# REPORT ON A STREET TREE INVENTORY OF JANESVILLE, WISCONSIN, AUGUST 2009

## EXECUTIVE SUMMARY

In the fall of 2007 the Janesville Shade Tree Advisory Committee (J-STAC) completed a sample street tree inventory of the City of Janesville. This work was instigated by the lack of comprehensive knowledge and plans for the urban forest with regards to the approach of the emerald ash borer. One goal of the inventory was to determine the number of ash trees that might be killed by the borer when it does arrive in Janesville.

A second goal was to provide a 'snapshot' image of the urban forest in 2007, including its condition, value, species distribution and recommendations for planning work that needs to be done to improve the quality of Janesville's street trees.

The work was planned and accomplished with the help of a Wisconsin DNR Urban Forestry grant as well as educational support in the use of the inventory software and process. Members of J-STAC inventoried street trees on just over 18 miles of the City's 345 miles of streets for a 90% probability of statistical accuracy in the projected numbers.

We found that the City's urban forest contains an estimated 2,482 green ashes and 639 white ashes for a total of 3,121 ash trees that probably will be lost when the emerald ash borer arrives. This accounts for 12.5% of the urban forest. The total value of the ash resource in the city is $4,587,500 +/- 10% based on 2007 figures. Total cost for removal and replacement of the dead ash trees could be $2,209,540 +/- 10%.

Just as importantly, we discovered that the street tree population is dominated by silver and Norway maples (44% of the total). This is an extremely high percentage and could lead to a catastrophic failure should another insect or disease strike one (or both) of these two species. The rule used by the National Arboretum is that there should be no more than 10% of one species or 20% of one genus (e.g. maples). Our numbers far exceed this rule.

Cornell University researchers have done studies that place the average percentage of street tree stocking (number of trees as a percentage of possible planting sites) at 60%. Janesville falls below this number with trees planted in only 36% of possible sites. In order to reach the goal of 60% stocking, 16,500 more street trees need to be planted. This would provide additional benefits for many neighborhoods including a calculated $939,000 energy savings in heating fuel and cooling expense.

Clearly, greater diversification and increased planting rates will improve the quantity and quality of Janesville's urban forest. A municipal tree management plan that would address the emerald ash borer threat, storm damage readiness, and improved street tree planting plans is recommended.

# REPORT ON A STREET TREE INVENTORY OF JANESVILLE, WISCONSIN

## INFORMATION COLLECTED, COMPILED AND EVALUATED BY THE JANESVILLE SHADE TREE ADVISORY COMMITTEE

Inventory Completed Fall, 2007

Report Submitted August, 2009

# INTRODUCTION:

During 2005 the northern tier of eastern states was informed of some startling concerns in regards to the ash tree component of our forests, both urban and rural. A non-native insect had been imported into central Michigan, probably in pallet wood from northwest China. Unlike the Asian long-horned beetle that moved fairly slowly, it was found that this insect, now destroying thousands of acres of trees throughout the Midwest, travels very quickly covering many miles in a season and is easily transported by human activity. This insect, the emerald ash borer, attacks all of the ash species common to North America.

The Wisconsin Department of Natural Resources (DNR) has approximated the total ash population in Wisconsin's forests (not including urban areas) at around 787 million trees. This is a substantial component of our forests, providing oxygen, carbon dioxide sequestration, shade, wildlife habitat and a myriad of other benefits for the state.

There was not an easy or immediate method by which City of Janesville officials could predict how badly Janesville might be affected should the emerald ash borer be found in the City. How many ash trees are within the City? How many are on streets and will become dangerous due to the slow but steady advance of the borer? These questions were all on the minds of members of the Janesville Shade Tree Advisory Committee. We sought to provide, at a minimum, a statistically significant estimate of the number of ash trees in particular but also other important information relating to the urban forest.

# PREPARATION:

A grant from the DNR Urban Forestry 2007 grant program provided J-STAC with the ability to purchase important street tree inventory supplies and equipment such as identification manuals, diameter tape measures, rain proof writing supplies and clipboards. The DNR supplied hand held computer equipment for recording information and transferring it to computers for final tabulations and reports.

We determined, after a number of meetings with Jeff Roe, DNR South Central Region Urban Forestry Coordinator, that we would use a software package available called STRATUM (Street Tree Resource Analysis Tool for Urban Forest Managers). The STRATUM software is freely available from a cooperative effort by the US Forest Service, the Davey Tree Expert Co., the Society of Municipal Foresters and the National Arbor Day Foundation. The DNR provided several training sessions with J-STAC members to help make the process as accurate and functional as possible.

STRATUM is one part of the "i-Tree" software suite that provides a hand-held computer database for field application and U-FORE, a complete urban forest inventory program that allows users to catalogue each and every tree in a community. The US Forest Service has provided a tremendous amount of data and background information in the

program for application to specific zones and areas of the country. The list provided for Southern Wisconsin contained almost all of the species we encountered during the inventory.

Since this is only a Street Tree sample inventory it is wise to consider the implications for the entire city. Private and public lands not on streets were not included and therefore the findings of this inventory represent only a portion of the actual urban forest and its constituent trees. According to Jill Johnson of the US Forest Service Minneapolis office, a city may have as much as 90% of its urban forest in off-street locations. Janesville may very well fall into this category because of the large amount of public land within the city. This factor applies to the energy savings discussed here as well. This report deals only with street trees and not the large number of trees in parks, yards, conservation land, etc.

