Tree Tech Consulting

Risk Analysis and Assessment of the Liberty Tuliptree:

St. John's College, Annapolis, MD

Maryland Dept. of General Services
Capital Field Operations Office
Mr. Steven G. Reinert
29 St. John's Street
Annapolis, MD 21401

October 9, 1999

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Summary

On September 16, 1999, Hurricane Floyd passed the mid-Atlantic region. Although the center of the hurricane passed several hundred miles to the east, it brought strong winds and heavy rain to the Annapolis area. A wind gusts caused a large fracture in the main trunk of the Liberty Tuliptree, standing on the front lawn of St. John's College.

The Liberty Tree is a tuliptree (*Liriodendron tulipifera*) of great historical significance. Colonists made treaty with the Susquahannock tribe in 1652, and the site has been visited by many historic figures, including several early presidents. The tree is now of great size, but also in great peril. Despite the care it has received over the years, including a monumental effort to protect it from decay and fill the extensive internal cavities, the tree is now structurally weakened to a degree that it poses a hazard to any person or object with reach of its branches.

After a thorough examination of the tree and analysis of the results of my investigation, I regrettably must recommend removal of the venerable old tree as the only prudent course of action.

Introduction

On the morning of September 27, 1999, I received a phone call from Mr. Brett Linkletter of The Care of Trees, Inc., requesting information about my services. He indicated that the Liberty Tree had suffered some damage during the recent hurricane, and that the Maryland Department of General Services, along with St. John's College, were seeking assistance in determining the condition of the tree. I discussed the situation with Mr. Linkletter in several communications, and later agreed that I would make an inspection of the tree Tuesday, October 5, under the auspices of the Department of General Services.

The purpose of the inspection was to determine the extent of decay present in the tree, and through analysis of the data collected, assess the risk associated with the tree. Both the physiological health of the tree and its structural integrity were investigated.

Observations of Tree and Site

The Liberty Tree stands 78 feet east of Pinkney Hall, and 125 feet southwest of the Barr-Buchanan Center. The area around the tree is mostly open lawn, and has not been recently disturbed. The tree has a measured trunk 26.75 feet in circumference, or 102 inches in diameter. The diameter at the ground line is slightly more than 12 feet. I measured the height[1] of the tree to be 97 feet. It limbs spread 44 feet to the south and east, 35 feet to the west, and 28 feet to the

[1] A clinometer was used to determine height by triangulation.

north.

Physiological Health

The tree has a full but asymmetrical canopy, with branches from 5 feet high to the top of the tree. The foliage is slightly smaller than normal for the species. Leaf color is darker than normal on most leaves, indicating good nitrogen and iron nutrient levels. Many leaves have begun changing to yellow, both as a response to the drought conditions this summer and due to injury from ozone. Ozone approaches damaging levels during hot, humid and calm weather, such as experienced this summer. Tuliptrees are sensitive to moderate levels of ozone, turning a mottled purplish to brown color on the underside of the leaves.

Twig growth was well below normal for the species, at two to 3 inches growth in 1999. Normal growth is four to 8 inches annually. Bark and bud color are normal, however. Callus growth around the edges of old wounds and pruning cuts was slow.

I found low levels of leaf aphids on the tree, a common pest of tuliptree. I did not find any indications of tuliptree scale, another common pest. I also did not find evidence of any twig or bark infections, except near of the cavities in the upper canopy.

I excavated the base of the tree about three to 4 inches deep around the base in several places. There were no indications of root or bark infection at these sites.

Structural Integrity

The structural integrity of the tree is the primary concern. There are several obvious open cavities and other old wounds that have closed over with new growth. The closed wounds have decay behind them, in most cases.

There are two exposed cavities on the north and east sides of the trunk, beginning at ground level (Figure 1). Both have been filled in years past. The smaller, to the north side, is 20 inches wide and about one foot high. It had been covered with Flexifill.® [2] The second cavity extends from the ground to about seven feet high, and is over 30 inches wide near the base of the tree. This cavity has been filled with concrete, brick and mortar. A bronze commemorative plaque is mounted on the face of the concrete filler.

