City of Aspen

COMMUNITY FOREST MANAGEMENT PLAN

October 2018

Parks & Recreation
Open Space & Natural Resources
Forestry Division

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City of Aspen

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EXECUTIVE SUMMARY

The Community Forest Management Plan (CFMP) is a 10-year vision for the City of Aspen. It will require the continuation of an integrated ecosystem-based management approach to develop a sustainable and resilient resource. That resource is recognized as a tangible asset which confers broad benefits to all citizens of the City of Aspen and complements the biodiversity values of the surrounding natural environment. There are three primary goals in this iteration of the CFMP which continue the tradition of comprehensive urban forest stewardship in Aspen: 1. Protection, maintenance and enhancement of the urban forest. 2. Design and management of the urban forest to preserve canopy cover and maximize the environmental, social, health, and economic benefits. 3. Development, consolidation and expansion of strong community understanding of the issues impacting the urban forest and support for the forest management plan.

OBJECTIVE

The objective of the City of Aspen Community Forest Management Plan is to provide direction for the future of our forest via management by the City of Aspen Parks Department. This plan will outline the implementation of strategies to maintain a fully stocked, healthy, dynamic, and aesthetically pleasing forest for the citizens and visitors of Aspen, now and into the future.

BACKGROUND

Trees have contributed greatly to the rich history of Aspen, Colorado. The native forests surrounding our city provided the first settlers with the necessary basic resources that have made our city what it is today. The mining business, with the help of the stately trees surrounding this area, put Aspen on the map back in the late 1800s with the history and benefits of our community forest outlined below.

HISTORY

After several shipments of eastern trees were planted with little success, the miners began relocating trees that were growing in the drainages and along our streams. Primarily, these trees consisted of Narrowleaf cottonwood, Colorado Blue and Engelmann spruce, Quaking aspen, Douglas fir, and were planted methodically in a grid system to imitate landscape designs large east coast cities like Philadelphia, New York, and Boston.

These cities had already established street tree plantings, as we know them today, along main traffic corridors. The single most important development was the installation of water carrying ditches, which were the lifeblood of the trees planted in early Aspen. These ditches can still be seen throughout town and are credited in keeping many of the trees alive during the slow times following the silver boom.

In the 1960s and early 1970s, the City of Aspen hired tree contractors to address the community forest. During those days, tree topping was common practice and was conducted on many of the trees slated for maintenance. Unfortunately, most of these trees died within the next 10 years as a result of these pruning techniques. The community forest was almost entirely comprised of just 3 species of trees, spruce, aspen, and cottonwood. The need for diversification was evident in order to avoid the potential threats that arise when monocultures exist. In the 1980s, the City of Aspen created the Parks & Open Space Department, and the community forest fell under its jurisdiction. During this time, the Parks & Open Space Department started planting varying species of trees in addition to the traditional species throughout the community. Community diversification was greatly enhanced with the introduction of the backyard forestry portion of the annual Arbor Day celebration, during which different species of trees that thrive in our climate are given to residents. In the 1980s, the City of Aspen also began the process for developing tree protection ordinances within the municipal code. In 1995, the City introduced the first tree ordinance, which called for the permitting process to remove trees (Appendix A). In addition, this ordinance gave definition to individual tree values and how these values are determined. The need for a professional forester/arborist arose in 1998, coinciding with the failure of several large trees throughout town. At that time there were over 3000 available planting spots and the urban forest was in poor shape. The new tree inventory revealed a healthy report card, with near full stocking levels given that there are less than 150 plantable spots within City limits on City property and a manageable percentage of older senescent trees.

The City of Aspen has had the Arbor Day Foundation 'Tree City USA' designation for 26 years and won a further Growth Award in 2018. The Parks & Open Space Department's forest management team currently consists of the Director of Parks and Recreation, Director of Parks and Open Space, Open Space and Natural Resource Manager, City Forester, and the Forestry Crew. In 2018, the Department is working toward building on that long history providing a long term, defined direction to nurture and protect Colorado's premier high-altitude resort community forest here in Aspen by following best management practice. With 30 designated parks, 1000 acres of protected open space and over 10,000 trees in the inventory, the Parks Department has demonstrated a high level of commitment to environmental protection generally and the preservation of the community forest. Since the last Community Forest Management Plan was written the City has added 4 more parks and all the trees on the Aspen Golf Course to its inventory. This high level of commitment to professional and cutting-edge management will continue.

The previous CFMP noted that the City of Aspen was at something of a crossroads due to the many over-mature narrowleaf cottonwoods that comprise much of the canopy cover throughout town. Although many of these individual trees have thrived in our community for upwards of 80 to 90 years, they are now approaching the end of their life span. In a natural setting, given ideal conditions, these

trees could last several more years, but the urban environment with its various stresses usually reduces the life span of most trees. It is one of the objectives of this plan to continue to maintain these heritage trees through arboriculturally sound practices up to the point when the tree becomes a liability in terms of community safety and its potential threat to the surrounding forest. There may be a need to accelerate the removal of hazardous trees. Re-planting these vacant spots quickly will be an important part of regenerating the canopy cover and increasing age and species diversity.

The loss of several narrowleaf cottonwoods throughout town due to natural maturation will render a community forest that will look quite different from the one we have today. The City of Aspen has been addressing the risks of an over-mature forest and will continue to do so. This document will detail those on-going efforts and the regular maintenance efforts needed to sustain a vibrant community forest resource. Upwards of 300 new trees are planted annually, along with the replacement of each large cottonwood that is removed. This younger, healthier forest will ensure that the citizens of Aspen and all who visit will enjoy our forest well into the next century.

It will be important to raise public awareness of the importance of the community forest. This comfortably fits the "Aspen Idea" of harmony between mind, body & spirit that defines Aspen – environmental health is integral to human health. Expansion of stakeholder outreach will be pursued with a view to both deepening citizen awareness of the importance of the community forest and active involvement in its preservation. Programs which focus on involving school children in tree planting events and educational activities will be broadened. Part of a wider community consideration is to remind people that the community forest is not just the area that the City maintains but also those areas privately owned. The community forest is the sum of trees growing on both public and private land. The Parks & Open Space Department, in conjunction with other City departments, will endeavor to foster that awareness with a view to preserving canopy coverage generally and protecting trees specifically. On-going development, invasive exotic insects and climate change pose the greatest threats to the sustainability of our community forest. To ensure the integrity of the community forest and maintain the desired canopy coverage, closer scrutiny of building footprint trend is recommended. Climate change will also require vigilance to prepare for both extended periods of drought, wildfire risk and abnormal or unseasonal storm events.

BENEFITS

It is well known that trees have many positive effects, particularly in the urban environment. These are increasingly quantifiable and are known as ecosystem benefits. In Aspen we are fortunate to have an extensive community forest as well as the natural forest in surrounding areas. In both cases, these trees contribute to our high quality of life in the following ways:

- Root systems significantly reduce erosion in many types of landscapes and especially slopes. In addition, as stated by the U.S. Forest Service, root systems can reduce peak storm runoff by up to 20%.
- The photosynthetic process of trees cleans the air. Carbon dioxide is sequestered during this process and oxygen is created. In addition to sequestering carbon dioxide, many sulfur dioxide and nitrogen oxide particles (major components in acid rain and ozone) are removed from the air.
- Trees have historically increased property values as well as economic stability. A University of Washington study (Wolf, 1998) shows that consumers are willing to pay 11% more for goods in a

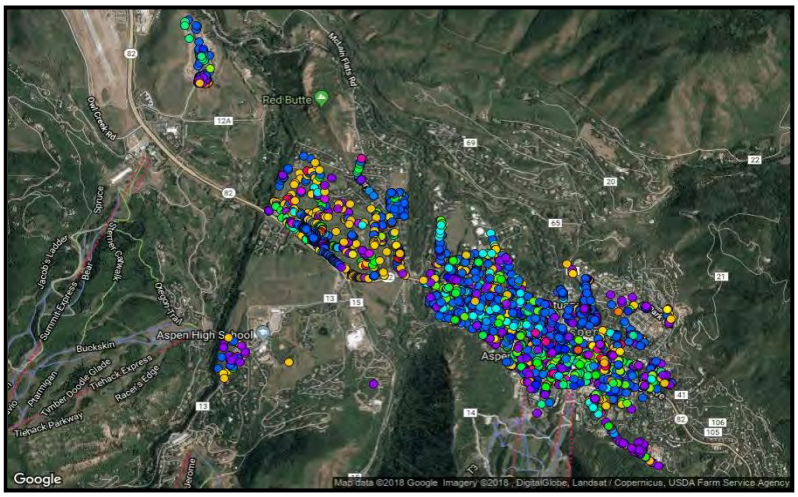
landscaped business district than a non-landscaped district. This figure was as high as 50% for convenience goods.

- In addition to the aesthetic benefit of our numerous street and right of way trees, they have a behavioral benefit. Trees lining the streets give the impression of narrowing the street, which encourages slower driving. Higher percentages of canopy cover are also correlated with safer neighborhoods and this effect is borne out in crime statistics.
- Our forest provides habitat for a wide variety of wildlife. There are many areas in town that contain contiguous stretches of uneven-aged tree canopies, which represent the ideal habitat for a number of wildlife species that otherwise would not survive in an urban setting.

The benefits of the urban forest are not limited to the above-listed items. In fact, research reveals increasing benefits as time passes. Citizens typically understand the concept of 'grey' infrastructure - roads, sidewalks, sewer lines, curbs, pipes, telephone poles, street lights, etc. Less understood is 'green' infrastructure – trees, shrubs, bioswales, greenspace, raingardens, green roofs, etc. As a tree gets bigger it does more for the environment, so unlike grey infrastructure, green infrastructure increases in value with age. Furthermore, a visit to the library or an internet search will yield a seemingly endless list of benefits of trees and green areas, including studies showing the decreased recovery time in hospitals from patients with views of trees in the landscape. In fact, the City of Aspen Parks & Open Space Department has been a leader in creating and installing green infrastructure in the City with initiatives using curbside raingardens, bioswales, and natural storm water treatment systems. Trees are an integral part of these designs. They actually save us money by keeping us healthier and cooler a - 2016 study of over 9 million trees in California showed that at least $11 dollars of cooling benefits were contributed per tree per year (Song et al., 2018). Trees have maintenance costs, but the return on the dollar is money well spent – the same study shows a ratio of costs to benefits of 1:1.5 and above. Trees should absolutely be viewed as assets and a critical part of the urban infrastructure.

INVENTORY

In 2017, the City of Aspen Parks & Open Space Department completed a comprehensive update of the tree inventory. In conjunction with the Colorado State Forest Service, all trees located within rights-of-way (ROW), parks and the Aspen Golf Course were included in this inventory. This project has added layers to a new database that can be utilized in a number of ways.



The following information can be found within the new 'Tree Plotter' inventory, a dynamic new software platform from PlanIT GEO. Though this is not an all-inclusive list, it includes: tree species types, management needs, tree diameters, insect and disease concerns, and tree conditions. In 2017 a new tree Risk Management Plan was adopted by the Parks & Open Space Department which specified, among other protocols, that a full hazard tree analysis be conducted on all trees in the inventory with diameters of 25-inches or greater. The intent of this annual analysis is to provide a clear and precise descriptions of all trees that need to be monitored for health and safety reasons. City of Aspen Parks & Open Space Department staff, in order to maximize the benefit of this data and to keep it relevant to our future forest goals, will update the Tree Plotter database utilizing

office computers, tablets and smart phones. Field crews and contractors can also delineate work done on each tree as part of the work order management system. The City Forester reviews work orders as they are completed to update the tree inventory. This will ensure the usefulness of the inventory into the future. It will be important to re-inventory the trees at approximately five-year intervals in order to keep recorded tree diameters consistent with the diameters in the field. These updates may be done in-house, or outsourced, depending upon the staffing levels at the time of need. Tracking tree growth, stocking levels and new disease or insect threats are an important part of creating a sustainable community forest. The Tree Plotter platform can be found on the City Website and is accessible by the general public. Interactivity and being able to learn a whole range of details about the community forest were important accessibility considerations when this software was adopted.

The following information represents our current urban forest condition as determined by the 2018 tree inventory, which is broken into two categories, street trees and park trees. For the first time this year, the Golf Course trees have been included in the inventory. Under each category we will look at the following four areas with the entire inventory attached as Appendix B.

1. Species Diversity
2. Size Diversity
3. Monetary value
4. Management Needs

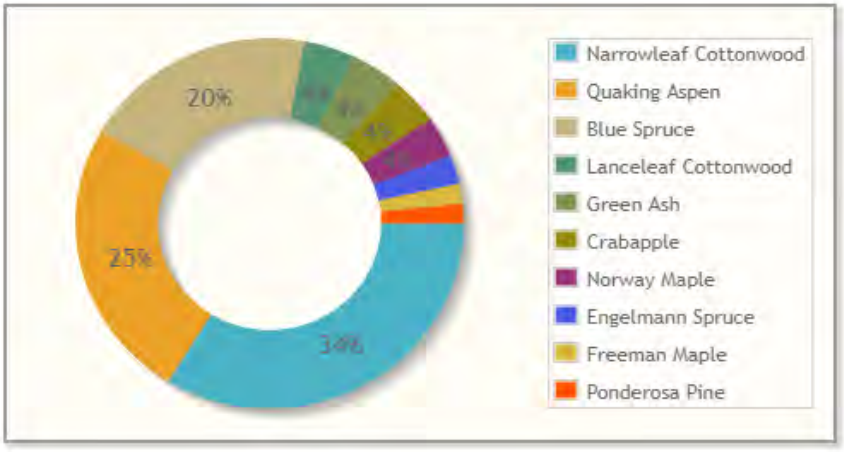
All Trees within the City of Aspen

These are trees in public areas along the right-of-way (ROW), City parks and the Aspen Golf Course.

1. Species Diversity

The following pie chart shows the diversity of species currently found throughout the community forest. This chart represents the composition of the top ten species of trees. For a complete listing of tree species and stocking levels, please refer to Appendix B, the 2017 Tree Inventory Report.

Table 1. Summary of species diversity



Plant diversity is extremely important to the overall health of the urban forest. Best management practice recommends that no single tree species exceed 10 percent of the total tree population. Plant diversity is a mechanism that helps keep insect and disease outbreaks from destroying an entire tree species population – for example Dutch Elm disease or the Emerald Ash Borer. The Emerald Ash Borer is currently killing all ash trees in the Midwest and the Northeast. This insect was found in

Boulder County, Colorado in 2013, and subsequently in Lafayette County. These pests are exotic invasive insects and native tree populations have no natural defenses to fight off the attacks.

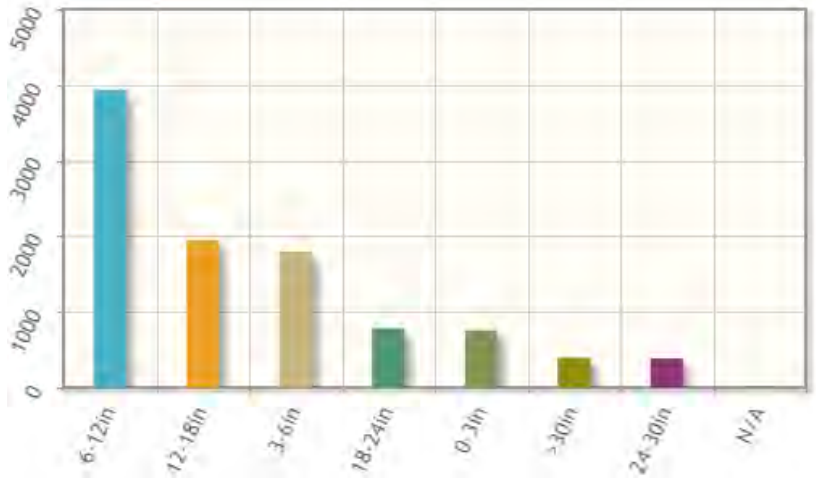
The City has been working to diversify the urban forest. Through the Backyard Forestry Program and others, the following trees have been introduced to the Aspen tree community; varieties and species of maple, hawthorn, mountain ash, serviceberry, euonymous, linden, locust, plum, boxelder, birch, and pines and spruces. Adding these and other trees species that have recently been planted in Aspen to the planting palette is wise and prudent. This is especially important because cottonwoods and aspens (i.e., the Populus genus) make up more than 50% of the total tree population.

The 2006 inventory report recommended the consideration of the following species; Rocky Mountain maple, Hotwings tatarian maple, Yellow buckeye, Thinleaf alder, Russian hawthorn, Downy hawthorn, Northern blaze ash, Thunderchild crabapple, Chinese white poplar, Princess Kay plum, Wafer ash, Burgundy Ussurian pear, Prairie Gem Ussurian pear, American linden, European larch, and Black Hills spruce. These species were selected from the Fort Collins Wholesale Nursery. This was done for two reasons. First, the City of Aspen has a history of purchasing trees from this nursery. Second, the nursery selects and grows trees that are acclimated to the cold droughty conditions of Colorado. The nursery was one of the first Colorado nurseries to select trees from the USDA Horticultural Station in Cheyenne, Wyoming for production. The City has had success trying these and other new species and varieties along the streets. Eight varieties of elm have been planted, along with eight varieties of maple and nine species of pine. The full list of species is identified in Appendix C of the 2017 Tree Inventory Report. Additional species recommended for the City of Aspen by the Colorado State Forest Service can be found in Appendix E of the same report.

2. Size Diversity

The following bar chart is a representation of the size diversity for the trees found within the City of Aspen. Varying tree size is very important to the overall health and value of the community forest. A higher percentage of small and medium-sized trees is essential for the future health of an urban forest to replace large trees that reach the end of their natural life cycle. The table includes all species of trees in the inventory; therefore, it does not clearly define any age classes. Some species of trees, such as a hackberry, will retain a smaller trunk diameter over the same number of years as compared to species with a more rapid growth rate such as a cottonwood. In addition, restricted growing sites, insects and diseases, poor soils and lack of maintenance are just a few of the factors that can contribute to a slower growth rate, therefore size is not always a good indicator of age.

Table 2. Summary of size diversity



3. Tree Value

The Colorado State Forest Service (CSFS) collected data in the tree inventory to determine overall tree value to the City and the environment. Trees are just as valuable as sidewalks, curbs, streets, utilities, or other 'grey' infrastructure. The City understands how much it costs to build and maintain thisinfrastructure. It can be overlooked that tree populations - 'green' infrastructure - also have monetaryvalue, and while they do require maintenance, as a tree gets older and larger its value increases becausethe environmental, social and aesthetic benefits conferred increase with tree size.

The formula used by the CSFS to determine tree value is based on monetary values and percentages from the latest version of the Species Rating and Appraisal Factors Guide, which is produced by the Rocky Mountain Chapter of the International Society of Arboriculture. The formula includes factors such as tree species, diameter, condition, and placement. A tree with a good condition rating or placement value will have a higher value than a tree in poor condition or with poor placement. The 2006 inventory excluded the placement component of the tree value but it was included in the 1992 and 1996 inventories. Aspen Forestry Staff decided to include placement in the 2017 tree values. The Comparison of the tree values with placement, without placement, and the formula the City of Aspen uses for replacement values can be found in the 2017 Tree Inventory Report, Appendix B. See appendix D within this report for an explanation of the value formula used in this inventory. The table below shows the total value of all the inventoried trees.

Table 3. Summary of tree inventory and value of City managed trees

CITY TREES	NUMBER OF TREES	TOTAL VALUE
Street Trees	5,062	$12,572,582.88
Park Trees	2,877	$6,271,621.18
Golf Course Trees	1,923	$4,957,454.97
Totals	**9,862**	**$23,801,659.03**

4.Tree Growth

The following tables show that the top ten trees making up the Aspen Street and Park tree populations have increased in average diameter. From the 1996 inventory to the 2006 inventory the cottonwoods diameters decreased in average size, most likely due to the doubling of the total number of cottonwoods as a result of the more inclusive inventory and the removal of more of the large historic cottonwoods in the Core area. From 2006 to this inventory, the average diameter has increased again.

Table 4. Aspen Street trees – Mean Diameter Comparison [DBH = Diameter at Breast Height]

Tree Species	1992 Mean DBH	1996 Mean DBH	2006 Mean DBH	2017 Mean DBH
Cottonwood, all species	15.2	18.2	15.9	16.7
Aspen	4.4	5.0	6.1	8.0
Colorado spruce	5.7	6.6	8.5	12.0
Green Ash	4.0	4.7	4.4	6.0
Norway Maple	3.4	4.9	5.7	6.0
Crabapple	4.8	4.5	4.1	5.0
Maple, other	-	-	3.6	3.3
Engelmann spruce	-	-	10.2	14.0
Pine, other	6.0	5.8	7.2	7.6
Silver Maple	7.1	8.5	12.4	16.0

Table 5. Aspen Park Trees – Mean Diameter Comparison

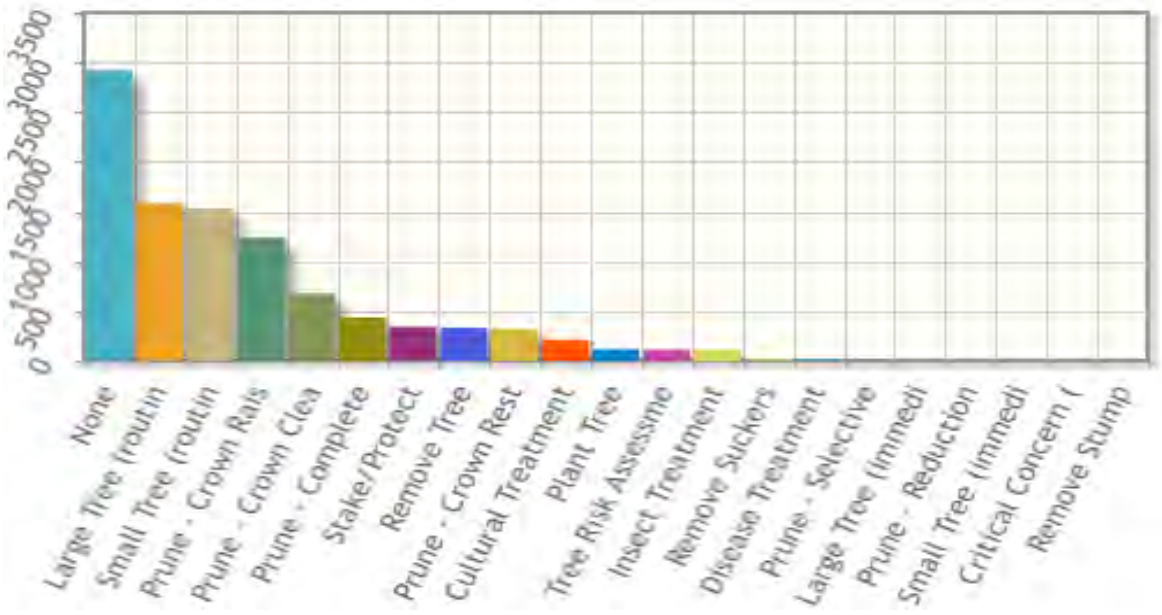
Tree Species	2006 Mean DBH	2017 Mean DBH
Cottonwood, all species	14.2	14.0
Aspen	6.9	6.0
Colorado spruce	9.7	11.0
Green Ash	9.4	9.0
Norway Maple	5.4	7.0
Crabapple	3.5	7.0
Maple, other	2.8	3.3
Engelmann spruce	10.1	17.0
Pine, other	5.9	7.5
Silver Maple	14.0	13.0

Indeed, overall growth in mean tree diameter is evident across the inventory. This bodes well for both the return on the maintenance investment and the resulting ecosystem benefits provided by the trees from carbon sequestration and cooling to storm water mitigation and air purification.

5.Management Needs

The Colorado State Forest Service (CSFS) provided the City of Aspen with a summary of recommended management needs on an individual tree basis while compiling data for the City-wide tree inventory in 2017. The following table represents those recommendations, though many trees have more than one management need. In instances where multiple actions should be taken, the most crucial was indicated in the recommendations.

Table 6. Primary management needs



The categories listed in the table are further described in the Tree Maintenance portion of this document. For the purpose of understanding this table, a complete prune includes thinning the crown, removing dead/dying branches and structure pruning. Clearance pruning only accounts for the removal of branches to provide adequate space above sidewalks/streets and around structures. Removal indicates the need for the complete removal of the tree including the stump. The 'insect treatment' and

'disease treatment' categories refer to all trees that have been determined to have any one of a variety of insects and/or diseases found within the community forest. The table below perhaps better illustrates that the vast majority of maintenance needs fall under routine maintenance pruning. The City of Aspen divides the maintenance areas into 5 zones and visits 1 zone per year. This 5-year pruning cycle more than satisfies best management practices and is a good indicator of both the health of the community forest and the on-going maintenance program. The goal is to continue this maintenance cycle and is reflected in the program objectives through 2028.

Primary Maintenance	Count	Percent
None	2923	29.3
Large Tree (routine)	1587	15.9
Small Tree (routine/train)	1533	15.4
Prune - Crown Raise	1237	12.4
Prune - Crown Clean	678	6.8
Prune - Complete	436	4.4
Stake/Protect	340	3.4
Remove Tree	332	3.3
Prune - Crown Restore	319	3.2
Cultural Treatment	211	2.1
Plant Tree	116	1.2
Tree Risk Assessment	110	1.1
Insect Treatment	108	1.1
Disease Treatment	13	0.1
Remove Suckers	13	0.1
Prune - Selective	10	0.1
Large Tree (immediate)	7	0.1
Prune - Reduction	2	0.0
Small Tree (immediate)	2	0.0
Remove Stump	1	0.0
Critical Concern (safety)	1	0.0

FOREST MANAGEMENT

The City of Aspen's Community Forest is constantly under pressure from natural forces, as well as from the challenges posed by people and development. Every day, many city entities strive to bring a sensible balance to this urban interface. In order to effectively confront and delineate the pressures on the urban forest and to maintain the functional efficiency of this management plan, it has been divided into the following sections:

- Support
- Goals and Strategies
- Maintenance
- Insect Threats – Immediate
- Insect and Disease Threats - Other
- Tree Preservation
- Implementation Schedule

Support

The City of Aspen has taken a lead role in management by employing a full-time position designated as the City Forester. The Forester is responsible for making sound management decisions to perpetuate the health and safety of the community forest, as well as sharing tree-related concerns with the Director of the Parks & Open Space Department, the City Manager, City Council, and the citizens of Aspen. Sharing information has enabled the most practical and effective management of our community forest. Beyond coordinating essential maintenance and planting activities, an important part of the Forester's duties is permit review for tree removal and drip-line excavation. In collaboration with other City departments, this a time intensive but critical task to find a balance in accommodating tree preservation while allowing the development of private property.

The Forestry Division has two full-time staff who segue over to other Parks & Open Space Department work during the winter. The Parks Department also employs part-time staff, under the direction of the City Forester, from the months of April through October each year. Consideration will need to be given in future years to whether the current Forestry staff should focus on forestry work year-round and whether additional full time staff should be hired. Pruning, planting, insect/disease control, removals, weed control and wildfire fuel mitigation comprise the primary duties of the Forestry crews. In addition, the Parks Department employs several contractors to maintain publicly-owned trees when in-house management capabilities are surpassed. Contracted services are hired through a public bidding process, and contracts are awarded to the successful bidder usually on a 2-year contract basis. The bidding information can be found in Appendix E. The need for contracted services is related to the City of Aspen's extensive community forest, which will be further described in the forest inventory section of this document.

Goals and Strategies

The community forest is one of Aspen's most distinguishing characteristics that sets it apart from other mountain towns. We are fortunate to have such a resource; therefore, it is imperative that we set reasonable goals with corresponding strategies for the management of these trees into the future. There are five goals with corresponding strategies within this management plan described below.

1. Species Diversity

This goal is intended to increase the species diversity, while maintaining the historical perspective of the native cottonwood plantings. The current forest is somewhat diverse in species however; some improvements can be made to increase this diversity. The purpose for this goal is to avoid potential threats from host specific insects and diseases that could cause devastating impacts to any one entire species of tree within our community forest. This goal has already started to take shape with the introduction of new tree species on special street tree planting projects throughout town, during the Arbor Day celebration each year when trees, very diverse in species, are given away. In addition, nurserymen throughout Colorado and the country are continuously developing new varieties of trees that are optimal for our environment. These are being planted in Aspen as available. The means to attaining this goal of species diversity will be addressed through

strategies implemented within public right of ways and is detailed below. Other opportunities may present themselves as a result of hardiness zone changes due to climate change.

- Streets

The community forest's current street tree stocking levels consist of 33.2% cottonwood, 18% aspen, 11.8% spruce, and the remainder is made up of, but not limited to, ash, maple, crabapple, hawthorn, pine, and vacant planting spaces. The high percentage of cottonwood reflects the City of Aspen's focus on keeping this historic planting regime as a priority. The species diversity goal will continue to target the reduction in percentage of blue spruce to 10%, aspen to 15%, increasing the "other" category's percentage to 40%, and increasing the cottonwood level to 35%. The increased percentage of other trees will incorporate the available planting spaces. At 124 inventoried & plantable sites, this constitutes a low percentage, putting the current stocking of the community forest at near full levels – an admirable position for an urban forest. This high standard of stewardship will be maintained.

The reduction of blue spruce and aspen in the right-of-way will continue over the course of many years. There are a considerable number of these trees that contribute substantially to the current community forest. These are large, established landmark trees which will not be removed simply to reduce the species percentages in the inventory. Rather, they will be removed when health and safety concerns render the removals necessary. Once this is done, replacement trees will be selected and sites planted with a species congruent with the desired right-of-way planting type determined by the Parks & Open Space Department and the City Forester, and not another coniferous species or aspen.

- Parks

The City of Aspen's parks system is dominated by cottonwoods, aspens, and spruce. Since the parks are currently well stocked with trees, increasing diversity by creating new planting spaces will not be an effective management strategy. However, as and when trees are removed for health or safety reasons, diversity can be addressed with the selection of replacement trees. The ideal diversity percentage will be managed on a park-by-park basis since each park has a unique, often native, composition. The Parks & Open Space Department and the City Forester will determine appropriate replacement trees according to the desired characteristics and functionality of the trees within each park as determined by the long-range plans for any given park.

2. Size/Age Diversity

A forest diverse in tree size and age provides a healthy eco-system, with benefits for wildlife habitat and as well as aesthetics. Additionally, it increases in monetary value and addresses sustainability goals while reducing management costs.

Currently, the majority of the trees in the community forest fall into the 6-inch to 12-inch diameter range. Therefore, the second part of the diversity goal is to continue to shift the size diameter from predominately small diameter trees to a forest comprised of many sizes, with the majority falling into the 12-inch to 18-inch diameter range. This medium size diameter range, considering the species index in Aspen, will better provide the desired characteristics of a healthy, sustainable community forest, as well as potentially reduce the expense of managing larger diameter trees. Large diameter trees do provide more benefits but also come with higher risks and maintenance costs as they reach the end of their life spans. Since age cannot be determined without extensive surveys, size class will substitute for age class determinations.

There are now 3935 trees in the 6”-12” inch diameter category alone and 780 trees falling into the category of 24 inches or more. The quantity of smaller diameter trees within the community forest are a tribute to a consistent strategy of planting vacant spaces throughout our community. Many of these smaller trees will move into the target diameter range within the next ten years. New plantings will continue to address the species diversity goal and will add to the small tree size category as larger trees are removed when they begin to decline. Success for this goal will be measured by reducing the smallest and largest size class categories to a number lower than the 6”-24” inch diameter combined size classes. There should be a shift in the dominant size classifications at that point, which can be used to predict the long-term sustainability of this goal. Park trees are not included in the size class portion of this goal due to the need for individual management of each park according to desired characteristics and functionality set forth by the long-range planning for that particular park.

3. Maintain Canopy Cover

Maintaining the current canopy cover of 30% City-wide is our third goal. Canopy cover is a vital component to measuring the health of the community forest. At this time, there is no exact measure for optimal canopy cover, however, 30%-40% is considered a reasonable target for the City of Aspen. The Vibrant Cities Lab on the American Forests website uses a synthesis of the latest research to create a tool kit to help municipalities adjust targets by taking into account variables such as development densities, land use patterns, ordinances and climate patterns. Vigilance and monitoring in these areas will be important and canopy targets can be adjusted accordingly.

In 2015, the City of Aspen hired Plan-it Geo, an Arvada, CO based company, to perform a canopy assessment. This assessment provided information on canopy cover for the entire City by zone class distribution as well as by individual parcels. This assessment also included a description of plantable spaces. Maintaining a full stocking level throughout our available planting spaces is a means of achieving our canopy cover goals. In order to achieve this goal, trees that are removed shall be replaced with appropriate plantings. Additionally, the last inventory in 2006 indicated planting sites within the City. These planting sites are well defined within the tree inventory and the canopy assessment. Success for this goal can be easily determined by a performing another canopy assessment in the year 2020. In the event that a tree is removed from an undesirable location, a replacement tree may not be planted in that space. An example of such a location includes: too narrow of a planting strip, inadequate room for canopy growth, inappropriate growth medium, or future development of the site.

Detailed maps including a fact sheet for canopy cover are located in Appendix D.

4. Meet and/or Exceed National Arbor Day Foundation Requirements

The fourth goal is to meet and/or exceed the requirements demanded by the National Arbor Day Foundation to obtain the designation of Tree City USA and continue to pursue growth awards. The National Arbor Day Foundation has recognized the City of Aspen as a Tree City U.S.A. since 1992. This is an honor that shows the City’s commitment to maintaining a premier community forest. Continuing to achieve this goal will be accomplished by the following:

- Maintaining a tree board or a city department designated for tree care (City Forester)
- Keeping a community tree ordinance
- Following a community forestry program with an annual budget of at least $2 per capita
- Observing Arbor Day annually

Proof of these criteria must be submitted in December of ever year to the Colorado State Forest Service, Grand Junction District. They will ensure all necessary information has been submitted and will then approve and send it to the Arbor Day Foundation. At the time of the writing of the 2018 edition of the Community Forest Management Plan, the City of Aspen had been a 'Tree City USA' for 26 years and had won growth awards for its forestry program for 9 consecutive years. This tradition of high quality forestry stewardship will continue.

5. Inventory Monitoring

The fifth goal will target the existing tree inventory. The inventory will be examined to determine the success rate for the goals described above. In addition, the inventory should be evaluated for its relevance and contribution to the community forest at that time. The inventory's quality standards and functionality in relation to new and upcoming technology was not available when the 2006 inventory was completed. The tree inventory was completely re-done in 2017 and integrated into the new Tree Plotter database in 2018. It will be critical to keep this database updated regularly

MAINTENANCE

Our urban forest will continue to be maintained to the highest possible level regarding health, safety, functionality, aesthetics, and sustainability. This portion of the document is designed to illustrate four technical strategies and practices of the City of Aspen's various maintenance needs within the community forest. Most management needs are accomplished by the Forestry Crew housed within the Parks & Open Space Department. This three-person crew is directed by the City Forester to handle insect/disease identification and control, pruning, removal, and planting. The Forestry Crew uses a wide variety of equipment including: brush chippers, chainsaws, stump grinder, soil injector, pesticide sprayer, sonic tomograph, resistograph, water tanker, skid steer, trencher, back hoe and a variety of hand tools. All persons conducting any tree maintenance within the City of Aspen must adhere to all standards set forth by the American National Standards Institute (ANSI) regarding tree work and safety within the industry of arboriculture. See standards in Appendix F.

1. Pruning

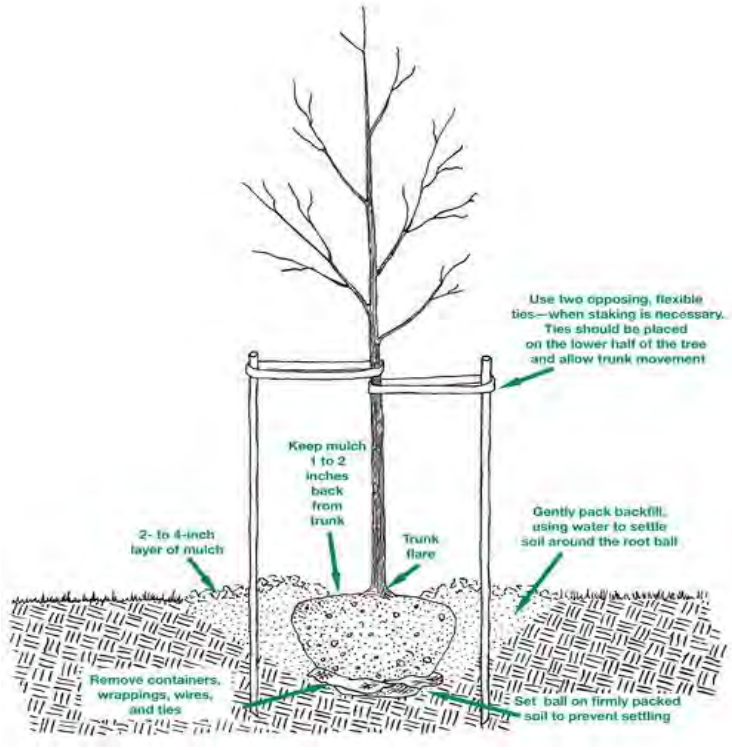
Maintaining a highly functional, safe, and sustainable community forest requires extensive pruning efforts year after year. It is crucial to have a clear definition for each pruning prescription assigned to address the needs of each individual tree. It is highly beneficial when contracted services are involved to clearly define the City of Aspen's expectations regarding tree work. The following list introduces the terms and their definitions to be utilized when pruning within the City of Aspen:

- Prune / complete – Thinning the tree's crown to increase light penetration and air movement, removal of crossing and interfering branches, removal of dead, dying, broken, and diseased branches, removal of branches to obtain appropriate clearance around structures, streets, and sidewalks, and removal of branches to improve or create appropriate structure. This applies to ¼ inch and greater diameter branches.
- Prune / routine – This is the standard maintenance description for trees requiring fairly minimal trimming as part of the annual program.
- Prune / crown clean or restore – Removal of dead, dying, diseased, broken, crossing or interfering, poorly attached, and insect-infested branches with diameter of ½" inch and greater.
- Prune / selective – The removal of selected branches, storm-damaged limbs or other specialized pruning for trees and shrubs. This can include structural pruning or training for smaller trees.
- Prune / crown restore – The removal of selected branches to improve and/or restore structure in trees significantly damaged by storms, previous pruning, or vandalism.
- Prune / crown raise – The removal of the lower branches from a tree in order to provide clearance for buildings, vehicles, and pedestrians.
- Remove – The complete removal of a tree, this includes the removal of all wood unless otherwise specified. Stump removal is specified as a separate service.

There are further delineations if the tree is small or large. All pruning cuts must adhere to the International Society of Arboriculture (ISA) pruning standards (see appendix F). Tree topping is not permitted within the City of Aspen. When significant trees along ROW and in parks are to be removed, the Parks Department will attach to the tree a notice of removal to remain in place for no fewer than seven calendar days.

2. Planting

When planting along ROW or in parks, the selection of tree species is crucial to achieve the desired conditions for that site. Prior to installation of new trees, the site will be evaluated for its growth medium, irrigation requirements, above ground growing space, aesthetic possibilities, and future use requirements. These factors will dictate the species of tree selected for the site. The Parks Department endeavors to stay abreast of new trees suitable for our area. The successful installation of a new tree can be accomplished according to the following diagram:



The City of Aspen no longer permits the planting of coniferous trees within the ROW in an effort to prevent encroachment by the tree into the street and walkways, to reduce snow and ice buildup from shading on streets and walks, and to increase visibility for pedestrian and vehicular traffic.

Tree planting is reviewed as part of the Water Efficient Landscaping Standard to ensure optimal water usage.

Landscaping plans are also reviewed to avoid the creation of hedgerows – symmetrical planting - and overly dense designs.

The Parks Department makes every effort to adhere to best practices and the most suitable tree species for our zone, with particular attention paid to species susceptible to new invasive insects and diseases. New trees will be needed in the planting palette in years to come to continue to diversify the tree inventory and create the resiliency needed in the community forest.

3. Tree Risk Management

In 2017 the City of Aspen Parks Department developed a new Risk Tree Management plan, based on new standards from the ISA (see appendix C). This was previously known as hazard tree management. The plan defines City of Aspen policies, procedures and practices int he management of City trees that may present a safety risk to people and property. The plan primarily concentrates on trees located on ROW, parks, trails, open spaces, and any other lands that may fall under City jurisdiction. The management of hazardous or defective trees within our community is of paramount importance in order to provide a safe environment for the citizens and visitors of Aspen and the trees surrounding them. The adoption of the 2018 Community Forest Management Plan includes the adoption of the new Risk Tree Management Plan.

Risk Policies

The definitions below constitute the core policies of the Risk Management Plan. Not all criteria have to be present for a particular risk rating. Definitions are based directly on accepted industry standard in the ISA Risk Tree Assessment standard.

- A ‘Risk Tree’ is a tree with a defect that has a likelihood of failure of ‘Probable’ or ‘Imminent’, a ‘target occupancy’ rate greater than ‘Rare’ and/or is located in a moderate or high wildfire risk area as determined by the City Forester.
- The City will assume the management of any tree with at least half of its trunk diameter measured at 4.5’ feet above grade located on a City right-of-way, easement or property.

- A risk tree located on private property, as determined by the City Forester, will be mitigated by the property owner or the City through a notice and order process as defined in the City of Aspen Code Chapter 13.12
- A City tree will only be removed if it is an imminent threat to public safety, dead, dying, diseased, surpassed its service life, or in conflict with a more important city project as determined by the City Forester.
- Tree removal Notification process follows existing municipal code and city policy.

In order to better manage these trees, it is important to clearly define what constitutes a risk. A risk tree is a tree with a defect present that has a likelihood of failure of Probable or Imminent, a target occupancy greater than Rare and/or located in a moderate or high wildfire risk area as determined by the City Forester. The defects in trees can be a number of things, including but not limited to dead wood, cracks, decay, root problems, or poor structure. These defects can, and do, occur throughout the entire tree, from under ground to the very top of the canopy. The target portion of the hazard tree equation could be people, animals, or structures. The target does not have to be a stationary item such as a house; it could be mobile such as children playing in a park. In addition to this definition, it is important to know that any and every tree is a candidate for failure if exposed to the proper conditions. In our sometimes-harsh environment, this is always an unfortunate possibility.

Risk trees have varying ratings of severity and monitoring needs. These differences are determined by the size of the defect, the likelihood of failure and by the likelihood of striking the target. For example, a small decay pocket in a 2-inch diameter tree branch would not rate as highly as a severe crack in the trunk of a 30-inch diameter tree (severity of impact). In addition, a very seldom-used open space would not rate as high as a busy playground in a park (low versus high target occupancy). These differences can sometimes be very subjective. In order to reduce these discrepancies, the City of Aspen uses the Tree Risk Assessment model as defined by the ISA. Along with this standardized rating system, risk tree actions can be prioritized. All risk tree assessments, identification records, maintenance schedules, and recommended actions will be kept on file at the City of Aspen Parks & Open Space Department. The information collected for risk trees will be regularly updated in the tree inventory. All of the risk trees are geographically identified and all information regarding monitoring and management is individual catalogued.

There are currently **371** trees along City right-of-way and in parks that have been identified in the tree inventory as trees that need to be monitored according to the program described in this section. This number will decrease during the course of this management plan as trees are removed and replaced. Some of these trees have risk ratings based on the latest ISA TRAQ standard. Those with moderate or

high-risk tree ratings will be monitored on an annual basis (as described in the implementation section). This is a crucial part of effectively managing these trees, since changes can occur rapidly depending upon each tree and its site characteristics. When a risk tree is identified, the date is recorded and the next inspection will occur no later than 12 months from that date. During each inspection, the tree risk assessment form will be completed and management strategies for that tree will be evaluated. A copy of the Basic Tree Risk Assessment forms can be found in this document as Appendix G. In addition, risk trees will be visited after major storm events, where a visual inspection will be conducted. The visual inspection will be documented and the need for action will be determined. Higher level diagnostics can include an aerial inspection, resistograph testing or sonic tomography.

4. Insect and Disease Management

The community forest plays host to many different insects and diseases. It is imperative to recognize the threat of undesirable insects, though it is just as important to understand the benefits of the desirables and the role that each plays within the forest. Due to the dynamic nature of insects and diseases, an all-inclusive list will not be provided here, but a list of the desirables and the undesirables can be found in many forms of reference materials located at the City of Aspen Parks & Open Space Department.

The undesirable insects can cause a variety of problems to trees, depending upon factors such as: infestation levels, tree parts targeted, timing of damage done, nature of the landscape, and predisposition to impacts based on tree species. There are several signs and symptoms to look for when investigating tree health, including: foliage color, foliage density, foliage size, twig growth, fungal fruiting bodies, soil condition, and insect remnants, just to name a few. All of the listed factors are an integral part of first identifying and then managing insects and disease.

Because many insects are host-specific, correctly identifying the species of the tree (the 'host') is the single most important factor in managing insect and disease problems. After this initial step, investigative techniques are applied to recognize the disease or pest damage to the tree. Understanding the life cycles and general characteristics of all pests associated with a particular species of tree provides the best chance of identifying the problem. Once this is done, control methods can be developed while taking into consideration the surrounding environment as well as the economic and social benefit of that particular tree. It is important to recognize the most severe and threatening pests and strive to control them as a priority over a less dangerous threat. This is both economically and environmentally effective.

In cases where a positive identification of an insect or disease cannot be made by Parks & Open Space Department staff, a sample will be collected and sent to Colorado State University Extension offices (CSU) or the Colorado State Forest Service (CSFS). Samples must be collected and sent no later than Tuesday of any week to prevent the chance of being left over the weekend en route through the postal service. This ensures a better opportunity of a positive identification from CSU or CSFS.

The City of Aspen is very fortunate to have so many citizens and visitors alike that are passionate about the community forest. The detection of insects and diseases that may threaten the trees lies mainly on citizen response, the Parks & Open Space Department's continual monitoring practices, and the contracted services provided in day-to-day maintenance. The City Forester will respond to concerns expressed by citizens regarding possible insect and disease issues with a site visit free of charge. This provides the opportunity of possible early detection of a new problem that could challenge other trees in the community.

Integrated Pest Management (IPM) is the best management strategy implemented within the community forest. This strategy allows for the most effective and efficient control of insects and disease while maintaining a safe and healthy forest. The following control methods are used within the IPM strategy: mechanical, cultural, chemical, and mapping. The goal in each strategy is to eliminate or reduce the targeted problem to a level that is economically and environmentally acceptable. The most effective strategies combine methods. Over-reliance on a single method such as pesticide use without changing products used can create insect resistance for example.

