

2010

CITY OF MANITOWOC Park Tree Management Plan

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EXECUTIVE SUMMARY

The City of Manitowoc invested in the development of a park tree inventory, a park tree management plan, and a cost/benefit analysis of inventoried park trees with grant monies from the Wisconsin Department of Natural Resources. The inventory was conducted by Stratapoint Incorporated and the analysis and plan development was performed by registered consulting arborist, Logan Nelson.

Based on the recent inventory of Manitowoc park trees and an in-depth interview with Recreation and Parks Director, Joe McLafferty and Assistant Parks Director Randy Albright, the following data analysis summary indicates the potential strengths and weaknesses identified within the Manitowoc parks tree population that will be addressed throughout this plan:

INVENTORY SUMMARY

GENERAL INFORMATION

- Largest Manitowoc park is Lincoln Park (114.69 acres)
- Smallest Manitowoc park is Mariners Landing West (.09 acre)
- Total park land in Manitowoc that was inventoried is approximately 430 acres
- Total inventoried park tree canopy cover is 56 acres
- Total inventoried park tree population is 4,817
- Total inventoried park tree species population is approximately 103
- Dominant age class for inventoried park tree population is middle-aged (12-24 inches)
- Total inventoried park tree priority removals are 173
- Total inventoried park tree priority prunes are 29
- Amount of trees that will need to be replaced in order to maintain current population are 1,484
- Total annual net benefits (annual benefits minus annual costs) of current park tree population are \$409,526 (\$85.67 per tree and 11.83 per capita)

POTENTIAL STRENGTHS

- Manitowoc park(s) with the largest inventoried canopy cover is Lincoln Park (15 acres)
- Manitowoc park(s) with the most amount of inventoried trees are Lincoln Park (1172), Silver Creek (678), and Henry Schuette (560)
- Manitowoc park(s) with the largest inventoried amount of age diversity is Henry Schuette
- Manitowoc park(s) with the largest variety of inventoried species is Lincoln Park with approximately 37 species
- Manitowoc park(s) with the best overall percentage of inventoried species diversity (number of species that make up no more than 10% of the population) are Dewey St. Park, Red Arrow, and Lincoln Park
- Manitowoc park(s) with the least amount of inventoried ash are Burger Boat (0), Dale St. (0), and Manitowoc Shipbuilders(0)
- Manitowoc park(s) with the least inventoried amount of reliance on ash are the same as above
- Total amount of Manitowoc inventoried park trees in good condition is 18
- Manitowoc park(s) with the greatest inventoried amount of trees in good condition are the Municipal Athletic Baseball Field (6), Henry Schuette (6), and Manitowoc River Walkway (5)
- Most **viable** park(s) in Manitowoc are Lincoln Park, Henry Schuette, and Silver Creek
- Total annual benefits of the inventoried park tree population are worth \$435,366 (\$91.08 per tree and 12.58 per capita)

POTENTIAL WEAKNESSES

- Manitowoc park(s) with the least amount of inventoried canopy cover is Emma Radant Park
- Manitowoc park(s) with the least amount of inventoried trees are Mariners Landing West (2), Emma Radant (2)
- Manitowoc park(s) with the least inventoried amount of age diversity is Lincoln Park
- Manitowoc park(s) with the least variety of inventoried species are Emma Radant (1) and Mariners Landing West(1)
- Manitowoc park(s) with the least overall percentage of inventoried species diversity (number of species that make up more than 10% of the population) are Manitowoc Shipbuilders, South Lakefront, and Little Manitowoc
- Manitowoc park(s) with the most reliance on any one inventoried species are Emma Radant (100% eastern cottonwood), Mariner’s Landing West(100% honey locust), Municipal Athletic Baseball Field (85% arborvitae), Indian Creek (83% green ash), Fleetwood (82% green ash)
- Manitowoc park(s) in need of most canopy cover development are Emma Radant, Lakeview, and Indian Creek
- Manitowoc park(s) in need of the most inventoried priority removals and prunes are Lincoln Park, Red Arrow, and Indian Creek
- Estimated total costs for implementing a 10 year park tree management plan are \$817,500 (however these costs fall below the Midwest average cost per tree and capita)
- Total amount of Manitowoc inventoried park trees in poor condition is 293
- Manitowoc park(s) with most amount of inventoried trees in poor condition are Lincoln Park (87), Red Arrow (45), and Indian Creek (36)
- Total amount of ash trees within the inventoried park tree population is 1,311 (27.2% of park tree population)
- Manitowoc park(s) with the most amount of inventoried ash trees are Lincoln Park (314), Henry Schuette (212), and Silver Creek (191)
- Manitowoc park(s) with the most reliance on inventoried ash trees are Fleetwood (102 out of 124), Indian Creek (66 out of 80)
- Manitowoc park(s) most threatened by tree loss are Indian Creek, Fleetwood, and Lakeview
- Estimated annual loss in park tree benefits due to large inventoried ash population is \$119,012

SUMMARY OF NEEDS

Based on the inventory analysis, the following bulleted items outline what is necessary for Manitowoc to sustain and maintain the current inventoried park tree population.

- Development and implementation of a Manitowoc park tree or urban forest marketing plan that publicizes the quantified benefits of trees
- Development of regional community partnerships through shared marketing tools
- Begin pro-actively removing ash trees now – before trees need to be removed in reaction to the need for crisis maintenance
- Begin replacing removed trees with a variety of species to restore lost canopy cover and begin optimizing species diversity within each of the parks
- Reduce risk to citizens by removing and pruning high risk trees
- Reduce risk to citizens by removing stumps in accordance with Manitowoc’s current tree ordinance
- Reduce risk by properly training staff and updating equipment needs
- Reduce risk to citizens, staff, and trees by making routine tree inspections and needs assessments
- Protect benefits by establishing a routine maintenance pruning cycle

- Restore and increase benefits by removing and replacing ash with a focus on optimizing species diversification in the parks
- Reduce risk, protect, restore, and increase benefits by ensuring an adequate budget for sustaining the park tree population

SUMMARY OF GOALS AND OBJECTIVES

This management plan also identified goals and objectives for meeting the identified park tree needs that are accompanied by a ten-year action plan and the costs associated with those necessary management actions.

GOAL #1: REDUCE RISK ASSOCIATED WITH PARK TREES

- Objective A: Train staff and purchase adequate equipment
- Objective B: Remove and prune high-risk park trees
- Objective C: Grind stumps in accordance with Manitowoc's current tree ordinance
- Objective D: Inspect park trees on a routine basis

GOAL #2: INCREASE BENEFITS ASSOCIATED WITH PARK TREES

- Objective A: Remove ash trees
- Objective B: Replace trees
- Objective C: Prune trees for maintainability and sustainability
- Objective D: Develop park tree management policies and procedures
- Objective E: Develop marketing tools for advertising the benefits of trees
- Objective F: Develop adequate annual budgets for implementing the management plan and sustaining the park tree population

The following is a summary of action plan costs associated with achieving management plan goals and objectives:

STAFF TRAINING	\$ 30,000.00
EQUIPMENT PURCHASING	\$ 33,900.00
PRIORITY REMOVALS	\$ 36,330.00
PRIORITY PRUNING	\$ 6,090.00
ASH REMOVALS	\$ 248,010.00
STUMP REMOVALS	\$ 23,695.00
PLANTING	\$ 338,500.00
INSPECTION & NEEDS ASSESSMENT	\$ 9,824.50
MAINTENANCE PRUNING	\$ 59,150.00
BUDGET DEVELOPMENT	\$ 6,400.00
POLICY & PROCEDURE DEVELOPMENT	\$ 16,000.00
MARKETING	\$ 9,600.00
TOTAL (ROUNDED TO NEAREST TEN)	\$ 817,500.00

ANNUAL AVERAGE COSTS FOR TEN YEAR PLAN IMPLEMENTATION	\$ 81,750.00
ANNUAL COST PER TREE	\$ 16.97
ANNUAL COST PER CAPITA	\$ 2.46

Due to the high costs associated with removing and replacing ash, it should be recognized that this plan does not identify actions or include costs for stocking currently available planting sites and removals associated with average tree attrition rates.

COST/BENEFIT SUMMARY

The Cost/Benefit Analysis for Manitowoc park trees indicates that park tree benefits are far exceeding current and proposed park tree costs, exceeding average Midwest annual tree benefits, and are below the average Midwest annual tree costs.

- **Manitowoc annual inventoried park tree benefits = \$435,366 (\$91.08 per tree and \$12.58 per capita)**
- **Total park tree expenditures for 2008 were estimated at \$ 25,840 (\$ 5.41 per tree and \$.75 per capita)**
- **Manitowoc proposed annual park tree budget = \$81,750 (16.97 per tree and \$2.46 per capita)**
- **Midwest average of annual urban tree benefits = \$25 - \$55 per tree**
- **Midwest average of annual urban tree costs = \$336,465 (\$35 per tree and 8.73 per capita)**

INTRODUCTION

BACKGROUND INFORMATION

The City of Manitowoc, Wisconsin is located 80 miles north of Milwaukee and 38 miles south of Green Bay. Located along the shore of Lake Michigan, Manitowoc is comprised of approximately 18 square miles (11,520 acres), and home to approximately 33,169 residents (based on 2008 state records).

The defining natural features of the Manitowoc area are the five miles of Lake Michigan shoreline, and the Manitowoc River which flows through the central part of the City, dividing parts of town into north and south.

The name Manitowoc is derived from the Ojibwa and Chippewa word “Munedowk”, meaning “home of the great spirit” which, very early on, was applied to the Manitowoc harbor and river. The harbor had the reputation of being the best harbor on the Wisconsin shore of Lake Michigan.

Manitowoc was chartered as a village on March 6, 1851, and incorporated as a City on March 12, 1870. The first ship built in the area was the “Citizen” in 1847. Citizen Park was named after the schooner and is currently the administrative headquarters of the current parks department.

The Manitowoc Parks & Recreation Department consists of three divisions. The Parks Division maintains approximately 648.28 acres of parklands (37 parks), boulevards and waysides; operates the Lincoln Park; and serves as Manitowoc’s Forestry Division. The Recreation Division organizes, plans, and develops a diversified program of recreation activities for all ages, and operates and maintains the Municipal Pool and Red Arrow Beach. The Senior Center Division plans, organizes, and supervises all activities for the Senior Center.

The Manitowoc Parks & Recreation Department is committed to improving the quality of life for all Manitowoc's residents and visitors. This is accomplished by providing and promoting well maintained parks/facilities and public open spaces as well as offering a variety of lifelong recreational opportunities and special events for people of all ages.

Recognizing the important role that trees play in public parks and the responsibility necessary to maintain and sustain **tree canopy** within the parks, the City of Manitowoc, with financial assistance from the Wisconsin Department of Natural Resources, is investing in a professional park tree, **inventory**, management **plan**, and **cost/benefit analysis** to ensure adequate sustainability, and maintainability, and funding for the future.

BASIS FOR MANAGING URBAN FORESTS

The long life of urban trees and forests mandates planning with a view to future needs. Investments in the planting and maintaining of trees represent a long term commitment of scarce dollars, and improper tree planting and care can increase costs and reduce benefits. Therefore, it is important to do it right and plan for future management. The effectiveness of urban trees and forests in providing benefits to people depends on their species composition, diversity, age, condition, and location with respect to people and other elements in the landscape. An ecosystem approach that recognizes people as the central component offers the best means to assess the complex interactions between urban trees and forests and the well-being of urbanites, linking management actions with their effects on urban forests and the associated benefits and costs (Dwyer 1992).

By quantifying the current benefits received and costs incurred from the total tree population within an urban community, the need for sustaining **urban forests** becomes undeniably essential to urban planning, as they are considered integral to the sustainability of cities as a whole and an irresistible cost effective investment in a community's growth and development.

The definition of a sustainable urban forest, "*The naturally occurring and planted trees in cities which are managed to provide the inhabitants with a continuing level of economic, social, environmental and ecological benefits today and into the future,*" (Clark, Matheny, Cross, Wake 1997) is based on three principles:

- Communities must acknowledge that city trees provide a wide range of net benefits.
- Given the goal of maintaining net benefits over time, the regeneration of urban forests requires intervention and management by humans.
- Sustainable urban forests exist within defined geographic and political boundaries.

Given these three principles, a model of urban forest sustainability was published in the *Journal of Arboriculture* (Clark, Matheny, Cross, Wake 1997) that is founded on three components:

1. A strong community framework of support
2. A vegetation resource
3. Appropriate management of the resource

However, urban forest sustainability should be viewed in terms of a process rather than a goal for urban forest management; a process that is based upon a shared vision for the vegetative resource, in which goals and needs are balanced. Therefore, management plans for urban trees should embrace the framework necessary for urban forest sustainability through criteria that allows managers to quantify and analyze the community and administrative support, the tree resource, and the management practices for sustaining the tree resource.

The Wisconsin Department of Natural Resources (WDNR) created a model for developing urban forest management plans that embraces the framework for sustainability. This park tree management plan for the City of Manitowoc is adapted from both models.

STATEMENT OF PURPOSE AND SCOPE

The purpose of the Manitowoc Park Tree Management Plan is to recommend a ten-year management strategy and an action plan for park managers to follow in order to reduce risks and increase benefits associated with sustaining a viable park tree population.

The scope of this plan is based on the 2008/2009 park tree inventory data provided by Stratapoint Incorporated, and includes an assessment of Manitowoc's specific needs for managing park trees, a park tree management strategy with specific goals and objectives, an action plan for achieving the specified goals and objectives, a **STRATUM**-based cost/benefit analysis, an evaluation component for measuring success, and many attached resources for implementing this plan.

The Recreation and Parks Director, or his/her designee, in cooperation with City employees and Administration, will be responsible for implementation of the Manitowoc Park Tree Management Plan.

This document was funded in part by an urban forestry grant from the State of Wisconsin Department of Natural Resources Forestry Program as authorized under s. 23.097, Wis. Stat. and is a component of Grant Project #UF882-08.

LIMITING CONDITIONS AND ASSUMPTIONS

I was not hired to physically visit the park sites in the City of Manitowoc. This management plan and cost/benefit analysis for the inventoried park trees in Manitowoc were developed based on the assumption that the inventory data and background information supplied to me are accurate within a reasonable degree of certainty. Additional conditions and assumptions are listed upon the conclusion of this document.

SECTION ONE: COMMUNITY AND ADMINISTRATIVE SUPPORT

Understanding the current status of community and administrative support for city green spaces allows managers to identify needs for meeting the criteria for sustaining viable and valuable green spaces. Therefore, this section focuses on understanding criteria for acquiring community and administrative support, assessing what you currently have for city green space community and administrative support (based on a recent interview with the current Recreation and Parks Director, Joe McLafferty, and Assistant Parks Director, Randy Albright), and analyzing what you will need to meet the sustainability criteria.

