ACAP SAINT JOHN

ADAPTSJ

# TREE INVENTORY

## FOR SOUTH CENTRAL PENINSULA, LOWER WEST SIDE & NORTH END

SAINT JOHN, NEW BRUNSWICK

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# Introduction

An urban forest can be described as any tree, planted or naturally growing, within an urban environment. This includes street trees, small urban forest clusters, and parks. There is evidence that urban forests provide environmental, economic, and social benefits (Nesbit et al., 2011, Mullaney et al., 2015). Urban forests can affect microclimatic conditions such as cooling, humidifying, and shading (Wang et al., 2019), and should be considered during climate adaptation planning (Pramova et al., 2012). Urban forests can also be affected by climate change, i.e. warming effects increasing pest occurrence (Raup et al., 2010) and urban heat island effect (Oke, 1973).

The City of Saint John's urban forest includes trees in public spaces (street trees and parks) and on privately owned land. PlanSJ recognizes the important role of trees and vegetation in maintaining and enhancing the quality of life in the City and has policies to plant street trees in public spaces and on City rights-of-way (City of Saint John, 2011). The City plants street trees when roads are being upgraded to the current design guidelines. The objective of this report is to summarize the formal inventory that was completed of Saint John Street trees from 2017 – 2019 in three different urban neighbourhoods.

A street tree is described as a tree that is planted on front lawns, along sidewalks or in other areas within a municipal road right-of-way. Although these trees can provide the same services as other trees within the urban environment, it is their location that makes them an important factor. The general public interacts with street trees daily. A population of street trees can provide a street with natural character and improve the quality of the given outdoor space (Ordonez and Duinker 2013). They can reduce city air pollution, storm water runoff, and urban noise, while also providing habitat for wildlife (Revelli and Porporato, 2018). Urban trees can also increase property values, improve aesthetics, and have been proven to reduce physical and mental stress in humans. Socioeconomics need to be considered during urban forest management plans, as to not leave the disenfranchised and lower income neighbourhoods behind, with larger spatial distribution of canopy cover (Greene et al., 2018). The management of urban forests is very important and falls under the municipal government due to their location.

The Emerald Ash Borer (*Agrilus planipennis*) (EAB) is an invasive species that is native to Asia. It was first detected in North America in 2002 in Detroit, Michigan, and in Windsor, Ontario. Since its introduction, the EAB has spread east of Windsor, to New Brunswick, Canada. EAB attacks true native ash species here in Canada including White Ash (*Fraxinus americana*) and Green Ash (*Fraxinus pennsylvanica*). The beetle is commonly spread by people transporting infested firewood, logs or wood chips. They can also spread naturally by flight, as researchers have found that adult EAB can travel up to 10 km, however, they usually remain close to where they originally emerged. Ash trees have often been planted along city streets due to their tolerance to urban environments. Until now, ash trees had very few diseases or problems with pests. As the spread of the EAB continues east across Canada, ash trees in New Brunswick are at risk of becoming infested with the invasive species, killing thousands of street trees in the province.

While some of the trees that are found in urban areas are remnant of natural growth, many trees have been planted by municipalities on public land at a large expense. Appropriate management is needed to maximize the benefits that urban forests offer and to eliminate any unnecessary risks that are associated

with urban forests (Conway et al., 2019). A proper management plan should include an inventory of trees, recommendations, threats to the urban forest, and identify any areas that need improvement.

# Methods

## Sites

Saint John, New Brunswick is surrounded by a natural Acadian forest landscape. The Acadian forest is comprised of a mixture of hardwood and softwood trees, including Red Spruce (*Picea rubens*), Yellow Birch (*Betula alleghaniensis*), Eastern Hemlock (*Tsuga canadensis*), Sugar Maple (*Acer saccharum*), Red Oak (*Quercus rubra*), Eastern White Pine (*Pinus strobus*), American Beech (*Fagus grandifolia*), and White Ash (*Fraxinus americana*). Variation in geology, topography, and proximity to ocean all play roles in establishing the diverse range of vegetation types (Loo and Ives, 2003). Saint John's urban forests are comprised of native and non-native species and exist in the neighbourhoods as street trees, clusters, and parks. Three neighbourhoods were surveyed over three years: the Central Peninsula (2017), the Lower-West Side (2018), and the North End (2019). The Tree Inventory is part of the Climate Change Adaptation Plan, which is being undertaken by ACAP Saint John and funded by Federation of Canadian Municipalities (FCM) and the Environmental Trust Fund (ETF) of New Brunswick.