Since we are only discussing street trees, the total amount of ash tree destruction for the entire city could be as high as 10 times the number provided: 30,000 or more trees when the emerald ash borer arrives. The question of removals and disposal of such large quantities of wood becomes a very real issue that should be considered.

We used the City's ward and neighborhood assessment map to indicate the areas that we needed to survey. The City had 345 linear street miles at that time, and in order to achieve a 90% probability of accuracy we needed to inventory just over 18 street miles. Using the ward maps we selected streets within each of the seven wards and precincts at random (using the random number generator from Microsoft Excel) that would provide a random coverage of the City. We mapped out the various sections that needed to be inventoried and provided a map to highlight the areas to be covered. There are 56 different segments within the seven wards that were inventoried.

## PROCESS:

Members of J-STAC and some additional volunteers formed groups of two (or more) surveyors that walked each of the 56 segments previously selected. The surveyors used a hand held Personal Digital Assistant (PDA) with the software, called i-TREE, to collect data and assign numbers to each location along the sample segment. The PDAs were loaned to J-STAC by the DNR. Each inventory section was outlined on a map showing the specific length and location of each street segment to be inventoried. Both sides of each street selected were inventoried, as well as any boulevard islands contained within the street right-of-way. Each tree (or empty planting space) was assigned a unique number consisting of the ward number, section number and tree (or space) number being inventoried.

The total length of all street segments inventoried equaled 18.34 miles. This is 5.32% of all the city streets at the time using the 2007 street length measurement of 345 miles. The simple random sampling conventions provided by the STRATUM software indicates that this value is larger than the 5% sample required for a city with a population ranging anywhere from 50,000 to 150,000 persons. Therefore we have provided, at a minimum, a

10% standard error (meaning that it is 90% likely that the values provided are correct). With a 5.32% sample we have minimized that 10% error by one or two percentage points.

Spaces were determined as planting sites if the location on the terrace was not completely grown over due to trees on private property or adjoining trees on the terrace. Whenever possible a small tree was selected when a space existed, unless the overhanging branches of adjacent trees made a planting absolutely impossible.

Each tree was identified as to species and diameter at breast height (dbh) in inches. Condition factors such as cavities, dead branches, exposed roots, and overhead wires were also taken into account when considering the viability of a tree in its location. Potential planting sites were given ratings as to the size of a tree that could fit into the location.

This process was accomplished by volunteer members of J-STAC during the late summer and fall of 2007. The entire process of collecting the data took 189 hours to accomplish.

Processing the information and tabulating results has taken another 80 hours of correcting the database and providing basic information to the STRATUM program so it can tabulate the results and provide us with viable information to be used in the future.

This inventory gives City officials and citizens a 'snapshot' view of the urban forest to work from for future improvements. It is a singular look at the street tree conditions and inventory from the year 2007 that should help us make some basic judgments concerning future planning for our urban forest.

## DATA:

Attached in the Appendix is a compilation of the data collected during the inventory process. The important items that we want to convey to the Janesville public and administration are the characteristics we found, how they affect the city and how they can be improved.

The appendix includes a City of Janesville map that shows the areas that were surveyed, including the exact streets and boundaries as laid out per the City Assessor map. This shows equivalent, random areas that were surveyed in each of the seven City zones identified as 1 through 3 and 5 through 8.

The primary categories of data that we have collected are the population summary of public trees, available public planting spaces and the annual energy benefits of public trees. This discussion will provide the basic and more detailed information necessary to put the quantities of trees and their value to the community in perspective for our citizens and government officials.

POPULATION SUMMARY OF PUBLIC TREES:

A summary of the street tree population is included in the appendix where the information is reported by zones. The national average for the level of street tree stocking is 60%. This stocking percentage was calculated by researchers at Cornell University, a leading institution in urban forest study and planning. The following number of street trees was inventoried and extrapolated for the City of Janesville:

| | |
|---|---|
| Total No. of Tree Sites Inventoried: | 3,665 |
| Total No. of Tree Sites Statistically Calculated: | 68,902 |
| Total No. of Planted Sites Inventoried: | 1,321 |
| Total No. of Planted Sites Statistically Calculated: | 24,835 |
| Total No. of Unplanted Sites Inventoried: | 2,343 |
| Total No. of Unplanted Sites Statistically Calculated: | 44,048 |
| Number of Trees Required to Meet National Avg.: | **16,506** |

In order for Janesville to meet the national average for street tree stocking we need to plant 16, 506 more trees on our terraces and boulevards. This may be a large task but it is not unattainable and will provide annual energy savings, as well as other benefits, in the future.

BROADLEAF DECIDUOUS LARGE

The largest constituent of trees on our public terraces and boulevards are broadleaf deciduous trees that fall into the "Large" category. Large is defined as having the ability to grow larger than 50 feet in height. This group of trees constitutes the largest number and percentage on our city streets. We counted a total of 660 large trees in the inventory. The species distribution is defined on the summary page. Unfortunately there are a number of problems with the primary species found on our city streets.

