A Guide to the Woody Plants of WPI

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the
requirements for the degree of Bachelor of Science

by
Leonela Sabrina Vega Loaisa

Date:
April 13, 2018

Report Submitted to:

Professor Robert Traver
Worcester Polytechnic Institute

Abstract

The purpose of this Interactive Qualifying Project (IQP) is to enhance the appreciation of the woody plants on campus. This project achieved its purpose through a diagrammatic representation of the trees and shrubs on the WPI campus and a self-guided tree tour. The map consists of the accurate location and the identified scientific and common name of the tree or shrub (found in https://drive.google.com/open?id=1sbJRrIHiZtPCUIMbRmlzM12DgrY&usp=sharing). The self-guided tree tour, in the form of a brochure consists of a guided path among the most important and/or interesting woody plants identified and a short description of the plant. With the completion of this project, WPI has more to offer from its campus.

Table of Contents

1. Introduction

Woody plants have a rich history of involvement in human life. They have proven to be useful environmentally, medicinally, nutritionally, and in psychological, social, and historic value (Morgan, 1993). When urban planning became increasingly popular in the 19th century, the use of ornamental trees and shrubs became commonplace. Using woody plants for aesthetic purposes became the norm (Hall, 2014). Ornamental use of woody plants made a large impact in the lives of humans as they modified plants to meet their visual needs; plants provide visual appeal that can make or break a scene.

Woody plants are used to make the landscape of both public and private properties look more inviting. Another large consumer of woody plants for this type of use are universities. For example, most university marketing material featuring a picture taken outdoors will surely include a green space on their campus.

Worcester Polytechnic Institute (WPI) has a rich community of woody plants that make the campus look extraordinary. For example, upon stepping onto campus through the main entrance, pedestrians encounter a split view of the Beech Circle rotary to their left and the walkway to the fountain on the right. What is truly breathtaking from that point of view, at any time of the year, is the great beech tree with a canopy that spans over 50 feet in the center of that rotary. Additionally, there many beautiful woody plants adorning the walkway and buildings on the way to the fountain and beyond. As simple as woody plants may seem to be, they play a significant role in enhancing the pedestrian experience on campus.

Until now, there has been no comprehensive record of the names and locations of these woody plants on campus. This is truly an oversight because current literature and case studies of

campuses across the nation show that such a record serves many uses. This report will explain why and how this project addresses this shortcoming.

2. Background / Literature Review

The green spaces on campus are an invaluable feature of college life. For a few seconds, students can escape the hectic environment and appreciate the contrasting simplicity and complexity of nature. When it is sunny outside, there is an immediate increase in the number of people who go out to explore what campus has to offer. The campus quadrangle, the spacious lawn surrounded by 4 buildings, becomes populated with students having a good time lying on the grass or going for walks. As seen with these examples, the plants and green spaces on campus not only give the opportunity for an escape but also have many other overlooked benefits.

2.1 Nature's Role in our Surroundings

From early on, humans have kept nature in proximity. Civilizations have destroyed nature to build homes and places for their people to thrive. However, they have purposefully maintained green spaces around them. People have learned to incorporate this instinctive need for nature into their homes and daily lives, even to this day. Currently, a myriad of studies have scientific evidence to prove the importance of the benefits that come with surrounding ourselves with nature.

2.1.1 Benefits of Green Spaces

Various studies show that landscapes with woody plants correspond to more relaxed physiological states for humans in comparison to people who don't have access to them (Dwyer, McPherson, Schroeder, & Rowntree, 1992). Surrounding green spaces reduce stress, improve physical health, increase enjoyment of daily life, and give a greater sense of meaningful

connection between people and nature (Dwyer, McPherson, Schroeder, & Rowntree, 1992). A study in the campus of the National Taiwan University (NTU) demonstrated that subjects experienced decreased pulse rates when exposed to green spaces (Chou, Lee, & Chang, 2016). Furthermore, the decreased pulse rates result in lower levels of fear and stress.

The College of Horticulture of the Jinling Institute of Technology in Nanjing, China, also studied the effects of green spaces on the community (Chang & Zhang, 2013). Their results show that the benefits of greater exposure to green spaces on campus can be seen to impact student life, even going as far as increasing students' ability to learn. Daily routines may require large mental efforts. Therefore, the study concluded that students need a place to appreciate nature as people are more peaceful and demonstrate a better mood with green spaces surrounding them (Chang & Zhang, 2013). Facilitating activity around green spaces fulfills that need.

