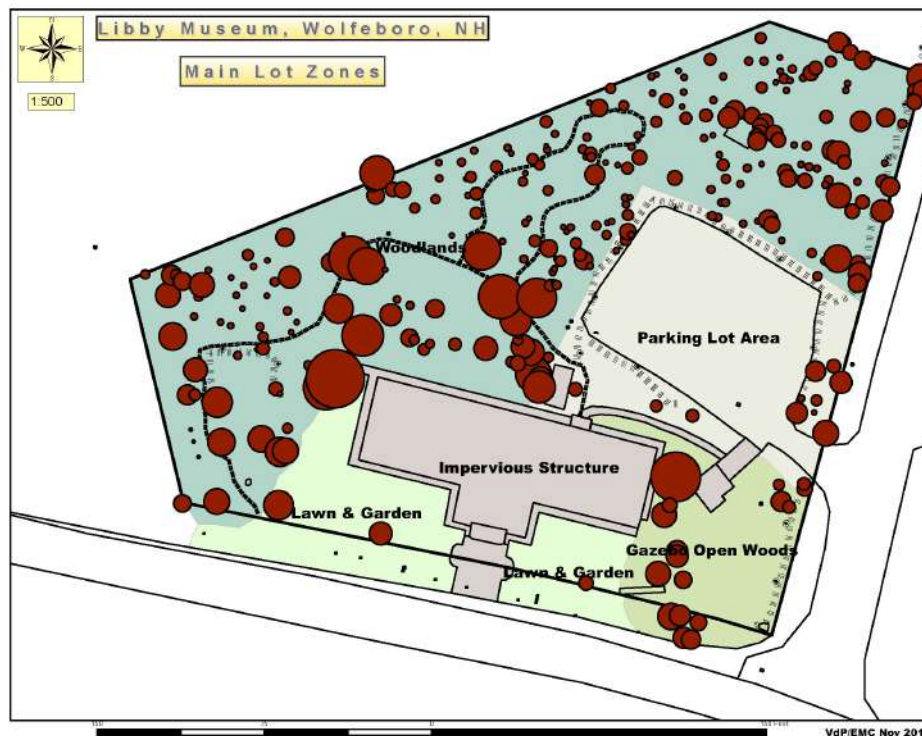


Landscaping Assessment of the Libby Museum Lot

Wolfeboro, NH



Tree influence map of the Libby Museum Lot showing zones and proportional tree sizes

Prepared for the

Friends of the Libby Museum

Rick Van de Poll, Ph.D.
Ecosystem Management Consultants
30 North Sandwich Rd.
Center Sandwich, NH 03227
rickvdp@gmail.com

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Landscaping Assessment of the Libby Museum Lot

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Overview

In January 2019, Museum Director, Alana Albee, contacted Ecosystem Management Consultants (EMC) in order to seek assistance with a landscaping upgrade that was part of the Museum's restoration project.¹ Specific to this request was a desire on the part of the Friends of the Libby Museum and the Museum Director to fulfill the wishes of the Museum's progenitor, Henry Forrest Libby, to create an arboretum of native New Hampshire trees and wildflowers. As stated in the approved grant application to the Biber Foundation, the goal was to help create "an environmentally diverse, sustainable landscape that fosters an appreciation of the natural world through education and inspiration." The goal of this initiative was discussed with EMC, after which three specific objectives were identified as a part of this project:

1. Base mapping and overlay tree mapping (CAD) of all species on the property over 3 inches in diameter and shrubs greater than 6 feet in height
2. Identification of tree species adaptable to the property, and a location/ planting design
3. Wildflower integration: Identifying native and non-native wildflowers; and identifying places for enhancement, and possible additions.

Beginning in April 2019 several visits were made to the Libby Museum Lot to inspect the current garden beds and natural forest areas in order to assess where design changes may be made to enhance the existing plant materials. The following report outlines the methods used in fulfilling the three objectives above and creating a natural renovation plan for consideration by the Director and the Friends of the Libby Museum Board. A public presentation on the findings of the project was given at the Wolfeboro Town Hall on December 5, 2019. A copy of the slide show is appended to this report, along with maps and species lists of the plants found on the Museum Lot.

Methods

An initial review of remote map data using an ArcGIS 10.x platform was completed prior to the first field site visit on April 24, 2019. GIS data that were uploaded into a base map that included the 2010 and 2015 Aerial Color Infrared (CIR) orthophotographs, the USGS topographic quad for Wolfeboro, Natural Resource Conservation Service soil data from the Web Soil Survey, and

¹ The Museum restoration project will insulate and temperature control the 108 year old building, and allow for acceptance of a new North American collection. A modest addition with a 1200 square foot footprint will house mechanical, storage and a donation of North American mammals. For the purposes of the landscaping part of this project, all work is to be confined to the 1.4-acre "Museum Lot" (7-1-19) in Wolfeboro.

roads and stream data (NHD) from the NH GRANIT GIS database as provided by Complex Systems Research Center at UNH, Durham. Also useful during the latter part of the project time period was the 2018 LiDAR mapping from NH GRANIT, which was uploaded onto an ArcGIS Pro 2.3 platform. This shaded relief imagery was used in refining the final map product.

Field site visits took place on April 24, May 9, June 28, July 18, August 30, September 4, and September 6, 2019. The first two field visits were used to tally tree and wildflower species and to get a sense of the general lay-out of the Museum lot property. Lot corners were identified using the 1990 Norway Plains survey, and flags were hung along the rear boundaries for better sighting of the property edge. Beginning in June, a compass and tape measure grid was laid out across the property and measurements were taken of all trees > 10 cms in diameter at breast height (dbh). These were designated by two or three-letter species codes along with dbh measurements on graph paper that was oriented true north-south. Notations were also made on large boulders, shrub cover of unique tree species that were not yet of tree size (i.e. < 10 cms dbh), and historic artifacts such as the monument rock, fountain rock, trails, foundations, and stone walls. Wildflower and shrub species were tallied by zone,² which was artificially constructed for the purposes of mapping and planting design as follows:

- 1) Woodlands – all forested areas away from the developed landscape
- 2) Lawn & Garden – the front lawn, garden, and planted bed area
- 3) Parking Lot Area – the gravel drive and parking area and associated stone walls, walkways, shed, and side banks above the Museum
- 4) Gazebo Open Woods – the area east of the museum building including the gazebo lawn, well-spaced trees, the planted juniper bank, and boundary stone walls
- 5) Impervious Structure Area – the main building, its front and side walkways, and gazebo

The tree measurement grid was laid out at 10-meter intervals and placed across the Woodland and Gazebo Open Woods zones. A reference line was also laid out along the east edge of the Parking Lot Area zone in order to capture the trees along Lang Pond Road. Trees were sighted perpendicularly along the grid lines using a 5-meter steel tape and measured using a steel diameter tape. Although a minimum diameter of 10 cms was used in general, five stems less than this dimension were also measured, including the three northern white-cedars that were planted in 1996 as a part of an earlier tree planting effort.

The Norway Plains survey was used as an initial base map for the tree location design, although slight errors in the observed boundary corner placement required adjustments in the final map product. Notably, the granite bound corner at the corner of Route 109 and Lang Pond Road was not locatable and required reference measurements off of the Museum building and walkways. From here the measurement along the front line was found to be six feet off and the eastern side line was found to be one foot off. In addition, the taped distance on the west side of the lot

² See the property zone map below.

between the two iron pipe corners was five feet shorter than the survey called for. In all cases, field measurements were used over the Norway Plains survey in the final map product.

Findings

General

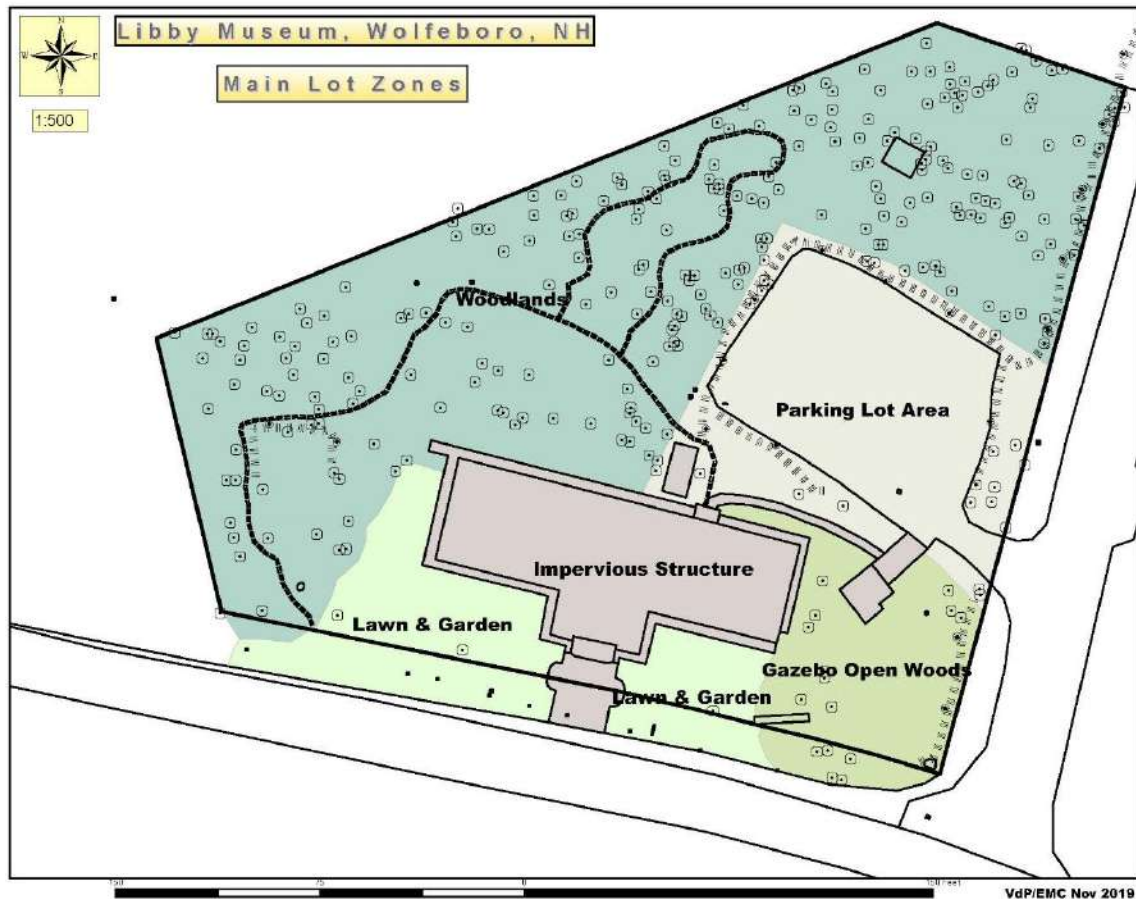


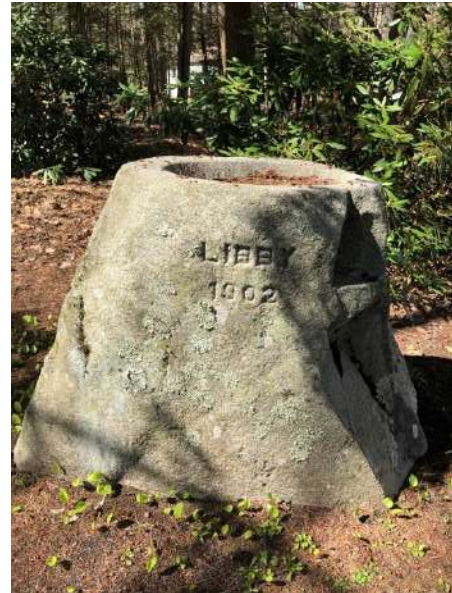
Figure 1. Zone Map of the Libby Museum Lot showing the location of the measured trees

Five general zones were identified for the Libby Museum lot with the following configuration:

Id	Label	Notes	ACRES	Area (s.f.)	Perimeter (s.f.)
1	Woodlands	Includes old foundation and trails	0.75	32701.6	1040.4
2	Lawn & Garden	Extended to edge of roadway	0.16	7243.2	603.4
3	Parking Lot Area	Includes fringe affected by lot run-off	0.26	11400.4	523.9
4	Gazebo Open Woods	Extended to edge of each road	0.13	5663.8	425.5
5	Impervious Structure	Extended to road edge	0.19	8213.4	760.9

The Museum Lot is relatively flat with less than a 6% slope from the back corner to the roadside at Route 109. Some prior cut and fills have accentuated this slope at the stairway that leads up to the Gazebo Open Woods through two patches of planted common juniper. It appears that the front lawn was leveled prior to the initial construction to allow for a suitably flat front entrance to the Museum building. Boulder removal was evident in all of the developed zones, especially the Lawn & Garden area and the Parking Lot Area. Many of these boulders are still visible at the edge of these two zones, wherein they form a rough boundary wall at the outer edge of these zones.

The entire lot was formerly covered with stony to bouldery, acidic glacial till that was well drained to moderately well drained. Boulders are common features throughout the lot away from smoothed areas, and form > 10% of the areal coverage of the lot in many areas. At least one of these boulders was tilted up and carved for what was a watering trough for Dr. Libby's horse near the beginning of the woodland trail (see at right). The undisturbed area in the Woodland Zone retain features of the Becket soil series, which is a sandy basal till characterized by a firm substratum. The latter was confirmed through observations of excavation work that was being conducted on an adjacent lot during the summer months.



Surface water features are absent from the Museum lot, although evidence of run-off was visible in the parking area and along the two bordering roadsides. Run-off is insignificant, however, and appeared to only affect areas of the property immediately adjacent to the impervious surfaces. Depositional sand was found, for example, on the downhill side of the parking lot and the adjacent walkway leading to the rear of the museum building. Soil disturbance on the west side of the building, which included boulder removal and smoothing out of the lawn area, has created fairly higher water tables amidst moderately well drained, Skerry series soils. The extremely bouldery west corner of the lot is well-endowed with hemlocks because of this higher water table, and ferns can be found commonly along the edge of the lawn.

Recorded wildlife species were mostly generalists that prefer open, mixed woods. Among mammals, gray and red squirrels and chipmunks were the most prevalent, although deer tracks were seen in the Woodland Zone, and one bear-excavated birch log was found back near the bear statue. Most of the wildlife species that was observed on the lot included birds, some of which likely breed on the property itself. In order of frequency of occurrence, the following species were seen: American crow, black-capped chickadee, red-breasted nuthatch, myrtle warbler, eastern tufted titmouse, downy woodpecker, red-eyed vireo, pine warbler, white-throated sparrow, chipping sparrow, yellow-bellied sapsucker, American goldfinch, blue jay,

song sparrow, swamp sparrow, ruby-throated hummingbird, ruby-crowned kinglet, hermit thrush, purple finch, and merlin. The latter species was seen in April and seemed to be establishing a nest territory nearby.

