THE ECONOMIC VALUE OF RECOVERING THE TOWN OF OAKVILLE'S URBAN FOREST AFTER THE IMPACTS OF THE EMERALD ASH BORER

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ABSTRACT

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Keywords: Urban forestry, Oakville, Emerald ash borer (*Agrilus planipennis*), Street trees, economics, Ash (*Fraxinus*), species diversity, National Tree Benefits Calculator

The Town of Oakville is responsible for maintaining some 2,016,500 city trees planted within boulevards on the city's streets (UFORE 2016). Prior to the emerald ash borer, ash trees represented the top 5 most trees planted in Oakville's city owned streets and parks (UFORE 2016). Additionally, ash make up approximately 3.6% of Oakville's urban forest. The occupation of urban forestry provides benefits which include the care and maintenance of street trees within cities and metro areas. Benefits to residents of these areas include improved air quality, lower urban air temperatures, stormwater management, added property values and a reduction of municipal property costs (Zabret 2015). Within this study, white and green ash diameter at breast height (dbh) were categorized into different dbh classes and averaged. The total benefits were attained (or provided) by the National Street Tree Benefit Calculator and combined to get a total cumulative loss of $1,984,226.46 CAD if these trees were to die off. However, errors in this study were concluded that the economic cost of a dollar were to be in current value in 2019. Additionally, there was another error that the town of Oakville did not document why the ash tree was removed. Further research will be required and needed increase comprehension of the results of this study. However, the Town of Oakville is implementing strategic management plans in order to still ensure a diverse and well beneficial urban forest.

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ACKNOWLEDGMENTS

I would like to acknowledge my thesis supervisor Dr. Don Henne and my second reader Dr. Ulf Runesson for making my thesis possible. I would also like to thank Jalil Hashemi, Andres Olaya and Mike Somerville from the Town of Oakville for the use of data found in this report and their expertise on urban forestry and ash removal. Finally, I would like to thank the Town of Oakville's Development Engineering section for starting my infatuation for urban forestry.

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INTRODUCTION

Trees in urban settings are beneficial to the surrounding environment based upon the fact that trees create numerous positive economic benefits, such as added property value and stormwater management. These economic benefits, along with overall aesthetic benefits, promote the importance of having trees in an urban area. Trees with larger stature and diameter create more benefits than newly planted trees, which is why it is important to incorporate an older urban forest into a newly planted urban forest. Ash trees are known as the "working horse" of urban street trees, known for its capability to withstand harsh urban environments. Unfortunately, pathogens and pests are a common threat and disturb these urban communities and change the outputs of benefits.

The emerald ash borer (EAB) is an invasive species that originated in China. This insect defoliates the canopy of strictly *Fraxinus* species, such as the green ash (*Fraxinus pennsylvannica*) and white ash (*Fraxinus Americana*). Fortunately, the emerald ash borer does not target mountain ash (*Sorbus spp*), a low-lying herbaceous species. Larvae of this tiny pest are approximately 2mm in width and chew through the inner bark along galleries, eventually stopping the transport of nutrients that trees need to grow and survive. The adult emerald ash borer creates "D" shaped exit holes (Figure 1) and is the most problematic when in the larval stage of its life cycle. Currently, there is a treatment available from Bioforest called "TreeAzin" (Bioforest.ca). This systemic pesticide works by killing the larvae of the emerald ash borer so that they do not girdle the inner bark.

Many municipalities have been caught with surprise when this insect invades,

while others have implemented a strategic emerald ash borer plan in hopes of minimizing impacts to their overall canopy cover percentage. The Town of Oakville created such a plan to remove, replant and treat their existing ash trees. The Town of Oakville's forestry section created an annual document entitled "UFORE" which describes the current state of their urban forest and what they expect to achieve in the future (UFORE 2016). The findings of this document are used to inform the public about what the future steps are, while allowing for a growing canopy cover along with urban sprawl. However, as the data spans over decades, it is difficult to forecast the future economy. For the sake of this paper, all dollar values are assumed to be at the current state of the economy at present 2019 values. The question being pursed in this thesis is: what are the economic impacts from the emerald ash borer on the urban forest in the town of Oakville?

Source: http://www.peterbenzlandscaping.com/blog/the-ash-tree-an-endangered-species/

Figure 1. "D" shaped exit holes and relative size of the emerald ash borer

LITERATURE REVIEW

URBAN FORESTRY

Urban forestry is an important part of municipal communities. The benefits of having urban street trees to cities include reducing energy costs and sequestering carbon. Urban forestry can be defined as the sustained planning, planting, and protection of trees, residential tree lines, and forests in urban areas as valuable for aesthetic, ecological and economic reasons (Jensen 2004). Additionally, effective urban forestry depends ultimately on public policy supporting it financially, administratively, and legally (Schwab 2009). Trees also have the added benefit of reducing urban noise, both directly and by altering human perception of noise, because visual screening increases the apparent quietness of a site (Dreistadt 1990).

BENEFITS OF URBAN TREES

Improved air quality

Nitrogen oxides, ozone, sulfur dioxide, carbon monoxide, and halogens can all be removed by woody trees (Dreistadt 1990). Apparent climatic changes may be ameliorated by large-scale urban afforestation, which can provide a carbon sink for the rising levels of CO_2 resulting from the deforestation and the combustion of fossil fuels and biomass (Dreistadt 1990). Automobile and truck exhaust is a major public concern because it contains significant pollutants, including carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NOx), and particulate matter (PM), where these impacts are reduced significantly from proximity to trees (Burden and Jackson

2006).

Lower Urban Air Temperatures

Asphalt and concrete streets and parking lots are known to increase urban temperatures by about 3 – 7 degrees Celsius (Burden and Jackson 2006). As a consequence of this, energy costs to homeowners will increase. With a shaded neighbourhood, urban trees can reduce energy bills by an estimated 15-35% (Burden and Jackson 2006). Expanding on the savings, the occurrence of street trees will aid in the cost of reducing energy bills while also providing a reduction in overall street temperature.

Stormwater Management

The process of urbanization leads to significant changes in surface cover, which influence the hydrological properties of an area (Zabret 2015). Urban trees can reduce the amount of precipitation reaching the ground due to rainfall interception, and are becoming increasingly recognized as an effective means for the regulation of storm water volumes and costs (Zabret 2015). Trees absorb the first 30% of most precipitation through their leaf system, allowing evaporation back into the atmosphere (Burden and Jackson 2006).

Added Property Value

Additionally, added property value is a great economic factor in which directly corresponds to the urban street tree environment. Realtor-based estimates of street tree versus non-street tree streets comparably relate to a $15,000-$25,000 increase in home or business value (Burden and Jackson 2006). This cost will more than likely be associated with the base tax cost which will allow for larger operating budgets for cities, ultimately increasing the maintenance budgets (Burden and Jackson 2006). Thus, having

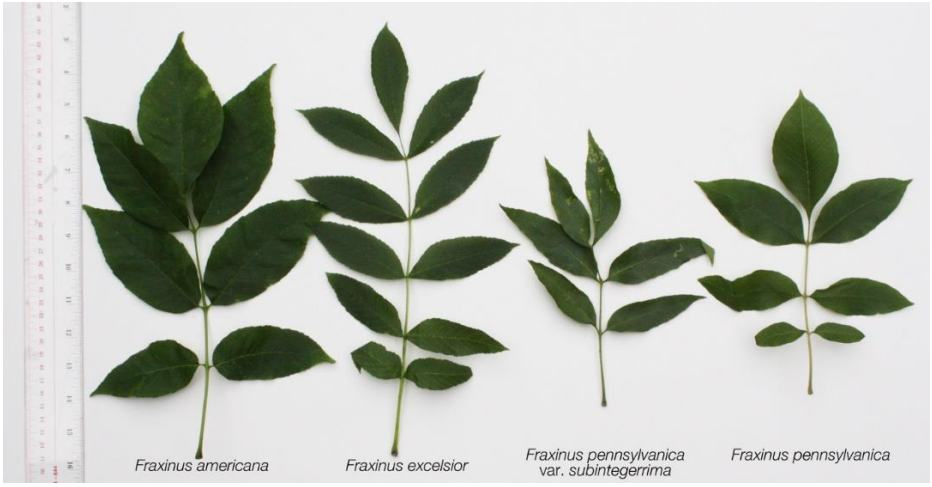
street trees on your property will aid in the resell cost of the home.

Reduction of Municipal Property Costs

The shade from urban trees can extend the lifespan of asphalt by 40-60% (Burden and Jackson 2006). This is based upon a reduction of daily heating and cooling cycles, which is the expansion and contraction of asphalt (Burden and Jackson 2006).

ASH TREES (*Fraxinus spp*)

The ash tree is considered to be an urban working horse that is often planted for its outstanding structure, tolerance to pollution and capability to grow in harsh conditions. In order to have an urban species thrive, it must be able to grow in extremely abnormal environmental conditions. For example, the soil pits in which the trees are planted, will be compacted and usually too small for the tree to retain a 'good structure.' There are about 60 tree and shrub species belonging to the genus *Fraxinus*; in which the size of the tree in this genus measures from small to large depending on the species. These deciduous trees have pinnately compound leaves arranged in opposite pairs, with 5-11 leaflets, as can be seen in figure 2.



Source: https://eabguelph.wordpress.com/2013/06/28/ash-tree-leaves/

Figure 2. Different species of the genus *Fraxinus* showing the compound leaf.

The fruits of this species hang in drupes and can be found hanging in clusters laterally from the branch, as shown in figure 3. Additionally, the trunk is found to be variable between species, but along an overall spectrum of firm ridges to soft ridges. The overall stature of ash as an urban street tree can be seen in figure 4. However, in addition to its benefits as an urban street tree, other benefits of ash include baseball bats, tool handles and furniture because of its hardness and durability when milled (Elias 1976).

Source: https://www.vanderbilt.edu/trees/ash/

Figure 3. The typical fruits of true *Fraxinus* species

Source: http://info.ncagr.gov/blog/2018/08/08/saving-north-carolinas-urban-ash-trees/

Figure 4. Ash as an urban street tree

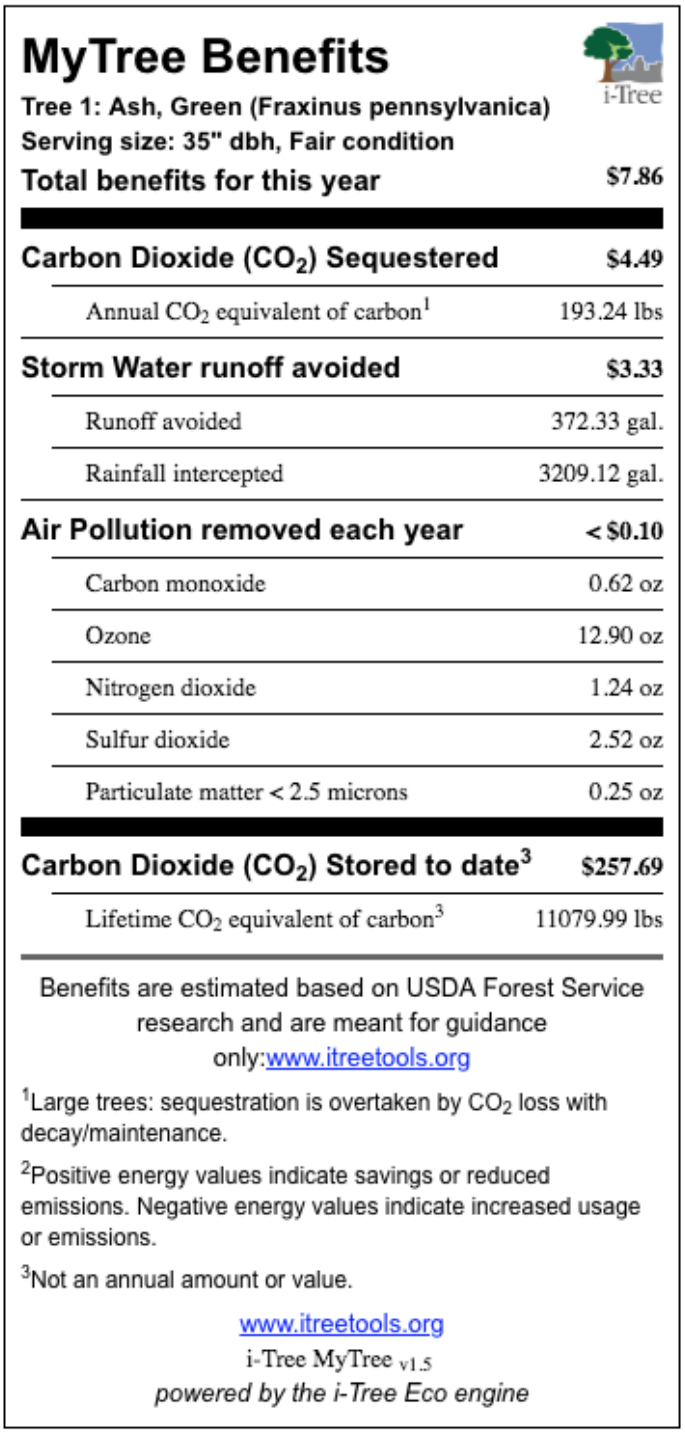
EMERALD ASH BORER

The emerald ash borer (EAB), *Agrilus planipennis* (Coleoptera: Buprestidae) is naitve to several Asian countries and was first discovered in southeastern Michigan and nearby Ontario in June of 2002 (Bauer 2003). EAB is currently expanding its range in much of the same region and is poised to eliminate the vast majority of its hosts in the genus *Fraxinus* (Morin 2016).