2.2 Inventories on College Campuses

Universities have a need to make their campuses appealing to its community and visitors. The primary reason for including green spaces in their marketing materials is simply that trees and nature look pretty in pictures. Beyond that, people do tend to be generally interested in trees and nature. However, many lack knowledge of them and their resources (Wood, 1999).

Having knowledge of all the benefits of green spaces on campus, universities and academic institutions have gone further to help integrate the nature on campus with the daily lives of their communities (Hipp, Gulwadi, Alves, & Sequeira, 2015). Many have conducted tree inventories for various purposes, including implementing tree management plans, gaining recognition for their woody plants, and creating arboretums and botanical gardens. A key outcome of having a tree inventory is that by educating people about woody plants, it fosters

community involvement and spirit (Dwyer, McPherson, Schroeder, & Rowntree, 1992) (Wood, 1999).

A few examples out of the many campuses that incorporate arboretums include Harvard University's Arnold Arboretum, The Arboretum at Penn State, and High Point University of North Carolina. These universities--like many others--had master plans that included creating inventories and arboretums on or near their campuses in order to take advantage of all the benefits that green spaces and their records provide ("Marian H. Qubein", 2013; "Mission", 2018; "The Mission of the Arnold Arboretum", 1990). Taking it one step further, these campuses have taken advantage of their inventories and/or arboretums by using them for educational and research purposes in addition to providing awareness of the woody plants to the students.

2.2.1 Case Studies

Case studies have been conducted on the effects of inventories and arboretums on college campuses to officially identify their advantages. This section will summarize two separate case studies and their results. The first case study was conducted as a meta-study of three distinct university campuses. The second case study discusses research conducted on one campus only. Conducting these case studies have provided further scientific evidence to support qualitative observations of the added benefits of inventories and arboretums.

2.2.1.1 Quality of Life Studied at 3 Universities

Studies have shown that the closeness and access to green spaces are valuable to students in numerous ways. The study "The Relationship Between Perceived Greenness and Perceived Restorativeness of University Campuses and Student-Reported Quality of Life" analyzed 3 universities (Hipp, Gulwadi, Alves, & Sequeira, 2015). The names of the universities are not given. However, the universities were chosen based on a similar ability to provide

generalizability to the results and by having what the researchers deemed “sufficient green space for exploring perceived greenness”. Out of the three chosen universities, one had a tree inventory and the other two did not.

This study was able to explain the link between quality of life and the green spaces on campus among its findings. Quality of life is a large factor in university quality perception. Students who spend more time outside have a better quality of life than those who do not. Another finding was that green spaces are preferred over any other type of student space. The university that contained the tree inventory and one other had their participants claiming that they perceived that their university had a restorative environment. Overall the university with the existing tree inventory received a high rating of student quality of life by the participants.

2.2.1.2 University of Pennsylvania

The University of Pennsylvania (UPenn) has initiated a multitude of projects to enhance their campuses. After studying the effects of all their initiatives, they concluded that trees enhance the urban environment, improve public health, and provides aesthetic benefits to the inclusive areas (Bassett, 2015). Having an inventory and map of the woody plants increases the value of the urban areas while quantifying information helps maximize benefits of urban green spaces. Additionally, having trees surrounding academic institutions has many positive impacts including: increased sustained attentional capacity, stress relief, and reducing effects of negative urban factors like overpopulation and air pollution.

The University of Pennsylvania has made strides in the improvement of their campus through rigorous planning and data collection of the plant species they have on their campus. UPenn has connections with the Morris Arboretum in Chestnut Hill and has a “Creating a Canopy” tree giveaway program (Bassett, 2015). UPenn has also been recognized as a Tree Campus USA for 6 years (Bassett, 2015). Over 500 universities have been recognized as a “Tree

Campus USA" as of spring 2016 (Tree Campus USA Schools, 2016). This is a large indication that many institutions invest into something that brings pride to the campus environment (Hipp, Gulwadi, Alves, & Sequeira, 2015).

2.3 Green Spaces at WPI

WPI has beautified its campus more and more as the years pass. From the first building on this campus being constructed in 1868 (Boynton Hall) to the last building in 2012 (Recreation Center), WPI has not failed to surround its buildings with beautiful flowers, trees, and shrubs (WPI, 2016).