Figure 1: Base of main trunk, showing large filled cavity. Smaller cavity is at bottom right of trunk.

The inspection was made with the aid of an aerial lift trunk provided by The Care of Trees. I inspected the cracked limb and the cavity from the lift.

A very large cavity is located on the

[2] Flexifill®, a product of the Bartlett Tree Expert Company of Stamford, Ct., is composed of wood fibers and resins. It was used to fill tree cavities, although is no longer in use.

top of the first lateral limb, extending to the west at 20 feet above the ground. Old concrete, placed in 1907, can be seen in the center of the cavity (Figure 2: blue arrow, lower left). Decay has continued around the concrete over the past 90 years, so the concrete is now out of contact with solid wood in most places. The concrete extends up into the limb, above the open cavity. An open cavity at 30 feet high, farther out the limb, also has concrete. I suspect this is a continuation of the same column of filler material.


Figure 2: Lateral limb with cavity on top side, and concrete filler.


Figure 3 View from the north, showing location of the bottom of the crack (blue arrow).

The lateral limb extends to the west, then sweeps upward and to the south, placing tremendous torque on the lower attachment of the limb, in the direction of the red arrow (Figure 2.). The cavity in the limb extends over 7 feet, from below the main crotch with the trunk. A newly opened crack (Figure 3) extends from the bottom of the cavity downward along the trunk for 8 feet, and was about 1.75 inches wide when I inspected it. The crack penetrates the solid wood of the trunk, exposing the hollow interior of the trunk. When this limb fails, half of the main trunk will be exposed.

This limb was pruned during the week before my inspection, to reduce the weight and wind resistance. The pruning was suggested to lessen the risk of failure before the assessment could be made. There is still substantial weight on the limb however, and the risk of failure remains.

At a height of 30 feet on the main stem of the tree is another large, open cavity (Figure 4). The cavity spans 20 percent of the circumference at this point, and extends to 41 feet above the ground. Testing with the Resistograph®[3] probe shows there is only an average of 3.5 inches of solid wood around the walls of this cavity. The stem diameter at this point is 40 inches.

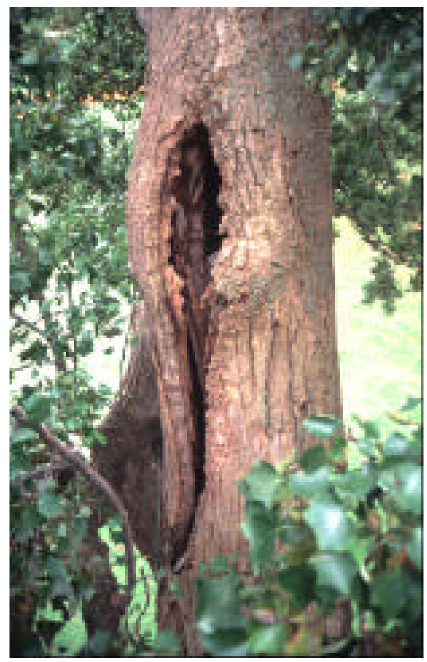

Figure 4 A large cavity at 32 feet in the main trunk, on the north side. There are steel bolts and concrete filler in this cavity.

At 60 feet high on the main stem is an old wound created when a large portion of the top was cut (Figure 5). This wound is about 32 inches in diameter. The center of the limb is decayed at this point. Several steel bolts were placed to add support to the cavity. Due to position and height, I was unable to determine if concrete was present in this cavity. The wood inside the stem is

[3] The Resistograph® is a mechanical drilling probe device that measures and charts resistance to a probe inserted into the wood of the tree. The results indicate the condition and extent of solid wood and the presence of internal decay.

decayed, and much of the bark around the outside is dead. Several large sucker sprouts have grown from the edges of this wound and are now of substantial size (eight to 14 inches in diameter). These branches are attached to rotting wood. I was not able to determine if the cavity at this wound continues down and coalesces with the main column of decay, although this is highly probable, given the size and extent of decay seen at the top of this stem.