## Central Peninsula

The Central Peninsula (Ward 3) is in the urban core of Saint John, and is the hub for employment, entertainment, and tourism. Since the Central Peninsula is a large employment area, many people commute from other parts of the city and outlying communities daily. There are a variety of land uses on the Central Peninsula, including transportation (railways, roadways and marine terminals), commercial, and residential. For example, as you move further eastward, land use shifts from commercial to residential. Zoning in the Central Peninsula includes waterfront commercial, urban center residential, major community facility zone, park space, uptown commercial zone, high rise residential, commercial corridor, general commercial, business park commercial zone, and mixed commercial. Throughout the peninsula there are three public squares: Queen Square, King Square, and the Loyalist Burial Grounds. These greenspaces contain many old growth hardwood trees, including American Elm (*Ulmus americana*). Because of their accessible location, these small parks are visited by thousands of people yearly including locals and tourists.

The Central Peninsula has a varied topography overlaid with a grid street structure that has resulted in steep slopes on the streets leading up from the water. The topography affects how stormwater flows through the peninsula, the walkability of streets, and the amount of sunlight that reaches buildings, streets, and public spaces.

The city has launched a neighbourhood planning process for the peninsula, which includes the Uptown, South End and the Waterloo Village areas (Figure 1). The Central Peninsula Neighbourhood Plan was formed to help drive smart and sustainable growth in one of Saint John's core neighbourhoods, while identifying the actions, programs, and services needed for the City.

*Figure 1. Map of the Central Peninsula in Saint John, New Brunswick.*

ACAP Saint John will contribute to the neighbourhood plan by developing a comprehensive plan that addresses the municipality's management of its street tree population. This plan established by ACAP will provide recommendations to maintain the diversity and health of Saint John neighbourhoods.

## Lower-West Side

The Lower-West Side of Saint John slopes downward toward the Wəlastəkw, with a provincial highway to the west, and hosting Fundy Heights neighbourhood to the south (Figure 2). The Lower-West side is largely a residential area and made up of single detached homes and mid-rise residential buildings. The area is zoned as two-unit residential and mid-high rise residential with a few small commercial areas that are occupied by convenience stores, restaurants, and daycare facilities. Other zoning in the Lower-West Side includes the transportation zone (Port and railway), park space, general commercial zone, and neighbourhood community facility zone. Bay Ferries operates a passenger ferry vessel from the Lower-West Side that travels from Saint John to Digby, Nova Scotia and completes 1-2 crossings daily.

*Figure 2. Map of the Lower-West Side, Saint John, New Brunswick.*

Urban parks in the Lower-West Side include Market Place Park, King Square West, and Queen Square West. The parks are natural assets hosting many mature trees and are valuable for recreation, culture, stormwater management, heat moderation, air purification, and carbon dioxide absorption.

## North End

Portland Place, Douglas Avenue, and the Old North End neighbourhoods comprise the North End. These neighbourhoods are situated in a valley with higher terrain north and south of the North End and the land slopes downward toward the Wəlastəkw in the west (Figure 3). Crescent Valley, followed by Rockwood Park, one of the largest municipally owned parks in Canada, borders Portland Place to the north. The Mount Pleasant and Central Peninsula neighbourhoods are located to the east and Millidgeville lies northwest of the North End.

*Figure 3: Map of the North End, Saint John, New Brunswick.*

The North End is largely residential with commercial strips located along Somerset Street, Lansdowne Avenue, and Main Street. Zoning in the area is comprised of general commercial, mid and high-rise residential, one unit residential, park space, and community facility zones.

