Tree Management Plan

City of Kingston, New York

September 2018

Prepared for:

City of Kingston

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Executive Summary

ArborPro, Inc. developed this plan for the City of Kingston, New York with a focus on the short- and long-term maintenance needs of all inventoried trees within the City limits. ArborPro completed the tree inventory to better understand the current state of the urban forest and to create a framework for future tree care and maintenance planning. This Tree Management Plan was developed by analyzing tree inventory data in relation to the City's current and future urban forestry goals. In addition to maintenance and planning needs, this report addresses the economic, environmental, and social benefits that trees provide to the City of Kingston.

Significant Findings from the Inventory

The July 2018 tree inventory included trees and stumps within City parks as well as trees, stumps, and vacant sites along public street rights-of-way (ROW). A total of 5,237 sites were recorded during the inventory which included 3,937 trees (75.2%), 102 stumps (1.9%), and 1,198 vacant sites (22.9%). Of the inventoried sites, 4,406 (84.1%) are located along street ROWs and 831 (15.9%) are in City parks and open spaces. Analysis of the tree inventory found:

1. The five most common species found in Kingston are: Norway maple (516 trees: 13.1%); honey locust (396 trees: 10.1%); ornamental pear (326 trees: 8.3%); sugar maple (300 trees: 7.6%); and red maple (219 trees: 5.6%).
2. The three most common young trees (under 6" DBH) are: ornamental pear (98 trees); crabapple (59 trees); and eastern hemlock (46 trees).
3. The three most common mature trees (over 25" DBH) are: sugar maple (122 trees); Norway maple (77 trees); and silver maple (77 trees).
4. A total of 116 distinct species of trees were recorded during the inventory.
5. 89.6% of Kingston's tree population is in "fair" or better condition.
6. Trees provide approximately $541,095 in annual environmental benefits.
7. Total Environmental Benefits
    - Energy savings: $232,595/year.
    - Stormwater interception: valued at $57,437/year.
    - Carbon sequestration: valued at $5,471/year.
    - Improved air quality: $42,790/year.
    - Improved property value associated with aesthetics: $202,802.
8. Total replacement cost for all trees is $16,781,087.

Tree Maintenance Needs

Maintenance recommendations recorded during the tree inventory were removal (4.0%), pruning (71.1%), stump removal (1.9%), and planting (22.9%).

While tree maintenance can be very costly and time consuming, the benefits that trees provide justify the expense. Proper pruning and regular maintenance help ensure that trees are providing maximum benefits throughout their life span. In addition to maximizing benefits, regular maintenance mitigates tree-related risk by removing hazardous limbs; reducing future storm damage clean-up; removing limb conflicts on sidewalks and roadways; improving the overall appearance of urban trees; and promoting proper growth patterns in young trees. Trees that pose the highest risk (Priority 1 removal and prunes) should be addressed first to properly mitigate risk and prioritize maintenance. After all Priority 1 maintenance has been completed, the Priority 2 prunes and removals should be addressed.

Several high-risk trees (Priority 1 Prune and Removal) were recorded during the inventory. These should be pruned or removed immediately to ensure public safety.

Tree Removal	Priority 1 Removal = 58 trees Priority 2 Removal = 154 trees
Priority Pruning	Priority 1 Prune = 82 trees Priority 2 Prune = 372 trees
Routine Pruning	Routine Prune = 2,779 trees Training Prune = 492 trees

In addition to high priority maintenance and risk mitigation, the City of Kingston would greatly benefit from a routine pruning cycle. The length of this cycle may vary depending on budget and tree maintenance needs, but a five-year cycle is recommended for established trees. For young trees, a three-year, young tree training cycle is recommended to improve the structure, health, and longevity of newly planted trees. Currently, the City of Kingston does not maintain trees in City street ROWs. All information pertaining to priority and routine maintenance are recommendations that can be used to determine the cost and feasibility of completing the prescribed work.

Maintaining a proactive pruning and tree training cycle means that young trees are visited every three years while established trees are pruned every five years. Kingston has a considerable number of newly planted trees and would benefit greatly from a tree training cycle. Proper tree training will reduce structural defects and maintenance needs as trees mature and become established. Investing the time and money to address these issues while trees are young will reduce future pruning costs and help ensure the longevity of newly planted trees. This report will later discuss long-term planning and maintenance cycles at length.

In addition to regular maintenance, tree planting is an important part of a comprehensive tree management plan. Adding new trees to the landscape is necessary to promote canopy growth, offset loss of trees due to natural mortality and other causes, and to increase biodiversity.

Introduction

The City of Kingston is home to more than 23,000 full-time residents. The City is responsible for maintaining thousands of trees in parks, public spaces, and along street Rights-of-Way. The City of Kingston is rich in both cultural and natural resources. Kingston has been a Tree City USA for

more than 22 years and continues to show a dedication to preserving and improving its urban forest.

Approach to Tree Management

The best approach to successfully managing an urban forest is to implement a proactive, organized program that sets goals and monitors progress. The first steps in this process are to complete a tree inventory and prioritize maintenance to guide short- and long-term planning. The City can utilize these tools to establish tree care priorities; generate strategic planting plans; draft cost-effective budgets based on projected needs; and ultimately reduce to a minimum the need for costly, reactive solutions to emergency situations.

In July of 2018, Kingston worked with ArborPro to conduct a comprehensive tree inventory and develop a Tree Management Plan. This plan considers the size characteristics, condition, and species distribution of the inventoried trees and provides a prioritized system for maintaining all trees within the survey area. The following tasks were completed:

- Inventory of trees, stumps, and vacant sites along street ROWs and in public parks.
- Analysis of tree inventory data.
- Development of a plan that prioritizes the recommended tree maintenance.

Tree Management Plan addresses:

- **Results of the inventory.**
- **Benefits of a healthy urban forest.**
- **Prioritization of tree maintenance.**
- **Short- and long-term goals.**

Trees are an important part of a community's green infrastructure — as essential as roads, bridges, or sewer mains. But trees, unlike other types of infrastructure, perform better and gain value over time. They are the only infrastructure that improves with age. A tree management plan, like a stormwater, street, or sewer management plan, protects an important infrastructure on which the City depends. The Tree Management Plan outlines how Kingston will protect and care for one component of its green infrastructure — its trees. The management plan is divided into four sections:

- Section 1: Highlights and Results of Inventory Data
- Section 2: Benefits of a Healthy Urban Forest
- Section 3: Tree Management
- Section 4: Emerald Ash Borer Management

Section 1: Highlights and Results of Inventory Data

In July of 2018, ArborPro, Inc. assigned two ISA Certified Arborists to inventory trees and vacant sites along City street rights-of-way and in public parks. A total of 5,327 sites were collected within the City of Kingston, which includes 3,937 trees (75.2%), 102 stumps (1.9%), and 1,198 vacant sites (22.9%). Table 1 shows a breakdown of sites collected by area.

Area	Count	%
Academy Green Park	46	0.9%
Block Park	44	0.8%
Cornell Park	34	0.6%
Forsyth Park	326	6.2%
Hasbrouck Park	32	0.6%
Hutton Park	59	1.1%
Kingston Point Park	166	3.2%
Loughran Park	79	1.5%
TR Gallo Park	45	0.9%
Total Park Trees	**831**	**15.9%**
Street Trees	4406	84.1%
Grand Total	**5,237**	

Table 1: Sites collected by area

Methods of Data Collection

Tree inventory data were collected using ArborPro's proprietary software. The software, ArborPro version 3.5.1, is loaded on pen-based tablets, equipped with geographic information systems (GIS), and uses both aerial imagery and global positioning system (GPS).

The following data fields were collected at each tree location:

- address
- condition
- crown spread
- hardscape damage
- height
- mapping coordinates
- notes
- observations
- overhead utilities
- parkway type
- parkway size
- recommended maintanence
- side
- site number
- species
- tree diameter

Assessment of Tree Inventory Data

Professional judgment based on experience and industry standards is used to determine maintenance recommendations. Data analysis is then used to summarize and generalize about the state of the inventoried urban forest. Understanding and recognizing these trends will help guide

short- and long-term management planning. This section of the management plan summarizes the following criteria of the inventoried tree population:

- Size characteristics
- Tree condition
- Species and genus distribution

Size Characteristics

A tree's general size provides insight into its age and value as well as the overall age of the urban forest. The two industry-wide recognized size characteristics are height and diameter at breast height. While height is self-explanatory, diameter at breast height (DBH) is determined by the diameter of the tree at 4.5 feet above grade. DBH range distribution can be used to analyze the relative age distribution of an urban forest. This allows a city to adjust their planting plans to ensure that there are enough young trees to replace aging and over-mature trees. It is important that all age classes are adequately represented throughout the urban forest to ensure a healthy, vibrant tree canopy for future generations.

Figure 1 illustrates the distribution of the City of Kingston's trees by diameter class while Figure 3 shows the distribution of its trees by height.

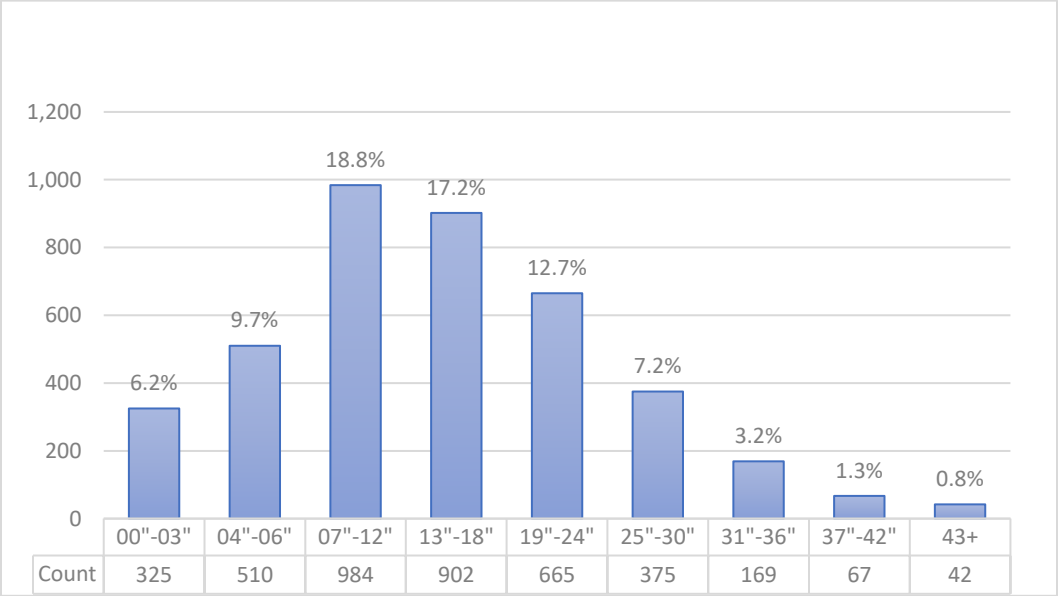
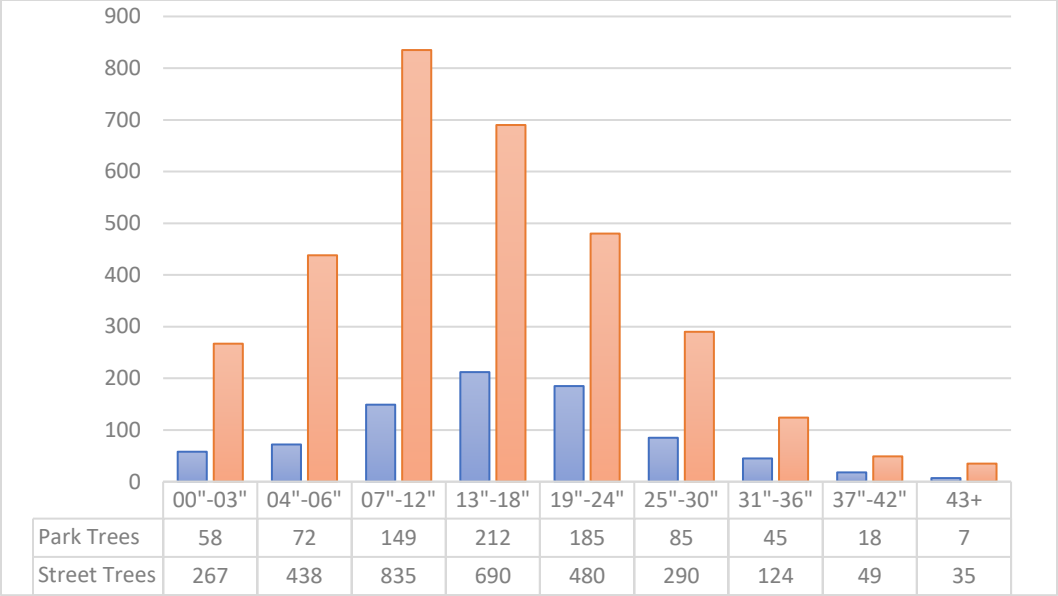
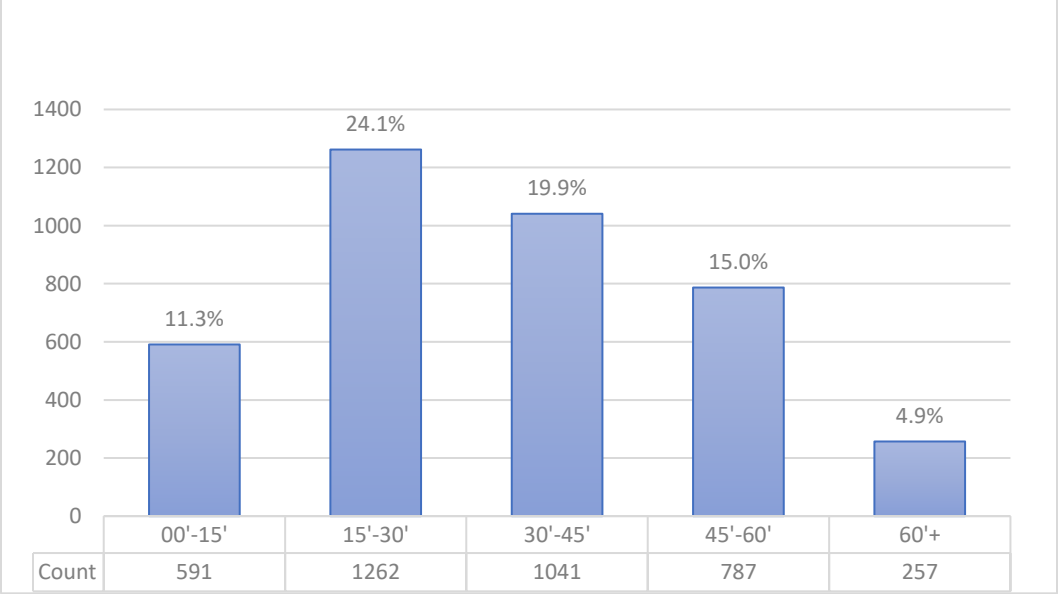


Figure 1: Diameter class distribution



	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+
Park Trees	58	72	149	212	185	85	45	18	7
Street Trees	267	438	835	690	480	290	124	49	35

Figure 2: Diameter class distribution by area



	00'-15'	15'-30'	30'-45'	45'-60'	60'+
Count	591	1262	1041	787	257

Figure 3: Height class distribution

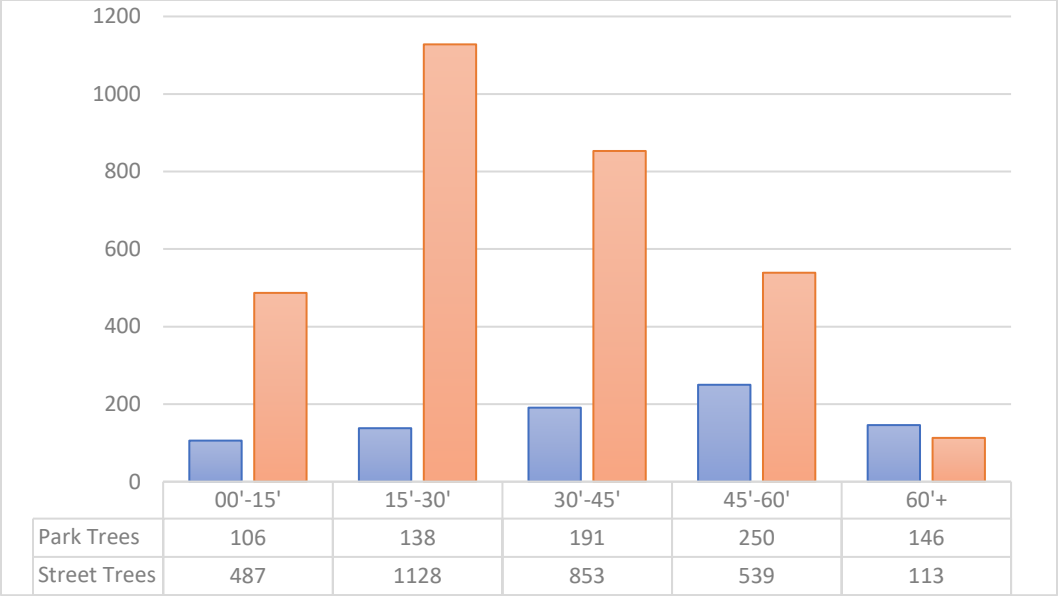


Figure 4: Height class distribution by area

Discussion

As the above graphs show, Kingston has a desirable distribution of size classes throughout the City. The diameter distribution is somewhat skewed towards young to semi-mature trees. While this is not entirely ideal, the young to semi-mature trees will grow over time to provide a healthy mature canopy, if properly managed. **ArborPro recommends continuing to plant new trees to further improve canopy cover and air quality.**

Tree Condition

Not necessarily about desirability, tree condition is a subjective, qualitative representation of overall health, vigor, and structure. Likewise, appearance is not a complete indication of overall condition. Table 2 and Figure 5 show the number of trees recorded in each condition as well as the percentage of the total population that they represent.

Good – The tree has no major structural problems; no significant damage from diseases or pests; no significant mechanical damage; a full, balanced crown; and normal twig condition and vigor for its species. Trees in this category are considered to be 80-90% healthy.

Tree Condition	Tree Count	%
Good	1,472	28.1%
Fair	2,056	39.3%
Poor	358	6.8%
Dead	51	1.0%
Stump	102	1.9%
Vacancy	1,198	22.9%
Total	**5,237**	

Table 2: Tree condition by count and percentage

Fair – The tree may exhibit the following characteristics: minor structural problems and/or mechanical damage; significant damage from non-fatal or disfiguring diseases; minor crown imbalance or thin crown; minor

structural imbalance; or stunted growth compared to adjacent trees. Trees in this category are considered to be 60-80% healthy.

Poor – A tree can appear healthy but may have structural defects. This classification also includes healthy trees that have unbalanced structures or have been topped. Trees in this category may also have severe mechanical damage, decay, severe crown dieback or poor vigor/failure to thrive. Trees in this category are considered to be 40-60% healthy.

Dead – This category refers only to trees that are completely dead. Trees in advanced states of decline that are still alive are generally recorded as poor or critical, not dead.

Stump – Stumps included interfere with pedestrian traffic or pose a tripping hazard. Stumps are not included in dead tree count.