The most common tree in the Large (Broadleaf Deciduous Large or BDL) category is the silver maple. This tree has numerous problems as a street tree as well as some huge benefits in terms of energy savings. Most common among the tree's problems are that it is easily damaged and frequently grows quite large, harboring structural problems. The largest of these trees on our terraces approach 90 feet in height and 60 inches in diameter. This is a huge tree that can present a danger for people and property in near proximity. This species frequently causes sidewalk and curb heaving due to surface roots growing to large diameters and disrupting the structures. On the other hand the cost savings in cooling and wind screening are tremendous.

The other most common Large trees found on the terrace are, in order of quantity found:

BROADLEAF DECIDUOUS LARGE TREES

| Species | Inventory Quantity | Projected Population |
|---|---|---|
| silver maple | 258 | 4,850 |
| green ash | 132 | 2,482 |
| sugar maple | 72 | 1,354 |
| red maple | 36 | 677 |
| white ash | 34 | 639 |
| quaking aspen | 15 | 282 |
| BDL other | 114 | 2,143 |
| | 661 | 12,427 |

This group of trees accounts for almost exactly 50% of the street trees inventoried. The green ash and white ash are at extreme risk of total destruction due to the spread of the emerald ash borer. (This was one of the reasons J-STAC decided to proceed with an inventory that would provide the City of Janesville with a statistically accurate number of trees that we can expect to lose when the ash borer gets to Janesville).

We inventoried 132 green ash trees and 34 white ash trees on the terraces. This is a total of 166 ash trees. When extrapolated by the inventory multiplier this means we have a total of 166 X 18.8 = 3121 ash trees on our city streets that will have to be removed if killed by the emerald ash borer. If the cost to remove an average 12" diameter tree is $340 we can estimate a total cost of $1,061,072 for removals alone. This is a minimum and does not include any additional costs such as site recovery, replanting, loss of environmental benefits, etc. Since this is a statistical study the number for any given species can vary by +/- 10%. That means the costs for removal of the dead trees could reach as high as $1,167,000.

## BROADLEAF DECIDUOUS MEDIUM

The largest constituent of our urban forest is the Norway maple. This tree is categorized as a medium sized tree (Broadleaf Deciduous Medium or BDM) that will reach a maximum height of 50 feet. The Norway maple also can be fairly broad with a 40 to 50 foot crown spread. Similar to the silver maple, the Norway has both excellent and poor qualities as an urban tree. It provides an extremely dense shade and therefore excellent cooling abilities during the summer should it be planted close enough to a house to provide shade. Unfortunately it has two very poor qualities. One is that the surface roots are often at or even above ground level making it difficult to maintain lawn cover under the tree. This allows erosion from areas of bare soil and also provides tripping hazards. Also, this species has a tendency to grow girdling roots that prevent the tree from growing properly as it ages. These roots will enlarge in diameter, choke off the main stem and impede the tree's ability to transfer water and nutrients from the roots to leaves. A majority of the trees we examined have these 'girdling' roots that will cause damage in

the future. The Norway maple is also a tree with very brittle wood that breaks more easily in storms than other maples and is susceptible to a number of diseases. Other problems that Norway maples face include verticillium wilt, maple decline syndrome, the Asian long-horned beetle (supposedly eradicated in the United States in 2009), leaf spot and anthracnose.

At an inventory count of 323 Norway maples, it is the single most numerous tree species on our streets. It accounts for 24.4% of our street trees and numbers at 6972 +/- 10% of our street trees.

The second most common tree in the Broadleaf Deciduous Medium category is the honeylocust. This tree is a common plant and the thornless varieties are very popular. They perform very well in difficult urban environments and provide a light, dappled shade that allows cool season turfgrass to grow well under their canopies. The wood is strong and moderately flexible providing a minimum of storm related problems except for minor breakage of branch tips requiring minor cleanup. Most of the varieties are relatively fruitless so that the large seed pods are not usually a problem.

The following is a chart showing the number of Medium trees found in the inventory:

BROADLEAF DECIDUOUS MEDIUM TREES

| Specie | Inventory Quantity | Projected Population |
|---|---|---|
| Norway maple | 323 | 6,072 |
| Honeylocust | 46 | 865 |
| littleleaf linden | 33 | 620 |
| callery pear | 17 | 320 |
| BDM other | 48 | 902 |
| | 467 | 8,780 |

## BROADLEAF DECIDUOUS SMALL

Broadleaf Deciduous Small (BDS) trees grow up to 20 feet in height. There are many varieties of trees that fit in this category; however, the overwhelming numbers of them are in the crabapple genus, Malus. We found one specimen that had a diameter of between 30 and 36 inches. The majority of these trees are smaller than 18 inches in diameter with the largest number being between 12 and 18 inches.

These are excellent selections for terraces that have power lines, telephone lines, street lighting issues, cable television lines and other utilities suspended from utility poles along the street. They provide a wide variety of flower types, leaf shapes, fall colors, summertime fruit colors or no fruit at all. Many varieties are disease resistant while some are very susceptible to leaf problems such as apple scab, leaf spot, fire blight and

powdery mildew. Some varieties of crabapple are resistant to all of these problems. Others succumb to the fungi and bacteria that produce these diseases. One other problem that could present itself is cedar-apple rust. This is a leaf disease on apple trees and the next year it is a golf ball sized fungal growth on redcedar (juniper) trees. It is unsightly but only damages the seasonal leaf growth of the plants.

