City of Hamilton, Ohio
Municipal Forest Resource Analysis
"Value of the Green Infrastructure"

City of Hamilton
BUTLER COUNTY OHIO

TREE CITY USA®

City of Hamilton, Ohio
Municipal Forest Resource Analysis
"Value of the Green Infrastructure"

January 3, 2017

Prepared For:

Pat Moeller, Mayor
City Council Members
Public Utilities Commission
Hamilton Tree Advisory Board
Joshua Smith, City Manager
Kevin Maynard, Director of Public Utilities
Rich Engle, Director of Public Works
Bud Scharf, Director of Community Development

Prepared by:

David S. Bienemann, Municipal Arborist/Utility Forester

Acknowledgement

Rose Haverkos, GIS Administrator
City of Hamilton
345 High Street
Hamilton, OH 45011

Ken Carrier, Senior GIS Specialist
City of Hamilton
345 High Street
Hamilton, OH 45011

Chelsea Obrebski, Miami University Intern
City of Hamilton
Arborist/Utilities

Jim Kozak, Development Analyst, Urban Forestry
Davey Tree Expert Company
259 S. Water Street, Suite #300
Kent, Ohio 43240

Dr. Greg McPherson, Research Forester
Center for Urban Forestry Research
Pacific Southwest Research Station
1731 Research Park Drive
Davis, CA 95618

Eric Kuehler, Technology Transfer Specialist
USDA Forest Service, Southern Research Group
320 Green Street Athens, GA 30602

Table of Contents

Hamilton Tree Board Fall Color Photo Winner

Executive Summary

Trees are an integral component of the urban environment and a city's green infrastructure. Urban forestry research confirms that healthy trees serve municipalities by reducing air pollution, stormwater runoff, and energy consumption. Trees also provide significant economic benefits, including increased property values and attractive areas for business development, while their shade and beauty contribute to the community's quality of life.

Trees are an important part of the City of Hamilton's identity and history, evident in the older sections of town where large oaks still stand from the days of Fort Hamilton. The City of Hamilton's street trees are also a valuable municipal resource and a critical component of Hamilton's green infrastructure. The City has been proactive in planting trees in the public rights-of-way, golf courses and parks; however, the need to manage the health of the City's urban forest has become a recent and important priority. In recent years, major storms have knocked down many city street and park trees resulting in tree-related power outages and infrastructure damage. Recognizing the importance of long-term tree care and in response to such events, the City hired a Municipal Arborist in 2016. The Municipal Arborist provides professional management in the effort of sustaining and enhancing the urban forest for future generations.

The Municipal Arborist initiated two major projects in 2016 to better understand Hamilton's urban forest and to quantify the positive impact this municipal resource has on the community. The first was a Global Positioning System (GPS) Street Tree Inventory to determine the species, condition, diameter, and infrastructure concerns (such as wires, sidewalks, tree lawn size, and visibility) of every tree located within a public right-of-way, city golf course, or city park. The second project involved an analysis of the City's complete urban forest utilizing the GPS Street Tree Inventory data to facilitate benefit-cost modeling in order to identify structure, function, value, and maintenance needs. Using this information, a long-term preventive maintenance program was created and implemented for Hamilton's urban forest.

By quantifying the value provided by municipal trees and accounting for annual urban forest management expenditures, the net annual value of Hamilton's public trees was determined. This document presents the analysis and results of the benefit-cost study.

Introduction

One goal of the Municipal Arborist is to keep Hamilton's urban forestry program in the top ten percent in Ohio by enhancing the City's Street Tree Program. The Society of Municipal Arborists Annual Conference provides information on cutting edge research for urban forestry management. One of the research tools highlighted for urban forestry management was the i-Tree (Ver. 6.1.13) software application STREETS (www.itreetools.org) from the United States Department of Agriculture (USDA) Forest Service.

STREETS is a street tree management and analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, carbon dioxide reduction, stormwater control, and property value increases. It is an easy-to-use, computer-based program that allows any community to conduct and analyze its street tree inventory. Baseline data can be used to effectively manage the resource, develop policy, and set priorities. Using the street tree inventory data, STREETS software allows managers to evaluate current benefits, costs, and management needs.