Urban parks in the North End include Shamrock Park, Victoria Square, Robertson Square, St. Peters Park, and Riverview Memorial Park. The parks host many mature trees and are natural assets valuable for recreation, culture, stormwater management, heat moderation, air purification, and carbon dioxide absorption. Shamrock Park attracts visitors and residents from all areas of the city to its multiple sports fields and recreational trails. Robertson Square provides a recreational area and public access to the Wəlastəkw. Riverview Memorial Park was developed in 1902 to honour veterans of the Boer War. The park is located on Douglas Avenue and overlooks the Wəlastəkw.

## Data collection

An inventory was created in three different neighbourhoods within the City including tree height, diameter, species, condition, and proximity to power lines to fully understand the sustainability of the urban forest in the urban core.

Data outlined in the project vary somewhat between 2017 and 2019, but crucial data remains.

During June to September 2017, and July to August 2018 & 2019 a detailed inventory of the street tree population was taken, including some parks, located within the Central Peninsula, Lower-West Side, and North End respectively.

For all years/neighbourhoods the detailed street tree survey included:

(1) specific street and GPS coordinates

(2) tree species identification

(3) diameter at breast high (DBH) (1.3 metres)

(4) tree height in meters

(5) proximity to overhead utility lines

For 2017 data collection on Central Peninsula the presence of trunk wounds was recorded (disturbances in the vascular cambium ≥50% the tree's circumference), along with any other notes.

For 2018 and 2019 data collection on Lower-West Side and North End also included a health rating, age approximation, conditions (i.e. fair, excellent, needs attention, dead), and any comments/ recommendations. The health rating ranged from 0-3 indicating either dead (0), needs attention (1), fair (2) or excellent (3) condition.

If a tree could not be identified in the field, a leaf, twig, or flower sample was taken for identification. The diameter of each tree was measured at breast height (1.3 m above ground) using a tree caliper or a diameter tape if the diameter was above 0.50 m. Tree height (m) was measured using a SUNNTO manual clinometer. The proximity to overhead utility lines was determined by the following criteria: contact, over head, or no direct or future contact. For the structural condition in 2018 and 2019 a rank was assigned (dead, needs attention, fair, or excellent) based on visual observations taking into considerations such things as: collapsed branches, trunk structure integrity, and ground support. Health was also assigned a ranking based on this condition from 0 (dead) to 3 (excellent), which was determined by identification of disease, parasites, fungal infections, and visual assessment of lack of nutrients based on lack of leaves and pigmentation of said leaves. A GPS coordinate was taken for every tree recorded using a Garmin GPSMAP 78 unit. A tree's proximity to overhead utility lines was classified as either overhead utility lines being in contact with the crown (C), overhead utility lines overhead (OH), and no overhead utility lines overhead (NO). After further discussion with Saint John Energy, the crown conflicts from the North End 2019 tree inventory were further divided to identify the type of utility line the tree was in contact with i.e. primary (P), secondary (S), communications (C), or service lines (SR). It was noted that trees touching the primary line were also touching the lines below.

It should be noted that the City of Saint John experienced multiple high wind weather events in the Fall of 2019, resulting in the loss of many trees in the City's parks and along urban streets. These events occurred after the completion of this inventory and may affect some of the data collected.

Ecosystem services such as energy savings, carbon dioxide ($CO_2$) emissions reduced, air quality improvements, stormwater management and aesthetic appeal have been calculated by using the i-Tree modeling software, developed by the United States Department of Agriculture (2006). Each variable is expressed as dollars saved/tree. This approach calculates a financial value of each tree in the inventory.

# Results and Discussion

## Central Peninsula

### Species composition

The Central Peninsula had a substantial 1,519 street trees in 2017. Maples were the dominant trees at 26% (Figure 4). A sizable proportion (15%) of the Central Peninsula's urban forest consists of Green Ash, Black Ash, or Red Ash, which have been known for their tolerance to urban environments. Until now, ash trees had very few diseases or problems with pests. The Emerald Ash Borer is a beetle that arrived in New Brunswick in the Spring of 2018 and trigger a 5-10-year terminal lifespan for these trees once infected. This means that up to 15% of the trees on the Central Peninsula could be at risk of being infected by the beetle.

