Climate Resilience in Allegheny's Urban Forest: A Tree Inventory and Management Plan

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Pledge

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Abstract

Urban forests consist of forest ecosystems in urban spaces. These forests provide many ecosystem services when managed correctly and can form a valuable part of urban life for humans and other ecosystem users. However, climate and pest threats are increasing the need for an urban forest that is climate resilient. What does an urban forest management plan focused on the creation of a climate resilient Allegheny campus look like? I analyze stakeholders needs and prior research to develop a vision, inventory, and strategic plan to increase climate resiliency on Allegheny's campus. The inventory includes 727 trees. Only a few of these trees are recently planted, only a handful are larger than 35 inches diameter at breast height, and 13% belong to one species - red maple. The majority, 60%, of the trees are native to North America, and many face dramatic threats from pests, sometimes with replacement costs over $100,000 per pest. The future of Allegheny's urban forest is dependent on the resilient management plan which will maintain the tree canopy and the environmental services of the urban forest without compromising the campus's aesthetics.

Introduction

Allegheny College in Meadville, Pennsylvania is home to a rich campus of trees that have been planted over the past 200 years. There is currently no management plan for this urban forest which has led to a variety of issues, including bad planting placement, limited understory habitat, and the planting and cultivation of invasive species. Compounding this problem, there is no current inventory of the trees on campus.

Trees are an important part of life on Allegheny's campus. Popular legend has it that the large sycamore next to Bentley Hall was planted at the college's founding. Students enjoy hammocking, reading, doing work, eating, and even climbing in and around the trees across campus. Both native and exotic trees have been planted across campus, and since 1987, there have been at least four inventories or assessments of the campus trees, all but one existing only in printed format, and each using different systems. These records of tree location, species, and complications have never been consolidated or digitized, limiting their usefulness for college planning, maintenance, and resource allocation.

The trees on Alleghey's grounds have been planted and maintained by Physical Plant or contracted arborists. However, various other groups including professors, Alumni Relations, and Admissions have had input (Bowden, personal communication). At least three recent in-class projects related to campus improvement and the urban forest have been completed. The campus started a tree nursery in 2023 to allow better control over new plantings and to decrease costs. Additionally, the process of applying to become a Tree Campus USA was the subject of a senior project in 2018 (Clark) and was submitted in 2024. The main Allegheny campus currently encompasses 79 acres and 34 buildings with an additional 200-some acres at the Robertson Athletic Complex and college-owned houses surrounding the main campus, and 283 acres at the Bousson Environmental Research Reserve (Allegheny.edu).

Urban forestry, benefits & goals

Centuries of planting trees in urban areas has created spaces where humans, human-built landscapes, and ecosystem elements interact. We call these spaces urban or community forests (Vogt 2020). Street trees, residential, and park plantings as well as the more complete ecosystem areas are typically included in urban forest definitions (Konijnendijk et al. 2006). One difference between a traditional urban forest and the one at Allegheny is the uniform ownership of the trees and the small size of the forest being considered. Urban forestry first emerged as a discipline in the US in the late 1800s, although the current terminology comes from the 1980s (Konijnendijk et al. 2006). Trees have always been a part of urban lives in some way, however the modern urban forest is cared for typically by municipalities or similar bodies rather than the gardens in historical Europe which were typically owned by nobility (Konijnendijk et al. 2006). These modern urban forests are cultivated by administrators for a variety of human benefits, including community, aesthetic, ecological, and economic benefits.

Among the many direct benefits to humans of urban forests, trees improve mental health and decrease stress to those who encounter them (Goa et al. 2020; Houlden et al. 2018). Physical health improvements, increased sense of community, and aesthetic enjoyment are other direct benefits attributed to trees (Vogt 2020).

There are many other benefits of trees. For example, urban forests decrease stormwater runoff volume and increase water quality (Berland et al. 2017). Trees also can be planted to shade and cool buildings by as much as three degrees Celsius (Pataki et al. 2021). Air pollutant reduction is another major benefit of urban forests (Wang et al. 2021). Urban forests also sequester and store carbon, especially in areas with large or more established trees (Steenburg et al. 2023, Smith et al. 2019).   All these benefits can be maximized by increased canopy coverage, correct species use, and location (Vogt 2020).

Diverse trees also support diverse non-arbor life forms. Even in an urban forest, endangered species may be found, as can considerable amounts of other biodiversity (Alvey 2006). Additionally, biodiversity in urban forests can range from microorganisms to large mammals, something that is very important given global biodiversity loss (Avery 2006). Allegheny recently became a Certified Wildlife Habitat and a Bee Campus, indicating the college's commitment to sustainability and biodiversity (Andolina et al. 2023). Trees alone are not sufficient, ecosystems depend on understory, forbs, and abiotic factors. Native plants tend to increase surrounding biodiversity, however there are some non-native trees that are ideal for certain urban conditions (Burghardt et al. 2009; Dickinson and Ramalho 2022).

Biodiversity and native plants are important for the functioning of urban forest ecosystems (Berthon et al). Low and mid- height plants are also essential for the ecosystem and the biodiversity within it. Understory vegetation structure and nesting safety as well as invertebrate diversity is known to inform bird diversity (Willson and Comet 1996). A healthy forest depends on natural cycles of nutrients and water and complex food webs (Four Elements of a Healthy Forest). These living spaces must include cavities and logs and a diverse range of plant species and sizes so that the birds and squirrels find insects and nuts to eat which depend on healthy trees as primary converters of the sun's energy. These plants and fruit depend on healthy populations of pollinators and decomposers. Everything is connected in an ecosystem, and for all its management, an urban forest is still an ecosystem. Ecosystem services are just one way of measuring the functionality of the system.

It is important to have large mature trees in an urban forest as they provide the most ecosystem services (Wang et al. 2021). However, the ideal forest age structure has juvenile trees of many ages that will replace the mature trees as they reach the end of their lifespan, safe-gaurding the future of the urban forest (Millward and Sabir 2010).

Urban forests are now understood to serve a variety of purposes. Broadly speaking, the goal of an urban forest is to function as multipurpose areas for ecosystems, human health, and human connectivity with the natural world (Borelli et al. 2018). Importantly, urban forests provide these environmental, ecological, social, and economic benefits over time (Clark and

Metheny. 1997). Urban forests are long-lasting, and benefits continue to accrue year after year under the correct management.

Issues with urban forestry

While urban forests have many benefits, there are also many potential associated issues and large amounts of maintenance and management required. To start, urban trees must be planted in the correct locations, in correct numbers and of the correct species to create the optimal benefits and survive. When the goal is to improve environmental outcomes or aesthetics, then those features must be heavily weighed during species and location selection, however goals and deciding features do not always align in practice (Roy et al. 2017). Administrative staff's opinions about potential threats to infrastructure may also impact plantings, specifically their frequency (Roy, 2017).

Beyond the basic planting issues, urban forests have the potential to introduce exotic species to the surrounding areas, or work as a reservoir of invasive species. For example, we know that the often planted Tree of Heaven (*Ailanthus altissima*) is a primary host of the Spotted Lanternfly (*Lycorma delicatula*) which is a serious agricultural concern in the United States (USDA APHIS). Species like the invasive Privet *(Ligustrum spp.*) can be introduced, become dominant and replace native biodiversity in nearby natural areas once planted in an urban forest (Templeton et al, 2020).

While urban forests may facilitate invasive species spread, they may be extremely vulnerable to it as well. Non-native invasive pest spread is a major threat to trees (Moser et al. 2009). Anthropogenic activities combined with the warming climate are allowing many of these species to establish themselves in new areas where they can cause untold damage (Hill et al 2017). Mild winters and longer growing seasons are even allowing already native pest species to cause more damage (Weed et al. 2013, Jacktel et al. 2019). Elm trees (Ulmus spp.), once a major component of urban forests, are now rarely seen after the invasive Dutch elm disease (*Ophiostoma novo-ulmi and O. ulmi*) ravaged the east coast (Hauer et al, 2020). Ash trees (Fraxinus spp.) are disappearing from all of our forests due to the invasive emerald ash borer (*Agrilus planipennis*). Looming threats to other trees include songy moth (*Lymantria dispar dispar*), beech bark disease, shellbark hickory canker, oak wilt, oak blight, hemlock wooly adelgid, and tamarack wooly adelgid (Haavik 2019, Lovett et al, 2016)

Street trees especially face a wide variety of stressors to which they are not adapted. These threats include extreme weather events, inappropriate planting, and tree/car collisions (Lu et al. 2010). Soil compaction, de-icing salt, spatial constraints, light availability and soil type are other important urban stressors (Jutras et al. 2016). Recently planted urban trees (those in the first five years after planting) typically have the greatest mortality, which in some studies has been up to 68% , However the median mortality across multiple studies is about 7% (Hilbert et al. 2019). Tree mortality is especially great in the first year, often exceeding twice the percent mortality of the following 4 years (Wattonhoffer & Johnson 2021)

These threats, in combination, increase a tree's stress. For example, even if invasive pests do not kill the trees, the combination of pests, climate change, and the stressors associated with living near a street may significantly weaken a tree, leading to eventual mortality from other causes (Teshome et al. 2020).

Finally, trees pose a threat to people and buildings if not maintained or planted appropriately. Branches break, trees crack or are uprooted, tree roots dig into foundations and uplift sidewalks, and even the yearly leaves, twigs, flowers and fruit can be a problem. Deng et al. (2022) has found that the microclimate impact of trees might negatively impact building longevity. Any portion of a tree touching or near a structure may also cause damage as leaf litter accumulates in roofs, untrimmed branches hit walls, or roots absorb water, causing seasonal ground contraction and expansion (Overbeke, 2008). Fifty percent of communities surveyed in the United States reported having claims filed against them for injuries or property damage resulting from improperly managed trees (Koeser et al, 2016). However, despite these risks, and even directly after a natural disaster where trees caused damage, members of the public generally support increasing urban forests and lament tree loss (Klien et al, 2019).

Climate change and Climate Resilience

Climate change is increasingly impacting our forests. Fossil fuel use since the start of the industrial era has released CO_2 and other greenhouse gasses into the atmosphere. These gasses are steadily warming the earth through the greenhouse effect (Zandalinas et al. 2021). This global warming is causing climatic change and increasing the frequency of extreme weather events (Zandalinas et al. 2021). The global average temperature is already one degree celsius above pre-industrial levels and we are seeing huge impacts to ecosystems and human systems

(Hoegh-Guldberg et al. 2019). The Paris Accords (2015) committed to keeping average temperatures well below 2 degrees celsius above pre-industrial levels and work towards keeping those levels under 1.5 degrees celsius. At 1 degree above pre-industrial levels, there have been increasingly severe heat waves and precipitation events, ecosystems have shifted up to 40km/year in latitude and/or elevation; arctic sea ice is now decreasing by up to 4.1% each year, while oceans rising, expanding, and becoming more acidic and 50% of the shallow coral in the Great Barrier Reef was lost in four years (Hoegh- Guldberg et al. 2019). Between 1.5 & 2 degrees warming above pre-industrial surface temperatures, many ecosystem tipping points may be reached, including extreme biodiversity loss and permafrost instability, while climate-induced droughts and flooding increases by 50% (Hoegh- Guldberg et al. 2019). 2023 was the warmest year in recorded history, 1.48 degrees Celsius above pre-industrial levels (Cornucopious, 2024).

As we look towards the future of our urban forests, we must consider the changing climate and world in which they exist. Climate-induced stressors like increasing temperatures and increasingly unpredictable seasons and precipitation events will have major impacts on trees. Compounding the issues associated with global climate change, the characteristics of an urban area have the potential to make these effects more pronounced in urban forests. Buildings and streets reflect and retain heat, impervious surfaces increase flooding and urban soils have decreased ability to retain water through droughts (Morabito et al. 2021, Konrad 2003, Craul 1992). A study of urban trees in the Midwest found that up to 25 percent of urban trees including Norway maples (Acer platanoides) and native pines (Pinus spp.) and spruces (Picea spp.) might be outside of their projected growth zone and vulnerable under some climate change models (Brandt et. al 2021).

Pennsylvania, in particular, is predicted to continue to experience many more hot days (90℉, 95℉, and 100℉+ days), and to have more total precipitation, although it will occur less frequently leading to worse droughts and flooding (PA Climate Impact Assessment 2021). In the face of these threats, we as a society and a campus are forced to consider ways to adapt.

Climate Resilience

Resilience is a term defined as “the capacity of a community, business, or natural environment to prevent, withstand, respond to, and recover from a disruption” by the U.S. Climate Resilience Toolkit (2023) . Climate resiliency is therefore “successfully coping with and managing the impacts of climate change while preventing those impacts from growing worse" according to the Union of Concerned Scientists (2023). In the inherent fluctuations of an urban space, this resilience understands that an urban forest will need to adapt and change to fit the changing environment, but that the many benefits associated with the urban forest must be maintained (Hale et al. 2015). Urban forest resiliency research is also known to emphasize "social-ecological interactions, uncertainty in predicting change, as well as reaction to and recovery from disturbances" (Huff et al. 2020). Huff et al. suggest that depending on climatic conditions, urban forest plantings might even double as initial testing for human-facilitated species migration.

As urban forest climate resiliency comes into focus among changing climatic conditions, we must change our management practices to match. Specific species of trees will be better able to withstand the changing conditions than others, certain pruning and watering practices are preferred, and ecosystem benefits must be maximized while ecosystem disservices are minimized.

Urban forest management plans

Urban Forest Management Plans (UFMPs), are one common way that many municipalities, campuses, and organizations across the world are working to thoughtfully create urban forests that are climate resilient (Vibrant Cities Lab 2023). These detailed management plans include assessing current forests, creating strategic plans, implementation plans, and maintenance plans, and reacting adaptively to each entity's changing needs. Stakeholder consultation, shared visions, and time and resource commitments are other important factors that can make these UFMPs successful or not (US Climate Resiliency Toolkit 2023, UFMP Toolkit 2023).

Landscape development plans and long term visions have been proven crucial to sustainably increasing urban forest cover (Roman et al. 2017). In a case study at the University of Pennsylvania, it was found necessary to understand the current tree status and the past successful drivers of canopy cover before implementing a landscape development plan (Roman et al. 2017). For a landscape plan to be effective, overall goals must be clear. Without them, reactionary decision making may limit species diversity and location, a disservice to urban forest potential (Dickinson and Ramalho 2022). Kennedy et al (2011) emphasizes that a UFMP should focus not solely on achieving canopy cover goals, but also on myriad other health, safety, and diversity concerns to truly target-set a successful urban forest.

Urban forests are felt to be most successful when financial resources are appropriate, decision-making is data-driven, and goals are clearly defined (Wirtz et al. 2021). All of these factors must be taken into consideration in developing a UFMP, and where needed, the plan is adapted to adjust for financial resources or buy-in. Many UFMPs are created with the goal of satisfying community needs and creating urban resilience(Ordonez Barona 2015).

Urban forests must satisfy the needs of their human and ecosystem communities. These needs are often diverse, conflicting and complex. Ultimately urban forests are created, maintained, and managed for the health and wellness of their human communities and broader ecosystem. To satisfy these human and ecosystem needs, communities and stakeholders as well as ecosystem requirements must have input in the UFMP process. Including these stakeholders from the beginning gives them ownership over the project and is associated with improved urban forest outcomes (UMFP toolkit 2023, Wirtz et al. 2021).

As community, expert, and stakeholder feedback is received, goals for the management plan must be developed. Without concrete goals, data-driven decisions can not occur, and community needs may not be met. Additionally managing urban forests without community input is unsustainable long term and potentially problematic (Dwyer et al 2003)

Financial resources are essential for urban forestry. Securing multi-year funding to allow long term planning and tracking expenditures is important for urban forest success (Wirtz et al. 2021). Many of the maintenance components of urban forestry are very expensive, from the cranes and crews needed to remove dangerous trees, to the pruning and planting cost. Removal alone may cost many hundred dollars for one tree (Hauer & Peterson 2015). Many UFMPs aim to increase canopy cover which by necessity means increasing management and associated funding.

Before planning can progress, the current status of the urban forest must be understood. Current urban forestry experts suggest using inventories of some sort to allow for data-driven management decisions (Wirtz et al. 2021). The types of data collected vary by location and facilities. Roman et al. (2013) found that city and non-profit respondents who were actively monitoring trees often measured survival and tree health or factors influencing health and survivability. This information was used to proactively manage, maintain and care for trees.

Some monitoring was also done in part to engage the community in urban forest activities. Location, species, health, planting data, and DBH are collected by a majority of monitoring systems (Roman et al. 2013, Ostberg et al. 2018). Data collection also allows for quantifying ecosystem benefits, something many governments want to see (Davies et al. 2017).

Many urban forests utilize Geographic Information System (GIS) technology as part of their monitoring activities. GIS mapping approaches allow multiple users and easy visualization of where trees are. It increases efficiency and reduces management costs (Tasoulas et al. 2013). Species, health, age, and other important information can all be included in the GIS map visuals for easy planning and data comprehension. This also makes it easy to find out information about an inventoried tree in the field as long as you have its location. Community members may also use GIS technology to access tree data.

Urban forest management plans are considered an important tool to efficiently strategize for maximization of urban forest ecosystem services, minimize disservices, and plan for the many threats facing today's forests. Allegheny currently has no current inventory and no UFMP for its forest. Therefore the purpose of this project is to create a GIS inventory of the trees on campus, meet with stakeholders to determine values and visions for the urban forest, and create a Climate Resilient Urban Forest Management Plan for the central portion of Allegheny's campus.

<u>Methods/Process/Approach</u>

Allegheny's Urban Forest Management Plan (UMFP) was developed based on the US Climate Resilience Toolkit (2023), the Inland Urban Forest Council Toolkit (2018), and multiple reference plans. Adjustments were made based on the smaller size of the Allegheny campus and the different stakeholder structure than municipal arrangements, as well as the necessarily reduced scope of this individually completed project.

Vision/Goal

The first step of any UFMP is to understand the vision or goal of the project. Many stakeholders and resources were consulted throughout the project in order to thoroughly understand these visions. On campus resources are shown in Table 1. Goals were informed by stakeholder conversations and research. Focuses included urban forest best practices, aesthetics, and environmental justice.

On-campus stakeholders were identified by advisors and contacted via email to schedule a short meeting. All but one meeting was conducted in person. The semi-structured interviews included questions about what components of the urban forest are most valued, the stakeholder's vision, department specific planning considerations, and the stakeholder's thoughts on increasing understory and undergrowth. Notes were taken during the meeting and are included in abbreviated form in Appendix 2.

Table 1. Campus specific resources and stakeholders that were consulted for this project. These resources include official college documents, contracted assessments, and student and class projects.

College Plans & Inventories	**Student Created Plans**	**Stakeholders**
Allegheny College Master Plan (2019)	Allegheny College Campus Wildlife Habitat Management Plan (2023)	Allegheny Physical Plant
Arboricultural Assessment for Allegheny College (2011)	Developing a Resilient Campus Forest at Allegheny College (2023)	Office of Sustainability
Allegheny College Tree Inventory Management (2001)	Allegheny College Integrated Pest Management Plan (2023)	Office of Admissions
Trees of Allegheny College, Deciduous and Evergreen (1987)	Recommendations for Managing the Urban Forest on the Allegheny College Campus (2022)	Office of Alumni Relations
Growing A Resilient Campus Forest: Opportunities, Barriers, Solutions (2023)	Tree Campus USA: The Future of Allegheny's Trees (2019)	President Ron Cole

The second step in developing a UFMP is to quantify the current status of the urban forest. During the Fall of 2023, I surveyed the trees within the central 35 acres of Alleghenys campus. The goals of the survey were to a) gain an understanding of the makeup of the current urban forest, and b) provide data for an updated digital map of trees on campus. Trees outside of the central portion of campus, college-owned residential properties, and the entire Robertson Athletic Complex were not analyzed.

Surveys were conducted in partnership with Molly Miller, a fellow senior focused on the herbaceous layer and mulch within Allegheny's urban forest. The location, diameter at breast height (DBH), and species of each tree was entered into a GIS Pro Field map form, as well as canopy size measured in two directions, the amount of mulch, and any additional impacting factors (moisture, light, and slope), and any noteworthy items (plaques, major damage, noteworthy proximity to buildings). The complete survey is attached in Appendix 1. GPS location was collected via a Juniper Systems Geode (GNS2) carried on a backpack and connected to a Samsung S8 or iPad used to input the rest of the measured data. All tree data points were within 20 ft, and the majority within 1 ft of actual location.

Breast height is intended to be 1.5m (4.5 ft) above ground, measured from the up-slope side, as recommended by i-Trees (2020) and the New York State Department of Environmental Conservation (n.d). Following more recent recommendations specific to multi-stemmed urban trees, when a fork occurred approximately 30 cm- 137cm (1 ft - 4.5 ft) from the ground, the diameter is taken directly below the fork (Magarik et al. 2020). Where there is a large bulge or buttress, DBH was calculated above the furthest extent of the bulge (New York State Department of Environmental Conservation n.d, i-Tree Eco– Field Guide for Complete Inventories 2020). For four trees, a DBH had to be estimated because of safety concerns in reaching the tree. These estimates are noted in the comments. Where trees split above ground, but below 30cm (1ft), each trunk was measured separately. For these, a single DBH was calculated by summing the squares of all stems and then taking the square root of the sum as suggested by Swiecki and Bernhardt (2001), and Monteiro et al., (2016).

Every tree was identified on site, assisted by the app Picture This for cultivars and non-native species. The three historic tree surveys, planting records, and the Virginia Tech Dendrology key (2022) were used to confirm difficult IDs.

Canopy size and mulch were both measured in two directions using a Zozen measuring wheel, with mulch measurements passing directly over the mounded mulch. The same wheel was used to measure distance to buildings when appropriate. Photos of tree damage and plaques were taken by the phone or tablet and immediately entered into the survey.

The interactive map was informed through consultation with Allegheny Physical Plant, Allegheny Admissions, the Office of Sustainability, and Environmental Science professors at the college, especially those involved in the tree nursery efforts. These elements allow the map to be used into the future for a variety of purposes including future planting activities, maintenance, on campus learning and projects, and calculating carbon sequestration as well as possible promotional material or other publishing of the map.

Invasive species (according to the Pennsylvania Department of Conservation and Natural Resources 2023), potentially invasive species (according to the Invasive Species Atlas of the US, specifically to northwest Pennsylvania, (Swearingen & Bargeron 2016)), and native species facing severe threats (according to the Pennsylvania Extension, 2021) were identified for potential proactive management action. The overall status of trees on campus was briefly examined and the modeling technology i-Tree Streets, was used to provide a very basic ecosystem services estimate similar to research on other campuses (Wang et al 2021).

Strategic Planning, Implementation, and Monitoring

The strategic planning portion of the UFMP was specifically informed by discussion about best practices and environmental justice. Additionally, as climate resilience differs by location and expected forest threats, these threats are discussed within the planning considerations as well. Beyond collecting general climate resiliency information about the northeastern United States, I examined specific modeled climatic conditions for Meadville, and current threats. Non-native species and pest responses to changing climatic conditions and introduction play a large role in forestry threats as well.

Many Allegheny urban forest projects have already been completed in recent years, including one focused on broad climate resiliency on campus. Recommendations from these projects factored heavily in the strategic planning. In many cases, the strategic planning portion of the UFMP acts to consolidate the various recommendations. Continued involvement of stakeholders including Physical Plant, the Admissions Office, the Environmental Science and Sustainability Department and others also informed my planning.

The final stages of a UFMP include implementation and monitoring plans. These plans were informed again by the stakeholders who will be carrying out the plans, as well as best practices and other colleges examples. Official approval of this plan and possible revisions are currently being sought.

Results & Discussion

Inventory

The inventory surveyed 727 trees. Eight inventoried trees are listed as Crawford County Big Trees (Crawford County Conservation District). The completed inventory is now accessible through ArcGIS Online & Field Maps for both Physical Plant and any other college department to use and keep updated; a public version (https://arcg.is/0rWv0H0) is available for members of the broader community and the link may soon be posted to the Office of Sustainability's new website. The major features revealed by the inventory fall under three categories: Species and Size, Invasives and Pest Susceptibility, and Tree Locations.

Species & Size Compositions

Eighty different species of trees were found in the inventory. Thirty-seven of the species found had five or more representatives on campus, while 22 species only had one representative among the trees inventoried. These include common trees to the area like Chestnut Oak (Quercus montana), Black Walnut (Juglans n*igra*), and the Eastern Tamarack or Larch (*Larix laricina*). However, many of the unique species are non-native, such as the Prickly Castor Oil Tree *Kalopanax septemlobus*) and Hinkoi cypress (*Chamaecyparis obtusa*).

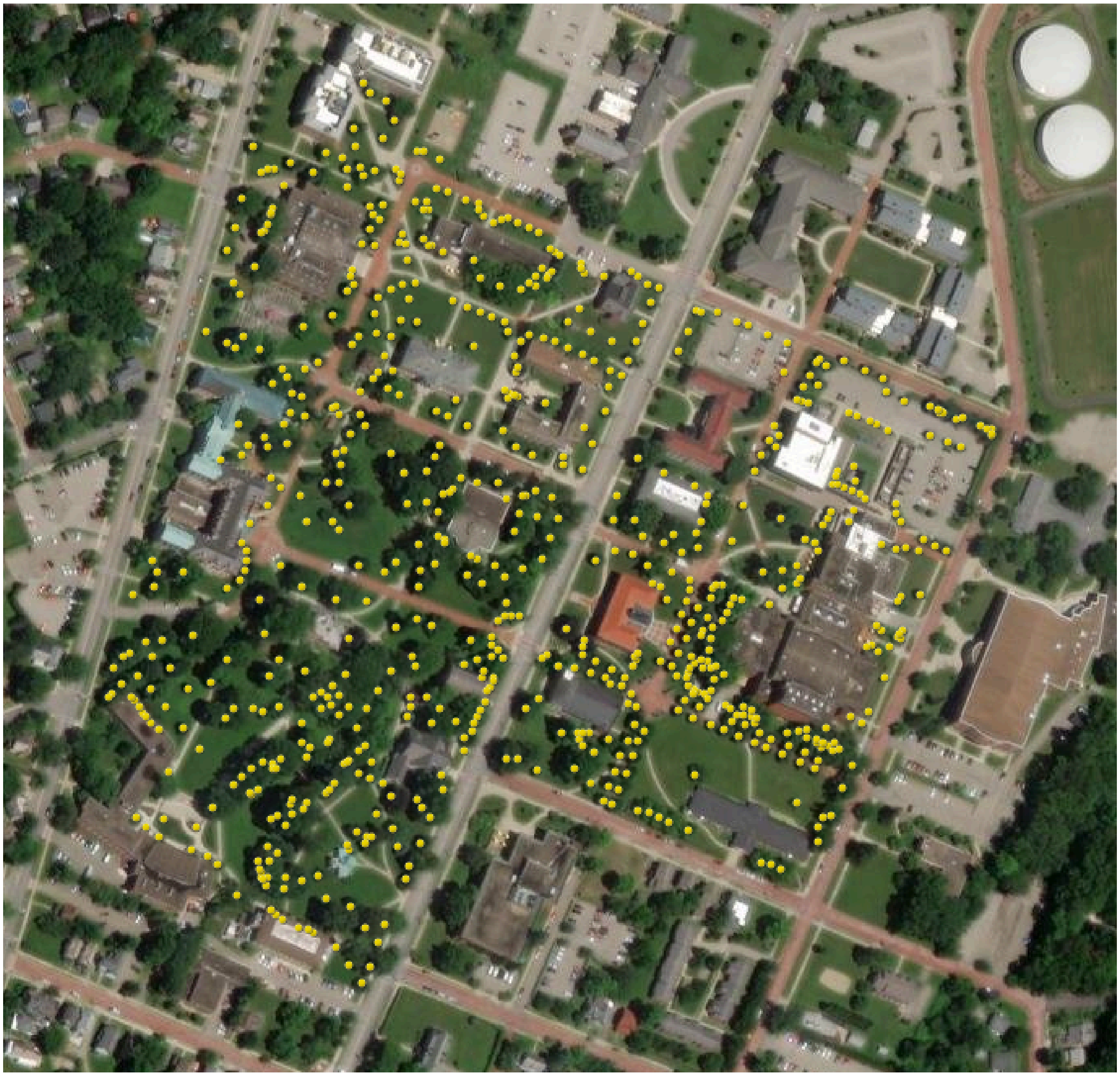


Figure 1. Image of the inventory interface. Each tree is represented by a yellow dot. Within the interface, each dot may be clicked on to reveal information about the tree it represents.