Figure 5: Sixty feet high in the main trunk is an old pruning wound, 32 inches across. The end of a steel bolt protrudes fro the side of the limb (blue arrow

Discussion

The Liberty Tree is an old specimen. Historical records indicate it was a large tree in 1652. Tuliptrees can grow rapidly when young, adding a half-inch or more to their girth each year. This pace can continue for several decades, and a tree of 50 years old can be over two feet in diameter, and 60 or 70 feet tall. As the tree matures and the mass increases, the width of the growth rings declines. In old age, the tree often has very slow growth rates. Although it may be impossible to ever know the actual age of the tree, due to decay of the wood, it is likely the Liberty Tree is over 400 years old.

The health of the Liberty Tree is very good for a tuliptree of this age. The care and attention it has received over the years have served to keep it in good health, despite the stresses of nature and its location on a busy college campus. Periodic pruning and fertilization have maintained the full canopy and allowed the tree remain vigorous. There are no serious pest problems present now, and no signs of significant disease infections that would threaten the health of the tree. Although growth of twigs has been less than normal and leaf size is slightly smaller than usual, these symptoms are expected on a very old tree.

Decay in trees

Although in good physiological health, the Liberty Tree is at great risk of massive structural failure. During its lifetime it has endured numerous injuries to the bark. Once the bark is damaged, various types of fungi invade the wound, first causing the underlying wood to discolor, and later to decay. The tree responds at the time of injury by initiating changes within the cells of the wood to limit the progress of the decay fungi. This resistance mechanism creates chemical barriers in the wood that slow the decay process. However, the fungus can continue to expand toward the interior of the tree in many cases, gradually dissolving the wood despite the barriers.

The tree does produce one effective barrier at the time of wounding, however. This barrier zone is created by the cambium, a paper-thin layer of cells between the live wood and the bark. The changes in the cells at this point are highly effective in preventing the decay fungi from colonizing any wood grown after the time of injury. This in effect, seals the decay inside the tree.

As the decay progresses, it dissolves the wood behind the initial wound. Depending on species, tree vigor, and the size and number of wounds, the decay may be limited to small areas. Given sufficient time, however, the decay can eventually rot all of the wood present at the time of wounding. If other injuries occur after the initial wounding, the process begins again, and the older barriers will succumb to the decay from the newer injuries. For the Liberty Tree, this process of wounding and decay has been repeated many times. Each broken branch, each pruning cut, each injury to the bark around the base, adds another wound to the list and another opportunity for decay to enter the system.

Following wounding, the tree, if healthy, continues to grow new wood, eventually covering the old wound. Although this excludes oxygen from the decay column and slows the progress of the fungi, it does not stop it entirely. As pockets of decay coalesce, there is greater opportunity for oxygen to diffuse throughout the cavity.

As new wood grows, the tree is adding strength to the trunk and stems. For many trees, this growth may be sufficient to counter the loss of wood due to the internal decay. However, since old trees cannot add new wood rapidly, the progress of decay may dissolve the wood faster than new wood can be produced. The result is a net loss of solid wood and the structural support it provides to the tree. In the case of the Liberty Tree, the decay has been progressing at an increasing pace for many years, while the growth rate has declined. There is no chance that the tree can now add sufficient new growth to even keep up with the rate of decay, much less regain strength already lost.

Previous efforts at preservation

In 1907, John Withers was contracted to provide some care and treatment to the Liberty Tree. The primary task was treatment of the large cavities found within the tree. Mr. Wither's later wrote that the decay had left only a shell of wood 11 inches thick near the bottom of the trunk, and extended upward about 55 feet. Although I think his measurements may be suspect, the general indication is that the rot within the trunk and limbs was already extensive. Mr. Withers and his associates worked inside the tree, cleaning and removing as much of the decayed wood as they could practically reach.

