CITY OF LIVINGSTON, MONTANA
2014 INVENTORY REPORT OF MUNICIPAL PARK, BOULEVARD, AND CEMETERY TREES

Conducted, written, and photographed by:

Mike Garvey, Registered Consulting Arborist®
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SUMMARY

The City of Livingston, Montana has a total of 3,880 trees located on boulevards, public parks, and the municipal cemetery. These trees provide an annual total of $589,197 worth of ecological, environmental, and aesthetic benefits, which equals a yearly average benefit of $152.00 per tree. The replacement value (monetary value) totals $16,253,608, or $4,189 per tree.
The inventory revealed that despite their value and functional utility, problems related to their age, weather extremes, condition, location, harmful insects, detrimental trimming techniques, and lack of after-care management of recently planted trees, has created expensive management options that will be required to reduce potential hazards, risks, and infrastructure damage, as well as the additional costs of planting new tree species to replace the aging, unhealthy trees that are growing out of their planting sites and living out their safe, useful life expectancy.
While the present tree population is dominated by three species: ash (*Fraxinus*), spruce (*Picea*), and maple (*Acer*), new species such as linden (*Tilia*), horsechestnut (*Aesculus*), and oak (*Quercus*), appear to be thriving and in thrifty condition.
A recommended tree management plan that identifies and prioritizes removal or remedial mitigation of large, structurally-damaged trees, prescriptive integrated pest management programs for existing and potentially-devastating invasive insects and diseases, and the future planting and aftercare management of diverse tree species at suitable sites will enable the City of Livingston to maintain the ecological, utility, and amenity benefits that healthy trees can provide their community.
An all out effort by the City to inform their city residents, schools, and businesses of the manner and extent in which trees improve their quality of life will be needed to ensure that both monetary expenses and civic-minded goals of keeping healthy and attractive trees are a realistic attainable community effort.

INTRODUCTION

The City of Livingston has a need to update information on municipal trees located in City parks, boulevard walkways, and the public cemetery grounds. The data they require to effectively manage and sustain their urban forest resources includes the following tree attributes:

- Population: includes total number and relative percentages of all tree species
- Species: includes type of tree and the measurement of its main stem size (diameter)
- Condition: includes structural and biological state of health
- Location: based on GPS coordinates
- Physical conflicts: heaved concrete sidewalks and overhead electrical utility lines
- Pest signs & symptoms: insect, mite, and disease (fungal/bacterial) problems
- Hazards & Risks: the source of harm and its probability of varied consequences
- Management recommendations & priorities: tree removal/pruning options/pesticide applications

The inventory was conducted by collecting data based on ground level visual observations and measurements of tree stem diameters. The field data was entered on a handheld digital device that was configured to accept i-Tree™ program software. This data was then entered into a computer where the software was designed to analyze and output meaningful qualitative and quantitative reports.

Limits of the tree inventory assignment: The collected data only reports the condition of each tree at the time it was visually reviewed and all trees in the inventory were assessed without dissection, excavation, probing, or coring of any tree part.

The inventory findings do not warranty or guarantee (expressed or implied) that structural problems or deficiencies of any tree may not arise in the future. The inventory findings do not predict that any one tree, or parts of that tree, will fail at any certain time.

The City of Livingston contracted the services of Garvey's Urban Forest, LLC to conduct the inventory and write a report of the findings. Funding for this project was provided by the Montana Department of Natural Resources & Conservation (MT-DNRC).

The purpose of the inventory and report is to provide the City of Livingston and the MT-DNRC with reliable data that will augment and help facilitate their respective agencies efforts and goals of promoting safer and more sustainable urban forest trees.

FIELD OBSERVATIONS

GENERAL TREE POPULATION *Note: words in **bold** font are defined in the Glossary, Page 20.
See Supplemental Field Observations Pictorial: Pages 21 - 63

The 3,380 inventoried trees [See Map: Page 19] total over 20 million square feet of leaf area, which converts to over 3.9 million square feet of **canopy** cover [See APPENDIX A: Supporting Material, Page 17]. The population represents 24 **genera** of trees, and 3of these genera comprise 70 percent of the total population [See Appendix A: Supporting Material, Page 16].

1. *Fraxinus.* Green ash: 1,770 trees = 45.6 %
2. *Acer*. Maple :540 trees = 13.9% *includes boxelder
3. *Picea*. Spruce: 417 trees = 10.7% *includes white, blue, & Engelman spruce

These 3 **species** are generally older than the other species [See APPENDIX A: Supporting Material, Page18] and those planted in boulevards have generally outgrown their original space; results of which are characterized by: up heaved concrete sidewalks, interference with overhead utility lines, reduced signage and street visibility for drivers and pedestrians, and mechanical damage to their stems and branches from being in contact with cars and other machines.

It is easy to observe that a significant number of the trees have been damaged by lightning strikes and abnormal wind events, as well as notice that a significant number of trees have been damaged and structurally weakened by work performed by unskilled contractors. It can be observed that there is a close association between unwatered boulevard trees and their lack of good leaf color and density, vigor, and vitality.

This observation also holds true for recently-planted trees in the parks, where numerous trees were either dead or dying, principally due to lack of sufficient water. Additionally, numerous recently-planted trees already had weak structure, were overly-staked, and showed damage to their bark by being gored with lawn mowing/trimming equipment.

Conversely, there are numerous older and larger trees that have adapted well to their planting site, and are in relatively good structural and biological condition. For example, silver maple (*Acer saccharinum*), white poplar (*Populus alba*), and white willow (*Salix alba*) were rated respectively at 71% - 70% - 87% "fair to good" structural condition. These tree species are also the largest diameter trees in the inventory.

BOULEVARD TREES:

Total number of trees: 2,504 = 64.5% of all City trees.
There are 1,490 green ash and 462 maple (including boxelder) trees and they account for 59% and 18% respectively of all boulevard trees.
*There are 800 potential planting sites located on boulevards, which include existing stumps. Potential sites account for about 32% and stumps account for about and 4% of all sites. These sites are listed as "PS" on i-Tree Streets collected data of species type, and stumps are listed as "STUMPS".

Condition:

Numerous boulevard trees have outgrown their original space for roots and canopy and this has resulted in mechanical damage of trees. Branches that overhang streets have been broken by cars & trucks, bark on main stems have been gouged, and roots have been cut away to make room for sidewalk repairs or new sidewalk installation.

Conflicts:

Numerous boulevard trees have branches growing into overhead utility power lines and have roots that have up-lifted concrete sidewalks. Also, many trees located close to street intersections have branches that limit or obscure visibility of stop and pedestrian crossing signage, as well as sight lines for driving.

Hazards and Risks:

Numerous boulevard trees were observed to have types of structurally-weak form, and biologically-related health problems that constitute serious **hazards** and raise levels of **risk**.
The main types of observed weak structure (form & architecture) include:

1. Co domininant stems (commonly referred to as "co-doms")
2. Co dominant stems with included bark
3. Cracks/splits
4. Cavities/hollowness

The main types of observed biologically-related health problems include:

1. Dieback of limbs/ branches due to age and lack of water
2. Dieback of limbs/branches due to insects & disease

Pests: Symptoms and Signs

Numerous green ash trees have **symptoms** of declining health, vigor, and vitality that include:

1. Poor leaf color (yellowing & stippling)
2. Sparse leaf density
3. Excessive seed set

Signs of pest problems related to green ash trees included:

1. Loose bark with numerous small holes and small tunnels
2. Small dark brown beetles insects found within the barks
3. Small winged insects found swarming around leaves
4. Small to medium sized insects found on the bark of main stems

NOTE: I identified the small beetle as the ash bark beetle (*Hylesinus californicus*) and the holes and tunnels in the bark were a by-product of its activity. I identified the small winged insects as ash plant bug (*Tropidosteptes amoenus*) and its feeding activity as the cause of the stippling, or flecking of the leaves. I identified the other medium sized insect as the banded ash borer (*Neoclytus caprea*) which is a type of wood-boring beetle commonly known as "longhorned beetles".

None of these 3 insects should be confused with the emerald ash borer (*Agrilus planipennis*). Emerald ash borer, commonly referred to as "EAB", is a non-native insect from Asia that was accidently introduced into the United States about 12-17 years ago. EAB has killed an estimated 10 million green ash trees, mostly in the mid western and northeastern parts of the country. EAB was confirmed last year in Boulder, Colorado***, but to date has not been confirmed in Montana***.

The most commonly seen harmful insects affecting Livingston's boulevard trees were aphids, hardshell scale, and mites. The most commonly seen disease affecting leaves was bacterial scorch on maple trees that appeared to be suffering from lack of adequate water.

Several species of trees that are listed by the City as "Not Suitable For Planting In Public Right-Of-Ways" were seen throughout all sections of town. The list includes:

1. Poplars (includes cottonwood, cottonwood hybrids, and quaking aspens)
2. Juniper
3. Pine (includes spruce and Douglas fir)
4. Willow
5. Boxelder
6. Siberian elm
7. Silver maple * One particular silver maple is very notable in its size and will be nominated for the Montana Big Tree Program as our State's largest silver maple.

CEMETERY TREES

A total of 403 trees are planted in the Cemetery, and the three most planted species are:

1. Spruce: 233 trees (includes blue, white, and Engelmann)
2. Green ash: 69 trees
3. White poplar: 55 trees

All larger spruce and fir trees have been limbed up for sight and maintenance machinery clearance and the majority of them are in good condition. Several of these trees have codominant stems with included bark, and it was observed that some of these stems have broken off by wind and/or heavy snow loads. One spruce has extensive stem damage and stem cavities that warrant its removal.