Mechanical controls are often a quick and inexpensive way to address specific insects and diseases. This method usually consists of simply removing the infected/infested portions of the tree by appropriate pruning practices, though the removal of the entire tree may sometimes be necessary. The removed portions of the tree or the entire tree must be processed through a chipper or moved to an appropriate site such as a landfill to eliminate the possibility of spreading the insect or disease to adjacent trees. All machinery and equipment used in these operations should be cleaned and disinfected before entering another site.

Cultural control is a preventative technique that attempts to hinder or deter the possibility of foreseeable problems through proper care and planting of individual trees. This includes watering schedules, care for root systems, adequate growing space, species selection, and overall suitable growing conditions. When trees are properly selected for the site and their vigor is maintained through proper care, these trees generate their own defenses against potential insect and disease threats. Cultural control methods yield healthy, vigorous trees that provide aesthetically pleasing results while minimizing the costs associated with many years of other treatments if natural defenses had not been encouraged through proper care and selection.

Chemical control is utilized throughout the community forest on an individual tree basis. Pesticides are selected for their phytotoxicity to the target species and used at the lowest possible effective rates. Any chemical applied within the community forest will adhere to local, state, and federal regulations, with particular attention to public safety. All types of control efforts will be researched and fully exhausted before chemical applications are carried forward. Typically, systemic soil or trunk injections are favored as the risk of environmental contamination is greatly reduced and desirable insects are less affected..

The mapping portion of IPM within the City of Aspen is housed within the GIS based tree inventory. The inventory can be queried to show, geographically, where major insect and disease problems occur. This capability aids in determining movement of the pest or disease through the community forest, while also showing reduction or enlargement of infested areas due to the relative effectiveness of other control methods. When maps reveal a direction or spread pattern, other control methods within the Integrated Pest Management scheme can be implemented in the zones of future infestation.

INSECT THREATS - HIGHEST PRIORITY

The largest threats to the community forest at this time are Emerald Ash Borer (EAB), Eriophyid Mites, the Mountain Pine Beetle, Spruce beetle and the Douglas Fir beetle. The City of Aspen is actively monitoring, researching and managing these pests both in-house and with the help of contracted services.

Emerald Ash Borer

The emerald ash borer (EAB) has recently been found in Colorado on the Front Range, in Boulder and Lafayette counties. This non-native insect pest has decimated the ash tree population in the Midwest and throughout the eastern region of the United States. This insect is difficult to detect and because they are non-native, there are no predators to keep them in check. The larvae will reside under the bark before the adults emerge in May through September. Trees may be infested for 3-4 years prior to detection. EAB only attacks ash in the genus *Fraxinus*, so Mountain ash trees are not susceptible.

Currently, there are no known EAB insects in Aspen. While we do have the continental divide as a natural barrier to this devastating pest, it is only a matter of time before it catches a ride in a load of campfire wood and moves into the Aspen area. Therefore, the City will stop planting any ash trees in the genus *Fraxinus* on City property. Private homeowners will be discouraged from planting these species to avoid mass mortality when this insect inevitably shows up. We are fortunate that our relatively diverse community forest is made up of only approximately 5% ash trees. 30 trees in the downtown core have been identified for preventative treatment should the insect makes its way here. These preventative treatments will ensure the sustainability of numerous desirable ash trees in the downtown core where their canopy cover is highly valued.

Additional information regarding this non-native pest and specific control methods can be found in appendix H.

Poplar Bud Gall Mite

The poplar bud gall mite belongs to the eriophyid mite family. The mites are microscopic - adults are about 0.2 mm in length, reddish in color, and spindle-shaped. Hosts of the poplar bud gall mite include poplars, cottonwoods, and aspens. The tissue damage is characterized by woody cauliflower-like galls that develop from leaf buds. The most commonly used scientific name for this mite is *Eriophyes parapopuli*.

Poplar bud gall mites spend most of their lives inside the galls. They reproduce rapidly with a generation developing in as little as two weeks, giving rise to as many as eight generations per year. Poplar bud gall mites overwinter inside galls on the tree and some may overwinter under bud scales. Mites are active inside the galls from about April to October. From about May through August, some mites migrate to new leaf buds and form new galls. Mites may remain active inside a gall for up to four seasons, and abandoned galls may persist for another season

before falling off. Mites do not have wings, but the small size of eriophyid mites allows them to infest other trees by drifting on wind currents. Some may be transferred by birds and insects.

Poplar bud gall mite prevents leaf buds from developing into normal leaves and stems. Instead, the buds develop into woody galls 3 to 4 cm (1.2 to 1.6 inches) in diameter. The galls have a cauliflower-like appearance and are dark green early in the season, turning to a brick-red or blackish-brown color by late summer. Older galls become hard, have ridged and furrowed surfaces, and turn a tan or grayish color. Galls are attached to one-year-old twigs. Lower branches are usually more heavily infested. Affected branches may be stunted, crooked, or have sparse foliage. Several years of repeated attack may cause the ends of the branches to die back beyond the galls. Leaf loss caused by gall formation may cause stress in the tree, making it more prone to other problems. Aesthetic damage can be considerable since heavy infestations are unsightly. Pruning is often recommended as a control method. Galls or the affected twigs or branches should be pruned in early spring when the tree is dormant and the mites are still overwintering in the galls. Care should be taken to remove all galls, since a single gall contains many mites and is capable of re-infesting the tree. Galls that are removed should be buried, burned, or otherwise disposed. Pruning is practical for a few small trees, but may not be for large trees or if many trees are involved. Although some sources claim that poplar bud gall mite cannot be controlled with a chemical, most do recommend the use of insecticide treatments for heavy infestations. Treatments should be applied immediately after bud break, usually about mid-March or later. Insecticides recommended for this pest include dormant oil and carbaryl (Sevin). Miticide trunk injections are also used. See appendix I.

Mountain Pine Beetle

Mountain Pine Beetle (MPB) was introduced into the City of Aspen's pine trees via flight of the insect in the summer of 2007, though it is a native insect that has been in the Rocky Mountain region for thousands of years with outbreaks occurring approximately every 15 to 30 years. Having killed millions of acres of Lodgepole pine forests, the threat posed by MPB is currently on the decline. Unfortunately, some counties reported a 90% to 95% mortality rate in their native lodgepole pine forests. Many factors led up to this epidemic outbreak including drought, fire suppression and higher than average winter low temperatures. In Aspen, several lodgepole and Scotch pine trees were hit by beetles, though there are many trees within these species that were untouched. Fortunately, local forests were diverse enough in terms of species composition that a large-scale outbreak of this beetle was avoided. Appropriate monitoring & management will continue but this insect is no longer seen as a severe threat. The Parks Department did not suffer the loss of many trees due to the low number of susceptible species found in the ROW and parks. See appendix J.

Spruce Beetle

Adult spruce beetles are dark brown to black, with reddish brown to black wing covers. The scientific name is *Dendroctonus rufipennis*. Beetles are approximately 1/4 inch (6 mm) long. The rear margins of their wing covers are evenly rounded. Engelmann and blue spruce are typical hosts. During very large outbreaks, this beetle has also attacked lodgepole pine, though such occurrences are not common. A 2-year life cycle is typical. Adults emerge from May through July, depending on local factors such as temperature, aspect, and elevation. The period of attack may last as long as 5-6 weeks.

With a 2-year life cycle, broods spend their first winter as larvae and their second as adults. Female beetles bore through the bark of trees (standing or fresh, cut or fallen) and deposit eggs on either side of constructed egg galleries. Egg galleries vary from a few to 12 inches (30 cm). Galleries are packed with frass. Larvae emerge from eggs and feed in phloem. In the 2-year life cycle, the first winter is spent in the larval stage. Larvae develop into pupae in summer (approximately 1 year after initial attack). The second winter is spent as adult beetles. Some of these beetles exit and colonize the base of trees, where snow insulates them from extremely cold temperatures. Beetles emerge and colonize new hosts in spring/summer, 2 years after initial attack. Outbreaks cause extensive tree mortality and can alter stand structure and composition. Average tree diameter, tree height, and stand density are all reduced following large outbreaks.

A sign of infestation is the presence of fine, bark-colored boring dust in bark crevices and around the base of standing trees. Pitch tubes may or may not be evident. Spruce beetles prefer downed spruce to standing trees. On windthrown and felled trees, spruce beetles commonly colonize the lower, shaded surfaces and may colonize the entire length of the trunk up to an 8-inch top. In standing trees, beetle activity is most common in the lower 30 ft of the trunk. Tree crowns typically remain green for up to a year after attack. By the second year, needles have faded and soon fall from the tree. In the winter, infested trees are often easily identified by the abundance of bark flakes on the snow, which is evidence of feeding activity by woodpeckers. Forest stands most susceptible to attack are located along drainage bottoms and have an average diameter at breast height (DBH) of 16 inches or more. Windthrown spruce should be removed before it is colonized by spruce beetles. Trees should be removed after beetle colonization and before brood beetles develop and exit. Insecticides can be applied to high-value trees to prevent beetle infestation. Once spruce beetle populations reach epidemic proportions and impact large landscapes, it is not possible to stop such an occurrence with management activities. Management activities can be successful at very limited scales, for example preventatively spraying a select number of high value specimen trees.

For management, trunk spray applications of insecticides (carbaryl) can be applied to high-value trees to prevent beetle infestation. Trunk injections of systemic pesticides can also be employed as a preventative measure. Removal of spruce beetle infested trees is recommended. Once spruce beetle populations reach epidemic proportions and impact large landscapes, it is extremely difficult to impact insect populations with management activities. See appendix K.

Douglas Fir Beetle

The insect is a small brown to black beetle, no larger than ¼" in length. The beetles can fly from late April until early October (in our region), The adult beetles fly from the trees infested in the previous year to neighboring firs. The beetles then chew their way under the bark where the female constructs chambers in which to lay eggs. Although not as noticeable as with MPB, if the tree has been attacked, the bark around these holes may have a fine sawdust. These beetles tend to attack further up the tree trunk and have less sap flowing from them in comparison to MPB. Again, this occurs higher up in the tree and is less visible than the heavy sap flows and popcorn-like pitch tubes on pines attacked by MPB. The sap from Douglas fir beetle attacks tends to be less opaque and runs down the trunk in lines known as 'stringers'. The sap flow is the tree's natural response in an effort to push the beetles out. The eggs hatch in early winter and the larvae begin to feed horizontally outward from the original vertical chamber. This larval

feeding essentially girdles the tree, preventing the passage of water and nutrients to the canopy. The feeding larvae molt into adult beetles and emerge from the tree and repeat the cycle all over again. It is unknown how far the beetle will fly in order to find the next tree. Douglas Fir trees have a distinct red color when the tree dies, hence the expression, 'red and dead'.

Trees can succumb within one year. It is important, if the trees can be identified, to remove heavily infested 'green' trees – trees that are still green and appear to be alive. This is the only effective way to control insect populations. Unlike MPB, because the Douglas fir beetles leave the dead tree quickly, removing dead trees is less important. Infested green trees should however receive the same treatment as trees infested with MPB by being either burned, debarked or chipped. The only proven, effective way of protecting Douglas firs from attack is the use of preventative sprays or trunk injections prior to tree colonization by the beetles. Trees should be sprayed or injected no later than April in order for this treatment to be effective. The spray will be effective for approximately 9 months. Trees should be sprayed yearly until the threat has eased in our area. Trunk injections provide residual protection for 1-2 years depending on the chemical used. MCH pheromone patches have been shown to be highly effective as deterrents but only serve to move the insect on to neighboring stands of trees. Stand density considerations are important. The beetle typically attacks only trees greater than 14" DBH, but will attack trees as small as 7" DBH if the stand density is high. Unlike MPB, Douglas fir beetle attacks are 'patchy' and every tree in the stand won't necessarily be attacked. See appendix L.

INSECT AND DISEASE THREATS – OTHER

This section is an overview of a few other pests that affect the community forest here in Aspen. All of these insects and diseases are fairly common throughout Colorado and have been studied by many entomologists leading to very precise and effective control methods. Due to these studies, fact sheets have been created by Colorado State University which are followed by the City of Aspen Parks Department for control of these pests.

The following are the most commonly found insects and diseases in the community forest in Aspen:

- Cytospora canker; fungal disease.
- Spider mites; insect pest.
- Pine needle scale; insect pest.
- White pine weevil; insect pest.
- Cooley spruce gall; insect pest.
- Aphids; insect pest.
- Aspen / Poplar leaf spots; fungal disease.
- Willow scale; insect pest.
- Polar borer; insect pest.

TREE PRESERVATION

The City of Aspen requires that a tree removal permit application be submitted when excavating within the dripline of a tree and when removing or relocating trees, regardless of whether they are on public or private land. The City Forester, the Open Space & Natural Resources Manager and a Project Coordinator review these applications. Applications are now only being accepted online through the digital Salesforce system. The City of Aspen Municipal Code, section 13.20, describes the parameters of the tree preservation regulations and provides the background for which all tree removal permit application reviews are based. This section of the Code can be found in Appendix A. An important part of the tree preservation and permitting process is the prescription for Tree Protection Zones (TPZ) for construction-based permits. These zones are delineated by fencing at the dripline of trees, which remain in place for the duration of the project. This barrier helps protect the tree trunks and keeps vehicular traffic, foot traffic and any construction material out of the critical root zone to avoid soil compaction. Regular inspections are undertaken to check the integrity of the TPZ. Site specific treatments are often prescribed in the tree permit. Air spade excavation is frequently required to carefully expose roots where excavation is in close proximity to driplines. This facilitates any root pruning needed and minimizes impacts to trees being retained. More clarity may be required in the municipal code for more robust fencing material, limits of disturbance, measurement criteria and independent monitoring of established TPZ.

IMPLEMENTATION SCHEDULE

The Parks & Open Space Department has been following a pruning cycle of 5 years in order to achieve the necessary levels of pruning throughout the City, which has proven to be successful. In other words, every public tree within the city limits of Aspen, will be examined and pruned if necessary every 5 years. In order to accomplish this task, the City has been geographically divided into 5 management units, with all parks included in one of these units. A map showing these delineations is available as Appendix S. This new pruning cycle will be examined for acheivability every December, and changes will be made if necessary prior to the next year's growing season.

This schedule will include the next ten years, beginning in January 2018 and continuing through December 2028. The quarterly updating of the tree inventory will provide the necessary means for determining the success rate of this implementation schedule. At the end of each calendar year, through 2021, the City Forester will examine this portion of the document and adjust, if necessary, the coming year's management strategies to achieve the goals set forth in this document.

2018

- Complete all pruning within management unit III. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.

- Replacement trees must be planted in the event that a tree is removed within management unit III. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees every week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2019 accordingly.
- Begin exploratory review of Community Development standards, particularly construction setback guidelines in the context of limits of excavation and the collateral implications for tree retention in development on private property.
- Complete 'Go Back' pruning from October 2017 storm and remaining areas within management unit II.
- Review preparedness protocols for both invasive pests and storm events.
- Begin in-house training of Forestry Crew in tree climbing techniques as this is a critical safety and arboricultural skill.
- Begin exploratory review of possible changes and additions to the municipal code as it pertains to tree preservation and removal.
- Evaluate staffing and workload.
- Hire additional seasonal forestry staff.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2019

- Complete all pruning within management unit IV. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit IV. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees every week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2020 accordingly.
- In the context of Community Development standards with a view to improving tree retention in redevelopment on private property, consider ordinance changes/improvements to increase tree retention and replacement.
- Institute new preparedness protocols for both invasive pests and storm events.
- Change or add to municipal code pertaining to tree preservation and removal.
- Explore possibility of creating an arboretum and expanded tree nursery on COA property.
- Continue in-house training of Forestry Crew in climbing techniques.
- Assist Forestry Crew members in attaining ISA Certified Arborist qualification as part of both Tree City USA Growth Awards program and an expansion of forestry stewardship excellence.
- Establish and hire Arborist Technician as a third full-time Forestry Crew position to help lead Forestry Crew, monitor development sites with tree Protection Zones (TPZ), and lead field projects as part of Wildfire Mitigation Program. With the increase in project and permit work generally, to the addition of

trees to the inventory from the creation of at least four new parks since 2007, as well as the inclusion of trees in the Aspen Golf course, to say nothing of the fees generated from permit applications and mitigation fees, there are substantive arguments in favor of increasing staffing.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.
- Review preparedness for wildfire, invasive insects and drought impacts from climate change.

2020

- Complete all pruning within management unit V (parks). This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs; then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must also be planted in the event that a tree is removed within management unit V. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees every week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2021 accordingly.
- Perform LIDAR canopy cover assessment and evaluate requirements to maintain canopy cover percentage moving into the future.
- If warranted, pursue creation of arboretum and tree nursery on COA property.
- Evaluate staffing and workload.
- Renew external provider contracts.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.
- Implement new preparedness protocols if warranted.

2021

- Complete all pruning within management unit I. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs; then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must also be planted in the event that a tree is removed within management unit I. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2022 accordingly.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees every week from April through September.
- Determine the need for a large-scale update of the tree inventory.
- Host the ISA Rocky Mountain Chapter tree climbing championships.

2022

- Complete all pruning within management unit II. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit II. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform initial inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2023 accordingly.
- Undertake large-scale update of the GIS based tree inventory if needed.
- Evaluate staffing and workload.
- Renew external provider contracts.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2023

- Complete all pruning within management unit III. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit III. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2024 accordingly.
- Review Tree Ordinances.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2024

- Complete all pruning within management unit IV. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit IV. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.

- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2025 accordingly.
- Evaluate staffing and workload.
- Renew external provider contracts.
- Implement changes to tree ordinances if warranted.
- Review preparedness for wildfire, invasive insects and drought impacts from climate change.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2025

- Complete all pruning within management unit V (parks). This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs; then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must also be planted in the event that a tree is removed within management unit V. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2026 accordingly.
- Perform LIDAR canopy cover assessment and evaluate requirements to maintain canopy cover percentage moving into the future.
- Implement new preparedness protocols if warranted.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2026

- Complete all pruning within management unit I. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs; then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must also be planted in the event that a tree is removed within management unit I. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2027 accordingly.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Evaluate staffing and workload.
- Renew external provider contracts.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2027

- Complete all pruning within management unit II. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit II. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2028 accordingly.
- Hire additional staff if warranted.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

2028

- Complete all pruning within management unit III. This will include in-house and contracted services, when necessary. Each tree in this unit will be examined for pruning needs, then that need will be addressed by one or more of the following: complete prune, crown thin, selective prune, crown raise, crown restoration, removal, or nothing needed.
- Replacement trees must be planted in the event that a tree is removed within management unit III. This will ensure that the planting goal will not fall behind due to necessary tree removals.
- Identify, treat, and monitor all insects and diseases found within the community that could devastate the health and safety of the forest. The City Forester will determine priority for treatment of individual insects and diseases.
- Perform inspections of the "monitor" trees identified by the tree inventory, and determine management need accordingly. This will be accomplished by visiting a prescribed number of 'risk' trees per week from April through September.
- Complete all inventory updates within the GIS. Evaluate success and adjust management for 2029 accordingly.
- Review Tree Ordinances.
- Renew external provider contracts.
- Renew Tree City USA certification, expand Arbor Day celebrations and improve stakeholder outreach.

CORE FORESTRY OPERATIONS – IMPLEMENTATION MATRIX 2018-2028

Management Activity	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Tree Maintenance Pruning	X	X	X	X	X	X	X	X	X	X	X
Tree Removals	X	X	X	X	X	X	X	X	X	X	X
Tree Planting	X	X	X	X	X	X	X	X	X	X	X
Risk Tree Assessments	X	X	X	X	X	X	X	X	X	X	X
Staffing & Workload Evaluation	X		X		X		X		X		X
New Staff Hiring		X								X	
Tree Inventory Reassessment										X	
Tree Ordinance Review	X					X					X
Tree Ordinance Change and Implementation		X					X				
Preparedness Review (fire, pests, climate)		X					X				
Preparedness Protocol Implementation			X					X			
LIDAR Canopy Cover Study			X					X			
Tree City USA renewal, Arbor Day celebrations	X	X	X	X	X	X	X	X	X	X	X
External Provider Contract Renewal			X		X		X		X		X
Host ISA RMC Tree Climbing Championships				X							
Noxious Weed Management	X	X	X	X	X	X	X	X	X	X	X
Plant Health Care Management	X	X	X	X	X	X	X	X	X	X	X
Wildfire Fuel Reduction Projects	X	X	X	X	X	X	X	X	X	X	X

CLOSING STATEMENT

Urban forests face unprecedented challenges in a warming climate. Aspen is fortunate to have an expansive and relatively healthy urban forest cared for by dedicated professionals who endeavor to consistently apply best management practices to maintain and protect the forest. In order to preserve our community forest and the myriad benefits conferred, the residents of Aspen will need to be vigilant and remain committed to the sound environmental standards which will ensure that generations to come will enjoy the same. If Aspen is to remain true to the 'Aspen Idea'; to a healthy mind, body and spirit, it would be very shortsighted not to place trees at the center of that mission. Indeed, if Aspen is to be a leader and environmental champion, the stewardship of its green infrastructure and the fundamental role played by trees in that ecology is paramount. This ten-year community forest management plan is one piece of that larger mission. All community stakeholders should be involved in bringing this to fruition and safeguarding the future of trees in our community.

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APPENDICES

A - City of Aspen Municipal Code, Forestry Section

Chapter 13.20

TREE REMOVAL PERMITS

Sec. 13.20.010. Legislative intent and purposes.

The City Council finds that trees provide important environmental, aesthetic and health benefits to the residents and guests of the City which extend beyond the boundaries of the property upon which trees may grow. The City Council further finds that trees enhance the real estate values of property upon which trees grow and neighboring properties. Large trees are a resource which cannot be fully replaced if injured, damaged or removed. Property development and construction activities can result in injury or loss of valuable trees in the City. It is the intent of this Chapter to preserve to the fullest extent possible existing trees considered desirable by the Manager of Parks and Recreation or his or her designee as hereinafter set forth. (Ord. 34-1995, § 3; Ord. No. 19-2004 § 1) **Sec. 13.20.020. Removal of trees; permit required; valuation.**

(a) Applicability of Section and definition. The terms and provisions of this Chapter shall apply to all private and public real property situated in or subsequently annexed to the corporate limits of the City. The term *tree* shall include, for purposes of this Chapter, all deciduous trees having a trunk diameter of six (6) inches or more, *Querus gambelli* (Gamble Oak), *Acer glabrum* (Rocky Mountain Maple), *Amelanchier spp.* (Serviceberry) and *Prunus Virginiana* (Chokecherry) with a trunk diameter of three (3) inches or more and coniferous trees having a trunk diameter of four (4) inches or more. Trunk diameters shall be measured in inches measured as close to four and one-half (4½) feet above ground as possible.

(b) Removal or damage to trees prohibited without permit.

(1) It shall be unlawful for any person, without first obtaining a permit as herein provided, to remove or cause to be removed any tree.

(2) It shall be unlawful for any person, without first obtaining a permit for tree removal as herein provided, to dig, excavate, turn, compact or till the soil within the dripline of any tree in such a manner as to cause material damage to the root system of the tree. For purposes of this Subsection, the *dripline* of a tree is a cylinder extending from grade level down to a depth of ten (10) feet below grade, having a radius equal to the length of the longest branch of the tree, with the center of the cylinder located at the center of the trunk of the tree.

(3) It shall be unlawful for any person in the construction of any structure or other improvement to park or place machinery, automobiles or structures; or to pile, store or place, soil, excavated material, fill or any other matter within the dripline of any tree. During construction the Manager of Parks and Recreation or his or her designee, may require the erection of suitable barriers around all trees, including trees not included in the definition set forth at Subsection (a) above, to be preserved. These protection areas will be established on site in order to protect existing natural resources when appropriate. Roots must be protected from exposure to the elements with burlap or other suitable materials and these materials must remain moist

during the extent of the project. In addition, during construction, no attachments or wires other than protective guy wires shall be attached to any tree.

(4) It shall be unlawful for any person, without first obtaining a permit for tree removal as herein provided or approval from the Manager of Parks and Recreation or his or her designee, of a project site plan, to pave, with any nonporous material, more than ten percent (10%) of the area within the dripline of any tree.

(5) It shall be unlawful for any person, without first obtaining a permit for tree removal as herein provided, to intentionally top, damage, girdle, limb up or poison any healthy tree. For purposes of this Section *topping* a tree is the removal of more than five percent (5%) of the height from the top of any deciduous tree or the removal of the terminal bud from a coniferous tree. The terminal bud of a coniferous tree is the highest bud on the tree.

(6) It shall be unlawful for any person, without first obtaining a permit as herein provided, to relocate any tree. If a relocated tree dies within two (2) years of relocation and is not replaced with a tree of equal value, the death of the relocated tree shall be deemed an unpermitted tree removal. This Section shall not apply to the initial planting of trees obtained from nursery stock.

(7) It shall be unlawful for any person to fail to provide the Manager of Parks and Recreation or his or her designee, with written notice, delivered at least four (4) working days in advance, of the time and date on which removal of any tree will occur. Written notice pursuant to this Section is required even if a permit for tree removal, as herein provided, has been obtained.

(8) Each violation of the above Subsections (b)(1—7) shall be a separate offense.

(c) Penalty. Any person convicted of violating any provision of Chapter 13.20 shall be subject to punishment as set forth in Section 1.04.080 of this Code.

(d) Tree removal permits.

(1) Any person wishing to obtain a permit or relocate a tree shall file an appropriate application with the Manager of Parks and Recreation or his or her designee. Such application shall contain such information as the Manager of Parks and Recreation or his or her designee, shall require to allow adequate enforcement of this Section.

(2) On request of the Manager of Parks and Recreation or his or her designee and when necessary to adequately apprise the Manager of Parks and Recreation or his or her designee, of the intended tree removal, said application shall include a site plan showing the following:

(i) Location of proposed driveways and other planned areas or structures on said site;

(ii) Location of all trees four (4) inches or over identified by trunk diameter and species;

(iii) Designation of all diseased trees and any trees endangering any roadway pavement or structures and trees endangering utility service lines;

(iv) Designation of any trees proposed to be removed, retained and relocated and areas which will remain undisturbed;

(v) Any proposed grade changes which may adversely impact any trees on the site.

(3) After filing said application, the Manager of Parks and Recreation or his or her designee, shall review the application (and site plan if required) and determine what effect the intended removal or relocation of trees will have on the natural and historic resources of the area. Based on a review of the following factors, the Manager of Parks and Recreation shall either grant or deny the requested permit:

(i) Whether the trees intended for removal or relocation are necessary to minimize flood, snowslide or landslide hazards;

(ii) Whether retention of the trees is necessary to prevent excess water runoff or otherwise protect the watershed;

(iii) Whether the removal or relocation of the trees will cause wind erosion or otherwise adversely affect air quality;

(iv) The condition of the trees with respect to disease, danger of falling and interference with utility lines;

(v) The number and types of trees in the neighborhood, the contribution of the trees to the natural beauty of the area and the effect of removal or relocation on property values in the area;

(vi) The necessity or lack thereof, to remove the trees to allow reasonable economic use and enjoyment of the property;

(vii) The implementation of good forestry practices, including consideration of the number of healthy trees that the parcel of land in question can support;

(viii) The adequacy of the methods proposed to be used to relocate any trees; and

(ix) The impact of any tree on a historically designated property or adjacent rightof-way by considering the following matters:

(A) In cases where a tree is jeopardizing the physical integrity of a historically designated structure through contact with the building, heaving due to roots or shading that results in decay, deterioration or structural defect, this shall be justification for the issuance of a tree removal permit exempt from mitigation pursuant to Section 13.20.020(d). Examples of unacceptable impacts to a historically designated structure include: deterioration of exterior walls, foundations or other vertical supports; deterioration of flooring or floor supports or other horizontal members; deterioration of external chimneys; deterioration or crumbling of exterior plasters or mortars; ineffective waterproofing of exterior walls, roofs and foundations; the inability to retain paint on exterior surfaces; or excessive weathering of exterior surfaces. The applicant for a tree removal permit shall be required to submit proof of the damage that is occurring in the form of a written evaluation from a third party with expertise in structural engineering or a relevant building trade. The Manager of Parks and Recreation may suggest means to prevent the tree from causing further damage short of its removal if these actions would meaningfully reverse the problem.

(B) In cases where, per the advice of the Historic Preservation Commission, a tree detracts from the integrity of a landscape which has been historically designated for its own merits, this shall be justification for the issuance of a tree removal permit exempt from mitigation pursuant to Section 13.20.020(d).

(C) In cases where the visibility of the street facing facades of a historically designated structure are impacted by an evergreen tree which is not located in the City right-of-way, to the extent that the public enjoyment of the resource is seriously diminished per the advice of the Historic Preservation Commission, this shall be justification for the issuance of a tree removal permit exempt from mitigation pursuant to Section 13.20.020(d). The Manager of Parks and Recreation may consider whether the tree in question has

a unique character to offset the negative impact to the structure. This character may include an unusual or unique species or specimen tree quality. The Manager of Parks and Recreation may suggest means to prevent the tree from obstructing the resource, short of its removal, if these actions would meaningfully reverse the problem.

(D)In cases where, per the advice of the Historic Preservation Commission, a tree is inconsistent with established historic landscape patterns in the area or landscape practices associated with the period of significance of the property or district, the removal or relocation of the tree should be considered, subject to mitigation pursuant to Section 13.20.020(d). The Manager of Parks and Recreation may consider whether the tree in question has a unique character to offset the negative impact to the structure. This character may include an unusual or unique species or specimen tree quality.

(E) In cases where, per the advice of the Historic Preservation Commission, the protection of a tree conflicts with the redevelopment of a historically designated property in a manner that is consistent with the "City of Aspen Historic Preservation Design Guidelines," the Manager of Parks and Recreation shall consult with the Historic Preservation Commission to consider the feasibility of all options including removal or relocation of the tree or redesign of the development. Unless the tree is an unusual or unique species or specimen tree quality, flexibility shall be allowed for its removal or relocation in favor of the best preservation option for the historic structure, subject to mitigation pursuant to Section 13.20.020(d).

(4) Where construction of structures or improvements on any property necessitates the removal or relocation of any trees, the Manager of Parks and Recreation or his or her designee, may, as a condition for the approval of the removal or relocation, require that the owner replace any removed or relocated trees with a tree or trees of comparable value on the affected property. When in the opinion of the Manager of Parks and Recreation or his or her designee, replacement of relocated trees cannot reasonably be accommodated on the affected property; the applicant shall pay a cash-in-lieu amount equal to the comparable value of the aggregate of all trees removed. *Comparable value* for purposes of this Section shall mean a tree or trees of equal aggregate value and species to the replacement cost of the tree to be removed or relocated.

(5) No trees shall be removed from City property except in accordance with Chapter 21.20 of this Code.

(6) The removal of dead trees shall require prior notice to the Manager of Parks and Recreation or his or her designee and a permit from the City.

(7) In case of an emergency caused by a tree being in a hazardous or dangerous condition posing an immediate threat to person or property, such tree may be removed without resort to the procedures herein described; provided, however, that evidence of such an emergency is provided to the Manager of Parks and Recreation or his or her designee, within twenty-four (24) hours.

(8) After obtaining a permit as herein provided the responsible party must post the permit in such a manner that it is clearly visible from curbside of the property.

(e) Valuation of trees. When, in accordance with this Section, the value of a tree must be determined, the Basic Value shall equal thirty-eight dollars ($38.00) per square inch of the cross sectional area of the tree at the point where the diameter of the tree is measured. In calculating the Basic Value, the following equation shall be used:

$$\text{Basic Value} = \$38.00 \times 3.14 \times (D/2)$$

Where: D = the diameter of the tree in inches.

(Ord.No. 34-1995, § 3; Ord. No. 19-2004 § 1)

Sec. 13.20.030. Fees.

The applicable administrative fees for tree removal permits and permits to landscape in the public right-of-way shall be as established in Section 2.12.080, Parks Department fees. (Ord. No. 19-2004, § 1)

Sec. 13.20.040. Appeals.

Any person not satisfied with the action taken by the Manager of Parks and Recreation or his or her designee or any other City staff person with regard to an application pursuant to this Chapter shall have the right to take successive appeals, first to the City Manager and then to the City Council. An appeal to the City Manager shall be taken by filing with the City Clerk a signed statement that the applicant desires to appeal to the City Manager, along with a copy of the application and the written denial or the permit objected to. An appeal of a decision by the City Manager to the City Council shall be taken by filing with the City Clerk copies of the application, denial or permit and the written decision issued by the City Manager, along with a signed statement that the applicant desires to appeal to the City Council. Each appeal shall be filed within two (2) days, exclusive of Saturdays, Sundays and legal holidays, of the decision appealed from. An informal summary hearing shall precede a decision by either the City Manager or City Council, and advance notice of the hearing shall be provided to the applicant and the City official whose decision is being appealed as soon as is practicable. The right to appeal an adverse decision by the City Manager to City Council shall be contingent upon City Council's regular meeting schedule. If the applicant's appeal cannot be heard by the City Council within ninety (90) days of the original decision then the City Manager's decision shall be final. (Ord. No. 19-2004, § 1).

Chapter 21.20

TREES AND LANDSCAPING ON PUBLIC RIGHT-OF-WAY[1]

Sec. 21.20.010. Approval required for landscaping in sidewalk area.

All trees, shrubs, foliage and other landscaping planted in the sidewalk area or other public right-of-way shall be approved as to location and type by the City Engineer and the Director of Parks in accordance with the provisions of this Chapter and the following considerations:

(a) Location, arrangement and species shall conform to the adopted street landscaping plan.

(b) Special consideration shall be given to the problem of drainage and snow removal.

(c) Location and arrangement shall provide for pedestrian access.

(d) Location shall be such as not to obstruct corner sight distances at intersections.

(e) Coordination of landscaping on public rights-of-way with required open or landscaped areas on private property so as to achieve the most effective use of the total area. (Code 1971, §19-121; Ord. No. 30-1975, §1; Ord. No. 36-1976, §1)

Sec. 21.20.020. Landscaping required for new construction.

For all new construction landscaping shall be provided in the sidewalk area or public right-of-way adjoining the building site in accordance with the adopted street landscaping plan. (Code 1971, §19-122; Ord. No. 30-1975, §1)

Sec. 21.20.030. Specifications for landscaping in sidewalk area.

Landscaping and planting areas shall meet the following specifications:

(a) Planting areas at sidewalk grade adjoining the curb shall be a minimum of four (4) feet in width.

(b) Planting areas provided in paved areas shall be a minimum of three (3) feet in diameter or eight (8) square feet in area.

(c) Trees planted at sidewalk grade shall be provided with tree grates and trunk protectors at least four (4) feet in height.

(d) Elevated planting areas are preferred in Commercial Districts and where provided, shall be a minimum of twenty (20) inches above sidewalk grade.

(e) Gravel, crushed stone, washed rock and similar materials shall not be allowed in the sidewalk area at grade. Such materials shall not be allowed in lieu of landscaping unless approved as part of an overall plan.

(f) When any area is paved, a minimum of twelve (12) inches of unsurfaced area shall be left around the base of all existing trees. (Code 1971, §19-123; Ord. No. 30-1975, §1)

Sec. 21.20.040. Property owner responsibility for landscaping after construction.

Whenever the landscaping in any portion of the sidewalk area or other public rights-of-way is disturbed by construction or excavation related to construction on private property, the owner of the property shall be responsible for landscaping the damaged right-of-way in accordance with the provisions of this Chapter. (Code 1971, §19-124; Ord. No. 30-1975, §1)

Sec. 21.20.050. Property owner responsible for maintenance of landscaping in adjoining right-of-way.

The property owner shall be responsible for maintaining the landscaping in that portion of the sidewalk area or other public right-of-way which adjoins his or her property; provided that the City shall be responsible for the pruning or removal of any trees which are not under any guarantee of the owner. Maintenance shall include mowing, trimming and planting of annual plants if such is required by the landscape plan. (Code 1971, §19-125; Ord. No. 30-1975, §1)

Sec. 21.20.060. Approval required for paving of planting areas.

Planting areas provided in accordance with an approved landscape plan shall not be paved without the approval of the Director of Parks. (Code 1971, §19-126; Ord. No. 30-1975, §1; Ord. No. 36-1976, §2)

Sec. 21.20.070. Requirements for removal of trees; approval required.

It shall be unlawful for any person, whether a property owner or not, to cut or remove trees situated upon City property, streets or other public rights-of-way without first obtaining written approval from the Director of Parks. Grant or denial of approval shall be based upon the adequacy of the replanting plan as relates to the number, size and species of new trees; guarantees for restoration of any other landscaping; indemnification of the City against any claims arising from damage to public or private property or injury to persons; and any other conditions the Director of Parks shall deem pertinent. (Code 1971, §19-127; Ord. No. 30-1975, §1; Ord. No. 36-1976, §3)

Sec. 21.20.080. Requirements of conservation of water in landscaping on public rights-of-way.

The Director of Parks shall develop and implement a conservation and irrigation program to increase the efficiency of water use on public open space areas including parks, greenbelts, public golf courses, roadway right-of-way plantings, street medians and all other public open spaces.

The program shall include, as a minimum, the following:

(a) Limiting to functional areas of heavy pedestrian traffic, such as ball fields or areas proximal to entryways, the locations on which frequently irrigated and mowed turf such as bluegrass is to be maintained and restricting the use of turf in median strips;

(b) Ensuring the use of efficient irrigation techniques and systems, including the limitation of landscape irrigation between the hours of 11:00 a.m. and 3:00 p.m.; employing the use of nonpotable water supplies and water reuse where such supplies and water reuse are available for irrigation of areas exceeding ten (10) acres; and using seasonally variable irrigation schedules which match the evapotranspiration needs of the plants being irrigated;

(c) Analyzing and improving soil on the site to maximize moisture availability for plant intake and to increase soil moisture penetration and retention;

(d) Using mulches to reduce water needs and weed growth and to check soil erosion;

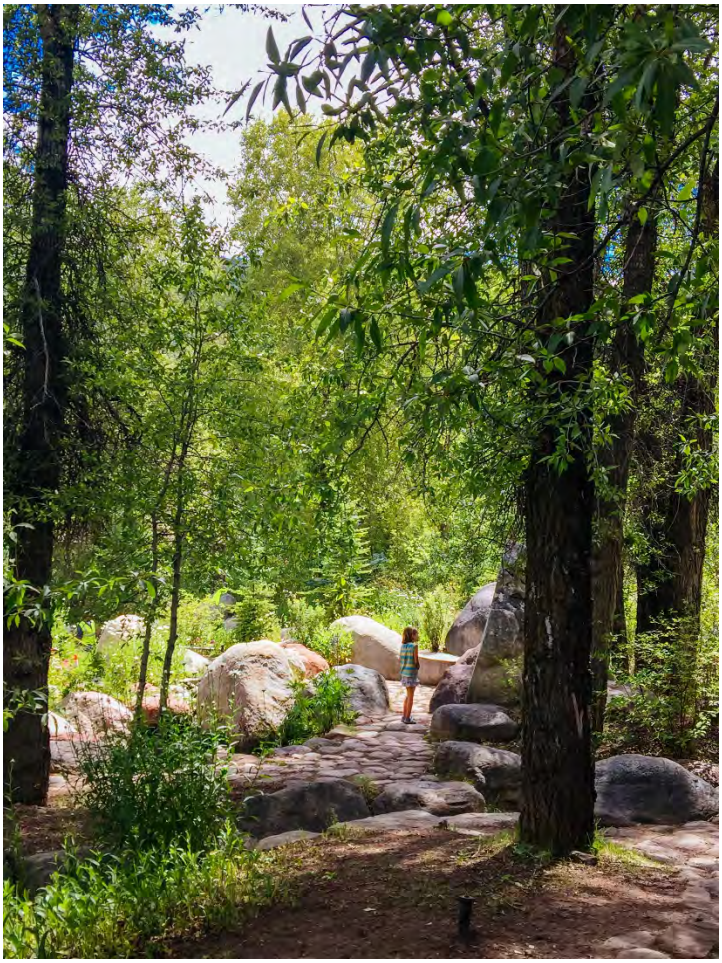
(e) Using lower water-demand plants, ground cover and grass species to reduce water usage;

(f) Planning for routine maintenance such as weed control, pruning and irrigation system adjustments so as to reduce water usage; and

(g) Using evapotranspiration data, when available, to determine water needs. (Code 1971, § 19-128; Ord. No. 37-1991, § 4)

B - 2017 Tree Inventory

City of Aspen
Street and Park Tree Inventory



January 2018
Colorado State Forest Service

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Appendices

Aspen Tree Inventory History: 1992-93

At the request of George Robinson, the Parks and Golf Director, the Colorado State Forest Service (CSFS) completed a street and park inventory of all trees in the winter of 1992-93. Crews used Radio Shack Model 100 hand-held computers or hard copy forms to record tree inventory data. The data was entered into the Radio Shack computers as text or numeric code. This data was then imported into File Express 5.1 software. File Express was a reasonably priced data base program used by the CSFS Grand Junction District to generate the reports for the 1992-93 inventory report. To the best of my knowledge the City of Aspen never purchased this software to update reports for their inventory. The cost to inventory the street trees was based on the City having 24.5 street miles. A flat fee was charged for the park inventory, compilation of data and recommendations report.

The following information was taken on every street tree.

1. *Tree number* – Every tree and tree space was assigned an identifying number.
2. *Tree location* – The physical address was noted for every tree planted on right-of-way.
3. *Tree species* – As defined by the CSFS (no cultivars). See Tree Species table in the Species section of the Tree Inventory: 2006 Data Fields.
4. *DBH* – measured at Diameter Breast Height
5. *Condition* – The following values were assigned; *Dead, Very Poor, Poor, Fair, Good*, *Excellent*. All judgments were based on factors observed above ground.
6. *Placement* – The following values were assigned; *Very Poor, Poor, Fair, Good, Excellent.* All based on the tree's growing space in relation to the surrounding conditions.
7. *Management Need* – One of the following recommendations was determined; *Remove* (hazard, non-hazard), *Clearance prune*, *Form prune*, *Plant*, *Protect*, *Water/Fertilize/Aerate*, *Sample/Treat disease*, *Do nothing.*
8. *Comments* – This field was used to elaborate further on the management need.

The same tree information (minus physical address) was taken on trees in the following 28 parks.

Bugsy Barnard	Rubey
Parks & Golf Office & Facility	Wagner
Shaw Triangle	Willoughby
Hillyard	Wheeler
Paepcke	Newbury
Koch Lumber	Herron
Bass	Aspen Pedestrian Mall
Glory Hole	Ajax
Aspen Art Museum	Clapper
Rio Grande	Henry Stein
Aspen Art Park	Freddie Fisher
Parking Plaza	Iselin Park/ Moore Pool
Milton Corner/City Hall	Plum Tree Ballfield
Electric Department Substation	Tot Lot

In addition to the reports, the CSFS placed *Tree Number* (by hand) on a City of Aspen generated street map. The number uniquely identified every tree and space inventoried for the City and corresponded to the information contained in the reports. This map showed the building footprints for the homes, which facilitated locating where the trees should be placed on the lot. The park maps were created using another software program called GenCADD, which was owned by the CSFS.

Here are some of the more interesting details from that first inventory.

- There were 3,861 total trees for both streets and parks.
- 2077 trees of the total trees count were growing along the streets.
- There were 187 planting spaces.
- The number one tree was cottonwood at 1,077 trees, 26.6% of the tree population.
- The number two tree was Aspen at 871 trees, 21.5% of the tree population.
- The number three tree was Colorado spruce at 725 trees, 17.9% of the tree population.
- The total value of the all the street trees was $3,274,774. This value was based on the following formula: $34 X Basal area X Species factor X Condition factor X Placement factor = Basic Value. The $34 figure came from the International Society of Arboriculture – Rocky Mountain Chapter. This $34 represents the cost per unit of area of a replacement tree.
- Here is an example of how that calculation was made. There is a 30 inch DBH silver maple in FAIR condition planted in a GOOD location. $34 X (.785 x 30 x 30) X .65 X .7 X .8 = $8,744
- There were 499 trees recommended for removal.
- Fifty-nine trees were deemed to be hazardous and were recommended for immediate removal.
- Refer to the 2006 Tree Inventory Report and its Appendix A for more 1992-93 inventory background information. Randy Overstreet wrote the report and was the lead man for this inventory.

There was no City Forester in Aspen at the time of the 1992-93 tree inventory. According to CSFS files, tree issues were handled by George Robinson and Rebecca Baker (aka Rebecca Schickling). The city used the information from this inventory in the following manner.

1. Removed trees recommended for removal because of a hazardous condition.
2. Selectively removed other trees recommended for removal.
3. Planted spaces identified as available.

Aspen Tree Inventory History: 1996

In 1995, George Robinson asked the CSFS to submit a proposal to re-inventory the trees that were mapped and counted in 1992-93. A proposal to complete this re-inventory was sent to George Robinson in July of 1995. This second inventory would be a carbon copy of what was done in 1992-93. In fact the same 24.5 street miles was used to generate a cost to the City.

For some reason the City declined to have the parks re-inventoried in 1996. So in the spring of 1996, the CSFS only looked at the streets originally done in 1992-93. The same data was gathered and the maps were updated. The maps were again done by hand. This task proved to be very tedious and questionable as to the overall value for the city. For this inventory File Express 6.0 was used to generate reports.

Here are some interesting details and comparisons from the 1996 inventory:

- There were 2,200 trees growing along the streets.
- There were 148 planting spaces identified.
- The number one tree was again cottonwood, 34.1% of the tree population. This represents a nearly 8% increase since 1992-93. The average DBH increased by three inches also.
- The number two tree was again Aspen, 16.9% of the tree population. This represents a nearly 6% drop since 1992-93.
- The number three tree was Colorado spruce, 14.7% of the tree population. This represents a 3% drop since 1992-93. This number is desirable since we are talking about trees planted in the right-of-way. Any evergreen planted in the right-of-way is undesirable from a pedestrian/vehicular safety stand point.
- The total value of the street trees was $4,145,572. The value was calculated using the same formula as the 1992-93 tree inventory. The only change was the replacement value was now $36, instead of the $34 figure used in 1992-93.
- Recorded 109 removals since the 1992-93 inventory.
- Recorded 23 trees planted to fill available spaces since the 1992-93 inventory.
- Refer to the 2006 Tree Inventory Report and its Appendix B for more 1996 inventory background information. Vince Urbina wrote the report and was the lead man for this inventory.

Aspen City Forester

In the fall of 1997 Vince Urbina supplied city forester job description information to Jeff Woods. The city was looking to hire a City Forester. The position was advertised as a City Forester/Natural Areas Specialist in the winter of 1998. Stephen Ellsperman was selected to fill the position and by our records he started in March of 1998. He worked in the City Forester position until 2001. In 2001 he took another position with the City so the position was vacant.