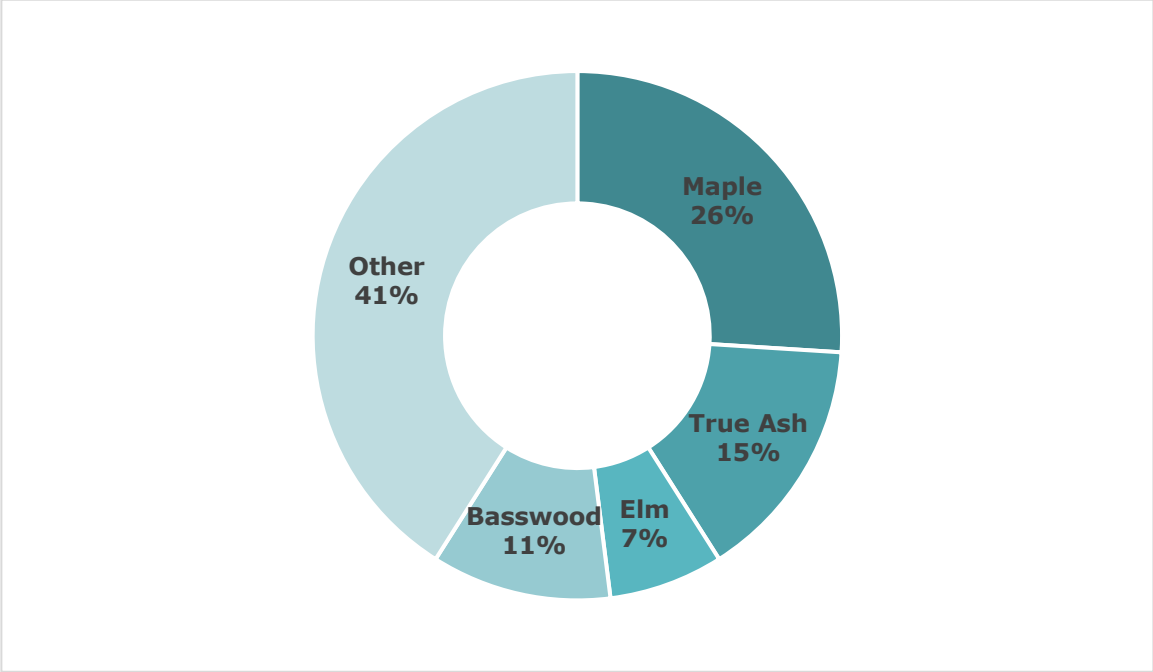


*Figure 4. Percentage composition of the urban tree inventory within the Central Peninsula neighbourhood.*

### Ecosystem services

The ecosystem services that the observed trees can provide to the neighbourhood have been calculated using the I-Tree Software (Table 1). In total, the residents and the City of Saint John saves approximately $79.29 per tree in the Central Peninsula, totalling $129,441. This value is based on the ecosystem services such as improved air quality, stormwater management, carbon intake, etc., that they provide for the community. Maintaining this substantial tree population on the Central Peninsula is therefore beneficial for both the municipality, the environment, and the community.

*Table 1: Annual public benefits of urban street trees in the Central Peninsula ($/tree) calculated using I-Tree Software (USDA Forest Service, 2006).*

| Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/other | Total |
|---|---|---|---|---|---|
| 12.83 | 1.73 | 0.95 | 10.02 | 53.76 | 79.29 |

## Tree Condition

Tree condition metrics for 2017 field program included: a) disturbance in the vascular cambium (wounds in base of tree) and b) of tree was dead, dying, healing, in poor condition. The largest occurrence of disturbances in cambium was still <50%, with only 26 occurrences out of the 1,519 trees assessed (Table 2). Dead trees were noted in 17 cases, which is less than 1% of the tree population. Generally, the trees on the Central Peninsula were seen to be in great health in 2017. Refer to the Tree Inventory Spreadsheet for full details.