WHAT ARE THE CRITERIA OF PARK TREE SUSTAINABILITY FOR COMMUNITY AND ADMINISTRATIVE SUPPORT?

- 1. Public Agency Cooperation:** Insure all city departments operate with common goals and objectives. Departments such as parks, public works, fire, planning, school districts and utilities should operate with common goals and objectives regarding the city's trees. Achieving this cooperation requires involvement of the city council and city commissions.
- 2. Involvement of Large Private and Institutional Landholders:** Large private landholders embrace city wide goals and objectives through specific resource management plans. Private landholders own and manage most of the urban forest. Their interest in, and adherence to, resource management plans is most likely to result from a community-wide understanding and valuing of the urban forest. In all likelihood, their cooperation and involvement cannot be mandated.
- 3. Green Industry Cooperation:** The green industry operates with high professional standards and commits to city-wide goals and objectives. From commercial growers to garden centers and from landscape contractors to engineering professionals, the green industry has a tremendous impact on the health of a city's urban forest. The commitment of each segment of this industry to high professional standards and their support for city-wide goals and objectives is necessary to ensure appropriate planning and implementation.
- 4. Neighborhood Action:** At the neighborhood level, citizens understand and participate in greenspace management. Neighborhoods are the building blocks of cities. They are often the arena where individuals feel their actions can make the biggest difference in their quality of life.
- 5. Citizen-Government-Business Interaction:** All constituencies in the community interact for the benefit of the urban forest. Having public agencies, private landholders, the green industry and neighborhood groups all share the same vision of the city's urban forest is a crucial part of sustainability. This condition is not likely to result from legislation. It will only result from a shared understanding of green spaces to the community and commitment to dialogue and cooperation among the stakeholders.
- 6. General Awareness of Trees as a Community Resource:** The general public understands the value of trees to the community. Fundamental to the sustainability of a city's urban forest is the general public's understanding of the value of its trees. People who value trees elect officials who value trees. In turn, officials who value trees are more likely to require the agencies they oversee to maintain high standards for management and provide adequate funds for implementation.
- 7. Regional Cooperation:** Provide for cooperation and interaction among neighboring communities and regional groups. Urban forests do not recognize geographic boundaries. Linking city's efforts to those of neighboring communities allows for consideration and action on larger geographic and ecological issues (such as water quality, air quality, and controlling the spread of invasive pests and disease).

WHAT DO YOU CURRENTLY HAVE?

A good foundation for an urban forestry program has been established. Manitowoc has a Tree Commission, a tree ordinance, and has been recognized as a Tree City for 26 consecutive years. With a strong existing park system and recognition of trees as a valuable urban forest resource, Manitowoc continues to invest in urban forest sustainability.

Public Agency Cooperation: The Manitowoc Municipal Tree Commission contains eight members acting in an advisory roll for the Parks and Recreation Committee on Urban Forestry issues. Three members of the Commission are Ex-officio; Recreation and Parks Director, Assistant Parks Director, and the Associate City Engineer. The other five appointments to the Tree Commission are made by the Mayor, which includes one alderperson. The Manitowoc Parks and Recreation Committee ultimately makes decisions on urban forestry management.

However, Manitowoc does not have a designated forestry department or *city forester*. All urban forestry work is generally performed by the Parks staff under the direction of the Assistant Parks Director, with the exception of public utilities line clearance; which is directed by the Manitowoc Public Utilities and is contracted out on a four-year line clearance cycle.

Involvement of Large Private and Institutional Land Holders: The Parks Department has a strong and viable relationship with the Manitowoc School District. The annual Arbor Day Celebration is planned in cooperation with school involvement, and other tree planting initiatives often involve student participation. There are not many large private landowners within the City of Manitowoc, but the Parks Department, Tree Commission, and City Planners develop strong working relationships with developers.

Green Industry Cooperation: The Parks Department is very conscientious about out-sourcing tree-related work and purchasing trees from qualified and reputable sources. They have multiple sources for purchasing tree-related goods and services. Silver Creek Nursery and other regional private companies often support the Manitowoc Urban Forest through donations of trees and services.

Neighborhood Action: Manitowoc has a dependable source of active community volunteer groups that often support and assist with park tree-related activities. Such groups include: Friends of the Mariners Trail, Friends of the Park Inc., Friends of the Manitowoc Aquatic Center, Citizens of Skateboarding Inc., and the Lincoln Park Zoological Society.

Citizen-Government-Business Interaction: As demonstrated above, there is a good foundation for citizen and government interaction. However, a cooperative relationship for urban forest support from local businesses could perhaps be strengthened.

General Awareness of Trees as a Community Resource: While there exists a general understanding that “trees are good,” many community members from the residential, commercial business, and government constituencies are unaware of just how good trees are. As is the case in many communities, quantified benefits for understanding the value of an urban tree resource has not been known. Now that a cost/benefit analysis for Manitowoc’s park trees has been completed, awareness of tree benefits can be heightened and strengthened by publicizing the quantification of benefits.

Regional Cooperation: No tangible regional urban tree cooperative projects or partnerships are established at this time.

WHAT DO YOU NEED IN ORDER TO MEET SUSTAINABILITY CRITERIA?

The following discussion explores and highlights the areas of community and administrative support that need to be strengthened in order to sustain park tree benefits in the City of Manitowoc:

Worldwide, established business enterprises that take pride in the goods or services they provide, spend a significant amount of time and resources marketing their goods and/or services. Further, savvy business entrepreneurs spend a significant amount of time and energy marketing their goods/services/ideas to potential investors.

As demonstrated by the cost/benefit analysis of Midwest urban forests and Manitowoc's park tree cost/benefit analysis, tree canopy cover offers significant benefits and economic savings to citizens. Yet most citizens, business managers, and governmental decision-makers are unaware of the benefits and functional value that trees provide.

Marketing the goods and services provided by park and urban trees is essential to sustainability. A well-developed park tree or urban forest marketing plan creates the community, commercial business, and governmental cooperative and economic support needed to sustain the tree resource and management of the resource.

Manitowoc is in need of greater cooperation and economic support for sustaining and managing the park tree population. Some time and dollars need to be dedicated for planning and implementing a marketing plan for the goods and services (benefits) that park trees provide. Further, efforts should be made to develop a regional marketing plan to begin developing partnerships with other surrounding communities.

SUMMARY OF NEEDS

- Development and implementation of a Manitowoc park tree or urban forest marketing plan that publicizes the quantified benefits of trees
- Development of regional community partnerships through shared marketing tools

SECTION TWO: TREE RESOURCE

This section focuses on understanding criteria for sustaining your park tree resource, assessing what you currently have for a park tree resource (based on the inventory of the City of Manitowoc park trees performed by Stratapoint Incorporated of Rosemount, Minnesota during 2008 and 2009), and analyzing what you will need to meet the sustainability criteria.

WHAT ARE THE CRITERIA OF PARK TREE SUSTAINABILITY FOR A PARK TREE RESOURCE?

1. **Canopy Cover:** Achieve climate-appropriate tree cover within the parks. Though the ideal amount of canopy cover will vary by climate and region (and perhaps by location within the community, there is an optimal degree of cover for every city). In general, a recommendation from the U.S. Forest Service suggests that urban forests east of the Mississippi should try to plan, plant, and maintain for 40% canopy coverage of land within the city. The amount of land set aside as green space within a city should be taken into account for estimating a total canopy coverage percentage allocated to parks.
2. **Age Distribution:** Provide for uneven age distribution. A mix of young and mature trees is essential if canopy cover is to remain relatively constant over time. To insure sustainability, an on-going planting program should go hand in hand with the removal of senescent trees. Some level of tree inventory will make monitoring for this indicator easier.
3. **Species Diversity:** Provide for species diversity. Species diversity is an important element in the long-term health of urban forests. Experience with species-specific pests has shown the folly of depending upon one species. Unusual weather patterns and pests may take a heavy toll on trees in a city. It is often recommended that no more than 10% of a city's tree population consist of one species, no more than 20% consist of one genus, and no more than 30% of one family. This same recommendation is also good for park tree planning.
4. **Native Vegetation:** Preserve and manage regional biodiversity. Maintain the biological integrity of native remnant forests. Maintain wildlife corridors to and from the city. Where appropriate, preserving native trees in a community adds to the sustainability of the urban forest. Native trees are well-adapted to the climate and support native wildlife. Replanting with nursery stock grown from native stock is an alternative strategy. Planting non-native, invasive species can threaten the ability of native trees to regenerate in greenbelts and other remnant forests. Invasive species may require active control programs. This may be of significant importance in set-aside land that has not yet be developed for recreational park use.

WHAT DO YOU CURRENTLY HAVE?

TREE LOCATION INFORMATION: PARK CHARACTERISTICS, NAMES, AND ASSIGNED ZONES

In order to utilize the inventory data in the i-Tree STRATUM-based cost/benefit analysis, Manitowoc Parks have been divided into seven zones based on their characteristics. The following is a list describing the characteristics of each zone, park, and associated zone assignment.

However, it is important to recognize that some Manitowoc Parks have large tracts of woodlands, and inventorying trees within the woodland tracts were not part of the Stratapoint inventory assignment. It is estimated that approximately 430 acres of tree canopy was inventoried out of approximately 648.28 acres of park green space. Due to these special circumstances, comments below indicate where a complete inventory of trees was not attempted.

Zone #1 – Community Parks:

Area of diverse environmental quality; may include areas suited for intense recreational facilities such as: athletic complexes, large swimming pools; may be an area of natural quality for outdoor recreation, such as walking, viewing, sitting, picnicking; may be any combination of the above, depending upon site suitability and community

need. **Zone #1 consists of 1,335 inventoried trees within approximately 259 acres of park green space.** Manitowoc parks included in zone #1 include:

Camp Vits: located at South Parkview Road on Manitowoc's West side with 76.62 acres of currently undeveloped land there is a **total inventoried tree count of 17** within a mowed area of the park. (Complete inventory of trees was not attempted; approximately 66 acres of tree canopy was inventoried).

Henry Schuette Park: located at 3800 Broadway Street on Manitowoc's South side with 65.17 acres of park space there is a **total inventoried tree count of 560**. (Complete inventory of trees was not attempted; approximately 22 acres of tree canopy was inventoried).

Indian Creek Park: located at 701 Albert Drive on Manitowoc's North side with 46.41 acres of currently undeveloped land there is a **total inventoried tree count of 80**. (Complete inventory of trees was not attempted; approximately 13 acres of tree canopy was inventoried).

Silver Creek Park: Arguably Manitowoc's finest park, Silver Creek is set on the shore of Lake Michigan located at 3001 South 10th Street on Manitowoc's South side. The park contains rolling topography and rural-like wooded picnic areas with over 50 picnic sites. Within the 71.74 acres of park space there is a **total inventoried tree count of 678**. (Complete inventory of trees was not attempted; approximately 20 acres of tree canopy was inventoried).

Zone #2 – Community Playfields:

Zone #2 consists of 778 inventoried trees within approximately 80 acres of park green space. Manitowoc parks included in zone #2 include:

Citizen Park: located at 930 North 18th Street on Manitowoc's North side. Citizen Park has something for almost every recreational interest. The building serves as the Parks & Recreation Department's main office facility. Within the 26.70 acres of park space there is a **total inventoried tree count of 162**.

Dewey Street Park: located at 1840 South 35th Street on Manitowoc's South side. Within the 26.51 acres of park space there is a **total inventoried tree count of 122**.

Municipal Athletic Baseball Field: located at 1921 South 23rd Street on Manitowoc's South side. Within the 7.16 acres of park space there is a **total inventoried tree count of 266**.

Red Arrow Park: located at 1931 South 9th Street on Manitowoc's South side. Within the 19.77 acres of park space there is a **total inventoried tree count of 228**.

Zone #3 – Neighborhood Parks;

Area for intense recreational activities such as field games, court games, crafts, skating, and picnicking; also for wading pool and playground apparatus. **Zone #3 consists of 479 inventoried trees within approximately 53 acres of park green space.** Manitowoc parks included in zone #3 include:

Emma Radandt Park: located at 2201 Flambeau Street. Within the 5.19 acres of park space there is a **total inventoried tree count of 2**.

Fleetwood Park: located at 1716 Fleetwood Drive on Manitowoc's North side. Within the 11.05 acres of park space there is a **total inventoried tree count of 124.**

Halversen Park: located at 3110 Mero Street on Manitowoc's South side. Within the 10.03 acres of park space there is a **total inventoried tree count of 74.**

Lakeview Park: located at 301 Huron Street on Manitowoc's North side. Within the 7.56 acres of park space there is a **total inventoried tree count of 33.**

Lincolnshire Park: located at 2032 Richmond Avenue on Manitowoc's North side. Within the 2.59 acres of park space there is a **total inventoried tree count of 2.**

Rheume Park: located at 1145 Fleetwood Drive on Manitowoc's North side. Within the 5.56 acres of park space there is a **total tree count of 49.**

Riverview Park: located at 708 North Water Street on Manitowoc's North side. Within the 2.68 acres of park space there is a **total tree count of 50.**

Washington Park: located at 1115 Washington Street on Manitowoc's South side and features the MetroStage. Within the 3.75 acres of park space there is a **total tree count of 107.**

Westfield Park: located at 1651 Wollmer Street on Manitowoc's South side. Within the 5.10 acres of park space there is a **total tree count of 38.**

Zone #4 – Neighborhood Playgrounds;

Zone #4 consists of 298 inventoried trees within approximately 23 acres of park green space. Manitowoc parks included in zone #4 include:

Pulaski Park: located at 1715 Columbus Street on Manitowoc's South side. Within the 3.14 acres of park space there is a **total inventoried tree count of 58.**

Riverview Drive Park: located at 514 Riverview Drive on Manitowoc's South side. Within the 15.75 acres of park space there is a **total inventoried tree count of 144.** (Complete inventory of trees was not attempted; approximately 5.7 acres of tree canopy was inventoried).

