public Brandon W. Vickery
My commission expires: 9-24-2015

EXHIBIT A

The premises are bounded and described in a plan titled "Plan of Land in Gill & Bernardston, MASS. (Franklin County) Surveyed for Sandri Trust" dated April 29, 2009, Roberge Associates Land Surveying, 21 Mohawk Trail #283, Greenfield, Mass. and are shown as "East Tract 112.628 ± Acres" and "West Tract 61 ± Acres," recorded in said Registry of Deeds in Plan Book 128, Page 13;

EXCLUDING therefrom, Lots 1, 2, 3 and 4 as shown on a plan titled "Plan of 4 Lots in Gill (Franklin Co.) MASS. surveyed for Franklin Land Trust" dated May 12, 2009, Roberge Associates Land Surveying, 21 Mohawk Trail #283, Greenfield, Mass., recorded in said Registry of Deeds in Plan Book 128, Page 21

and Parcel 1, as shown on a plan of land titled "Plan of Barn Lot in Gill (Franklin Co.) MASS. surveyed for Franklin Land Trust" dated June 9, 2009, Roberge Associates Land Surveying 21 Mohawk Trail #283, Greenfield, Mass. and recorded in said Registry of Deeds in Plan Book 128, Page 35.

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