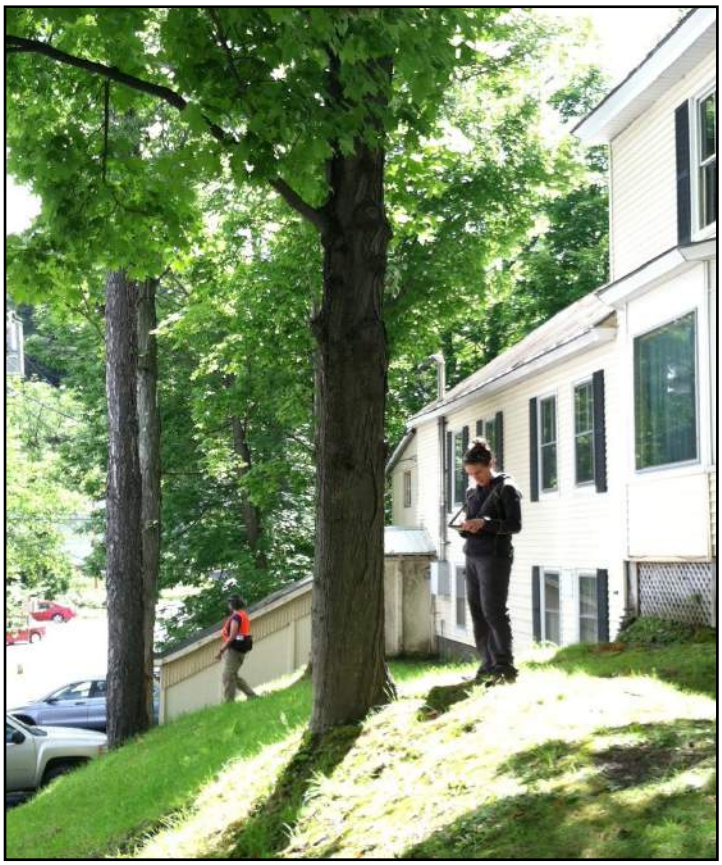
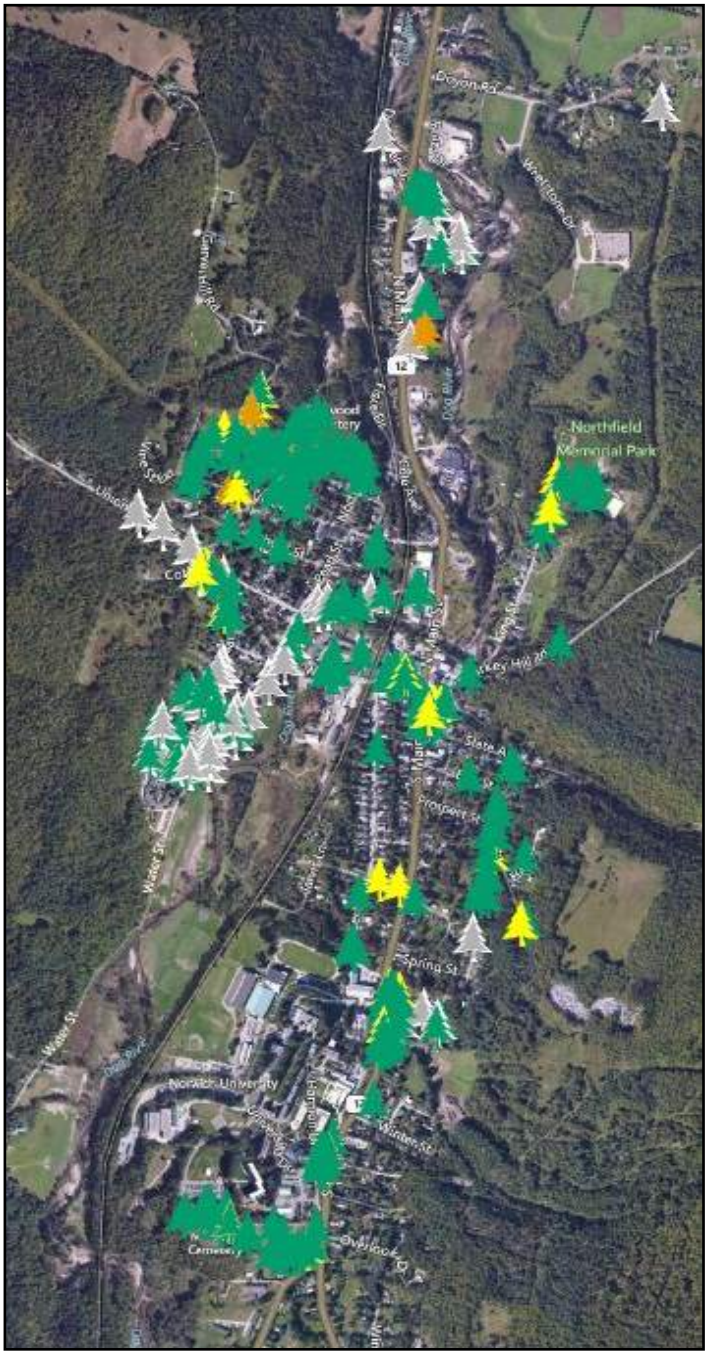
Northfield Public Tree Inventory Report





Prepared for the Town of Northfield by the Land Stewardship Program and the Vermont Urban & Community Forestry Program
November 2014

VERMONT
AGENCY OF NATURAL RESOURCES

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

PLANT LIVE GROW
VERMONT URBAN & COMMUNITY FORESTRY PROGRAM

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The Land Stewardship Program

sca

Acknowledgements

This report was developed by the Land Stewardship (LANDS) intern team and Vermont Urban & Community Forestry Program staff based on work done for Northfield, Vermont during the summer of 2014. We would like to thank the members of the Northfield Conservation Commission for their help in planning and designing the public tree inventory project. Particularly, we would like to thank Russ Barrett for preparing the inventory maps and acting as a point of contact, and Ruth Ruttenberg for her generous hospitality and allowing the LANDS interns to camp on her property.

LANDS is grateful to the Rubenstein School of Environment and Natural Resources (RSENR) at UVM and the Student Conservation Association (SCA) for facilitating the internship program. We also greatly appreciate the Aiken Center at UVM for providing resources and housing during office work days.

About the Vermont Urban & Community Forestry Program

The field of forestry management is not confined to the natural areas and forests of Vermont, but extends to the urban and rural spaces where trees play important roles. The trees in public parks, along roadsides, town greens, and municipal forests compose our urban and community forests and merit careful stewardship. The Vermont Urban & Community Forestry Program (VT UCF) is a collaborative effort between the Department of Forests, Parks, & Recreation, the University of Vermont Extension, and the USDA Forest Service. The program provides technical and financial assistance as well as educational programs and resources for the management of trees and forests in and around Vermont communities. The mission of VT UCF is ***to lead citizens, businesses, and governments in understanding the value of urban and community forests and promote civic responsibility for and participation in the stewardship of these resources for this and future generations***. Since 1991, the program has been guided by a small staff and a twenty-member advisory council. The council meets quarterly to share information and advise the program; its members come from various professional associations, non-profits, educational institutions, tree boards, regional officials, and state agencies.

The trees in our communities offer a wide variety of environmental, social, and economic benefits to the surrounding community, including stormwater control, CO_2 sequestration, and aesthetic value. VT UCF seeks to maximize these benefits by working with state and municipal officials and dedicated volunteers to steward the urban forest's ecological integrity and diversity. VT UCF's programming and support reaches 100 Vermont communities annually. More information about VT UCF and its programming can be found at www.vtcommunityforestry.org.

About LANDS

The field of conservation is rapidly evolving to meet the growing demands of society. New ideas and strategies are changing how we conserve and steward the land; The Land Stewardship Program (LANDS) is one of these new ideas. During the Great Depression, the Civilian Conservation Corps model was pioneered as a means to promote stewardship in the nation and provide jobs for the unemployed. The idea has since been reinvented many times by local and state corps across the United States. However, the theme is the same: young people learning and growing through service. LANDS is an innovative *College Conservation Corps* designed to train tomorrow's conservationist practitioners and leaders, and is a pilot partnership between the University of Vermont and the Student Conservation Association in its eighth year of successful programming.

Thanks to college-level education and prior experience in environmental science fields, LANDS interns are able to take on projects that are more technical than the work traditionally done by conservation crews. LANDS interns draft management plans, map areas of interest using GPS and GIS, inventory resources, survey for non-native species, survey soils, and evaluate river geomorphology. Municipalities, land trusts, state agencies, university researchers, national forests and parks, and volunteer-managed conservation organizations all benefit from LANDS's high quality, affordable services. LANDS interns are advanced undergraduates and recent graduates with natural resource experience from all over the world, and they bring a wide

range of skills and interests to the program. LANDS is a unique service-learning model that addresses an ever-expanding list of conservation needs, while training students as future environmental leaders.

The Summer 2014 LANDS Crew in Northfield

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Executive Summary

The goals of the Northfield public tree inventory were to:

1. **Document the location, size, species, and condition of trees planted within the public right-of-way (ROW) and on select town-owned properties in the downtown corridor and most densely-populated neighborhoods of Northfield (formerly the Village of Northfield) and**
2. **Survey a portion of rural roads in Northfield for ash trees, which are currently threatened by the invasive forest pest the emerald ash borer (EAB)**.

The data collected through the Northfield public tree inventory will provide local decision-makers and town residents with a better understanding of the health, composition, and benefits of Northfield's urban forest and can facilitate planning for future tree planting and maintenance using a map-based tree inventory system.

The inventory was commissioned by the Northfield Conservation Commission and planning for the inventory began in the spring of 2014. LANDS interns completed an inventory of **303 trees** located within the public right-of-way (ROW) of 55 streets and on select town-owned properties and identified 44 specific locations or strips of public land appropriate for future tree plantings. Approximately 10 miles of rural roads were also surveyed for ash trees by the LANDS interns; **1,415 ash trees** were tallied. Staff from VT UCF provided technical assistance in data collection, tree species identification, and data analysis. This report was drafted in the summer of 2014 by the LANDS interns and subsequently edited and supplemented by VT UCF program staff. It presents the results of the inventory and basic assessment of the trees and canopy cover in the downtown corridor and most densely-populated neighborhoods of Northfield. In October 2014 the Northfield Schools properties were inventoried by the Students Taking Alternate Routes (STAR) program at Northfield High School (Appendix D).

Local government, conservation agencies, and private landowners all play an important role in monitoring and maintaining urban forests. Urban trees provide a number of benefits to a community, including reducing stormwater runoff, reducing air pollution, providing shade,

sequestering carbon dioxide, increasing property values, and improving the aesthetics of the community. The 303 public trees that were inventoried provide an estimated **$34,520 in benefits annually** to the residents of Northfield. In addition to the public trees inventoried, an urban tree canopy (UTC) assessment was completed for the full inventory (public and private) area, which indicated **existing canopy cover of 36%** and an estimated **stored value carbon dioxide of $423,475**.

Summary of findings

Forest Diversity

- Of the 303 public trees, there are over 30 different species in over 15 different genera.
- The top five most common tree genera: *Acer* (maple), *Malus* (apple), *Picea* (spruce), *Fraxinus* (ash), and *Quercus* (oak) make up 81% of the public trees in Northfield.
- 52% percent of the public trees are either ash or maple; both of these genera are currently threatened by invasive tree pests: the emerald ash borer (EAB) for ash species and Asian longhorned beetle (ALB) for maple species.
- The top three most common species: Sugar maple (27.4%), crabapple (19.8%), and Norway maple (11.9%), comprise 59.1% of the stocking.

Forest structure

- The diameter distribution – indicative of age structure – of Northfield public trees is generally well-distributed.
- The 6-12” diameter class was most well-represented, with 26.4% (80) trees.
- 70 (23.1%) public trees fall within the 0-6” size category, likely all young trees that have been planted in recent years.
- 25 (8.3%) of the public trees are over 30” in diameter, indicating old age and were likely trees around which development occurred (naturally growing trees, not planted).

Forest Cover

- Canopy cover (public and private property) within the inventory boundaries (downtown corridor and most densely-populated neighborhoods of Northfield) was assessed to be approximately 36%.
- Trees could potentially cover an additional 40% of the area's land surface; these "possible UTC (urban tree canopy)" areas include grass and impervious surfaces (e.g. parking lots, paved playgrounds, and along the ROW).
- The remaining 24% of the area is occupied by buildings, water, or other permanent features and is generally unsuited to UTC improvement.

Forest health

- An overwhelming majority (89.1%) of the public trees was assessed as being in "Good" condition; of the remaining trees 32 were considered to be in "Fair" or "Poor" condition and only 1 dead public tree was found.
- There were 23 (7.6%) public trees flagged as in need of a consultation by a trained arborist or the Northfield Tree Warden.

Benefit output

- The total annual energy conservation (electricity and natural gas) benefits of all inventoried trees in Northfield are valued at $14,328.
- Northfield public trees intercept an estimated 487,706 gallons of rainfall each year, yielding an annual stormwater cost benefit of $3,902.
- Northfield public trees currently store 1,480,539 lbs. of carbon.
- The annual aesthetic benefit of Northfield's public trees is valued at $13,203.
- When considering all the benefits trees have on a community (energy, carbon, air quality, storm water, and aesthetic), Northfield public trees have a total average annual benefit value of $114 per tree and cumulative annual benefit of $34,520.

Rural Roadside Ash Survey

- The LANDS interns, divided in pairs, walked approximately 10 miles along Union Brook Road, Turkey Hill Road, and RT 12A, and tallied roadside ash trees.
- 1,415 ash trees were counted, with the vast majority (1,245, or 88%) were found to be in good condition.
- 1,021 (72%) of the ash trees were estimated to be below 6" in diameter.

Summary of recommendations

We recommend that the Town of Northfield work to ***increase the diversity*** of tree species to ensure the long-term health and resilience of Northfield's urban forest. Plant a mix of species versus high-density stands of the same species (monocultures) whose close proximity may be conducive to the spreading of disease and pests.

Monitor tree health, specifically for signs and symptoms of EAB, ALB, and other forest pests and diseases.

Maintain tree health by ensuring that those who are caring for Northfield's public trees are trained in best tree care practices; prune public trees routinely and systematically to promote long-term structural integrity, irrigate newly-planted trees, and prevent mechanical damage to trees.

Plan for the arrival of EAB by developing a community preparedness and response plan.

Develop a long-term plan for updating the public tree inventory on a regular cycle and consider expanding the inventory to other neighborhoods of Northfield.

Develop a comprehensive public tree management plan based on this inventory report, with explicit tree care responsibilities assigned to appropriate departments/individuals in Northfield.

Communicate the benefits of Northfield's public trees at local events, work towards increasing local stewardship and awareness of urban forest benefits and health, and encourage

participation in VT UCF educational programming such as the *Stewardship of the Urban Landscape* course and the *Forest Pest First Detectors* trainings.