*Table 2. Visual condition of trees in Central Peninsula during 2017 field season.*

| **Disturbance in vascular cambium** | **Occurrences** |
|---|---|
| <30% | 2 |
| <50% | 26 |
| Minor | 7 |
| Small cracks | 2 |
| **Status notes** | **Occurrences** |
| Bark pulled off | 2 |
| Dead | 17 |
| Dying | 25 |
| Healing | 2 |
| Poor condition – no leaves | 2 |

## Overhead Utility Line Conflicts

Overhead utility line conflicts were categorized into three fields: a) crown conflict b) overhead utility line overhead and no risk. On the Central Peninsula in 2017 there were 289 trees (11%) with overhead utility lines above them and 462 crowns of trees (18%) contacting overhead utility lines. The remaining 71% of trees were at no risk of contacting lines. Saint John Energy regularly monitors canopy growth, removing branches as needed. It will be important to continue to do so in the coming years to help maintain a vibrant community of street trees and the safety of the community living under both the trees and lines.

# Lower-West Side

## Species Composition

Lower-West species composition can be presented as a percentage composition of each genus in relation to the inventory. Species found at a low percentage (<6%) were grouped as Others. The urban street tree inventory for the Lower-West area counted a total of 587 trees. Like the Central Peninsula, the Lower-West urban tree inventory is dominated by maples (*Acer spp.*), including Sugar Maple (*Acer saccharum*), Silver Maple (*Acer saccharinum*) and the predominant Norway Maple (*Acer platanoides*) (Figure 5). There were also trees from Elms (*Ulmus spp.*) (12%) and Queen Street West had a high volume of true Ash (*Fraxinus spp.*), putting the health status of street trees under threat from the Emerald Ash Borer. Maple

trees were found to be generally in good health. Black Tar Spot (*Rhytisma acerinum*) infection was observed on some Maples but does not represent any more than a cosmetic issue.

