DUNSTER & ASSOCIATES
Environmental Consultants Ltd.

Risk Assessment of Two Black Cottonwoods at Georgia Avenue at the south east corner of 577 6th Street

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Background

The City of Nanaimo is planning to construct a new bridge across Chase River to connect the North East corner of Harewood Centennial Park to Georgia Avenue. Close to the planned alignment there are two large black cottonwood trees on the north bank. Dunster& Associates has been asked to conduct a risk assessment of these two trees to determine if they are suitable for retention.

The site was visited on May 1st 2018. Julian Dunster met with Kurtis Noble from the engineering department to discuss the project. Each tree was visually assessed and then a Level 3 assessment was undertaken using sonic tomography and resistance drilling to explore the inner conditions of each tree.

Figure 1 shows the approximate location of the two trees tested.

Figure 1. Approximate location of trees tested.

Tests Conducted

Both trees were tested using the Rinntech Arbotom for tomography, and the Rinntech Resistograph7 for drilling. The tomography provides a complete picture of internal conditions in one plane of the tree trunk. The drilling is used to confirm the tomography. In combination, the data provides an accurate assessment of internal conditions. Both trees were tested at 1.3 metres above the ground.

Figure 2 shows part of the tomography test on the downstream cottonwood tree.

Figure 2. Tomography set up.

Results

For ease of discussion I have labelled the downstream tree # 1 and the upstream tree # 2.

Tree # 1

Nineteen sensors were used to gain an image. Figure 3 shows the resulting tomogram. The low velocity data (purple) represents areas of decayed or missing wood (possibly hollow). The high velocity data (green) represents solid wood in good condition.

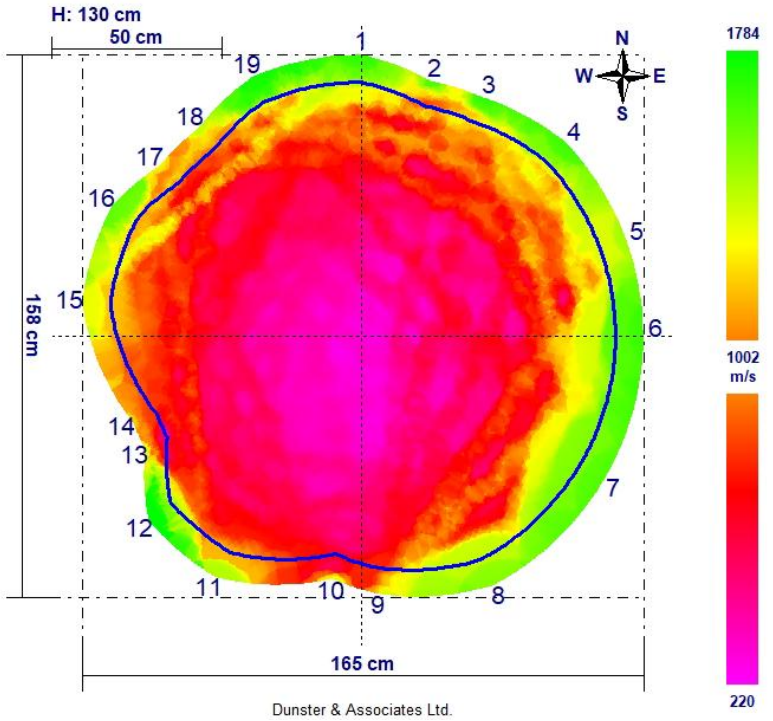

Figure 3. Tomogram of tree # 1.

Figures 4, and 5 are the results of drilling at sensors 7 and 16.