Students have found various ways to take advantage of the green spaces on campus. On days with nice weather, students find time in between classes and sit on the grass or in the shade under a tree and just relax. It is guaranteed that when it is sunny out, there will be at least one hammock on the Magnolia's by the fountain or people playing Frisbee on the quad. The plants and shrubs of our campus provide a place for students to relax and to enjoy their view.

WPI has over 800 trees and shrubs on campus that visitors often overlook. Visitors get to peek at the plants when they sign up for campus tours. On this tour, they get to walk around campus to learn where various buildings are or any important student centers on campus (WPI, www.wpi.edu, 2016)

The grounds crew of WPI (part of the Department of Facilities) manages all the plants on campus. They are in charge of the maintenance, removal, and addition of the plants. The grounds crew may know exactly what they are looking at or how special a plant is, but the vast majority of students and faculty do not. Due to this gap in knowledge, there is a need on campus for an enhancement of the exposure to the trees and shrubs. The woody plants must be located, researched, and identified.

Based on this need, the data that was collected for each woody plant species included the accurate identification, location, and any historical or meaningful information of the species. With this data, a map and brochure of the woody plants of WPI was created as the deliverables of this IQP. WPI visitors and community will be able to use the map and brochure and guide themselves throughout the campus to view and learn more about the woody plants. Initially this project will serve to allow WPI to take further advantage of the beautiful woody plants on its campus and increase awareness of the plants to the community, however, in the long run the advantages of such a development may expand much further as seen in previous examples at other campuses.

3. Methodology

The methodology chapter will explain the steps that were taken to complete this project. The two subsections of this methodology are plant identification and plant location. Plant identification was completed by using in-text sources as well as field observations and then consulting and shadowing field experts. Plant location was acquired and communicated using a mobile global positioning system (GPS) and transferring that information onto online mapping software to create a map and a brochure. The methodology also includes interviewing representatives of the WPI facilities department as well as Bartlett Tree plant identification experts in order to gain the expertise and information necessary for both the plant identification and location efforts.

3.1 Woody Plant Identification

The woody plants on campus include trees and shrubs. The woody plants that were identified are west of Grove Street, east of Park Avenue and north of Institute Road up into Institute Park. The land included in this is mostly WPI owned with the exception of the park. The

project included Institute Park trees because it is very common for students to spend time there since it is neighboring the campus. In addition, many members of the community walk home or to Gateway via the Institute Park walkway.

Plant identification was approached first by consulting plant identification literature accompanied by field observations. Due to university use of local tree experts, the majority of the trees on the main campus were identified by the Bartlett Tree Experts while the project researcher shadowed them. The rest of the woody plants in the aforementioned areas were identified by the project researcher.

3.1.1 Text and Field Observation

Plant identification requires acquaintance with the necessary resources. The main in-text resources were plant identification literature. These included field guides, pictorial keys, buyer's guides, and interactive multi-entry keys.

Field guides provide descriptions and illustrations of different types of species; they direct attention to such things as bark pattern, leaf number and placement, and flower/fruit type. The standard field guides: *A Field Guide to Trees and Shrubs* (1972) and *Trees: A Guide to Familiar American Trees* (1952), assisted with the accurate identification of the woody plants.

Pictorial keys are useful because they allow the user to identify species based on visual comparisons rather than written descriptions. The pictorial keys used in this project were *The Tree Identification Book* (1958) and *The Shrub Identification Book* (1963).

Buyer's guides were especially helpful to identify the shrubs since most of shrubs on campus are of landscape variety. This project utilized *Weston Nurseries Online Buying Guide*. This buyer's guide was recommended by the Bartlett Tree Experts arborist.

Interactive online keys helped for the few woody plants that were not in the field guides. The online keys *What Tree is That? Tree Identification Guide at arborday.org*, *OPLIN What Tree is That?* and *University of Wisconsin's Dichotomous Tree Identification Key* all assisted with the woody plants that were not well represented in the aforementioned literature.

3.1.2 Field Experts and Shadowing

Overall, the identification keys worked well. However, the use of field guides and plant identification websites are limiting due to the size of their inventories in addition to user error. Therefore, it was essential to have additional input on the identification. Some plants are naturally more difficult to identify than others, so having an expert is the best way to settle any confusion or even just to confirm completed identifications. This project collaborated with experts from the Bartlett Tree Experts (BTE).