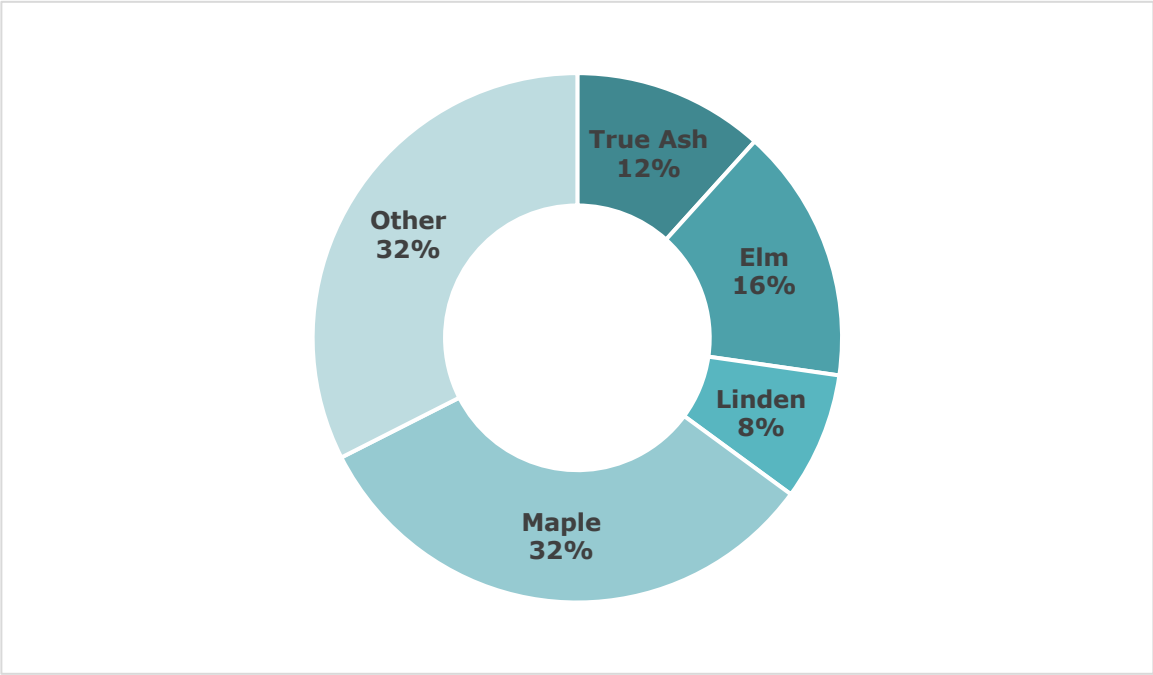


*Figure 5. Percentage composition of the urban tree inventory within the Lower-West Saint John area.*

## Ecosystem services

The ecosystem services that the observed trees can provide to the neighbourhood have been calculated using the I-Tree Software. In total, the residents and the City of Saint John saves approximately $103.31 per tree in the Lower-West Side (Total $60,643) (Table 3). Once again, this suggests it is an environmentally and economically significant decision to continue maintaining this urban tree population.

*Table 3. Annual public benefits of urban street trees in the Lower-West Side ($/tree) calculated using I-Tree Software (USDA Forest Service, 2006).*

| Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/other | Total |
|---|---|---|---|---|---|
| 42.39 | 3.73 | 4.55 | 18.68 | 34.01 | 103.31 |

Aside from the public realm inventory it was observed that many of the residential private properties could add a considerable amount to the overall inventory and would be a great contribution by the community to urban climate change adaptation. Providing education about the importance of preserving and maintaining these trees could see an increase of communal contributions to improve the urban forest.

## Tree conditions

Most trees (90%) assessed on the Lower-West Side had an excellent health ranking of 3 (Table 4). Less than 8% had a rating of fair (2), and the remaining 2% of trees needed attention (rating of 1) or were dead (0). Two ash trees were observed to have dying crown/leaves and should be monitored for EAB. These

numbers suggest that, for the most part, the urban tree population of the Lower-West Side is in great condition.

*Table 4. Visual condition of trees in Lower-West Side during 2018 field season.*

| **Health rank** | **Occurrences** |
|---|---|
| 0 | 6 |
| 1 | 9 |
| 2 | 45 |
| 3 | 527 |
| **Status notes** | **Occurrences** |
| Bark missing/fissure | 11 |
| Broken/missing branches | 5 |
| Dead branches | 4 |
| Dead/missing leaves or flowers | 12 |
| Exposed roots | 5 |
| Fungal disease/growth | 6 |
| Trunk decay/in poor condition | 2 |
| Dead/dying (remove or replace) | 8 |
| Stress growth | 6 |
| Conflict with buildings | 2 |
| Tar spot infection | 18 |

### Overhead utility line Conflicts

Overhead utility line conflicts were categorized into three fields: a) crown conflict b) overhead utility line c) overhead and no risk. There were 283 trees (48%) at no risk of contacting lines. There were 59 trees (10%) with overhead utility lines above them and 245 crowns of trees (42%) contacting overhead utility lines on the Lower-West Side. This is a large percentage of trees that are contacting lines and should be monitored to ensure the urban tree population remains thriving while keeping the community safe.

## North End

### Species Composition

The urban street tree inventory for the North End counted a total of 499 trees. Like the Central Peninsula and Lower-West Side, the North End urban tree inventory is dominated by Maples (*Acer spp.*), including Sugar Maple (*Acer saccharum*), Silver Maple (*Acer saccharinum*) and the predominant Norway Maple (*Acer platanoides*) (36%) (Figure 6). Other species were found including Linden (*Tilia spp.*) (11%), Elm (*Ulmus spp.*) (6%) and true Ash (*Fraxinus spp.*) (6%).