In November of 2001, Aaron Reed was hired to fill the vacant City Forester position. Existing programs continued to flourish during his tenure. In fact the City of Aspen Urban Forestry program was accredited by the Society of Municipal Arborists as a result of all the positive tree programs going on in the City. Aaron took another position with the City in July of 2006.

Aspen Tree Inventory History: 2006

In 2003, Aaron Reed approached the CSFS about re-inventorying the City trees. Several proposals were written and discussed between the CSFS, Stephen Ellsperman, and Aaron Reed. Items 1–6 represent what Stephen and Aaron requested in the inventory.

1. The inventory will be a stand-alone product; it would not be an update of the previous inventories.
2. New parks had been added to the system and needed to be inventoried. The City provided a list of parks to be inventoried.
3. The City wanted this inventory to be Geographic Information System (GIS) based. The street trees do not need to be GPS'ed but the park trees should have latitudinal and longitudinal coordinates assigned.
4. All large trees were to be thoroughly examined and rated for any defects.
5. The City wanted any construction activity that would impact the publicly-owned trees to be noted on the day it was observed.
6. Planting spaces were be noted and reported. No planting space were reported if it fell within 25 feet of a street corner. Minimal planting spaces were noted in Parks due to water line locations.
7. A Service Agreement was drafted to inventory the right-of-way trees and park trees within the Aspen city limits. It was signed in May of 2006.

Tree Inventory: Process

- The CSFS used HP iPAQ hand-held computers (PDA) to record data for each tree and space in the field. These units were owned by the CSFS.
- The City's GIS department provided high resolution aerial photography of the City taken in 2004. These aerial photographs were used to locate trees and spaces using GIS software.
- The CSFS secured a geodatabase program from a Front Range community to serve as the template for the Aspen tree inventory. This program was customized with drop down menus for the Aspen inventory and put on the PDA's with ArcPad 6.02 software.
- Once data was incorporated on to the aerial photos and in the database it was imported from the PDA's into the ArcGIS 9.1 program on a laptop.
- Once the Aspen tree inventory data was stored on a laptop it afforded all the advantages that GIS software has to offer. All previous inventories for the City were no more than a snapshot in time.

Tree Inventory: Ground Rules

- A complete defective tree analysis was done for all trees that measured 25 inches or greater at DBH. Large spruce trees were not analyzed unless necessary. The CSFS sat down with the City Forester before starting the inventory to determine what information would be taken on the large trees using the CTC – Single Tree Recording Form as a template.
- Shortly after the inventory started it was noted that some trees had a significant defect but were less than 25 inches at DBH. For this inventory, only the existing defect was noted for these trees. All other fields in the defective tree analysis were left unfilled. However, the appropriate mitigation action for the defect was suggested.
- In this inventory the parks were given the first priority for completion. In the course of tallying parks inventory we discovered that there were certain parks (e.g., Ute, Iselin, Snyder, Glory Hole, John Denver) that had an excessive number of either Aspen sprouts or transplants within the park boundaries. After discussing this situation with Stephen Ellsperman, it was decided to count only the significant trees in these parks as one being six inches or greater measured at DBH. This significant label was mostly applied to spens and cottonwoods.

Aspen Tree Inventory: 2017 Background

In 2016, Ben Carlsen, City Forester, approached the CSFS about re-inventorying the City street and park trees and conducting an tree risk assessment on trees 25 inches in diameter or larger. Several proposals were written and discussed between the CSFS and Ben, the final agreement was signed in 2017 (Appendix A). The following items represent what was desired in the inventory.

- The City of Aspen Parks Department wanted the Colorado State Forest Service (CSFS) to provide a Geographic Information Systems (GIS) software based update to the previous inventory of the City's trees. The update will encompass all City owned properties including streets and parks.

- Every tree in these areas will be assessed from the ground and their attributes will be updated in the City's inventory. This will include the addition, deletion, or moving of tree points and updating their attributes in the inventory. The information will be collected using TreePlotter software created and maintained by Plan-IT-Geo. The City will provide the CSFS with the appropriate user access to make changes to the inventory in TreePlotter. The CSFS will provide their own devices for data entry.

- There are approximately 27.3 miles of streets and 36 parks that will be updated. Trees in these areas will be updated for specific attributes and must include:

    1) Detailed location of the trees
    2) Tree species
    3) Tree value (to be included in report)
    4) Tree diameter
    5) Tree condition
    6) Risk rating for trees greater than 25 inches diameter (Level 2 Assessment, including a Tree Risk Assessment (TRAQ))
    7) Tree spaces (mostly identified on streets)
    8) Maintenance/pruning needs
    9) Comments

The field data collection portion of this agreement was to be completed by November 1, 2017. All data was collected into the TreePlotter software. In addition, a written report based on the updated inventory will be provided to the City of Aspen. The written report should detail the composition and structure of the community forest; it should also analyze the information and give recommendations. The written report should be completed by January 31, 2018.

Aspen Tree Inventory: 2017 Data Fields

The following data fields represent the tree inventory observations that were recorded into Tree Plotter. These questions are also found in Appendix B. There are four tabs with in the Tree Plotter system. The first tab is Tree Information, the following information was collected:

Common Name:

- List provided by the City and added to as additional species were identified.
- The tree species list was based on known native and non-native trees planted in the area, the list is found in Appendix C.

Status:

- Identifies the current status of the tree point. Options were: Alive, Dead, Proposed Site (planting space), Removed, or Stump.

Diameter at Breast Height (DBH)

- DBH is a measurement of the tree trunk diameter at 4.5 feet above the ground.
- The Tree Plotter system rounded the number entered down to the nearest whole number.

Number of Stems

- Number of tree stems observed, ranging from one to more than three (1-3+).

Condition

- Condition choices included: Excellent, Good, Fair, Poor, Very Poor, or Dead.
- The condition categories are slightly subjective, depending on the person observing the tree in regards to condition. As a rule, most data collectors avoid using the excellent category. Most trees are placed in the good category, unless the tree's condition is truly superior to the other trees of the same species they have inventoried.
- Trees rated as fair would have some of the following issues: stagnant growth pattern, poor vigor, uneven growth pattern, minor trunk damage, deadwood, etc.
- Trees rated as poor would exhibit some of the same issues as above but the problem or condition is more advanced than a tree with a fair rating.
- Very poor trees are usually barely alive, very unattractive specimens, heavily damaged, or are being severely impacted by insects or disease. These trees are normally recommended for removal.

Placement

- Placement choices included: Excellent, Good, Fair, Poor, or Liability.
- The placement categories are slightly subjective, depending on the person observing the tree in regards to placement. As a rule, most data collectors avoid using the excellent category. Most trees are placed in the good category, unless the tree's placement is truly superior to the other trees of the same species they have inventoried.
- Trees rated as fair would have some of the following issues: close proximity to other vegetation or structures that impede normal growth habits, have the potential to negatively impact sidewalk pathways in the future, or are growing beneath an overhead line but have not yet made contact.
- Trees rated as poor would exhibit some of the same issues as above but the problem or placement is worse than a tree having a fair rating.

- Liability trees are located where they are currently creating problems for infrastructure items such as sidewalks or overhead lines. These trees may also negatively impact pedestrian or vehicle safety. These trees are usually recommended for removal.

Condition of Leaf

- The purpose of this question is to identify any tree health issues that can be shown by leaf size and color. Options included: Good, Fair, or Poor.

Percent Dieback

- This question identified if there were any existing branch dieback in the tree crown. Dieback can indicate the tree's health is declining or decay exists. Options included: None, <25%, 25-50%, 50-75%, or >75%.

Observations

- This list of 19 items were used to identify current issues that were observed on the tree, multiple selections could be made. These are not management needs but can assist the tree manager in determining actions to take. The list can be found in Appendix B.

Tree Comments

- Additional comments that further addressed observations from the tree observation field.

Staff Member

- The initials of the employee who conducted the inventory on that tree point. CSFS staff included Kamie Long, Vince Urbina, and Barbara Russell.

Primary ID

- Each tree within the City was given a unique identification number by Tree Plotter.

The second inventory tab: Location Information, the following information was collected:

Address/Address Number/Address Street/Street the tree is on

- Tree Plotter identified this information based on the location of the tree point.

City Managed

- This box was checked for all trees/spaces inventoried.

Date Assessed

- Date the tree was inventoried.

Growing Space

- This field was used to identify where the tree is located. Options that were selected include: Park or Street. Other options were available but CSFS was instructed to choose between these two.

Land Use

- To assist the tree manager with information on what type of land use the tree is growing in. Options included: Single Family, Multi Family, Small Commercial, Industrial/Large Commercial, or Park/Vacant/Other.

Park Name

- Every Park tree was assigned to one of the following 36 parks:

Aspen Parks	Aspen Parks
Ajax Park	Moore Playing Fields
Aspen Art Museum	Newberry Park
Aspen Ice Garden	Paepke Park
Aspen Pedestrian Mall	Pioneer Park
Bugsy Barnard Park	Red Brick Recreation Center
Burlingame Commons	Red Butte Cemetery
Conner Park	Rio Grande Park
Fox Crossing Park	Rubey Park
Francis Whitaker Park (Bass)	Skate Park
Freddie Fisher Park	Snyder Park
Glory Hole Park	Tot Lot Park
Herron Park	Triangle Park
Hillyard Park	Ute Park
Silvercircle Ice Rink	Wagner Park
Iselin Park	Wheeler Park
John Denver Sanctuary	Willa Park
Koch Park	Willoughby Park
Mollie Gibson Park	Yellowbrick Park

Wires

- Identified if power lines or other wires were located near the tree and if causing conflicts. Options included: No Lines, Present/No Conflict, or Present and Conflicting.

The third inventory tab: Management Needs, the following information was collected:

Primary Maintenance – one selection per tree/space

- Critical Concern (safety): This option was never chosen. If a critical concern tree was identified, a call was made to Ben to make him aware of the situation.
- Cultural Treatment: This need is chosen when the tree health would be improved by adding fertilizer or if the growing site needs mitigation (e.g., soil compaction). Although the need is not immediate, the tree would benefit from further inspection to determine how to improve the existing situation.
- Disease Treatment: There is physical evidence of a disease at the time the tree was inventoried (e.g. fire blight, canker, oozing).
- Insect Treatment: There is physical evidence of an insect at the time the tree was inventoried.
- Large Tree (immediate): This option was never chosen. If a tree with safety issues was identified, a call was made to Ben to make him aware of the situation.
- Large Tree (routine): Normal periodic pruning is suggested to maintain scaffold branching, eliminate conflicting branches, correction of stubs, and/or removal of small deadwood, trunk sprouts, or root collar suckers. No major structural issues were identified.
- None: The tree is in good health and condition. In its present state, the tree is a good example of the species for that site. No immediate action is recommended at this time.

- Plant Tree: A space has been identified as suitable for planting based on the existing site conditions and the horizontal and vertical space available.
- Prune – Complete: Multiple types of pruning cuts are required on this tree, including but not limited to: deadwood removal, crown lifting, structural improvement, correcting crossing or rubbing branches.
- Prune – Crown Clean: Pruning is needed to correct a structural, aesthetic, or a tree health problem. The problem does not pose an immediate threat to the public or personal property, however, if left alone the problem will not resolve itself. Examples include crossing branches, included bark, scaffold (permanent) branches too close to each other, no central leader, and/or an unbalanced growth pattern.
- Prune – Crown Raise: Pruning is needed to prevent damage to personal property or injury to people. This tree management need addresses public safety. The standard branch height over streets is 13-14 feet and a branch height of 8 feet over sidewalks. Trees or branches must not block public safety signs. Additional information for type of clearance issue is found in the Clearance Conflicts question.
- Prune – Crown Restore: This was selected for trees that have been severely headed back, topped, or damaged in any other way, such as storms. Restoration is done by cutting back to lateral branches to improve structure, form, and appearance.
- Prune – Reduction: Tree branches are beginning to interfere with other vegetation or structures. Branch reduction is recommended to eliminate the interference.
- Prune – Selective: This type of pruning is recommended when specific branches need removal as they are creating issues within the tree or impacting other vegetation or structures.
- Remove Stump: The original tree was removed and the stump is still existing. Remove the stump.
- Remove Suckers: Suckers from the root system are becoming a nescience to the tree's growth and impacting the trees overall aesthetic. Suckers should be removed at their point of origin.
- Remove Tree: This tree is either dead or in very poor health due to damage to the tree, overall tree health, improper planting, over-crowding, pests, or people abuse. It would be prudent to remove it from the growing site. Trees harboring aggressive or nuisance pests or pose a hazard to the public should be a priority.
- Small Tree (immediate): This option was never chosen. If a tree with safety issues was identified, a call was made to Ben to make him aware of the situation.
- Small Tree (routine/train): Two reasons for selecting this maintenance need. Either the tree has not reach maturity and requires pruning to ensure the tree has good structure as it grows or it needs basic routine pruning. This can include normal periodic pruning to maintain scaffold branching, eliminate conflicting branches, correction of stubs, and/or removal of small deadwood, trunk sprouts, or root collar suckers.
- Stake/Protect: The tree is being damaged by existing external or internal factors, examples can include lawn mower/ grass-trimmers damage, weed barrier fabric cutting into the tree, or caging. If grass is growing against a tree trunk, the tree would benefit from grass removal within a three foot radius. Deer or other animal damage would also fall into this management need.
    - This option may also be selected if there are girdling roots visible around the trunk flare/root collar of the tree. If possible, girdling root(s) should be cut as soon as possible to prevent the root from growing larger and causing further damage. This need may also be selected if there is no visible trunk flare and girdling roots are suspected. Further investigation is suggested and action is highly recommended in all situations to mitigate and/or prevent further damage.
- Tree Risk Assessment: If the tree inventory collector identified issues that are beyond the scope of a Level 2 assessment (from the ground), it is highly recommended that the tree manager conduct a Level 1 tree risk assessment to determine risk and management.

Maintenance Needs

- This list of 22 items were to recommended management needs based on the information collected in the tree inventory, multiple selections could be made. The Primary Need of the tree was addressed in the previous question; this Maintenance Needs list is to assist the tree manager in creating a better picture of the tree's management needs and issues. The list can be found in Appendix B.

Clearance Conflicts

- This question builds off the Maintenance Need of Prune-Clearance or Raise. It identifies the type of clearance conflicts that are occurring. Options included (multiple selections could be made): Building, Light, N/A, None, Other, Pedestrian, Sign or Signal, Underground Utilities, Vegetation, or Vehicle.

Watch This Tree?

- This box was checked when the tree's DBH was less than 25 inches but the tree inventory collector felt the tree manager should keep an eye on the tree to watch for any decline in tree health or if safety concerns arise.

Maintenance Notes/Prune History

- Additional comments were made in reference to Maintenance Needs for clarification.
- Also used by City employees to make comments about maintenance or pruning history.

The forth inventory tab: Risk Assessment, the following information was collected in this tab for trees with a diameter at breast height (DBH) of 25 inches or greater.

Likelihood of Failure

- This is used to assess the likelihood that a tree or branch may fail during normal weather conditions; this was based on the tree species and determined by the City Forester.
- Options were: Improbable, Possible, Probable, or Imminent
- Possible was the minimum value for the following species: Cottonwood, Silver maple, Willow, Boxelder

Likelihood of Impacting Target

- This is used to assess the likelihood that the failed tree or branch would impact a specific target; this was based on frequency of use determined by the City Forester.
- Options were: Rural Road/Natural area - Very Low, Residential Street - Low, Residential Street Intersection - Medium, or Occupied Structure/Arterial Street Intersection/School/Playground - High

Likelihood

- This field was automatically filled out based on the previous two answers. Options were: Unlikely, Likely, or Very Likely.

Consequences of Failure

- This is used to assess the consequence of the tree or branch failing and impacting a specific target. Options were: Negligible, Minor, Severe, or Significant

Risk Rating

- This field was automatically filled out based on the previous answers. Options were: Low, Moderate, or High.

Tree Species and Value

The Colorado State Forest Service (CSFS) takes data collected during the tree inventory and determines a tree's overall value to the City and the environment. This is done primarily to show the tree's caretakers that their trees are just as valuable as street paving, internal infrastructure, or other hard scape items. The City understands how much it costs to build a bathroom or picnic structure and that this infrastructure periodically needs maintenance. It can be overlooked that tree populations also have a monetary value and while they do require maintenance, as a tree gets older and larger its value increases.

The formula used by the CSFS to determine tree value is based on dollar figures and percentages obtained from the latest version of the Species Rating and Appraisal Factors Guide, which is produced by the Rocky Mountain Chapter of the International Society of Arboriculture. The formula takes into account the tree's species, diameter, condition, and placement. A tree with good condition or placement will have a higher value than a tree in poor condition or with poor placement. The 2006 inventory excluded the placement component of the tree value, it was included in the 1992 and 1996 inventories. It was decided by Aspen Forestry Staff to include placement in the 2017 tree values. The Comparison of the tree values with placement, without placement, and the formula the City of Aspen uses for replacement values can be found in Appendix G. See Appendix D for an explanation of the value formula used in this inventory. Table 1 shows the total value of all the inventoried trees.

City Trees	Total Number of Trees	Total Value	Tree with Highest Value
Street Trees	5,062	$12,572,582.88	Narrowleaf cottonwood, 53 inches DBH, 633 W. Francis Street
Park Trees	2,877	$6,271,621.18	Blue spruce, 37 inches DBH, Pioneer Park
Golf Course Trees	1,923	$4,957,454.97	Narrowleaf cottonwood, 51 inches DBH
Totals	**9,862**	**$23,801,659.03**	-

Table 1. Summary of tree inventory and value of City managed trees

The City of Aspen manages a wonderful and valuable urban forest; the following table, Table 2, shows the top five most valuable trees broken out by Park, Street, and Golf Course trees.

Aspen Street Tree Inventory - Top Five Most Valuable Trees			
Tree Species	Value	DBH	Street
Narrowleaf Cottonwood	$30,376.98	53	West Francis Street
Silver Maple	$28,802.59	42	North 1st Street
Narrowleaf Cottonwood	$28,475.23	48	West Hallam Street
Narrowleaf Cottonwood	$28,475.23	48	North 2nd Street
Narrowleaf Cottonwood	$28,475.23	48	North 2nd Street
Top Five Total	**$144,605.26**	-	-
Tree Inventory Total	**$12,572,582.88**	-	-

Aspen Park Tree Inventory - Top Five Most Valuable Trees			
Tree Species	Value	DBH	Park
Blue Spruce	$29,230.89	37	Pioneer
Narrowleaf Cottonwood	$22,851.86	43	Herron
Narrowleaf Cottonwood	$22,851.86	43	Red Butte
Narrowleaf Cottonwood	$21,801.35	42	Red Butte
Narrowleaf Cottonwood	$21,801.35	42	Koch
Top Five Total	$118,537.31	-	-
Tree Inventory Total	$6,271,621.18	-	-

Aspen Golf Course Tree Inventory - Top Five Most Valuable Trees			
Tree Species	Value	DBH	Park
Narrowleaf Cottonwood	$28,127.63	51	Golf Course
Narrowleaf Cottonwood	$24,915.82	48	Golf Course
Narrowleaf Cottonwood	$21,898.67	45	Golf Course
Narrowleaf Cottonwood	$20,936.21	44	Golf Course
Blue Spruce	$20,345.79	33	Golf Course
Top Five Total	$116,224.12	-	-
Tree Inventory Total	$4,957,545.97	-	-

Table 2. Top five most valuable trees in the City Streets, Parks, and Golf Course

Tree Species Diversity

Based on the comparison table below not much has changed with the top three trees on the City Streets and Parks since 1992. The first number represents the physical count for each species. The percent number represents what part of the total tree population that particular tree species occupies. Notice that the percentage that for the top tree species is nearly the same for all inventories. The *Populus* genus still occupies over 50% of the trees in 2017, the good news is that it is slightly down since 2006.

Aspen Street Trees - Top 10 Species Comparision				
Tree Species	1992-93	1996	2006	2017
Cottonwood, all species	741 – 35%	752 – 34%	1688 – 34%	1679 - 33.2%
Aspen	345 – 16%	373 – 17%	1040 – 21%	913 - 18%
Colorado spruce	264 – 13%	325 – 15%	756 – 15%	596 - 11.8%
Green ash	115 – 5%	111 – 5%	196 – 4%	296 - 5.9%
Norway maple	148 – 7%	133 – 6%	217 – 4%	275 - 5.4%
Crabapple	159 – 8%	169 – 8%	285 – 6%	261 - 5.2%
Maple, other	-	-	78 – 2%	186 - 3.8%
Engelmann spruce	-	-	61 - 1.2%	139 - 2.8%
Pine, other	64 – 3%	89 – 4%	164 – 3%	123 - 2.4%
Silver maple	58 – 3%	71 – 3%	102 – 2%	80 - 1.6%

Aspen Park Trees - Top 10 Species Comparison			
Tree Species	1992-93	2006	2017
Cottonwood, all species	336 – 19%	734 – 30%	842 - 29.3%
Aspen	526 – 30%	634 – 26%	962 - 33.4%
Colorado spruce	458 – 26%	544 – 22%	594 - 20.6%
Crabapple	73 – 4%	137 – 6%	90 - 3.1%
Pine, Pond./Aust.	70 – 4%	61 – 3%	95 - 3.3%
Pine, other	49 – 3%	79 – 3%	67 - 2.3%
Spruce, other	43 – 2%	59 – 2%	47 - 1.6%
Norway maple	40 – 2%	32 – 1%	24 - 0.8%
Green ash	32 – 2%	25 – 1%	36 - 1.3%
Fir, species	-	21 – 1%	17 – 0.6%

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Spruce, other	43 – 2%	59 – 2%	47 - 1.6%
Norway maple	40 – 2%	32 – 1%	24 - 0.8%
Green ash	32 – 2%	25 – 1%	36 - 1.3%
Fir	-	21 – 1%	743 – 30%

**Park trees were not inventoried in 1996

Aspen Golf Course Trees - Top 10 Species	
Tree Species	2017
Narrowleaf Cottonwood	762 - 39.6%
Colorado spruce	509 - 26.5%
Aspen	243 - 12.6%
Ponderosa pine	88 - 4.6%
Green ash	36 - 1.9%
Engelmann spruce	35 - 1.8%
Lodgepole pine	32 - 1.7%
Scotch pine	32 - 1.7%
Lanceleaf Cottonwood	31 - 1.6%
Douglas-fir	25 - 1.3%

Table 3. Comparison charts of top 10 Street and Park trees species from previous inventories and the top 10 list of species inventoried on the Golf Course.

Plant diversity is extremely important to the overall health and quality of the urban forest. The CSFS recommends that no tree species exceed 10 percent of the total tree population. Plant diversity is recommended as it is a mechanism that helps to keep insect and disease outbreaks from destroying an entire tree species population. For example, two infectious fungal diseases and one recent insect outbreak have wiped out the native American elm, American chestnut, and the ash tree populations in the United States.

The two diseases are the chestnut blight on American chestnut and the Dutch elm disease in American elm. The emerald ash borer, an insect, is currently killing all ash trees in the Midwest and the Northeast. This insect was found in Boulder County, Colorado in 2013. These pests are exotic and have been introduced to our native tree populations that have no natural defenses to fight off the attacks.

The two insects that have the potential to decimate deciduous trees in the City is the emerald ash borer (EAB), which kills all species of ash, and the Asian longhorned beetle which affects maples, horsechestnut, poplar, willow, elm, and black locust. These tree species are presently growing in the City of Aspen.

Both of these insects need a human vector to get into the urban forests of the Rocky Mountain States, which is how it arrived in Boulder County. Since there is no way of predicting when these insects will arrive out west, we must plan for the worse by making our tree populations as diverse as possible right now.

The City has been working on diversifying the urban forest though the Backyard Forestry Program instituted by Stephen Ellsperman. Through this program and others, the following trees have been introduced to the Aspen tree community; varieties and species of maple, hawthorn, mountain ash, serviceberry, euonymous, linden, locust, plum, boxelder, birch, and pines and spruces. Adding these and other trees species that have recently been planted in Aspen to the planting palette is wise and prudent. This is especially important in light of the fact that cottonwoods and aspens (i.e., the *Populus* genus) make up more than 50% of the total tree population.

In the 2006 inventory report it was recommend to consider the following species; Rocky Mountain maple, Hotwings tatarian maple, Yellow buckeye, Thinleaf alder, Russian hawthorn, Downy hawthorn, Northern blaze ash, Thunderchild crabapple, Chinese white poplar, Princess Kay plum, Wafer ash, Burgundy ussurian pear, Prairie gem ussurian pear, American linden, European larch, and Black Hills spruce. These species were selected out of the Fort Collins Wholesale Nursery *Descriptive Guide* – Third Edition. This was done for two reasons. First, the City of Aspen has a history of purchasing trees from this particular nursery. Secondly, this nursery does an

excellent job of selecting and growing trees that are acclimated to the cold droughty conditions of Colorado. This nursery was one of the first Colorado nurseries to select trees from the USDA Horticultural Station in Cheyenne, Wyoming for production. The Russian hawthorn and Ussurian pear are two good examples of their commitment to new plant introduction. Both of these trees were thriving at the Cheyenne Horticulture Station.

The City has done an excellent job of trying these and other new species and varieties along the streets. Eight varieties of elm were identified during the inventory, along with eight varieties of maple and nine species of pine. The species list in this report was condensed down for simplicity but the full list of species identified is in Appendix C. Additional species that is recommended for the City of Aspen to plant is in Appendix E.

There is a caveat to all species recommendations, most of the ornamental tree recommendations produce fruit. It is understood that wildlife will be attracted to some of these trees, therefore the City should read up on these new tree recommendations to determine if they would create future bear problems before purchasing and planting any of these recommendations.

The following table shows that the top ten trees making up the Aspen Street and Park tree populations have increased in average diameter. From the 1996 inventory to the 2006 inventory the cottonwoods diameters decreased in average size, most likely due to the doubling of the total number of cottonwoods as a result of the more inclusive inventory and the removal of more of the large historic cottonwoods in the Core area. From 2006 to this inventory, the average diameter has increased again.

Aspen Street Trees - Mean Diameter Comparision				
Tree Species	1992-93: Mean DBH	1996: Mean DBH	2006: Mean DBH	2017: Mean DBH
Cottonwood, all species	15.2	18.2	15.9	16.7
Aspen	4.4	5.0	6.1	8.0
Colorado spruce	5.7	6.6	8.5	12.0
Green ash	4.0	4.7	4.4	6.0
Norway maple	3.4	4.9	5.7	6.0
Crabapple	4.8	4.5	4.1	5.0
Maple, other	-	-	3.6	3.3
Engelmann spruce	-	-	10.2	14.0
Pine, other	6.0	5.8	7.2	7.6
Silver maple	7.1	8.5	12.4	16.0

Aspen Park Trees - Mean Diameter Comparision		
Tree Species	2006: Mean DBH	2017: Mean DBH
Cottonwood, all species	14.2	14.0
Aspen	6.9	6.0
Colorado spruce	9.7	11.0
Green ash	9.4	9.0
Norway maple	5.4	7.0
Crabapple	3.5	7.0
Maple, other	2.8	3.3
Engelmann spruce	10.1	17.0
Pine, other	5.9	7.5
Silver maple	14.0	13.0

Aspen Golf Course Trees - Mean Diameter Comparision	
Tree Species	2017: Mean DBH
Narrowleaf Cottonwood	12.9
Colorado spruce	13.8
Aspen	7.8
Ponderosa pine	9.5
Green ash	7.3
Engelmann spruce	9.9
Lodgepole pine	10.1
Scotch pine	10.3
Lanceleaf Cottonwood	15
Douglas-fir	7.4

Table 4. Comparison charts of the mean diameters of the top 10 tree species from the last four inventories for Street Trees, the last two inventories for Park trees, and the 2017 data for the Golf Course trees

Insects and Diseases

Native insects and diseases are part of all plant ecosystems. In the forest, they are Mother Nature's way of removing unhealthy specimens and ensure the stands do not become too dense. In urban environments, they are Mother Nature's way of removing trees stressed by human or environmental factors, planted incorrectly, or are incompatible with the planting site.

Minimal insect activity was observed during the inventory, for Street trees only 277 trees had Pest problem – Insect selected in Maintenance Need and only 62 trees in the Parks. The primary insect issues were aphids and eriophyid mites on Street trees and aphids and white pine weevil on Park trees. Other insects identified were borers, primarily poplar borer, and scale, however, these were on very few trees. Diseases were even less prevalent, it was only identified as a Maintenance Need on 31 trees in Street trees and on 14 Park trees, and this does not include trees with decay or cavities. These trees exhibited signs of cholorsis, cytospora canker, bacterial wetwood, and leaf spots caused by rust.

Using the tree inventory data, City staff can make informed decisions on tree species selection, planting locations in relation to infested or infected trees, and how to manage trees with current insect or disease issues based on the type, severity, and location. Management may include tree removal or a spraying regime to control or prevent the insect. Most of the insects currently found in the City will not kill trees outright, but instead stress the tree by killing leaves, branches, or tree leaders. This is usually a result of feeding or boring activity, sometimes in conjunction with the introduction of pathogens brought along on body parts. Stress can predispose trees to attracting and/or being more susceptible to attacks by invasive insects. Resulting whole tree mortality or poor tree structure from tissue damage may require additional future maintenance considerations in terms of pruning, removals, and risk management.

Current Street Tree Situation

The purpose of the 2017 City of Aspen Street tree inventory was to update the previous inventory, determine the current health of the trees, conduct risk assessments of large trees, and identify individual tree's management needs. Foresters from the CSFS collected data on all Street and Park trees, an employee of Plan-It-Geo collected the Golf Course tree data. Table 5 shows the condensed species summary of the Street tree inventory. A full list of the species inventoried can be found in Appendix F. In total 5,062 trees were inventoried and 113 tree planting spaces were identified. The value of these trees is approximately $12.6 million.

The cottonwood tree (comprised of three species: Narrowleaf, Lanceleaf, and Valley) is the dominant tree species growing along the City streets, followed by aspen trees. Between these two tree species, they make up more than 50 percent of the total number of trees on the Streets. It is recommended to not have any one tree species make up more than 10 percent of the total canopy; this is to reduce potential for insect or disease outbreaks killing a majority the trees in a community. These cottonwood trees have been part of the image of the City of Aspen for a long time, however, their numbers are too high and City Forestry staff must continue to find other species to plant when replacing and adding trees to the street planting areas.

Street Tree Species Summary	Total Number	Percent of Trees	Average DBH	Average Value	Total Value
Cottonwood, all species	1679	33.17%	16.7	$3,418.57	$7,174,714.25
Aspen	913	18.04%	8.0	$963.12	$879,328.60
Spruce, all species	736	14.54%	11.7	$8,739.26	$2,701,733.66
Maple, all species	541	10.69%	8.4	$1,797.11	$660,727.42
Ash, all species	368	7.27%	5.0	$399.44	$174,546.50
Crabapple	261	5.16%	5.0	$772.23	$201,552.58
Pine, all species	184	3.63%	8.9	$1,525.66	$295,732.74
Boxelder	65	1.28%	4.0	$317.84	$20,659.46
Chokecherry	50	0.99%	6.0	$964.27	$48,213.57
Mountain ash	42	0.83%	4.0	$278.01	$11,676.48
Elm, all species	39	0.77%	4.9	$855.88	$42,522.02
Fir, all species	35	0.69%	11.0	$2,867.10	$106,089.90
Hawthorn, all species	34	0.67%	2.0	$152.82	$5,577.69
Linden, all species	29	0.57%	3.5	$239.76	$9,485.44
Douglas-fir	16	0.32%	16.0	$6,244.07	$99,905.15
Buckeye, Ohio	12	0.24%	3.0	$118.24	$1,418.90
Apple	10	0.20%	4.0	$477.03	$4,770.29
Willow	8	0.16%	29.0	$8,499.06	$67,992.50
Japanese Tree Lilac	7	0.14%	3.0	$211.69	$1,481.80
Locust, black	6	0.12%	17.0	$3,636.08	$21,816.47
Plum	6	0.12%	4.0	$264.13	$1,584.80
Poplar, all species	6	0.12%	19.5	$4,826.44	$36,830.38
Birch	3	0.06%	6.0	$195.71	$587.13
Juniper, rocky mountain	3	0.06%	2.0	$82.29	$246.88
Broadleaf deciduous, mediu	2	0.04%	4.0	$236.48	$472.97
Cherry	2	0.04%	3.0	$201.78	$403.55
Hackberry	2	0.04%	7.0	$808.39	$1,616.77
Horsechestnut	1	0.02%	4.0	$298.22	$298.22
Lilac	1	0.02%	2.0	$21.54	$21.54
Oak, all species	1	0.02%	5.0	$565.20	$565.20
Space**	113	-	-	-	-
Total Trees	**5062**	**100.00%**	**3.7**	**$1,665.91**	**$12,572,582.88**
Total Trees and Spaces	**5175**				
**Not included in any calculations					

Table 5. Street trees species and value summary. The extended inventoried species list is found in Appendix F.

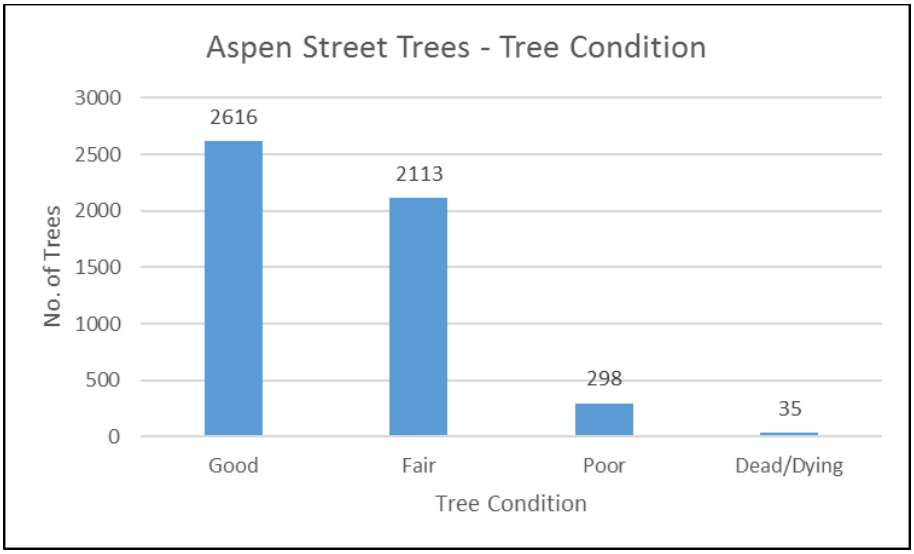


Figure 1. Condition ratings of Street trees, total 5,062 trees

Tree condition is used to describe the overall health of the tree at the time of the inventory and is an important component of determining tree value. A tree in good health does not exhibit any of the following characteristics: stagnant growth pattern, poor vigor, uneven growth pattern, minor trunk damage, and/or deadwood. Condition is also used to determine the tree's value. A tree in good condition will have a higher value then a tree in poor condition. This field was also used to indicate if a tree is standing dead so City staff can determine if it poses a safety risk and needs to be removed.

City Street trees are mostly in good condition, 51.7 percent. Trees in fair condition are very common, with 41.7% of the population and only 6.5 percent are in poor condition or dead/dying (see Figure 1). Trees in the fair condition category mostly require mitigation of various pruning needs such as to raise the tree crown, general crown cleaning, or routine pruning. This will be discussed further in the Management Priorities section.

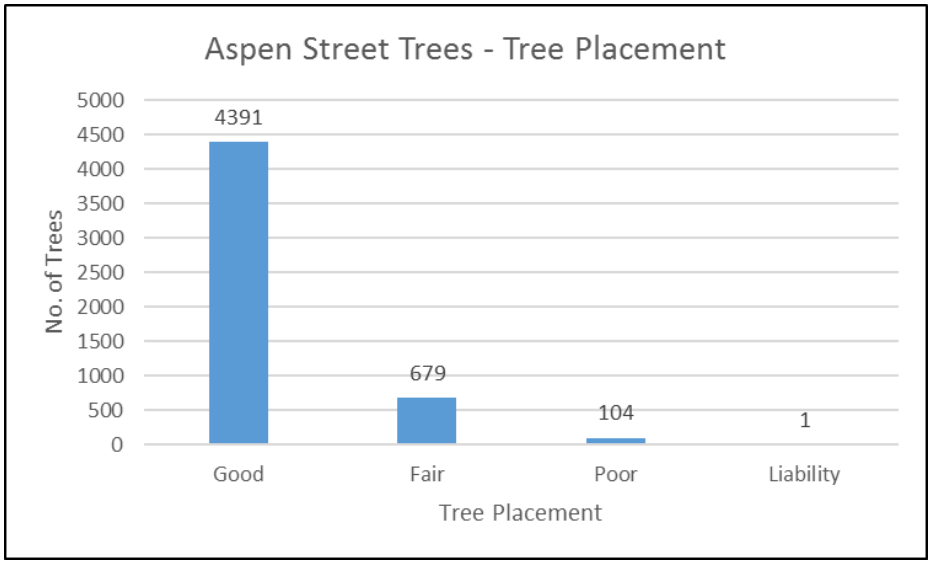


Figure 2. Placement ratings of Street trees, total 5,175 trees (includes planting spaces)

Tree placement is used to describe the quality of the location the tree is planted in, or for a planting space, if a tree would be appropriate for the site. Placement is also an important component of determine the tree's value. Trees rated as fair would have some of the following issues: close proximity to other vegetation or structures that

impede normal growth habits, have the potential to negatively impact sidewalk pathways in the future, or are growing beneath an overhead line but have not yet made contact. Trees rated as poor would exhibit some of the same issues as above but the problem or placement is worse than a tree having a fair rating. Placement is also used to determine the tree's value. A tree with good placement will have a higher value then a tree with poor placement. This field is also used to indicate if a tree is a liability so park staff can determine if it poses a safety risk and needs to be removed.

Eighty-seven percent of the trees growing on City Streets have good placement, with only 15.5 percent in the fair or poor category. This illustrates that the City staff are selecting good locations to place new trees and the current trees have enough space to grow in.

The following bar graphs are created from data collected during the Street tree inventory.

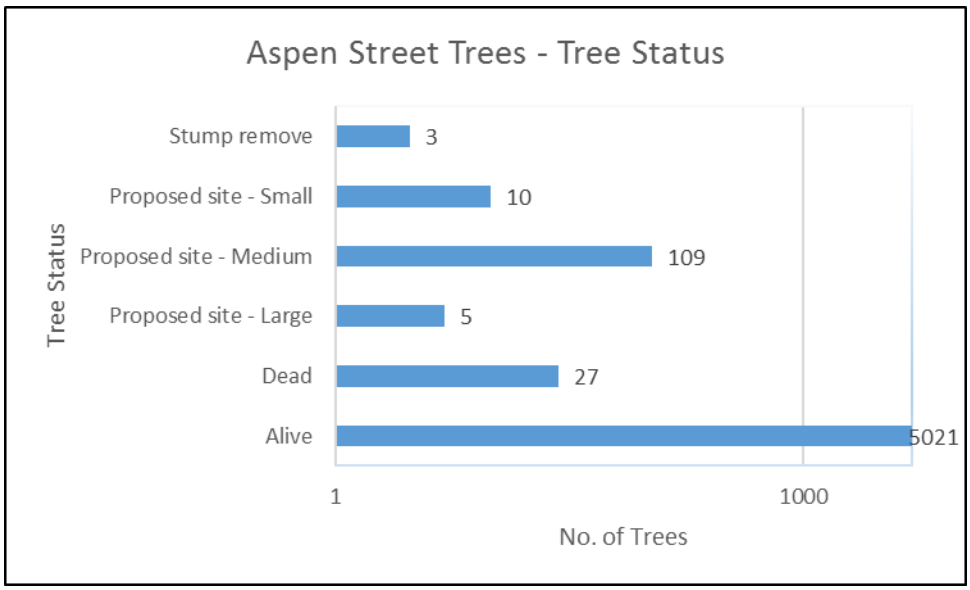


Figure 3. Tree Status ratings for Street trees, total 5,175 trees (includes planting spaces)

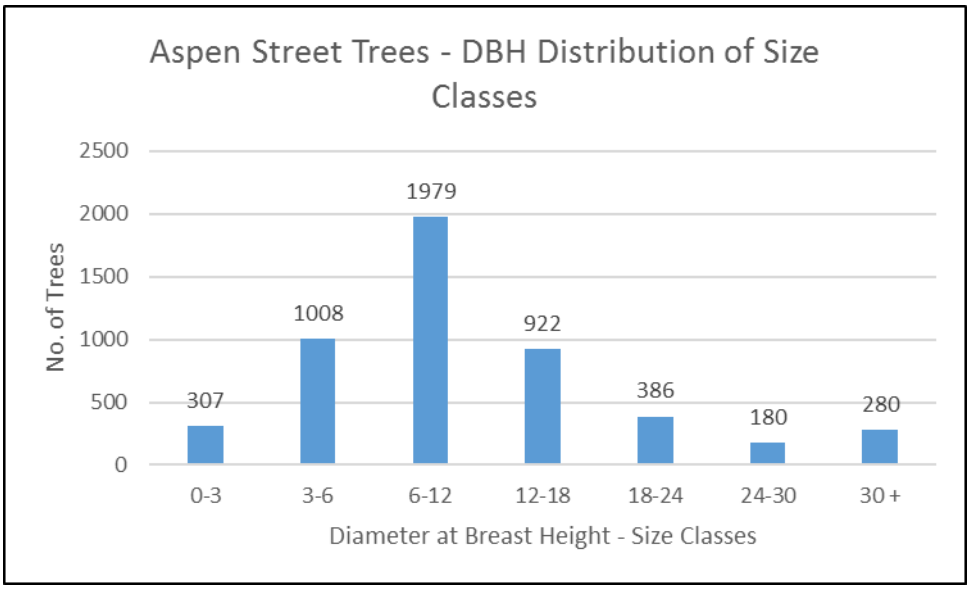


Figure 4. Diameter at Breast Height distribution of size classes for Street trees, total 5,062 trees

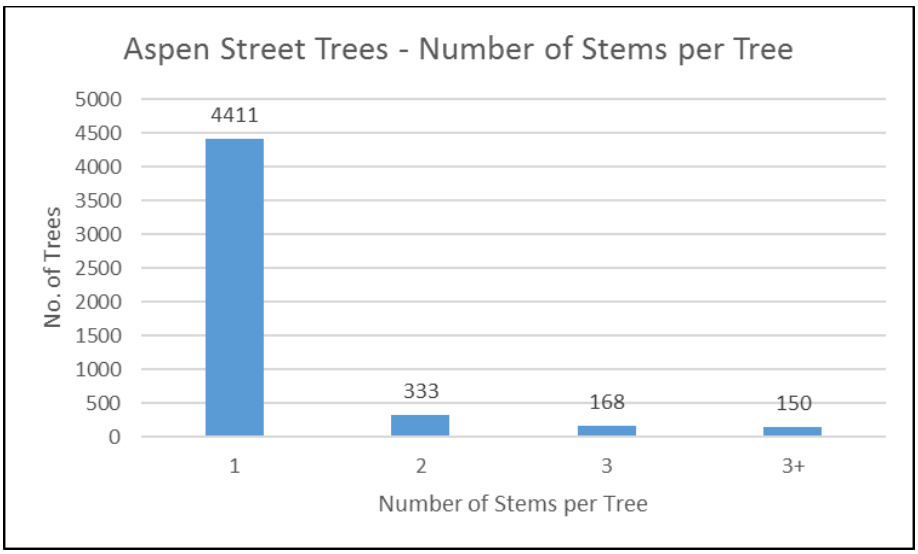


Figure 5. Number of stems per tree for Street trees, total 5,062 trees

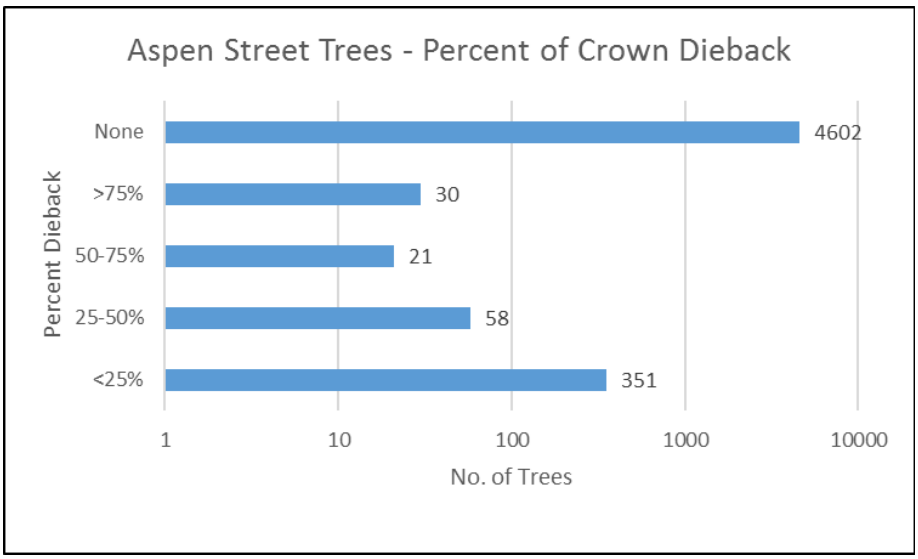


Figure 6. Percent of crown dieback observed in Street trees, total 5,062 trees

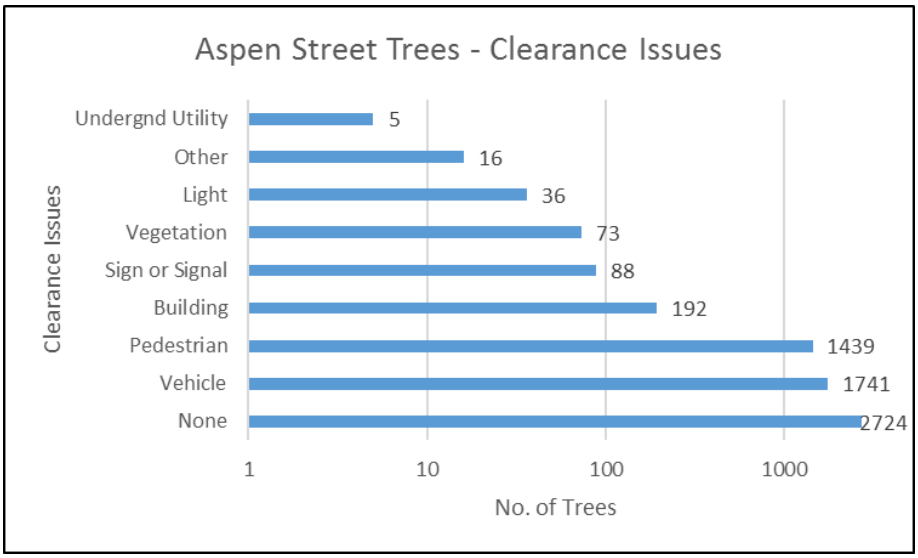


Figure 7. Clearance issues observed in Street trees, total 6,314 observations

Street Tree Observations

The tree data collectors identified current issues that were observed on the tree, multiple selections could be made or none at all. These issues are not necessarily items that could be corrected by management but the tree manager should be aware of what was observed during the time of inventory. There were 19 observation choices.

