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Introduction

The process of evaluating tree health and condition involves gathering information in the field, determining the significance of that information and producing a report of the findings. As many reports are the product of periodic ongoing monitoring of a developing situation, over time, some repetition in explanatory information is inevitable.

In producing and explaining the findings, each report is intended to be readily understood and able to stand alone, with no further reference being required by the reader.

Each report contains the following sections;

- **Overview** Describes the events that precipitated the initial evaluation and identifies the subject, owner and location.
- **Tree Inspection and Risk Assessment** Containing an explanation of the field work techniques and an outline of methods and instruments used in analysis and an explanation of the Risk Assessment system.
- **Observations** Gives site and tree specific information and commentary.
- **Conclusions** An interpretation of the field work observations, testing and analysis, with recommendations for treatment.

Overview

The Native Growth Protection Areas that surround the homes of Chestnut Trails are an integral part of the community landscape. Because of the size, age, and location of the trees, and the alterations in exposure following the development of the site, tree failure has occurred. In an effort to assess the risk associated with the trees the NGPA's have been periodically inspected; with the first evaluation being carried out in 1997. The periodic assessments of the trees takes place so that representatives of community can best manage the risk associated with the trees minimize harm and implement their duty of care. The periodic inspection took place on 1 / 3 / 13

Tree Inspection and Risk Assessment

To develop an accurate picture of tree health and condition, information must be gathered about the multiple, changeable, factors which influence tree vitality and stability. Vital, healthy tree growth is the result of a complex association of internal and external influences and to consider each tree as an isolated entity is to fall short in understanding the whole picture. As a practical matter, information must be gathered and structured in the best way to communicate the results of the observations and to impart any recommendations for treatment.

Individual tree inspection begins at ground level; tree genus and species is determined and soil quality, rooting conditions, soil level, irrigation and drainage characteristics are observed. Soil is a living micro-system that relies on an active working relationship between structural and living organic components. In an urban setting the structural condition of the soil is most commonly adversely affected. Alterations to physical soil structure will have an effect on the functions of the living soil components.

The quality of the soil may be assessed in its ability to contain and disperse available moisture and the level of soil compaction may be tested to evaluate the aeration capacity of the soil. Some soil types are easily compacted and although they are high in nutrient quantity, little nutrient is available to the growing tree. Compact soils also cause problems by restricting the trees ability to discharge the gasses produced as part of the growth cycle.

The visible parts of the tree, the trunk, branches and leaves live in balance with the unseen roots. Damage to the soil leads to inhibited root growth and causes a lack of vitality and decline within the tree as a whole. Soil compaction may be the result of short term heavy or long term frequent traffic in the root zone. The effects of soil compaction may not become apparent in the tree for decades following the initial compaction event.

If signs of stress are present, a soil test may be made to assess the fertility of the soil. Testing establishes the presence and degree of vital nutrients and micro-flora. Vital soil is essential to vital tree growth, the presence of nutrients and organisms within the soil mean that growth can continue. An imbalance of nutrients can cause poor vitality; often exhibited by leaf discoloration, distortion or lack of annual growth. Poor nutrition will slow growth can diminish the trees natural defense mechanisms and expose the tree to disease.

In nature, few tree species grow alone; the forest is their natural and protected setting. Whether native or introduced, regardless of a trees' origin, trees in a landscape setting demand special attention. Although bound by the genetic code of its predecessors each tree is also the product of its local environment in terms of health and structural form.

Looking at the overall picture, the health and condition of the soil, turf and other plants and trees can reveal the cause of disease, or indicate potential

problems. The presence of certain species of fungus can indicate decay. Decay fungi may destroy support tissues and leave conductive tissues unharmed. The tree may appear healthy and continue to grow until the internal decay outpaces the new outer growth whole tree collapse can result.

A root crown examination may be necessary if root decay is suspected. By removing the soil at the base of the tree, the location, health and condition of the absorbing and support roots can be determined.