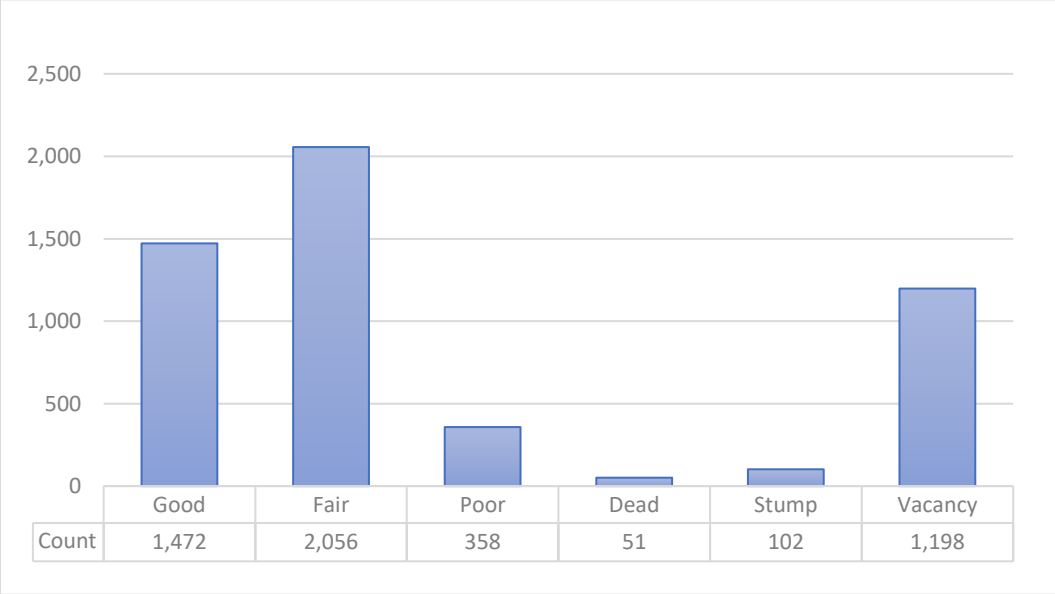
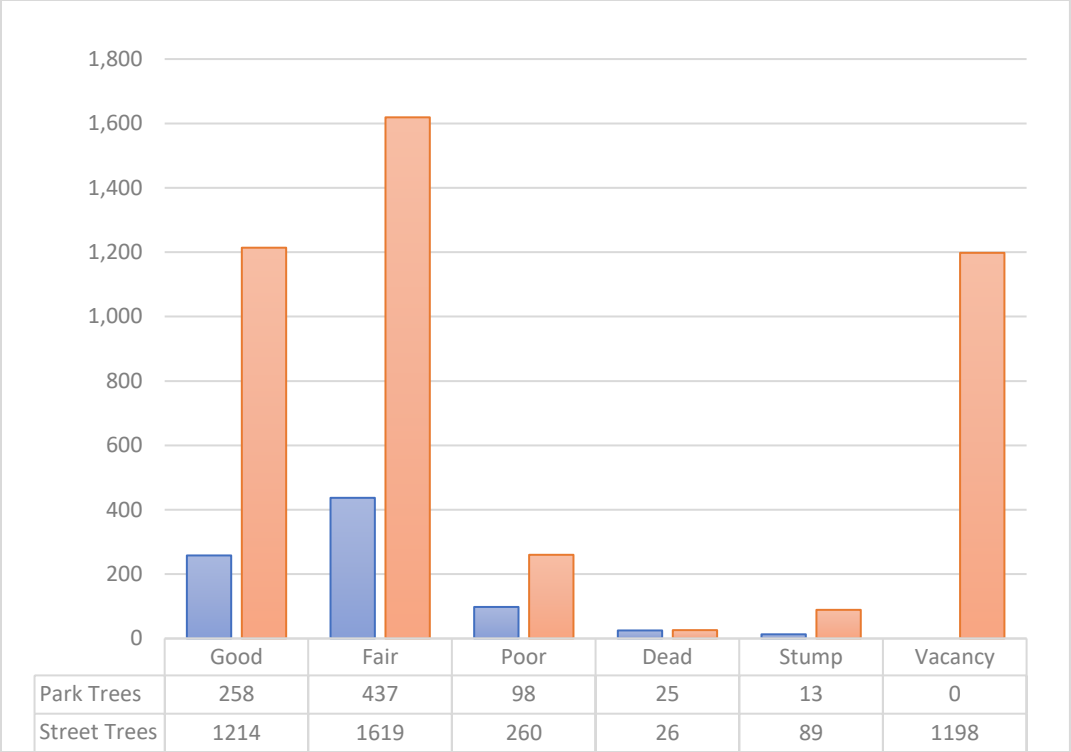


Figure 5: Tree condition by count and percentage

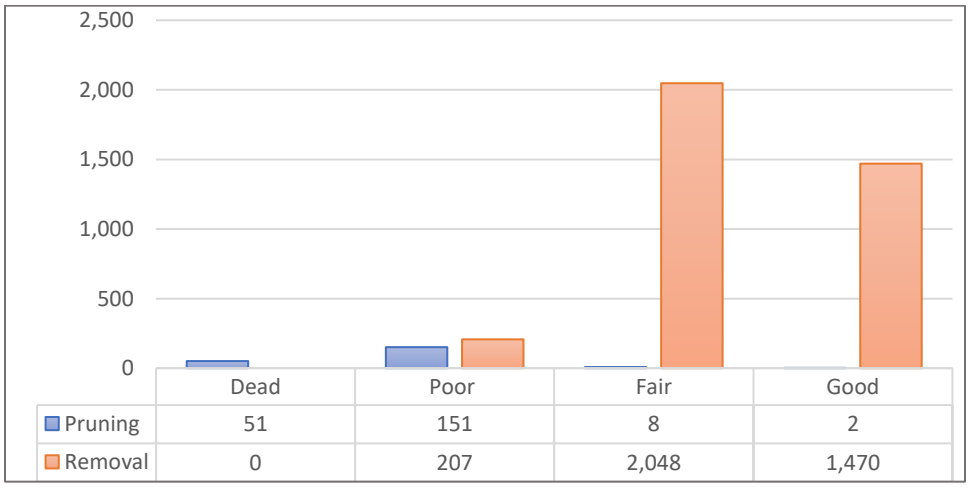


	Good	Fair	Poor	Dead	Stump	Vacancy
Park Trees	258	437	98	25	13	0
Street Trees	1214	1619	260	26	89	1198

Figure 6: Condition by area

Discussion

A majority of trees in Kingston (90.6%) were observed to be in Fair or better condition at the time of the inventory. This number excludes stumps and vacant sites and is used only to compare the condition of trees recorded in the inventory. Therefore, the overall health and condition of the City's trees would be rated as Good. However, approximately 8.6% of the City's trees are in poor condition; another 1% are dead. Figure 7 shows the maintenance recommendations by condition.



	Dead	Poor	Fair	Good
Pruning	51	151	8	2
Removal	0	207	2,048	1,470

Figure 7: Maintenance recommendations by condition

Species and Genus Distribution

Understanding species and genus distribution is important when determining which species should be planted and which ones are currently overrepresented in the urban forest. Biodiversity is extremely important to the overall health and longevity of a tree population. The accepted guideline for urban biodiversity is the 10-20-30 rule. This means that no species should represent more than 10%, no genus should represent more than 20%, and no family should represent more than 30% of the total tree population. Figure 8 shows the distribution of genera representing 2% or more of the total tree population.

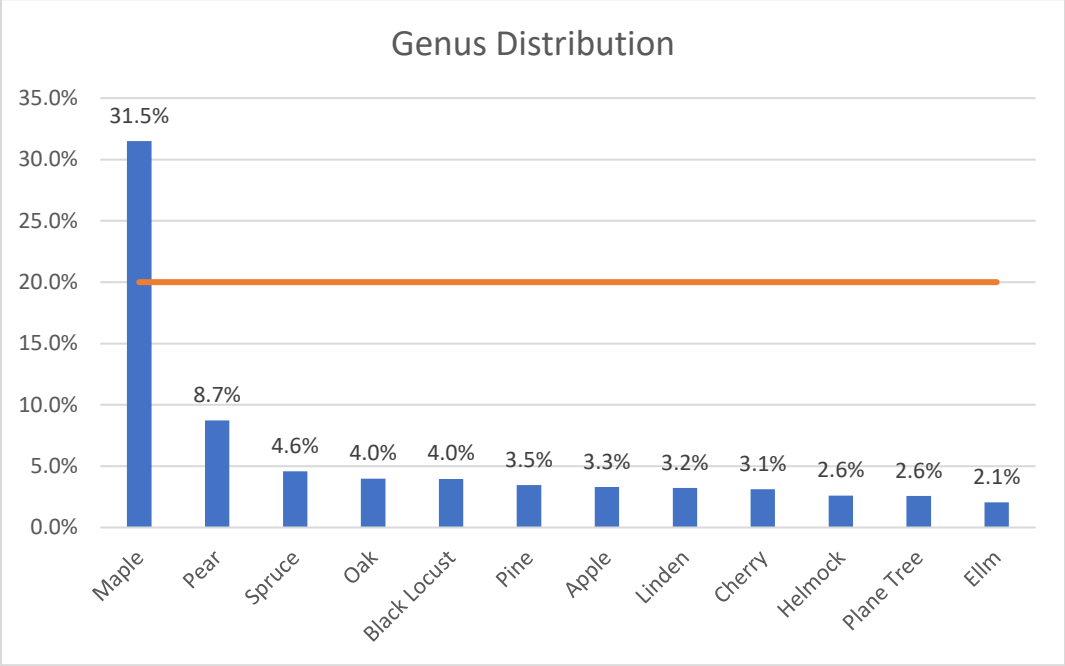


Figure 8: Genus distribution by count and percentage over 2%

Table 3 contains the top 10 species of trees recorded in Kingston by count and percentage of the total tree population. A full species frequency report can be found in Appendix A.

Botanical Name	Common Name	Count	%
Acer plantanoides	Norway Maple	516	13.1%
Gleditsia triacanthos forma inermis	Thornless Honey Locust	396	10.1%
Pyrus calleryana	Ornamental Pear	326	8.3%
Acer saccharum	Sugar Maple	300	7.6%
Acer rubrum	Red Maple	219	5.6%
Robinia pseudoacacia	Black Locust	156	4.0%
Acer saccharinum	Silver Maple	121	3.1%
Tilia cordata	Little-Leaf Linden	119	3.0%
Malus floribunda	Crabapple	117	3.0%
Pinus strobus	White Pine	107	2.7%

10%

Table 3: Ten most common species by percentage of total population

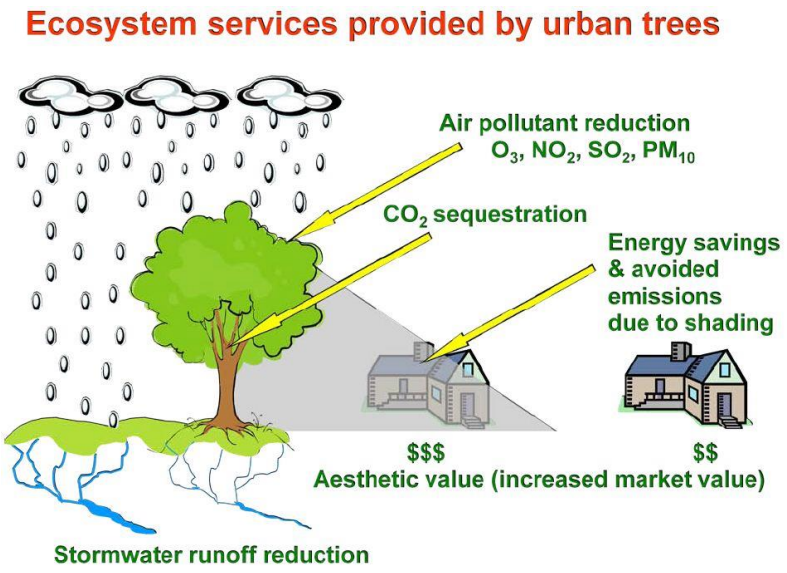
Discussion

The City of Kingston maintains 116 distinct species of urban trees. The distribution of these trees across species, genus, and family trends toward ideal but could be improved over time. ArborPro recommends the City of Kingston reduce or discontinue the planting of Norway maple and crabapple trees as they exceed the recommended 10% threshold for a particular species. Additionally, the genus *Acer* (maples) is widely overrepresented throughout the City. Maples make up 38.5% of the total tree population, which far exceeds the recommended 20% threshold for a particular genus. While it is common for most cities to have an excess of certain species, it leaves Kingston susceptible to future outbreaks of insects and diseases. This risk can be mitigated by analyzing the current list of species being planted by the City and focusing on species that do well in the area while actively promoting biodiversity in the landscape. A list of recommended tree species for future plantings can be found in Appendix B.

Section 2: Benefits of a Healthy Urban Forest

Trees provide a host of environmental, social, and economic benefits in urban areas. When properly maintained, trees can reduce pollution, divert stormwater runoff, and lower energy costs. The benefits trees provide can offset the cost associated with tree maintenance. A properly implemented tree maintenance program will maximize tree benefits in the urban setting, allowing trees to provide benefits that meet or exceed the time and money invested in maintenance activities.

The i-Tree Streets application was used to quantify the benefits provided by Kingston's trees. This application uses growth and benefit models designed around predominant urban trees to calculate the specific benefits that trees provide in dollar amounts. The benefits calculated by i-Tree Streets include energy conservation, air quality improvements, carbon dioxide (CO_2) reduction, stormwater control, and aesthetic/other. The i-Tree annual benefit reports demonstrate the value urban trees provide to the surrounding community.



Energy Conservation

Trees contribute to energy conservation by providing shade that reduces cooling costs in the summer and diverting wind to reduce heating costs in the winter. The savings in electricity and natural gas are converted into monetary values to illustrate the annual energy savings that trees provide. Kingston's trees save $232,595 in energy consumption each year.

Zone	Total Electricity (MWh)	Electricity ($)	Total Natural Gas (Therms)	Natural Gas ($)	Total ($)	Standard Error	% of Total Tree Numbers	% of Total $	Avg. $/Tree
Street Trees	280.48	39,295.64	101,209.82	142,503.42	181,799.06	(N/A)	79.22	78.16	58.29
Forsyth Park	26.72	3,743.29	9,292.55	13,083.91	16,827.20	(N/A)	8.20	7.23	52.10
Loughran Park	9.15	1,282.42	3,332.30	4,691.88	5,974.29	(N/A)	2.01	2.57	75.62
Hutton Park	6.48	907.96	2,295.63	3,232.25	4,140.21	(N/A)	1.35	1.78	78.12
Cornell Park	3.06	428.37	1,105.60	1,556.68	1,985.06	(N/A)	0.81	0.85	62.03
TR Gallo Park	4.32	604.61	1,527.87	2,151.24	2,755.86	(N/A)	1.14	1.18	61.24
Block Park	4.90	686.29	1,756.61	2,473.30	3,159.59	(N/A)	1.12	1.36	71.81
Academy Green Park (	6.00	840.28	2,085.84	2,936.86	3,777.14	(N/A)	1.17	1.62	82.11
Kingston Point Park	14.59	2,043.49	5,398.00	7,600.38	9,643.87	(N/A)	4.19	4.15	58.45
Hasbrouck Park	4.07	570.39	1,393.75	1,962.41	2,532.79	(N/A)	0.79	1.09	81.70
Total	**359.76**	**50,402.73**	**129,397.96**	**182,192.33**	**232,595.07**	**(N/A)**	**100.00**	**100.00**	**59.08**

Air Quality

Trees improve air quality by removing a number of pollutants from the atmosphere, including ozone, nitrogen dioxide, and particulate matter. The estimated value of pollutant removal by the inventoried tree population each year is $42,790.

Species	Total Deposition ($)	Total Avoided ($)	BVOC Emissions (lb)	BVOC Emissions ($)	Total (lb)	Total ($)	% of Total Tree Numbers	Avg. $/tree
Street Trees	18,001.02	16,727.62	- 692.19	- 1,598.96	6,514.66	33,129.68	79.22	10.62
Forsyth Park	2,341.50	1,574.48	- 228.06	- 526.82	566.62	3,389.16	8.20	10.49
Loughran Park	519.66	547.50	- 2.69	- 6.22	220.30	1,060.94	2.01	13.43
Hutton Park	462.13	384.17	- 31.58	- 72.95	142.75	773.34	1.35	14.59
Cornell Park	196.67	182.48	- 3.00	- 6.93	75.67	372.22	0.81	11.63
TR Gallo Park	250.47	255.78	- 11.13	- 25.71	94.53	480.53	1.14	10.68
Block Park	381.20	291.55	- 34.88	- 80.58	102.91	592.17	1.12	13.46
Academy Green Park (	414.34	353.43	- 11.11	- 25.67	147.59	742.10	1.17	16.13
Kingston Point Park	935.59	877.22	- 18.22	- 42.09	357.94	1,770.72	4.19	10.73
Hasbrouck Park	268.85	238.70	- 12.13	- 28.01	93.03	479.54	0.79	15.47
Citywide Total	**23,771.42**	**21,432.94**	**- 1,045.00**	**- 2,413.95**	**8,316.00**	**42,790.41**	**100.00**	**10.87**

Carbon Dioxide Sequestration

It is well known that trees absorb carbon dioxide and release oxygen into the atmosphere as a product of photosynthesis. Carbon absorbed during this process is ultimately stored in the wood

of trees. The amount of carbon sequestered by the inventoried tree population is valued at $5,471 annually.

Zone	Sequestered (lb)	Sequestered ($)	Total Release ($)	Avoided (lb)	Avoided ($)	Net Total (lb)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Street Trees	642,735.56	2,121.03	- 590.25	844,809.65	2,787.87	1,308,681.75	4,318.65	79.22	78.94	1.38
Forsyth Park	43,903.75	144.88	- 52.39	80,476.21	265.57	108,503.08	358.06	8.20	6.54	1.11
Loughran Park	16,385.66	54.07	- 19.32	27,570.40	90.98	38,102.28	125.74	2.01	2.30	1.59
Hutton Park	14,432.43	47.63	- 13.55	19,520.05	64.42	29,846.91	98.49	1.35	1.80	1.86
Cornell Park	7,052.38	23.27	- 5.98	9,209.53	30.39	14,448.28	47.68	0.81	0.87	1.49
TR Gallo Park	9,190.55	30.33	- 10.12	12,998.47	42.89	19,123.59	63.11	1.14	1.15	1.40
Block Park	10,947.42	36.13	- 9.84	14,754.43	48.69	22,719.97	74.98	1.12	1.37	1.70
Academy Green Park (	15,414.52	50.87	- 12.73	18,065.10	59.61	29,621.64	97.75	1.17	1.79	2.13
Kingston Point Park	29,555.63	97.53	- 34.55	43,932.63	144.98	63,018.45	207.96	4.19	3.80	1.26
Hasbrouck Park	14,334.09	47.30	- 9.26	12,262.62	40.47	23,790.20	78.51	0.79	1.43	2.53
Citywide Total	803,952.00	2,653.04	- 757.99	1,083,599.11	3,575.88	1,657,856.15	5,470.93	100.00	100.00	1.39

Stormwater Control

Trees reduce the costs associated with diverting stormwater by intercepting rainfall before it hits the ground and enters the storm runoff system. This greatly reduces the strain placed on public stormwater runoff systems. This can represent a significant monetary savings the amount of infrastructure needed to divert stormwater throughout the City is reduced. The estimated savings for the City in the management of stormwater runoff is $57,437 annually.

Zone	Total rainfall interception(Gal)	Total ($)	% of Total Tree Numbers	% of Total $	Avg. $/tree
Street Trees	5,519,741.31	44,157.93	79.22	76.88	14.16
Forsyth Park	571,203.16	4,569.63	8.20	7.96	14.15
Loughran Park	164,579.87	1,316.64	2.01	2.29	16.67
Hutton Park	145,676.46	1,165.41	1.35	2.03	21.99
Cornell Park	60,910.84	487.29	0.81	0.85	15.23
TR Gallo Park	72,964.80	583.72	1.14	1.02	12.97
Block Park	122,535.36	980.28	1.12	1.71	22.28
Academy Green Park (	128,840.39	1,030.72	1.17	1.79	22.41
Kingston Point Park	307,995.24	2,463.96	4.19	4.29	14.93
Hasbrouck Park	85,191.08	681.53	0.79	1.19	21.98
Citywide total	**7,179,638.50**	**57,437.11**	**100.00**	**100.00**	**14.59**

Aesthetic/Other

Trees provide many social and economic benefits that are classified as aesthetic/other in the i-Tree Streets application. The major economic benefit in this category is increased property values. Trees contribute to higher property values when compared to similar properties that do not have trees. The major social benefits provided by trees are lower crime rates, improved mental health, greater time spent in businesses with tree lined streets, and higher productivity in the workplace when a view of nature is available. The inventoried trees in Kingston contribute $202,802 annually in aesthetic/other benefits.