Specific Findings – Trees

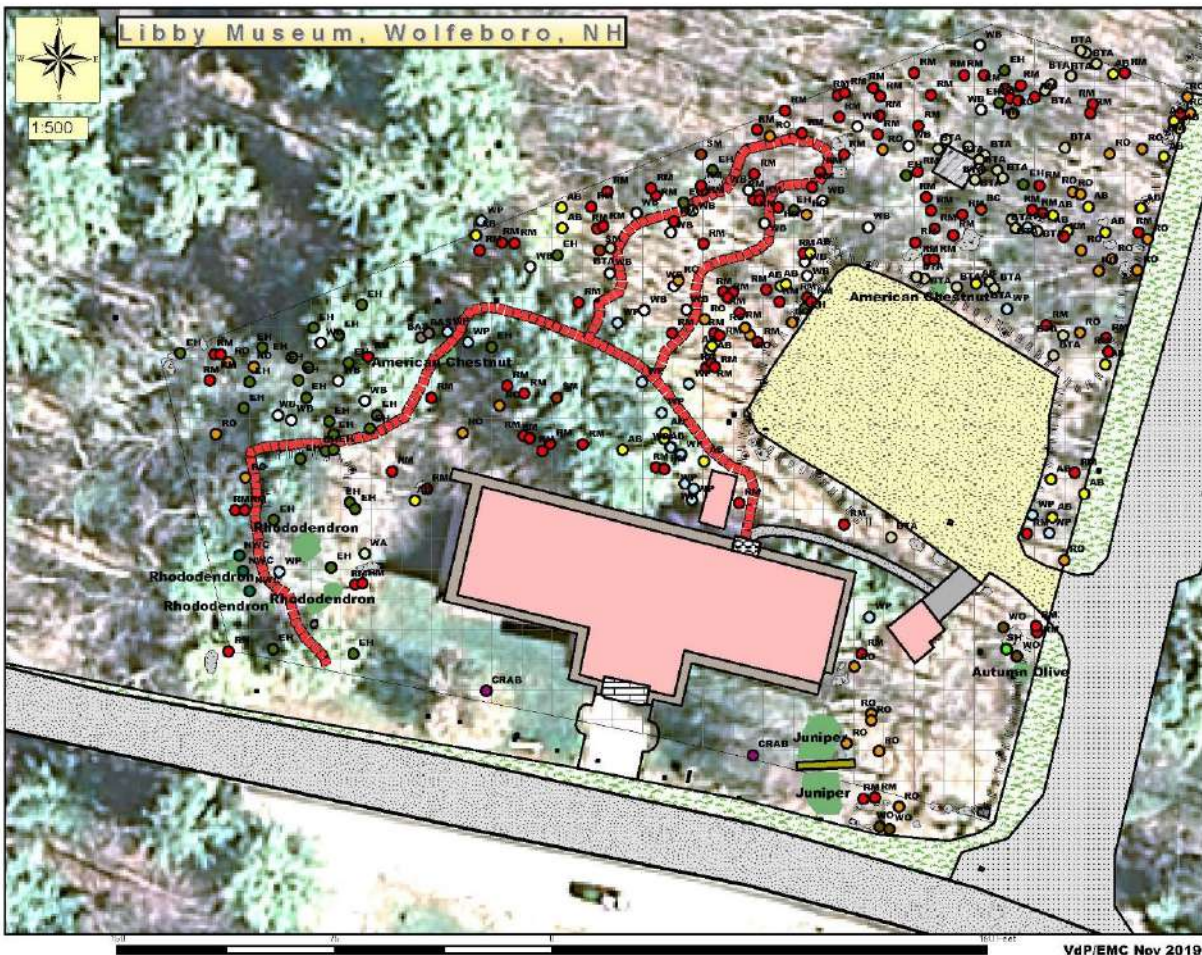


Figure 3. Tree inventory map of the Libby Museum Lot

A total of 22 tree species was identified on the Libby Museum lot, 15 of which were tallied as being of tree size.³ All but one tree species was native. The only non-native was the crabapple represented by two individuals that were planted in the front of the building.⁴ The following table summarizes the tree tally by species, number, and average diameter in inches:

CODE	Common Name	Scientific Name	Number & Average DBH
AB	American beech	<i>Fagus grandifolia</i>	N = 27, ave. dbh = 9.26 in
BAS	Basswood	<i>Tilia americana</i>	N = 2, ave dbh = 10.5 in
BC	Black cherry	<i>Prunus serotina</i>	N = 1, ave dbh = 4.3 in

³ As noted above, one of the tallied tree species, northern white-cedar, was below tree size.

⁴ Although described as a “pear,” it appeared that these two trees were pear-leaved crabapples (*Malus prunifolia*)

BTA	Bigtooth Aspen	<i>Populus grandidentata</i>	N = 29, ave dbh = 11.47"
CRAB	Crab-apple	<i>Malus sylvestris</i> X	N = 2, ave dbh = 14.67
EH	Eastern hemlock	<i>Tsuga canadensis</i>	N = 35, ave dbh = 7.53 in
NWC	Northern white-cedar	<i>Thuja occidentalis</i>	N = 3, ave dbh = 2.8 in
RM	Red maple	<i>Acer rubrum</i>	N = 109, ave dbh = 8.57 in
RO	Red oak	<i>Quercus rubra</i>	N = 34, ave dbh = 15.28 in
SH	Shagbark hickory	<i>Carya ovata</i>	N = 1, ave dbh = 15.75
SM	Sugar maple	<i>Acer saccharum</i>	N = 3, ave dbh = 9.45 in
WA	White ash	<i>Fraxinus americana</i>	N = 1, ave dbh = 7.8 in
WB	White birch	<i>Betula papyrifera</i>	N = 23, ave dbh = 7.94 in
WO	White oak	<i>Quercus alba</i>	N = 4, ave dbh = 12.6 in
WP	White pine	<i>Pinus strobus</i>	N = 18, ave dbh = 22.14

Table 1. Tally of trees on the Libby Museum Lot

As can be seen in the above table and map, red maple was the most frequent tree and had the highest overall basal area.⁵ It did not, however, have the largest average diameter. Among the more common trees, both white pine and red oak had higher overall mean diameters, followed by bigtooth aspen, beech, and white (paper) birch. With the exception of eastern hemlock, all of the remaining tree species were much less important on the lot.

All of the tree species on the Museum Lot are common in the region and typically found in the Hemlock-Beech-Oak-Pine Forest natural community. This naturally occurring aggregation of mixed hardwood and softwood species commonly occurs on moderately well drained to well drained stony glacial tills in central New England. The Museum Lot contains all of the characteristics that typify the physical environment for this type of natural community. The specific set of trees on the lot also reflect the post-pasture, agricultural history of the region. The tallest trees were the even-aged white pines, which at roughly 120 – 130 feet in height, likely resulted from the late 19th century abandonment of previously pastured ground.

Subsequent logging and other disturbance events during the early part of the 20th century resulted in some of the other tree species on the property. The bigtooth aspen, an early successional species that requires open woodlands in which to grow, were all even-aged and probably arose after the abandonment of the “tea house” during the latter years of Dr. Libby’s life. American chestnut was likely present as a canopy tree at the time of the Museum’s start, but soon perished at the hands of chestnut blight in the 1920s. It is now a remnant stump sprout in two patches in the Woodland Zone. A few other species have arisen on account of more recent disturbance associated with changes to the immediate landscape. Quaking aspen, black cherry, and pitch pine are present as small shrubs and saplings at the edge of the parking lot and roadside. These individuals could be encouraged to grow to tree size if isolated, cared for, and released from surrounding shade.

Shrubs

A total of 14 shrub species were identified for the Museum Lot, not including the *Rhododendron* and *Juniper* that was planted as a part of the earlier landscaping. Most of these species are also considered

⁵ Basal area = the cross-sectional area of each stem at breast height

common in the mixed forests of central New England, and few can reach tree size.⁶ Over half of these were native species that grew along or near the Woodland Trail. This included species such as alternate-leaved dogwood, American fly-honeysuckle, maple-leaved viburnum, maleberry, lowbush blueberry, beaked hazelnut, blackberry, red raspberry, and witch-hazel. The latter was particularly frequent in the moderately well drained soils of the western part of the Woodland Zone. Non-natives, some of which are considered invasive plants and should be removed, included glossy buckthorn, autumn olive, winged Euonymus, and Eurasian bittersweet. The latter was one of two vine species identified on the lot. The other vine species, fox grape, is also non-native but not invasive.

Herbs

A total of 75 species of herbaceous plants was identified on the Museum Lot during 2019. This included six species of ferns and fern allies: lady fern, sensitive fern, marginal wood fern, tree clubmoss, bracken, and interrupted fern. The latter mostly occurred in the garden bed in the west part of the front lawn. It is a native species that can also be found in the Woodland Zone. Most herbaceous forbs in this zone were shade-tolerant acidophiles that regularly occur in stony glacial tills on well drained soils. Good examples of ones that occurred along the Woodland Trail included round-leaved pyrola, trailing arbutus, wintergreen, partridgeberry, and whorled aster. The Gazebo Open Woods Zone contained slightly different native herbs on account of more open conditions. These included common speedwell, wavy-leaved aster, silverrod (white goldenrod), and whorled loosestrife. Some of these species were also found in the Lawn & Garden Area where various clovers, grasses, oxalis, violets, and dandelions were abundant. The Parking Lot area was characterized by plants that typically require open sunlight and constant disturbance in order to thrive. Many of these were non-native species such as lady's tear-thumb, plantain, common wormwood, and crab-grass. Natives included American burnweed (thoroughwort), indian-tobacco, autumn bentgrass, poverty oatgrass, and little bluestem grass.

A few of the herbaceous plants were noteworthy in their occurrence on the Museum Lot owing to their rarity or the specific site conditions they require. The high percentage of beech in the understory of the Woodland Zone has brought about two close beech associates that are mostly parasitic on beech roots, beech-drops and American cancer-root. Whereas beech-drops are common, cancer-root is not and was (at least prior to widespread beech blight) a state-listed threatened plant. While it is more common in recent decades, it is still unusual to find this plant in the midst of a regularly disturbed landscape. Another plant that is not necessarily uncommon but which has fairly rigid site requirement is pointed-leaved tick-trefoil. Several plants of this species was found on the gravelly bank in the southwest corner of the Parking Lot Area. This plant typically requires some soil enrichment, which may be a result of run-off from the parking lot. Other herbaceous plants in this area that also typically occur in slightly enriched soils included blue-stemmed goldenrod, hairy Solomon's-seal, wavy-leaved aster, and flat-stemmed bluegrass. It is suspected that some of the calcium enrichment may also be a result of recently weathered bedrock along the parking lot edge.

In all, the Woodland Zone had the highest plant diversity with 67 plant species, the Parking Lot Area had the second highest diversity with 44 species, the Gazebo Open Woods was third with 40 species, and the Lawn & Garden area had the least plant diversity with 17 species. Although these are only rough estimates of zone diversity owing to the lack of an exact dividing line between the zones, they do

⁶ Serviceberry, autumn olive, and glossy buckthorn can achieve the minimum tree size of 10 cms dbh.

provide an approximate measure of the distribution of plant diversity on the Museum Lot. They also provide a useful index for helping guide where new native plants could be established and persist.

Planting Recommendations

In terms of the tree arboretum, the Museum Director related the fact that Dr. Libby wanted an arboretum that had “two examples of every native tree to New Hampshire.” This was a lofty goal, especially considering the fact that there are at least 61 native tree species in the state and site conditions on the Museum Lot are only appropriate for two thirds of them. At present, there are 15 species of trees of tree size (minimum of 10 cms dbh), and another seven species of trees that are not yet of tree size, but could be encouraged to grow into trees. Of the remaining native NH trees, four exclusively grow in wetlands, four grow mostly in wet soils, six are rare species with very specific site condition requirements, and two are impractical since they are so disease-prone. That leaves roughly 23 species of native NH trees that could be added to the Museum Lot landscape.

Of these 23 species, nine could be planted at any time without needing a great deal of alteration to the existing landscape. The map below offers one representation of a planting scheme for these nine species:

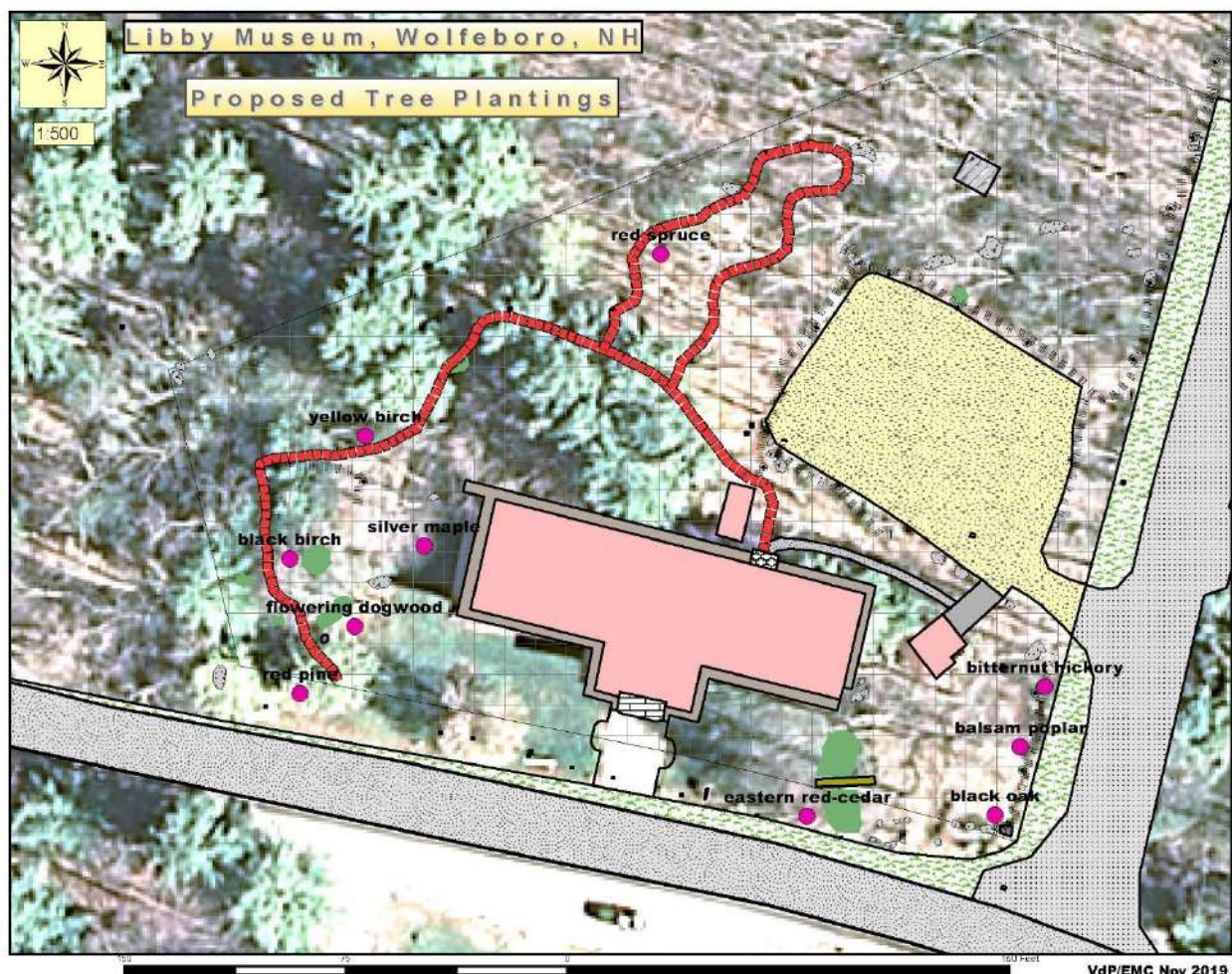


Figure 4. Proposed initial tree planting map for the Libby Museum Lot

Each of these nine species would be served well by the proposed sites as depicted. Beginning near the parking lot entrance and going counterclockwise, this includes:

- **Bitternut hickory** – this shade-tolerant tree, also known as ‘yellow bud’ owing to its bright yellow buds in fall and winter, grows as large as the shagbark hickory immediately to the north of the proposed site, and does best in sub-acidic, open woodland situations. The semi-open ground at this locale, once the autumn olive is removed, would have ample nutrients, sun, and fair to good drainage to support this species.
- **Balsam poplar** – this species is native to the northern half of the state, notably in the Connecticut River valley where the soils are more basic. It prefers semi-open to open ground, fair to moderate drainage, and fairly deep soils. The proposed site has all three of these conditions, and with some regular liming of the Gazebo lawn area, will encourage the growth of this tree and the nearby bitternut.
- **Black oak** – unlike the balsam poplar, this tree grows in the southern half of the state and in the Lakes Region reaches its northern limit. It likes open, dry, sunny locations, especially on rocky sites, which match the conditions present on the corner of Lang Pond Road. Both red oak and white oak are already present at this locale, and are common associates in the coastal plain oak forests of central and southern New England.
- **Eastern red-cedar** – also known as ‘tree juniper,’ the site conditions at the proposed location would be perfect for this species since it likes open, sunny, acidic to sub-acidic soils on ledge or near rocks. The fact that the adjacent shrub junipers at this location are doing well testifies that these conditions are present. Eastern red-cedar is also salt-tolerant, which will allow it to survive at a roadside site.
- **Red pine** – this acid-loving tree does well on well drained to excessively well drained sandy soils like those that are present near the edge of the roadway. It also does best in sunny locations, which this south-facing edge offers. Red pine can tolerate salt to a moderate degree so will also survive the regular snow-salt spray along Route 109. Although pine trees in this location will shade the hemlocks behind it, hemlocks are very shade-tolerant and won’t be affected by new trees in this location.
- **Flowering dogwood** – this small tree is slow-growing and prefers semi-shaded conditions with fairly good drainage and slightly rich soil. The proposed location at the edge of the woods near the fountain will provide a good, semi-shaded edge for this plant to grow. This site also receives some run-off from the building and supports herbaceous plants that indicate that suitable conditions are present. Some cutting back of the double-stemmed red maple that lies just behind the planting site for this tree might be required.
- **Silver maple** – this tree is proposed for a location near the edge of the building in the direct path of roof run-off because it prefers fairly wet, heavy soils of floodplains. The previous clearing of the building site and backfilled loam has resulted in soil filled with earthworms. Earthworm-laden soil with heavier, wet conditions should be suitable for silver maple to thrive in. Silver maple is fairly tolerant of soil drainage regimes, however, and has been planted in a variety of semi-open to open ground in landscapes of New Hampshire.
- **Black birch** – it was somewhat surprising that no tree-sized black birch or yellow birch were found on the Museum Lot. These two species grow quite commonly in the region on acidic, stony soils and can be found nearby along Route 109 and Lang Pond Road. Black birch likes fairly well drained soils and is commonly found with hemlock, which the proposed site is well endowed with.
- **Yellow birch** – like black birch, this very common Lakes Region tree grows nearby (e.g. on the Libby Park Lot) and tolerates fairly wet, acidic soils among stones or boulders. It is a climax forest tree in

northern hardwood forests, and is therefore quite shade tolerant. The proposed site is in moderately well drained soils right along the current Woodland Trail in the midst of several hemlocks, which is a common tree associate in these types of woodlands.