The white poplar -also commonly referred to as "silver poplar"- trees are the largest diameter trees on the grounds (39 of them have stems measuring over 42 inches in diameter). They appear to be in fair to good condition but most have large diameter limbs that are dead or dying. One large poplar located in the main road divider has several structural problems and warrants removal. A few other poplars located on the northwestern corner are dead & dying and also warrant removal.

The green ash trees located along the north boundary fence are mostly in poor structural condition and are being crowded between adjacent spruce trees. Two green ash in this row warrant removal.

Recently planted trees in the southeast section are in poor condition due to mechanical damage from lawn mowers/trimmers and compacted, dry soils.

PARKS

Sacajawea Park

A total of 349 trees are located in the park. Green ash accounts for 126 of these trees, with crabapples and mountainash accounting for 37 and 31 trees respectively. Spruce account for 46 of the 63 total evergreens.

The largest trees are white willow and white poplar, which are located mainly along both sides of River Drive, which appears draw numerous vehicles. There are several large dumpsters located along this road and it appears that people favor parking their cars along this road. Green ash trees are located around the main play area (fort structure) and among the evergreens on the southwest park corner.

Most trees appear to be in fair to good condition, but the large willows and poplars show dead and dying limbs in their upper canopies. These trees, along with the green ash and evergreens have grown into each other's space. The spruce trees are infested with spider mites feeding on their needles.

Sacajawea Park appears to draw many people of varying ages participating in a variety of activities, and there are two covered shelters, fire pits, and several benches picnic tables located under the trees. As such, this park has many moving and stationary high value targets.

Bozeman Park *Includes 2 pocket parks by B Street underpass

There are 178 trees in Bozeman park, of which 52 are spruce and 46 are green ash. Most spruce are large mature trees that have codominant stems and the needles of many spruce were fading in color due to spider mite activity. Numerous ash trees appear to have been hit by lightning strikes, and many trees in the park have burrowing animal holes near their main stem.

There is a well-utilized walking trail throughout the park and picnic tables near large trees. Park Street is adjacent to large trees along the park's south boundary, and it has a high volume of traffic and pedestrians.

Katy Bonnel/Street Park

There are 28 trees in this park, with 12 crabapple trees and 7 hybrid poplars accounting for most of the trees. The hybrid poplars are in poor condition and some are located under overhead utility lines and a picnic table. Most of the recently-planted trees are in poor condition due to lack of water and mechanical stem damage caused by mowing and trimming equipment. There is very little shade from trees in this park.

Mike Webb Park/G Street

There are 25 trees in this park, and 11 of those trees are large willows located on the south edge of the park. Two picnic tables are located under these trees. Many of the recently-planted trees, such as linden and crabapple are dead or in poor condition due to lack of water and mechanical stem damage caused by mowing and trimming equipment.

Mayor's Landing/Mojo Park

There are 35 trees in this park, the majority of them are large willow and cottonwood trees located by a picnic area and an outhouse. Overhead utility lines run through many of these trees. Two large diameter willows with low-hanging and wide-spreading limbs are located on the north side trail and it trees appears that many park visitors like to climb on these trees.

Mars Park

*Includes North Side Soccer Park, Jack Weimer Memorial park (baseball field) and the walking trail between Bitterroot and 9th Street North.

There are 150 trees in these parks and most of them are recently-planted, smaller diameter and height trees. Several of these trees are already dead or in poor condition to lack of water and mechanical stem damage caused by mowing/trimming equipment. The trees located on either side of the walking trail were planted in 2013, and the majority of them are already dead or in poor condition due to improper planting methods and lack of adequate water. Trees located around the soccer fields appear to be subjected to high wind loads and the needles of several evergreen trees appear to be damaged by excessive winter solar radiation.

Firefighter Park
A total of 6 trees are located in this park and the large boxelder and green ash trees are in fair condition with dead/dying branches. This is a small park but appears to be a favorite spot for visitors to access the lagoon. A picnic table is under one large boxelder.

Riverside Park
There are 48 trees in this park, including the linear park by the Yellowstone River. A stand of 18 large spruce are located adjacent to overhead utility lines and these trees have had their mid-bole canopy cleared for contact with these lines. They are in generally good condition.
Six large diameter and wide-spreading poplar and cottonwood trees overhand the west side of the park onto 10 Street South. They are in generally good condition but have hangers and large diameter limbs that are dead or dying.
A large willow with structural damage is located by the side of the park next to the river and a picnic table is placed directly next to the main stem.

ANALYSIS: Collection of tree data

All pertinent tree observations and measurements were entered into a Trimble™ Juno SB field handheld computer & receiver capable of collecting GPS location points. The collected data was configured by i-Tree™ Streets software. iTree™ is a "*state-of-the art, peer-reviewed software suite from the USDA Forest Service that provides urban and community forestry analysis and benefits assessment tools*" (i-Tree Users Manual v.3). This public domain software was developed with expert technical support from: the Davey Tree Expert Company, National Arbor Day Foundation, the Society of Municipal Arborists, and the International Society of Arboriculture.
i-Tree Streets quantitatively analyses the environmental and ecological utility services that trees provide and calculates the monetary value relative to a tree's yearly amenity and ecological benefits that include:

- stormwater reduction
- property value
- air quality improvement
- energy conservation
- carbon dioxide reduction

i-Tree Streets analysis requires that each inventoried tree must include the species common or scientific name and measurement of that tree's stem diameter (as measured at 54 inches from the ground). This measurement is commonly referred to as "DBH" –Diameter at Breast Height" or as "DSH"-Diameter at the Standard Height".

All other collected data is optional, but including data such as the tree's physical location, structural condition, maintenance recommendations and priorities, insect and disease detection, conflicts with utility lines or heaved sidewalks, and replacement value greatly enhance the ability to get a "big picture" of a community's tree resources and the potential expenses related to management options that will sustain a tree's resource.

It's imperative to know that the benefit-cost analysis reports calculated by i-Tree Streets is calculated in part by comparing tree species and data from a very broad and encompassing national tree data base. The replacement factor percent (RFP) that i-Tree Streets uses to figure a given tree's replacement value is based on the CTLA (Council of Tree and Landscape Appraisers) method that "*reflect the relative structural integrity and health of a typical tree in a given situation*" (i-Tree Users Manual v.3. Page 15). Regional and local data fields are considered but the benefit to cost ratio reports are not meant to represent "to the dime" data.

NOTES:

1. i-Tree Streets contains drop down "menu" selections for data information such as overhead utility line conflicts. For the purpose of this inventory, if a tree was not in actual contact with lines but was within the fall range of making contact with the line, the data was enter as "present and conflicting". Also, for the purpose of this inventory, high-voltage and low-voltage line were not differentiated.

2. DBH data (stem diameter) was recorded by classes instead of exact measurements. Measurement classes range from 0-3 inches and up to 42 plus inches. Numerous individual trees were measured if their diameter class was in question, or if they measured over 42 inches. Diameter tapes were used for all measurements.

3. i-Tree Streets maintenance and priority data default to categories of:

- none
- small tree (routine)
- small tree (immediate)
- large tree (routine)
- large tree (immediate)
- Critical concern (public safety)

For the purpose of this inventory, small trees are considered trees that don't necessarily need power equipment to work on a tree. And, a tree was considered "immediate" if its condition was abnormally defective (large cavities/excess lean/cracks in stems/or combinations of all defects). Trees that were considered a public safety concern were reported by email to appropriate City personnel.

4. Three categories of data relate to potential tree failure, the targets the failure could contact, and the risk, or combination factors of the potential failure and target contact.

<u>These data sets are not intended to predict failure of any tree, or tree part, at any given time in the future.</u> Only very small well-structured and anchored trees, generally less than 8 feet tall, were listed as "improbable" failures. <u>Most trees are listed as "possible" as any tree can fail at any time</u>. <u>Trees listed as "probable" were reported by email to the appropriate City personnel</u>.

<u>The data sets do not category the level of failure consequences for each target. As such, damage caused by a falling small branch that cracks an unoccupied car windshield is not differentiated from damage caused by a large limb falling on an occupied car roof.</u>

For the purpose of this inventory, high target values included pedestrians, homes, utility lines, and vehicles. Medium to low target values included fences, sheds, mailboxes, etc. Also, for the purpose this inventory, most mature trees (taller than 30 feet) that had any dead, broken, or dying branches, and that are located on streets with higher pedestrian and car traffic, parked cars and recreational vehicles, were rated as "high" or "moderate" risks.
For a hypothetical comparison, a 30 foot tall boulevard ash tree located near a stop sign intersection, with observable dead or broken branches in its canopy would be rated as a "high" risk, whereas the same tree in the same condition located at a remote corner of the cemetery could be rated as a "moderate" risk. Fewer chances of high targets being present when a tree fails equal lower risk ratings.

DISCUSSION OF OBSERVATIONS & DATA ANALYIS

The inventory revealed that the City of Livingston has a mature-to aging municipal tree population where only three species comprise 70 percent of all trees. These three species: green ash, maple (includes boxelder), and spruce are also some of the oldest and largest trees by stem girth and height. In particular, green ash, silver maple, and boxelder account for 68% of the total canopy cover (green ash accounts for 59% of that total) yet their Respective Relative Performance index (RPI) values of 0.92 and 0.91 ranks below several other smaller species such as serviceberry, which maintains a RPI value of 1.29.