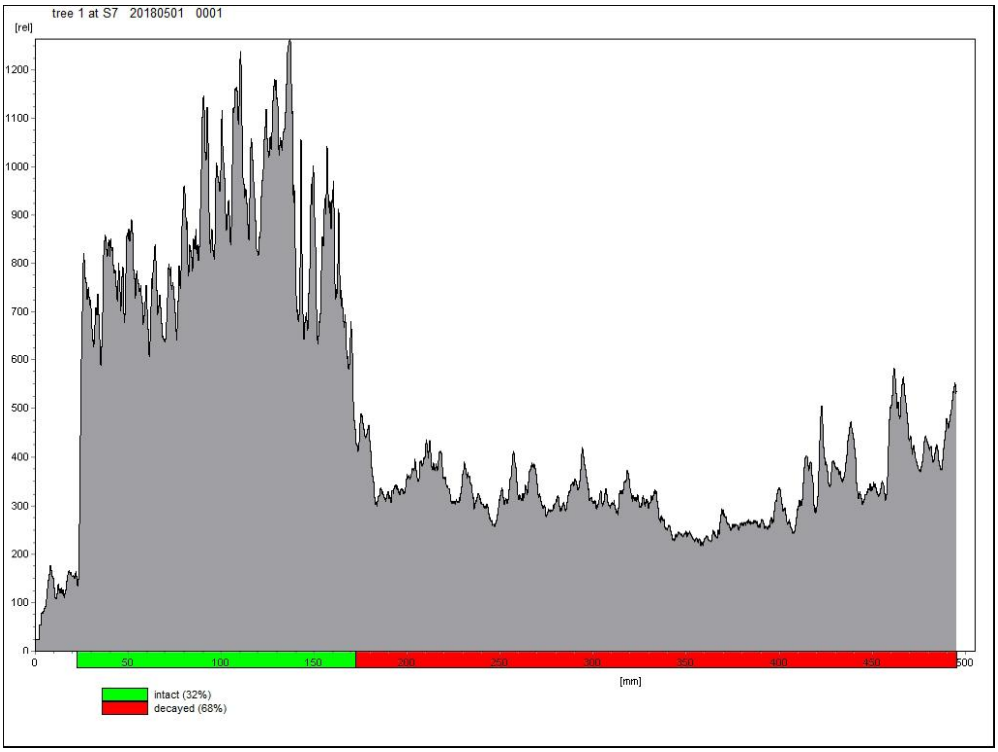

Figure 4. Drill data at Sensor 7.

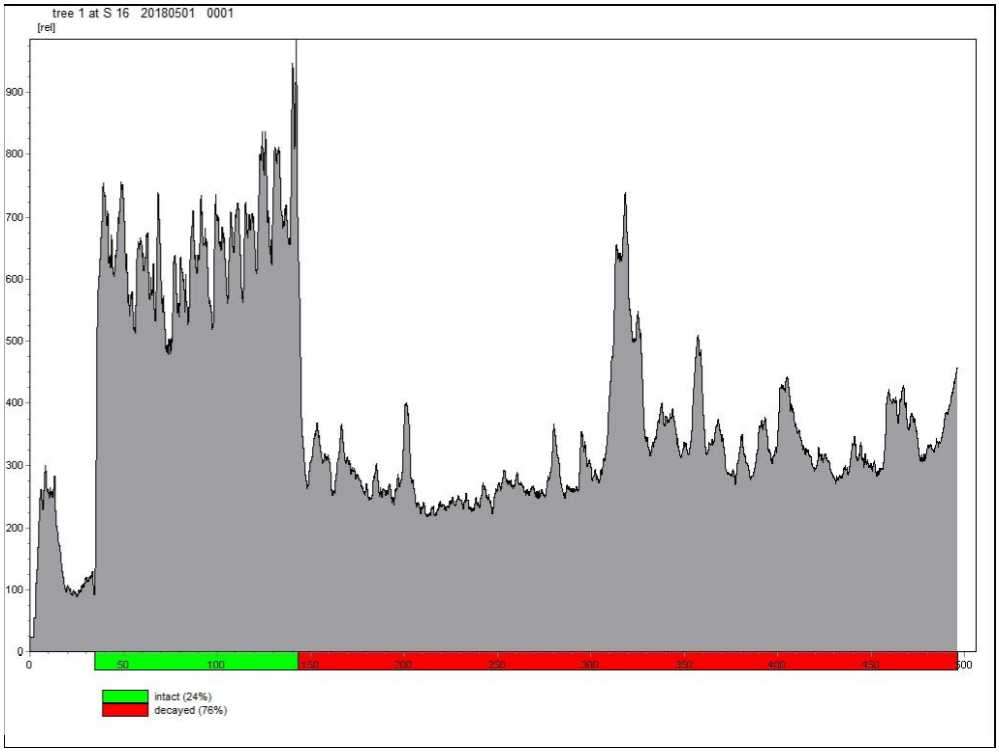

Figure 5. Drill data at Sensor 16.