Union Park: located at 611 Park Street on Manitowoc's North side. Within the 3.71 acres of park space there is a **total inventoried tree count of 96.**

Zone #5 – Mini Parks;

Specialized facilities that serve a concentrated or limited population or specific group such as tots or senior citizens. **Zone #5 consists of 85 inventoried trees within approximately 9 acres of park green space.** Manitowoc parks included in zone #5 include:

Burger Boat Company Park: located at 821 South 8th Street on Manitowoc's South side. Within the .70 acre of park space there is a **total inventoried tree count of 44.**

Dale Street Park: located at 3520 Dale Street on Manitowoc's South side. Within the 2.17 acres of park space there is a **total inventoried tree count of 16.**

South 14th Street Parkland: located at 2344 South 14th Street on Manitowoc's South side. Within the 5.82 acres of park space there is a **total inventoried tree count of 0.**

Manitowoc Shipbuilders Company Park: located at 51 Maritime Drive on Manitowoc's North side. Within the .54 acre of park space there is a **total inventoried tree count of 23.**

Mariner's Landing West: located at 806 South 8th Street on Manitowoc's South side. Within the .09 acre of park space there is a **total inventoried tree count of 2.**

Zone #6 – Special Use Facilities:

Areas for specialized or single-purpose recreational activities such as: golf courses, nature centers, marina, zoos, conservatories, arboreta, display gardens, arenas, outdoor theaters, gun ranges, or downhill ski areas, or areas that preserve, maintain and interpret buildings, sites, and objects of archeological significance; also plazas or squares in or near commercial centers, boulevards, and parkways. **Zone #6 consists of 670 inventoried trees within approximately 97 acres of park green space.** Manitowoc parks included in zone #6 include:

Calumet Avenue Wayside Park: located at 2106 South 42nd Street on Manitowoc's South side. Within the 4.82 acres of park space there is a **total inventoried tree count of 70.**

Little Manitowoc River Walkway: located at 900 Maritime Drive on Manitowoc's North side. Within the 5.25 acres of park space there is a **total inventoried tree count of 13.**

Manitou Park and Conservancy: located at 2901 Michigan Avenue on Manitowoc's North side. Within the 25.33 acres of park space there is a **total inventoried tree count of 140.**

Manitowoc River Walkway: Within 2 acres (108,889 square feet) of park space there is a **total inventoried tree count of 66.**

Manitowoc Senior Center: located at 3330 Custer Street on Manitowoc's South side. Within the 3.64 acres of park space there is a **total inventoried tree count of 66.**

Manitowoc Small Boat Harbor: located at 425 Maritime Drive on Manitowoc's North side. Within the 22.41 acres of park space there is a **total inventoried tree count of 244.**

Memorial Drive Wayside Park: located at 1635 Memorial Drive. Within 7.51 acres of park space there is a **total inventoried tree count of 55.**

Riverheights Park: located at 1730 North Rapids Road on Manitowoc's North side. Within the 23.94 acres of park space there is a **total inventoried tree count of 0.**

South Lakefront Wayside: located at 1225 South Lakeview Drive on Manitowoc's South side. Within the 1.66 acres of park space there is a **total inventoried tree count of 16.**

Zone #7 – Lincoln Park:

Lincoln Park, located at 1215 North 8th St. on Manitowoc's North side, was given a separate and specific zone (#7) because of the large population of trees established in this park. **Zone #7 consists of 1,172 inventoried trees within the 114.69 acres of park green space.**

TREE POPULATION DATA

Within the inventory database a tree identification number has been assigned to every park tree identified in the Manitowoc parks. Each tree was also identified by assigning the proper *genus*, *species*, and trunk diameter measured at the standard height of 4.5 feet (DBH). In the Supporting Materials Section are summaries and analyses that allow us to understand Manitowoc park tree populations and the diversity among tree size, age, and species. Of significant importance is the following:

Parks

- 35 parks were inventoried
- Estimated total acres of inventoried park space equals approximately 430 acres
- Largest Manitowoc park is Lincoln Park (114.69 acres)
- Smallest Manitowoc park is Mariners Landing West (.09 acre)

Canopy Cover

- Total inventoried park tree population estimated within 35 inventoried parks is 4,817
- Manitowoc park(s) with the most inventoried amount of trees are Lincoln Park (1172), Silver Creek (678), and Henry Schuette (560)
- Manitowoc park(s) with the least inventoried amount of trees are Mariners Landing West(2), Emma Radant (2)
- Total inventoried park tree canopy cover is 56 acres
- Manitowoc park(s) with the least amount of inventoried canopy cover is Emma Radant Park
- The highest concentration of inventoried canopy coverage (15 acres) currently exists in Zone #7 (Lincoln Park)
- Lincoln Park consists of approximately 114.69 acres with 1,172 trees and represents 27.4% of the total inventoried park tree canopy cover.
- Lincoln Park is currently your best model for maximizing park tree canopy cover throughout Manitowoc

Age Distribution

- Dominant age class for total inventoried park tree population is middle-aged, and range in size from 12-24 inches in diameter
- Within this age range the three most dominant species include eastern red cedar (*Juniperus virginiana*), eastern cottonwood (*Populus deltoides*), and green ash (*Fraxinus pennsylvanica*).

- Manitowoc park(s) with the least inventoried amount of age diversity is Lincoln Park
- Manitowoc park(s) with the most inventoried amount of age diversity is Henry Schuette
- Henry Schuette Park is currently your best model for optimizing uneven tree age distribution in parks throughout Manitowoc

Species Diversity

- Total inventoried park tree species population is approximately 103
- Manitowoc park(s) with the largest variety of inventoried species is Lincoln Park with approximately 37 species
- Manitowoc park(s) with the least variety of inventoried species are Emma Radant (1) and Mariners Landing West(1)
- Manitowoc park(s) with the least overall percentage of inventoried species diversity (number of species that make up more than 10% of the population) are Manitowoc Shipbuilders, South Lakefront, and Little Manitowoc
- Manitowoc park(s) with the most reliance on any one inventoried species are Emma Radant (100% eastern cottonwood), Mariner's Landing West(100% honey locust), Municipal Athletic Baseball Field (85% arborvitae), Indian Creek (83% green ash), Fleetwood (82% green ash)
- Largest population of a single inventoried species (25.2%) is green ash which accounts for 1,212 of the total park tree population.
- Total amount of the genus ash (*Fraxinus*) within the inventoried park tree population is 1,311 (27.2% of park tree population)
- Manitowoc park(s) with the most amount of inventoried ash trees are Lincoln Park (314), Henry Schuette (212), and Silver Creek (191)
- Manitowoc park(s) with the most reliance on inventoried ash trees are Fleetwood (102 out of 124), Indian Creek (66 out of 80)
- Manitowoc park(s) with the least amount of inventoried ash are Burger Boat (0), Dale St. (0), and Manitowoc Shipbuilders(0)
- Manitowoc park(s) with the least amount of reliance on inventoried ash are the same as above
- Manitowoc park(s) with the best overall percentage of inventoried species diversity (number of species that make up no more than 10% of the population) are Dewey St. Park, Red Arrow, and Lincoln Park
- Red Arrow Park is currently your best model for optimizing species diversity in parks throughout Manitowoc

Native Vegetation

- Manitowoc native tree habitats include a native prairie at Manitowoc Prairie, a native woodlands at Camp Vits, and many native tree species throughout Lincoln Park. However, these native habitats were not assessed or analyzed for native tree species management or growth within the city parks.

WHAT DO YOU NEED IN ORDER TO MEET SUSTAINABILITY CRITERIA?

The following discussion explores and highlights the areas of park tree resource viability that need to be strengthened in order to sustain park tree benefits in the City of Manitowoc:

As demonstrated in the cost/benefit analysis of Manitowoc's park tree population, the larger the tree and the greater the tree population, the more benefits can be expected from tree canopy cover as a return on the investment.

The key to receiving large returns on investment dollars is to ensure tree establishment for new plantings and increase longevity rates for established trees.

The single-most effective way to receive the most benefits from investment dollars is a well-developed planting program based on recommended industry standards for:

- Site evaluation and species selection
- Obtaining quality nursery stock
- Proper handling, storing, and planting of trees
- Proper measures to ensure establishment

Based on the recent inventory of Manitowoc park trees, there is a significant reliance on ash trees (1,311 @ 27.2%) and a majority of parks failing to meet recommendations for no more than 10% of any one species.

However, after a 2000 inventory of the Manitowoc street tree population indicated a significant reliance on maple trees (*Acer spp.* 83% –of the street tree population is maple), the 2009 street tree inventory indicates that Manitowoc has been able to decrease this reliance on maple to less than fifty percent.

The following excerpts are taken from a tree diversity study published in *Arboriculture & Urban Forestry* by Michael Raupp, professor of entomology at the University of Maryland. The findings in this study are hauntingly similar to the alarming need for Manitowoc tree managers to continue to pay careful attention to diversifying tree populations in the city.

*The exotic pest that captured the attention of urban foresters and changed our thinking about the design of urban forests was Dutch elm disease (DED) caused by *Ophiostoma ulmi*. American elm has many attributes such as a magnificent habit, fast growth rate, tolerance to a wide range of soils and moisture conditions, and hardiness that made it a favored street tree. Elms were often planted in pure stands that lined the streets of many cities in the United States. DED was first reported in Europe in the 1920's as the agent killing millions of elm trees. It was introduced into the United States from Europe around 1930 in logs to be used for veneer. Since its introduction, it has killed millions of elm trees in the United States and throughout the world. The heavy use of elms in cities and huge costs associated with their removal stretched municipal budgets and left many city streets barren (Sinclair and Campana 1978).*

The DED disaster forced urban foresters to broaden the scope of factors considered when selecting trees for cities. Before this event, architectural features such as form, habit, color, and environmental tolerances to temperature, soil composition, and moisture regimes were the primary drivers in the plant selection process. More recently, the importance of increasing the diversity of tree species in urban forests has found its way into the plant selection process as a buffer against catastrophic losses resulting from pests (Grey and Deneke 1986; Miller 1997; Gerhold and Porter 2000).

One approach to help guide the planning process has been to set diversification goals or guidelines for urban forests. After DED, scientists began creating formulas to help guide the planning process... Santamour (1990) adopted a comprehensive strategy and suggested that urban forests could be protected from pest outbreaks if no more than 10% of a single species, 20% of a single genus, or 30% of a single family of plants were used.

However, a 2006 study included inventory surveys from nationwide cities to analyze whether urban forests were actually becoming diversified. One analysis demonstrated that maple and ash were each one of the top five established trees growing in U.S. cities, making up 48%-59% of urban tree populations. Another analysis demonstrated the average percentage of species being purchased for planting in U.S. cities, which indicated no change in the amount of maple being purchased by cities from 2000-2005, and an increase in the amount of ash being purchased by cities from 2000-2005. The results seem to indicate that many U.S. urban forests are still relying on only a handful of species for establishing canopy cover within their communities, and a heavy reliance on the genus maple and ash.

*In the last decade, two important and devastating insect pests have been introduced to North America, the Asian longhorned beetle, *Anoplophora glabripennis*, and the emerald ash borer, *Agrillus planipennis*. Both species are believed to be Asian in origin and were likely transported to this country as larvae in low-quality lumber used for crating and packing material. In recent years, Asian longhorned beetle populations have become established in several states, including New York, Illinois, New Jersey, and in Canada. Emerald ash borer was initially detected in the summer of 2002 in six counties in Michigan. Since then, detections have been made in more than 30 counties throughout the state. Several counties in Ohio, Illinois, and Indiana have reported infestations and nearby Ontario, Canada, has an infested area. In spring of 2003, the emerald ash borer arrived in Maryland with shipments of infested nursery stock from Michigan. (Since this article was published, EAB has been identified in seven Wisconsin counties, in 2008 and 2009, and is expected to spread rapidly throughout the state). These two species of wood-boring beetles share an ability to attack and kill seemingly healthy trees of most age classes in both urban and native forest stands (with the favored host for Asian longhorned beetle being maple and the favored host for emerald ash borer being ash).*

EAB was identified on the border of Ozaukee and Washington Counties in 2008. Manitowoc is located approximately 23 miles from the closest EAB quarantined county of Sheboygan. Of Manitowoc's current park tree population of 4,817, there are 1,311 ash trees, comprising 27.2% of the park tree population.

The pattern of ash destruction associated with this pest is well documented. While chemical treatment can be effective for preventing emerald ash borer infestations in ash trees, economic and environmental responsibilities lend themselves to managing a large ash tree population by removing ash and replacing them with a host of different tree species to optimize species diversity.

If management of this problem relies on chemical control, managers need to be prepared to treat trees annually for decades or longer. For Manitowoc's park tree ash population, the long-range costs of treatment will far surpass the costs associated with removal and replacement.

Further, the insecticides used for emerald ash borer also kill many beneficial insects needed to keep populations of our native problem pests at low-risk levels. For Manitowoc's park tree ash population, many other park trees may suffer from an ecological imbalance created by chronic use of insecticides on ash.

However, there may be a few significant ash trees that park managers may identify as worthy to committing to a treatment program. Chemical options for treating ash trees are discussed in the Supporting Materials Section.

Of primary importance, however, is recognizing that the time has come for urban forest managers to apply experience and knowledge to their purchasing and planting practices for diversifying valuable canopy covers. The urgency for Manitowoc to replace park ash trees with a variety of different species should be, and is, the primary focus of investment dollars for tree benefits within this management plan.

If Manitowoc chooses to wait for ash to decline after infestation occurs, the amount of dead and declining ash trees to remove will be unmanageable. Therefore, there is a need for park managers to begin the process of ash removal while removal costs can be balanced over a ten year period of time, making the replacement of ash trees a management focus rather than simply managing the removal of a large population of dead and dying trees.

SUMMARY OF NEEDS

- Begin pro-actively removing ash trees now – before trees need to be removed in reaction to the need for crisis maintenance
- Begin replacing removed trees with a variety of species to restore lost canopy cover and begin optimizing species diversity within each of the parks

SECTION THREE: TREE RESOURCE MANAGEMENT

This section focuses on understanding criteria for sustaining your park tree resource through management, assessing what you currently have for a park tree management, and analyzing what you will need to meet the sustainability criteria.

WHAT ARE THE CRITERIA OF PARK TREE SUSTAINABILITY FOR TREE RESOURCE MANAGEMENT?

1. **Park Tree Management Plan:** Develop and implement a management plan for park trees. A park tree management plan will add to an urban forest's sustainability by addressing important issues and creating a shared vision for the future of the community's green spaces. Elements may include: species and planting guidelines, performance goals and standards for tree care, requirements for new development (tree preservation and planning), and specifications for managing natural and open space areas.
2. **Citizen Safety:** Maximize public safety with respect to trees. In designing parks and other public spaces, public safety should be a key factor in placement, selection, and management of trees. Regular inspections for potential tree hazards are an important element in the management program.
3. **Assessment Tools:** Develop methods to collect information about the park trees on a routine basis. Using canopy cover assessment, tree inventories, aerial mapping, geographic information systems, risk assessment procedures, and other tools, it is possible to monitor trends in a city's green spaces resource over time.
4. **Standards for Tree Care:** Adopt and adhere to professional standards for tree care. Sustainability will be enhanced by adhering to the professional standards such as the Tree Pruning Guidelines (ISA) and ANSI Standards.