BTE is a tree service company that appraises and maintains trees for institutional, commercial, educational, municipal, and individual clients. When requested, BTE can also make tree inventories. In addition, they can establish the status of the trees by appraising the trees' health and by suggesting improvements. WPI has utilized these services.

To date, tree maintenance and removal has been the focus of BTE's work on our campus. Recently their attention has turned to creating a record of the trees that exist on campus as well as their condition. This type of data allows for easier management of tree maintenance since some trees are of higher priority due to their declining health. For example, if a disease specific to one type of tree is spreading in the New England area, the university can more readily divert their efforts to providing care to the specified trees by knowing how many there are and where they are located.

To begin the work of gathering this data, the BTE team set out with GPS enabled devices to input the location, identification, health statistics, recommendations, and pictures as part of

their other duties. The experts record the data in the GPS device and transfer it to a computer to upload to Arborscope (Bartlett Inventory Solutions, 2015). Arborscope is the software BTE uses in order for their clients to view the inventory and collected data. The project drew on the BTE collected data to begin the project's inventory of the trees. Due to the large volume of unique data collected for each individual tree, the data had to be synthesized and organized for the average community member so as to easily access the location and identification information only.

As the tree experts were gathering their data, the project team shadowed the experts from June 20th to 22nd of 2017, 8am-3pm. The shadowing watched what experts do to identify plant species and to gather tips and tricks to make identifications quickly. For example, when unsure which of two species a specimen might be, the experts immediately looked at the ground for pinecones or foliage to examine the shape and size. With the experience, the project team successfully identified the unexamined trees and shrubs. The next step of the project, communicating woody plant location, was approached by using the synthesized data in conjunction with the completed plant identification of the unexamined trees and shrubs.

3.2 Plant Location and Significance

This section will include details on the procedure and resources used to obtain plant location and significance. The first deliverable of the project, the woody plant inventory map, requires having the accurate location of the plant in addition to the proper identification. The resources that were used to complete this deliverable are a mobile GPS application in conjunction with microsoft office Excel and Google My Maps. The reasoning for using these resources will be described. The second deliverable of the project, the self-guided tree tour brochure, requires information acquired to create the map as well as significant information on the featured plants. As the tree tour brochure is meant to be self-guided, the following sections

will also explain how the map and plant significance data play a role for the creation of this deliverable.

3.2.1 Woody Plant Map

The project researcher was not equipped with professional tools to create a tree inventory. The tree service industry typically uses a device that will collect all data necessary for a tree inventory at once. This data is then uploaded into their own private software. While this method clearly has many positive features, the project chose to use alternatives because the aforementioned device and software are typically expensive and not readily available to the public. For that reason the project utilizes the applications GPS Tour and Excel in a novel way in order to complete the task of location data acquisition. To create the woody plant map, Google My Maps was used.

Data acquisition for plant location utilized the GPS Tour application and Excel. GPS Tour is a mobile application typically used for outdoor sporting events where the location of the participant must be quickly and accurately determined (Apple, 2016). Using this mobile app, the user can save and define their coordinates as a location record. The location record can be made even when there is little or no internet connection. The only limiting parameter of the software was that it could only store up to 20 location records at a time. To surmount this problem, the project transferred the data to Excel. Once the data was transferred, the local storage in the application could be deleted to begin storing new location records. In doing so, the storage limit was no longer an issue. The data gathered using GPS Tour and Excel was later used to create the web-based woody plant map.

Google My Maps was chosen as the software to create the final version of the woody plant map. An important reason for choosing this platform for the map creation was that its

parent company, Google Maps, is the default GPS and map service on most mobile phones. The largest advantage of this fact is that potential users of the campus woody plant map would not have to download additional applications to find the campus inventory. Additionally, Google My Maps has a user interface that can be learned quickly. To begin the creation of the map the location of the woody plant must be matched to its identity and marked on Google My Maps. This step was repeated throughout the campus and adjoining park until the entirety of the woody plants were catalogued. The completion of this deliverable made possible work on the second deliverable, the tree tour brochure.

3.2.2 Self-Guided Tree Tour Brochure

The second goal of the project was to create a brochure for a self-guided tree tour. The brochure would contain a selection of trees with information such as their identification, description, and location marked on a mini map. The aim was to allow anyone with this brochure to guide themselves from tree to tree, one by one. Although the woody plant map has the location and identification of the woody plants on campus, it might not attract a general audience of campus visitors due to the large volume of identified species. Additionally, the self-guided tree tour brochure would also contain descriptions that are not given in the woody plant map that describe the plants' interest to the WPI community.