The Municipal Arborist contacted the USDA Forest Service, Davey Tree Expert Company, and the Society of Municipal Arborists to determine the scope and size of the STREETS Project for the City of Hamilton in May 2016. The project required inventorying all city street and park trees. Rose Haverkos, City of Hamilton GIS Administrator, and Ken Carrier, City of Hamilton Senior GIS Specialist, were instrumental in the GIS data bundling and conversion process. Jim Kozak, Development Analyst with Davey Tree, and Eric Kuehler, Technology Transfer Specialist with the USDA Forest Service, provided additional support in the conversion process and assisted the Municipal Arborist in preparation and review of the STREETS final reports.

The STREETS Project will help the City of Hamilton better manage its urban forest by assisting in the development and justification of long-term, stable budgets that support a sustainable urban forest and maximize the community's benefits from this resource.

Hamilton's Street Tree Resource

The City of Hamilton manages 14,163 street, park, and golf course trees in public rights-of-way and City-owned green spaces. There are additional unmanaged trees located within rights-of-way, such as natural areas and privately planted trees. This urban forest resource analysis focused on the 14,163 managed trees.

The City has more than 144 distinct species of trees growing along streets, in parks, and in golf courses. The eight predominate species are pear (*Pyrus spp.,* 14%), silver maple (*Acer saccharinum*, 12.8%), sugar maple (*Acer saccharum*, 7.5%) sweetgum (*Liquidambar styraciflua*, 5.2%), red maple (*Acer rubrum*, 4.4%), white ash (*Fraxinus Americana*, 3.6%), northern hackberry (*Celtis occidentalis*, 3.2%) and red oak (*Quercus rubra*, 2.8%). This composition is of concern because silver maples are considered to be large, weak wooded trees. A large portion of the tree canopy will be lost with removal of silver maple trees in the future.

The age structure of Hamilton's trees approaches the ideal due to the large number of young trees. The City's trees are distributed as 44.5% young trees (<6 inches Diameter at Breast Height (DBH)), 21% established trees (6-12 inches DBH), 26.8% maturing trees (12-24 inches DBH), and 7.7% mature trees (>24 inches DBH).

A majority of Hamilton's city-managed trees are in good condition (58.31%), with 26.43% classified as fair, 10.89% in poor condition, and 4.37% are dead or dying. The urban forestry management plan is designed to manage the entire existing tree population to increase its lifespan and maintain the flow of benefits.

In Hamilton, the estimated street tree canopy covers only 269 acres, or 1.90% of the City's Total Land Area and 22.16% of the Total Street and Sidewalk Area (1,212 acres).

The total value to replace the City of Hamilton's city-managed trees with trees of similar size, species, and condition would cost approximately $16,375,426. The breakdown is $12,028,986 for street trees, $3,110,669 for park trees, and $1,235,771 for golf course trees.

Costs of Managing Hamilton's Street Trees

Before 2016, Hamilton's urban forestry program was administered by the Department of Public Works. Additionally, the former Parks & Recreation Division (now the Hamilton Parks Conservancy) and the Department of Public Utilities had an impact on the urban forest. Parks & Recreation trees were not actively managed unless the trees needed attention as the result of inclement weather. Hamilton Utilities pruned and/or removed trees around power lines, water lines, and for natural gas, water, and sewer projects.

The City of Hamilton hired a Municipal Arborist in January 2016 in an effort to better coordinate the management of the urban forest for public rights-of-way and City-owned green spaces. City departments, residents, and businesses can contact the Municipal Arborist for technical support on trees, as well as information on City policies and procedures pertaining to trees and landscaping.

The urban forestry budget is funded through the General Fund, Public Utilities, and grants. The City's 2016 tree-related expenditures totaled approximately $470,204, or 0.103% of the City's total 2016 municipal budget of $453 million. The street tree portion of $345,600 represents 73.5% of the 2016 tree-related expenditures; park tree expenditures were $89,339 or 19%, and golf course tree expenditures were $35,265 or 7.5%. The total expenditure per tree was approximately $33.20, while the total expenditure per capita was $7.55. Any unmanaged trees located within City-owned natural areas or any privately-owned planted trees which were pruned and/or removed for Public Utilities purposes were excluded from the urban forestry program cost analysis.

The City of Hamilton also strives to plant and maintain quality nursery stock that is critical to sustaining a healthy urban forest. On average, about 300 new street and park trees (2.0 to 2.5 inch DBH) are planted per year at an estimated total cost of $105,000, or 22.33% of the City's 2016 tree-related expenditures.

