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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. Many reports are the product of periodic ongoing monitoring of a developing situation; as is the case at Chestnut Trails and 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 either the first time reader or the reader of multiple previous reports.

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 Chestnut Trails community was developed within several Native Growth Protection Areas. The areas containing pre-existing mature and semi mature trees form buffers that surround the homes of Chestnut Trails. They are an integral part of the community landscape providing natural habitat appreciation with informal walking trails that provide recreational opportunities and add to the overall livability of the community.

In part because of the size, age, condition, location, and exposure of the trees; tree failure has occurred in the past. In an effort to assess the risk associated with the trees and to facilitate risk management decisions the trees in the buffers have been periodically inspected. The inspections have taken place over a19 year span with the first evaluation being carried out in 1997.

The periodic assessments of the trees takes place so that representatives of the community can act to best manage the assessed risk associated with the trees, minimize harm, and implement their duty of care. This is the report of the periodic inspection which took place during early March of 2016.

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 nutrient 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, vitality 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 amount of live growth 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 assessment goes on to evaluate the consequences of such a failure by looking at the size of the part deemed most probable to fail and the potential for harm should failure take place. 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. Further guidance is provided in the **ISA's Best Management Practices, Tree Risk Assessment. ANSI A300 Part 9**

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 to provide tree owners/managers with pertinent information on trees under their care as a matter of due diligence to meet a standard of care.

Developing a Risk Rating

Past evaluations have relied on a modified quantitative approach to assessing risk based on the Likelihood of Failure and the consequences of failure in respect of harm. The method attached an ascending numeric value to

specific aspects of trees and the probability that damage or injury may occur in the case of failure. The ratings were added together to produce a risk rating. This method has been revised in light of information about the mathematical accuracy of the approach. Subsequently this report uses a qualitative approach characterizing the field work entries to produce descriptors of tree condition and potential consequences of failure to produce a risk rating and mitigation recommendations. The objective in carrying out the recommended risk mitigation procedures is to reduce the high risk trees to Low/Moderate.

Observations

The Native Growth Protection Areas (Buffers) at Chestnut Trails consist of stands or groups of indigenous conifers in the form of semi-mature Douglas fir (*Pseudotsuga menziesii*) with some Western Hemlock (*Tsuga heterophylla*), Western redcedar (*Thuja plicata*), Red Alder (*Alnus rub*ra) and Bigleaf Maple (*Acer macrophyllum*).

The issues in relation to the trees in the buffers at Chestnut Trails are well defined and documented. Prior inspections have identified and isolated root disease sites and identified individual trees in proximity to those sites that were prone to failure. In 2016 two severe windstorms took place and tree failure occurred. Subsequently, a new area of expanded disease was confirmed upon examination of the fallen tree. This area has been added to the updated sketch plan and is shown as D8. After the 2015 inspection trees that had a high probability of failure and that represented a high risk have been removed or cut to snags to avert damage or injury. Since the original evaluation in 1997 the process of Hazard Evaluation has evolved and the current Best Management

Practice is provided by the Tree Risk Assessment process. The process of Risk Assessment is described in the preceding section.

In 2013 it was recognized that the situation at Chestnut Trails would require an adaptation of the Risk Assessment system to identify high risk trees en-bloc. It was decided to attribute risk ratings for groups of trees in similar, condition and location. Trees in Risk categories, High 1 and High 2 were identified for special attention or action within the annual evaluation cycle.

In the past, the primary mode of tree failure at Chestnut Trails has been windthrow of whole trees. Failure was largely due to the effect of high winds on exposed trees with decayed roots. Past inspections 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 are shown on the sketch plan of the site. The high target zones contain trees adjacent to residential property that are exposed. The sketch plan has been updated to show the results of the 2016 Tree Inspection and Risk Assessment.

Since the inspection of February of 2011 a single significant tree failure has taken place. The mode of failure was atypical in that 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, although severely decayed, was still growing at the time of failure.