Figure 2. The inventory with all red maple dots highlighted. Other trees surveyed can be seen in the background.

Red Maples make up almost 13% of all trees surveyed with Eastern White Pine 6.4%, and Honey Locust and Sugar Maple 4.3% and 4.2% respectively (Table 2). The campus understory consists mostly of Siberian Crabapple (8.2% of all trees), with Japanese Flowering Cherry, Serviceberries (*Amelanchier Spp.*) and Dogwood species (*Cornus kousa & C. florida*) also occurring in high numbers. Various other understory species are common in specific areas (eg: zelkova (*Zelkova Serrata)* between the Campus Center and Tippi Alumni Center)

Table 2. Composition of inventoried campus trees by species on the Allegheny College campus. Only trees with more than 7 inventoried individuals are shown.

Common Name	Count	Percentage of total
Black Cherry	8	1.1%
American Holly	9	1.2%
Black Tupelo	9	1.2%
Ginkgo	9	1.2%
Maple Norway	9	1.2%
Sweet Gum	9	1.2%
American Sycamore	10	1.4%
Bradford Pear	10	1.4%
Magnolia sp.	11	1.5%
Colorado Blue spruce	12	1.7%
Florida Dogwood	15	2.1%
Oak Pin	15	2.1%
Zelkova	15	2.1%
Black Hawthorn	16	2.2%
Kousa Dogwood	16	2.2%
Hemlock	19	2.6%
Norway Spruce	19	2.6%
Maple Silver	20	2.8%
Serviceberry	21	2.9%
Japanese Cherry	22	3.0%
Oak Red	22	3.0%
Maple Sugar	29	4.0%
Thornless Honey Locust	31	4.3%
Pine White	46	6.3%
Siberian Crabapple	57	7.8%
Maple Red	93	12.8%

Allegheny College has a handful of extremely large trees on its central campus, especially near Bentley Hall. These trees, generally larger than 35 inches in diameter, were called Monarch Trees in the 2011 Arboricultural Assessment because of their importance to the campus. Generally there are more trees of each diameter class as the diameters decrease (Figure 3). It is interesting that there are fewer trees less than 5 inches DBH than between 5-10 inches. This may partially be attributed to trees being planted at DBH's greater than 1 inch, but might show the lack of small trees on campus. Within the survey area, only 15 trees were found to be recent plantings still being established, and some of those trees were planted in 2022 (James Mulligan, personal communication). If we assume large canopy trees live 100 years on average in urban settings, and many ornamental trees may live less than 50 years, then younger trees must be constantly planted to provide a succession of trees and ecosystem benefits. In order to maintain the current tree population with the above assumptions, more than 5 large-statured trees and more than 5 ornamental trees must be planted on average each year. One issue with determining where plantings are needed is that once large trees establish in the canopy, growth may be less visible, and DBH in large shade trees has little to do with how much longer they will live (Lorimer 2004). This means in order to have established trees in place to take over when giants decline, guesswork about lifespan of each specific tree must be conducted.

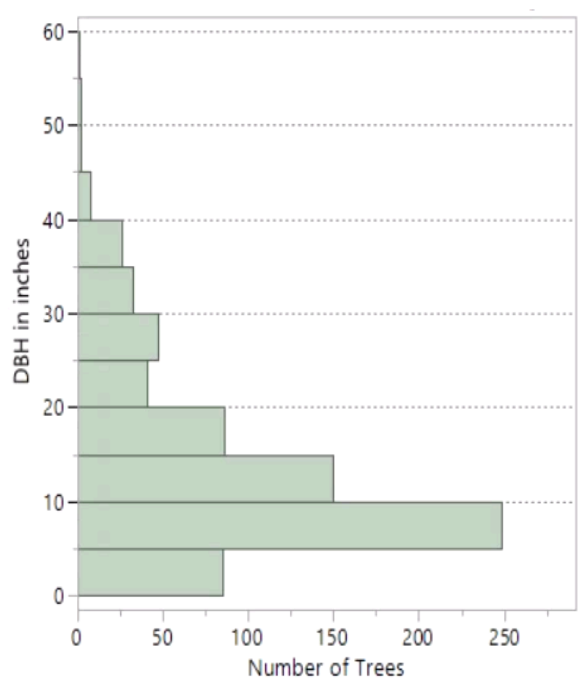


Figure 3. Distribution of tree diameters on the Allegheny College campus.

Some species have a wide variety of sizes on campus, while others less so. Red and sugar maples (*Acer rubrum* and *A. Saccharum*) and red oak (*Quercus rubra*) range in DBH from very small to very large specimens (Figure 4). Interestingly, the American sycamore (*Platanus occidentalis*) which stands behind Bentley is an outlier for its species as the entire rest of the population is under 16 inches in diameter. Some trees like the holly (*Ilex opaca*), and zelkova are smaller as a rule, being understory trees, however neither shows any recent planting. Of the other trees that show no recent plantings or smaller trees, some, like the ginkgo (*Ginkgo biloba*) are non-natives, while others like the pin oak (*Q. palustris*) were not counted as a desirable species by Van Yahres Associates in the Arboricultural Assessment of 2011, which is the latest contracted assessment. This rating is said to be based on speed of growth and maintenance needs.

Some species that were considered highly desirable by this assesment but still don't have recent plantings include: Scarlet and white oaks (*Q. coccinea, Q. albus*), American linden (*Tilla americana*), and black gum (*Nyssa sylvatica*). Additionally there are some large species of valuable native landscaping species that do not exist at all on campus, for example hickories (*Carya spp.*).

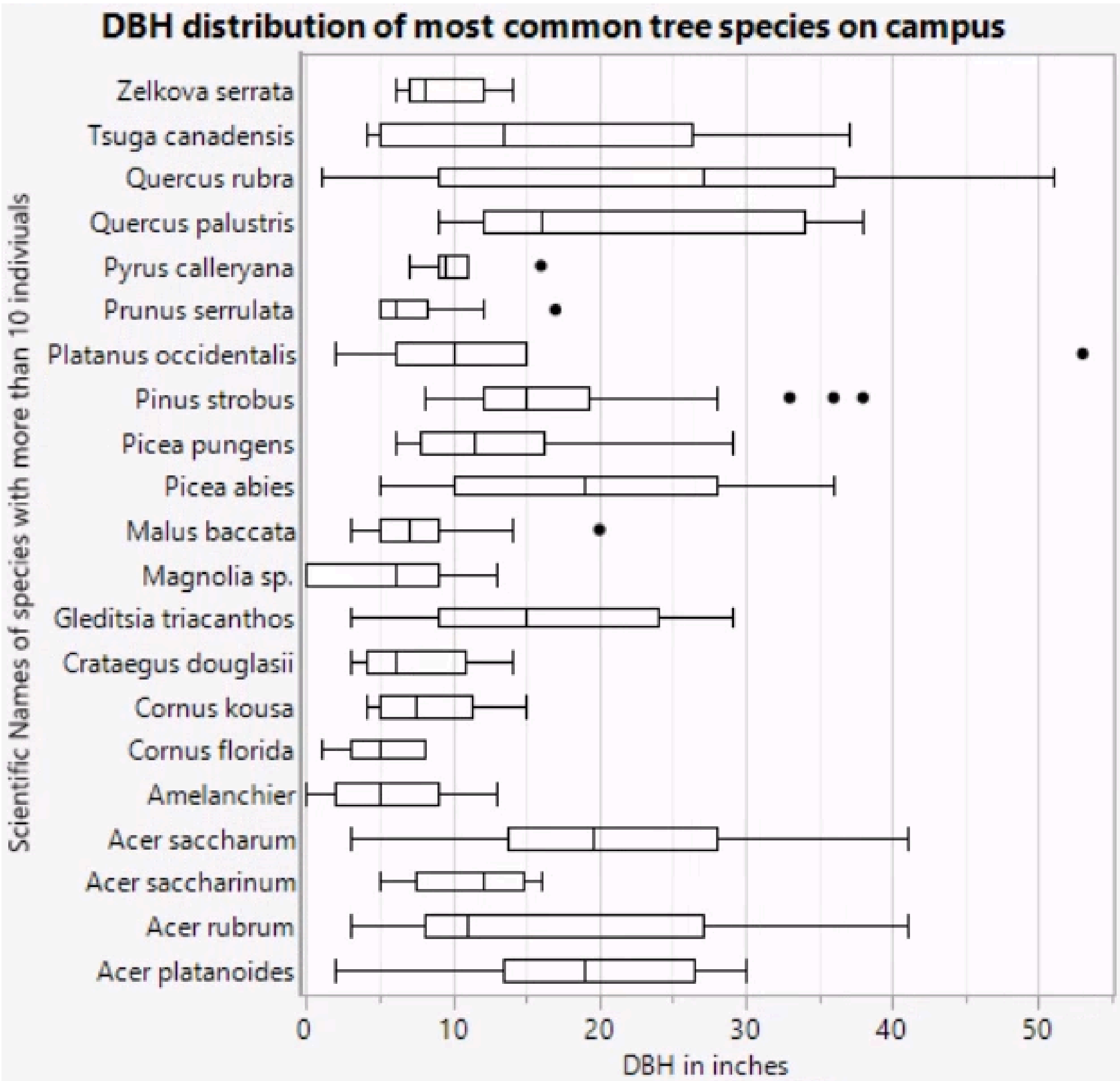


Figure 4. Distribution of tree DBH by species for those with more than 10 trees within the inventory. The box covers the range of the central 50% of the data with the middle line representing the median. The full extent of the range is shown by the whiskers with data outliers appearing as dots.

Invasives & Pests

Almost 70% of the trees on campus are native to North America, and 60% of them to Pennsylvania (Figure 5). The campus understory especially has a large representation of non-native trees with the emphasis on Siberian crabapples, and Japanese cherries. Current management practice is to primarily plant native species, so most of the non-native species are older, and generally already producing fruit. Many of the non-native trees on campus are not known to be harmful to the local ecosystem should they escape; however some are.

Callery pear and Norway maple are listed as invasive species in Pennsylvania (PA Dep. Conservation and Natural Resources). In fact Callery pears are now considered noxious weeds with their planting forbidden by the state (PA Dep. of Ag). There are a large number of both Norway maples and Callery pears within the surrounding community (Personal observation). The only known large tree-of-heaven tree on campus was cut down before the inventory took place, however there are multiple in the surrounding community, and one below reproductive age being used as an example outside of Carr. Both Callery pear and tree-of-heaven are considered to be so deeply established that there is no chance of eradication, however, the tree-of-heaven's association with the spotted lanternfly makes its control desirable (PA Dep. of Ag, Noxious Weeds).

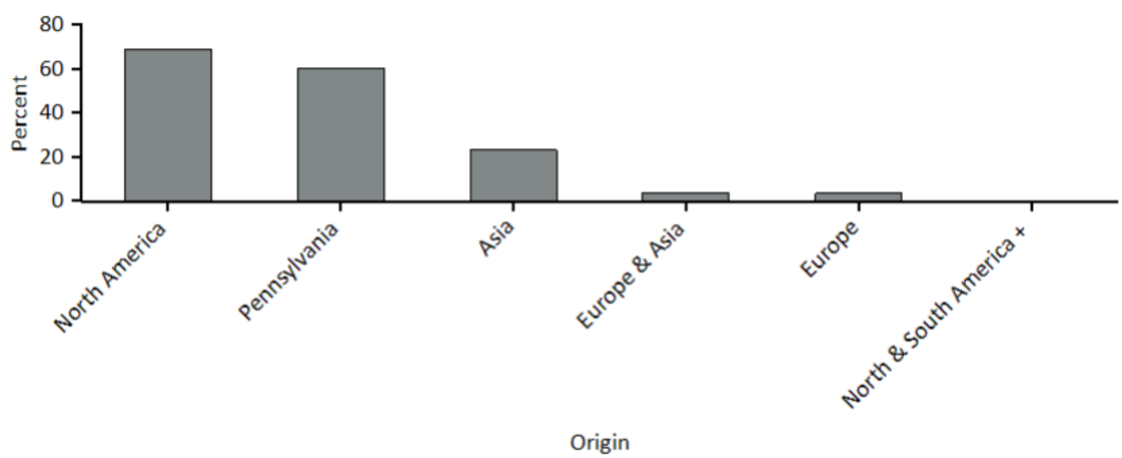


Figure 5. Percent of Allegheny College campus trees by area of species origin. North America includes Pennsylvania. Europe & Asia indicates species native to both continents.

Spotted Lanternfly is not the only threat to Allegheny College's urban forest. There are many pests, from the insectoid to the fungal, that threaten the future of many of the forest's trees. Some of these pests have even already impacted the forest. i-Tree Eco is a tool developed by a coalition of actors in the US which provides benefit and replacement values for trees based inputted tree inventories. Spongy Moths, *Lymantria dispar dispar,* are one of the most serious potential threats to the health of the forest because they are generalists that eat many different species. According to the i-Trees report, multiple bad Spongy Moth infestations could lead to $450,000 worth of value being lost on Allegheny's campus(Figure 6). Many other pests also could cause thousands of dollars worth of replacement costs.

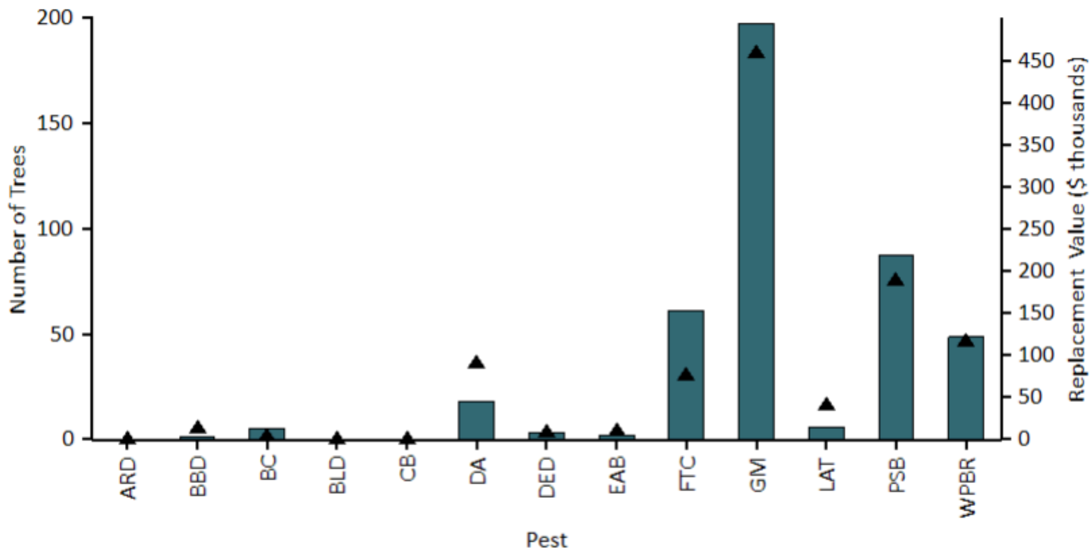


Figure 6. Risk associated with the most threatening pests to the campus urban forest, based on pests within Crawford County in 2014. Triangles represent the number of trees at risk. Bars represent the estimated replacement value. Acronym meanings: Armillaria Root Disease (ARD), Beech Bark Disease (BBD), Butternut canker (BC), Beech Leaf Disease (BLD), Chestnut Blight (CB), Dogwood Anthracnose (DA), Dutch Elm Disease (DED), Emerald Ash Borer (EAB), Forest Tent Caterpillar (FTC), Gypsy (now known as Spongy) Moth (GM), Large Aspen Tortrix (LAT), Pine Shoot Beetle (PSB), White Pine Blister Rust (WPBR).

There are large potential financial risks associated with worst-case scenarios of certain pests, but these numbers do not weigh the actual risk associated with these pests. For example, Large Aspen Tortrix conceivably could kill trees worth a replacement value of $20,000, however

Large Aspen Tortrix generally only causes issues among large stands of aspen where defoliation happens many years in a row (Figure 6). An explanation of the risk of some of the major threats is contained in Resource D of the UFMP contained in Appendix 3. Many of these threats could be extremely expensive if Allegheny experiences a major outbreak. To discuss one threat in particular, Hemlock Woolly Adelgid was not considered a serious threat to this area in 2014 (as seen by its absence within Figure 8), however, its recent range expansion is causing dramatic hemlock mortality within Pennsylvania, and we have reason to be worried for our hemlocks. Hemlocks are particularly vulnerable because they tend to be a cold weather species and may already be under stress in Meadville because of warming climates.

Tree Locations

Within Allegheny College's urban forest, trees tend to be clustered near similar trees. Much of this appears to be done purposefully to create appealing rows of the same type of tree. This is visible especially on the walkways around the campus center, on the north side of Baldwin/Arter, the north side of Quigley, the north side of Murray, and along N. Main street. Of these locations, only Murray has rows of trees over 21 inches DBH; most of the other rows average around 14.

As with a non-planted ecosystem, diversity generally means resistance in urban forests. While the main campus contains a wide variety of trees, these mono-species and mono-sized rows are a specific potential problem. A row of ash trees near College Court was removed within the last few years because of their dramatic decline associated with the emerald ash borer. Currently the vast majority of rows on campus are maples, specifically red maples. Should a pest devastate maples the same way the emerald ash borer devastated ash populations, the entire aesthetic of central campus would be altered and most of the rows forced to be completely removed. Even without pest concerns, trees have a finite lifespan. Once these rows start to reach the end of their lifespan, entire rows may have to be removed within a few decades, again dramatically changing the aesthetic of the college.

Additionally, there are some areas of campus with relatively high tree density, while other areas have much less density. Interestingly the area around the Senior Circle contains the highest density despite containing the large Murray lawn and the lawn south of Montgomery. The dense rows of trees lining the sidewalks here may account for this.

Stakeholder Values

For our UFMP to be effective, we must understand the complex and sometimes apparently conflicting needs and desires of the multitude of stakeholders on campus. Six departments were consulted. Maintenance of the urban forest & associated costs, general appearance, signage around visible sustainability initiatives, and the different needs of different areas were emphasized consistently.

For many stakeholders, maintenance is important for alumni and potential students. However crime deterrence through maintenance was also discussed by James Basinger of Public Safety. One of the foremost worries was the potential maintenance cost of changes to the urban forest. Physical Plant has greatly reduced its in-house staffing in recent years, and any new plantings or plans will need human power to complete.

For some stakeholders, especially Admissions, Alumni, and President Ron Cole, colors and seasonal appearance was very important as well. Graduation and Alumni weekend are two annual events that were noted as times the campus should look especially nice. Winter color was also discussed as were spring blooms and the signature fall colors. Specific locations also are of particular importance to alumni and the campus's image. These areas include Bentley Lawn, the Ravine and Chapel, and the Brooks walkway and lawn.

The current wildflower gardens on campus were also discussed frequently. According to the stakeholder meetings, there is a specific image (large expanses of strictly maintained trees and lawn) that is expected of a relatively rural college campus. When we choose to challenge this image, having clear and concise signage about what is happening and why, is really important to these visitors' understanding of Allegheny. The wildflower gardens near Bentley are an example of sustainable plantings where the current (temporary) signs explaining "Wildflower plantings" are essential to maintaining the image of a well maintained campus. Several stakeholders suggested permanent signs where plantings and trees fall outside of the expected look.

James Basinger of Public Safety emphasized some of the physical dimensions and sightline requirements around cameras – in particular, trees that block security cameras and those with limbs under 8ft that could be used to climb buildings are a safety concern. Kelly Boulton and Kurt Hatcher of the Office of Sustainability mentioned that geothermal bore holes are in the renovation plans for many buildings and that future plantings might be uprooted if placed in the site of the geothermal fields. Rachel Sloan from Admissions emphasized the many diverse campus users and the importance of navigational sightlines for campus visitors. A complete summary of each interview can be found in Appendix 2.

Planning Considerations

Once data is collected, stakeholders involved, and goals set, urban forests must actually be planned. In this planning, there are endless considerations. However, some specific factors have been detailed below including an overview of social, location, and ecosystem considerations, specific tree types, and maintaining diversity.

Social Considerations

Our entire understanding of urban forestry is rooted in a capitalist understanding of urban forests, which devalues human connections to the land through its focus on maximizing specific benefits. However, there are no other established frameworks for western management of urban forests (Prebble et al. 2022). This means that relational values and intrinsic values tend to be lost in the understanding of urban forest's benefits.

To understand the current urban forest, we must understand that according to historian Francis Parkman in 1885, "early settlers regarded the forest as an enemy to be overcome by any means" and it is only his descendants who find "the old enemy has become an indispensable friend"; at least once tamed and ordered (Jonnes 1952 p. 15). In fact, Arbor Day was founded on the idea of planting trees on a tree-less prairie in an attempt to tame the windswept hot plains and that trees were considered "missionaries of culture" (Jonnes 1952 p. 21). As city planners have come to understand the vast services that trees provide, especially in monetary terms, plantings and 'tame' urban forests have seen increased prioritization (Jonnes 1952 p. 280).

It is well documented that urban forests are least complete in less influential areas. Tree-cover often reflects redlining of areas which may exacerbate heat islands, and reveal inequalities in urban ecosystem benefits (Nowak et al. 2022). Additionally, even as we discuss the many issues with non-native and invasive species in the United States, we must be very careful to not promote xenophobia. Tree-of-Heaven, with all of its weedy properties, smell, and spotted lanternfly issues, has been tied to "the 'wrong kind' of immigrant" since 1852 with protest of the tree stemming in part from "patriotic objections" (Jonnes 1952 p. 11). And yet, as patriotic native trees were pronounced superior for American cities, governments and settlers were still commiting a genocide against Native Americans.

Understanding these social histories, we also understand the intersection at which Allegheny College stands. As a university that values social change and justice, understanding the complex powers at play is essential. However, the college is dependent on alumni and prospective students financially, and these people expect the tidy, well-tamed forest of urban parks and cities. Perhaps the acknowledgement of these social histories and realities has to start in less visible portions of campus.

Ecosystem Considerations

While trees may be central to most urban forest discussions, the focus on individual trees ignores the rest of the urban forest (animals, smaller plants, people, infrastructure) and is problematic. Urban forests can contain endangered species, support multitudes of wildlife, and provide essential ecological corridors between other more natural forests.

Forests should be diverse and complex. This is important for urban forests as well. Just because a forest has visible human-caused change and management, diversity and complexity need not completely suffer. Urban forests must meet a variety of different needs that natural forests, but their ecosystem interactions, wildlife, and corridor roles should be planned for.

Location Considerations

Planting location is obviously essential for tree success and longevity. There are both human and arboreal needs that must be considered in this planting process. Of course trees can not block roads or building entrances, and some species have roots that may interfere with water lines or building foundations. Trees must receive the correct amount of light and water, soil conditions must be within the pH and soil texture bounds of each specific species, and the space must be large enough for both the roots and the tree. As we heard from stakeholders, future plans for geothermal bore-fields, sight lines and campus beauty must also be considered when deciding on location.

Planting, Diversity, & Resiliency Considerations

Fruit-producing trees in urban areas and associated Urban Food Forests, were considered by Kowalski and Conway (2019). They found that despite the many nutritional benefits potentially provided by urban fruit trees, fruit trees were relatively rarely planted. They attribute some of this to a municipal focus on canopy cover, as well as falling fruit worries. However, those municipalities that do include urban food forests discuss community engagement, forest diversity, and food security as well as public perception as positives to food trees within urban areas. American chestnuts used to dominate forests in the area and provide an important nut source. Should a blight resistant variety become available, chestnut planting should be prioritized.

Oak trees are a typical landscaping choice because of their longevity and the grand structure that is characteristic of many species, and here in Meadville they make a lot of sense. They are part of the historical forest, are gorgeous trees and have many ecosystem benefits not just for humans. For example, oak trees are known for supporting the largest diversity of caterpillars (over 530 species) of any genus in the US (Tallamy and Shropshire 2009).

Currently, across the northeastern US, *Prunus, Acer,* and *Quercus* genuses are the most planted (Doroski et. al 2020). While in much of the Northeast, the historical forest might include at least Acer and/or Quercus, the large planting numbers creates potential issues, especially given the already existent oak and maple threats (Oak Wilt, Sudden Oak Death, Spongy Moth, Asian Long Horn Beetle, etc.). *Carya, Fagus*, and *Betula* are genera that would traditionally be part of these northeastern forests but are relatively rare in northeastern cities' planting palettes, a fact blamed partially on nursery stocking (Doroski et. al 2020). Doroski et al. also found that ornamental trees and short-statured trees specifically tend to be overwhelmingly non-native across northeastern cities, indicating a need to focus on increasing native ornamental plantings (2020). In particular, in small cities, not only were native trees being planted less, but invasive trees were planted more, specifically Callery pears.

Best practices for urban plantings include using diverse, native planting palettes with high quality stock (Doroski et. al 2020). However some historically native species may soon be out of their range because of rising temperatures (extremes and averages) (Khan and Conaway 2020). One potential solution is human assisted migration which is already being considered for natural forests throughout Pennsylvania (Climate Change Adaptation and Mitigation Plan (PA)).

Here trees that are native to slightly south of the site and are more suited for the expected future climate are planted in the place of those who might be especially susceptible. According to the USDA plant hardiness zones, Meadville is now in the 6a or 6b zone, having moved from the 5a zone (2023). Increased drought, increased precipitation events, and increased pest issues will also impact this forest and trees should be selected and planted in appropriate areas based on their ability to withstand these concerns (PA Climate Impact Assessment 2021).

Diversity is essential for maximizing ecosystem services as well as protecting the current urban forest. A metaanalysis found that mixed-species forests received less herbivory, especially when the trees were very taxonomically different and fewer trees were susceptible to a given herbivorous insect (Jactel and Brockerhoff 2007). Additionally, as seen in the historical examples of the emerald ash borer and Dutch elm disease, species level diversity is not sufficient. It is suggested that family-level diversity is needed to protect the forest of our future (Raupp et al. 2006). In 1990, Santamour proposed as a general guideline that no more than 10 percent of trees should be of one species, 20 percent from one genus or 30 percent from one family to protect the urban forest from potential pests and stressors; while this rule is far from exact, it does have some use as a baseline (Santamour 1990, Lohr et al. 2014).