This procedure was a common practice until the 1970s. We now know that attempting to remove the decayed wood is usually counterproductive. In his attempts to remove the rot, Mr. Withers undoubtedly breached the protective barriers the tree had established to contain the decay. This allowed the fungi to continue into any sound wood that remained. It also circumvented the defense mechanisms of the tree. Since the bark was not necessarily damaged in the process, there was no formation of a new barrier zone in the cambium to protect the new wood that grew after the treatment. In effect, the decay organisms were given free access to the interior of the tree.

After excising the rotted wood, Mr. Withers went on to fill the exposed cavities with concrete. Steel rods were placed in some cavities to lend stiffness and stability to the limbs. The concrete was placed around some of these rods. Reinforcing rods were also used in some places to stiffen the concrete. The intent of the procedure was to provide long-term support for the tree, in the absence of its own wood that had decayed.

As applied, the procedure lasted only a short time, until the decay had progressed into the wood surrounding the concrete. Within as little as five years, the wood had rotted around the filler materials enough that they were no longer in contact. Within 10 to 20 years, the concrete probably offered no support to the tree at all. The decay progressed from the inside outward, and from new injuries as well.

Current Structural Condition

During my investigation of the tree, I found numerous open cavities, in the main trunk and in the limbs, along with several areas of hidden decay. Some of these areas had concrete filler, although it was detached from the wood in every case and no longer provided support to the tree. In many cases I could see that the columns of decay were connected. The extent and the placement of the other decay pockets suggest that they are also connected to the main columns. The result is that the entire tree now consists of a hollow shell of wood, sometimes only two or three inches thick.

To remain relatively stable, a tree needs at least one third of the stem diameter as solid, supportive wood. Where there are open cavities, the amount necessary to provide adequate support is even greater. Throughout the Liberty Tree, the sound wood remaining is much below the safe threshold level. At the base of the tree, as little as 5 inches of solid wood remains in a trunk 102 inches in diameter. In the first lateral limb, 36 inches in diameter where the crack recently developed, there is only between three and six inches of wood. At the open cavity at 40 feet high, 40 inches in diameter, there remains only 3.5 to 7.0 inches of wood. In every case, the strength loss due to decay has placed the tree beyond a safe threshold.

When assessing the relative risk associated with any tree, the potential targets near the tree must be considered, along with the frequency of use. The size of the tree itself, and the size of the parts most likely to fail are also factors. Finally, the potential for failure must be included.

The area around Liberty Tree must be considered high-use. The nearby buildings are far enough from the tree that they are not likely to be damaged should the tree fall. Only the uppermost small branches could reach Pinkney or McDowell Halls. Although windows could be broken, damage to the buildings would be minimal. Pedestrians in the area are at greatest risk of injury. Students and college faculty frequently pass the tree, and visitors to the campus often stop to admire and observe the old tree. While we can assume that there is little activity at night, during daytime hours people may be present at almost any time.

The size of the tree parts likely to fail is the second consideration. It is massive by any measurement. The trunk is 102 inches, more than eight feet, across. The main limbs are larger than many trees. Even 40 feet above the ground the main trunk is over 40 inches in diameter. Tuliptree wood is not as heavy as some woods, but at an average of about 38 pounds per cubic foot, there is tremendous weight in the canopy. Combined with the distances these limbs would fall upon failure, the forces on impact at ground level are extremely high. The large spread of the canopy and the length of the limbs means that a large area of ground would be affected by falling limbs, leaving anyone nearby with few options for escape.

The likelihood of failure, and the part most likely to collapse, is the main issue in question. Based on the evidence I found in my inspection, and presented in this report, I believe the main limbs in the canopy are at greatest risk of failure. Decay is extensive throughout the main trunk and scaffold limbs. The remaining sound wood is thinnest near some of the large cavities in the crown. These points are also under critical stress from the weight of the limbs and the force of wind.