NATIONAL STREET TREE BENEFITS CALCULATOR

The National Street Tree Benefit Calculator (NSTBC) is an online tool that provides detailed knowledge of the economic benefits a given street tree produces. By entering factors such as location, diameter at breast height and horizon, the NSTBC will produce the current amount of benefits in terms of a dollar value. An example of this can

be found in Figure 5, where a mock production of the outcome from the NSTBC can be found. It displays the cost value for carbon dioxide removed, air, and other environmental factors for a given tree species at a certain dbh. The designers indicated that, due to a large variation between climate and geography, the exact calculations would be difficult to achieve. Thus, this device is not intended to be used for determining precise values but instead is used to understand the potential values and benefits of urban street trees. Additionally, the cost associated with this tool does not include the costs that each municipality contributes for maintenance, care, and planting. For a more in depth calculation, a sister program called STREETS by i-Tree is available (davey.com). The NSTBC is a simple version of STREETS which provides intel estimated upon annual economic benefits for stormwater, electricity, natural gas reduction, carbon dioxide emittance and property values. This website can be found at http://www.davey.com/arborist-advice/articles/national-tree-benefit-calculator/.



MyTree Benefits

Tree 1: Ash, Green (Fraxinus pennsylvanica)
Serving size: 35" dbh, Fair condition

Total benefits for this year	**$7.86**
Carbon Dioxide (CO_2) Sequestered	**$4.49**
Annual CO_2 equivalent of carbon[1]	193.24 lbs
Storm Water runoff avoided	**$3.33**
Runoff avoided	372.33 gal.
Rainfall intercepted	3209.12 gal.
Air Pollution removed each year	**< $0.10**
Carbon monoxide	0.62 oz
Ozone	12.90 oz
Nitrogen dioxide	1.24 oz
Sulfur dioxide	2.52 oz
Particulate matter < 2.5 microns	0.25 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$257.69**
Lifetime CO_2 equivalent of carbon[3]	11079.99 lbs

Benefits are estimated based on USDA Forest Service research and are meant for guidance only:www.itreetools.org

[1]Large trees: sequestration is overtaken by CO_2 loss with decay/maintenance.

[2]Positive energy values indicate savings or reduced emissions. Negative energy values indicate increased usage or emissions.

[3]Not an annual amount or value.

www.itreetools.org
i-Tree MyTree v1.5
powered by the i-Tree Eco engine

Source: USDA.com

Figure 5. A mock example of the outputs from the tree benefits calculator

TOWN OF OAKVILLE

The town of Oakville is a municipality within the greater Toronto area (GTA) and has several facilities that benefit the community such as an urban forestry department. With a population of 193,830 in 2016, this city is situated in the municipality of Halton at the northwestern end of Lake Ontario (Oakville.ca). Additionally, Oakville boasts abundant employment opportunities, low crime rates, and a strong sense of community that depicts the city as being an excellent, livable, place. The town of Oakville's mission statement is to be Canada's most livable city and quite fittingly, the municipality won the 2018 Money Sense best city to live in (Oakville.ca). Oakville strives to be economically sufficient, socially acceptable and ecologically sound, and is currently working towards expanding its resources by expanding the population and creating additional housing and employment opportunities (Oakville.ca).

CITY OF THUNDER BAY

As a comparison to the Town of Oakville, the city of Thunder Bay is located in Northern Ontario bordering Lake Superior. With a population of 107,910 this City is considered the 'hub' of north western Ontario. Abundant outdoor recreation opportunities exist throughout the Thunder Bay municipality. Additionally, this city plants urban trees in monocultures with ash making up 26% of their urban trees as of 2011 (FMP2011). The city of Thunder Bay currently does not have an urban forestry department, but however has a parks department that will take care of all arboricultural needs. The EAB first started to show up in June of 2016 according to the city of Thunder Bay's website.

HAZARDS TO URBAN TREES

Urban areas are generally not suitable for trees to grow to maturity. There are many factors that affect tree health and longevity. For instance, there is insufficient room for the tree roots to penetrate effectively, and some municipalities suggest having a root break out zone. This is where they will excavate underneath the sidewalk to allow for more room for roots to grow. Additionally, due to weak root anchoring, there will often be more fallen/dead trees after windstorms. Although storms account for some urban tree loss, there are also many pests and pathogens that attack urban trees due to their already weakened condition.

UFORE

The UFORE is a report that was produced in 2016 that is a comprehensive study of Oakville's urban forest. This report states in detail the current condition of Oakville's urban forest and how it will be altered in the future due to storm damage, insects and pathogens, and incorporating old growth with new urban development. This report was a contribution from the Town of Oakville, KBM, BioForest, Plan-it GEO, the US Forest Service and the United States Department of Agriculture.

CANOPY COVER

In highly populated urban areas, a minimum canopy cover percentage is required to be met to ensure there is enough urban green space. This means that municipalities must plant a certain number of trees that total 40% of their overall canopy. The Mayor of Oakville, Rob Burton explained that the tremendous economic, environmental and health benefits that a thriving tree canopy brings to a community are critical to overall

livability (Oakville 2016). Thus, it is important to maintain and care for urban trees as it provides a greater canopy cover. Additionally, canopy cover allows for higher density of urban sprawl (Oakville 2016).

MATERIALS AND METHODS

To determine the annual economic benefits of having ash (*Fraxinus*) as urban street trees in the Town of Oakville, Ontario, the amount and value of ash as street trees needed to be calculated. GIS shapefiles with data from 2014 to 2017 (Table 1) were provided by Mr. Andres Olaya, a forestry information analyst at the Town of Oakville. The GIS data was sorted into different diameter at breast height (dbh) classes and organized into years planted. The data also had to be classified into trees removed, treated or replanted. The information needed from these files included the location, dbh, and species (all from the genus *Fraxinus*). The National Tree Benefits Calculator (Davey Tree Company) was used to provide the economic benefit value, such as carbon sequestered, storm water runoff, energy used, and carbon dioxide stored. To attain the required data, the tree species, dbh, amount of sunlight and condition was needed to be inputted into the NSTBC to get results. Data was separated by dbh classes, from 0-9cm to 150-159 cm, going up in increments of 10 cm each time. Within each diameter class, green ash and white ash were separated to determine each species average dbh and then entered into the national tree benefit calculator independently and calculated together. The data for mountain ash was disregarded, as EAB only infects true ash i.e, the genus *Fraxinus*. The output served to identify factors that will be calculated together, with all DBH classes, to identify the overall lost benefits of the removed ash trees. This process was then repeated to determine the overall benefits from the new trees planted. However, for ash trees treated with TreeAzin, an overall economic benefit calculator was extrapolated to show the effects of the ash tree species saved. The costs of treating

these ash trees were calculated by using current data from Bioforest of about $5.00/diameter at breast height.

RESULTS

According to the Town of Oakville's 2016 UFORE report, there are 192,500 urban trees, including woodlots, that are hosts to EAB, valued at about 59.4 million CAD (appendix). Additionally, there were 222,989 m^3, of trees removed in 2012 with 9,186 being ash trees. However, the value of trees includes mountain ash which is not impacted by EAB, but is impacted by remedial measures (Appendix). Table 1 shows the different years with the allocated amount of ash trees as street trees in the Town of Oakville. Where the number of ash trees has been increasing since 2015 to ensure the longetivity of ash as a street tree species. Table 2 displays the total white and green ash benefits that was removed based on the 9,186 trees removed in 2012 and 2013.

Table 1 Year and the number of Ash trees present as street trees

Year	Amount of Ash
2014	15,000
2015	5,000
2016	7,000
2017	10,000

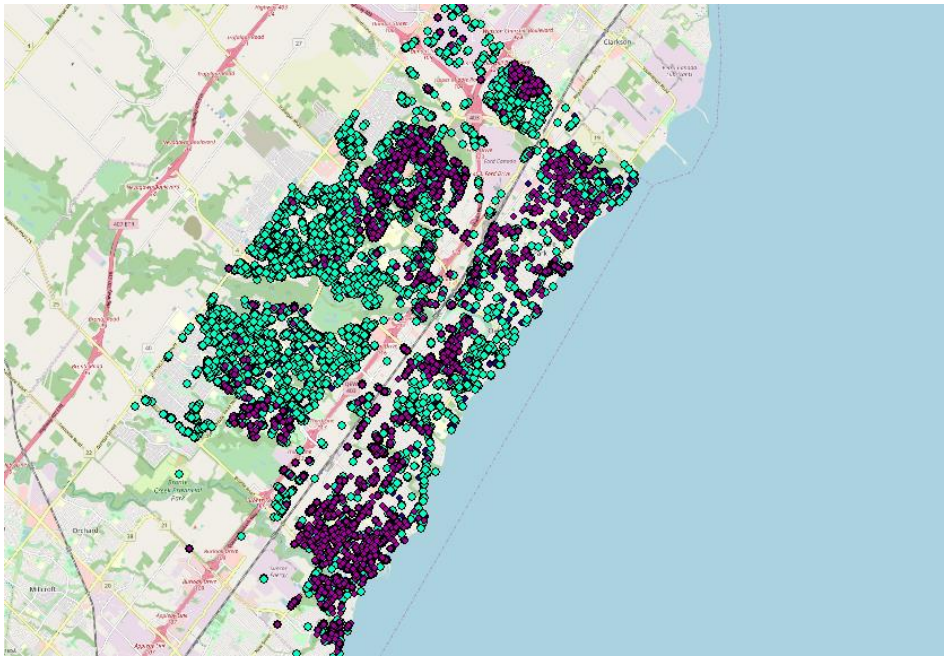
Source: UFORE 2017

Table 2. Total White and Green Ash Tree Benefits Removed

Total Tree Benefits	
Carbon Dioxide Sequestered	3238.21 lbs
Air Pollution Removed	
Runoff avoided	5431.48 gal.
Rainfall intercepted	40212.65 gal.
Energy Usage	
Electricity savings	833.08 kWh
Avoided Energy Emissions	
Carbon Dioxide	276.47 lbs
Carbon Monoxide	9.91 oz
Nitrogen Dioxide	2.72 oz
Sulfer Dioxide	29.88 oz
Carbon Dioxide Stored	388595.49 lbs

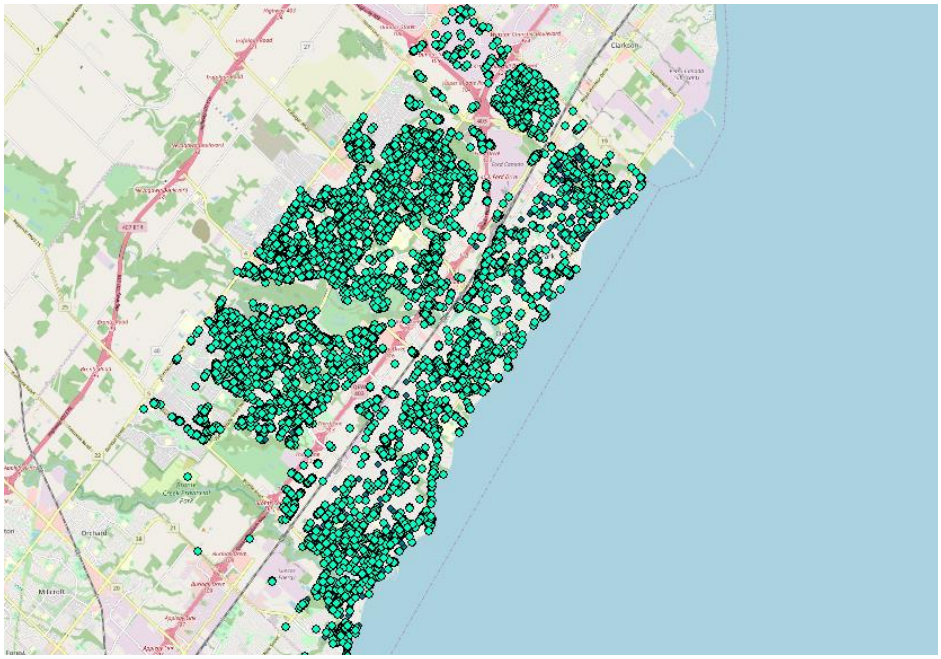
Source: Davey Tree Company Benefits Calculator

Figures 6, 7 and 8 display an ArcMap of the Town of Oakville with the locations of all currently planted ash trees, and all removed ash trees. All teal points are ash trees removed, whereas all newly planted are displayed in purple and dark blue. These figures show all species of ash in Oakville, including mountain ash. As can be seen throughout these figures, the removed amount of ash (9,186) as a street tree now exceeds the amount of remaining ash trees (5,453) in the Town of Oakville.