What this indicates is that the trees providing the most environmental benefits like shade cover and stormwater reduction are in generally poorer condition and health relative to other trees. In fact, the data shows that Livingston's ash trees intercept and reduce stormwater runoff by an average of over 4 million gallons, which equates to an average utility value of $24 per tree per year. In comparison, serviceberry trees intercept rainfall runoff by an average of 131 gallons per year, which equates to an average utility value of 35 cents per tree per year.

The fact that green ash accounts for 59.5% of all boulevard trees, and that boulevard trees account for 64.5% of all inventoried trees indicates problems associated with monoculture planting (the over- dependence upon one majority tree species) are, and will continue to be, a costly management issue for all neighborhood sections of Livingston. Monoculture plantings are troublesome and problematic in the sense that if a few trees are inflicted with serious fungal, viral, or bacterial diseases, the probabilities are rather high that a majority of the same species will also be affected. These especially holds true for harmful insects that vector, or transmit diseases as they tunnel into the bark and wood of susceptible trees.
This scenario has already happened in Livingston with the arrival of elm bark beetles that killed most of the City's American elms by means of introducing a wilting fungus (*Ophiostoma novo-ulmi*) commonly known as "Dutch Elm Disease". In like manner, the mountain pine beetle (*Dendroctonus ponderosae*) has killed thousands of pine trees throughout Montana over the past 10 years by means of its breeding habits and introduction of a disease commonly known as "blue stain fungus".

For these reasons, the City of Livingston needs to be diligent by inspecting and identifying the signs and symptoms associated with ash trees that have been attacked by the emerald ash borer. Although this invasive insect has not been confirmed in Montana to date, the chances that it's arrival in Park County/City of Livingston are at least "50/50".

The field observations revealed that a great number of City trees have been detrimentally trimmed/pruned over a period of several years. The most commonly seen unskilled trimming is commonly known as "topping". Topping can be defined as the unskilled method of reducing tree height by cutting between two other branches on the same limb or stem. It can easily be seen as the result of such work makes the tree extremely flat, as if cut in half. Problems that arise from this tree butchery are many:

- Topping removes to much of the tree's food source: leaves
- Topping cuts do not naturally seal over with new wood that protects the tree from disease & rot
- Topping produces a flush a new growth that is weakly-attached and prone to failure
- Topping reduces energy reserves that sustain root growth and anchorage
- Topping produces ugly trees in form and architecture

This all matters because a biologically-weakened tree is more susceptible to contacting diseases and attracting harmful insects. Additionally, the topping of trees increases hazards and risks for trees hanging over pedestrians, homes, and cars, etc.
Virtually all trees tall enough to get into the power lines have been topped several times over the past years and this best illustrates the extra maintenance problem that this professionally-discredited type of tree work creates.

The trees that have been recently planted (within the past 5-7 years) indicate that several types of species other than ash can survive and thrive in Livingston. However, many of these trees are overly staked, have bark damage on their stems from mowing/trimming equipment, and are suffering from lack of water. Numerous scientific studies have indicated that keeping trees staked more than one year after planting has a negative effect on their overall growth. This is because the staking hardware reduces the natural sway of trees in the wind. Wind loads actually stimulate and increase stem diameter and so a tree that is not allowed to build up a natural resistance to wind loads tend to be more susceptible to abnormal wind loads as they grow taller. Also, studies indicate that damage to bark and lack of adequate water are among the most common reasons for early tree mortality.

<u>Sidewalks, underground utility line installation and tree roots</u>

Hundreds of Livingston's boulevard trees have over time heaved or lifted concrete sidewalk sections. Several homeowners I meet while conducting the inventory asked a similar question: "When is the City going to fix the sidewalks?" "They are dangerous to walk on". Many large trees with large supporting roots have been cut away where concrete repairs or replacement work has taken place. Another similar type of root damage that is currently ongoing in Livingston is the installation of underground gas lines along the grass boulevards. Tree roots have been severed, gouged, and exposed to drying air by mechanical trenchers.

These types of root damage often are the first cause of decline in color, health, vigor, vitality, and even outright mortality of trees, but the symptoms of scorched leaves, twig dieback, sparse canopy, and the start of a lean from its original upright position may take a long time (up to 7 years) to develop. This phenomenon is known in arboriculture as a "biological lag".

When trees are injured in this manner they tend to use up stored energy in their roots to overcome the damage and as such may not show the typical symptoms of stress and decline until long after the damage was done. For this reason, damage to root systems is usually not diagnosed as being the start or cause of the problems. **Note**: A Livingston construction worker told me that an engineer told him that "*trees get over it*".
Removal and mechanical injuries of roots causes tree stress and decline by reducing their energy storage reserves, exposing absorbing roots to drying air, cutting off the uptake of water, weakening the integrated anchorage system of roots and soil. Additionally, roots that are roughly severed, crushed, or gouged are susceptible to harmful soil pathogens (fungi) that can cause systemic tree disease and root rot.
Numerous trees located along boulevards east of D Street that have had recent sidewalks replaced are good illustrations of biological lag symptoms of stress and decline.

CONCLUSIONS

The City of Livingston has hundreds of large and aging trees that have provided millions of dollars worth of ecological, environmental, monetary, and amenity benefits to the community. Factors such as age, harsh and abnormal weather conditions, human-caused damage, lack of water, and harmful insect activity are reducing the service benefits of these trees, while increasing the hazard and risk factors of structural tree failure.
The general population of trees is dominated by one species, green ash, which accounts for almost half of the entire number of trees. Numerous green ash trees in Livingston are presently infested with ash bark beetles, and would be highly susceptible to being killed in a short period of time if the emerald ash borer insect is introduced into the community.

A significant number of new tree species have being planted in the past few years, but because of their relative small size and canopy cover, contribute less beneficial ecological and environmental utility value than the larger trees. These younger and smaller trees have been damaged by lawn mowing/trimming equipment and suffer from a lack of adequate water. Many of these trees have weak structural form that would be improved by skilled and artful pruning techniques. Such work would be relatively inexpensive and would lessen the need for more expensive and time-consuming tree work as they grow in girth and height. Skilled pruning of these young and smaller trees would also reduce hazard and risk factors as they grow larger.

The planting and location of boulevard tree species listed by the City of Livingston as "not suitable for planting in public right-of- ways" indicates that either many homeowners are not aware, or have ignored the City's tree planting application permit.
Additionally, several homeowners I talked with during the inventory asked the same questions:

- "*Who owns the boulevards?"*
- *"Who owns the trees?"*
- *"Who is responsible for the trees?"*
- *"Is the City going to make me cut my tree down?"*
- *"Who is going to pay for this?"*

It appears that many people don't know the distinctions of private versus public ownership of trees located on boulevards.

Numerous trees in Livingston have been subjected to detrimental pruning techniques; in particular, the practice of tree topping that is performed by unskilled and uneducated tree workers. The topping of trees has over time reduced the vitality, vigor, and beauty of trees and has increased the number of hazards and levels of risk. New branches that sprout where topping cuts have been made are structurally weak and prone to failure under excessive wind and snow events.
The ongoing improvements and replacement of boulevard sidewalks, along with the installation of new underground utility lines has, and will continue to be a stress factor for trees due to the subsequent removal or damage to energy storing, water transporting, and structural anchoring root systems.

The future management options and decisions regarding the safe, useful life expectancy of municipal trees in Livingston will be an expensive undertaking and somewhat controversial subject. Many people I talked with during the inventory mentioned that they "*love trees*" but don't like the idea of having to "*pay*" for their upkeep and safety. It appears that many community members do not realize the overall value that trees provide for them.

RECOMMENDATIONS

The City of Livingston should consider the following recommendations to maintain, promote, and sustain healthy and safer municipal trees in their community [See Recommendation Chart, Page 15]:

Create a written tree management plan that identifies and prioritizes the essential actions needed to improve and sustain urban forest resources over the course of the next 5-7 years.
This plan should take into account all the benefits, costs, hazards, and risks associated with decisions related to the retention, remedial mitigation, removal and replacement of the aging and maturing trees that presently comprise a large percentage of all boulevard, parks, and cemetery trees.

To better calculate the ecological, environmental, monetary, and amenity benefits versus actual costs of tree management, this tree inventory should be customized by incorporating existing infrastructure data specific to the City of Livingston. i-Tree Streets software lists the following information needed for the program to create more precise tree management budget numbers:

1. Total municipal budget
2. Population
3. Total land area (square miles)
4. Average sidewalk width (feet)
5. Total linear miles of streets
6. Average street width (feet)

In conjunction with this data, i-Tree Streets can be further customized to produce a specific tree benefit-cost ratio unique to the City of Livingston. Defined annual costs include:

1. Planting
2. Pruning
3. Stump removal and disposal
4. Pest and disease control
5. Irrigation/watering
6. Price of repair or mitigation of infrastructure damage
7. Storm damage and litter clean up
8. Litigation and settlement costs related to tree claims
9. Program administration expenses
10. Inspection/consulting fees

The City of Livingston should use all available media sources to inform and educate their community about the actual benefits that trees provide, and the actual costs that it takes to manage and sustain healthy, safer trees.
Information regarding “ownership” of boulevard trees could be included.