Adopt a Northfield tree policy or ordinance, overseen by the Northfield Conservation Commission, to establish agreed-upon policies and activities for citizen engagement.

Collaborate with the Northfield Planning Commission to achieve all community tree goals laid out in the new Northfield Town Plan and ensure trees are considered in new development projects.

LANDS interns collected public tree data and tallied rural road ash trees for two days in July.

Introduction

Project Description

VT UCF is currently working on a project funded by the USDA Forest Service to assist twenty priority communities in Vermont in moving their forestry programs forward. The project, *Care of the Urban Forest*, is a multi-year effort that aims to support these communities in three specific ways: (1) conducting a public tree inventory to assess urban forest structure, diversity, and health; (2) helping the community in the development of an urban forest management plan (or master plan) using information from the inventory; and (3) providing technical training for volunteers and town employees to promote the proper care and management of public trees.

Northfield was identified as an ideal candidate for participation in the Care of the Urban Forest Project based on population density, percent of impervious surface cover, and local capacity and interest in the project. The Northfield Conservation Commission (NCC) was approached about the opportunity in the spring of 2014 and the NCC members worked with VT UCF to plan for the inventory into the summer months. In September 2014, a month after the LANDS interns conducted the Northfield public tree inventory and rural road ash survey, the new Northfield Town Plan was adopted; in the plan, community trees are explicitly addressed and goals for Northfield's urban forest are established, many of which are or will be addressed through the NCC's collaboration with VT UCF:

> *"Trees in the Town Community*
> *53. Within the next 5 years, complete an inventory of the trees for which the town is responsible including street trees and those in parks and on other town lands. [CC]*
> *54. Develop a master plan for the town's trees, including: a) an approach to protect trees from invasive insects, primarily emerald ash borer, Asian longhorn beetle, and wooly hemlock adelgid; and b) scheduling maintenance or replacement of trees per year, with the goal of addressing at least the 5% in most need of care; c) a strategy to increase*

diversity; d) a commitment to increase the planting of new street trees throughout the community. [CC]

55. Educate community, including town officials and staff, on the benefits of street trees. [CC]

56. Consider establishing town tree committee. [SB]" (Northfield Town Plan, 2014)

The goal of the public tree inventory was to document the location, size, species, and condition of trees planted within the public ROW and on select Town-owned sites in the downtown corridor and most densely populated neighborhoods of Northfield (formerly Northfield Village). The goal of the rural road ash survey was to better understand the ash tree population along Northfield's roads in preparation for the arrival of EAB. This inventory establishes a baseline for future inventories, management decisions, and improvements to Northfield's urban forest.

In October 2014 the Northfield Schools properties, were inventoried by eight students in the STAR program at Northfield High School. The results of that supplementary inventory were not part of this project and are not included in this report but are attached in Appendix D and the 85 trees surveyed should be considered part of Northfield's urban forest.

Importance of Inventory and Urban Forestry in Vermont

An inventory of urban trees provides a record of the trees present in a community. An inventory can provide information about the species, size, health, and location of each tree and future management needs. This detailed information allows town planners to estimate the monetary contributions of their community's green infrastructure. In the event of a disease outbreak or insect infestation, data from an inventory may assist in monitoring and preventing the spread of a forest health epidemic. An inventory can also help build public support for expanding community forests and to guide future urban planning.

Urban trees improve the quality of life for Vermont communities in a variety of ways. The most readily apparent benefit is the aesthetic value that trees provide a street, home, or public space. Along with this beauty is the functional benefit of providing shade along the streets in the summertime and blocking wind to reduce heating costs in the wintertime. The presence of trees has been shown to positively affect property values (Morales 1973; 1983) and boosts foot traffic in commercial areas. Parks and tree-lined sidewalks promote physical activity by creating shaded, comfortable outdoor spaces. Many types of urban wildlife depend on trees as sources of food and shelter. Unseen environmental benefits of urban trees include improvements in air quality and temperature regulation through reduction of the heat island effect. Trees can mitigate noise pollution common in an urban environment and can clean and conserve water by controlling run-off. Additionally, urban forests create opportunities for environmental education, community engagement and in some instances can be related to crime reduction. Trees are an integral part of the green infrastructure of a community and contribute to keeping our families healthier and our everyday lives more fulfilling.

Northfield Community Profile

Chartered in 1781, the Town of Northfield encompasses 38.3 square miles and is located 10 miles south of the state capital, Montpelier, along VT RT 12. The population of the Town of Northfield is 6,207 (US Census 2010). The public tree inventory was conducted in the downtown corridor along VT RT 12 and in the most densely-populated neighborhoods of Northfield, which was formerly known as Northfield Village. This population of this area is estimated at 3,208 (US Census 2000); approximately half of the Town's total population resides within the public tree inventory area. The Village of Northfield officially merged with the Town of Northfield on July 1, 2014. Northfield is home to Norwich University, the first private military college in the United States. The University contributes greatly to the character of Northfield, but was not included in the public tree inventory project.

Methodology

Prior to the public tree inventory, VT UCF staff met numerous times with the NCC to plan for the inventory. Fifty-five streets and seven Town-owned properties in Northfield were selected to be included in the inventory. In total, the land area of the inventory was about .75 of a square mile, representing less than 2% of the total land area of the Town of Northfield, but including the most densely populated sections. The ROW boundaries for all streets were provided by the NCC. The list of streets and sites with associated ROW boundaries is found in Appendix A and maps of the inventory area are found in Appendix E. The rural road segments for the ash survey were selected by the NCC and represent approximately 10 miles of road.

VT UCF has developed a street tree inventory system in collaboration with the VT Agency of Natural Resources' (ANR) GIS team. The map-based system uses the free application "Collector" by ArcGIS for data collection and is linked to the ANR Atlas online mapping tool. Instructions for how to view the Northfield tree data online is included in Appendix C.

On July 16th and 17th, 2014, four teams of LANDS interns walked along pre-designated streets and sites of Northfield, inventorying the public trees and identifying appropriate potential

planting locations or green strips (recorded as “Vacant”). To ensure that only public trees were inventoried (opposed to trees on private property), each team had a list of the ROW boundaries for each street. Their first step upon reaching a new street was to determine the extent of the ROW from the curb (or edge of the road); the team measured the road width, subtracted that number from the full ROW boundary, and then divided the number in half to determine the ROW extent back the curb on each side of the street. The following equation expresses this process:

ROW distance from curb (or edge of road) = (ROW width - road width)/2

Each public tree identified was recorded into the “Collector” application using an iPad, provided by VT UCF. “Collector” is map-based and uses GPS and a base layer map to allow the user to input information about a tree, linking it to a particular geographic location. Data recorded for each tree included condition, tree number, street name, species, diameter class (using a diameter at breast height, or DBH, measurement), a consultation recommendation, comments, and nearest house or building number. In most cases, a picture was also taken of each tree or vacant (potential) tree location. A full list and description of the parameters used in data collection can be found in Table 1.

For the rural road ash survey, each team of two LANDS interns was assigned a segment of road along Turkey Hill Road, RT 12A, or Union Brook Road. Surveying both sides of the road, the interns tallied each ash tree along the road they saw and assigned it an approximated size and condition class.

Table 1: Parameters for Inventory Data Collection

Data Parameters	Description
Site ID	Street name or property name.
Tree Number	Count starts at 1 for each street/site. Unique to tree.
Species	Common name. Include in comments box if not listed.
Tree Condition	• *Good:* full canopy (75-100%), no dieback of branches over 2" in diameter, no significant defects, minimal mechanical damage • *Fair:* thinning canopy (50-75%), medium to low new growth, significant mechanical damage, obvious defects/insects/disease, foliage off-color and/or sparse • *Poor:* declining (25-50%), visible dead branches over 2" in diameter, significant dieback, severe mechanical damage or decay (over 40% of stem affected) • *Dead:* no signs of life, bark peeling; scratch test on twigs for signs of life (green) • *Vacant:* potential spot for a tree within the public ROW. Add "small", "medium", or "large" in the comments box - Small= max 30' at maturity, presence of overhead wires, minimum planting space 4' x 4' - Medium= 30-50' at maturity, green belts over 6' wide, no overhead wires - Large= 50'+ at maturity, parks and open space
Diameter (DBH)	Diameter taken at 4.5' above ground in classes of 0-3", 3-6", 6-12", 12-18", 18-24", 24-36", 36-42", 42"+. If on slope, uphill side measured. If abnormal growth, measured above or below growth. If multi-stemmed, each stem's DBH is squared, all squares summed, and the square root taken; indicate "multi-stemmed" in comments box.
Consult	• *Yes:* any one defect is affecting >40% of the tree, posing a hazard to people/infrastructure/cars, growing into utility wires, dead or poor condition, ash tree showing evidence of woodpecker flecking, blonding, epicormic branching/water sprouts, and/or suspicious exit holes • *No:* no major defects, tree in good or fair condition
Comments	Notes, elaborate on any existing conditions; max 255 characters.
House Number	Corresponding house address, numerical field. If a corner lot house is on a different street, enter house number and write "House located on X Street; corner tree" in comments box.
Collection Date/Time	Date and time.
Photo	Photo of full tree. Additional photos of any significant defects.

Left: each morning and afternoon the LANDS interns met to discuss and plan the most effective routes for data collection using a large parcel map.

Right: An example of a photograph of an individual tree that is attached to the record in the "Collector" application.

The data were compiled and subsequently analyzed and summarized using Microsoft Excel and ArcGIS. Data were also uploaded to i-Tree Streets in order to determine the monetary and ecosystem services benefits of Northfield's public trees inventoried. VT UCF staff conducted a baseline assessment of downtown Northfield's full tree canopy coverage, encompassing both private and public property, using i-Tree Canopy. i-Tree is a free software suite developed by the USDA Forest Service and is available at www.itreetools.org.

Inventory Results

Urban Forest Diversity

Of the 303 trees inventoried within the public ROW or on Town-owned land, there were over 30 different species in 15 different genera represented. The most common genera: maple (*Acer*), apple (*Malus*), ash (*Fraxinus*), spruce (*Picea)*, and oak (*Quercus*) comprise 81% of the urban forest (Figure 1). Sugar maple (*Acer saccharum)* (27.4%) was the most common species, followed by crabapple (*Malus spp.*) (19.8%), and Norway maple (*Acer platanoides*) (11.9%) (Figure 2). Complete species and genera lists can be found in Appendix B.

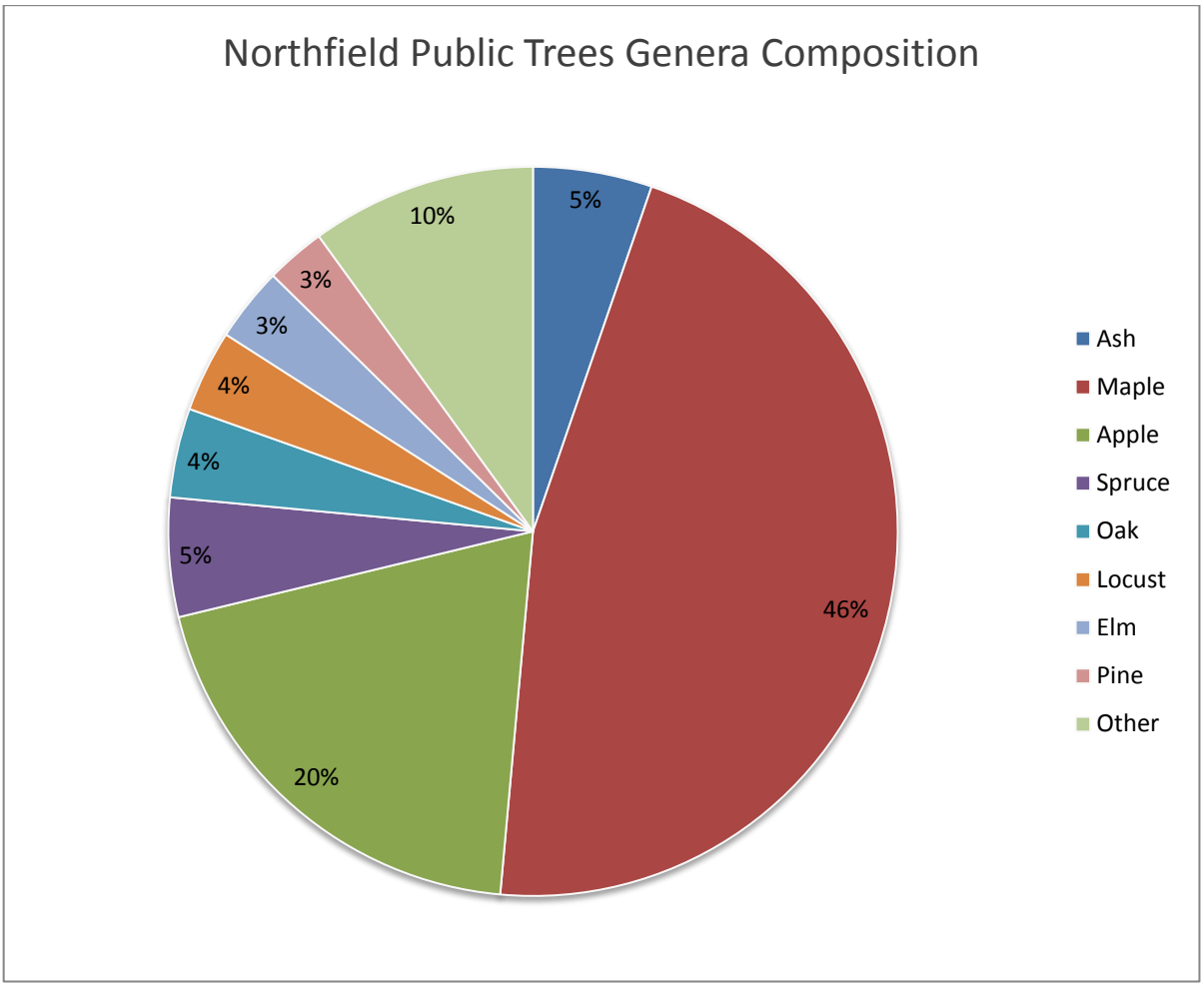


Figure 1: Chart showing tree genus by percent composition of all public trees inventoried in downtown Northfield. "Other" indicates all genera that were represented by less than 2% of the total population.