As with last year, this year’s report

includes some comparative photos. The photos are used to monitor visual condition of the same subject. Using this method along with on site observations will facilitate assessment of comparative tree condition.

Conclusions and Recommendations

The annual Tree Inspection and Risk Assessment of the trees at Chestnut Trails took place during the early March of 2016. The tree work that was recommended following the last inspection has been completed and trees have been cut to the ground or reduced to high stumps to form wildlife snags. This year's recommended work includes:

- Removal or snagging to a safe height a Hemlock tree; this tree is co-dominant with a crack developing between the stems; resonance testing gave indication that the tree is significantly decayed. The tree is located behind the residence at 3030 200th Pl. SE below Z1 on the native area adjacent to the path. As shown, the tree is painted with fluorescent orange and shown on the revised sketch.
- Removal or snagging to a safe height a Douglas fir behind the residence at 3018 200th Pl. SE close to a tree failure that occurred during the recent windstorm, painted with fluorescent orange

- Removal of a Cherry tree in the same vicinity within the NGPA (Z1) painted with fluorescent orange

- Also within Z1 are three large Douglas firs; behind 3106 200th Pl. SE and playground (shown in the photograph on the previous page). These trees should be crown cleaned and thinned to reduce windsail by 20%. They have been flagged with green tape and are shown on the revised sketch.
- Two additional Douglas firs have been marked for snagging or removal; one tree is co-dominant with a crack developing, located in the native area behind 3328 200th Pl. SE. The other tree is dead and approximately behind 3320 200th Pl. SE. Both are above Z4 and shown on the revised sketch.
- Two Douglas firs should be put on a high-priority monitoring schedule for potential removal down the line. They are located behind the home and adjacent home at 20011 34th Avenue SE. Access was limited and should be made available for the next inspection cycle.

In general the trees as a group appear to have continued in good health. Where die-back of the tops of trees has occurred the rate of tip dieback has slowed or abated (see photos below).This ongoing improvement in health as shown by growth extension, leaf color and density may be attributed in part to the identification and removal of diseased trees. Tree health improvement is likely also due to a further acclimatization of the remaining trees to the site conditions; also to an overall maturation of the site conditions and an adjustment of soil quality, tree rooting environment which occurs naturally over time.

The 2016 photograph at left illustrates new re-iterative growth in the upper canopy. This type of growth indicates that the tree is in the process of re-establishing a central leader. Monitoring the trees at Chestnut Trails remains important. The site has a history of tree failure and although there has been continued improvement in overall health and condition, some trees are showing signs which may indicate early stage decline. These indications may also represent temporary setbacks due to local environmental alterations, excessive rainfall, high winds and changes in exposure. Continued monitoring will help assess the significance of the symptoms over time. The next inspection should be scheduled for 2017.

As a separate issue, areas of concern were observed in several locations, for example, the shrubs and trees growing adjacent to the Play Area on 200th Pl SE next to the residence at 3106. The topsoil here has been washed, eroded or blown away. Where roots are now exposed replacement of the soil with fertile mulch is recommended. Two Douglas firs, one adjacent to 20018 33rd Dr. SE and another adjacent to 20011 33rd Dr. SE are on a high-priority monitoring schedule as of this year's inspection. Although resonance testing gave no indication of significant disease, they are "edge trees" and newly exposed.