Some other examples of small trees include Japanese tree lilac, flowering plum, Amur maple and thornless hawthorn.

The following is a chart showing the number of Small trees found in the inventory:

BROADLEAF DECIDUOUS SMALL TREES

| Specie | Inventory Quantity | Projected Population |
|---|---|---|
| crabapple spp. | 94 | 1,767 |
| BDS other | 55 | 1,034 |
| | 149 | 2,801 |

## CONIFEROUS EVERGREEN TREES

The deciduous tree population accounts for 96.5% of the street trees that were inventoried. The 3.5% of coniferous trees found on terraces include white pine, red pine, arborvitae or eastern white cedar and upright juniper or eastern redcedar. The total number of plants counted in the survey for all three size classes of evergreens is 46. This makes the evergreen constituent of the Janesville street tree population insignificant although still appropriate in some settings such as boulevards where there is a planting strip in the middle of the street or in quiet, very low traffic neighborhoods, where privacy is valued over visual safety when entering or exiting a driveway.

The following is a chart showing the number of Evergreen trees found in the inventory:

EVERGREEN TREES OF ALL THREE SIZE GROUPS

| Specie | Inventory Quantity | Projected Population |
|---|---|---|
| Combined spp. | 46 | 865 |

## PLANTING SITES

One of the important factors that we discovered from the information obtained in the inventory is a stocking percentage for the number of street trees. A target number for the stocking percentage is 60%, the national average as stated in a report by Cornell University Community Forestry. The Janesville stocking percentage is a very low 36%

as determined by our survey. An increase of 24% in our stocking percentage would make a tremendous difference in the amount of energy saved and rain run-off retained.

The lowest percentage of stocking rate occurs in zone 7 which includes much of the new development in the northeast portion of the city. This is a direct result of developers not having clear direction from the City about the planting of trees in new building areas. J-STAC inventoried a total of 259 sites in zone 7 and found only 41 trees planted within the right-of-way. That is a stocking percentage of 16%, which is surprisingly low. Many more street trees can and should be planted in these areas.

The two zones with the highest stocking percentages are zone 2, the older sections of Look West and along the south side of west Court St., and zone 6, the Palmer Park area north to Highway 14 including those neighborhoods built in the 1950's and 1960's. These areas have the greatest number of street trees given the available space with 43% of the sites planted. Even our most heavily planted areas are still well below the national average for street tree plantings.

When considering and counting the available planting sites, our committee decided to count all locations where a tree could be planted on the terrace unless that space was so completely impeded by large shade trees, in conflict with utility lines, poles, or other structures, or was physically too small to support even a small tree. A location that was surrounded by mature silver maples or oaks, whether or not they were located on the street or on private property, and would prevent even a small tree from being located in a healthy location, was not counted as a potential planting site. Some sites had terrace areas with sidewalk that provided no opportunity for street trees without sidewalk or utility removal. These sites were also not counted. Given those limitations, we still found that the City can benefit from the planting of over 16,500 trees to just reach the national average for street coverage of 60% of sites being planted.

The Summary of Available Planting Sites in the appendix provides a count by zone number and tree size.

## ANNUAL ENERGY BENEFITS OF PUBLIC TREES

The STRATUM program provides a number of measures for the value of street trees as they affect the environment in their locales. The detailed information regarding energy values of street trees in Janesville can be found in the Appendix broken down by the zones.

The citywide totals for the reduction of demand of energy use due to the presence of trees is quite large, in the millions of dollars, based on information provided by the STRATUM program and the unit cost of resources in 2007. The Annual Energy page in the appendix shows the sample numbers, that is the value of the 5.34% of trees sampled. Extrapolated, the values of trees to our community can be expressed in the following terms:

**SUMMARY OF ANNUAL ENERGY BENEFITS OF EXISTING STREET TREES**

| SAMPLED ELECTRICITY USE (MWh) | SAMPLE SAVINGS | CITY WIDE ELECTRICAL SAVINGS |
|---|---|---|
| 251.7 | $30,735 | $577,819.64 |

| SAMPLED NATURAL GAS USE (Therms) | SAMPLE COST | CITY WIDE NATURAL GAS SAVINGS |
|---|---|---|
| 34,206 | $44,468 | $835,998.40 |

| | | |
|---|---|---|
| AVERAGE ANNUAL BENEFIT PER STREET TREE: | **$56.92** | |
| TOTAL ESTIMATED NUMBER OF STREET TREES: | 24,825 | |
| TOTAL ESTIMATED AMOUNT OF ANNUAL SAVINGS: | **$1,413,039.00** | (differences in totals due to statistical error of +/- 10%) |

If Janesville was to plant the additional trees necessary to meet the national average stocking percentage we could accrue another **$924,026 in annual energy savings**. This would bring us up to a **Total Annual Energy Savings of $2,355,065** based on 2007 energy costs. We all know that energy costs have not decreased and that this number will continue to rise making our street tree resource even more valuable in the future. A healthy urban forest has excellent energy saving benefits as well as social and psychological benefits for the people of the city.