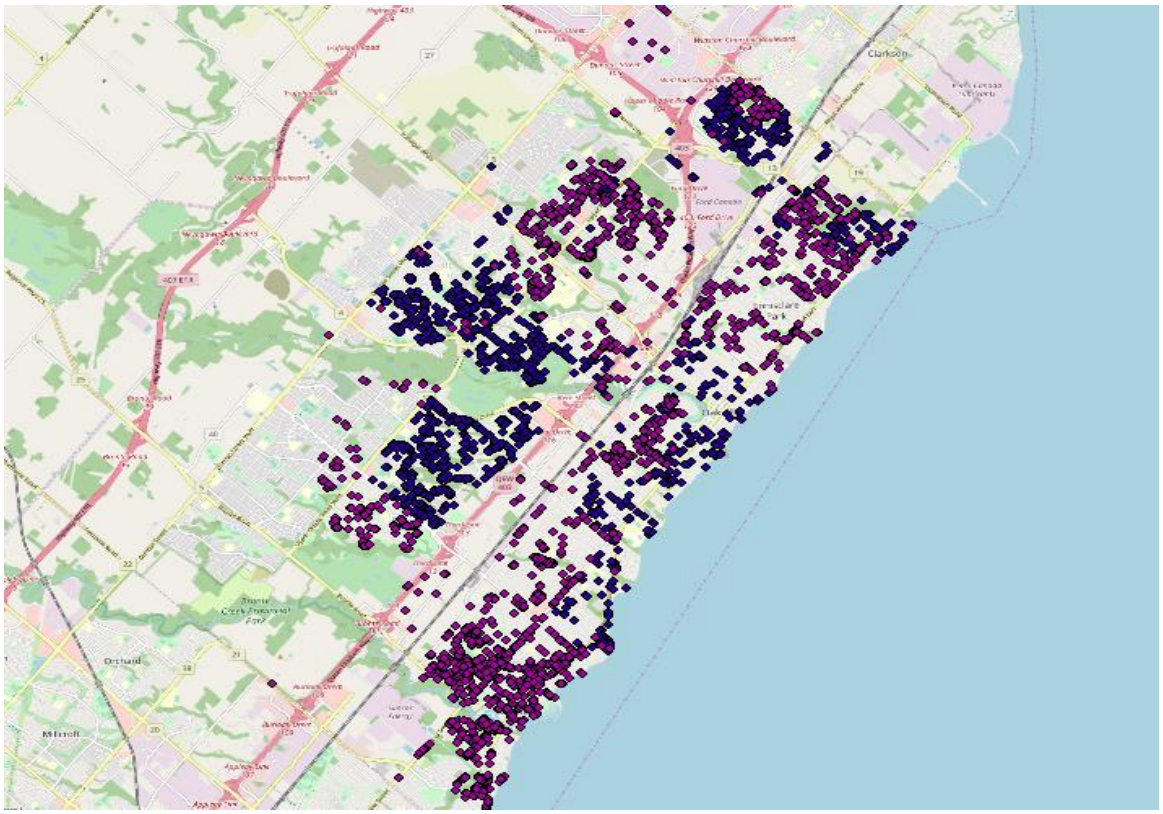
Source: ArcMap/GIS 2019

Figure 6. ArcMap showing locations of removed (teal) and actual (purple) ash trees currently in Oakville



Source: ArcMap/GIS 2019

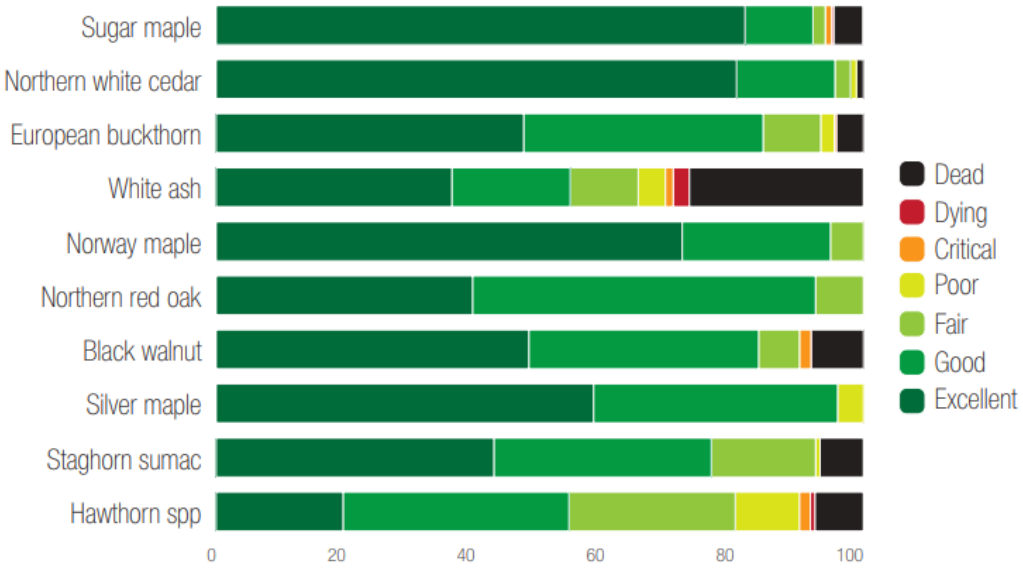
Figure 7. ArcMap showing locations of all ash trees removed in Oakville



Source: ArcMap/GIS 2019

Figure 8. ArcMap showing locations of all surviving ash trees currently in Oakville

Where as, figure 9 displays the condition ratings of Oakville's top 10 urban tree species where it is evident that 40% white ash is in decline.



Source: UFORE 2016

Figure 9. Condition ratings of Oakville's top 10 species.

i-Tree Streets Results Summary	
Street Tree Population	95,770
Structural Value of Street Trees	$201.6 million
Benefits Provided by Street Trees	$11.9 million (Annual Value)
Street Tree Benefit-Cost Ratio	1.52
Carbon Stored by Street Trees (Tonnes)	63,295 (Value of $605,908)
Air Quality Improvement by Street Trees	$576,700 (Annual Value)
Aesthetic Benefits	$7,436,922 (Annual Value)

Source: UFORE 2016

Figure 10. UFORE i-Tree Street Results Summary

Displayed in figure 10, the overall street tree results from the growing livability (UFORE) report by the town of Oakville in 2016. Where the overall benefits provided is estimated around $12 million dollars CAD.

DISCUSSION

The Chinese insect EAB that is invasive in Canada, is a defoliator and wood boring insect that is aversely affecting municipalities. The larva or insect creates galleries underneath the bark, which then causes the ash tree to be stressed and have a weakened state predisposing it to other pathogens to attack.

The aim of this study was to determine the economic impact that EAB has created for the Town of Oakville. The assessment of EAB by the Town of Oakville is rare. Therefore, the results of this study constitute a preliminary assessment on this topic contributing to future knowledge of this subject. This is an important matter because if all ash trees are affected by EAB and die then there will be less diversity within the urban forest. This species is one of which that can withstand harsh environmental conditions and should be considered important to all urban forests. Additionally, with the extinction of this species, the amount of other tree species being planted as urban trees will increase resulting in fewer aesthic and economic benefits to the municipal community.

Based on the current street tree inventory, the Town of Oakville has a street tree population of 95,770 street trees of which ash makes up about 5% with an overall structural value of approximately 201.6 million Canadian dollars. Using the Tree Benefits Calculator vividly highlights the annual environmental and economic benefits of ash trees in Oakville. The Town has removed 9,186 ash trees as of 2016 with approximately 7,150 ash trees that were removed due to damaged or mortality from EAB activity (UFORE 2016). However, it was not noted whether all 9,186 trees were

removed because of EAB activity, or due to new developments, weather such as wind storms, and removal of hazardous trees. Thus, all of this should be taken into consideration when understanding the total benefits lost from removed ash trees. Additionally, 10% of the trees removed were a mixture of white and green ash accounting for 0.4% of the Oakville's total number of street trees. Additionally, these percentages are based only upon street trees and does not include ash in decline in woodlots. With the presence of woodlots and private trees included in the estimates, the total loss would likely be much higher. However, even in the presence of EAB, the town of Oakville's urban canopy cover is increasing (UFORE 2016).

Based on the 9,186 removed ash trees, there is a calculated aggregate loss of about $216.49 CAD per average tree. Resulting in a loss of 1,984,226.46 CAD per year (Appendix). With this loss of ash trees there is a gain of 388,595.49 lbs of carbon dioxide that is still trapped in the atmosphere that is negatively impacting the environment. A newly planted street tree needs to be about 10 years old in order to be considered a beneficial tree (Elias 1976) which means that, because of EAB, the town of Oakville is potentially losing out of $19,842,260 of benefits to our environment. All costs are in current dollar values, as of 2019 and may have had lower costs in the past due to inflation and changing economic values. In Summary, the removal of these ash trees results in a net negative impact on surrounding environments.

There was a calculated loss of 3,238.21 lbs of sequestered carbon dioxide in the environment due to the removal of ash trees. However, the current percentage of ash planted to date does not total the amount of ash removed. This is because new and different tree species have been planted to replace the lost trees to increase in total economic benefits while still obtaining a growing canopy cover percentage. BioForest

developed a systemic insecticiede called TreeAzin, which gets injected into each ash tree every two years to kill the larvae of EAB (Bioforest.ca). This treatment was first used in Windsor, Ontario in 2002 when EAB was first found. Oakville is currently using this treatment and has had tremendous success thus far (UFORE 2016). With 98% of treated ash trees still present in Oakville (Oakville 2013). The high costs associated with TreeAzin (currently being $5.00 CAD per diameter at breast height) is beneficial, as it allows the Town to maintain its trees and their economic importance.

The Town of Oakville is currently treating some of the remaining ash with TreeAzin (at a cost of $5.00 CAD per centimetre of diameter at breast height), plus a fee for a trained professional to inject the tree once every two years for the next several years until EAB does not pose a threat. Figure 11 shows a forestry professional injecting TreeAzin into an urban ash tree. This cost is introduced in their EAB management plan to ensure they can have ash trees remaining in their urban forest. The Town of Oakville has set aside a certain budget prior to the total invasion of EAB in Oakville to mediate the impacts of the disturbance**.** Thus, this insect will cost the Town $22,342,125 CAD over the next 15 years in order to achieve the same benefit values before EAB appeared about in 2008. The relative cost associated with the destruction of EAB is quite high, as ash only makes up 3.6% of Oakville's urban forest with regards to street trees with maple being the number one street tree species accounting for 25.5%, followed by white cedar at 13.4% (UFORE 2016). The benefits received from other tree species well surpasses that of the cost removed of ash from EAB.

Source: http://www.bioforest.ca/index.cfm?MenuID=19&PageID=1049

Figure 11. Professional treatment of TreeAzin in an Ash tree.

This strategic management plan could be implemented successfully in other municipalities such as Thunder Bay and Winnipeg, where ash is threatened with extirpation. Northern municipalities that plant in monocultures are most at risk for negative impacts from EAB and an associated reduction in canopy cover. In order to prevent the extreme effects of EAB in Thunder Bay, it would be beneficial to be proactive and implement a similar program to Oakville. This will ensure a stable canopy cover percentage as well as the survival of ash trees. According to a financial risk assessment by the city of Thunder Bay, it was calculated that, over a 16-year period, EAB would cost the city $19.3 million CAD (Walker 2012). Whereas, treating only 25% of ash trees and removing the other 75% would cost the City $15 million CAD with the treatment of each tree with TreeAzin (Walker 2012). When thinking about introducing a strategic plan, it should be considered to replant as close to the removal date as possible in order to preserve aesthetic and economic values. Another strategy that Oakville

implements is that they do not plant more than four of the same tree species in a row, in case of a pathogenic outbreak. Thus, it is beneficial to grow and plant trees in polycultures to offset an invasives species such as EAB to ensure the stability and longevity of the urban forest, as well as maintaining the appropriate canopy cover.

However, with regards to Oakville's urban forest it is recommended that they should continue to care and maintain their ash trees in order to maintain past environmental benefits. Additionally, it was not noted whether ash trees ther were removed were due to EAB or were based on construction activites or other external factors. One recommendation, in order to account for the total loss would be for municipalities to document why trees were removed. This will help for planning for future impacts of EAB and other pathogens and pests.

CONCLUSION

In conclusion, ash trees planted along the streets in the Town of Oakville, Ontario account for 3.6% of their urban street trees, as mentioned in the 2016 UFORE report. The Town of Oakville is making executive decisions in protecting its remaining ash trees and replanting of removed ash trees. The economic benefits and aesthetic values of urban trees are understood while still being able to surpass their target canopy cover.