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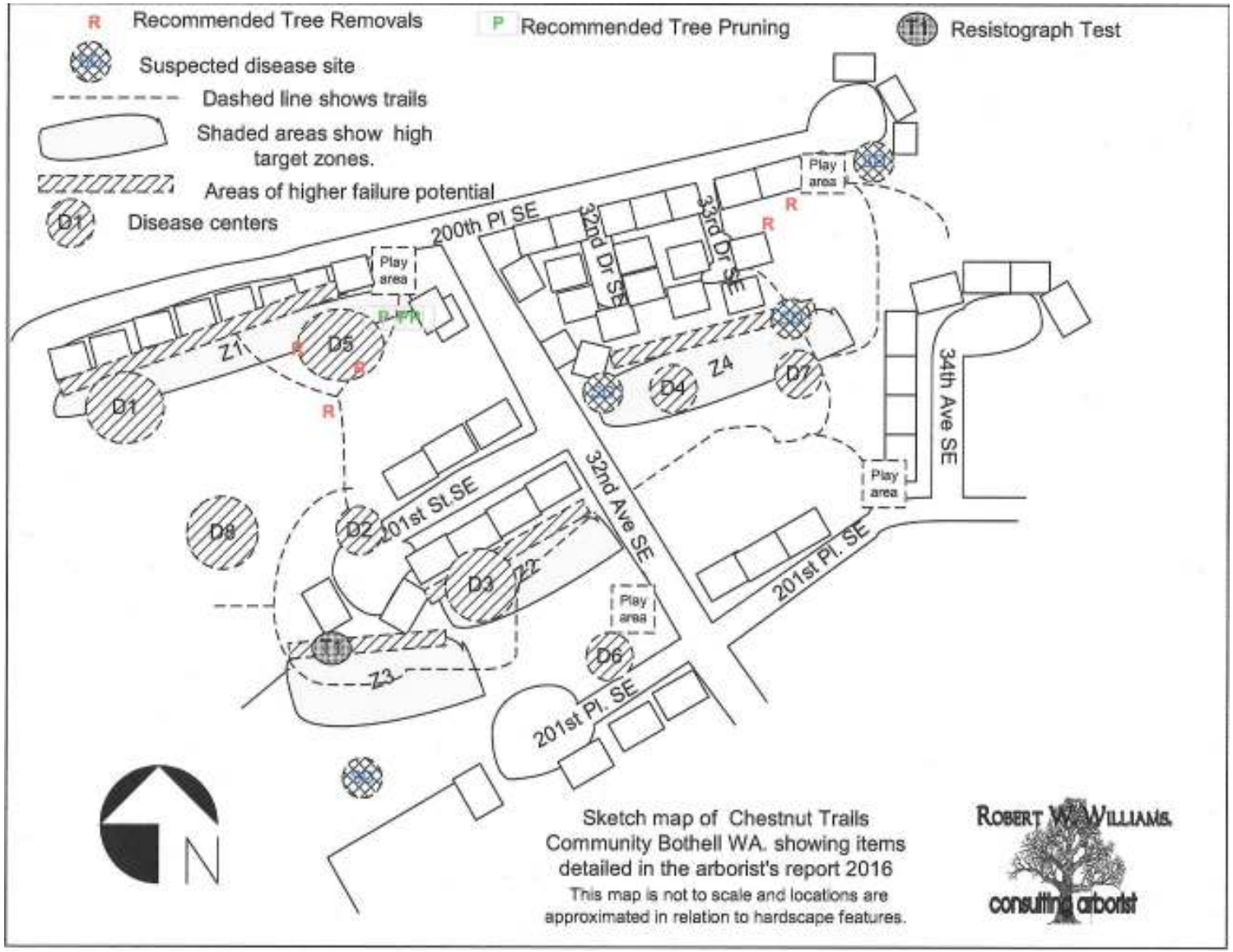
R Recommended Tree Removals
P Recommended Tree Pruning
T1 Resistograph Test
Suspected disease site
Dashed line shows trails
Shaded areas show high target zones.
Areas of higher failure potential
D1 Disease centers
200th Pl SE
32nd Dr SE
33rd Dr SE
34th Ave SE
32nd Ave SE
201st St SE
201st Pl. SE
Play area
Z1
Z2
Z3
Z4
D1
D2
D3
D4
D5
D6
D7
D8
N
Sketch map of Chestnut Trails Community Bothell WA. showing items detailed in the arborist's report 2016
This map is not to scale and locations are approximated in relation to hardscape features.
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