## OUR ASH TREE RESOURCE AND THE EMERALD ASH BORER

The primary reason for J-STAC to conduct the street tree inventory for Janesville is to understand the potentially devastating effects that the emerald ash borer will have on our community when that insect does appear. Toward that end J-STAC provided an informational slide show report for the Janesville City Council and has presented the information at public venues for the past two years.

ASH TREE POPULATION

| Species | Inventory Quantity | Projected Population | Percentage of Street Tree Population |
|---|---|---|---|
| green ash | 132 | 2482 | 10.0% |
| white ash | 34 | 639 | 2.5% |
| | 166 | 3121 | 12.5% |
| Original estimate of ash tree population: | | 3725 - 7450 | 15% - 30% |

This chart shows that we originally expected to find from 15% to 30% of our street trees were one of the ash tree species. Our actual findings indicate that the percentage is lower than average and we have approximately 12.5% of our street trees in the ash genus. We did not encounter any black or blue ash in our survey. Both of these trees are able to grow in our area but are uncommon as street trees. Black ash is much more common in the lowland forests of central and northern Wisconsin while blue ash is found sporadically throughout the midwestern states south of Wisconsin and into southern Tennessee and Missouri.

The importance of this population in terms of our urban forest is very high. Ash trees tend to be tolerant of urban conditions, fighting off the various problems that affect them and living to a mature age without major difficulties. Older ash trees, just like any other tree, will exhibit problems with storm damage and disease but vigorous young trees grow quickly providing excellent street coverage, rain water interception, shade, wind protection, wildlife support and aesthetic qualities. Some of the white ash varieties such as 'Autumn Purple' ash provide a tremendous fall color show and beautiful shape. 'Marshall Seedless' green ash has the ability to brighten our streets with wonderful yellow fall color and it does not produce seeds that create the plethora of seedlings other trees, such as silver maple.

Properly pruned and cared for, an ash tree of either species, can provide decades of value and benefits to our city. Green ash is slightly more tolerant of the stresses of urban life than white ash but both are excellent candidates for our streets and deserve our full measure of protection from the emerald ash borer and other problems.

## VALUE OF ASH RESOURCE

The average ash tree we found during the inventory is a green ash in the 12" to 18" dbh (diameter breast height) class. This tree was generally in good condition, healthy but in need of some pruning. It showed signs of some urban stress but was likely to continue to grow into a large tree possibly reaching 90 feet in height and as much as 42" in diameter.

The value of this average sized tree was placed at $1,470 taking into account the length of time it has been in place, cost of purchase and planting and an estimate of replacement for a tree of that size.

A medium sized ash tree, such as the average tree in our survey, provides an individual annual energy benefit of $16 while removing 1,000 lbs. of carbon dioxide from the air, collecting and trapping 4.3 lbs. of pollutants, recycling 5,380 gallons of rainwater that does not travel to the river carrying soil, pollution and leaching phosphorous from our soils. This tree also can save a residential homeowner up to 20% on utility costs by providing shade and wind protection in summer and winter.

Using our extrapolated population number of 3,121 and the 10% projected error rate we can say that our standing ash tree population has a value of between **$4,129,083.00 and $5,046,657.00.**

COSTS TO REPLACE THE ASH TREE COMPONENT OF OUR URBAN FOREST

During the development and discussions surrounding the approach of the emerald ash borer to Wisconsin the Department of Natural Resources (DNR) provided seminars, information and guidance as to how we might deal with this problem when it occurs, as it most certainly will. In 2007 there was not a practical method for controlling the insect with chemicals. Newer methods have since evolved and the future of North America's ash tree population is not as uncertain as it was when the first emerald ash borer destroyed so much of Michigan's ash resource.

The projected costs in 2007 stated here are for a tree that is 12" in diameter. This "average" tree might be as tall as 25 to 30 feet and have a beautiful crown spread that would match its height. Costs given are retail costs that might be negotiated in a contract or paid by a homeowner for the removal and replanting of a tree for one that is killed by the emerald ash borer.

Removal of an average 12" diameter tree including felling, taking the wood and brush away, sweeping and cleaning up remaining ground debris but not including any repair of turf damage or sidewalk that may be necessary is estimated at **$340**. In our survey the diameter class that 12" trees falls into actually includes all trees 12" to 18". This was the largest class with a total of 43 trees. If the average removal cost of a 12" tree is $340 then the average for these 43 trees would be somewhat higher due to the class ranging all the way to 18" in diameter.

Using the $340 cost we can extrapolate a total removal cost for all ash trees should they be killed by the emerald ash borer at 3,121 X $340 = **$1, 061,140** (+/- 10%).

Replanting the ash tree with a reasonable substitute is the next step. With the loss of over 3,000 street trees the city will suffer a substantial loss in energy savings and storm water control. Replanting is question only of cost and time, not necessity. The benefits of street trees are real, have been proven and are not in question.
A standard size and adequate replacement tree will be one of several species but should be balled and burlapped and of an adequate size to insure successful growth after planting. The size of a tree that is not too large to dig, move and replant is approximately 2.5" in caliper. This is a diameter measurement taken at, or close to, the ground just above the root flare. A typical contract or retail price for purchase and planting of a tree this size is **$400**.