Zone	Total ($)	% of Total Tree Numbers	% of Total ($)	Avg $/tree
Street Trees	162,874.54	79.22	80.31	52.22
Forsyth Park	8,755.48	8.20	4.32	27.11
Loughran Park	6,386.47	2.01	3.15	80.84
Hutton Park	3,298.43	1.35	1.63	62.23
Cornell Park	1,592.42	0.81	0.79	49.76
TR Gallo Park	2,382.64	1.14	1.17	52.95
Block Park	2,266.62	1.12	1.12	51.51
Academy Green Park (	3,993.20	1.17	1.97	86.81
Kingston Point Park	8,963.36	4.19	4.42	54.32
Hasbrouck Park	2,289.34	0.79	1.13	73.85
Citywide Total	**202,802.50**	**100.00**	**100.00**	**51.51**

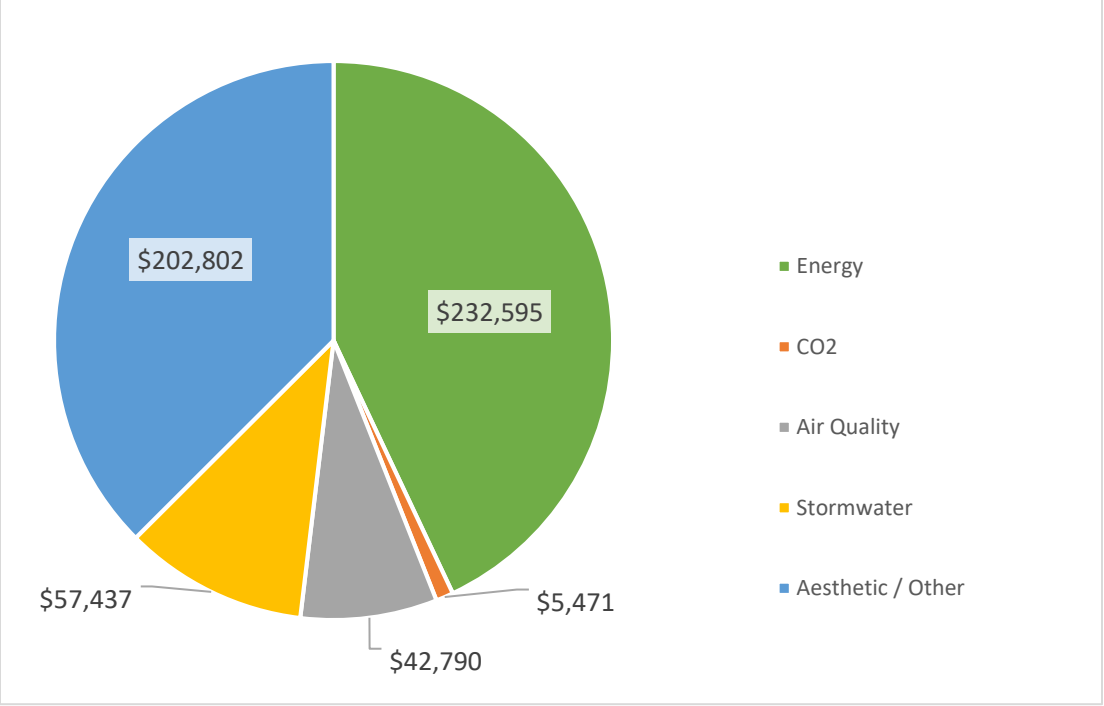


Figure 9: Annual monetary benefits provided by Kingston's trees

Total Replacement Value

In addition to environmental benefits, the City can consider the total replacement value for its urban forest. Total replacement value is the amount of money it would take to completely replace the existing urban forest with trees of the same size. While this is a scenario that will likely never happen, it gives the City the specific dollar value of its trees in their current state. Replacement value differs from environmental benefits in that it shows how much the trees are worth instead of the dollar values that they provide in benefits. For example, a mature sugar maple could

provide $2,100 in environmental benefits by reducing stormwater runoff, improving air quality, etc. but the total cost of replacing an 18" DBH sugar maple would be $24,270. According to i-Tree Streets, the total replacement cost for Kingston's trees is $16,781,087. Table 4 shows the breakdown of replacement value by diameter class.

DBH Class	Replacement Value
00"-03"	$35,269
04"-06"	$219,515
07"-12"	$1,308,658
13"-18"	$2,902,307
19"-24"	$4,365,457
25"-30"	$3,717,139
31"-36"	$2,371,533
37"-42"	$1,161,107
43+	$700,102
Total	**$16,781,087**

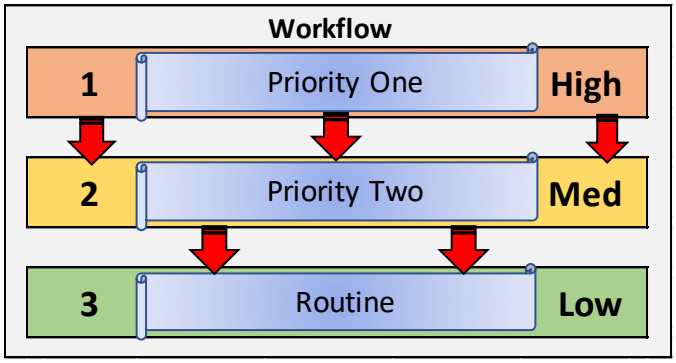
Table 4: Replacement value by diameter class

Section 3: Tree Management

The purpose of this tree management plan is to provide a framework for the short- and long-term maintenance of Kingston's urban trees. While the City does not currently manage its trees, it is important to understand the cost and scope of the work that needs to be done. This section of the management plan will detail the maintenance recommendations from the inventory as though the City will be completing the work. The information contained within this section can be used to secure funding, work with homeowners to complete the work, and to understand the general needs of Kingston's trees.

It is also important to recognize that the tree inventory data provides a snapshot of Kingston's trees' current condition. Prioritized tree maintenance will help reduce the overall risk of tree related catastrophes. However, because conditions can change drastically, routine maintenance should be coupled with the identification and monitoring of trees that may become hazardous in the future. The focus of this report is to identify and mitigate the trees that were deemed maintenance prioritizations at the time of the inventory while planning for the future through proactive maintenance.

Recommended Maintenance and Tree Risk



A description and summary of the maintenance recommendations for the entire inventory follows below. As the names imply, Priority 1 pruning and removals pose the highest risk and should be dealt with first. Priority 2 pruning and removals should be considered after all Priority 1 pruning and removals have been completed. The remaining trees will be assigned to either routine pruning or young tree training activities, i.e. proactively pruned on a five-year and three-year basis respectively. The following more thoroughly describes each maintenance recommendation.

Priority 1 Prune – Trees that require Priority 1 pruning are recommended for trimming to remove hazardous deadwood, hangers, or broken branches. These trees have broken or hanging limbs; hazardous deadwood; and dead, dying, or diseased limbs or leaders greater than four inches in diameter.

Maintenance	Tree Count	%
Priority 1 Prune	82	1.6%
Priority 1 Removal	58	1.1%
Priority 2 Prune	372	7.1%
Priority 2 Removal	154	2.9%
Routine Prune	2,779	53.1%
Training Prune	492	9.4%
Stump Removal	102	1.9%
Plant Tree	1,198	22.9%
Total	**5,237**	

Table 5: Recommended maintenance by tree count

Priority 1 Removal – Trees designated for removal have defects, which cannot be cost-effectively or practically treated. A majority of trees in this category have a large percentage of dead crown and pose an elevated level of risk for failure. Any hazards that cannot be mitigated with pruning could be seen as potential dangers to persons or property. Large dead and dying trees that are high liability risks are included in this category.

Priority 2 Prune – Trees that require Priority 2 pruning are recommended for trimming to remove deadwood, correct structural problems, or resolve clearance issues. These trees do not pose as much risk as "Priority 1" trees.

Priority 2 Removal – Trees that should be removed but do not pose a liability as great as the first priority will be identified here. This category would need attention as soon as "Priority 1" trees are removed.

Routine Prune – These trees require routine horticultural pruning to correct structural problems or growth patterns, which would eventually obstruct traffic or interfere with utility wires or

buildings. Trees in this category are large enough to require bucket truck access or manual climbing.

Training Prune – Small, young trees, up to 12 feet in height, that will grow to be large trees must be pruned to correct or eliminate weak, interfering, or objectionable branches in order to minimize future maintenance requirements. A person standing on the ground can prune these trees with a pole-pruner.

Stump Removal – Typically located in high use areas, stumps that interfere with pedestrian traffic and pose a tripping hazard should be removed.

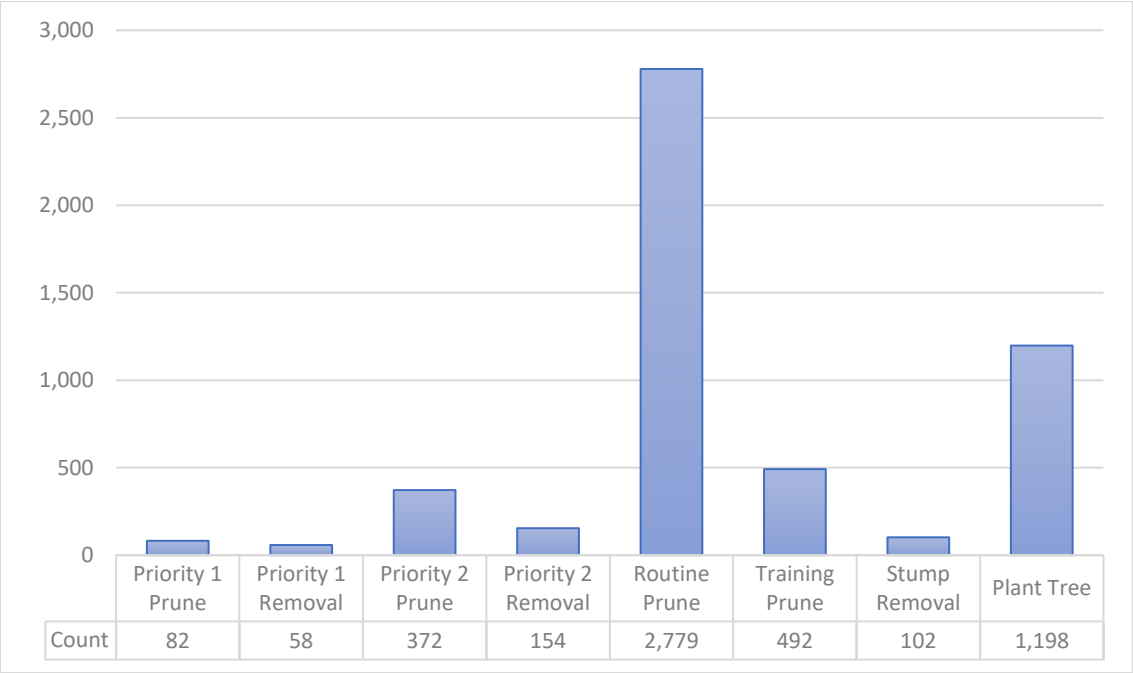
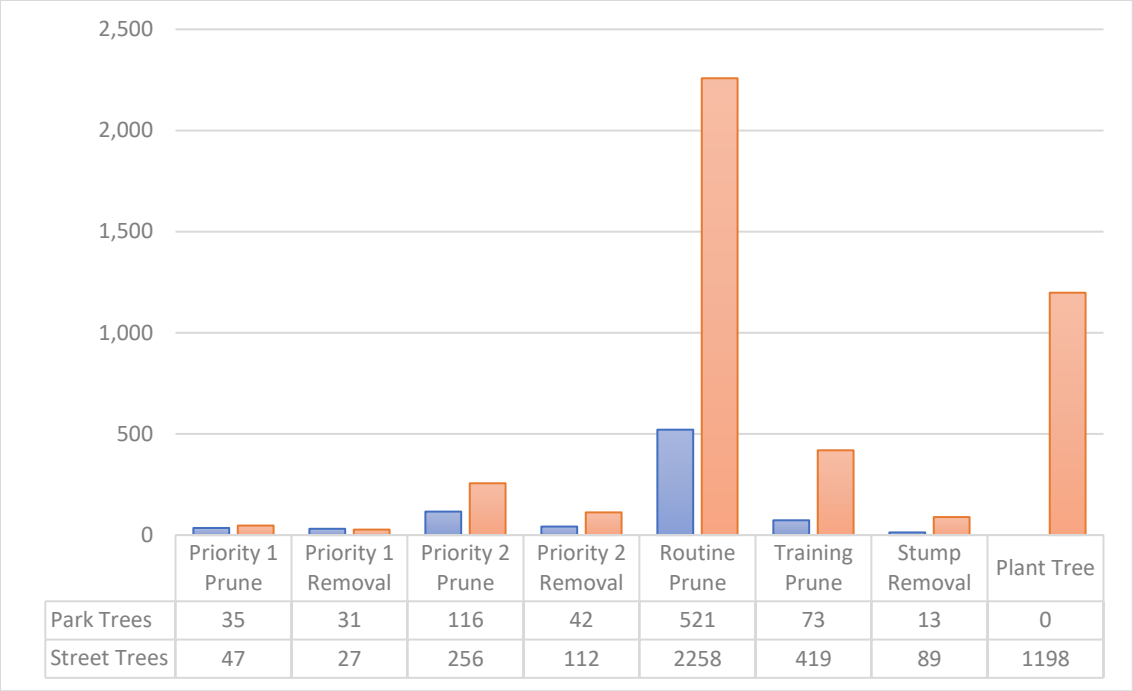


Figure 10: Recommended maintenance



	Priority 1 Prune	Priority 1 Removal	Priority 2 Prune	Priority 2 Removal	Routine Prune	Training Prune	Stump Removal	Plant Tree
Park Trees	35	31	116	42	521	73	13	0
Street Trees	47	27	256	112	2258	419	89	1198

Figure 11: Recommended maintenance by area

Priority and Proactive Maintenance

Not all communities are able to implement a proactive maintenance schedule. Often, they simply rely on an on-demand response to hazardous or urgent situations. **However, a proactive program systematically reduces risk while improving the overall health of urban trees**. A proactive program will also help stabilize maintenance budgets and improve long-term planning.

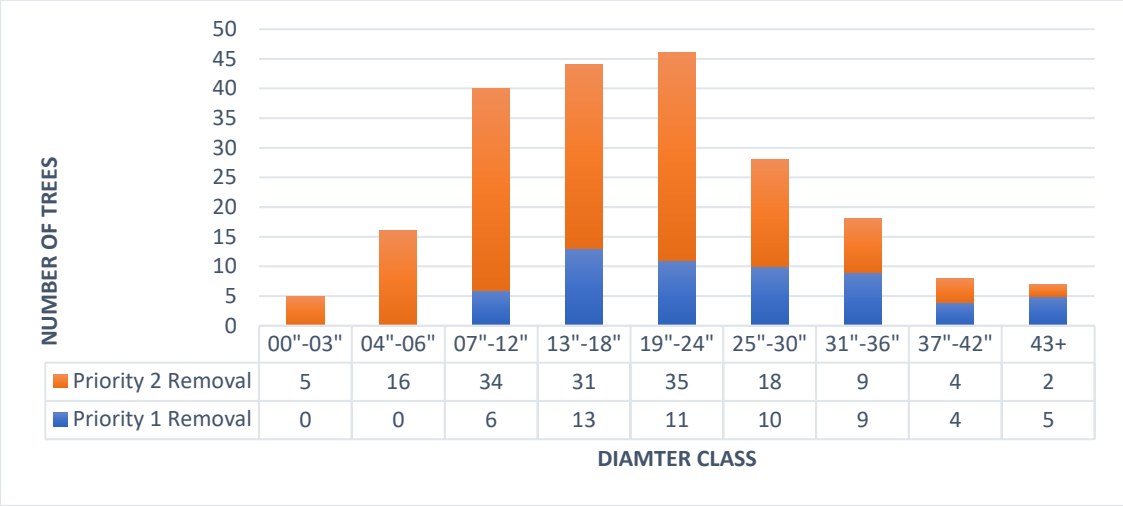
In this plan, we chose to use a five-year cycle for routine tree trimming and a three-year cycle for young tree training. As previously explained, this involves pruning each tree every five years while conducting structural pruning on young trees every three years. These activities are considered proactive maintenance while trees in the Priority 1 and 2 categories are priority maintenance.

Priority Maintenance

Prioritizing maintenance is one of the tree inventory's main objectives. It allows tree work to be assigned based on observed risk over multiple years. Once prioritized, the work can be approached systematically to mitigate risk by addressing the highest priority trees first. In this plan, all trees designated as Priority 1 prunes and removals will be considered first. Priority 2 prunes and removals will be considered after all Priority 1 trees have been addressed. Trees in the Routine Prune and Training Prune category will be entered into the proactive maintenance schedule.

Priority Removals

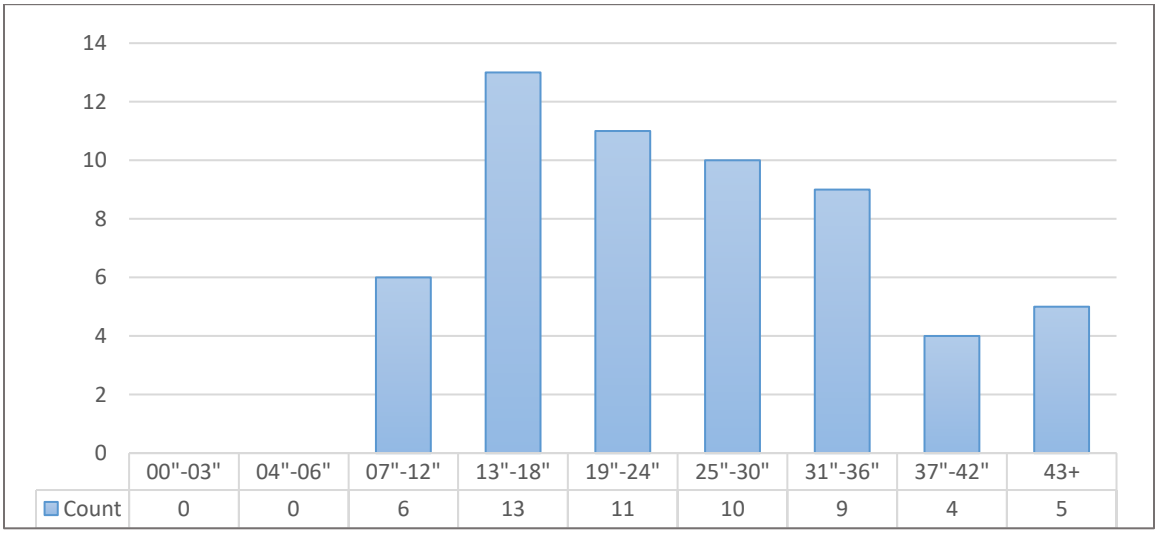
While tree removal is often a last resort, in some situations it cannot be avoided. In parks and other high-use areas, creating a safe environment is more important than preserving hazardous trees that may have a social or cultural significance. Priority removals include Priority 1 and Priority 2 removals identified during the inventory. Figure 12 shows the trees and their respective diameter classes for these two categories.