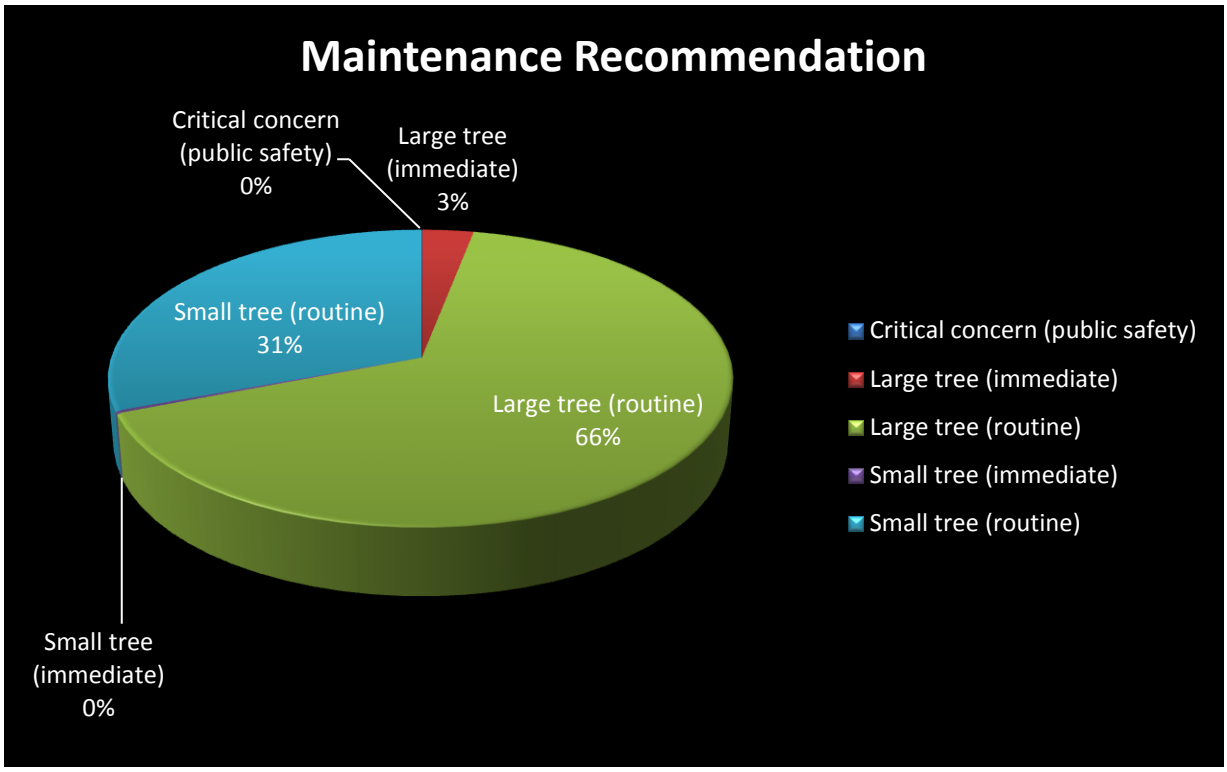
All previously- topped trees located under overhead power lines should be scheduled for removal. Those ash trees whose inventory condition is rated as "poor" to "dead/dying" should be removed first. Northwest Energy should be contacted to see if they will remove these trees at no cost to the City.

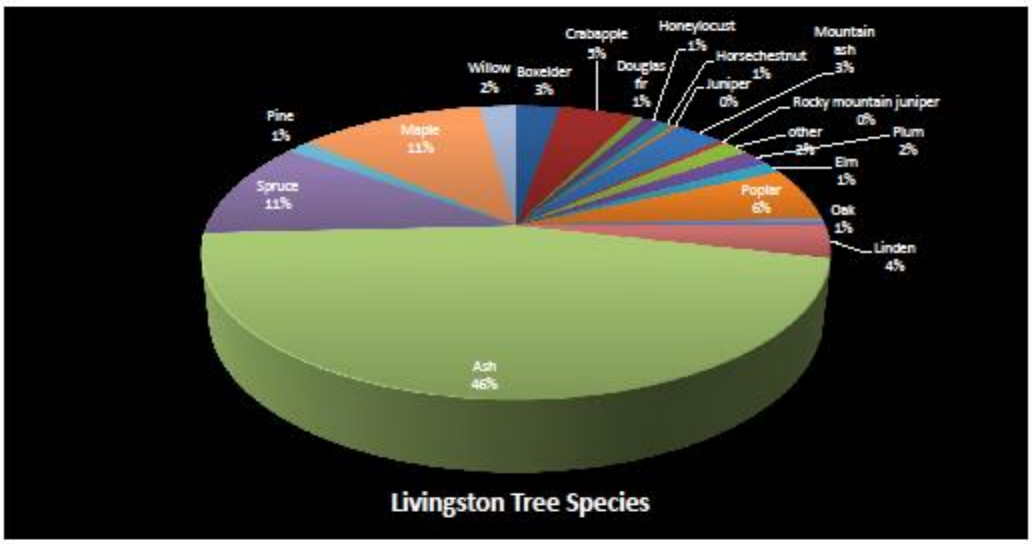
Budgets for tree maintenance should include costs associated with the regular irrigation of park trees that have been planted within the last 5 years. A dedicated water truck works best for this work, and each tree should have a minimum of 5-10 gallons of water applied weekly during the months of July through August.
Park trees, especially trees planted within the last 5 years should have turf removed at least 12-24 inches from the stem and inexpensive organic matter such as grass clippings should be installed to a depth of 2 inches. Organic coverings like grass clippings help reduce mower and trimmer damage to tree bark, cools roots and helps retain soil moisture, and protects the tree from contact with herbicide applications.

Companies contracting the City for tree trimming/pruning should be required to have at least one International Society of Arboriculture (ISA) Certified Arborist on staff and on site when work is performed on parks, boulevards, and cemetery trees.
Topping of trees on public property should be strictly prohibited by the City, and the City should consider developing a protocol that calls for warnings and fines for contractors who top trees.

The City should consider expanding its tree species diversity by planting the following trees in appropriate sites relative to their natural height and shape:
Swamp white oak (*Quercus bicolor*)
Gingko biloba (*Ginkgo biloba*)
Amur Maackia (*Maackia amurensis*)
Amur Corktree (*Phellodendron amurense*)
Lacebark elm (*Ulmus parvifolia*)

The City should utilize all available media sources to inform the community about the potential destruction of ash trees caused by the emerald ash borer. Information should include EAB identification descriptions and protocols for reporting suspected activity. This protocol can be downloaded from the Montana Department of Natural Resource and Conservation website: http://dnrc.mt.gov. Click "MUCFA" and open "EAB Sampling Protocol.
The City should be prepared to spend at least $150,000.00 in preventative insecticide applications to control EAB. **NOTE**: Chemicals applied to manage EAB will not control ash bark beetles.
*The creation of a city-wide tree management plan should identify ash trees that may not be worth saving (due to poor condition ratings) and figure out the difference between costs of removal versus retention.


Maintenance Recommendation
Critical concern (public safety) 0%
Large tree (immediate) 3%
Small tree (routine) 31%
Large tree (routine) 66%
Small tree (immediate) 0%
Critical concern (public safety)
Large tree (immediate)
Large tree (routine)
Small tree (immediate)
Small tree (routine)


Crabapple 3%
Honeylocust 1%
Mountain ash 3%
Willow 2%
Boxelder 3%
Douglas fir 1%
Horsechestnut 1%
Juniper 0%
Rocky mountain juniper 0%
Pine 1%
Maple 11%
other 2%
Plum 2%
Elm 1%
Spruce 11%
Poplar 6%
Oak 1%
Linden 4%
Ash 46%
Livingston Tree Species