When the wind blows against the tree, the "sail effect," or resistance to the wind, is not uniform. It places uneven stress on the tree and the limbs, depending on the length of the branches, amount of foliage, and the direction of the wind. Foliage from other branches may divert or intensify the effects of wind. The limbs bend and sway unsynchronized in the wind, creating divergent harmonic stresses. The limbs may twist as they bend, creating torque on the lower parts. These stresses are mostly unpredictable for the force created or the vectors of action on the tree. When the forces exceed the limits of the wood supporting the limb or tree, the wood fibers will buckle or rupture. If sufficient strength is lost, the tree fails at that point.

When the upper limbs fail, they will probably fall mostly straight down, with some lateral movement depending on the configuration of the remaining wood and the direction and strength of the wind at the time. The greatest spread of branches is about 44 feet from the center of the base, so it could be expected that the greatest risk of damage or injury is within 50 feet of the tree. However, the area within 100 feet, the approximate height of the tree, should remain a protected zone and use of that area completely restricted.

The lower trunk is less at risk, although it also could fail. The base is wider, and still has some solid wood. The root system, while not particularly strong, shows no signs of extensive decay at ground level. There is undoubtedly decay in the roots beneath the base, but there is still sufficient strength to keep it upright under normal conditions. A strong wind, especially from the north or northwest, could cause the roots to fracture and the entire tree to topple, however.

Alternatives to Removal

Inevitably in cases such as this, questions of alternatives will arise. Options to preserve a historic tree are sought. I offer my opinion on several possibilities.

Pruning

Pruning of the tree will reduce the risk of failure somewhat, by reducing weight and wind resistance in the canopy. For the Liberty Tree, pruning would have to be extreme to be effective. Over 50 percent of the height, representing as much as 70 percent or more of the live canopy, would have to be removed. The top would have to be reduced from nearly 100 feet to about 50 feet (see Figure 6). All longer lateral limbs would have to be shortened to relieve the stresses on the main trunk. Although this drastic reduction will reduce the risk of failure, it will not eliminate it. The shear weight of the main trunk and the lack of solid wood could still result in failure, especially during windy conditions. Following pruning, new sprout growth may occur, growing from latent buds in the bark. The resulting sucker sprouts would be only weakly attached to the tree. As they increase in size over a few years, they would increase in risk of breakage and add more weight to the shortened tree. Repeated pruning would be necessary to maintain the size of the tree.

Pruning also has a physiological effect on the tree. The leaves are the mechanism by which the tree converts solar energy and light into the food sources it needs to sustain itself. Removal of a large portion of the canopy will dramatically alter the ability of the tree to maintain its life processes.

Figure 6 Comparative views of the Liberty Tree. The left photograph is an actual view of the tree, looking to the north. The right photograph is a modified view, representing what the tree would look like following severe pruning.

Defenses against insect and disease problems, and resistance to decay, will be compromised. The capacity to nourish the root system will falter, and a spiral of decline will begin.

Structural Supports: Cabling and Bracing

Installing support cables to help stabilize the limbs would be ill-advised on this tree. To be effective, there must be adequate anchorage for the supports. Cables are attached to a tree by drilling into the wood and placing steel eyebolts, to which the cables are attached. The Liberty Tree does not have sufficient sound wood remaining to hold the bolts securely. Support cables are intended to limit the stress on limbs by limiting their motion. Movement of the limbs and branches puts stress on the cables and on the limbs where they are attached. If a limb supported by a cable were to fail, it would either break free of the cabling hardware, or possibly cause the supporting limb to fail along with it.

Bolts installed though cavities offer only limited support, by distributing the forces on the sidewalls of the cavity. The intent of such bolts is usually to prevent widening and collapse of open cavities, or in some case to reduce the torque forces on limb attachments. Again, there is insufficient solid wood remaining in the Liberty Tree for this to be an effective remedy. Fiber buckling on a cellular level is a great risk for this tree, and mechanical supports by bolting or cabling will not alleviate this condition.