Although EAB is prominent in Oakville's urban forest, it is not allowed to take a negative toll on the City. The Town is proactive and is considering alternative methods in order to maintain all benefits of lost urban trees. Even with the impacts of EAB, Oakville is still able to increase the canopy cover percentage to assure the old stature of mature urban trees as well as new plantings where ash trees were removed. They are working towards treating some of their ash trees with TreeAzin to maintain the larger benefits of the old ash, and trees that were removed and replaced to assure the continued benefits of their old ash trees. Additionally, the Town of Oakville is constantly working on improving their urban forest and trying to not let EAB interfere with their plans. Constant efforts are needed in order to contend with this EAB infestation and allow for the new economic impacts to surpass the old. Even with the removal of ash trees and the loss of most economic impacts attributed to ash, the Town of Oakville is increasing the value of their urban forest by replacing, replanting and treating its ash trees.

Therefore, the Town of Oakville should be cited as an example for other

municipalities to follow to ensure that the economic viability of their own urban forest that may have not yet been impacted by EAB invasion is maintained.

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APPENDICES

APPENDIX I

Tree Benefit Calculations For Different Input Scenarios

(DBH 10-19)

MyTree Benefits

Tree 1: (Green Ash) Ash, Green (Fraxinus pennsylvanica)

Serving size: 6” dbh, Good condition

Total benefits for this year

$2.71

Carbon Dioxide (CO_2) Sequestered	**$0.67**
Annual CO_2 equivalent of carbon[1]	47.39 lbs
Storm Water runoff avoided	**$0.38**
Runoff avoided	43.59 gal.
Rainfall intercepted	322.76 gal.
Air Pollution removed each year	**$0.12**
Carbon monoxide	0.00 oz
Ozone	2.20 oz
Nitrogen dioxide	0.28 oz
Sulfur dioxide	< 0.10 oz
Particulate matter < 2.5 microns	< 0.10 oz
Energy Usage each year[2]	**$1.35**
Electricity savings (A/C)	15.55 kWh
Fuel savings (Natural Gas,Oil)	< 0.10 MMBtu
Avoided Energy Emissions	**$0.19**
Carbon dioxide	11.60 lbs
Carbon monoxide	0.21 oz
Nitrogen dioxide	< 0.10 oz
Sulfur dioxide	0.75 oz
Particulate matter < 2.5 microns	< 0.10 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$3.87**
Lifetime CO_2 equivalent of carbon[3]	272.01 lbs

MyTree Benefits

Tree 2: (White Ash (10-19)) Ash, White (Fraxinus am8mericanaServing size: 13"

”bh, Good condition

Total benefits for this year

$9.45

Carbon Dioxide (CO_2) Sequestered	**$1.34**
Annual CO_2 equivalent of carbon[1]	94.31 lbs
Storm Water runoff avoided	**$1.12**
Runoff avoided	127.49 gal.
Rainfall intercepted	943.87 gal.
Air Pollution removed each year	**$0.37**
Carbon monoxide	< 0.10 oz
Ozone	6.10 oz
Nitrogen dioxide	0.76 oz
Sulfur dioxide	0.26 oz
Particulate matter < 2.5 microns	0.24 oz
Energy Usage each year[2]	**$5.43**
Electricity savings (A/C)	20.29 kWh
Fuel savings (Natural Gas,Oil)	0.37 MMBtu
Avoided Energy Emissions	**$1.19**
Carbon dioxide	78.28 lbs
Carbon monoxide	0.49 oz
Nitrogen dioxide	0.27 oz
Sulfur dioxide	2.85 oz
Particulate matter < 2.5 microns	< 0.10 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$37.97**
Lifetime CO_2 equivalent of carbon[3]	2671.98 lbs

MyTree Benefits

Tree 3: (White Ash 20-29) Ash, White (Fraxinus am8mericanaServing size: 25" ”bh,

Fair condition

Total benefits for this year

$7.81

Carbon Dioxide (CO_2) Sequestered	**$2.39**
Annual CO_2 equivalent of carbon[1]	168.26 lbs
Storm Water runoff avoided	**$2.06**
Runoff avoided	234.24 gal.
Rainfall intercepted	1734.25 gal.
Air Pollution removed each year	**$0.54**
Carbon monoxide	< 0.10 oz
Ozone	9.26 oz
Nitrogen dioxide	1.10 oz
Sulfur dioxide	0.41 oz
Particulate matter < 2.5 microns	0.30 oz
Energy Usage each year[2]	**$2.58**
Electricity savings (A/C)	45.13 kWh
Fuel savings (Natural Gas,Oil)	-0.08 MMBtu
Avoided Energy Emissions	**$0.24**
Carbon dioxide	10.96 lbs
Carbon monoxide	0.52 oz
Nitrogen dioxide	0.14 oz
Sulfur dioxide	1.50 oz
Particulate matter < 2.5 microns	0.16 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$179.58**
Lifetime CO_2 equivalent of carbon[3]	12637.61 lbs

MyTree Benefits

Tree 4: (Green Ash (30-39)) Ash, Green (Fraxinus pennsylvanica)

Serving size: 34" ”bh, Good condition

Total benefits for this year

$8.68

Carbon Dioxide (CO_2) Sequestered	**$1.51**
Annual CO_2 equivalent of carbon[1]	106.33 lbs
Storm Water runoff avoided	**$3.33**
Runoff avoided	377.97 gal.
Rainfall intercepted	2798.33 gal.
Air Pollution removed each year	**$0.74**
Carbon monoxide	< 0.10 oz
Ozone	12.80 oz

Nitrogen dioxide	1.47 oz
Sulfur dioxide	0.57 oz
Particulate matter < 2.5 microns	0.36 oz
Energy Usage each year[2]	**$2.84**
Electricity savings (A/C)	48.51 kWh
Fuel savings (Natural Gas,Oil)	-0.08 MMBtu
Avoided Energy Emissions	**$0.26**
Carbon dioxide	12.81 lbs
Carbon monoxide	0.57 oz
Nitrogen dioxide	0.15 oz
Sulfur dioxide	1.64 oz
Particulate matter < 2.5 microns	0.18 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$185.18**
Lifetime CO_2 equivalent of carbon[3]	13031.28 lbs

MyTree Benefits

Tree 5: (White Ash (30-39)) Ash, White (Fraxinus am10mericanaServing size: 34" ”bh,

Good condition

Total benefits for this year

$10.93

Carbon Dioxide (CO_2) Sequestered	**$4.23**
Annual CO_2 equivalent of carbon[1]	297.46 lbs
Storm Water runoff avoided	**$2.91**
Runoff avoided	330.20 gal.
Rainfall intercepted	2444.70 gal.
Air Pollution removed each year	**$0.69**
Carbon monoxide	< 0.10 oz
Ozone	11.95 oz
Nitrogen dioxide	1.39 oz
Sulfur dioxide	0.53 oz
Particulate matter < 2.5 microns	0.36 oz
Energy Usage each year[2]	**$2.84**
Electricity savings (A/C)	48.51 kWh
Fuel savings (Natural Gas,Oil)	-0.08 MMBtu
Avoided Energy Emissions	**$0.26**
Carbon dioxide	12.81 lbs
Carbon monoxide	0.57 oz
Nitrogen dioxide	0.15 oz

Sulfur dioxide	1.64 oz
Particulate matter < 2.5 microns	0.18 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$372.89**
Lifetime CO_2 equivalent of carbon[3]	26240.95 lbs

MyTree Benefits

Tree 6: (Green Ash (40-49)) Ash, Green (Fraxinus pennsylvanica)

Serving size: 43" ”bh, Fair condition

Total benefits for this year

$7.81

Carbon Dioxide (CO_2) Sequestered	**$0.79**
Annual CO_2 equivalent of carbon[1]	55.75 lbs
Storm Water runoff avoided	**$3.50**
Runoff avoided	397.51 gal.
Rainfall intercepted	2942.99 gal.
Air Pollution removed each year	**$0.70**
Carbon monoxide	< 0.10 oz
Ozone	12.34 oz
Nitrogen dioxide	1.39 oz
Sulfur dioxide	0.56 oz
Particulate matter < 2.5 microns	0.31 oz
Energy Usage each year[2]	**$2.58**
Electricity savings (A/C)	45.13 kWh
Fuel savings (Natural Gas,Oil)	-0.08 MMBtu
Avoided Energy Emissions	**$0.24**
Carbon dioxide	10.96 lbs
Carbon monoxide	0.52 oz
Nitrogen dioxide	0.14 oz
Sulfur dioxide	1.50 oz
Particulate matter < 2.5 microns	0.16 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$294.26**
Lifetime CO_2 equivalent of carbon[3]	20707.79 lbs

MyTree Benefits

Tree 7: (White Ash (40-49)) Ash, White (Fraxinus am11mericanaServing size:

44" ”bh, Fair condition

Total benefits for this year

$11.18

Carbon Dioxide (CO_2) Sequestered	**$5.20**
Annual CO_2 equivalent of carbon[1]	365.71 lbs
Storm Water runoff avoided	**$2.55**
Runoff avoided	289.82 gal.
Rainfall intercepted	2145.69 gal.
Air Pollution removed each year	**$0.61**
Carbon monoxide	< 0.10 oz
Ozone	10.50 oz
Nitrogen dioxide	1.22 oz
Sulfur dioxide	0.47 oz
Particulate matter < 2.5 microns	0.31 oz
Energy Usage each year[2]	**$2.45**
Electricity savings (A/C)	26.73 kWh
Fuel savings (Natural Gas,Oil)	< 0.10 MMBtu
Avoided Energy Emissions	**$0.37**
Carbon dioxide	22.30 lbs
Carbon monoxide	0.36 oz
Nitrogen dioxide	0.13 oz
Sulfur dioxide	1.36 oz
Particulate matter < 2.5 microns	0.10 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$688.10**
Lifetime CO_2 equivalent of carbon[3]	48422.93 lbs

MyTree Benefits

Serving size: 20 trees

Total benefits for this year

$162.50

Carbon Dioxide (CO_2) Sequestered	**$46.02**
Annual CO_2 equivalent of carbon[1]	3238.21 lbs
Storm Water runoff avoided	**$47.80**
Runoff avoided	5431.48 gal.
Rainfall intercepted	40212.65 gal.
Air Pollution removed each year	**$11.20**
Carbon monoxide	0.23 oz
Ozone	193.56 oz

Nitrogen dioxide	22.54 oz
Sulfur dioxide	8.61 oz
Particulate matter < 2.5 microns	5.83 oz
Energy Usage each year[2]	**$51.98**
Electricity savings (A/C)	833.08 kWh
Fuel savings (Natural Gas,Oil)	-1.07 MMBtu
Avoided Energy Emissions	**$5.50**
Carbon dioxide	276.47 lbs
Carbon monoxide	9.91 oz
Nitrogen dioxide	2.72 oz
Sulfur dioxide	29.88 oz
Particulate matter < 2.5 microns	3.05 oz
Carbon Dioxide (CO_2) Stored to date[3]	**$5522.03**
Lifetime CO_2 equivalent of carbon[3]	388595.49 lbs

Table 3: Susceptibility of trees to major pests.

Pest	Known Host Population	Leaf Area of Host Population (% of Total)	Value of Trees ($ million)
Dutch Elm Disease	36,600	1	8.3
Emerald Ash Borer	192,500	5.5	59.4
Gypsy Moth	409,000	23	325
Asian Longhorned Beetle	481,000	42	391

A comparison of the distribution of ground cover types observed by field crews in 2005 and in 2015 suggests that there may be less suitable tree habitat today than existed ten years ago (Figure 8). Total impervious ground covers are estimated to have risen from 37% of ground cover in 2005 to 42.5% in 2015.

Table 10: Trees and Urban Forest Cover (m²) Removed by Tree Removal Notifications through Oakville's Departments of Forestry and Development Engineering, 2012-2015.