5. **Equipment and Staffing:** Gain access to necessary equipment and employ and train adequate staff to implement a park tree management plan. An urban forest's sustainability is increased when all city tree staff, utility and commercial tree workers and arborists are adequately trained. Continuing education in addition to initial minimum skills and/or certifications is desirable.
6. **Protection of Existing Trees:** Conserve existing resources, planted and natural, to ensure maximum function. Protection of existing trees and replacement of those that are removed is most often accomplished through policy vehicles. Ordinances that specify pruning standards and/or place restrictions on the removal of large or other types of trees during development are examples.
7. **Species and Site Selection:** Provide guidelines and specifications for species use on a context-defined basis. Providing good planting sites and appropriate trees to fill them is crucial to sustainability. Allowing adequate space for trees to grow and selecting trees that are compatible with the site will reduce the long-and short-term maintenance requirements and enhance their longevity.
8. **Recycling:** Create a closed system for tree waste. A sustainable urban forest is one that recycles its products by composting, reusing chips as mulch and/or fuel and using wood products as firewood and lumber.
9. **Funding:** Develop and maintain adequate funding to implement a park tree management plan. The average annual cost for tree care 20 years after planting ranges from \$27-\$36 per tree (depending on the size of the tree), with \$35 per tree being the average cost of most Midwest municipally-managed trees.
 - \$27 for a small tree
 - \$33 for a medium tree
 - \$36 for a large tree

Based on reports submitted to the National Arbor Day Foundation for Tree City, USA Certification, the average municipal urban forestry budgets and average per capita expenditure by population level as reported by 3,130 communities in 2006 indicates that a city-wide population of 30,000-49,999 has an annual urban forest budget of \$336,465, which equates to approximately \$8.73 per capita.

However, perhaps most important to recognize, is that the amount of funding available from both the public and private sector is often a reflection of the level of education and awareness within a community for the value of its green spaces.

WHAT DO YOU CURRENTLY HAVE?

Park Tree Management Plan: Manitowoc has recently made the investment in this park tree management plan, and is in the process of developing and adopting an EAB Response/Management Plan.

Citizen Safety: Manitowoc does not currently have an in-house *tree risk assessment plan* and procedure in place. However, during the data collection process of the inventory, the following were identified and documented within the inventory database to be high priority removals and prunes in an effort to increase citizen safety around park trees.

- Total inventoried park tree *priority removals* are 173
- Total inventoried park tree *priority prunes* are 29

- Manitowoc park(s) in need of most priority removals and prunes are Lincoln Park, Red Arrow, and Indian Creek

Assessment Tools: As mentioned above, Manitowoc does not have an in-house tree assessment program. However, during the data collection process of the inventory, park trees were assessed for their current condition. Within the inventory database a tree condition rating has been assigned to most park trees identified in the Manitowoc parks. The condition rating assignments indicate the current state of a tree's health, structural soundness, overall shape and relative growth rate. **Crown** developments, trunk condition, major branch structure, twig growth rate, disease, pests, and root condition all are considered. Symptoms of poor condition include extensive discoloration (leaf or stem), **decay**, **dieback**, decreased **internodal** length and/or disfigured or **necrotic** stems or roots. In general, the condition of each tree is recorded in one of the following categories adapted from the rating system established by the International Society of Arboriculture (ISA):

Good – The tree has no major structural problems; no significant damage due to diseases or pests; no significant mechanical damage; a full, balanced crown; and normal twig condition and elongation for the species.

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.

Poor – The tree appears unhealthy and 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, and severe crown dieback or poor vitality/failure to thrive.

Dead – Trees in an advanced state of decline are not included. This category refers only to dead trees.

In the Supporting Materials Section are summaries and analyses that allow us to understand the current structural and health condition of different park tree species and their locations within the Manitowoc parks. Of significant importance is the following:

- Within the 35 parks inventoried, a total of 293 inventoried trees are in poor condition with the majority of such trees (87 trees out of a total 1,172) located at Lincoln Park
- Most threatened Manitowoc park(s), due to an anticipated amount of inventoried removals, are Indian Creek, Fleetwood, and Lakeview
- Within the 35 parks inventoried, a total of 4,015 inventoried trees are in fair condition with the majority of such trees (561 trees out of a total 678) located at Silver Creek Park
- Within the 35 parks inventoried, a total of 18 inventoried trees are in good condition with the majority of such trees (6 out of a total 560) located at Henry Schuette Park and (6 out of a total 266) located at the Municipal Athletic Baseball Field
- Most viable park(s) in Manitowoc are Lincoln Park, Henry Schuette, and Silver Creek

For understanding future needs, it is also important to recognize where current environmental challenges may affect the future condition of trees. Of significant importance is the following:

- Within the 35 parks inventoried, a total of 15 inventoried trees are growing in a current conflict with overhead utility lines
- Within the 35 parks inventoried, a total of 72 inventoried trees are growing under power lines but are not in current conflict with those lines

- Within the 35 parks inventoried, a total of 1,311 inventoried ash trees (27.2% of total park tree population) are under serious threat of infestation and probable death from emerald ash borer

Standards for Tree Care: Manitowoc tree care providers already operate in adherence to the *American Standard for Safety in Tree Care Operations (ANSI Z133)* and the *American Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance Standard Practices (ANSI A300)*. There was also an adoption of Tree Planting Specifications provided by Ranger Services Inc. in the 2000 street tree management plan. And there is an EAB Response Plan currently being developed for the City of Manitowoc. However, there is no current Tree Health and Risk Assessment Plan.

Staffing and Equipment: Most tree care operations are performed in-house. However, no park staff are currently *certified arborists* at this time and there is not an in-house urban forester to supervise and train staff. Present equipment available for tree work includes bucket trucks, brush chippers, dump trucks, tractors, chainsaws and hand tools. All heavy equipment is currently in good condition. The City does not have a stump grinder for which there is a pending need.

Protection of Existing Trees: Manitowoc currently has a tree ordinance and is diligent about policing for infractions of the ordinance. However, as mentioned, there is not an in-house assessment program for documenting tree needs on a routine basis. Further, since efforts have been focused on street tree maintenance, minimal park tree maintenance pruning occurs.

Species and Site Selection: Inventory data reflects that many Manitowoc parks are struggling to meet optimized levels of tree species diversity. See Section Two and individual park data sheets.

Recycling: Manitowoc has an established program for woodchip and wood utilization for the current average amount of waste material being produced.

Park Tree Funding

Funding for the management of Manitowoc park trees is primarily provided through an allocation of dollars from an annual budget allotted for the Buildings and Grounds Parks Budget. However, additional dollars are sometimes sought after and acquired through the Wisconsin DNR Urban Forestry Grant Program. Of significant importance is the following:

- The 2008 budget allotment from the Buildings and Grounds Parks Budget for urban forest management is \$ 103,360 for an estimated inventoried total of 14,120 city owned/managed trees. (This equates to \$7.32 per tree and \$3.11 per capita)
- The 2008 funding allocated from the urban forest management budget to park tree management was \$25,840 for an estimated total of 4,817 inventoried park trees. (This equates to \$5.36 per tree and \$.78 per capita)

WHAT DO YOU NEED IN ORDER TO MEET SUSTAINABILITY CRITERIA?

The following discussion explores and highlights the areas of park tree resource management that need to be strengthened in order to sustain park tree benefits in the City of Manitowoc:

Park Tree Management Plan: The long life of urban trees and forests mandates planning with a view to future needs. Urban tree management plans foster the vision and actions necessary to sustain urban tree benefits. Manitowoc has taken the necessary steps for developing a park tree management plan.

Citizen Safety: The most critical objective for tree managers is to identify trees that pose a high risk to citizen safety and take necessary action to prevent harm to citizens. A high risk tree is any tree, or tree part, that demonstrates a high risk of failure or fractures which would result in damage or injury to people or property. Usually, high risk trees exemplify visible defects.

There are two distinct factors that contribute to an identified high risk tree: 1) a physical defect within a tree that increases its potential for failure; 2) the proximity of the tree to people or property that increases the likelihood of personal injury or property damage. For instance, an extensively decayed tree in the middle of a non-use native woodland has potential for failure, but the chance that the tree will cause personal injury is perhaps remote. However, that same tree located in Silver Creek Park may be considered high risk because of its proximity to citizen land use and frequency in which citizens visit Silver Creek Park.

The recent park tree inventory indicates that there is a total of 173 park trees that need to be removed and 29 trees that can be mitigated by pruning. While it is not clear that within the inventory database all of these trees are considered high-risk trees, it would be irresponsible to assume otherwise. Therefore, there is a current need for Manitowoc to remove 173 potentially high-risk trees and prune 29 potentially high risk trees as indicated in the inventory.

Further, stumps generated by tree removals pose a risk for tripping and falling, particularly in park settings. Reducing such risk requires stump removal. The estimated amount of stumps generated within this management plan is 1,484. Manitowoc will need to be mindful to address this situation in accordance with their current tree ordinance.

Assessment Tools: The always present objective to protect citizens from potentially high-risk trees, and to ensure longevity of park trees, requires routine inspections and risk assessments of the park tree population. There are three compelling reasons to implement a tree assessment program:

- By preventing and/or eliminating dangerous situations, public safety is enhanced.
- Tree assessment is a tool for prioritizing, scheduling, and budgeting needed work, allowing a greater degree of management efficiency and flexibility.
- By identifying and correcting structural defects and health problems that prevent failure and decline, tree longevity is enhanced.

However, arborists with the responsibility for tree inspections and assessing future needs to mitigate structural or health defects must be knowledgeable about tree biology, patterns of failure, diagnostic processes, site condition analysis, and related topics. This knowledge comes only with specialized training and experience.

Training programs can be developed in-house if a qualified trainer is on staff, through seminars conducted by specialized organizations, and/or contracted out to professional private consultants.

Manitowoc does not currently perform routine tree inspections and assessments for their park trees. Indeed, while collecting data for the recent tree inventory, quick inspections and assessments were performed, but collecting such information was not the primary goal for the inventory and so the assessments are not complete. Nor would this limited inventory assessment fulfill the need for routine inspections, as this management plan may not be updated for ten years.

There is a critical need for Manitowoc to implement a routine assessment program, with each park tree being inspected and assessed every three to five years (or more frequently upon identified needs). This can be achieved by training in-house staff and implementing a scheduled program or outsourcing the inspections and assessments to be completed by a trained consultant.

Standards for Tree Care Policies and procedures for park tree management allows for responsibilities and expectations to be well understood, effective training and planning to be implemented, and consistency of anticipated results when administrative or staff personnel and tree population changes over time.

Effective polices and procedures currently in effect for managing Manitowoc public trees at this time include:

- A tree ordinance
- Tree planting specifications
- ANSI Z133
- ANSI A300

With the pending threat to Manitowoc's large ash population, there is an immediate need for an **EAB management plan** to manage EAB-related specific details that this broader-in-scope management plan does not. At the time of this plan development, Manitowoc is currently developing an EAB Response/Management Plan to be adopted by the City. There is also a need for routine inspections and assessments of the park tree population. A plan and procedures should be developed for routine health and risk assessments. Developing this plan and procedures will assist with regular identification of park tree needs, protecting citizens from harm, protecting trees from early decline, preparation of tree maintenance schedules, preparation of planting schedules, budget development, and developing future management plans.

Staffing and Equipment: Properly trained staff is critical for ensuring safe work practices, managing liability, and sustaining health and longevity of the park tree resource. Currently, no park staff has a certified arborist designation. At least three Manitowoc park staff should be trained, preferably ISA certified, in safe work practices, tree risk assessment, proper pruning and removal techniques, proper planting techniques, and basic tree health diagnostics. For managing both the street tree population and the park tree population, hiring or designating a qualified park staff employee to assume the role of a full time urban forester would be extremely beneficial.

It is important to recognize that by certifying three staff, future costs for tree health and risk assessments, updating city-wide urban forest management plans, and hiring a full-time city forester could be significantly reduced. If efforts are made now to certify staff, such training could qualify your current staff to fulfill these needs that have historically been subcontracted out to more qualified professionals.

Adequate supplies and equipment is also essential for ensuring safe work practices, managing liability, and sustaining health and longevity of the park tree resource. However, if there is not enough need to justify purchasing adequate equipment to properly complete tree work, then the work should be outsourced to a subcontractor who has the necessary equipment and is properly trained to use the equipment.

Manitowoc has the necessary equipment to accomplish most tree work in the parks. However, small equipment (i.e. chainsaws and parts, rigging supplies, saw blades, etc.) will need to be replaced as needed. Further, given the amount of stumps estimated to be generated following ash removal, purchasing a stump grinder and grinding stumps in-house may prove to be more cost effective than outsourcing.

Protection of Existing Trees: A successful Urban Forestry program should strive to maximize the amount of scheduled routine pruning, thus lessening the need for crisis maintenance. Types of crisis maintenance that routine maintenance can prevent include: broken limbs, uprooted trees, trunk and branch failures, obstructed traffic signs, and citizen complaints. Further, studies suggest that the cost per unit of maintenance is generally twice as high with crisis management as it is with a routine scheduled approach (Technical Guide to Urban and Community Forestry 1993).

A routine scheduled approach to pruning is often referred to as a pruning cycle. The longer the pruning cycle (time between prunings) the greater the reduction in tree vigor, structure, benefits, and value may be. Indeed, extending the pruning cycle saves money by reducing annual pruning costs, but studies show that when pruning cycles go beyond six years, the loss in tree value exceeds savings. As a result, the optimum routine pruning cycles for urban trees has been suggested to be four to five years for trees over eight inches in diameter and two to three years for trees eight inches in diameter or less.

Because the Manitowoc parks department has primarily focused maintenance pruning efforts on the street tree population since 2000, park tree maintenance pruning has been minimal. In order to sustain the current park tree population, more effort needs to be made for routine pruning of park trees that are based on clear and recorded objectives.

Species and Site Selection: This need was discussed thoroughly in Section Two, but it is worth reiterating the urgent need for implementing a procedure for species selection that will optimize diversity in each park.

Recycling: This program is currently sufficient. But, Manitowoc's tree waste recycle program should be assessed to determine whether current operations can handle the large volume of ash removals anticipated.

Park Tree Funding: Park tree and community forestry programs succeed when there is strong political and public economic support. The key to getting such economic support is to have both the political and public groups understanding that trees have value and require managed care.

If the needs for managing park trees are not quantified and understood, it is difficult to create adequate budgets. Just as important, if the benefits of trees are not quantified and understood, it is difficult to justify the dollars needed to sustain and/or increase benefits.

Manitowoc has made a strategic and entrepreneurial step toward quantifying and understanding the costs and benefits associated with Manitowoc park trees. In so doing, you now know what you have, what you stand to lose in the near future, and what it will cost to regain and sustain your current benefits.