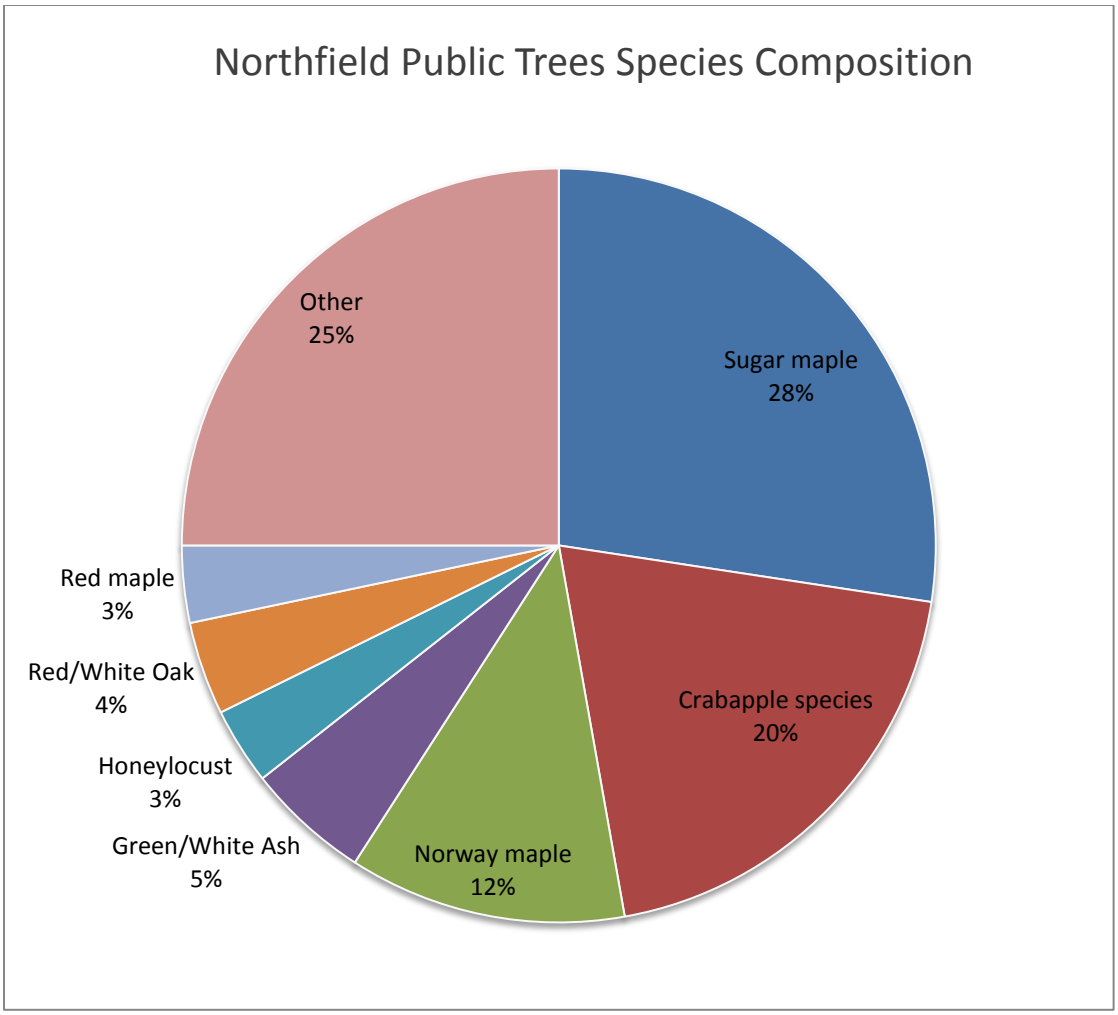


Figure 2: Chart showing tree species by percent composition of all public trees that were inventoried in downtown Northfield. "Other" indicates all species that were represented by less than 2% of the total population.

Urban Forest Structure

Diameter at breast height (DBH) can be correlated with approximate age class to estimate the age structure of an urban forest. Of the 303 public trees inventoried, 80 (26.4%) had a DBH of 6 – 12". There were 59 (19.5%) trees that measured less than 12-18" in diameter and 52 trees (17.2%) of the in the 18-24" diameter range (Figures 3, 4, 5); together these size classes indicate that 36.7% of public trees are reaching maturity. Younger trees – those under 6" in diameter – make up 23.1% of the Northfield public tree population; these are trees that have likely been planted with the past five years. Only 42 public trees (13.9%) were measured to be over 24" in diameter, indicating a small population of large, aging trees. It is important to note that large,

long-lived trees provide more ecosystem services and aesthetic benefits and it is important to retain these larger trees for the overall well-being of the urban forest. These trees are growing within the public ROW or on Town-owned land and were probably not planted as street trees but left as remnants as downtown Northfield grew. The largest public tree inventoried was a 61" silver maple on Central Street; since the inventory was conducted VT UCF has been informed that this large specimen tree will be removed due to infrastructure conflicts.

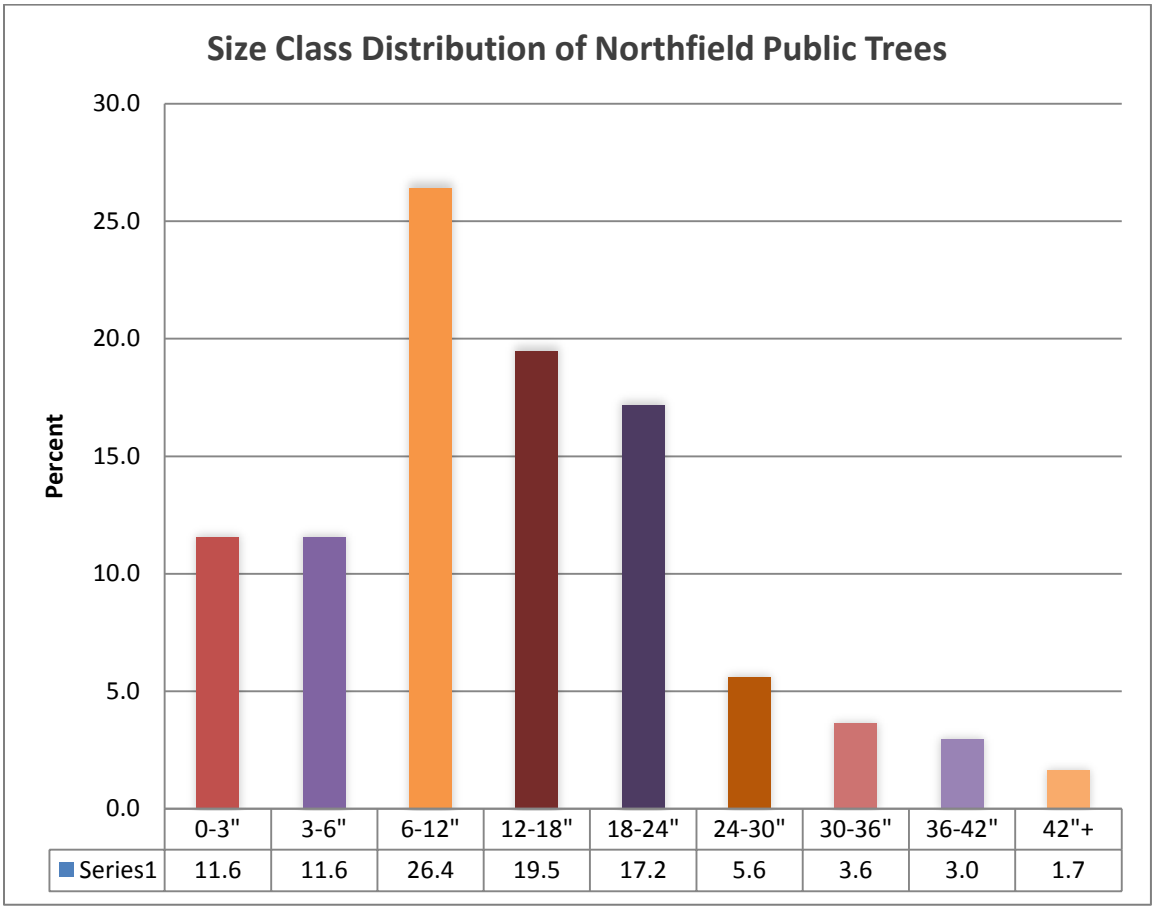


Figure 3: Diameter (inches) distribution of Northfield public trees by percentage.

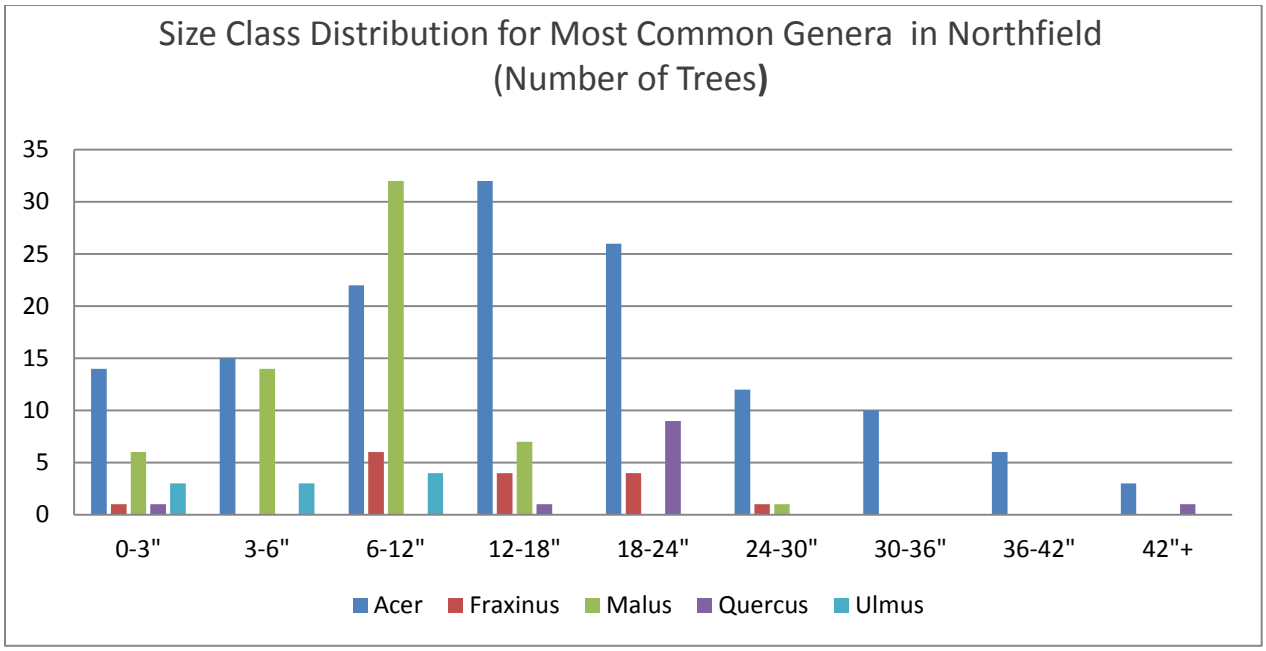


Figure 4: Diameter distribution by number of trees of the top five genera of public trees in downtown Northfield.

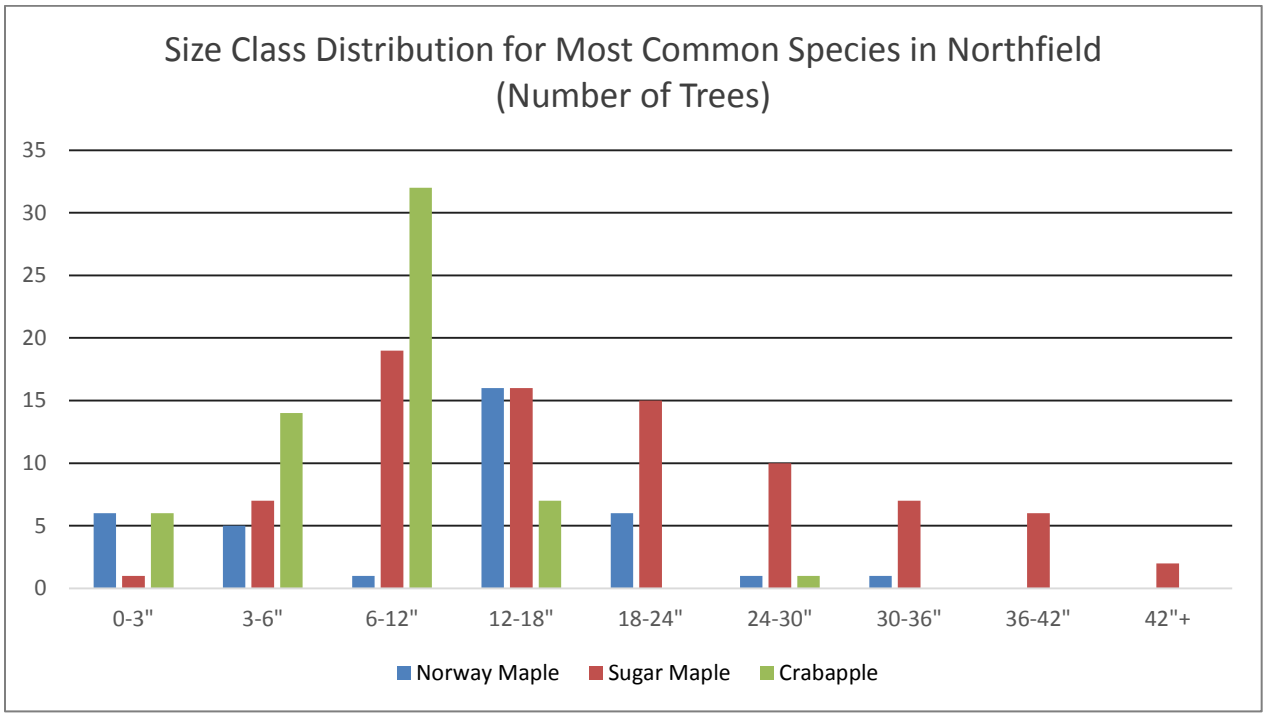


Figure 5: Diameter distribution by number of trees of the top three species of public trees in downtown Northfield.

Potential Tree Planting Locations

There were 44 "Vacant" potential tree planting sites or strips identified in Northfield. The majority of the potential planting sites were identified along Water Street and its adjacent roads, including Richardson Street, Western Avenue, Summer Street, Pleasant Street, and Cotter Avenue. There were no potential planting sites identified on the Northfield Green or at any of the Town-owned building properties (Town Offices, Library, Police Department) because of existing tree stocking levels and/or conflicting infrastructure. Likewise, no potential tree planting locations were identified at Mount Hope Cemetery because of our assumptions about intended land use at the cemetery. However, the LANDS interns were informed that there will likely be a future park developed along Water Street and there will be ample additional opportunities to plant riparian tree buffers and landscape trees at that site. See the map in Appendix E for all "Vacant" sites. Of the 44 identified locations, 25 were explicitly indicated to be appropriate for small-growing trees, 8 would be appropriate for medium-growing trees, and the remaining 11 would be most suitable for large-growing trees.

Urban Forest Health

An overwhelming majority (89%) of Northfield's inventoried public trees were assessed as being in "Good" condition; of the remaining trees, 28 (9.2%) were considered in "Fair" condition, 4 (1.3%) were in "Poor" condition, and just one was assessed to be "Dead" (Figure 6). The trees in the genus *Acer* (maple) had the most trees in fair or poor condition; however, this genus also comprised the highest percentage of overall trees inventoried. The one dead tree was identified as a maple and was located in front of 43 Cotter Avenue. See the maps in Appendix E for locations of all "Good", "Fair", and "Poor" trees.