Each of the above tree locations could support two or more individuals in order to satisfy Dr. Libby's wishes of having two examples of each species, although a second individual could be planted elsewhere on the lot as well. This is particularly true for the birches, the hickory, and the maple.

Other native tree species that could be planted on the lot that may require some site enhancements include the following:

1. Gray birch – this small tree would require open light in poorly drained to moderately well drained acidic soils that could be found at the upper edge of the parking lot. Some other trees in this locale would have to be significantly cut back in order for it to grow.
2. American hornbeam – this riverine floodplain shrub-tree requires regularly moist, fine soils that are not generally present on the lot. With some soil pediments, a sample of this small tree could be introduced to the area where the silver maple is proposed to be planted.
3. Sweet pignut hickory – this medium-sized tree could be planted near the other hickories where there is well drained soils in a semi-shaded glade. Although it is not native to most of the state, it has been used in landscaping on an occasional basis.
4. Hackberry – similar to pignut hickory, this species only grows in the Connecticut River Valley and is not common even there. It does transplant fairly well, although it requires site conditions similar to those preferred by American hornbeam and so is not very well suited for the Museum Lot.
5. Hawthorne – there are nearly a dozen native hawthorns in New Hampshire, a few of which can attain tree size. Whereas the Lakes Region only supports shrub-sized hawthorns, some planted cultivars are tree-sized and are used in landscaping on account of their attractive flowers and fruits.
6. Green ash – this is another floodplain species that grows in the southern part of the state and prefers wet, sandy soils. As with the hornbeam, hackberry, and hawthorn, site conditions are not optimal on the Museum Lot for this species.
7. White spruce – this northern conifer prefers cool, well drained, sandy or stony soils. Although it grows well north and west of the Lakes Region, it is regularly planted as an ornamental and/or Christmas tree throughout the state. It would do well anywhere on the lot where there is ample light.
8. Fire or pin cherry – this early successional plant naturally grows to small tree size after being released from shade due to fire, windstorm, or clearcut logging. It was likely present on the lot after the pasture was released, but has been absent for decades on account of its shade intolerance (in the Woodland Zone) and regular gardening activities (in the remaining open ground areas). It could easily grow on the Museum Lot but would require full light in order to succeed into a tree size.
9. Scarlet oak – The lower southeastern part of the state supports scarlet oak in dry, oak-dominated woodlands. Although it does not grow naturally in the Lakes Region, it is commonly planted as an ornamental. It survives well in dry, acidic soils, and does best in full or near full sunlight.
10. American mountain-ash – This small tree is a northern montane species that grows in acidic, mesic soils. With enough care and moisture, it could grow on the lot, although it would have to be well-protected from deer. Its close cousin, European mountain-ash, is the species that is typically used in landscaping.

Nearly 20 other trees occur in the state. Most are completely unsuitable for the Museum Lot, although a few, such as larch and black gum, have been used in landscaping sites that have soils that are atypical for what they prefer. With some encouragement, these could be coaxed to grow on the lot as well.

There are many more native shrubs than trees in New Hampshire, yet on the Museum Lot trees outnumber shrubs by a considerable number. If the Museum staff and Board wish to enhance the arboretum with native shrubs, several dozen species would do well on the Museum Lot. Common species that not only provide showy foliage and flowers but also good edible fruit include highbush blueberry, black huckleberry, black raspberry, common elderberry, American hazelnut, and riverbank grape. Excellent wildlife forage species include winterberry holly, mountain holly, silky dogwood, red-osier dogwood, gray dogwood, sweet pepperbush, witherod, nannyberry, and hobblebush. All of these species could be interplanted within the existing zones, especially along the edge of the Woodland Zone and the Gazebo Open Woods Zone.

As noted above, every effort should be made to eliminate the non-native invasive shrub species that were identified for the property, specifically, glossy buckthorn, winged Euonymus, autumn olive, and bittersweet vine. In addition, the Japanese tree lilac that was found near the roadside can become an aggressive “weed” if not kept in check. Japanese barberry also occurs immediately adjacent to the lot and should be removed if it gets established. Each of these invasive plants generally take over the understory and edges of naturally vegetated areas, and can eliminate native species quite quickly.

In terms of herbaceous plants, at least ten times as many native forbs and grasses occur in the region as is present on the Museum Lot. The first step in establishing low-growing native species into the arboretum is to clear away shrubby vegetation that is visually blocking them along the Woodland Trail. Eliminating excessive shade will benefit all five of the herbs noted above, as well as marginal wood fern, hairy Solomon’s-seal, pipsissewa, zig-zag Solomon’s-seal, starflower, and Canada mayflower. Other species that were found in the Woodland Zone that could be transplanted into the trailside area include lady fern, sensitive fern, tree clubmoss, large-leaved aster, American hog-peanut, and showy tick-trefoil. The latter species will flower more profusely if given ample light, so it would benefit from being planted along the powerline opening if a trailside site is preferred.

Other plants that could be encouraged to grow in sight of the trail include the three parasitic to hemi-parasitic plants, beech-drops, American cancer-root, and indian-pipe. All three will transplant with good success if enough of the root structure is included and the plant roots are able to quickly connect to their parasitized host. At present, both the beech-drops and indian-pipe are fairly close to the trail already.

Perhaps one of the best planting areas for native wildflower species is the Lawn & Garden Area itself. Both the interrupted fern bed on the west side of the front walkway and the herb/flower bed east of the walkway could support a number of native species that require more light. Attractive perennials such as the above-mentioned showy tick-trefoil and the pointed-leaved tick-trefoil would do well in either of these beds. Other showy-flowered native species that could be transplanted include wood lily, Canada lily, smooth aster, native wormwood, orange milkweed (butterfly weed), common milkweed, woodland sunflower, and cardinal flower. Many of these are good pollinators, and can be obtained from nurseries if natural transplants are not available.

Summary

The 1.46-acre Libby Museum Lot on the north side of Route 109 is an excellent site for an outside arboretum that could augment the exceptional natural history displays inside the museum building. Ample diversity of soil types, soil pH, light, plant associations and moisture provide appropriate site conditions for a wide array of plants. The current documentation of 22 tree species, 16 shrub and vine species, and 75 herbaceous species should form the basis for highlighting existing native species through selective release from shade, transplanting, micro-site management, and importing selected new native plant materials. Understanding the light and moisture requirements for each new species is required prior to installation and management. Whereas selective thinning of existing overstory and understory plants will help the museum create an adequate exhibit of roughly half of the native plant materials on site, more rigorous management activities such as transplanting, trail relocation, and purchasing new plant materials will be required in order to double the existing diversity of plants.

The latter action will be required in order to maximize the number of native New Hampshire tree species, of which only one third exists on the Museum Lot at present. At least one half of the trees that are not yet on the lot can be brought in and planted successfully if appropriate site locations are chosen. Some minor cutting back or removal of existing plants may be required in order to provide the requisite planting conditions for new trees, however, many can be established *in situ* without excessive site preparation. The same can be said for most of the 60 – 70 species of native shrubs that are not yet on the Museum Lot, as well as many of the hundreds of native New Hampshire wildflowers that do not yet exist on the lot.

Of the 246 trees that were tallied and mapped for the Museum Lot, very few will require removal or significant alteration in order to secure a solid foundation for the arboretum lay-out. Several rotting white pines have already been marked for removal. This action will not only make room for the planned renovation of the Museum building, it will also release more light into the understory that will aid in the growth of thinned and transplanted individuals along the Woodland Trail. Clearing around the two American chestnut stump sprouts will allow these to flourish to a great degree, perhaps even to the point of flowering and fruiting. Thinning out the trees along the edge of the parking area will result in better regeneration of wildflowers and shrubs, some of which could then be transplanted into more visible and poignant locations for viewing.

In sum, the Director and the Friends of the Libby Museum Board are encouraged to follow this project up with an implementation phase that further fulfills Dr. Libby's wishes of establishing an exemplary, demonstrative, and educational arboretum in the near future.

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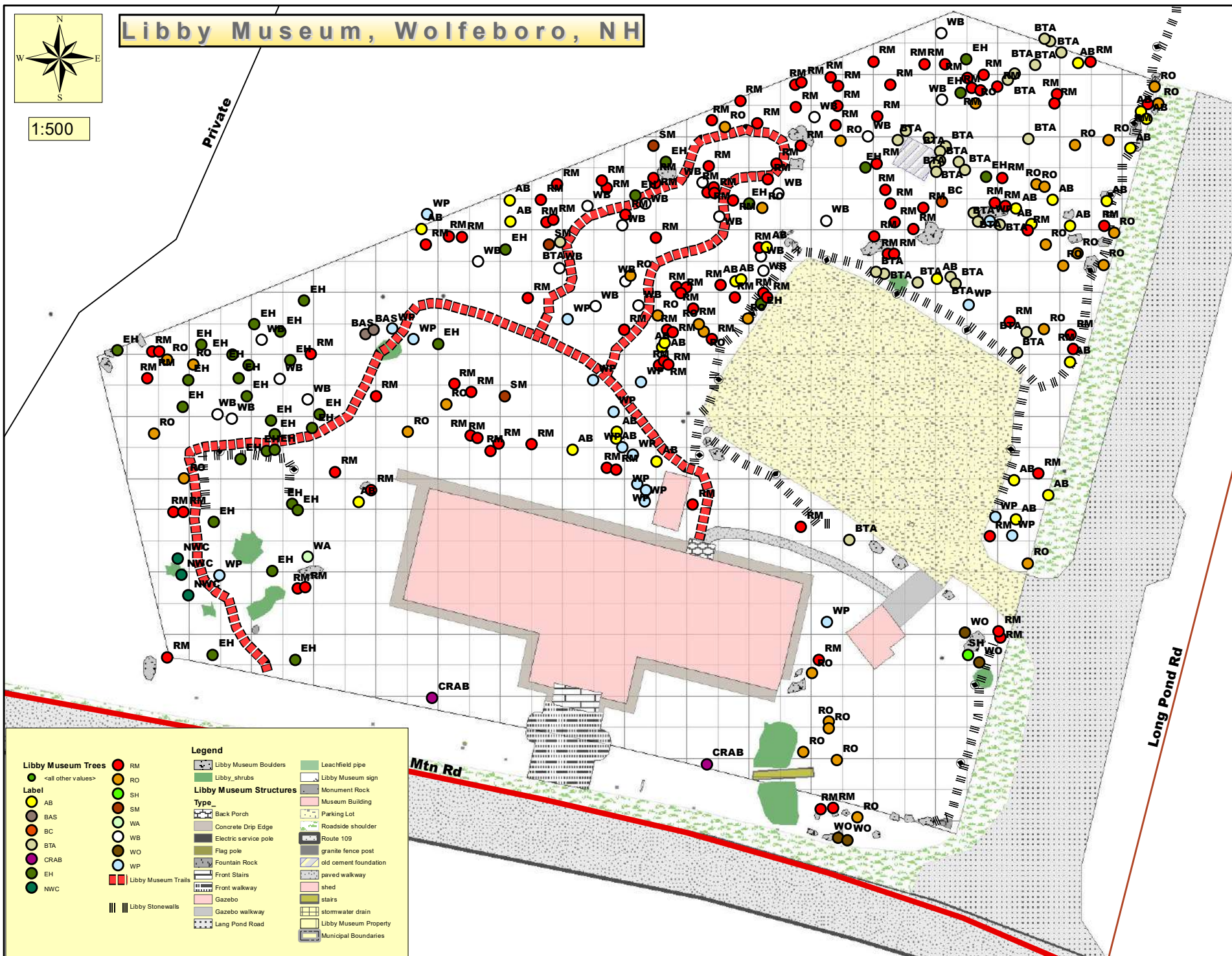
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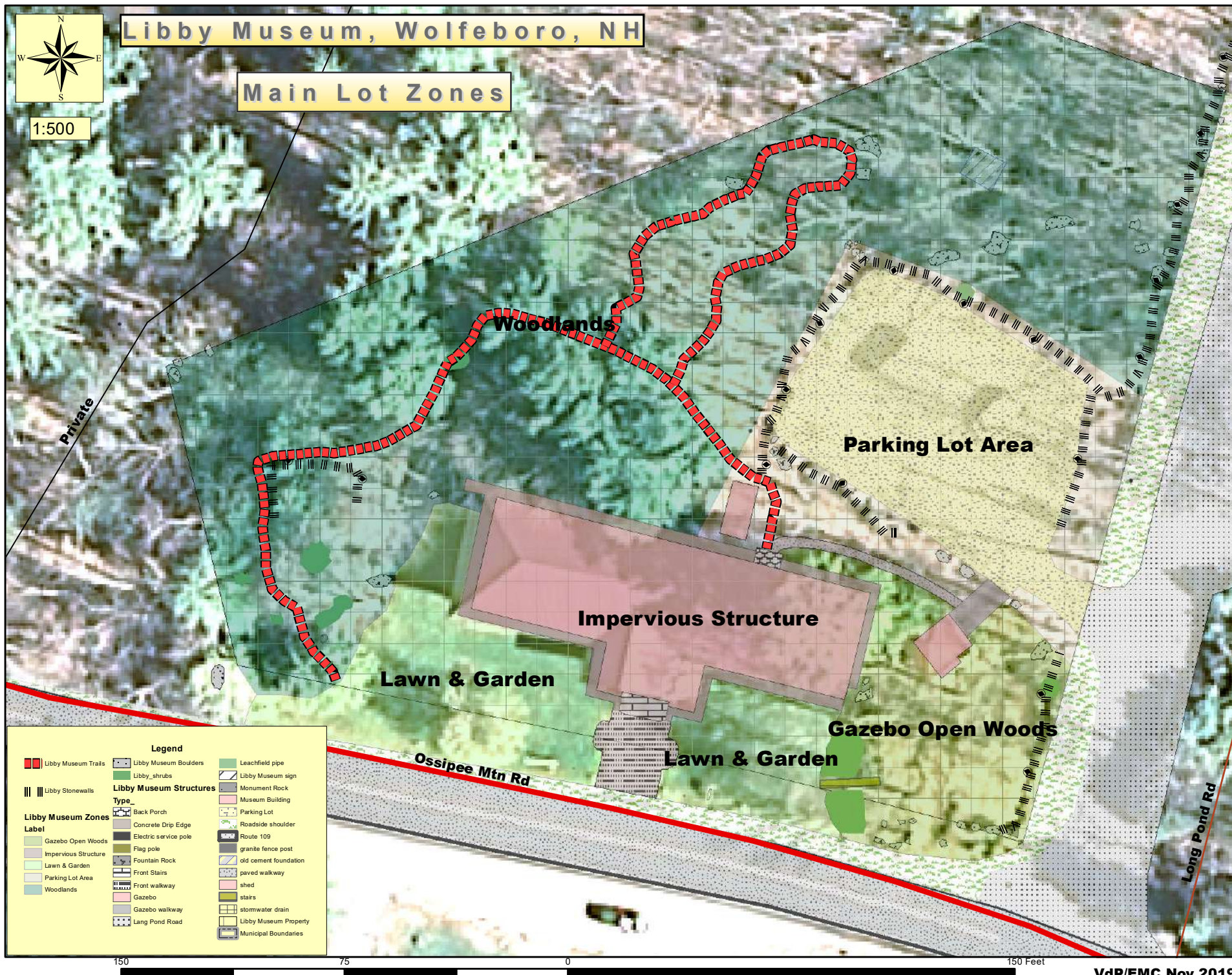
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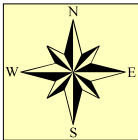
Appendix A