	2012	2013	2014	2015	Total
Forestry trees removed	907	863	952	834	3,556
Forestry m² removed	41,442	39,754	45,727	40,773	167,696
Dev. & Eng. trees removed	236	280	335	226	1,077
Dev. & Eng. m² removed	11,319	14,361	16,145	12,931	54,216
				Trees Removed	4,633
				Total m² Removed	222,989

APPNDIX II

CALCULATIONS

Total Loss Per Tree	162.5
Total Trees	9186
Total Trees - 20 Averaged Trees	9166
Total Loss	1489475

Total Loss	1489475
Years	15
Total Cost	22342125

APPENDIX III

Rough Data From the Town of Oakville

FID	OBJECTID	FACILITYID	SPECIES	DBH
2741	11203723	5555	Ash, green - Fraxinus pennsylvanica	0
5236	11209082	434715	Ash, green - Fraxinus pennsylvanica	0
6225	11205672	20368	Ash, green - Fraxinus pennsylvanica	0
248	11199830	430583	Ash, white - Fraxinus americana	1
761	11211754	428916	Ash, white - Fraxinus americana	1
763	11211778	429602	Ash, white - Fraxinus americana	1
786	11212363	427305	Ash, green - Fraxinus pennsylvanica	1
793	11212426	428874	Ash, white - Fraxinus americana	1
794	11212431	428880	Ash, white - Fraxinus americana	1
796	11212452	428906	Ash, white - Fraxinus americana	1
871	11214428	427283	Ash, green - Fraxinus pennsylvanica	1
935	11215720	427420	Ash, green - Fraxinus pennsylvanica	1
956	11216112	428894	Ash, white - Fraxinus americana	1
957	11216119	428918	Ash, white - Fraxinus americana	1
975	11216631	421311	Ash, black - Fraxinus nigra	1
1925	11211757	428923	Ash, white - Fraxinus americana	1
1946	11212205	428337	Ash, green - Fraxinus pennsylvanica	1
1961	11212389	429598	Ash, white - Fraxinus americana	1
1977	11212591	421239	Ash, green - Fraxinus pennsylvanica	1
2148	11216633	421313	Ash, black - Fraxinus nigra	1
2220	11219081	429277	Ash, white - Fraxinus americana	1
2500	11196418	499604	Ash, white - Fraxinus americana	1
2502	11196461	499659	Ash, white - Fraxinus americana	1
2503	11196550	499734	Ash, white - Fraxinus americana	1
2639	11201047	429753	Ash, green - Fraxinus pennsylvanica	1
3084	11211750	428908	Ash, white - Fraxinus americana	1
3085	11211751	428910	Ash, white - Fraxinus americana	1
3096	11212057	429745	Ash, green - Fraxinus pennsylvanica	1
3105	11212364	427306	Ash, green - Fraxinus pennsylvanica	1
3106	11212366	427308	Ash, green - Fraxinus pennsylvanica	1
3116	11212434	428883	Ash, white - Fraxinus americana	1
3117	11212436	428885	Ash, white - Fraxinus americana	1
3119	11212448	428899	Ash, white - Fraxinus americana	1
3120	11212450	428901	Ash, white - Fraxinus americana	1
3145	11213217	427421	Ash, green - Fraxinus pennsylvanica	1
3172	11214022	421240	Ash, green - Fraxinus pennsylvanica	1
3246	11216122	428922	Ash, white - Fraxinus americana	1
3270	11216397	421305	Ash, green - Fraxinus pennsylvanica	1
3288	11216630	421310	Ash, white - Fraxinus americana	1
3359	11219080	429276	Ash, white - Fraxinus americana	1

3555	11194663	422871	Ash, green - Fraxinus pennsylvanica	1
3619	11196416	499587	Ash, white - Fraxinus americana	1
3625	11196743	499284	Ash, white - Fraxinus americana	1
3958	11206482	422869	Ash, green - Fraxinus pennsylvanica	1
4226	11212358	418607	Ash, green - Fraxinus pennsylvanica	1
4228	11212361	427303	Ash, green - Fraxinus pennsylvanica	1
4236	11212438	428887	Ash, white - Fraxinus americana	1
4277	11213630	427302	Ash, green - Fraxinus pennsylvanica	1
4394	11216094	428860	Ash, white - Fraxinus americana	1
4395	11216096	428862	Ash, white - Fraxinus americana	1
4396	11216098	428864	Ash, white - Fraxinus americana	1
4697	11194185	424689	Ash, green - Fraxinus pennsylvanica	1
5385	11212291	428890	Ash, white - Fraxinus americana	1
5388	11212362	427304	Ash, green - Fraxinus pennsylvanica	1
5395	11212439	428888	Ash, white - Fraxinus americana	1
5406	11212592	429622	Ash, white - Fraxinus americana	1
5567	11216632	421312	Ash, white - Fraxinus americana	1
5784	11193335	428316	Ash, green - Fraxinus pennsylvanica	1
5836	11194615	421199	Ash, green - Fraxinus pennsylvanica	1
6075	11202967	436951	Ash, green - Fraxinus pennsylvanica	1
6494	11212365	427307	Ash, green - Fraxinus pennsylvanica	1
6502	11212451	428905	Ash, white - Fraxinus americana	1
6669	11216095	428861	Ash, white - Fraxinus americana	1
6670	11216099	428891	Ash, white - Fraxinus americana	1
6671	11216103	428850	Ash, white - Fraxinus americana	1
6672	11216104	428852	Ash, white - Fraxinus americana	1
6703	11216629	421309	Ash, white - Fraxinus americana	1
7636	11211755	428917	Ash, white - Fraxinus americana	1
7661	11212281	429084	Ash, white - Fraxinus americana	1
7672	11212453	428907	Ash, white - Fraxinus americana	1
7683	11212589	421241	Ash, green - Fraxinus pennsylvanica	1
7856	11216097	428863	Ash, white - Fraxinus americana	1
7877	11216398	421307	Ash, green - Fraxinus pennsylvanica	1
8158	11193832	499477	Ash, white - Fraxinus americana	1
8248	11196124	499700	Ash, white - Fraxinus americana	1
8261	11196953	420632	Ash, green - Fraxinus pennsylvanica	1
8583	11206483	422870	Ash, green - Fraxinus pennsylvanica	1
8798	11211925	427367	Ash, green - Fraxinus pennsylvanica	1
8816	11212379	428871	Ash, white - Fraxinus americana	1
8824	11212444	428855	Ash, white - Fraxinus americana	1
8858	11213309	427422	Ash, green - Fraxinus pennsylvanica	1
8982	11216102	15158	Ash, white - Fraxinus americana	1
40	11192293	492516	Ash, green - Fraxinus pennsylvanica	2
41	11192296	492521	Ash, green - Fraxinus pennsylvanica	2
45	11192384	423755	Ash, green - Fraxinus pennsylvanica	2
74	11193852	499476	Ash, white - Fraxinus americana	2
466	11205248	423500	Ash, green - Fraxinus pennsylvanica	2

508	11206488	422864	Ash, green - Fraxinus pennsylvanica	2
788	11212374	428866	Ash, white - Fraxinus americana	2
789	11212376	428868	Ash, white - Fraxinus americana	2
812	11212820	427322	Ash, green - Fraxinus pennsylvanica	2
954	11216100	428892	Ash, white - Fraxinus americana	2
1256	11194002	432959	Ash, green - Fraxinus pennsylvanica	2
1357	11195976	499780	Ash, white - Fraxinus americana	2
1371	11196948	499312	Ash, white - Fraxinus americana	2
1683	11206485	422857	Ash, green - Fraxinus pennsylvanica	2
1958	11212380	428872	Ash, white - Fraxinus americana	2
1968	11212446	428897	Ash, white - Fraxinus americana	2
1980	11212819	427321	Ash, green - Fraxinus pennsylvanica	2
2008	11213773	487700	Ash, white - Fraxinus americana	2
2024	11214276	426256	Ash, green - Fraxinus pennsylvanica	2
2089	11215601	465785	Ash, black - Fraxinus nigra	2
2394	11193820	499479	Ash, white - Fraxinus americana	2
2413	11194186	424692	Ash, green - Fraxinus pennsylvanica	2
2501	11196420	499610	Ash, white - Fraxinus americana	2
2739	11203603	475387	Ash, green - Fraxinus pennsylvanica	2
3087	11211775	429599	Ash, white - Fraxinus americana	2
3108	11212378	428870	Ash, white - Fraxinus americana	2
3115	11212430	428879	Ash, white - Fraxinus americana	2
3159	11213772	487699	#NAME?	2
3181	11214326	488689	Ash, white - Fraxinus americana	2
3243	11216107	428931	Ash, white - Fraxinus americana	2
3245	11216121	428921	Ash, white - Fraxinus americana	2
3263	11216277	427320	Ash, green - Fraxinus pennsylvanica	2
3308	11217904	428315	Ash, Mountain, European - Sorbus aucuparia	2
3519	11193670	471812	Ash, Mountain, American - Sorbus americana	2
3622	11196547	499712	Ash, white - Fraxinus americana	2
3628	11196944	499304	Ash, white - Fraxinus americana	2
4195	11211792	428291	Ash, white - Fraxinus americana	2
4207	11211948	430456	Ash, white - Fraxinus americana	2
4212	11212210	428339	Ash, green - Fraxinus pennsylvanica	2
4222	11212288	56608	Ash, white - Fraxinus americana	2
4300	11214273	426261	Ash, green - Fraxinus pennsylvanica	2
4419	11216463	23011	Ash, green - Fraxinus pennsylvanica	2
4681	11193890	499418	Ash, white - Fraxinus americana	2
4761	11195912	500230	Ash, green - Fraxinus pennsylvanica	2
4772	11196171	499822	Ash, white - Fraxinus americana	2
4776	11196460	499645	Ash, white - Fraxinus americana	2
4814	11198465	424410	Ash, green - Fraxinus pennsylvanica	2
5387	11212347	428909	Ash, white - Fraxinus americana	2
5389	11212381	427114	Ash, green - Fraxinus pennsylvanica	2
5394	11212427	428875	Ash, white - Fraxinus americana	2

5413	11212818	427324	Ash, white - Fraxinus americana	2
5436	11213636	477421	Ash, green - Fraxinus pennsylvanica	2
5457	11214274	426262	Ash, green - Fraxinus pennsylvanica	2
5541	11216115	428903	Ash, white - Fraxinus americana	2
5566	11216628	10143	Ash, green - Fraxinus pennsylvanica	2
5629	11218903	466960	Ash, green - Fraxinus pennsylvanica	2
5769	11192295	492520	Ash, green - Fraxinus pennsylvanica	2
5829	11194478	421224	Ash, green - Fraxinus pennsylvanica	2
5889	11195852	499737	Ash, white - Fraxinus americana	2
5913	11196983	499374	Ash, white - Fraxinus americana	2
6078	11203115	421225	Ash, green - Fraxinus pennsylvanica	2
6467	11211797	428296	Ash, white - Fraxinus americana	2
6487	11212292	424165	Ash, green - Fraxinus pennsylvanica	2
6490	11212340	424976	Ash, green - Fraxinus pennsylvanica	2
6496	11212375	428867	Ash, white - Fraxinus americana	2
6499	11212425	428873	Ash, white - Fraxinus americana	2
6501	11212449	428900	Ash, white - Fraxinus americana	2
6558	11213631	474511	Ash, white - Fraxinus americana	2
6633	11215426	472612	Ash, green - Fraxinus pennsylvanica	2
6652	11215751	438083	Ash, green - Fraxinus pennsylvanica	2
6668	11216092	428857	Ash, white - Fraxinus americana	2
6673	11216105	428853	Ash, white - Fraxinus americana	2
6735	11218366	471920	Ash, green - Fraxinus pennsylvanica	2
6765	11218979	471919	Ash, green - Fraxinus pennsylvanica	2
6920	11193333	426468	Ash, white - Fraxinus americana	2
6927	11193819	499478	Ash, white - Fraxinus americana	2
7645	11211945	427274	Ash, green - Fraxinus pennsylvanica	2
7671	11212437	428886	Ash, white - Fraxinus americana	2
7688	11212811	483600	Ash, green - Fraxinus pennsylvanica	2
7710	11213221	427431	Ash, green - Fraxinus pennsylvanica	2
7753	11214272	426260	Ash, green - Fraxinus pennsylvanica	2
7755	11214277	426257	Ash, green - Fraxinus pennsylvanica	2
7805	11215187	492544	Ash, green - Fraxinus pennsylvanica	2
8142	11193253	440756	Ash, white - Fraxinus americana	2
8165	11193888	499414	Ash, white - Fraxinus americana	2
8195	11194558	420383	Ash, green - Fraxinus pennsylvanica	2
8196	11194578	436448	Ash, white - Fraxinus americana	2
8223	11195523	471106	Ash, white - Fraxinus americana	2
8301	11199195	3007	Ash, green - Fraxinus pennsylvanica	2
8335	11200020	474841	Ash, green - Fraxinus pennsylvanica	2
8787	11211758	428924	Ash, white - Fraxinus americana	2
8818	11212385	427316	Ash, green - Fraxinus pennsylvanica	2
8823	11212432	428881	Ash, white - Fraxinus americana	2
8842	11212814	426080	Ash, white - Fraxinus americana	2
8862	11213635	477415	Ash, white - Fraxinus americana	2
8893	11214271	426259	Ash, green - Fraxinus pennsylvanica	2
8894	11214278	426107	Ash, white - Fraxinus americana	2