Livingston

Importance Values of Public Trees

9/5/2014

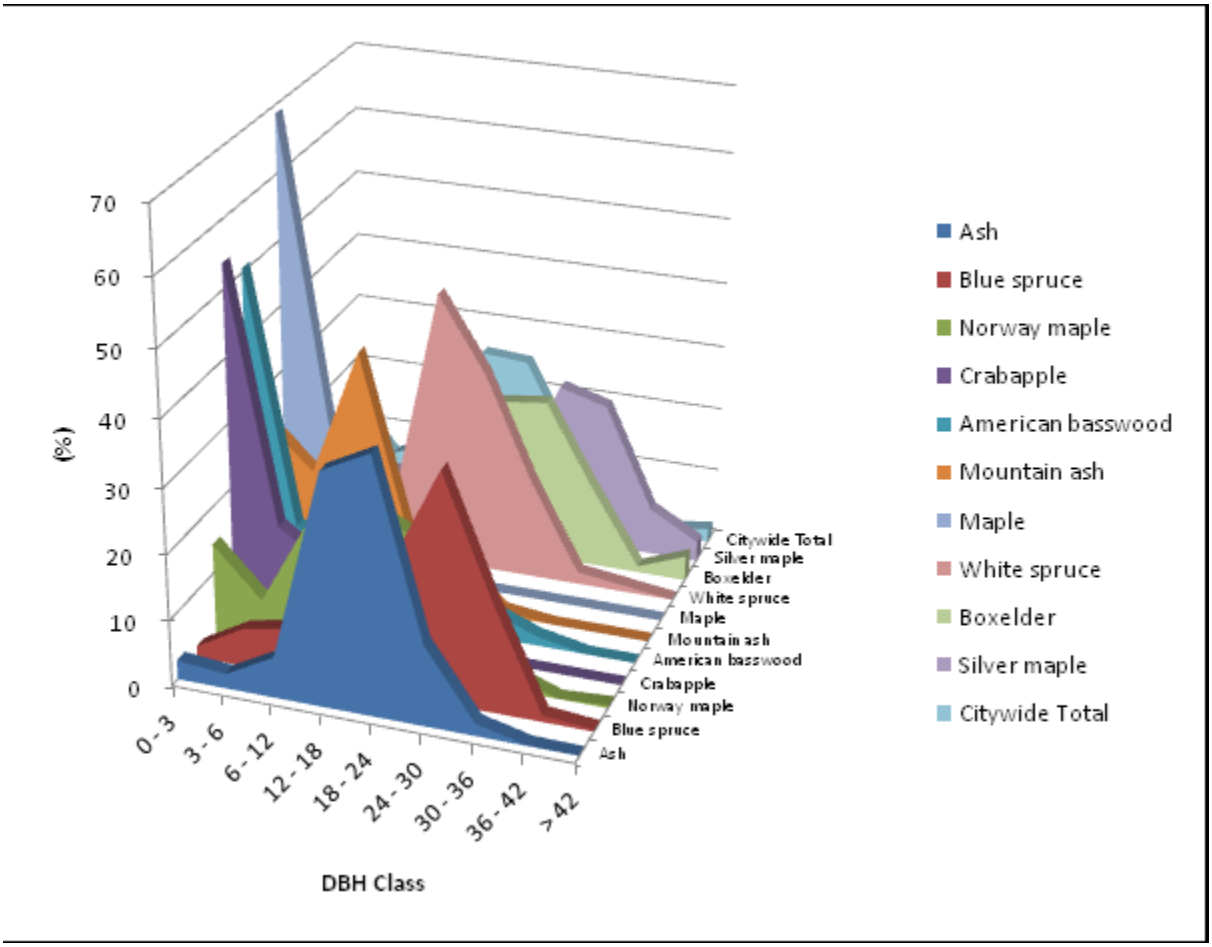
Species	Number of Trees	% of Total Trees	Leaf Area (ft²)	% of Total Leaf Area	Canopy Cover (ft²)	% of Total Canopy Cover	Importance Value
Ash	1,770	45.62	11,568,290	57.61	2,338,350	59.20	54.15
Blue spruce	289	7.45	1,569,699	7.82	205,504	5.20	6.82
Norway maple	215	5.54	802,477	4.00	189,352	4.79	4.78
Crabapple	182	4.69	143,931	0.72	54,741	1.39	2.26
American basswood	138	3.56	318,238	1.58	42,566	1.08	2.07
Mountain ash	117	3.02	123,069	0.61	50,419	1.28	1.63
Maple	112	2.89	40,332	0.20	12,415	0.31	1.13
White spruce	106	2.73	414,375	2.06	63,390	1.60	2.13
Boxelder	104	2.68	854,503	4.26	163,141	4.13	3.69
Silver maple	97	2.50	873,954	4.35	167,912	4.25	3.70
White poplar	91	2.35	1,180,096	5.88	212,691	5.39	4.54
Quaking aspen	88	2.27	65,349	0.33	16,012	0.41	1.00
Cherry plum	59	1.52	15,495	0.08	7,807	0.20	0.60
Willow	47	1.21	313,573	1.56	63,144	1.60	1.46
Honeylocust	43	1.11	53,658	0.27	15,803	0.40	0.59
White willow	41	1.06	440,693	2.19	81,320	2.06	1.77
Cottonwood	37	0.95	244,763	1.22	48,308	1.22	1.13
Siberian elm	33	0.85	280,494	1.40	48,273	1.22	1.16
Horsechestnut	29	0.75	111,128	0.55	26,953	0.68	0.66
Bur oak	28	0.72	7,693	0.04	2,111	0.05	0.27
Austrian pine	27	0.70	36,367	0.18	7,884	0.20	0.36
Douglas fir	26	0.67	82,833	0.41	13,880	0.35	0.48
American elm	16	0.41	99,317	0.49	22,998	0.58	0.50
Rocky mountain juniper	16	0.41	21,455	0.11	4,544	0.12	0.21
Ponderosa pine	15	0.39	40,318	0.20	6,097	0.15	0.25
Juniper	14	0.36	23,218	0.12	4,888	0.12	0.20
Scotch pine	12	0.31	8,432	0.04	2,110	0.05	0.13
Sugar maple	12	0.31	50,031	0.25	12,691	0.32	0.29
Norway spruce	10	0.26	31,817	0.16	5,421	0.14	0.18
Black locust	9	0.23	30,081	0.15	6,367	0.16	0.18
Northern hackberry	9	0.23	32,877	0.16	6,419	0.16	0.19
Plum	9	0.23	1,098	0.01	659	0.02	0.08
Engelmann spruce	8	0.21	23,587	0.12	4,032	0.10	0.14
Broadleaf Deciduous	8	0.21	2,521	0.01	1,055	0.03	0.08
Plains cottonwood	7	0.18	76,871	0.38	15,784	0.40	0.32
Common chokecherry	7	0.18	7,055	0.04	2,527	0.06	0.09
Hawthorn	6	0.15	4,626	0.02	1,907	0.05	0.08
Birch	5	0.13	14,645	0.07	3,784	0.10	0.10
Russian olive	4	0.10	2,912	0.01	1,272	0.03	0.05
Serviceberry	4	0.10	445	0.00	230	0.01	0.04
Black walnut	4	0.10	25,164	0.13	5,225	0.13	0.12
Sumac	4	0.10	723	0.00	379	0.01	0.04
Black spruce	4	0.10	9,795	0.05	1,663	0.04	0.06
Amur maple	4	0.10	3,190	0.02	1,421	0.04	0.05
Pine	3	0.08	4,487	0.02	919	0.02	0.04
linden	2	0.05	1,888	0.01	436	0.01	0.02
Honeysuckle	2	0.05	5,775	0.03	1,820	0.05	0.04
Red maple	1	0.03	70	0.00	22	0.00	0.01
Pear	1	0.03	42	0.00	19	0.00	0.01
Red cedar	1	0.03	1,044	0.01	271	0.01	0.01
Swamp white oak	1	0.03	70	0.00	22	0.00	0.01
Balsam poplar	1	0.03	14,138	0.07	2,526	0.06	0.05
Littleleaf linden	1	0.03	20	0.00	17	0.00	0.01
Black poplar	1	0.03	530	0.00	190	0.00	0.01
Total	3,880	100.00	20,079,252	100.00	3,949,690	100.00	100.00

1

Livingston

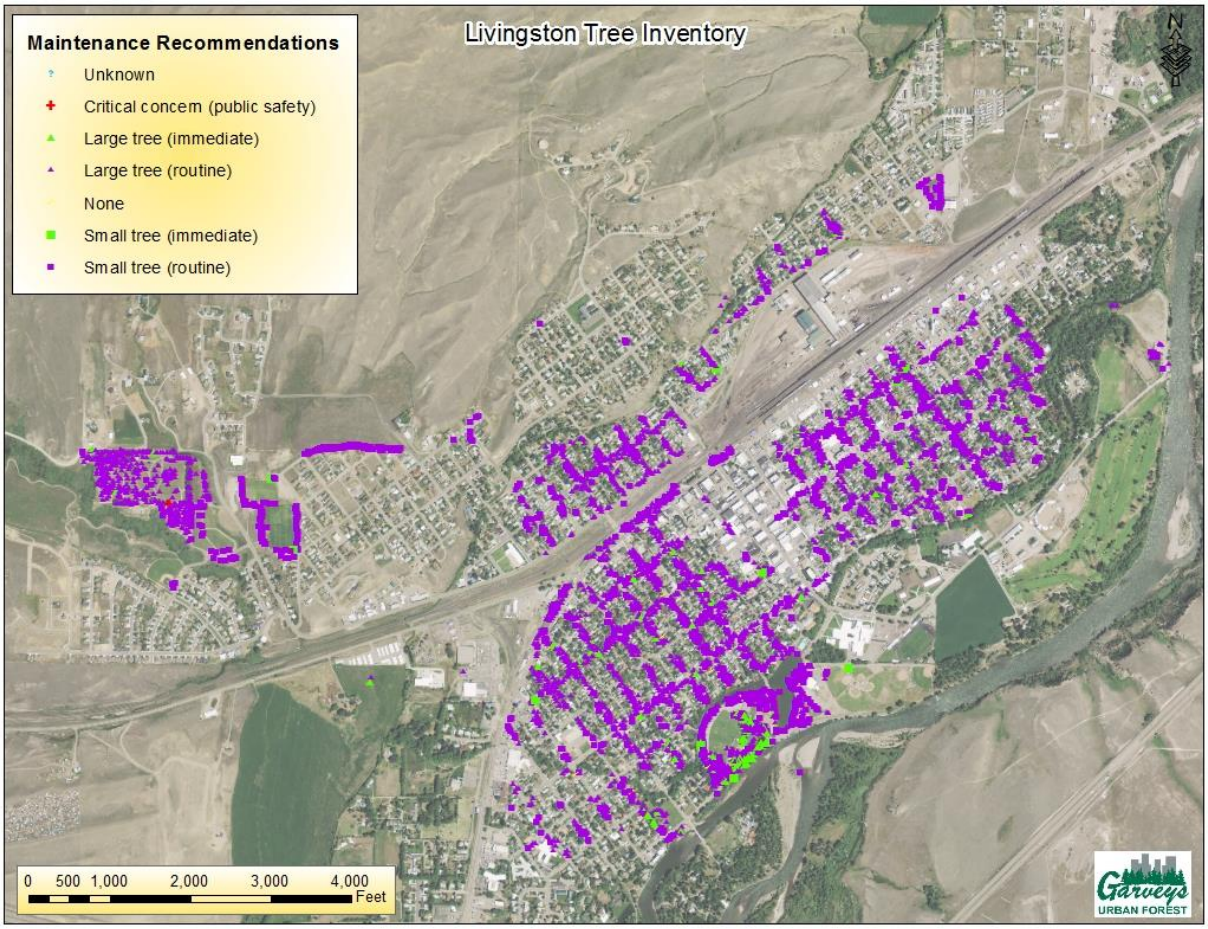
Relative Age Distribution of Top 10 Public Tree Species for All Zones (%)