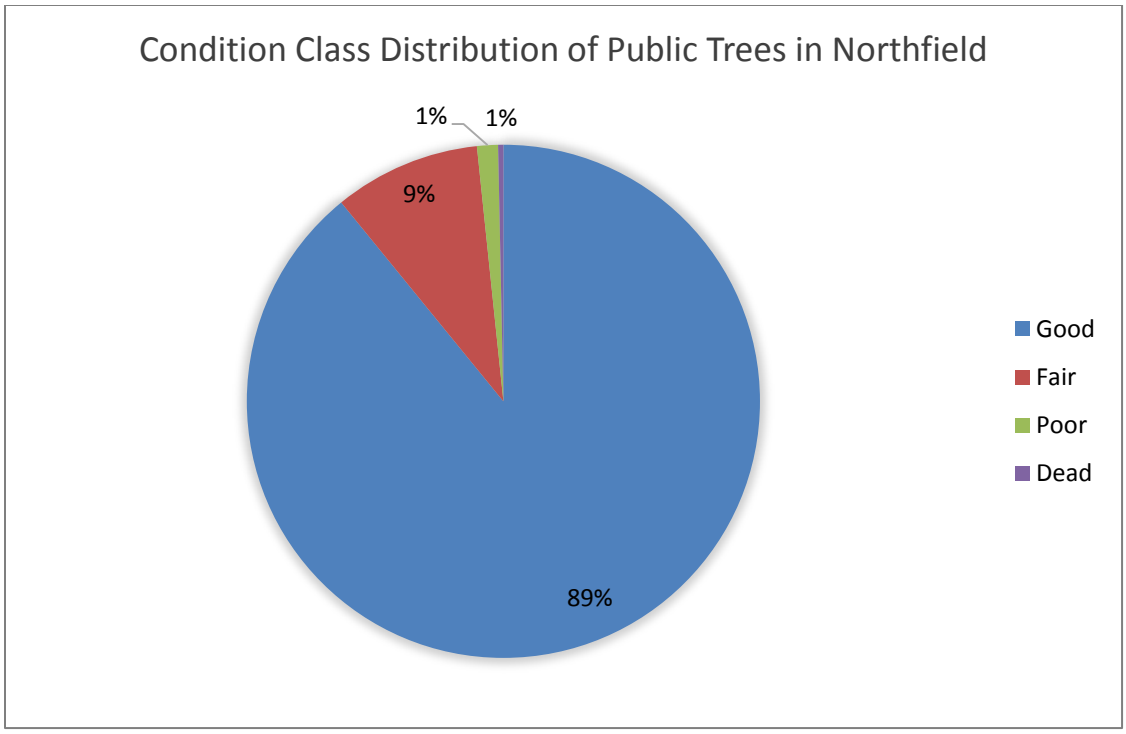


Figure 6: Chart showing condition class distribution, by percent, of all public trees inventoried in Northfield.

There were 23 trees (7.6%) that were flagged for a consult during the inventory and should be reassessed by an International Society of Arboriculture Certified Arborist or the Northfield Tree Warden, Russ Barrett, in a timely matter. Mount Hope Cemetery had the most trees recommended for a consult of any site (5). See the map in Appendix E for the location of trees requiring a consult. Trees that were flagged for a consult expressed one or more of the following conditions:

- The tree had a defect affecting >40% of the tree,
- The tree posed a hazard to people/infrastructure/cars,
- The tree was growing into utility wires,
- The tree was dead or in poor condition, or
- The tree was an ash (*Fraxinus*) and was showing evidence of a sign or symptom of infestation by the emerald ash borer (extensive woodpecker flecking, bark blonding, epicormic branching/water sprouts, and/or suspicious exit holes).

Rural Roadside Ash Survey

A total of 1,415 ash trees were tallied along approximately 10 miles of rural roads in Northside by the LANDS interns. These trees were not mapped and their size and condition were estimated based on a rapid assessment. In total, 1,254 of the ash trees were assessed to be in good condition (88.6%) and 1,021 (72.1%) were estimated to be under 6" in diameter, indicating a young and healthy population of roadside ash in Northfield. Figures 7-9 below show the results of each of the road segments.

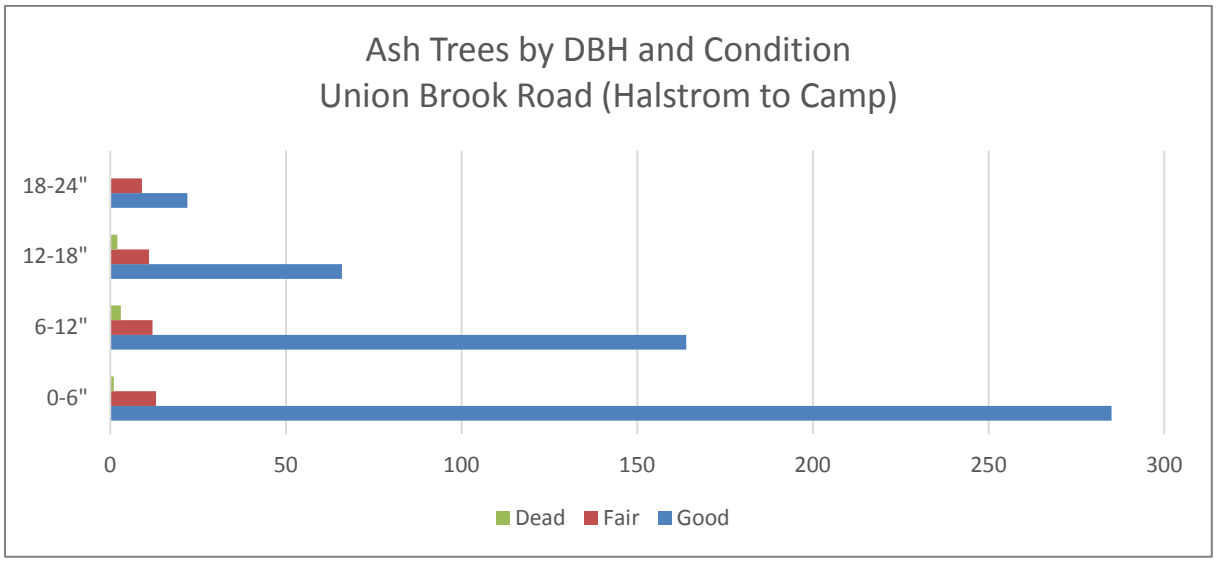


Figure 7: Size and condition distribution of the roadside ash trees tallied on Union Brook Road from Halstrom Road to Camp Road.

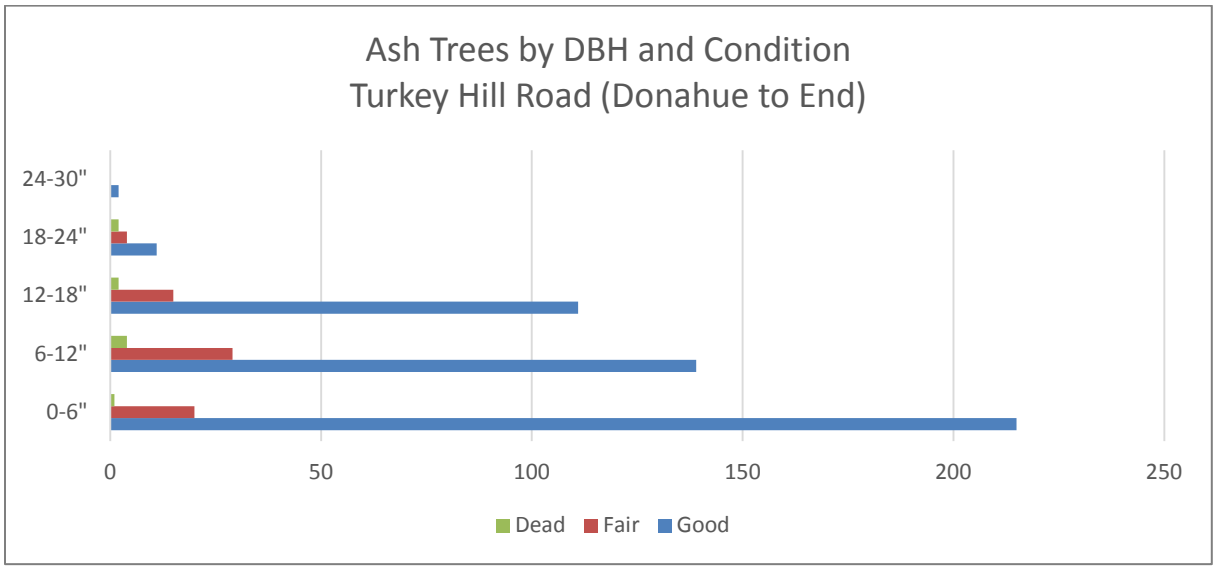


Figure 8: Size and condition distribution of the roadside ash trees tallied on Turkey Hill Road from Donahue Road South to the road's end.

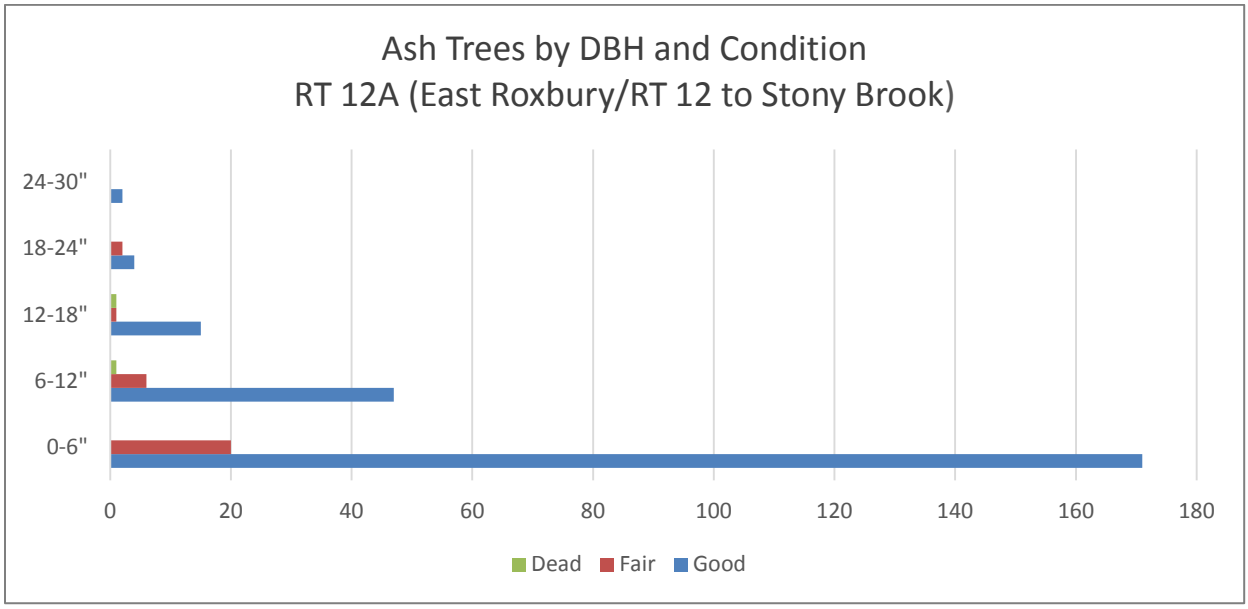


Figure 9: Size and condition distribution of the roadside ash trees tallied on RT 12A from RT 12 (East Roxbury Road) to Stony Brook Road.

Monetary Value and Ecosystem Services

The data was analyzed using i-Tree Streets software to determine the monetary value of ecosystem services provided by Northfield's downtown public trees. Using sophisticated models, i-Tree streets assesses the total annual monetary value of inventoried public trees and the average monetary value per inventoried public tree based on the ecological and societal benefits described in Table 2. The 303 trees provide a total of **$34,520** in total annual benefits by filtering air pollutants, mitigating stormwater, sequestering carbon dioxide (CO_2), conserving energy, and increasing property values. On average, each tree contributes $114 annually in savings or services. Figure 10 and Table 2 provide an overview of each ecosystem service provided by the Northfield public trees. Energy conservation and property value increase are the most significant services provided by these trees by monetary value. The full i-Tree Streets reports for Northfield are available through VT UCF.

It is significant to note that the trees inventoried through this project are located on less than 2% of the total land area of the Town of Swanton – approximately .75 of a square mile (of 38

total square miles). Expanding the inventory to all Northfield ROWs and town-owned properties would increase these figures dramatically. It is also noteworthy that larger and long-living trees provide substantially more benefits than young, small trees; regular maintenance and care are needed to provide for urban tree health, longevity, and maximized urban forest benefits.

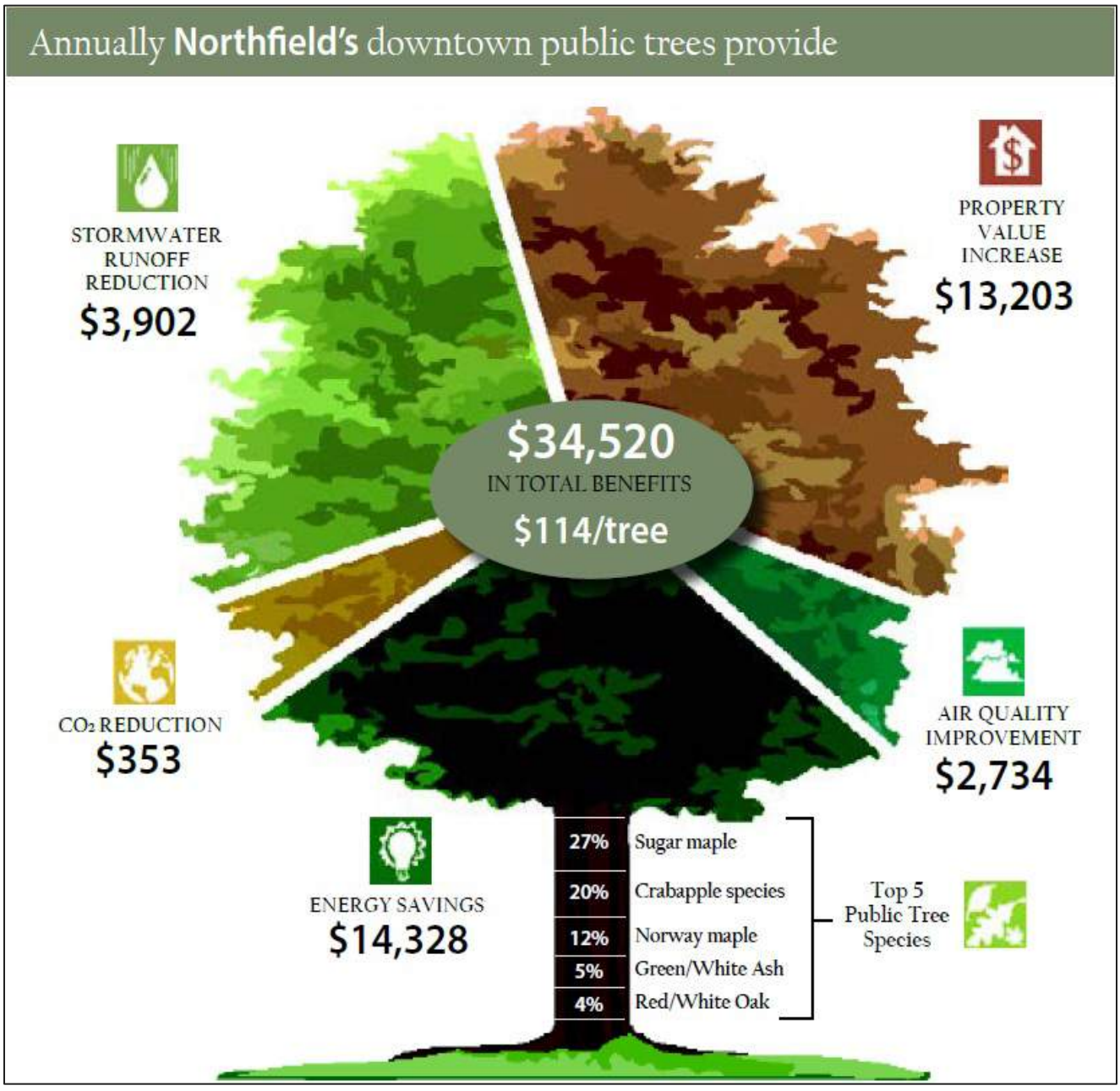


Figure 10: Summary of benefits provided by Northfield's downtown public trees. Data generated through i-Tree streets and tree graphic concept courtesy of City of New York Department of Parks & Recreation.