	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+
Priority 2 Removal	5	16	34	31	35	18	9	4	2
Priority 1 Removal	0	0	6	13	11	10	9	4	5

Figure 12: Priority removals by diameter class

Trees in the Priority 1 Removal category pose a risk that cannot be mitigated through pruning. ArborPro recommends removing these trees in the first year of the five-year maintenance plan. The inventory found a total of 58 trees that were assessed to be Priority 1 Removals. Figure 13 shows a breakdown of the number of Priority 1 removals by diameter class.



	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+
Count	0	0	6	13	11	10	9	4	5

Figure 13: Priority 1 removals by diameter class

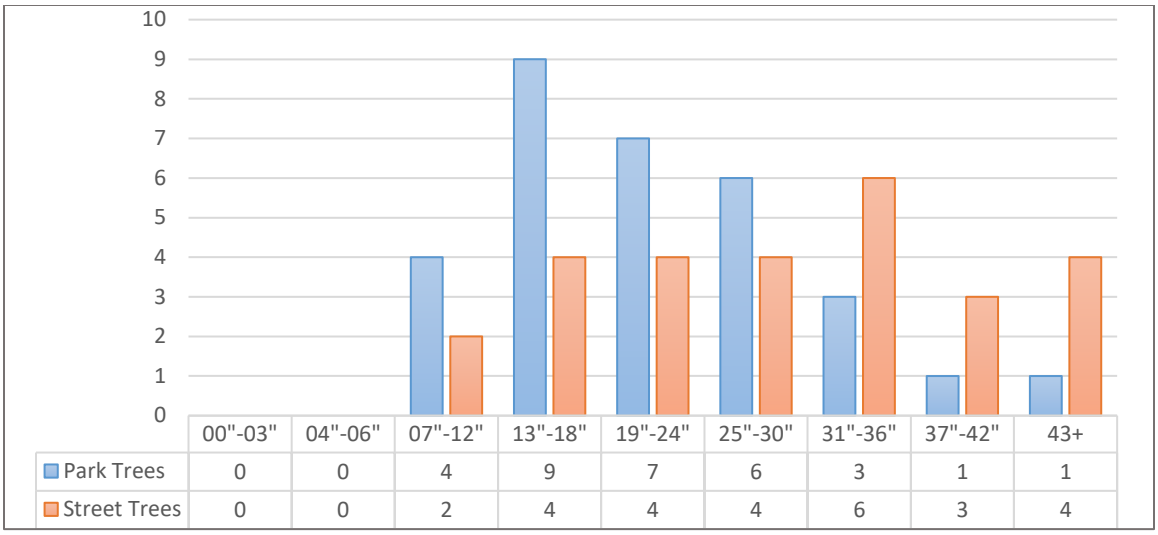


Figure 14: Priority 1 removals by diameter class and area

Priority 2 Removals do not pose significant risk to people or property and should not be addressed until all Priority 1 Removals have been completed. ArborPro recommends removing these trees in the second year of the five-year maintenance plan. The inventory found a total of 154 Priority 2 Removals. Figure 15 shows a breakdown of Priority 2 removals by count and diameter class.

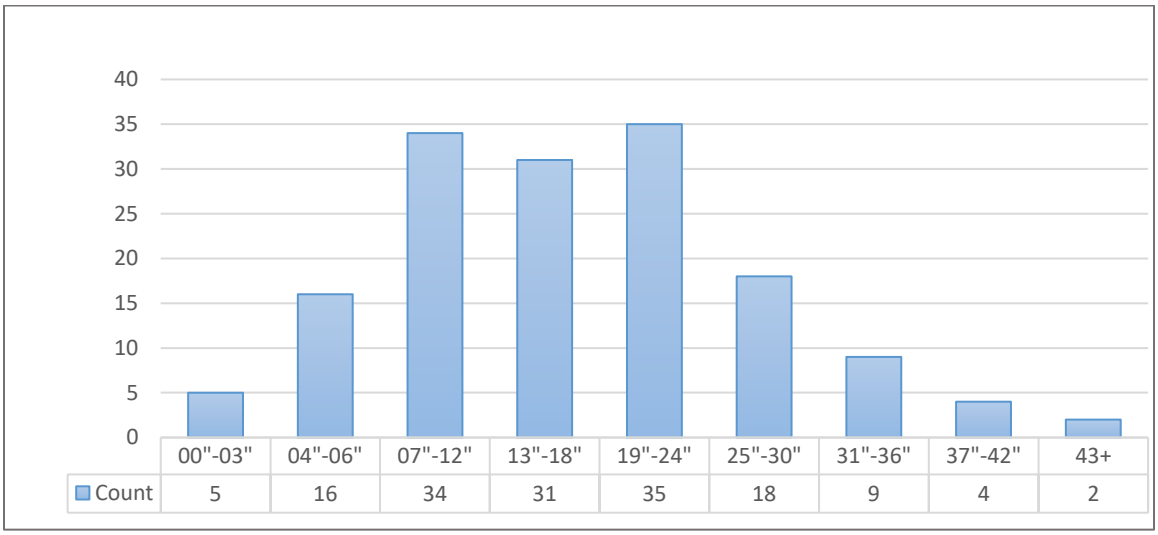
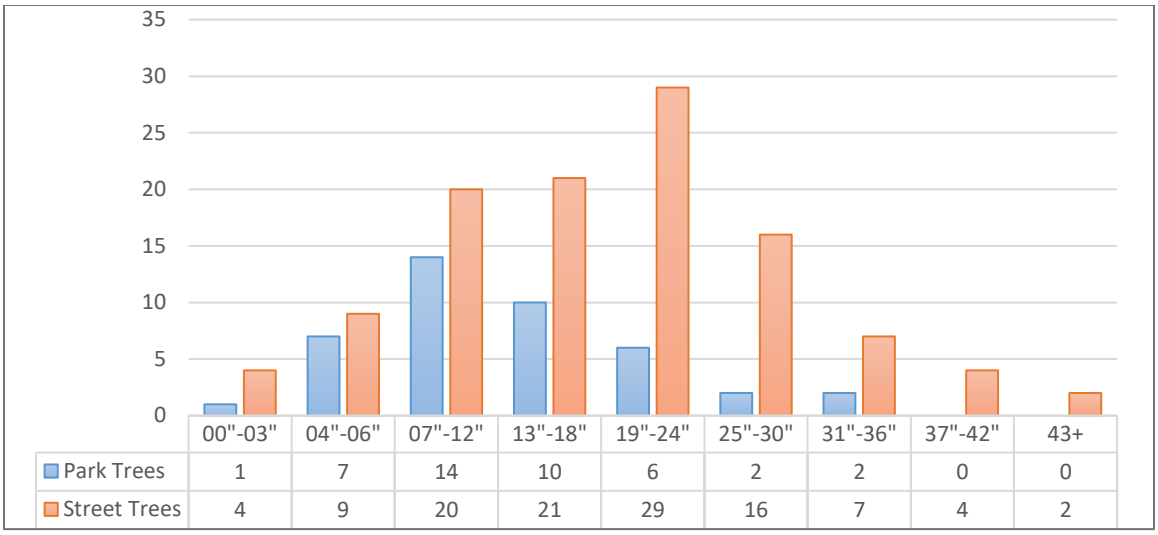


Figure 15: Priority 2 Removals by diameter class



	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+
Park Trees	1	7	14	10	6	2	2	0	0
Street Trees	4	9	20	21	29	16	7	4	2

Figure 16: Priority 2 Removals by diameter class and area

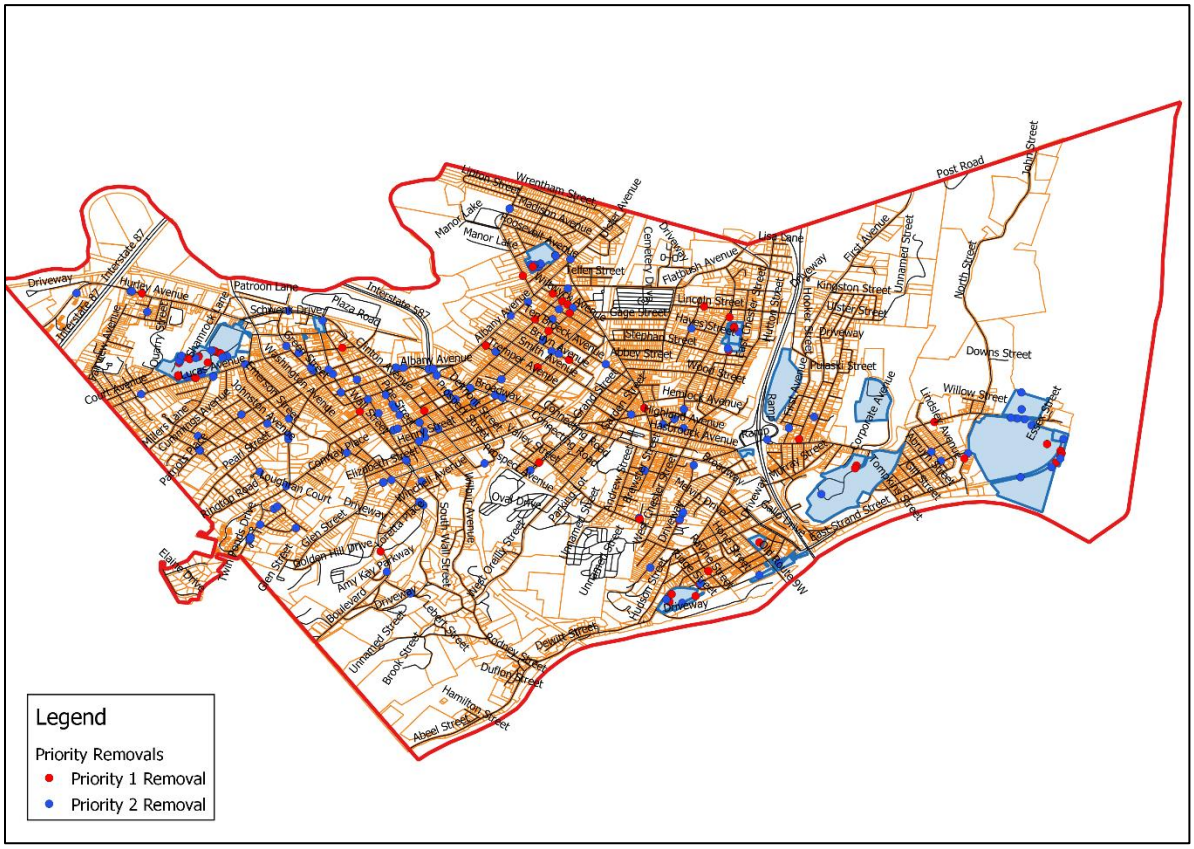


Figure 17: Location of priority removals

Priority Pruning

Priority pruning includes trees in the Priority 1 and Priority 2 category that need to be pruned to mitigate risk and remove obstructions to sidewalks, roads, etc. Figure 18 shows all of the trees and their respective diameter classes for these two categories.

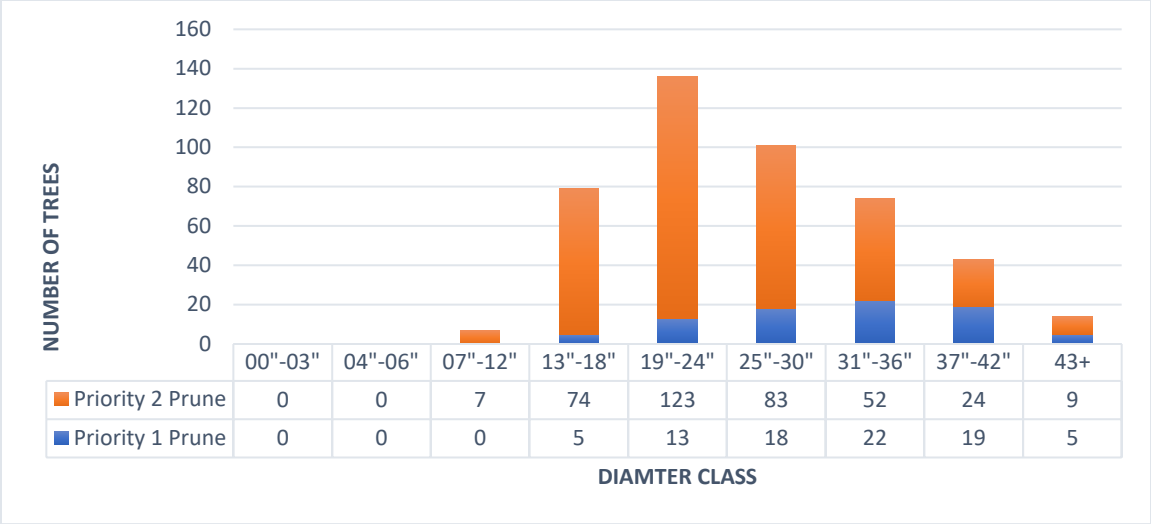


Figure 18: Priority pruning by diameter class

Trees in the Priority 1 Prune category pose a high risk to public safety that can be mitigated through pruning. ArborPro recommends pruning these trees in the first year of the five-year maintenance plan. The inventory found a total of 82 Priority 1 Prunes. Figure 19 shows a breakdown of Priority 1 Prunes by diameter class and count.

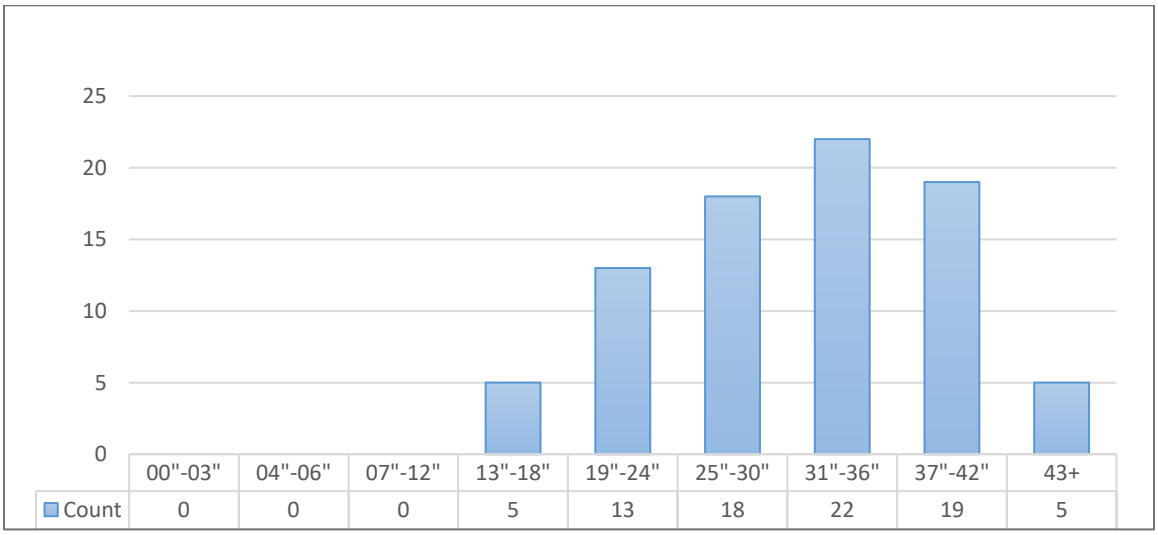


Figure 19: Priority 1 Prunes by diameter class

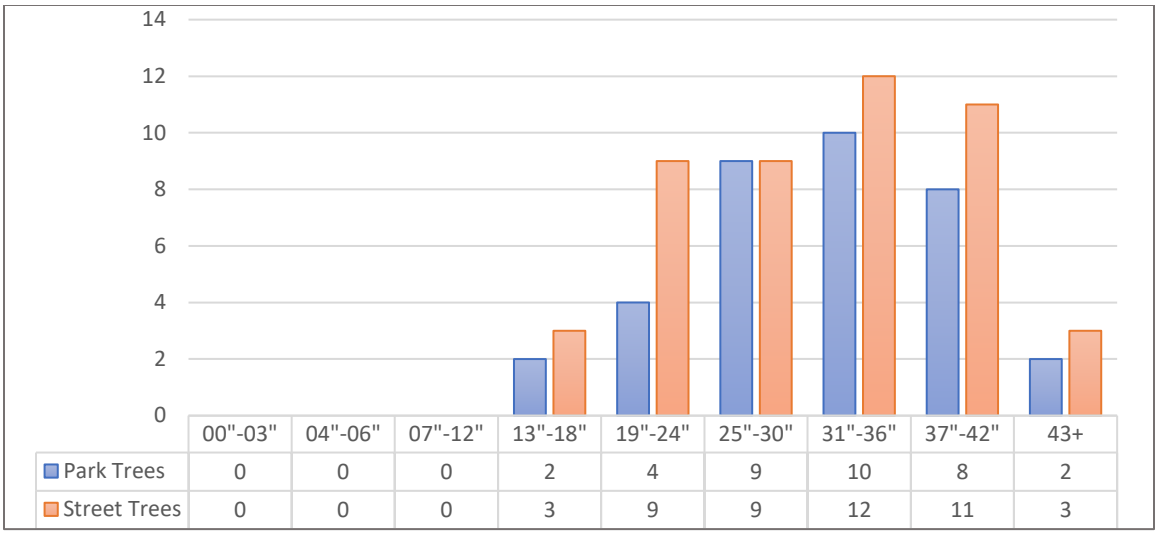


Figure 20: Priority 1 Prunes by diameter class and area

Trees in the Priority 2 Prune category pose a limited risk to public safety that can be mitigated through pruning. ArborPro recommends pruning these trees in the second and third year of the five-year maintenance plan. The inventory found a total of 372 Priority 2 Prunes. Figure 21 shows a breakdown of the number of Priority 2 Prunes by diameter class.