Discussion

Tree # 1

The tree trunk has very extensive decay across the entire trunk. In this test I have set the shell wall thickness line (the blue line on the tomogram) to 10%. Strength loss calculations in the Arbotom software suggest that there is a average 48% loss of strength in the trunk when the wind was blowing from the south west to the north east. The Resistograph7 tests confirm that there is only 11 centimetres of solid wood at sensor 16 and 20 centimetres at sensor 7.

Overall the tree trunk is close to vertical, and there is a high crown with very little dieback. The base of the tree trunk has several pronounced flares, which likely represent response growth (new wood) being added onto the base of the tree to offset the internal decay which will go to the ground and extend upwards for several metres above the test point.

Using a standard tree risk assessment process the following factors are assessed and rated.

Likelihood of Impact

In the current setting there are almost no targets. The trail along the bank is occasionally used and the buildings are close to or beyond the reach of the top of the tree if it fell that way. I rate this factor as very low right now. However, during construction of the new bridge, and once it is built the target rating becomes high.

Likelihood of Failure

The tree is dominant in the riparian area. I note that there is a recent windthrown tree just upstream and it had the typical shallow root plate I would expect to see for a cottonwood in this type of location. Once the area is opened up to allow for the bridge construction the wind dynamics will change and tree # 1 will be more exposed. After that happens I would set a timeframe of two years and the likelihood of failure at probable. There are no signs that the tree is already starting to break up so I have not rated it as imminent.

Consequences.

Related to the target, in its current setting consequences would be minor in most scenarios, although Severe if the tree landed on a person. Once construction is underway and once the bridge is built consequences for people and property would be severe. A tree this large would likely destroy the bridge.

Overall, the risk for tree # 1 is rated as low in its current state and will be high during and after construction.

Tree # 2

Nine sensors were used to gain an image. Figure 6 shows the resulting tomogram. The low velocity data (purple) represents areas of decayed or missing wood (possibly hollow). The high velocity data (green) represents solid wood in good condition.

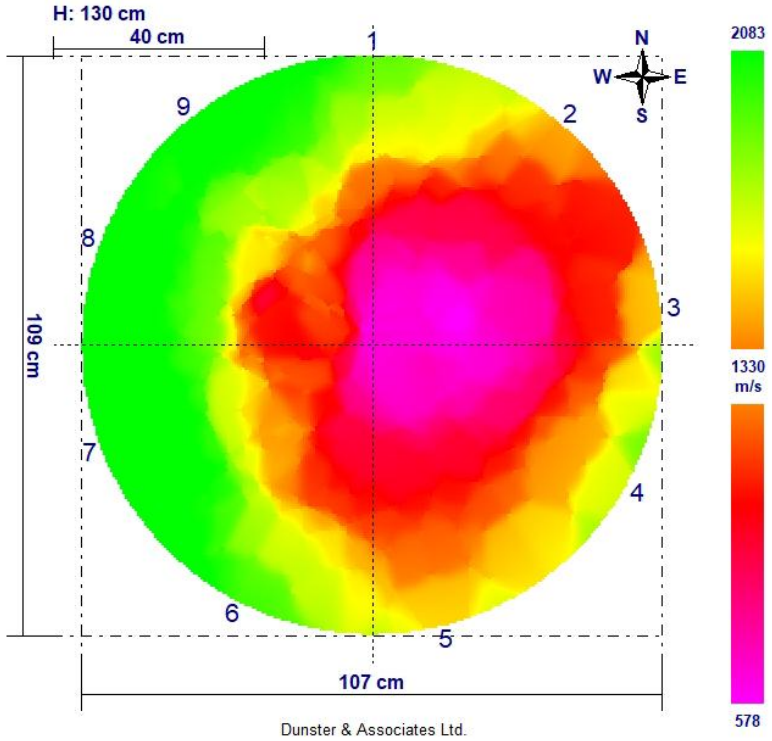

Figure 6. Tomogram of Tree # 2.

Figures 7 and 8 show drilling data at sensors 3 and 7.