Routine maintenance, pruning, removal, irrigation, and storm debris clean-up dominated the City's 2016 tree-related expenditures, totaling approximately $275,994 or 58.70% of the urban forestry program budget.

Pest Management for insects and disease, such as the Japanese beetle, accounted for $1,000 or 0.21% of the City's 2016 tree-related expenditures. Japanese beetle populations cycle each year and defoliate deciduous trees such as linden, crab apple, plum, and cherry.

Administrative costs include the salaries of the Municipal Arborist and clerical staff, equipment supplies, training, site inspections, and service calls. Combined administrative costs totaled $87,210 or 18.55% for 2016.

Annual tree-related expenses, such as infrastructure repair related to tree-hardscape conflicts, were also captured. A total of 256 public trees were identified with sidewalk

conflicts or 1.8% of the total number of public trees in the City. The Municipal Arborist works with the Department of Public Works to resolve tree sidewalk conflicts and all identified locations will be addressed and completed over 8-10 years. Annual expenditures for tree liability claims amounts to less than $1,000.

2016 Arbor Day Tree Planting – Riverview Elementary School

Benefits of Hamilton's Street Trees

Street and park trees are important to Hamilton. Forests once covered an estimated 85% of Butler County prior to settlement. However, because Butler County is considered to have some of the best agricultural land in Ohio, today only 19% of the county is forested. Each tree in Hamilton helps conserve and reduce energy usage, improve air quality, reduce carbon dioxide (CO_2) levels, and mitigate stormwater runoff. Trees also provide a wealth of psychological, social, and economic benefits.

Calculations related to the benefits listed below can be found in the Appendix.

Energy Savings

The quantity of electricity and natural gas saved annually in Hamilton from both the shading and climate effects of trees equals 2,504.8 megawatt-hours (MWh) ($318,109) and 339,422.9 therms ($254,567), for a total annual savings of $572,677. This equates to a city-wide average of $40.43 per tree. Ward 1 South is estimated to contribute the most in annual electricity and natural gas savings at $215,854, and Ward 2 is estimated to contribute the least at $18,729.

Leaf surface area and canopy cover are the most important factors in the ability of an urban forest to produce benefits. The more canopy cover present in a given area of the city, the more benefits that area will create. Looking at the average city-managed energy savings on a per tree basis, Norway maple, honey locust, little leaf linden, sugar maple, and green ash are the greatest contributors compared to the rest of the urban forest tree population due to large stature and mature age.

Atmospheric Carbon Dioxide (CO_2) Reduction

Hamilton's urban forest resource directly reduces an estimated 2,823.8 tons of CO_2 from the air through storage in woody and foliar biomass, and indirectly reduces 2,100.7 tons of CO_2 through avoided power plant emissions. This atmospheric CO_2 reduction has a total value of $31,511.

Air Quality Improvement

Each year, 3.1 tons of nitrogen dioxide (NO_2), small particulate matter (PM10), ozone (O_3), and sulfur dioxide (SO_2) are intercepted or absorbed by city-managed trees, for a total value of $19,529.

Avoided Pollutants

The energy savings provided by trees also have the indirect benefit of reduced air pollution emissions of NO_2, PM10, volatile organic compounds (VOCs), and SO_2 that result from avoided energy production. Collectively, 13.3 tons of pollutants are avoided annually with an estimated total value of $74,354.

Stormwater Runoff Reduction

The City's sanitary sewer collection system experiences significant inflow and infiltration during large rain events. Rainfall interception by trees can help reduce the magnitude of this problem. Trees can serve as mini reservoirs, controlling runoff at the source. This is particularly important in Hamilton because of the significant quantity of impervious surfaces in such close proximity to the Great Miami River.

Healthy urban trees can reduce runoff and pollutant loads in receiving waters, such as the Great Miami River, in three primary ways. First, leaf and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and the onset of peak flows. Second, root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow. And third, tree canopies reduce soil erosion and surface transport by diminishing the impact of raindrops on barren soils surfaces.

Hamilton's city-managed trees intercept an estimated 24,116,295 gallons of stormwater annually, or an average of 1,703 gallons per tree per year. The total value to the City is $653,552 per year at an average benefit of $46.14 per managed tree. It is estimated that silver maples provide the most stormwater benefits, accounting for 26.3% of the annual benefit ($94.52 per tree). Other top-performing street tree species based on benefits per tree include hackberry ($64.29), sugar maple ($60.85), and northern red oak ($56.10). Primarily due to their small size, serviceberry trees' contribution is minimal, accounting for only 0.3% of the annual stormwater benefits ($0.93 per tree). Ward 1 South intercepts the most stormwater in the city at 9,061,727 gallons per year, accounting for 37.6% of the city's total stormwater benefits.