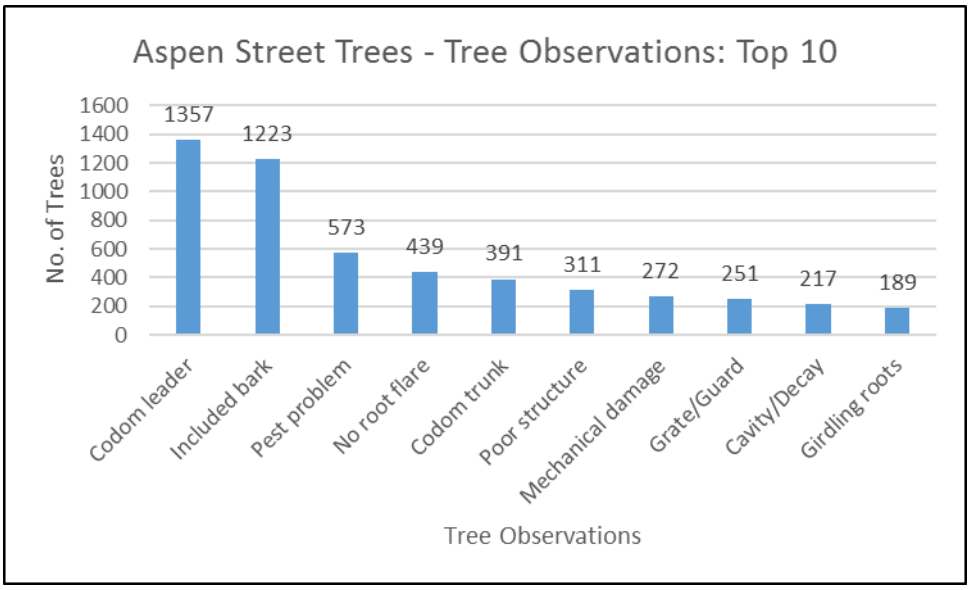


Figure 8. Top 10 Tree Observations for Street trees, total 5,223 observations

Figure 8 identifies the top 10 Tree Observations made, in total there were 5,834 as more than one observation could be made per tree. Codominant leader was the most observed issues on trees. A codominant leader on younger trees can be corrected, and the Maintenance Need – Structural Prune was most likely selected. A codominant leader on larger trees cannot usually corrected due to branch size and canopy coverage but pruning cuts can be made to reduce branch weight that may contribute to failure in the future. The second most commonly observed tree characteristic was Included Bark. Management of this observation is dependent on the location of the included bark and the age of the tree. In younger trees or on smaller branches in larger trees, these branches can be removed or the weight can be reduced. In larger trees, the best course of action is to reduce the branch weight and watch the tree for signs of bark cracking.

Street Tree Maintenance Needs

All urban forest trees require maintenance as they establish and mature. The Maintenance Needs question was used to report the observed needs the tree had at the time of the inventory, more than one could be selected per tree. These selections are to assist the tree manager in identifying current needs the tree had that could be addressed with management.

Some trees did not have a Maintenance Need at the time of inventory, but would benefit from being placed on a pruning rotation schedule. There were 21 Maintenance Need categories selected during the Street tree inventory, included None Needed. The list is very similar to the Primary Needs list, found in the Tree Inventory: 2017 Data Fields section, but have some small differences. The full list of Maintenance Needs can be found in Appendix B. The following graph shows the top ten Maintenance Needs selected, in total 9,021 Maintenance Needs were identified, including None Needed.

Figure9 shows the top Maintenance Needs selected, these were mostly tree pruning related, including Structural pruning, Clearance pruning, and Crown cleaning. Other top needs included, either too much or too little water, insect issues, the tree requiring additional monitoring, the tree needing to be removed, or a foreign object is interfering with the trees growth. Trees with pruning needs such as structural or clearance should be addressed to correct poor form before the tree becomes too large, to prevent tree damage from vehicles, and to protect pedestrians from low tree branches. The None Needed selection was the number four selected need for trees. This indicates that a portion of the tree population is doing well and the City's current maintenance schedule is addressing the tree's needs.

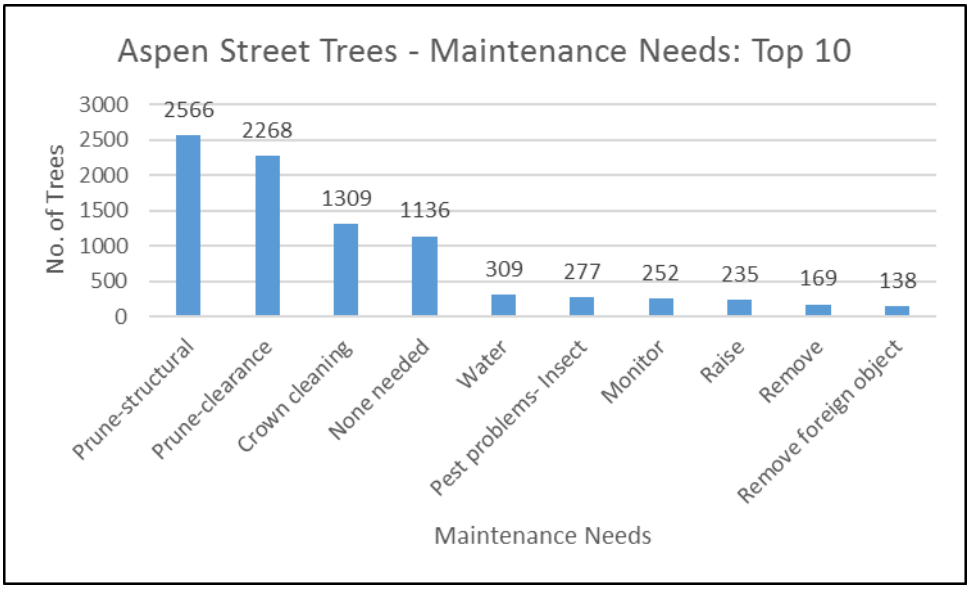


Figure 9. Top 10 Maintenance Needs for Street trees, total 8,659 observations

The Primary Maintenance options are identified in the Tree Inventory: 2017 Data Fields section. There were 16 of the 21 options were selected, including None, and only one Primary Maintenance need could be selected per tree or space. The data collector determined the Primary Maintenance need based many factors, including the Tree Observations and Maintenance Needs of each tree.

The top three Primary Maintenance needs for Street trees is Crown Raise, followed by None, then Large tree and Small tree routine prune, shown in Figure 9. The Crown raise need indicates that many of the Street trees are beginning to mature and are in need of pruning to reduce conflicts. The follow-up question on what type of clearance issues are occurring for trees with this need show that 48 percent are due to vehicles (739 trees), followed by pedestrian conflicts with 630 trees. Multiple selections could be made per tree; over 400 trees had multiple Crown raise needs. This is a relatively easy problem to fix but takes time to address. Trees with vehicle concerns may include the tree is visually blocking the road or branches may be too low and could be hit by traffic. For pedestrians, the concern is primarily low branches that are growing into the area where people are walking.

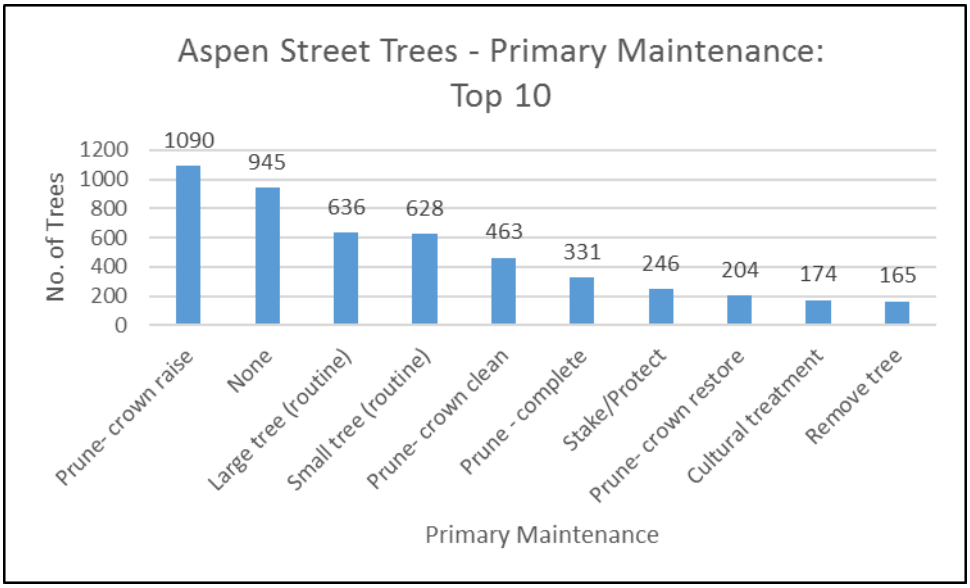


Figure 10. Top 10 Primary Maintenance needs for Street trees, total 4,891 trees

Both Large tree and Small tree routine prune accounts for 12 percent (each) of the Primary Maintenance needs. This need indicates the tree would benefit from general pruning, however, there is not an obvious defect such as codominant leaders or included bark. Routine prune should be done on a rotational basis to ensure that no tree maintenance needs go overlooked for too long. See Figure 9 for the additional Primary Maintenance needs.

Street Tree Risk Assessment Methods

The goal of this tree inventory - risk evaluation section is to provide the City Forester with a strategy to reduce tree risk while working within budgetary limitations. Corrective actions should be completed as soon as is feasible and should be prioritized according to the tree risk analysis and priority ratings. Once high risk trees have been identified and management actions prioritized, the inventory data should be updated as tree risk management occurs. Bi-annual monitoring and inspection of trees with moderate and low ratings should be scheduled, all high risk trees having been mitigated first.

For this evaluation, all trees 25 inches diameter at breast height (dbh) and greater were assessed for risk to determine the priority management action for that tree. Trees below that size threshold and were assessed with a defect or other risk factor, were identified as a Watch Tree and if warranted, given the Primary Maintenance need – Tree Risk Assessment.

The criteria for assessing the trees was determined by the City Forester and based on the International Society of Arboriculture's Tree Risk Assessment manual. Each tree was assessed looking at the three following concerns:

Likelihood of Failure

- This is used to assess the likelihood that a tree or branch may fail during normal weather conditions; this was based on the tree species and determined by the City Forester.
- Options were: Improbable, Possible, Probable, or Imminent
- Possible was the minimum value for the following species: Cottonwood, Silver maple, Willow, Boxelder

Likelihood of Impacting Target

- This is used to assess the likelihood that the failed tree or branch would impact a specific target; this was based on frequency of use determined by the City Forester.
- Options were: Rural Road/Natural area - Very Low, Residential Street - Low, Residential Street Intersection - Medium, or Occupied Structure/Arterial Street Intersection/School/Playground - High

Based on the Likelihood of Failure and the Likelihood of Impacting Target, a Likelihood value was determined. Options were: Unlikely, Likely, or Very Likely. The next question was in regards to the Consequences of Failure.

Consequences of Failure

- This is used to assess the consequence of the tree or branch failing and impacting a specific target. Options were: Negligible, Minor, Severe, or Significant

Based on the Likelihood value and the Consequences of Failure, a Risk Rating was determined by the program. Options were: Low, Moderate, or High. No numeric values were given to the trees.

Street Tree Risk Assessment Analysis

Of the 5,062 Street trees inventoried, 426 trees have diameters larger than 25 inches and all but three of these received a risk assessment. Overall, the tree species with the most large trees is cottonwood, specifically the Narrowleaf cottonwood, which makes up more than 80 percent (357 trees) of the large tree population. Lanceleaf cottonwood comes in second with 26 trees (6 percent), and blue spruce comes in third with 19 trees (4.5 percent). The City is doing a good job managing their large trees with approximately 50 percent of the trees having a low risk rating.

The most common species with a high risk rating is Narrowleaf cottonwood (44 trees). All trees with a high risk rating should receive a more in-depth tree risk assessment by the tree manager or a Tree Risk Assessment Qualified (TRAQ) arborist. The inventory consisted of a Level 2 risk assessment, which is conducted from the ground and using a rubber mallet to test (by sound) the trunk and root flare for potential cavities or decay pockets. Issues that were identified in trees with a high risk rating had comments that included: basal cavities, sounds hollow, root flair rotting, large deadwood, bird cavities, and topped in past. With more information on amount of sound wood and an inspection from off the ground, the tree manager should be able to determine the best course of action to manage these trees.

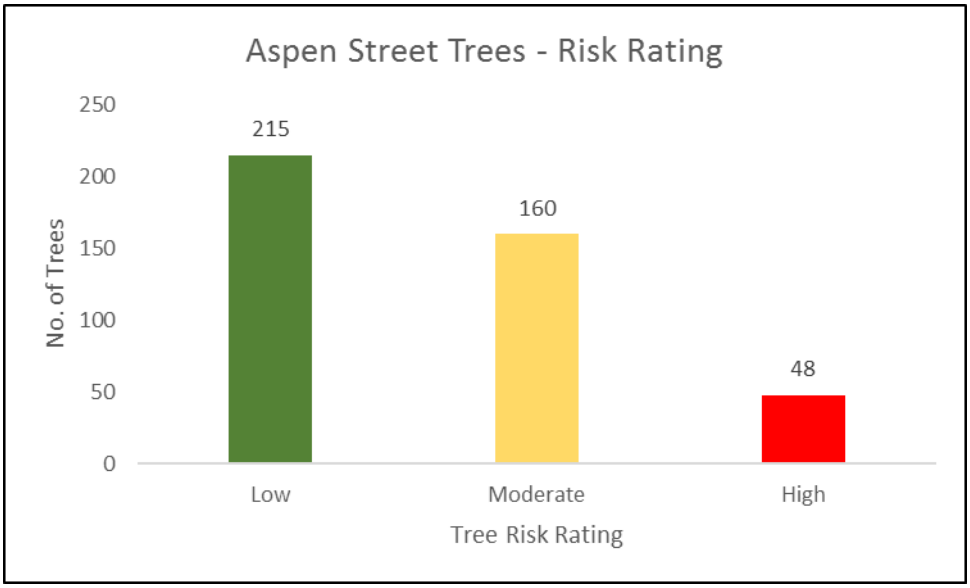


Figure 11. Risk ratings for Street trees 25 inches and larger, total 423 ratings

Street Tree Management Actions and Recommendations

After completion of the general tree inventory and the tree risk assessment, management actions were determined and are listed below. The management recommendations for risk assessed trees are based on the determined risk ratings. These ratings will help guide the City Forester in recognizing and prioritizing a work plan for each year. As in all management plans, the scheduling and achievement of these management activities will depend upon the City's resources and environmental conditions.

To understand the management actions recommended it is important to define what is considered a risk tree. A risk tree is a tree with a defect located near a target. Risk trees are those trees with a structural defect and location that increases the chance of a branch part or the tree failing and hitting a target. The combination of a defect and target can result in property damage or personal injury. A target may be a structure, vehicle, or person that could be struck by a falling tree or tree part. The value of a target has a direct bearing on the relative risk a tree represents. A tree falling on a fence is less serious than one falling on a restroom facility. A tree that could injure or kill people, such as one leaning over a picnic table, poses more risk than a tree leaning away from a trail. Liability from failure increases where people are present.

The following list includes many of the most common types of high risk tree conditions:

- Decay
- Cavities – in trunk or branches
- Dead limbs
- Splits/cracks in branches
- Heavily used areas with compacted soil and injured roots
- Heavy horizontal limbs
- Basal or crown rot; root decay
- Damage from wind and/or vehicles
- Construction damage
- Leaning trees, heaving soil
- Soil slippage areas
- Tree declines: insect and disease situations
- Weak branch or trunk unions

Figures 12-15: The following photos depict some of the issues that were observed during the tree inventory on the Streets. Not all trees with issues or defects need to be removed; management actions can reduce the tree's risk rating and prolong its contribution to the tree canopy.

Figure 12. Narrowleaf cottonwood with codominant stems. Common occurrence in the City.

Figure 13. Silver maple with large wounds on trunk and scaffold branch. Some callus wood present.

Figure 14. Narrowleaf cottonwood's root are affecting the sidewalk by lifting it.

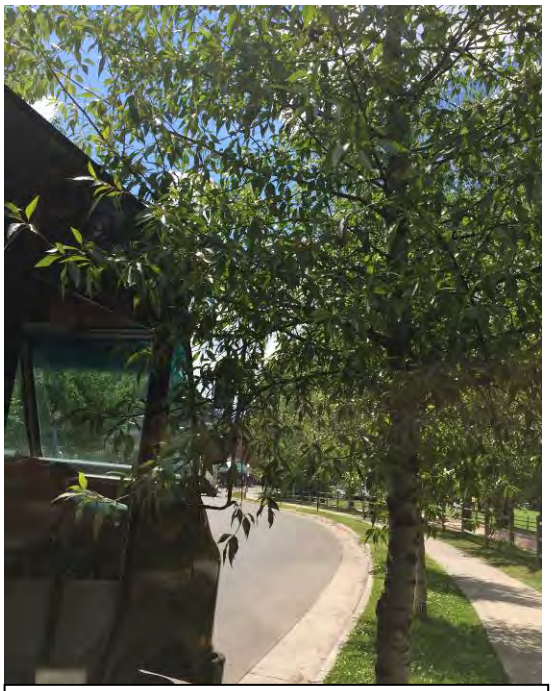


Figure 15. Narrowleaf cottonwood, growing in planting strip. Requires Crown Raise to reduce vehicle impacts.

Street Trees Management Priorities

The following recommendations are in order of priority. This list can be used to create an implementation schedule and to update the tree management plan.

The Number One priority for Street trees in the City is to determine management for large trees with a moderate or high risk rating (208 trees) and perform assessment on trees that have a Priority Maintenance need of Tree Risk Assessment (77 trees).

The Second priority for the City staff is to visit trees that are have the Primary Maintenance need of Remove (165 trees), have the Condition rating of poor (298 trees) or dead/dying (35), or the Placement rating of poor (104 trees) or liability (1 tree). Some of these trees may over lap but these attributes can be search for in the Tree Plotter software program. Once these trees are identified on the Streets, management actions can be determined.

The Number Three priority is to have the 252 trees with the Maintenance Need Monitor assessed by City Forestry staff and assess trees with Watch this Tree (308 trees) selected. Monitor and Watch this Tree selections were made when the tree was less than 25 inches in diameter but had issues, defects, or other maintenance needs that the data collector felt needed additional attention. Again, these trees will most likely overlap and the attributes can be searched for in Tree Plotter.

Some things to consider when further assessing trees, if the tree has been flagged as having decay or a cavity, it will be useful to determine the level of holding wood in the trunk or roots. An aerial inspection may be required if bird cavities or damaged canopy branches were identified. The main goal for the inspecting arborist is: how can we make this tree safe for the public. The questions the arborist needs to answer is: 'is mitigation an option?', "can mitigation be conducted to reduce risk and keep the tree, is there too much decay?", or 'will mitigation remove too much of the canopy for the tree's health and removal is the better option?'. The answers from the in depth assessment should determine this for each of the identified Watch or Monitor trees.

If there is a large basal wound or the tree's soundness is in question, the goal is to determine the amount of holding wood/sound wood the tree has and if it meets minimum criteria for safety. As a rule, if the amount of sound wood in a tree is larger than 1/6th of the tree's diameter or 1/3rd of the tree's radius, there is sufficient wood to hold the tree or branch in place under normal weather conditions. That means for every 12 inches in diameter there must be at least two inches of sound wood completely encircling the decayed portion of the tree. Again, the key to sound wood being an effective deterrent to tree failure is that it must completely encircle the decay. Additional information on holding wood and defect is in Appendix H.

Priority Number Four is to have a Certified Arborist remove any defective tree parts identified during the inventory (25 trees), specifically hangers. Trees that were observed with either dead branches or deadwood as the problem needing attention, would have received the Primary Maintenance need of Prune – Crown clean or Prune - Complete. While it is not uncommon for trees to have some deadwood in their crowns, the unpredictable timing of branch failure makes it imperative those trees close to sidewalks, parking areas, picnic tables, the playground, or infrastructure to receive a higher priority for mitigation action.

The Fifth priority is to schedule Prune – Crown raise for the 1,090 trees with this as their Primary Maintenance need. This was the number one observation made on what Street trees required. The other two common Primary Maintenance need selections were Routine prune for Large and Small trees. It is valuable to create a proactive pruning rotation for all trees, with pruning occurring every three to five years. A regular pruning cycle

can prevent future needs of crown raising, structural, or defective pruning and having a Tree Risk Assessment Qualified (TRAQ) arborist observe the tree from in the crown can assist in catching problems that are not visible from the ground.

Also important to the overall health and longevity of the City's urban canopy is species diversity. This is an important component to all urban forests, especially on such a large scale. Appendix E is a list of suggested tree species to plant that will provide the shade the public enjoys but doesn't have the maintenance needs of the cottonwood trees currently growing in the City. As stated before, the CSFS no longer recommends planting any ash species (*Fraxinus*). While ash do not make up a large component of the Street trees in the urban forest, they do represent over seven percent which would leave a gap in the canopy. There are preventative sprays that can be used on ash trees to reduce the odds of the emerald ash borer killing the tree, however actions are NOT recommended until the borer has been confirmed within 10-15 miles of the City. Increasing species diversity will lessen the impact of removing ash trees if the emerald ash borer does arrive in the western slope.

Current Park Tree Situation

The parks in Aspen are heavily used, especially by dog owners, families, and people looking for a place to recreate or relax. There are 36 park parks are in good condition and are a value to the community.

The purpose of the 2017 City of Aspen Park tree inventory was to update the previous inventory, determine the current health of the trees, conduct risk assessments of large trees, and identify individual tree's management needs. Foresters from the CSFS collected data on all Street and Park trees, an employee of Plan-It-Geo collected the Golf Course tree data. Table 6 shows the list of the 36 parks inventoried. The condensed species summary of the Park tree inventory is shown in Table 7. A full list of the species inventoried can be found in Appendix F. In total 2,877 trees were inventoried and 1 tree planting space was identified. The value of these trees is approximately $6.3 million.

Aspen Parks	Aspen Parks
Ajax Park	Moore Playing Fields
Aspen Art Museum	Newberry Park
Aspen Ice Garden	Paepke Park
Aspen Pedestrian Mall	Pioneer Park
Bugsy Barnard Park	Red Brick Recreation Center
Burlingame Commons	Red Butte Cemetery
Conner Park	Rio Grande Park
Fox Crossing Park	Rubey Park
Francis Whitaker Park (Bass)	Skate Park
Freddie Fisher Park	Snyder Park
Glory Hole Park	Tot Lot Park
Herron Park	Triangle Park
Hillyard Park	Ute Park
Silvercircle Ice Rink	Wagner Park
Iselin Park	Wheeler Park
John Denver Sanctuary	Willa Park
Koch Park	Willoughby Park
Mollie Gibson Park	Yellowbrick Park

Table 6. Inventoried City of Aspen Parks

The aspen tree is the dominant tree currently growing in the City Parks with 962 trees. Cottonwood trees (comprised of two species: Narrowleaf and Lanceleaf) is the second dominant tree species growing in Parks and between these two tree species, they make up more than 60 percent of the total number of trees in all of the Parks. It is recommended to not have any one tree species make up more than 10 percent of the total canopy; this is to reduce potential for insect or disease outbreaks killing all the trees in a community. Aspen trees are an iconic Colorado tree and has been part of the image of the City of Aspen for a long time, however, their numbers are too high and City Forestry staff must continue to find other species to plant when replacing and adding trees to the Parks.

Park Tree Species Summary	Total Number	Percent of Trees	Average DBH	Average Value	Total Value
Aspen	962	33.44%	6.0	$656.81	$631,849.50
Cottonwood, all species	842	29.27%	14.0	$2,991.51	$2,803,388.49
Spruce, all species	641	22.28%	14.7	$4,882.31	$2,276,580.67
Pine, all species	162	5.63%	7.3	$1,233.19	$209,742.41
Crabapple	90	3.13%	7.0	$1,434.07	$129,066.43
Maple, all species	45	1.56%	6.6	$1,096.50	$56,062.56
Ash, green	36	1.25%	9.0	$1,250.17	$45,005.95
Fir, all species	17	0.59%	10.3	$2,193.71	$48,751.02
Elm, all species	16	0.56%	2.0	$63.36	$1,049.59
Mountain ash	14	0.49%	5.0	$705.61	$9,878.58
Chokecherry	10	0.35%	5.0	$692.72	$6,927.16
Boxelder	8	0.28%	2.0	$39.19	$313.50
Linden, littleleaf	7	0.24%	2.0	$99.48	$696.33
Juniper	6	0.21%	6.0	$740.71	$4,144.23
Poplar, white	5	0.17%	24.0	$4,667.70	$23,338.52
Apple	4	0.14%	10.0	$2,019.65	$8,078.59
Birch	4	0.14%	5.0	$640.13	$2,560.54
Locust, black	2	0.07%	7.0	$527.74	$1,055.48
Willow, white	2	0.07%	11.0	$1,287.53	$2,575.05
Cedar, deodar	1	0.03%	18.0	$6,348.33	$6,348.33
Cherry, european bird	1	0.03%	16.0	$4,099.58	$4,099.58
Ginkgo	1	0.03%	1.0	$22.51	$22.51
Other, deciduous small	1	0.03%	2.0	$86.16	$86.16
Space**	1	-	-	-	-
Total Trees	**2877**	**100.00%**	**8.3**	**$1,642.55**	**$6,271,621.18**
Total Trees and Spaces	**2878**			**-**	
**Not included in any calculations					

Table 7. Park trees species and value summary. The extended inventoried species list is found in Appendix F.

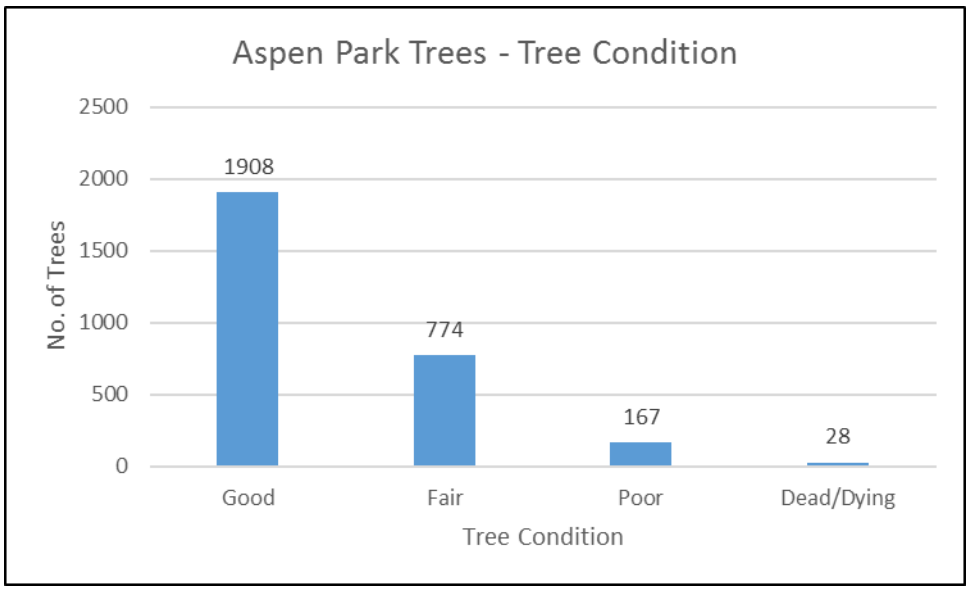


Figure 16. Condition ratings of Park trees, total 2,877 trees

Tree condition is used to describe the overall health of the tree at the time of the inventory and is an important component of determining tree value. A tree in good health does not exhibit any of the following characteristics: stagnant growth pattern, poor vigor, uneven growth pattern, minor trunk damage, and/or deadwood. Condition is also used to determine the tree's value. A tree in good condition will have a higher value then a tree in poor condition. This field is also used to indicate if a tree is standing dead so City staff can determine if it poses a safety risk and needs to be removed.

City Park trees are predominately in good condition, 66.3 percent or 1,908 trees. Trees in fair condition make up 26.9 percent of the total, and only 6.8 percent are in poor condition or dead/dying (see Figure 16). Trees in the fair condition category mostly require routine pruning or crown cleaning. This will be discussed further in the Management Priorities section.

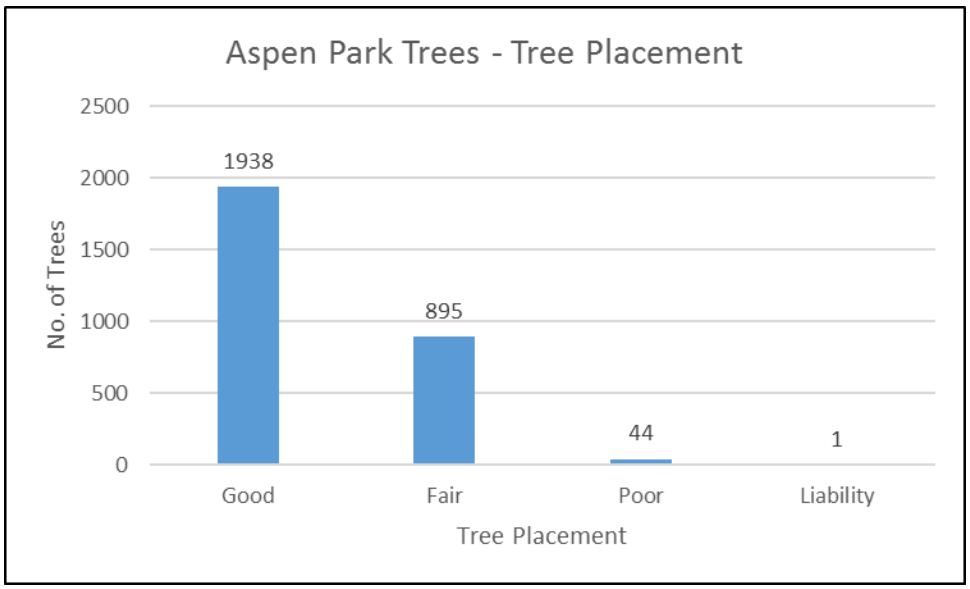


Figure 17. Placement ratings of Park trees, total 2,878 trees (includes planting space)

Tree placement is used to describe the quality of the location the tree is planted in, or for a planting space, if a tree would be appropriate for the site. Placement is also an important component of determine the tree's value.

Trees rated as fair would have some of the following issues: close proximity to other vegetation or structures that impede normal growth habits, have the potential to negatively impact sidewalk pathways in the future, or are growing beneath an overhead line but have not yet made contact. Trees rated as poor would exhibit some of the same issues as above but the problem or placement is worse than a tree having a fair rating. Placement is also used to determine the tree's value. A tree with good placement will have a higher value then a tree with poor placement. This field is also used to indicate if a tree is a liability so park staff can determine if it poses a safety risk and needs to be removed.

Ninety-one percent of the trees growing in City Parks have good placement, with only 8.9 percent in the fair or poor category. This illustrates that the City staff are selecting good locations to place new trees and the current trees have enough space to grow in.

The following bar graphs are created from data collected during the Park tree inventory.

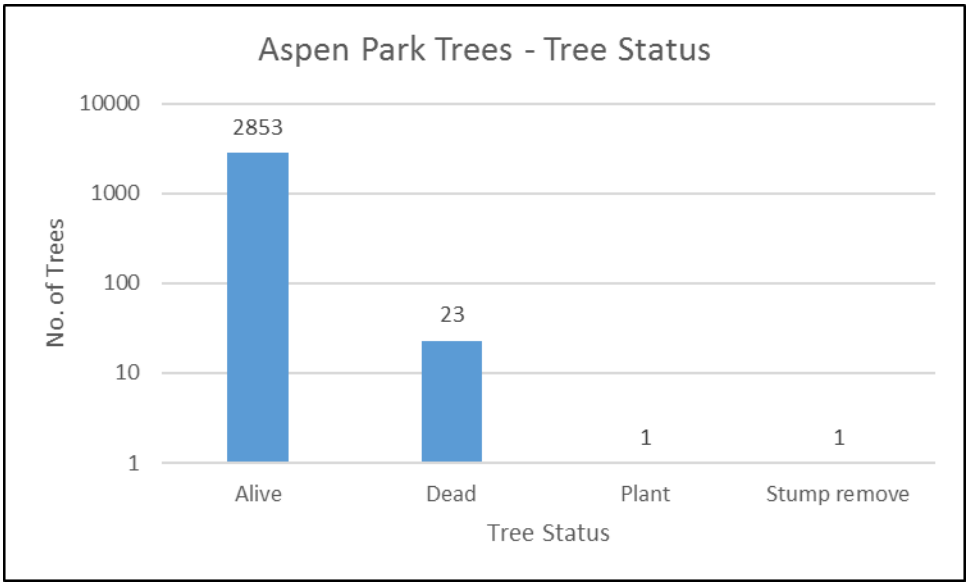


Figure 18. Tree Status ratings for Park trees, total 2,878 trees (includes planting spaces)

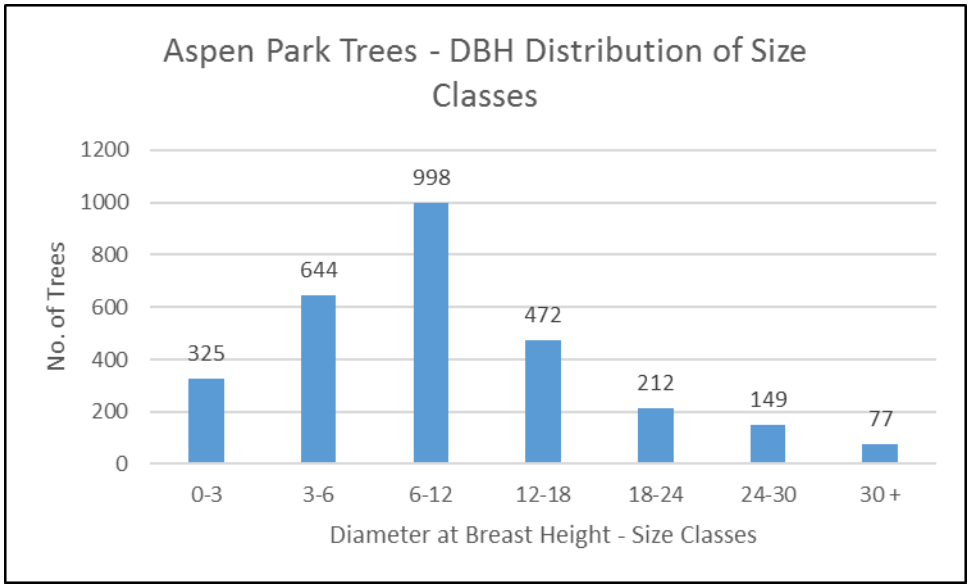


Figure 19. Diameter at Breast Height distribution of size classes for Park trees, total 2,877 trees

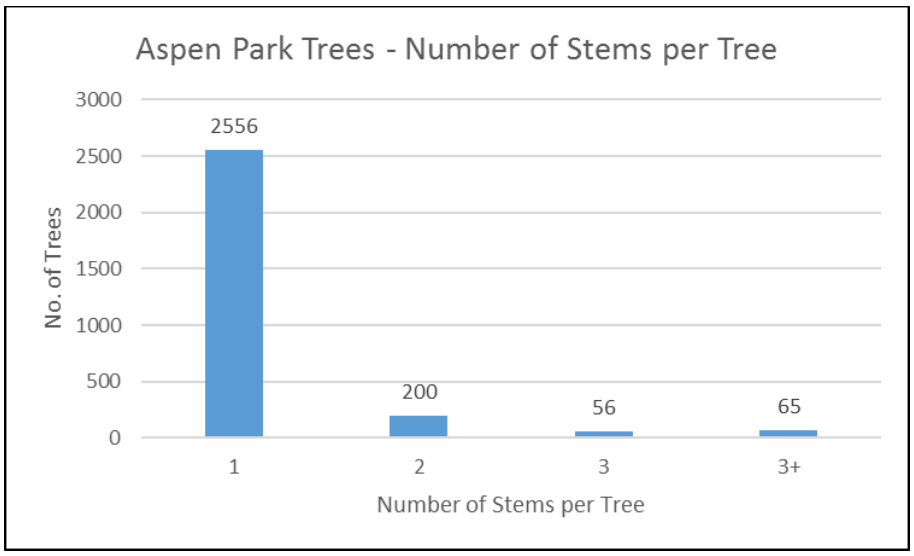


Figure 20. Number of stems per tree for Park trees, total 2,877 trees

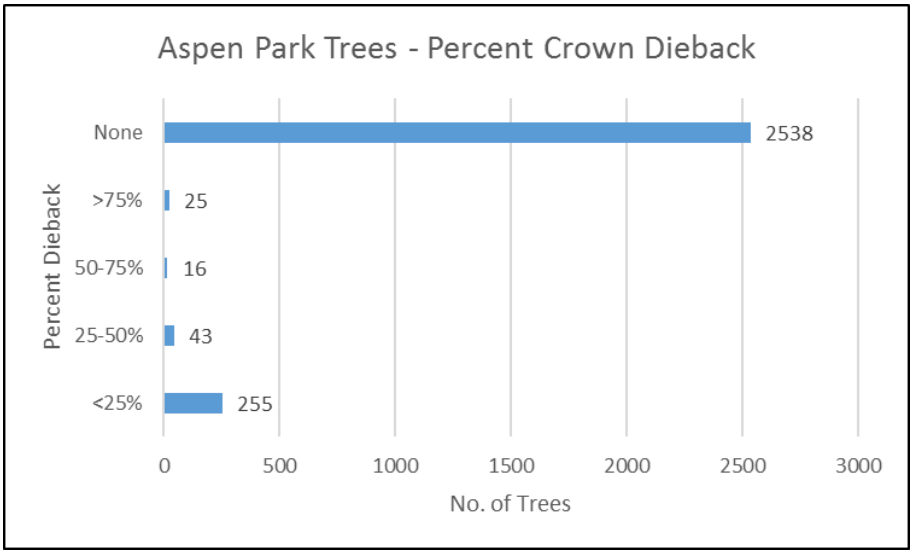


Figure 21. Percent of crown dieback observed in Park trees, total 2,877 trees

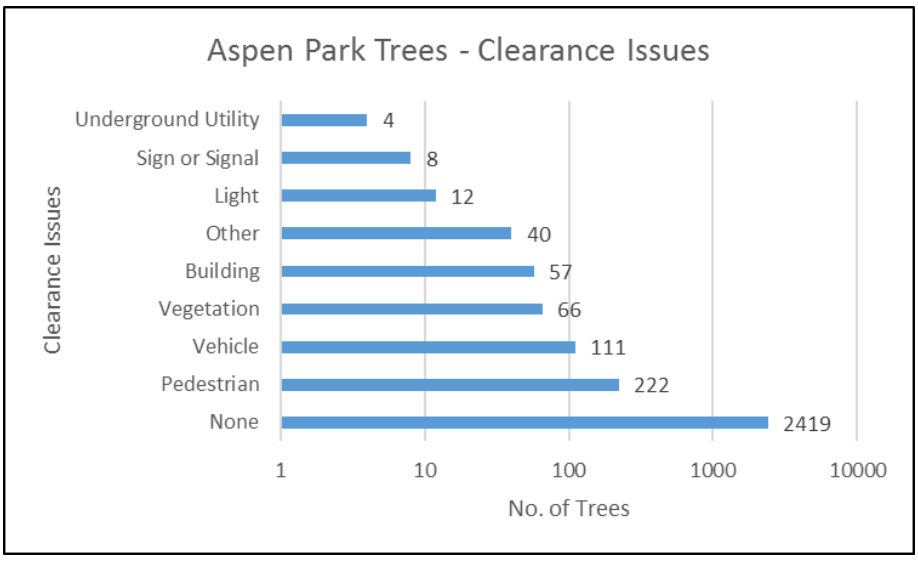


Figure 22. Clearance issues observed in Park trees, total 2,935 observations

Park Tree Observations

The tree data collectors identified current issues that were observed on the tree, multiple selections could be made or none at all. These issues are not necessarily items that could be corrected by management but the tree manager should be aware of what was observed during the time of inventory. There were 19 observation choices.

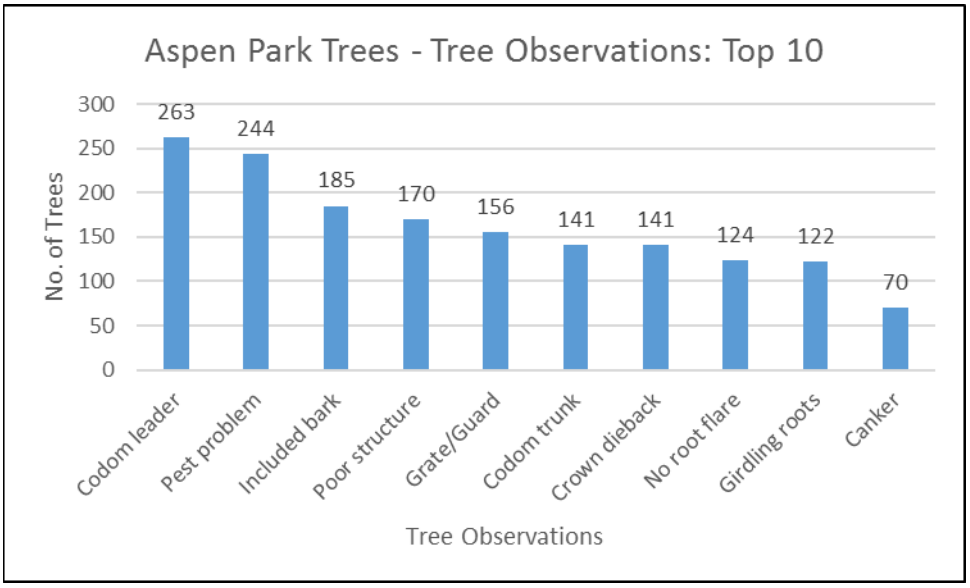


Figure 23. Top 10 Tree Observations for Park trees, total 1,616 observations

Figure 23 identifies the top 10 Tree Observations made, in total there were 1,841 as more than one observation could be made per tree. Codominant leader was the most observed issues on trees. A codominant leader on younger trees can be corrected, and the Maintenance Need – Structural Prune was most likely selected. A codominant leader on larger trees is not usually corrected due to branch size and canopy coverage but pruning cuts can be made to reduce branch weight that may contribute to failure in the future. The second most commonly observed tree characteristic was Pest problem, followed by Included Bark. Pest problem covers both insect and disease issues, refer to the Insect and Disease section for information on what was observed in the Parks. The Management of the Included Bark observation is dependent on the location of the included bark and the age of the tree. In younger trees or on smaller branches in larger trees, these branches can be removed or the weight can be reduced. In larger trees, the best course of action is to reduce the branch weight and watch the tree for signs of bark cracking.

Park Tree Maintenance Needs

All urban forest trees require maintenance as they establish and mature. The Maintenance Needs question was used to report the observed needs the tree had at the time of the inventory, more than one could be selected per tree. These selections are to assist the tree manager in identifying current needs the tree had that could be addressed with management.

Some trees did not have a Maintenance Need at the time of inventory, but would benefit from being placed on a pruning rotation schedule. There were 19 Maintenance Need categories selected during the Parks tree inventory, included None Needed. The list is very similar to the Primary Needs list, found in the Tree Inventory: 2017 Data Fields section, but have some small differences. The full list of Maintenance Needs can be found in

Appendix B. The following graph shows the top ten Maintenance Needs selected, in total 3,721 Maintenance Needs were identified, including None Needed.

Figure 24 shows the top Maintenance Needs selected, these were mostly tree pruning related, including Crown cleaning, Structural pruning, and Clearance pruning. Other top needs included, the tree needing to be removed, raising of the crown, crown restoration, insect issues, and the tree requiring additional monitoring. Trees with pruning needs such as structural or clearance should be addressed to correct poor form before the tree becomes too large, to prevent tree damage from vehicles, and to protect pedestrians from low tree branches. The None Needed selection was the number one selected need for Park trees. This indicates that a large portion of the tree population is doing well and the City's current maintenance schedule is addressing the tree's needs.

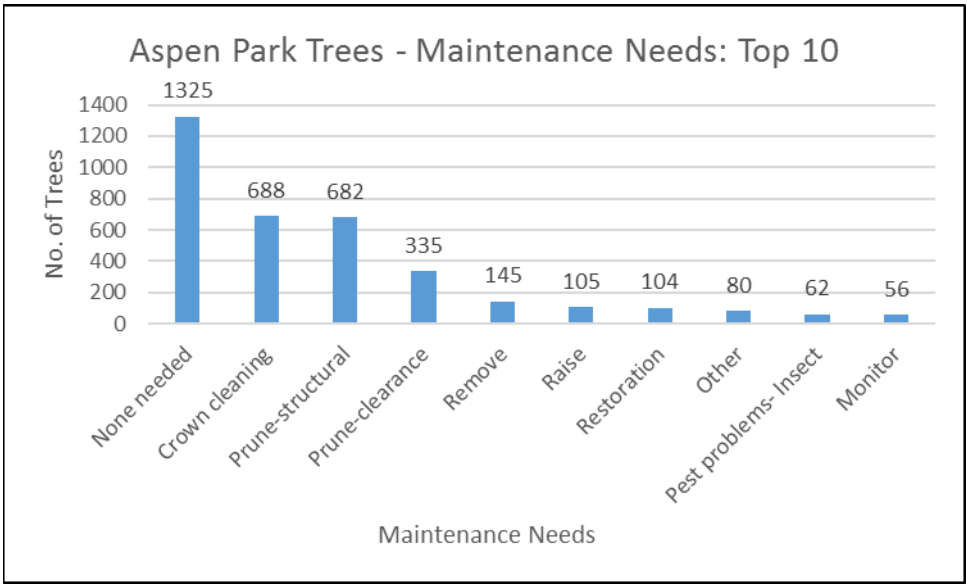


Figure 24. Top 10 Maintenance Needs for Park trees, total 3,582 observations

The Primary Maintenance options are identified in the Tree Inventory: 2017 Data Fields section. There were 17 of the 21 options were selected, including None, and only one Primary Maintenance need could be selected per tree or space. The data collector determined the Primary Maintenance need based many factors, including the Tree Observations and Maintenance Needs of each tree.