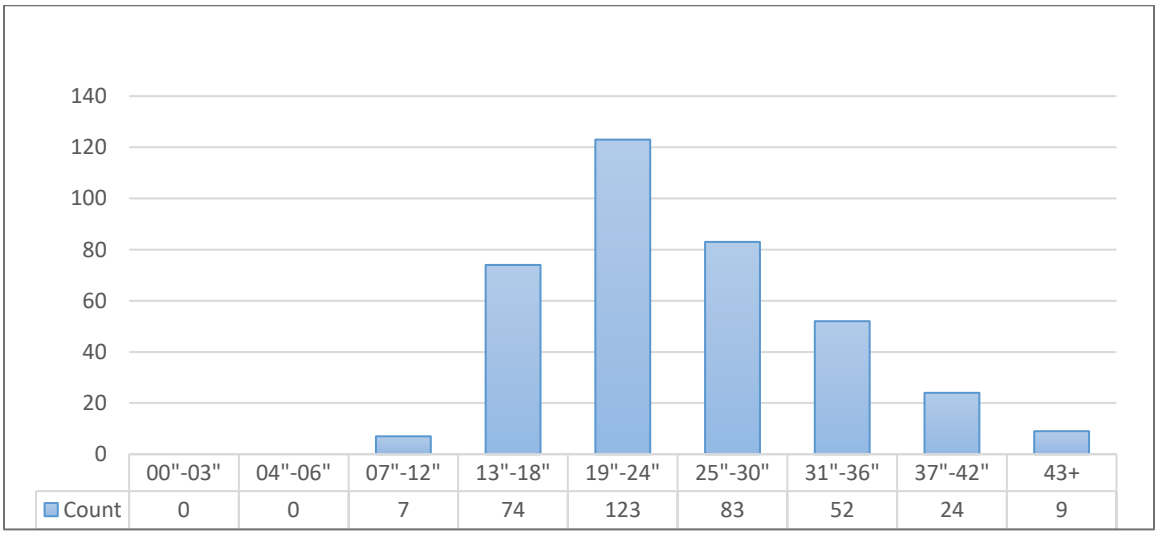
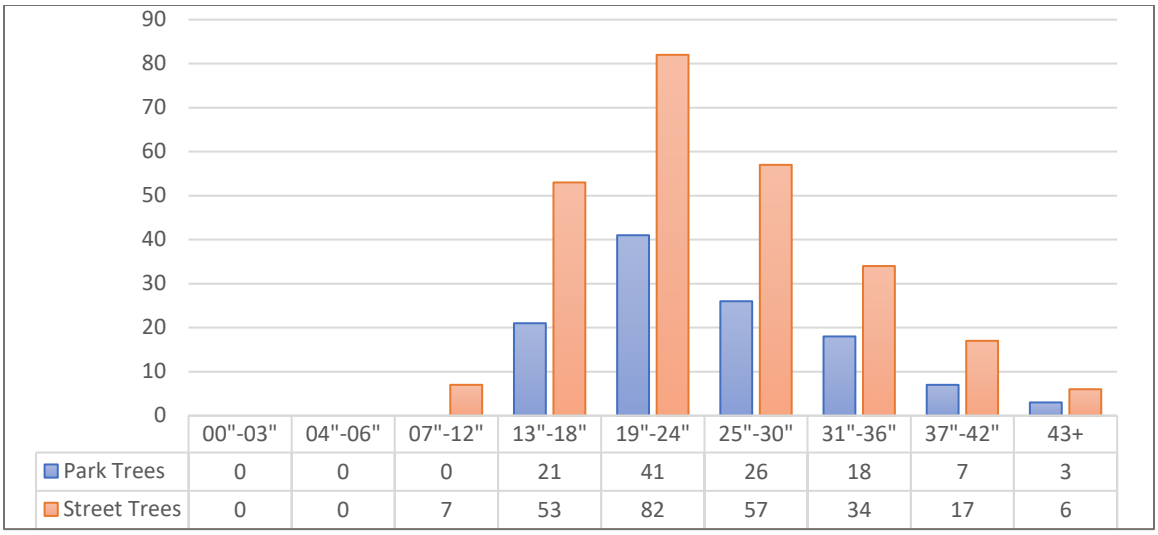


Figure 21: Priority 2 Prunes by diameter class



	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+
Park Trees	0	0	0	21	41	26	18	7	3
Street Trees	0	0	7	53	82	57	34	17	6

Figure 22: Priority 2 Prunes by diameter class and area

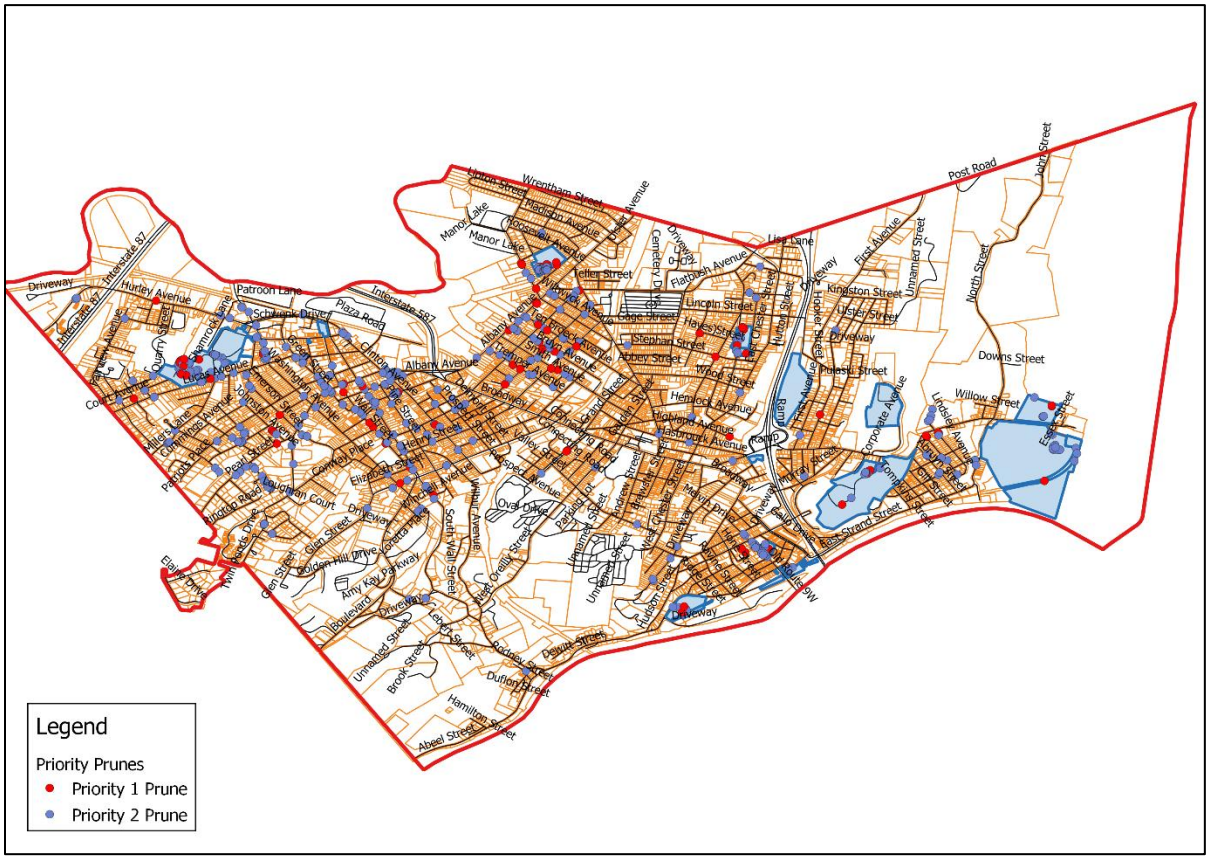


Figure 23: Location of Priority Prunes

Proactive Maintenance

Proactive tree maintenance requires that trees are systematically managed over time. To accomplish this, trees are placed in a pruning cycle that routinely addresses tree health and form.

While it may be costly to implement a routine pruning cycle, it will reduce both risk and maintenance costs over time. Maintaining a routine pruning cycle will allow the City to address minor maintenance needs on a regular basis. Over time, this will reduce the number of emergency situations and will allow the City to regularly monitor potential problem trees.

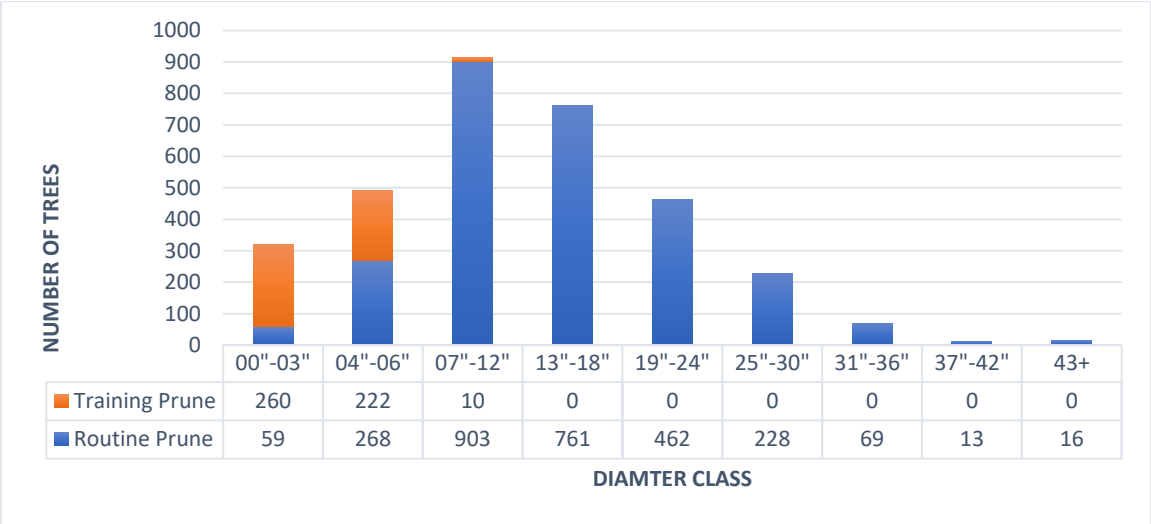


Figure 24: Proactive maintenance by diameter class

Routine Pruning Cycle

The routine pruning cycle includes all trees entered as a Routine Prune during the inventory. These trees pose little to no risk but could benefit from regular pruning to mitigate tree-related risk. By removing hazardous limbs, the City can reduce future storm damage clean-up; remove limb conflicts on sidewalks and roadways; improve the overall appearance of urban trees; and promote proper growth patterns in young trees.

The length of a routine pruning cycle depends on the size of the tree population. ArborPro recommends a five-year cycle for the trees included in this inventory, i.e. prune approximately one-fifth of the tree population each year. This number will fluctuate as the City removes trees and completes priority maintenance, and as young trees grow into maturity. This report and five-year maintenance plan will only consider trees in the Routine Prune category at the time of the inventory for the routine pruning cycle. As mentioned previously, while the City does not currently maintain its urban trees, it is important to understand the quantity and cost of maintaining the trees within public parks and street ROWs.

The 2018 tree inventory found a total of 2,779 trees that would benefit from routine pruning. Therefore, approximately 555 trees (one-fifth of the total population) will need to be pruned each year, starting in year four of the five-year maintenance plan. Figure 25 shows a breakdown of Routine Prunes by diameter class and count.

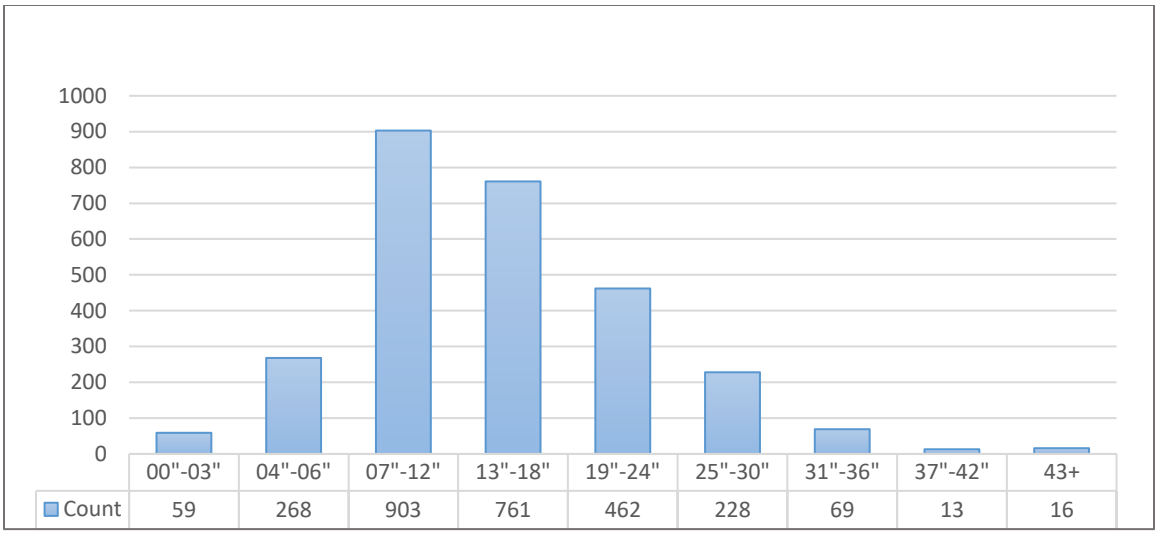


Figure 25: Routine Prunes by diameter class

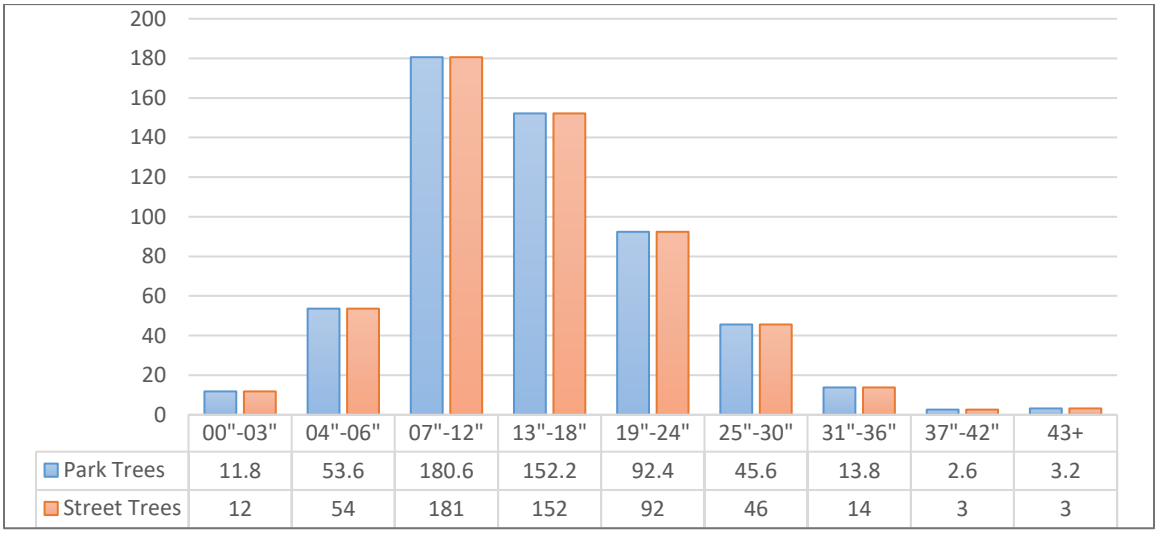


Figure 26: Routine Prunes by diameter class and area

Young Tree Training Cycle

Although the City of Kingston has an adequate number of newly planted trees, planting additional trees will help promote a healthy urban forest for years to come. It is also important to remember that older, more mature trees provide the most benefits to the community. The City must promote tree preservation and proactive tree care to ensure older trees survive as long as possible. One of Kingston's objectives is to have an uneven-aged distribution of trees at the street, neighborhood, and citywide levels. **ArborPro recommends that Kingston support a strong planting and maintenance program to ensure that young, healthy trees are in place to fill gaps in tree canopy and**

Planting trees is necessary to increase canopy cover and to replace trees lost to natural causes (expected to be 1–3% per year).

provide for gradual succession of older trees. Tree planting and tree care will allow the distribution to normalize over time.

Trees included in the Young Tree Training Cycle are typically less than 8 inches DBH and will benefit from structural pruning. Young trees tend to have higher growth rate and therefore require a shorter pruning cycle than mature trees. For this reason, ArborPro recommends a three-year cycle for young tree training.

Establishing a training cycle for young trees is equally important for Kingston's parks. A significant amount of money has been spent to plant new trees in many of the parks. Investing time and money to properly prune these trees will greatly reduce future structural problems and maintenance issues. Figure 27 illustrates the number of trees that would benefit from young tree training.

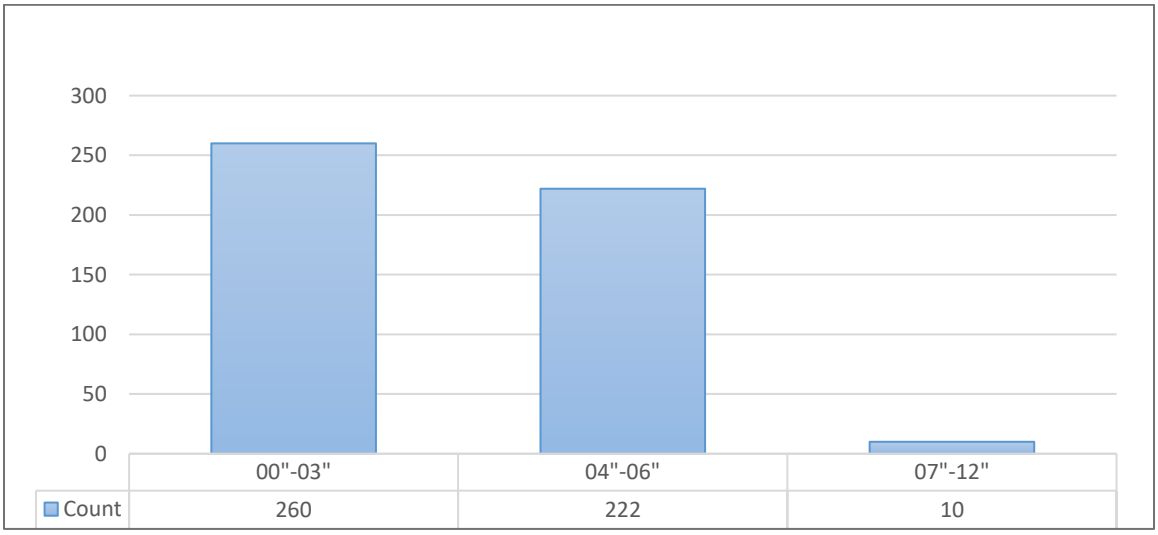


Figure 27: Number of trees in the Young Tree Training Cycle

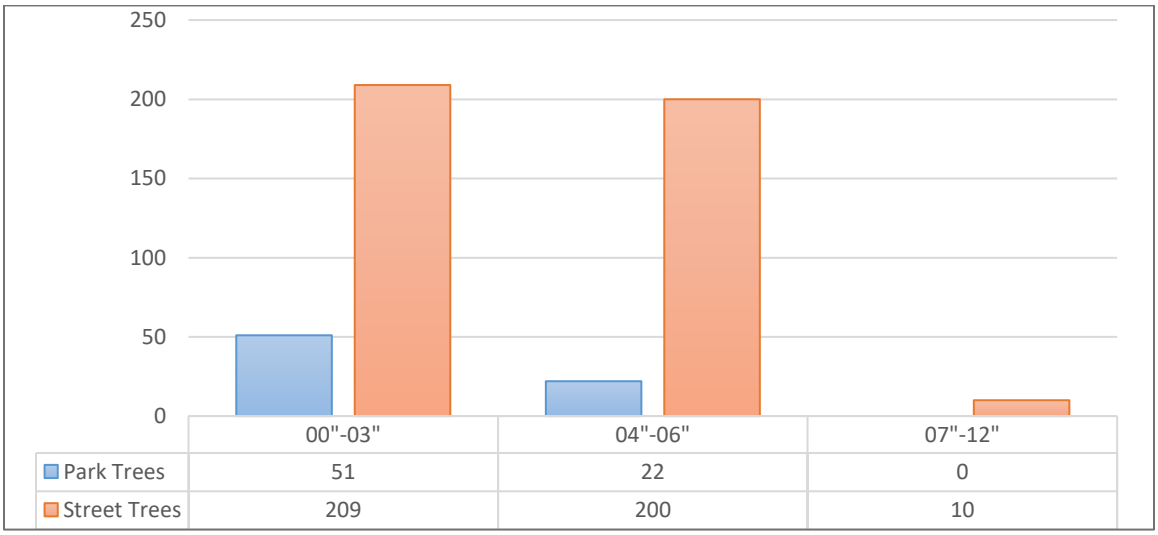


Figure 28: Number of trees in the Young Tree Training Cycle by area

The three-year Young Tree Training Cycle should begin on year four of the maintenance plan. For the sake of this management plan, it will only include existing young trees. One-third of young trees should be structurally pruned each year. In reality, the number of trees in the training cycle will fluctuate as new trees are planted and as older plantings become established and no longer require training. Therefore, the amount of money spent and the number of trees in the training cycle will not remain constant.

The inventory found a total of 492 trees under 8 inches DBH that would benefit from structural pruning. Therefore, approximately 164 trees (one-third of the total population) should be trained each year beginning in year three of the five-year maintenance plan. However, if budget allows, the Young Tree Training Cycle could be moved to year one to benefit all of the recently planted trees.

Relatively inexpensive, young tree training can easily be done by City staff or volunteers. Training young trees helps to reduce future maintenance costs by improving the structure and health of young trees. Since it can be done from the ground with little equipment, ArborPro recommends that the City of Kingston implement a young tree training program as soon as possible. This program will also present a good opportunity to interact with homeowners and discuss the importance of tree maintenance.