9/5/2014



DBH class (in)

Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	> 42
Ash	2.94	2.26	6.21	35.31	39.04	12.20	1.92	0.11	0.00
Blue spruce	1.73	5.88	7.27	12.11	19.72	34.95	16.96	1.04	0.35
Norway maple	14.42	6.98	20.47	25.12	21.40	8.37	2.79	0.00	0.47
Crabapple	53.85	15.38	10.44	13.74	5.49	1.10	0.00	0.00	0.00
American basswood	50.72	12.32	8.70	14.49	7.97	4.35	1.45	0.00	0.00
Mountain ash	24.79	17.95	37.61	11.11	7.69	0.85	0.00	0.00	0.00
Maple	68.75	22.32	8.04	0.89	0.00	0.00	0.00	0.00	0.00
White spruce	0.00	0.94	7.55	42.45	31.13	15.09	1.89	0.94	0.00
Boxelder	4.81	4.81	3.85	20.19	24.04	25.00	12.50	0.96	3.85
Silver maple	11.34	7.22	6.19	8.25	9.28	24.74	22.68	7.22	3.09
Citywide Total	14.90	6.37	9.77	25.41	24.90	11.42	4.02	1.08	2.14


Livingston Tree Inventory
Maintenance Recommendations
Unknown
Critical concern (public safety)
Large tree (immediate)
Large tree (routine)
None
Small tree (immediate)
Small tree (routine)
N
0 500 1,000 2,000 3,000 4,000
Feet
Garvey's
URBAN FOREST

GLOSSARY

Canopy
All the leaves, twigs, branches, and limbs of a tree. When including the main stem or trunk, the term is often called the "crown".

Genera
Plural form of genus. A biological division of trees [ranked below Family and above Species] that share common physical and genetic traits and that can interbreed to reproduce trees with the same qualities. Pronounced: jen´ er ah.

Hazard
"A likely source of harm. In relation to trees, a *hazard* is the tree part(s) identified as a likely source of harm". [Smiley, E., Matheny, Nelda, Lilly, Sharon.2011. *Tree Risk Assessment: Best Management Practices*. International Society of Arboriculture.

Risk
"The combination of the likelihood of an event and severity of the potential consequences. In the context of trees, risk is the likelihood of a conflict or tree failure occurring and affecting a target and the severity of the associated consequences-personal injury, property damage, or disruption of services." ". [Smiley, E., Matheny, Nelda, Lilly, Sharon.2011. *Tree Risk Assessment: Best Management Practices*. International Society of Arboriculture.

Sign
Physical, left over evidence created by insects, mites, humans, and diseases that help diagnose and identify the first cause of a specific tree problem related to its structural and biological health. Example: the discovery of an ash bark beetle beneath the bark of an ash tree is a sign.

Symptom
The appearance or reaction of a tree affected by insects, mites, humans, and diseases. Example: yellow leaves seen on a maple tree. **Note**: Several factors can cause the same symptoms: yellow leaves on a maple tree could be caused by aphids, bacterial infection, nutrient deficiency, waterlogged soils, branch or root damage, weather events, seasonal changes, herbicide damage, or the combination of all factors.

Target(s)
People, homes, pets, cars, utility lines, and infrastructure located within the fall zone of a specific tree that could be harmed, injured, or damaged by that tree's failure. The fall zone of a tree can be measured at 1.5 times its height.

FADING AND DYING ASH TREES: COMMON THROUGHOUT LIVINGSTON. BOTH TREES ON LEFT SIDE OF PHOTOS ARE RATED: POOR TO DYING CONDITION

FADING AND DYING ASH TREES: TYPICAL THROUGHOUT LIVINGSTON. ARROWS POINT TO TREES RATED AS “REMOVALS”

TREES OUTGROWING THEIR SPACE

PHOTO SHOWS A RESPROUTED COTTONWOOD TREE STUMP

ROOTS OUTGROWING THEIR SPACE

PHOTO SHOWS EXTREME EXAMPLE OF OVERGROWN ROOTS. * THIS SILVER MAPLE MAY BE THE LARGEST MAPLE OF ITS KIND IN MONTANA.

PHOTO SHOWS TYPICAL ROOT DAMAGE TO BOULEVARD TREES THAT HAVE RAISED OR EXPOSED SUPPORTING ROOTS

CONFLICTS WITH UTILITY LINES: HIGH RISK AND HIGH MAINTENANCE

PHOTO SHOWS TYPICAL LINE CLEARING TECHNIQUE KNOWN AS “DROP CROTCH” PRUNING. SUCH WORK TENDS TO TRANSFER EXTRA WEIGHT & LOADS ONTO OUTER BRANCHES. MANY PEOPLE DON’T LIKE THE FINAL LOOK THAT THIS WORK PRODUCES.

CONTACT WITH UTILITY LINES: HAZARDOUS AND RISKY

SIGNAGE CONFLICTS: HAZARDOUS AND RISKY

*City of Livingston ordinance specifies a 28 foot setback from stop signs and a 10 foot setback from other signs.

ARROW POINTS TO A STOP SIGN COMPLETELY COVERED BY FOILAGE

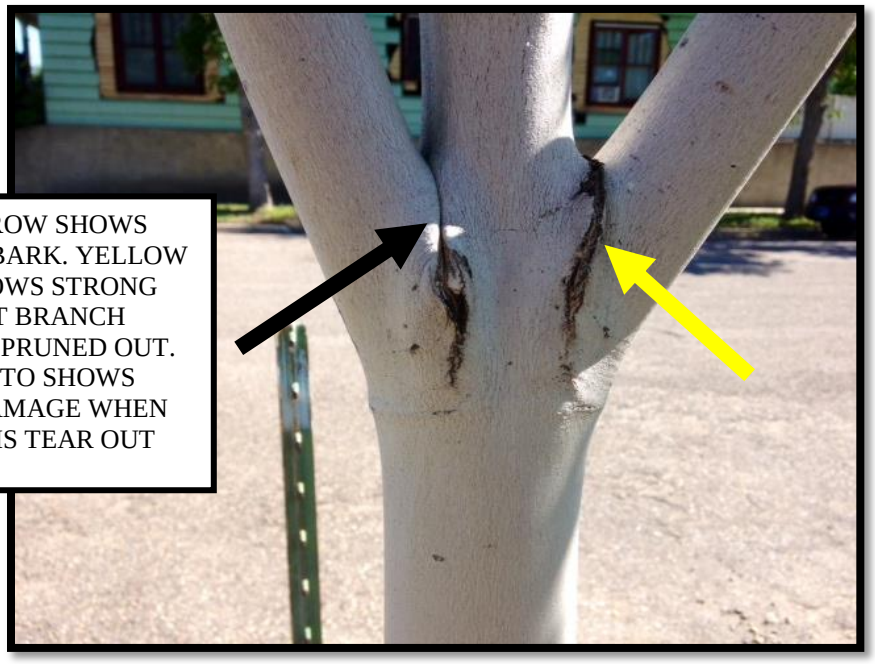
DEAD WOOD: CAN FAIL AT ANY TIME - UNPREDICTABLE & RISKY

HANGERS: UNATTACHED BRANCHES ELEVATE RISKS. VERY COMMON IN LIVINGSTON'S BOULEVARD, PARK, AND CEMETERY TREES

HEALTHY LOOKING SILVER MAPLE WITH A DANGEROUS CAVITY ON THE MAIN STEM**: TREES WITH HAZARDS AND HIGH RISKS CAN STILL LOOK HEALTHY**

SPLIT MAIN STEMS: DANGEROUS HAZARDS AND HIGH RISKS

CO DOMINANT STEM WITH INCLUDED BARK:

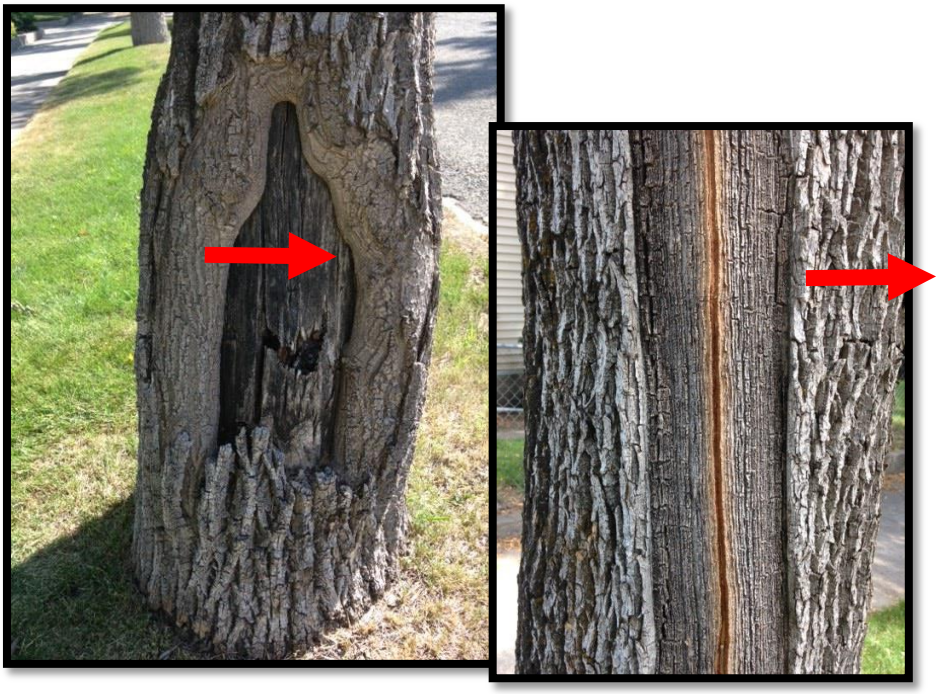


BLACK ARROW SHOWS INCLUDED BARK. YELLOW ARROW SHOWS STRONG UNION. LEFT BRANCH SHOULD BE PRUNED OUT. LOWER PHOTO SHOWS TYPICAL DAMAGE WHEN WEAK STEMS TEAR OUT

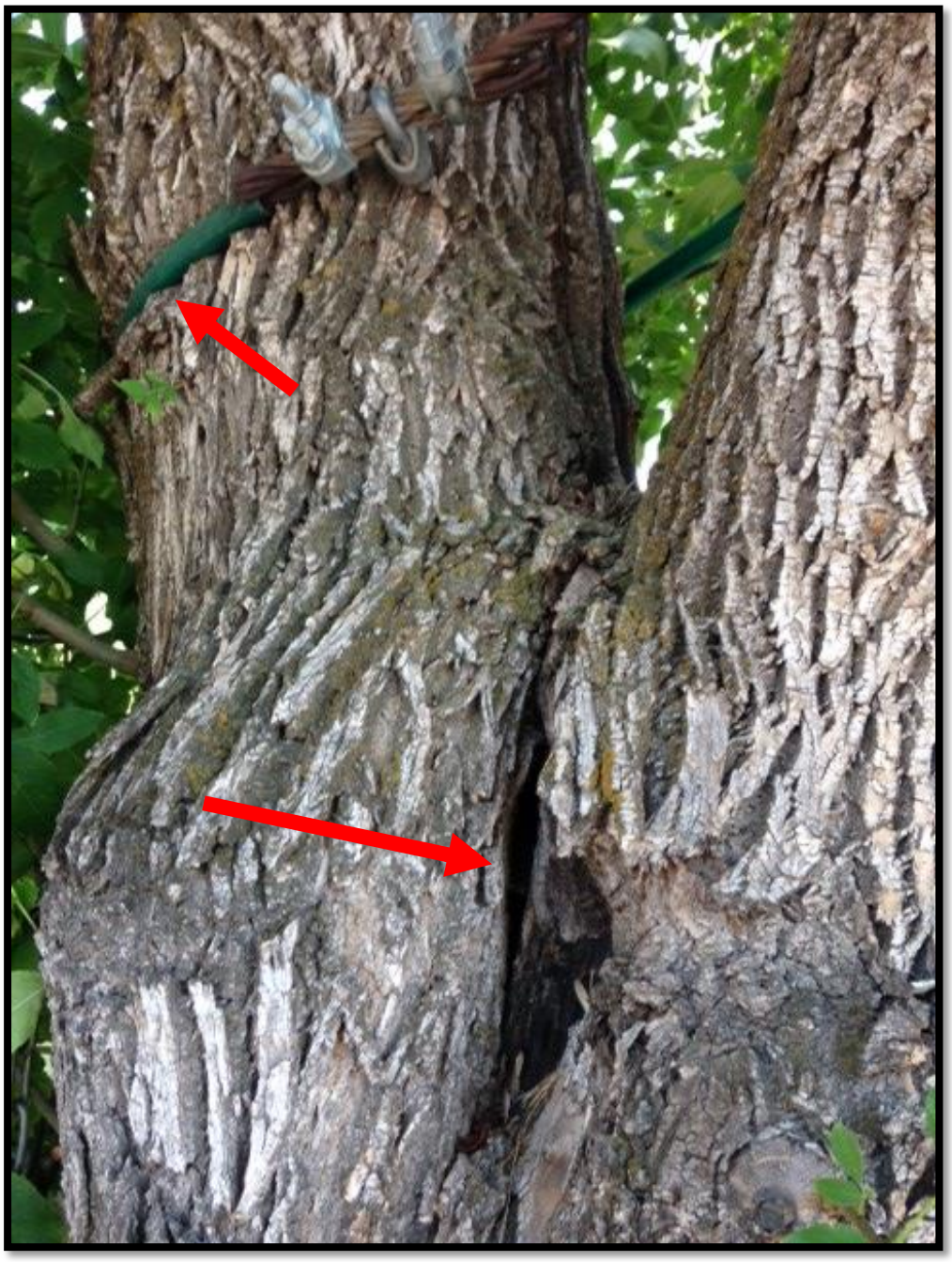
CO DOMINANT STEMS: WEAK STRUCTURAL UNIONS THAT TEND TO FAIL.
COMMON DEFECT SEEN ON LIVINGSTON'S TREES

CAVITIES, HOLLOWNESS, AND DECAYING WOOD: DIFFICULT TO VISUALLY ASSESS EXTENT OF INNER DECAY

COMMON DAMAGE ON TREE STEMS: RIGHT PHOTO SHOWS MECHANICAL DAMAGE THAT IS STARTING TO DECAY. RIGHT PHOTO SHOWS A “SEAM” CAUSED BY A LIGHTENING STRIKE.



UNSKILLED TREE WORK: RIGID CABLES MAKE THE TREE UNABLE TO SWAY NATURALLY UNDER WIND LOADS AND ARE REDUCING UPTAKE OF WATER DUE TO CABLE GROWING INTO BARK & WOOD. LOWER ARROW POINTS TO DANGEROUS CRACK IN STEM-TREE SHOULD HAVE BEEN REMOVED

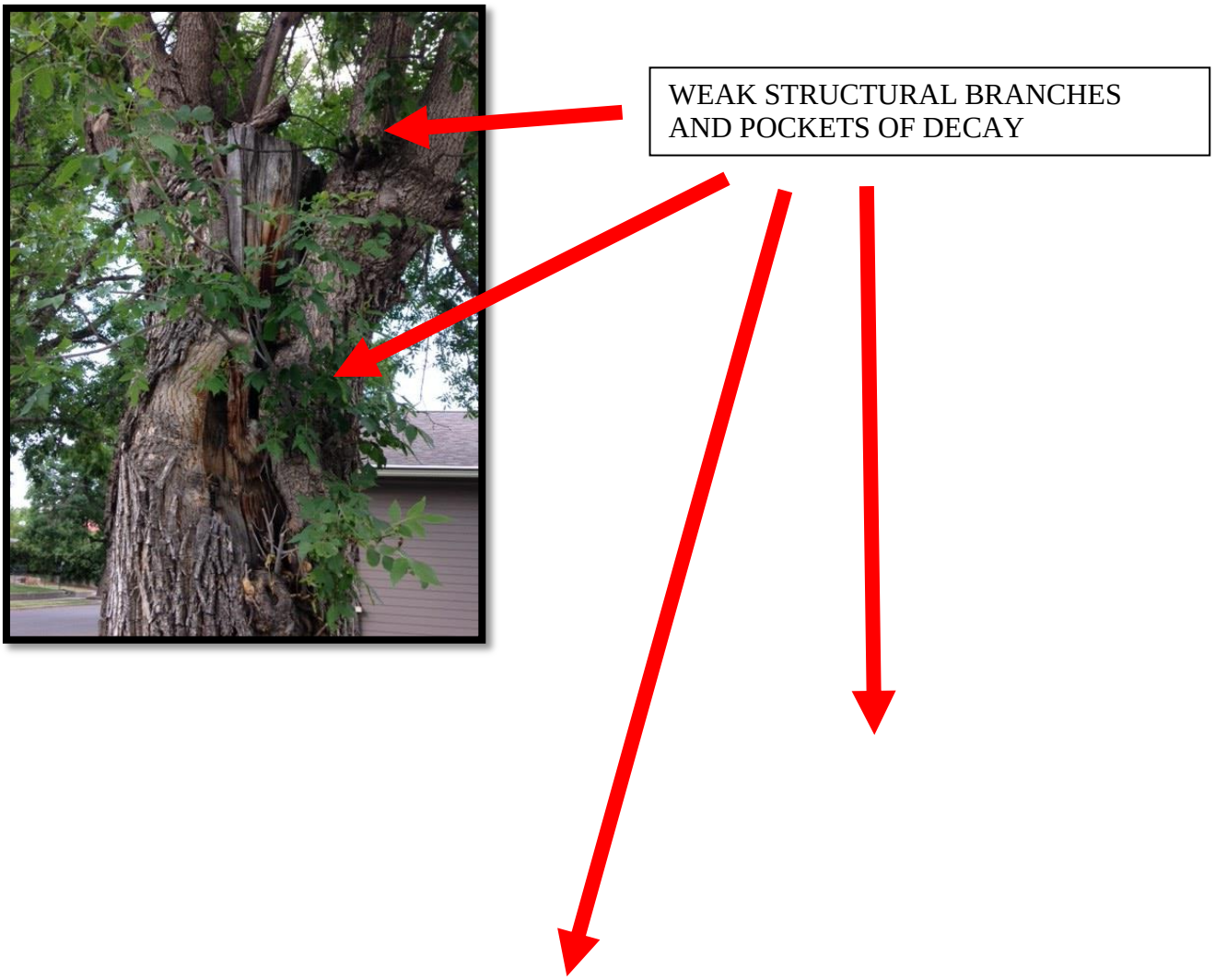


UNSKILLED TREE WORK: TOPPING CUTS: ALL BRANCHES IN THIS PHOTO ARE WEAKLY ATTACHED AND PRONE TO FAILURE

UNSKILLED TREE WORK: TOPPING CREATES HAZARDS & ELEVATES RISK

ARROWS POINT TO LIMBS THAT HAVE BEEN “TIPPED” OR “STUBBED”-ANOTHER FORM OF TOPPING THAT PRODUCES WEAKLY-ATTACHED NEW GROWTH.