In the primary examination of the root crown and trunk a mallet is used to test for loose bark. Bark lifting can indicate dead or hollow areas and give signs of the presence of decay in the root crown zone and at the base of the trunk. The mallet may be used to "sound" for decay but has limited reliability. If decay is suspected the tree will be tested using the Resistograph. Where Resistograph tests were made a more detailed explanation and an interpretation with illustrations is given later in the text.

The type of decay and its effect on the stability of the wood depends on the species of fungus involved. Soil and root tissue samples may be taken to determine the cause of disease by laboratory testing.

The inspection continues with an evaluation of the tree crown, first by eye or with the use of binoculars then, if necessary, by climbing into the canopy of the tree. The color, size and condition of the leaves, trunk, branches and twigs are assessed. The shape and formation of all the trees components give information about health, vitality and structural strength. The crown density, the number of leaves on each stem, and past and current growth extension, indicate current health and reveal previous problems. Changes in growth rate in past growth may indicate prior disease or injury.

An evaluation of the general growth habit will reveal any problems related to vigor, or the genetic component of tree growth. Previous treatments such as pruning or cabling are observed, the quality of the work, and its effect on the tree is assessed. Any growth abnormalities are noted: weak limbs, discolored or missing bark, cracks or cavities in branches or trunks. Indications of disease are observed within the canopy of the tree, disease may be indicated by leaf blight, leaf loss, poor vitality, stem canker, fungal growth or insect and bird activity.

Trees produce adaptive growth to compensate for the stress related to growth and injury. The shape and formation of limbs and trunks can reveal the ability of the tree to compensate for weakness or may indicate internal problems that could lead to limb or trunk breakage. The interpretation of these changes in

form is part of a growing body of knowledge pioneered in Europe and adopted across the globe. The knowledge is not new but the application of that knowledge in risk assessment is in the forefront of progress in understanding how trees compensate for stress. Research into stress-loading of trees and materials testing of wood structure has led to the development of systems of structural evaluation based on the principals of bio-engineering.

In many situations the results of the Tree Inspection are used as the basis of a Risk Assessment. The extent and depth to which the processes described above are followed depends on the scope of the assessment. For example; whether a single, high value tree next to a popular meeting place is the subject of the inspection or whether groups of trees in a relatively little used area of a community are of concern. Where large groups of trees are evaluated and are in similar condition and circumstances, group Risk Ratings may be applied.

Tree Risk Assessment

The assessment of risk in trees involves taking the information gathered during the Tree Inspection phase to determine a probability that all or part of a tree will break or fail. The Risk Assessment protocols also assess the risk that the tree failure will harm someone or something.

The method is outlined in the manual; ***Tree Risk Assessment in Urban Areas and the Urban Rural Interface.*** The manual forms the basis of the ***Tree Risk Assessment Course and Certification*** process.

Tree Risk Assessment is used to identify hazardous situations before damage or injury occurs. Risk Assessment is also used to facilitate risk management specifically to manage the risk associated with the retention of trees, using cultural practices to maintain the risk at an acceptable level. Risk Assessments are undertaken periodically by Certified Tree Risk Assessors as a matter of due diligence to allow the owner/ manager of the trees to meet a standard of care.

The method assesses three components and attaches a numeric value:

- **Probability of Failure (1-5 points)**
- **Size of the Defective Part (1-3 points)**
- **The presence and rate of occupation of a target. (1-4 points)**

Each of the three categories has been given a rating based on an assessment of a multiplicity of factors in each component.
The components are dealt with individually and the ratings are explained below.

Probability of Failure (1-5 points)

1. Low
2. Moderate
3. Moderately High
4. High
5. Extreme

The Probability of Failure rating represents an assessment of the condition of the tree and the likelihood of failure during ordinary conditions and predicable

extraordinary conditions such as prevalent local storm conditions. Predictable tree failure is usually due to structural weakness revealed by a combination of injury, decline, disease and defect, or changes in exposure. However, trees are shedding organisms, they periodically drop parts of themselves to maintain defense against disease and to provide for growth, this periodic shedding poses an element of risk and not all periodic shedding is predictable.