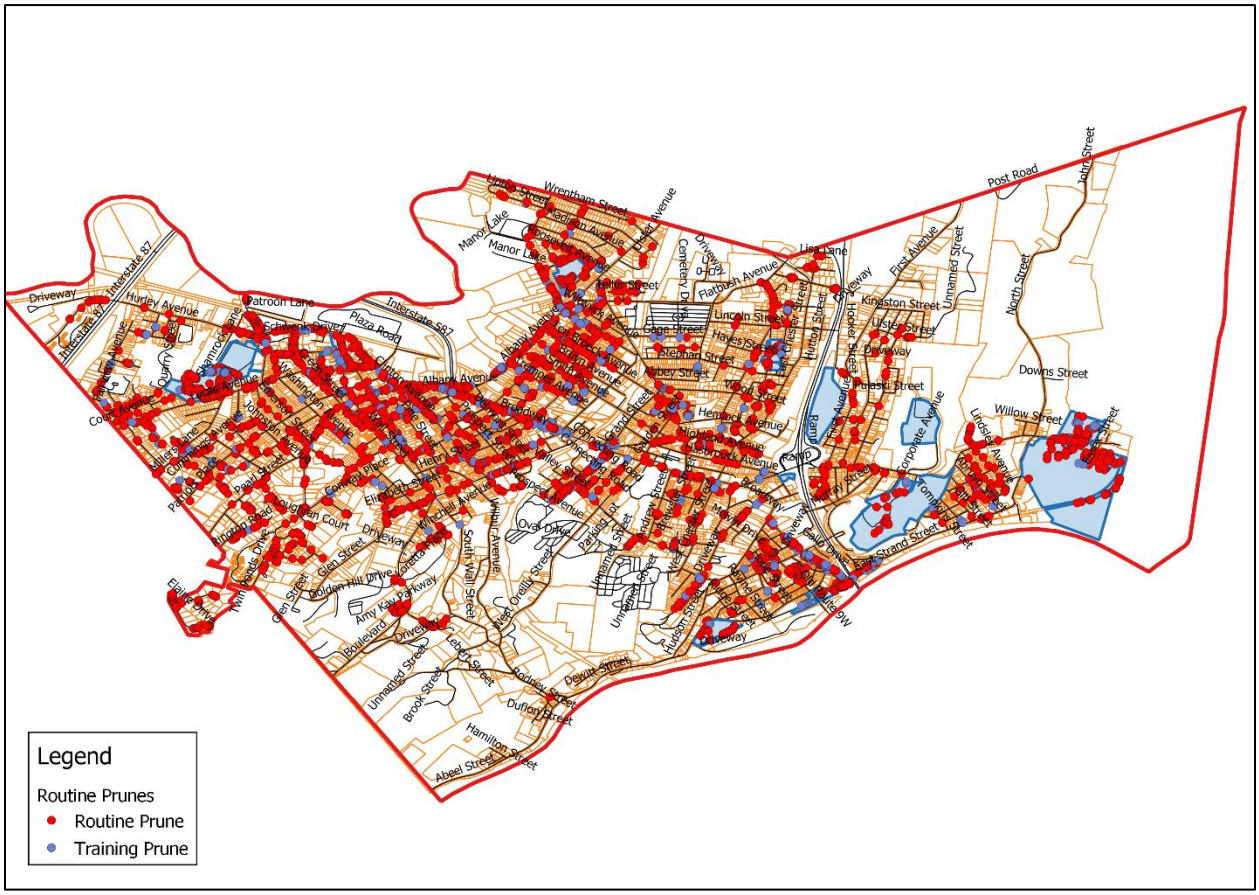


Figure 29: Location of Routine and Training Prunes

Importance of Tree Maintenance

Trees are naturally occurring, organic organisms. Often, they are treated as though they do not need human interference to thrive. While this may be true in undisturbed forests, it is certainly not true for urban trees. Urban trees require regular maintenance to maximize the benefits they provide. When maintenance is neglected, trees can pose a serious risk to people and property. In addition, trees in urban environments are subject to many more stressors than trees in forests or rural areas. Urban trees grow in restricted spaces; are exposed to pollutants and road salt; are subject to soil compaction; and can be easily damaged by mowers or other maintenance activities.

Proactive pruning and hazard mitigation greatly reduce the risk of tree failure and subsequent damage. In addition, proactive maintenance will prolong the life of a tree and reduce future maintenance costs. A well-maintained urban forest will be less susceptible to disease and disaster. Trees that are regularly pruned and maintained will not be as prone to disease as trees that have been neglected. When trees are pruned on a regular basis — or removed when they become diseased or hazardous — it eliminates some of the pathways for potential pests and diseases. Many of these pests and diseases attack stressed trees or enter through open wounds or dead branches. Therefore, a well-maintained urban forest will be less likely to succumb to pest infestations. In addition, species selection is an important part of maintaining a healthy urban forest. Careful species selection will increase biodiversity and reduce the risk of a catastrophic pest infestation. Most pests have preferred hosts (EAB for example). Increasing biodiversity will limit the number of species that are susceptible to individual pests.

While it is impossible to predict when a natural disaster will strike, a level of disaster preparedness can be achieved through regular maintenance. Trees that have been pruned to remove dead or hanging limbs will be less likely to experience branch failure in high winds, thus reducing storm damage clean-up. Also, removing diseased or declining trees from the landscape will reduce the risk of whole tree failure in major storm events.

The importance of urban tree maintenance cannot be understated. A well-maintained urban forest will provide maximum benefits to the community while reducing the inherent risk of tree failure.

Importance of Updating Inventory Data

Trees are living organisms that change with time. Inventory data, however, is static and will not reflect the current state of an urban forest unless it is continually updated. Whenever a tree is removed, inspected, pruned, or planted it should be updated in the inventory. If inventory data is not properly maintained, it will quickly become obsolete and will ultimately be of little use. Significant time and money have been invested in surveying Kingston’s trees. The only way to protect this investment is to continually update the inventory.

Vacant Sites and Tree Planting

During the inventory, a total of 1,198 vacant sites were recorded in areas that were suitable for planting new trees. Vacant sites were broken down into three categories based on the size of planting space.

- Small Vacant Site – 4'to 6' planting space or any vacant site under electric utilities
- Medium Vacant Site – 6' to 8' planting space
- Large Vacant Site – 8'+ planting space

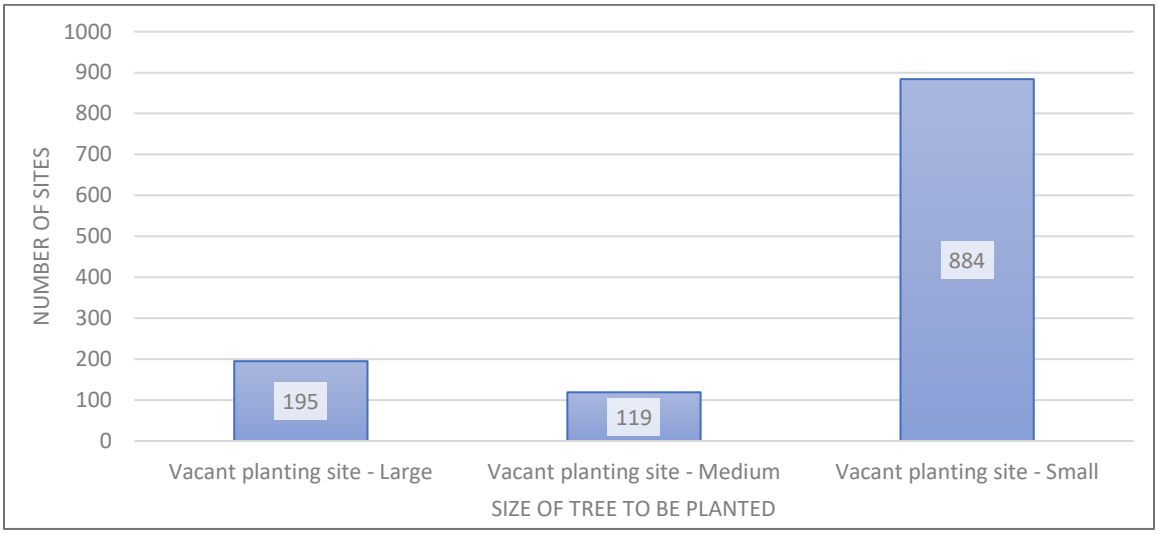


Figure 30: Vacant sites by size

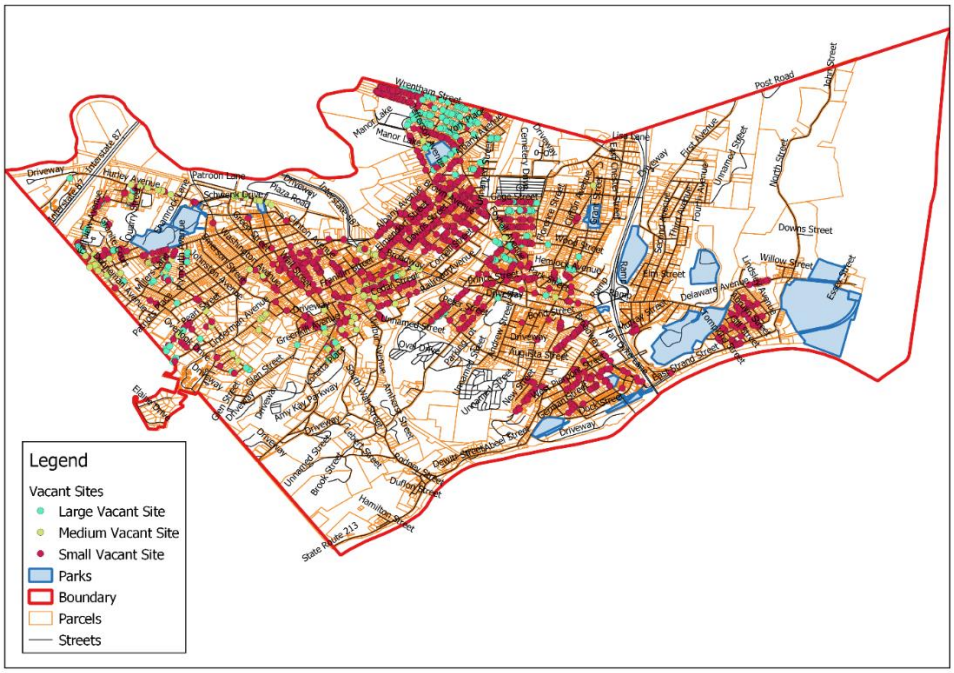


Figure 31: Vacant site locations

It is important that the City of Kingston implement and support a comprehensive planting plan. Planting new trees would greatly benefit these neighborhoods and would increase the overall canopy cover of the entire City.

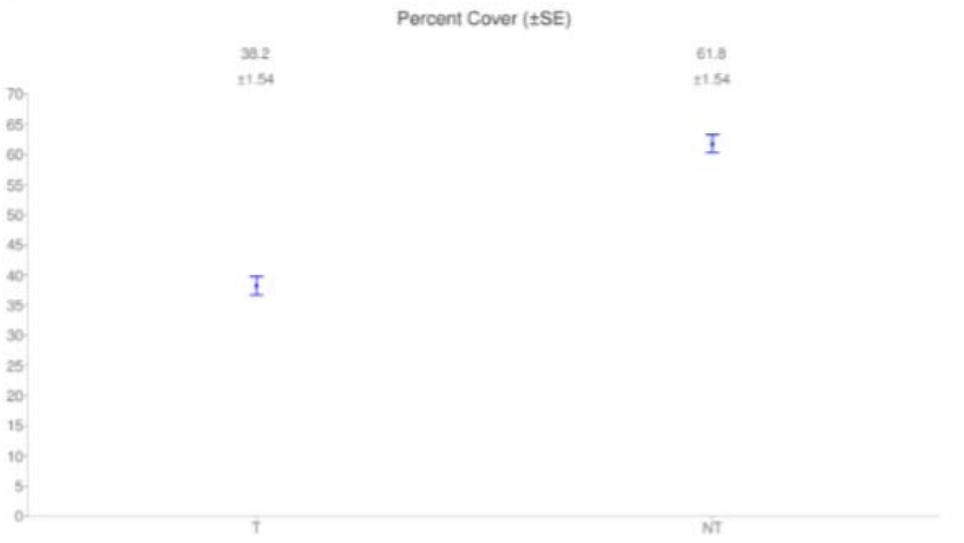
The number of trees planted each year depends on budgeting and may vary from year to year. However, ArborPro recommends planting at least 50 to100 trees per year to offset loss of trees due to natural mortality while gradually increasing canopy cover and biodiversity. In order to increase biodiversity, trees should be carefully selected and planted in areas suitable for that species. For example, planting a pin oak directly under power lines will only create problems in the future. As the trees grow into the power lines, they will require severe pruning or topping to prevent them from impacting the lines. The end result will be a tree that is visually unappealing and in poor health.

ArborPro recorded a total of 1,198 vacant sites during the inventory. This indicates that roughly 22% of Kingston's streets are lacking trees. If 100 trees are planted each year, the City will annually increase the total tree population by roughly 2.5%. At this rate, it will take approximately 11 years to fill all of the vacant sites. In addition to recording vacancies during the inventory, the i-Tree Canopy software quantified the total canopy cover within the City limits. This software uses a series of sample points that are visually designated as either Tree or Non-Tree to calculate the canopy cover for the entire survey area. After analyzing a total of 1,000 sample sites the City of Kingston's canopy cover was determined to be 38.2%, with a standard error of +/- 1.54%.

i-Tree Canopy v6.1

Cover Assessment and Tree Benefits Report

Estimated using random sampling statistics on 9/21/18



Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	382	38.2 ±1.54
Non-Tree	All other surfaces	NT	618	61.8 ±1.54

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	102.90 USD	±4.14	1,683.00 lb	±67.69
NO2	Nitrogen Dioxide removed annually	296.12 USD	±11.91	3.76 T	±0.15
O3	Ozone removed annually	14,232.15 USD	±572.44	42.15 T	±1.70
PM2.5	Particulate Matter less than 2.5 microns removed annually	31,743.07 USD	±1,276.77	2.13 T	±0.09
SO2	Sulfur Dioxide removed annually	44.78 USD	±1.80	1.72 T	±0.07
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	5,551.60 USD	±223.30	10.59 T	±0.43
CO2seq	Carbon Dioxide sequestered annually in trees	298,747.79 USD	±12,016.20	8,473.82 T	±340.83
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	9,572,377.31 USD	±385,019.18	271,515.39 T	±10,920.86

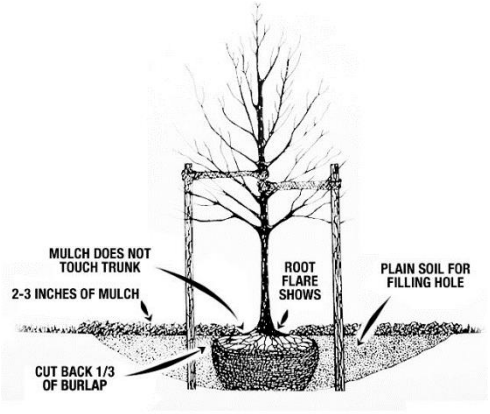
Canopy cover percentage is a good metric for setting goals and monitoring the total canopy growth in the City. Many major cities use the goal of 40% canopy cover as their guideline for canopy growth. ArborPro recommends that the City of Kingston meet or exceed this metric in conjunction with available vacant sites to guide an annual planting plan.

Tree Planting

Tree planting is an important part of maintaining and cultivating a healthy urban forest. Newly planted trees will become the foundation of the urban tree canopy as older trees start to die and are removed from the landscape. However, tree planting is only a worthwhile activity when trees are properly selected, properly planted, and properly cared for as they become established. If

trees are not properly planted and cared for, they will become a future problem and not provide the benefits associated with healthy, mature trees.

When planting new trees:



- Consider the purpose of the tree that is being planted.
- Assess the site conditions. Note any growth limitations or space requirements e.g., overhead utilities, proximity to buildings, existing tree canopy, etc.
- Select the best species for the site conditions.
- Ensure that the tree is properly planted and have a plan in place for follow-up tree care.
- Monitor and record how newly planted species react to the site conditions. Incorporate this information into future planting plans.

Tips for Planting Trees

To ensure that newly planted trees will survive the planting process:

- Handle trees with care during transportation. Avoid damaging the trunks or branches when loading and unloading.
- Avoid storing trees for lengthy periods before planting. Make sure the root ball is kept moist if they are not being immediately planted.
- Dig the hole 2 to 3 times the size of the root ball using hand tools when possible. When augers are used, the sides of the hole can become compacted, which negatively affects root growth.
- Fill the hole with native soil when possible. If the native soil is undesirable, add soil amendments to improve soil structure. Gently tamp down the soil. Add water to promote a proper mixture of air, water, and soil.
- Stake trees for the first year of growth to both protect against wind and provide a barrier against mechanical damage from mowing.
- Add a thin layer of mulch. Make sure not to let mulch build up around the trunk. Over mulching is extremely common and will do irreversible damage in the long run.

Newly Planted Tree Maintenance

Proper young tree maintenance is just as important as proper planting techniques. If trees are not cared for after planting, they have little chance of surviving and becoming established. Newly planted trees will require maintenance for several years after planting.

Water

Watering newly planted trees is the most important key to their survival. Typically, it takes at least two months of watering for a new tree to become established. The time of year and tree

species will dictate how much water should be applied after this period. The general rule is to keep soil moist to promote root growth.

Mulching

Applying mulch to newly planted trees has many benefits. Mulch will help retain soil moisture and regulate temperatures around the root ball. Because over-mulching will have devastating effects on the long-term health of a tree, it is extremely important to avoid piling mulch around the trunk. Spread 3 to 4 inches of mulch around newly planted trees while ensuring the root flare is visible and mulch is not touching the trunk.

Caring for Established Young Trees

After planting, trees will take a few years to become established. The general rule: trees take one year for each inch in caliper when planted to become established. (Caliper is the trunk diameter at 6 inches above ground.) For example, if you are planting a 2-inch caliper tree, it will take 2 years for the roots to become fully established. Established trees still require regular watering and will need structural pruning as they begin to grow. Structural pruning establishes a central leader; removes dead or diseased branches; removes crossing limbs; and creates an overall structure that will benefit the tree into maturity.

Maintenance Cycle

Utilizing data from the 2018 tree inventory, ArborPro developed an annual maintenance schedule detailing the number and types of tasks to be completed each year. Budget projections were made using average cost of tree work based on diameter class. These costs are not specific to the City of Kingston; they only represent average costs based on industry knowledge and experience.

Maintenance Plan

This summary will include tree data collected within the City limits during the inventory. It represents the total cost of priority maintenance and the recurring cost of proactive maintenance. A summary of the maintenance schedule is presented here. The complete table of estimated costs for this five-year plan can be found in Appendix C.

In addition to the five-year maintenance plan, it is important to understand the total cost of priority maintenance and the recurring cost of proactive maintenance. It may not be possible to implement a five-year maintenance plan, but it is very important to understand what it would cost to maintain all of Kingston’s trees. Priority maintenance is the one-time cost of pruning or removing all of the Priority 1 and Priority 2 trees. Proactive maintenance is the recurring cost of routine pruning and young tree training.

The breakdown of cost for all priority maintenance is:

Maintenance	Cost
Priority 1 Removal	$45,550
Priority 1 Prune	$23,740
Priority 2 Removal	$73,715
Priority 2 Prune	$79,280
Total	**$222,285**

Table 6: Cost of priority maintenance

The recurring cost of proactive maintenance is:

Maintenance	Cost per Year
Routine Prune	$66,706
Young Tree Training	$4,165
Total	**$70,871**

Table 7: Recurring cost of proactive maintenance

To implement the recommended maintenance schedule, the maintenance plan budget should be no less than $75,595 for Year One; $78,050 for Year Two; $74,945 for Year Three; $70,871 for Year Four; and $70,871 for Year Five.