Additional Social and Economic Benefits

Trees provide additional values to the community such as aesthetic beauty in an urban landscape and wildlife habitat. They also serve to improve human health and foster a sense of calm and comfort. These additional social and economic values can be captured in property values.

The calculation of such benefits is tied to a tree's annual increase in leaf surface area. When a tree is actively growing, leaf surface area rapidly increases. At maturity, there may be no net increase in leaf surface area from year to year and thus no incremental annual aesthetic benefit for those years. A long-term tree planting program throughout the city would continue to increase trees' aesthetic benefits, as well as property values, in Hamilton.

The estimated total annual aesthetic benefit of the managed tree population in Hamilton is $184,507, or an average of $13.03 per tree per year. Tree species with the highest annual aesthetic benefits include white poplar ($34.53), honey locust ($33.18), and pin oak ($31.42). Some species rank high in social, economic, and other benefits due to their size and growth rates, but may not be desirable to plant for other reasons. For example, most silver maples are in fair to poor condition (67.6%) and a have low performance index rating (0.96%) because they are weak wooded and prone to storm damage. The safety risks associated with silver maples make this species undesirable as a street tree despite their high ranking benefits.

Management Recommendations

The City's urban forest provides benefits back to the community and is one of Hamilton's greatest assets. It has a dynamic legacy and its character will continue to change over the coming decades. This change will be impacted by improved management and increased investment. An ideal urban forestry program is one that routinely maintains trees from the day they are planted through maturity. **The City can achieve a sustainable urban forest and increase overall benefits to the community through stable annual funding. The current benefit-cost ratio estimates a 333% return on investment, meaning the City will realize annual benefits significantly greater than the cost to manage its trees.**

Removal

The urban environment is stressful on trees and the City's public trees will continue to decline and die as the stresses compromise their ability to thrive. Invasive pests such as emerald ash borer will also continue to have a major impact on Hamilton's trees.

One of the key elements to an urban forestry program is maintaining public safety. A total of 1,679 trees (11.85%) in public rights-of-way and green spaces were identified in 2016 as priority removal trees across the City of Hamilton. Each tree was inspected by the Municipal Arborist, who is an International Society of Arboriculture (ISA) Certified Arborist, to verify the need for removal. Removing any dead trees or trees in severe decline will minimize the overall potential for danger or harm caused by high-risk trees while also increasing the aesthetic beauty of the City's street trees.

An aggressive tree risk management program is critical to the overall health of the urban forest. The goal beginning in 2017 will be for external tree crews to remove about 335 trees per year. **In return, the priority removal tree program will significantly reduce property damage, power outages, and overtime costs to the City.**

Cyclical Pruning

The Hamilton Tree Advisory Board has aggressively planted 100 to 200 trees per year since 2004, resulting in a 13.5% increase in the total city tree population**. This has significantly increased the stocking level of city trees and the maintenance dollars required to maintain the urban forest. As trees continue to grow, pruning costs are also likely to rise as the time it takes to prune will increase.**

Trees pruned on a cyclical basis will take less time to prune, thereby improving the cost effectiveness of the City's pruning program. Although pruning frequency differs by species and location, a return frequency of about 5 to 8 years is usually sufficient for older trees. The City's external tree crews prune an estimated 1,700 to 1,800 trees per year. A cyclical

pruning program will allow the City to distribute pruning costs over time and is critical to annual budget planning.

Future Street Tree Identification Kiosk

New Tree Establishment

The City's tree planting goal is to increase canopy cover in order to conserve energy, reduce stormwater runoff, improve air quality and aesthetics, increase carbon storage and sequestration, and preserve wildlife habitat in the community. Many urban sites do not provide sufficient irrigation and/or nutrient needs for trees, especially required during a tree's establishment period. Successful care of young trees should involve staking, watering, mulching, pruning, and insect/disease prevention. Investing in a young tree care program will reduce future routine maintenance costs as the trees mature.