Current annual inventoried park tree benefits = \$435,366 (\$91.08 per tree and \$12.58 per capita)

Projected annual economic threat to inventoried park trees = \$119,012

Estimated future annual costs for sustaining current benefits = \$81,750 (equivalent to \$16.97 per tree and \$2.46 per capita)

Further, the cost/benefit analysis for Manitowoc park trees currently indicates that park tree benefits are currently far surpassing the amount of investment dollars necessary for maintaining and sustaining the benefits of Manitowoc park trees; and that Manitowoc's current investment in park trees falls below the average of Midwest municipally-managed trees:

- **Manitowoc annual park tree benefits = \$435,366 (\$91.08 per tree and \$12.58 per capita)**
- **Midwest average of annual urban tree benefits = \$25 - \$55 per tree**
- **Manitowoc projected annual park tree costs = \$ 81,750 (\$16.97 per tree and \$2.46 per capita)**
- **Midwest average of annual urban tree costs = \$336,465 (\$35 per tree and 8.73 per capita)**

Based on the threat of substantial loss of benefits to the inventoried park tree population, it is necessary to increase funding for sustaining and maintaining the current park tree population. Annual costs for urban trees in other Midwest cities exemplify that increased funding is obtainable.

SUMMARY OF NEEDS

- Reduce risk to citizens by removing and pruning high risk trees
- Reduce risk to citizens by removing stumps
- Reduce risk by properly training staff and updating equipment needs
- Reduce risk to citizens, staff, and trees by making routine tree inspections and needs assessments
- Protect benefits by establishing a routine maintenance pruning cycle
- Restore and increase benefits by removing and replacing ash with a focus on optimizing species diversification in the parks
- Reduce risk, protect, restore, and increase benefits by ensuring an adequate budget for sustaining the park tree population

SECTION FOUR: MANAGEMENT STRATEGY

HOW TO GET WHAT YOU NEED

Based on the needs identified in Section Three, a management strategy for meeting those needs has been developed by setting goals. Further, objectives have been identified to assist park tree managers and practitioners to achieve those goals. Finally, an action plan has been developed based on the identified goals and objectives. A commitment of support, dollars, and implementation for this management strategy is necessary to get what you need.

GOALS AND OBJECTIVES

GOAL #1: REDUCE RISK ASSOCIATED WITH PARK TREES

Objective A: Train staff and purchase adequate equipment

Objective B: Remove and prune high-risk park trees

Objective C: Grind stumps on a routine basis

Objective D: Inspect park trees on a routine basis

GOAL #2: INCREASE BENEFITS ASSOCIATED WITH PARK TREES

Objective A: Remove ash trees

Objective B: Replace trees

Objective C: Prune trees for maintainability and sustainability

Objective D: Develop park tree management policies and procedures

Objective E: Develop marketing tools for advertising the benefits of trees

Objective F: Develop adequate annual budgets for implementing the management plan and sustaining the park tree population

GOAL #1: REDUCE RISK ASSOCIATED WITH PARK TREES

We encounter risk throughout our daily lives; from the safety of our roads to the quality of the foods we eat to the recreation we enjoy. What is well within the tolerance of one person may be unacceptable to others. The variable nature of risk acceptance among public agencies, elected officials, and citizens often creates uncomfortable situations in which municipal arborists must act.

Risk management is the process by which an individual or agency assesses and monitors its risks and selects and implements measures to address those risks. The ultimate goal of risk management is to protect the health, safety, and well being of municipal staff and the public (Matheny and Clark 2007).

Integral to managing risk associated with trees is managing liability should a tree fail. The question of liability is of critical importance because society tends to equate management responsibility with negligence. There is a clear feeling that, "when I am in a city park, it should be safe to sit under a tree. And if a tree fails, then it is someone's fault."

There are four conditions that define the presence of negligence and degree of any associated liability:

- Duty – the obligation or responsibility to care for trees
- Breach of Duty – the failure to act in a reasonable manner
- Harm – physical damage or property injury
- Causality – the breach of duty caused the damage or injury

Municipal arborists are actively involved in the first two of these four conditions. In Wisconsin, municipal governments have a legal duty to exercise reasonable care to protect the general public from foreseeable harm. Thus, a park manager, urban forester, or municipal arborist who is responsible for a park trees with a hazardous condition has a duty to respond to the situation, like any manager of urban property does.

A breach of duty is the failure to act reasonably under the circumstances. The measuring stick against which acts are judged as reasonable is the standard of care. Standard of care is defined as, “that degree of care which a reasonably prudent person should exercise in the same or similar circumstances. If a person’s conduct falls below such a standard, he may be liable in damages for injuries or damages resulting from his conduct.” (Black 1990). In essence, the standard of care determines how the duty of care is measured (Dunster and Murray 1997).

The objectives below address Manitowoc’s need to address staff safety, public safety, and liability management. Therefore, achieving the following objectives will considerably reduce the identified risks currently associated with Manitowoc park trees.

Objective A: Train staff and purchase adequate equipment

There are currently no certified arborists on Manitowoc Park Staff. Staffing needs identified in Section Three can be fulfilled by encouraging and funding three park staff to become certified arborists through the International Society of Arboriculture (ISA) and becoming members of ISA’s Wisconsin Chapter – the Wisconsin Arborist Association (WAA) for continuing education. Continuing education credits are easily obtained by attending the various educational offerings such as the WAA Annual Conference, University of Wisconsin Extension Seminars, and WDNR Workshops.

While certification is not necessary to fulfill the need to keep park staff trained to operate in a safe and professional manner, it is being recommended for Manitowoc as a means to eventually reduce costs associated with future needs such as tree risk assessments, updated management plans, and a full time city forester.

Average annual costs for staff training were estimated based on certification costs, membership dues, and necessary certification continuing education credits for three park staff.

Please refer to the Supporting Materials Section concluding this management plan for more staff related information.

Equipment needs, also identified in Section Three, can be fulfilled by adequately budgeting for and purchasing small equipment as needed, and a 35-horse stump cutter.

The cost for a 35-horse self-propelled stump cutter (\$15,900) was estimated by averaging quotes from Vermeer, Rayco, and Brush Bandit. In order to further justify this purchase, an inventory of estimated stumps generated by street tree removals may be helpful.

Objective B: Remove and prune high-risk park trees

This management plan objective assists with meeting citizen safety needs for managing your park tree resource that were identified in Section Three.

At this time 173 park trees have been identified as priority removals and 29 park trees have been identified as priority prunes. Every effort should be made to remove these trees within the first two years of implementing this plan.

Within the Stratapoint inventory database, park trees requiring priority action have been identified. The following designations were used for prioritizing needed action to be taken.

Immediate: Trees designated as 'Immediate Removals' include dead trees or those having one or more defects that cannot be cost-effectively or practically remedied. These include; extensive trunk decay or severely decayed or weakened crotches where the potential for failure is very high. This category denotes trees, which represent an immediate risk of hazard to people or property.

High Priority: Trees in this category should be removed because they are dead or have serious structural defects. Such defects include extensive trunk decay or severely decayed or weakened crotches, or where the removal of limbs for hazard abatement would drastically impact the tree health and/or its visual usefulness. Trees may also be recommended for removal where crowding occurs, in order to increase growth space for more desirable trees.

Priority Pruning: Trees in this category require pruning to remove deadwood and/or broken branches that pose a potential risk to people or property. Trees in need of immediate priority pruning have broken, hanging, dead or otherwise potentially dangerous limbs greater than 4 inches in diameter. Priority pruning is recommended for trees with broken, hanging, dead or otherwise potentially dangerous limbs of over 2 inches but less than 4 inches in diameter that do not pose an immediate risk to people or property.

All pruning and removals should be done in adherence to the current revision of the *American Standard for Safety in Tree Care Operations (ANSI Z133)* and the *American Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance Standard Practices (ANSI A300)*. These standards can be found in the Supporting Materials Section of this management plan.

While average attrition rates of 1-2% of the park tree population can be expected, this management plan does not account for such removals, due to the high volume and costs of priority and ash removals anticipated.

Costs for 202 priority removal and prunes were estimated for a three-person crew to spend an average of two hours for each tree removal or prune (park tree settings do not usually require as much time to complete these tasks as do street trees), at a rate of \$35 per worker hour. While a three-person crew may not be required for such removals, enhanced safety and efficiency with a three-person crew allow for completing these removals within the recommended two-year period.

Objective C: Grind stumps on a routine basis

This management plan objective assists with meeting citizen safety needs for managing your park tree resource that were identified in Section Three.

After priority removals and ash removals are performed, an estimated 1,484 stumps will need to be eliminated. Whether Manitowoc chooses to continue outsourcing the duty of stump removal or begins to perform this duty in-house, operators should be properly trained in safety, care, and maintenance of the grinder.

If stumps cannot be ground immediately following removal, bright colored paint or barricades should be used to alert citizens of stumps in the park landscape.

Costs for 1,484 stump removals were estimated for a one-person in-house operator to spend an average of 30 minutes for each stump removed, at a rate of \$35 per worker hour.

Objective D: Inspect park trees and assess risk on a routine basis

This management plan objective assists directly with meeting the assessment tool need identified in Section Three, but indirectly addresses the need to protect existing park trees and to practice a standard of care.

During the inventory data collection process, information was gathered to offer condition ratings for each park tree inventoried. The definitions for such ratings were discussed in Section Three. However, as mentioned, this was a general and incomplete structural and health assessment of your park tree population.

It is highly recommended that you develop an in-house tree inspection and assessment program or outsource this duty to a qualified professional.

When outsourcing this duty, make sure that the qualified consultant is experienced and knowledgeable in:

- *A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas* by Clark and Matheny
- Tree biology, structure, patterns of failure, health, patterns of decline
- Site conditions such as soils, prevailing wind, climate, and recent history
- Key tree and site characteristics that may lead to failure or decline
- Risk assessment procedures and rating system
- Health assessment procedures and rating system

And that inspections will include observations of:

- Site conditions
- Root flare (and root system when deemed necessary)
- Trunk
- Branch structure
- Crown development
- Twig growth rate
- Foliage

This management plan was developed based on out-sourcing this duty for an estimated 3,333 park trees that will need to be inspected and assessed for risk and health on a routine basis, allowing the City time to develop an in-house program for implementation in a future management plan. Key components for developing a tree inspection and assessment program are listed under the Policy and Procedure Development Objective of the management plan and supporting resources for developing such a plan can be found in Supporting Materials.

Costs for routine tree inspections and assessments were based on one qualified arborist, spending an average of five minutes assessing each tree at \$35 per hour.

GOAL #2: INCREASE BENEFITS ASSOCIATED WITH PARK TREES

From small towns surrounded by cropland or forests to the large metropolitan cities of Chicago, Minneapolis, Kansas City and Cleveland, the Midwest Region contains a diverse assemblage of communities. With manufacturing, information technology, insurance and financial industries joining the economies of agriculture and livestock, the region is experiencing rapid change. The Midwest Region is home to approximately 50 million people. It is characterized by wooded states on the eastern side and former prairie lands mostly converted to corn, soy, and alfalfa fields on the western side. In the glacially sculpted landscape, lakes, streams, and wetlands are abundant. In many areas, forests at the interface of development continue to be an important component of the region's economic, physical, and social fabric. Community forests bring opportunity for economic renewal, combating development woes, and increasing the quality of life for community residents.

In the Midwest Region, urban forest canopies form living umbrellas. They remain distinctive features of the landscape that protect residents from the elements, clean the water they drink and the air they breathe, and form a living connection to earlier generations that planted and tended these trees. Lessons learned in the wake of Dutch elm disease that swept through the region and devastated large populations of American elms, and the current threat to large populations of ash trees from emerald ash borer suggest an urgency for diversifying the urban and community forest with increased citizen participation.

As many Midwest communities continue to grow during the next decade, sustaining healthy community forests becomes integral to the quality of life residents experience. The role of urban forests in enhancing the environment, increasing community attractiveness and livability, and fostering civic pride is taking on greater significance as communities strive to balance economic growth with environmental quality and social well-being. The simple act of planting trees provides opportunities to connect residents with nature and with each other. Neighborhood tree plantings and stewardship projects stimulate investment by local citizens, businesses, and government for the betterment of their communities.

Midwest communities can promote energy efficiency through tree planting and stewardship programs that strategically locate trees to save energy and minimize conflicts with urban infrastructure. The same trees can provide additional benefits by reducing stormwater runoff; improving local air, soil, and water quality; reducing atmospheric carbon dioxide; providing wildlife habitat; increasing property values; slowing traffic; enhancing community attractiveness and investment; and promoting human well-being.

The average annual net benefits (benefits minus costs) for Midwest trees is:

- \$3 to \$15 for a small tree
- \$4 to \$34 for a medium tree
- \$58 to \$76 for a large tree

Environmental benefits alone, such as energy savings, stormwater runoff reduction, and reduced air pollutant uptake, were three to five times greater than tree care costs for small, medium, and large trees.

The objectives below address Manitowoc's need to address the threat to park tree canopy cover associated with emerald ash borer, greater park tree age distribution and species diversity, formalizing policies and procedures that ensure park tree longevity, and creating community-wide appreciation and cooperation for a shared park tree management vision. Therefore, achieving the following objectives will aid in increasing the identified benefits currently associated with Manitowoc park trees.

Objective A: Remove ash trees (*Fraxinus spp*)

This management plan objective assists with meeting canopy cover and species diversity needs for protecting your park tree resource that were identified in Section Two.

There are a total of 1,311 ash trees within Manitowoc parks. The sooner managers meet the challenge of managing this large ash tree population, the sooner they can focus efforts on planning for future growth and diversity.

Years three through six of this plan focus on parks that have been identified as most threatened by emerald ash borer, due to the parks' heavy reliance on ash for any canopy cover. Years seven through ten focus on parks that have a large population of ash, but less reliance on ash for canopy cover.

As with all pruning and removal practices, ash removals should be done with adherence to ANSI Z133 and ANSI A300.

Costs for 1,311 ash tree removals were estimated for a three-person crew to spend an average of two hours to remove each tree, at a rate of \$35 per worker hour. While a three-person crew may not be required for such removals, enhanced safety and efficiency with a three-person crew allow for completing these removals within the recommended eight-year period.

Objective B: Replace trees

This management plan objective assists with meeting park tree resource needs, along with species and site selection needs identified in Sections Two and Three.

After removing priority trees and ash in Manitowoc parks, there will be an estimated 1,484 park trees to be replaced. While there are also an estimated 1,451 additional planting sites available, this management plan is only focusing on replacement planting due to the high costs associated with the large ash population to be replaced.

However, once replacement has been completed, a new management plan should focus on increasing the park tree cover and begin stocking for filling available planting sites.