The top three Primary Maintenance needs for Park trees is None, followed fairly equally by Large tree and Small tree routine prune, and Prune – Crown raise. Large tree and Small tree routine prune accounts for 15.4 percent and 14.2 percent respectively of all of the Primary Maintenance needs. This need indicates the tree requires general pruning and there is not an obvious defect such as codominant leaders or included bark. The primary tree species that require routine prune, for both large and small trees, is narrowleaf cottonwood, followed by aspen. Routine prune should be done on a rotational basis to ensure that no tree maintenance needs go overlooked for too long.

The Crown raise need indicates that many of the Park trees are beginning to mature and are in need of pruning to reduce conflicts. The follow-up question on what type of clearance issues are occurring for trees with this need show that 54.9 percent are due to pedestrian (73 trees), followed by buildings with 26 trees. See Figure 23 for the additional Primary Maintenance needs.

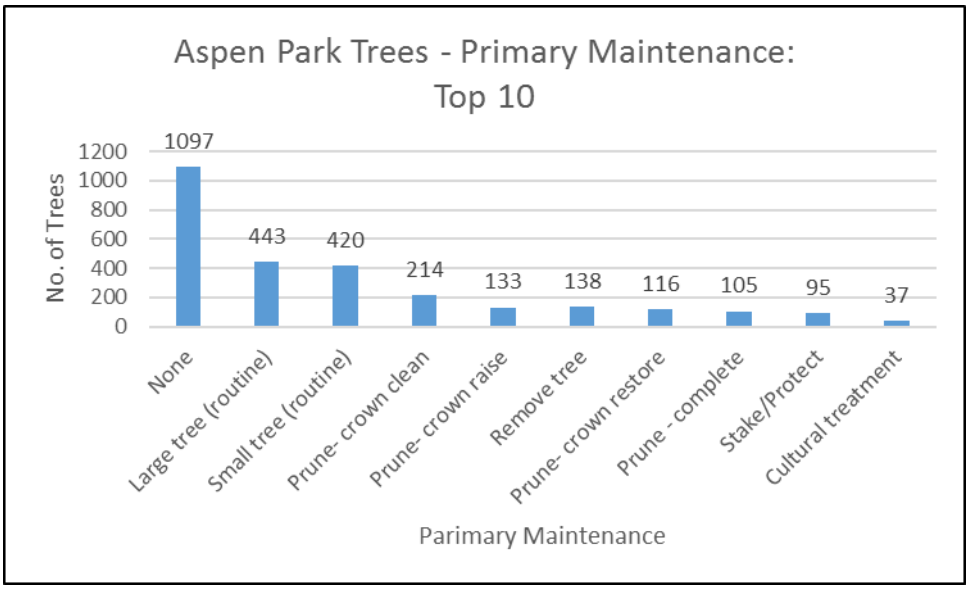


Figure 25. Top 10 Primary Maintenance needs for Park trees, total 2,798 trees

Park Tree Risk Assessment Methods

The goal of this tree inventory - risk evaluation section is to provide the City Forester with a strategy to reduce tree risk while working within budgetary limitations. Corrective actions should be completed as soon as is feasible and should be prioritized according to the tree risk analysis and priority ratings. Once high risk trees have been identified and management actions prioritized, the inventory data should be updated as tree risk management occurs. Bi-annual monitoring and inspection of trees with moderate, low, and lowest ratings should be scheduled, all high risk trees having been mitigated first.

For this evaluation, all trees 25 inches diameter at breast height (dbh) and greater were assessed for risk to determine the priority management action for that tree. Trees below that size threshold and were assessed with a defect or other risk factor, were identified as a Watch Tree and if warranted, given the Primary Maintenance need – Tree Risk Assessment.

The criteria for assessing the trees was determined by the City Forester and based on the International Society of Arboriculture's Tree Risk Assessment manual. Each tree was assessed looking at the three following concerns:

Likelihood of Failure

- This is used to assess the likelihood that a tree or branch may fail during normal weather conditions; this was based on the tree species and determined by the City Forester.
- Options were: Improbable, Possible, Probable, or Imminent
- Possible was the minimum value for the following species: Cottonwood, Silver maple, Willow, Boxelder

Likelihood of Impacting Target

- This is used to assess the likelihood that the failed tree or branch would impact a specific target; this was based on frequency of use determined by the City Forester.
- Options were: Rural Road/Natural area - Very Low, Residential Street - Low, Residential Street Intersection - Medium, or Occupied Structure/Arterial Street Intersection/School/Playground - High

Based on the Likelihood of Failure and the Likelihood of Impacting Target, a Likelihood value was determined. Options were: Unlikely, Likely, or Very Likely. The next question was in regards to the Consequences of Failure.

Consequences of Failure

- This is used to assess the consequence of the tree or branch failing and impacting a specific target. Options were: Negligible, Minor, Severe, or Significant

Based on the Likelihood value and the Consequences of Failure, a Risk Rating was determined by the program. Options were: Low, Moderate, or High. No numeric values were given to the trees.

Park Trees Risk Assessment Analysis

Of the 2,877 street trees inventoried, 200 trees have diameters larger than 25 inches. Overall, the tree species with the most large trees is the Narrowleaf cottonwood, which makes up more than 86 percent (173 trees) of the large tree population. Blue spruce comes in second with 19 trees (9.5 percent), and white poplar comes in third with 4 trees (2 percent). The City is doing a good job managing their large trees with only one tree with a high risk rating and over 70 percent of the trees having a low risk rating.

The most common species with a high risk rating is Narrowleaf cottonwood (173 trees). The single trees with a high risk rating is a narrowleaf cottonwood located in Red Butte cemetery and should receive a more in-depth tree risk assessment by the tree manager or a Tree Risk Assessment Qualified (TRAQ) arborist. The inventory consisted of a Level 2 risk assessment, which is conducted from the ground and using a rubber mallet to test (by sound) the trunk and root flare for potential cavities or decay pockets. Issues that were identified in trees with a high risk rating had comments that included: basal cavities, sounds hollow, root flair rotting, large deadwood, bird cavities, and topped in past. With more information on amount of sound wood and an inspection from off the ground, the tree manager should be able to determine the best course of action to manage these trees.

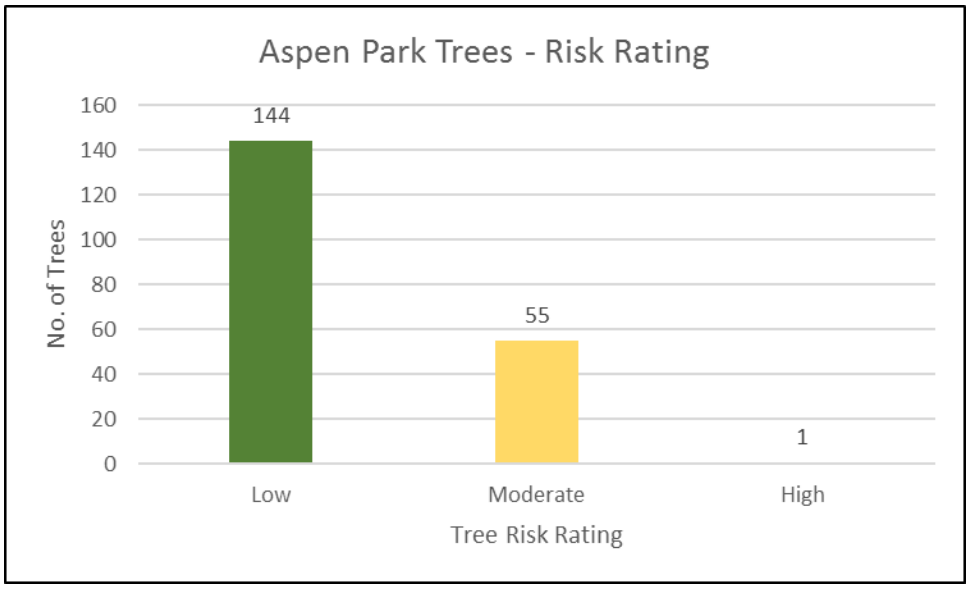


Figure 26. Risk ratings for Park trees 25 inches and larger, total 200 ratings

Park Tree Management Actions and Recommendations

After completion of the general tree inventory and the tree risk assessment, management actions were determined and are listed below. The management recommendations for risk assessed trees are based on the determined risk ratings. These ratings will help guide the City Forester in recognizing and prioritizing a work plan for each year. As in all management plans, the scheduling and achievement of these management activities will depend upon the City's resources and environmental conditions.

To understand the management actions recommended it is important to define what is considered a risk tree. A risk tree is a tree with a defect located near a target. Risk trees are those trees with a structural defect and location that increases the chance of a branch part or the tree failing and hitting a target. The combination of a defect and target can result in property damage or personal injury. A target may be a structure, vehicle, or person that could be struck by a falling tree or tree part. The value of a target has a direct bearing on the relative risk a tree represents. A tree falling on a fence is less serious than one falling on a restroom facility. A tree that could injure or kill people, such as one leaning over a picnic table, poses more risk than a tree leaning away from a trail. Liability from failure increases where people are present.

The following list includes many of the most common types of high risk tree conditions:

- Decay
- Cavities – in trunk or branches
- Dead limbs
- Splits/cracks in branches
- Heavily used areas with compacted soil and injured roots
- Heavy horizontal limbs
- Basal or crown rot; root decay
- Damage from wind and/or vehicles
- Construction damage
- Leaning trees, heaving soil
- Soil slippage areas
- Tree declines: insect and disease situations
- Weak branch or trunk unions

Figures 27-30: The following photos depict some of the issues that were observed during the tree inventory in the Parks. Not all trees with issues or defects need to be removed; management actions can reduce the tree's risk rating and prolong its contribution to the tree canopy.

Figure 27. Aspen tree with poplar borer damage.

Figure 28. Dense planting of narrrowleaf cottonwood that will require pruning.

Figure 29. Ganoderma conk on aspen tree in Park tree. City forester was notified.

Figure 30. Structural issues in conifer trees, can be addressed by pruning.

Park Trees Management Priorities

The following recommendations are in order of priority. This list can be used to create an implementation schedule and to update the tree management plan.

The Number One priority for Park trees in the City is to determine management for large trees with a moderate or high risk rating (56 trees) and perform assessment on trees that have a Priority Maintenance need of Tree Risk Assessment (33 trees).

The Second priority for the City staff is to visit trees that are have the Primary Maintenance need of Remove (138 trees), have the Condition rating of poor (167 trees) or dead/dying (28), or the Placement rating of poor (44 trees) or liability (1 tree). Some of these trees may over lap but these attributes can be search for in the Tree Plotter software program. Once these trees are identified in the Park, management actions can be determined.

The Number Three priority is to have the 56 trees with the Maintenance Need Monitor assessed by City Forestry staff and assess trees with Watch this Tree (234 trees) selected. Monitor and Watch this Tree selections were made when the tree was less than 25 inches in diameter but had issues, defects, or other maintenance needs that the data collector felt needed additional attention. Again, these trees will most likely overlap and the attributes can be searched for in Tree Plotter.

Some things to consider when further assessing trees, if the tree has been flagged as having decay or a cavity, it will be useful to determine the level of holding wood in the trunk or roots. An aerial inspection may be required if bird cavities or damaged canopy branches were identified. The main goal for the inspecting arborist is: how can we make this tree safe for the public. The questions the arborist needs to answer is: 'is mitigation an option?', "can mitigation be conducted to reduce risk and keep the tree, is there too much decay?", or 'will mitigation remove too much of the canopy for the tree's health and removal is the better option?'. The answers from the in depth assessment should determine this for each of the identified Watch or Monitor trees.

If there is a large basal wound or the tree's soundness is in question, the goal is to determine the amount of holding wood/sound wood the tree has and if it meets minimum criteria for safety. As a rule, if the amount of sound wood in a tree is larger than 1/6th of the tree's diameter or 1/3rd of the tree's radius, there is sufficient wood to hold the tree or branch in place under normal weather conditions. That means for every 12 inches in diameter there must be at least two inches of sound wood completely encircling the decayed portion of the tree. Again, the key to sound wood being an effective deterrent to tree failure is that it must completely encircle the decay. Additional information on holding wood and defect is in Appendix H.

Priority Number Four is to have a Certified Arborist remove any defective tree parts identified during the inventory (3 trees), specifically hangers. Trees that were observed with either dead branches or deadwood as the problem needing attention would have received the Primary Maintenance need of Prune – Crown clean or Prune - Complete. While it is not uncommon for trees to have some deadwood in their crowns, the unpredictable timing of branch failure makes it imperative those trees close to sidewalks, parking areas, picnic tables, the playground, or infrastructure to receive a higher priority for mitigation action.

The Fifth priority is to schedule Large and Small tree routine prune for the 863 trees with this as their Primary Maintenance need. This was the number one observation made on what Park trees required (after None). The other two common Primary Maintenance need selections were Prune – Crown clean and Crown raise. It is valuable to create a proactive pruning rotation for all trees, with pruning occurring every three to five years. A

regular pruning cycle can prevent future needs of crown raising, structural, or defective pruning and having a licensed/certified arborist observe the tree from in the crown can assist in catching problems that are not visible from the ground.

Also important to the overall health and longevity of the City's urban canopy is species diversity. This is an important component to all urban forests, especially on such a large scale. Appendix F is a list of suggested tree species to plant that will provide the shade the public enjoys but doesn't have the maintenance needs of the cottonwood trees currently growing in the City. As stated before, the CSFS no longer recommends planting any ash species (*Fraxinus*). While ash do not make up a large component of the Street trees in the urban forest, they do represent over seven percent which would leave a gap in the canopy. There are preventative sprays that can be used on ash trees to reduce the odds of the emerald ash borer killing the tree, however actions are NOT recommended until the borer has been confirmed within 10-15 miles of the City. Increasing species diversity will lessen the impact of removing ash trees if the emerald ash borer does arrive in the western slope.

Golf Course Trees Summary

The following data was compiled from the Golf Course tree inventory completed by Plan-It Geo staff. For Risk Assessment Trees, there were 80 trees with diameters 25 inches or larger. Of those trees, 11 were missing Risk Assessments, five narrowleaf cottonwoods and six blue spruce. The data below is for the 69 large diameter tree's with assessments. The value of the golf course tree's is approximately $4.9 million.

Golf Course Tree Species Summary	Total Number	Percent of Trees	Average DBH	Average Value	Total Value
Cottonwood, all species	795	41.34%	14.1	$2,425.70	$1,822,147.53
Spruce, all species	545	28.34%	9.2	$2,294.27	$2,398,698.07
Aspen	243	12.64%	7.8	$1,049.00	$254,907.79
Pine, all species	180	9.36%	7.1	$1,066.22	$331,530.48
Ash, all species	38	1.98%	7.7	$859.30	$23,497.15
Maple, all species	31	1.61%	5.1	$464.93	$20,281.50
Douglas-fir	25	1.30%	7.4	$1,529.26	$38,231.58
Fir, all species	21	1.09%	9.8	$2,259.20	$46,988.07
Hawthorn	14	0.73%	3.5	$287.97	$4,031.61
Oak, gambel	11	0.57%	4.6	$458.58	$5,044.41
Chokecherry	7	0.36%	6.1	$869.09	$6,083.62
Birch	3	0.16%	4.0	$393.88	$1,181.64
Alder	2	0.10%	3.0	$193.86	$387.73
Apple	2	0.10%	7.0	$1,223.85	$2,447.69
Crabapple	2	0.10%	4.0	$337.61	$675.23
Hackberry, northern	1	0.05%	6.0	$645.68	$645.68
Japanese Tree Lilac	1	0.05%	3.0	$221.56	$221.56
Serviceberry	1	0.05%	4.0	$129.24	$129.24
Willow, white	1	0.05%	7.0	$415.42	$415.42
Total Trees	**1923**	**100.00%**	**6.3**	**$901.30**	**$4,957,545.97**

Table 8. Golf Course tree species and value summary

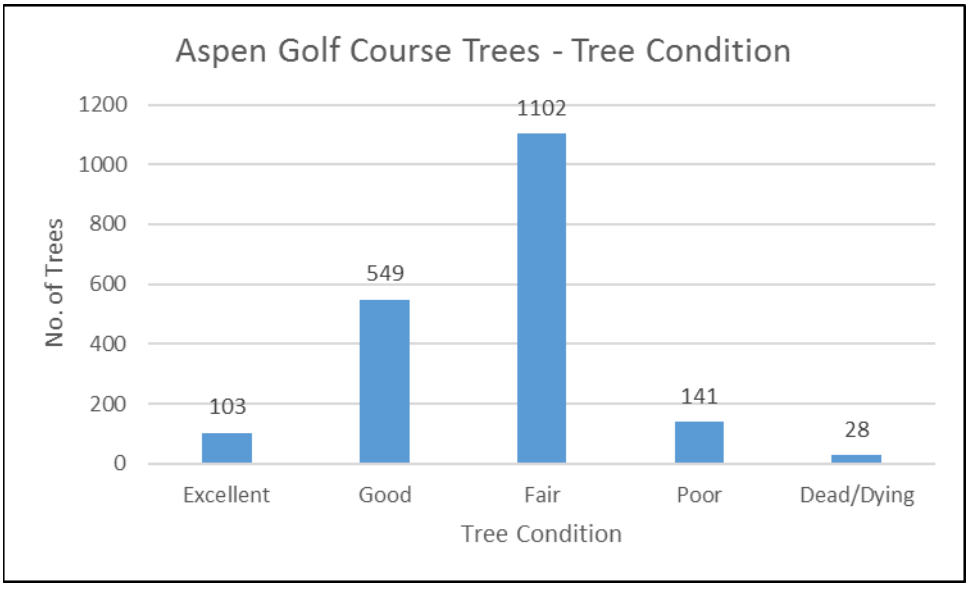


Figure 31. Condition ratings of Golf Course trees, total 1,923 trees

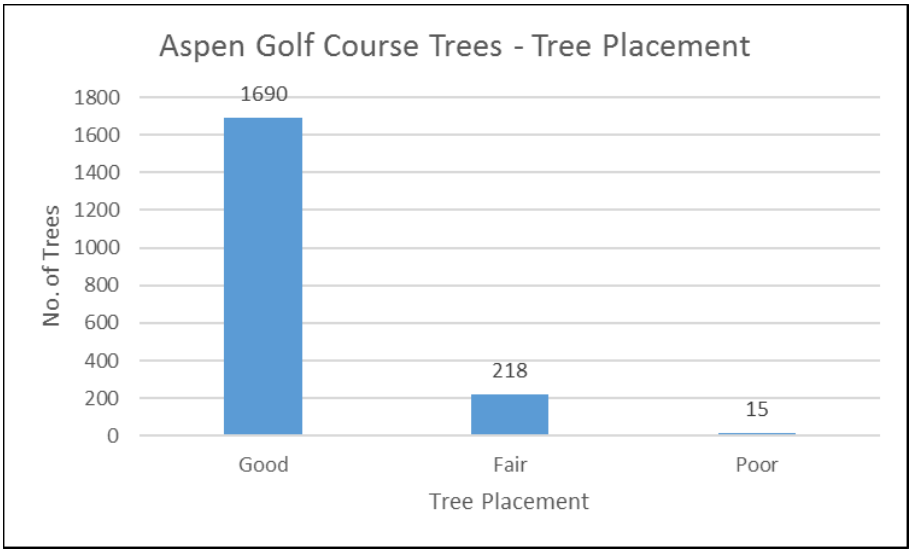


Figure 32. Placement ratings of Golf Course trees, total 1,923 trees

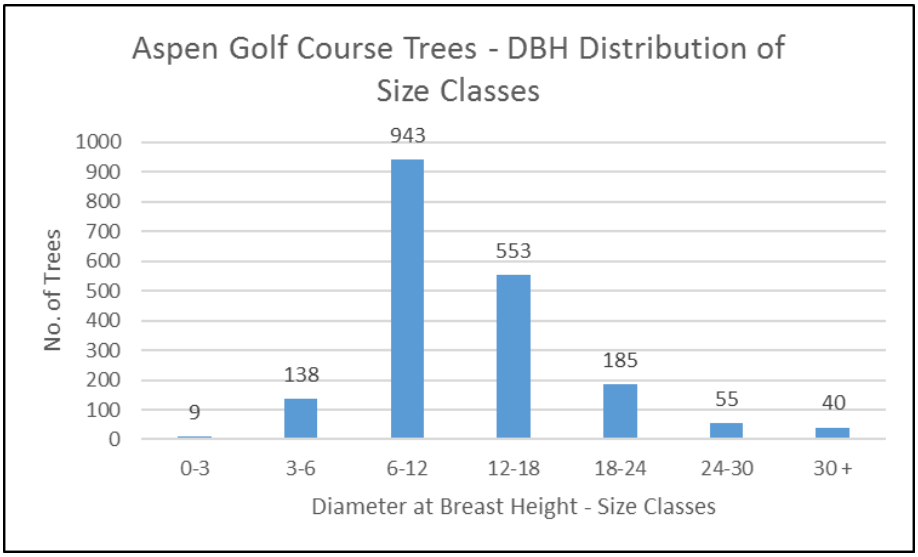


Figure 33. Diameter at Breast Height distribution of size classes for Golf Course trees, total 1,923 trees

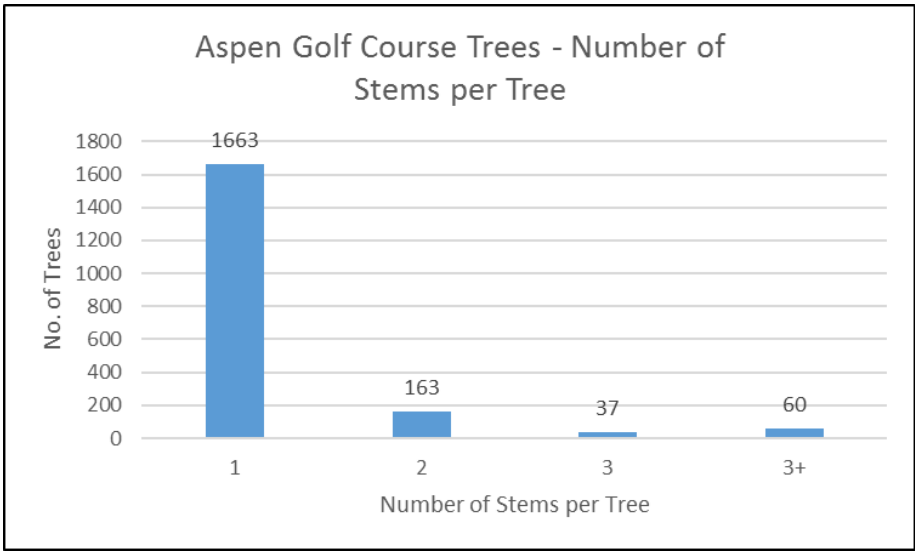


Figure 34. Number of stems per tree for Golf Course trees, total 1,923 trees

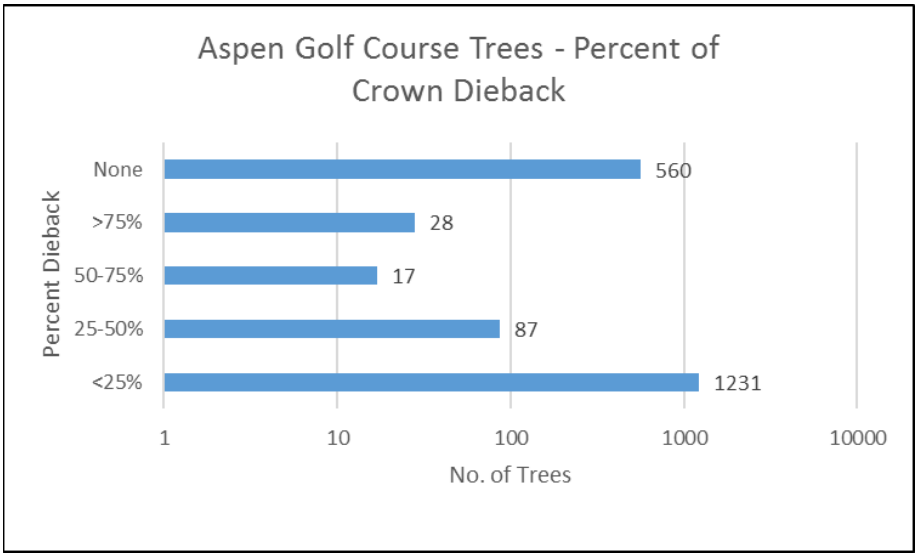


Figure 35. Percent of crown dieback observed in Golf Course trees, total 1,923 trees

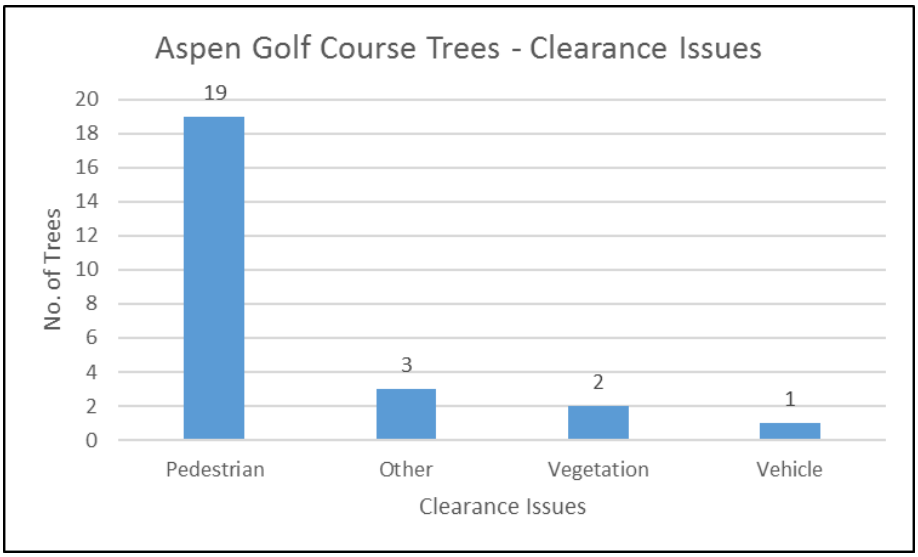


Figure 36. Clearance issues observed in Golf Course trees, total 25 observations

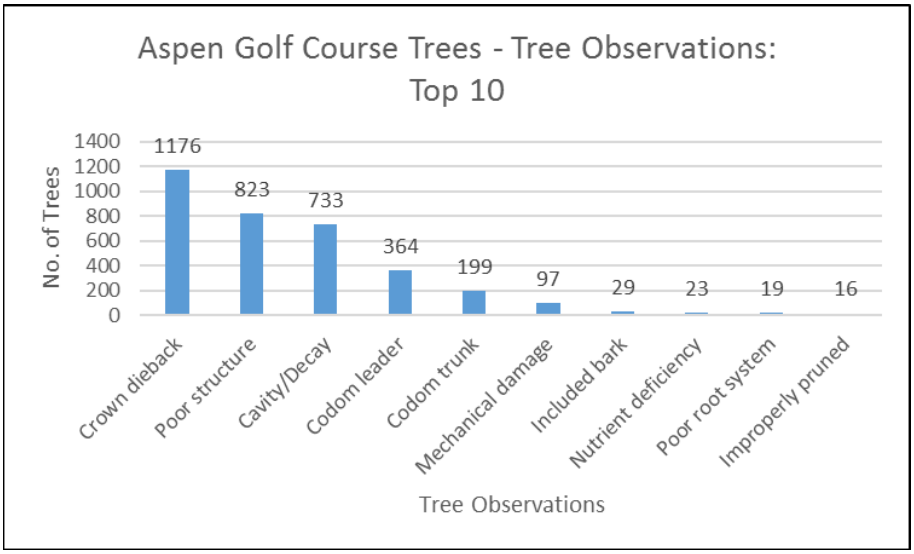


Figure 37. Top 10 Tree Observations for Golf Course trees, total 3,479 observations

Figure 38. Top 10 Maintenance Needs for Golf Course trees, total 2,672 observations

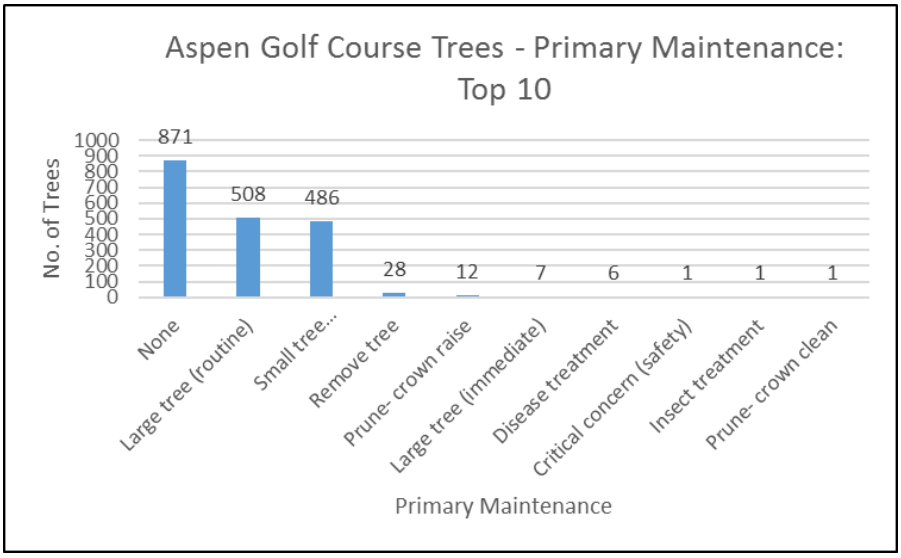


Figure 39. Top 10 Primary Maintenance needs for Golf Course trees, total 1,923 trees

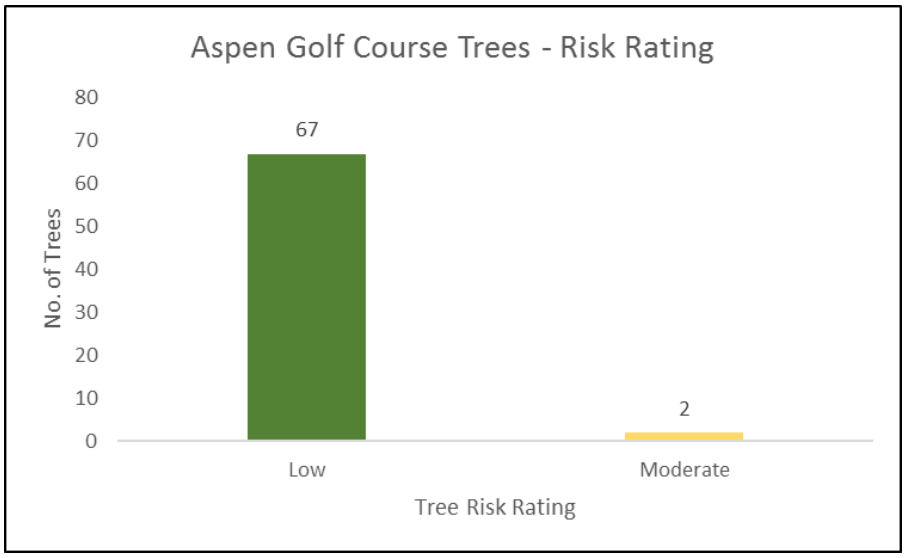


Figure 40. Risk ratings for Park trees 25 inches and larger, total 69 ratings

Short and Long Term Recommendations

- In early 2018
  1. Have a Certified Arborist conduct a deeper inspection on the trees with a Tree Risk Assessment rating of high or moderate or a Primary Maintenance need of Tree Risk Assessment.
  2. Take actions based on the in depth assessment recommended by the arborist.
  3. Visit all trees that are: recommended for removal, have a condition rating of poor or lower, or have a placement rating of poor or lower. Determine management actions.
  4. Continue to update the inventory in Tree Plotter with work completed this year.
  5. Establish a pruning rotation for all Street and Park trees, beginning with trees requiring Prune - Crown clean or Prune – Crown restore.

- In mid – late 2018
  1. Based on the current budget allocation:
     a. Continue pruning any remaining Crown clean or Crown restore need trees and removing any remaining removal trees.
     b. Determine a schedule to begin pruning all trees with Large and Small tree routine prune as their Primary Maintenance need.
     c. Continue all trees on a rotational pruning plan (e.g. every 2-3 years).
  2. Implement an updating process in the GIS software database for when management actions are taken.
  3. Update the Tree Management Plan.
  4. Have staff that are Certified Arborists conduct bi-annual assessments of trees with moderate or high risk assessment levels (at a minimum).
  5. Start planting trees from the Suggested Planting list.

- 2019 and beyond
  1. Continue to update tree inventory database as management actions are taken.
  2. Implement the Tree Management Plan.
  3. Publicize findings with experimental trees for public benefit. Landscapers will pick up on the information as well.

C - 2017 Tree Risk Management Program

DRAFT TREE RISK MANAGEMENT PLAN

CITY OF ASPEN, COLORADO

DEPARTMENT OF PARKS & RECREATION

FORESTRY & NATURAL RESOURCES

MAY 2017

INTRODUCTION

Trees are a valuable asset to the community of Aspen, beautifying our City and linking us to the natural environment. They also provide other benefits such as cleaning our air, reducing energy consumption and costs, and reducing storm water runoff. However, a structurally defective tree in the urban setting can present a safety risk to people and property. Dying and defective trees can also increase wildfire risks, a concern in Aspen and the Roaring Fork Valley.

City Forestry is responsible for managing trees located on city street rights-of-way (street trees), parks and city owned properties. One of these responsibilities includes reducing the risks trees can pose to people and property. This is accomplished by identifying and evaluating defective City trees, assessing and quantifying the safety risks and taking the appropriate actions to reduce these risks. The City of Aspen Community Forestry Plan defines this process as Hazard Tree Management. Since then Aspen's urban forest has grown and there have been advances and changes in arboriculture; some as simple as dropping the terminology including "hazard" in favor of "risk". This document is an update to this management process and is redefined as a Tree Risk Management Plan.

Figure 1. This spruce tree on Main Street failed (uprooted) in March of 2009.

The purpose of this document is to inform the public of the City's Tree Risk Management Plan. A plan that defines City policies, procedures and practices in the management of city trees that may present a safety risk to people and property.

RISK TREE MANAGEMENT IN ASPEN

HISTORY

The City has actively managed risk trees for over 25 years with a concerted effort beginning in 1992. At that time, the Parks Department (the City Forestry Department did not exist yet) recognized the need to develop of long-range plans for the maintenance of the urban forest. To that end, more management information regarding Aspen's urban forest would be required and the Colorado State Forest Service (CSFS) was retained and completed the City's first public tree inventory. This inventory identified 59 risk trees and recommended removal of these trees. Since then, there have been three updates of the tree inventory, a City Forester was hired in 1998 and the City Forester wrote the city's first hazard tree management plan in 2003.

In 2007, the City published and City Council officially adopted the City of Aspen Community Forest Management Plan. This plan included a brief overview of the hazard tree management. It included a definition of a "hazard tree" and noted the use of the Colorado Tree Coalition (CTC) and International Society of Arboriculture (ISA) evaluation processes and forms for assessing risk trees. It also explained a process of designating certain trees as "Monitor" trees; trees to be evaluated for tree risks once per year and after storm events.

This process has served the City well, however our current City Forester recognized the need for an update. There are new standards and tools for assessing risk trees and Aspen's urban forest is growing and aging. New assessment technologies such as the Resistograph and Sonic Tomography were developed and have become part of the City Forester's toolkit. The ISA has developed the new Tree Risk Assessment methodology, which differed from past evaluation techniques and has been standardized in the tree care industry. These changes and challenges in managing Aspen's urban forest, advancements in technology and arboricultural practices, and the Forestry's continuing efforts to provide the best urban forestry management services for the City brings us to today, 2017 and this Tree Risk Management Plan.

ASPEN'S TREASURED COTTONWOOD TREES

One of the unique challenges of managing Aspen's urban forest and most treasured is the population of the native Populus angustifolia – narrowleaf cottonwood trees. The "cotton" bore by the female trees can be a nuisance and cottonwood trees are known to be a weaker wooded tree species that are prone to more structural failures than other tree species. In addition, their large size, and the number of cottonwood in our population presents more opportunities for possible damages and consequences as a result of the failure of a tree or tree part. Cottonwoods grow to 100 feet tall and we have over 2,400 cottonwoods in Aspen's population representing just over 30% of the public tree population.

Therein lies the challenge and one of the justifications for a clearly defined tree risk management strategy. The result is that maintaining the cottonwood population requires more intensive management versus less "problematic" trees. This more intensive management comes with a little higher cost to the community as well as accepting a little higher degree of tree related risk.

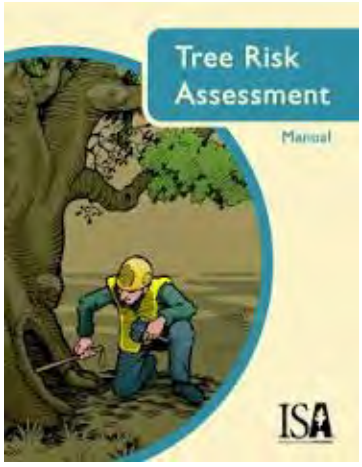
Figure 2. Row of stately narrowleaf cottonwood trees on West Bleeker Street.

POLICY

Policies guide all City practices and managing risk trees is no exception. The City of Aspen Community Forestry Plan adopted by City Council established tree risk management as an important community safety policy. The following updated policies have been developed to guide the City in the implementation of the Tree Risk Management Plan.

RISK TREE

A potential risk tree will be evaluated by the City Forester. The tree will be evaluated using the International Society of Arboriculture's (ISA) Tree Risk Assessment Methodology (www.isa-arbor.com). This is the industry standard for evaluating a risk tree. It includes evaluating potential targets of a tree failure, defects in the tree that



may fail, the probability the defect(s) may fail and finally the potential consequences if the defective tree part fails. The culmination of the assessment results in a Risk Rating; Low, Moderate, High or Severe. Other factors that are considered in determining the risk include; wildfire risk in a defined wildfire control area, is the tree a strong or weak-wooded tree species and the exposure of the tree to strong wind events.

A risk tree is defined by the following City policy.

- A Risk Tree is a tree with a defect present that has a likelihood of failure of Probable or Imminent, a target occupancy rate greater than Rare and/or located in a moderate or high wildfire risk area as determined by the City Forester.

CITY TREE

The City is responsible for managing all trees located on public property. These include trees located on City street right-of-ways (street trees), parks and other City properties. However, trees are living, growing organisms that do not adhere to our people-made boundaries. A small young tree beginning its life clearly on a property, grows in diameter with age and may grow over a property line. In these cases of "border trees", is it the City's or the private property owner's responsibility to manage the tree? The following City policy defines a City Tree and the responsibility for management of City/private property border trees.

- The City will assume the management responsibility of any tree with at least half of its trunk diameter measured at 4.5 feet above grade located on a City right-of-way, easement or property.
  - If necessary, a professional survey will be performed to provide clarification.
  - In cases where there is clearly mutual responsibility, the City will work with the property owner to reach a mutually acceptable arrangement.

Figure 3. Example of a "border tree" on West Hallam Street.

RISK TREES LOCATED ON PRIVATE PROPERTY

There are trees located on private property that may pose an unacceptable risk to City property or neighboring properties. If the City identifies a risk tree on private property or is informed of a risk tree on private property, the following policy will direct City action.

- A risk tree located on private property, as determined by the City Forester, will be mitigated by the property owner or the City through a notice and order process as defined in the City of Aspen Code Chapter 13.12.
    - In general, it includes a process of notifying the property owner and agreeing on mitigation strategy.

TREE REMOVAL

In a natural setting trees die or fall creating space for a new tree to grow in its place. In the urban setting, it is people that must manage this process. Dead, diseased or declining trees need to be removed when they become an unacceptable risk. People must plant trees to replace removed trees. The City values all trees, however at a certain point tree removal may be the best management practice to reduce risks to people and property, protect the urban forest from insect pests and disease, unacceptable wildfire risks and introduce renewal by planting replacement trees. The following tree removal policy directs public tree removal decisions in the City of Aspen.

Figure 4. "Renewal of the urban forest". Tree planting on the golf course.

- A City Tree will only be removed if it is an imminent threat to public safety, dead, dying, diseased, surpassed its service life, or in conflict with a more important city project as determined by the City Forester.
- Tree Removal Notification Process
    - A tree removal notice, stating the removal reasons, will be posted by the City Forester on the tree prior to the scheduled removal.
    - The City Forester will notify the Parks and Recreation Director, the City Manager and City Council when a tree deemed significant by the City Forester is removed.

IDENTIFICATION OF RISK TREES

There are two ways Risk Trees are identified by the City; happenstance and periodic inspections.

Happenstance is simply cases where a City staff person, by chance and observation, identifies a potential risk tree during their normal work activities. A city forestry crew or contractor may be pruning a tree and identify a problem. A city staff person may notice a problem with a tree. The inspection of a request for service from the public may reveal a potential risk tree.

The second way risk trees are identified is through the City's periodic tree pruning and inventory programs. Each year 1/5th of the City's trees in a particular geographic area are pruned. Prior to the actual pruning, City Forestry performs a basic walk around inspection of each tree in the scheduled area. Through this inspection process Risk Trees may be identified. Further, as the pruning work is being completed on a tree, problems may be identified by

the pruner and it is their responsibility to notify City Forestry for further evaluation. The City may also periodically perform a complete inventory of City Trees or a special project that may reveal a Risk Tree.

Figure 5. Conks (fungal fruiting bodies) like the one pictured here are an indicator of decay working in the tree. In this case, the Ganoderma fungus decayed the base of this aspen resulting in the tree failing.

HOW RISK TREES ARE MANAGED

Once a potential Risk Tree is identified by one of the methods described above the following procedures are implemented.

1. A Tree Risk Assessment is scheduled for the tree of concern.
2. The tree receives a Basic Tree Risk Assessment resulting in one of three of the outcomes.
    a. Arboricultual treatments to mitigate the risks of defective tree part(s) will be scheduled and completed.
    b. The tree will be scheduled for an advanced tree risk assessment.
    c. The tree will be placed on the Risk Tree Monitoring Program.

TREE RISK ASSESSMENT

As described above, an International Society of Arboriculture (ISA) Tree Risk Assessment is the industry standard for assessing risk trees and quantifying tree risk. In addition to detailing the methodology for performing a Tree Risk Assessment, the ISA qualifies arborists to perform a Tree Risk Assessment (http://www.isa-arbor.com/certification/becomeQualified/becomeQualified.aspx). This includes a training and testing program whereby upon the successful completion of the program, an arborist is given the designation of Tree Risk Assessment Qualified. All Tree Risk Assessments performed as part of this program are performed by ISA Tree Risk Assessment Qualified arborists.

TREE RISK MITIGATION ARBORICULTURAL TREATMENTS & PRACTICES

TREE PRUNING

Figure 6. Reduction pruning was performed on this tree to reduce the risk of failure.

The City's standard tree pruning specifications include the pruning of defective branches that may pose an unacceptable risk of failing. A tree pruner will be directed to prune the defective branch(s) from the tree and as a result reduce the risks of these defective branches failing.

In some cases, a more aggressive pruning practice called "Reduction" pruning may be specified. Reduction pruning includes the arboriculturally correct practice of pruning the terminal portions of scaffold and lateral branches to shorten the length of the branches, spread of the tree, and height of the tree. This treatment is used in cases where there may be significant root or trunk defects, or multiple scaffold branch defects. Shortening the length of branches and/or the height of the tree increases the amount of force that is required to break a tree part and as a result reduces the probability and risk the tree part will fail.

ADVANCED TREE RISK ASSESSMENT

A Basic Tree Risk Assessment is the first assessment performed after a potential risk tree is identified. The basic assessment is completed from the ground and is primarily a visual assessment. If the City Forester finds it is needed, then an Advanced Tree Risk Assessment will be performed on the tree. This may include an inspection with an aerial lift truck and possibly the use of some more advanced diagnostic tools such as a Resistograph and a Tomograph.

RESISTOGRAPH & TOMOGRAPH USES

Decay is very common in trees and particularly in older trees. The amount of decay in a tree part or more importantly the amount of soundwood around a decayed tree part is the most important variable in assessing the probability that a decayed tree part may fail. The Resistograph and Tomograph are two tools used to measure soundwood and decay present in a tree part. Both of these tools provide more information for assessing the risk a tree part may fail. The findings these tools provide do not provide the "end all" answer to what management treatment should be taken. They do provide more information for the assessor to quantify failure risk and the final management decision to be taken is a culmination of the findings of these tests and other conditions present with the tree.

Figure 7. Tomograph measurements being taken on a tree in Washington Park, Denver, CO.

RESISTOGRAPH

A Resistograph drills into the wood of a tree part and measures and records the resistance being applied on the drill bit as it drills into the tree part. The result is a visual measurement of the “sound” and “unsound” wood where the tree part was drilled.

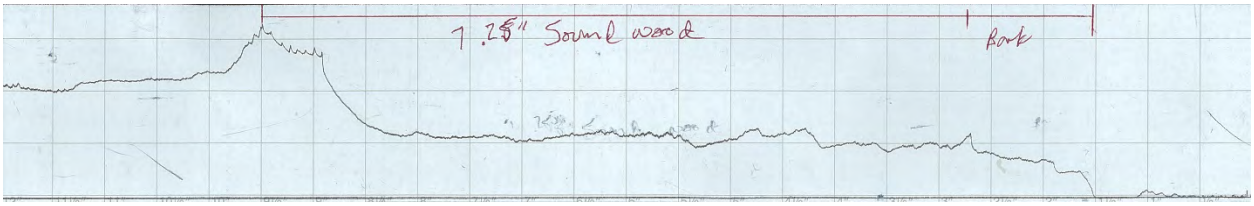


Figure 8. Resistograph tape showing the thickness of soundwood.

TOMOGRAPH

A Tomograph uses soundwaves to measure the “soundness” of a tree part. Unlike the Resistograph, the Tomograph provides a graphic representation of the “soundness” of the wood around the whole tree part measured, is a more accurate measure and provides more information with which to make a probability of failure judgement.

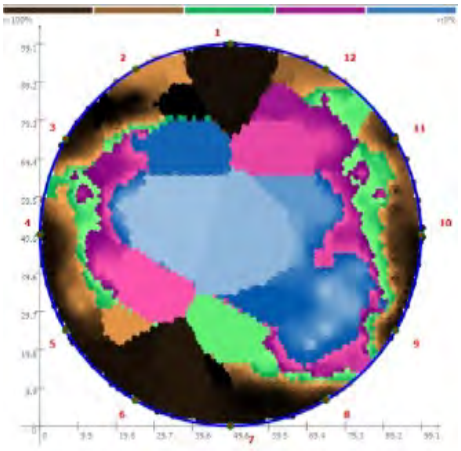


Figure 9. Tomograph chart illustrating the "soundness" of the tree part measured.