The average cost of a new 2 inch DBH, balled and burlapped tree in Hamilton is $35. Newly planted trees also require a minimum of 20 gallons of water per week from May 15 to November 15 each year for two years. **The City's total investment for each newly planted tree is $455. Assuming the City waters 300 trees per year, the total investment for new trees is $136,500 per year.**

Volunteers Planting Swamp White Oak Seedlings - Riverside Natural Area

Tree Diversity

The City's objective is to follow the 10-20-30 rule for diversity. The City will plant no more than 10% of any species, no more than 20% of any genus, and no more 30% of any family of trees. This is necessary to reduce the impact of any future invasive insect pests or new diseases that could harm Hamilton's urban forest.

Tree-Related Maintenance Activities

Some tree-related maintenance considerations include the conflict between trees and infrastructure. One goal is to reduce sidewalk repair expenditures by planting the right tree in the right place. The City does not plant trees in narrow growing spaces that would prevent trees from growing to maturity, nor does the City plant trees within the visibility triangle at street intersections. Tree planting decisions take into account street signs, business signs, and other visibility concerns.

Tree canopy/overhead utility conflicts are another major concern of any municipal forestry program. The City of Hamilton's Municipal Arborist manages the Public Utilities Line Clearance Program for the Electric Division, which involves the pruning and/or removal of any public or private tree that may interfere with electric service. In Hamilton, nearly 20% of

the city-managed canopy is within 10 feet of an overhead utility and thus subject to utility line clearance maintenance activities. Overhead utility line clearance requires a reduction in tree canopy and results in a significant reduction in leaf surface area, thereby limiting the overall benefits a tree is able to provide the community.

To minimize future maintenance costs and the negative impact to trees, the Municipal Arborist carefully selects tree species based on existing site conditions (visibility concerns, location of overhead and underground utilities, etc.) when planting new trees.

Utility Line Clearance Program

Conclusion

This analysis describes the valuation of the City of Hamilton's street tree resource to determine the environmental, social, and economic benefits provided to the City and its residents. The benefits reports included as part of this analysis were generated using the 100% GPS Street Tree Inventory, which provides accurate and updated data to plan, budget, and manage resources for the urban forestry program.

When evaluating the bottom line, Hamilton's trees are worth the reported and invested costs of management and operations. The 14,163 city-managed trees are a valuable asset, providing $16,375,426 in value to Hamilton's residents.

Canopy cover is the driving force behind the urban forest's ability to produce benefits for the community. As canopy cover increases, so do the benefits afforded by the leaf surface area. Hamilton's urban forest resource is vulnerable and must be proactively managed to sustain benefits, safety, and aesthetics in the short and long term. It is critical that the City continues to plant new trees throughout the public rights-of-way and City-owned green spaces.

Under the direction of the Municipal Arborist, Hamilton's urban forestry program aims to significantly reduce overtime costs in both the Utilities and Public Works Departments. By better managing City-owned trees, it also seeks to minimize the liability and claims due to property damage. Overall, these efforts will help the City maintain services to the public with reduced long-term operating costs.

The City strives to create an urban forestry program that is one of the elite programs in Ohio and the United States. The Municipal Arborist continues to pursue new technologies, the latest arboriculture training, and most recent research to bring the program to the next level.

Hamilton is a great city in which to work, live, and play, and street and park trees substantially improve the quality of life in the community. The magnitude of benefits and environmental services provided by trees offer a compelling argument for continued tree care and resource management.

Appendix

In 2016, the City of Hamilton initiated a new 100% GPS Street Tree Inventory. The inventory concentrated on public street trees; however, it also included park trees. In this analysis, park trees are termed unmanaged street trees. Hamilton's tree inventory data was collected by a Miami University intern and Davey Tree Resource Urban Foresters using TreeKeeper Software. The data was converted to US Forest Service i-Tree software called STREETS.

STREETS assesses tree population structure and the function of those trees, such as their role in building energy use, air pollution removal, stormwater interception, carbon dioxide removal, and property value increases. In order to analyze the economic benefits of Hamilton's street trees, STREETS assigned a dollar value to the annual resource functionality and compareed that to annual program expenditures. This analysis combined the results of the City's street tree inventory with benefit-cost modeling data to produce information regarding resource structure, resource function, and resource value to make resource management recommendations. For a detailed accounting of how STREETS handles tree sampling, tree growth modeling, replacement value, and the calculations of annual benefits, refer to the City of Minneapolis, Minnesota Municipal Tree Resource Analysis (McPherson et al., 2005) and the Midwest Community Tree Guide (McPherson et al., 2006).