Genetic diversity within species is also important. Some trees will inherently have greater resistance to disease, and choosing diverse genotypes increases the chance that some of them may survive. Additionally we must be aware of the genetic interchange occurring between natural forests and urban forests. Natural forests are being pollinated by planted nursery grown trees which might have extremely bad genotypes for natural survival. Where possible the presence on campus of highly bred trees should be avoided. Clones especially are problematic for the homogeneous nature of their genotypes.

Other Considerations

Other areas of consideration include the age and status of trees when planted. In Philadelphia, it was found that the less expensive bare-rooted trees had similar survival rates in the first 5 years to trees whose roots were balled and burlap covered (more expensive) (Jack-Scott, 2011), although other studies show that such bare-rooted trees may need more extensive care before planting (Wattonhoffer & Johnson 2021). Additionally, post-planting maintenance is extremely important for sapling success (Wattonhoffer & Johnson 2021). In New

York City, an area of extremely high stress for trees, only 41% of street trees may survive for more than 40 years (Jonnes 1952 p. 284).

Beyond the threats associated with lack of diversity, diversity, nativity, and age of trees are all other important indicators of the ecosystem services trees can provide, as well as an indicator of the possible future of the urban forest. The ideal temperate urban forest typically has many different species of trees. Shorter tree species fill spaces that larger canopied and older growing species can not, and conifer and deciduous trees work in conjunction to produce optimal ecosystem services and habitat (Dickinson and Ramalho 2022; Wang et al. 2021). Additionally street trees and park trees should be treated differently given their different stressors (Doroski et al 2020, Huff et al. 2020).

Finally, the social importance of urban forests is often underestimated (Barron et al. 2016). Community involvement, investment and comprehensive planning is essential. Dynamic urban forests need dynamic involvement, investment and planning (Dwyer et al. 2003).

<u>Urban Forest Management Plan</u>

My recommendations are contained within the UFMP that is attached as Appendix 3. The summary of the plan is contained below.

Summary

Allegheny College has a rich urban forest that will require maintenance and management to increase its climate resilience and functions. Allegheny's urban forest is not static, rather it is constantly growing. This Urban Forest Management Plan is only a starting place, therefore I focus on broad issues and considerations for the forest, before discussing themes in specific areas and a few relevant tree replacements.

A climate resilient forest requires planning, management, diversity, and adaptability. An uneven aged urban forest is necessary to ensure constant canopy for the future, reduce forest stress, and distribute costs over time. Trees must be managed for safety, appearances, disease, structure, and long term growth. This maintenance must be regular, and especially frequent until the initial structure of the tree is established (generally >6 inches DBH). Regular inventories and keeping track of issues, removals and plantings is essential to recognising trends. Planting is only the first part of an urban forest. Without good management, resilience is hard to create.

Genetics, species, genus, and functional diversity within the forest allow for resilience in the face of extreme and changing weather, increasing disease issues, and the aesthetic needs of campus. Sourcing and planting trees with an eye to this diversity is essential. Conifers, shade trees, mid-sized trees, and small/ornamental trees all have important roles to play in the urban ecosystem. There is a list of suggested resilient species attached in the resources section. Any tree not on this list should be examined in detail for climate and disease resilience before planting on campus.

Tree removals should be carefully considered given the costs associated. Removal of larger, Monarch Trees should be specially considered, and maintenance and trimming specially considered to protect these trees that have an outsized impact on the character of the campus. A more complete ecosystem is more resistant to threats and therefore more adaptable. As the Allegheny Urban Forest grows, its needs will change too, and the plan will need to be revised.

Conclusions

The biggest challenge with this project is long-term sustainability. There are so many moving parts in a college like Allegheny, and without someone taking long term ownership over the urban forest, the inventory and UFMP will be forgotten within 10 years. Unfortunately, because of the short-term nature of a college education, it can not be students that take up this mantle. They can help with the inventory, and they can help develop new plans for areas as the college transitions into its next lower enrollment phase, but students will need help. It is my hope that the Environmental Working Group, in collaboration with Physical Plant, adopts the Urban Forest Management Plan (Appendix 3) and lets it grow with the Allegheny College Urban Forest.

There are many things that have not been considered within this plan. Some of the most important next steps are trialing the actual plan, testing soil around campus to understand acidity, soil texture, and soil depth, and expanding the tree inventory to cover all of the main campus as well as the managed portions of Robertson.

References

2023 USDA Plant Hardiness Zone Map | USDA Plant Hardiness Zone Map. (n.d.). Retrieved February 23, 2024, from https://planthardiness.ars.usda.gov/

Alvey, A. A. (2006). Promoting and preserving biodiversity in the urban forest. Urban Forestry & Urban Greening, 5(4), 195–201. https://doi.org/10.1016/j.ufug.2006.09.003

A Guide to Preserving Trees in Development Projects. (n.d.). Retrieved March 19, 2024, from https://extension.psu.edu/a-guide-to-preserving-trees-in-development-projects

Anderson, R. L., Knighten, J. L., Windham, M., Hedrix, F., & Roncadori, R. (n.d.). Dogwood Anthracnose and its Spread in the South.

Atlas of Climate Change Genetic Risk. (n.d.). Retrieved February 11, 2024, from https://www.geobabble.org/ForeCASTS/

Barron, S., Sheppard, S. R. J., & Condon, P. M. (2016). Urban forest indicators for planning and designing future forests. Forests, 7(9), Article 9. https://doi.org/10.3390/f7090208

Beech Leaf Disease—NYDEC. (n.d.). Retrieved January 27, 2024, from https://dec.ny.gov/nature/forests-trees/forest-health-beech-leaf-disease

Berland, A., & Elliott, G. P. (2014). Unexpected connections between residential urban forest diversity and vulnerability to two invasive beetles. Landscape Ecology, 29(1), 141–152. https://doi.org/10.1007/s10980-013-9953-2

Berland, A., Shiflett, S. A., Shuster, W. D., Garmestani, A. S., Goddard, H. C., Herrmann, D. L., & Hopton, M. E. (2017). The role of trees in urban stormwater management. Landscape and Urban Planning, 162, 167–177. https://doi.org/10.1016/j.landurbplan.2017.02.017

Bernhardt, E. A., & Swiecki, T. J. (n.d.). Guidelines for developing and evaluating tree ordinances. International Society of Arboriculture.

Big trees of Crawford County. (n.d.). Crawford County Conservation District. Retrieved March 18, 2024, from https://www.crawfordconservation.com/forestry-management/big-trees-of-crawford-county/

Berthon, K., Thomas, F., & Bekessy, S. (2021). The role of 'nativeness' in urban greening to support animal biodiversity. Landscape and Urban Planning, 205, 103959. https://doi.org/10.1016/j.landurbplan.2020.103959

Borelli, S., & Conigliaro, M. (2018). Urban forests in the global context. Unasylva, 69.

Branco, M., Nunes, P., Roques, A., Fernandes, M. R., Orazio, C., & Jactel, H. (2019). Urban trees facilitate the establishment of non-native forest insects. NeoBiota, 52, 25–46. https://doi.org/10.3897/neobiota.52.36358

Brandt, L. A., Johnson, G. R., North, E. A., Faje, J., & Rutledge, A. (2021). Vulnerability of street trees in upper midwest cities to climate change. Frontiers in Ecology and Evolution, 9. https://www.frontiersin.org/articles/10.3389/fevo.2021.721831

Burghardt, K. T., Tallamy, D. W., & Gregory Shriver, W. (2009). Impact of native plants on bird and butterfly biodiversity in suburban landscapes. Conservation Biology, 23(1), 219–224. https://doi.org/10.1111/j.1523-1739.2008.01076.x

Callery pear information. (n.d.). Pennsylvania Department of Agriculture. Retrieved January 27, 2024, from https://www.agriculture.pa.gov:443/Plants_Land_Water/PlantIndustry/NIPPP/Pages/Callery-Pear.aspx

Chan, K. M. A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., Luck, G. W., Martín-López, B., Muraca, B., Norton, B., Ott, K., Pascual, U., Satterfield, T., Tadaki, M., Taggart, J., & Turner, N. (2016). Why protect nature? Rethinking values and the environment. Proceedings of the National Academy of Sciences, 113(6), 1462–1465. https://doi.org/10.1073/pnas.1525002113

Clark, A. (n.d.). Tree Campus USA: the future of Allegheny's trees. Retrieved October 18, 2022, from https://dspace.allegheny.edu/bitstream/handle/10456/48691/Clark%20_%20Comp%20%281%29.pdf?sequence=1&isAllowed=y

Clark, J., Matheny, N., Cross, G., & Wake, V. (1997). A model of urban forest sustainability. Arboriculture & Urban Forestry, 23(1), 17–30. https://doi.org/10.48044/jauf.1997.003

City of Meadville, PA code. (n.d.). City of Meadville, PA Code. Retrieved February 11, 2024, from https://ecode360.com/ME4534

Controlled plant & noxious weed lists. (n.d.). Pennsylvania Department of Agriculture. Retrieved January 28, 2024, from https://www.agriculture.pa.gov:443/Plants_Land_Water/PlantIndustry/NIPPP/Pages/Controlled-Plant-Noxious-Weed.aspx

Copernicus: 2023 is the hottest year on record, with global temperatures close to the 1.5°C limit | Copernicus. (n.d.). Retrieved March 21, 2024, from https://climate.copernicus.eu/copernicus-2023-hottest-year-record

Costanza, K. K. L., Whitney, T. D., McIntire, C. D., Livingston, W. H., & Gandhi, K. J. K. (2018). A synthesis of emerging health issues of eastern white pine (Pinus strobus) in eastern North America. Forest Ecology and Management, 423, 3–17. https://doi.org/10.1016/j.foreco.2018.02.049

Davies, H. J., Doick, K. J., Hudson, M. D., & Schreckenberg, K. (2017). Challenges for tree officers to enhance the provision of regulating ecosystem services from urban forests. Environmental Research, 156, 97–107. https://doi.org/10.1016/j.envres.2017.03.020

de Vries, S., van Dillen, S. M. E., Groenewegen, P. P., & Spreeuwenberg, P. (2013). Streetscape greenery and health: Stress, social cohesion and physical activity as mediators. Social Science & Medicine, 94, 26–33. https://doi.org/10.1016/j.socscimed.2013.06.030

Deng, L., Jia, X., Wang, W., & Hussain, S. A. (2022). Revealing impacts of trees on modeling microclimate behavior in spaces between buildings through simulation monitoring. Buildings, 12(8), Article 8. https://doi.org/10.3390/buildings12081168

Dickinson, D. C., & Ramalho, C. E. (2022). A balancing act: Biodiversity and human wellbeing considerations in the management of urban forest in a global biodiversity hotspot. Urban Forestry & Urban Greening, 74, 127656. https://doi.org/10.1016/j.ufug.2022.127656

Dogwood diseases. (n.d.). Retrieved January 27, 2024, from https://extension.psu.edu/dogwood-diseases

Doroski, D. A., Ashton, M. S., & Duguid, M. C. (2020). The future urban forest – A survey of tree planting programs in the Northeastern United States. Urban Forestry & Urban Greening, 55, 126816. https://doi.org/10.1016/j.ufug.2020.126816

Dwyer, J., Nowak, D., & Noble, M. (2003). Sustaining urban forests. arboriculture & urban forestry, 29(1), 49–55. https://doi.org/10.48044/jauf.2003.007

Eastern white pine—modern disease threats to a historically important species. (n.d.). Retrieved January 28, 2024, from https://extension.psu.edu/eastern-white-pine-modern-disease-threats-to-a-historically-important-species

Effects of long-term feeding by spotted lanternfly (Hemiptera: Fulgoridae) on ecophysiology of common hardwood host trees | Environmental Entomology | Oxford Academic. (n.d.). Retrieved January 28, 2024, from https://academic.oup.com/ee/article-abstract/52/5/888/7254515?redirectedFrom=fulltext&login=true

Faulkenberry, M. (2023). Pennsylvania forest health highlights 2022. USDA. https://www.fs.usda.gov/foresthealth/docs/fhh/PA_FHH_2022.pdf

Forest Health Protection, USDA Forest Service. (n.d.). Large aspen tortrix. Retrieved January 28, 2024, from https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5343826.pdf

Forest Pests and Diseases | Penn State Extension. (n.d.). Retrieved December 2, 2023, from https://extension.psu.edu/forests-and-wildlife/forest-management/pests-and-diseases/

Forest Pest Insects in North America: A Photographic Guide. (n.d.). Retrieved January 27, 2024, from https://www.forestpests.org/vd/304.html

Four Elements of a Healthy Forest | U.S. Fish & Wildlife Service. (2022, October 5). https://www.fws.gov/story/2022-10/four-elements-healthy-forest

Guo, L.-N., Zhao, R.-L., Ren, A.-H., Niu, L.-X., & Zhang, Y.-L. (2020). Stress recovery of campus street trees as visual stimuli on graduate students in autumn. International Journal of Environmental Research and Public Health, 17(1), Article 1. https://doi.org/10.3390/ijerph17010148

Gilman, E. F., & Paterson Sadowski, L. (2007). Chapter 7 — Choosing suitable trees for urban and suburban sites: site evaluation and species selection: ENH 1057/EP310, 9/2007. EDIS, 2007(20). https://doi.org/10.32473/edis-ep310-2007

Hale, J. D., Pugh, T. A. M., Sadler, J. P., Boyko, C. T., Brown, J., Caputo, S., Caserio, M., Coles, R., Farmani, R., Hales, C., Horsey, R., Hunt, D. V. L., Leach, J. M., Rogers, C. D. F., & MacKenzie, A. R. (2015). Delivering a multi-functional and resilient urban forest. Sustainability, 7(4), Article 4. https://doi.org/10.3390/su7044600

Hauer, R. J., Hanou, I. S., & Sivyer, D. (2020). Planning for active management of future invasive pests affecting urban forests: The ecological and economic effects of varying Dutch elm disease management practices for street trees in Milwaukee, WI USA. Urban Ecosystems, 23(5), 1005–1022. https://doi.org/10.1007/s11252-020-00976-6

Hauer, R. J., & Peterson, W. D. (2017). Effects of emerald ash borer on municipal forestry budgets. Landscape and Urban Planning, 157, 98–105. https://doi.org/10.1016/j.landurbplan.2016.05.023

Hilbert, D., Roman, L., Koeser, A., Vogt, J., & Van Doorn, N. (2019). Urban tree mortality: a literature review. Arboriculture & Urban Forestry, 45(5). https://doi.org/10.48044/jauf.2019.015

Hill, M. P., Gallardo, B., & Terblanche, J. S. (2017). A global assessment of climatic niche shifts and human influence in insect invasions. Global Ecology and Biogeography, 26(6), 679–689. https://doi.org/10.1111/geb.12578

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Guillén Bolaños, T., Bindi, M., Brown, S., Camilloni, I. A., Diedhiou, A., Djalante, R., Ebi, K., Engelbrecht, F., Guiot, J., Hijioka, Y., Mehrotra, S., Hope, C. W., Payne, A. J., Pörtner, H.-O., Seneviratne, S. I., Thomas, A., … Zhou, G. (2019). The human imperative of stabilizing global climate change at 1.5°C. Science, 365(6459), eaaw6974. https://doi.org/10.1126/science.aaw6974

Houlden, V., Weich, S., Albuquerque, J. P. de, Jarvis, S., & Rees, K. (2018). The relationship between greenspace and the mental wellbeing of adults: A systematic review. PLOS ONE, 13(9), e0203000. https://doi.org/10.1371/journal.pone.0203000

Huff, E., Johnson, M., Roman, L., Sonti, N., Pregitzer, C., Campbell, L., & McMillen, H. (2020). A Literature Review of Resilience in Urban Forestry. Arboriculture & Urban Forestry, 46(3), 185–196. https://doi.org/10.48044/jauf.2020.014

Invasive plant fact sheets. (n.d.). Pennsylvania Department of Conservation & Natural Resources. Retrieved December 2, 2023, from https://www.dcnr.pa.gov:443/Conservation/WildPlants/InvasivePlants/InvasivePlantFactSheets/Pages/default.aspx

i-Tree Eco – Field guide for complete inventories. (2020). i-Tree. https://www.itreetools.org/documents/662/Cheat_Sheet_English_for_distribution_03.01.2021_OFS.pdf

Jack-Scott, E. (2012). Survival and growth factors affecting community-planted urban street trees. Cities and the Environment (CATE), 4(1). https://digitalcommons.lmu.edu/cate/vol4/iss1/10

Jactel, H., & Brockerhoff, E. G. (2007). Tree diversity reduces herbivory by forest insects. Ecology Letters, 10(9), 835–848. https://doi.org/10.1111/j.1461-0248.2007.01073.x

Jactel, H., Koricheva, J., & Castagneyrol, B. (2019). Responses of forest insect pests to climate change: Not so simple. Current Opinion in Insect Science, 35, 103–108. https://doi.org/10.1016/j.cois.2019.07.010

Jamie King. (n.d.). Virginia Tech campus tree care plan. Virginia Tech Facilities Department.

Jonnes, J. (1952). Urban forests: a natural history of trees in the American cityscape. New York, Viking.

Jutras, P., Prasher, S., & Mehuys, G. R. (2010). Appraisal of key abiotic parameters affecting street tree growth. Arboriculture and Urban Forestry, 36, 1–10. https://doi.org/10.48044/jauf.2010.001

Kenney, W. A., Van Wassenaer, P., & Satel, A. (2011). Criteria and indicators for strategic urban forest planning and management. Arboriculture & Urban Forestry, 37(3), 108–117. https://doi.org/10.48044/jauf.2011.015

Khan, T., & Conway, T. M. (2020). Vulnerability of common urban forest species to projected climate change and practitioners perceptions and responses. Environmental Management, 65(4), 534–547. https://doi.org/10.1007/s00267-020-01270-z

Klein, R., Koeser, A., Hauer, R., & Hansen, G. (2019). Risk assessment and risk perception of trees: a review of literature relating to arboriculture and urban forestry. Arboriculture & Urban Forestry, 45, 26–38. https://doi.org/10.48044/jauf.2019.003

Koeser, A., Vogt, J., Hauer, R., Northrop, R., & Peterson, W. (2016). The cost of not maintaining trees: findings and recommendations from an international symposium and summit. Arboriculture & Urban Forestry, 42(6). https://doi.org/10.48044/jauf.2016.032

Konijnendijk, C. C., Ricard, R. M., Kenney, A., & Randrup, T. B. (2006). Defining urban forestry – A comparative perspective of North America and Europe. Urban Forestry & Urban Greening, 4(3), 93–103. https://doi.org/10.1016/j.ufug.2005.11.003

Konrad. (n.d.). Effects of urban development on floods. USGS. Retrieved November 6, 2023, from https://pubs.usgs.gov/fs/fs07603/

Kowalski, J. M., & Conway, T. M. (2019). Branching out: The inclusion of urban food trees in Canadian urban forest management plans. Urban Forestry & Urban Greening, 45, 126142. https://doi.org/10.1016/j.ufug.2018.05.012

Krasny, M. E., & Delia, J. (2015). Natural area stewardship as part of campus sustainability. Journal of Cleaner Production, 106, 87–96. https://doi.org/10.1016/j.jclepro.2014.04.019

Lerner, J. (n.d.). City of Durham General Services Department.

Liquidambar styraciflua L. (n.d.). Retrieved March 18, 2024, from https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_2/liquidambar/styraciflua.htm

Lohr, V., Kendal, D., & Dobbs, C. (2016). Urban trees worldwide have low species and genetic diversity, posing high risks of tree loss as stresses from climate change increase. Acta Horticulturae, 1108, 263–270. https://doi.org/10.17660/ActaHortic.2016.1108.34

Lorimer, C. G., Dahir, S. E., & Nordheim, E. V. (2001). Tree mortality rates and longevity in mature and old-growth hemlock-hardwood forests. Journal of Ecology, 89(6), 960–971. https://doi.org/10.1111/j.1365-2745.2001.00619.x

Lovett, G. M., Weiss, M., Liebhold, A. M., Holmes, T. P., Leung, B., Lambert, K. F., Orwig, D. A., Campbell, F. T., Rosenthal, J., McCullough, D. G., Wildova, R., Ayres, M. P., Canham, C. D., Foster, D. R., LaDeau, S. L., & Weldy, T. (2016). Nonnative forest insects and pathogens in the United States: Impacts and policy options. Ecological Applications, 26(5), 1437–1455. https://doi.org/10.1890/15-1176

Lu, J. W. T., Svendsen, E. S., Campbell, L. K., Greenfeld, J., Braden, J., King, K. L., & Falxa-Raymond, N. (2010). Biological, social, and urban design factors affecting young street tree mortality in New York City.

Lymantria dispar dispar (Spongy Moth). (n.d.). Pennsylvania Department of Conservation & Natural Resources. Retrieved January 27, 2024, from https://prddcnr.pwpca.pa.gov:443/Conservation/ForestsAndTrees/InsectsAndDiseases/SpongyMoth/Pages/default.aspx

Magarik, Y. A. S., Roman, L. A., & Henning, J. G. (2020). How should we measure the DBH of multi-stemmed urban trees? Urban Forestry & Urban Greening, 47, 126481. https://doi.org/10.1016/j.ufug.2019.126481

Millward, A. A., & Sabir, S. (2010). Structure of a forested urban park: Implications for strategic management. Journal of Environmental Management, 91(11), 2215–2224. https://doi.org/10.1016/j.jenvman.2010.06.006

Morabito, M., Crisci, A., Guerri, G., Messeri, A., Congedo, L., & Munafò, M. (2021). Surface urban heat islands in Italian metropolitan cities: Tree cover and impervious surface influences. Science of The Total Environment, 751, 142334. https://doi.org/10.1016/j.scitotenv.2020.142334

Moser, W. K., Barnard, E. L., Billings, R. F., Crocker, S. J., Dix, M. E., Gray, A. N., Ice, G. G., Kim, M.-S., Reid, R., Rodman, S. U., & McWilliams, W. H. (2009). Impacts of nonnative invasive species on US forests and recommendations for policy and management. Journal of Forestry.

New York State Department of Environmental Conservation. (n.d.). Measuring tree diameters. Retrieved November 30, 2023, from https://extapps.dec.ny.gov/docs/lands_forests_pdf/DBHguidelines.pdf

Nicholas J. Brazee. (2019, July 8). Dieback of eastern white pine [Text]. Center for Agriculture, Food, and the Environment. https://ag.umass.edu/landscape/fact-sheets/dieback-of-eastern-white-pine

Nowak, D. J., Ellis, A., & Greenfield, E. J. (2022). The disparity in tree cover and ecosystem service values among redlining classes in the United States. Landscape and Urban Planning, 221, 104370. https://doi.org/10.1016/j.landurbplan.2022.104370

NYSIPM interactive spotted lanternfly map. (n.d.). Looker Studio. Retrieved January 27, 2024, from http://lookerstudio.google.com/reporting/b0bae43d-c65f-4f88-bc9a-323f3189cd35/page/QUCkC?feature=opengraph

Okerson, J. (2016). Beyond the campus tour: College choice and the campus visit. https://doi.org/10.21220/W43W20

Ordóñez, C., & Duinker, P. N. (2013). An analysis of urban forest management plans in Canada: Implications for urban forest management. Landscape and Urban Planning, 116, 36–47. https://doi.org/10.1016/j.landurbplan.2013.04.007

Östberg, J., Wiström, B., & Randrup, T. B. (2018). The state and use of municipal tree inventories in Swedish municipalities – results from a national survey. Urban Ecosystems, 21(3), 467–477. https://doi.org/10.1007/s11252-018-0732-3

Other insects and diseases. (n.d.). Pennsylvania Department of Conservation & Natural Resources. Retrieved January 27, 2024, from https://prddcnr.pwpca.pa.gov:443/Conservation/ForestsAndTrees/InsectsAndDiseases/OtherInsectsandDiseases/Pages/default.aspx

Overbeke, C. (2008). Do trees really cause so much damage to property? Journal of Building Appraisal, 3(4), 247–258. https://doi.org/10.1057/jba.2008.6

PA Department of Conservation and Natural Recources. (2018). Climate change adaptation and mitigation plan (PA). PA Department of Conservation and Natural Recources. http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_20033655.pdf

Paquette, A., Sousa-Silva, R., Maure, F., Cameron, E., Belluau, M., & Messier, C. (2021). Praise for diversity: A functional approach to reduce risks in urban forests. Urban Forestry & Urban Greening, 62, 127157. https://doi.org/10.1016/j.ufug.2021.127157

Pataki, D. E., Alberti, M., Cadenasso, M. L., Felson, A. J., McDonnell, M. J., Pincetl, S., Pouyat, R. V., Setälä, H., & Whitlow, T. H. (2021). The benefits and limits of urban tree planting for environmental and human health. Frontiers in Ecology and Evolution, 9. https://www.frontiersin.org/articles/10.3389/fevo.2021.603757

Pennsylvania climate impacts assessment 2021. (2021, May). https://www.depgreenport.state.pa.us/elibrary/PDFProvider.ashx?action=PDFStream&docID=3667348&chksum=&revision=1&docName=PENNSYLVANIA+CLIMATE+IMPACTS+ASSESSMENT+2021&nativeExt=pdf&PromptToSave=False&Size=6739063&ViewerMode=2&overlay=0

Pine shoot beetle – profile and resource. (n.d.). Invasive Species Centre. Retrieved January 28, 2024, from https://www.invasivespeciescentre.ca/invasive-species/meet-the-species/invasive-insects/pine-shoot-beetle/

Prebble, S., McLean, J., & Houston, D. (2021). Smart urban forests: An overview of more-than-human and more-than-real urban forest management in Australian cities. Digital Geography and Society, 2, 100013. https://doi.org/10.1016/j.diggeo.2021.100013

Raupp, M. J., Cumming, A. B., & Raupp, E. C. (2006). Street tree diversity in eastern North America and its potential for tree loss to exotic borers. Arboriculture & Urban Forestry (AUF), 32(6), 297–304. https://doi.org/10.48044/jauf.2006.038

Roman, L. (2006). Trends in street tree survival, Philadelphia, PA. Master of Environmental Studies Capstone Projects. https://repository.upenn.edu/mes_capstones/4

Roman, L. A., Fristensky, J. P., Eisenman, T. S., Greenfield, E. J., Lundgren, R. E., Cerwinka, C. E., Hewitt, D. A., & Welsh, C. C. (2017). Growing canopy on a college campus:

understanding urban forest change through archival records and aerial p hotography. Environmental Management, 60(6), 1042–1061. https://doi.org/10.1007/s00267-017-0934-0

Roman, L. A., Fristensky, J. P., Lundgren, R. E., Cerwinka, C. E., & Lubar, J. E. (2022). Construction and proactive management led to tree removals on an urban college campus. Forests, 13(6), Article 6. https://doi.org/10.3390/f13060871

Roman, L., McPherson, E. G., Scharenbroch, B., & Bartens, J. (2013). Identifying common practices and challenges for local urban tree monitoring programs across the United States. Arboriculture & Urban Forestry, 39(6). https://doi.org/10.48044/jauf.2013.038

Roy, S. (2017). Anomalies in Australian municipal tree managers' street-tree planting and species selection principles. Urban Forestry & Urban Greening, 24, 125–133. https://doi.org/10.1016/j.ufug.2017.03.008

Roy, S., Davison, A., & Östberg, J. (2017). Pragmatic factors outweigh ecosystem service goals in street tree selection and planting in South-East Queensland cities. Urban Forestry & Urban Greening, 21, 166–174. https://doi.org/10.1016/j.ufug.2016.12.003

Santamour Jr, F. S. (2004). Trees for urban planting: Diversity uniformity, and common sense. C. Elevitch, The Overstory Book: Cultivating Connections with Trees, 396–399.