RISK TREE MONITORING PROGRAM

Risk Trees that have an ISA Risk Rating of Moderate or higher, even after arboricultural treatments have been completed, will be assigned to the City’s Risk Tree Monitoring Program. Using the City’s computerized tree inventory, each of these trees will be designated as Risk Monitor trees. Each of these trees will receive a Tree Risk Assessment every year. The findings of the annual assessment will direct further action such as arboricultual treatments, advanced tree risk assessment, retention on the Tree Risk Monitoring Program or if the condition of the tree warrants, removal.

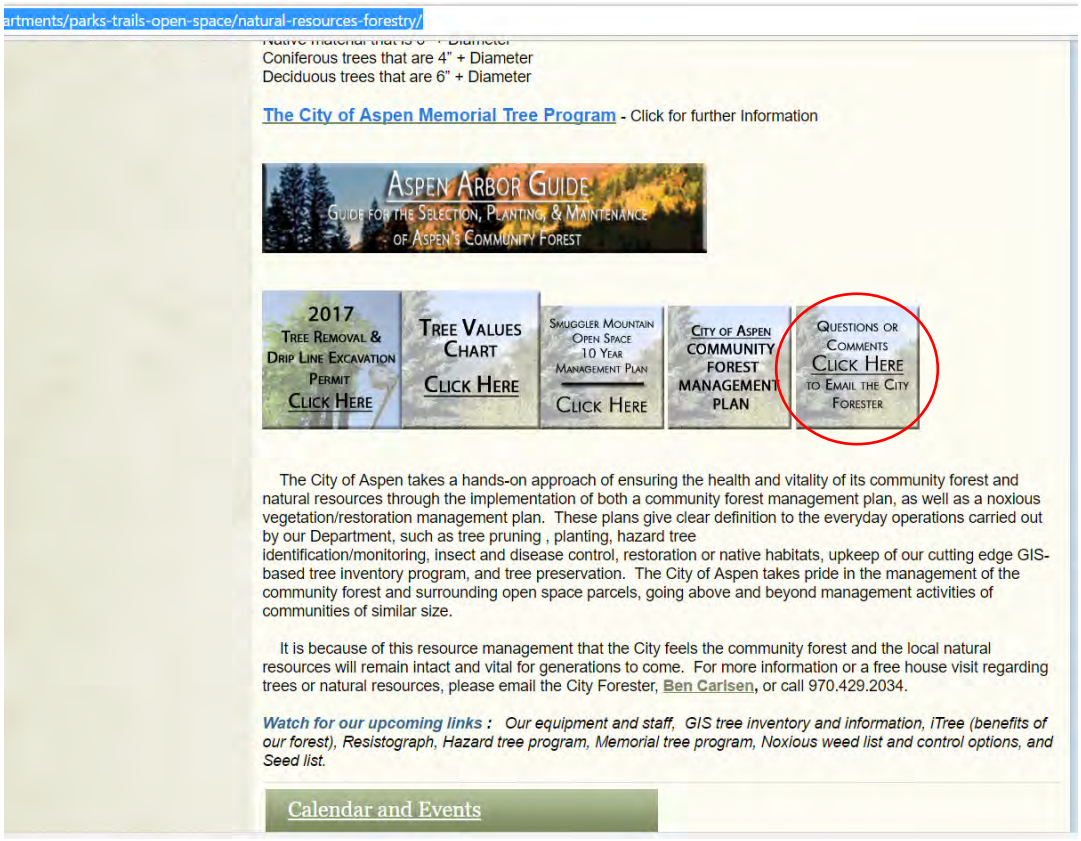
TREE REMOVAL

Ultimately a tree may have declined to a point that removal and planting a new tree is the best management decision.

HOW CAN YOU HELP?

If you see a tree that you believe may pose a risk to public safety report your concern to City Forestry in the following ways. Be prepared to provide the address and general location of the tree of concern. The tree will be inspected by City Forestry and inform you of the findings.

- Call the Forestry Division at (970) 429-2034 to report your concern.
- Send the City Forester an email via the City's website by going to: (http://www.aspenpitkin.com/departments/parks-trails-open-space/natural-resourcesforestry/-) and navigate down to the "Email the City Forester" button.



REFERENCES & ACKNOWLEDGEMENTS

Andrew G. Pleninger, Consulting Arborist, Aspen Tree Service, 1111 Village Road, Carbondale, CO 81623. www.myaspentree.com. Coauthor of this document.

International Society of Arboriculture, Champlain, IL. Publication illustrations on pages 3 &5.

VERSION 1 - 2017

TREE RISK MANAGEMENT PROCEDURES

FOR CITY STAFF & FORESTRY CONTRACTORS

CITY OF ASPEN, COLORADO

DEPARTMENT OF PARKS & RECREATION

Natural Resources & Forestry

CONTENTS

INTRODUCTION

This document details the policies and procedures for implementing the City's Tree Risk Management Plan. It is intended for use by City staff and contracted service providers completing activities that are related to the implementation of the plan.

Potential risk trees may be identified during daily work activities or programs specifically designed to identify risk trees. City staff or contracted service providers are required to use the methods and procedures in this document to report and take the required action steps in managing risk trees.

When a potential risk tree is identified action, steps will be taken. These will include reporting the tree to initiate and complete a tree risk assessment, schedule and complete arboricultural treatments to minimize tree risks and possible inclusion of the tree in the Risk Tree Monitoring Program.

POLICIES

RISK TREE

- Risk Tree - A Risk Tree is a tree with a defect present that has a likelihood of failure of Probable or Imminent, a target occupancy rate greater than Rare and/or located in a moderate or high wildfire risk area as determined by the City Forester.

CITY TREE

City Forestry is responsible for managing all trees located on public property as well as providing an environment that is free of unreasonable risks that trees can pose to people and property. Trees are living, growing organisms and will span man-made boundaries such as property lines; growing from public or private property over a border line to or from public or private property. The following policy is a definition of a public vs private tree.

- The City will assume the management responsibility of any tree with at least half of its trunk diameter measured at 4.5 feet above grade located on a City right-of-way, easement or property.
  - If necessary, a professional survey will be performed to provide clarification.
  - In cases where there is clearly mutual responsibility, the City will work with the property owner to reach a mutually acceptable arrangement.

If the City identifies a risk tree on private property or is informed of a risk tree on private property, the following policy will direct City action.

- A risk tree located on private property, as determined by the City Forester, will be mitigated by the property owner or the City through a notice and order process as defined in the City of Aspen Code Chapter 13.12.
  - In general, it includes a process of notifying the property owner and agreeing on mitigation strategy.

TREE REMOVAL

- A city tree will only be removed if it is an imminent threat to public safety, dead, dying, diseased, surpassed its service life or in conflict with a more important city project as determined by the City Forester.
- Tree Removal Notification Process
  - A tree removal notice, stating the removal reasons, will be posted by the City Forester on the tree for two weeks prior to the scheduled removal.
  - The City Forester will notify the Parks and Recreation Director, the City Manager and City Council of the scheduled tree removal

DEFINITION OF TERMS & REFERENCES

DEFINITIONS OF TERMS

- **Emergency Response** Plan – Action plan directing the City's response to a forestry related emergency.
- **Monitor Tree** – A tree that will receive annual risk tree monitoring inspections based on its current risk rating.
- **Risk Rating** – The resulting Risk Rating as determined by the completion of an ISA Tree Risk Assessment.
- **Risk Tree Monitoring Program** – A program of annual inspection and management of trees that have been placed in the program based on their Risk Rating.
- **Rotational Pruning Program** – Annual pruning and inspection schedule of all trees in a geographic area.
- **Service Request** – A request from the public or other City department to inspect a site for a tree related issue that has been logged in Tree Plotter, the City's tree inventory management application.
- **Tree Inventory** – A complete inventory update of city trees located within a geographic area.
- **Tree Risk Assessment** – An evaluation of a tree utilizing the International Society or Arboriculture's (ISA) Tree Risk Assessment methodology.
- **Tree Risk Assessment Qualified** – The ISA qualification required for person to be qualified to complete a Tree Risk Assessment.
- **Work Order** – A work order generated from Tree Plotter, the City's tree inventory management application directing work to be completed on a tree or site.

REFERENCES

- ISA Basic Tree Risk Assessment Form

http://www.isa-arbor.com/education/resources/BasicTreeRiskAssessmentForm_Fillable_FirstEdition.pdf

- ISA Basic Tree Risk Assessment Instructions

http://www.isa-arbor.com/education/resources/isabasictreeriskassessmentform_instructions.pdf

- ISA Tree Risk Assessment BMP
- ANSI Standard A300 Part 9 – Tree Risk Assessment a. Tree Structure Assessment
- City Code

TOOLS

The following are the tools that are required or may be used in the completion of tree inspection or Tree Risk Assessment.

1) Internet Ready Device
   a) ISA Basic TRA Form
   b) Login Credentials to Tree Plotter Inventory App
2) Safety Vest & Hard Hat
3) Diameter Tape
4) Clineometer
5) Sounding Mallet
6) Binoculars/Monocular
7) Drill & Drill Bit
8) Resistograph
9) Tomograph
10) Aerial Lift

MANAGEMENT OPTIONS TO MITIGATE TREE RISK

The following are the management options that will be taken to mitigate tree risks.

✓ TREE RISK ASSESSMENT (TRA)

A detailed assessment of a tree and its surroundings for qualifying the risk of tree failure and consequences. A Basic TRA and an advanced TRA can be performed.

- BASIC TRA – An ISA Tree Risk Assessment completed from the ground through visual observation and with simple hand tools.
- ADVANCED TRA – The use of specialized equipment such as an aerial lift, drill or tomograph to provide more data in qualifying tree risk and making a management decision.

The result of a TRA is a management action to mitigate the tree risk to an acceptable level. The following are the management actions that will be taken.

✓ PRUNING

- CROWN CLEANING – prune dead, diseased, detached and broken branches
- REDUCE – reduce the height and spread of the tree; shorten the length of leaders, scaffolds and branches thereby increasing the force required to break defective parts and as a result reduce the risk of failure.
- PRUNE STRUCTURAL – subordinating or removing structural defective stems, scaffolds and branches.

✓ STRUCTURAL SUPPORT SYSTEMS

- Cabling – installation of static or dynamic cabling systems to support defective stem or branch defects
- Bracing - installation of through bolting or bracing systems to support defective stem or branch defects

✓ RSK TREE MONITORING PROGRAM

- Each tree on the program undergoes an annual TRA.

- The City Forester dictates whether a tree is place on the annual Risk Tree Monitoring program.

✓ REMOVAL

- Remove the tree.
- Requires City Forester approval.

TREE PLOTTER INVENTORY APPLICATION REPORTING

The following tree inventory data fields will be utilized for reporting a potential risk tree and managing Risk Trees.

➢ SERVICE REQUEST

Definition - A request from the public, city staff or contractor to inspect a potential risk tree

0 PRIMARY COMPLAINT/ISSUE

- Inspect

0 COMMENTS

- Note; “Possible risk tree”

➢ WORK ORDER

Definition - A work order added by the City Forester to perform a Tree Risk Assessment on the tree of concern.

0 MAINTENANCE NEED

- Primary Maintenance
  - ✓ Tree Risk Assessment

0 LOGGING COMPLETION OF A WORK ORDER

- Select
  - ✓ Date of Work
  - ✓ Crew
  - ✓ Maintenance Performed

➢ TREE DATA FIELDS DEFINITIONS

0 Maintenance Need – SELECT THE FOLLOWING MAINTENANCE CHOICES

- Primary Maintenance
  - ✓ Critical Concern – tree has defects present that warrant a Tree Risk Assessment to be completed
  - ✓ Tree Risk Assessment – perform a tree risk assessment
- Maintenance Needs
  - ✓ Monitor Tree – tree is on the Risk Tree Monitoring program schedule

0 TREE INFORMATION

- Condition – the following condition ratings have tree risk implications. Selecting one of these choices should result in or should have resulted in a documented TRA.
  - ✓ Dead Dying
  - ✓ Poor – major problems
- Observations – The following observations are defects that have tree risk implications. Selecting one of these choices should result in or have resulted in a documented TRA.
  - ✓ Canker
  - ✓ Cavity Decay
  - ✓ Frost Cracks
  - ✓ Girdling Roots
  - ✓ Mechanical Damage
  - ✓ Poor Root System
  - ✓ Poor Structure
  - ✓ Serious Decline
- Percent Dieback
  - ✓ Selecting a Dieback choice of <25% or more has tree risk implications and should result in a pruning work order and possibly a documented TRA.
- Tree Comments
  - ✓ Note your Major Condition of Concern
- Photos
  - ✓ Do Not Add photos

RISK TREE IDENTIFICATION PROCEDURES

There are several scenarios while working in the field where you may identify a potential risk tree. The following are the procedures to follow based on the scenario.

PUBLIC TREES

HAPPENSTANCE

Definition – You identify a potential risk tree while performing your regular daily work activities. This could include noticing a problem tree as you are driving around the City (Happen by), you are pruning a tree, or you were directed to a site to inspect a Service Request. If failure appears imminent, contact the City Forester immediately.

PROCEDURE

1. Navigate to the tree of concern
2. Open Tree Plotter
   a. Navigate to the tree
   b. If you are TRA Qualified, perform a TRA and enter data in Tree Plotter as specified in the TRA Procedure
   c. If you are not TRA Qualified
      - ✓ Add a Service Request
        1. Primary Complaint/Issue – Inspect
        2. Comments – Possible risk tree

ROTATIONAL TREE PRUNING PROGRAM

Definition – Each year, all the trees in one Forestry Management Unit are schedule for pruning. Prior to scheduling the work, the City Forester observes all trees from the ground.

Inspection Schedule – Leaf off

PROCEDURE

1. Inspector
    a. Open Tree Plotter
        i. Navigate to the tree
        ii. If you are TRA Qualified perform a TRA and enter data in Tree Plotter as specified in the TRA Procedure
        iii. If you are not TRA Qualified
            1. Add a Service Request
                a. Primary Complaint/Issue – Inspect
                b. Comments – Possible risk tree
2. City or Contract Crew Performing Work
    a. Add a Service Request
        i. Primary Complaint/Issue – Inspect
        ii. Comments – Possible risk tree

TREE INVENTORY

Definition – Periodically the City may complete a re-inventory of every public tree in the City or as part of an area specific project, updating all tree inventory data.

Schedule – Work is to be scheduled during the growing season.

PROCEDURE

1. Edit the Tree Location data fields
    a. The City Forester will provide a list of data fields to be filled for the inventory.
    b. Comments – note conditions of concern
    c. Staff Member
    d. Last Modified Date
    e. Photos – add photos that may assist in the TRA
2. Edit Location Information as necessary
3. Edit the Management Need data fields as follows
    1. Primary Maintenance to: Critical Concern
    2. Maintenance Needs: TRA
    3. Perform TRA per TRA Procedure

TREE RISK ASSESSMENT PROCEDURE

Definition – An ISA Tree Risk Assessment completed by a person holding a current ISA TRA Qualification

PROCEDURE

1. Stand back from the tree and make general visual observations of the canopy, scaffold attachments, trunk, root crown and potential targets.
2. Approach the tree and perform a detailed inspection, noting defects and possible targets using the ISA TRA form and methods as a guide.
    a. Roots/Root Crown
        i. Signs of root damage or root decay fruiting bodies
        ii. Sound the root crown for decay
    b. Trunk
        i. Sound the trunk for decay
        ii. Note any signs of defects
    c. Trunk/Scaffold Attachment
        i. Note any signs of defects
    d. Scaffolds
        i. Note any signs of defects
    e. Branches
        i. Note any signs of defects
    f. Advanced Tree Risk Assessment tools or methods required?
        i. Yes – Add Work Order
        ii. Suspend Evaluation until equipment needs are required then proceed
3. Open Tree Plotter
    a. Navigate to the subject tree
        i. Edit the Tree Location data fields
            1. All data fields as necessary
            2. Observations
                a. Select Observations found in your evaluation
            3. Comments – note conditions of concern and targets of each
            4. Staff Member
            5. Last Modified Date
            6. Photos – add photos that may assist in the TRA
        ii. Edit Location Information as necessary
        iii. Edit the Management Need data fields as follows
            1. Select a Primary Maintenance
                a. Remove – tree to be removed
                b. All Others – select the long term Primary Maintenance that applies
            2. All Others - Select Maintenance Needs
                a. Maintenance Needs that may be required to mitigate tree defect findings
                    i. Cable/Brace
                    ii. Crown Cleaning
                    iii. Monitor
                    iv. Prune Reduce
                    v. Prune Clearance
                    vi. Prune Structural
                b. Monitor – Tree is placed on the Tree Risk Monitoring Program
        iv. Tree Risk Rating & ISA TRA Form
            1. ISA Basic Tree Risk Assessment Form

a. Complete only if tree is to be removed

2. Specific Tree Risk Rating Assignments

Factor	Value
Occupancy Rates	1 – Rural Road or Natural Area
	2 – Residential Street
	3 – Residential Street Intersection or Arterial Street, Wildfire Risk Area
	4 – Occupied Structure, Arterial Street Intersection, School or Playground
Probability of Failure	Minimum value – Possible - for the following species;
	Cottonwood, Silver Maple, Willow, Boxelder

3. Risk Rating Action Thresholds
    a. Moderate or Higher
        i. Add Work Order
            1. Specify arboricultural treatments to reduce tree risks
        ii. Moderate Rating post treatment
            1. Add to Tree Risk Monitoring Program

v. Add History of TRA to the tree and close the Work Order if applies

RISK TREE MONITORING PROCEDURE

Definition – Trees with defects present that warrant an annual inspection.

Schedule – Complete inspections in leaf off and for a duration that ensures completion of all trees within one week.

PROCEDURE

1. Create Work Order list of trees to be inspected from Tree Plotter
    a. Primary Maintenance Needs = Monitor
2. Organize the list in the most efficient geographic inspection order
3. Perform a TRA on each tree per the TRA Procedure.

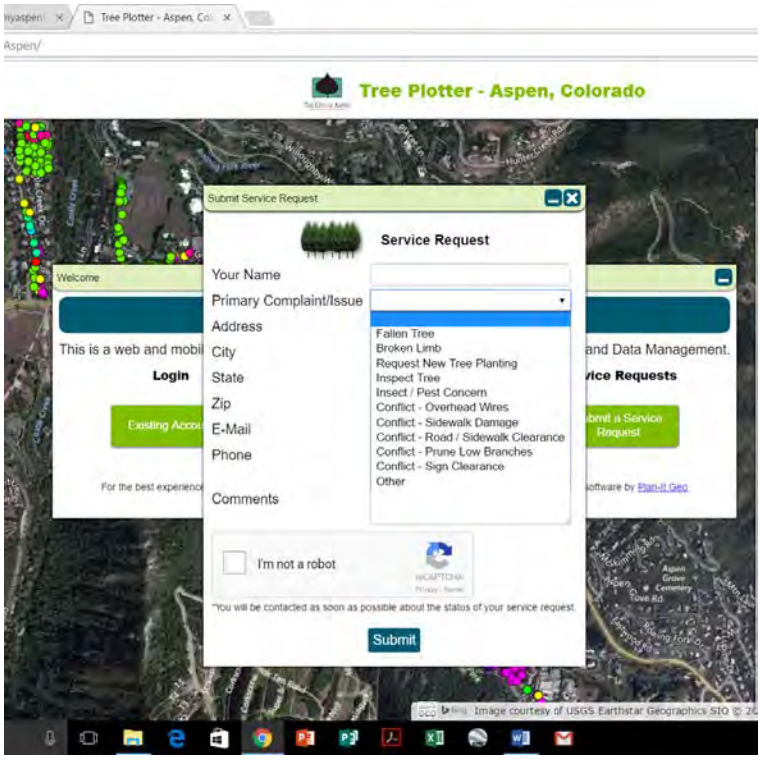
PRIVATE RISK TREE PROCEDURE

Definition – A potential risk tree that was identified by any means and appears to be on private property.

PROCEDURE

1. Tree has defects posing a threat to public property and these defects can be mitigated with pruning.
    a. Open Tree Plotter
        i. Add the Tree to the inventory.
            1. Note as “not managed by City”
        ii. Add a Work Order to the tree for pruning
2. Tree poses a threat to public or private property and should be removed.
    a. Open Tree Plotter
        i. Add a Service Request

1. Complete all the information fields, selecting “Inspect” as the Primary Complaint/Issue
2. In the Comments field note tree information including;
    a. Species, DBH, Location on the property & issues of concern



b. Send a letter to the property owner detailing the issues of concern…..???

EMERGENCY RESPONSE PLAN

The City Forester will be available during normal work hours for responding to an emergency tree event. When the City Forester is off, he/she may be reached on his/her work cell phone or home phone. If the City Forester is unable to respond, the contracted tree service, Aspen Tree Service can be reached at 970-963-3070. The following are procedures for responding to tree damage because of an incident or damaging weather event.

- When a major weather event occurs, and City staff becomes aware of widespread failures, they will immediately call the City Forester.
    - The City Forester will assign the Forestry Crew the priority areas.
    - The City Forester will drive town and assess damage.
        - Use City resources to manage debris
        - Use contract crews to manage debris

DEFINITIONS

LEVEL 1 EVENT

- Approximately 1 – 5 calls

- All work can be completed by City Forestry crews
- Pre-inspection of work may be required for prioritization

LEVEL 2 EVENT

- Approximately 6 - 8 calls
- Completion of work will require contract tree service provider assistance
- Work/Calls will require pre-inspection and prioritization

LEVEL 3 EVENT

- Approximately 9 - 15 calls
- Completion of tree work will require contract tree service provider assistance
- Work/Calls will require pre-inspection and prioritization using high call volume management units
- Cleanup work will be completed by DPW

WILDFIRE EVENT

- Wildfire areas rated moderate or high will receive special consideration for removal to reduce risk of tree failures into the roadway during a wildfire event. A wildfire map is attached to this document in Appendix A.

TOOLS

1. Safety Vest & Hardhat
2. Flashlight
3. Internet Accessible Device
4. Maps
    a. Forestry Management Unit Map
    b. Forestry Emergency Response Unit Map
5. Emergency Response Form

PROCEDURES

1. Receive Call
    a. Go to office and assess call volume and event
    b. Classify Event
        i. Call for additional resources as required for Event
2. Level 1 Event
    a. Collect Tools & Resources to perform work inspections
        i. Internet Ready Device
    b. Inspect each Call
        i. Prioritize if needed
        ii. Log a Work Order in Tree Plotter for affected tree(s)
        iii. Distribute to Work Crews
3. Level 2 Event
    a. Collect Tools & Resources to perform work inspections
        i. Internet Ready Device

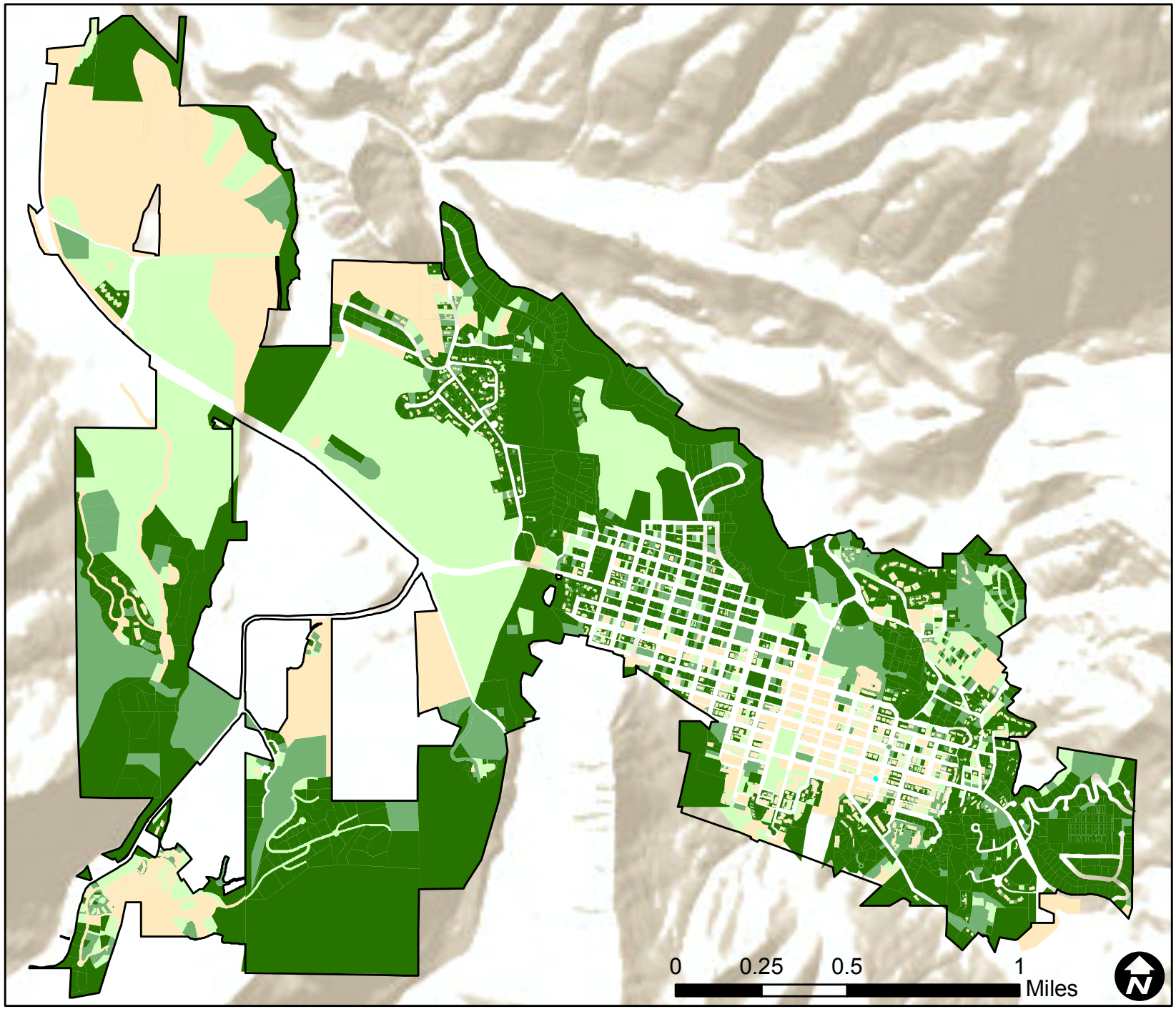
        ii. Forestry Management Unit Map
        iii. Storm Damage Survey Log
    b. Inspect each Call by Management Unit
        i. Prioritize
        ii. Log a Work Order in Tree Plotter for affected tree(s) or if call volume is too high use the Storm Damage Survey Log
        iii. Distribute Priority 1 work to Work Crews
        iv. Completion of Management Unit Survey
            1. Distribute to Crew(s) to complete work
4. Level 3 Event
    a. Collect Tools & Resources to perform work inspections
        i. Internet Ready Device
        ii. Forestry Level 3 Event Management Unit Map
        iii. Storm Damage Survey Log
    b. Inspect each Call by Management Unit
        i. Prioritize
        ii. Log work on Storm Damage Survey Log
        iii. Distribute Priority 1 work to Work Crews
        iv. Completion of Management Unit Survey
            1. Distribute to Crew(s) to complete work
5. Post Event
    a. Review Storm Damage Survey & Crew Work Logs
        i. Completion of all work
        ii. Trees requiring inspection
    b. Perform Post Storm Inspections
        i. Storm Event
        ii. Risk Tree Monitor Trees
    c. Complete Tree Plotter inventory update
    d. Complete any outstanding work

D - 2015 Canopy Cover Assessment

Tree Canopy (%)

by Parcel in Aspen, CO

Community Forest Assessment (2015)



Key Terms

Tree Canopy:

Tree canopy within the study area when viewed from above. Percentages are based on land area.

Plantable Space

Areas like open space where it is biophysically possible to plant trees.

Other:

Any other area that was not included in the canopy study. This includes (but isn't limited to) unsuitable areas like golf courses, bare soil, streets, and structures.

Legend

Aspen City Limits

Tree Canopy (%) by Parcel

- <10%
- 10% - 20%
- 20% - 30%
- >30%

This dataset was created by Plan-It Geo for use by the City of Aspen using 2012 LiDAR data and high-resolution aerial imagery provided by the City.

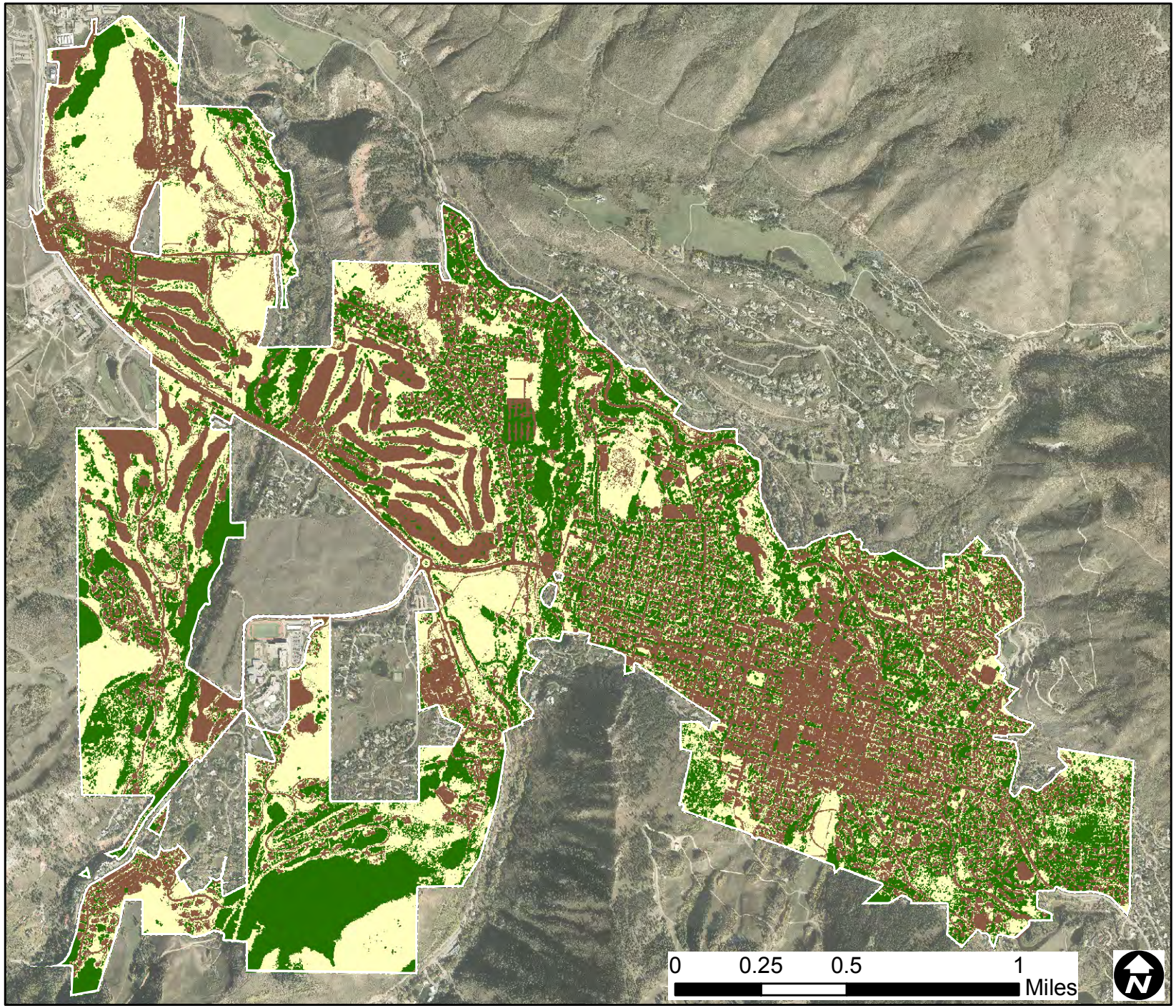
Land Cover

in Aspen, CO

ASPEN PARKS & RECREATION

THE CITY OF ASPEN

Community Forest Assessment (2015)



Key Terms

Tree Canopy:

Tree canopy within the study area when viewed from above. Percentages are based on land area.

Plantable Space:

Areas like open space where it is biophysically possible to plant trees.

Other:

Any other area that was not included in the canopy study. This includes (but isn't limited to) unsuitable areas like golf courses, bare soil, streets, and structures.

Legend

- Aspen City Limits
- Tree Canopy
- Plantable Space
- Other

plan-it GEO

This dataset was created by Plan-It Geo for use by the City of Aspen using 2012 LiDAR data and high-resolution aerial imagery provided by the City.

E - City Contract Bidding Information

INVITATION TO BID

Sealed bids will be received by the City of Aspen, Colorado, Purchasing office, 130 South Galena Street, Aspen, Colorado, until, time & date TBD at which time the bids will be publicly opened and read aloud, for the following City of Aspen project:

Tree Trimming and Removal

Complete Bid Packages are available on or after time and date TBD, from the Purchasing office, 130 South Galena Street, Aspen, Colorado or the Purchasing Department website: http://www.aspenpitkin.com/depts/54/rfp_and_bid.cfm

The City reserves the right to reject any or all Bids or accept what is, in its judgment, the Bid which is in the City's best interest. The City further reserves the right, in the best interests of the City, to waive any technical defects or irregularities in any and all Bids submitted.

The Bid must be placed in one envelope securely sealed therein and labeled: **"Tree Trimming and Removal"**, and addressed to:

City of Aspen
Purchasing Department
130 South Galena Street
Aspen, Colorado 81611

In addition to price, the criteria set forth in the Instruction to Bidders and any specific criteria listed in the bid documents may be considered in judging which Bid is in the best interests of the City. No bid may be withdrawn within a period of sixty (60) calendar days after the date fixed for opening bids. No bids will be considered which are received after the time mentioned, and any bids so received after the scheduled closing time will be returned to the bidder unopened.

By: Rebecca Hodgson

Invitation to Bid
Tree Trimming and Removal

Introduction
The City of Aspen Parks Department has issued an Invitation to Bid for Tree Trimming and Removal. Bids are due by date and time TBD in the Purchasing Office, City of Aspen, 130 South Galena Street, Aspen, Colorado, 81611. No late bids will be accepted.

The City reserves the right to reject any or all bids or accept what is, in its judgment, the bid which is in the City's best interest. The City further reserves the right, in the best interests of the City, to waive any technical defects or irregularities in any and all bids submitted.

Description of Services

Tree Trimming and Removal Services shall be in accordance with the City of Aspen Tree Trimming and Removal Standards.

Complete Prune

Thinning the tree's crown to increase light penetration and air movement, removal of crossing and interfering branches, removal of dead, dying, broken, and diseased branches, removal of branches to obtain appropriate clearance around structures, streets, and sidewalks, and removal of branches to improve or create appropriate structure. This applies to ¼ inch and greater diameter branches and all final cuts shall be made according to the ANSI 300 pruning standards as well as the ANSI Z133 safety requirements.

Crown Clean

The removal of dead, dying, diseased, broken, crossing/interfering, poorly attached, and insect-infested branches with diameters of ½ inch and greater.

Selective Prune

The removal of selected branches, storm-damaged limbs or other specialized pruning for trees and shrubs as determined by the City Forester.

Crown Restoration

The removal of selected branches to improve and/or restore structure in trees significantly damaged by storms, previous pruning, or vandalism.

Crown Raise

The removal of the lower branches from a tree in order to provide clearance for buildings, vehicles, and pedestrians.

Removal

The complete removal of a tree, this includes the removal of all wood unless otherwise specified, as well as removal of the stump to a depth of no shallower than 9 inches.

Special Requirements

The successful recipient of the Tree Trimming and Removal contract must meet the following special requirements designed to provide the highest quality and most efficient services. These requirements are above and beyond the standard City of Aspen requirements:

- The successful Vendor must be an International Society of Arboriculture licensed Arborist.
- Must possess the following equipment:
    1. A 65 foot aerial boom in good operationg condition with a copy of current OSHA safety certification.
    2. High capacity forestry body chip truck designed to contain at least 9 yards of chip waste.

3. High capacity knuckle boom/crane designed to handle and transport large pieces of wood waste quickly and efficiently.
4. Trailer mounted stump grinder with a minimum 12 inch flywheel in good operation condition.
5. Large capacity wood chipper with a minimum 13 inch diameter wood wast capacity in good operating condition.
6. Standardized safety equipment including large traffic control hazard signs, 24 inch traffic control cones, and personal safety equipment adequate for passing the ANSI 300 safety standards.
7. Diverse sizing of chainsaws in excellent operating condition.

- Must be able to prove the ability to:
    1. Conduct diverse and complicated tree trimming and removal services under difficult and stressful site condition.
    2. Conduct high volumes of complicated tree trimming and removal services.
    3. Conduct tree trimming and removal services during hours other than regular workday hours including weekends and evenings.
    4. Provide emergency tree trimming and removal services within 5 hours during summer field season (May-October) and within 12 hours in winter field season (November-April).
    5. Conduct and arrange for appropriate traffic control with City and/or County when necessary for work adjacent to rights of way (ROW).
    6. Provide efficient ground staff to quickly and completely remove all branch material within an hour of its falling to the ground.
    7. Provide efficient ground staff to ensure public safety during tree trimming and removal services INCLUDING a dedicated ground safety person in areas designated by the City Forester.
    8. Proved complete trim services as outlined in standards for trees of up to 90 feet in height. All climbers must be experienced and climb gear must adhere to ANSI 300 safety standards.

<u>Bid and Contract Specifications</u>

The duration of this contract for Tree Trimming and Removal Services shall be for two (2) calendar years. The contract period shall begin in April 1 and expire March 31.
Bids must be specified in one hourly rate that includes all services: complete prune, crown clean, selective prune, crown restoration, crown raise, and removal services.

F - Pruning and Safety Standards

City of Aspen – Pruning Types based on ANSI A300 standard definitions:

Prune Clean – The selective removal of dead, diseased, detached, cracked, and broken branches.

Prune Thin – The selective removal of small live branches to reduce crown density.

Prune Raise – The selective removal of branches to provide vertical clearance.

Prune Reduce – The selective removal of branches and stems to decrease the height and/or spread of a tree or shrub.

Prune Structural – The removal of live branches and stems to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems.

Prune Restore – The selective removal of branches, sprouts and stubs from trees and shrubs that have been topped, severely headed, vandalized, lion tailed, broken in a storm or otherwise damaged.

Prune Routine – This is the general pruning action for trees in Aspen. It consists of raising the canopy for safety pertaining to sidewalk and street clearance, removing dead, dying, broken and damaged branches and creating sound tree structure.

The ANSI A300 pruning standard addresses:

- Pruning objectives
- Pruning systems
- Pruning specifications
- Pruning cuts
- Pruning practices
- Palms and similar plants
- Pruning definitions

A300 Pruning standards recognize, but are not limited to, the following pruning objectives:

- Manage risk
- Manage health

- Develop structure, such as to: Improve branch and trunk architecture Promote or subordinate certain leaders, stems, or branches; Promote desirable branch spacing; Promote or discourage growth in a particular direction (directional pruning); Minimize future interference with traffic, lines of sight, or infrastructure, or other plants; Restore plants following damage; and/or, Rejuvenate shrubs.

- Provide clearance, such as to: Ensure safe and reliable utility services; Minimize current interference with traffic, lines of sight, infrastructure, or other plants; Raise crown(s) for movement of traffic or light penetration; Ensure lines-of-sight or desired views; Provide access to sites, buildings, or other structures; and/or, Comply with regulations.

- Manage size or shape

- Improve aesthetics

- Manage production of fruit, flowers, or other products

- Manage wildlife habitat

Certain pruning practices are not acceptable and can injure trees:

- Topping: The reduction of a tree's size using heading cuts that shorten limbs or branches back to a predetermined crown limit.
- Lion's Tailing: The removal of an excessive number of inner, lateral branches from parent branches.
- Rooster-Tailing: The over-thinning of palms, usually by removing too many lower, live fronds.

Any workers involved in forestry operations are subject to ANSI standards as they pertain to arboricultural operations as defined in Z133.1-2012. The purpose of this standard is:

- The provision of safety criteria for arborists and other workers engaged in arboricultural operations. It is intended as a guide to federal, state and local authorities in drafting their regulations.

American National Standard

ANSI® Z133-2017

for Arboricultural Operations—

Safety Requirements

ISA

Approved American National Standard ANSI

G - TRAQ Risk Tree Assessment Form

Basic Tree Risk Assessment Form

Client _____ Date _____ Time _____

Address/Tree location _____ Tree no. _____ Sheet _____ of _____

Tree species _____ dbh _____ Height _____ Crown spread dia. _____

Assessor(s) _____ Time frame _____ Tools used _____

Target Assessment

Target number	Target description	Target zone: Target within drip line	Target zone: Target within 1 x Ht.	Target zone: Target within 1.5 x Ht.	Occupancy rate (1 – rare, 2 – occasional, 3 – frequent, 4 – constant)	Practical to move target?	Restriction practical?
1							
2							
3							
4							

Site Factors

History of failures ☐ _____ **Topography** ☐ Flat ☐ Slope _____% **Aspect** _____

Site changes ☐ None ☐ Grade change ☐ Site clearing ☐ Changed soil hydrology ☐ Root cuts Describe _____

Soil conditions ☐ Limited volume ☐ Saturated ☐ Shallow ☐ Compacted ☐ Pavement over roots _____% Describe _____

Prevailing wind direction _____ **Common weather** ☐ Strong winds ☐ Ice ☐ Snow ☐ Heavy rain Describe _____

Tree Health and Species Profile

Vigor ☐ Low ☐ Normal ☐ High **Foliage** ☐ None (seasonal) ☐ None (dead) _____% Normal _____% Chlorotic _____% Necrotic

Pests _____ **Abiotic** _____

Species profile failure pattern ☐ Branches ☐ Trunks ☐ Roots Describe _____

Load Factors

Wind exposure ☐ Protected ☐ Partial ☐ Full ☐ Wind funneling _____ **Relative crown size** ☐ Small ☐ Medium ☐ Large

Crown density ☐ Sparse ☐ Normal ☐ Dense **Interior branches** ☐ Few ☐ Normal ☐ Dense **Vines/Mistletoe/Moss** ☐ _____

Recent or planned change in load factors _____

Tree Defects and Conditions Affecting the Likelihood of Failure

— Crown and Branches —

Unbalanced crown ☐ LCR _____%

Dead ☐ ____% overall Max. dia. _____

Broken/Hangers Number _____ Max. dia. _____

Over-extended branches ☐

Pruning history

Crown cleaned ☐ Thinned ☐ Raised ☐

Reduced ☐ Topped ☐ Lion-tailed ☐

Flush cuts ☐ Other _____

Cracks ☐ _____ Lightning damage ☐

Codominant ☐ _____ Included bark ☐

Weak attachments ☐ _____ Cavity/Nest hole ____% circ.

Previous branch failures ☐ _____

Dead/Missing bark ☐ Cankers/Galls/Burls ☐ Sapwood damage/decay ☐

Conks ☐ Heartwood decay ☐ _____

Response growth _____

Main concern(s) _____

Load on defect ☐ N/A ☐ Minor ☐ Moderate ☐ Significant _____

Likelihood of failure ☐ Improbable ☐ Possible ☐ Probable ☐ Imminent _____

— Trunk —

Dead/Missing bark ☐ Abnormal bark texture/color ☐

Codominant stems ☐ Included bark ☐ Cracks ☐

Sapwood damage/decay ☐ Cankers/Galls/Burls ☐ Sap ooze ☐

Lightning damage ☐ Heartwood decay ☐ Conks/Mushrooms ☐

Cavity/Nest hole _____% circ. Depth _____

Lean _____° Corrected? _____

Poor trunk taper ☐

Response growth _____

Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐

Likelihood of failure

Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

— Roots and Root Collar —

Collar buried/Not visible ☐ Depth _____ Stem girdling ☐

Dead ☐ Decay ☐ Conks/Mushrooms ☐

Ooze ☐ Cavity ☐ _____% circ.

Cracks ☐ Cut/Damaged roots ☐ Distance from trunk _____

Root plate lifting ☐ Soil weakness ☐

Response growth _____

Main concern(s) _____

Load on defect N/A ☐ Minor ☐ Moderate ☐ Significant ☐

Likelihood of failure

Improbable ☐ Possible ☐ Probable ☐ Imminent ☐

Risk Categorization

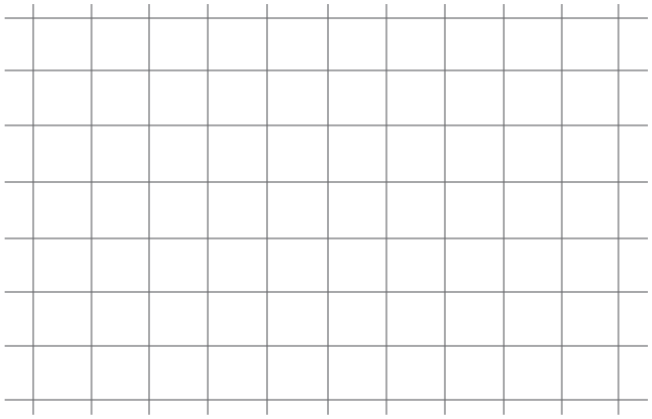
Condition number	Tree part	Conditions of concern	Part size	Fall distance	Target number	Target protection	Likelihood: Failure: Improbable	Likelihood: Failure: Possible	Likelihood: Failure: Probable	Likelihood: Failure: Imminent	Likelihood: Impact: Very low	Likelihood: Impact: Low	Likelihood: Impact: Medium	Likelihood: Impact: High	Likelihood: Failure & Impact (from Matrix 1): Unlikely	Likelihood: Failure & Impact (from Matrix 1): Somewhat	Likelihood: Failure & Impact (from Matrix 1): Likely	Likelihood: Failure & Impact (from Matrix 1): Very likely	Consequences: Negligible	Consequences: Minor	Consequences: Significant	Consequences: Severe	Risk rating of part (from Matrix 2)
1																							
2																							
3																							
4																							

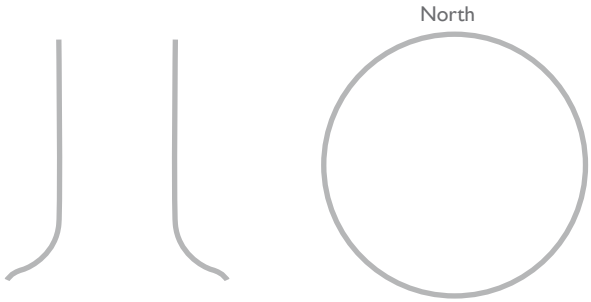
Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low





Notes, explanations, descriptions _____

_____

_____

_____

_____

Mitigation options _____ **Residual risk** _____

_____ **Residual risk** _____

_____ **Residual risk** _____

_____ **Residual risk** _____

Overall tree risk rating Low ☐ Moderate ☐ High ☐ Extreme ☐ **Work priority** 1 ☐ 2 ☐ 3 ☐ 4 ☐

Overall residual risk Low ☐ Moderate ☐ High ☐ Extreme ☐ **Recommended inspection interval** _____

Data ☐ Final ☐ Preliminary **Advanced assessment needed** ☐ No ☐ Yes-Type/Reason _____

Inspection limitations ☐ None ☐ Visibility ☐ Access ☐ Vines ☐ Root collar buried Describe _____

H - Emerald Ash Borer Fact Sheet

QUICK GUIDE SERIES UCF 2016-1

Emerald Ash Borer

Much of the information for this brochure was provided by the USDA Animal and Plant Health Inspection Service, the Colorado Department of Agriculture and Colorado State University Extension.