STREETS regionalizes the tree benefit calculations of its output by incorporating detailed reference city project information for 17 climate zones across the United States. Hamilton falls within the Midwest Zone (Figure 1). Sample inventory data from Minneapolis, Minnesota represents the basis for the Midwest Reference City Project for the Midwest Community Tree Guidelines. The basis for the benefit modeling in this study compares the inventory data from Hamilton to the results of the Midwest Reference City Project to obtain an estimation of the annual benefits provided by Hamilton's urban forest resource.

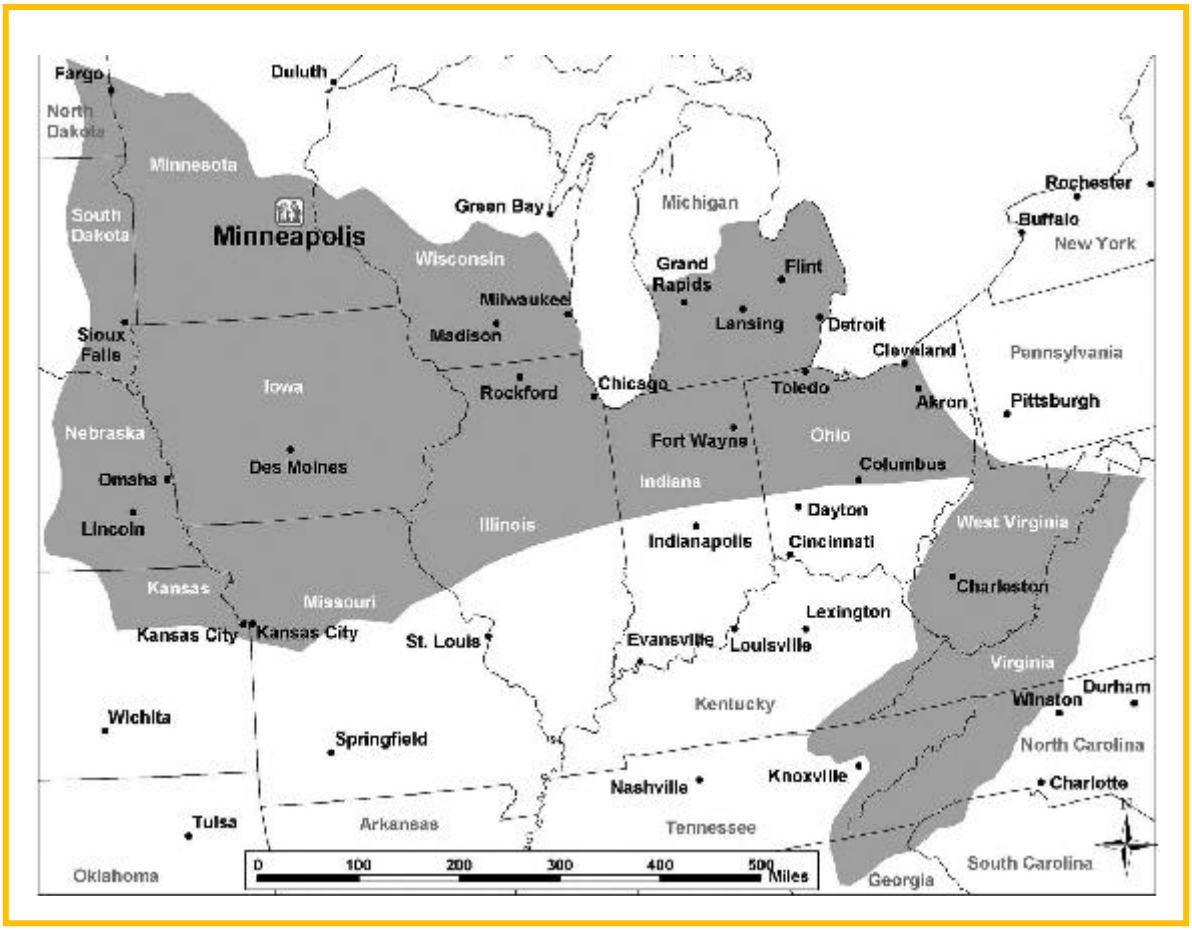

FIGURE 1. The Midwest Zone (shaded area) extends from Fargo, North Dakota to Kansas City, Missouri, and from Cleveland, Ohio through small communities in the Appalachian Mountains. Minneapolis, the reference city for the Midwest Zone, is highlighted.