Using the $400 replanting cost we can extrapolate the total replanting cost including digging the hole, proper tree placement, initial watering and mulching to be 3,121 x $400 = **$1,248,400** (+/- 10%).

Therefore, the total cost that the City of Janesville might incur based on the results of the Janesville Shade Tree Advisory Committee's sample street tree inventory is **$2,309,540.**

## DISCUSSION AND SUMMARY

The impetus for this sample street tree inventory was the imminent approach of the emerald ash borer and a desire on the part of the Janesville Shade Tree Advisory Committee to help the City be prepared when action is necessary. There was no previous inventory of our street tree resource, nor an accounting of the tremendous value that resource provides to our citizens.

Our general information includes the total number of trees that we have on the streets of Janesville at **24,835.** This number is somewhat surprising as it represents, even though it seems we have many street trees, only a 36% stocking percentage. This means that Janesville actually needs to plant trees in 24% more of its available planting spaces to reach a 60% recommended average that has been published by Cornell University. That 24% represents **16,506** more street trees.

Two species represent the largest constituents of our urban forest: the Norway maple and the silver maple. Both of these trees provide excellent shade, storm water runoff control, carbon sequestration, pollution control, oxygen generation and aesthetic pleasure. Both of these species also have numerous disease and structural problems.

One of the most important implications of this information is that there are many more Norway and silver maples on the streets of Janesville than there should be, according to the standards suggested for urban forestry by Geneticist Frank Santamour, Jr. of the U.S. National Arboretum. His dissertation on "Diversification Planting" suggests that we should follow a 30% - 20% - 10% guideline. These standards indicate that there should be no more than 30% of any one scientific family (in this case maples: *Aceracaea*) and no more than 20% of a single genus (maples: *Acer*) and no more than 10% of any single species (Norway maple: *platanoides)*.

Disturbingly, our survey finds that Janesville has 24.5% of its street tree population as one species: Norway maple (*Acer platanoides*). We also have more than 10% of silver maple on the streets. That tree (*Acer saccharinum*) represents 19.5% of all the street trees in Janesville.

These are very large percentages of the population that should cause us to consider a temporary restriction on the planting of these two species. They also account, together with red maple and sugar maple, for 52.2% of all street trees. Much higher than the 20% genus limit and the 30% family limit suggested by Mr. Santamour in his diversity plan. A disease or insect that was virulent could cause tremendous damage to our entire urban forest. If, for example, the Asian long-horned beetle had been much more mobile and able to escape the Chicago area, Janesville's 24.5% of Norway maples would have been

in grave danger of total destruction. At least one small city in Illinois removed all of their Norway maples in the effort to control this insect.

The only other tree species in this category of being in danger of being overplanted is the green ash. It accounts for 10.0% of the street trees in Janesville, exactly at the limit suggested by Mr. Santamour. While it is not strictly overplanted it is at the point where other tree species need to be substituted to keep it from becoming a species with a dangerous stocking level. Combined with the white ash, the genus total for ash (*Fraxinus*) is 12.5%, well within the 20% limits suggested by Mr. Santamour.

In conclusion, we found that the City of Janesville has a viable, albeit under stocked, urban forest with plenty of room on the street terraces for many more trees. The breakdown by zone shows that the newer sections of the city, zones seven and eight, have the lowest stocking levels and can benefit the most from additional plantings along our city streets. These zones are both in the northeast quadrant of the city and represent the newest subdivisions.

An addition of **16,506** trees, to bring the city's stocking percentage up to average at 60%, would provide annual energy savings of **$939,522** based on the average annual energy savings of **$56.92** listed in the appendix under Annual Energy Benefits.

Clearly, greater diversification is necessary to protect our urban forest from the unknown pests and problems of the futures. Additionally, more street trees would save the individual home and business owners, energy dollars in the future. There is, of course, a cost per tree and while that amount is not addressed here its existence is certainly acknowledged and considered. The additional social and psychological benefits are not measured either but are known to exist.

Finally, we now know that we stand to lose 12.5% of our urban forest when the emerald ash borer makes its appearance in the City of Janesville. Hopefully, this knowledge and demonstration of the status of our street tree population will provide an impetus to the citizens, government, nurseries and forestry professionals of the city to improve the species diversity, apply better planting and maintenance practices and bring the condition and value of the urban forest to the forefront of our everyday planning process.

## RECOMMENDATIONS

There are a number of actions that should be taken to improve and insure the quality of the city's urban forest. These include restrictions on what species of trees can be planted on the city streets and where trees can and should be planted. Many other items can be discussed but since the survey focused primarily on the species and sizes of street trees we will address those items in the recommendations.

Our primary focus for the results of the survey was the number of ash trees the city is in danger of losing due to the emerald ash borer. We discovered that there are 3,124 +/-

10% ash trees on the streets. Should all of these trees die there will be a tremendous cost in terms of removal, disposal and replanting non-ash species in their place. While replanting is not immediately necessary we certainly recommend that these trees be replaced at the earliest possible opportunity. As mentioned earlier, it is possible that the city could lose as many as 30,000 trees on streets, in parks and on private property. That amount of loss will certainly be noticeable in terms of energy costs and psychological benefit.