A removal-replacement plan is extremely helpful for softening the public outcry against tree removal. It eases the public perception that community decision-makers and managers just want to remove trees, and allows for a better suited species to be planted in removal locations, resulting in a sustained community forest in each community park setting.

It is important to recognize that “replacement” does NOT mean putting the same tree back in the same location. Replacements should restore benefits lost with a tree of equal value. While the functional value of a 1.5” caliper basswood (*Tilia Americana*) will not be initially equal to the functional value of a 12” diameter ash, over time the basswood will deliver an equal amount of canopy cover and functional value as the ash. Further, while tree replacements should be installed at the same park that trees are being removed, replacements do not need to be installed in the exact same location within the park from which trees were removed. In fact, care should be taken not to plant trees where stumps were recently removed. Rather, trees should be replaced at least three to six feet away from recently removed stumps.

As mentioned in Section Three, there are key factors that need to be considered for ensuring establishment and longevity that are associated with tree planting. The following information addresses these necessary considerations and is accompanied by supporting materials at the conclusion of this plan.

For now, Manitowoc should plant trees in accordance with the tree planting specifications adopted in the 2000 street tree management plan. However, in the future Manitowoc may want to develop more comprehensive planting specifications. A model developed by Gary Watson at the Morton Arboretum in Chicago, and published by the ISA: *Principles and Practices of Planting Trees and Shrubs*, is offered in the Supporting Materials Section of this plan.

Further, Manitowoc should carefully select tree species that will promote park tree diversity. Examine inventory data and species benefit reports to understand current reliance on species in each park and try to develop park populations that consist of no more than 10% of any one species and 20% of any one genus. Obviously, for a currently unknown period of time, Manitowoc should refrain from planting any ash, and should only plant minimal amounts of maple.

Site Evaluation and Species Selection

A complete evaluation of the planting site needs to be completed before selecting a species to be planted. The following general information adapted from an ISA tree selection publication is instructive.

Tree Selection is one of the most important investment decisions a land owner/manager makes when making landscape improvements or replacing a tree lost to damage or disease. Considering that most trees have the potential to outlive the people who plant them, the impact of this decision is one that can influence a lifetime. Match the tree to the site, and both lives will benefit.

The question most frequently asked of tree care professionals is “Which kind of tree do you think I should plant?” Before this question can be answered, a number of factors need to be considered. Think about the following questions:

Why is the tree being planted? Do you want the tree to provide shade, fruit, or seasonal color, or act as a windbreak or screen? Maybe more than one reason?

What is the size and location of the planting site? Does the space lend itself to a large, medium, or small tree? Are there overhead or belowground wires or utilities in the vicinity? Do you need to consider clearance for sidewalks, patios, or driveways? Are there other trees in the area?

Which type of soil conditions exist? Is the soil deep, fertile, and well drained, or is it shallow, compacted, and infertile?

Tree Function:

Trees make our surroundings more pleasant. Properly placed and cared for, trees increase the value of our real estate. A large shade tree provides relief from summer's heat and, when properly placed, can reduce summer cooling costs. An ornamental tree provides beautiful flowers, leaves, bark, or fruit. Evergreens with dense, persistent leaves can be used to provide a windbreak or a screen for privacy. A tree that drops its leaves in the fall allows the sun to warm a house in the winter. A tree or shrub that produces fruit can provide food for the owner and/or attract birds and wildlife into the landscape. Street and park trees decrease the glare from pavement, reduce runoff, filter out pollutants, and add oxygen to the air we breathe. Street and park trees also improve the overall appearance and quality of life in a city or neighborhood.

Form and Size:

Frank Lloyd Wright, the famous architect, once made the comment, "form follows function." This is a good rule to remember when selecting a tree. Selecting the right form (shape) to complement the desired function (what you want the tree to do) can significantly reduce maintenance costs and increase the tree's value in the landscape. When making a selection about form, also consider mature tree size. Trees grow in a variety of sizes and shapes. They can vary in height from several inches to several hundred feet. Select a form and size that will fit the planting space provided.

Depending on your site restriction, you can choose from among hundreds of combinations of form and size. You may choose a small-spreading tree in a location with overhead utility lines. You may select a narrow, columnar form to provide a screen between two buildings. You may choose large, vase-shaped trees to create an arbor over a driveway or city street. You may even determine that the site just does not have enough space for a tree of any kind.

Site Conditions:

Selecting a tree that will thrive in a given set of site conditions is the key to long-term tree survival. The following is a list of the major site conditions to consider before selecting a tree for planting:

- Soil conditions
- Exposure to sun, wind and salt

- Human activity
- Drainage
- Space constraints
- Hardiness zone

Species Selection:

Now that your homework is done, you are ready to select a species for the planting site you have chosen. Diversity should play a major role in the selection process. Make sure you use the information you have gathered about your site conditions, and balance it with the decisions you make related to your current reliance on other species in each park (examine inventory data and species benefit reports to understand current reliance on species in each park and try to develop park populations that consist of no more than 10% of any one species and 20% of any one genus).

The species must be suitable for the geographic region (hardy), tolerant to the moisture and drainage conditions of your soil, be resistant to pests in your area, and have the right form and size for the site and function you have envisioned.

If you are having difficulty extrapolating information about your site conditions, contact a local ISA Certified Arborist, tree care professional or extension agent for assistance. Their assistance will help you to plant the right tree in the right place. It is better to get a professional involved in the selection process than to call one later to ask if you made the wrong decision.

Other helpful references for proper species selection are included in the Supporting Materials Section of this plan. In addition, the following resources are good investments for tree planting planners:

A Guide to Selecting Landscape Plants by E.R. Hasselkus (publication #A2865 available at U.W. Extension offices)

Principles and Practices of Planting Trees and Shrubs by Gary Watson (available for purchase through the ISA)

Trees and Shrubs for Northern Gardens by Leon Snyder (available for purchase at most bookstores)

Horticopia Professional by Ed Gilman and Robert Lyons (a species selection computer software program for species selection and stocking diversification available for purchase through the American Nursery Association)

Obtaining Quality Nursery Stock

The following general information adapted from an ISA tree purchasing publication is instructive.

When you buy a high-quality tree, plant it correctly, and treat it properly, you and your tree will benefit greatly in many ways for many years. When you buy a low-quality tree, you and your tree will have many costly problems even if you take great care in planting and maintenance.

What Determines Tree Quality?

A high-quality tree has

- Enough sound roots to support healthy growth.
- A trunk free of mechanical wounds and wounds from incorrect pruning.
- A strong form with well-spaced, firmly attached branches.

A low-quality tree has

- Crushed or circling roots in a small root ball or small container
- A trunk with wounds from mechanical impacts or incorrect pruning
- A weak form in which multiple stems squeeze against each other or branches squeeze against the trunk.

Any of these problems alone or in combination with the others will greatly reduce the tree's chances for a long, attractive, healthy, and productive life. When buying a tree, inspect it carefully to make certain it does not have problems with roots, injuries, or form. Remember the acronym RIF; it will help you remember to check the Roots, Injuries, and Form.

Root Problems:

Roots on trees for sale are available as one of three types:

- Bare root: no soil; usually available as small trees
- Root balled; roots in soil held in place by burlap or some other fabric; the root ball may be in a wire basket.
- Container grown; roots and soil in a container

Bare root stock: Bare roots should not be crushed or torn. The ends of the roots should be clean cut. If a few roots are crushed, re-cut them to remove the injured portions. Use sharp tools. Make straight cuts. Do not paint the ends. The cuts should be made immediately before planting and watering.

Root balled stock: You should be able to see the basal trunk flare. The flare is the spreading trunk base that connects with the roots. Root balls should be flat on top. Roots in soil in round bags often have many major woody roots cut or torn during the bagging process. Avoid trees with many crushed or torn roots.

The diameter of the root ball should be at least 10 to 12 times the diameter of the trunk as measured 6 inches above the trunk flare. Examine any roots that protrude from the soil. If many roots are obviously crushed or torn, the tree will have severe growth problems. If only a few roots are injured, cut away only the injured portions.

Container grown stock: Roots should not twist or circle in the container. Remove the root ball from the container. Inspect the exposed larger roots carefully to see whether they are twisting or turning in circles. Circling roots often girdle and kill other roots. If only a few roots are circling, cut them away with a sharp tool. The trunk flare should be obvious. Be on alert for trees planted too deeply in containers or trees buried in fabric bags. As with root-balled stock, you should be able to see the basal trunk flare with container grown plants.

Injuries:

Never buy a tree without thoroughly checking the trunk and branches for injuries. If the tree is wrapped, remove the wrap and inspect the trunk and branches for wounds, incorrect pruning cuts, canker injuries caused from disease, and boring insect injuries.

Form:

Good, strong form, or architecture, starts with branches evenly spaced along the trunk. The branches should have firm, strong attachments with the trunk.

Squeezed branches signal problems. Weak branch unions occur where the branch and trunk squeeze together. As the squeezing increases during diameter growth, dead spots or cracks often begin to form below where the branch is attached to the trunk. Once this problem starts, the weak branch attachment could lead to branches cracking or breaking during mild to moderate storms.

When several branches are on the same position on the trunk, the likelihood of weak attachments and cracks increases greatly. As the branches grow larger and tighter together, the chances for splitting increase. Avoid trees with two or more stems squeezing together.

Tree planting specifications for purchasing street trees, adopted by the City of Manitowoc in 2000, is also included in the Supporting Materials Section of this plan.

Proper Handling, Storing, and Planting of Trees

Proper planting techniques set the stage for a tree's overall health throughout its life. Most tree health problems are related to the condition of the root system, and planting trees too deep is a common mistake that predisposes a tree to an early death. The following general information adapted from an ISA tree planting publication is instructive.

Think of the tree you just purchased as a lifetime investment. How well your investment grows, depends on the type of tree and location you select for planting, the care you provide when the tree is planted, and follow-up care the tree receives after planting.

Planting the Tree:

The ideal time to plant trees and shrubs is during the dormant season – in the fall after leaf drop or early spring before budbreak. Weather conditions during these times are cool and allow plants to establish roots in the new location before spring rains and summer heat stimulate new top growth.

However, trees properly cared for in the nursery or garden center, and given the appropriate care during transport to prevent damage, can be planted throughout the growing season. In either situation, proper handling during planting is essential to ensure a healthy future for new trees and shrubs.

Whether the tree you are planting is balled and burlapped or is bare root, it is important to understand that its root system has been reduced by 90-95 percent of its original size during transplanting. As a result of the trauma caused by the digging process, trees commonly exhibit what is known as transplant shock. Transplant shock is indicated by slow growth and reduced vigor following transplanting. Proper site preparation before and during planting coupled with good follow-up care reduces the amount of time the plant experiences transplant shock and allows the tree to quickly establish in its new location. Carefully follow the following ten simple steps, and you can significantly reduce the stress placed on the plant at the time of planting.

1. **Call Diggers Hotline** – Before you begin planting your tree, be sure you have had all underground utilities located prior to digging.
2. **Identify the trunk flare.** The trunk flare is where the roots spread at the base of the tree. This is NOT the same as the swelling at the base where many trees are grafted. If the trunk flare is not partially visible, you may have to remove some soil from the top of the root ball. Find it so you can determine how deep the hole needs to be for proper planting.

3. **Dig a shallow, broad planting hole.** Make the hole wide, as much as three times the diameter of the root ball but only as deep as the root ball. It is important to make the hole wide because the roots on the newly establishing tree must push through surrounding soil in order to establish. On most planting sites in new developments, the existing soils have been compacted and are unsuitable for healthy root growth. Breaking up the soil in a large area around the tree provides the newly emerging roots room to expand into loose soil to hasten establishment.
4. **Place the tree at the proper height.** Before placing the tree in the hole, check to see that the hole has been dug to the proper depth – and no more. The majority of the roots on the newly planted tree will develop in the top 12 inches of soil. If the tree is planted too deep, new roots will have difficulty developing because of a lack of oxygen. It is better to plant the tree a little high, 1-2 inches above the base of the root flare, than to plant it at or below the original growing level.
5. **Remove root ball dressings.** Burlap, twine, and wire baskets should be cut away from the root ball. Do not leave any of these materials in the planting hole, as they too will hinder root growth and cause your tree to die prematurely.
6. **Straighten the tree in the hole.** Before you begin backfilling, have someone view the tree from several directions to confirm that the tree is straight. Once you begin backfilling, it is difficult to reposition the tree.
7. **Fill the hole gently but firmly.** Fill the hole about one-third full and gently but firmly pack the soil around the base of the root ball. Fill the remainder of the hole, taking care to firmly pack soil to eliminate air pockets that may cause roots to dry out. To avoid this problem, add the soil a few inches at a time and settle with water. Continue this process until the hole is filled and the tree is firmly planted. It is not recommended to apply fertilizer at the time of planting.
8. **Stake the tree, only if necessary.** If the tree is grown and dug properly in the nursery, staking for support will not be necessary in most landscape situations. Studies have shown that trees establish more quickly and develop stronger trunk and root systems if they are not staked at the time of planting. However, protective staking may be required on sites where lawn mover damage, vandalism, or windy conditions are concerns. But remember to remove support staking and ties after the first year of growth.
9. **Mulch the base of the tree.** Mulch is simply organic matter applied to the area at the base of the tree. It acts as a blanket to hold moisture, it moderates soil temperature extremes, and it reduces competition from grass and weeds. A 2-4 inch layer is ideal. When placing mulch, be sure that the actual trunk of the tree is not covered. A mulch-free area, 1-2 inches wide at the base of the tree, is sufficient to avoid moist bark conditions and prevent decay.
10. **Provide follow-up care.** Keep the soil moist but not soaked; overwatering causes leaves to turn yellow or fall off. Water trees at least once a week, barring rain, and more frequently during hot weather. When

the soil is dry below the surface of the mulch, it is time to water. Continue until mid-fall, tapering off for lower temperatures that require less frequent watering.

Other follow-up care may include minor pruning of branches damaged during the planting process. However, if possible, try not to prune any branches until after a full season of growth in the new location.

Additional supporting materials at the conclusion of this plan include an illustration of proper tree planting.

Ensuring Tree Establishment

Watering:

Every tree should be watered at the time of planting to settle the soil and to assure adequate soil moisture. Then watering should be continued throughout the growing season. Trees must be watered for two to three years after transplanting to provide adequate soil moisture while root systems are becoming established, longer for trees over four caliper inches. A newly planted tree is most easily watered if a raised ring of soil (approximately 4" high) is formed around the edge of the root ball to create a basin for water. The basin should be filled with six to eight gallons of water (4 gallons per caliper inch for trees over 3 caliper inches), twice each week during periods of hot, dry weather; once each week during cooler, wetter periods (Watson and Himelick 1997). Adding large quantities of water too frequently to heavy clay soils is detrimental and may result in death of the tree. Conversely, waiting to water until the tree wilts and the leaves start to turn brown is too late.