What is the Emerald Ash Borer?

Figure 1. *Adult emerald ash borers are approximately 1/2-inch long. Photo: Dan West, CSFS*

The emerald ash borer (EAB), *Agrilus planipennis*, is an exotic insect responsible for the death or decline of tens of millions of ash trees throughout the eastern United States and Canada. Native to Asia, the first detection of the beetle in the U.S. occurred in southeastern Michigan in 2002, most likely arriving in the 1990s, hidden in wood-packing materials commonly used for shipping. EAB already has cost impacted communities billions of dollars to treat, remove and replace ash trees. Infestations are difficult to detect, as the larvae reside under the bark, the adults generally are only present from May through September, and ash trees may be infested for up to four years before there are visible signs of decline.

Potential Impacts in Colorado

In Colorado, EAB was detected for the first time in 2013 in the City of Boulder. As a non-native insect, EAB has no native predators to keep populations in check, and threatens all true ash species (*Fraxinus* spp.). As a result, the beetle poses a serious threat to Colorado's urban forests, where ash trees comprise an estimated 15 percent to 20 percent of all trees; the Metro Denver area alone has an estimated 1.45 million ash trees. Green and white ash, including 'Autumn Purple' ash and other varietals, have been widely planted in Colorado due to their fast growth, ability to tolerate urban growing conditions and high aesthetic value. Many of the state's ash trees are located on private property and in parks and other community areas. The future costs of EAB in Colorado, in terms of ash tree treatments, removals and replacements, could exceed 1 billion dollars.

Figure 2. *Ash trees comprise an estimated 15 percent to 20 percent of all trees in Colorado cities, neighborhoods, parks and backyards. Photo: Colorado State University Facilities*

This quick guide was produced by the Colorado State Forest Service to promote knowledge transfer.

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www.csfs.colostate.edu

Commonly mistaken for EAB:

Lilac/ash borer exit holes

Figure 3. *When lilac/ash borers exit an ash tree, they create irregular round holes. Photo: Whitney Cranshaw, Colorado State University*

Other metallic wood borers

Figure 4. *Several metallic green beetles are native to Colorado, including* Phaenops gentilis *(left) and* Buprestis langii *(right), both associated with declining or recently killed conifers. Photo: Whitney Cranshaw, Colorado State University*

Flatheaded appletree borer

Figure 5. *Dead and dying branches on ash trees may be infested with the flatheaded appletree borer. Photo: James Solomon, USDA Forest Service*

Life History

EAB adults are approximately 1/2-inch long, with a metallic, emerald-green head/back and a coppery reddish-purple abdomen. The adult beetles consume ash foliage, but cause little damage to affected trees, which allows them to remain unnoticed by homeowners.

Females lay eggs in bark crevices, where they develop into worm-like larvae in the fall. The larvae are cream colored and consist of bell-shaped segments. The EAB larvae feed on the inner bark of ash trees, girdling the tree and disrupting the transportation of water and nutrients, much like mountain pine beetle larvae affect pines.

The tunneling and feeding under the bark is what eventually kills impacted trees. Once the larvae mature into adults in the spring, they emerge from under the bark, leaving D-shaped exit holes. The adult beetles may fly up to a half-mile to infest new trees; however, under certain conditions, they are capable of flying up to several miles. Adults also may re-infest the same tree from which they emerged.

Insects commonly mistaken for EAB include other metallic wood borers and the flatheaded appletree borer. Also, lilac/ash borer exit holes can be mistaken for those left by EAB.

Figure 6. *S-shaped emerald ash borer galleries under the bark. Photo: David Cappaert, Michigan State University**

Figure 7. *Emerald ash borer larva. Photo: David Cappaert, Michigan State University**

Figure 8. *Adult beetles can fly approximately a half-mile to infest a new tree. Photo: Howard Russell, Michigan State University**

Figure 9. *EAB adults have an emerald-green head/back and a coppery reddish-purple abdomen. Photo: David Cappaert, Michigan State University**

Ash Tree Identification

Only ash trees are at risk from EAB* – but all species of true ash (*Fraxinus* spp.) are at risk. To detect an EAB infestation, it is important to first identify the tree species to ensure that it is an ash tree. In Colorado, ash trees can be found in most communities. Ash trees have the following characteristics:

- Branches and buds grow in pairs, directly opposite from each other, rather than alternating on a stem.
- Leaves are compound, which means multiple leaflets occur on a common stalk, and typically have five to nine leaflets. The exception is single-leaf ash (*Fraxinus anomala*), which may have simple or compound leaves, with up to five leaflets.
- Leaflets are smooth or finely toothed along the edges.
- Seeds on female trees are paddle-shaped.
- Mature bark displays diamond-shaped ridges.

A video on ash tree identification is available at www.csfs.colostate.edu/emerald-ash-borer.

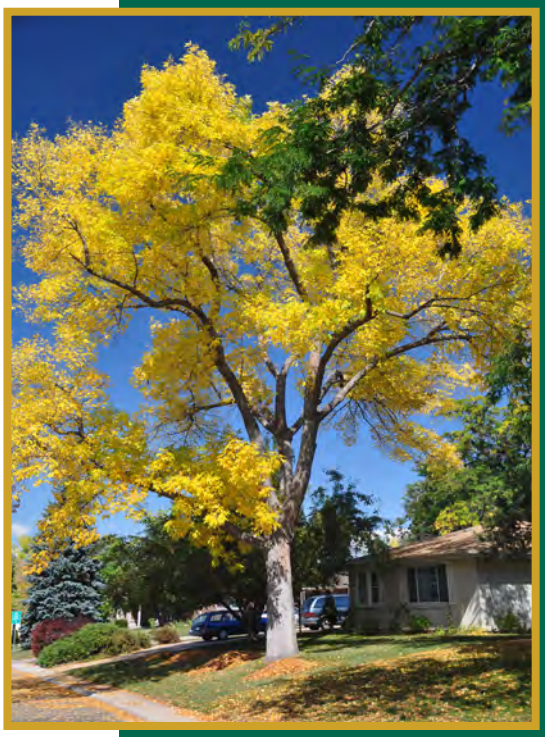

Figure 10. *Ash trees have been planted extensively in Colorado over the last 50 years because they grow quickly and can tolerate the growing conditions in urban areas. Photo: William M. Ciesla*

Figure 11. *Ash trees have five to nine leaflets on each stalk. Photo: Julie Stiewig, CSFS*

Figure 12. *The bark on mature ash trees has diamond-shaped ridges. Photo: Ryan Lockwood, CSFS*

Figure 13. *Seeds on ash trees are paddle-shaped. Photo: Franklin Bonner, USDA Forest Service**

Figure 14. *Ash leaves can either have smooth or finely toothed edges. Photo: Ryan Lockwood, CSFS*

Figure 15. *Branches and buds on ash trees grow in pairs, directly opposite from each other. Photo: Ryan Lockwood, CSFS*

*Although rare in Colorado, white fringetree (*Chionanthus virginicus*) also has been documented as susceptible to EAB.

Figure 16. *EAB is responsible for the death or decline of tens of millions of ash trees in at least 25 states. Photo: Dan West, CSFS*

Figure 17. *New sprouts grow on the lower trunk of an ash tree infested with EAB. Photo: James W. Smith, USDA APHIS PPQ**

Figure 18. *Woodpeckers are an important predator of EAB. Photo: David Cappaert, Michigan State University**

Signs and Symptoms of EAB Infestation

Signs of EAB infestation include:

- Sparse leaves or branches in the upper part of the tree
- D-shaped exit holes approximately 1/8-inch wide
- New sprouts on the lower trunk or lower branches
- Vertical splits in the bark
- Winding, S-shaped tunnels under the bark
- Increased woodpecker activity

Many ash trees in Colorado are in poor health, which can make it even more difficult to determine if they are impacted by EAB. If you're not sure if a tree has EAB or not, the CSFS offers a diagnostics video at www.csfs.colostate.edu/emerald-ash-borer.

If an ash tree is experiencing dieback or appears unhealthy, have it examined by a professional. Landowners that suspect the presence of EAB in their ash trees should contact the Colorado Department of Agriculture (CDA) at (888) 248-5535 or send an email to CAPS.program@state.co.us.

Figure 19. *D-shaped exit holes can indiciate the presence of EAB. Photo: Pennsylvania Department of Conservation and Natural Resources**

Figure 20. *Ash trees may be infested with EAB for up to four years before signs of decline are visible. Photo: David Cappaert, Michigan State University**

Figure 21. *Vertical splits in the bark are another sign that EAB has infested the tree. Photo: Joseph O'Brien, International Society of Arboriculture**

Figure 22. *S-shaped tunnels or galleries can be found under the bark of an infested ash tree. Photo: Ryan Lockwood, CSFS*

Responding to EAB

Quarantines

Like many other states, Colorado has established a quarantine and detection process to prevent the spread of EAB into new areas, and to reduce the impacts of EAB on ash trees in already impacted areas. The EAB quarantine prohibits the movement of all regulated material that has not met treatment requirements – which includes ash nursery stock, green lumber, ash wood products, all hardwood firewood and related products – out of EAB-regulated areas. To legally move regulated material out of a quarantined area, it must meet the treatment options defined by the federal quarantine options. For updated information on the Colorado EAB quarantine and treatment requirements, visit www.eabcolorado.com.

Figure 23. *A CSFS forester and CSU Extension specialist assess the branch of an ash tree to determine the presence of EAB. Photo: Ryan Lockwood, CSFS*

Management & Prevention

The best EAB management option depends on the value of each ash tree to a landowner, and the costs associated with each option. Options for treating at-risk or infested trees include removal, replacement and chemical treatments. For more information about treatment options, visit www.csfs.colostate.edu/emerald-ash-borer.

Tree Removal

Trees killed by EAB will need to be removed at some point, but homeowners who are concerned about future infestation also may elect to remove dying or even healthy trees prior to infestation. Trees may become more expensive to remove as they decline and after they have died. Dead and dying trees also may represent a hazard to surrounding property and infrastructure. When choosing to remove an ash tree, it is best to hire a licensed and insured arborist or tree service company. A list is available at www.isa-arbor.com.

Figure 24. *Planning for tree replacement is an effective management strategy for EAB. Photo: Vince Urbina, CSFS*

Tree Replacement

Planning for tree replacement can begin prior to the removal of an ash tree, as can planting small trees under existing ash to give them a head start. To reduce the impacts of EAB and other insect and disease threats in Colorado's urban and community forests, the Colorado State Forest Service encourages diversity when planting new trees. A single type of tree should comprise no more than 10 percent of all trees in a planted landscape. Ash trees (*Fraxinus* spp.) have been widely planted in Colorado, but due to the risk of EAB, future plantings are not recommended. The Colorado Tree Coalition offers a list of the best replacement trees for ash at www.coloradotrees.org.

Chemical Treatments

The decision to chemically treat individual ash trees is a personal preference, and consumers should educate themselves and use caution when purchasing products that claim to protect trees against the pest. Homeowners may opt to periodically apply insecticide treatments to help protect high-value trees; however, the early presence of EAB in Colorado may not warrant immediate preventive treatments in communities where EAB has not been detected. The closer ash trees are to an area of known infestation, the higher the risk that they will become infested by EAB through natural spread. Also, trees within or near the EAB Quarantine area are at a higher risk of infestation through human-assisted spread of the pest, because infested

Figure 25. *A syringe-like applicator is used to inject imidacloprid to control EAB. Photo: David Cappaert, Michigan State University**

wood can legally be moved throughout the area. Current information on the extent of the EAB infestation within the state is available at www.eabcolorado.com.

Trees not regularly treated with an insecticide will die once infested with EAB. Ash trees can be chemically treated if they are healthy or are showing only early signs of EAB. If a tree appears unhealthy, or is showing many outward signs of EAB, it most likely is too late to save the tree. Talk to a forestry professional first when considering the use of chemical treatments to protect high-value trees, and only hire licensed professionals certified by the Colorado Department of Agriculture to administer treatments.

Don't Move Firewood!

Removed ash trees can be used for firewood or mulch at the removal site. However, this wood should not be transported to other locations due to the high risk of spreading EAB to healthy trees. Remember, moving regulated wood materials outside of a quarantine area is illegal and punishable by significant fines.

Never transport firewood or other untreated products from ash trees, including logs or nursery stock, as this is the most likely method of accidental spread. Transporting firewood is a primary cause of many costly insect introductions, often due to the larvae's ability to survive under the bark. When wood is moved from one place to another, pests can hitchhike to new locations and spread further. More information is available at www.dontmovefirewood.org.

For More Information

- EAB in Colorado (including management, identification, reporting, quarantine boundaries and treatment options): www.csfs.colostate.edu/emerald-ash-borer or www.eabcolorado.com
- General EAB information: www.EmeraldAshBorer.info or http://stopthebeetle.info
- Facts about insects and diseases that threaten Colorado's trees (Colorado State Forest Service): www.csfs.colostate.edu
- Information about the dangers of moving firewood: www.dontmovefirewood.org
- Common problems of ash trees (Iowa State University): www.extension.iastate.edu/Publications/SUL21.pdf
- Treatment options: www.csfs.colostate.edu/emerald-ash-borer
- General tree facts (Colorado Tree Coalition): www.coloradotrees.org/find.php

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*Photos are from www.forestryimages.org

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COLORADO DEPARTMENT OF AGRICULTURE

Colorado State Forest Service

Colorado State University Extension

DONTMOVEFIREWOOD.org

COLORADO TREE COALITION

I - Poplar Bud Gall Mite Fact Sheet

UNIVERSITY OF NEVADA •Reno

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Fact Sheet-04-47

Ornamental Plant Damage By Eriophyid Mites

(and What to Do About It)

Jessica Graham, Undergraduate Research Assistant, University of Nevada, Reno
Wayne S Johnson; Associate Professor, Department of Resource Economics, College of Agriculture Biotechnology and Natural Resources; IPM Specialist, University of Nevada Cooperative Extension

Introduction

There are hundreds of species of eriophyid mites. They are commonly divided into groups of gall, bud, rust, and blister mites, depending on the type of damage they cause. Their microscopic size makes their identification difficult. They are identified by their host plant or by the damage they produce. Most eriophyid mites are not considered to be serious pests because the damage is generally only aesthetic and rarely kills the plant.

Do not equate eriophyid mites with other species of mites that damage plants. Eriophyid mites are much different and smaller, and their infestation is usually less damaging – see Biology on page three.

Damage

Eriophyid mites are considered plant parasites because they seldom kill plants. They are host-specific, with each species usually feeding on a particular plant or plant part. The relationship between the host and the mite reflects a degree of specialization between the two.

Eriophyid mites penetrate plant cells and suck up the cellular contents, causing visible deformation or abnormalities. The response of the plant is specific to the species of mite feeding on it. When present, they may cause some plants to form stem or leaf galls. Other common symptoms are russeting, folding, or blistering of leaves or flower petals.

Gall mites cause abnormal growth of leaf and stem tissues by injecting growth regulators into the tissues. The galls that the plant develops provide a protective pocket in which the mites can feed and reproduce (Fig. 1). There is an exit hole at the bottom of each gall. Galls may develop on the underside of leaves as hairy mats called erinea (Fig. 1). The leaf hairs provide the mites with food and protection. Feeding by the mite may distort the upper leaf surface. Most galls are on the leaves of plants, but they may occur on flowers, petioles, stems, and roots of plants. Galls are generally most abundant early in the year on new growth, foliage, and near the trunk.

Bud mites invade developing buds and fruits of particular plants (Fig. 2). Partial or

Figure 1. Erineum mites cause leaves to develop mats on the undersides leaves (left). Damage by maple bladder gall mite on sugar maple (right).

Figure 2. Blueberry bud mite damage.

total arrest of bud development or swelling of the buds (referred to as “big bud”) may result from an infestation in the bud tissue. The buds die after the mites leave.

Rust mites are generally not as damaging as other eriophyid mites, but do cause a bronzing, browning, or silvering of the leaf surface as a result of their feeding on the leaf’s cellular contents. Rolling and folding of leaf edges may also result (Fig. 3). Rust mites are often on the undersides of leaves, but may feed on both leaf surfaces.

Figure 3. Leaf curling caused by eriophyid mites.

Damage by **blister mites** is similar to the injury caused by gall mites, but the pocket is formed in the internal leaf tissue (mesophyll) rather than on the outer surface. This internal damage causes an external deformity of the leaf and is expressed as a discolored blister (Fig. 4).

Figure 4. Damage caused by walnut blister mite.

The blisters dry out in the summer, leaving dead areas on the leaf blades.

Flower galls dwarf stalks by causing the shortening of stem internodes, or they may stimulate secondary development of leaf hairs.

Eriophyid mites may also cause “witches broom,” which is a cluster of brushlike growth of stunted twigs or branches on trees and shrubs.

Eriophyid Mites in Nevada

Poplar bud gall mite (*Eriophyes parapopuli*) is one species prevalent in Nevada. Various species of poplars, cottonwoods, and aspens are hosts to this mite. It prevents leaf buds from developing into normal leaves and stems and produces galls near the ends of new growth that are wrinkled and less than one inch in diameter. They are irregular, lumpy, solid masses of plant tissue (Fig. 5). The galls develop on one side of the twig, but eventually encircle the base of the bud or shoot. Young galls are greenish, but older galls are red to brown. Galls from

Figure 5. Three-year-old gall (left) and current year’s galls (right) on poplar.

previous years are gray-black. Lower branches are usually more heavily infested and may become crooked or stunted. Infestations may cause stress in the tree and make it more prone to other problems. Another species, *E. populi*, causes

multiple, irregular buds to be produced in poplars and cottonwoods.

The leaf gall caused by *Phyllocoptes didelphis* may also be found in Nevada. This mite infests quaking aspen (*Populus tremuloides*) and produces circular, shallow galls protruding from the upper surface of the leaf blade. The underside of the leaf is open and filled with solid, yellowish, irregular tissue. The mites reside within the nooks of the growth or partially on the surface of the gall. Lower shaded branches of the tree are more likely to be affected than limbs in the upper canopy in full sun.

Ash flower gall mites (*Eriophyes* fraxiniflora) damage male trees by feeding on the blooms and causing galls to form. The galls are large, blackened, irregular masses (Fig. 6). These aesthetically damaging mites are common in southern Nevada.

Figure 6. Ash flower gall mite damage.

Biology

Eriophyid mites are more closely related to spiders and ticks than to insects. They are long, ringed (annulate), and worm-like. Most other mites have four pairs of legs, but eriophyid mites only have two pairs, located near their heads (Fig. 7). At less than 1/100 of an inch long, eriophyid mites are among the smallest of mites and a hand lens or microscope is required for examination. They are poor crawlers, but their small size facilitates

Figure 7. A microscope is needed to see eriophyid mites.

travel between hosts by wind, water, insects, birds, and people.

Eriophyid mites reproduce rapidly. Fertilization occurs when females come in contact with sperm sacs left on the host by males. Females can lay as many as 80 eggs in one month under favorable conditions.

Most eriophyid mites have a simple life cycle in which they develop through three growth stages: egg, first and second nymphs, and adult. Some species have a more complicated life cycle. They alternate between a generation of only overwintering females called deutogynes, and a male-female generation, where the females are called protogynes. Alternating generations is more common in eriophyids that feed on deciduous, woody plants, and appears to be an adaptation based on the seasonal changes of the hosts. Adults live for about one month, and there are as many as six to eight generations per year where seasons are long (southern Nevada).

Management

Detecting eriophyid mites requires a thorough diagnosis of the plant's symptoms. Galls, blisters, or leaf bronzing are common symptoms of their presence, but other pests may cause similar tissue damage. Eriophyid mites usually do not cause serious injury, even large populations can be tolerated by plants, but the damage may be unsightly. Examining

plants early in the season will allow quick detection and removal. Look for any color changes or abnormalities in the leaves or buds. Closely inspect the foliage. To avoid problems with eriophyid mites, plant resistant varieties or keep uninfested plants away from susceptible varieties.

It is fairly easy to control eriophyid mites in ornamental plants. Infected leaves and twigs can be pruned off to eliminate adult mites and remove unattractive tissues. Burn or bag and dispose of infested tissues in the trash. Trees should be pruned in early spring when the tree is dormant and the mites are overwintering. All infected branches should be removed or else there is a great possibility of reinfestation.

Heavy infestations can be controlled with insecticides, but spraying plants will not get rid of the galls or erinea once they have been produced. Apply insecticides just after bud break in early spring. Dormant oil, carbaryl, dicofol, horticultural oils, and insecticidal soaps may be effective. Carbaryl is highly toxic to bees and should not be applied when they are active. Exposed mites are easily controlled, but most pesticides do not kill the mites living within galls. Caution: applying chemicals to control eriophyid mites may also kill beneficial insects.

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Figure 1 (left). Erineum mites. UGA0907041. Figure 1 (right). Maple bladder gall mite. UGA0907042. Ronald S. Kelley, Vermont Department of Forests, Parks and Recreation. <www.ipmimages.org>.

Figure 2. Blueberry bud mite. UGA1227018. Jerry A. Payne, USDA ARS. <www.ipmimages.org>.

Figure 3. Leaf curling. UGA1326054. Figure 6. UGA1325062. Whitney Cranshaw, Colorado State University. <www.ipmimages.org>.

Figure 4. Walnut blister mites. Ken Gray Image Collections. Oregon State University. <www.ent3.orst.edu/kgphoto/index.cfm>.

Figure 5. Wayne S Johnson. University of Nevada, Reno.

Figure 6. Ash flower gall mites. UGA3067030. James Solomon, USDA Forest Service. <www.ipmimages.org>.

Figure 7. Bindweed gall mite. UGA0021003. Neal Spencer, USDA ARS. <www.ipmimages.org>.

J - Mountain Pine Beetle Fact Sheet

TREES & SHRUBS

Mountain Pine Beetle no. 5.528

by D.A. Leatherman, I. Aguayo, and T.M. Mehall[1]

Quick Facts...

Mountain pine beetles (MPB) are the most important insect pest of Colorado's pine forests. MPB often kill large numbers of trees annually during outbreaks.

Trees that are not growing vigorously due to old age, crowding, poor growing conditions, drought, fire or mechanical damage, root disease and other causes are most likely to be attacked.

For a long-term remedy, thin susceptible stands. Leave well-spaced, healthy trees.

For short-term controls, spray, cover, burn or peel attacked trees to kill the beetles. Preventive sprays can protect green, unattacked trees.

Mountain pine beetle (MPB), *Dendroctonus ponderosae*, is native to the forests of western North America. Periodic outbreaks of the insect, previously called the Black Hills beetle or Rocky Mountain pine beetle, can result in losses of millions of trees. Outbreaks develop irrespective of property lines, being equally evident in wilderness areas, mountain subdivisions and back yards. Even windbreak or landscape pines many miles from the mountains can succumb to beetles imported in infested firewood.

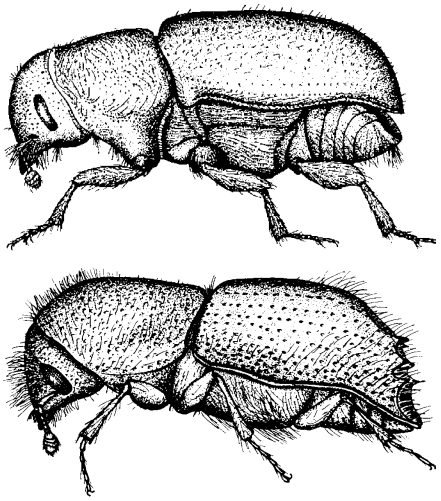

Figure 1: Adult *Dendroctonus* (top) versus *Ips* (bottom). Note gradually curved wing of *Dendroctonus*. Actual size of *Dendroctonus* from 1/8 to 1/3 inch, *Ips* 1/3 to 1/4 inch.

Mountain pine beetles develop in pines, particularly ponderosa, lodgepole, Scotch and limber pine. Bristlecone and pinyon pine are less commonly attacked. During early stages of an outbreak, attacks are limited largely to trees under stress from injury, poor site conditions, fire damage, overcrowding, root disease or old age. However, as beetle populations increase, MPB attacks may involve most large trees in the outbreak area.

A related insect, the Douglas-fir beetle (*D. pseudotsugae*), occasionally damages Douglas-fir. Most often, outbreaks are associated with previous injury by fire or western spruce budworm. (See fact sheet 5.543, *Western Spruce Budworms*). Spruce beetle (*D. rufipennis*) is a pest of Engelmann and Colorado blue spruce in Colorado. Injured pines also can be attacked by the red turpentine beetle (*D. valens*).

Mountain pine beetles and related bark beetles in the genus *Dendroctonus* can be distinguished from other large bark beetles in pines by the shape of the hind wing cover (Figure 1, top). In side view, it is gradually curved. The wing cover of *Ips* or engraver beetles, another common group of bark beetles attacking conifers, is sharply spined (Figure 1, bottom).

Signs and Symptoms of MPB Attack

- Popcorn-shaped masses of resin, called "pitch tubes," on the trunk where beetle tunneling begins. Pitch tubes may be brown, pink or white (Figures 2 and 6).
- Boring dust in bark crevices and on the ground immediately adjacent to the tree base.

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Figure 2: "Pitch tubes" indicating trunk attacks by MPB. Success of the attacks is confirmed by looking under the bark with a hatchet for beetles, their tunnels and/or bluestaining.

- Evidence of woodpecker feeding on trunk. Patches of bark are removed and bark flakes lie on the ground or snow below tree.
- Foliage turning yellowish to reddish throughout the entire tree crown. This usually occurs eight to 10 months after a successful MPB attack.
- Presence of live MPB (eggs, larvae, pupae and/or adults) as well as galleries under bark. This is the most certain indicator of infestation. A hatchet for removal of bark is needed to check trees correctly (Figures 3, 5 and 8).
- Bluestained sapwood (Figure 9). Check at more than one point around the tree's circumference.

Life History and Habits

Figure 3: Top view of adult MPB (actual size, 1/8 to 1/3 inch).

Mountain pine beetle has a one-year life cycle in Colorado. In late summer, adults leave the dead, yellow- to red-needled trees in which they developed. In general, females seek out large diameter, living, green trees that they attack by tunneling under the bark. However, under epidemic or outbreak conditions, small diameter trees may also be infested. Coordinated mass attacks by many beetles are common. If successful, each beetle pair mates, forms a vertical tunnel (egg gallery) under the bark and produces about 75 eggs. Following egg hatch, larvae (grubs) tunnel away from the egg gallery, producing a characteristic feeding pattern.

Figure 4: Mountain area infested by MPB, showing three years of mortality. Old, dead trees are gray; newly killed trees are straw yellow or orange. Some trees may also be infested but do not turn color until nine months or so under attack.

MPB larvae spend the winter under the bark. Larvae are able to survive the winter by metabolizing an alcohol called glycerol that acts as an antifreeze. They continue to feed in the spring and transform into pupae in June and July. Emergence of new adults can begin in mid-June and continue through September. However, the great majority of beetles exit trees during late July (lodgepole pine) and mid-August (ponderosa pine).

A key part of this cycle is the ability of MPB (and other bark beetles) to transmit bluestain fungi. Spores of these fungi contaminate the bodies of adult beetles and are introduced into the tree during attack. Fungi grow within the tree and assist the beetle in killing the tree. The fungi give a blue-gray appearance to the sapwood.

Figure 6: Not all pitch tubes indicate successful attacks. Note the beetle trapped in this large pitch tube. If the majority of tubes look like this, the tree may have survived the current year's attack.

Figure 5: Larva of MPB (actual size, 1/8 to 1/4 inch). They are found under the bark in tunnels.

Infested Trees

- Once MPB infests a tree, nothing practical can be done to save that tree.
- Under epidemic or outbreak conditions, enough beetles can emerge from an infested tree to kill at least two, and possibly more, trees the following year.
- *Ips* and related beetles that emerge early in summer often are mistaken for mountain

Figure 7: Checking beneath the bark for MPB. This attack was successful (note tunnels and stain).

Figure 9: Cut tree killed by MPB, showing the characteristic blue-staining pattern.

Figure 11: The appearance of a forest thinned to help prevent MPB. This can also improve mountain views and reduce fire hazard.

pine beetle, leading to early reports that "MPB is flying." Be sure to properly identify the beetles you find associated with your trees.

- Trees from which MPB have already emerged (look for numerous round, pitch-free exit holes in bark) do not need to be treated.
- The direction and spread rate of a beetle infestation is impossible to predict. However, attacked trees usually are adjacent to or near previously killed trees.

Figure 8: Characteristic tunnels (galleries) of mountain pine beetle made by the adults and larvae. The underbark area looks like this in late spring. Bluestained wood is caused by fungi the beetles introduce.

Control

Natural controls of mountain pine beetle include woodpeckers and insects such as clerid beetles that feed on adults and larvae under the bark. However, during outbreaks these natural controls often fail to prevent additional attacks.

Extreme cold temperatures also can reduce MPB populations. For winter mortality to be a significant factor, a severe freeze is necessary while the insect is in its most vulnerable stage; i.e., in the fall before the larvae have metabolized glycerols, or in late spring when the insect is molting into the pupal stage. For freezing temperatures to affect a large number of larvae during the middle of winter, temperatures of at least 30 degrees below zero (Fahrenheit) must be sustained for at least five days.

Logs infested with MPB can be treated in various ways to kill developing beetles before they emerge as adults in summer.

One very effective way to kill larvae developing under the bark (though very labor intensive) is by peeling away the bark, either by hand or mechanically; this exposes the larvae to unfavorable conditions—the larvae will dehydrate, starve and eventually die. Logs my also be burned or scorched in a pile—preferably when there is snow on the ground (contact your local forester for assistance). They can also be buried under at least eight inches of soil, or chipped. Following beetle emergence, wood can be used without threat to other trees.

Figure 10: Large, uninfested pine being preventively sprayed. This protects high-value trees and should be done annually between April 1 and July 1.

Chemical control options for MPB larvae have been greatly limited in recent years. At present, there are no labeled pesticides for use on MPB.

Solar treatments may be appropriate in some areas of Colorado to reduce beetle populations in infested trees. For the treatment to be effective, the temperature under the bark much reach 110 degrees Fahrenheit or more. Such treatments can be performed with or without plastic. This method is also labor intensive; contact your local forester for more details on solar treatments.

Prevention

An important method of prevention involves forest management. In general, MPB prefers forests that are old and dense. Managing the forest by

creating diversity in age and structure with result in a healthy forest that will be more resilient and, thus, less vulnerable to MPB. Most mature Colorado forests have about twice as many trees per acre as those forests which are more resistent to MPB. Contact your local forester for more information on forest management practices.

Certain formulations of carbaryl (Sevin and others) permethrin (Astro, Dragnet and others), and bifenthrin (Onyx) are registered for use to prevent attacks on individual trees. These sprays are applied to living green trees in early summer to kill or deter attacking beetles. This preventive spray is generally quite effective through one MPB flight (one year). During epidemic conditions, the pressure from beetle populations may result in less satisfactory results due to several factors:

Always carefully read and follow all label precautions before applying insecticides for MPB prevention.

- Misidentification of healthy trees: Under dry conditions, trees may not produce pitch tubes when infested, therefore healthy trees are not as obvious. Time may need to be spent looking for sawdust around a tree's circumference and at the base of the tree.
- Timing of application: Trees sprayed after June may already have been attacked.
- Improper coverage: Spray may not have been applied high enough (up to where the trunk tapers to less that six inches), or spray coverage of the tree did not begin at ground level, or was not applied to the entire circumference of the tree (thus creating "windows" for beetle attack).
- Improper dosage/mixing of chemical: Low dosage—effective dosages for bark beetles are higher than the percent used for other insects. Mixture—the carbaryl and water were not fully mixed.
- Environmental conditions: Significant rain or moisture within two hours of application may wash off the insecticide. Very high temperatures may break down the chemical (this can occur when treated trees are near forest fires).
- Chemical shelf life/storage: Manufacturers guarantee stable chemical properties for at least two years after manufacturing date, if stored properly. Chemical properties of carbaryl may be altered if stored at very high or very low temperatures.
- Improper volume/formulation: Not enough spray is used to cover the bark area susceptible to beetle attack; lodgepole pine has "flaky" bark which may require more spray. The label on the chemical does not indicate bark beetle prevention (if using Sevin, SL or XLR is recommended).

Always carefully read and follow all label precautions before applying insecticides for MPB prevention.

Related Fact Sheets

5.543, *Western Spruce Budworms*

5.558, *Ips Beetles*

Contact the Colorado State Forest Service for additional information related to mountain pine beetles.

Colorado State Forest Service

This fact sheet was produced in cooperation with the Colorado State Forest Service.

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K - Spruce Beetle Fact Sheet

QUICK GUIDE SERIES FM 2014-1

Spruce Beetle

An Agent of Subalpine Change

The spruce beetle is a native species in Colorado's spruce forest ecosystem. Endemic populations are always present, and epidemics are a natural part of the changing forest. There usually are long intervals between such events as insect and disease epidemics and wildfires, giving spruce forests time to regenerate. Prior to their occurrence, the potential impacts of these natural disturbances can be reduced through proactive forest management.

Figure 1. *Engelmann spruce trees infested with spruce beetles on Spring Creek Pass. Photo: William M. Ciesla*

The spruce beetle (*Dendroctonus rufipennis*) is responsible for the death of more spruce trees in North America than any other natural agent. Spruce beetle populations range from Alaska and Newfoundland to as far south as Arizona and New Mexico. The subalpine Engelmann spruce is the primary host tree, but the beetles will infest any spruce tree species within their geographical range, including blue spruce. In Colorado, the beetles are most commonly observed in high-elevation spruce forests above 9,000 feet.

At endemic or low population levels, spruce beetles generally infest only downed trees. However, as spruce beetle population levels in downed trees increase, usually following an avalanche or windthrow event – a high-wind event that topples trees over a large area – the beetles also will infest live standing trees. Spruce beetles prefer large (16 inches in diameter or greater), mature and over-mature spruce trees in slow-growing, spruce-dominated stands. However, at epidemic levels, or when large-scale, rapid population increases occur, spruce beetles may attack trees as small as 3 inches in diameter. Attacks also have been observed in krummholz – trees near timberline that exhibit stunted growth due to harsh conditions.

Figure 2. *Spruce beetles are no larger than a grain of rice. Photo: William M. Ciesla*

Life History

Spruce beetles have a life cycle of one to three years, and a two-year life cycle is the most common. Adult spruce beetles usually are dark brown to black with reddish-brown or black wing covers. They are cylindrical in shape and

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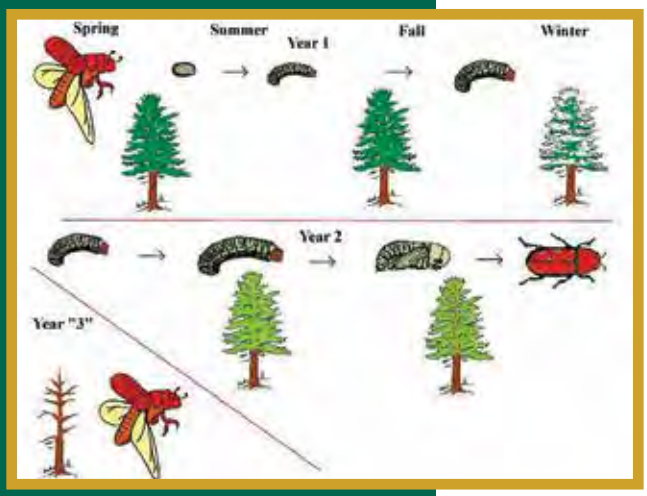

Figure 3. *The spruce beetle life cycle. Graphic: U.S. Forest Service*

Figure 5. *Light reddish-brown boring dust at the base of a tree or in bark crevices can be a sign of spruce beetle infestation. Photo: William M. Ciesla*

approximately ¼-inch (6 millimeters) long and ⅛-inch (3 millimeters) wide, or about the size of a grain of rice.

Each year, adult spruce beetles emerge from dead or dying trees between late May and July. Emerging beetles search for sufficient host material, such as a windthrow; freshly cut logs or stumps; or mature, standing trees. The females bore through the outer bark of the host tree to create galleries in the sapwood, or phloem, where they will lay their eggs. Spruce beetle eggs are minute, oblong in shape and pearly white in color.

After the eggs hatch, the spruce beetle larvae spend the winter developing under the bark of their host trees. The larvae are creamy white and about ¼-inch (6 millimeters) long. They tunnel outward, away from the egg gallery, creating individual feeding galleries, or tunnels, in the phloem of the tree. The phloem layer, which transports nutrients created from photosynthesis throughout the tree, also provides food for the larvae. However, the feeding galleries created by the larvae prevent the flow of nutrients, ultimately killing the tree.

Figure 4. *Spruce beetles in the pupal stage reside under the bark. Photo: William M. Ciesla*

The larvae turn into pupae approximately 18 months after the host tree is attacked. Spruce beetle pupae, like mature adults, have wings, legs and antennae, and turn a pale tan color as they mature.

During the second year of the spruce beetle life cycle, some beetles spend the winter in pupal chambers at the end of larval galleries, while others emerge from their host tree and bore back into the same tree near the base to hibernate for the winter. Overwintering at the litter line, or base of the host tree, decreases the risk of predation by woodpeckers and the risk of beetle mortality due to cold winter temperatures, as accumulating snowpack adds an insulating layer around the lower trunk of the host tree. After the beetles have developed for 2 years, they will exit the host tree and look for a new host.

Signs and Symptoms of Spruce Beetle Infestation

Unlike some other dying and dead conifers infested by bark beetles, needles of infested spruce trees do not turn bright red or orange. Instead, after being attacked by spruce beetles, spruce needles slowly fade to a pale yellowish-green color before turning gray. Spruce trees often retain their needles for several years after being attacked by spruce beetle. Thus, loss of foliage is not readily apparent until a year or more after a tree has been attacked.

After a tree has been infested by spruce beetles, early signs of attack may include:

- Light reddish-brown boring dust accumulates in bark crevices and around the base of the tree, which is produced when beetles bore new entry holes.

- Pitch streamers – strings of resin that look similar to candle wax – generally visible 8 feet or higher on the tree trunk.
- Small pitch tubes, or masses of resin, although these may not be present on an infested tree.

These signs of infestation are most visible during the summer of initial attack and become less visible in the following seasons. Other signs of attack that may be observed later include:

- Small, round holes in the bark of an infested tree. These holes usually are a result of mature beetles exiting the tree after they have completed their development under the bark, but they also may indicate spruce beetle entrance and/or ventilation holes.
- Evidence of increased woodpecker activity. Woodpeckers will attempt to remove tree bark to prey on the underlying bark beetles, usually in the winter and spring, which often results in the accumulation of bark flakes on the snow or ground below the infested tree.
- Pale green needles. As they begin to drop, these needles also will accumulate under the canopies of infested trees.

Spruce beetle attacks also can be detected on the bottom surfaces of downed, windthrown trees or shady surfaces on trees, usually on the north side. For further assistance in identifying spruce trees attacked by spruce beetle, contact your local forester.

Natural Controls

Multiple natural controls keep spruce beetle populations in check when they are not at epidemic levels. Woodpeckers and other insects that feed on spruce beetles account for several of these controls. During epidemics, however, natural control agents, while abundant, do not have a significant impact on the beetle population. Extreme cold temperatures also can increase spruce beetle mortality. However, adult beetles will colonize around the base of a tree, or under the snow line, because the snow will insulate them from extreme cold.

Management/Prevention

One of the best ways to mitigate the effects of spruce beetle outbreaks is to manage for overall forest health and resiliency. Improving tree stand condition, by creating tree age and species diversity, will maintain and support forest health and reduce the potential impact of future spruce beetle attacks. Removing downed spruce also may prevent the build-up of large local spruce beetle populations.

When considering any treatment for spruce beetles, choose an option that best meets individual management objectives. Treatments can be effective if directions are carefully followed, but can be time-consuming and costly, and may not be practical or effective for all situations. Also, it is important to note that spruce forests usually are present only at higher elevations, where access to sites is limited and may be restricted by snow. It is essential to research the best possible treatments for a specific area before taking action.

Figure 7. *Pitch streamers look like candle wax and usually are found above 8 feet on a tree. Photo: Lisa Mason, CSFS*

Figure 8. *Small masses of resin called pitch tubes sometimes can be seen after spruce beetles have infested a tree. Photo: CSFS*

Figure 9. *The accumulation of bark flakes on the ground indicates that woodpeckers have fed on spruce beetles living in this tree. Photo: CSFS*

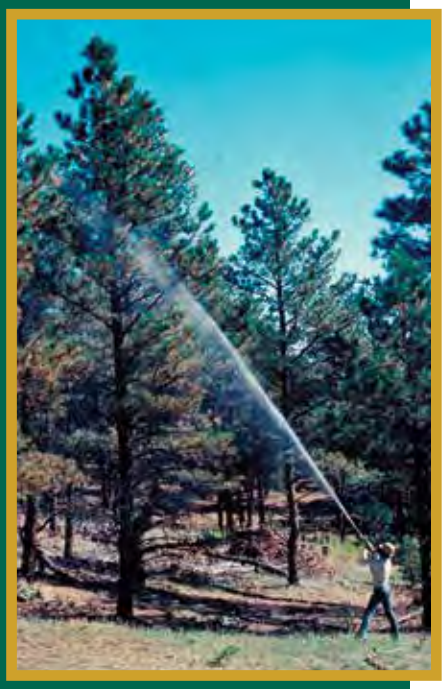

Figure 10. *Spraying insecticides is an effective management technique to prevent bark beetle attacks. Photo: CSFS*

Preventive Sprays

Use of insecticides is a management technique that has proven effective in preventing spruce beetle infestation of individual trees. Certain formulations of carbaryl and pyrethroids that are registered and have been tested for effectiveness are the primary insecticide sprays used to help reduce the likelihood of attacks on individual, high-value trees. The Colorado State Forest Service (CSFS) recommends spraying only high-value trees, such as those near homes, businesses or recreation sites. Overuse of insecticide sprays may have negative environmental impacts on water supplies and wildlife. Also, these sprays are not cost-effective on a landscape scale.

Before using preventive chemical sprays, consider the following guidelines:

Insecticide sprays may be effective if applied to live, green trees:

- in the late spring or early summer, before the next year's flight
- in the fall, before the next year's flight, if access to the site is difficult in the early spring
- in the proper dosage and mixture
- annually
- consistently, to cover the entire tree

Insecticide sprays will NOT be effective if:

- applied to trees already infested with spruce beetles
- applied in improper dosages or mixtures
- significant rainfall or very high air temperatures occur immediately after application
- chemicals were not properly stored before use

If planning to use preventive sprays, carefully read all label precautions before application. The CSFS recommends that preventive sprays be applied only by a certified applicator.

Solar Treatments

Solar treatments also can be used to reduce spruce beetle populations in infested stands. These treatments involve felling infested trees and stacking logs in an area with full sun before covering them with clear plastic. Solar treatment of infested trees creates conditions unsuitable for survival of spruce beetles, forcing them to either relocate or die. The temperature under the bark must reach a minimum of 110 degrees F for this treatment to effectively reduce beetle populations. Remember that spruce beetles tend to reside on the bottom side of horizontal trees or logs, where the environment is cooler and moister. Turning the logs periodically is essential for all of the bark to reach 110 degrees F. Solar treatments in spruce forests can be challenging, because spruce forests tend to be cool, moist and shady, without ample sunlight. Talk to your local CSFS forester to determine if this is an appropriate treatment for your area.

Trap Trees

Trap trees are another management option that can prevent the spread of spruce beetle populations. These trees serve as traps for emerging, adult spruce beetles. Trap trees are intentionally baited with a spruce beetle attractant chemical that ideally will be selected as suitable hosts for emerging spruce beetles. After the

trap trees become infested with beetles, they are removed and destroyed by forest managers while all of the spruce beetles are still inside, thereby reducing the population level of the next generation. This method is effective, but requires a significant amount of time and effort to plan, monitor and safely remove trees in a timely manner. Many variables must be considered, including the number of trap trees per acre, tree diameter and timing for tree cutting and removal. It is highly recommended that a local CSFS forester be contacted before using this treatment option.

Figure 11. *Solar treatments can be effective, but also challenging because spruce forests often are cool, moist and shady in the summer. Photo: CSFS*

Pheromones

Studies currently are being conducted on pheromones, including MCH (a successful anti-aggregate pheromone for Douglas-fir beetle), to determine whether they will serve as effective anti-aggregate treatments for spruce beetle. Anti-aggregate pheromones essentially are "No Vacancy" signs that communicate to beetles that specific trees are unavailable to more beetles. The CSFS will make information available on pheromone effectiveness as soon as sufficient research on its use has been conducted.

Mechanical Treatments

Mechanical treatments, such as felling trees and subsequently chipping the wood and/or burning the resulting slash piles, is another management option, but it often is difficult to get the proper equipment on steep, remote terrain where spruce forests exist. Debarking is another mechanical means to kill developing larvae under the tree bark. This is a labor-intensive method that involves peeling away the bark by hand or using machinery. Logs also can be buried under at least 8 inches of soil. However, debarking and burying logs often are not feasible options in native spruce forests because of the terrain.

Contact a local CSFS forester for more information on best forest management practices to improve forest health and mitigate spruce beetle outbreaks.

Figure 12. *The San Juan Mountains in southwestern Colorado have been heavily infested with spruce beetle. In the photo above, 70-90 percent of the mature Engelmann spruce trees have been killed by spruce beetle and have turned gray. Photo: Ron Klatt, USDA Forest Service (retired)*

It is important to remember that transporting infested wood can spread spruce beetles to other areas. Trees and logs are only safe to transport when a tree has lost all of its needles or has been dead for some time and the spruce beetles have long-since emerged.

Figure 13. *The Clark's nutcracker is an important species in spruce-fir forests because it helps disperse tree seeds in the forest. Photo: Dave Leatherman*

Potential Implications of Spruce Beetle in Colorado

Colorado's high-elevation forests provide clean air and water, wildlife habitat, world-class recreational opportunities, wood products and unparalleled scenery. These benefits contribute to quality of life and are vital to state and local economies. However, without careful management of forest resources, these assets and community safety are at risk.