Table 2: Ecosystem services and monetary benefits provided by Northfield's downtown public trees.

Benefit Type	Benefit Description	Total Value of Trees Inventoried	Average value/tree
Energy conservation	Reduced natural gas use in winter and reduced electricity use for air conditioning in summer	$14,328	$47.92
Carbon dioxide	Annual reductions in atmospheric CO2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use. The model accounts for CO2 released as trees die and decompose and CO2 released during the care and maintenance of trees.	$353	$1.16
Air quality	Quantifies the air pollutants (O_3, NO_2, SO_2, PM_{10}) deposited on tree surfaces and reduced emissions from power plants (NO_2, PM_{10}, VOCs, SO_2) due to reduced electricity use. Also reported are the potential negative effects of trees on air quality due to BVOC emissions.	$2,734	$9.02
Stormwater	Reductions in annual stormwater run-off due to rainfall interception by trees.	$3,902	$12.88
Aesthetic/other	Tangible and intangible benefits of trees reflected in increases in property values.	$13,203	$43.57
Stored carbon dioxide	Tallies all of the carbon dioxide stored in the urban forest over the life of the trees as a result of sequestration; *not an annual benefit but a cumulative benefit.	$4,886*	$16.12*
Totals		**$39,406* cumulative, $34,520 annually**	**$131* cumulative, $114 annually**

Northfield Full Tree Canopy Assessment

As a complement to the public tree inventory, VT UCF's staff completed an i-Tree Canopy assessment for area covered by the public tree inventory in Northfield. i-Tree canopy is a free, easy-to-use online application that allows users to assess total tree cover (encompassing both public and private land) over a defined area based on randomly generated map points and user-defined land cover types. The tool also assigns dollar values to the benefits associated with the overall tree canopy cover. The aim of this type of assessment is to help citizens and decision-makers better understand the existing and potential tree canopy in their community. Based on the Northfield i-Tree Canopy assessment, approximately 36% of the downtown corridor and most densely-populated areas in Northfield are currently occupied by tree canopy cover (Figure 11). In consideration of the other land cover types detected through the 50-point assessment, Northfield could potentially increase its total tree canopy cover by an additional 22% on open lands of low-lying vegetation. Currently 24% of the area is occupied by buildings, wetlands, or water – not suitable for tree planting – but the remaining 18% is impervious surface (parking lots, playgrounds, roads and the ROW) and with strategic planning initiative, could be partially converted to tree canopy. In total, there is currently potential to increase overall tree canopy cover in Northfield by 40% (Figure 12).

Figure 13 compliments the i-Tree Streets analysis of the monetary value of benefits provided by Northfield's public trees by estimating the air quality benefits and corresponding monetary value for the full area's urban forest canopy. Of note is an estimated total of $423,475 in CO_2 storage and $16,795 in annual CO_2 sequestration value.

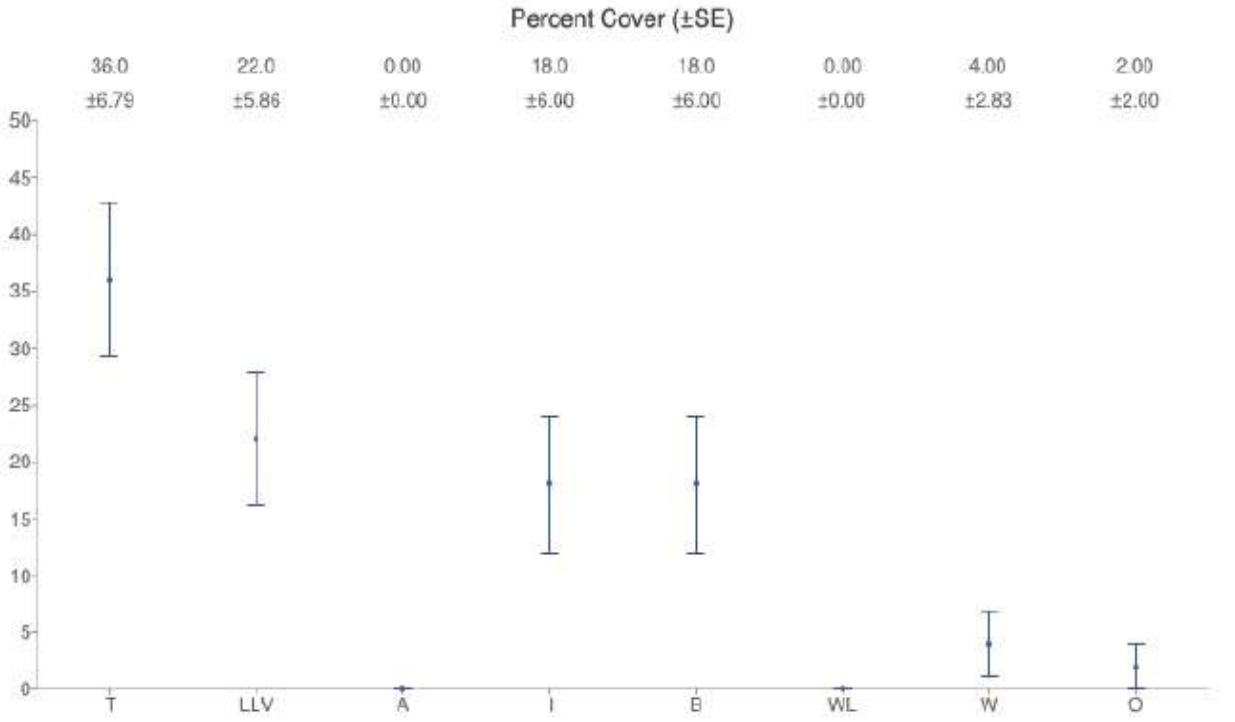
i-Tree

Tools for Assessing and Managing
Community Forests

i-Tree Canopy v6.1

Cover Assessment and Tree Benefits Report

Estimated using random sampling statistics on 11/11/14



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	18	36.0 ±6.79
Low Lying Vegegation	grasses, open spaces	LLV	11	22.0 ±5.86
Agriculture	agricultural fields or farms	A	0	0.00 ±0.00
Impervious	streets, parking lots, sidewalk	I	9	18.0 ±6.00
Building	building, structure	B	9	18.0 ±6.00
Wetland	marsh, wetlands	WL	0	0.00 ±0.00
Water	water	W	2	4.00 ±2.83
Other	Other land cover types (sand, quarries, etc.)	O	1	2.00 ±2.00

Figure 11: i-Tree Canopy assessment for downtown Northfield based on 50 random points.

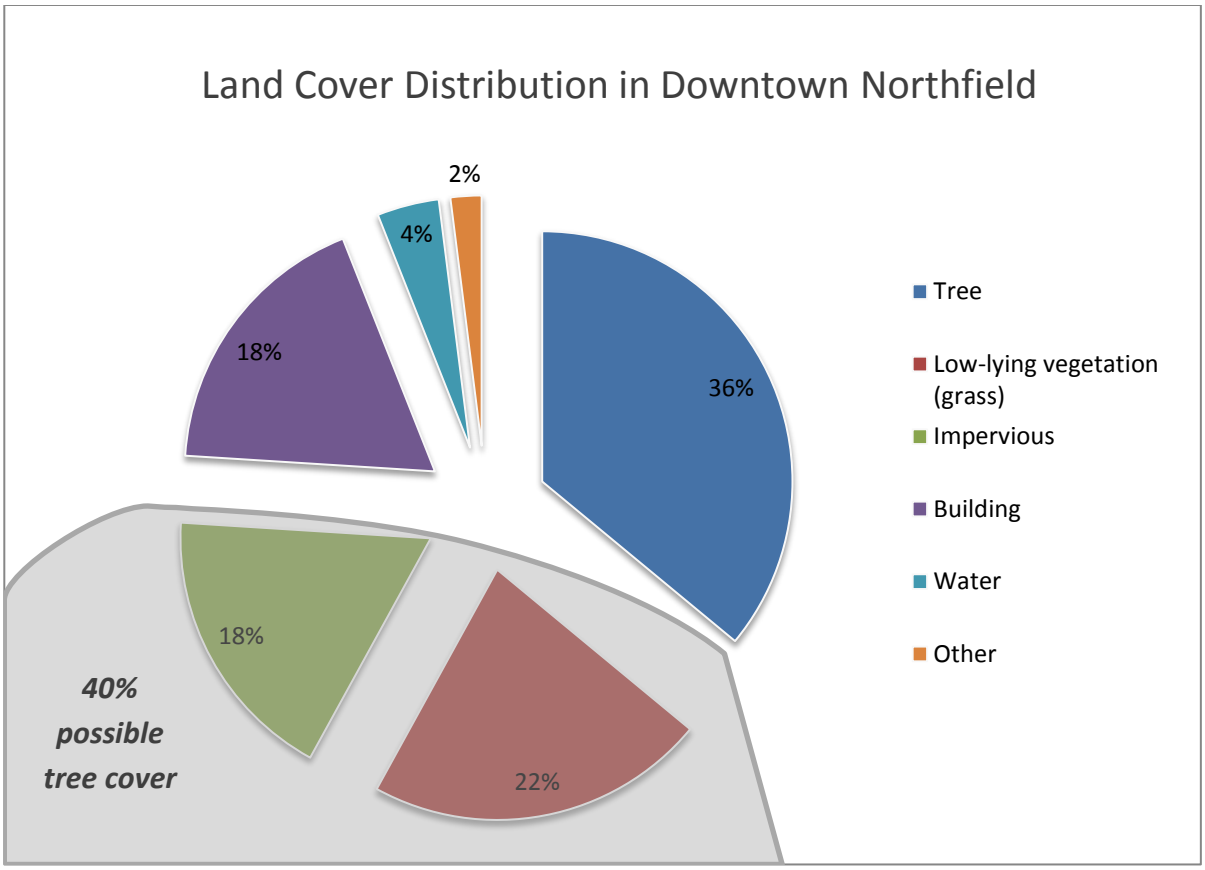


Figure 12: Land cover distribution in downtown Northfield based on the i-Tree Canopy assessment.

Tree Benefit Estimates

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$6.65	±1.25	156.88 lb	±29.58
NO2	Nitrogen Dioxide removed annually	$11.45	±2.16	855.45 lb	±161.31
O3	Ozone removed annually	$596.27	±112.43	4.26 T	±0.80
PM2.5	Particulate Matter less than 2.5 microns removed annually	$1,232.60	±232.42	414.00 lb	±78.06
SO2	Sulfur Dioxide removed annually	$2.00	±0.38	539.09 lb	±101.65
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$432.88	±81.62	1.43 T	±0.27
CO2seq	Carbon Dioxide sequestered annually in trees	$16,795.85	±3,167.06	867.40 T	±163.56
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$423,475.63	±79,851.33	21,869.97 T	±4,123.84

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and $/T/yr: CO 0.902 @ $85.08 | NO2 4.917 @ $26.86 | O3 48.968 @ $140.47 | PM2.5 2.379 @ $5,975.67 | SO2 3.098 @ $7.45 | PM10 16.403 @ $304.43 | CO2seq 9,970.817 @ $19.43 | CO2stor is a total biomass amount of 251,395.359 @ $19.43*
Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

Figure 13: Air quality benefits provided by the total canopy of downtown Northfield based on the random point i-Tree Canopy assessment.

Discussion and Recommendations

Urban Forest Diversity and Structure

An important best management practice in urban forestry is to maintain a diverse range of species. It is recommended that communities work towards a goal of no more than 20% representation of a single genus (for example: maples) in a tree population and no more than 10% of one species (for example: sugar maple). Resistance to disease and insect infestation is one of the many reasons that diversity within the urban forest is of paramount concern. A more diverse forest will be more resistant to environmental stressors, and therefore remain healthy and resilient in the face of change. Furthermore, by maintaining higher diversity a community can prevent a rapid loss of canopy due to insect and disease issues.

In Northfield, nearly half (46%) of all public trees inventoried were in the maple (*Acer*) genus, which is over double the recommended representation within the community's urban forest. Specifically, sugar maple, Norway maple, red maple, silver maple, and boxelder represent 27.4%, 11.9%, 3.3%, 1%, and 1%, of the species diversity respectively. Sugar maple, an iconic Vermont tree, is by far the most prevalent species in Northfield. Coming in at third most represented, Norway maple is now

Components for Managing a Vibrant and Resilient Urban Forest

A successful urban forestry program requires a combination of organized leadership, comprehensive information about the tree population, dedicated personnel, and effective public relations. We recommend the following components for successful urban forest management.

Public Policies: A tree ordinance or policy provides authority for conducting forestry programs, defining municipal responsibility for public and private trees, passing regulations and setting minimum standards for urban forestry management.

Leadership: Define who is responsible for the oversight of the community forest, including formulating policies, advising, administration, management, representation and/or advocacy.

Partnerships: A well-managed urban forest takes the work of many. Seek strategic partnership to meet a shared vision. At a minimum the tree warden, a local advisory committee like a tree board or conservation commission and municipal staff (parks, roads, planning) should collaborate.