Mechanical supports, coupled with severe pruning, will reduce the risk of failure more than any of the treatments alone. Although this will "buy some time" for the tree, it will still not eliminate all risk of failure, and will still be only temporary measures at best.

Internal Supports

Internal supports, such as the concrete installed long ago, could be considered, but would be of questionable value, in my opinion. Cleaning and filling of the hollowed portions is not practical, and would be tremendously expensive.

Attempts to remove the decay, as I have discussed above, can be counterproductive to the tree.

Concrete or other cement products are rigid and inflexible, and do not allow movement of the tree. This has the effect of redistributing the forces from wind, often shifting them to critically weakened areas and actually increasing the risk of failure at those points. Also, concrete products are difficult and expensive to remove, when the tree finally has to be taken down.

An internal steel framework might be designed to support the tree. I am not trained as an engineer, so I can only speculate on what this type of system might entail. I envision a frame of support members, firmly secured to a basal footing, built from the ground up, and attached in many places to the remaining hulk of the tree. The framework would have to be built on site in small sections, and each fitted into the structure of the tree.

External Supports

An external support mechanism could also be devised to hold the tree. This would entail constructing several vertical support towers around the tree, and attaching the tree to these towers by means of support cables. Placement and number of the supporting towers would have to be determined based on analysis of the tree's structure and potential placement of the cables.

For both internal and external mechanisms, severe pruning would still be in order, as it would not be possible to provide adequate support to the long outer limbs. A scaffold would have to be erected around the entire tree to fully hold it up while the work is in progress. If an internal structure is devised, all old concrete and other supports would have to be removed- a formidable task. Even with scaffolding in place, there will be a risk of collapse. The artificial supports will be expensive, difficult to install and maintain, and will still not totally relieve the risk of failure.

Conclusions

Every tree has two aspects that it requires to remain viable: a physiological aspect and a structural aspect. For the Liberty Tree, the physiological tree has maintained good health, due in great part to the care and maintenance it has received over the years. The structural tree has been severely compromised however. Large limbs have broken from the tree, as evidenced by the large wounds and cavities throughout the canopy. An extensive network of decay has progressed through the trunk and limbs, despite efforts to limit its advance. The result is now a shell of wood that continues to lose strength.

Although the tree appears to be healthy, judging by the foliage, it is no longer capable of supporting its own great weight. Based on my analysis, the tree has lost as much as 85 percent or more of its wood to decay.

Efforts to support the tree artificially are not likely to help much. There is too little of the wood left. The limbs would have to be supported in numerous places. Severe pruning would be necessary to shorten and lighten the long, heavy branches. The very process of installing these support mechanisms and shortening the canopy would be detrimental to the tree, and would result in more rapid decline of its vitality. It would be an obtrusive and ignominious life support system for this grand old champion.

As a professional arborist, I must assess this situation with a detached view of the tree itself, irrespective of any significance of the tree or the site. I investigated the condition of the tree, and have based my opinions on that investigation. My conclusions are drawn solely from the empirical data I collected. Public safety must be an overriding consideration in the decision on the fate of the Liberty Tree. After much careful consideration of the condition of this tree, and the potential options for preserving it for a while longer, I must conclude that the only prudent and viable option remaining now is to remove the tree as soon as possible.

Prolonging the life of this tree cannot be justified when weighed against the risk of personal safety and cost. The tree is old. It has stood as silent witness for over four centuries. It has seen the development of a nation. Despite its grand size and age, the Liberty Tree has suffered many hardships over the years. Storms have ruthlessly shredded its leaves, and ripped branches, even large limbs, from its frame. Insects have made it their home, some boring into the wood, others sucking the juices of life from the leaves and twigs. Campers and wanderers, children and philosophers, vagrants and presidents, have all stood in the shade of this ancient giant. But finally, it is time to say goodbye to our old friend.

Recommendations

Removal

The only prudent course of action, in my professional opinion, is to remove the tree now. It is inherently unsafe, and at high risk of failure. Arrangements should be made to take it down as soon as possible.