The most disturbing result of the inventory is that the city has such a large percentage of maples on the streets. Norway maple is overstocked by 14.5% on the streets and silver maple is overstocked by 9.5%. These two trees alone make up 44% of the city's street trees. This is so far above the recommendations of the National Arboretum that we should mandate a restriction on the planting of these two species of trees until they reach a more acceptable level of stocking. 10% is the suggested maximum for a single species. Maples account for 52.2% of all street trees. The suggested maximum for a family is 30% and a genus 20%. Both of these maximum levels are well exceeded on our city streets. A disease or insect that targets maples would be very destructive to our urban forest. A plan to control this possibility, and limit the number of maples on our city streets, is recommended.

Finally, the number of trees per number of available planting sites is referred to as the stocking level. Janesville's stocking level is surprisingly low at 36%. The average stocking level, as stated by the USFS Minneapolis, is 60% for our area of the country. That means that Janesville could easily plant 24% more of the available planting spaces with trees, a total of 16,500 trees, and reach the average for our region. A management plan that includes a planting program is highly recommended for the City of Janesville. This will put the program on the City's Five Year Plan (the capital improvement and project plan) and make it available for possible funding, if and when funding becomes available.

The Janesville Shade Tree Advisory Committee is ready to take part in implementing these recommendations in whatever way possible. Input from the public, and citizen groups like J-STAC, is important in helping to make management decisions that will affect the street tree population and the entire urban forest of our city.

**Janesville**



## Population Summary of Public Trees

2/24/2008

| | DBH Class (in) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| pecies | 0-3 | 3-6 | 6-12 | 12-18 | 18-24 | 24-30 | 30-36 | 36-42 | >42 | Total | Standard Error |
| **Broadleaf Deciduous Large (BDL)** | | | | | | | | | | |
| ilver maple | 6 | 10 | 19 | 48 | 45 | 61 | 48 | 16 | 5 | 258 | (±NaN) |
| ireen ash | 6 | 16 | 29 | 41 | 22 | 12 | 5 | 2 | 0 | 132 | (±NaN) |
| ugar maple | 4 | 3 | 11 | 26 | 18 | 10 | 0 | 0 | 0 | 72 | (±NaN) |
| ed maple | 1 | 11 | 11 | 10 | 3 | 0 | 0 | 0 | 0 | 36 | (±NaN) |
| White ash | 9 | 8 | 7 | 2 | 7 | 1 | 0 | 0 | 0 | 34 | (±NaN) |
| Quaking aspen | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | (±NaN) |
| BDL OTHER | 7 | 11 | 21 | 18 | 28 | 12 | 9 | 5 | 2 | 114 | (±NaN) |
| **Total** | **41** | **65** | **99** | **145** | **122** | **97** | **62** | **22** | **7** | **660** | **(±NaN)** |
| **Broadleaf Deciduous Medium (BDM)** | | | | | | | | | | |
| Norway maple | 15 | 13 | 62 | 103 | 89 | 37 | 3 | 0 | 0 | 323 | (±NaN) |
| Honeylocust | 2 | 2 | 9 | 10 | 10 | 7 | 3 | 2 | 0 | 46 | (±NaN) |
| Littleleaf linden | 4 | 4 | 7 | 14 | 2 | 2 | 1 | 0 | 0 | 33 | (±NaN) |
| Callery pear | 6 | 9 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 17 | (±NaN) |
| BDM OTHER | 9 | 7 | 7 | 11 | 7 | 6 | 2 | 0 | 0 | 48 | (±NaN) |
| **Total** | **35** | **34** | **86** | **141** | **108** | **52** | **8** | **2** | **0** | **466** | **(±NaN)** |
| **Broadleaf Deciduous Small (BDS)** | | | | | | | | | | |
| Apple | 8 | 34 | 33 | 18 | 0 | 0 | 1 | 0 | 0 | 94 | (±NaN) |
| BDS OTHER | 21 | 16 | 10 | 4 | 4 | 0 | 0 | 0 | 0 | 55 | (±NaN) |
| **Total** | **30** | **50** | **43** | **21** | **4** | **0** | **1** | **0** | **0** | **149** | **(±NaN)** |
| **Broadleaf Evergreen Large (BEL)** | | | | | | | | | | |
| BEL OTHER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **Total** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Broadleaf Evergreen Medium (BEM)** | | | | | | | | | | |
| BEM OTHER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **Total** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Broadleaf Evergreen Small (BES)** | | | | | | | | | | |
| BES OTHER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **Total** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Conifer Evergreen Large (CEL)** | | | | | | | | | | |
| CEL OTHER | 7 | 2 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 16 | (±NaN) |
| **Total** | **7** | **2** | **4** | **2** | **2** | **0** | **0** | **0** | **0** | **16** | **(±NaN)** |
| **Conifer Evergreen Medium (CEM)** | | | | | | | | | | |
| Blue spruce | 2 | 7 | 15 | 3 | 1 | 0 | 0 | 0 | 0 | 28 | (±NaN) |
| CEM OTHER | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | (±NaN) |
| **Total** | **2** | **7** | **16** | **3** | **1** | **0** | **0** | **0** | **0** | **29** | **(±NaN)** |
| **Conifer Evergreen Small (CES)** | | | | | | | | | | |
| CES OTHER | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | (±NaN) |
| **Total** | **0** | **0** | **0** | **1** | **0** | **0** | **0** | **0** | **0** | **1** | **(±NaN)** |
| **Grand Total:** | **115** | **159** | **247** | **313** | **236** | **149** | **72** | **24** | **7** | **1,321** | **(±NaN)** |