Smith, I. A., Dearborn, V. K., & Hutyra, L. R. (2019). Live fast, die young: Accelerated growth, mortality, and turnover in street trees. PLOS ONE, 14(5), e0215846. https://doi.org/10.1371/journal.pone.0215846

Steenberg, J. W. N., Ristow, M., Duinker, P. N., Lapointe-Elmrabti, L., MacDonald, J. D., Nowak, D. J., Pasher, J., Flemming, C., & Samson, C. (2023). A national assessment of urban forest carbon storage and sequestration in Canada. Carbon Balance and Management, 18(1), 11. https://doi.org/10.1186/s13021-023-00230-4

Stemkovski, M. (n.d.). Pyrus calleryana (Bradford Pear). NC INVASIVE PLANT COUNCIL. Retrieved February 17, 2024, from https://nc-ipc.weebly.com/pyrus-calleryana-bradford-pear.html

Straughan, E., Phillips, C., & Atchison, J. (2023). Finding comfort and conviviality with urban trees. Cultural Geographies, 30(4), 507–524. https://doi.org/10.1177/14744740221136284

Swann-Quinn, J., Pallant, E., Boulton, K., Michael, J., McRae, S., & Bowden, R. D. (2023). Growing A Resilient Campus Forest: Opportunities, Barriers, Solutions. In W. Leal Filho, A. Lange Salvia, E. Pallant, B. Choate, & K. Pearce (Eds.), Educating the Sustainability

Leaders of the Future (pp. 493–512). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-22856-8_27

Swearingen, J., & C. Bargeron. (2016). Trees: Invasive plant atlas of the United States. http://www.invasiveplantatlas.org/.

Tallamy, D. W., & Shropshire, K. J. (2009). Ranking lepidopteran use of native versus introduced plants. Conservation Biology, 23(4), 941–947. https://doi.org/10.1111/j.1523-1739.2009.01202.x

Tasoulas, E., Varras, G., Tsirogiannis, I., & Myriounis, C. (2013). Development of a GIS application for urban forestry management planning. Procedia Technology, 8, 70–80. https://doi.org/10.1016/j.protcy.2013.11.011

Templeton, S., Gover, A., Jackson, Da., & Wurzbatcher, S. (n.d.). Privet. PennState Extension. Retrieved October 26, 2022, from https://extension.psu.edu/privet

Teshome, D. T., Zharare, G. E., & Naidoo, S. (2020). The threat of the combined effect of biotic and abiotic stress factors in forestry under a changing climate. *Frontiers in Plant Science*, *11*. https://www.frontiersin.org/articles/10.3389/fpls.2020.601009

The invasive Amur corktree. (n.d.). Retrieved March 19, 2024, from https://extension.psu.edu/the-invasive-amur-corktree

Tree mortality rates and longevity in mature and old‐growth hemlock‐hardwood forests—Lorimer—2001—Journal of Ecology—Wiley Online Library. (n.d.-a). Retrieved March 21, 2024, from https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2745.2001.00619.x

Tree mortality rates and longevity in mature and old‐growth hemlock‐hardwood forests—Lorimer—2001—Journal of Ecology—Wiley Online Library. (n.d.-b). Retrieved March 21, 2024, from https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2745.2001.00619.x

Urban Forest Management Plan Toolkit. (2018). Inland Urban Forest Council. https://ufmptoolkit.net/

Urban Forest Management Plan Toolkit | U.S. Climate Resilience Toolkit. (2021). https://toolkit.climate.gov/tool/urban-forest-management-plan-toolkit

USDA. (2023). 2023 USDA plant hardiness zone map. USDA Plant Hardiness Zone Map. https://planthardiness.ars.usda.gov/

USDA APHIS | Spotted Lanternfly. (n.d.). Retrieved October 26, 2022, from https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/spotted-lanternfly/spotted-lanternfly

Vaz Monteiro, M., Doick, K. J., & Handley, P. (2016). Allometric relationships for urban trees in Great Britain. Urban Forestry & Urban Greening, 19, 223–236. https://doi.org/10.1016/j.ufug.2016.07.009

Virginia Tech Dept. of Forest Resources and Environmental Conservation. (2022). Virginia Tech Dendrology. https://dendro.cnre.vt.edu/dendrology/idit.htm

Vogt, J. (2020). Urban forests: Biophysical features and benefits. In Encyclopedia of the World's Biomes (pp. 48–57). Elsevier. https://doi.org/10.1016/B978-0-12-409548-9.12404-2

Wang, X., Wang, Y., Qu, X., Huang, B., Li, Z., Sun, J., Wei, X., & Yang, X. (2021). Urban trees in university campus: Structure, function, and ecological values. Environmental Science and Pollution Research, 28(33), 45183–45198. https://doi.org/10.1007/s11356-021-13841-6

Wattenhofer, D. J., & Johnson, G. R. (2021). Understanding why young urban trees die can improve future success. Urban Forestry & Urban Greening, 64, 127247. https://doi.org/10.1016/j.ufug.2021.127247

Weed, A. S., Ayres, M. P., & Hicke, J. A. (2013). Consequences of climate change for biotic disturbances in North American forests. Ecological Monographs, 83(4), 441–470. https://doi.org/10.1890/13-0160.1

What is Climate Resilience? | Union of Concerned Scientists. (n.d.). Retrieved November 6, 2023, from https://www.ucsusa.org/resources/what-climate-resilience

White pine blister rust. (n.d.). Invasive Species Centre. Retrieved January 28, 2024, from https://www.invasivespeciescentre.ca/invasive-species/meet-the-species/invasive-pathogens/white-pine-blister-rust/

Wicaksono, A., & Hernina, R. (2021). Urban tree analysis using unmanned aerial vehicle (uav) images and object-based classification (case study: University of indonesia campus). IOP Conference Series: Earth and Environmental Science, 683(1), 012105. https://doi.org/10.1088/1755-1315/683/1/012105

Willson, M. F., & Comet, T. A. (1996). Bird Communities of Northern Forests: Ecological Correlates of Diversity and Abundance in the Understory. The Condor, 98(2), 350–362. https://doi.org/10.2307/1369153

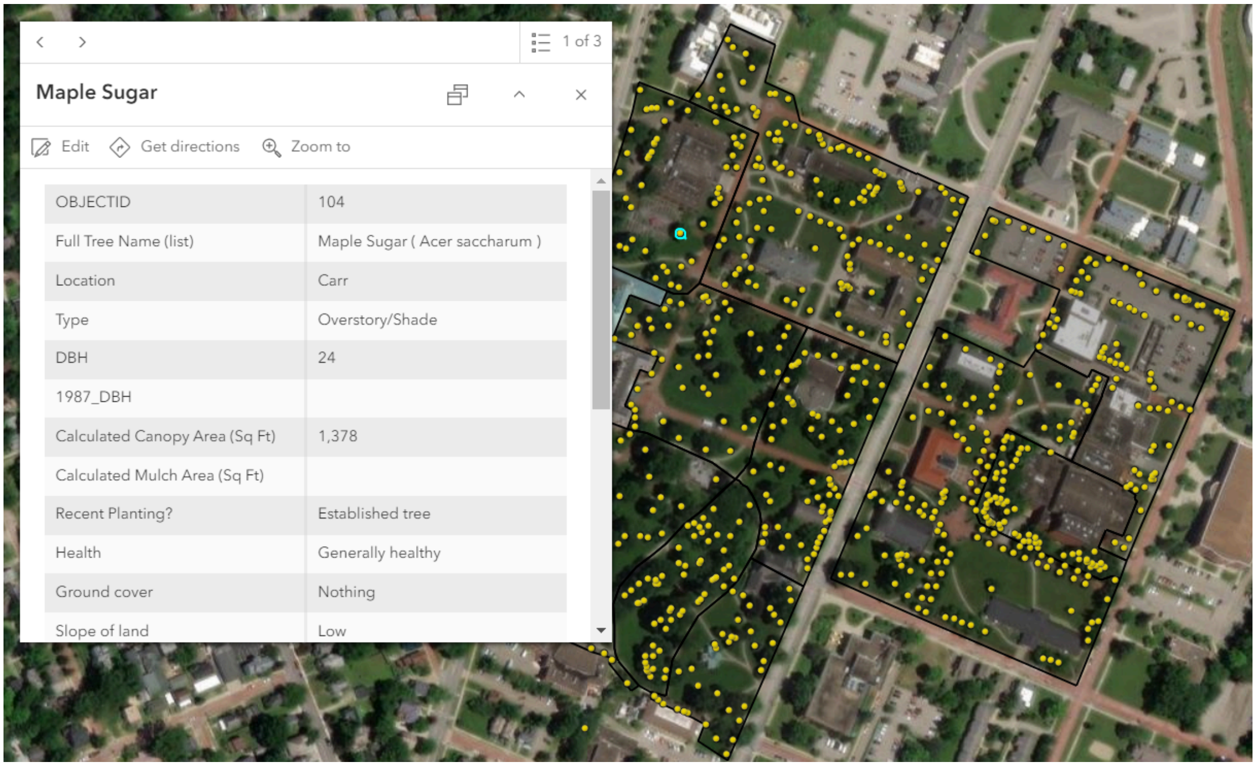
Wirtz, Z., Hagerman, S., Hauer, R. J., & Konijnendijk, C. C. (2021). What makes urban forest governance successful? – A study among Canadian experts. Urban Forestry & Urban Greening, 58, 126901. https://doi.org/10.1016/j.ufug.2020.126901

Zandalinas, S. I., Fritschi, F. B., & Mittler, R. (2021). Global warming, climate change, and environmental pollution: Recipe for a multifactorial stress combination disaster. Trends in Plant Science, 26(6), 588–599. https://doi.org/10.1016/j.tplants.2021.02.011

Appendix

Appendix 1 - Complete Inventory

Ownership of the online inventory and data is now held by Allegheny's GIS supervisor. Access may be requested from Chris Shaffer (csaffer@allegheny.edu). Additionally I recommend a public version of the mapped inventory be linked on the Office of Sustainability website. The url is https://arcg.is/0rWv0H0 , and instructions for basic use are in the description of the map. A screen grab of the public interface appears below. An abridged data table follows in spreadsheet form.



ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
1	41.6504690100	-80.1465462583	Fagus	Beech Purple	N Central	6	188.7	Mulch	38.48	
2	41.6505585050	-80.1466052033	Prunus	Japanese Cherry	N Central	6	227.0	Mulch	33.18	
3	41.6505491483	-80.1465581483	Prunus	Japanese Cherry	N Central	7	283.5	Mulch	44.18	
4	41.6506015967	-80.1465802650	Prunus	Japanese Cherry	N Central	6	227.0	Mulch	44.18	
5	41.6505753367	-80.1464429417	Crataegus	Black Hawthorn	N Central	13	829.6	Mulch	143.14	
6	41.6507202400	-80.1464474817	Picea	Colorado Blue spruce	N Central	10	268.8	Nothing		
7	41.6507170283	-80.1464055450	Picea	Colorado Blue Spruce	N Central	7	132.7	Nothing		
8	41.6507627883	-80.1464249617	Picea	Colorado Blue Spruce	N Central	6	113.1	Nothing		
9	41.6507559800	-80.1464970200	Liquidambar	Sweet Gum	N Central	5	188.7	Mulch	33.18	
10	41.6508667433	-80.1466044600	Malus	Siberian Crabapple	N Central	5	143.1	Mulch	50.27	
11	41.6508924933	-80.1465928600	Malus	Siberian Crabapple	N Central	4	132.7	Mulch	44.18	
12	41.6509173883	-80.1466290917	Malus	Siberian Crabapple	N Central	5	227.0	Mulch	56.75	
13	41.6510758717	-80.1467144633	Tilia	Linden Littleleaf	N Central	10	490.9	Mulch	28.27	
14	41.6511643533	-80.1466345083	Tilia	Linden Littleleaf	N Central	18	779.3	Mulch	103.87	
15	41.6512570933	-80.1466905250	Liriodendron	Tulip Poplar	N Central	2	19.6	Mulch	4.91	Brian Andrew Hill
16	41.6512975383	-80.1467949417	Acer	Maple Norway	N Central	10	433.7	Mulch	19.63	
17	41.6513416233	-80.1468403083	Acer	Maple Red	N Central	10	314.2	Other		
18	41.6511185583	-80.1469024717	Quercus	Oak Scarlett	N Central	15	907.9	Mulch	33.18	
19	41.6510297833	-80.1468886183	Metasequoia	Dawn Redwood	N Central	10	415.5	Mulch	38.48	
20	41.6509295833	-80.1468651833	Acer	Maple Red	N Central	13	779.3	Mulch	23.76	
21	41.6509112767	-80.1467666400	Tilia	Linden Littleleaf	N Central	19	907.9	Mulch	33.18	
22	41.6508905833	-80.1468363800	Platanus	American Sycamore	N Central	15	683.5	Mulch	50.27	
23	41.6509225867	-80.1469510250	Acer	Maple Red	N Central	11	298.6	Mulch	23.76	
24	41.6509749150	-80.1469809167	Larix	Tamarak	N Central	3	38.5	Nothing		
25	41.6508317967	-80.1469423783	Quercus	Oak Swamp White	Carr	9	346.4	Other		
26	41.6491716933	-80.1475951317	Amelanchier	Serviceberry	Brooks	9	530.9	Other		
27	41.6492629567	-80.1474756917	Betula	Birch River	Brooks	7	829.6	Mulch	33.18	
28	41.6493514250	-80.1473903533	Cornus	Cornelian Cherry	Brooks	1	50.3	Mulch	12.57	
29	41.6493958650	-80.1474543950	Betula	Birch Grey	Brooks	8	176.7	Mulch	12.57	
30	41.6495057500	-80.1476408933	Malus	Siberian Crabapple	Brooks	12	572.6	Grass		
31	41.6495595567	-80.1475969450	Cornus	Florida Dogwood	Brooks	1	12.6	Mulch	3.14	
32	41.6494849700	-80.1477861467	Acer	Maple Sugar	Brooks	21	779.3	Grass		
33	41.6496615467	-80.1476646483	Gleditsia	Thornless Honey Locust	Brooks	24	989.8	Grass		
34	41.6496006283	-80.1474947500	Gleditsia	Thornless Honey Locust	Brooks	21	779.3	Grass		
35	41.6495494733	-80.1474761567	Picea	Norway Spruce	Brooks	26	907.9	Grass		
36	41.6491776667	-80.1472123183	Gleditsia	Thornless Honey Locust	Brooks	3	153.9	Mulch	9.62	
37	41.6491780333	-80.1470443933	Cercis	Redbud	Brooks	8	283.5	Mulch	12.57	
38	41.6491379217	-80.1469994950	Quercus	Oak English	Brooks	7	330.1	Mulch	4.91	
39	41.6489675800	-80.1468705100	Tilia	Linden Littleleaf	Brooks	3	15.9	Mulch	3.14	
40	41.6489324050	-80.1467021267	Tsuga	Hemlock	Brooks	4	78.5	Mulch	33.18	
41	41.6489814533	-80.1466243067	Cladrastis	Yellowwood	Brooks	17	1590.4	Mulch	63.62	
42	41.6492717850	-80.1465533383	Quercus	Oak White	Brooks	36	3217.0	Mulch	240.53	
43	41.6494212900	-80.1465756933	Quercus	Oak Chestnut	Brooks	36	2827.4	Mulch	188.69	
44	41.6494296783	-80.1464155750	Quercus	Oak White	Brooks	46	3369.6	Grass		
45	41.6495019833	-80.1463695900	Picea	Norway Spruce	Brooks	22	730.6	Grass		
46	41.6495548900	-80.1463335000	Malus	Siberian Crabapple	Brooks	14	637.9	Grass		
47	41.6495184517	-80.1466524333	Morus	Mulberry	Brooks	30	1847.5	Other		
48	41.6496566000	-80.1468232850	Picea	Norway Spruce	Brooks	36	1017.9	Other		
49	41.6497069583	-80.1468608867	Malus	Siberian Crabapple	Brooks	12	754.8	Mulch	23.76	
50	41.6497423317	-80.1470473917	Crataegus	Black Hawthorn	Brooks	6	298.6	Mulch	9.62	
51	41.6497460683	-80.1470178367	Crataegus	Black Hawthorn	Brooks	6	240.5	Mulch	12.57	
52	41.6497130783	-80.1470004600	Crataegus	Black Hawthorn	Brooks	6	380.1	Mulch	15.90	
53	41.6496138683	-80.1469295917	Nyssa	Black Tupelo	Brooks	16	804.2	Mulch	86.59	
54	41.6495326533	-80.1469641700	Cornus	Kousa Dogwood	Brooks	6	314.2	Mulch	23.76	
55	41.6495186833	-80.1470216233	Kalopanax	Prickly Castor Oil Tree	Brooks	31	730.6	Mulch	153.94	
56	41.6494615800	-80.1469942650	Taxodium	Bald Cypress	Brooks	34	660.5	Mulch	153.94	
57	41.6493759400	-80.1469972467	Metasequoia	Dawn Redwood	Brooks	30	962.1	Mulch	122.72	
58	41.6493709933	-80.1470826300	Crataegus	Black Hawthorn	Brooks	10	683.5	Mulch	78.54	
59	41.6492583750	-80.1469355850	Acer	Maple Red	Brooks	34	1963.5	Mulch	330.06	
60	41.6493065017	-80.1472529033	Liquidambar	Sweet Gum	Brooks	6	240.5	Mulch	15.90	
61	41.6505459650	-80.1467673533	Pyrus	Bradford Pear	Carr	9	201.1	Other		
62	41.6505510550	-80.1468477033	Cercis	Redbud	Carr	10	330.1	Other		
63	41.6506243017	-80.1467991700	Acer	Maple Red	Carr	16	706.9	Mulch	63.62	
64	41.6506757367	-80.1467293933	Betula	Birch River	Carr	12	551.5	Other		
65	41.6506954050	-80.1467709167	Betula	Birch River	Carr	12	346.4	Other		
66	41.6507372367	-80.1467922567	Betula	Birch Grey	Carr	9	201.1	Other		
67	41.6507436417	-80.1467142283	Betula	Birch River	Carr	14	594.0	Grass		
68	41.6509978283	-80.1470875633	Platanus	American Sycamore	N Central	14	1075.2	Other		
69	41.6509024250	-80.1471722683	Pinus	Pine White	Carr	24	962.1	Mulch	122.72	
70	41.6509534533	-80.1473171333	Acer	Maple Sugar	Carr	3	70.9	Mulch	56.75	
71	41.6509207050	-80.1474298483	Tsuga	Hemlock	Carr	9	240.5	Mulch	70.88	
72	41.6509186367	-80.1474740000	Tsuga	Hemlock	Carr	7	165.1	Mulch	63.62	
73	41.6509066350	-80.1475199650	Tsuga	Hemlock	Carr	7	165.1	Mulch	50.27	
74	41.6510289267	-80.1475724650	Acer	Maple Red	Carr	16	706.9	Mulch	15.90	
75	41.6507796300	-80.1476418917	Quercus	Oak Red	Carr	29	2596.7	Mulch	50.27	
76	41.6508365817	-80.1473674850	Malus	Siberian Crabapple	Carr	5	95.0	Mulch	63.62	
77	41.6507239450	-80.1474362300	Gleditsia	Thornless Honey Locust	Carr	12	683.5	Grass		
78	41.6507047417	-80.1474541550	Gleditsia	Thornless Honey Locust	Carr	10	143.1	Grass		
79	41.6506926983	-80.1474536333	Gleditsia	Thornless Honey Locust	Carr	9	330.1	Grass		
80	41.6506444167	-80.1474741683	Gleditsia	Thornless Honey Locust	Carr	12	330.1	Grass		
81	41.6506182833	-80.1474974850	Gleditsia	Thornless Honey Locust	Carr	16	298.6	Grass		
82	41.6506046567	-80.1475104817	Gleditsia	Thornless Honey Locust	Carr	16	855.3	Grass		
83	41.6506352733	-80.1476820450	Quercus	Oak Scarlett	Carr	9	615.8	Mulch	19.63	
84	41.6505194867	-80.1477426767	Quercus	Oak Souther Red	Carr	11	452.4	Mulch	12.57	
85	41.6504405500	-80.1475545150	Styphnolobium	Japanese Pagoda Tree	Carr	29	2042.8	Grass		
86	41.6503553717	-80.1476924867	Pyrus	Pear Common	Carr	5	240.5	Grass		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
87	41.6502998917	-80.1476497917	Pyrus	Asian pear	Carr	5	176.7	Grass		
88	41.6501183467	-80.1478846967	Liquidambar	Sweet Gum	Carr	6	298.6	Mulch	12.57	
89	41.6500596650	-80.1477412750	Acer	Maple Sugar	Carr	26	1164.2	Mulch	188.69	
90	41.6500409383	-80.1476910050	Acer	Maple Norway	Carr	17	637.9	Mulch	283.53	
91	41.6500973733	-80.1476350133	Acer	Maple Sugar	Carr	23	730.6	Mulch	132.73	
92	41.6500314517	-80.1475255033	Acer	Maple Sugar	Carr	31	1320.3	Mulch	298.65	
93	41.6498610533	-80.1474384567	Quercus	Oak Red	Carr	26	1847.5	Grass		
94	41.6499315733	-80.1473777317	Crataegus	Black Hawthorn	Carr	13	490.9	Mulch	44.18	
95	41.6498981367	-80.1473437667	Crataegus	Black Hawthorn	Carr	14	551.5	Mulch	70.88	
96	41.6499321450	-80.1472288600	Crataegus	Black Hawthorn	Carr	10	283.5	Other		
97	41.6498168200	-80.1473161433	Picea	Norway Spruce	Carr	31	615.8	Mulch	471.44	
98	41.6498005433	-80.1472470267	Picea	Norway Spruce	Carr	28	637.9	Mulch	86.59	
99	41.6497008017	-80.1472257867	Ginkgo	Ginkgo	Brooks	32	1698.2	Mulch	95.03	
100	41.6497181717	-80.1473253817	Phellodendron	Amur Corktree	Brooks	18	510.7	Mulch	132.73	
101	41.6496653350	-80.1473663483	Malus	Crabapple	Brooks	11	397.6	Mulch	113.10	
102	41.6495634567	-80.1473396100	Acer	Maple Norway Purple	Brooks	2	33.2	Mulch	3.14	
103	41.6499668067	-80.1471401600	Acer	Maple Red	Carr	12	510.7	Other		
104	41.6501434500	-80.1472339900	Acer	Maple Sugar	Carr	24	1385.4	Nothing		
105	41.6501956083	-80.1470394333	Acer	Maple Sugar	Carr	16	1134.1	Mulch	78.54	
106	41.6503229233	-80.1469453750	Acer	Maple Sugar	Carr	18	829.6	Mulch	33.18	
107	41.6503542917	-80.1469029267	Pyrus	Bradford Pear	Carr	9	240.5	Mulch	7.07	
108	41.6503902283	-80.1469275033	Amelanchier	Serviceberry	Carr	0	78.5	Grass		
109	41.6504205683	-80.1469136750	Morus	Mulberry	Carr	0	103.9	Grass		
110	41.6490725867	-80.1476457417	Amelanchier	Serviceberry	Brooks	5	201.1	Other		
111	41.6490393283	-80.1476139717	Amelanchier	Serviceberry	Brooks	9	363.1	Grass		
112	41.6489908750	-80.1476132833	Amelanchier	Serviceberry	Brooks	10	330.1	Grass		
113	41.6489395783	-80.1476170817	Quercus	Oak Red	Brooks	19	660.5	Mulch	56.75	Robert Sherman
114	41.6488898717	-80.1476512600	Amelanchier	Serviceberry	Bently	10	314.2	Grass		
115	41.6488523267	-80.1477351967	Catalpa	Catalpa	Bently	11	397.6	Grass		
116	41.6489284817	-80.1480309300	Acer	Maple Sugar	Bently	33	1555.3	Grass		
117	41.6489869567	-80.1482327800	Picea	Norway Spruce	Bently	26	346.4	Grass		
118	41.6489323400	-80.1482035867	Picea	Norway Spruce	Bently	14	433.7	Mulch	132.73	
119	41.6488597883	-80.1482212817	Quercus	Oak Pin	Bently	21	1288.2	Grass		Evi Mavrogeorgis
120	41.6488179667	-80.1483607517	Picea	Norway Spruce	Bently	5	95.0	Other		George Miller
121	41.6486187000	-80.1479630150	Quercus	Oak Red	Bently	51	6082.1	Grass		
122	41.6485988867	-80.1481726550	Quercus	Oak Red	Bently	18	1194.6	Grass		
123	41.6485871550	-80.1482789583	Quercus	Oak Red	Bently	17	881.4	Other		
124	41.6485328350	-80.1483883450	Tsuga	Hemlock	Bently	29	804.2	Nothing		
125	41.6485131433	-80.1484290700	Tsuga	Hemlock	Bently	36	989.8	Nothing		
126	41.6484576150	-80.1484939467	Picea	Norway Spruce	Bently	19	754.8	Nothing		
127	41.6483182067	-80.1485198600	Tilia	Linden American	Bently	18	594.0	Nothing		
128	41.6483313483	-80.1485071917	Tilia	Linden American	Bently	16	615.8	Nothing		
129	41.6483801300	-80.1484353917	Tsuga	Hemlock	Bently	24	615.8	Nothing		
130	41.6484203017	-80.1483312483	Acer	Maple Norway	Bently	28	2164.8	Nothing		
131	41.6485136567	-80.1482358417	Quercus	Oak Red	Bently	1	15.9	Mulch	7.07	George Cook
132	41.6484568300	-80.1481139933	Picea	Norway Spruce	Bently	26	1017.9	Nothing		
133	41.6483585850	-80.1482465200	Tsuga	Hemlock	Bently	33	1225.4	Nothing		
134	41.6483184050	-80.1483691767	Malus	Siberian Crabapple	Bently	7	227.0	Other		
135	41.6483016917	-80.1483505183	Malus	Siberian Crabapple	Bently	6	165.1	Nothing		
136	41.6482693900	-80.1483205350	Malus	Siberian Crabapple	Bently	7	213.8	Grass		
137	41.6482371467	-80.1483033533	Malus	Siberian Crabapple	Bently	11	268.8	Nothing		
138	41.6482216583	-80.1482752133	Malus	Siberian Crabapple	Bently	5	227.0	Nothing		
139	41.6481885117	-80.1482457917	Malus	Siberian Crabapple	Bently	10	165.1	Grass		
140	41.6481526367	-80.1481911150	Cornus	Kousa Dogwood	Bently	9	227.0	Other		
141	41.6482634183	-80.1481477167	Fagus	Beech, fern-leaved	Bently	6	165.1	Mulch	3.14	
142	41.6481651633	-80.1480311017	Malus	Siberian Crabapple	Bently	14	907.9	Nothing		
143	41.6483560483	-80.1480001867	Acer	Maple Sugar	Bently	10	510.7	Mulch	15.90	
144	41.6483876050	-80.1478469700	Aesculus	Horse Chestnut	Bently	38	1626.0	Grass		
145	41.6485017600	-80.1477385383	Quercus	Oak Red	Bently	35	2042.8	Grass		
146	41.6486245117	-80.1474902633	Platanus	American Sycamore	Bently	53	3848.5	Mulch	1590.43	
147	41.6484998767	-80.1473985517	Acer	Maple Red	Bently	27	1661.9	Grass		
148	41.6484444450	-80.1472293033	Acer	Maple Sugar	Bently	36	2003.0	Grass		
149	41.6484169450	-80.1474667467	Acer	Maple Red	Bently	35	1847.5	Grass		
150	41.6482698967	-80.1473925750	Acer	Maple Red	Bently	21	730.6	Grass		
151	41.6482452017	-80.1475043383	Pinus	Pine White	Bently	33	881.4	Grass		
152	41.6482594117	-80.1475681117	Acer	Maple Red	Bently	41	1452.2	Grass		
153	41.6482560683	-80.1476938900	Acer	Maple Red	Bently	27	1352.7	Grass		
154	41.6482088500	-80.1477521100	Acer	Maple Norway	Bently	26	1256.6	Grass		
155			Cornus	Florida Dogwood	Bently	8	176.7	Other		
156	41.6479457183	-80.1481220250	Acer	Maple Red	Bently	36	1626.0	Other		
157	41.6477201967	-80.1483443483	Cornus	Kousa Dogwood	Bently	15	754.8	Other		
158	41.6476751950	-80.1482805333	Prunus	Japanese Cherry	Bently	6	240.5	Other		
159	41.6477169633	-80.1481634767	Pinus	Pine Mexican Piñon	Bently	2	38.5	Other		
160	41.6476284167	-80.1481905433	Malus	Siberian Crabapple	Bently	8	254.5	Other		
161	41.6475583283	-80.1479742467	Malus	Siberian Crabapple	Bently	9	363.1	Other		
162	41.6476754717	-80.1479410883	Pinus	Pine Mexican Piñon	Bently	2	23.8	Other		
163	41.6477732350	-80.1478344900	Quercus	Oak White	Bently	36	2042.8	Grass		
164	41.6475296650	-80.1478695200	Magnolia	Magnolia sp.	Bently	7	227.0	Other		
165	41.6474852617	-80.1478016233	Magnolia	Magnolia sp.	Bently	13	397.6	Other		
166	41.6473395400	-80.1476803283	Gleditsia	Thornless Honey Locust	Bently	29	1320.3	Grass		
167	41.6472638117	-80.1474548083	Carpinus	Musclewood	Newton	7	188.7	Other		
168	41.6472375033	-80.1474178283	Carpinus	Musclewood	Newton	7	176.7	Other		
169	41.6472139567	-80.1473807750	Carpinus	Musclewood	Newton	7	240.5	Other		
170	41.6471789583	-80.1472635750	Carpinus	Musclewood	Newton	7	254.5	Other		
171	41.6471677683	-80.1472060050	Carpinus	Musclewood	Newton	6	153.9	Grass		
172	41.6471556667	-80.1471705150	Carpinus	Musclewood	Newton	7	176.7	Other		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
173	41.6470818850	-80.1470184450	Picea	Colorado Blue Spruce	Newton	17	113.1	Mulch	103.87	
174	41.6469949583	-80.1469346400	Platanus	American Sycamore	Newton	2	44.2	Mulch	9.62	
175	41.6469011867	-80.1468497917	Acer	Maple Red	Newton	15	754.8	Mulch	33.18	
176	41.6469866250	-80.1467935967	Acer	Maple Red	Newton	3	56.7	Mulch	15.90	
177	41.6471077517	-80.1467404767	Acer	Maple Red	Newton	3	56.7	Mulch	12.57	
178	41.6471732533	-80.1468333467	Tilia	Linden American	Newton	59	2248.0	Mulch	213.82	
179	41.6471945183	-80.1467005517	Acer	Maple Red	Newton	27	1885.7	Mulch	165.13	
180	41.6472820200	-80.1469281367	Tilia	Linden American	Newton	14	907.9	Mulch	33.18	
181	41.6473235933	-80.1470878117	Acer	Maple Red	Newton	4	143.1	Mulch	15.90	
182	41.6474338200	-80.1471405067	Pyrus	Bradford Pear	Newton	16	594.0	Mulch	103.87	
183	41.6474121800	-80.1472466900	Ulmus	Elm Scotch	Newton	16	490.9	Mulch	380.13	
184	41.6475860950	-80.1469507633	Taxus	Yew	Newton	9	176.7	Nothing		
185	41.6475613667	-80.1469390717	Prunus	Cherry Weeping	Newton	21	188.7	Other		
186	41.6476470167	-80.1468857083	Pinus	Pine Red	Newton	18	829.6	Mulch		
187	41.6475952733	-80.1468315633	Acer	Maple Japanese	Newton	18	637.9	Mulch		
188	41.6476273467	-80.1468127633	Pinus	Pine Red	Newton	19	283.5	Mulch		
189	41.6476241283	-80.1467817900	Pinus	Pine Red	Newton	23	471.4	Mulch		
190	41.6477351083	-80.1467515067	Picea	Spruce White	Newton	11	240.5	Mulch	380.13	Morten Luvaas
191	41.6479117967	-80.1467989583	Picea	Spruce White	Newton	14	254.5	Mulch	153.94	
192	41.6487932083	-80.1475227483	Cercis	Redbud	Bently	1	56.7	Mulch	19.63	
193	41.6489669633	-80.1473822950	Amelanchier	Serviceberry	Brooks	2	38.5	Mulch	12.57	
194	41.6488629917	-80.1472461017	Amelanchier	Serviceberry	Brooks	2	33.2	Mulch	19.63	
195	41.6487941567	-80.1470246933	Amelanchier	Serviceberry	Brooks	2	44.2	Mulch	12.57	
196	41.6487856200	-80.1468180233	Amelanchier	Serviceberry	Brooks	2	38.5	Mulch	9.62	
197	41.6486058833	-80.1469355683	Acer	le Norway Purple -- Crimson	Bently	21	1164.2	Grass		
198	41.6486588900	-80.1466256850	Picea	Colorado Blue Spruce	Central	29	754.8	Mulch	86.59	
199	41.6485140217	-80.1465222933	Acer	Maple Red	Central	33	1075.2	Mulch	213.82	
200	41.6484692150	-80.1464907067	Acer	Maple Red	Central	28	1486.2	Mulch	298.65	
201	41.6486999433	-80.1464855617	Liquidambar	Sweet Gum	Central	14	530.9	Mulch	213.82	
202	41.6486696217	-80.1463889350	Ulmus	American Elm	Central	23	1452.2	Mulch	188.69	
203	41.6485956517	-80.1461361667	Liriodendron	Tulip Poplar	Central	28	1486.2	Mulch	95.03	
204	41.6486118850	-80.1459942400	Magnolia	Magnolia sp.	Central	8	240.5	Mulch	63.62	
205	41.6485732983	-80.1459876967	Malus	Siberian Crabapple	Central	9	298.6	Mulch	63.62	
206	41.6485511667	-80.1459468467	Malus	Siberian Crabapple	Central	9	268.8	Other		
207	41.6485073617	-80.1459210783	Malus	Siberian Crabapple	Central	10	433.7	Other		
208	41.6485130383	-80.1459911367	Acer	Maple Red	Central	25	907.9	Mulch	201.06	
209	41.6484989083	-80.1460933983	Acer	Maple Red	Central	11	346.4	Mulch	113.10	
210	41.6484713367	-80.1461738200	Malus	Siberian Crabapple	Central	9	706.9	Mulch	56.75	
211	41.6484414567	-80.1460436667	Acer	Maple Red	Central	26	660.5	Mulch	103.87	
212	41.6484098850	-80.1459775233	Prunus	Japanese Cherry	Central	6	188.7	Mulch	86.59	
213	41.6483918133	-80.1459814450	Prunus	Japanese Cherry	Central	6	86.6	Mulch	56.75	
214	41.6483608550	-80.1459981633	Prunus	Japanese Cherry	Central	5	122.7	Mulch	50.27	
215	41.6483438450	-80.1460214317	Prunus	Japanese Cherry	Central	6	188.7	Mulch	56.75	
216	41.6484116267	-80.1460522733	Ilex	American Holly	Central	4	103.9	Mulch	70.88	
217	41.6482908100	-80.1460393450	Prunus	Japanese Cherry	Central	5	153.9	Mulch	103.87	
218	41.6482489933	-80.1460689100	Prunus	Japanese Cherry	Central	5	78.5	Mulch	38.48	
219	41.6484278650	-80.1469599633	Quercus	Oak Red	Ravine	42		Ravine		
220	41.6483687883	-80.1470419000	Stewartia	Common Stewartia	Ravine	2		Ravine		
221	41.6483120650	-80.1470716250	Cornus	Florida Dogwood	Ravine	5		Ravine		
222	41.6483213667	-80.1469974317	Magnolia	Magnolia sp.	Ravine	3		Ravine		
223	41.6482763967	-80.1470542250	Quercus	Oak Red	Ravine	1		Ravine		Richard Cook
224	41.6482574833	-80.1471200967	Cornus	Florida Dogwood	Ravine	8		Ravine		
225	41.6483383050	-80.1471229267	Acer	Maple Red	Ravine	37		Ravine		
226	41.6483170967	-80.1471730283	Acer	Maple Red	Ravine	32		Ravine		
227	41.6481859467	-80.1472497300	Fagus	Beech, fern-leaved	Ravine	4		Mulch		
228	41.6480918450	-80.1472495967	Acer	Maple Red	Ravine	34		Ravine		
229	41.6480116333	-80.1473867100	Acer	Maple Norway	Ravine	12		Ravine		
230	41.6479862983	-80.1474415183	Betula	Birch Grey	Ravine	8		Ravine		
231	41.6479602850	-80.1474440883	Betula	Birch Grey	Ravine	9		Ravine		
232	41.6479609400	-80.1474215117	Betula	Birch Grey	Ravine	7		Ravine		
233	41.6479928567	-80.1475061017	Quercus	Red Oak	Ravine	39		Ravine		
234	41.6479632117	-80.1475779167	Quercus	Oak Red	Ravine	42		Ravine		
235	41.6479184267	-80.1476442017	Acer	Maple Red	Ravine	23		Ravine		
236	41.6478843117	-80.1476982150	Acer	Maple Red	Ravine	35		Ravine		
237	41.6478391083	-80.1475867717	Cornus	Florida Dogwood	Ravine	8		Ravine		
238	41.6478364917	-80.1475810767	Prunus	Black Cherry	Ravine	3		Ravine		
239	41.6478581350	-80.1475403600	Cornus	Florida Dogwood	Ravine	8		Ravine		
240	41.6480194283	-80.1472103567	Tsuga	Hemlock	Ravine	27		Ravine		
241	41.6480681683	-80.1471934767	Pinus	Pine White	Ravine	28		Ravine		
242	41.6480893367	-80.1470780317	Cornus	Kousa Dogwood	Ravine	5		Ravine		Vietnam war
243	41.6481064017	-80.1470636650	Cornus	Kousa Dogwood	Ravine	5		Ravine		
244	41.6482272017	-80.1469978017	Morus	Mulberry	Ravine	4		Ravine		
245	41.6482681400	-80.1469310967	Cornus	Kousa Dogwood	Ravine	7		Ravine		Gretchen Moss
246	41.6481645083	-80.1468769283	Liriodendron	Tulip Poplar	Ravine	25		Ravine		
247	41.6482569150	-80.1468178550	Acer	Maple Red	Ravine	12		Ravine		
248	41.6483466617	-80.1467391650	Acer	Maple Red	Ravine	17		Ravine		
249	41.6484469233	-80.1466540050	Quercus	Oak Red	Ravine	27		Ravine		
250	41.6480733917	-80.1468253983	Acer	Maple Sugar	Ravine	40		Ravine		
251	41.6480496200	-80.1468691367	Pinus	Pine White	Ravine	20		Ravine		
252	41.6479406100	-80.1468758383	Pinus	Pine White	Ravine	28		Ravine		
253	41.6480016717	-80.1469340033	Prunus	Black Cherry	Ravine	21		Ravine		
254	41.6479932467	-80.1469486417	Prunus	Black Cherry	Ravine	16		Ravine		
255	41.6479852817	-80.1469683650	Cornus	Florida Dogwood	Ravine	5		Ravine		
256	41.6478939317	-80.1470321333	Pinus	Pine White	Ravine	38		Ravine		
257	41.6478601483	-80.1470647017	Magnolia	Magnolia sp.	Ravine	0		Ravine		
258	41.6478456017	-80.1470833583	Taxus	Yew	Ravine	17		Ravine		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
259	41.6482200683	-80.1460909800	Acer	Maple Red	Central	11	452.4	Mulch	122.72	
260	41.6481856533	-80.1461051933	Prunus	Japanese Cherry	Central	5	103.9	Mulch	86.59	
261	41.6481462617	-80.1461204350	Prunus	Japanese Cherry	Central	5	122.7	Mulch	103.87	
262	41.6477900900	-80.1472182983	Malus	Siberian Crabapple	Ravine	10		Ravine		
263	41.6477632833	-80.1472396300	Cercis	Redbud	Ravine	0		Ravine		
264	41.6478066900	-80.1473092983	Acer	Maple Sugar	Ravine	12		Ravine		
265	41.6477896867	-80.1473206750	Tilia	Linden American	Ravine	20		Ravine		
266	41.6477343767	-80.1473113817	Quercus	Oak Red	Ravine	27		Ravine		
267	41.6476793817	-80.1473561900	Quercus	Oak Red	Ravine	37		Ravine		
268	41.6477313667	-80.1474031817	Nyssa	Black Tupelo	Ravine	16		Ravine		
269	41.6477128050	-80.1474512600	Pinus	Pine White	Ravine	20		Ravine		
270	41.6475768817	-80.1474670867	Tsuga	Hemlock	Ravine	21		Ravine		
271	41.6475457600	-80.1474080800	Aesculus	Horse Chestnut	Ravine	28		Ravine		
272	41.6475076350	-80.1474590750	Malus	Apple	Ravine	15		Ravine		
273	41.6475078800	-80.1475319067	Pinus	Pine Red	Ravine	19		Ravine		
274	41.6474668800	-80.1475297033	Tsuga	Hemlock	Ravine	29		Ravine		
275	41.6474494033	-80.1475186700	Tsuga	Hemlock	Ravine	20		Ravine		
276	41.6474239100	-80.1475190467	Tsuga	Hemlock	Ravine	18		Ravine		
277	41.6474168900	-80.1475008217	Tsuga	Hemlock	Ravine	21		Ravine		
278	41.6473823433	-80.1474868933	Tsuga	Hemlock	Ravine	22		Ravine		
279	41.6474278717	-80.1474670867	Picea	Colorado Blue Spruce	Ravine	17	3903.6	Mulch	2733.97	
280	41.6473705367	-80.1473631000	Acer	Maple Red	Ravine	32	1320.3	Mulch	201.06	
281	41.6474234400	-80.1473572917	Ulmus	American Elm	Ravine	23	962.1	Mulch	346.36	
282	41.6479915217	-80.1467904317	Prunus	Japanese Cherry	Ravine	9	433.7	Mulch	70.88	Harold J Fox
283	41.6478905950	-80.1467136383	Acer	Maple Paperback	Newton	4	86.6	Grass		
284	41.6478267550	-80.1466537233	Acer	Maple Norway Purple	Newton	30	1626.0	Mulch	452.39	
285	41.6476659283	-80.1466482283	Acer	Maple Sugar	Newton	15	1626.0	Mulch	78.54	departed classma
286	41.6475734317	-80.1466104167	Picea	Colorado Blue Spruce	Newton	12	490.9	Mulch	240.53	
287	41.6474802050	-80.1465423933	Acer	Maple Red	Newton	39	1256.6	Mulch	122.72	
288	41.6474194517	-80.1465647117	Acer	Maple Red	Newton	18	962.1	Mulch	95.03	
289	41.6475911667	-80.1464626017	Acer	Maple Red	Newton	13	1017.9	Mulch	95.03	
290	41.6477230667	-80.1463991883	Acer	Maple Red	Newton	30	881.4	Mulch	113.10	
291	41.6477669533	-80.1464505867	Acer	Maple Red	Newton	35	855.3	Mulch		
292	41.6478090750	-80.1464828800	Acer	Maple Red	Newton	40	1520.5	Mulch	962.11	
293	41.6478558100	-80.1463117867	Ilex	American Holly	Newton	5	86.6	Nothing	0.00	
294	41.6479292083	-80.1463260950	Ilex	American Holly	Newton	6	50.3	Other		
295	41.6480524167	-80.1461740517	Ilex	American Holly	Central	5	95.0	Mulch	78.54	
296	41.6481112933	-80.1461735600	Acer	Maple Red	Central	12	530.9	Mulch	33.18	Chapel Memorial
297	41.6481961850	-80.1462257950	Quercus	Oak Scarlet	Central	37	1847.5	Mulch	201.06	
298	41.6482577067	-80.1463400400	Fraxinus	American Ash	Central	7	452.4	Mulch	19.63	›parted Classmate
299	41.6483134250	-80.1465252350	Fagus	Beech Purple	Central	11	660.5	Mulch	346.36	
300	41.6482691450	-80.1465277650	Cornus	Florida Dogwood	Central	3	201.1	Other		
301	41.6482198717	-80.1465469650	Acer	Maple Sugar	Central	8	471.4	Mulch	452.39	
302	41.6481847600	-80.1463894100	Gleditsia	Thornless Honey Locust	Central	24	2827.4	Mulch	132.73	
303	41.6483115667	-80.1464196617	Acer	Maple Red	Central	35	1046.3	Mulch	113.10	
304	41.6488602667	-80.1464795650	Quercus	Oak Red	Central	19	1320.3	Mulch	103.87	
305	41.6489377533	-80.1464616483	Pinus	Pine White	Central	36	804.2	Mulch	188.69	
306	41.6489729450	-80.1463713617	Liquidambar	Sweet Gum	Central	29	1734.9	Mulch	510.71	
307	41.6489179717	-80.1461478967	Tsuga	Hemlock	Central	37	804.2	Other		
308	41.6488729033	-80.1460543183	Gleditsia	Thornless Honey Locust	Central	28	1590.4	Grass		
309	41.6487789617	-80.1458918183	Acer	Maple Red	Central	32	1661.9	Grass		
310	41.6487195683	-80.1458063650	Malus	Siberian Crabapple	Central	11	415.5	Mulch	12.57	
311	41.6487150317	-80.1458616667	Malus	Siberian Crabapple	Central	7	176.7	Mulch	50.27	
312	41.6487155867	-80.1459079750	Malus	Siberian Crabapple	Central	11	452.4	Mulch	70.88	
313	41.6486903000	-80.1459467150	Magnolia	Magnolia sp.	Central	6	113.1	Mulch	56.75	
314	41.6489120450	-80.1459030117	Acer	Maple Red	Central	32	1809.6	Mulch	78.54	
315	41.6489664833	-80.1459718067	Acer	Maple Norway	Central	15	907.9	Nothing		
316	41.6489985683	-80.1460894933	Cornus	Kousa Dogwood	Central	14	934.8	Other		
317	41.6490138567	-80.1461308883	Cornus	Kousa Dogwood	Central	4	63.6	Grass		
318	41.6490738250	-80.1462986483	Cornus	Kousa Dogwood	Central	12	415.5	Other		
319	41.6490907900	-80.1463000917	Cornus	Kousa Dogwood	Central	8	176.7	Other		
320	41.6491113200	-80.1463409067	Cornus	Kousa Dogwood	Central	12	201.1	Other		
321	41.6490702650	-80.1464788467	Quercus	Oak White	Central	35	2248.0	Mulch	298.65	
322	41.6492263467	-80.1463474983	Liquidambar	Sweet Gum	Central	32	1104.5	Grass		
323	41.6492743217	-80.1464205717	Malus	Siberian Crabapple	Brooks	9	346.4	Mulch	298.65	
324	41.6493176350	-80.1463089050	Larix	European Larch	Central	16	510.7	Grass		
325	41.6493210600	-80.1462698083	Magnolia	Magnolia sp.	Central	6	268.8	Mulch	122.72	
326	41.6493385900	-80.1462503583	Magnolia	Magnolia sp.	Central	9	330.1	Other		
327	41.6493935950	-80.1462001433	Viburnum	Black Haw	Central	13	452.4	Mulch	153.94	
328	41.6493763650	-80.1460860267	Picea	Norway Spruce	Central	33	1104.5	Grass		
329	41.6493765033	-80.1459529167	Picea	Norway Spruce	Central	31	660.5	Grass		
330	41.6492947300	-80.1458978900	Viburnum	Black Haw	Central	10	471.4	Mulch	63.62	
331	41.6493054550	-80.1457905250	Picea	Norway Spruce	Central	17	683.5	Mulch	240.53	
332	41.6493078483	-80.1457625500	Crataegus	Black Hawthorn	Central	11	283.5	Mulch	113.10	
333	41.6493365867	-80.1456978817	Acer	Maple Red	Central	28	683.5	Grass		
334	41.6493032250	-80.1455925000	Acer	Maple Red	Central	32	1452.2	Grass		
335	41.6491973300	-80.1455554667	Quercus	Oak Red	Central	32	1885.7	Mulch	95.03	
336	41.6491007467	-80.1456097117	Acer	Maple Norway	Central	29	2375.8	Mulch	153.94	
337	41.6489943533	-80.1456628750	Acer	Maple Red	Central	34	1352.7	Mulch	153.94	
338	41.6489510233	-80.1457888650	Catalpa	Catalpa	Central	32	1520.5	Mulch	56.75	
339	41.6491306450	-80.1458389650	Acer	Maple Red	Central	25	1486.2	Mulch	44.18	
340	41.6492223100	-80.1458042000	Platanus	American Sycamore	Central	15	989.8	Mulch	44.18	
341	41.6492079233	-80.1456961117	Acer	Maple Red	Central	22	706.9	Grass		
342	41.6494616433	-80.1455195700	Malus	Siberian Crabapple	N Central	9	283.5	Other		
343	41.6495022000	-80.1455184500	Malus	Siberian Crabapple	N Central	8	240.5	Other		
344	41.6495111100	-80.1457241383	Quercus	Oak Pin	N Central	12	683.5	Mulch	153.94	