Figure 14. *Spruce-fir forests provide habitat for many wildlife species. Photo: Dave Leatherman*

It is important to remember that the spruce beetle is a native insect in Colorado's spruce forest ecosystem and a natural part of the changing forest. However, the potential impacts of these natural disturbances can be reduced through proactive forest management.

Forests typically attacked and killed by spruce beetles are located at the headwaters of Colorado's rivers, which provide water to 18 states. Water yields may be influenced by the death of so many trees, and the impacts to water quality and quantity may be significant when large wildfires occur in these forests.

Spruce-fir forests provide important habitat to a number of wildlife species, including the red squirrel, snowshoe hare, pine marten, boreal owl, Clark's nutcracker and three-toed woodpecker. Spruce-fir forests also are essential to the habitat matrix required by the reintroduced Canada lynx and one of Colorado's most at-risk amphibians, the boreal toad, which inhabits open, high-moisture areas within spruce-fir forests. Seventeen of Colorado's "Species of Greatest Conservation Need," as identified by Colorado Parks and Wildlife, rely on spruce-fir forests for their primary habitat. Change in forest cover of spruce-fir forests could negatively impact the habitat of these species.

Figure 15. *Spruce beetle mortality in the upper Rio Grande Basin. Photo: Joe Duda, CSFS*

Recreational opportunities, such as downhill and cross-country skiing, camping, hunting and fishing, also are predominant in areas of the state that could be impacted by the spruce beetle.

It is critical to proactively manage spruce forests and for individuals and communities to remain informed about threats to forest health to ensure survival of vast, healthy forests for present and future generations.

Wildfire Safety in Spruce-fir Forests

When addressing spruce beetle concerns in high-elevation forests, it is important to understand historical wildfire occurrence in spruce forests. Unlike many other Colorado forest types, spruce-fir forests are not adapted to frequent fires. The interval between naturally occurring wildfires in Colorado spruce-fir forests may be 300 years or longer. If a wildfire does occur in a spruce forest, the trees' thin bark and the persistence of many dead lower limbs increases their susceptibility to fire, as well as the likelihood of intense crown fires and widespread tree mortality. If a stand-replacing fire occurs in a spruce-fir forest where most or all of the trees in the stand are killed, it may take as long as 400 years for the forest to mature.

Figure 16. *Spruce beetle mortality can contribute to high wildfire risk. Photo: Kent Grant, CSFS*

When treating spruce-fir forests to mitigate wildfire risk, concentrate on reducing fuel loads. Heavier fuels, such as brush and trees, are more hazardous and produce more intense fires than light fuels, such as grasses. Fuels mitigation focuses on breaking up the continuity of fuels, with greater distance between trees and other vegetation.

When managing spruce-fir forests for wildfire hazard reduction around homes or other structures, consider the following:

- Remove dead and downed debris on the ground to break up the continuity of flammable material. This can help slow the spread of a wildfire. Leave rotting wood on the ground.
- Prune off the dead lower branches of any spruce tree within 100 feet of the home or structure. This will reduce the likelihood of a wildfire traveling up the tree.
- Remove all dead trees within one-and-a-half times the tree height around homes, structures or roads. Not only are they a wildfire hazard, they also are more apt to fall.
- Spruce forests are susceptible to windthrow and thinning them can increase this risk. Before thinning spruce forests or designing a defensible space around a home or structure, it is advisable to talk with a forester.
- For more information on reducing wildfire risk on your property, refer to the CSFS website at http://csfs.colostate.edu.

Figure 17. *Blowdown areas in spruce forests can increase the continuity of flammable material during a wildfire. Photo: Rio Grande National Forest*

Figure 18. *Pruning the lower branches of a spruce tree can reduce the chances of a wildfire traveling up a tree. Photo: CSFS*

Figure 19. *Colorado's spruce-fir forests provide clean air and water, wildlife habitat, world-class recreational opportunities, wood products and unparalleled scenery. Photo: William M. Ciesla*

For More Information

For more information on spruce beetles or forest management, contact a local Colorado State Forest Service district office or visit the CSFS website at www.csfs.colostate.edu.

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Note: The "Species of Greatest Conservation Need" referred to in this Quick Guide were identified by Colorado Parks and Wildlife as part of Colorado's State Wildlife Action Plan, available online at: http://wildlife.state.co.us/WildlifeSpecies/ColoradoWildlifeActionPlan/Pages/ColoradoWildlifeActionPlan.aspx.

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L - Douglas Fir Beetle Fact Sheet

QUICK GUIDE SERIES FM 2016-1

Douglas-fir Beetle

About Douglas-fir Beetle

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is the most destructive bark beetle of mature Douglas-fir forests in western North America. It is a native insect found throughout the range of its only host tree, Douglas-fir, from southern Canada to northern Mexico. Douglas-fir beetle usually kills only small groups of trees, but during major outbreaks groups of 100 or more infested trees are not unusual. Infested trees may occur on a landscape-scale across multiple drainages during outbreaks.

Outbreaks tend to be associated with mature Douglas-fir forests, especially following extended periods of below-normal precipitation. Wind-thrown and downed trees often create suitable habitat for Douglas-fir beetle infestations, and subsequent generations later attack standing trees, in a pattern similar to that of its close relative, the spruce beetle (*Dendroctonus rufipennis*). Several factors can weaken and predispose trees to attacks by Douglas-fir beetle. These include: prior outbreaks of defoliating insects, such as western spruce budworm (*Choristoneura freemani*) and Douglas-fir tussock moth (*Orgyia pseudotsugata*); low-intensity wildfires; the presence of root disease, caused by several species of fungi; and heavy infestations of Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*).

In Colorado, outbreaks typically occur in the southern part of the state, especially in portions of the Rampart Range, Wet Mountains, Sangre de Cristo/Culebra ranges, La Garita Range, West Elk and Elk mountains, and the southern slopes of the San Juan Mountains.

Figure 1. A tree killed by Douglas-fir beetle. *Photo: Dan West, CSFS*

Figure 2. Douglas-fir tree cones are characterized by three-pronged "tails" jutting from between the scales. *Photo: William M. Ciesla*

This Quick Guide was produced by the Colorado State Forest Service to promote knowledge transfer.

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Figure 3. Douglas-fir beetle larvae underneath the bark. *Photo: Malcom Furniss, www.bugwood.org*

Figure 4. An adult Douglas-fir beetle. *Photo: William M. Ciesla*

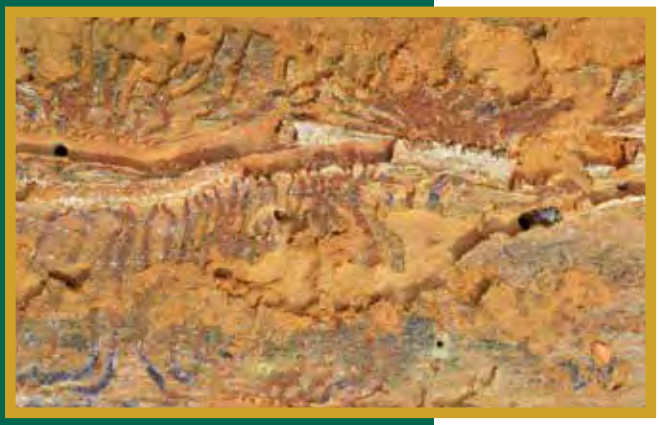

Figure 5. Galleries created by Douglas-fir beetle. *Photo: William M. Ciesla*

Life History

Douglas-fir beetles typically produce one new generation per year. Adults and some larvae survive the winter months under the bark of infested trees. The overwintering adults begin to emerge in April and May, when temperatures consistently exceed 60 degrees F, and continue to fly and attack new trees until early June, depending on local conditions. Adults that emerge early may make a second attack later in the summer, typically from late June through August. Individuals that spent the winter as larvae typically emerge as adults in July or August.

Adults are stout, cylindrical beetles less than ¼-inch (4-6 mm) long, or smaller than a grain of rice. The head and midsection are black and the elytra (wing covers) are typically reddish-brown. Adult females typically initiate an attack on new host trees, and mating then occurs near the entrance hole bored through the bark, by pairs that are monogamous. Males subsequently guard the hole after mating, while under the bark the female constructs a single egg gallery parallel to the grain of the wood, ranging in length from 8 to 10 inches and tightly packed with frass (boring dust). Females deposit eggs singly in small niches along one side of the gallery, then alternate sides and continue to deposit eggs, repeating the alternating pattern along the gallery. Eggs hatch within one to three weeks.

Larvae are white, C-shaped, legless grubs with an amber-colored head capsule. After hatching, they mine side galleries perpendicular to the egg gallery and parallel to one another. The larvae pass through three growth stages, also called "instars," and when they finish feeding, they construct pupal cells at the end of their respective galleries. They then pupate, assuming a white to tan color and may have some adult features, like wings folded beneath the abdomen. By late summer, most have transformed into adults to overwinter.

Signs and Symptoms of Infestation

The most apparent indicators of Douglas-fir beetle infestation are small groups of dead and dying Douglas-fir trees. When a tree is dying from Douglas-fir beetle, its needles fade from green to red-brown before starting to drop off. Fading foliage occurs about one year after trees have been attacked, typically after adult beetles have emerged.

Other symptoms of Douglas-fir beetle infestation may include:

- The presence of reddish-brown boring dust around the base of trees and within the cracks and crevices of the bark.
- Streaming resin along the main trunk (not always present), usually white and/or clear in appearance.
- Vertically oriented galleries under the bark, with alternating larval side galleries.

Figure 6. Boring dust from beetles entering a tree. *Photo: Dan West, CSFS*

Figure 7. Resin streaming from a Douglas-fir tree. *Photo: Sam Pankratz, CSFS*

- Woodpecker damage, where the birds have stripped portions of the bark from infested trees in search of larvae, leaving accumulations of bark at the base of trees.
- Exit holes on the bark surface, after the adult beetles emerge from infested trees.

Douglas-fir beetle also may be associated with attacks by Douglas-fir pole beetle (*Psuedohylesinus nebulosus*). However, the Douglas-fir pole beetle often attacks smaller-diameter (less than 6 inches) Douglas-fir trees or the tops of trees.

Natural Controls

The natural resistance of healthy, vigorous Douglas-fir trees is the primary factor preventing the development of major Douglas-fir beetle outbreaks. As trees become stressed by drought, insects defoliating the tops of the trees, wildfire and/or the weakened resistance of advanced age, they become more susceptible to attack.

Natural enemies of Douglas-fir beetle include a variety of parasitic wasps, flies and predatory beetles. Some mites and nematodes also parasitize various life stages of the beetle, and woodpeckers will strip bark from infested trees in search of developing insects. However, natural enemies tend to have little or no real effect on beetle populations during major outbreaks.

Figure 8. *Douglas-fir trees often grow on steep terrain, creating management challenges. Photo: CSFS*

Figure 9. Sam Pankratz, forester at the CSFS Gunnison Field Office, uses a hatchet to look for beetles underneath the bark. *Photo: Ryan Lockwood, CSFS*

Management/ Prevention

Ongoing management of Douglas-fir forests is the most effective long-term strategy for reducing tree losses from Douglas-fir beetle. Thinning overly dense stands of trees, to reduce the competition between trees, is the most successful forest management strategy to promote tree vigor. Other harvesting strategies may include the removal of:

- infested trees and slash, by no later than May the year following an attack by Douglas-fir beetle
- wind-thrown trees susceptible to Douglas-fir beetle infestation
- trees already infested by other insects and diseases
- excess numbers of older trees, as the beetles most frequently attack the largest trees first

When possible, trees infested by Douglas-fir beetle should be considered for harvest and processing into wood products as soon as they are detected. This can help reduce management costs.

Figure 10. An MCH pheromone packet. *Photo: Dan West, CSFS*

When considering any treatment for Douglas-fir beetle, choose an option that best meets your individual management objectives. Treatments often can be effective, but also time-consuming and costly, and may not be practical or effective for all situations. It is essential to research the best possible management option for a specific area before taking action.

Besides long-term forest management strategies, other more immediate management options include the use of pheromones, preventive sprays, solar treatments, trap trees, and mechanical treatments of infested wood.

Pheromones

Pheromones, which are chemicals used by beetles for communication between individuals, regulate the behavior of attacking Douglas-fir beetles. These chemicals have been synthetically reproduced for management use, demonstrating some success to deter attacks on individual trees and stands of Douglas-fir.

Packets containing the pheromone Methylcyclohexanone (MCH) disrupt the attraction of incoming beetles and can be used to reduce attacks on Douglas-fir trees. Packets are attached to un-infested trees and should be applied to trees before adult beetles begin to emerge, which in Colorado is typically April or May. These packets can be purchased through retail vendors, but it is recommended to work with a local forester to assist in designing the layout for pheromone application.

Preventive Sprays

The use of insecticides has proven effective in preventing Douglas-fir beetle infestation. Certain formulations of carbaryl and pyrethroids that are registered and have been tested for effectiveness are the primary insecticide sprays used to help reduce the likelihood of attacks on individual trees. The Colorado State Forest Service (CSFS) recommends spraying only high-value trees, such as those near homes, businesses or recreation sites, and not using insecticides to treat at a stand level. Overuse of insecticide sprays may have negative environmental impacts on water supplies and wildlife; also, these sprays are not cost-effective on a landscape scale. Before using preventive chemical sprays, consider the following guidelines.

Insecticide sprays may be effective if applied to living, green trees:

- in the late spring, before adult emergence
- in the fall, if access to the site would be difficult in the early spring
- in the proper dosage and mixture
- annually
- consistently, to cover the entire tree

Insecticide sprays will NOT be effective if:

- applied to trees already infested with Douglas-fir beetles
- applied in improper dosages or mixtures
- significant rainfall or very high air temperatures occur immediately after application
- chemicals are not properly stored before use

If planning to use preventive sprays, carefully read all label precautions before application. The CSFS recommends that preventive sprays be applied only by a certified applicator.

Figure 11. Solar treatments are a possible management option for beetle-killed trees, in areas with ample sunlight. *Photo: Carolina Manriquez, CSFS*

Figure 12. Trees removed due to Douglas-fir beetle attacks often can be processed into wood products. *Photo: Carolina Manriquez, CSFS*

Solar Treatments

Solar treatments can be used to reduce Douglas-fir beetle populations in infested stands. These treatments involve felling infested trees and stacking cut logs in an area with full sun before covering them with clear plastic. The solar treatment of infested trees creates conditions unsuitable for survival of Douglas-fir beetles, forcing them to either relocate or die. The temperature

Figure 13. Douglas-fir beetle-killed trees at the Howelsen Hill Ski Area in Steamboat Springs. *Photo: Carolina Manriquez, CSFS*

under the bark must reach a minimum of 110 degrees F for this treatment to effectively reduce beetle populations, and turning the logs periodically is essential for all of the bark to reach this temperature. Solar treatments can be challenging, because forests with Douglas-fir often are cool, moist and shady, without ample sunlight. Talk to your local CSFS forester to determine if this is an appropriate treatment for your area.

Trap Trees

Trap trees are another management option that can prevent the spread of beetle populations. These trees serve as traps for recently emerged, adult beetles. Trap trees are suitable hosts intentionally baited with a Douglas-fir beetle attractant chemical. After the trap trees become infested with beetles, trees are removed and destroyed, usually during the fall or winter, while all of the Douglas-fir beetles are still inside. This strategy effectively reduces the population level of the next generation. The method is effective, but requires a significant amount of time and effort to plan, monitor and safely remove trees in a timely manner. Many variables must be considered, including the number of trap trees per acre, tree diameter and timing for tree cutting and removal. It is highly recommended that a local forester be contacted before using this treatment option.

Mechanical Treatments

Mechanical treatments, such as felling trees and subsequently chipping the wood and/or burning the resulting slash piles, are another management option; however, it is often difficult to utilize the proper equipment on steep, remote terrain. Debarking is another mechanical means to kill developing larvae under the tree bark. This is a labor-intensive method that involves peeling away the bark by hand or using machinery. Logs also can be buried under at least 8 inches of soil to trap the beetles inside. However, debarking and burying logs often are not feasible options in forests with Douglas-fir, again because of the terrain.

Figure 14. Beetle-killed trees in the Black Canyon of the Gunnison. *Photo: Dan West, CSFS*

Impacts of Douglas-fir Beetle on Colorado's Forests

Douglas-fir beetle is a native insect, playing an integral part in Colorado's mixed-conifer ecosystems. But the beetle is capable of killing many trees over large areas, and adverse effects may result:

The Importance of Forest Management

It is important to remember that the Douglas-fir beetle is a native insect in Colorado's forest ecosystems and part of an ever-changing forest. However, the potential negative impacts of natural disturbances, such as this beetle and other insects and diseases, can be reduced through proactive forest management.

Colorado's forests provide clean air and water, wildlife habitat, world-class recreational opportunities, wood products and unparalleled scenery. These benefits contribute to quality of life and are vital to state and local economies. Without careful management of forest resources, these assets and community safety are at risk. It is critical to proactively manage forests, and for landowners and communities to remain informed about related threats, to ensure healthy, resilient forests for present and future generations.

Figure 15. Beetle-killed trees can be hazardous, especially in recreation areas or places that people frequent, and often need to be removed. *Photo: Carolina, Manriquez, CSFS*

- Large numbers of beetle-killed trees can increase the volume of dead and dried fuels and, therefore, the intensity of wildfires, should an ignition occur.
- Standing dead trees pose a falling danger to hikers, campers, cross-country skiers and other recreationists.
- Large numbers of dead trees can affect water yields and quality, increase soil erosion, and reduce soil stability.
- Changes in habitat caused by Douglas-fir beetle outbreaks may adversely affect wildlife. For example, many migratory songbirds breed in mixed-conifer forests where Douglas-fir is a component, and elk use the forests extensively throughout the year, especially during calving season.
- Regeneration of Douglas-fir forests after an outbreak may be slow on some sites because of steep slopes, the lack of open mineral soil.

Figure 16. Douglas-fir trees are often a component of larger mixed-conifer forests. *Photo: CSFS*

For More Information

For more information on Douglas-fir beetle, other forest insects and general forest management, contact a local Colorado State Forest Service district office or visit the CSFS website at www.csfs.colostate.edu.

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Figure 17. Among aspen stands are forested areas with Douglas-fir beetle-kill in the West Elk Mountains near the West Elk Wilderness. *Photo: Sam Pankratz, CSFS*

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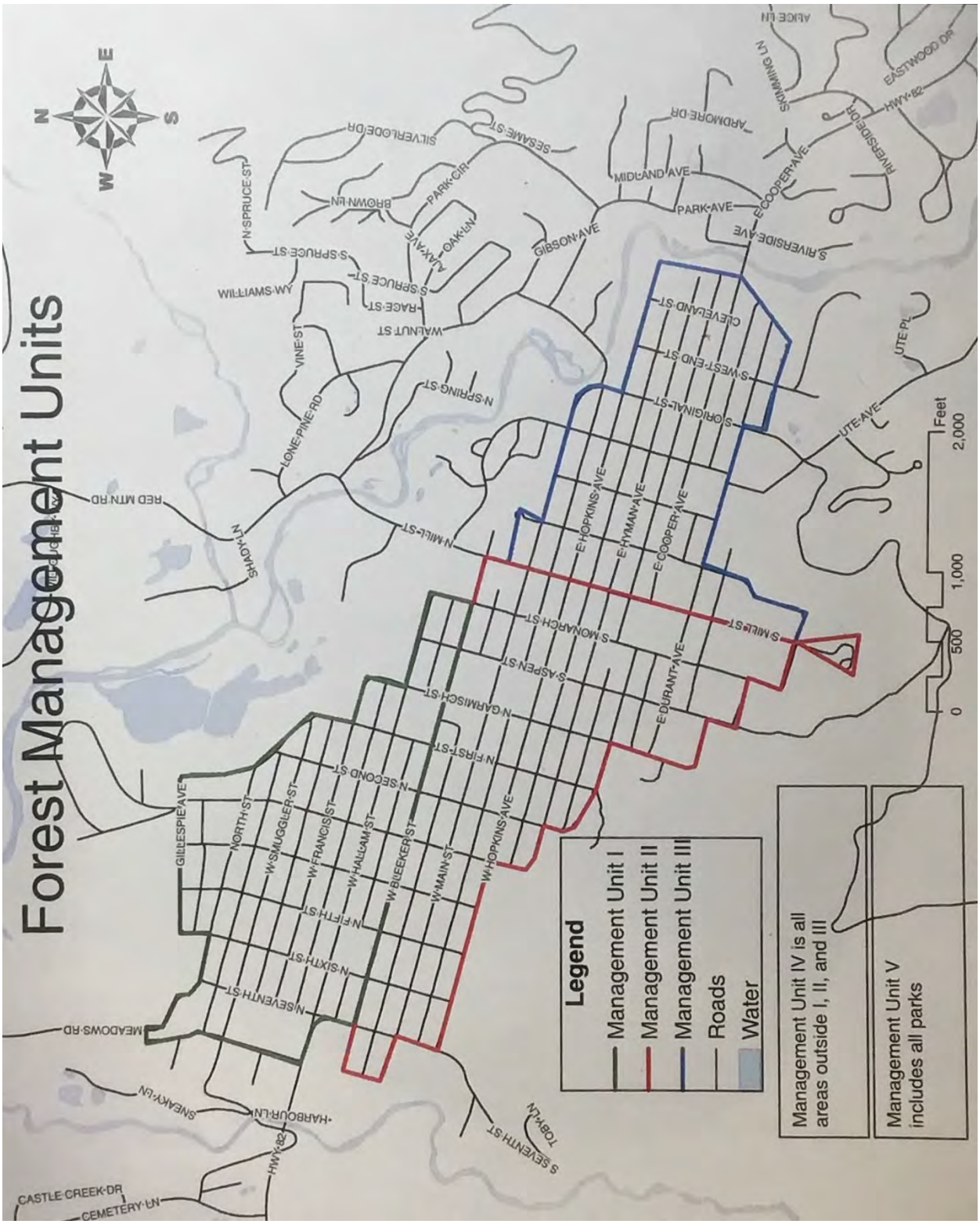
M - Management Unit Map



N - LIST OF TREE SPECIES AND VALUES

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

All Street Tree Species	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Cottonwood, narrowleaf	1344	26.55%	18.0	$4,556.88	$6,124,449.66	$7,809,524.82	$19,174,989.33
Aspen	913	18.04%	8.0	$963.12	$879,328.60	$1,119,348.57	$2,303,482.02
Spruce, blue	596	11.77%	12.0	$3,606.59	$2,149,527.53	$2,722,613.54	$3,428,847.03
Cottonwood, lanceleaf	313	6.18%	16.0	$3,178.32	$994,813.70	$1,257,234.93	$2,973,696.18
Ash, green	296	5.85%	6.0	$506.04	$149,788.15	$188,316.63	$420,796.11
Maple, Norway	275	5.43%	6.0	$874.70	$240,541.40	$304,408.07	$420,565.32
Crabapple	261	5.16%	5.0	$772.23	$201,552.58	$256,431.24	$302,367.87
Spruce, Engelmann	139	2.75%	14.0	$3,964.30	$551,037.76	$695,889.43	$1,000,672.47
Maple, freeman	122	2.41%	5.0	$541.03	$66,005.56	$82,788.22	$101,316.81
Maple, silver	80	1.58%	16.0	$4,239.75	$339,180.27	$431,457.20	$764,508.36
Ash, white	68	1.34%	4.0	$343.74	$23,374.19	$29,325.19	$47,147.10
Boxelder	65	1.28%	4.0	$317.84	$20,659.46	$25,946.21	$75,501.30
Pine, lodgepole	64	1.26%	10.0	$2,205.31	$141,140.05	$179,302.87	$257,495.70
Chokecherry	50	0.99%	6.0	$964.27	$48,213.57	$60,563.14	$70,390.95
Mountain ash	42	0.83%	4.0	$278.01	$11,676.48	$15,543.21	$24,101.07
Pine, bristlecone	37	0.73%	7.0	$1,108.55	$41,016.45	$54,451.84	$75,896.94
Fir, other	34	0.67%	11.0	$3,041.26	$103,402.96	$132,761.13	$163,926.84
Maple, other	34	0.67%	3.0	$291.35	$9,905.89	$12,947.32	$14,243.04
Pine, Austrain	29	0.57%	9.0	$1,421.80	$41,232.21	$54,638.83	$94,557.96
Hawthorn, cockspur	27	0.53%	2.0	$171.92	$4,641.72	$5,802.15	$5,967.57
Linden, littleleaf	27	0.53%	4.0	$341.06	$9,208.52	$11,562.58	$15,331.05
Cottonwood, valley	22	0.43%	16.0	$2,520.50	$55,450.89	$69,386.03	$204,611.82
Pine, pinyon	20	0.40%	6.0	$406.88	$8,137.66	$11,280.14	$25,419.87
Douglas-fir	16	0.32%	16.0	$6,244.07	$99,905.15	$124,881.44	$152,090.61
Buckeye, Ohio	12	0.24%	3.0	$118.24	$1,418.90	$1,773.62	$2,703.54
Pine, ponderosa	12	0.24%	13.0	$3,009.47	$36,113.64	$45,183.50	$77,149.80
Pine, Scotch	11	0.22%	10.0	$1,617.54	$17,792.93	$22,589.51	$38,245.20
Apple	10	0.20%	4.0	$477.03	$4,770.29	$6,236.04	$7,451.22
Maple, red	10	0.20%	3.0	$223.10	$2,230.97	$2,788.71	$3,659.67
Maple, tatar	10	0.20%	2.0	$78.93	$789.30	$1,015.48	$1,120.98
Elm, accolade	8	0.16%	2.0	$60.95	$487.60	$609.51	$1,055.04
Elm, species	8	0.16%	3.0	$132.49	$1,059.92	$1,324.90	$2,373.84
Maple, amur	8	0.16%	3.0	$170.02	$1,360.12	$1,700.15	$1,945.23
Willow	8	0.16%	29.0	$8,499.06	$67,992.50	$87,439.97	$244,142.85
Elm, American	7	0.14%	8.0	$2,379.47	$16,656.27	$21,144.96	$30,563.19
Hawthorn, other	7	0.14%	2.0	$133.71	$935.97	$1,317.29	$1,252.86
Japanese Tree Lilac	7	0.14%	3.0	$211.69	$1,481.80	$1,852.25	$2,736.51
Elm, siberian	6	0.12%	16.0	$3,900.83	$23,405.01	$29,256.26	$63,137.55
Locust, black	6	0.12%	17.0	$3,636.08	$21,816.47	$27,270.59	$55,488.51
Pine, southwestern white	6	0.12%	9.0	$1,484.78	$8,908.66	$11,229.58	$16,221.24
Plum	6	0.12%	4.0	$264.13	$1,584.80	$1,981.00	$3,395.91
Poplar, white	5	0.10%	22.0	$6,794.38	$33,971.88	$42,902.21	$106,097.46
Ash, other	4	0.08%	5.0	$348.54	$1,394.16	$1,742.70	$3,659.67

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

All Street Tree Species	Total Number	Percent of Trees	Avg DBH	Avg Value (w Placement)	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Pine, other	4	0.08%	2.0	$73.48	$293.90	$391.87	$527.52
Birch	3	0.06%	6.0	$195.71	$587.13	$733.91	$3,989.37
Elm, new horizon	3	0.06%	3.0	$108.82	$326.45	$408.06	$725.34
Elm, princeton	3	0.06%	2.0	$57.85	$173.55	$216.94	$395.64
Juniper, rocky mountain	3	0.06%	2.0	$82.29	$246.88	$308.60	$395.64
Broadleaf deciduous, medium	2	0.04%	4.0	$236.48	$472.97	$591.21	$956.13
Cherry	2	0.04%	3.0	$201.78	$403.55	$504.44	$593.46
Elm, choice city	2	0.04%	3.0	$148.76	$297.52	$371.90	$593.46
Elm, triumph	2	0.04%	2.0	$57.85	$115.70	$144.63	$263.76
Hackberry	2	0.04%	7.0	$808.39	$1,616.77	$2,020.97	$2,802.45
Linden, American	2	0.04%	3.0	$138.46	$276.92	$346.15	$428.61
Maple, hedge	2	0.04%	4.0	$356.96	$713.91	$892.39	$956.13
Fir, white	1	0.02%	11.0	$2,686.94	$2,686.94	$3,358.67	$3,989.37
Horsechestnut	1	0.02%	4.0	$298.22	$298.22	$372.78	$527.52
Lilac	1	0.02%	2.0	$21.54	$21.54	$107.70	$131.88
Oak, other	1	0.02%	5.0	$565.20	$565.20	$706.50	$824.25
Pine, limber	1	0.02%	8.0	$1,097.24	$1,097.24	$1,567.49	$2,110.08
Poplar, lombardy	1	0.02%	17.0	$2,858.50	$2,858.50	$3,573.12	$9,528.33
Spruce, Norway	1	0.02%	9.0	$1,168.37	$1,168.37	$1,669.11	$2,670.57
Space**	113	-	-	-	-	-	-
Total Trees	**5062**	**100.00%**	**7.5**	**$1,412.30**	**$12,572,582.88**	**$15,984,049.41**	**$32,812,733.10**
Total Trees and Spaces	**5175**						

**Not included in any calculations

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

Street Tree Species Summary	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Cottonwood, all species	1679	33.17%	16.7	$3,418.57	$7,174,714.25	$9,136,145.78	$22,353,297.33
Aspen	913	18.04%	8.0	$963.12	$879,328.60	$1,119,348.57	$2,303,482.02
Spruce, all species	736	14.54%	11.7	$8,739.26	$2,701,733.66	$3,420,172.07	$4,432,190.07
Maple, all species	541	10.69%	8.4	$1,797.11	$660,727.42	$837,997.53	$1,308,315.54
Ash, all species	368	7.27%	5.0	$399.44	$174,546.50	$219,384.52	$471,602.88
Crabapple	261	5.16%	5.0	$772.23	$201,552.58	$256,431.24	$302,367.87
Pine, all species	184	3.63%	8.9	$1,525.66	$295,732.74	$380,635.63	$587,624.31
Boxelder	65	1.28%	4.0	$317.84	$20,659.46	$25,946.21	$75,501.30
Chokecherry	50	0.99%	6.0	$964.27	$48,213.57	$60,563.14	$70,390.95
Mountain ash	42	0.83%	4.0	$278.01	$11,676.48	$15,543.21	$24,101.07
Elm, all species	39	0.77%	4.9	$855.88	$42,522.02	$53,477.15	$99,107.82
Fir, all species	35	0.69%	11.0	$2,867.10	$106,089.90	$136,119.80	$167,916.21
Hawthorn, all species	34	0.67%	2.0	$152.82	$5,577.69	$7,119.45	$7,220.43
Linden, all species	29	0.57%	3.5	$239.76	$9,485.44	$11,908.73	$15,759.66
Douglas-fir	16	0.32%	16.0	$6,244.07	$99,905.15	$124,881.44	$152,090.61
Buckeye, Ohio	12	0.24%	3.0	$118.24	$1,418.90	$1,773.62	$2,703.54
Apple	10	0.20%	4.0	$477.03	$4,770.29	$6,236.04	$7,451.22
Willow	8	0.16%	29.0	$8,499.06	$67,992.50	$87,439.97	$244,142.85
Japanese Tree Lilac	7	0.14%	3.0	$211.69	$1,481.80	$1,852.25	$2,736.51
Locust, black	6	0.12%	17.0	$3,636.08	$21,816.47	$27,270.59	$55,488.51
Plum	6	0.12%	4.0	$264.13	$1,584.80	$1,981.00	$3,395.91
Poplar, all species	6	0.12%	19.5	$4,826.44	$36,830.38	$46,475.34	$115,625.79
Birch	3	0.06%	6.0	$195.71	$587.13	$733.91	$3,989.37
Juniper, rocky mountain	3	0.06%	2.0	$82.29	$246.88	$308.60	$395.64
Broadleaf deciduous, medium	2	0.04%	4.0	$236.48	$472.97	$591.21	$956.13
Cherry	2	0.04%	3.0	$201.78	$403.55	$504.44	$593.46
Hackberry	2	0.04%	7.0	$808.39	$1,616.77	$2,020.97	$2,802.45
Horsechestnut	1	0.02%	4.0	$298.22	$298.22	$372.78	$527.52
Lilac	1	0.02%	2.0	$21.54	$21.54	$107.70	$131.88
Oak, all species	1	0.02%	5.0	$565.20	$565.20	$706.50	$824.25
Space**	113	-	-	-	-	-	-
Total Trees	**5062**	**100.00%**	**3.7**	**$1,665.91**	**$12,572,582.88**	**$15,984,049.41**	**$32,812,733.10**
Total Trees and Spaces	**5175**						

**Not included in any calculations

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

All Park Tree Species	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Aspen	962	33.44%	6.0	$656.81	$631,849.50	$821,162.59	$1,728,353.34
Cottonwood, narrowleaf	814	28.29%	14.0	$3,353.52	$2,729,762.41	$3,470,059.25	$8,233,795.92
Spruce, blue	594	20.65%	11.0	$3,345.37	$1,987,148.23	$2,544,170.87	$3,204,420.24
Crabapple	90	3.13%	7.0	$1,434.07	$129,066.43	$170,290.99	$201,215.91
Pine, Austrian	49	1.70%	6.0	$732.65	$35,899.93	$47,864.67	$78,831.27
Pine, ponderosa	46	1.60%	8.0	$1,514.79	$69,680.31	$87,100.38	$141,012.69
Spruce, Engelmann	45	1.56%	17.0	$6,205.33	$279,240.00	$353,732.78	$508,034.73
Ash, green	36	1.25%	9.0	$1,250.17	$45,005.95	$57,620.37	$130,791.99
Cottonwood, lanceleaf	28	0.97%	14.0	$2,629.50	$73,626.08	$95,110.54	$214,766.58
Maple, Norway	24	0.83%	7.0	$1,224.89	$29,397.47	$36,968.32	$51,993.69
Pine, lodgepole	22	0.76%	9.0	$1,785.10	$39,272.31	$50,447.40	$71,742.72
Pine, bristlecone	20	0.70%	6.0	$993.03	$19,860.56	$25,073.69	$35,376.81
Pine, Scotch	16	0.56%	12.0	$2,392.15	$38,274.34	$50,140.54	$77,908.11
Mountain ash	14	0.49%	5.0	$705.61	$9,878.58	$12,543.44	$15,265.11
Fir, other	12	0.42%	13.0	$3,457.47	$41,489.63	$53,134.99	$70,720.65
Chokecherry	10	0.35%	5.0	$692.72	$6,927.16	$9,181.60	$9,956.94
Elm, triumph	10	0.35%	2.0	$66.12	$661.16	$826.45	$1,318.80
Maple, silver	9	0.31%	13.0	$2,572.37	$23,151.32	$29,923.61	$54,037.83
Boxelder	8	0.28%	2.0	$39.19	$313.50	$391.87	$1,055.04
Linden, littleleaf	7	0.24%	2.0	$99.48	$696.33	$870.41	$1,088.01
Maple, other	7	0.24%	2.5	$285.08	$1,995.56	$2,507.92	$3,066.21
Juniper	6	0.21%	6.0	$740.71	$4,144.23	$5,484.06	$7,616.07
Elm, frontier	5	0.17%	2.0	$66.12	$330.58	$413.22	$659.40
Maple, freeman	5	0.17%	4.0	$303.64	$1,518.21	$1,957.87	$2,538.69
Poplar, white	5	0.17%	24.0	$4,667.70	$23,338.52	$29,173.15	$107,647.05
Apple	4	0.14%	10.0	$2,019.65	$8,078.59	$10,248.96	$13,847.40
Birch	4	0.14%	5.0	$640.13	$2,560.54	$3,462.79	$7,682.01
Pine, pinyon	4	0.14%	2.0	$28.79	$115.18	$202.22	$527.52
Fir, white	3	0.10%	8.0	$1,014.08	$3,042.23	$4,024.85	$6,396.18
Pine, other	3	0.10%	10.0	$1,801.79	$5,405.38	$6,756.73	$9,792.09
Fir, balsam	2	0.07%	10.0	$2,109.58	$4,219.16	$5,773.58	$6,857.76
Locust, black	2	0.07%	7.0	$527.74	$1,055.48	$1,507.83	$3,231.06
Pine, southwestern white	2	0.07%	6.0	$617.20	$1,234.40	$1,543.00	$2,373.84
Spruce, other	2	0.07%	16.0	$5,096.22	$10,192.44	$12,740.55	$17,836.77
Willow, white	2	0.07%	11.0	$1,287.53	$2,575.05	$3,337.51	$7,682.01
Cedar, deodar	1	0.03%	18.0	$6,348.33	$6,348.33	$7,935.41	$10,682.28
Cherry, european bird	1	0.03%	16.0	$4,099.58	$4,099.58	$5,124.48	$8,440.32
Elm, new horizon	1	0.03%	2.0	$57.85	$57.85	$72.31	$131.88
Ginkgo	1	0.03%	1.0	$22.51	$22.51	$28.13	$32.97
Other, deciduous small	1	0.03%	2.0	$86.16	$86.16	$107.70	$131.88
Space	1	-	-	-	-	-	-
Total Trees	**2877**	**100.00%**	**8.26**	**$1,674.27**	**$6,271,621.18**	**$8,019,017.01**	**$15,048,859.77**
Total Trees and Spaces	**2878**						

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

Park Tree Species Summary	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Aspen	962	33.44%	6.0	$656.81	$631,849.50	$821,162.59	$1,728,353.34
Cottonwood, all species	842	29.27%	14.0	$2,991.51	$2,803,388.49	$3,565,169.78	$8,448,562.50
Spruce, all species	641	22.28%	14.7	$4,882.31	$2,276,580.67	$2,910,644.20	$3,730,291.74
Pine, all species	162	5.63%	7.3	$1,233.19	$209,742.41	$269,128.62	$417,565.05
Crabapple	90	3.13%	7.0	$1,434.07	$129,066.43	$170,290.99	$201,215.91
Maple, all species	45	1.56%	6.6	$1,096.50	$56,062.56	$71,357.72	$111,636.42
Ash, green	36	1.25%	9.0	$1,250.17	$45,005.95	$57,620.37	$130,791.99
Fir, all species	17	0.59%	10.3	$2,193.71	$48,751.02	$62,933.42	$83,974.59
Elm, all species	16	0.56%	2.0	$63.36	$1,049.59	$1,311.99	$2,110.08
Mountain ash	14	0.49%	5.0	$705.61	$9,878.58	$12,543.44	$15,265.11
Chokecherry	10	0.35%	5.0	$692.72	$6,927.16	$9,181.60	$9,956.94
Boxelder	8	0.28%	2.0	$39.19	$313.50	$391.87	$1,055.04
Linden, littleleaf	7	0.24%	2.0	$99.48	$696.33	$870.41	$1,088.01
Juniper	6	0.21%	6.0	$740.71	$4,144.23	$5,484.06	$7,616.07
Poplar, white	5	0.17%	24.0	$4,667.70	$23,338.52	$29,173.15	$107,647.05
Apple	4	0.14%	10.0	$2,019.65	$8,078.59	$10,248.96	$13,847.40
Birch	4	0.14%	5.0	$640.13	$2,560.54	$3,462.79	$7,682.01
Locust, black	2	0.07%	7.0	$527.74	$1,055.48	$1,507.83	$3,231.06
Willow, white	2	0.07%	11.0	$1,287.53	$2,575.05	$3,337.51	$7,682.01
Cedar, deodar	1	0.03%	18.0	$6,348.33	$6,348.33	$7,935.41	$10,682.28
Cherry, european bird	1	0.03%	16.0	$4,099.58	$4,099.58	$5,124.48	$8,440.32
Ginkgo	1	0.03%	1.0	$22.51	$22.51	$28.13	$32.97
Other, deciduous small	1	0.03%	2.0	$86.16	$86.16	$107.70	$131.88
Space**	1	-	-	-	-	-	-
Total Trees	**2877**	**100.00%**	**8.3**	**$1,642.55**	**$6,271,621.18**	**$8,019,017.01**	**$15,048,859.77**
Total Trees and Spaces	**2878**			-			

**Not included in any calculations

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

All Golf Course Tree Species	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Cottonwood, narrowleaf	762	39.63%	12.9	$2,275.24	$1,733,732.50	$2,191,954.92	$5,518,254.84
Spruce, Blue	509	26.47%	13.8	$4,576.65	$2,329,512.88	$2,933,491.23	$3,867,084.27
Aspen	243	12.64%	7.8	$1,049.00	$254,907.79	$330,880.25	$710,074.89
Pine, ponderosa	88	4.58%	9.5	$2,169.88	$190,949.73	$239,381.75	$340,415.25
Ash, green	36	1.87%	7.3	$590.00	$21,239.97	$28,875.24	$64,159.62
Spruce, Engelmann	35	1.82%	9.9	$1,967.03	$68,846.07	$86,057.59	$118,790.91
Pine, lodgepole	32	1.66%	10.1	$1,984.39	$63,500.41	$79,375.51	$116,680.83
Pine, Scotch	32	1.66%	10.3	$1,734.43	$55,501.79	$69,377.24	$119,054.67
Cottonwood, lanceleaf	31	1.61%	15.0	$2,703.84	$83,819.01	$105,849.38	$251,099.52
Douglas-fir	25	1.30%	7.4	$1,529.26	$38,231.58	$48,121.27	$58,027.20
Maple, freeman	24	1.25%	6.2	$731.92	$17,566.20	$25,256.12	$30,925.86
Fir, white	16	0.83%	8.8	$2,217.83	$35,485.32	$44,356.64	$51,565.08
Hawthorn	14	0.73%	3.5	$287.97	$4,031.61	$5,464.17	$5,769.75
Pine, Austrian	12	0.62%	8.4	$1,327.52	$15,930.28	$20,410.55	$31,552.29
Oak, gambel	11	0.57%	4.6	$458.58	$5,044.41	$6,941.36	$8,407.35
Pine, bristlecone	10	0.52%	4.2	$375.22	$3,752.17	$4,690.22	$8,176.56
Chokecherry	7	0.36%	6.1	$869.09	$6,083.62	$7,658.38	$12,165.93
Fir, other	5	0.26%	10.8	$2,300.55	$11,502.75	$14,378.44	$21,562.38
Birch	3	0.16%	4.0	$393.88	$1,181.64	$1,477.06	$1,582.56
Maple, amur	3	0.16%	3.3	$213.61	$640.83	$915.47	$1,120.98
Pine, southwestern white	3	0.16%	3.3	$216.35	$649.07	$811.30	$1,252.86
Alder	2	0.10%	3.0	$193.86	$387.73	$484.66	$593.46
Apple	2	0.10%	7.0	$1,223.85	$2,447.69	$3,059.62	$3,824.52
Ash, white	2	0.10%	8.0	$1,128.59	$2,257.18	$2,821.48	$4,220.16
Cottonwood, plains	2	0.10%	14.5	$2,298.01	$4,596.02	$5,745.02	$14,012.25
Crabapple	2	0.10%	4.0	$337.61	$675.23	$844.03	$1,055.04
Maple, Norway	2	0.10%	6.0	$695.34	$1,390.67	$1,738.34	$2,439.78
Pine, other	2	0.10%	7.0	$525.05	$1,050.09	$2,100.19	$3,231.06
Hackberry, northern	1	0.05%	6.0	$645.68	$645.68	$922.41	$1,186.92
Japanese Tree Lilac	1	0.05%	3.0	$221.56	$221.56	$276.95	$296.73
Maple, red	1	0.05%	4.0	$344.65	$344.65	$430.81	$527.52
Maple, silver	1	0.05%	6.0	$339.12	$339.12	$423.90	$1,186.92
Pine, pinyon	1	0.05%	4.0	$196.94	$196.94	$246.18	$527.52
Serviceberry	1	0.05%	4.0	$129.24	$129.24	$184.63	$527.52
Spruce, white	1	0.05%	4.0	$339.12	$339.12	$423.90	$527.52
Willow, white	1	0.05%	7.0	$415.42	$415.42	$519.28	$1,615.53
Total Trees	**1923**	**100.00%**	**7.1**	**$1,083.51**	**$4,957,545.97**	**$6,265,945.46**	**$11,373,496.05**

List of Tree Species and Values by Inventory Area in the City of Aspen - 2017

Golf Course Tree Species Summary	Total Number	Percent of Trees	Avg DBH	Avg Value w/ Placement	Total Value w/ Placement	Total Value w/o Placement	Aspen Value Formula
Cottonwood, all species	795	41.34%	14.1	$2,425.70	$1,822,147.53	$2,303,549.33	$5,783,366.61
Spruce, all species	545	28.34%	9.2	$2,294.27	$2,398,698.07	$3,019,972.72	$3,986,402.70
Aspen	243	12.64%	7.8	$1,049.00	$254,907.79	$330,880.25	$710,074.89
Pine, all species	180	9.36%	7.1	$1,066.22	$331,530.48	$416,392.93	$620,891.04
Ash, all species	38	1.98%	7.7	$859.30	$23,497.15	$31,696.72	$68,379.78
Maple, all species	31	1.61%	5.1	$464.93	$20,281.50	$28,764.64	$36,201.06
Douglas-fir	25	1.30%	7.4	$1,529.26	$38,231.58	$48,121.27	$58,027.20
Fir, all species	21	1.09%	9.8	$2,259.20	$46,988.07	$58,735.08	$73,127.46
Hawthorn	14	0.73%	3.5	$287.97	$4,031.61	$5,464.17	$5,769.75
Oak, gambel	11	0.57%	4.6	$458.58	$5,044.41	$6,941.36	$8,407.35
Chokecherry	7	0.36%	6.1	$869.09	$6,083.62	$7,658.38	$12,165.93
Birch	3	0.16%	4.0	$393.88	$1,181.64	$1,477.06	$1,582.56
Alder	2	0.10%	3.0	$193.86	$387.73	$484.66	$593.46
Apple	2	0.10%	7.0	$1,223.85	$2,447.69	$3,059.62	$3,824.52
Crabapple	2	0.10%	4.0	$337.61	$675.23	$844.03	$1,055.04
Hackberry, northern	1	0.05%	6.0	$645.68	$645.68	$922.41	$1,186.92
Japanese Tree Lilac	1	0.05%	3.0	$221.56	$221.56	$276.95	$296.73
Serviceberry	1	0.05%	4.0	$129.24	$129.24	$184.63	$527.52
Willow, white	1	0.05%	7.0	$415.42	$415.42	$519.28	$1,615.53
Total Trees	**1923**	**100.00%**	**6.3**	**$901.30**	**$4,957,545.97**	**$6,265,945.46**	**$11,373,496.05**