While the City of Kingston may not be able to implement a proactive maintenance cycle immediately, it is an important goal to work towards. At very least, the priority maintenance should be budgeted for and completed within the first three years. ArborPro recommends implementing the five-year maintenance plan as soon as possible.

2018

Count	Activity	Estimated Cost
58	Priority 1 Removal	$45,550
82	Priority 1 Prune	$23,740
102	Stump Removal	$6,305
Total Cost		**$ 75,595**

2019

Count	Activity	Estimated Cost
79	Priority 2 Removal	$37,880
188	Priority 2 Prune	$40,170
Total Cost		**$ 78,050**

2020

Count	Activity	Estimated Cost
75	Priority 2 Removal	$35,835
184	Priority 2 Prune	$39,110
Total Cost		**$ 74,945**

2021

Count	Activity	Estimated Cost
556	Routine Prune	$66,706
163	Young Tree Train	$4,165
Total Cost		**$ 70,871**

2022

Count	Activity	Estimated Cost
556	Routine Prune	$66,706
163	Young Tree Train	$4,165
Total Cost		**$ 70,871**

Figure 32: Five-year maintenance plan

Section 4: Emerald Ash Borer Management Strategies

Emerald Ash Borer

Emerald ash borer is a small insect native to Asia. In the 1990s, it was introduced to the United States through solid wood packing materials near Detroit, Michigan. Since its introduction to North America, it has spread to 29 states, largely concentrating in the Midwest and Northeast. EAB has been confirmed in New York and surrounding states so will eventually necessitate a management strategy in Kingston. EAB attacks all species of ash trees by boring into the tree and disrupting nutrient flow, ultimately causing the tree to die. The insect is responsible for killing hundreds of millions of North American trees and is constantly moving to new areas. The following image shows the distribution of EAB infestations by state.

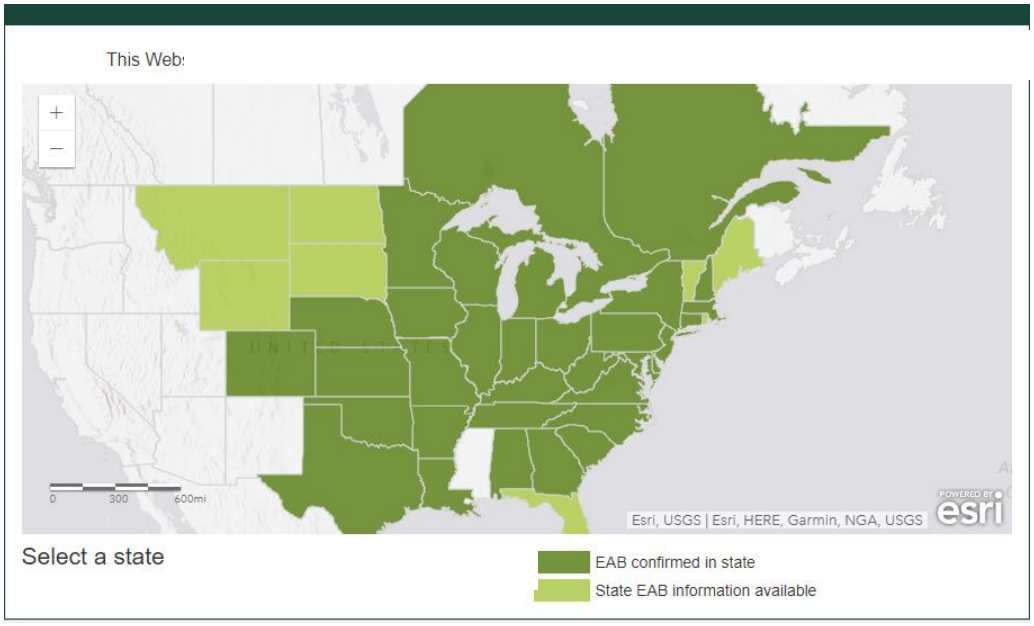


Figure 33: Emerald ash borer infestations by state

Identification

Metallic green in color, the adult beetle is 3/8- to 5/8-inches long. The adult beetles are visible from late May to early August when they emerge from the trees to feed on leaves. Leaf feeding

does not significantly damage the trees but is an important part of the insect's life-cycle. The female beetles then lay eggs in the branches and trunks of ash trees. The eggs hatch into larvae that bore into the wood beneath the bark. Larvae are white and can only be seen by removing the bark to expose galleries beneath the bark. The larvae feed on the inner bark and phloem tissue, disrupt the flow of nutrients to the tree, and inflict the most significant damage done throughout the insect's life-cycle.

EAB Gallery
Photograph courtesy of Missouri Department of Conservation

Because the insect spends a majority of its life-cycle inside the tree, EAB is very difficult to detect and often goes unnoticed for years before the infestations are confirmed. Early warning signs of an infestation are: yellowing/thinning of the foliage; canopy dieback; drooping branches in the upper canopy; woodpecker damage to the bark; and the presence of epicormic shoots at the tree base or in branches. The most easily identifiable sign of an infestation are the D-shaped exit holes left by the beetles when they emerge from the tree as adults. However, during early phases of infestation, these exit holes are often high up in the canopy and not easily identifiable by the naked eye. Once a tree is infested, it will often die within two years if not treated with insecticide.

Ash Population

Kingston is fortunate to have a relatively small ash population compared to other cities. The inventory found 43 ash trees within the survey area, accounting for 1.1% of the total inventoried population. Of the 43 trees, 12 are white ash (Fraxinus americana) and 31 are green ash (Fraxinus pennsylvanica). Figure 34 shows a breakdown of ash trees by species and condition. Table 8 shows a breakdown of ash trees by diameter class by condition.

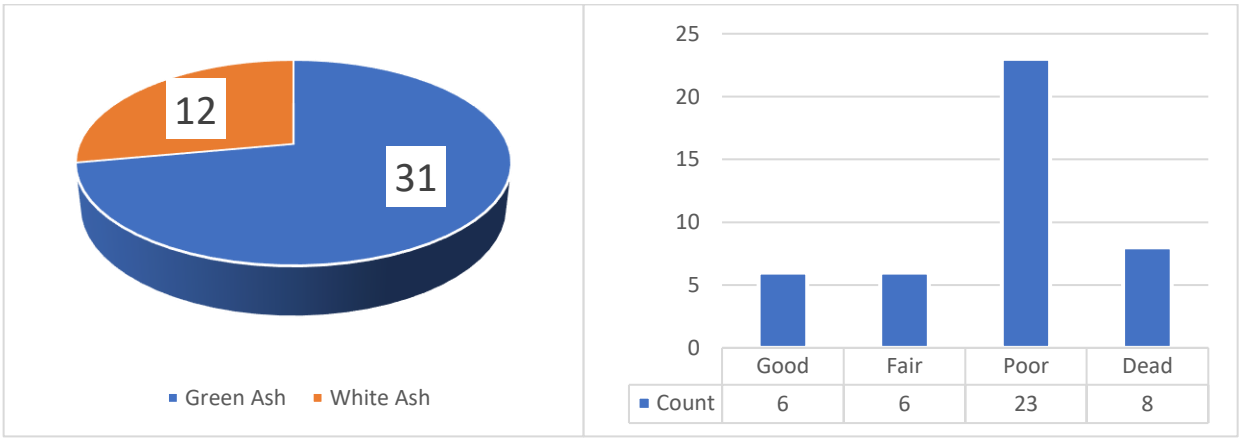


Figure 34: Species and condition of ash trees

		Diameter Class									
		00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+	**Total**
Condition Class	Good	1	3	2	0	0	0	0	0	0	**6**
	Fair	1	1	2	2	0	0	0	0	0	**6**
	Poor	0	1	12	5	4	0	1	0	0	**23**
	Dead	0	2	1	3	2	0	0	0	0	**8**
	Total	**2**	**7**	**17**	**10**	**6**	**0**	**1**	**0**	**0**	**43**

Table 8: Diameter class of ash trees by condition

EAB Management Options

Three basic options for EAB management include: treat all ash trees; remove all ash trees; or a combination of treatment and removal. When deciding which approach to take, it is important to consider a number of factors that will affect Kingston's health, safety, and financial stability. For example, treating all ash trees would be extremely costly and would not benefit trees that are already in active decline due to EAB infestation. Removing all ash trees will greatly reduce the risk of EAB related tree failure but involves not only the cost of removing the trees but the cost of replanting to compensate for canopy loss. When removing ash trees, it is extremely important that these trees be replaced. A well thought out planting plan should be in place before starting any removal operations. A mix of removals and treatment tends to be the best option, but careful consideration should be used to determine which trees will be retained and receive treatment.

Strategy 1: Treat All Ash Trees in "Fair" and "Good" Condition

Treating all of Kingston's ash trees will reduce the annual mortality rate and stabilize removals. Treatment also allows these trees to continue providing benefits to the community into the foreseeable future. While initially cheaper than removing all of the ash trees, it represents a recurring cost. EAB trunk injections need to be repeated every two years to remain effective, which becomes quite costly.

Because they will not likely benefit from treatment, trees in poor condition have been recommended for removal. In addition, trees under 6 inches in DBH are recommended for removal as they would need to be treated for their entire life span. Also, these trees are very easily and cost-effectively removed due to their small size.

In order to estimate treatment costs, the general price of $7 per inch DBH was used for trees 10 inches and smaller while $10 per inch DBH was used for trees 11 inches or larger at the time of the inventory.

Removal										
	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+	**Total**
Good	0	1	0	0	0	0	0	0	0	**1**
Fair	1	0	0	0	0	0	0	0	0	**1**
Poor	0	1	9	4	4	0	1	0	0	**19**
Dead	0	2	1	3	2	0	0	0	0	**8**
	1	**4**	**10**	**7**	**6**	**0**	**1**	**0**	**0**	**29**
Treatment										
Good	1	2	2	0	0	0	0	0	0	**5**
Fair	0	1	2	2	0	0	0	0	0	**5**
Poor	0	0	3	1	0	0	0	0	0	**4**
Dead	0	0	0	0	0	0	0	0	0	**0**
	1	**3**	**7**	**3**	**0**	**0**	**0**	**0**	**0**	**14**

Activity	DBH	Cost/Tree	# of Trees	Total Cost
Removal	00"-03"	$25	1	$25
	04"-06"	$105	4	$420
	07"-12"	$220	10	$2,200
	13"-18"	$355	7	$2,485
	19"-24"	$525	6	$3,150
	25"-30"	$845	0	$0
	31"-36"	$1,140	1	$1,140
	37"-42"	$1,470	0	$0
	43+	$1,850	0	$0
Total			**29**	**$9,420**
Treatment	00"-03"	$7/Inch	1	$14
	04"-06"	$7/Inch	3	$98
	07"-12"	$7/Inch	7	$599
	13"-18"	$10/inch	3	$460
	19"-24"	$10/inch	0	$0
	25"-30"	$10/inch	0	$0
	31"-36"	$10/inch	0	$0
	37"-42"	$10/inch	0	$0
	43+	$10/inch	0	$0
Total			**14**	**$1,171**

*treatment is a recurring cost every two years

Figure 35: Cost of removal and treatment for ash trees

Strategy 2: Remove All Ash Trees

This strategy involves removing and replacing all 126 inventoried ash trees. This would represent a significant cost upfront and would remove all of the trees in “Good” and “Fair” condition that are still providing benefits. While this option will greatly reduce the risk of

damage and/or death due to whole tree failure, it will significantly decrease the total canopy cover in Kingston. If this strategy is implemented, it is extremely important to develop a plan to replace every tree that is removed. This requires a detailed, well thought-out planting plan that will promote biodiversity and compensate for the loss of canopy cover.

	Removal									
	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+	**Total**
Good	0	1	0	0	0	0	0	0	0	**1**
Fair	1	2	7	11	19	9	3	1	0	**53**
Poor	0	0	2	7	4	1	2	1	0	**17**
	1	**3**	**9**	**18**	**23**	**10**	**5**	**2**	**0**	**71**

Activity	DBH	Cost/Tree	# of Trees	Total Cost
Removal	00"-03"	$25	2	$50
	04"-06"	$105	7	$735
	07"-12"	$220	17	$3,740
	13"-18"	$355	10	$3,550
	19"-24"	$525	6	$3,150
	25"-30"	$845	0	$0
	31"-36"	$1,140	1	$1,140
	37"-42"	$1,470	0	$0
	43+	$1,850	0	$0
Total			**43**	**$12,365**

Figure 36: Cost of removal for ash trees

Strategy 3: Combination of Treatment and Removal

Often the best strategy, this has been shown to be the most cost-effective in the long run. It involves treating all of the ash trees over 6 inches DBH in “Good” condition; treating half of the trees in “Fair” condition; removing the remaining trees in “Fair” condition; and removing all of the trees in “Poor” and “Dead” condition. To implement this strategy, 55 trees would need to be treated while 71 would be removed.

Removal										
	00"-03"	04"-06"	07"-12"	13"-18"	19"-24"	25"-30"	31"-36"	37"-42"	43+	**Total**
Good	1	3	0	0	0	0	0	0	0	**4**
Fair	1	1	0	0	0	0	0	0	0	**2**
Poor	0	1	12	5	4	0	1	0	0	**23**
Dead	0	2	1	3	2	0	0	0	0	**8**
	2	**7**	**13**	**8**	**6**	**0**	**1**	**0**	**0**	**37**
Treatment										
Good	0	0	2	0	0	0	0	0	0	**2**
Fair	0	0	2	2	0	0	0	0	0	**4**
Poor	0	0	0	0	0	0	0	0	0	**0**
Dead	0	0	0	0	0	0	0	0	0	**0**
	0	**0**	**4**	**2**	**0**	**0**	**0**	**0**	**0**	**6**

Activity	DBH	Cost/Tree	# of Trees	Total Cost
Removal	00"-03"	$25	2	$50
	04"-06"	$105	7	$735
	07"-12"	$220	13	$2,860
	13"-18"	$355	8	$2,840
	19"-24"	$525	6	$3,150
	25"-30"	$845	0	$0
	31"-36"	$1,140	1	$1,140
	37"-42"	$1,470	0	$0
	43+	$1,850	0	$0
Total			**37**	**$10,775**
Treatment	00"-03"	$7/Inch	0	$0
	04"-06"	$7/Inch	0	$0
	07"-12"	$7/Inch	4	$238
	13"-18"	$10/inch	2	$330
	19"-24"	$10/inch	0	$0
	25"-30"	$10/inch	0	$0
	31"-36"	$10/inch	0	$0
	37"-42"	$10/inch	0	$0
	43+	$10/inch	0	$0
Total			**6**	**$568**

*treatment is a recurring cost every two years

Figure 37: Cost of removal and treatment for ash trees

It is important that Kingston implement an EAB management strategy. Having a proactive management strategy that fits the needs of both the City and surrounding community will greatly reduce the financial burden of an EAB infestation.

Conclusions

Properly managing urban trees requires planning, communication, public support, and adequate funding. For these reasons, it is complicated and can only be accomplished through a well-defined vision for the future. The combination of priority and proactive maintenance detailed in this Tree Management Plan will create a framework for short- and long-term management that will help ensure a healthy, vibrant tree canopy for future generations. Kingston must balance the needs of its residents with a knowledge and understanding of tree management to create a safe, enjoyable environment for everyone.

Appendix A – Species Distribution

Botanical Name	Common Name	Count	%
Abies balsamea	Balsam Fir	1	0.0%
Abies concolor	White Fir	6	0.2%
Acer buergeranum	Trident Maple	4	0.1%
Acer ginnala	Amur Maple	9	0.2%
Acer griseum	Paperbark Maple	6	0.2%
Acer negundo	Box Elder	18	0.5%
Acer negundo 'Flamingo'	Variegated Box Elder	1	0.0%
Acer palmatum	Japanese Maple	41	1.0%
Acer plantanoides	Norway Maple	516	13.1%
Acer rubrum	Red Maple	219	5.6%
Acer saccharinum	Silver Maple	121	3.1%
Acer saccharum	Sugar Maple	300	7.6%
Acer tataricum	Tatarian Maple	1	0.0%
Acer x freemanii	Freeman Maple	4	0.1%
Aesculus hippocastanum	Common Horsechestnut	10	0.3%
Aesculus x carnea	Red Horsechestnut	1	0.0%
Ailanthus altissima	Tree of Heaven	30	0.8%
Albizia julibrissin	Mimosa, Silk Tree	2	0.1%
Amelanchier canadensis	Canadian Serviceberry	26	0.7%
Betula lenta	Sweet Birch	1	0.0%
Betula nigra	River Birch	10	0.3%
Betula papyrifera	Paper Birch	3	0.1%
Betula pendula	European White Birch	1	0.0%
Betula populifolia	Gray Birch	8	0.2%
Carpinus betulus	European Hornbeam	1	0.0%
Carpinus betulus “Fastigiata”	Upright European Hornbeam	1	0.0%
Carya cordiformis	Bitternut Hickory	15	0.4%
Carya ovata	Shagbark Hickory	5	0.1%
Carya tomentosa	Mockernut Hickory	1	0.0%
Castanea mollissima	Chinese Chestnut	1	0.0%
Catalpa speciosa	Western Catalpa	34	0.9%
Celtis occidentalis	Common Hackberry	16	0.4%
Cercidiphyllum japonicum	Katsura Tree	2	0.1%
Cercis canadensis	Eastern Redbud	10	0.3%
Cornus florida	Eastern Dogwood	35	0.9%
Cornus kousa	Kousa Dogwood	3	0.1%
Crataegus crus-galli	Cockspur Thorn	10	0.3%
Crataegus crus-galli inermis	Thornless Hawthorn	12	0.3%
Diospyros virginiana	American Persimmon	1	0.0%
Fagus sylvatica	European Beech	1	0.0%
Fagus sylvatica “Fastigiata”	Upright European Beech	3	0.1%
Fraxinus americana	White Ash	12	0.3%
Fraxinus pennsylvanica	Green Ash	31	0.8%
Ginkgo biloba	Maidenhair Tree	59	1.5%

Gleditsia triacanthos forma inermis	Thornless Honey Locust	396	10.1%
Juglans cinerea	Butternut	1	0.0%
Juglans nigra	Black Walnut	20	0.5%
Juglans regia	English Walnut	1	0.0%
Juniperus virginiana	Eastern Red Cedar	58	1.5%
Koelreuteria paniculata	Goldenrain Tree	1	0.0%
Liquidambar styraciflua	American Sweet Gum	2	0.1%
“Rotundiloba”	Round-Leafed Sweet Gum	1	0.0%
Liriodendron tulipifera	Tulip Tree	8	0.2%
Maackia amurensis	Manchurian Maackia	4	0.1%
Magnolia stellata	Star Magnolia	3	0.1%
Magnolia x soulangiana	Saucer Magnolia	8	0.2%
Malus domestica	Edible Apple Species	13	0.3%
Malus floribunda	Crabapple	117	3.0%
Metasequoia glyptostroboides	Dawn Redwood	13	0.3%
Morus alba	White Mulberry	52	1.3%
Ostrya virginiana	American Hophornbeam	2	0.1%
Picea abies	Norway Spruce	99	2.5%
Picea glauca	White Spruce	22	0.6%
Picea glauca albertiana	Alberta Spruce	2	0.1%
Picea pungens	Colorado Spruce	57	1.4%
Pinus mugo	Mugho Pine	1	0.0%
Pinus nigra	Austrian Black Pine	27	0.7%
Pinus strobus	White Pine	107	2.7%
Pinus sylvestris	Scotch Pine	1	0.0%
Platanus occidentalis	American Sycamore	101	2.6%
Populus deltoides	Cottonwood	33	0.8%
Populus tremuloides	Quaking Aspen	1	0.0%
Prunus avium	Sweet Cherry	1	0.0%
Prunus cerasifera	Purple-leaf Plum	20	0.5%
Prunus domestica	Plum	2	0.1%
Prunus persica	Peach	8	0.2%
Prunus serotina	Eastern Black Cherry	32	0.8%
Prunus serrulata	Japanese Flowering Cherry	38	1.0%
Prunus serrulata “Kwanzan”	“Kwanzan” Flowering Cherry	1	0.0%
Prunus species	Stone Fruit species	5	0.1%
Prunus subhirtella “Pendula”	Weeping Flowering Cherry	9	0.2%
Prunus yeodensis	Yoshino Cherry	7	0.2%
Pyrus calleryana	Ornamental Pear	326	8.3%
Pyrus communis	Edible Pear	18	0.5%
Quercus alba	White Oak	10	0.3%
Quercus bicolor	Swamp White Oak	4	0.1%
Quercus coccinea	Scarlet Oak	3	0.1%
Quercus imbricaria	Shingle Oak	4	0.1%
Quercus macrocarpa	Bur Oak	3	0.1%
Quercus palustris	Pin Oak	98	2.5%
Quercus phellos	Willow Oak	2	0.1%