Leave the basin for watering the tree in place for two years before removing it. Applying two to four inches of wood chips or composted leaf mulch over the planting hole (inside and outside the basin soil ring) is greatly beneficial for water retention and other needs for tree establishment and longevity.

Mulching:

Mulches are materials placed over the soil surface to maintain moisture and improve soil conditions. Mulching is one of the most beneficial things a tree owner can do for the health of a tree. Mulch can reduce water loss from the soil, minimize weed competition, and improve soil structure. Properly applied, mulch can give landscapes a handsome, well-groomed appearance. Mulch must be applied properly; if it is too deep or if the wrong material is used, it can actually cause significant harm to trees and other landscape plants.

Benefits of Proper Mulching:

- Helps maintain soil moisture. Evaporation is reduced, and the need for watering can be minimized.

- Helps control weeds. A 2-4 inch layer of mulch will reduce the germination and growth of weeds.
- Mulch serves as nature's insulating blanket. Mulch keeps soils warmer in the winter and cooler in the summer.
- Many types of mulch can improve soil aeration, structure (aggregation of soil particles), and drainage over time.
- Some mulches can improve soil fertility.
- A layer of mulch can inhibit certain plant diseases.
- Mulching around trees helps facilitate maintenance and can reduce the likelihood of damage from weed whackers or the dreaded lawn mower.
- Mulch can give planting beds a uniform, well-cared for look.

Proper Mulching:

It is clear that the choice of mulch and the method of application can be important to the health of landscape plants. The following are some guidelines to use when applying mulch.

- Inspect plants and soil in the area to be mulched. Determine whether drainage is adequate. Determine whether there are plants that may be affected by the choice of mulch. Most commonly available mulches work well in most landscapes. Some plants may benefit from the use of slightly acidifying mulch such as pine bark.
- If mulch is already present, check the depth. Do not add mulch if there is a sufficient layer in place. Rake the old mulch to break up any matted layers and to refresh the appearance. Some landscape maintenance companies spray mulch with a water soluble, vegetable-based dye to improve the appearance.
- If mulch is piled against the stems or tree trunks, pull it back several inches so that the base of the trunk and the root crown are exposed.
- Organic mulches usually are preferred to inorganic materials due to their soil-enhancing properties. If organic mulch is used, it should be well aerated and, preferably, composted. Avoid sour-smelling mulch.
- Composted wood chips can make good mulch, especially when they contain a blend of leaves, bark, and wood. Fresh wood chips also may be used around established trees and shrubs. Avoid using composted wood chips that have been piled deeply without exposure to oxygen.
- For well-drained sites, apply a 2-4 inch layer of mulch. If there are drainage problems, a thinner layer should be used. Avoid placing mulch against the tree trunks. Place mulch out to the tree's drip line or beyond. REMEMBER: If the tree had a say in the matter, its entire root system would be mulched.

Problems Associated with Improper Mulching:

- Deep mulch can lead to excess moisture in the root zone, which can stress the plant and cause root rot.
- Piling mulch against the trunk or stems of plants can stress stem tissues and may lead to insect and disease problems.
- Some mulches, especially those containing cut grass, can affect soil pH. Continued use of certain mulches over long periods can lead to micronutrient deficiencies or toxicities.
- Mulch piled high against the trunks of young trees may create habitats for rodents that chew the bark and can girdle the trees.
- Thick blankets of fine mulch can become matted and may prevent the penetration of water and air. In addition, a thick layer of fine mulch can become like potting soil and may support weed growth.
- Anaerobic “sour” mulch may give off pungent odor, and the alcohols and organic acids that build up may be toxic to young plants.

Costs associated with replacing park trees are based on the average cost associated with purchasing a 2” caliper balled and burlapped tree through a Wisconsin regional vendor, plus labor for installation and aftercare, making the average installed cost per tree approximately \$250. However, trees purchased in higher quantities may be purchased through wholesale dealers at wholesale costs. In addition, bare root trees are often less expensive for the initial purchase, but limited windows of opportunity for digging and shipping bareroot trees can sometimes create scheduling challenges.

Objective C: Prune trees for maintainability and sustainability

This management plan objective assists with meeting protection of existing tree needs identified in Section Three.

It incorporates an eight-year pruning cycle (years 2-5) for all inventoried park trees that have not been scheduled for removal. There are an estimated 3,333 park trees that are in need of routine pruning.

However, as mentioned, it is important to recognize that routine pruning should be carried out based on clear and documented objectives. Such objectives might be one or more of the following:

- Train for structure and form (structural prune or training prune)
- Reduce risk of failure (combination of what is necessary)
- Provide clearance (raise)
- Reduce shade and wind resistance (thin and/or reduce)
- Maintain health (combination of what is necessary)
- Improve a view (vista prune)
- Improve aesthetics (crown clean or deadwooding or restoration prune)

These objectives and pruning types are discussed in ANSI A300 and the companion publication *Best Management Practices – Tree Pruning*. Of particular interest is that pruning early in a tree's life will have the greatest cost-benefit ratio than any other time in its life. Pruning for proper branch development and establishing clearance while a tree is small, significantly decreases future maintenance costs. Large trees which have not been maintained with routine structural training pruning practices often become candidates for removal at a younger age than those that receive regular pro-active maintenance prunes.

Also of particular importance for maintenance pruning in adherence to ANSI A300 is that no more than 25% of a tree's live crown should be removed in a single year. Energy reserves (starch, sugars, and oils) are stored in branches, stems, trunk, and roots. Excessive branch removal depletes these reserves and reduces the ability of the tree to photosynthesize more energy. Energy reserves can be preserved by removing the fewest number of live branches necessary to accomplish the desired objective.

Within the Sratapoint inventory database, inventoried park trees were assessed for current priority and maintenance pruning needs. Those that required some pruning at this time were given a maintenance pruning task that is currently desired. The following definitions will be helpful for understanding routine pruning needs for the current park tree population:

Routine Pruning: Trees receiving this rating include those trees, which would benefit from regular maintenance to limit the development of future problems or trees, which have problems that may become future risks if not corrected. This includes primarily large trees (over 20 feet in height) with minor amounts of deadwood and correctable structural problems. For conifers, routine pruning generally refers to raising (1-2ft) the crown to provide better clearance beneath the trees or the removal of broken or dead branches. This category also includes trees that may, already or without pruning, eventually interfere with the movement of citizens or where important visibility requirements are affected, such as playability or screening.

Cleaning/Deadwood: Cleaning refers to removing dead, dying, diseased and crossing branches. Thinning of the crown may be necessary for light and air circulation for turf health.

Training Pruning (TRP): This includes trees less than 20 feet in height with minor amounts of deadwood, that pose little or no threat of personal injury or property damage, and trees with correctable structural problems. This category also includes trees with growth patterns that will eventually obstruct or interfere with the movement of important visibility requirements are affected.

Raise Pruning: Raise pruning refers to taking the lower branches and removing them to raise the crown of the tree. Situations for raising the crown would be if there is interference with maintenance equipment or if it obstructs views.

As with priority pruning, maintenance pruning should be done in adherence to ANSI Z133 and A300. Pruning can be accomplished throughout the year other than during leaf development and leaf drop. However, to avoid an increase in tree susceptibility to Oak Wilt or Dutch Elm Disease, oaks and elms should only be pruned during the tree dormant season (November – April in the upper Midwest). Further, all maintenance pruning is often easiest to schedule, and very beneficial for trees if done during dormancy.

Costs for maintenance pruning were estimated for a two-person crew spending an average of fifteen minutes for pruning each tree, at a rate of \$35 per worker hour.

Objective D: Develop park tree management policies and procedures

This management plan objective assists with meeting many of the needs identified in Sections One, Two, and Three.

Park Administration, in collaboration with the Manitowoc Tree Commission, is strongly advised to develop an EAB Management Plan for the city's entire ash population and a Tree Health and Risk Assessment Program.

Key elements for developing an EAB Management Plan include:

- Purpose and Scope of Plan
- History – description and life cycle of EAB
- Public ash tree assessment (number, size, and condition of ash trees; associated removal, disposal, replacement, and treatment costs)
- Assessment of staff training and equipment needs for monitoring, removal and planting
- Process for incorporating EAB authority into community tree ordinances
- Ash management recommendations, preparations, or actions
- Staff hours, contract and equipment costs, and funding methods for all recommended plan elements
- Community outreach strategy

Supporting materials for developing an EAB Management Plan can be found at the conclusion of this park tree management plan.

Key elements for developing a Tree Health and Risk Assessment Program include:

- Policy statement
- Goals of the program
- Standard of Care Statement
- Determination of acceptable risk
- Training and qualifications of health and risk assessors
- Rating system for assessment
- Assessment procedures
- Frequency of assessments
- Management options based on assessed needs
- Record-keeping protocols
- Funding solutions
- Program evaluation

Supporting materials for developing Tree Health and Risk Assessment Program can also be found at the conclusion of this park tree plan.

Annual costs for policy and procedure development were estimated for one administrator to spend 40 hours annually at \$40 per hour.

Objective E: Develop marketing tools for advertising the benefits of trees

While this management plan objective directly assists with meeting community and administrative support needs identified in Section One, marketing the benefits of trees has an indirect effect on meeting needs for protecting and managing the park tree resource.

An estimated 24 hours have been included in the action plan for marketing park and other community trees. In cooperation with the tree commission, commercial businesses, schools, and volunteer support groups such as those listed in Section One, Park Administration should create a marketing scheme for urban trees.

See Supporting Materials for a list of publicity and marketing ideas, and an Urban and Community Forestry Appreciation Tool Kit. The toolkit includes:

- Publicity Brochure of the, "Top 10 Reasons We Need Trees"
- Sample letter to your local newspaper editor
- Sample Action Alert
- Tree Benefit Statistics Sheet
- Six articles for publishing in local news
- A website to download other materials, including a power-point presentation for marketing the benefits of community trees

Annual costs for developing marketing tools were estimated for one administrator to spend 24 hours annually at \$40 per hour.

Objective F: Develop adequate annual budgets for implementing the management plan and sustaining the park tree population

Developing adequate budgets assists with meeting community and administrative support needs, protecting, and managing the park tree resource.

Annual budgets should be based on annual needs assessments. These assessments should come from this management plan, and routine staff, equipment, and tree condition assessments. Substantiated cost estimates should be used for estimating annual budget needs, and quantified park tree benefits should be used to justify investment dollars needed to sustain the park tree population. Adequate time should be allotted for analyzing annual needs and substantiating estimated costs.

Supporting materials are provided for developing adequate budgets and exploring other funding ideas.

Annual costs for developing adequate park tree budgets were estimated for one administrator to spend 16 hours annually at \$40 per hour.

PLAN OF ACTION

The Action Plan, contained in the Supporting Materials Section, is a break-down of the actions and associated costs necessary for achieving the goals and objectives discussed in the Manitowoc Park Tree Management Plan in a five year time period.

Listed actions were prioritized from year one to year ten, with the first two year's priorities being removal and pruning of high risk trees, the third through sixth year focusing on ash removal and replacement in the most threatened Manitowoc parks, and the seventh through tenth year concentrating on ash removal and replacement in Manitowoc's more viable parks.

Further, a break-down of park data and management needs has been created for each park to use as a quick reference prior to working at various sites. However, the most updated and accurate data for individual trees in each park can be found in the Stratapoint inventory database.

SECTION FIVE: COST/BENEFIT ANALYSIS

BENEFITS ASSOCIATED WITH TREES

A park tree cost/benefit analysis was prepared using the i-Tree STRATUM model, which can be accessed using the i-Tree software program provided with this plan. Within the Cost/Benefit Analysis the park tree inventory was analyzed to estimate five annual benefits currently being provided by Manitowoc's park tree canopy cover. Each benefit is quantified in terms of resource units and a dollar value is assigned to the resource units. This allows Manitowoc Park Tree Managers to understand the *functional value* of the park trees derived from associated benefits being provided by the total population of park trees, the *importance values* for the most abundant species within the total population of park trees, and the *replacement values* associated with costs for replacing trees within the total park tree population.

DEFINITION OF VALUES

Functional Value – Five annual benefits are assessed in a STRATUM-based benefit analysis. Each benefit is quantified in terms of resource units and a dollar value is assigned to the resource unit. The dollar value of total resource units is often referred to as the Functional Value of an urban tree.

Importance Value – Within a STRATUM-based benefit analysis an Importance Value is displayed for all species that make up more than one percent of the population. The STRATUM Importance Value is the mean of three relative values (percent of total trees, percent of total leaf area, and percent of canopy cover). An Importance Value of 100 suggests total reliance on one tree species, whereas an Importance Value of 0 suggests no reliance. Importance Values are particularly meaningful to urban forest managers because they suggest a community's reliance on the functional benefits of particular tree species.

Replacement Value – Within a STRATUM-based benefit analysis Replacement Values are estimates of the full costs of replacing trees in their current condition, should they be removed for some reason. Species ratings,

replacement costs, and basic prices were obtained for each species in each reference city from regional appraisal guides. Because of the approximations used in these calculations, replacement values are first-order estimates for the population, and are not intended to be definitive on a tree-by-tree basis. Replacement Values can be meaningful to urban forest managers looking to establish a basis for fines associated with removing trees. However it is important to carefully define Replacement Value, based on this analysis, as an estimated depreciated reproduction cost.

In the Supporting Materials Section are analysis reports that allow us to understand the benefits and different types of values associated with overall park tree canopy cover in Manitowoc. Of significant importance is the following:

- **Annual Functional Value associated with the benefit of energy reduction is estimated at \$ 126,501**
- **Annual Functional Value associated with the benefit of carbon sequestration is estimated at \$ 15,613**
- **Annual Functional Value associated with the benefit of air quality control is estimated at \$ 18,896**
- **Annual Functional Value associated with the benefit of storm water uptake is estimated at \$ 140,054**
- **Annual Functional Value associated with aesthetic contribution is estimated at \$ 136,247**
- **Annual Functional Value associated with total park tree population is estimated at \$ 437,311 which is estimated to be an average functional value of \$ 90.78 per park tree**
- **The species of tree currently contributing the highest percentage of Importance Value derived from the benefits of park trees is green ash which is currently providing approximately 27.2% of the park tree population's canopy cover**
- **Total Replacement Value derived from depreciated costs for reproducing the current park tree population is estimated at \$ 3,703,820**

Saving Energy

Conserving energy by greening our cities is important because it is often more cost effective than building new power plants. In the Midwest region, there is ample opportunity to retrofit communities with more sustainable landscapes through strategic tree planting and stewardship of existing trees. Strategically located tree plantings could reduce annual heating and cooling costs by 20-25 percent for typical households. Trees modify climate and conserve building energy use in three principal ways:

- Shading reduces the amount of heat absorbed and stored by built surfaces.
- Evapotranspiration (ET) converts liquid water to water vapor and thus cools the air by using solar energy that would otherwise result in heating of the air.
- Wind speed reduction reduces the infiltration of outside air into interior spaces and reduces conductive heat loss, especially where conductivity is relatively high (e.g. glass windows) (Simpson 1998).