List of Maps

Libby Museum Base Map (small)	A - 1
Libby Museum Main Lot Zone Map (small)	A - 2
Libby Museum Tree Influence Map (small)	A - 3
Libby Museum Proposed Tree Additions Map (small)	A - 4



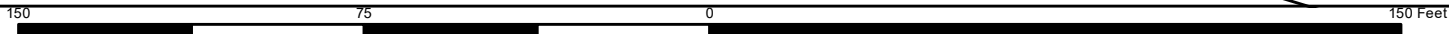
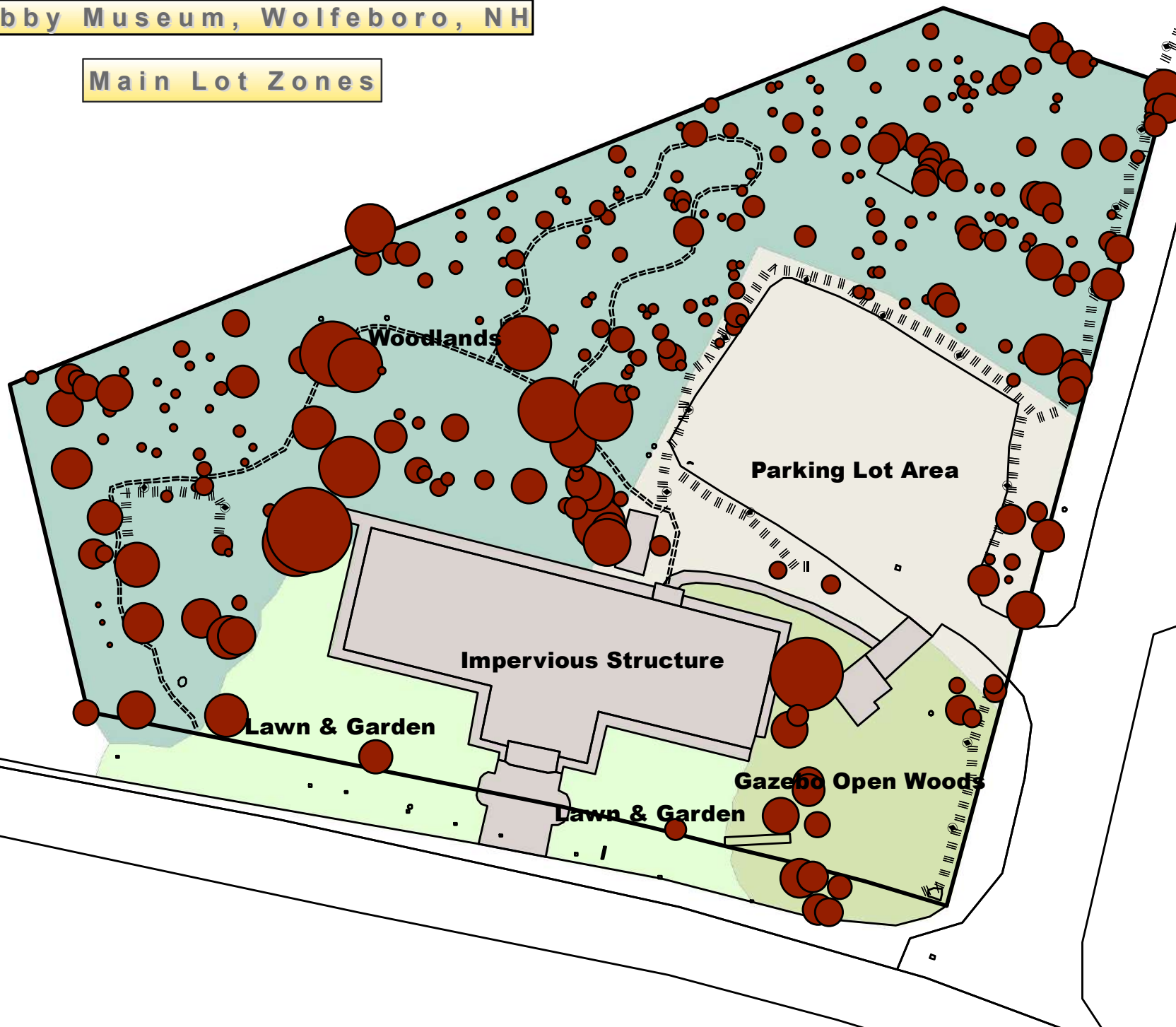


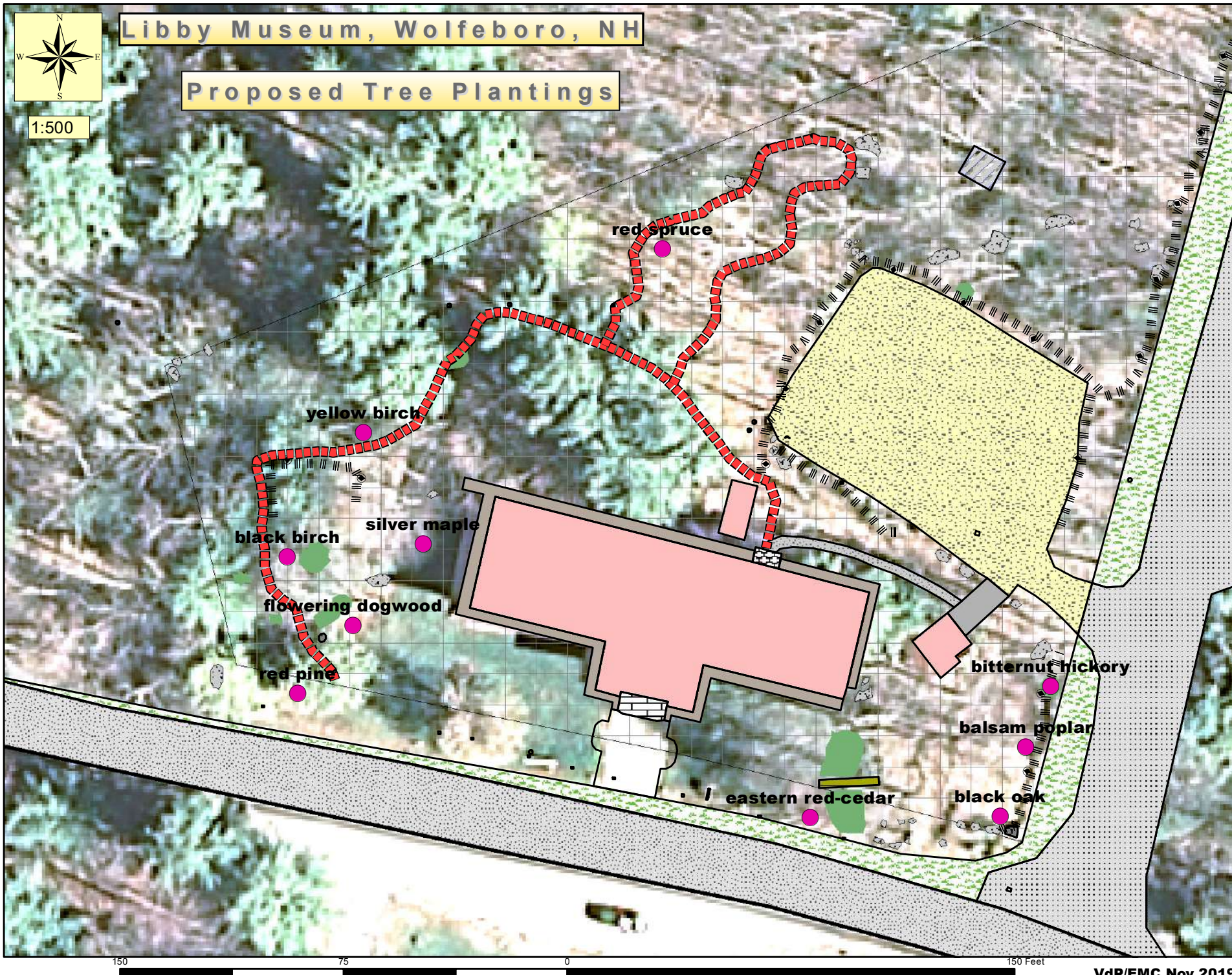


Libby Museum, Wolfeboro, NH

Main Lot Zones

1:500





Appendix B.

Species Lists

- 1) Vascular Plant Species List – Libby Museum Lot**
- 2) Native Trees of NH**

Tracheophyte Checklist of New England - LIBBY MUSEUM PROPERTY									ZONE			
Group	Family	Family Common Name	HABIT	Scientific Name	Synonyms	Common Name	Origin	Species Type	LAWN	WOODS	PKG LOT	GAZEBO
Gymnosperms	Pinaceae	pine family	T	<i>Abies balsamea</i> (L.) P. Mill.	<i>Abies balsamea</i> var. <i>phanerolepis</i> Fern.; <i>Pinus balsamea</i> L.	balsam fir	part native	orthospecies		X		
Tricolpates	Sapindaceae	soapberry family	T	<i>Acer pensylvanicum</i> L.		striped maple	native	orthospecies		X		
Tricolpates	Sapindaceae	soapberry family	T	<i>Acer rubrum</i> L.	<i>Acer carolinianum</i> Walt.; <i>Acer rubrum</i> var. <i>tridens</i> Wood; <i>Acer stenocarpum</i> Britt.; <i>Rufacer rubrum</i> (L.) Small; <i>Rufacer carolinianum</i> (Walt.) Small	red maple	native	orthospecies		X	X	X
Tricolpates	Sapindaceae	soapberry family	T	<i>Acer saccharum</i> Marsh. var. <i>saccharum</i>	<i>Acer nigrum</i> var. <i>glaucum</i> (F. Schmidt) Fosberg; <i>Acer nigrum</i> var. <i>saccharophorum</i> (K. Koch) Clausen; <i>Acer saccharum</i> var. <i>glaucum</i> (F. Schmidt) Sarg.; <i>Saccharodendron saccharum</i> (Marsh.) Moldenke	sugar maple	native	orthospecies		X		
Tricolpates	Asteraceae	aster family	H	<i>Achillea millefolium</i> L. ssp. <i>lanulosa</i> (Nutt.) Piper	<i>Achillea borealis</i> Bong.; <i>Achillea lanulosa</i> Nutt.; <i>Achillea millefolium</i> ssp. <i>borealis</i> (Bong.) Breitung; <i>Achillea millefolium</i> var. <i>lanulosa</i> (Nutt.) Piper; <i>Achillea millefolium</i> var. <i>nigrescens</i> E. Mey.; <i>Achillea millefolium</i> ssp. <i>occidentalis</i> (DC.) Hyl.; <i>Achillea millefolium</i> var. <i>occidentalis</i> DC.; <i>Achillea nigrescens</i> (E. Mey.) Rydb.	common yarrow	native	orthospecies	X			X
Tricolpates	Ranunculaceae	crowfoot family	H	<i>Actaea pachypoda</i> Ell.	<i>Actaea alba</i> , of authors not (L.) P. Mill.	white baneberry	native	orthospecies		X		
Monocots	Poaceae	grass family	H	<i>Agrostis capillaris</i> L.	<i>Agrostis tenuis</i> Sibthorp	Rhode Island bentgrass	non-native	orthospecies		X		X
Monocots	Poaceae	grass family	H	<i>Agrostis perennans</i> (Walt.) Tuckerman	<i>Agrostis altissima</i> (Walt.) Tuckerman; <i>Agrostis perennans</i> var. <i>elata</i> (Pursh) A.S. Hitchc.; <i>Cornucopiae perennans</i> Walt.	autumn bentgrass	native	orthospecies	X			X
Tricolpates	Asteraceae	aster family	H	<i>Ambrosia artemisiifolia</i> L.	<i>Ambrosia artemisiifolia</i> var. <i>elatiar</i> (L.) Descourtils; <i>Ambrosia artemisiifolia</i> var. <i>paniculata</i> (Michx.) Blank.; <i>Ambrosia elatiar</i> L.; <i>Ambrosia monophylla</i> (Walt.) Rydb.; <i>Ambrosia paniculata</i> Michx.	common ragweed	native	orthospecies				X
Tricolpates	Rosaceae	rose family	S	<i>Amelanchier arborea</i> (Michx. f.) Fern.	<i>Mespilus arborea</i> Michx. f.; <i>Pyrus wangenheimiana</i> Tausch	downy shadbush	native	orthospecies		X		
Tricolpates	Fabaceae	legume family	H	<i>Amphicarpaea bracteata</i> (L.) Fern.	<i>Amphicarpaea bracteata</i> var. <i>comosa</i> (L.) Fern.; <i>Amphicarpaea comosa</i> (L.) G. Don; <i>Amphicarpaea monoica</i> (L.) Ell.; <i>Amphicarpaea pitcheri</i> Torr. & Gray; <i>Falcata comosa</i> (L.) Kuntze; <i>Glycine bracteata</i> L.; <i>Glycine comosa</i> L.	American hog-peanut	native	orthospecies		X		
Tricolpates	Apiaceae	celery family	H	<i>Aralia nudicaulis</i> L.		wild sarsaparilla	native	orthospecies		X		
Tricolpates	Asteraceae	aster family	H	<i>Artemisia vulgaris</i> L. var. <i>vulgaris</i>	<i>Artemisia vulgaris</i> var. <i>glabra</i> Ledeb.; <i>Artemisia vulgaris</i> var. <i>latiloba</i> Ledeb.	common wormwood	non-native	orthospecies	X			
Monilophytes	Woodsiaceae	lady fern family	F	<i>Athyrium angustum</i> (Willd.) C. Presl.	<i>Athyrium filix-femina</i> (L.) Roth ssp. <i>angustum</i> (Willd.) Clausen; <i>Athyrium filix-femina</i> (L.) Roth var. <i>angustum</i> (Willd.) Lawson; <i>Athyrium filix-femina</i> (L.) Roth var. <i>michauxii</i> (Spreng.) Farw.; <i>Athyrium filix-femina</i> (L.) Roth var. <i>rubellum</i> Gilbert	northern lady fern	native	orthospecies		X		
Tricolpates	Betulaceae	birch family	T	<i>Betula papyrifera</i> Marsh.	<i>Betula alba</i> L. var. <i>commutata</i> Regel; <i>Betula papyrifera</i> var. <i>commutata</i> (Regel) Fern.; <i>Betula papyrifera</i> var. <i>macrostachya</i> Fern.	paper birch	native	orthospecies		X	X	
Monocots	Cyperaceae	sedge family	H	<i>Carex communis</i> Bailey var. <i>communis</i>		fibrous-rooted sedge	native	orthospecies		X		
Monocots	Cyperaceae	sedge family	H	<i>Carex debilis</i> Michx. var. <i>debilis</i>	<i>Carex debilis</i> var. <i>intercursa</i> Fern.	white-edged sedge	native	orthospecies		X		
Monocots	Cyperaceae	sedge family	H	<i>Carex tonsa</i> (Fern.) Bickn. var. <i>tonsa</i>	<i>Carex rugosperma</i> Mackenzie var. <i>tonsa</i> (Fern.) E.G. Voss; <i>Carex umbellata</i> var. <i>tonsa</i> Fern.	shaved sedge	native	orthospecies	X			
Tricolpates	Juglandaceae	walnut family	T	<i>Carya ovata</i> (P. Mill.) K. Koch	<i>Carya ovata</i> var. <i>pubescens</i> Sarg.; <i>Hicoria ovata</i> (P. Mill.) Britt.; <i>Juglans alba</i> L., in part	shagbark hickory	native	orthospecies		X		X
Tricolpates	Fagaceae	beech family	T	<i>Castanea dentata</i> (Marsh.) Borkh.	<i>Fagus-castanea dentata</i> Marsh.	American chestnut	native	orthospecies		X		
Tricolpates	Celastraceae	bittersweet family	V	<i>Celastrus orbiculatus</i> Thunb.		Asian bittersweet	non-native	orthospecies		X	X	
Tricolpates	Ericaceae	heath family	H	<i>Chimaphila maculata</i> (L.) Pursh	<i>Pyrola maculata</i> L.	spotted prince's-pine	native	orthospecies				
Tricolpates	Myricaceae	bayberry family	S	<i>Comptonia peregrina</i> (L.) Coult.	<i>Comptonia peregrina</i> var. <i>aspleniifolia</i> (L.) Fern.; <i>Myrica aspleniifolia</i> L.; <i>Myrica peregrina</i> (L.) Kuntze; <i>Liquidambar peregrina</i> L.	sweet-fern	native	orthospecies			X	
Tricolpates	Orobanchaceae	broom-rape family	H	<i>Conopholis americana</i> (L.) Wallr. f.	<i>Orobanche americana</i> L.	American squaw-root	native	orthospecies		X		
Tricolpates	Betulaceae	birch family	S	<i>Corylus cornuta</i> Marsh. ssp. <i>cornuta</i>	<i>Corylus rostrata</i> Ait.	beaked hazelnut	native	orthospecies		X	X	