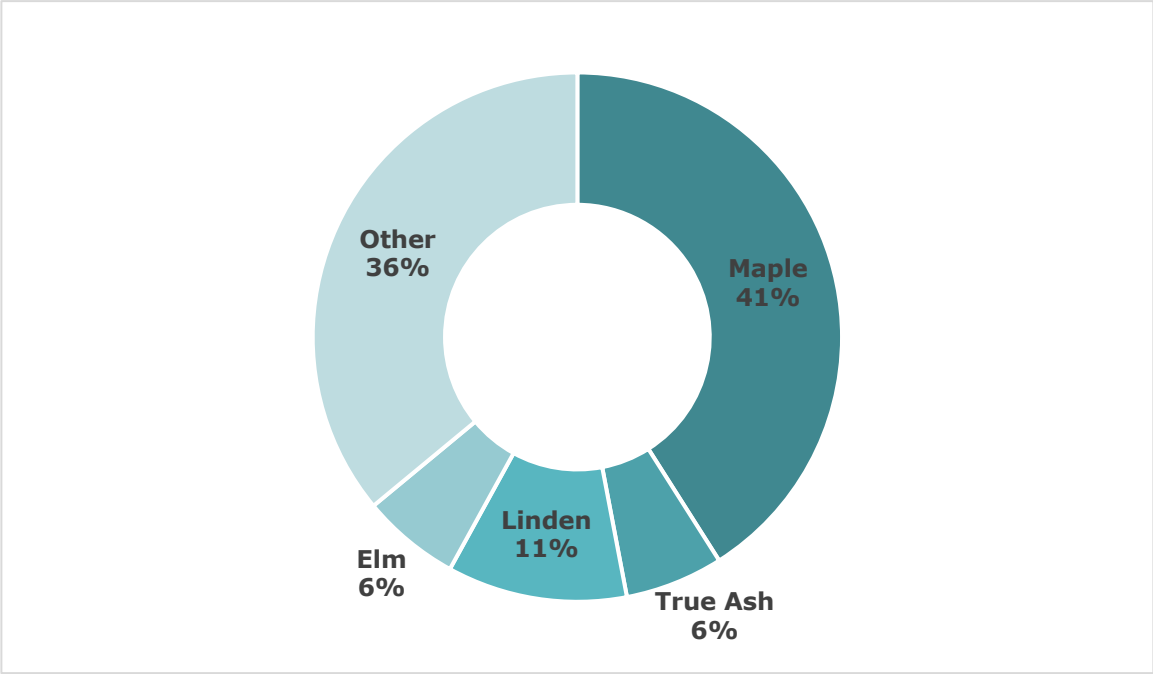


*Figure 6. Percentage composition of the urban tree inventory within the North End Neighbourhood.*

As with the other inventories, Norway Maple was again found to outnumber the other species found (32%). The Norway Maple is considered invasive in many parts of North America due to its ability to outcompete surrounding foliage with the help of shallow roots. This tree was used as an ornamental street and shade tree for many years and it sees continued use in some municipalities.

## Ecosystem services

The ecosystem services that the observed trees can provide to the North End have been calculated and in total, the residents and the City of Saint John saves approximately $71.28 per tree (Total $35,569) (Table 5).

*Table 5. Annual public benefits of urban street trees in the North End ($/tree) calculated using I-Tree Software (USDA Forest Service, 2006).*

| Energy | $CO_2$ | Air Quality | Stormwater | Aesthetic/other | Total |
|---|---|---|---|---|---|
| 28.86 | 0.98 | 6.84 | 8.15 | 26.44 | 71.28 |

The surveyors noted that the heat difference between working on streets with no trees versus moderate – dense cover was noticeable; however, this was sometimes dependant on the species of tree. For example, Ivory Silk Lilac (ISL), a popular tree to place under powerlines, usually grow to a height of 4-6.5 meters. The tight, rounded crown would never provide as much shade as an Elm or Maple, but those trees would grow to a height that would require more maintenance.