8984	11216116	428904	Ash, white - Fraxinus americana	2
9039	11218161	472431	Ash, white - Fraxinus americana	2
9045	11218267	472131	Ash, green - Fraxinus pennsylvanica	2
8	11190214	472015	Ash, green - Fraxinus pennsylvanica	3
35	11192154	423736	Ash, green - Fraxinus pennsylvanica	3
75	11193882	499451	Ash, white - Fraxinus americana	3
103	11194494	494405	Ash, green - Fraxinus pennsylvanica	3
382	11203866	414590	Ash, green - Fraxinus pennsylvanica	3
541	11207348	445370	Ash, white - Fraxinus americana	3
683	11210650	84317	Ash, green - Fraxinus pennsylvanica	3
760	11211752	428912	Ash, white - Fraxinus americana	3
795	11212435	428884	Ash, white - Fraxinus americana	3
797	11212464	451256	Ash, green - Fraxinus pennsylvanica	3
802	11212525	476115	Ash, green - Fraxinus pennsylvanica	3
843	11213748	420363	Ash, green - Fraxinus pennsylvanica	3
910	11215037	492536	Ash, white - Fraxinus americana	3
1010	11218359	471976	Ash, green - Fraxinus pennsylvanica	3
1208	11192156	423740	Ash, green - Fraxinus pennsylvanica	3
1215	11192381	423759	Ash, green - Fraxinus pennsylvanica	3
1216	11192406	432680	Ash, green - Fraxinus pennsylvanica	3
1218	11192475	437142	Ash, green - Fraxinus pennsylvanica	3
1240	11193802	471807	Ash, green - Fraxinus pennsylvanica	3
1255	11194001	432958	Ash, green - Fraxinus pennsylvanica	3
1263	11194063	428849	Ash, white - Fraxinus americana	3
1292	11194581	436447	Ash, white - Fraxinus americana	3
1328	11195484	423474	Ash, green - Fraxinus pennsylvanica	3
1546	11203604	81080	Ash, green - Fraxinus pennsylvanica	3
1826	11210267	444016	Ash, green - Fraxinus pennsylvanica	3
1844	11210657	25603	Ash, green - Fraxinus pennsylvanica	3
1956	11212352	427115	Ash, green - Fraxinus pennsylvanica	3
1965	11212428	428877	Ash, white - Fraxinus americana	3
1973	11212560	423463	Ash, green - Fraxinus pennsylvanica	3
2023	11214270	426258	Ash, green - Fraxinus pennsylvanica	3
2033	11214413	479671	Ash, green - Fraxinus pennsylvanica	3
2047	11214618	488736	Ash, white - Fraxinus americana	3
2341	11191105	463568	Ash, green - Fraxinus pennsylvanica	3
2383	11193527	471909	Ash, green - Fraxinus pennsylvanica	3
2395	11193833	499562	Ash, white - Fraxinus americana	3
2619	11200424	481275	Ash, green - Fraxinus pennsylvanica	3
2621	11200463	436712	Ash, green - Fraxinus pennsylvanica	3
2624	11200466	436721	Ash, green - Fraxinus pennsylvanica	3
2778	11204365	463183	Ash, green - Fraxinus pennsylvanica	3
3024	11210580	443544	Ash, green - Fraxinus pennsylvanica	3
3026	11210598	443549	Ash, green - Fraxinus pennsylvanica	3
3080	11211606	451522	Ash, green - Fraxinus pennsylvanica	3
3142	11212957	475871	Ash, green - Fraxinus pennsylvanica	3
3171	11214020	423991	Ash, green - Fraxinus pennsylvanica	3

3190	11214690	435453	Ash, green - Fraxinus pennsylvanica	3
3224	11215599	451547	Ash, green - Fraxinus pennsylvanica	3
3230	11215789	423490	Ash, green - Fraxinus pennsylvanica	3
3262	11216243	455847	Ash, green - Fraxinus pennsylvanica	3
3274	11216415	444142	Ash, green - Fraxinus pennsylvanica	3
3358	11219077	471967	Ash, green - Fraxinus pennsylvanica	3
3478	11191379	469467	Ash, green - Fraxinus pennsylvanica	3
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3505	11192407	432682	Ash, green - Fraxinus pennsylvanica	3
3506	11192929	492550	Ash, green - Fraxinus pennsylvanica	3
3507	11192930	492551	Ash, green - Fraxinus pennsylvanica	3
3525	11193851	499428	Ash, white - Fraxinus americana	3
3564	11194923	476748	Ash, green - Fraxinus pennsylvanica	3
3629	11196949	499313	Ash, white - Fraxinus americana	3
3676	11199369	97587	Ash, white - Fraxinus americana	3
3678	11199450	451586	Ash, green - Fraxinus pennsylvanica	3
3976	11207137	451358	Ash, green - Fraxinus pennsylvanica	3
4112	11210596	443547	Ash, green - Fraxinus pennsylvanica	3
4113	11210597	443548	Ash, green - Fraxinus pennsylvanica	3
4189	11211578	451514	Ash, green - Fraxinus pennsylvanica	3
4237	11212442	428838	Ash, white - Fraxinus americana	3
4317	11214550	433095	Ash, white - Fraxinus americana	3
4341	11215038	492538	Ash, white - Fraxinus americana	3
4475	11218559	436794	Ash, green - Fraxinus pennsylvanica	3
4641	11192178	423747	Ash, green - Fraxinus pennsylvanica	3
4642	11192218	432672	Ash, green - Fraxinus pennsylvanica	3
4643	11192223	492499	Ash, green - Fraxinus pennsylvanica	3
4777	11196557	438363	Ash, green - Fraxinus pennsylvanica	3
4993	11203814	475391	Ash, green - Fraxinus pennsylvanica	3
5366	11211912	439746	Ash, green - Fraxinus pennsylvanica	3
5378	11212214	51901	Ash, green - Fraxinus pennsylvanica	3
5396	11212440	428834	Ash, white - Fraxinus americana	3
5399	11212488	2379	Ash, white - Fraxinus americana	3
5557	11216413	444107	Ash, green - Fraxinus pennsylvanica	3
5767	11192228	492505	Ash, white - Fraxinus americana	3
5776	11192389	432551	Ash, white - Fraxinus americana	3
5777	11192405	432679	Ash, green - Fraxinus pennsylvanica	3
5782	11193303	432546	Ash, white - Fraxinus americana	3
5795	11193821	499480	Ash, white - Fraxinus americana	3
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6514	11212546	479289	Ash, green - Fraxinus pennsylvanica	3
6676	11216111	428936	Ash, white - Fraxinus americana	3
6696	11216524	488663	Ash, white - Fraxinus americana	3

6714	11217402	74881	Ash, white - Fraxinus americana	3
6898	11192057	435866	Ash, green - Fraxinus pennsylvanica	3
6901	11192090	435886	Ash, green - Fraxinus pennsylvanica	3
6906	11192219	432673	Ash, green - Fraxinus pennsylvanica	3
6910	11192696	434776	Ash, white - Fraxinus americana	3
6911	11192935	492557	Ash, green - Fraxinus pennsylvanica	3
6923	11193424	440718	Ash, white - Fraxinus americana	3
6930	11193884	499460	Ash, white - Fraxinus americana	3
6962	11194492	494399	Ash, green - Fraxinus pennsylvanica	3
7000	11195853	499745	Ash, white - Fraxinus americana	3
7014	11196125	499701	Ash, white - Fraxinus americana	3
7070	11199100	70159	Ash, green - Fraxinus pennsylvanica	3
7071	11199128	480994	Ash, green - Fraxinus pennsylvanica	3
7274	11204356	61901	Ash, green - Fraxinus pennsylvanica	3
7339	11205387	467269	Ash, green - Fraxinus pennsylvanica	3
7480	11208535	95445	Ash, green - Fraxinus pennsylvanica	3
7635	11211753	428914	Ash, white - Fraxinus americana	3
7641	11211846	428300	Ash, white - Fraxinus americana	3
7644	11211924	427364	Ash, white - Fraxinus americana	3
7685	11212689	477320	Ash, white - Fraxinus americana	3
7709	11213219	427419	Ash, green - Fraxinus pennsylvanica	3
7833	11215691	512381	Ash, white - Fraxinus americana	3
7857	11216123	428925	Ash, white - Fraxinus americana	3
7868	11216249	451521	Ash, green - Fraxinus pennsylvanica	3
7938	11218660	471907	Ash, green - Fraxinus pennsylvanica	3
8087	11190488	473250	Ash, green - Fraxinus pennsylvanica	3
8125	11192227	492503	Ash, white - Fraxinus americana	3
8135	11192936	492558	Ash, green - Fraxinus pennsylvanica	3
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8344	11200161	436828	Ash, white - Fraxinus americana	3
8348	11200196	467267	Ash, green - Fraxinus pennsylvanica	3
8349	11200197	467268	Ash, green - Fraxinus pennsylvanica	3
8356	11200423	481274	Ash, green - Fraxinus pennsylvanica	3
8614	11207362	443267	Ash, green - Fraxinus pennsylvanica	3
8709	11210487	47638	Ash, green - Fraxinus pennsylvanica	3
8788	11211796	428295	Ash, white - Fraxinus americana	3
8797	11211910	439433	Ash, green - Fraxinus pennsylvanica	3
8799	11211926	427253	Ash, white - Fraxinus americana	3
8802	11212087	451340	Ash, green - Fraxinus pennsylvanica	3
8807	11212211	488000	Ash, white - Fraxinus americana	3
8827	11212524	476114	Ash, green - Fraxinus pennsylvanica	3
8829	11212557	423475	Ash, green - Fraxinus pennsylvanica	3
8844	11212828	491155	Ash, white - Fraxinus americana	3

8872	11213771	487421	Ash, white - Fraxinus americana	3
8901	11214318	444130	Ash, green - Fraxinus pennsylvanica	3
8966	11215859	480342	Ash, white - Fraxinus americana	3
8974	11216026	72558	Ash, green - Fraxinus pennsylvanica	3
8996	11216416	444143	Ash, green - Fraxinus pennsylvanica	3
7	11190213	472013	Ash, green - Fraxinus pennsylvanica	4
48	11192934	492556	Ash, green - Fraxinus pennsylvanica	4
60	11193570	495527	Ash, white - Fraxinus americana	4
71	11193828	499515	Ash, white - Fraxinus americana	4
86	11194181	433004	Ash, green - Fraxinus pennsylvanica	4
99	11194414	83423	Ash - Fraxinus spp.	4
135	11195324	423457	Ash, green - Fraxinus pennsylvanica	4
168	11196215	499815	Ash, white - Fraxinus americana	4
177	11196746	14501	Ash, green - Fraxinus pennsylvanica	4
275	11200448	436625	Ash, green - Fraxinus pennsylvanica	4
278	11200481	474864	Ash, green - Fraxinus pennsylvanica	4
286	11200658	435958	Ash, green - Fraxinus pennsylvanica	4
516	11206776	69525	Ash, white - Fraxinus americana	4
669	11210296	1598	Ash, green - Fraxinus pennsylvanica	4
772	11212091	451344	Ash, green - Fraxinus pennsylvanica	4
798	11212465	451257	Ash, green - Fraxinus pennsylvanica	4
826	11213034	493928	Ash, green - Fraxinus pennsylvanica	4
885	11214674	455858	Ash, white - Fraxinus americana	4
936	11215723	480329	Ash, green - Fraxinus pennsylvanica	4
937	11215727	455258	Ash, white - Fraxinus americana	4
938	11215729	455260	Ash, green - Fraxinus pennsylvanica	4
945	11215942	427722	Ash, green - Fraxinus pennsylvanica	4
963	11216236	451615	Ash, white - Fraxinus americana	4
971	11216490	451611	Ash, white - Fraxinus americana	4
1238	11193776	471806	Ash, green - Fraxinus pennsylvanica	4
1243	11193826	499500	Ash, white - Fraxinus americana	4
1366	11196462	499666	Ash, white - Fraxinus americana	4
1441	11200136	443922	Ash, green - Fraxinus pennsylvanica	4
1456	11200470	474862	Ash, green - Fraxinus pennsylvanica	4
1632	11205190	423494	Ash, green - Fraxinus pennsylvanica	4
1927	11211791	428290	Ash, white - Fraxinus americana	4
1934	11211847	428301	Ash, white - Fraxinus americana	4
1957	11212356	418605	Ash, green - Fraxinus pennsylvanica	4
1966	11212433	428882	Ash, white - Fraxinus americana	4
1998	11213469	480995	Ash, green - Fraxinus pennsylvanica	4
2093	11215667	423434	Ash, green - Fraxinus pennsylvanica	4
2098	11215788	423489	Ash, green - Fraxinus pennsylvanica	4
2150	11217078	451511	Ash, green - Fraxinus pennsylvanica	4
2171	11217636	494380	Ash, green - Fraxinus pennsylvanica	4
2364	11192290	492513	Ash, green - Fraxinus pennsylvanica	4
2370	11192939	492563	Ash, green - Fraxinus pennsylvanica	4
2382	11193467	474013	Ash, black - Fraxinus nigra	4