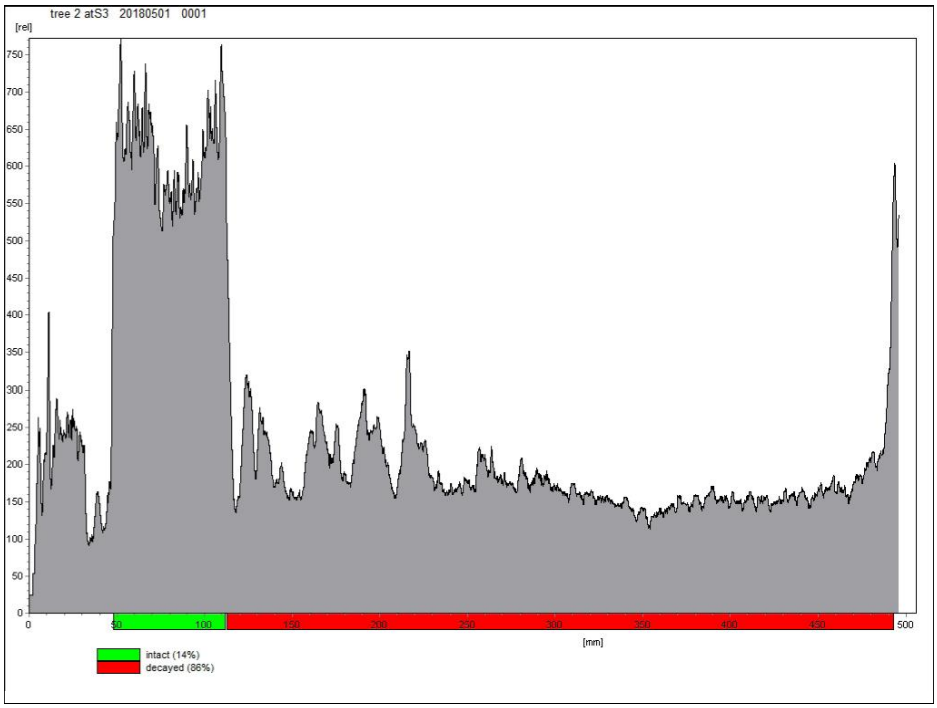

Figure 7. Drill data at Sensor 3.

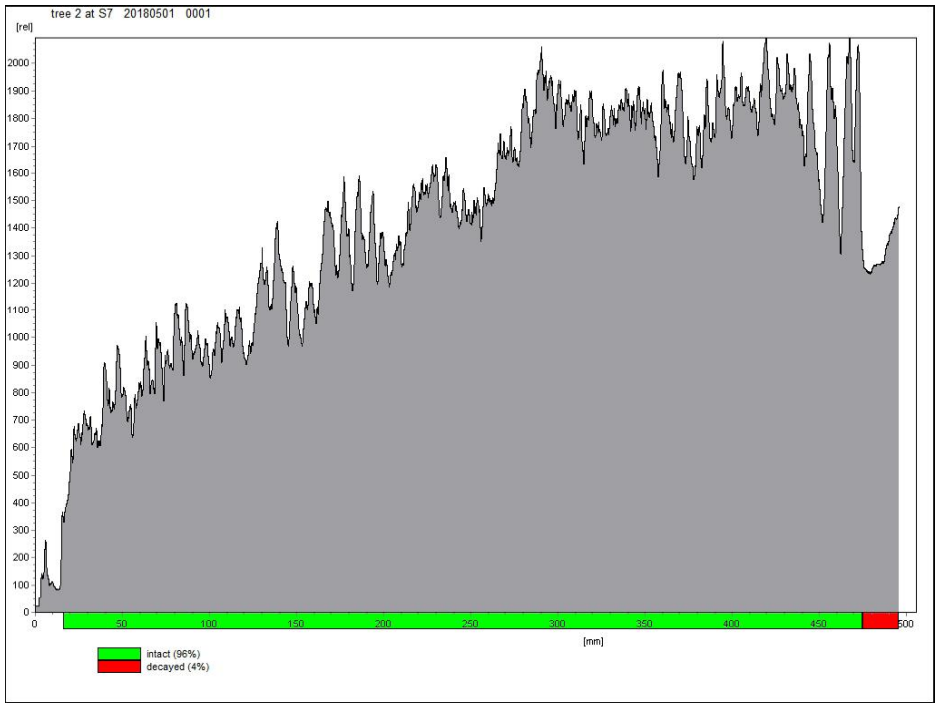

Figure 8. Drill data at Sensor 7.