Until the tree has been taken down, the protection barriers that were erected should be maintained. I suggest that some signs might be placed at key points, warning of the extreme hazard the tree presents.

Replacement

I suggest some consideration be given to replacement of the Liberty Tree. Although it cannot possibly be replaced in stature or significance, a young tree can be planted in its place. Some care must be given first to site preparation, however.

Although I did not find direct evidence of root disease, I suspect that there may be a fungus present in the soil that could affect future plantings. The shoestring root rot disease, *Armillaria mellea*, is a common pathogen that both progressively kills trees and causes their decay. While it was not found on the basal roots, it may be present inside the large cavity. To reduce the possibility of a new tree becoming infected, the soil in the immediate area around the site should be removed and replaced with suitable fresh topsoil. The old soil should be excavated about two feet deep, and about five feet beyond the base of the existing tree in all directions.

Glossary

Arborist A person possessing the technical competence through experience and related training to provide for or supervise the management of trees or other woody plants in a landscape setting.

Bracing Installation of steel rods or bolts through the stems or limbs, to reduce twisting or splitting of the wood.

Cabling Installation of steel cables, attached to lag screws or bolts placed in tree limbs, to provide additional support or to limit movement and stress of limbs.

Callus Undifferentiated cells, often formed at the edges of recent injuries. This tissue quickly becomes differentiated, forming cells of the type characteristic of that position on the tree (ie: forming wood, bark, roots, etc.)

Cambium A thin layer of actively growing and dividing cells, located between the xylem (sapwood) and bark of a plant; the part responsible for lateral growth of a tree stem or branch.

Canopy The live, foliage-bearing part of a tree.

Cavity An open and exposed area of wood, where the bark is missing and internal wood has been decayed and dissolved.

Crotch The union of two or more branches; the axillary zone between branches.

Crown The upper portions of a tree or shrub, including the main limbs, branches, and twigs.

Decay Progressive deterioration of organic tissues, usually caused by fungal or bacterial organisms, resulting in loss of cell structure, strength, and function. In wood, the loss of structural strength.

Decline Progressive reduction of health or vigor of a plant.

Fertilization The process of adding nutrients to a tree or plant; usually done by incorporating the nutrients into the soil, but sometimes by foliar application or injection directly into living tissues.

Foliage — The live leaves or needles of the tree; the plant part primarily responsible for photosynthesis.

Limb — A large lateral branch growing from the main trunk or from another larger branch.

Pathogen — A disease-causing organism, usually a fungus in plants, but may also be viral or bacterial.

Root System — The portion of the tree containing the root organs, including buttress roots, transport roots, and fine absorbing roots; all underground parts of the tree.

Sprout — Also water sprout. A shoot or stem that grows from the bark of a tree; adventitious or secondary growth.

Sucker — Same as sprout.

Target — Any person or object within reach of a falling tree or part of a tree, that may be injured or damaged.

Vigor — Active, healthy growth of plants: ability to respond to stress factors.

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Certification of Performance

I, Russell E. Carlson, certify:

• That I have personally inspected the tree(s) and / or the property referred to in this report, and have stated my findings accurately. The extent of the evaluation and appraisal is stated in the attached report and the Terms and Conditions;

• That I have no current or prospective interest in the vegetation or the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

• That the analysis, opinions and conclusions stated herein are my own, and are based on current scientific procedures and facts;

• That my compensation is not contingent upon the reporting of a predetermined conclusion that favors the cause of the client or any other party, nor upon the results of the assessment, the attainment of stipulated results, or the occurrence of any subsequent events;

• That my analysis, opinions, and conclusions were developed and this report has been prepared according to commonly accepted arboricultural practices;

• That no one provided significant professional assistance to the consultant, except as indicated within the report.

I further certify that I am a member of the American Society of Consulting Arborists, and I am an International Society of Arboriculture Certified Arborist. I have been involved in the practice of arboriculture and the care and study of trees for over 25 years.

*Signed:*______________________________________

*Date:*_______________________________________