Tracheophyte Checklist of New England - LIBBY MUSEUM PROPERTY									ZONE			
Group	Family	Family Common Name	HABIT	Scientific Name	Synonyms	Common Name	Origin	Species Type	LAWN	WOODS	PKG LOT	GAZEBO
Monocots	Poaceae	grass family	H	<i>Danthonia spicata</i> (L.) Beauv. ex Roemer & J.A. Schultes	<i>Danthonia spicata</i> var. <i>longipila</i> Scribn. & Merr.; <i>Danthonia spicata</i> var. <i>pinetorum</i> Piper	poverty oatgrass	native	orthospecies			X	
Lycophytes	Lycopodiaceae	clubmoss family	F	<i>Dendrolycopodium obscurum</i> (L.) A. Haines	<i>Lycopodium obscurum</i> L.	flat-branched tree-clubmoss	native	orthospecies		X		
Monilophytes	Dennstaedtiaceae	hay-scented fern family	F	<i>Dennstaedtia punctilobula</i> (Michx.) T. Moore	<i>Nephrodium punctilobulum</i> Michx.	eastern hay-scented fern	native	orthospecies				X
Tricolpates	Fabaceae	legume family	H	<i>Desmodium canadense</i> (L.) DC.	<i>Hedysarum canadense</i> L.; <i>Meibomia canadensis</i> (L.) Kuntze	showy tick-trefoil	native	orthospecies			X	
Monocots	Poaceae	grass family	H	<i>Dichanthelium lanuginosum</i> (Ell.) Gould	<i>Dichanthelium acuminatum</i> (Sw.) Gould & C.A. Clark ssp. <i>fasciculatum</i> (Torr.) Freckmann & Lelong; <i>Dichanthelium lanuginosum</i> var. <i>fasciculatum</i> (Torr.) Spellenberg; <i>Panicum lanuginosum</i> Ell.; <i>Panicum lanuginosum</i> Ell. var. <i>fasciculatum</i> (Torr.) Fern.; <i>Panicum lanuginosum</i> Ell. var. <i>tennesseense</i> (Ashe) Gleason; <i>Panicum tennesseense</i> Ashe	woolly rosette-panicgrass	native	orthospecies				X
Monocots	Poaceae	grass family	H	<i>Digitaria sanguinalis</i> (L.) Scop.	<i>Panicum sanguinale</i> L.	hairy crabgrass	non-native	orthospecies				X
Monilophytes	Dryopteridaceae	wood fern family	F	<i>Dryopteris marginalis</i> (L.) Gray	<i>Polypodium marginale</i> L.	marginal wood fern	native	orthospecies		X		
Tricolpates	Elaeagnaceae	oleaster family	S	<i>Elaeagnus angustifolia</i> L.		Russian-olive	non-native	orthospecies			X	
Tricolpates	Orobanchaceae	broom-rape family	H	<i>Epifagus virginiana</i> (L.) W. Bart.	<i>Leptantrum virginianum</i> (L.) Raf.	beech-drops	native	orthospecies		X		
Tricolpates	Ericaceae	heath family	H	<i>Epigaea repens</i> L.	<i>Epigaea repens</i> var. <i>glabrifolia</i> Fern.	trailing-arbutus	native	orthospecies		X		X
Monocots	Orchidaceae	orchid family	H	<i>Epipactis helleborine</i> (L.) Crantz	<i>Epipactis latifolia</i> (L.) All.; <i>Serapias helleborine</i> L.	broad-leaved helleborine	non-native	orthospecies		X		
Tricolpates	Asteraceae	aster family	H	<i>Erechtites hieracifolius</i> (L.) Raf. ex DC. var. <i>hieracifolius</i>	<i>Erechtites hieracifolius</i> var. <i>intermedius</i> Fern.; <i>Erechtites hieracifolius</i> var. <i>praealtus</i> (Raf.) Fern.; <i>Senecio hieracifolius</i> L.	American burnweed	native	orthospecies			X	
Tricolpates	Asteraceae	aster family	H	<i>Erigeron pulchellus</i> Michx. var. <i>pulchellus</i>		Robin's plantain fleabane	native	orthospecies			X	
Tricolpates	Celastraceae	bittersweet family	S	<i>Euonymus alatus</i> (Thunb.) Sieb.	<i>Celastrus alatus</i> Thunb.	winged spindle-tree	non-native	orthospecies		X	X	
Tricolpates	Asteraceae	aster family	H	<i>Eurybia divaricata</i> (L.) Nesom	<i>Aster castaneus</i> Burgess; <i>Aster divaricatus</i> L.; <i>Aster excavatus</i> Burgess; <i>Aster tenebrosus</i> Burgess	white wood-aster	native	orthospecies		X		X
Tricolpates	Asteraceae	aster family	H	<i>Eurybia macrophylla</i> (L.) Cass.	<i>Aster ianthinus</i> Burgess; <i>Aster macrophyllus</i> L.; <i>Aster macrophyllus</i> L. var. <i>apricensis</i> Burgess; <i>Aster macrophyllus</i> L. var. <i>excelsior</i> Burgess; <i>Aster macrophyllus</i> L. var. <i>ianthinus</i> (Burgess) Fern.; <i>Aster macrophyllus</i> L. var. <i>pinguifolius</i> Burgess; <i>Aster macrophyllus</i> L. var. <i>velutinus</i> Burgess	large-leaved wood-aster	native	orthospecies		X		X
Tricolpates	Fagaceae	beech family	T	<i>Fagus grandifolia</i> Ehrh.	<i>Fagus grandifolia</i> var. <i>caroliniana</i> (Loud.) Fern. & Rehd.	American beech	native	orthospecies		X	X	X
Monocots	Poaceae	grass family	H	<i>Festuca rubra</i> L. ssp. <i>rubra</i>	<i>Festuca duriuscula</i> L.; <i>Festuca ovina</i> var. <i>rubra</i> (L.) Sm.	red fescue	non-native	orthospecies	X			X
Tricolpates	Rosaceae	rose family	H	<i>Fragaria vesca</i> L. ssp. <i>vesca</i>	<i>Fragaria vesca</i> var. <i>alba</i> (Ehrh.) Rydb.	woodland strawberry	non-native	orthospecies		X	X	X
Tricolpates	Rhamnaceae	buckthorn family	S	<i>Frangula alnus</i> P. Mill.	<i>Rhamnus frangula</i> L.	glossy false buckthorn	non-native	orthospecies		X	X	
Tricolpates	Oleaceae	olive family	T	<i>Fraxinus americana</i> L.	<i>Fraxinus americana</i> var. <i>biltmoreana</i> (Beadle) J. Wright ex Fern.; <i>Fraxinus americana</i> var. <i>microcarpa</i> Gray; <i>Fraxinus biltmoreana</i> Beadle	white ash	native	orthospecies		X	X	
Tricolpates	Ericaceae	heath family	H	<i>Gaultheria procumbens</i> L.		eastern spicy-wintergreen	native	orthospecies		X		X
Tricolpates	Hamamelidaceae	witch-hazel family	S	<i>Hamamelis virginiana</i> L.	<i>Hamamelis virginiana</i> var. <i>parvifolia</i> Nutt.	American witch-hazel	native	orthospecies		X	X	
Tricolpates	Asteraceae	aster family	H	<i>Hieracium lachenalii</i> K.C. Gmel.	<i>Hieracium vulgatum</i> Fries	common hawkweed	non-native	orthospecies			X	X
Tricolpates	Asteraceae	aster family	H	<i>Hieracium paniculatum</i> L.		panicked hawkweed	native	orthospecies		X		X
Tricolpates	Rubiaceae	madder family	H	<i>Houstonia caerulea</i> L.	<i>Hedyotis caerulea</i> (L.) Hook.; <i>Houstonia caerulea</i> var. <i>faxinorum</i> Pease & Moore	little bluet	native	orthospecies	X		X	X
Tricolpates	Fabaceae	legume family	H	<i>Hylodesmum glutinosum</i> (Muhl. ex Willd.) H. Ohashi & R.R. Mill	<i>Desmodium acuminatum</i> (Michx.) DC.; <i>Desmodium glutinosum</i> (Muhl. ex Willd.) Wood; <i>Hedysarum glutinosum</i> Muhl. ex Willd.; <i>Meibomia acuminata</i> (Michx.) Blake	pointed-leaved tick-clover	native	orthospecies			X	
Monocots	Juncaceae	rush family	H	<i>Juncus brevicaudatus</i> (Engelm.) Fern.		short-tailed rush	native	orthospecies			X	
Monocots	Juncaceae	rush family	H	<i>Juncus tenuis</i> Willd.	<i>Juncus macer</i> S.F. Gray; <i>Juncus tenuis</i> var. <i>williamsii</i> Fern.	path rush	native	orthospecies			X	
Tricolpates	Campanulaceae	bellflower family	H	<i>Lobelia inflata</i> L.		bladder-pod lobelia	native	orthospecies			X	X

Tracheophyte Checklist of New England - LIBBY MUSEUM PROPERTY									ZONE			
Group	Family	Family Common Name	HABIT	Scientific Name	Synonyms	Common Name	Origin	Species Type	LAWN	WOODS	PKG LOT	GAZEBO
Tricolpates	Caprifoliaceae	honeysuckle family	S	<i>Lonicera canadensis</i> Bartr. ex Marsh.	<i>Xylosteum ciliatum</i> Pursh	American honeysuckle	native	orthospecies		X		
Monocots	Juncaceae	rush family	H	<i>Luzula multiflora</i> (Ehrh.) Lej. ssp. <i>multiflora</i>	<i>Luzula campestris</i> var. <i>multiflora</i> (Ehrh.) Celak.	common wood-rush	native	orthospecies				X
Tricolpates	Ericaceae	heath family	S	<i>Lyonia ligustrina</i> (L.) DC. var. <i>ligustrina</i>	<i>Arsenococcus ligustrinus</i> (L.) Small; <i>Xolisma ligustrina</i> (L.) Britt.	maleberry	native	orthospecies		X		
Tricolpates	Mysinaceae	colicwood family	H	<i>Lysimachia borealis</i> (Raf.) U. Manns & A. Anderb.	<i>Trientalis americana</i> Pursh; <i>Trientalis borealis</i> Raf.	starflower	native	orthospecies		X		
Tricolpates	Mysinaceae	colicwood family	H	<i>Lysimachia quadrifolia</i> L.		whorled yellow-loosestrife	native	orthospecies		X	X	
Monocots	Ruscaceae	butcher's-broom family	H	<i>Maianthemum canadense</i> Desf.	<i>Maianthemum canadense</i> var. <i>pubescens</i> Gates & Ehlers; <i>Unifolium canadense</i> (Desf.) Greene	Canada-mayflower	native	orthospecies		X		X
Monocots	Ruscaceae	butcher's-broom family	H	<i>Maianthemum racemosum</i> (L.) Link ssp. <i>racemosum</i>	<i>Convallaria racemosa</i> L.; <i>Smilacina racemosa</i> (L.) Desf.; <i>Smilacina racemosa</i> var. <i>lanceolata</i> Boivin; <i>Vagnera racemosa</i> (L.) Morong; <i>Unifolium racemosum</i> (L.) Britt.	feathery false Solomon's-seal	native	orthospecies		X		X
Tricolpates	Rubiaceae	madder family	H	<i>Mitchella repens</i> L.		partridge-berry	native	orthospecies		X		
Tricolpates	Ericaceae	heath family	H	<i>Monotropa uniflora</i> L.	<i>Monotropa brittonii</i> Small	one-flowered Indian-pipe	native	orthospecies		X		
Tricolpates	Asteraceae	aster family	H	<i>Oclemena acuminata</i> (Michx.) Nesom	<i>Aster acuminatus</i> Michx.	sharp-toothed nodding-aster	native	orthospecies		X		
Monilophytes	Onocleaceae	fiddlehead fern family	F	<i>Onoclea sensibilis</i> L.	<i>Onoclea sensibilis</i> var. <i>obtusilobata</i> (Schkuhr) Torr.	sensitive fern	native	orthospecies		X		
Monocots	Poaceae	grass family	H	<i>Oryzopsis asperifolia</i> Michx.		white-grained rice grass	native	orthospecies		X		
Monilophytes	Osmundaceae	royal fern family		<i>Osmunda claytoniana</i> L.	<i>Claytosmunda claytoniana</i> (L.) Metzgar & Rouhan; <i>Osmundastrum claytonianum</i> (L.) Tagawa	interrupted fern	native	orthospecies	X	X		
Tricolpates	Betulaceae	birch family	T	<i>Ostrya virginiana</i> (P. Mill.) K. Koch	<i>Carpinus virginiana</i> P. Mill.; <i>Ostrya virginiana</i> var. <i>lasia</i> Fern.	hop-hornbeam	native	orthospecies		X		
Tricolpates	Oxalidaceae	wood sorrel family	H	<i>Oxalis stricta</i> L.	<i>Ceratoxalis cymosa</i> (Small) Lunell; <i>Oxalis cymosa</i> Small; <i>Oxalis europaea</i> Jord.; <i>Oxalis europaea</i> Jord. var. <i>bushii</i> (Small) Wieg.; <i>Oxalis interior</i> (Small) Fedde; <i>Oxalis stricta</i> var. <i>villicaulis</i> (Wieg.) Farw.; <i>Xanthoxalis bushii</i> Small; <i>Xanthoxalis cymosa</i> (Small) Small; <i>Xanthoxalis interior</i> Small; <i>Xanthoxalis stricta</i> (L.) Small	common yellow wood sorrel	native	orthospecies	X		X	
Tricolpates	Polygonaceae	knotweed family	H	<i>Persicaria maculosa</i> S.F. Gray	<i>Persicaria persicaria</i> (L.) Small; <i>Persicaria vulgaris</i> Webb & Moq.; <i>Polygonum dubium</i> Stein; <i>Polygonum persicaria</i> L.	lady's-thumb smartweed	non-native	orthospecies			X	
Tricolpates	Asteraceae	aster family	H	<i>Pilosella</i> × <i>floribunda</i> (Wimmer & Grab.) Arv.-Touv.	<i>Pilosella caespitosa</i> × <i>P. lactucella</i> (Wallr.) P.D. Sell & C. West; <i>Hieracium</i> × <i>floribundum</i> Wimmer & Grab.		non-native	nothospecies	X			
Gymnosperms	Pinaceae	pine family	T	<i>Pinus rigida</i> P. Mill.		pitch pine	native	orthospecies		X		
Gymnosperms	Pinaceae	pine family	T	<i>Pinus strobus</i> L.	<i>Strobus strobus</i> (L.) Small	eastern white pine	native	orthospecies		X	X	X
Tricolpates	Plantaginaceae	snapdragon family	H	<i>Plantago lanceolata</i> L.	<i>Arnoglossum lanceolatum</i> S.F. Gray; <i>Plantago altissima</i> , of authors not L.; <i>Plantago lanceolata</i> var. <i>sphaerostachya</i> Mert. & Koch	English plantain	non-native	orthospecies	X			X
Tricolpates	Plantaginaceae	snapdragon family	H	<i>Plantago major</i> L.	<i>Plantago major</i> var. <i>pilgeri</i> Domin	common plantain	non-native	orthospecies	X		X	X
Monocots	Poaceae	grass family	H	<i>Poa annua</i> L.		annual blue grass	non-native	orthospecies	X			
Monocots	Poaceae	grass family	H	<i>Poa compressa</i> L.		flat-stemmed blue grass	non-native	orthospecies			X	
Monocots	Poaceae	grass family	H	<i>Poa pratensis</i> L. ssp. <i>pratensis</i>	<i>Poa pratensis</i> var. <i>domestica</i> Laestad.	Kentucky blue grass	non-native	orthospecies	X			X
Monocots	Ruscaceae	butcher's-broom family	H	<i>Polygonatum pubescens</i> (Willd.) Pursh	<i>Convallaria pubescens</i> Willd.	hairy Solomon's-seal	native	orthospecies		X		
Tricolpates	Salicaceae	willow family	T	<i>Populus grandidentata</i> Michx.	<i>Populus grandidentata</i> var. <i>angustata</i> Victorin	big-toothed poplar	native	orthospecies		X		
Tricolpates	Salicaceae	willow family	T	<i>Populus tremuloides</i> Michx.	<i>Populus tremula</i> ssp. <i>tremuloides</i> (Michx.) A. & D. Löve; <i>Populus tremuloides</i> var. <i>magnifica</i> Victorin	quaking poplar	native	orthospecies			X	
Tricolpates	Rosaceae	rose family	H	<i>Potentilla simplex</i> Michx.	<i>Potentilla simplex</i> var. <i>argyrisma</i> Fern.; <i>Potentilla simplex</i> var. <i>calvescens</i> Fern.; <i>Potentilla simplex</i> var. <i>typica</i> Fern.	old-field cinquefoil	native	orthospecies				X
Tricolpates	Rosaceae	rose family	T	<i>Prunus serotina</i> Ehrh. var. <i>serotina</i>	<i>Padus serotina</i> (Ehrh.) Borkh.	black cherry	native	orthospecies		X	X	
Monilophytes	Dennstaedtiaceae	hay-scented fern family	F	<i>Pteridium aquilinum</i> (L.) Kuhn ssp. <i>latiusculum</i> (Desv.) Hultén	<i>Pteridium aquilinum</i> var. <i>latiusculum</i> (Desv.) Underwood ex Heller; <i>Pteridium latiusculum</i> (Desv.) Hieron.	bracken fern	native	orthospecies		X	X	