Due to the nature of this deliverable, the project could only include fourteen trees. Choosing this number of trees kept the brochure from becoming a catalog and allowed it to fit comfortably in a typical tri-fold brochure. Due to the limited number of trees that could be included, criteria were chosen to decide which trees appeared in the brochure. The first criteria was that the selection of trees must give some indication of campus plant diversity. This meant for example, that although the campus may have varying types of oaks (a generic name or genus), only two of the same genus would be chosen. The second criteria was less objective than

the first, since it was based on the researcher's favorites. For example, some trees such as the River Birch, exhibit a highly interesting bark that appears to peel off like pieces of paper as it matures. The third and final criteria for choosing the trees was campus significance. This criteria could include trees, for example, that could have resisted a well-known woody plant disease outbreak in the region. Though there are many tree candidates that could be included in the brochure, the three criteria identify those that should make for a self-guided tour that is truly enjoyable.

Aside from choosing trees to be a part of the brochure, there also had to be research done to investigate their significance further. The use of field guides and local experts facilitated this. Finding the significance of plants by using field guides is possible because the guides not only explain the physical characteristics of plant species, but also explain other uses and interesting facts. However, local experts are necessary to find any culturally or WPI-specific significance. For expert assistance, the team spoke to the WPI Manager of Grounds and Properties, Alan Carlsen. Mr. Carlsen has been taking care of the grounds at WPI for 5 years. The project scheduled walks with Mr. Carlsen in order to learn more about the woody plants from his point of view. Since Mr. Carlsen is in charge of grounds, he also provided insight on any rare plants on campus.

4. Results

The results chapter will demonstrate the deliverables that were completed in this project. The first deliverable is the web based map and the second deliverable is the self-guided tree tour brochure. Both deliverables serve as the culmination of the information acquired and communicated as described in the methodology chapter. Additionally this chapter also describes the current use of the web based map in WPI classrooms.

4.1 Web Based Map

The first deliverable of the project, the woody plant map, features a tree inventory of the existing woody plants in the main WPI campus and the neighboring Institute Park. It is accessible on computers and mobile devices through the following link: [https://drive.google.com/open?id=1sbJRrIHiZtPCUIMbRmlzM12DgrY&usp=sharing]. Figure 1 shows an example of an open item on the map.