The benefit of energy savings is calculated by estimating the sum of energy savings due to reduced natural gas use in winter (measured in MBtu/tree/year) and reduced electricity use for air conditioning in summer (measured in kWh/tree/year).

Reducing Atmospheric Carbon Dioxide

Human activities, primarily fossil-fuel consumption, are adding greenhouse gases to the atmosphere, resulting in gradual temperature increases. This warming is expected to have a number of adverse effects. Melting polar ice caps are predicted to raise sea level by 6 to 37 inches. With 50 to 70 percent of the world's population living in coastal areas, the effects could be disastrous. Increasing frequency and duration of extreme weather events will tax emergency management resources. Some plants and animals may become extinct as habitat becomes restricted.

Urban forests have been recognized as important storage sites for carbon dioxide, the primary greenhouse gas. At the same time, private markets dedicated to economically reducing carbon dioxide emissions are emerging. Carbon credits are selling for \$.11 to \$20 per metric tonne (McPherson and Simpson 1999). As carbon reductions become accredited and prices rise, carbon credit markets could become monetary resources for community forestry programs.

Trees can reduce atmospheric carbon dioxide in two ways:

- Trees directly sequester carbon dioxide in their stems and leaves while they grow.
- Trees near buildings can reduce the demand for heating and air conditioning, thereby reducing emissions associated with power production.

The benefit of reducing atmospheric carbon dioxide is calculated by estimating the sum of decreased atmospheric carbon dioxide due to sequestration by trees and reduced emissions from power plants due to reduced energy use. The model accounts for carbon dioxide released as trees die and decompose and carbon dioxide released during the care and maintenance of trees.

Improving Air Quality

Approximately 159 million people live in areas where ozone concentrations violate federal air quality standards, and 100 million people live in areas where dust and other small particles exceed levels for healthy air. Air pollution is a serious health threat to many city dwellers, causing coughing, headaches, respiratory and heart diseases, and cancer. Impaired health results in increased social costs for medical care, greater absenteeism on the job, and reduces longevity.

Recently, the Environmental Protection Agency recognized tree planting as a measure for reducing ozone in State implementation plants. Air-quality-management districts have funded tree planting projects to control particulate matter. These policy decisions are creating new opportunities to plant and care for trees as a method for controlling air pollution (Luley and Bond 2002).

Urban forests provide four main air quality benefits:

- They absorb gaseous pollutants (e.g. ozone, nitrogen oxides, and sulfur dioxide) through leaf surfaces.
- They intercept particulate matter (e.g. dust, ash, pollen, smoke).
- They release oxygen through photosynthesis.
- They transpire water and shade surfaces, which lowers air temperatures, thereby reducing ozone levels.

The benefit of improving air quality is calculated by estimating the sum of air pollutants (O₃, NO₂, SO₂, PM₁₀) deposited on tree surfaces and reduced emissions from power plants (NO₂, PM₁₀, VOCs, SO₂) due to reduced electricity use (measured in pounds/tree/year) The model accounts for potential negative effects of trees on air quality due to BVOC emissions.

Reducing Stormwater Runoff and Improving Hydrology

Urban stormwater runoff is a major source of pollution entering wetlands, streams, lakes, and oceans. Healthy trees can reduce the amount of runoff and pollutants loading lakes and oceans. This is important because federal law requires states and localities to control nonpoint-source pollution, such as from pavements, buildings, and landscapes.

Trees are mini-reservoirs, controlling runoff at the source because their leaves, branches, and roots intercept and store rainfall, thereby reducing runoff volumes and erosion of watercourses, as well as delaying the onset of peak flows.

Trees reduce runoff in several ways:

- Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
- Roots increase the rate at which rainfall infiltrates soil and the capacity of soil to store water, thereby reducing overland flow.
- Tree canopies reduce soil erosion by diminishing the impact of raindrops on barren surfaces.
- Transpiration through tree leaves reduces soil moisture, increasing the soil's capacity to store rainfall.

The benefit of reducing stormwater runoff is calculated by estimating a measure of reduced annual stormwater runoff due to trees (measured in hundred cubic feet CCF/tree/year)

Aesthetic and Other Benefits

Trees provide a host of aesthetic, social, economic, and health benefits that should be included in any benefit analysis. One of the most frequently cited reasons that people plant trees is for beautification. Trees add color, texture, line, and form to the landscape. In this way, trees soften the hard geometry that dominates built environments.

Other benefits attributed to the aesthetic contribution of trees in urban interfaces include:

- Attractiveness of retail settings
- Increased property values
- Social and psychological benefits
- Human health benefits
- Noise reduction
- Wildlife habitat
- Jobs and environmental education

Aesthetic and other benefits are calculated by estimating a measure of the tangible and intangible benefits of trees reflected in increases in property values due to trees.

COSTS ASSOCIATED WITH TREES

Within the Cost/Benefit Analysis the park tree inventory and past annual expenditures were analyzed to estimate the costs associated with currently managing the total park tree population. The costs analyzed were estimates provided by Manitowoc's Recreation and Parks Director, and currently reflect average annual expenditures within the restraints of a budget. Therefore, it is important to recognize that budget-based expenditures may not reflect actual costs necessary to adequately sustain the current or recommended park tree population.

Costs that were considered within the cost analysis of Manitowoc's park tree population include:

- Planting
- Contract Pruning
- Pest Management
- Irrigation
- Removal
- Administration
- Tree Inspections
- Infrastructure Repairs
- Debris clean-up and disposal
- Liability claims

In the Supporting Materials Section are analysis reports that allow us to understand the costs associated with overall park tree canopy cover in Manitowoc. However, these estimates are based on the amount of dollars that were allocated to park tree management and maintenance in 2008, and do not reflect the annual proposed costs reflected in this ten-year plan. Of significant importance is the following:

- **Total park tree expenditures for 2008 were estimated at \$ 25,840 (\$ 5.41 per tree and \$.75 per capita)**

NET BENEFITS BASED ON ANNUAL BENEFITS AND COSTS

As mentioned, using the collected inventory data, benefits and costs were measured and analyzed in an i-Tree STRATUM model to estimate the net benefits (benefits minus costs) being provided by Manitowoc park trees. However, it is important to recognize that STRATUM is not intended to account to the penny for every benefit that trees produce. Reported benefits and costs are initial approximations as some benefits and costs are intangible or difficult to quantify (e.g., impacts on psychological health, crime, and violence). Also, 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). Further, tree growth and mortality rates are highly variable and benefits and costs depend on the specific conditions at the site (e.g., tree species, growing conditions, maintenance practices). Finally, as was mentioned previously, not all park trees were inventoried; as inventorying large tracts of woodland areas were not included in the Stratapoint inventory assignment.

Therefore, STRATUM provides a general accounting of the benefits urban trees produce and costs necessary to manage urban trees given limited knowledge of site-specific conditions – an accounting with an accepted degree of uncertainty that can nonetheless provide a platform on which urban forest management and funding decisions can be made.

In the Supporting Materials Section are analysis reports that allow us to understand the net benefits associated with overall park tree canopy cover in Manitowoc. Of significant importance is the following:

- **When dollar amounts reflecting annual costs are subtracted from dollar amounts reflecting functional value, total park tree net benefits are estimated at \$ 409,526 (\$87.67 per tree and \$11.83 per capita)**

SECTION SIX: EVALUATING SUCCESS

ARE YOU GETTING WHAT YOU NEED?

The most important tools you have for measuring success are routine updating of your inventory database and routine assessments of tree, staff, and equipment needs.

The most important tools you have for evaluating success are questions. The Tree Commission and City Council should be routinely asking for updates from the Parks Department to understand what is getting accomplished in the Manitowoc Park Tree Management Plan and how that is affecting park tree sustainability. The questions below are provided for routine monitoring of your success, and identifying challenges or weaknesses.

ARE YOU ACHIEVING GOALS AND OBJECTIVES?

GOAL #1: REDUCE RISK ASSOCIATED WITH PARK TREES

Objective A: Train staff and purchase adequate equipment

- How many staff are getting certified or receiving training this year?
- What are they getting trained in?
- What new equipment purchases were made this year? Is it adequate?

Objective B: Remove and prune high-risk park trees

- How many high risk trees have been removed and pruned this year?
- What is needed to make this happen in a time efficient manner?

Objective C: Grind stumps on a routine basis

- Are stumps getting ground shortly after removal?
- How many this year?

Objective D: Inspect park trees on a routine basis

- Are park trees getting routinely inspected to assess structural risk and health problems?
- Which parks and which trees have been assessed?
- What are the results?
- Is the average condition rating of park trees getting better over time?

GOAL #2: INCREASE BENEFITS ASSOCIATED WITH PARK TREES

Objective A: Remove ash trees

- How many ash trees have been removed this year?
- In which parks?

Objective B: Replace trees

- Are removed trees getting replaced in a timely manner?
- How many trees have been planted this year? In which parks?
- Are we optimizing diversity of tree species within the parks?
- How many different species have been utilized this year?

Objective C: Prune trees for maintainability and sustainability

- Is routine maintenance pruning occurring in the parks?
- How many young trees have been trained this year?
- Is there enough time being allotted annually for 3-5 year pruning cycles?

Objective D: Develop park tree management policies and procedures

- Has an EAB Management Plan been developed for all of the city's ash population?
- Will any ash trees be receiving annual chemical treatment to protect against EAB infestation?
- Does the EAB plan affect the Action Plan for park trees?
- Has a Tree Health and Risk Assessment Plan been developed?
- Have any new trees been identified with health or structural problems?
- Does this affect the Action Plan for park trees?

Objective E: Develop marketing tools for advertising the benefits of trees

- What tools are being used to publicize and market the benefits of park trees?
- Do any of them seem more effective than others? If so, how so?

- Have we extended these tools to include regional community partners?

Objective F: Develop adequate annual budgets for implementing the management plan and sustaining the park tree population

- Have we been able to accomplish actions in the Management Plan within the suggested time frame?
- If not, is this attributed to an insufficient amount of time, staff, funds, or all the above?
- How do you know this?
- What are the identified and substantiated needs and associated costs for the proposed budget this year?
- Based on the quantified benefits, what is the return on the dollar per tree and per capita?

COMMUNITY AND ADMINISTRATIVE SUPPORT

1. **Public Agency Cooperation:** Are all city departments operating with common goals and objectives?
2. **Involvement of Large Private and Institutional Land Holders:** Do you have large private land holders who have embraced city-wide goals and objectives through specific resource management plans?
3. **Green Industry Cooperation:** Are your green industry associates and contractors operating with high professional standards and commitment to city-wide goals and objectives?
4. **Neighborhood Action:** Are neighborhood citizens understanding of and participating in greenspace management?
5. **Citizen-Government-Business Interaction:** Are all constituencies in the community interacting for the benefit of greenspaces?
6. **General Awareness of Trees as a Community Resource:** Does the general public understand the value of greenspace to the community?
7. **Regional Cooperation:** Is there cooperation and interaction for sustaining greenspace among neighboring communities and regional groups?

TREE RESOURCE

1. **Canopy Cover:** Have you achieved a climate-appropriate degree of tree cover in the parks?
2. **Age Distribution of Trees in the Parks:** Are you providing for uneven age distribution of trees in the parks?
3. **Species Mix:** Are you providing for species diversity of trees in the parks?
4. **Native Vegetation:** Are you preserving and managing regional biodiversity? Are you maintaining the biological integrity of native remnant forests? Are you maintaining wildlife corridors to and from the city?

TREE RESOURCE MANAGEMENT

1. **Park Tree Management Plan:** Have you developed and implemented a management plan for trees and forests in the parks?
2. **Park Tree Funding:** Do you have adequate funding to implement and continue development of a park tree management plan?
3. **Staffing:** Do you have an adequate amount of trained staff to implement and continue development of a park tree management plan?
4. **Assessment Tools:** Have you developed methods/procedures for collecting information about park trees on a routine basis?

5. **Protection of Existing Trees:** Have you developed and enforced policies to conserve and ensure longevity of the existing park tree resource?
6. **Species and Site Selection:** Have you developed and followed guidelines and specifications for species use, including a mechanism for evaluating planting sites in the parks?
7. **Standards for Tree Care:** Have you adopted and adhere to professional standards for tree care?
8. **Citizen Safety:** Have you developed and implemented a risk management plan to maximize public safety with respect to trees?
9. **Recycling:** Have you created a closed system for tree waste (all tree material is getting recycled or used with no outside disposal)?

FUTURE PLANNING

As mentioned, this park tree management plan focuses on sustaining Manitowoc's current park tree benefits by managing a large population of park trees that need to be removed and replaced.

Future management plans should analyze and account for tree attrition rates and the costs associated with removals and replacements, along with stocking and planting in available sites.

Future planning should also consider the strengths and weaknesses of your ability to implement this management plan identified in your evaluation process, and identified needs associated with your routine inventory updates and tree assessments.

SUPPORTING MATERIALS

SECTION ONE – COMMUNITY AND ADMINISTRATIVE SUPPORT

- Article from the Journal of Arboriculture: *A Model of Urban Forest Sustainability*

SECTION TWO – TREE RESOURCE

- Park Tree Data
- Article from Arboriculture and Urban Forestry: *Street Tree Diversity in Eastern North America and Its Potential for Tree Loss to Exotic Borers*

SECTION THREE – TREE RESOURCE MANAGEMENT

- Park Tree Condition Data

SECTION FOUR – MANAGEMENT STRATEGY & ACTION PLAN

- ANSI Z133 and A300
- Species Selection Guides
- Tree Planting Illustration and Planting Specifications Model
- 2000 Street Tree Specifications for Manitowoc
- Tree Assessment Tools
- WDNR EAB Management Tools
- USDAFS Urban Forestry Appreciation Toolkit
- WDNR Staffing, Budget, and Funding Resources

ACTION PLAN

- Activity Schedules
- Individual Park Data & Management Needs Summary Sheets

SECTION FIVE – COST/BENEFIT ANALYSIS

- Benefits and Values Data
- Cost Data
- Net Benefits Data
- Article from the Journal of Arboriculture: *Assessing the Benefits and Costs of the Urban Forest*

OTHER

- Glossary of Management Plan Terminology
- Management Plan References
- General Conditions and Assumptions
- Disclosure Statement
- Certification of Professionalism