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Tricolpates	Ericaceae	heath family	H	<i>Pyrola americana</i> Sweet	<i>Pyrola asarifolia</i> ssp. <i>americana</i> (Sweet) Krisa; <i>Pyrola rotundifolia</i> L. ssp. <i>americana</i> (Sweet) Clausen; <i>Pyrola rotundifolia</i> L. var. <i>americana</i> (Sweet) Fern.	American shinleaf	native	orthospecies		X		
Tricolpates	Fagaceae	beech family	T	<i>Quercus alba</i> L.		eastern white oak	native	orthospecies		X		X
Tricolpates	Fagaceae	beech family	T	<i>Quercus rubra</i> L.	<i>Quercus borealis</i> Michx. f.; <i>Quercus borealis</i> Michx. f. var. <i>maxima</i> (Marsh.) Ashe; <i>Quercus rubra</i> var. <i>ambigua</i> (Gray) Fern.; <i>Quercus rubra</i> var. <i>borealis</i> (Michx. f.) Farw.	northern red oak	native	orthospecies		X	X	X
Tricolpates	Rosaceae	rose family	S	<i>Rubus allegheniensis</i> Porter	<i>Rubus allegheniensis</i> var. <i>gravesii</i> Fern.; <i>Rubus auroralis</i> Bailey; <i>Rubus fernaldianus</i> Bailey; <i>Rubus longissimus</i> Bailey; <i>Rubus nigrobaccus</i> Bailey; <i>Rubus pugnax</i> Bailey; <i>Rubus saluensis</i> Bailey; <i>Rubus sativus</i> Brainerd	common blackberry	native	orthospecies			X	
Tricolpates	Rosaceae	rose family	S	<i>Rubus idaeus</i> L. ssp. <i>strigosus</i> (Michx.) Focke	<i>Batidea strigosa</i> (Michx.) Greene; <i>Rubus idaeus</i> var. <i>aculeatissimus</i> Regel & Tiling; <i>Rubus idaeus</i> var. <i>canadensis</i> Richards.; <i>Rubus idaeus</i> var. <i>caudatus</i> (Robins. & Schrenk) Fern.; <i>Rubus idaeus</i> var. <i>egglestonii</i> (Blanch.) Fern.; <i>Rubus idaeus</i> var. <i>eucyclus</i> Fern. & Weatherby; <i>Rubus idaeus</i> var. <i>heterolasius</i> Fern.; <i>Rubus idaeus</i> ssp. <i>melanolasius</i> (Dieck) Focke; <i>Rubus idaeus</i> ssp. <i>sachalinensis</i> (Levl.) Focke; <i>Rubus melanolasius</i> Dieck; <i>Rubus strigosus</i> Michx.; <i>Rubus strigosus</i> var. <i>canadensis</i> (Richards.) House	red raspberry	native	orthospecies		X		
Tricolpates	Polygonaceae	knotweed family	H	<i>Rumex acetosella</i> L. ssp. <i>pyrenaicus</i> (Pourret ex Lapeyr.) Akeroyd	<i>Acetosella vulgaris</i> (Koch) Fourr. ssp. <i>pyrenaica</i> (Pourret ex Lapeyr.) A. Löve; <i>Rumex acetosella</i> var. <i>pyrenaicus</i> (Pourret ex Lapeyr.) Timbal-Lagrange; <i>Rumex pyrenaicus</i> Pourret ex Lapeyr.	sheep dock	non-native	orthospecies				X
Monocots	Poaceae	grass family	H	<i>Schizachyrium scoparium</i> (Michx.) Nash var. <i>scoparium</i>	<i>Andropogon scoparius</i> Michx.; <i>Andropogon scoparius</i> Michx. var. <i>ducis</i> Fern. & Grise.; <i>Andropogon scoparius</i> Michx. var. <i>frequens</i> F.T. Hubbard; <i>Andropogon scoparius</i> Michx. var. <i>neomexicanus</i> (Nash) A.S. Hitchc.; <i>Andropogon scoparius</i> Michx. var. <i>septentrionalis</i> Fern. & Grise.	little bluestem	native	orthospecies			X	X
Tricolpates	Asteraceae	aster family	H	<i>Solidago bicolor</i> L.		white goldenrod	native	orthospecies				X
Tricolpates	Asteraceae	aster family	H	<i>Solidago caesia</i> L. var. <i>caesia</i>	<i>Solidago axillaris</i> Pursh; <i>Solidago caesia</i> var. <i>axillaris</i> (Pursh) Gray	axillary goldenrod	native	orthospecies		X		
Tricolpates	Asteraceae	aster family	H	<i>Solidago gigantea</i> Ait.	<i>Solidago gigantea</i> ssp. <i>serotina</i> (Kuntze) McNeill; <i>Solidago gigantea</i> var. <i>serotina</i> (Kuntze) Cronq.	smooth goldenrod	native	orthospecies			X	
Tricolpates	Caryophyllaceae	pink family	H	<i>Stellaria media</i> (L.) Vill. ssp. <i>media</i>	<i>Alsine media</i> L.; <i>Stellaria apetala</i> Ucria ex Roemer; <i>Stellaria media</i> var. <i>procera</i> Klatt & Richter	common stitchwort	non-native	orthospecies		X		
Tricolpates	Cornaceae	dogwood family	S	<i>Swida alternifolia</i> (L. f.) Small	<i>Bothrocaryum alternifolia</i> (L. f.) Pojark.; <i>Cornus alternifolia</i> (L.) DC.	alternate-leaved dogwood	native	orthospecies		X	X	
Tricolpates	Asteraceae	aster family	H	<i>Symphyotrichum lateriflorum</i> (L.) A. & D. Löve	<i>Aster hirsuticaulis</i> Lindl. ex DC.; <i>Aster lateriflorus</i> (L.) Britt.; <i>Aster lateriflorus</i> (L.) Britt. var. <i>angustifolius</i> Wieg.; <i>Aster lateriflorus</i> (L.) Britt. var. <i>hirsuticaulis</i> (Lindl. ex DC.) Porter; <i>Solidago lateriflora</i> L.	calico American-aster	native	orthospecies		X		X
Tricolpates	Asteraceae	aster family	H	<i>Symphyotrichum undulatum</i> (L.) Nesom	<i>Aster loriformis</i> (Burgess) Burgess; <i>Aster undulatus</i> L.; <i>Aster undulatus</i> L. var. <i>loriformis</i> Burgess	wavy-leaved American-aster	native	orthospecies		X	X	
Tricolpates	Oleaceae	olive family	S	<i>Syringa reticulata</i> (Blume) Hara ssp. <i>reticulata</i>	<i>Syringa amurensis</i> Rupr. var. <i>japonica</i> (Maxim. ex Dcne.) Franch. & Sav.; <i>Syringa japonica</i> Maxim. ex Dcne.	Japanese tree lilac	non-native	orthospecies			X	
Tricolpates	Asteraceae	aster family	H	<i>Taraxacum officinale</i> G.H. Weber ex Wiggers	<i>Leontodon taraxacum</i> L.	common dandelion	non-native	orthospecies	X		X	X
Gymnosperms	Cupressaceae	cypress family	T	<i>Thuja occidentalis</i> L.		northern white-cedar	part native	orthospecies		X		
Tricolpates	Malvaceae	mallow family	T	<i>Tilia americana</i> L. var. <i>americana</i>	<i>Tilia americana</i> var. <i>neglecta</i> (Spach) Fosberg; <i>Tilia glabra</i> Vent.; <i>Tilia neglecta</i> Spach	American linden	native	orthospecies		X		
Tricolpates	Fabaceae	legume family	H	<i>Trifolium hybridum</i> L.	<i>Trifolium elegans</i> Savi; <i>Trifolium hybridum</i> ssp. <i>elegans</i> (Savi) Aschers. & Graebn.; <i>Trifolium hybridum</i> var. <i>elegans</i> (Savi) Boiss.; <i>Trifolium hybridum</i> var. <i>pratense</i> Rabenh.	alsike clover	non-native	orthospecies	X		X	X
Tricolpates	Fabaceae	legume family	H	<i>Trifolium pratense</i> L.	<i>Trifolium pratense</i> var. <i>sativum</i> (P. Mill.) Schreb.	red clover	non-native	orthospecies	X		X	X
Gymnosperms	Pinaceae	pine family	T	<i>Tsuga canadensis</i> (L.) Carr.	<i>Pinus canadensis</i> L.	eastern hemlock	native	orthospecies		X	X	


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Tricolpates	Ulmaceae	elm family	T	<i>Ulmus americana</i> L.		American elm	native	orthospecies		X		
Tricolpates	Ericaceae	heath family	S	<i>Vaccinium angustifolium</i> Ait.	<i>Vaccinium angustifolium</i> var. <i>hypolasium</i> Fern.; <i>Vaccinium angustifolium</i> var. <i>laevifolium</i> House; <i>Vaccinium angustifolium</i> var. <i>nigrum</i> (Wood) Dole; <i>Vaccinium nigrum</i> (Wood) Britt.	common lowbush blueberry	native	orthospecies		X		X
Tricolpates	Plantaginaceae	snapdragon family	H	<i>Veronica officinalis</i> L.	<i>Veronica officinalis</i> var. <i>tournefortii</i> (Vill.) Reichenb.; <i>Veronica tournefortii</i> Vill.	common speedwell	non-native	orthospecies		X		X
Tricolpates	Adoxaceae	elderberry family	S	<i>Viburnum acerifolium</i> L.	<i>Viburnum acerifolium</i> var. <i>glabrescens</i> Rehd.; <i>Viburnum acerifolium</i> var. <i>ovatum</i> (Rehd.) McAttee	maple-leaved viburnum	native	orthospecies		X		
Tricolpates	Apocynaceae	dogbane family	H	<i>Vinca minor</i> L.		lesser periwinkle	non-native	orthospecies	X			
Tricolpates	Violaceae	violet family	H	<i>Viola sagittata</i> Ait. var. <i>ovata</i> (Nutt.) Torr. & Gray	<i>Viola fimbriatula</i> Sm.	arrowhead violet	native	orthospecies				X
Tricolpates	Vitaceae	grape family	V	<i>Vitis labrusca</i> L.	<i>Vitis labrusca</i> var. <i>subdentata</i> Fern.	fox grape	native	orthospecies		X	X	
SUM ALL												
4	46		T	22	113		Native	84	17	67	44	40
			S	15			Non-Native	28				
			V	2			Partly Native	1				
			H	69			Invasive	4				
			F	6								