Responsibility: A clear understanding of which trees and areas will be managed is an important first step. Street trees, parks and village greens, cemeteries and schools are typical areas of municipal responsibility.

Assessment: A complete public tree inventory, including tree locations, species, condition, and management needs provides the necessary information to manage the resource. An inventory is the foundation to developing a strategic management plan.

Management Plan: A management plan provides a vision for the long-term management of the community forest. It should include strategies, budgets, and responsibilities for meeting that vision.

Staffing: The care of urban forest requires a certain skill set that can be found in-house with professional staff or through consultants. Whether creating a staff position for a certified arborist or urban forester, or contracting with them on an as-needed basis, professional assistance will have some of the greatest and most immediate impacts on a community forestry program.

Tree Canopy Goals: Consider a community's entire tree canopy to reduce loss and maximize gains over time by protecting undeveloped forest and impacts of land development, enhance the health condition and function of forests, and reforest through active replanting or allowing regeneration.

considered to be a non-native invasive species. Although an aesthetically pleasing and hearty tree, Norway maple can spread into nearby forests and out-compete native species such as sugar maple. In fact, Vermont's Plant Quarantine Rule prohibits the movement, distribution, and sale of Norway maple, as well as other invasive plant species. Maple trees are currently threatened by the invasive tree pest the Asian longnorned beetle (ALB); while this pest has not been discovered to-date in Vermont, the largest ALB infestation in North America is a little over 50 miles to our southern border in Worcester, MA.

Ash trees (genus *Fraxinus*) are also threatened by an invasive tree pest, the emerald ash borer (EAB), but trees of the ash genera make up just about 5% of the public tree canopy of Northfield. This means that an infestation of EAB in Northfield would not significantly impact the overall public tree density or composition. However, as of late 2014, EAB has not yet been detected in the state, but Vermont is surrounded on all sides by states or provinces with isolated infestations of EAB. However, based on the rural roadside ash survey conducted through this project, Northfield should be planning for the arrival of EAB. A total of 1,415 ash trees were tallied adjacent to just 10 miles of road. The Northfield Highway Department is responsible for over 80 miles of road throughout the Town of Northfield; assuming that ash densities are consistent throughout the rest of town, total roadside ash numbers could be over 11,000 trees.

In addition to improving species diversity, striving for age class diversity is also important. There is a concentration (63%) of public trees within the 6-24" size classes. Only 14% of the public trees are over 24" in diameter and it is important to monitor and maintain the health of those trees since larger, longer-lived trees provide greater benefits. Approximately a quarter (23.1%) of the public trees is less than 6" in diameter, indicating that new trees are being planted in Northfield. A well-distributed age structure is an important element of a strategically planned urban forest that will provide continued long-term benefits.

Recommendation:

Develop species, structural, and age diversity by planting new species and increasing the number of lesser represented species using best management practices in order to promote long-term health and resilience of individual trees and Northfield's urban forest.

Recommended action practices:

- We advise against planting high-density stands of the same species (monocultures) whose close proximity may be conducive to the spreading of disease or pests.
- Because of the high concentration of maple trees in downtown Northfield, the additional planting of any maple trees (*Acer*) or crabapples (*Malus*) is not recommended.
- We suggest planting tree species that have been grown successfully in the area that do not show any signs of diseases and deformity, and that are not non-native invasive species (specifically Norway maple).
- Existing ash trees should be consulted and regularly monitored for signs of EAB, and additional ash trees should not be planted.
- Plan for the arrival of EAB by using the Community Preparedness Toolbox, available at http://www.vtinvasives.org/tree-pests/community-preparedness.
- Encourage Northfield citizens to participate in the Vermont Forest Pest First Detector Training to expand local capacity to identify and monitor for invasive forest pests.
- In order to diversify in both species composition and age structure, create a strategic planting plan to prioritize new plantings in the 44 identified vacant planting sites.
- In planning for future tree plantings, consider obstructions above ground (power lines) and below ground, minimize grey infrastructure conflicts (sidewalks, streets, buildings, etc.) available soil volume, species mature size (height and spread), branching patterns, environmental tolerances (exposure, salt, and drought), and desired function when choosing species. For more information on site assessment and species selection, refer to the VT Tree Selection Guide at http://www.vtcommunityforestry.org/resources/tree-care/tree-selection.

- Encourage residents to plant trees on their properties to increase species diversity, age structure, and overall tree canopy benefits to the community.

Maintenance

Proper tree maintenance, especially pruning, can extend the life and health of trees, as well as reduce public safety issues. There are four main pruning practices of note:

- Crown cleaning: removes dead, diseased, and damaged limbs
- Crown thinning: selective removal of stems and branches to increase light penetration and air movement throughout the crown of a tree
- Crown raising: the removal of lower branches over 2 inches in diameter to provide clearance for pedestrians and vehicles
- Crown reduction: removing individual limbs from structures or utility wires

While the LANDS interns did not specifically collect data on pruning needs, establishing a systematic pruning cycle is an important component to a well-managed urban forest. In addition to pruning, proper mulching for soil health, moisture retention, and to protect from mechanical damage is encouraged. Finally, for newly-planted trees, an irrigation regime should be in place to ensure proper establishment and tree root regeneration.

Recommendation:

Establish a routine maintenance cycle, implemented by trained professionals and overseen by the Northfield Warden and the NCC for all public trees to promote tree health and reduce any threat to public safety.

Recommended action practices:

- Consider expanding upon the inventory to include other densely-populated areas in Northfield. A comprehensive baseline inventory is important in order to establish a routine maintenance regime for all Town-managed trees.
- Work with VT UCF to ensure municipal tree maintenance staff is trained in best management practices.

- Establish a systematic pruning cycle to reduce branch and tree failures due to poor structure, minimize conflicts with people and infrastructure, improve line of sight, and reduce storm damage. When trees are located near electrical utility lines, it is important to work directly with the local utility company.
- Encourage Northfield citizens to participate in VT UCF's Stewardship of the Urban Landscape training course to continue to build local capacity to care for and promote Northfield's canopy.

Urban Forest Health

Overall, Northfield appears to have a healthy population of public trees. Approximately 10% (32) of Northfield's public trees were either considered to be in "Fair" or "Poor" condition and 1 tree was determined to be "Dead". Concentrations of fair and poor trees were found Cotter Avenue, Kent Street, and Sherman Avenue. There were 23 (7.6%) trees flagged to be revisited by a trained arborist or the Northfield Tree Warden; many of these trees overlap those designated to be in poor condition or dead, but others were likely noted because of conflict with utility wires or other infrastructure. See Appendix E for a map detailing the locations of the fair, poor, and dead trees in downtown Northfield and a map indicating the location of the 23 trees requiring a consult.

Low soil volume and fertility, exposure to salt spray, root damage, mechanical damage to the stem, poor pruning, and improper planting are some of the contributing factors that may lead to decreased tree health in an urban setting.

Recommendation:

Continue to monitor trees in good and fair condition, plan to lose trees in poor condition, and remove the one dead tree to increase overall urban forest health.

Recommended action practices:

- Assess the 23 trees flagged for consultation in a systematic and timely fashion.
- Remove the one dead public tree (within the ROW, in front of 43 Cotter Avenue).

- Closely monitor the health of the 4 public trees in poor condition and plan for their removal and replacement in the near future.
- Continue to monitor the health of the trees in good and fair condition and record any changes in tree health through a regular inventory cycle.

Assessment Tools

Using free i-Tree software developed by the USDA Forest Service, we were able to assess the value and potential expansion of Northfield's urban tree canopy. i-Tree Streets allowed us to determine the economic value of the ecosystem services provided by the 303 inventoried trees in downtown Northfield. Northfield's public trees contribute $34,520 annually through the benefits of air quality improvement, carbon storage, electricity and natural gas, aesthetics, and storm water control; on average, each tree offers $114 in service or savings every year. Combined with trees on private land – assessed by using the i-Tree Canopy tool – and their estimated air quality benefits, Northfield's urban forest is providing around half a million dollars in benefits through its ecosystem services. The trees of Northfield provide services in the following ways:

- **Aesthetics**: Urban trees can make an urban or suburban environment a more pleasant and satisfying place to live, work, and spend leisure time (Dwyer et al. 1991). In monetary terms, presence of shade trees can significantly increase property value. There are also numerous health benefits to trees. For example, hospital patients with window views of trees have been shown to recover faster than patients without such views (Ulrich 1984).
- **Air quality**: Trees improve air quality by removing air pollutants through their leaves, altering emissions from building energy use, and by lowering air temperature.
- **Energy use**: Trees influence thermal comfort and energy use by providing shade, transpiring moisture, and reducing wind speeds. Over 100 million trees have been established around residences in the U.S. and it saves $2 billion annually in reduced energy costs (Akbari et al. 1992).

- **Stored Carbon Dioxide**: Urban trees can affect climate change by storing carbon in their tissues and reduce emissions through lowered building energy use. Urban trees in the contiguous United States store 770 million tons of carbon, which is valued at $14.4 billion (Nowak and Crane 2002).
- **Storm water run-off**: Trees and soil improve water quality and reduce costs associated with storm water treatment by retaining or slowing flow of precipitation.

Recommendation:

Use the information generated through the i-Tree Streets and i-Tree Canopy tools to promote investment in urban forest management and local stewardship.

Conclusion

Trees in our urban landscapes contribute to environmental integrity, social cohesiveness, economic activity, cultural heritage, and overall well-being. This report is one component of a long-term effort by the Town of Northfield and the Northfield Conservation Commission to understand, manage, and steward its urban forest. The recommendations outlined in this report are based on the LANDS interns' observations and data analysis combined with the experience and evaluation of VT UCF staff; they should considered by the NCC in correlation with, and based upon, long-term goals and vision, as well as capacity to implement. VT UCF will continue to be a resource as the Town moves its urban forestry program forward.

LANDS interns with the largest public tree found in Northfield, the 60.5” silver maple located on Central Street.

Sources

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Appendix A: Full Street and Site List for the Swanton Village Inventory

Street or Site Name	Public ROW (in feet)	Number of Trees Inventoried	Number of Vacant Sites Identified
Belknap Avenue	49.5'	0	
Byam Hill	33'	3	
Carpenter Street	24'	2	
Cemetery Street	33'	28	
Central Street	49.5'	7	
Cherry Street	28'	0	
Cotter Avenue	24'	15	2
Crescent Avenue	33'	2	1
Cross Street	33'	1	
Demasi Street	33'	8	
Depot Square	n/a	0	
Dog River Drive	33'	0	1
Dogwood Glen	33'	12	6
Doyon Road (Old Camp Road)	33'	0	
East Street	49.5'	0	
Elm Street	45'	1	
Fiske Drive	16.5'	0	
Garvey Hill Road	19'	0	
Highland Avenue	49.5'; extension = 41.5'	16	
Hill Street	33'	1	
Houston Avenue	40'	14	2
Jarvis Lane	16.5'	0	
Jefferson Avenue	33'	0	
Kent Street	19'	0	
Kimball Avenue	20'	0	
King Street	33'	10	
Main Street (Rt. 12)	49.5' south and north of downtown, 66' between East and Vine	41	
Maple Avenue	30'	0	
Memorial Park	n/a	10	
Mount Hope Cemetery	n/a	30	
Noridge Drive	33'	1	
North Street	49.5'	2	
Northfield Library Grounds	n/a	6	
Northfield Police and Fire Grounds	n/a	10	

Northfield Town Green	n/a	12	
Northfield Town Offices	n/a	16	
Northview Drive	33'	1	1
Pearl Street	33'	0	
Pleasant Street	33'	3	4
Prospect Street	33'	0	
Richardson Street	40'	8	4
School Street	33'	3	
Slate Street	33'	0	
South Street	24'	0	
Spring Street	33'	0	
Summer Street	40'	9	4
Traverse Street	24'	0	
Tuckaway Lane	33'	0	1
Turkey Hill Road	49.5'	1	
Union Street/ Unionbrook Road	33'	0	3
Vine Street	33' btwn Main and North, 41.5' between North and Upper Vine St. Extension, 24' along Upper Vine St. Extension	9	
Wall Street	33'	0	
Warren Avenue	33'	0	
Warren Street	33'	0	
Washington Street	33'	2	
Water Street	49' between Main and Union, then 41.5'	14	12
Western Avenue	40'	5	3
Whetstone Drive	33'	0	
Total		**303**	**44**

Appendix B: Complete Species List of Northfield's Inventoried Public Trees

Common Name	Scientific Name	Number of Trees	Percent of Total Tree Population
Sugar maple	*Acer saccharum*	83	27.39%
Crabapple	*Malus spp.*	60	19.80%
Norway maple	*Acer platanoides*	36	11.88%
Green ash	*Fraxinus pennsylvanica*	14	4.62%
Oak	*Quercus spp.*	12	3.96%
Red maple	*Acer rubrum*	10	3.30%
Honeylocust	*Gleditsia triacanthos*	10	3.30%
American elm	*Ulmus americana*	10	3.30%
Conifer Evergreen Misc.		8	2.64%
Blue spruce	*Picea pungens*	8	2.64%
Broadleaf Deciduous Misc.		7	2.31%
White spruce	*Picea glauca*	6	1.98%
Maple	*Acer spp.*	4	1.32%
Pine	*Pinus spp.*	4	1.32%
Eastern white pine	*Pinus strobus*	4	1.32%
Douglas fir	*Pseudotsuga menziesii*	4	1.32%
Boxelder	*Acer negundo*	3	0.99%
Silver maple	*Acer saccharinum*	3	0.99%
River birch	*Betula nigra*	3	0.99%
Broadleaf Evergreen Other		2	0.66%
Hickory	*Carya spp.*	2	0.66%
White ash	*Fraxinus americana*	2	0.66%
Amur maple	*Acer campestre*	1	0.33%
Paper birch	*Betula papyrifera*	1	0.33%
Norway spruce	*Picea abies*	2	0.66%
Eastern Cottonwood	*Populus deltoides*	1	0.33%
Plum	*Prunus spp.*	1	0.33%
Common chokecherry	*Prunus virginiana*	1	0.33%
Black locust	*Robinia pseudoacacia*	1	0.33%
TOTAL		**303**	**100.00%**

Appendix C: Instructions for Accessing Public Tree Data in ANR Atlas

Anyone with internet access can view all of the inventoried Northfield public trees by using the Vermont Agency of Natural Resources' (ANR) Atlas mapping tool. Follow these simple steps:

1. Set your web browser to http://anrmaps.vermont.gov/websites/anra/
2. Zoom in to Northfield using the +/- scale navigation tool in the upper left portion of the map (the tree data layer won't show up unless you are zoomed in to the town-level so that you can see the street names on the map).
3. In the information pane on the left of the screen switch over to the "map layers" tab at the bottom.
4. Expand the "Forests, Parks, & Recreation" heading,
5. Click on the box to the left of "Urban Tree Inventory" to load public tree data (it might take a moment for the layer to load).
6. Once you see all the trees on the map, you can zoom in and right-click on any individual tree and click on "What's here"; when you do this, the left information pane will change to give you the basic details for that specific tree.
    - To access all of the information collected on that specific tree, click on the grey text title of the tree in the left pane and a new window will open with all of the inventory data.
    - In this new window there are three tabs: "Details" and "Attributes" display the same information in different formats and if a photo was taken of the tree, it will show up in the "Attachments" tab.