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
345	41.6495507183	-80.1458268433	Quercus	Oak Pin	N Central	14	907.9	Mulch	23.76	
346	41.6496331583	-80.1459215550	Crataegus	Black Hawthorn	N Central	10	346.4	Other		
347	41.6496554950	-80.1461511067	Quercus	Oak Pin	N Central	12	855.3	Mulch	15.90	
348	41.6497846833	-80.1462223217	Juniperus	Juniper	N Central	14	240.5	Mulch	95.03	
349	41.6497030350	-80.1462802233	Crataegus	Black Hawthorn	N Central	6	471.4	Mulch	23.76	
350	41.6497272950	-80.1463521633	Quercus	Oak Pin	N Central	13	510.7	Mulch	19.63	
351	41.6498094650	-80.1466051400	Quercus	Oak Pin	N Central	9	706.9	Mulch	23.76	
352	41.6498355150	-80.1466739900	Acer	Maple Sugar	N Central	35	1352.7	Grass		
353	41.6499224633	-80.1466447417	Juniperus	Juniper	N Central	12	176.7	Mulch	122.72	
354	41.6498196433	-80.1468621517	Quercus	Oak Pin	N Central	11	433.7	Other		
355			Malus	Siberian Crabapple	N Central	8	490.9	Other		Alyson Lawendowsl
356	41.6499176883	-80.1467469350	Amelanchier	Serviceberry	N Central	0	50.3	Mulch	28.27	
357	41.6499963983	-80.1466967283	Syringa	Lilac	N Central	0	38.5	Mulch	50.27	
358	41.6500570500	-80.1469138667	Prunus	Black Cherry	N Central	28	1104.5	Grass		
359	41.6500965217	-80.1468683300	Acer	Maple Red	N Central	16	934.8	Mulch	28.27	
360	41.6501143633	-80.1467481783	Platanus	American Sycamore	N Central	10	730.6	Mulch	23.76	
361	41.6500939400	-80.1466523817	Prunus	Japanese Cherry	N Central	17	471.4	Mulch	9.62	
362	41.6502073967	-80.1467693400	Platanus	American Sycamore	N Central	10	594.0	Mulch	15.90	
363	41.6502837083	-80.1467468917	Quercus	Oak Red	N Central	4	15.9	Mulch	50.27	
364	41.6503245733	-80.1466547017	Betula	Birch River	N Central	7	363.1	Mulch	19.63	
365	41.6501734833	-80.1465940017	Quercus	Oak Swamp White	N Central	8	433.7	Mulch	19.63	
366	41.6501679683	-80.1464803683	Liriodendron	Tulip Poplar	N Central	9	240.5	Grass		
367	41.6502764317	-80.1465387017	Magnolia	Cucumber magnolia	N Central	4	86.6	Mulch	15.90	
368	41.6503486750	-80.1465778717	Catalpa	Catalpa	N Central	8	268.8	Mulch	19.63	
369	41.6503568850	-80.1464944200	Gleditsia	Thornless Honey Locust	N Central	7	314.2	Mulch	12.57	
370	41.6502739200	-80.1462518600	Gleditsia	Thornless Honey Locust	N Central	6	330.1	Mulch	9.62	
371	41.6502427567	-80.1461490367	Gleditsia	Thornless Honey Locust	N Central	6	363.1	Mulch	19.63	
372	41.6502129800	-80.1460685817	Gleditsia	Thornless Honey Locust	N Central	6	213.8	Mulch	19.63	
373	41.6501942983	-80.1459864183	Gleditsia	Thornless Honey Locust	N Central	5	346.4	Mulch	19.63	
374	41.6501650367	-80.1459048183	Gleditsia	Thornless Honey Locust	N Central	7	452.4	Mulch	33.18	
375	41.6501158317	-80.1458800783	Gleditsia	Thornless Honey Locust	N Central	9	594.0	Mulch	19.63	
376	41.6500459867	-80.1461081450	Liriodendron	Tulip Poplar	N Central	11	363.1	Grass		
377	41.6498288267	-80.1459004433	Malus	Siberian Crabapple	N Central	5	165.1	Mulch	122.72	
378	41.6498100033	-80.1458741500	Malus	Siberian Crabapple	N Central	5	165.1	Mulch	63.62	
379	41.6497925933	-80.1458826300	Malus	Siberian Crabapple	N Central	5	188.7	Mulch	33.18	
380	41.6498098717	-80.1458378700	Acer	Maple Norway Purple	N Central	14	176.7	Grass		
381	41.6497941800	-80.1458239017	Thuja	Arborvitae	N Central	0	165.1	Nothing		
382	41.6497694700	-80.1456397183	Liquidambar	Sweet Gum	N Central	17	779.3	Grass		
383	41.6499197317	-80.1458267633	Acer	Maple Norway Purple	N Central	14	330.1	Grass		
384	41.6499460683	-80.1458227800	Abies	Fir White	N Central	5	103.9	Mulch	86.59	
385	41.6499974083	-80.1458425150	Abies	Fir White	N Central	5	78.5	Mulch	28.27	
386	41.6500689967	-80.1457963167	Callitropsis	Nootka Cypress	N Central	5	113.1	Mulch	165.13	
387	41.6501019600	-80.1457427883	Gleditsia	Thornless Honey Locust	N Central	17	855.3	Mulch	50.27	
388	41.6500863350	-80.1456520483	Gleditsia	Thornless Honey Locust	N Central	15	530.9	Mulch	3267.45	
389	41.6500704717	-80.1455699717	Gleditsia	Thornless Honey Locust	N Central	14	510.7	Mulch		
390	41.6500385017	-80.1454841017	Gleditsia	Thornless Honey Locust	N Central	15	510.7	Mulch		
391	41.6500048717	-80.1453915617	Gleditsia	Thornless Honey Locust	N Central	14	433.7	Mulch		
392	41.6499774433	-80.1453131767	Gleditsia	Thornless Honey Locust	N Central	17	829.6	Mulch		
393	41.6499284650	-80.1452042233	Cornus	Florida Dogwood	N Central	8	143.1	Mulch	188.69	
394	41.6498493300	-80.1452160850	Cornus	Florida Dogwood	N Central	6	213.8	Mulch	9.62	
395	41.6499044367	-80.1451379400	Acer	Maple Sugar	N Central	3	44.2	Grass		
396	41.6499735183	-80.1450884000	Acer	Maple Red	N Central	3	56.7	Mulch	15.90	
397	41.6500696083	-80.1452002200	Quercus	Oak Swamp White	N Central	7	433.7	Mulch	9.62	
398	41.6501170983	-80.1453356400	Platanus	American Sycamore	N Central	3	165.1	Mulch	4.91	
399	41.6501684250	-80.1454925367	Picea	Colorado Blue Spruce	N Central	12	363.1	Mulch	201.06	
400	41.6502329767	-80.1454100300	Fagus	Beech Purple	N Central	4	33.2	Mulch	28.27	Emily Boughton
401	41.6504180667	-80.1455918283	Picea	Colorado Blue Spruce	N Central	11	165.1	Mulch		
402	41.6504029700	-80.1456118850	Picea	Colorado Blue Spruce	N Central	14	153.9	Mulch		
403	41.6503822350	-80.1456269533	Picea	Colorado Blue Spruce	N Central	7	176.7	Mulch	1385.44	
404	41.6504307033	-80.1456591967	Malus	Siberian Crabapple	N Central	7	143.1	Mulch	28.27	
405	41.6503932300	-80.1457000550	Malus	Siberian Crabapple	N Central	6	188.7	Mulch	23.76	
406	41.6503408783	-80.1457011883	Taxus	Yew	N Central	0	50.3	Mulch	63.62	
407	41.6503568133	-80.1457410250	Malus	Siberian Crabapple	N Central	3	33.2	Mulch	56.75	
408	41.6503248033	-80.1458005933	Quercus	Oak Pin	N Central	36	2123.7	Grass		
409	41.6503440900	-80.1459341783	Quercus	Oak Pin	N Central	34	2206.2	Grass		
410	41.6503845017	-80.1460647450	Quercus	Oak Pin	N Central	34	3068.0	Grass		
411	41.6504722283	-80.1461045467	Cornus	Florida Dogwood	N Central	6	227.0	Mulch	70.88	
412	41.6505126083	-80.1463125750	Prunus	Cherry Weeping	N Central	14	397.6	Mulch	103.87	
413	41.6505436900	-80.1464074700	Pinus	Pine Japanese White	N Central	11	188.7	Mulch	70.88	
414	41.6505472200	-80.1463874500	Pinus	Pine Japanese White	N Central	5	50.3	Mulch	165.13	
415	41.6508215967	-80.1463535233	Nyssa	Black Tupelo	N Central	6	213.8	Mulch	12.57	
416	41.6509704383	-80.1463369783	Picea	Spruce White	N Central	6	143.1	Mulch	78.54	
417	41.6510068633	-80.1464455933	Metasequoia	Dawn Redwood	N Central	6	165.1	Mulch	70.88	
418	41.6510055650	-80.1464850433	Picea	Spruce White	N Central	6	153.9	Mulch	70.88	
419	41.6508048367	-80.1462839517	Nyssa	Black Tupelo	N Central	7	268.8	Mulch	15.90	
420	41.6507696900	-80.1461655067	Nyssa	Black Tupelo	N Central	7	227.0	Mulch	12.57	
421	41.6507507433	-80.1460803883	Malus	Siberian Crabapple	N Central	6	254.5	Mulch	15.90	
422	41.6507224833	-80.1460734133	Malus	Siberian Crabapple	N Central	5	201.1	Mulch	9.62	
423	41.6506898367	-80.1460438900	Malus	Siberian Crabapple	N Central	5	213.8	Mulch	12.57	
424	41.6506584117	-80.1459785150	Malus	Siberian Crabapple	N Central	5	188.7	Mulch	15.90	
425	41.6506693233	-80.1459219933	Malus	Siberian Crabapple	N Central	4	70.9	Mulch	9.62	
426	41.6506812267	-80.1458892467	Malus	Siberian Crabapple	N Central	4	122.7	Mulch	12.57	
427	41.6506529067	-80.1458236700	Nyssa	Black Tupelo	N Central	8	510.7	Mulch	23.76	
428	41.6506278317	-80.1457468467	Nyssa	Black Tupelo	N Central	7	415.5	Mulch	15.90	
429	41.6506083383	-80.1456756583	Nyssa	Black Tupelo	N Central	7	363.1	Mulch	12.57	
430	41.6505255150	-80.1456100750	Malus	Siberian Crabapple	N Central	8	283.5	Nothing		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
431	41.6505116817	-80.1455734300	Malus	Siberian Crabapple	N Central	9	213.8	Mulch		
432	41.6504979867	-80.1455447383	Picea	Colorado Blue Spruce	N Central	11	201.1	Mulch		
433	41.6504526667	-80.1453989233	Prunus	Japanese Cherry	N Central	7	165.1	Other		
434	41.6504290933	-80.1453973967	Prunus	Japanese Cherry	N Central	5	176.7	Other		
435	41.6504095083	-80.1453795050	Prunus	Japanese Cherry	N Central	7	188.7	Other		
436	41.6503950917	-80.1452531533	Prunus	Japanese Cherry	N Central	8	314.2	Other		
437	41.6504179217	-80.1450650100	Pinus	Pine Japanese White	N Central	5	122.7	Mulch	56.75	
438	41.6503914167	-80.1450281700	Abies	Balsam Fir	N Central	8	132.7	Mulch		
439	41.6503492033	-80.1449649617	Betula	Birch White	N Central	7	268.8	Mulch	15.90	
440	41.6503376983	-80.1448911617	Acer	Maple Red	N Central	7	490.9	Mulch	33.18	
441	41.6502614117	-80.1449386967	Acer	Maple Red	N Central	8	433.7	Mulch	23.76	
442	41.6501625950	-80.1449911350	Acer	Maple Red	N Central	9	615.8	Mulch	15.90	
443	41.6500679333	-80.1450406533	Acer	Maple Red	N Central	9	433.7	Mulch	23.76	
444	41.6497243767	-80.1452394167	Acer	Maple Red	N Central	8	490.9	Mulch	23.76	
445	41.6496462967	-80.1453809400	Malus	Siberian Crabapple	N Central	8	415.5	Mulch	95.03	
446	41.6495687833	-80.1453298317	Acer	Maple Red	N Central	8	452.4	Mulch	12.57	
447	41.6494382867	-80.1453927667	Acer	Maple Red	N Central	7	452.4	Mulch	23.76	
448	41.6482470767	-80.1447542750	Acer	Maple Red	SE of CC	11	530.9	Mulch	33.18	
449	41.6482111800	-80.1446583267	Acer	Maple Red	SE of CC	10	397.6	Mulch	38.48	
450	41.6481780983	-80.1445419817	Acer	Maple Red	SE of CC	9	530.9	Mulch	23.76	
451	41.6481509500	-80.1444568050	Acer	Maple Red	SE of CC	11	530.9	Mulch	33.18	
452	41.6481201317	-80.1443638967	Acer	Maple Red	SE of CC	11	490.9	Mulch	23.76	
453	41.6480908283	-80.1442572317	Acer	Maple Red	SE of CC	7	363.1	Mulch	12.57	
454	41.6480626267	-80.1441801783	Acer	Maple Red	SE of CC	7	346.4	Mulch	19.63	
455	41.6480312750	-80.1440694233	Acer	Maple Red	SE of CC	9	530.9	Mulch	15.90	
456	41.6479938617	-80.1439573517	Acer	Maple Red	SE of CC	8	433.7	Mulch	15.90	
457	41.6479612367	-80.1438610350	Acer	Maple Red	SE of CC	8	415.5	Mulch	12.57	
458	41.6480051367	-80.1438338767	Acer	Maple Red	SE of CC	9	397.6	Mulch	19.63	
459	41.6480391633	-80.1439178350	Acer	Maple Red	SE of CC	9	572.6	Mulch	28.27	
460	41.6480730917	-80.1440327850	Acer	Maple Red	SE of CC	10	415.5	Mulch	28.27	
461	41.6481072783	-80.1441461083	Acer	Maple Red	SE of CC	10	615.8	Mulch	33.18	
462	41.6481358867	-80.1442214683	Acer	Maple Red	SE of CC	10	706.9	Mulch	28.27	
463	41.6481934333	-80.1444035783	Acer	Maple Red	SE of CC	9	415.5	Mulch	28.27	
464	41.6482691383	-80.1446222200	Acer	Maple Red	SE of CC	8	433.7	Mulch	19.63	
465	41.6482961517	-80.1447123000	Acer	Maple Red	SE of CC	9	510.7	Mulch	19.63	
466	41.6483335250	-80.1446649750	Viburnum	Black Haw	Woods CC	2	23.8	Mulch	19.63	
467	41.6483377883	-80.1446300600	Tsuga	Hemlock	Woods CC	6	70.9	Mulch		
468	41.6483480433	-80.1446476867	Tsuga	Hemlock	Woods CC	5	70.9	Mulch	113.10	
469	41.6483552933	-80.1446617533	Tsuga	Hemlock	Woods CC	6	50.3	Mulch		
470	41.6483734450	-80.1446884833	Tsuga	Hemlock	Woods CC	5	122.7	Other		
471	41.6487754833	-80.1441529100	Betula	Birch Grey	Woods CC	9	314.2	Other		
472	41.6488545483	-80.1440703733	Quercus	Oak Scarlet	SE of CC	21	1418.6	Mulch	298.65	
473	41.6489403750	-80.1440757350	Quercus	Oak Scarlet	SE of CC	18	907.9	Mulch	33.18	
474	41.6488757350	-80.1439703483	Cornus	Kousa Dogwood	SE of CC	4	132.7	Mulch	44.18	
475	41.6489007983	-80.1439552083	Cornus	Kousa Dogwood	SE of CC	6	283.5	Mulch	165.13	
476	41.6489645300	-80.1439790383	Pyrus	Bradford Pear	SE of CC	7	330.1	Mulch	15.90	
477	41.6490931550	-80.1439176617	Quercus	Oak Scarlet	SE of CC	24	1486.2	Mulch	132.73	
478	41.6490737467	-80.1438550300	Cornus	Kousa Dogwood	SE of CC	9	227.0	Other		
479	41.6490356583	-80.1438331233	Heptacodium	Seven Sons Tree	SE of CC	5	113.1	Grass		
480	41.6492310067	-80.1437474867	Prunus	Japanese Cherry	SE of CC	12	227.0	Mulch		
481	41.6491948317	-80.1437720900	Prunus	Japanese Cherry	SE of CC	11	227.0	Mulch	452.39	
482	41.6491631867	-80.1438003033	Prunus	Japanese Cherry	SE of CC	11	227.0	Mulch		
483	41.6491776050	-80.1436343283	Heptacodium	Seven Sons Tree	NW of CC	6	201.1	Mulch	23.76	
484	41.6493817717	-80.1435933650		UNKOWN	NW of CC		33.2	Mulch	15.90	
485	41.6494522167	-80.1435988200	Betula	Birch White	NW of CC	4	298.6	Mulch	12.57	
486	41.6491954467	-80.1440809917	Betula	Birch White	NW of CC	5	314.2	Other		
487	41.6492575350	-80.1443233567	Quercus	Oak Scarlet	SE of CC	29	2042.8	Mulch	38.48	
488	41.6490872200	-80.1444023800	Platanus	American Sycamore	SE of CC	9	637.9	Mulch	28.27	
489	41.6489315283	-80.1442020417	Platanus	American Sycamore	SE of CC	7	314.2	Mulch	19.63	
490	41.6487987983	-80.1443368533	Quercus	Oak Scarlet	SE of CC	28	2827.4	Mulch	56.75	
491	41.6488031367	-80.1443904133	Acer	Maple Sugar	Woods CC	19	730.6	Mulch		
492	41.6487686150	-80.1444127217	Acer	Maple Sugar	Woods CC	16	660.5	Mulch	268.80	
493	41.6487285933	-80.1444364800	Acer	Maple Sugar	Woods CC	15	363.1	Mulch		
494	41.6486897250	-80.1444676267	Acer	Maple Sugar	Woods CC	22	530.9	Mulch	433.74	
495	41.6486575867	-80.1445289000	Pinus	Pine White	Woods CC	13	268.8	Other		
496	41.6487062317	-80.1445604533	Cornus	Kousa Dogwood	Woods CC	8	176.7	Grass		
497	41.6486454133	-80.1446013250	Pinus	Pine White	Woods CC	12	240.5	Grass		
498	41.6486168033	-80.1446108383	Pinus	Pine White	Woods CC	10	268.8	Grass		
499	41.6485998967	-80.1445433533	Pinus	Pine White	Woods CC	11	363.1	Grass		
500	41.6485443933	-80.1445515533	Gleditsia	Thornless Honey Locust	Woods CC	25	397.6	Grass		
501	41.6485161017	-80.1446707950	Pinus	Pine White	Woods CC	15	471.4	Grass		
502	41.6484970100	-80.1446081617	Pinus	Pine White	Woods CC	8	240.5	Grass		
503	41.6484909650	-80.1445664800	Pinus	Pine White	Woods CC	19	254.5	Grass		
504	41.6484606917	-80.1445930767	Pinus	Pine White	Woods CC	11	95.0	Grass		
505	41.6484556167	-80.1445431767	Quercus	Oak Pin	Woods CC	24	471.4	Grass		
506	41.6484709167	-80.1445149467	Pinus	Pine White	Woods CC	21	143.1	Grass		
507	41.6484257600	-80.1444524433	Pinus	Pine White	Woods CC	15	176.7	Grass		
508	41.6484052017	-80.1445173100	Quercus	Oak Pin	Woods CC	16	415.5	Grass		
509	41.6483452567	-80.1445386233	Quercus	Oak Pin	Woods CC	23	510.7	Grass		
510	41.6483071483	-80.1445670367	Picea	Norway Spruce	Woods CC	10	283.5	Mulch	23.76	
511	41.6483278400	-80.1445819883	Picea	Norway Spruce	Woods CC	9	227.0	Mulch	33.18	
512	41.6482729867	-80.1444467133	Picea	Norway Spruce	Woods CC	12	213.8	Mulch	56.75	
513	41.6482581600	-80.1444108100	Picea	Norway Spruce	Woods CC	9	227.0	Mulch	23.76	
514	41.6482249100	-80.1443758633	Picea	Norway Spruce	Woods CC	8	268.8	Mulch	19.63	
515	41.6482231967	-80.1443300067	Pinus	Pine White	Woods CC	16	188.7	Grass		
516	41.6482662850	-80.1443281100	Pinus	Pine White	Woods CC	14	188.7	Grass		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
517	41.6482472500	-80.1442787650	Acer	Maple Sugar	Woods CC	14	452.4	Grass		
518	41.6482187417	-80.1442720750	Pinus	Pine White	Woods CC	13	254.5	Grass		
519	41.6481821100	-80.1443165550	Pinus	Pine White	Woods CC	15	153.9	Grass		
520	41.6481832267	-80.1442560017	Pinus	Pine White	SE of CC	16	298.6	Grass		
521	41.6482132017	-80.1442449017	Pinus	Pine White	Woods CC	14	165.1	Grass		
522	41.6481352000	-80.1440420233	Pinus	Pine White	Woods CC	15	314.2	Grass		
523	41.6481464917	-80.1439676017	Acer	Maple Sugar	Woods CC	17	490.9	Grass		
524	41.6481534733	-80.1439131017	Pinus	Pine White	Woods CC	12	706.9	Grass		
525	41.6481116917	-80.1439092967	Pinus	Pine White	Woods CC	16	572.6	Grass		
526	41.6481084967	-80.1438490550	Pinus	Pine White	Woods CC	16	165.1	Grass		
527	41.6480934217	-80.1438445950	Pinus	Pine White	Woods CC	14	227.0	Grass		
528	41.6480669533	-80.1438124983	Pinus	Pine White	Woods CC	12	240.5	Grass		
529	41.6480870367	-80.1437996767	Pinus	Pine White	Woods CC	16	201.1	Grass		
530	41.6480746700	-80.1437705367	Pinus	Pine White	Woods CC	15	153.9	Grass		
531	41.6480491633	-80.1437388650	Pinus	Pine White	Woods CC	16	153.9	Grass		
532	41.6480621933	-80.1436951483	Pinus	Pine White	Woods CC	24	804.2	Grass		
533	41.6480912083	-80.1437294217	Acer	Maple Red	Woods CC	15	706.9	Grass		
534	41.6481608050	-80.1437817717	Pinus	Pine White	Woods CC	20	283.5	Other		
535	41.6479806667	-80.1436140883	Betula	Birch Grey	Woods CC	8	176.7	Other		
536	41.6478620367	-80.1436766933	Gleditsia	Thornless Honey Locust	SE of CC	24	989.8	Grass		
537	41.6477269667	-80.1437501717	Gleditsia	Thornless Honey Locust	SE of CC	29	1418.6	Other		
538	41.6477184567	-80.1438013467	Gleditsia	Thornless Honey Locust	SE of CC	26	706.9	Grass		
539	41.6476750550	-80.1438395700	Malus	Siberian Crabapple	SE of CC	8	95.0	Other		
540	41.6477909733	-80.1439769817	Malus	Siberian Crabapple	SE of CC	14	510.7	Grass		
541	41.6476030250	-80.1438348033	Quercus	Oak Red	SE of CC	8	471.4	Grass		
542	41.6474668033	-80.1440822900	Gleditsia	Thornless Honey Locust	SE of CC	25	1017.9	Grass		
543	41.6474851967	-80.1441509800	Ginkgo	Ginkgo	SE of CC	30	934.8	Grass		
544	41.6474983017	-80.1442109050	Ginkgo	Ginkgo	SE of CC	16	551.5	Grass		
545	41.6476595233	-80.1446936283	Ginkgo	Ginkgo	SE of CC	26	934.8	Grass		
546	41.6477005450	-80.1448183900	Ginkgo	Ginkgo	SE of CC	22	779.3	Grass		
547	41.6477197750	-80.1448856133	Ginkgo	Ginkgo	SE of CC	28	1075.2	Grass		
548	41.6477465533	-80.1449503050	Ginkgo	Ginkgo	SE of CC	15	452.4	Grass		
549	41.6477548833	-80.1450233533	Ginkgo	Ginkgo	SE of CC	30	660.5	Grass		
550	41.6479269350	-80.1446465383	Ginkgo	Ginkgo	SE of CC	17	510.7	Grass		
551	41.6481465967	-80.1449836000	Malus	Siberian Crabapple	SE of CC	20	1046.3	Grass		
552	41.6480984250	-80.1450212850	Acer	Maple Silver	SE of CC	15	660.5	Grass		
553	41.6480232717	-80.1450575750	Acer	Maple Silver	SE of CC	12	471.4	Grass		
554	41.6479408750	-80.1451032083	Acer	Maple Silver	SE of CC	13	637.9	Grass		
555	41.6478618033	-80.1451507683	Acer	Maple Silver	SE of CC	15	779.3	Grass		
556	41.6477828167	-80.1451923917	Acer	Maple Silver	SE of CC	16	754.8	Grass		
557	41.6478035883	-80.1452532100	Acer	Maple Silver	SE of CC	15	829.6	Grass		
558	41.6478717250	-80.1452204567	Acer	Maple Silver	SE of CC	11	551.5	Mulch	23.76	
559	41.6479475817	-80.1451726583	Acer	Maple Silver	SE of CC	12	683.5	Mulch	23.76	
560	41.6480258233	-80.1451420050	Acer	Maple Silver	SE of CC	6	433.7	Mulch	12.57	
561	41.6480968283	-80.1450952933	Acer	Maple Silver	SE of CC	13	779.3	Mulch	15.90	
562	41.6481767533	-80.1450495517	Acer	Maple Silver	SE of CC	10	551.5	Mulch	23.76	
563	41.6481038567	-80.1452158283	Acer	Maple Silver	SE of CC	15	754.8	Mulch	28.27	
564	41.6480384200	-80.1453193667	Cladrastis	Yellowwood	SE of CC	13	989.8	Mulch	28.27	
565	41.6478882400	-80.1453420483	Cladrastis	Yellowwood	SE of CC	12	1104.5	Mulch	38.48	
566	41.6479581217	-80.1454483717	Cladrastis	Yellowwood	SE of CC	6	594.0	Mulch	15.90	
567	41.6480741400	-80.1453953950	Quercus	Oak Pin	SE of CC	38	2780.5	Mulch	254.47	
568	41.6481101933	-80.1454135483	Ilex	American Holly	SE of CC	6	86.6	Mulch		
569	41.6481395217	-80.1454217650	Ilex	American Holly	SE of CC	5	63.6	Mulch		
570	41.6481415067	-80.1453958800	Ilex	American Holly	SE of CC	5	143.1	Mulch		
571	41.6481389900	-80.1453528700	Ilex	American Holly	SE of CC	3	33.2	Mulch	1288.25	
572	41.6481358167	-80.1455326517	Ilex	American Holly	SE of CC	4	122.7	Mulch		
573	41.6479569700	-80.1456918050	Acer	Maple Sugar	SE of CC	41	1885.7	Mulch	165.13	
574	41.6480139183	-80.1458156717	Acer	Maple Sugar	SE of CC	9	452.4	Mulch	44.18	
575	41.6480138167	-80.1458959650	Liriodendron	Tulip Poplar	SE of CC	30	754.8	Mulch	122.72	
576	41.6482554183	-80.1457613883	Quercus	Oak Red	SE of CC	36	2206.2	Mulch	240.53	
577	41.6483038967	-80.1456828183	Quercus	Oak Red	SE of CC	27	1924.4	Mulch	176.71	
578	41.6489921200	-80.1453003600	Taxus	Yew	SE of CC	10	86.6	Other		
579	41.6490339750	-80.1451716383	Zelkova	Zelkova	SE of CC	14	730.6	Mulch	28.27	
580	41.6490212850	-80.1450560067	Stewartia	Common Stewartia	SE of CC	3	19.6	Mulch	19.63	
581	41.6489632650	-80.1449620833	Acer	Maple Trident	SE of CC	9	380.1	Mulch	132.73	
582	41.6488782900	-80.1449323750	Juglans	Black Walnut	SE of CC	48	1885.7	Mulch	132.73	
583	41.6488602200	-80.1448748667	Amelanchier	Serviceberry	SE of CC	4	143.1	Other		
584	41.6489296383	-80.1447985583	Amelanchier	Serviceberry	SE of CC	2	19.6	Mulch	23.76	
585	41.6488959250	-80.1446790383	Acer	Maple Trident	SE of CC	5	201.1	Mulch	23.76	
586	41.6488468150	-80.1446782683	Quercus	Oak Red	SE of CC	4	78.5	Mulch	50.27	
587	41.6487889883	-80.1447088083	Zelkova	Zelkova	SE of CC	6	240.5	Mulch	28.27	
588	41.6487932717	-80.1448342100	Zelkova	Zelkova	SE of CC	6	227.0	Mulch	23.76	
589	41.6487545883	-80.1446263767	Quercus	Oak Red	SE of CC	9	551.5	Mulch	38.48	
590	41.6486858733	-80.1446737900	Fraxinus	Ash	SE of CC	12	363.1	Other		
591	41.6486061600	-80.1447090050	Fraxinus	Ash	SE of CC	13	530.9	Other		
592	41.6485338233	-80.1447575933	Fraxinus	Ash	SE of CC	11	380.1	Other		
593	41.6487241100	-80.1447329567	Zelkova	Zelkova	SE of CC	10	551.5	Mulch	28.27	
594	41.6486516617	-80.1447736317	Amelanchier	Serviceberry	SE of CC	0	33.2	Mulch	28.27	Terrific Tippies
595	41.6485865700	-80.1448128033	Malus	Siberian Crabapple	SE of CC	6	176.7	Mulch	63.62	
596	41.6484796917	-80.1446492400	Malus	Siberian Crabapple	SE of CC	6	153.9	Mulch	63.62	
597	41.6484554667	-80.1446853233	Tsuga	Hemlock	Woods CC	5	0.0	Ravine		
598	41.6484312850	-80.1446890717	Tsuga	Hemlock	Woods CC	5	0.0	Grass		
599	41.6484084900	-80.1447030300	Tsuga	Hemlock	Woods CC	5	572.6	Other		
600	41.6484168567	-80.1447711750	Tsuga	Hemlock	Woods CC	5	0.0	Mulch	7.07	
601	41.6484631817	-80.1448037367	Nyssa	Black Tupelo	Woods CC	4	165.1	Mulch	9.62	
602	41.6484879700	-80.1448777033	Zelkova	Zelkova	SE of CC	12	683.5	Mulch	28.27	Lou Womer Barn