Quercus robur “Fastigiata”	Upright English Oak	2	0.1%
Quercus rubra	Red Oak	27	0.7%
Quercus velutina	Black Oak	4	0.1%
Rhamnus cathartica	Common Buckthorn	6	0.2%
Robinia pseudoacacia	Black Locust	156	4.0%
Salix babylonica	Weeping Willow	4	0.1%
Salix discolor	Pussy Willow	1	0.0%
Salix integra	Dappled Willow	1	0.0%
Salix matsudana “Tortuosa”	Corkscrew Willow	1	0.0%
Salix nigra	Black Willow	4	0.1%
Sassafras albidum	Sassafras	1	0.0%
Sorbus americana	American Mountain Ash	2	0.1%
Styphnolobium japonicum	Japanese Pagoda Tree	2	0.1%
Syringa reticulata	Japanese Tree Lilac	21	0.5%
Syringa vulgaris	Common Lilac	4	0.1%
Taxus spp.	Yew Species	6	0.2%
Thuja occidentalis	American Arborvitae	51	1.3%
Tilia americana	American Linden	8	0.2%
Tilia cordata	Little-Leaf Linden	119	3.0%
Tsuga canadensis	Eastern Hemlock	102	2.6%
Ulmus americana	American Elm	13	0.3%
Ulmus parvifolia	Chinese Elm	6	0.2%
Ulmus pumila	Siberian Elm	47	1.2%
Ulmus rubra	Slippery Elm	3	0.1%
Ulmus x species	Hybrid Elm	12	0.3%

Appendix B – Suggested Species List for New Plantings

Small to Medium Trees	
Botanical Name	**Common Name**
Acer ginnala	Amur Maple
Acer tataricum	Tatarian Maple
Amelanchier species	Serviceberry Varieties
Carpinus caroliniana	American Hornbeam
Maackia amurensis	Amur Maackia
Malus species (upright varieties)	Upright Flowering Crabapples
Prunus virginiana “Canada Red Select”	Canada Red Select Cherry
Sorbus thuringiaca fastigiata	Columnar Oakleaf Mountain Ash
Syringa reticulata (varieties)	Japanese Tree Lilac
Cornus mas	cornelian cherry dogwood
Carpinus caroliniana	American hornbeam
Cercis canadensis	Eastern redbud
Osage orange “white shield”	Maclura pomifera ‘white shield’
Large Trees	
Botanical Name	**Common Name**
Acer x fremanii (varieties)	Freeman Maple
Acer platanoides (varieties)	Norway Maple
Acer rubrum (varieties)	Red Maple
Aesculus hippocastanum (varieties)	Horsechestnut
Aesculus x carnea (varieties)	Horsechestnut
Alnus glutinosa	Black Alder
Carpinus betulus “fastigiata”	European Hornbeam
Catalpa speciosa	Northern Catalpa
Celtis occidentalis	Hackberry
Corylus colurna	Turkish Filbert
Gingko biloba	Gingko
Gleditsia triacanthos inermis	Thornless Honeylocust
Gymnocladus dioicus	Kentucky Coffeetree
Liriodendron tulipifera	Tulip Tree
Ostrya virginiana	American Hophornbeam (Ironwood)
Phellodendron amurense “Macho”	Macho Amur Corktree
Platanus x acerfolia	London Planetree
Prunus sargentii	Sargent Cherry
Pyrus calleryana (varieties)	Callery Pear
Quercus bicolor	Swamp White Oak
Quercus macrocarpa	Bur Oak
Quercus rubra	Northern Red Oak
Robinia pseudoacacia	Blacklocust
Tilia cordata	Littleleaf Linden
Ulmus species	Elm
Metasequia glyptostoboides	Dawn Redwood
Nyssa sylvatica	Black Tupelo

Quercus alba	White Oak
Quercus coccinea	Scarlet Oak
Quercus imbricaria	Shingle Oak
Quercus muehlengergii	Chinkapin Oak
Quercus shumardii	Shumard Oak
Quercus robur	English Oak
Taxodium distichum	Bald Cypress
Tilia Americana	American Linden
Tilia tomentosa	Silver Linden

Appendix C – Five-year Budget

Year			2018		2019		2020		2021		2022		Five-Year
Activity	DBH	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	Cost
Priority 1 Removal	00"-03"	$25	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	04"-06"	$105	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	07"-12"	$220	6	$1,320	0	$0	0	$0	0	$0	0	$0	$1,320
	13"-18"	$355	13	$4,615	0	$0	0	$0	0	$0	0	$0	$4,615
	19"-24"	$525	11	$5,775	0	$0	0	$0	0	$0	0	$0	$5,775
	25"-30"	$845	10	$8,450	0	$0	0	$0	0	$0	0	$0	$8,450
	31"-36"	$1,140	9	$10,260	0	$0	0	$0	0	$0	0	$0	$10,260
	37"-42"	$1,470	4	$5,880	0	$0	0	$0	0	$0	0	$0	$5,880
	43+	$1,850	5	$9,250	0	$0	0	$0	0	$0	0	$0	$9,250
Total			**58**	**$45,550**	**0**	**$0**	**0**	**$0**	**$0**	**$0**	**0**	**$0**	**$45,550**
Priority 2 Removal	00"-03"	$25	0	$0	3	$75	2	$50	0	$0	0	$0	$125
	04"-06"	$105	0	$0	8	$840	8	$840	0	$0	0	$0	$1,680
	07"-12"	$220	0	$0	17	$3,740	17	$3,740	0	$0	0	$0	$7,480
	13"-18"	$355	0	$0	16	$5,680	15	$5,325	0	$0	0	$0	$11,005
	19"-24"	$525	0	$0	18	$9,450	17	$8,925	0	$0	0	$0	$18,375
	25"-30"	$845	0	$0	9	$7,605	9	$7,605	0	$0	0	$0	$15,210
	31"-36"	$1,140	0	$0	5	$5,700	4	$4,560	0	$0	0	$0	$10,260
	37"-42"	$1,470	0	$0	2	$2,940	2	$2,940	0	$0	0	$0	$5,880
	43+	$1,850	0	$0	1	$1,850	1	$1,850	0	$0	0	$0	$3,700
Total			**0**	**$0**	**79**	**$37,880**	**75**	**$35,835**	**0**	**$0**	**0**	**$0**	**$73,715**
Stump Removal	00"-03"	$25	1	$25	0	$0	0	$0	0	$0	0	$0	$25
	04"-06"	$25	4	$100	0	$0	0	$0	0	$0	0	$0	$100
	07"-12"	$25	24	$600	0	$0	0	$0	0	$0	0	$0	$600
	13"-18"	$40	18	$720	0	$0	0	$0	0	$0	0	$0	$720
	19"-24"	$60	21	$1,260	0	$0	0	$0	0	$0	0	$0	$1,260
	25"-30"	$85	18	$1,530	0	$0	0	$0	0	$0	0	$0	$1,530
	31"-36"	$110	8	$880	0	$0	0	$0	0	$0	0	$0	$880
	37"-42"	$130	3	$390	0	$0	0	$0	0	$0	0	$0	$390
	43+	$160	5	$800	0	$0	0	$0	0	$0	0	$0	$800
Total			**102**	**$6,305**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$6,305**
Priority 1 Prune	00"-03"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	04"-06"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	07"-12"	$75	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	13"-18"	$120	5	$600	0	$0	0	$0	0	$0	0	$0	$600
	19"-24"	$170	13	$2,210	0	$0	0	$0	0	$0	0	$0	$2,210
	25"-30"	$225	18	$4,050	0	$0	0	$0	0	$0	0	$0	$4,050
	31"-36"	$305	22	$6,710	0	$0	0	$0	0	$0	0	$0	$6,710
	37"-42"	$380	19	$7,220	0	$0	0	$0	0	$0	0	$0	$7,220
	43+	$590	5	$2,950	0	$0	0	$0	0	$0	0	$0	$2,950
Total			**82**	**$23,740**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$23,740**
Priority 2 Prune	00"-03"	$20	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	04"-06"	$30	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	07"-12"	$75	0	$0	4	$300	3	$225	0	$0	0	$0	$525
	13"-18"	$120	0	$0	37	$4,440	37	$4,440	0	$0	0	$0	$8,880
	19"-24"	$170	0	$0	62	$10,540	61	$10,370	0	$0	0	$0	$20,910
	25"-30"	$225	0	$0	42	$9,450	41	$9,225	0	$0	0	$0	$18,675
	31"-36"	$305	0	$0	26	$7,930	26	$7,930	0	$0	0	$0	$15,860
	37"-42"	$380	0	$0	12	$4,560	12	$4,560	0	$0	0	$0	$9,120
	43+	$590	0	$0	5	$2,950	4	$2,360	0	$0	0	$0	$5,310
Total			**0**	**$0**	**188**	**$40,170**	**184**	**$39,110**	**0**	**$0**	**0**	**$0**	**$79,280**
Routine Prune	00"-03"	$20	0	$0	0	$0	0	$0	12	$236	12	$236	$472
	04"-06"	$30	0	$0	0	$0	0	$0	54	$1,608	54	$1,608	$3,216
	07"-12"	$75	0	$0	0	$0	0	$0	181	$13,545	181	$13,545	$27,090
	13"-18"	$120	0	$0	0	$0	0	$0	152	$18,264	152	$18,264	$36,528
	19"-24"	$170	0	$0	0	$0	0	$0	92	$15,708	92	$15,708	$31,416
	25"-30"	$225	0	$0	0	$0	0	$0	46	$10,260	46	$10,260	$20,520
	31"-36"	$305	0	$0	0	$0	0	$0	14	$4,209	14	$4,209	$8,418
	37"-42"	$380	0	$0	0	$0	0	$0	3	$988	3	$988	$1,976
	43+	$590	0	$0	0	$0	0	$0	3	$1,888	3	$1,888	$3,776
Total			**0**	**$0**	**0**	**$0**	**0**	**$0**	**556**	**$66,706**	**556**	**$66,706**	**$133,412**
Young Tree Training	00"-03"	$20	0	$0	0	$0		$0	86	$1,720	86	$1,720	$3,440
	04"-06"	$30	0	$0	0	$0		$0	74	$2,220	74	$2,220	$4,440
	07"-12"	$75	0	$0	0	$0		$0	3	$225	3	$225	$450
Total			**0**	**$0**	**0**	**$0**		**$0**	**163**	**$4,165**	**163**	**$4,165**	**$8,330**
Cost Grand Total				**$75,595**		**$78,050**		**$74,945**		**$70,871**		**$70,871**	**$370,332**

Appendix D - Maps

Academy Green Park
Kingston, NY 2018

ArborPro URBAN FOREST MANAGEMENT

Block Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

Cornell Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

Forsyth Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

Hasbrouck Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

Hutton Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

Kingston Point Park
Kingston, NY 2018

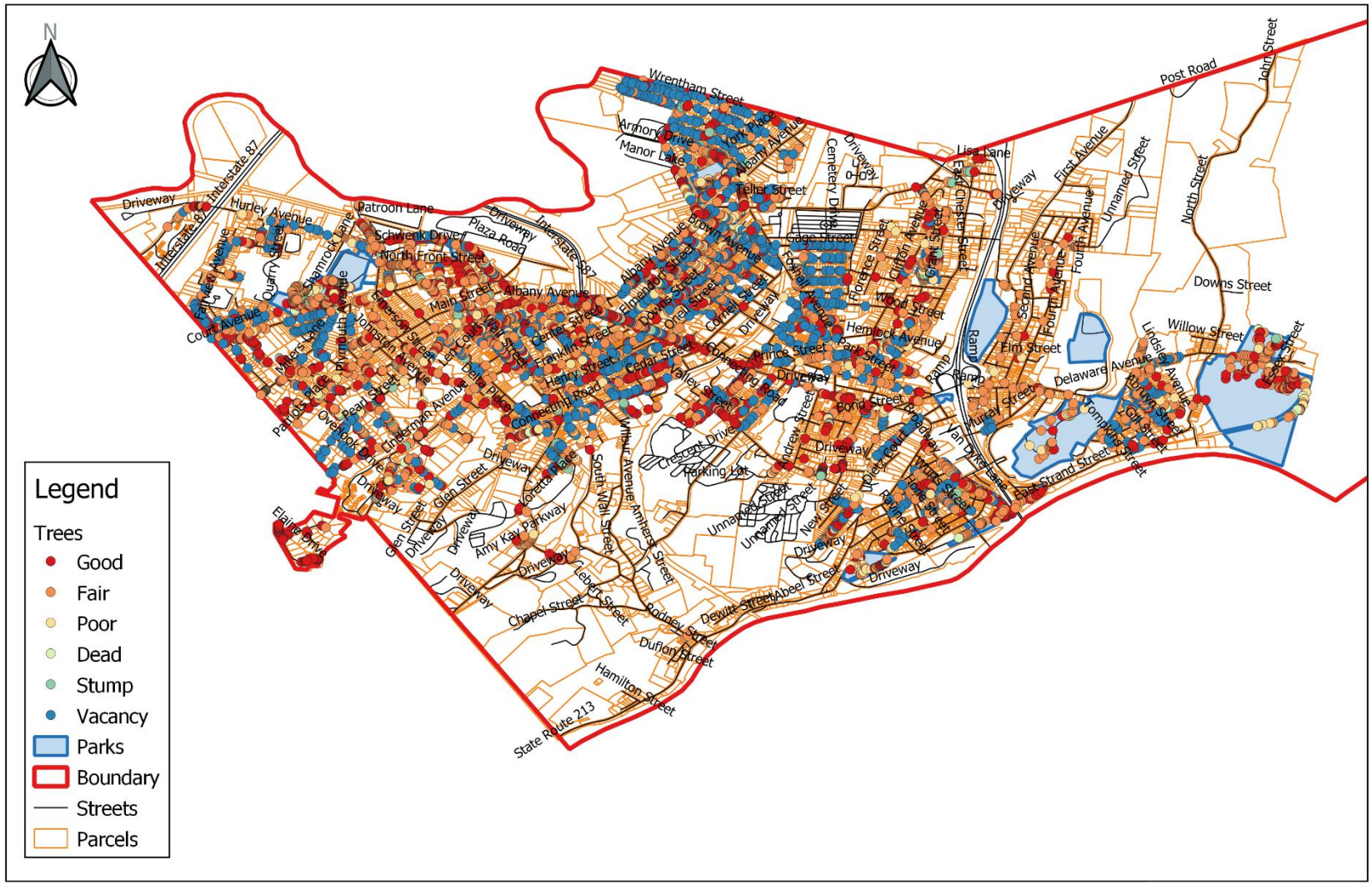
ArborPro
URBAN FOREST MANAGEMENT

Loughran Park
Kingston, NY 2018

ArborPro
URBAN FOREST MANAGEMENT

TR Gallo Park
Kingston, NY 2018

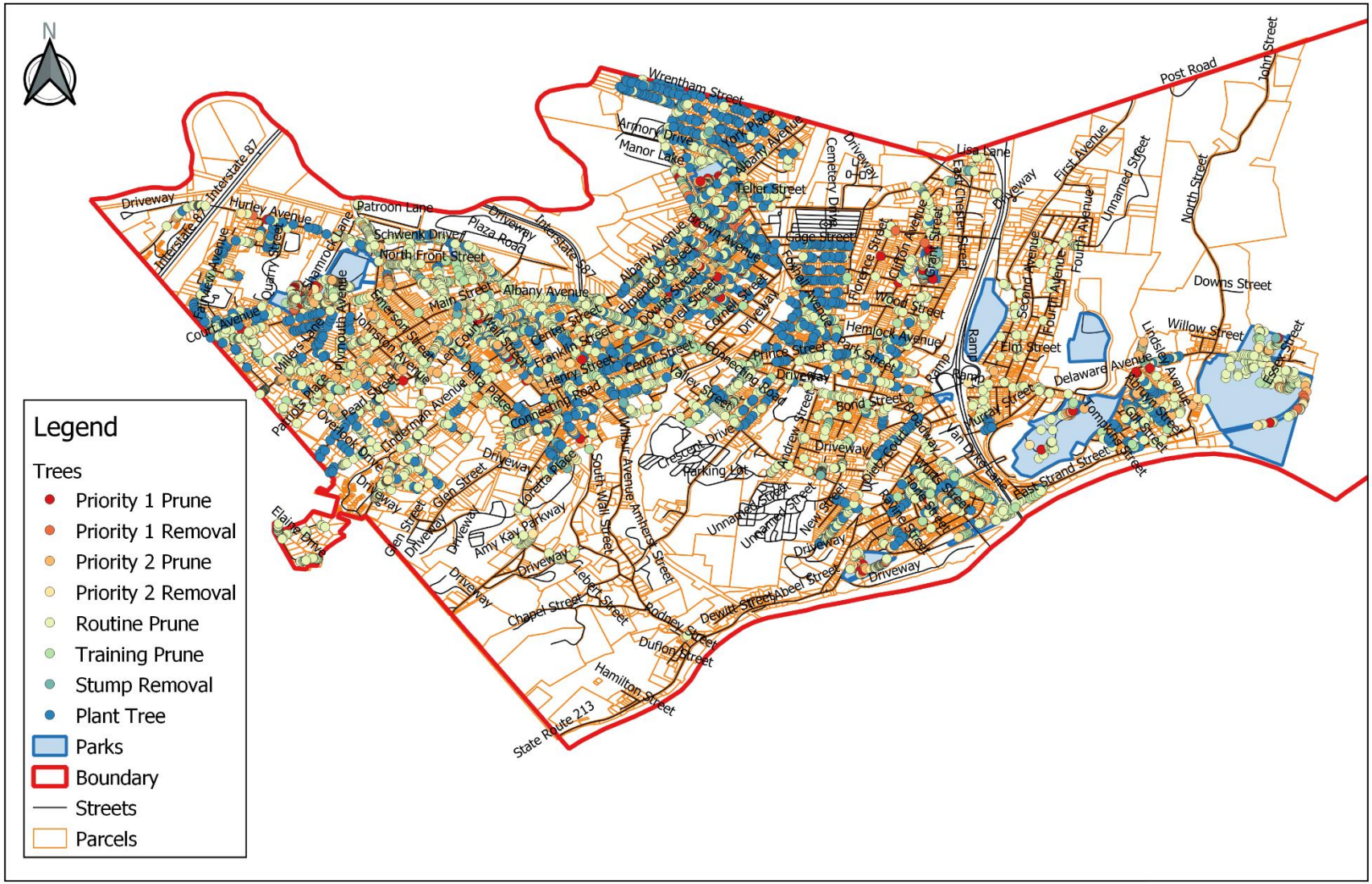
ArborPro
URBAN FOREST MANAGEMENT



Condition Map
Kingston, NY

0.25 0 0.25 0.5 0.75 1 mi

ArborPro
URBAN FOREST MANAGEMENT



Recommended Maintenance Map
Kingston, NY

0.25 0 0.25 0.5 0.75 1 mi

ArborPro
URBAN FOREST MANAGEMENT