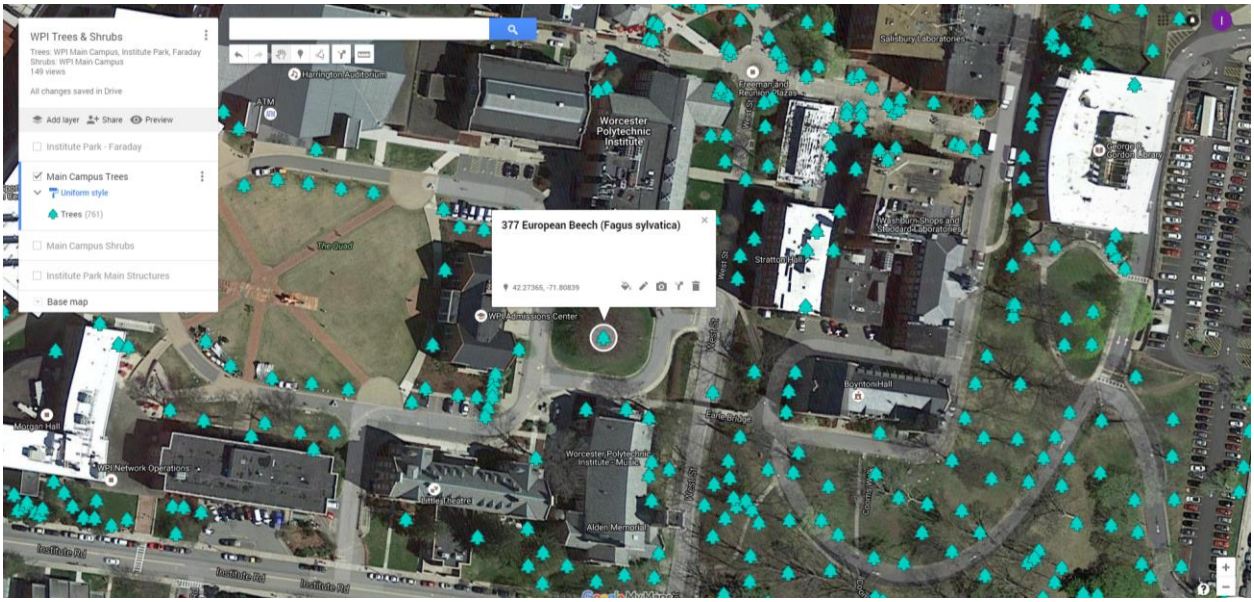

Fig. 1 Woody Plants Map

Each woody plant has its own icon, which is described as a “Pin” on the Google My Maps software. When the user clicks the icon, a pop up describes the plant identification. The trees and shrubs are pinned with a green tree symbol and a purple flower symbol respectively (Table 1 and Figure 2). A polygon is used to reduce clutter if there are many shrubs in one area.

Table 1: Tag Meanings

Pin	Meaning
	Tree
	Shrub
	Large area of shrubs

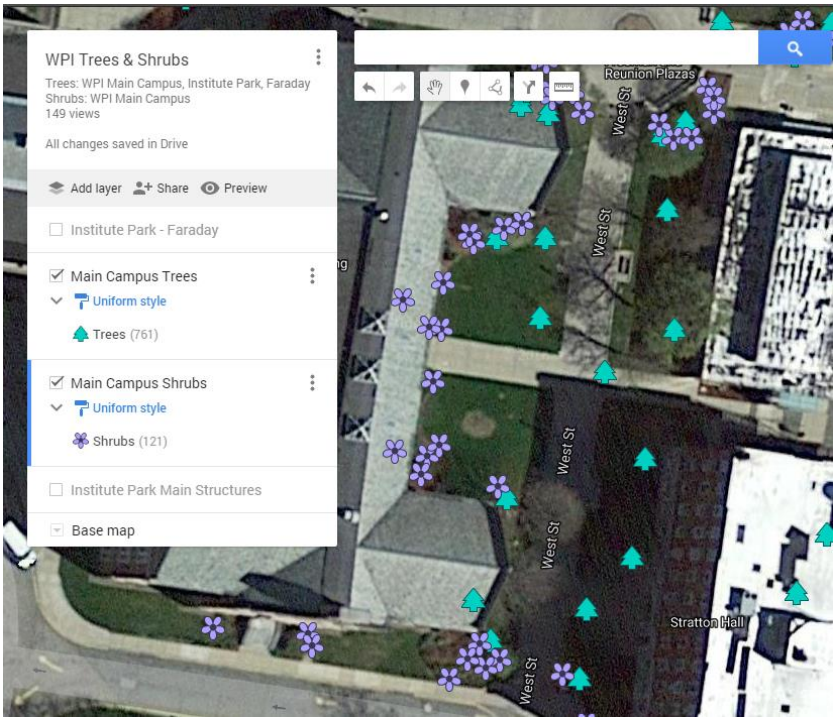

Fig. 2 Tree and Shrub Pins

As seen in Figure 2, the user interface has check boxes for the different groups of trees and shrubs. This means that the map also gives an option to view only trees and to view only shrubs. Likewise, they can be viewed at the same time or not at all. These features, along with the data the map provides, paves the way for this woody plant map to be used for alternative purposes other than its primary leisurely use.

To date, (C-Term, 2018) the map has served as a field guide in a WPI classroom. Professor Marja Bakermans teaches a Great Problems Seminar (GPS) *Extinctions* class, a course aimed at debating past and present causes of extinction and its consequences. The students were divided into teams and assigned different locations on campus. By using the woody plant map as a species catalog, students learned how to calculate measures of diversity such as species richness and Shannon diversity. The students also examined the Institute Park area for the same diversity measures. With their data the students were able to compare the areas. Additionally, the inventory helped students study the native and invasive species on campus in order to understand the consequences for other species and the natural area as a whole.

4.2 Tree Tour Brochure

The Tree Tour Brochure gives the WPI community and its visitors a chance to learn about the campus's woody plants without being overwhelmed by the myriad specimens of plants that appear in the campus map. As illustrated in Figure 3, the tour includes the fourteen most interesting trees on campus with a brief description. This way, tree tourists can not only discover the beauty of the trees but also learn some interesting facts about them.