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
603	41.6485340717	-80.1450231300	Zelkova	Zelkova	SE of CC	8	363.1	Mulch	19.63	
604	41.6484988050	-80.1450335217	Pinus	Pine White	SE of CC	15	551.5	Other		
605	41.6485191917	-80.1450482867	Picea	Norway Spruce	SE of CC	16	268.8	Other		
606	41.6484632000	-80.1450591067	Pinus	Pine White	SE of CC	12	298.6	Other		
607	41.6484110600	-80.1451101850	Cornus	Kousa Dogwood	SE of CC	5	86.6	Other		
608	41.6484512483	-80.1451971633	Acer	Maple Red	SE of CC	8	471.4	Mulch	19.63	
609	41.6484890333	-80.1453024700	Acer	Maple Red	SE of CC	11	660.5	Mulch	44.18	
610	41.6485236000	-80.1453939300	Acer	Maple Red	SE of CC	12	730.6	Mulch	28.27	
611	41.6485653250	-80.1453934150	Acer	Maple Red	SE of CC	9	268.8	Mulch	23.76	
612	41.6485947717	-80.1453837833	Acer	Maple Norway	SE of CC	22	1075.2	Mulch	113.10	
613	41.6486545417	-80.1454995567	Viburnum	Black Haw	SE of CC	3	78.5	Mulch	44.18	
614	41.6485220467	-80.1456224300	Acer	Maple Norway	SE of CC	24	1320.3	Mulch	78.54	
615	41.6485073817	-80.1456549133	Malus	Siberian Crabapple	SE of CC	5	213.8	Other		
616	41.6484699300	-80.1455546550	Malus	Siberian Crabapple	SE of CC	9	330.1	Other		
617	41.6484630983	-80.1454398350	Acer	Maple Sugar	SE of CC	27	934.8	Mulch	44.18	
618	41.6484360300	-80.1453414517	Acer	Maple Red	SE of CC	8	397.6	Mulch	33.18	
619	41.6484104000	-80.1452415850	Acer	Maple Red	SE of CC	10	572.6	Mulch	56.75	
620	41.6483818367	-80.1452071950	Acer	Maple Red	SE of CC	10	594.0	Mulch	33.18	
621	41.6483721767	-80.1451377267	Malus	Siberian Crabapple	SE of CC	7	176.7	Mulch	28.27	
622	41.6483281317	-80.1450680450	Acer	Maple Red	SE of CC	9	380.1	Mulch	38.48	
623	41.6482858850	-80.1450911317	Malus	Siberian Crabapple	SE of CC	7	314.2	Other		
624	41.6482653250	-80.1450334550	Malus	Siberian Crabapple	SE of CC	5	240.5	Other		
625	41.6488028750	-80.1445473417	Malus	Siberian Crabapple	SE of CC	6	240.5	Other		
626	41.6488525417	-80.1445326933	Acer	Maple Sugar	Woods CC	20	754.8	Mulch	70.88	
627	41.6488698050	-80.1445111167	Cornus	Florida Dogwood	Woods CC	2	86.6	Mulch	9.62	
628	41.6488649083	-80.1444716033	Cornus	Florida Dogwood	Woods CC	3	63.6	Mulch	12.57	
629	41.6493574033	-80.1446487417	Quercus	Oak Pin	Woods CC	15	907.9	Mulch	70.88	
630	41.6493126067	-80.1445621633	Amelanchier	Serviceberry	SE of CC	12	471.4	Other	0.00	
631			Acer	Maple Sugar Column	SE of CC	13	28.3	Mulch	63.62	
632	41.6491791833	-80.1446035583	Amelanchier	Serviceberry	SE of CC	0	95.0	Mulch	56.75	
633	41.6491280817	-80.1446415200	Amelanchier	Serviceberry	SE of CC	5	132.7	Mulch	44.18	
634	41.6490560233	-80.1446335400	Cornus	Cornelian Cherry	SE of CC	0	201.1	Other		
635	41.6490297400	-80.1447370717	Acer	Maple Sugar	SE of CC	25	1772.1	Mulch	78.54	
636	41.6491140233	-80.1447889817	Acer	Maple Trident	SE of CC	7	213.8	Mulch	23.76	
637	41.6490726800	-80.1448568233	Gleditsia	Thornless Honey Locust	SE of CC	27	2827.4	Mulch	56.75	
638	41.6491121600	-80.1449976167	Acer	Maple Trident	SE of CC	7	283.5	Mulch	23.76	
639	41.6491913533	-80.1450429950	Acer	Maple Trident	SE of CC	6	143.1	Mulch	23.76	
640	41.6491920250	-80.1451908483	Acer	Maple Sugar	SE of CC	40	2551.8	Mulch	314.16	
641	41.6493088050	-80.1451616067	Acer	Maple Trident	SE of CC	9	213.8	Mulch	23.76	
642	41.6494957400	-80.1450296600	Prunus	Japanese Cherry	SE of CC	5	227.0	Mulch	19.63	
643	41.6494179333	-80.1448589883	Acer	Maple Red	SE of CC	32	962.1	Mulch	213.82	
644	41.6500188350	-80.1447563233	Amelanchier	Serviceberry	SE of CC	13	452.4	Mulch	38.48	
645	41.6501209267	-80.1446960900	Acer	Maple Red	NW of CC	8	254.5	Other		
646	41.6502222917	-80.1446357867	Acer	Maple Red	NW of CC	6	188.7	Other		
647	41.6502113367	-80.1446070450	Acer	Maple Red	NW of CC	8	363.1	Mulch	9.62	
648	41.6502132933	-80.1444993000	Chamaecyparis	Hinkoi cypress	NW of CC	5	44.2	Other		
649	41.6501702683	-80.1443689383	Acer	Maple Red	NW of CC	4	153.9	Mulch	12.57	
650	41.6501543533	-80.1443007467	Acer	Maple Red	NW of CC	4	113.1	Mulch	15.90	
651	41.6501056900	-80.1441663667	Acer	Maple Red	NW of CC	4	143.1	Mulch	19.63	
652	41.6500640433	-80.1440390067	Acer	Maple Red	NW of CC	4	122.7	Mulch	9.62	
653	41.6499179950	-80.1440625550	Acer	Maple Red	NW of CC	5	132.7	Mulch	12.57	
654	41.6494313250	-80.1442494117	Acer	Maple Silver	NW of CC	6	50.3	Mulch	12.57	Theta Chi
655	41.6495075700	-80.1442111967	Acer	Maple Silver	NW of CC	9	268.8	Mulch	38.48	
656	41.6495815767	-80.1441611083	Acer	Maple Silver	NW of CC	7	176.7	Other		
657	41.6495529517	-80.1441184850	Acer	Maple Silver	NW of CC	7	176.7	Other		
658	41.6496024233	-80.1440896017	Heptacodium	Seven Sons Tree	NW of CC	8	122.7	Other		
659	41.6496557367	-80.1441229800	Viburnum	Black haw	NW of CC	5	122.7	Other		
660	41.6497825283	-80.1439744817	Acer	Maple Silver	NW of CC	5	95.0	Mulch	12.57	
661	41.6497700117	-80.1439473500	Pinus	Pine White	NW of CC	14	213.8	Other		
662	41.6497672017	-80.1439000783	Pinus	Pine White	NW of CC	9	122.7	Other		
663	41.6498473350	-80.1439347967	Pinus	Pine White	NW of CC	13	201.1	Other		
664	41.6499019650	-80.1438875400	Liriodendron	Tulip Poplar	NW of CC	12	363.1	Other		
665	41.6499639267	-80.1438475033	Liriodendron	Tulip Poplar	NW of CC	10	176.7	Other		
666	41.6499785200	-80.1438263617	Pinus	Pine White	NW of CC	13	314.2	Other		
667	41.6499770033	-80.1436653483	Pinus	Pine White	NW of CC	15	415.5	Other		
668	41.6499260167	-80.1435209383	Acer	Maple Silver	NW of CC	11	254.5	Other		
669	41.6498848183	-80.1434102400	Acer	Maple Silver	NW of CC	12	254.5	Other		
670	41.6498235017	-80.1433813600	Zelkova	Zelkova	NW of CC	9	176.7	Other		
671	41.6499466133	-80.1437773283	Zelkova	Zelkova	NW of CC	8	213.8	Mulch	23.76	
672	41.6498578350	-80.1438349467	Zelkova	Zelkova	NW of CC	12	330.1	Other		
673	41.6497152817	-80.1436272850	Zelkova	Zelkova	NW of CC	10	227.0	Mulch	7.07	
674	41.6497002067	-80.1435731917	Crataegus	Cockspur Hawthorn	NW of CC	2	70.9	Mulch	12.57	
675	41.6496777317	-80.1434937983	Crataegus	Cockspur Hawthorn	NW of CC	2	56.7	Mulch	19.63	
676	41.6496577117	-80.1434527383	Crataegus	Cockspur Hawthorn	NW of CC	2	44.2	Mulch	12.57	
677	41.6496288450	-80.1433693633	Crataegus	Cockspur Hawthorn	NW of CC	2	50.3	Mulch	9.62	
678	41.6492958900	-80.1435187950	Crataegus	Cockspur Hawthorn	NW of CC	2	63.6	Mulch	12.57	
679	41.6493188483	-80.1435554467	Crataegus	Black Hawthorn	NW of CC	3	33.2	Other		
680	41.6493292200	-80.1436135117	Crataegus	Black Hawthorn	NW of CC	3	33.2	Other		
681	41.6493493817	-80.1436583133	Crataegus	Black Hawthorn	NW of CC	4	33.2	Other		
682	41.6493659367	-80.1437084450	Crataegus	Black Hawthorn	NW of CC	4	33.2	Other		
683	41.6493686867	-80.1437387717	Crataegus	Black Hawthorn	NW of CC	4	33.2	Other		
684	41.6494023067	-80.1437211433	Amelanchier	Serviceberry	NW of CC	5	33.2	Other		
685	41.6494305933	-80.1437018650	Amelanchier	Serviceberry	NW of CC	5	33.2	Other		
686	41.6497755450	-80.1432686367	Amelanchier	Serviceberry	NW of CC	5	33.2	Other		
687	41.6497487433	-80.1430943667	Zelkova	Zelkova	NW of CC	8	201.1	Mulch	15.90	
688	41.6497362383	-80.1430363983	Zelkova	Zelkova	NW of CC	12	594.0	Mulch		

ID #	Latitude	Longitude	Genus	Combined_Names	Area	DBH_in	Canopy Area (sq.ft)	Ground cover	lch Area (sc	Plaque
689	41.6497272250	-80.1430208133	Robinia	Black Locust	NW of CC	17	829.6	Mulch		
690	41.6497201200	-80.1430293800	Robinia	Black Locust	NW of CC	16	0.0	Mulch		
691	41.6497212983	-80.1430042067	Robinia	Black Locust	NW of CC	15	0.0	Mulch		
692	41.6496886083	-80.1429207333	Robinia	Black Locust	NW of CC	13	0.0	Mulch		
693	41.6496904767	-80.1428837050	Robinia	Black Locust	NW of CC	27	989.8	Mulch		
694	41.6496538883	-80.1427602667	Robinia	Black Locust	NW of CC	20	0.0	Mulch		
695	41.6496415567	-80.1427192117	Robinia	Black Locust	NW of CC	19	1075.2	Mulch		
696	41.6496339800	-80.1426887233	Prunus	Black Cherry	NW of CC	15	0.0	Mulch		
697	41.6496126200	-80.1426861800	Prunus	Black Cherry	NW of CC	12	0.0	Mulch		
698	41.6496093083	-80.1426907917	Prunus	Black Cherry	NW of CC	8	0.0	Mulch		
699	41.6495488083	-80.1428952367	Prunus	Black Cherry	NW of CC	13	0.0	Mulch	2970.57	
700	41.6495706367	-80.1429744383	Zelkova	Zelkova	NW of CC	7	132.7	Mulch	23.76	
701	41.6496092967	-80.1430962967	Zelkova	Zelkova	NW of CC	6	113.1	Mulch	19.63	
702	41.6492686317	-80.1433161300	Zelkova	Zelkova	NW of CC	7	165.1	Mulch	19.63	
703	41.6492231833	-80.1433182117	Magnolia	Magnolia sp.	NW of CC	10	165.1	Other		
704	41.6491797400	-80.1432851183	Magnolia	Magnolia sp.	NW of CC	0	165.1	Other		
705	41.6490694250	-80.1434193900	Magnolia	Magnolia sp.	NW of CC	0	227.0	Grass		
706	41.6490480783	-80.1433206700	Acer	Maple Paperbark	NW of CC	10	298.6	Other		
707	41.6490488583	-80.1432508167	Pyrus	Bradford Pear	NW of CC	11	363.1	Other		
708	41.6490378817	-80.1431708067	Pyrus	Bradford Pear	NW of CC	10	330.1	Other		
709	41.6490920117	-80.1431348867	Pyrus	Bradford Pear	NW of CC	9	268.8	Other		
710	41.6490617250	-80.1430613500	Pyrus	Bradford Pear	NW of CC	11	380.1	Other		
711	41.6490393267	-80.1429862300	Pyrus	Bradford Pear	NW of CC	9	397.6	Other		
712	41.6488212500	-80.1431645083	Pyrus	Bradford Pear	NW of CC	11	530.9	Mulch	132.73	
713	41.6488156650	-80.1432843033	Acer	Maple Red	NW of CC	9	615.8	Nothing		
714	41.6487865967	-80.1433089883	Pinus	Pine White	NW of CC	10	298.6	Other		
715	41.6486455700	-80.1432780017	Pinus	Pine White	NW of CC	8	240.5	Other		
716	41.6486314767	-80.1432957400	Pinus	Pine White	NW of CC	8	201.1	Mulch		
717	41.6486066167	-80.1432914050	Pinus	Pine White	NW of CC	13	227.0	Mulch		
718	41.6486117150	-80.1433105900	Malus	Siberian Crabapple	NW of CC	6	122.7	Mulch		
719	41.6486407450	-80.1434122033	Malus	Siberian Crabapple	NW of CC	5	103.9	Mulch	683.49	
720	41.6486677633	-80.1434492150	Betula	Birch Paper	NW of CC	11	530.9	Other		
721	41.6485621567	-80.1435154750	Cornus	Cornelian Cherry	NW of CC	5	176.7	Grass		
722	41.6485740233	-80.1434843633	Cornus	Cornelian Cherry	NW of CC	4	143.1	Other		
723	41.6485419150	-80.1434368700	Cornus	Cornelian Cherry	NW of CC	4	103.9	Other		
724	41.6485608467	-80.1433668167	Acer	Maple Silver	NW of CC	14	530.9	Grass		
725	41.6484133517	-80.1433971950	Cornus	Florida Dogwood	NW of CC	3	50.3	Other		
726	41.6482439933	-80.1434987400	Liquidambar	Sweet Gum	NW of CC	8	363.1	Mulch	56.75	
727	41.6481825633	-80.1435412833	Liquidambar	Sweet Gum	NW of CC	6	201.1	Mulch	23.76	
728	41.6482189300	-80.1436164483	Cornus	Florida Dogwood	NW of CC	4	95.0	Mulch	12.57	
729			Malus	Siberian Crabapple	NW of CC	8	176.7	Grass		

Appendix 2 - Results from stakeholder interviews

Stakeholder	Department	Major Points

Joe Michael	Physical Plant	- Recent transition to only native plantings and working to transition towards perennials.
		    - Mentioned that some fun native to incorporate back could be fruit and nut bearing trees
		- Mowing and mulching is contracted out.
		- Phys plant staffing continues to decrease.
		- Maintenance takes a lot of work.
		- Some areas we can look at more specifically is the triangle by Wise center and possibly by Doane/Steffee
		    - Recommendations are always welcome for the Ravine.
		- Specific replacement trees would be helpful
		    - Callery Pear, Ash, NV Parking lot
		- Inventory would increase usefulness through
		    - Last *Measurement* date
		    - Good search features
		    - Identification of all PA state & historical trees

Kelly Boulton & Kurt Hatcher	Office of Sustainability	- The Campus Ecosystem Working Group may be the best way to move the project forward after the author's graduation.
		- Recommendations that will be most usable
		    - Contractor language or suggestions
		    - Best practices
		    - Criteria for future plantings beyond immediate replacements
		    - Think about in the future assessments on soil PH & moisture content, etc.
		- Different areas of campus have different needs and uses.
		- Multiple sustainability certifications landscaping may work towards.
		    - For one certification, the number of cut down, pruned, and planted trees is needed.
		- Geothermal Boreholes are part of renovation plans for many buildings and require tree-free areas to install.
		- “Strategic” placing of native plants in certain areas

Ron Cole	President	- Landscaping should reflect the values of the college & also continue being “shockingly attractive”.
		    - More natural spaces must balance with a more manicured look.
		    - Labeling and specific visible-sustainability areas may be helpful.

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Campus still needs to be attractive to new and current students, as well as alumni
“Welcoming and a safe space for people”
How can we create spaces that are welcoming and usable for students?
Working through the Master Plan may lend permanence to landscaping plans.
Build pragmatism into work.
Big focus on graduation and ensuring the campus looks especially nice for that.

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<tr><td>James Basinger</td><td>Public Safety</td><td>

Shrubs over 3ft, especially near buildings and dark walks may be problematic
Tree limbs between 3-8 feet, especially near buildings, may be problematic, as are climbing trees that allow access to roofs.
Tree limbs are trimmed around cameras and lights once a semester
Lack of maintenance may increase crime and dangerous activities

Crime prevention through environmental design
Shrubs to decrease sound pollution
Be careful of the type of habitat we are creating
Animals wise (ex. Skunks at Caflisch)
Ex of Amazon boxes, and the space behind it could be dangerous. Could incorporate low lying plants that require minimum maintenance.

Where does campus begin/end? Can plantings provide more clues?
Possible suggestion of incorporating bushes to indicate edge
Good recommendation for native plants is to start with low lying to fit within those parameters listed before

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<tr><td>Sara Pineo</td><td>Director of Annual Giving</td><td>

Ultimate goal for her is to create a feeling of philanthropy among the alumni.
Alumni have great pride in the campus and how it looks.
There are few locations that people take high levels of pride within, so being mindful of changes we are making and ensuring it still reflects the campus well.

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		- Keep in mind the memorial trees and plaques.
		- Fall is very “iconic” on campus,
		    - Keep trees that could incorporate those beautiful colors in mind.
		- Maintenance is a big focus, making sure that anything that is incorporated is well kept and can keep a nice image for the campus.
		    - Maybe keep in mind cross seasonality, how can we make campus look nice when students are here in the fall and spring?
		    - While also keeping in mind visitors in the summer and having nice aesthetics then as well.

Rachel Sloan	Admissions	- Maintenance is extremely important
		    - Families are expecting the maintenance of a 70k tuition
		    - Needs to be easy and able to be kept up with.
		- As a non-urban campus, our space and trees are important elements of campus.
		    - There is such a thing as too much, wildflowers esp. can be seen as lazy
		    - View down Brooks walk and Bentley-Chapel views are important
		- Outdoors event space is important
		- Consideration of primary space uses, users and passerbys is important
		    - Visitors to campus ideally should have good sightlines to landmarks etc.
		- Signage is important, however must be clear and concise
		    - Could add a QR code, to give the option of more info for those who wish to seek it.
		- Think about how to have plants across-seasonality.
		- Plantwise, low lying could be a good option but again it needs to be maintained well.
		- Keep in mind who is using the spaces we are recommending plantings in?
		    - Cater plants to what is being done in those areas.

Appendix 3 - Allegheny's Urban Forest Management Plan (UMFP)

1. Summary

Allegheny College has a rich urban forest that will require maintenance and management to increase its climate resilience and functions. Allegheny's urban forest is not static, rather it is constantly growing. This Urban Forest Management Plan is only a starting place, therefore I focus on broad issues and considerations for the forest, before discussing themes in specific areas and a few relevant tree replacements.

A climate resilient forest requires planning, management, diversity, and adaptability. An uneven aged urban forest is necessary to ensure constant canopy for the future, reduce forest stress, and distribute costs over time. Trees must be managed for safety, appearances, disease, structure, and long term growth. This maintenance must be regular, and especially frequent until the initial structure of the tree is established (generally >6 inches DBH). Regular inventories and keeping track of issues, removals and plantings is essential to recognising trends. Planting is only the first part of an urban forest. Without good management, resilience is hard to create.

Genetics, species, genus, and functional diversity within the forest allow for resilience in the face of extreme and changing weather, increasing disease issues, and the aesthetic needs of campus. Sourcing and planting trees with an eye to this diversity is essential. Conifers, shade trees, mid-sized trees, and small/ornamental trees all have important roles to play in the urban ecosystem. There is a list of suggested resilient species attached in the resources section. Any tree not on this list should be examined in detail for climate and disease resilience before planting on campus.

Tree removals should be carefully considered given the costs associated. Larger, Monarch Trees especially should be specially considered before removal, and maintenance and trimming specially considered to protect these trees that have an outsized impact on the character of the campus. A more complete ecosystem is more resistant to threats and therefore more adaptable. As the Allegheny Urban Forest grows, its needs will change too, and the plan will need to be revised.

2. Table of Content

3. <u>Scope</u>
    a. This plan as well as the general management of the urban forest falls under the purview of Physical Plant. Physical Plant will hold and maintain this management plan.
        i. Physical Plant is responsible to uphold all policy with consultation from the CEWG.
    b. The Campus Ecosystem Working Group (CEWG) shall
        i. Serve as the primary stakeholder consultation group for all management.
        ii. Provide recommendations to institutional implementers, based on research, best practices, and community input, to maintain our campus from an ecosystems perspective with aesthetics, maintenance, and long-term sustainability in mind.
        iii. Make UFMP recommendations to departments (which will follow typical operational and governance processes)
        iv. Receive reports on annual plantings, removals and other tree activity at the annual fall meeting.
        v. Identify potential issues in management or management planning and suggest recommendations, including updates to this plan.
    c. Tree Damage must be assessed and enforced in consultation with CEWG and Physical Plant
        i. It is the purview of Physical Plant to initiate this process.
        ii. A qualified arborist must assess any tree damage.
        iii. Enforcement and potential fees will be the responsibility of project managers, HR, or Residence life, depending on the circumstances of the damage
4. <u>Current Urban Forest and Needs</u>
    a. History
    Hundreds of years of plantings have created the current Urban Forest. From transplants of local seedlings to aspirations of an arboretum filled with trees from all over the world, the vision for the Allegheny campus has changed over time.

Recently the decision was made to plant primarily native trees. The historic buildings and grand trees are essential to Allegheny's branding as a rural, established, liberal arts college. The Sycamore tree (behind Bentley) continues to be a storied treasure of the Allegheny community and has most recently become the name of a new bar in McKinley's dining hall.

b. Inventory

As part of the senior comprehensive project creating this management plan, I also carried out an inventory of the central areas of campus. This inventory revealed many nonnative species, especially dominating the understory, insufficient new plantings, and limited diversity, especially within the monoculture rows adjacent to walkways. The link to the public version is https://arcg.is/0rWv0H0. The GIS specialist holds the primary version.

c. Needs, Goals & Vision

The vision for the future of Allegheny's Urban Forest is that of a strikingly beautiful one, filled with older trees, and beautiful fall color. This forest maintains its characteristic sightlines and maximizes arboreal ecosystem services without hindering event spaces or other projects. The goal is to have a sustainable urban forest that will be better able to withstand expected climate and pest treats. Additionally the forest should be visibly sustainable and ecological (including permanent signage), while traditional manicured trees and lawn dominate the central campus spaces.

5. <u>Assessment & Inventory</u>
    a. It is the purview of the CEWG to prompt assessment and inventory actions which will be completed by Physical Plant
    b. All the trees on the main campus should be assessed for maintenance needs at least every 5 years.Trees near facilities at Roberston should be assessed as well.
    c. Younger trees (< 6 inches DBH) should be assessed every one to two years with associated maintenance to ensure proper growth & structure.
    d. American National Standards Institute (ANSI) A300 standards and ISA Best Management Practices must be followed by all urban forest workers.

e. Inventories should be completed/updated at minimum every 10 years.
f. All assessment and inventory results shall be reported every year to the fall meeting of the Campus Ecosystem Working Group (CEWG).

6. <u>Maintenance</u>
    a. Maintenance should be completed by trained Physical Plant personnel or contractors in accordance with the American National Standards Institute (ANSI) A300 standards and ISA Best Management Practices
    b. General Maintenance
        i. Pruning must always have specific goals. These goals may include safety and health, but aesthetics should be the lowest priority goal.
        ii. Species specific natural structure should be maintained while weak, dead, decaying or structurally unsound branches are removed.
        iii. Where mulch is used to protect roots and trunk from compaction and injury, it should be applied in a donut shape. Mulch should be spread around the base of each tree 2-3 inches thick to such width as necessary to protect surface roots. The area directly next to the tree's trunk should remain clear and the root flair exposed.
        iv. Along sidewalks, trees should be trimmed such that there is clearance eight feet above the surface of the sidewalk and 14 feet above the surface of the roadway in accordance with Meadville city code and public safety suggestions.
        v. Where newly planted trees are not self-supported, they should be staked or guyed. Ties should be inspected and adjusted monthly to remove chance of tree girdling or rubbing.
        vi. Water bags must be removed during the winter months and tree’s trunk regularly inspected when the bag is in place.
        vii. All tree protection devices (construction, herbivory, etc) should be regularly inspected for tree safety.
    c. Other Considerations

i. Any memorial tree, tree significant to the college, or larger than 25” DBH should have no more than 20% of their canopy removed at one time.
ii. Where possible and prudent, all pruning should be completed during the winter/early spring to reduce disease potential and stress.
    1. Exceptions are especially for certain flowering species.

d. Special Considerations
    i. During construction, care should be taken to protect trees. The PSU Guide to Preserving Trees in Development Areas should be followed. (https://extension.psu.edu/a-guide-to-preserving-trees-in-development-projects). In summary:
        1. Before construction, the health and quality of each tree should be considered. Trees in bad health may need to be removed regardless of precautions and it is less expensive to remove them without nearby infrastructure (see section 6 on tree removal)
        2. Trees stress should be limited including by watering the tree when less than an inch of rain falls in a week, and ensuring dust does not cover leaves.
        3. Tree roots are extremely susceptible to damage. A tree protection zone should be created around the tree at the edge of the canopy and nothing should be stored under the tree. Where foot traffic or other traffic under the canopy is unavoidable, planks or similar should be laid.
        4. Soil levels under a trees canopy must remain the same, and existing water paths should be maintained as changing hydrology or salt deposition can be fatal to trees
    ii. Any tree damaged by contractors should result in a fee equal to the tree’s replacement value. Any tree killed by contractors should be replaced by the contractor in addition to a fee of half of the replacement value.

    e. The integrated pest management plan (IPM) created by Anna Westbrook during spring 2023 should be used as a starting place for all pest management actions (see Resource A. for an abridged version).
    f. Prohibited practices
        i. Tree-Topping: The removal of the top -main stem & upper branches- of a tree. Tree topping weakens trees and may lead to bad structure.

7. <u>Tree Removal</u>
    a. Limiting Removals
        i. Trees that have cavities or other faults but appear structurally sound should be left for wildlife with increased inspections to ensure stability of the tree.
        ii. Where tree removal seems inevitable, the cost to move or the tree should be considered.
    b. Tree behavior when cut should be considered.
        i. Tree-of-heaven and Amur corktree among others are known to aggressively resprout after the main trunk is cut unless additional (typically chemical) measures are taken.
    c. Removals should be conducted by certified arborists.
    d. The entire community should be informed of any significant tree removal before that removal happens if possible. Otherwise the communications should occur immediately after. See section 9 (Community Involvement) for specific communication plans.

8. <u>Planting & Replacement</u>
    a. At a minimum: for every tree that is removed or falls in a given year, one similar statured tree should be planted to replace it in a similar area.
    b. How Many and How Frequently
        i. In order to maintain the current urban forest, about 1 tree should be planted every 10 years for every 10 large trees in the area. Ornamental trees will need to be replaced on average twice as fast based on their shorter lifespans. This will amount to at least 5 large/shade trees a year and 5 ornamental/understory trees, however this is only an estimate and tree

planting should provide adequate replacement trees for a given area before the existing trees decline.

c. Location
    i. Trees must be spaced out in such a way that they have room to grow to their normal size.
        1. A minimum 10 feet from fire hydrants (with trees known for root entanglement planted further)
        2. A minimum 10 feet from light poles
        3. A minimum 3 feet from walkways and sidewalks. 5 feet from roads.
        4. Sufficient distance from buildings.
    ii. Ecosystem benefits like summer shading, wind protection, and storm water absorption should be considered.
    iii. Tree rows composed of single aged and single species trees should be avoided.
        1. Planting alternating tree genera at least 25 years apart allows for natural continuance of the rows and lowers the risk of entire rows being wiped out like the Ash next to college court.
    iv. Sightlines
        1. Trees should not obscure sightlines at any intersection or traffic crossing.
        2. Important visual sightlines should be maintained including:
            a. Shultz/Bentley Lawn to Shultz
            b. From the Chapel across the ravine to the lawn and Bentley
            c. The open sightline down Brooks walk from Main St.
            d. The sightline to the Observatory from Main St.
        3. Where sightlines are not important, or already obscured, planting understory, mid-size and canopy trees provides habitat.
    v. The specific feel and use of areas should be maintained unless proper consultation is had. Stakeholders include: catering and events, the office of

sustainability, dean of students, students, and professors. Outdoor event spaces are important on campus, and some spaces may have hidden uses.