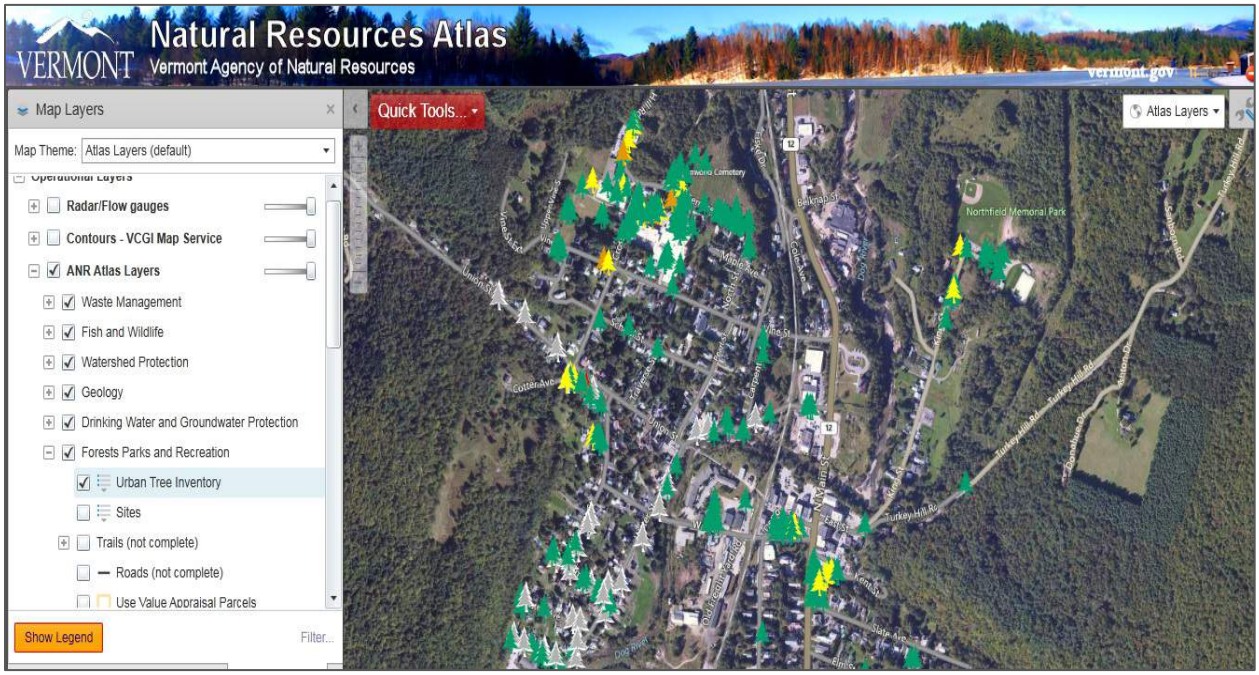


Figure 14: A screen shot of the ANR Atlas mapping tool zoomed in to view Northfield's public tree data.

Appendix D: Results from Northfield Schools Tree Inventory

On October 14th, 2014, VT UCF staff trained the Students Taking Alternate Routes (STAR) program participants from Northfield High School in basic tree identification and the VT UCF public tree inventory system. After the training, the students split into small teams and inventoried 85 trees on the Northfield Elementary and Northfield Middle/High School properties.

The 85 Northfield Schools trees were not included in the Northfield Public Tree Inventory and are not included in the results or discussion section of this overall report; they are, however, accessible on ANR Atlas and as part of the Northfield urban forest should considered in future urban forest decisions and assessments. The results from the Northfield Schools inventory are summarized below.

Forest Diversity

- The 85 Northfield Schools trees inventoried represent 14 species (Figure 15) in 13 genera.
- The most common tree species is crabapple (*Malus spp.)* with 20 trees (24%), followed by American linden (*Tilia americana*) with 15 trees (18%) and northern white-cedar (*Thuja occidentalis*) with 12 trees (14%).

Forest Structure

- 51% (43) of the Northfield Schools trees had a diameter at breast height (DBH) measurement of 6-12". Of the remaining trees, 9% (8) were 0-3", 28% (24) were 3-6", 11% (9) were 12-18", and just one tree (1%) was over 18" in diameter.
- The DBH measurements indicate the age structure of the Northfield Schools trees; most of the trees are young or are approaching maturity and there are few mature trees on the campus.

Forest Health

- The vast majority (87% or 74) of the Northfield Schools trees was assessed to be in "Good" condition, 8% (7) were in "Fair" condition, and 5% (4) were in "Poor" condition (Figure 17).
- There were no "Dead" trees on the Northfield Schools grounds, but 7 trees were recommended for a consultation by a trained arborist or the Northfield Tree Warden.

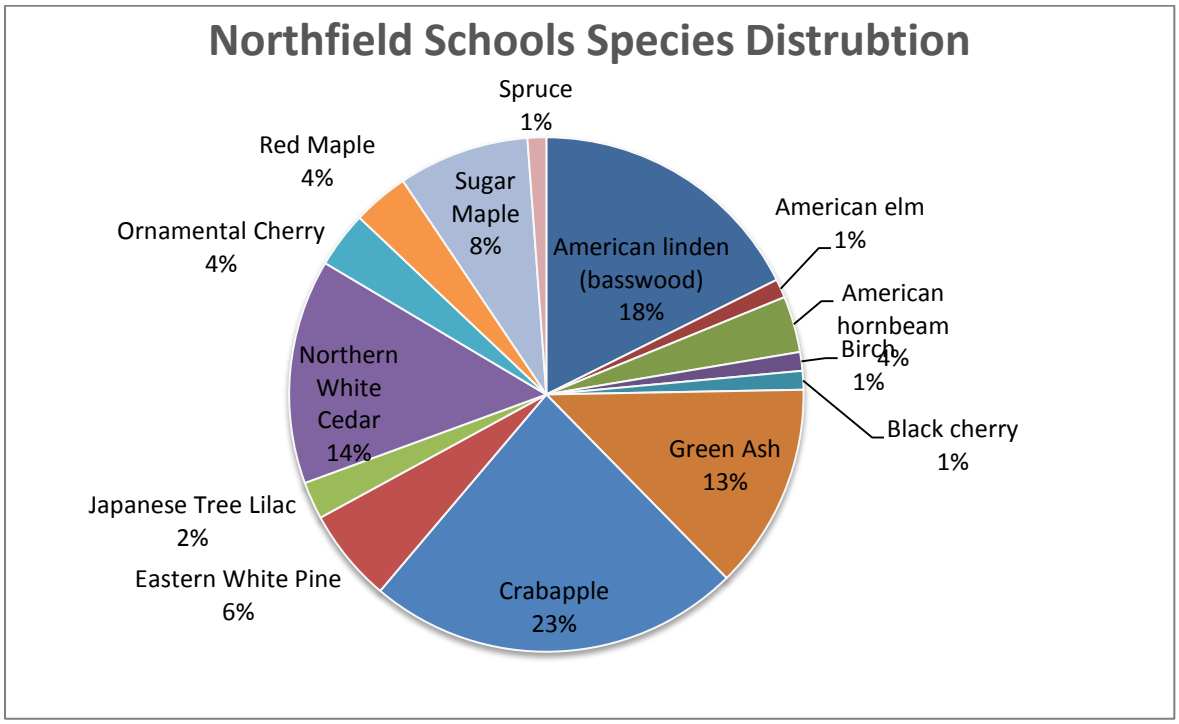


Figure 15: Species distribution of Northfield Schools trees by percent.

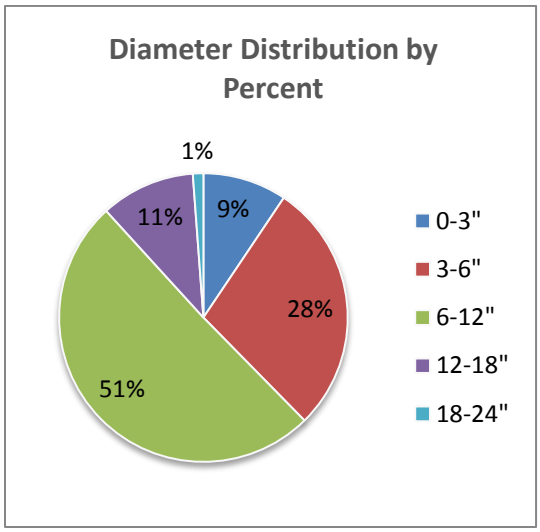


Figure 16: Diameter distribution by percent.

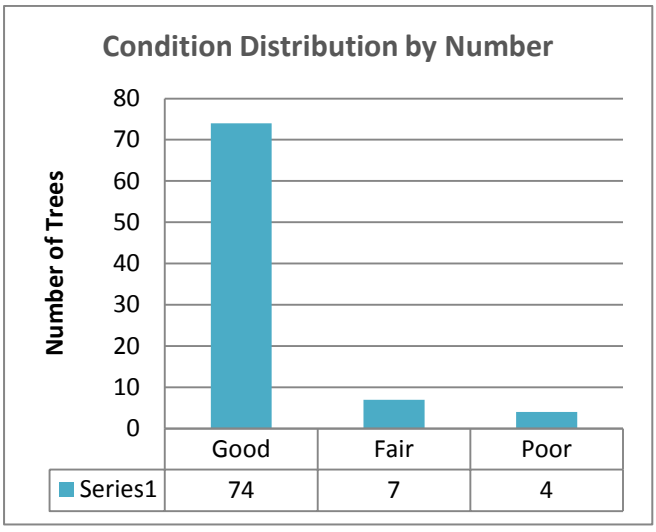
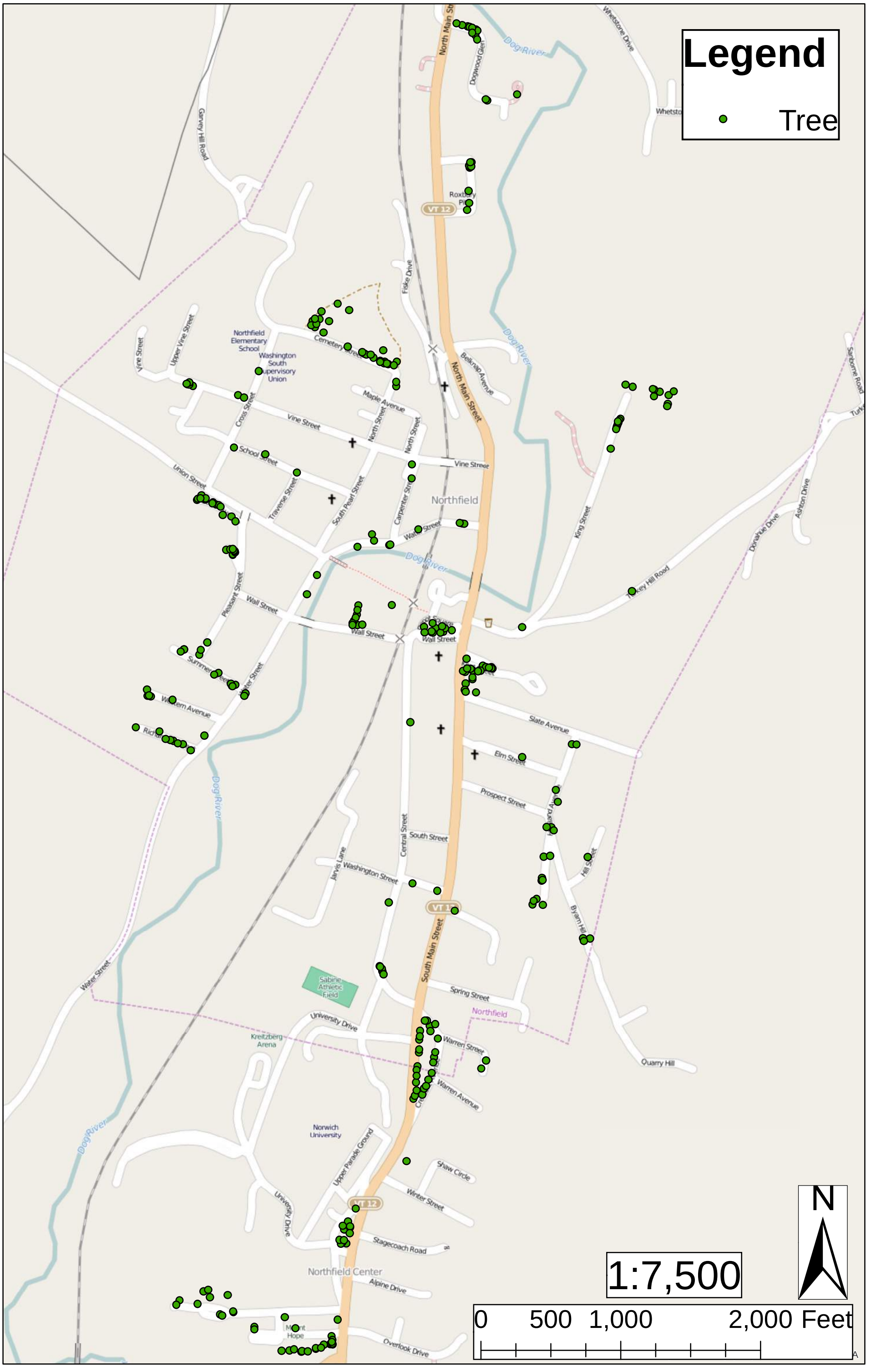


Figure 17: Condition distribution by number.