2449	11194922	476747	Ash, green - Fraxinus pennsylvanica	4
2490	11195901	500165	Ash, green - Fraxinus pennsylvanica	4
2505	11196712	460135	Ash, green - Fraxinus pennsylvanica	4
2614	11200189	436779	Ash, green - Fraxinus pennsylvanica	4
2641	11201260	493772	Ash, green - Fraxinus pennsylvanica	4
2724	11203355	483218	Ash, white - Fraxinus americana	4
2784	11204524	64813	Ash, white - Fraxinus americana	4
2867	11205815	455857	Ash, green - Fraxinus pennsylvanica	4
3079	11211604	467599	Ash, green - Fraxinus pennsylvanica	4
3098	11212143	470768	Ash, white - Fraxinus americana	4
3155	11213641	493907	Ash, green - Fraxinus pennsylvanica	4
3259	11216238	451618	Ash, white - Fraxinus americana	4
3260	11216241	451621	Ash, white - Fraxinus americana	4
3273	11216414	444141	Ash, green - Fraxinus pennsylvanica	4
3275	11216418	444145	Ash, green - Fraxinus pennsylvanica	4
3281	11216563	450130	Ash, green - Fraxinus pennsylvanica	4
3511	11193251	440754	Ash, white - Fraxinus americana	4
3524	11193827	499514	Ash, white - Fraxinus americana	4
3613	11195981	420275	Ash, green - Fraxinus pennsylvanica	4
3713	11200469	474861	Ash, green - Fraxinus pennsylvanica	4
3799	11203268	491790	Ash, green - Fraxinus pennsylvanica	4
3909	11205403	475381	Ash, green - Fraxinus pennsylvanica	4
4033	11208508	107681	Ash, green - Fraxinus pennsylvanica	4
4095	11210382	44852	Ash - Fraxinus spp.	4
4206	11211933	442175	Ash, green - Fraxinus pennsylvanica	4
4251	11212692	480083	Ash, white - Fraxinus americana	4
4278	11213640	493904	Ash, green - Fraxinus pennsylvanica	4
4342	11215039	492539	Ash, green - Fraxinus pennsylvanica	4
4420	11216467	57592	Ash, green - Fraxinus pennsylvanica	4
4434	11216740	495179	Ash, white - Fraxinus americana	4
4581	11345258	455846	Ash, green - Fraxinus pennsylvanica	4
4644	11192224	492500	Ash, white - Fraxinus americana	4
4647	11192292	492515	Ash, green - Fraxinus pennsylvanica	4
4649	11192471	437138	Ash, green - Fraxinus pennsylvanica	4
4656	11193249	440752	Ash, white - Fraxinus americana	4
4657	11193301	53835	Ash, white - Fraxinus americana	4
4662	11193348	487611	Ash, white - Fraxinus americana	4
4678	11193845	499578	Ash, white - Fraxinus americana	4
4725	11194833	111716	Ash, green - Fraxinus pennsylvanica	4
4763	11195965	420267	Ash, green - Fraxinus pennsylvanica	4
4784	11196945	499343	Ash, white - Fraxinus americana	4
4865	11199867	477348	Ash, white - Fraxinus americana	4
4887	11200429	436618	Ash, green - Fraxinus pennsylvanica	4
4888	11200490	494267	Ash, white - Fraxinus americana	4
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5353	11211599	463799	Ash, green - Fraxinus pennsylvanica	4
5367	11211915	437520	Ash, green - Fraxinus pennsylvanica	4
5407	11212593	423668	Ash, green - Fraxinus pennsylvanica	4
5443	11213761	493727	Ash, green - Fraxinus pennsylvanica	4
5454	11214212	447734	Ash, green - Fraxinus pennsylvanica	4
5468	11214541	427311	Ash, green - Fraxinus pennsylvanica	4
5478	11214705	451512	Ash, green - Fraxinus pennsylvanica	4
5560	11216484	451603	Ash, white - Fraxinus americana	4
5561	11216506	488666	Ash, white - Fraxinus americana	4
5812	11194117	418807	Ash, white - Fraxinus americana	4
5830	11194493	494400	Ash, green - Fraxinus pennsylvanica	4
5990	11200133	443925	Ash, green - Fraxinus pennsylvanica	4
6217	11205404	45851	Ash, white - Fraxinus americana	4
6449	11211458	300121	Ash, white - Fraxinus americana	4
6464	11211759	429402	Ash, white - Fraxinus americana	4
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6466	11211789	428288	Ash, white - Fraxinus americana	4
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6674	11216108	428932	Ash, white - Fraxinus americana	4
6694	11216492	451614	Ash, white - Fraxinus americana	4
6713	11217329	451612	Ash, white - Fraxinus americana	4
6767	11219074	451608	Ash, white - Fraxinus americana	4
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6915	11193250	440753	Ash, white - Fraxinus americana	4
6950	11194206	436504	Ash, white - Fraxinus americana	4
6954	11194293	91644	Ash - Fraxinus spp.	4
6974	11194841	39525	Ash, green - Fraxinus pennsylvanica	4
6981	11195200	47283	Ash, green - Fraxinus pennsylvanica	4
7003	11195970	420272	Ash, green - Fraxinus pennsylvanica	4
7004	11195972	499753	Ash, white - Fraxinus americana	4
7024	11196946	499305	Ash, white - Fraxinus americana	4
7348	11205601	437942	Ash, green - Fraxinus pennsylvanica	4
7388	11206487	422861	Ash, green - Fraxinus pennsylvanica	4
7514	11209667	493898	Ash, green - Fraxinus pennsylvanica	4
7639	11211798	428297	Ash, white - Fraxinus americana	4
7662	11212289	427791	Ash, green - Fraxinus pennsylvanica	4
7712	11213235	21659	Ash, green - Fraxinus pennsylvanica	4
7735	11213869	448647	Ash, green - Fraxinus pennsylvanica	4
7754	11214275	426255	Ash, green - Fraxinus pennsylvanica	4
7786	11214820	483519	Ash, green - Fraxinus pennsylvanica	4
7806	11215189	492547	Ash, green - Fraxinus pennsylvanica	4

7838	11215784	423484	Ash, green - Fraxinus pennsylvanica	4
7839	11215785	423486	Ash, green - Fraxinus pennsylvanica	4
7840	11215787	423488	Ash, green - Fraxinus pennsylvanica	4
7867	11216237	451616	Ash, white - Fraxinus americana	4
7882	11216562	450129	Ash, green - Fraxinus pennsylvanica	4
7883	11216569	444228	Ash, white - Fraxinus americana	4
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7890	11216782	476644	Ash, green - Fraxinus pennsylvanica	4
7927	11218502	471977	Ash, green - Fraxinus pennsylvanica	4
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8264	11196984	499375	Ash, white - Fraxinus americana	4
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8353	11200320	450128	Ash, green - Fraxinus pennsylvanica	4
8408	11202487	78350	Ash, white - Fraxinus americana	4
8448	11203736	95157	Ash, white - Fraxinus americana	4
8584	11206486	422859	Ash, green - Fraxinus pennsylvanica	4
8713	11210569	46560	Ash, white - Fraxinus americana	4
8796	11211909	423665	Ash, white - Fraxinus americana	4
8805	11212141	470766	Ash, white - Fraxinus americana	4
8806	11212142	470767	Ash, white - Fraxinus americana	4
8819	11212386	427317	Ash, green - Fraxinus pennsylvanica	4
8851	11213033	493927	Ash, green - Fraxinus pennsylvanica	4
8878	11213875	448210	Ash, white - Fraxinus americana	4
8884	11214148	95407	Ash, green - Fraxinus pennsylvanica	4
8885	11214149	473333	Ash, green - Fraxinus pennsylvanica	4
8910	11214560	432855	Ash, white - Fraxinus americana	4
9000	11216486	451605	Ash, white - Fraxinus americana	4
9005	11216525	488665	Ash, white - Fraxinus americana	4
9038	11218087	451513	Ash, green - Fraxinus pennsylvanica	4
53	11193313	421564	Ash, white - Fraxinus americana	5
117	11194834	44867	Ash, green - Fraxinus pennsylvanica	5
122	11194965	476854	Ash, green - Fraxinus pennsylvanica	5
163	11195973	499760	Ash, white - Fraxinus americana	5
165	11196074	424062	Ash, green - Fraxinus pennsylvanica	5
172	11196549	499722	Ash, white - Fraxinus americana	5
279	11200486	494260	Ash, white - Fraxinus americana	5
300	11201562	493477	Ash, white - Fraxinus americana	5
512	11206687	73304	Ash, white - Fraxinus americana	5
775	11212158	494013	Ash, green - Fraxinus pennsylvanica	5
787	11212367	104553	Ash, white - Fraxinus americana	5
806	11212572	423448	Ash, green - Fraxinus pennsylvanica	5
844	11213758	448470	Ash, white - Fraxinus americana	5
863	11214253	78427	Ash, green - Fraxinus pennsylvanica	5
955	11216101	428893	Ash, white - Fraxinus americana	5
988	11217404	437966	Ash, white - Fraxinus americana	5
989	11217408	437970	Ash, white - Fraxinus americana	5

990	11217411	451609	Ash, white - Fraxinus americana	5
1012	11218397	434313	Ash, green - Fraxinus pennsylvanica	5
1016	11218474	436801	Ash, green - Fraxinus pennsylvanica	5
1044	11219277	435956	Ash, green - Fraxinus pennsylvanica	5
1189	11191701	436788	Ash, green - Fraxinus pennsylvanica	5
1222	11193306	440694	Ash, white - Fraxinus americana	5
1225	11193336	428354	Ash, green - Fraxinus pennsylvanica	5
1230	11193438	468538	Ash, white - Fraxinus americana	5
1250	11193887	499406	Ash, white - Fraxinus americana	5
1294	11194611	250	Ash, green - Fraxinus pennsylvanica	5
1311	11195161	12519	Ash, green - Fraxinus pennsylvanica	5
1351	11195854	499746	Ash, white - Fraxinus americana	5
1407	11199045	36220	Ash, white - Fraxinus americana	5
1432	11199800	443919	Ash, green - Fraxinus pennsylvanica	5
1453	11200430	436619	Ash, green - Fraxinus pennsylvanica	5
1457	11200518	493478	Ash, white - Fraxinus americana	5
1462	11200843	67545	Ash, green - Fraxinus pennsylvanica	5
1478	11201612	83596	Ash, white - Fraxinus americana	5
1549	11203720	5142	Ash, white - Fraxinus americana	5
1704	11206978	435312	Ash, white - Fraxinus americana	5
1721	11207277	435313	Ash, white - Fraxinus americana	5
1900	11211408	442662	Ash, green - Fraxinus pennsylvanica	5
1916	11211601	463973	Ash, green - Fraxinus pennsylvanica	5
1945	11212159	494014	Ash, green - Fraxinus pennsylvanica	5
1960	11212384	427315	Ash, green - Fraxinus pennsylvanica	5
1971	11212549	479306	Ash, green - Fraxinus pennsylvanica	5
1993	11213233	88174	Ash, white - Fraxinus americana	5
2022	11214261	427314	Ash, green - Fraxinus pennsylvanica	5
2106	11215945	428739	Ash, green - Fraxinus pennsylvanica	5
2120	11216113	428895	Ash, white - Fraxinus americana	5
2138	11216485	451604	Ash, white - Fraxinus americana	5
2139	11216487	451606	Ash, white - Fraxinus americana	5
2161	11217330	451617	Ash, white - Fraxinus americana	5
2164	11217406	437968	Ash, white - Fraxinus americana	5
2181	11218266	495513	Ash, white - Fraxinus americana	5
2221	11219085	522367	Ash, green - Fraxinus pennsylvanica	5
2361	11192232	492509	Ash, white - Fraxinus americana	5
2428	11194490	494606	Ash, green - Fraxinus pennsylvanica	5
2512	11196889	499334	Ash, white - Fraxinus americana	5
2569	11199047	106086	Ash, white - Fraxinus americana	5
2690	11202646	494300	Ash, green - Fraxinus pennsylvanica	5
2761	11204125	12716	Ash, white - Fraxinus americana	5
2893	11206910	106403	Ash, white - Fraxinus americana	5
3040	11210859	28208	Ash, white - Fraxinus americana	5
3127	11212551	479308	Ash, green - Fraxinus pennsylvanica	5
3128	11212552	479309	Ash, green - Fraxinus pennsylvanica	5
3137	11212938	451160	Ash, green - Fraxinus pennsylvanica	5