Annual benefits for Hamilton's street trees were estimated for fiscal year 2016. Growth rate modeling information was used to perform computer-simulated growth of the existing sample tree population for one year and account for the associated annual benefits. This "snapshot" analysis assumed that no trees were added to, or removed from, the existing population during the year; however, calculations of CO_2 released due to decomposition of wood from removed trees did consider average annual mortality. This approach directly connects benefits with tree-size variables such as Diameter at Breast Height (DBH) and leaf surface area. Many benefits of trees are related to processes that involve interactions between leaves and the atmosphere (e.g., interception, transpiration, photosynthesis); therefore, benefits increase as tree canopy cover and leaf surface area increase.

For each of the modeled benefits, an annual resource unit was determined on a per tree basis. Resource units are measured as MWh of electricity saved per tree; MMBtu of natural gas conserved per tree; lbs of atmospheric CO_2 reduced per tree; lbs of NO_2, PM10, and VOCs reduced per tree; cubic feet of stormwater runoff reduced per tree; and square feet of leaf surface area added per tree to increase property values.

Prices were assigned to each resource unit using economic indicators of society's willingness to pay for the environmental benefits trees provide. Estimates of benefits are initial approximations as some benefits are difficult to quantify (e.g., impacts on psychological health, crime, and violence). In addition, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Therefore, this method of quantification provides first-order approximations. It is meant to be a general accounting of the benefits produced by urban trees – an accounting with an accepted degree of uncertainty that can, nonetheless, provide science-based platform for decision-making.

For a detailed description of how the default benefit prices are derived, refer to the City of Minneapolis, Minnesota Municipal Tree Resource Analysis (McPherson et al., 2005) and the Midwest Community Tree Guide (McPherson, et al. 2006). In order to further refine the estimation of cost saving benefits to Hamilton, certain benefit prices have been obtained specific for Hamilton (Table 1).

TABLE 1. Benefit prices used for the City of Hamilton in this analysis.

City of Hamilton Benefit Prices		
Benefit	**Price**	**Unit Source**
Electricity	$0.1270 / kWh	Hamilton Utilities
Natural Gas	$0.75 / Therms	Hamilton Utilities
CO_2	$0.0075 / lb	STRATUM default - Midwest
PM10	$2.84 / lb	STRATUM default - Midwest
NO_2	$3.34 / lb	STRATUM default - Midwest
SO_2	$2.06 / lb	STRATUM default - Midwest
VOC	$3.75 / lb	STRATUM default - Midwest
Stormwater Interception	$0.0271 / gallon	STRATUM default - Midwest
Average Home Resale Value	$70,500	City of Hamilton, Department of Strategy & Information

The local benefit prices for electricity ($0.1270/kWh) and natural gas ($7.5./Mcf; $0.750/Therms) were obtained from Hamilton Utilities in September 2016. STREET's default values from the Midwest climate zone were used for all additional benefit prices (air quality and stormwater), excluding average home resale value. The local average home

resale value ($125,000) was obtained from City of Hamilton in September 2016. Using these prices, the magnitude of the benefits provided by Hamilton's street tree resource was calculated using STREETS.

Wendi Van Buren, ODNR Urban Forester and Ann Coombs, Hamilton Tree Board & Tree Commission Academy Graduate

This report is based on the entire series of *Municipal Forest Resource Analysis* reports prepared and published by the USDA Forest Service, Pacific Southwest Research Station, and Center for Urban Forest Research. These reports are companions to the regional *Tree*

Guides and i–Tree's STREETS application developed by the USDA Forest Service, Pacific Southwest Research Station, Center for Urban Forest Research and can be found at http://fs.fed.us/psw/topics/urban_forestry/.

References

McPherson, Gregory E., James R. Simpson, Paula J. Peper, Scott E. Maco, Shelley L. Gardner, Shauna K. Cozad, and Qingfu Xiao. *City of Minneapolis, Minnesota Municipal Tree Resource Analysis*. Davis, CA: Center for Urban Forest Research USDA Forest Service, Pacific Southwest Research Station, 2005.

McPherson, Gregory E., James R. Simpson, Paula J. Peper, Scott E. Maco, Shelley L. Gardner, Shauna K. Cozad, and Qingfu Xiao. *Midwest Community Tree Guide: Benefits, Costs, and Strategic Planting*. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, 2006.