Appendix E: Maps

- All public trees inventoried in Northfield
- Public trees by DBH in Northfield
- Public trees in “Good” condition in Northfield
- Public trees requiring a consult in Northfield
- Potential tree planting locations within the ROW or on Town-owned property
- “Dead”, “Fair”, and “Poor” condition public trees in Northfield

All Trees in Northfield VT



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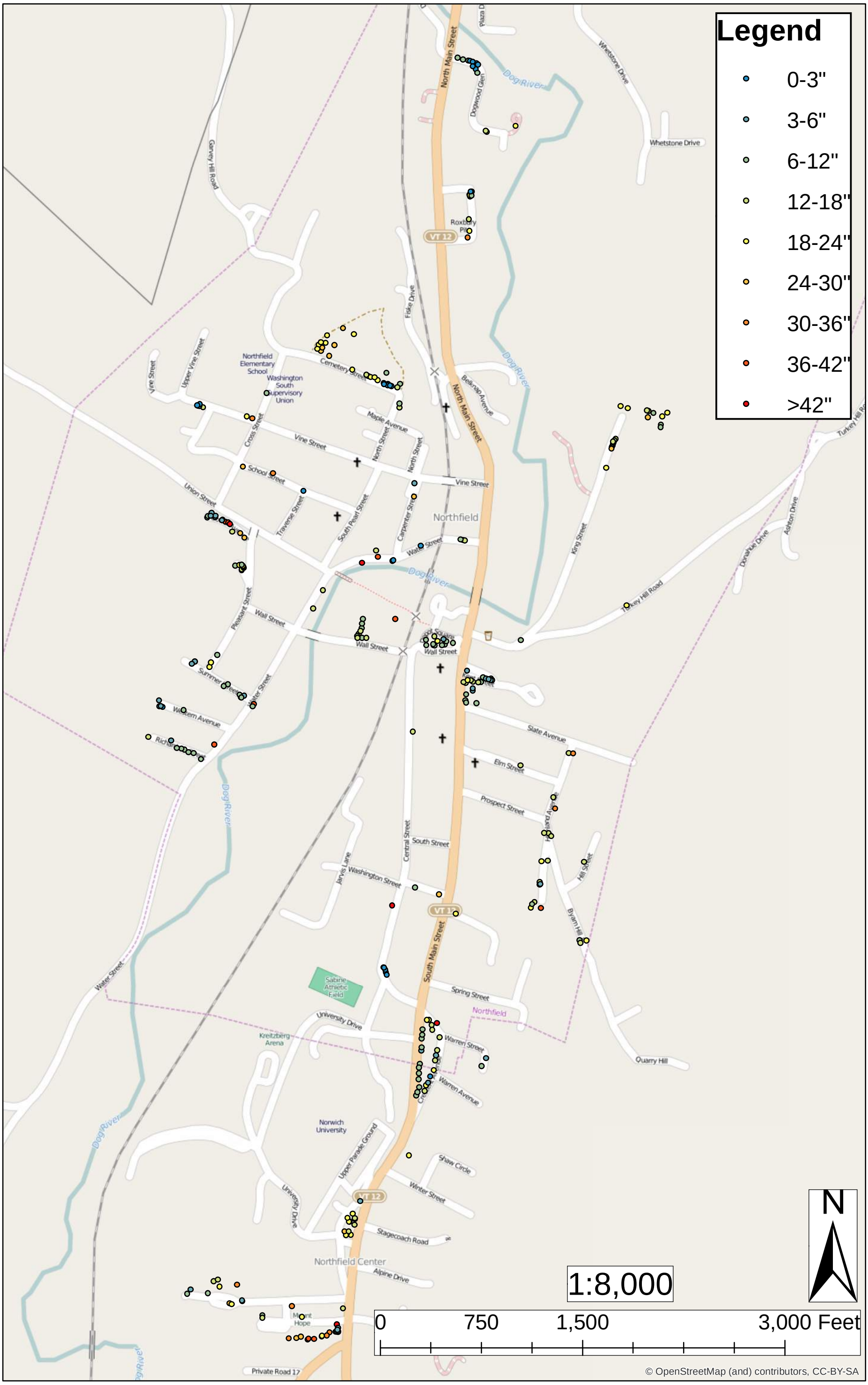
Trees by DBH in Northfield VT



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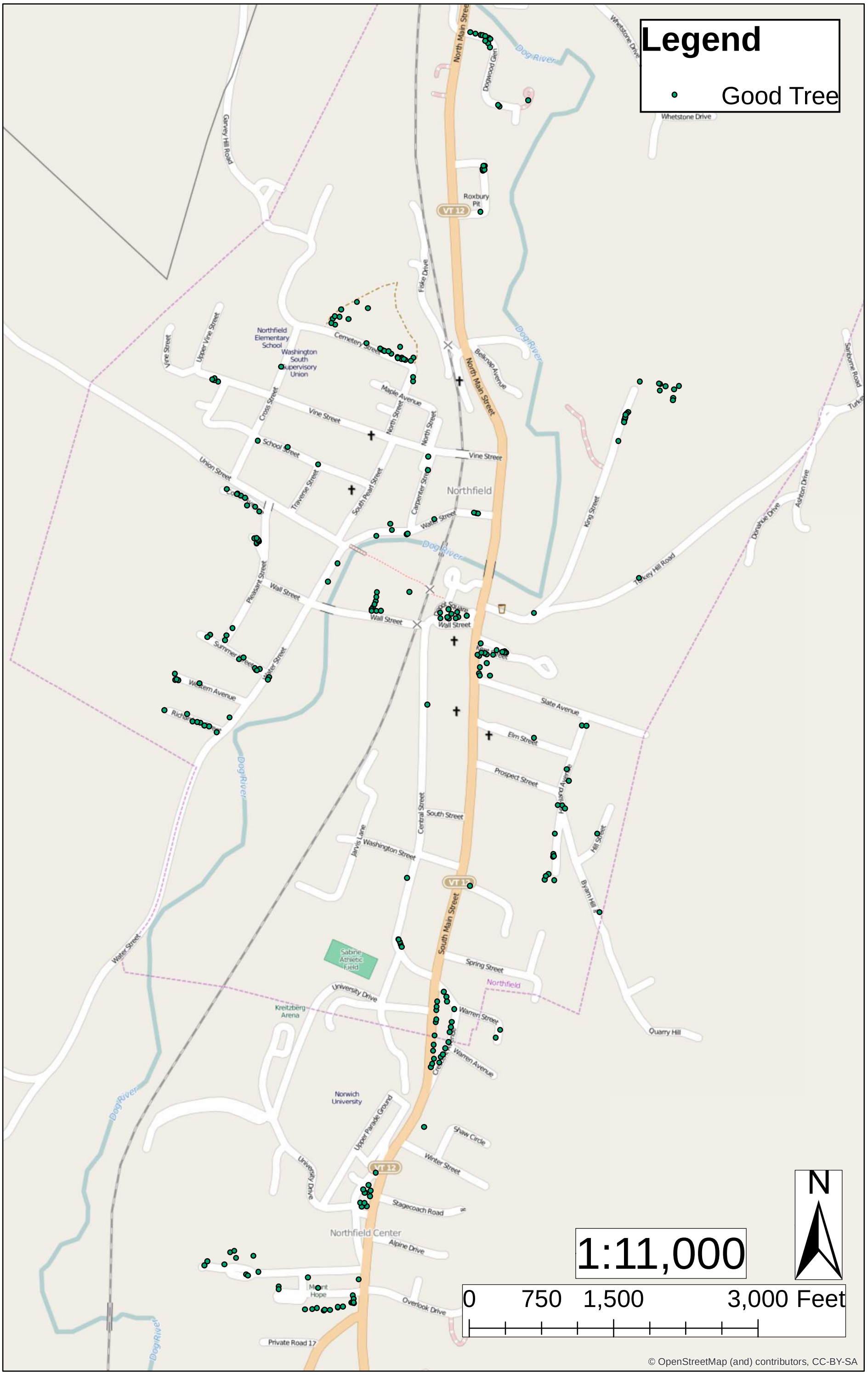
Trees in Good Condition Northfield VT



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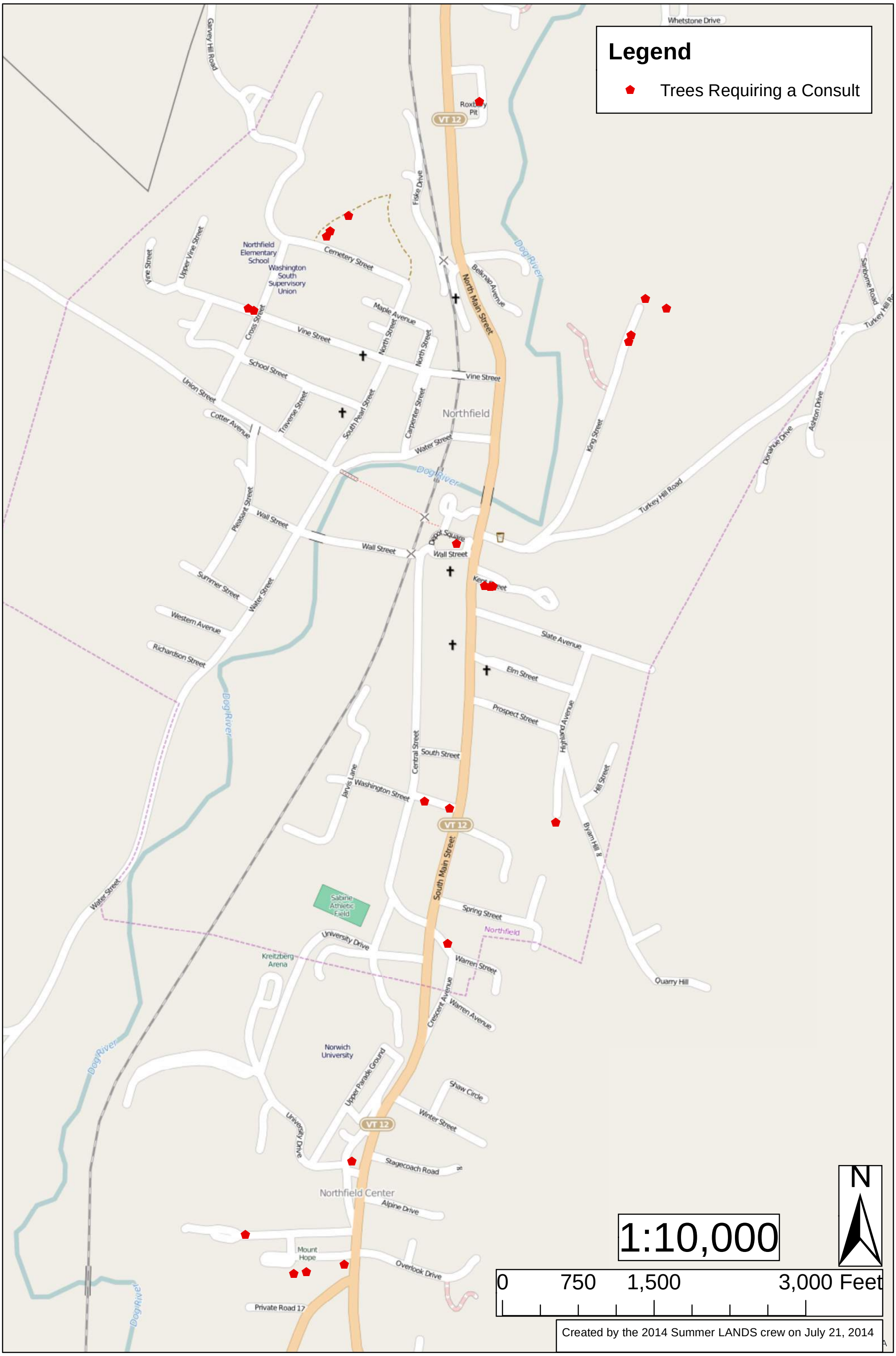
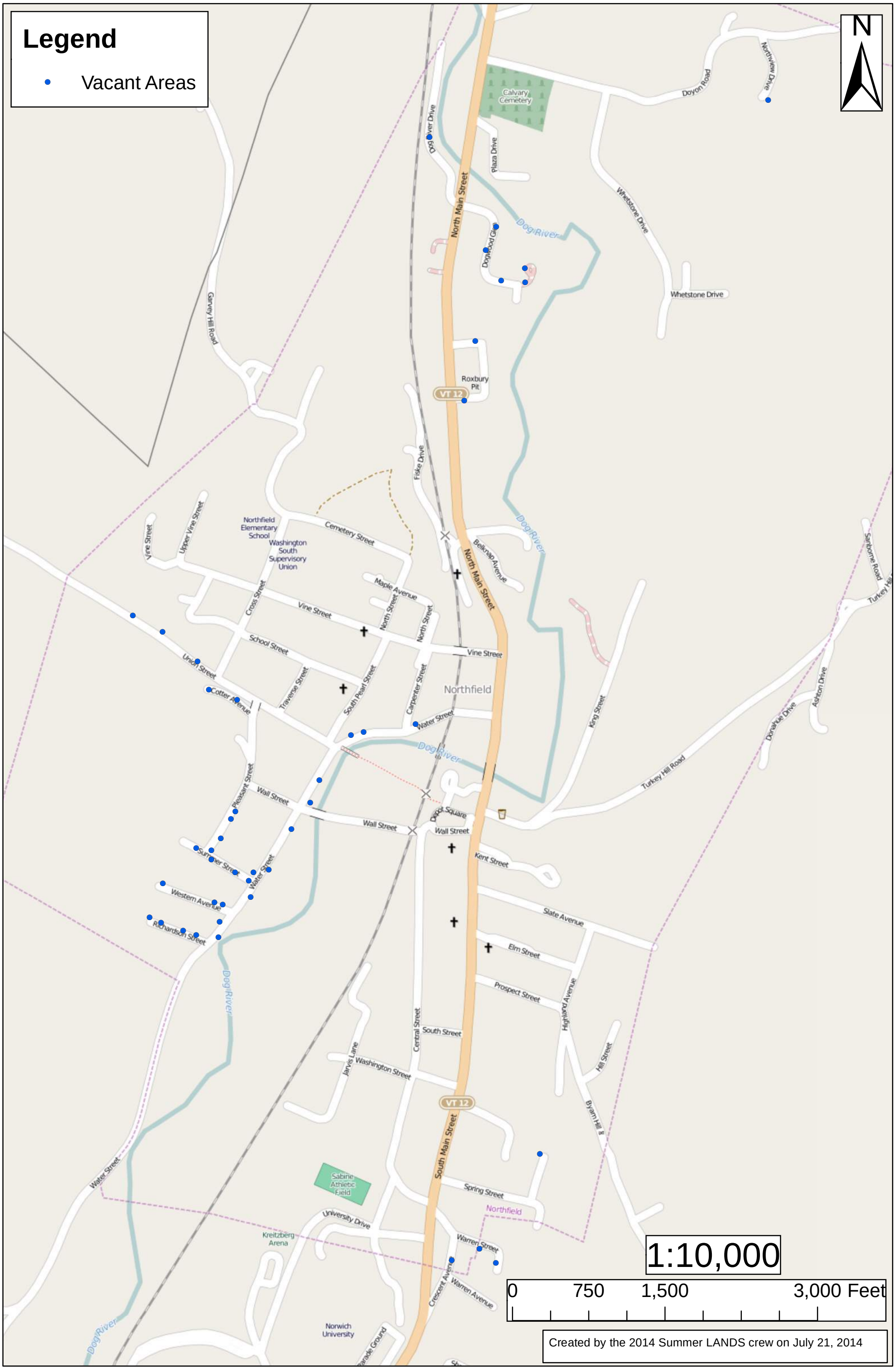
Trees Requiring a Consult in the Public Right of Way of Northfield, VT



Potential Tree Planting Locations in the Public Right of Way of Northfield, VT



Dead, Poor and Fair Condition Trees in Northfield, VT