1. Different areas of campus have different human uses and different ecosystem uses. Where event usage and area visibility is already limited, planting should focus on increasing habitat and natural cycles.

d. Sapling and Planting considerations
    i. Smaller sapling size is preferred and should be utilized where possible
        1. Smaller saplings tend to cost less and require less labor to establish
        2. Where trees are so small that deer herbivory may be a problem, a cage, white grow tube or similar should be installed and the cage or tube itself staked down solidly and inspected regularly
    ii. Trees are best planted before bud burst or in early to mid-fall.
e. Tree Type
    i. Trees should be chosen from the list of suggested trees contained as Resource A. Where other species are considered, they must not appear on the list of prohibited species (Resource A).
        1. New tree species should only be planted in consultation with CEWG.
        2. The addition of more fruit and nut trees to the suggested tree list should be considered by the CEWG.
    ii. Acer species are currently well represented on campus, especially Red Maple. Only in specific circumstances should more red maple be planted, and other maples should be limited.
    iii. Many fruiting trees should be planted away from sidewalks and roads to avoid nut and/or berry staining.
        1. Walnuts
        2. Hickories
        3. Black & choke cherries
        4. Mulberry & hackberry

iv. While the decision to plant primarily native trees is an enviable goal, there may be times and places where specific non-native trees have direct ecosystem services benefit.
    1. The stressful urban environment may have certain niches that are not suitable for any native species.
        a. The numerous threats of many conifers in PA make Norway spruce a good potential exception.
    2. Some trees which may not be native to this area of Pennsylvania, but are native further south might be planted as part of facilitative migration. Any of such plantings should be carefully considered.
    3. Fruit trees especially may not be native, however they are already an important part of the current urban forest.
    4. All non-native trees should be thoroughly examined for invasive potential.

v. Trees should be chosen for their resilience at the nursery or seed level
    1. Diverse tree genetics increases the urban forest's resistance to specific stresses and diseases as there is potential for some individuals to survive outbreaks.
    2. Cloned or named varieties should be avoided if at all possible given their limited genetic diversity.
    3. Local seedlings should be prioritized given their adaptations to the area.

vi. Only healthy saplings should be planted.

9. <u>Specific Suggestions</u>
    a. Specific Tree Replacements

    There are a few trees on campus that should be medium to high priority replacements.

    i. Callery/Bradford Pear

    There were 10 *Pyrus calleryana* within the area surveyed. The tree is currently listed as a noxious weed in PA, however there are many planted in the surrounding community. The trees tend to have structural weaknesses, send up shoots from the root collar, and smell bad when in bloom.

General suggested replacements include musclewood/American hornbeam (*Carpinus caroliniana*) which may be multi trunked but can be trained to be single-trunked and lower growth pruned if needed. For flowering accents, redbud trees (*Cercis canadensis*) have gorgeous purple/fuchsia or white options in the early spring and can slowly gain height. And Serviceberry (*Amelanchier spp.*) has similar flowers as well as edible fruit although it is more of a shrub with multiple trunks. American basswood (*Tilia Americana)* forms very nice shade trees and may be appropriate for areas that a larger tree would be welcome in.

ii. Amur Corktree

The Amur corktree is starting to be found in our native woodlands of PA (Weikert 2024). The only Amur corktree on campus is next to the northernmost entrance to Walker Anex and was observed fruiting. This tree should be removed and replaced with a midsize or small tree that enjoys shade. Perhaps flowering dogwood, American fringetree, or a redbud.

iii. Ash

There are three ash trees between the Campus Center and the Tippie Alumni Center that are dying because of the Emerald Ash Borer. The medium-sized American hop-hornbeam (*Ostrya virginiana*) is my choice for the area as it does well in slightly drier, less compacted areas far that are not exposed to salt. The American hophornbeam has low limb breakage and small papery seeds which is ideal given the proximity to one of the busiest areas of campus.

The ES 322 class suggested sassafras trees (*Sassafras albidum*) for the area which have lovely fall foliage and edible leaves. The trees do tend to send up root sprouts and be midsize and full of character which might be preferred in other areas.

b. Specific Locations/ current recommendations

These recommendations are informed by the work of Dr. Rich Bowden's ES322 (2022). There are many areas of campus that should have new plantings as well as some trees that could be replaced to further ecosystem services, wildlife value, or students' relationships to the urban forest.

i. South/ West of CC
    1. The white pine area is gorgeous and well used by students for hammocking. There are few younger trees or undergrowth in the area itself. Plantings of red oak and occasional serviceberry and sassafras, would increase the long term potential of this area.
    2. The lawn north of Murray currently is an extremely wet field. While it historically was home to athletics, the limited drainage prohibits activities for much of the year. A sycamore or two, pin oaks, and perhaps, river or black birch, spice bush or redbud tree accents would provide shade to the area and start to drain some of the water, yet could be planted near the buildings and sidewalks so that the lawn is still usable for playing. A bushy Juniper could provide some winter color next to the building and away from any sidewalks or doors.
        a. Potential future geothermal boring should be considered before planting any trees.
    3. The lawn south of Montgomery is currently dominated by a few larger trees and a scattering of small holly bushes. This area is very visible from the road, but gets little traffic and tends to be moist. Shagbark & other hickories, as well as oaks (Swamp White, White, Pin) planted over time will allow for regeneration of the area without obscuring the view.
        a. Potential future geothermal boring should be considered before planting any trees.
    4. The Ginko row should have a second row of trees planted just north of it to take over the function of the ginkgos when they eventually die. Alternating oaks, hickories (if far enough from the street),

hackberry, or native river birches might work well. Faster growing cucumber or tulip poplar trees might replace any trees that die without a nearby successor.

ii. Bentley/Shultz

1. The Central Bentley/Schultz Lawn has an old and majestic canopy with few younger trees. One or two new trees should be planted every 20 years in this area to create the next generation of canopy. This rate will allow photography and graduation to continue as normal and anticipate the eventual decline of the current trees. Shade tolerant large species will do best here where keeping the area free from undergrowth is important.
2. Some of the crabapples and other small trees surrounding Shultz should eventually be replaced or every other one replaced with larger deciduous shade trees to increase summer shade and continue the aesthetic of buildings among the trees while allowing sightlines. The south/parking lot side (not included in inventory) could receive more large or mid-sized deciduous trees including black or red oak, Kentucky coffee tree and sassafras.

iii. Ravine

1. Currently the Ravine has a large number of older trees and is home to some of the only large shrub sized plantings on campus with the rhododendrons. One or two oaks or tulip poplar trees should be planted over the next few years to maintain the canopy. Other additions could include *Betula alleghaniensis* and *B. lenta.* Their location should be prudently chosen to not interfere with sightlines too much as they grow to the canopy. There are currently some older gray birch in the ravine that will eventually need to be replaced by medium/small trees in areas that will not impact the sightline.

iv. Brooks Lawn

1. There are already a few smaller trees in the area, however at least one large oak should be planted near the chestnut and red oak on the hill to eventually take their place. A few larger deciduous trees should be planted near the building of brooks to improve ecosystem services.
2. The Carrden area is gorgeous and seems to work well for the space. Additional sugar maples or two oaks should be planted by the currently established trees to provide regeneration of the forest.

10. <u>Community Involvement</u>
    a. Unlike any urban forests that are located in cities, much of Allegheny's community consists of paying students who are only on campus for four years and may have vastly different reasons for engaging with the forest than most.
        i. Student energy can be harnessed, especially in planting efforts. More long term management with students is hard because of the quick turn over
        ii. Encouraging student interactions, learning, and engagement with the forest through specific planting and chair/bench placement is important to increase student ecosystem benefits and relational benefits.
        iii. Additional educational opportunities including potential tree trails, letter writing to trees, and tree plaques should be considered as future projects.
    b. Wider community members are also important forest users. Allegheny College is a great green space for photographs and dog walking. This is a valuable service to the community, and means that many of the neighbors have a vested interest in the forest.
        i. Management activities in the summer especially may impact wider community members. Posted signs on site and potentially even Meadville Tribune announcements may communicate these activities.
    c. Communications
        i. Resources such as My Allegheny and The Campus should be utilized to communicate plantings, removals and major maintenance to students, staff, and other community members.
        ii. Narrative of actions

        1. All communications should include the goal of what is happening and the reasons behind that goal
        2. Ex: "Three medium sized ash trees will be removed from between the CC & Tippie Alumni Center this week. They will be replaced by ______. The Ash trees have been declining due to the invasive emerald ash borer and would soon present a danger to pedestrians. Please watch out for crews working"
        3. Ex: "Please be aware that a crew will be pruning unhealthy and badly structured branches across campus for the next few days to keep trees healthy and everyone safe."

11. <u>Adaptive management</u>
    a. This UFMP should be a living document.
        i. When adaptations to this plan are needed, stakeholders must be consulted, and records kept of the new plans and pilot projects
    b. This plan provides basic procedures and expectations based on current understandings and climate and pest estimates. Procedures will need to adapt to the realities facing the Allegheny urban forest, and those responses will likely exceed the limits of this UFMP.
        i. Specific issues that might be adapted
            1. Pests & appropriate plantings
            2. Rate of planting in different areas

12. <u>Resources</u>

There are many resources already in existence. I have taken the liberty of including links and short descriptions of some of the most potentially helpful resources as well as those mentioned in the Strategic Planning and Implementation and Goals sections. I have also included copies of some of the resources developed specifically for this campus by other working groups in the hopes that placing them in the same place will improve their accessibility.

A. Suggested & Prohibited Tree Lists

The lists of suggested and prohibited trees can be found below, hosted by the Office of Sustainability. The addition of more fruit and nut trees to the suggested tree list should be considered by the CEWG.
Prohibited:https://docs.google.com/spreadsheets/d/1OF25VFvMGIMCV_08By7-9P7Pn44cvCTqauOHDLQkAyk/edit?usp=sharing
Suggested:https://docs.google.com/spreadsheets/d/1zZnYrrIWrb9m9_sGl3K7JdkbI92S7mrGMpqAD8aJ1Us/edit?usp=sharing

Prohibited Tree & Bush Species		
Common Name	**Scientific Name**	**Reason**
Tree-of-heaven	Ailanthus altissima	PA Noxious Weed
Japanese Angelica Tree	Aralia elata	PA Noxious Weed
Callery Pear	Pyrus calleryana	PA Noxious Weed
Common Buckthorn	Rhamnus cathartica	PA Noxious Weed
Glossy Buckthorn	Rhamnus frangula	PA Noxious Weed
Burning bush	Euonymus alatus	PA Noxious Weed
Privet	Ligustrum sinense, L. vul(	PA Noxious Weed
Honeysuckle	Lonicera spp.	PA Noxious Weed. Two native exemptions
Amur Corktree	Phellodendron amurense	Invading PA woodlands
Japanese Pagoda Tree	Styphnolobium japonicum	Emerging invasive
Ginko Tree	Ginko biloba	Overplanted with little ecosystem benifit

Common Name	Scientific names	Deciduous	Max height (ft)	Moist soil	Well-drained soil	Soil tolerance	Shade tolerant	Slope	Street side	Wildlife	Aesthetic	Pests/diseases	Additional notes
Pawpaw	Asinima triloba	Deciduous	30	X	X		X			X			Large edible fruit
Sugar Maple	Acer saccharum	Deciduous	90	X				X			X	X	Good large ornamental
Service berry	Amelancheir sp.	Deciduous	25	X	X							Resistant	Occasionally 40+ feet tall
Yellow Birch	Betula alleghaniensis	Deciduous	80	X	X						X		Fall foliage, relativly long lived for a birch
Sweet Birch	Betula lenta	Deciduous	60	X	X	X						X	Fall foliage
River birch	Betula nigra	Deciduous	70	X	X	X						Pretty resistant	Most borer-resistant birch
Paper birch	Betula papyrifera	Deciduous	70	X	X					X	X	X	Short-lived, less lively in part shade
American Chestnut	Castanea dentata	Deciduous										X*	Will depend on the release of a blight dependent
Musclewood	Carpius caroliniana	Deciduous	30	X			X						
Bitternut hickory	Carya cordiformis	Deciduous	75	X	X		X	X			X	X	Nuts
Shellbark hickory	Carya laciniosa	Deciduous	80	X				X			X	X	Nuts in high demand
Shagbark Hickory	Carya ovata	Deciduous	115		X					X		X	Nuts. Visually intresting bark and good habitat
Common hackberry	Celtis occidentalis	Deciduous	80	X		X	X	X	X	X		X	Small fruit, 80' in moist limestone
Eastern Redbud	Cercis canadensis	Deciduous	25		X	X					X		Pretty pink flowers
American Fingetree	Chionanthus virginicus	Deciduous	15	X	X					X	X	X	Spring white flowers, fall yellow foliage. Can live in wet areas
Flowering Dogwood	Cornus floridia	Deciduous	30	X	X		X				X	X	White flowers, red berries
American Perssimon	Diospyros virginiana	Deciduous	60	X	X					X			Male and female trees needed for fruit. Fruit potentially messy
Ash	Fraxinus Spp.	Deciduous										X*	Will depend on release of resistant varieties
Honey locust	Gleditsia triacanthos	Deciduous	80	X					X		X	X*	Thorns (available thornless variety), pests, fragrance
Black Walnut	Julgans nigra	Deciduous	90	X	X							X	Contains chemical which inhibits growth in other plants. Large messy fruit
Tuliptree	Liriodendron tulipifera	Deciduous	140								X	X	Cone-like, flowers (May - June), good shade
Cucumber tree	Magnolia acuminata	Deciduous	90	X		X		X				X	Flowers (April - June)
American crabapple	Malus coronaria	Deciduous	25	X	X	X				X	X	X	Fragrance, fruit, don't plant with pests alternative host Junipers
Red mulberry	Morus rubra	Deciduous	50	X				X		X		X	Conservation status (issues with hyprids), fruit, needs lots of space
Sour gum	Nyssa sylvatica	Deciduous	50	X	X	X					X	X	Acidic soils, slow-growing, flowers, fruits
Hop-hornbeam	Ostrya virginiana	Deciduous	50		X		X				X	Resistant	
Sycamore	Platanus occidentalis	Deciduous	100	X		X	X					X*	Pod fruit
Quacking Aspen	Populus tremuloides	Deciduous	50	X							X	X	Good for quickly filling in space and obscuring sighttlines. Short lived tree
Black cherry	Prunus serotina	Deciduous	110	X	X					X		X	Wildlife fruit and pretty fall colors
Choke cherry	Prunus virginiana	Deciduous	30							X		X	Small fruit, short-lived, fast-growing, several dozen species eat fruit
White oak	Quercus alba	Deciduous	100	X	X					X	X	X	Acorns, long-lived
Scarlet oak	Quercus coccinea	Deciduous	80		X	X					X	X	Acorns, fungus infections
Chestnut Oak	Quercus montana	Deciduous	80		X			X		X		X	Occasional large mast years
Pin Oak	Quercus palustris	Deciduous	80	X					X	X		X	Small lower branches persist after dying
Northern red oak	Quercus rubra	Deciduous	75 +	X	X	X				X		X*	Acorns, good shade
Sumard Oak	Quercus shumardii	Deciduous	70	X	X	X			X	X	X	X	Relativly fast growing. Red autumn leaves
Black oak	Quercus velutina	Deciduous	60	X	X	X		X			X	X	Flowers (April - May), good shade
Black Willow	Salix nigra	Deciduous	80	X								X	Fast growing/short lived. Roots may impact foundations, pipes etc. Water loving
Sassafras	Sassafras albidum	Deciduous	60	X	X						X		Pretty fall colors, will send up shoots
American Linden	Tilia americana	Deciduous	100	X								X	Large native w/ light small seed
American Holly	Ilex opaca	Evergreen	60	X	X							X	
Red Cedar	Juniperus virginiana	Evergreen	40	X						X		X	Alternative hoast for ceda-apple fungus. Generally have lower branches
Mountian Laural	Kalmia latifolia	Evergreen	15	X	X		X						Acidic soil, state flower
Red spruce	Picea rubens	Evergreen	75	X	X							X	Cones, flowers (May)
Rhododenron	Rhododenron maximum	Evergreen	15	X	X		X				X		
White Cedar	Thuja occidentalis	Evergreen	40	X	X							X	Dry wind and too much shade will impact foliage. Often used for hedges. Compact form
Pitch pine	Pinus rigida	Evergreen	60			X			X			X	Poor & sandy soils, cones
Eastern Hemlock	Tsuga canadensis	Evergreen	70	X			X					X*	State tree, cones, long-lived
Non- native to PA Species													
Norway Spruce	Picea abies	Evergreen	100	X	X							Resistant	European
Atlantic white cedar	Chamaecyparis thyoide	Evergreen	75	X								Resistant	Fragrance. Native to US eastern coast. Very high mosture/wetland needs)
Sweet gum	Liquidambar styraciflua	Deciduous	75	X	X						X	X	seed balls with spiky appearance + native south and east of meadville (Kormanik n.d)
Umbrella magnolia	Magnolia tripetela	Deciduous	30	X	X		X		X			X	Fruit, flowers, native further south in US
Kentuky Coffee Tree	Gymnocladus dioicus	Deciduous	80	X								Resistant	Depends on source if listed as native. Large seed pods and litter

B. Citree : Database of trees by planting specifications

https://citree.de/database.php?language=en#

This is an amazing resource to search for trees by location considerations, or to confirm that a suggested tree will fit a specific area. Searches can be filtered by natural distribution, plant hardiness, allergies, fall color, root damage, limb breakage, maintenance levels and more. I suggest "locking" and therefore completely excluding the filter *Origin* to *North America* and *Plant Hardiness Zone* to *6b*. Most other settings may be adjusted depending on the location and need.

C. North Carolina Extension Gardener Plant Toolbox: Tree descriptions

https://plants.ces.ncsu.edu/

The toolbox is a great source for concise and clear information about utilizing trees in landscaping, their potential threats, and where they survive and look the best. While created by the North Carolina Cooperative Extension office, the information is provided in a way that can be applied in Meadville.

D. The ForeCASTS project: Shows projected future tree ranges

https://www.geobabble.org/ForeCASTS/

The ForeCASTS project contains projected range maps for many species and is a helpful tool for determining what species might do will in Meadville in the future based on two different climate models

E. City of Meadville Requirements

A few relevant are City of Meadville requirements described below. The entire requirements can be found at https://ecode360.com/42390043 .

- 909.05A
    - (1) Trim and prune such trees within city streets so that no part of its limbs, branches or foliage shall have a clearance of less than eight feet above the surface of the sidewalk or of less than 14 feet above the surface of the roadway, street or alley. Tree trimmings shall be properly removed and disposed of.
    - (2) Trim and remove dead, diseased, broken and decayed limbs and branches from trees within city streets which constitute a hazard to sidewalk pedestrians, street traffic, or to the public generally.
    - (3) Remove from within city streets all dead, diseased or such other trees, including stumps, which constitute a hazard to the public by reason of diseased or other dangerous condition.
- 1306.16

- Buffers are required between certain developments & family residences. These buffers, if plants, must be replaced within 6 months of death.
- 3 rows of conifers or opaque fence & plantings or 25ft plantings.

F. Pest Threats

Some of the major disease threats to the Allegheny Urban forest and an evaluation of their respective potential impacts.

Pest/ Disease	Primary Host(s)	Detailed Analysis
Spongy (Gypsy) Moth		A serious concern found within Crawford County. However, the majority of the moth's defoliating impacts have so far centered around the PA Wilds region, where spraying and biocontrols help limit the destruction (USDA Forest Health Highlights). There have been some high spongy moss egg mass counts in Crawford county (including 1 count of >800 eggs/acre in 2022), however so far the county has not seen the same level of defoliation and tree stress as the central northern portion of the state (USDA Forest Health Highlights).
Beach Leaf Disease and Beech Bark Disease	Beach Trees	Both diseases may kill their beach hosts over time, and have limited control options. There are only 5 beaches on campus, all varieties of the European Beech. Roberstson and Bouson forests may face much more damage.
Dogwood Anthracnose	Dogwood species, especially C. floridia (Florida or Flowering dogwood)	Over the course of multiple years it may kill the tree, although younger and more shaded trees are more susceptible. There are ways to control the Anthracnose in planted conditions.
The Emerald Ash Borer (EAB)		The EAB was detected in 2013-14 in Crawford county (USDA Forest Health Highlights) . It is impressive that we have any large surviving ashes at all, however three of the four we do have are very obviously in decline necessitating removal.
Dutch Elm	Elms	Dutch Elm Disease has been present in Pennsylvania

Disease		for decades and has a very high mortality rate, although there are now disease resistant cultivars. The three Elm trees found during the survey appear to be in good health.
The Hemlock Woolly Adelgid (HWA)	Hemlocks	HWA was just found in Crawford County for the first time in 2024 (Dr. Rich Bowden, Personal Communication). Elongate hemlock scale is also found within Crawford County and is a threat to Allegheny College's Hemlocks as well. There are 24 threatened Hemlocks within the current inventory, mortality may reach 90% over multiple years if there is a bad infection. Hemlock is the state tree of PA.
Oak Wilt (Bretziella fagacearum	Oaks	Oak Wilt can rapidly kill trees and spread through roots as well as mechanically. Oak wilt has been found in most of PA's western counties, including Erie and Venengo, but not Crawford (USDA Forest Health Highlights). All 56 oaks on campus could be threatened by the blight, with red oaks being especially susceptible (PA DCNR, Other Insects and Diseases). Many of the large trees on campus are oaks.
Pine Shoot Beetle, White Pine Blister Rust and Brown spot needle blight	Pines (especially white pines)	These, as well as other diseases may all impact Pine health. The combination of all these pests is creating a health concern for White Pines, such that their long term health may be in danger (Costanza et al. 2018). Climate change has a contributing role in White Pine decline, however limiting stress and increasing light may help pines survive infections (Brazee 2019)
The Spotted Lanternfly (SLF)	Many trees and plants	The SLF has been reported in Mercer County, but again not yet Crawford County (as of March 2024). At least 322 trees on campus are vulnerable to the pest, with a value of $891,000 according to i-Trees. However, new research shows that trees may not be as vulnerable to the Spotted Lanternfly as thought, growth and leaf density might be impacted but tree mortality would likely be limited on the Allegheny campus (Hoover et al. 2023) Pennsylvania

		Department of Agriculture monitoring efforts have included placing traps on Allegheny's campus (Personal Communication, Kelly Boulton).
Asian Longhorned Beetles	Many Species	A threat to almost 200 of Allegheny College's inventoried trees. There are effective management and quarantine methods for the Beatles, so although they have been found within 250 miles of Meadville, there is reason to hope they will to impact the campus in the near future if at all (PA DCNR, Other Insects and Disease)

G. IPM Tree Plan

The following is an excerpt of the Allegheny College Integrated Pest Management Plan created by Anna Westbrook, a student intern in the college's Office of Sustainability during spring 2023. This excerpt contains pages 14-16, with a few edits.

Tree Plan

Thanks to the work of dedicated students and faculty, there is a lot of information about the current state of Allegheny's urban forest. Most of it is linked in this document titled Allegheny College Forest Management. The Office of Sustainability submitted an application to become a part of the Tree Campus program of the Arbor Day Foundations. Also of note is a published paper co-authored by multiple environmental science professors and the Office of Sustainability titled Growing a resilient campus forest: opportunities, barriers, solutions. These documents contain information about the health of trees on campus and can be a useful additional resource when determining how to deal with pests in an efficient, environmentally-friendly manner.

01. Preventative practices

Inspections and monitoring
Physical Plant will conduct regular monitoring of the trees on campus, which will enable them to identify potential pest or disease manifestations early on.

Hand weeding/maintenance and mulching
Physical Plant and contractors will mulch appropriate tree beds at the beginning of spring. When there are weeds in the beds, Physical Plant will hand-weed the affected area and then apply a thin layer of mulch on top to prevent further growth. Where reasonable alternatives to mulching should be explored including native plantings (See Molly Miller's Comp, 2024).

All trees should have mulch surrounding their base at a radius of at least 2 feet in order to protect the trunks from being hit by lawn care equipment, like edgers or mowers. This will prevent the equipment from hitting the trunks and causing gaps in the bark that make it easier for harmful fungi to enter the tree. Additionally, the mulch should not be mounded up around the trunk. Instead, the mulch should start 3 to 6 inches away from the trunk of the tree, which will prevent the trunk from rotting. The mulch should have a depth of 2 to 4 inches. Mulch any deeper than that will encourage the expansion of the tree roots into the mulch pile, which does not have the necessary nutrients for the tree. Regular mulching will decrease competition from surrounding grass, conserve moisture for trees to use, and protect trees from lawn care equipment, which prevents the trunk of the tree from becoming a weak point that is susceptible to pest infestation (K-State).

02. Problem Pests

When the IPM Plan is up for review each year, Physical Plant will fill out the following table with information on what pests they suspect will be a recurring problem for the trees that year:

Pest		
Severity of infestation (prior year)		
Severity of infestation (anticipated in upcoming year)		
Possible treatments		
Goal of treatments		

03. Pesticide use

Physical Plant will follow the same pesticide application procedures that are outlined in the turf management portion of this IPM Plan.

Under no circumstances will Physical Plant apply pesticides to trees that produce edible fruit, like the apple trees. If Physical Plant identifies any pest infestations in these trees, the Campus Ecosystem Working Group and the student groups who maintain those trees will be notified.

04. Tree removal and replacement

The decision to remove sick trees will be made by Physical Plant in consultation with the college's arborist. The decision of what tree to plant in replacement will be determined by the Campus Ecosystem Working Group and the college's arborist. In all cases, trees replaced on campus should be native.

During the annual renewal process of this IPM Plan, Physical Plant will fill out the following table so that all members of the Campus Ecosystems Working Group are aware of upcoming tree removal and the reason for it:

Location of tree removal		
Tree species (and # of trees)		
Reason for tree removal		
Prior integrated pest management practices that failed to prevent pest infestation		
Replacement tree (species, age)		

05. Communication

Allegheny students care deeply about the trees on campus. In the past, when trees have been removed, it often appears to students to happen suddenly. As a result, students and environmental clubs have expressed their unhappiness to one another, to the Director of Sustainability, and anonymously over YikYak. In an effort to engage the student body with their campus environment, it will be a priority of the Campus Ecosystem Working Group and Physical Plant going forward to communicate to students ahead of a tree removal why the removal is going to take place. In addition to quelling concerns, this awareness can be an opportunity for educating students about common pests, like the Emerald Ash Borer or harmful fungi.