NATIVE TREES OF NEW HAMPSHIRE										
Scientific Name	Common Name	ABBREV	Code	Family	R1IND	Habit	E/T/W	SRANK	GRANK	
Acer negundo	Maple, Ash-leaved or Boxelder	ACENEG	AIM	Sapindaceae	FAC	T,S				
Abies balsamea	Fir, Balsam	ABIBAL	BF	Pinaceae	FAC	T				
Acer nigrum	Maple, Black	ACENIG		Sapindaceae	FACU	T	T	S2	G5	
Acer pensylvanicum	Maple, Striped	ACEPEN	StM	Sapindaceae	FACU	S,T				
Acer rubrum	Maple, Red	ACERUB	RM	Sapindaceae	FAC	T				
Acer saccharinum	Maple, Silver	ACESAC1	SiM	Sapindaceae	FACW	T				
Acer saccharum	Maple, Sugar	ACESAC2	SM	Sapindaceae	FACU	T				
Amelanchier arborea	Serviceberry, Downy	AMEARB	DSE	Rosaceae	FACU	S,T				
Benthamidia (=Cornus) florida	Dogwood, Flowering	BENFLO	FID	Cornaceae	FACU	T,S	IND	SU	G5	
Betula alleghaniensis	Birch, Yellow	BETALL	YB	Betulaceae	FAC	T				
Betula lenta	Birch, Black	BETLEN	BB	Betulaceae	FACU	T				
Betula papyrifera	Birch, Paper or White	BETPAP	WB	Betulaceae	FACU	T				
Betula papyrifera var. cordifolia	Birch, Heartleaf	BETPAPC	HLB	Betulaceae	FACU	T				
Betula populifolia	Birch, Gray	BETPOP	GB	Betulaceae	FAC	T				
Carpinus caroliniana	Hornbeam, American	CARCAR	AH	Betulaceae	FAC	S,T				
Carya cordiformis	Hickory, Bitternut	CARCOR	BiH	Juglandaceae	FAC	T				
Carya glabra	Hickory, Pignut	CARGLA	PIH	Juglandaceae	FACU	T				
Carya ovalis	Hickory, Sweet Pignut	CAROVA1	SPH	Juglandaceae	UPL	T				
Carya ovata	Hickory, Shagbark	CAROVA2	SH	Juglandaceae	FACU	T				
Castanea dentata	Chestnut, American	CASDEN	AC	Fagaceae	UPL	T	W	S3	G5	
Celtis occidentalis	Hackberry, Common	CELOCC	HkB	Cannabaceae	FAC	T	W	S3	G5	
Chamaecyparis thyoides	Cedar, Atlantic White-	CHATHY	AWC	Cupressaceae	OBL	T	W	S3	G5	
Crataegus spp.	Hawthorne	CRASPP	HAW	Rosaceae	-	S,T				
Fagus grandifolia	Beech, American	FAGGRA	AB	Fagaceae	FACU	T				
Fraxinus americana	Ash, White	FRAAME	WA	Oleaceae	FACU	T				
Fraxinus nigra	Ash, Black	FRANIG	BA	Oleaceae	FACW	T				
Fraxinus pensylvanica	Ash, Green	FRAPEN	GA	Oleaceae	FACW	T				
Juglans cinerea	Butternut	JUGCIN	BU	Juglandaceae	FACU	T	W	S3	G5	
Juniperus virginiana	Redcedar, Eastern	JUNVIR	RC	Cupressaceae	FACU	S,T				
Larix laricina	Tamarack or Eastern Larch	LARLAR	TA	Pinaceae	FACW	T				
Nyssa sylvatica	Gum, Black	NYSSYL	BG	Cornaceae	FAC	T				
Ostrya virginiana	Hop-Hornbeam	OSTVIR	HH	Betulaceae	FACU	T				
Picea glauca	Spruce, White	PICGLA	WS	Pinaceae	FACU	T				
Picea mariana	Spruce, Black	PICMAR	BS	Pinaceae	FACW	T				
Picea rubens	Spruce, Red	PICRUB	RS	Pinaceae	FACU	T				
Pinus banksiana	Pine, Jack	PINBAN	JP	Pinaceae	FACU	T	T	S2	G5	
Pinus resinosa	Pine, Red or Norway	PINRES	RP	Pinaceae	FACU	T				
Pinus rigida	Pine, Pitch	PINRIG	PP	Pinaceae	FACU	T				
Pinus strobus	Pine, Eastern White	PINSTR	WP	Pinaceae	FACU	T				
Platanus occidentalis	Sycamore	PLAOCC	SYC	Platanaceae	FACW	T	W	S3	G5	
Populus balsamifera ssp. balsamifera	Poplar, Balsam	POPBALB	BP	Salicaceae	FACW	T				
Populus deltoides	Cottonwood, Eastern	POPDEL	EC	Salicaceae	FAC	T				
Populus grandidentata	Aspen, Bigtooth	POPGRA	BTA	Salicaceae	FACU-	T				
Populus tremuloides	Aspen, Quaking	POPTRE	QA	Salicaceae	FACU	T				
Prunus pensylvanica var. pensylvanica	Cherry, Fire	PRUPENP	PC	Rosaceae	FACU	T				
Prunus serotina var. serotina	Cherry, Black	PRUSERS	BC	Rosaceae	FACU	T				
Prunus virginiana var. virginiana	Cherry, Choke	PRUVIRV	CC	Rosaceae	FACU	S,T				
Quercus alba	Oak, White	QUEALB	WO	Fagaceae	FACU	T				
Quercus bicolor	Oak, Swamp White	QUEBIC	SWO	Fagaceae	FACW	T				
Quercus coccinea	Oak, Scarlet	QUECOC	ScO	Fagaceae	UPL	T	W	S3	G5	
Quercus rubra	Oak, Northern Red	QUERUB	RO	Fagaceae	FACU	T				
Quercus velutina	Oak, Black	QUEVEL	BO	Fagaceae	UPL	T				
Robinia pseudoacacia	Locust, Black	ROBPSE	BIL	Fabaceae	FACU	T	(likely escaped here)			
Salix bebbiana	Willow, Bebb's	SALBEB	BeW	Salicaceae	FACW	S,T				
Salix nigra	Willow, Black	SALNIG	BiW	Salicaceae	OBL	T,S				
Sassafras albidum	Sassafras	SASALB	SAS	Lauraceae	FACU	S,T				
Sorbus americana	Mountain-Ash, American	SORAME	AMA	Rosaceae	FAC	S,T				
Sorbus decora (= S. groenlandica)	Mountain-Ash, Northern	SORDEC		Rosaceae	FACU	S,T				
Thuja occidentalis	White-cedar, Northern	THUOCC	NWC	Cupressaceae	FACW	S,T				
Tilia americana	Basswood, American	TILAME	BAS	Malvaceae	FACU	T				
Tsuga canadensis	Hemlock, Eastern	TSUCAN	EH	Pinaceae	FACU	T				
Ulmus americana	Elm, American	ULMAME	AE	Ulmaceae	FACW	T				
Ulmus rubra	Elm, Slippery or Red	ULMRUB	SIE	Ulmaceae	FAC	S,T				
Ulmus thomasi	Elm, Winged	ULMTHO	WIE	Ulmaceae	FAC	S,T	IND	SU	G5	
	R1 (Region 1) INDicator Status		T = Tree		1 = 1 - 5 populations in state					
	OBL = > 99% in wetlands		S = Shrub		2 = 6 - 20 populations in state					
	FACW = 67 - 99% in wetlands		E = Endangered		3 = 20 - 100 populations in state					
	FAC = 34 - 66% in wetlands		T = Threatened		4 = demonstrably secure but limited range					
	FACU = 1 - 33% in wetlands		W = Watch		5 = common throughout					
	UPL = < 1% in wetlands									

Appendix C

December 5, 2019 Slide Show of Findings & Recommendations

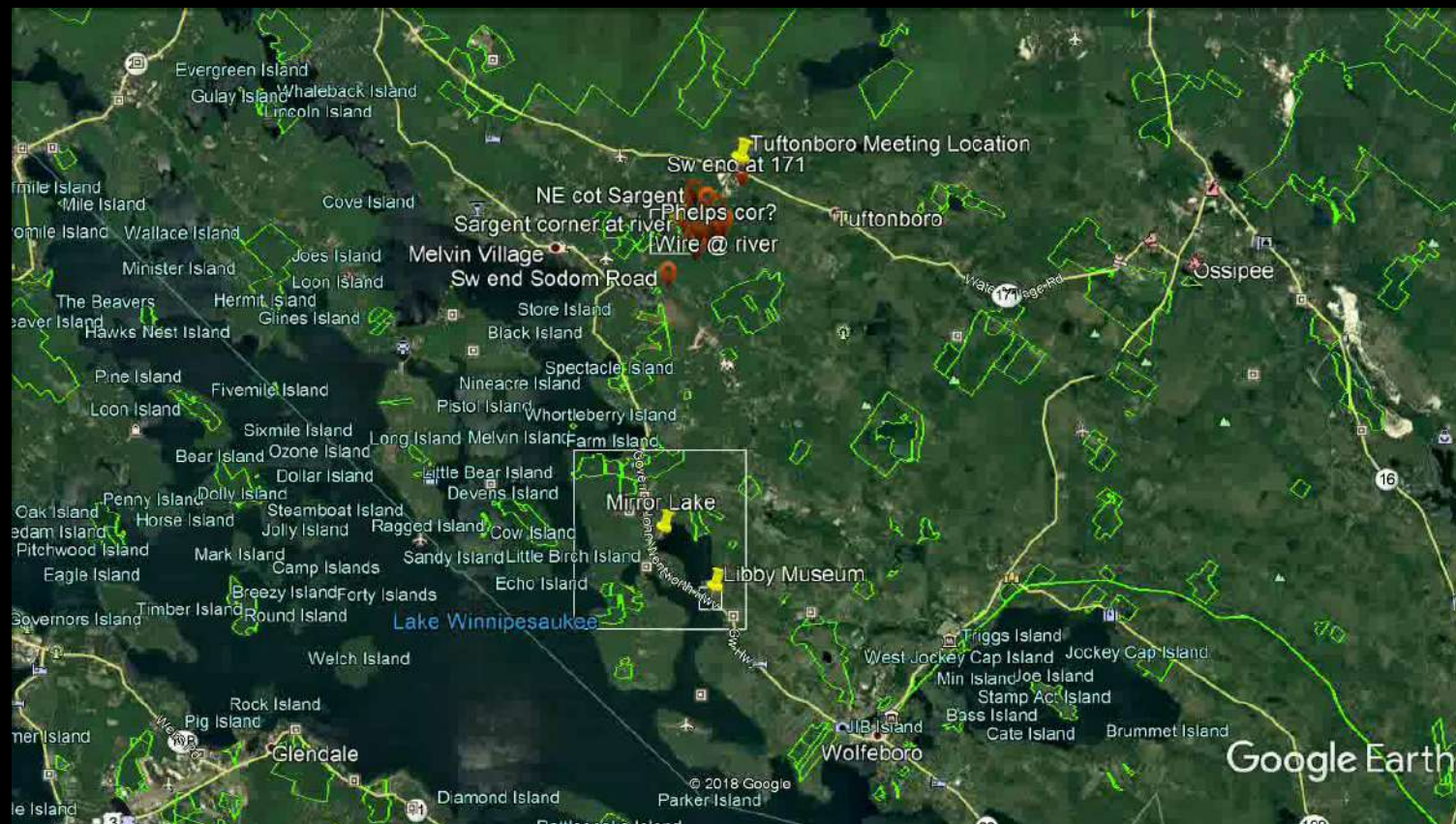
Given at the Wolfeboro Town Hall



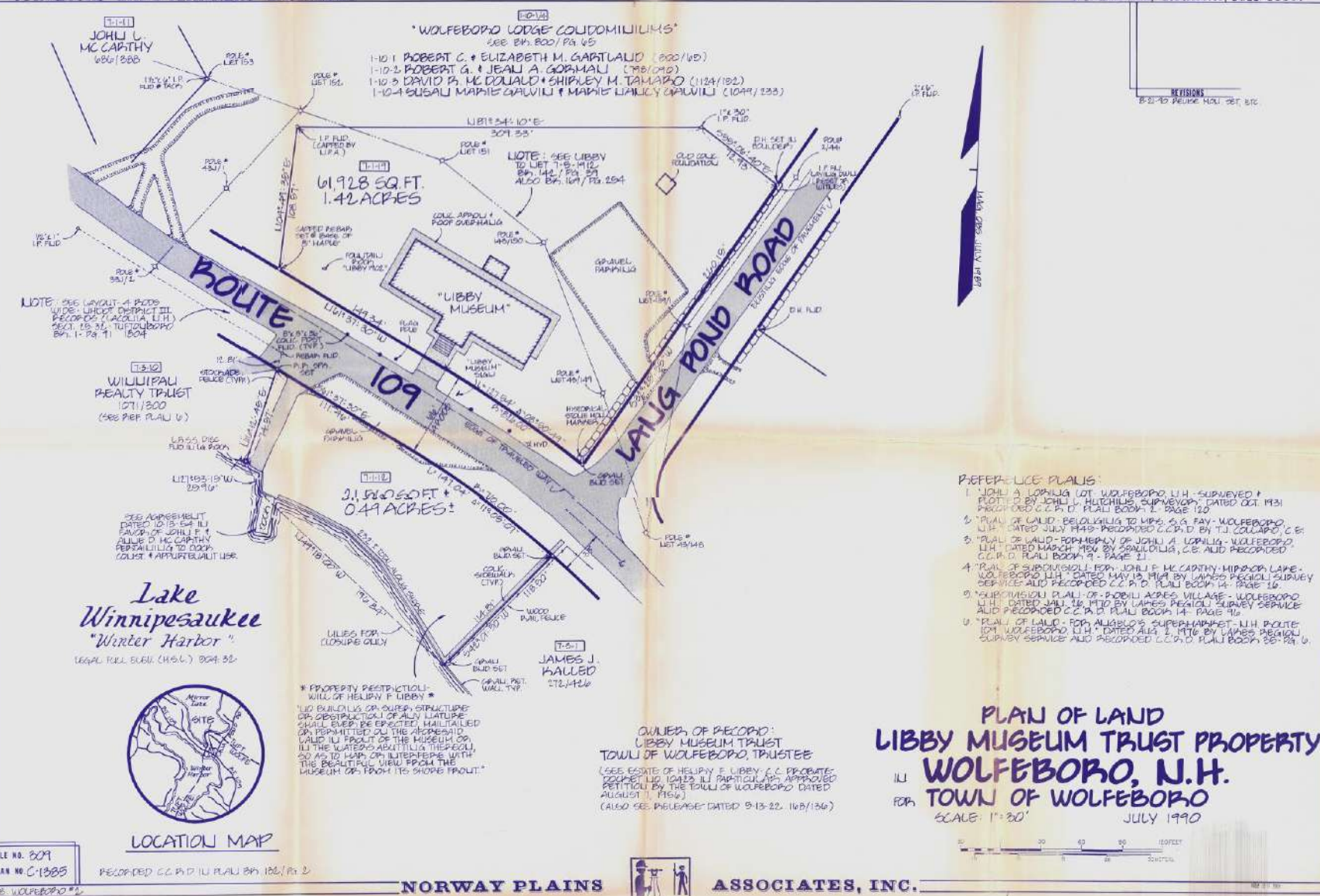
LANDSCAPE ENHANCEMENTS AT THE LIBBY MUSEUM

Dr. Rick Van de Poll
Ecosystem Management Consultants
Sandwich, NH

BACKGROUND INFORMATION



[illegible]



SAMPLE PHOTOS



SAMPLE PHOTOS

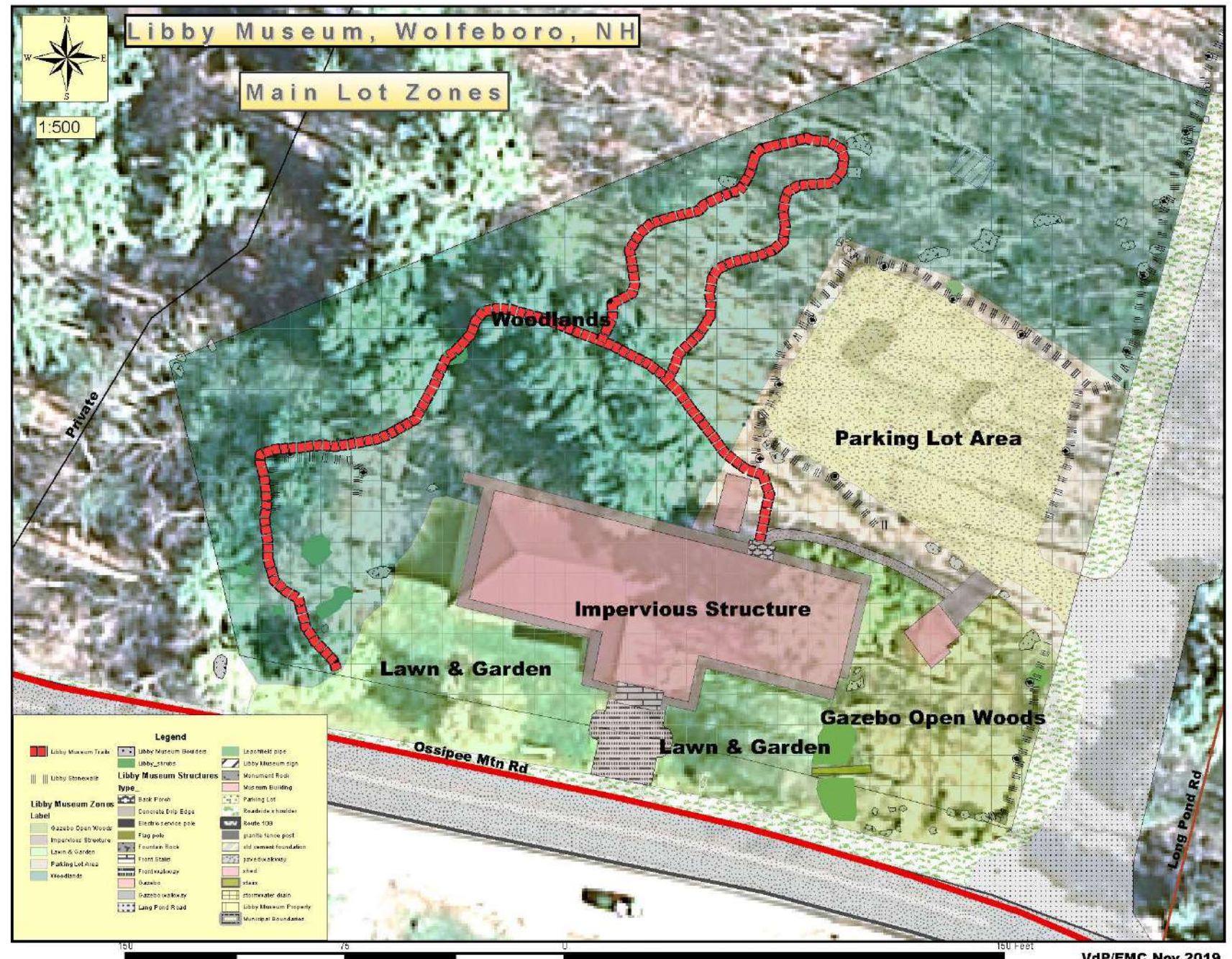


SAMPLE PHOTOS



FIVE ZONES:

1. Impervious Structures
2. Lawn & Garden
3. Parking Lot Area
4. Gazebo Open Woods
5. Woodland





2) LAWN & GARDEN



3) GAZEBO OPEN WOODS

1) WOODLAND

4) PARKING AREA



LIBBY MUSEUM PLANT DIVERSITY

Tracheophyte Checklist of New England - LIBBY MUSEUM PROPERTY							ZONE			
Family Common Name	HABIT	Scientific Name	Synonyms	Common Name	Origin	Species Type	LAWN	WOODS	PKG LOT	GAZEBO
soapberry family	T	<i>Acer pensylvanicum</i> L.		striped maple	native	orthospecies		X		
soapberry family	T	<i>Acer rubrum</i> L.	<i>Acer carolinianum</i> Walt.; <i>Acer rubrum</i> var. <i>tridens</i> Wood; <i>Acer stenocarpum</i> Britt.; <i>Rufacer rubrum</i> (L.) Small; <i>Rufacer carolinianum</i> (Walt.) Small	red maple	native	orthospecies		X	X	X
soapberry family	T	<i>Acer saccharum</i> Marsh. var. <i>saccharum</i>	<i>Acer nigrum</i> var. <i>glaucum</i> (F. Schmidt) Fosberg; <i>Acer nigrum</i> var. <i>saccharophorum</i> (K. Koch) Clausen; <i>Acer saccharum</i> var. <i>glaucum</i> (F. Schmidt) Sarg.; <i>Saccharodendron saccharum</i> (Marsh.) Moldenke	sugar maple	native	orthospecies		X		
aster family	H	<i>Achillea millefolium</i> L. ssp. <i>lanulosa</i> (Nutt.) Piper	<i>Achillea borealis</i> Bong.; <i>Achillea lanulosa</i> Nutt.; <i>Achillea millefolium</i> ssp. <i>borealis</i> (Bong.) Breitung; <i>Achillea millefolium</i> var. <i>lanulosa</i> (Nutt.) Piper; <i>Achillea millefolium</i> var. <i>nigrescens</i> E. Mey.; <i>Achillea millefolium</i> ssp. <i>occidentalis</i> (DC.) Hyl.; <i>Achillea millefolium</i> var. <i>occidentalis</i> DC.; <i>Achillea nigrescens</i> (E. Mey.) Rydb.	common yarrow	native	orthospecies	X			X
crowfoot family	H	<i>Actaea pachypoda</i> Ell.	<i>Actaea alba</i> , of authors not (L) P. Mill.	white baneberry	native	orthospecies		X		
grass family	H	<i>Agrostis capillaris</i> L.	<i>Agrostis tenuis</i> Sibthorp	Rhode Island bentgrass	non-native	orthospecies		X		X
grass family	H	<i>Agrostis perennans</i> (Walt.) Tuckerman	<i>Agrostis altissima</i> (Walt.) Tuckerman; <i>Agrostis perennans</i> var. <i>elata</i> (Pursh) A.S. Hitchc.; <i>Cornucopiae perennans</i> Walt.	autumn bentgrass	native	orthospecies	X			X
aster family	H	<i>Ambrosia artemisiifolia</i> L.	<i>Ambrosia artemisiifolia</i> var. <i>elatior</i> (L.) Descourtils; <i>Ambrosia artemisiifolia</i> var. <i>paniculata</i> (Michx.) Blank; <i>Ambrosia elatior</i> L.; <i>Ambrosia monophylla</i> (Walt.) Rydb.; <i>Ambrosia paniculata</i> Michx.	common ragweed	native	orthospecies				X
legume family	H	<i>Amphicarpaea bracteata</i> (L.) Fern.	<i>Amphicarpaea bracteata</i> var. <i>comosa</i> (L.) Fern.; <i>Amphicarpaea comosa</i> (L.) G. Don; <i>Amphicarpaea monoica</i> (L.) Ell.; <i>Amphicarpaea pitcheri</i> Torr. & Gray; <i>Falcata comosa</i> (L.) Kuntze; <i>Glycine bracteata</i> L.; <i>Glycine comosa</i> L.	American hog-peanut	native	orthospecies		X		
celery family	H	<i>Aralia nudicaulis</i> L.		wild sarsaparilla	native	orthospecies		X		
aster family	H	<i>Artemisia vulgaris</i> L. var. <i>vulgaris</i>	<i>Artemisia vulgaris</i> var. <i>glabra</i> Ledeb.; <i>Artemisia vulgaris</i> var. <i>latifolia</i> Ledeb.	common wormwood	non-native	orthospecies	X			
lady fern family	F	<i>Athyrium angustum</i> (Willd.) C. Presl.	<i>Athyrium filix-femina</i> (L.) Roth ssp. <i>angustum</i> (Willd.) Clausen; <i>Athyrium filix-femina</i> (L.) Roth var. <i>angustum</i> (Willd.) Lawson; <i>Athyrium filix-femina</i> (L.) Roth var. <i>michauxii</i> (Spreng.) Farw.; <i>Athyrium filix-femina</i> (L.) Roth var. <i>rubellum</i> Gilbert	northern lady fern	native	orthospecies		X		
birch family	T	<i>Betula papyrifera</i> Marsh.	<i>Betula alba</i> L. var. <i>commutata</i> Regel; <i>Betula papyrifera</i> var. <i>commutata</i> (Regel) Fern.; <i>Betula papyrifera</i> var. <i>macrostachya</i> Fern.	paper birch	native	orthospecies		X	X	
sedge family	H	<i>Carex communis</i> Bailey var. <i>communis</i>		fibrous-rooted sedge	native	orthospecies		X		



Hyloidesmum glutinosum

LIBBY MUSEUM PLANT DIVERSITY

Vascular Plants:

- 46 plant families
- 22 trees
- 14 shrubs
- 2 vines
- 69 herbs
- 6 ferns & allies
- 82 native
- 2 rare species
- 29 non-native
- 4 invasives



Crab-apple – *Malus sylvestris* x



Hellebore – *Epipactis helleborine*

LIBBY MUSEUM RARE PLANTS



American chestnut



American cancer-root

LIBBY MUSEUM PLANT DIVERSITY

Vascular Plants:

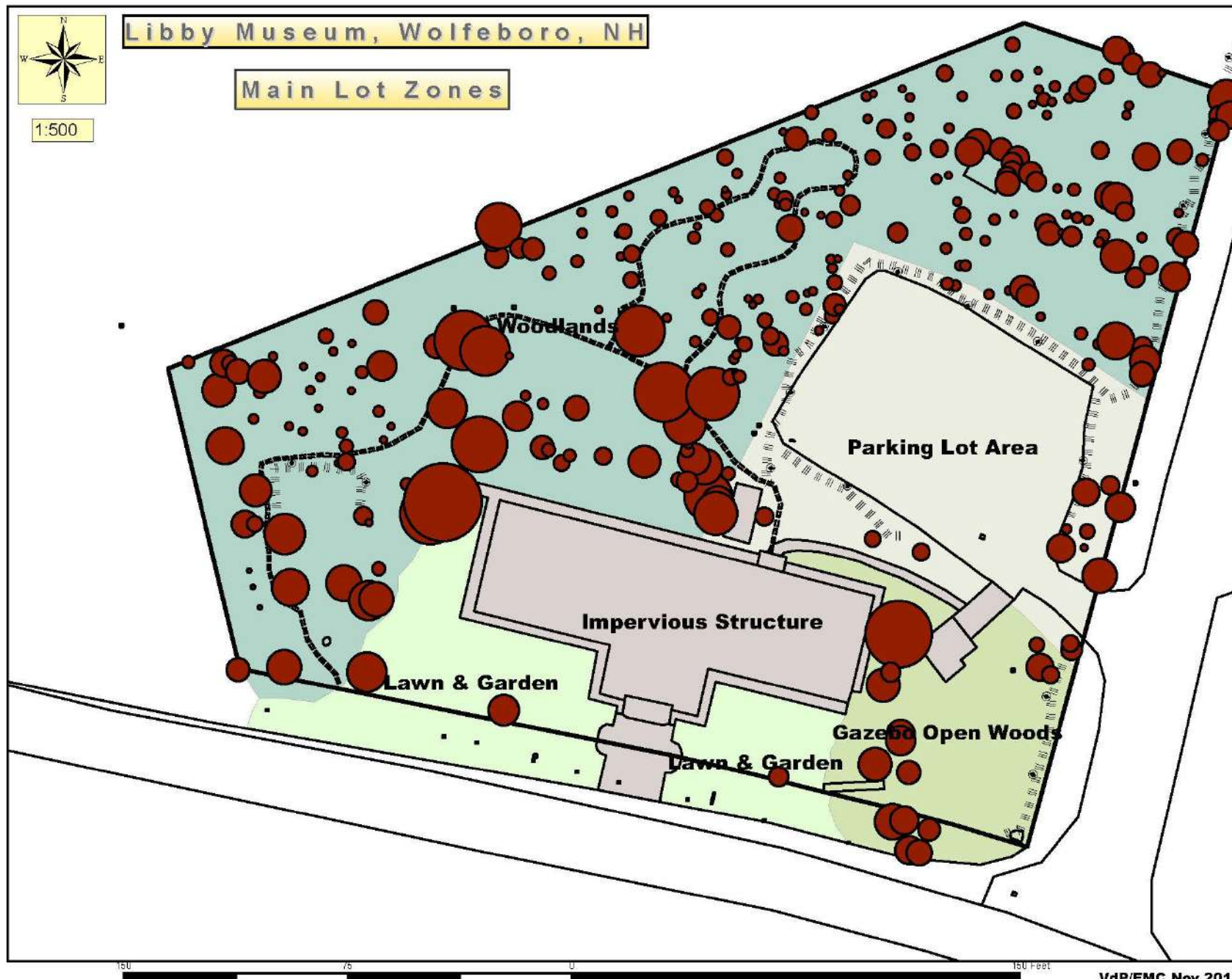
- White Pine (N = 22, ave dbh = 22.14")
- Red Maple (N = 109, ave dbh = 8.57")
- Eastern Hemlock (N = 35, ave dbh = 7.53")
- Red Oak (N = 34, ave dbh = 15.28")
- American Beech (N = 27, ave dbh 9.26")
- White Birch (N = 29, ave dbh = 7.94")
- Big-tooth Aspen (N = 29, ave dbh = 11.47")
- 46 plant families
- 22 trees (> 4" dbh)
- 14 species tree-sized
- 8 species of shrub size
- 283 stems
 - 274 living
 - 5 dead
 - 4 dying (WP)
 - 12 flagged for removal
- White Oak (N = 4, ave dbh = 12.6")
- Sugar Maple (N = 3, ave dbh = 9.45")
- Crab-apple (N = 2, ave dbh = 14.67")
- Basswood (N = 2, ave dbh = 10.5")
- Shagbark Hickory (N = 1, ave dbh = 15.75")
- White Ash (N = 1, ave dbh = 7.8")
- Black Cherry (N = 1, ave dbh = 4.3")



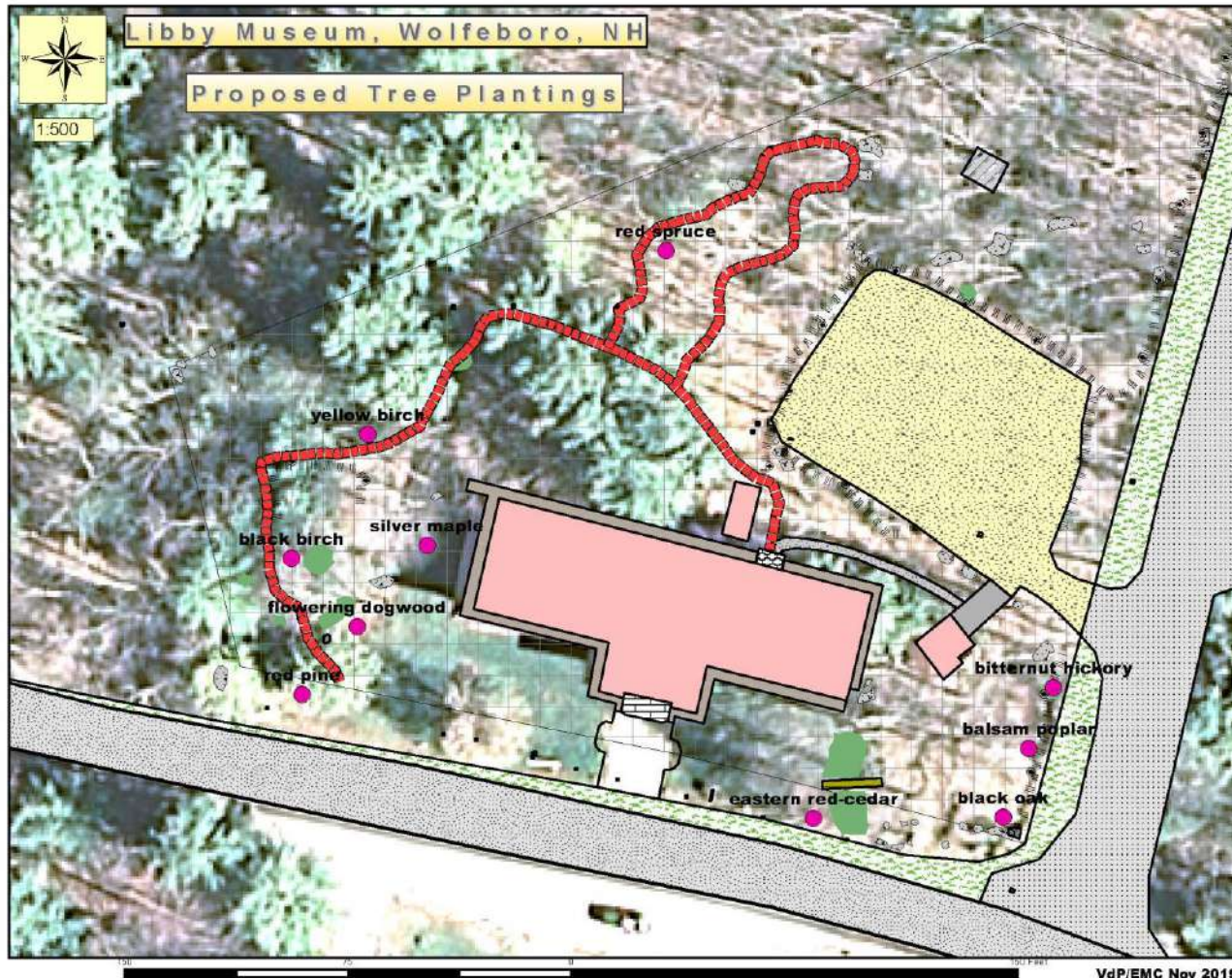
Libby Museum, Wolfeboro, NH

Main Lot Zones

1:500



PROPOSED ADDITIONS - TREES



- *Acer saccharinum* – silver maple
- *Benthamidia florida* – flowering dogwood
- *Betula alleghaniensis* – yellow birch
- *Betula lenta* – black birch
- *Carya cordiformis* – bitternut (yellow bud)
- *Juniperus virginiana* – eastern red-cedar
- *Picea rubens* – red spruce
- *Pinus resinosa* – red pine
- *Populus balsamifera* – balsam poplar
- *Quercus velutina* – black oak

OTHER ACTIONS - TREES

- Re-assess woodland trees after removal of pines and other trees for thinning, additions, and/or enhancements
 - American chestnut
 - American elm
 - Balsam fir
 - Basswood
 - Quaking aspen
 - Serviceberry
- Consider creating a wetland planting area in NW corner
- Determine space/desirability of remaining native NH trees
 - Blue beech (musclewood or hornbeam)
 - Hackberry
 - Larch or tamarack
 - Black gum
 - White spruce
 - Sycamore



PROPOSED ACTIONS – OTHER PLANTS



- Label existing plants near trail
 - *Pyrola americana*
 - *Epigaea repens*
 - *Hylodesmum glutinosum*
 - *Athyrium filix-femina*
- Transplant wildflowers to near trail
 - *Desmodium canadense*
 - *Chimaphila umbellatum*
 - *Amphicarpaea bracteosa*
- Eliminate Invasive plants
 - Autumn olive
 - Bittersweet
 - Glossy buckthorn
 - Winged Euonymus

OTHER SUGGESTED ACTIONS



- Enrich front flower beds with more native plants (e.g. Osmunda ferns)
- Add native plant beds to edge wall along Lang Pond Road
- Clear understory shrubs along trail that are blocking the view of native wildflowers
- Re-route trail as needed to include other areas of the property (e.g. near foundation)
- Include fungi in the nature trail labeling
- Consider a limited use nature trail on the Libby Park Lot

OTHER CONCERNS - BOUNDARIES



ACKNOWLEDGMENTS

- Alana Albee, Museum Director, the Libby Museum
- Friends of the Libby Museum
- Town of Tuftonboro
- Town of Wolfeboro



Appendix D

1) Large Format Tree and Structures Map of Libby Museum

(In separate pocket)