3160	11213777	487418	Ash, white - Fraxinus americana	5
3167	11213873	448193	Ash, white - Fraxinus americana	5
3213	11215280	84926	Ash, green - Fraxinus pennsylvanica	5
3214	11215282	492554	Ash, green - Fraxinus pennsylvanica	5
3261	11216242	451622	Ash, white - Fraxinus americana	5
3316	11218438	436796	Ash, green - Fraxinus pennsylvanica	5
3498	11192225	492501	Ash, white - Fraxinus americana	5
3508	11192937	492559	Ash, green - Fraxinus pennsylvanica	5
3514	11193401	432557	Ash, green - Fraxinus pennsylvanica	5
3611	11195967	420269	Ash, green - Fraxinus pennsylvanica	5
3612	11195969	420271	Ash, green - Fraxinus pennsylvanica	5
3630	11196951	499359	Ash, white - Fraxinus americana	5
3669	11199043	75787	Ash, white - Fraxinus americana	5
3716	11200587	493473	Ash, white - Fraxinus americana	5
3718	11200659	435959	Ash, green - Fraxinus pennsylvanica	5
3758	11202359	443520	Ash, green - Fraxinus pennsylvanica	5
3828	11203935	449124	Ash, white - Fraxinus americana	5
3969	11206971	46949	Ash, white - Fraxinus americana	5
4114	11210602	415094	Ash, green - Fraxinus pennsylvanica	5
4302	11214302	79332	Ash, green - Fraxinus pennsylvanica	5
4315	11214542	427312	Ash, green - Fraxinus pennsylvanica	5
4316	11214548	433093	Ash, white - Fraxinus americana	5
4376	11215725	480335	Ash, green - Fraxinus pennsylvanica	5
4393	11216093	428858	Ash, white - Fraxinus americana	5
4403	11216232	443539	Ash, green - Fraxinus pennsylvanica	5
4404	11216239	451619	Ash, white - Fraxinus americana	5
4405	11216240	451620	Ash, white - Fraxinus americana	5
4451	11217905	451518	Ash, green - Fraxinus pennsylvanica	5
4516	11222200	522365	Ash, green - Fraxinus pennsylvanica	5
4618	11190280	451506	Ash, green - Fraxinus pennsylvanica	5
4645	11192231	492508	Ash, white - Fraxinus americana	5
4651	11192931	492552	Ash, green - Fraxinus pennsylvanica	5
4679	11193879	499397	Ash, white - Fraxinus americana	5
4680	11193889	499417	Ash, white - Fraxinus americana	5
4696	11194184	433019	Ash, green - Fraxinus pennsylvanica	5
4764	11195975	499774	Ash, white - Fraxinus americana	5
4825	11198997	79261	Ash, green - Fraxinus pennsylvanica	5
4834	11199097	75285	Ash, green - Fraxinus pennsylvanica	5
4842	11199286	1461	Ash - Fraxinus spp.	5
4862	11199839	488094	Ash, white - Fraxinus americana	5
4907	11201560	493441	Ash, green - Fraxinus pennsylvanica	5
4978	11203665	92089	Ash, green - Fraxinus pennsylvanica	5
5000	11203938	95535	Ash - Fraxinus spp.	5
5018	11204262	63342	Ash, white - Fraxinus americana	5
5080	11205250	423502	Ash, green - Fraxinus pennsylvanica	5
5158	11207281	43983	Ash, white - Fraxinus americana	5
5297	11210733	415110	Ash, green - Fraxinus pennsylvanica	5

5398	11212487	471564	Ash, green - Fraxinus pennsylvanica	5
5401	11212550	479307	Ash, green - Fraxinus pennsylvanica	5
5403	11212567	423477	Ash, green - Fraxinus pennsylvanica	5
5475	11214673	455856	Ash, green - Fraxinus pennsylvanica	5
5480	11214760	428846	Ash, white - Fraxinus americana	5
5558	11216479	451272	Ash, white - Fraxinus americana	5
5607	11218536	69733	Ash, white - Fraxinus americana	5
5620	11218737	436749	Ash, green - Fraxinus pennsylvanica	5
5773	11192380	423758	Ash, green - Fraxinus pennsylvanica	5
5781	11192933	492555	Ash, green - Fraxinus pennsylvanica	5
5827	11194434	490995	Ash, white - Fraxinus americana	5
5882	11195576	436747	Ash, green - Fraxinus pennsylvanica	5
5894	11196083	420706	Ash, green - Fraxinus pennsylvanica	5
5920	11197811	455848	Ash, green - Fraxinus pennsylvanica	5
5927	11198012	455850	Ash, green - Fraxinus pennsylvanica	5
6017	11201159	493475	Ash, white - Fraxinus americana	5
6084	11203294	420717	Ash, green - Fraxinus pennsylvanica	5
6088	11203357	483220	Ash, white - Fraxinus americana	5
6151	11204525	20430	Ash, white - Fraxinus americana	5
6152	11204526	31428	Ash, green - Fraxinus pennsylvanica	5
6282	11207278	435314	Ash, white - Fraxinus americana	5
6479	11212163	494018	Ash, green - Fraxinus pennsylvanica	5
6485	11212280	429067	Ash, green - Fraxinus pennsylvanica	5
6495	11212372	521294	Ash, white - Fraxinus americana	5
6588	11214289	6565	Ash, white - Fraxinus americana	5
6614	11214829	481684	Ash, green - Fraxinus pennsylvanica	5
6693	11216477	455849	Ash, green - Fraxinus pennsylvanica	5
6710	11216949	451519	Ash, green - Fraxinus pennsylvanica	5
6716	11217455	437945	Ash, green - Fraxinus pennsylvanica	5
6743	11218514	455236	Ash, white - Fraxinus americana	5
6750	11218643	434332	Ash, green - Fraxinus pennsylvanica	5
6778	11222201	522368	Ash, green - Fraxinus pennsylvanica	5
6975	11194876	483674	Ash, green - Fraxinus pennsylvanica	5
7006	11195978	499804	Ash, white - Fraxinus americana	5
7019	11196551	499735	Ash, white - Fraxinus americana	5
7028	11197040	493474	Ash, white - Fraxinus americana	5
7049	11198585	443915	Ash, green - Fraxinus pennsylvanica	5
7050	11198586	443916	Ash, green - Fraxinus pennsylvanica	5
7092	11199649	78218	Ash, green - Fraxinus pennsylvanica	5
7108	11200029	413604	Ash, green - Fraxinus pennsylvanica	5
7124	11200489	494266	Ash, white - Fraxinus americana	5
7125	11200517	493476	Ash, white - Fraxinus americana	5
7136	11201265	489332	Ash, white - Fraxinus americana	5
7224	11203356	483219	Ash, white - Fraxinus americana	5
7648	11212138	470762	Ash, white - Fraxinus americana	5
7739	11213890	423485	Ash, green - Fraxinus pennsylvanica	5
8134	11192932	492553	Ash, green - Fraxinus pennsylvanica	5

8137	11192983	432559	Ash, green - Fraxinus pennsylvanica	5
8140	11193174	472014	Ash, green - Fraxinus pennsylvanica	5
8180	11194205	436503	Ash, white - Fraxinus americana	5
8275	11198095	431487	Ash, green - Fraxinus pennsylvanica	5
8276	11198096	431489	Ash, green - Fraxinus pennsylvanica	5
8326	11199863	436827	Ash, white - Fraxinus americana	5
8378	11201605	25366	Ash, white - Fraxinus americana	5
8462	11204003	42290	Ash, white - Fraxinus americana	5
8548	11205728	415100	Ash, green - Fraxinus pennsylvanica	5
8700	11210266	444015	Ash, green - Fraxinus pennsylvanica	5
8718	11210673	23704	Ash - Fraxinus spp.	5
8770	11211475	444065	Ash, green - Fraxinus pennsylvanica	5
8812	11212269	475382	Ash, green - Fraxinus pennsylvanica	5
8828	11212548	479305	Ash, green - Fraxinus pennsylvanica	5
8834	11212688	474172	Ash, green - Fraxinus pennsylvanica	5
8875	11213859	521293	Ash, white - Fraxinus americana	5
8888	11214254	11382	Ash, green - Fraxinus pennsylvanica	5
8913	11214581	444031	Ash, green - Fraxinus pennsylvanica	5
8917	11214617	488731	Ash, white - Fraxinus americana	5
9001	11216488	451607	Ash, white - Fraxinus americana	5
9032	11217463	451517	Ash, green - Fraxinus pennsylvanica	5
9089	11219084	522366	Ash, green - Fraxinus pennsylvanica	5
62	11193651	468533	Ash, green - Fraxinus pennsylvanica	6
107	11194677	481296	Ash, white - Fraxinus americana	6
162	11195968	420270	Ash, green - Fraxinus pennsylvanica	6
229	11199417	495012	Ash, green - Fraxinus pennsylvanica	6
253	11199914	41278	Ash, white - Fraxinus americana	6
255	11199931	490636	Ash, white - Fraxinus americana	6
304	11201788	18582	Ash, white - Fraxinus americana	6
369	11203663	37145	Ash, green - Fraxinus pennsylvanica	6
504	11206430	75617	Ash, green - Fraxinus pennsylvanica	6
515	11206772	104159	Ash, Mountain, European - Sorbus aucuparia	6
551	11207490	42099	Ash, white - Fraxinus americana	6
625	11209109	451837	Ash, green - Fraxinus pennsylvanica	6
682	11210604	415097	Ash, green - Fraxinus pennsylvanica	6
697	11210854	17133	Ash, white - Fraxinus americana	6
742	11211396	442658	Ash, white - Fraxinus americana	6
784	11212339	424975	Ash, green - Fraxinus pennsylvanica	6
803	11212559	423479	Ash, green - Fraxinus pennsylvanica	6
805	11212566	423473	Ash, green - Fraxinus pennsylvanica	6
840	11213634	475152	Ash, green - Fraxinus pennsylvanica	6
877	11214521	479981	Ash, green - Fraxinus pennsylvanica	6
884	11214619	488742	Ash, white - Fraxinus americana	6
965	11216341	428930	Ash, white - Fraxinus americana	6
970	11216417	444144	Ash, green - Fraxinus pennsylvanica	6
977	11216674	87312	Ash, white - Fraxinus americana	6

987	11217403	58856	Ash, white - Fraxinus americana	6
1194	11191780	441147	Ash, green - Fraxinus pennsylvanica	6
1217	11192474	437141	Ash, green - Fraxinus pennsylvanica	6
1327	11195442	85316	Ash, green - Fraxinus pennsylvanica	6
1331	11195500	495672	Ash, green - Fraxinus pennsylvanica	6
1362	11196123	499699	Ash, white - Fraxinus americana	6
1363	11196164	451717	Ash, green - Fraxinus pennsylvanica	6
1378	11197058	492697	Ash, green - Fraxinus pennsylvanica	6
1402	11199000	65823	Ash, white - Fraxinus americana	6
1405	11199028	83314	Ash - Fraxinus spp.	6
1410	11199079	433933	Ash, white - Fraxinus americana	6
1413	11199126	480974	Ash, white - Fraxinus americana	6
1447	11200345	474840	Ash, green - Fraxinus pennsylvanica	6
1449	11200413	468540	Ash, white - Fraxinus americana	6
1465	11201272	57988	Ash, white - Fraxinus americana	6
1486	11202204	9555	Ash, white - Fraxinus americana	6
1558	11203918	71838	Ash, white - Fraxinus americana	6
1843	11210599	415087	Ash, green - Fraxinus pennsylvanica	6
1849	11210727	11709	Ash, white - Fraxinus americana	6
1860	11210880	99756	Ash, white - Fraxinus americana	6
1865	11210963	92843	Ash, white - Fraxinus americana	6
1892	11211218	451566	Ash, green - Fraxinus pennsylvanica	6
1911	11211560	463793	Ash, green - Fraxinus pennsylvanica	6
1936	11211913	439747	Ash, green - Fraxinus pennsylvanica	6
1954	11212349	73801	Ash, white - Fraxinus americana	6
2014	11213874	448202	Ash, white - Fraxinus americana	6
2040	11214539	52250	Ash, green - Fraxinus pennsylvanica	6
2041	11214540	83551	Ash, green - Fraxinus pennsylvanica	6
2050	11214691	487659	Ash, white - Fraxinus americana	6
2054	11214828	481561	Ash, white - Fraxinus americana	6
2057	11214857	449332	Ash, white - Fraxinus americana	6
2097	11215782	423481	Ash, green - Fraxinus pennsylvanica	6
2105	11215939	426267	Ash, green - Fraxinus pennsylvanica	6
2114	11216014	486049	Ash, green - Fraxinus pennsylvanica	6
2140	11216489	451610	Ash, white - Fraxinus americana	6
2160	11217328	451560	Ash, green - Fraxinus pennsylvanica	6
2163	11217405	437967	Ash, white - Fraxinus americana	6
2219	11219076	465731	Ash, green - Fraxinus pennsylvanica	6
2348	11191751	45140	Ash, white - Fraxinus americana	6
2359	11192226	492502	Ash, white - Fraxinus americana	6
2360	11192230	492507	Ash, white - Fraxinus americana	6
2374	11193193	440751	Ash, white - Fraxinus americana	6
2431	11194506	92948	Ash - Fraxinus spp.	6
2457	11195116	421207	Ash, green - Fraxinus pennsylvanica	6
2546	11198782	8162	Ash, white - Fraxinus americana	6
2583	11199370	24720	Ash, white - Fraxinus americana	6
2615	11200190	436780	Ash, green - Fraxinus pennsylvanica	6

2616	11200191	436781	Ash, green - Fraxinus pennsylvanica	6
2617	11200202	475715	Ash, green - Fraxinus pennsylvanica	6
2625	11200467	474857	Ash, green - Fraxinus pennsylvanica	6