Size of Part (1-3 points)

The size rating is based on the diameter of the part.

1. Up to 4”
2. Between 4” to 20”
3. Greater than 20”

Target (1-4 points)

The target is rated on use and occupancy. The Target ratings are shown with an example.

1. Occasional use [trails]
2. Intermittent use [picnic/parking areas]
3. Frequent use, secondary structures [storage areas, frequently used structures]
4. Constant use, structures.[residences, buildings used for a number of hours each day, year round]

The Overall Risk Rating and Action Thresholds (3-12 points)

The Risk Rating is the sum of the three categories a number from 3 to 12 an interpretation of the rating and a discussion of the implications is provided in the Table Appendix One below:

The Overall Risk Rating and Action Thresholds		
Risk Rating	***Risk Category***	***Interpretation and Implications***
3	Low 1	Insignificant- no concern at all.
4	Low 2	Insignificant-very minor issues.
5	Low 3	Insignificant-minor issues not of concern for many years yet.
6	Moderate 1	Some issues but nothing that is likely to cause any problems for another 10 years or more.
7	Moderate 2	Well defined issues-retain and monitor. Not expected to be a problem for at least another 5-10 years.
8	Moderate 3	Well defined issues-retain and monitor. Not expected to be a problem for at least another 1-5 years.
9	High 1	The assessed issues have now become very clear. The tree can still reasonably be retained as it is not likely to fall apart right away, but it must now be monitored annually. At this stage it may be reasonable for the risk manager/owner to hold public education sessions to inform people of the issues and prepare them for the reality that part or the entire tree has to be removed.
10	High 2	The assessed issues have now become very clear. The probability of failure is now getting serious, or the target rating and/or site context have changed such that mitigation measures should now be on a schedule with a clearly defined timeline for action. There may still be time to inform the public of the work being planned, but there is not enough time to protracted discussion about whether or not there are alternative options available.
11	High 3	The tree, or a part of it has reached a stage where it could fail at any time. **Action to mitigate the risk is required within weeks rather than months.** By this stage there is not time to hold public meetings to discuss the issue. Risk reduction is a clearly defined issue and although the owner may wish to inform the public of the planned work, he/she should get on with it to avoid clearly foreseeable liabilities.
12	Extreme	This tree, or apart of it, is in the process of failing. **Immediate action is required**. All other less significant tree work should be suspended, and roads or work areas should be closed off, until the risk issues have been mitigated. This might be as simple as removing the critical part, drastically reducing overall tree height, or taking the tree down and cordoning off the area until final clean up, or complete removal can be accomplished. The immediate action required is to ensure that the clearly identified risk of harm is eliminated. For areas hit by severe storms, where many extreme risk trees can occur, drastic pruning and/or partial tree removals, followed by barriers to contain traffic, would be an acceptable first stage of risk reduction. There is no time to inform people or worry about public concerns. Clearly defined safety issues preclude further discussion.

Observations

The issues in relation to the trees at Chestnut Trails are well defined and documented. Periodic inspections have identified and isolated root disease sites and individual trees that were prone to failure. Trees have been removed or cut to snags to preclude failure and avert damage or injury. Since the original evaluation in 1997 the process of Hazard Evaluation has been adapted and Risk Assessment has become the norm. The process of Risk Assessment is described in the preceding section.

The situation at Chestnut Trails calls for an adapted use of the Risk Assessment system and this inspection has identified trees within the Risk categories, High 1 and High 2 for special attention or action within the annual evaluation cycle.

High 1	The assessed issues have now become very clear. The tree can still reasonably be retained as it is not likely to fall apart right away, but it must now be monitored annually. At this stage it may be reasonable for the risk manager/owner to hold public education sessions to inform people of the issues and prepare them for the reality that part or the entire tree has to be removed.
High 2	The assessed issues have now become very clear. The probability of failure is now getting serious, or the target rating and/or site context have changed such that mitigation measures should now be on a schedule with a clearly defined timeline for action. There may still be time to inform the public of the work being planned, but there is not enough time to protracted discussion about whether or not there are alternative options available.