**Janesville**

## Annual Energy Benefits of Public Trees by Zone

5/18/2009

| Zone | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| | 32.0 | 3,910 | 4,290.8 | 5,578 | 9,488 | (N/A) | 11.8 | 12.6 | 60.66 |
| | 43.1 | 5,263 | 5,793.0 | 7,531 | 12,794 | (N/A) | 15.3 | 17.0 | 63.32 |
| | 39.1 | 4,772 | 5,220.6 | 6,787 | 11,559 | (N/A) | 14.5 | 15.4 | 60.27 |
| | 53.4 | 6,517 | 7,291.7 | 9,479 | 15,996 | (N/A) | 21.2 | 21.3 | 57.08 |
| | 62.8 | 7,663 | 8,662.6 | 11,261 | 18,924 | (N/A) | 21.8 | 25.2 | 65.78 |
| | 4.4 | 533 | 627.8 | 816 | 1,350 | (N/A) | 3.1 | 1.8 | 32.95 |
| | 17.0 | 2,076 | 2,319.3 | 3,015 | 5,092 | (N/A) | 12.3 | 6.8 | 31.43 |
| Citywide total | 251.7 | 30,735 | 34,205.9 | 44,468 | 75,202 | (N/A) | 100.0 | 100.0 | 56.92 |

## Summary of Available Planting Sites for Public Trees

2/24/2008

| Zone | No. of Unplanted Sites | No. of Planted Sites | Total No. of Sites | Stocking (%) | No. of Unplanted Sites | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Small | Medium | Large | Undefined |
| 1 | 353 | 156 | 509 | 31 | 85 | 4 | 163 | 101 |
| 2 | 266 | 202 | 468 | 43 | 56 | 1 | 90 | 119 |
| 3 | 264 | 192 | 456 | 42 | 57 | 0 | 126 | 82 |
| 5 | 399 | 280 | 680 | 41 | 175 | 1 | 131 | 92 |
| 6 | 382 | 288 | 669 | 43 | 70 | 0 | 200 | 112 |
| 7 | 218 | 41 | 259 | 16 | 27 | 0 | 133 | 58 |
| 8 | 461 | 162 | 623 | 26 | 61 | 0 | 296 | 104 |
| Citywide total | 2,343 | 1,321 | 3,665 | 36 | 530 | 6 | 1,140 | 668 |

**Janesville**

## Annual Energy Benefits of Public Trees by Species

6/17/2009

| Species | Total Electricity (MWh) | Electricity ($) | Total Natural Gas (Therms) | Natural Gas ($) | Total ($) | Standard Error | % of Total Trees | % of Total $ | Avg. $/tree |
|---|---|---|---|---|---|---|---|---|---|
| Norway maple | 67.7 | 8,271 | 9,626.4 | 12,514 | 20,786 | (N/A) | 24.5 | 27.6 | 64.34 |
| Silver maple | 74.3 | 9,069 | 9,669.4 | 12,570 | 21,639 | (N/A) | 19.5 | 28.8 | 83.91 |
| Green ash | 25.3 | 3,087 | 3,341.4 | 4,344 | 7,431 | (N/A) | 10.0 | 9.9 | 56.21 |
| Apple | 6.6 | 811 | 1,019.9 | 1,326 | 2,137 | (N/A) | 7.1 | 2.8 | 22.73 |
| Sugar maple | 15.2 | 1,854 | 1,984.8 | 2,580 | 4,434 | (N/A) | 5.4 | 5.9 | 61.86 |
| Honeylocust | 11.8 | 1,437 | 1,553.8 | 2,020 | 3,457 | (N/A) | 3.5 | 4.6 | 75.78 |
| Red maple | 5.1 | 619 | 662.8 | 862 | 1,480 | (N/A) | 2.8 | 2.0 | 40.77 |
| White ash | 3.9 | 473 | 523.2 | 680 | 1,154 | (N/A) | 2.5 | 1.5 | 34.42 |
| Littleleaf linden | 4.6 | 567 | 611.7 | 795 | 1,362 | (N/A) | 2.5 | 1.8 | 41.81 |
| Blue spruce | 1.7 | 202 | 250.9 | 326 | 528 | (N/A) | 2.1 | 0.7 | 18.90 |
| Callery pear | 0.8 | 100 | 117.0 | 152 | 252 | (N/A) | 1.3 | 0.3 | 15.05 |
| Quaking aspen | 0.3 | 33 | 37.3 | 48 | 82 | (N/A) | 1.1 | 0.1 | 5.49 |
| Other street trees | 34.5 | 4,210 | 4,807.4 | 6,250 | 10,460 | (N/A) | 17.8 | 13.9 | 44.58 |
| Citywide total | 251.7 | 30,735 | 34,205.9 | 44,468 | 75,202 | (N/A) | 100.0 | 100.0 | 56.92 |