Fig. 3 Tree Tour Brochure

The brochure includes a balance of qualitative and scientific information, meant to bridge the gap between the WPI community and trees. No background knowledge of trees is necessary

to use this brochure. Anyone may pick up the brochure and enjoy the small descriptions full of interesting anecdotes, facts, or quotes about the handpicked featured trees residing on the WPI campus.

5. Conclusion

With the completion of this project WPI has more to offer for the WPI community and its visitors. Along with any activities and programs that are currently in place, WPI will be able to offer a campus map with all the woody plants on campus tagged and identified. Along with this, there will be a brochure offered for a self-guided tour of the most significant woody plants. This project has made one more part of the existing WPI campus visitor-friendly. Additionally, as the inventory and map has already shown promising use in classrooms, further development of this project holds the opportunity to further broaden the advantages the campus tree inventory can have.

Going forward, obtaining consistent maintenance of the tree inventory to keep it current would be a priority as the author of this report and advisor cannot provide on-going support. Furthermore, this project and any continuation of it would enrich the WPI campus at no cost to the environment.

References

Apple. (2016). *Apple itunes GPS Tour*. Retrieved from itunes.apple.com: https://itunes.apple.com/us/app/gps-tour/id492684276?mt=8

Bartlett Inventory Solutions. (2015). Retrieved from www.Bartlett.com: https://www.bartlett.com/resources/Bartlett-Inventory-Solutions-Brochure.pdf

Bartlett Tree Experts: About Us. (2016). Retrieved from www.Bartlett.com: https://www.bartlett.com/about-us.cfm

Bassett, C. G. (2015). The Environmental Benefits of Trees on an Urban University Campus. *Master of Environmental Studies Capstone Projects*, Paper 66.

Chang, J.-L., & Zhang, X.-L. (2013). The Application and Exploration of plant Landscape in University Campus. *Journal of Applied Sciences*, 4595-4599.

Chou, w.-Y., Lee, C.-H., & Chang, C.-Y. (2016). Relationships between urban open spaces and humans' health benefits from an ecological perspective: a study in an urban campus. *Landscape and Ecological Engineering*, 255-267.

Dwyer, J. F., McPherson, E. G., Schroeder, H. W., & Rowntree, R. A. (1992). Assessing the Benefits and Costs of the Urban Forest. *Journal of Arboriculture*, 18(5): September 1992.

Hall, P. (2014). *Cities of Tomorrow: An Intellectual History of Urban Planning and Design since 1880.* Wiley-Blackwell.

Hipp, J. A., Gulwadi, G. B., Alves, S., & Sequeira, S. (2015). The Relationship Between Perceived Greenness and Perceived Restorativeness of University Campuses and Student-Reported Quality of Life. *Environment and Behavior*, 1-17.

Mariana H. Qubein Arboretum and Botanical Gardens Provide Sanctuary for Students, Community: Lush Plants in the Mariana H. Qubein Arboretum and Botanical Gardens Sprawl through Campus, but in Truth, Their Roots Stretch Farther into the Greater High Point Community. (2013, July 1). *Business North Carolina*, *33*(7).

Mission / Vision / Core Values. (2018). Retrieved January 22, 2018, from https://arboretum.psu.edu/about/mission/

Morgan, R. (1993). *A Technical Guide to Urban and Community Forestry, Values of Urban Trees*. Retrieved from Northeastern Area State & Private Forestry-USDA Forest Service.

The Mission of the Arnold Arboretum. (1990). *Journal of the Arnold Arboretum, 71*(1), Iii. Retrieved from https://biodiversitylibrary.org/page/9256570.

Top 22 Benefits of Trees. (n.d.). Retrieved from www.treepeople.org: https://www.treepeople.org/resources/tree-benefits

Tree Campus USA Schools. (2016, Spring). Retrieved from www.arborday.org: https://www.arborday.org/programs/treecampususa/campuses.cfm

Wood, J. P. (1999). *Tree Inventories and GIS in Urban Forestry.* Blacksburg: Virginia Polytechnic Institute and State University.

WPI. (2016). *WPI Tech Bible*. Retrieved from www.wpi.edu: https://www.wpi.edu/academics/library/history/techbible/campus.html

WPI. (2016). *www.wpi.edu*. Retrieved from WPI Admissions.