UNSKILLED TREE WORK: TOPPING CREATES HAZARDS & ELEVATES RISKS



UNSKILLED TREE WORK: EXTREME CANOPY RAISING REDUCES STRUCTURAL STABILITY AND INCREASES CHANCE OF FAILURE

CONFLICTS, HAZARDS, AND RISKS ASSOCIATED WITH SIDEWALKS HEAVED BY TREE ROOTS. VERY COMMON ON LIVINGSTON'S BOULEVARDS

CONFLICTS: TREE ROOTS & CONCRETE - RISKY AND EXPENSIVE TO FIX

HARMFUL INSECTS SEEN ON LIVINGSTON'S GREEN ASH TREES. **NOTE**: THESE INSECTS ARE **NOT** EMERALD ASH BORERS

ARROW POINTS TO AN ADULT ASH BARK BEETLE (*Hylesinus californicus*). EACH TUNNEL AND HOLE IN BARK EQUALS ONE BEETLE.

ARROW IN LOWER PHOTO SHOWS AN ADULT BANDED ASH BORER (*Neoclytus caprea*). BOTH INSECTS TEND TO ATTACK ASH TREES IN POOR HEALTH AND VIGOR

MUSHROOMS: SIGNS OF POTENTIAL DECAY AND ROT

FOLIAR SYMPTOMS OF TREES IN DECLINING HEALTH & COLOR:
LEAF SCORCH ON BUCKEYE & MAPLE TREES

MIKE WEBB PARK: HUMAN- CAUSED TREE DEATH. ARROW POINTS TO MECHANICAL DAMAGE ON STEM. LACK OF WATER IS ALSO A PROBLEM

NORTH SIDE SOCCER PARK: DEAD & DYING TREES FROM LACK OF WATER

KATIE BONNELL PARK: DYING TREES CAUSED BY LACK OF WATER AND MECHANICAL DAMAGE ON STEMS

PROBLEMS WITH NEW TREE PLANTINGS: NO AFTERCARE MANAGEMENT

BITTERROOT & 12TH STREET NORTH WALKING TRAIL. DEAD WITHIN ONE YEAR OF PLANTING

LEWIS AVENUE. SEVERAL MAPLES DEAD FROM LACK OF WATER

PROBLEMS WITH NEWLY PLANTED TREES: MOWER & TRIMMER DAMAGE TO MAIN STEMS IS A LEADING CAUSE OF DECLINE AND DEATH

BOZEMAN PARK: ARROW POINTS TO BURROWING ANIMAL DAMAGE OF ROOTS
MANY TREES IN THIS PARK HAVE EXTENSIVE ROOT DAMAGE CAUSED BY BURROWING

GOOD NEW TREE SPECIES: TOP LEFT PHOTO: AUTUMN BLAZE MAPLE. TOP RIGHT PHOTO-BUR OAK. BOTTOM PHOTOS: TATARIAN MAPLE “HOTWINGS”

SUSTAINABLE MANAGEMENT PLANTING TECHNIQUES: GATOR WATER BAGS AND WATER WELLS TO PROTECT STEMS FROM MOWER & TRIMMERS

FACTORS THAT AFFECT RISK ASSESSMENT: BOTH TREES LEAN.
THE LIKIHOOD OF FAILURE AND THE POTENTIAL EXTENT OF DAMAGES TO HIGH VALUE TARGETS NEED TO BE EVALUATED

FACTORS AFFECTING RISK RATINGS: TARGET OCCUPANCY RATES

FACTORS ASSOCIATED WITH RISK:
MOVING AND STATIC HIGH VALUE TARGETS

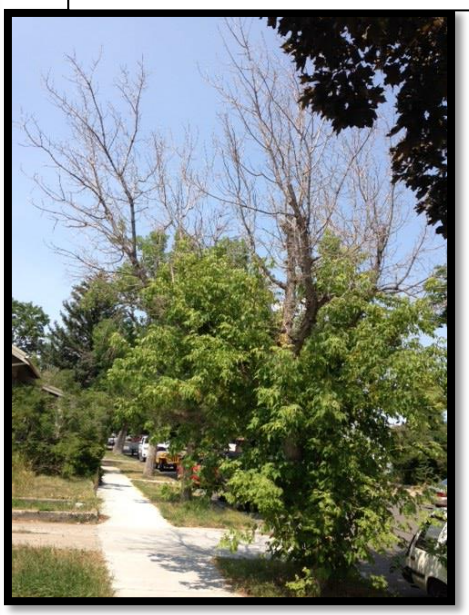
FACTORS ASSOCIATED WITH RISK: ***THE TIME OF SEASON***.
MOVABLE AND NON-MOVABLE TARGETS

SPRUCE & FIR TREES MAY POSE A HIGHER RISK IN WINTER WHEN KIDS ARE SLEDDING ON HILL DOWNWIND FROM TREES & UNMOVABLE UTILITY LINES. HEAVY SNOW & ICE MAY ELEVATE HAZARDS IN WINTER

MOVABLE BENCH MAY REDUCE OCCUPANCY RATES IN SUMMER WHEN RIVER RECREATION & TOURISM DRAWS MORE PEOPLE.* NOTE DEFECT ON TREE STEM

PROBLEMS CREATED BY HAZARD & RISK MITIGATION:
NEW SIDEWALK INSTALLATION WORK ELIMINATES TRIPPING ON UPLIFTED WALKS BUT CONTRIBUTES TO TREE DECLINE BY REMOVING, OR DAMAGING TREE ROOT ANCHORAGE, ENERGY RESERVES, AND WATER TRANSPORT

FADING TREES IN ASSOCIATION WITH NEW SIDEWALK REPAIR & REPLACEMENT



ANY TREE CAN FAIL AT ANY TIME

MOUNTAINASH TREE SNAPPED OFF AT STEM

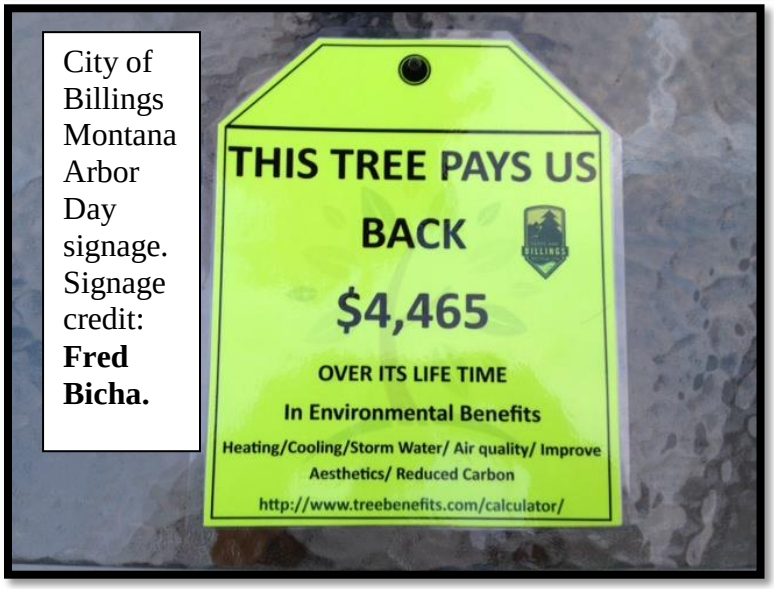
NOTE: Mountainash (*Sorbus aucuparia*) is not an ash (*Fraxinus* species) tree!

FUTURE BOULEVARD TREE ISSUES:
CURRENT INSTALLATION OF UNDERGROUND UTILITY LINES HAS CAUSED HARM BY CRUSHING, GOUGING, DRYING, AND REMOVING ROOTS

FUTURE RECOMMENDATIONS:
INTRODUCE NEW TREE SPECIES THAT ARE APPROPRIATE FOR THE PLANTING SITE. KEEP OBSERVING EXISTING TREES IN RELATION TO THE MANY FACTORS THAT AFFECT THEIR STRENGTH, HEALTH, AND AMENITY VALUES

WHAT CONDITION WILL THIS ASH TREE BE IN THE NEXT 2 YEARS?

Sacajawea Park



City of Billings Montana Arbor Day signage. Signage credit: **Fred Bicha.**

THE LOOK OF LIVINGSTON:
WITH AND WITHOUT TREES