The primary mode of tree failure at Chestnut Trails has been windthrow of whole trees due to high winds acting on exposed trees with decayed roots. Past reports have identified and confirmed root disease sites and called for the removal of exposed trees in proximity to those sites. High target zones have also been identified and shown on the sketch map of the site. The high target zones contain trees adjacent to residential property that are exposed.

Since the last inspection in February of 2011 a single significant tree failure has taken place; the location of the failure is shown on the site plan. The mode of failure was atypical for the site. The tree snapped at approximately 10' in height. Examination of the remains of the tree and the stump show that internal decay was present in the trunk, indications are that the tree was alive.

Conclusions and Recommendations

The periodic Inspection of the trees at Chestnut Trails took place on 1 / 3 / 2013. The tree work that was recommended following the 2011 inspection had been carried out with the trees being removed or reduced to high stumps to form wildlife snags. These trees had shown signs of decline during the last site visit and were located in a high target area with a history of previous failure and known root disease. The location of the recommended tree removals is shown on the 2011 sketch plan.

Trees growing at the base of the slope which rises to the north from 201st Pl. SE are showing indications of decline that is likely associated with Laminated Root Rot. These four trees were marked with a dot of fluorescent paint and are to be reduced or removed; shown on the updated sketch plan which is attached. At the top of the slope in the high target area adjacent to 201st St. SE two trees were marked. These trees are also located on the updated sketch plan. Resistograph tests were taken on two trees in the middle section of the slope, the location of the tests is shown on the updated sketch; no significant decay was found in the two trees. The test charts have been retained for reference.

Following the tree failure described above, which occurred outside the recommended Tree Inspection schedule, concerns were raised about another tree growing in close proximity to a residence on 201st St. SE. This tree was

noted to have some die-back in the leader during the last inspection. In that report it was noted that die-back of this kind can occur in drought related

circumstances and may not be indicative of severe root decay. This type of decline may also be related to the vestigial effect of site development, a trace result of clearing grading and construction. The true cause of the decline in this tree cannot be known without further extensive investigation which may include laboratory analysis. The recent failure that occurred caused damage to this property and the homeowner is understandably concerned about the condition of this tree. The recent failure occurred in a tree with extensive internal decay in the trunk. No such condition was detected in the tree shown in the photograph at left. In ordinary circumstances the recommendation would be to classify this tree as High 1 shown in the table on page 9. The current recommendation is that the site as a whole is monitored annually as outlined in the High 1 category. Three options exist in this situation: To investigate further to determine the cause of decline. To maintain the current recommended schedule of annual inspection or to remove or snag the tree. The choice of option is dependent on the preference of the community based on the preceding information and following conditions.

Where there is a likelihood of failure there is the possibility of injury and damage and the associated exposure to litigation. Trees, although generally long lived, are organic structures with a finite life cycle, which includes senescence and decline. They are also shedding organisms that periodically cast off parts to manage disease and to provide for growth. Each of these elements involves a degree of risk. Much of the risk can be managed by cultural techniques such as pruning or additional structural support. To remove *all risk* associated with trees would call for the removal of all trees. As a solution, wholesale tree removal is

neither prudent nor practical. To live with trees is to assume some level of risk. The degree of risk that is acceptable must be determined by the owner or manager of the property on which the tree resides. The goal is to provide a conservative assessment of the current condition of trees with an assessment of the associated risk and recommendations to aid in decision making.

Tree Inspection should not be considered as a one time event. Trees are dynamic organisms growing, aging and responding to multiple internal and external influences over time. In order to fully appreciate the effects of change continued monitoring through periodic inspection is necessary.

Monitoring by inspection is particularly important in the case of Chestnut Trails. The site has a history of failure and a number of trees are showing symptoms which may indicate early stage decline. These indications may also represent temporary set backs due to local environmental alterations and these trees may well recover and continue growing for many years to come. Continued monitoring will help assess the significance of the symptoms over time. The next inspection should be scheduled in January of 2014.

I hope the preceding information is clear. Please let me know if you require any further action on our part.

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