Although completely anecdotal, streets with many trees in the North End core seemed to have more people sitting outside on stoops/chairs. Victoria Street was a good example of this; this street contains very large Elms and Maple which provide shade. Main Street, by comparison was mainly used for walking, rather than sitting.

## Tree Condition

Most trees (89%) assessed in the North End had an excellent (3) health ranking (Table 6). Approximately 7% had a rating of fair (2), and the remaining 4% of trees needed attention (rating of 1) or were dead (0). These numbers suggest that, for the most part, the urban tree population of the North End is in excellent condition. Ash trees were found to be generally in good health. On average, the Green Ash trees we found were healthy and without EAB, on a quick inspection. There were three Ash trees assessed to be in fair condition due to loss of leaves and damage to the bark. The surveyors were not able to determine if these conditions were from EAB.

*Table 6. Visual condition of trees in the North End during 2019 field season. Refer ACAP tree inventory spreadsheet for more information.*

| **Health rank** | **Occurrences** |
|---|---|
| 0 | 6 |
| 1 | 15 |
| 2 | 37 |
| 3 | 441 |
| **Status notes** | **Occurrences** |
| Dead crown/supported by another tree | 3 |
| Loss of leaves | 4 |
| Mostly dead | 3 |
| Many bugs, leaves partially eaten | 2 |
| Crown dieback | 14 |
| Exposed roots | 2 |
| Has been cut/trimmed | 2 |
| Dead/broken branches | 5 |
| Dieback | 1 |
| Bark peeling/missing around trunk | 3 |
| Scars in bark | 1 |
| Trunk damage | 2 |

## Overhead Utility Line Conflicts

The proximity of surveyed trees to overhead utility lines was observed during the tree inventory to identify areas that may be at risk due to limb failure or swaying branches. In the previous two tree inventories, overhead utility line conflicts were categorized into three fields: a) crown conflict b) utility line overhead and no risk (Table 7). Trees that were sorted into the crown conflict category were observed to be near any overhead utility lines. After further discussion with Saint John Energy, the crown conflicts from the North End 2019 tree inventory were further divided to identify the type of utility line the tree was in contact with i.e. primary, secondary, communications, or service lines (Table 8). It was noted that trees touching the primary line were also touching the lines below.

*Table 7: Overhead utility line conflicts for the North End tree inventories.*

| | **Crown Conflict** | **Utility Line Overhead** | **No Contact** |
|---|---|---|---|
| **North End** | 87 *See below | 13 | 397 |

*Table 8: Overhead utility line conflicts for the North End tree inventories.*

| | Contacting Primary Line | Contacting Secondary Line | Contacting Communications Line | Contacting Service Line | Total Contacting |
|---|---|---|---|---|---|
| **North End** | 8 | 24 | 42 | 13 | **87** |

## Conclusion

Out of the 2,605 trees were surveyed in the Central Peninsula, Lower-West Side, and North End, approximately 76% of surveyed trees were identified to be in good condition. This inventory suggests a significant proportion of the urban forest is comprised of invasive or introduced species, primarily Norway Maple (*Acer platanoides*) (29%), which is prone to disease and limb failure during storm events.

There was a vast number of street trees contained in all neighbourhoods, the largest amount being in the Central Peninsula. The ecosystem services they provide are extremely valuable, not only monetarily, but also for the municipality, community members, and for the environment. It is important to monitor and maintain the health of these trees as much as possible to continue receiving these benefits. Well managed street tree populations provide ecological services by reducing burdens on storm water management, reductions in energy consumption, improvements in air quality, and increased property values. The ecosystem services that the observed trees can provide are approximately $73.31 per tree in the study neighbourhoods (Total $190,972).

As there is a substantial number of Ash trees in all three neighbourhoods, it is recommended that monitoring occurs regularly to inspect and treat for Emerald Ash Borer infections, in hopes that the disease will not spread through the entire neighbourhood. The Lower-West Side had two observed cases of dead Ash trees so inspecting these for the infection would be a good place to start. As there were many trees found to have their crowns contacting overhead utility lines, continued monitoring and trimming, as necessary, is also recommended.

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