Discussion

Tree # 2

There is an offcentre column of decay extending towards the east side. The tree leans southwest so the decay area is more on the tension side of the structure. Strength loss calculations in the Arbotom software suggest that there is a average 27% loss of strength in the trunk when the wind was blowing from the north east to the south west. The Resistograph7 tests confirm that there is only 7 centimetres of solid wood at sensor 3. On the tension side at sensor 7 there is about 45 centimetres of sound wood.

The tree leans over considerably and has a couple of areas of obvious crown dieback. The base of the tree trunk is quite symmetrical suggesting that the decay column may not be as extensive towards the ground or above the test point. There is an old wire rope embedded into the tree trunk close to the ground. The south side of the root mat is at the edge of the bank and slightly undermined. It appears to have been in that condition for a long time and is adapted to that setting.

Using a standard tree risk assessment process the following factors are assessed and rated.

Likelihood of Impact

In the current setting there are almost no targets. The trail along the bank is occasionally used and the buildings are close to or beyond the reach of the top of the tree if it fell that way. I rate this factor as very low right now. However, during construction of the new bridge, and once it is built the target rating becomes high.

Likelihood of Failure

The tree is dominant in the riparian area. I note that there is a recent windthrown tree just upstream and it had the typical shallow root plate I would expect to see for a cottonwood in this type of location. This recent failure affects tree # 2 more than tree # 1. Once the area is opened up to allow for the bridge construction the wind dynamics will change and tree # 2 will be much more exposed. After that happens I would set a timeframe of one year and the likelihood of failure at probable. There are no signs that the tree is already starting to break up so I have not rated it as imminent.

Consequences.
Related to the target, in its current setting consequences would be minor in most scenarios, although Severe if the tree landed on a person. Once construction is underway and once the bridge is built consequences for people and property would be severe. A tree this large would likely destroy the bridge.

Overall, the risk for tree # 2 is rated as low in its current state and will be high during and after construction.

Recommendations

Both trees have decay and both will be high risk trees once construction gets underway. The options available are as follows.

1 Retain both trees as is. Not recommended as both are a high risk for construction workers and for the completed bridge and bridge users.

2 Remove both trees in their entirety. That will eliminate all risk issues associated with both trees.

3 Consider creating wildlife trees. This only applies to tree # 1. Because both trees are in a riparian area I expect that removal will require use of a crane to avoid dropping materials into the river. To convert tree# 1 into a good wildlife tree remove the crown and retain a trunk about 10 metres high. Jag up the top cut surface of the trunk. That would leave a large standing column of wood. To add an extra degree of safety I would attach steel cables to the trunk at a point several metres below the top. Those cables would be attached to the ground downstream on either side of the bank and would act to prevent a collapse of the trunk onto the bridge. The tree trunk would then become an excellent habitat for owls, woodpeckers and other bird life. Tree # 2 leans too far and is not suitable for a wildlife tree.

Summary

Both trees have columns of decay in their trunks. Both trees are rated as a high risk once construction starts and the bridge is completed. Tree # 2 should be removed in its entirety. Tree # 1 could be retained as a wildlife tree.

Limitations of This Assessment

It is the policy of Dunster & Associates Environmental Consultants Ltd. to attach the following clauses regarding limitations. We do this to ensure that developers, owners, and approving officers are clearly aware of what is technically and professionally realistic in retaining trees.

1 The assessment of the two trees presented in this report has been made using accepted arboricultural techniques. These include a visual examination of each tree for structural defects, scars, external indications of decay such as fungal fruiting bodies, evidence of insect attack, discoloured foliage, the condition of any visible root structures, the degree and direction of lean (if any), the general condition of the tree(s) and the surrounding site, and the current or planned proximity of property and people. Neither of the trees examined were dissected, cored, probed, or climbed, and detailed root crown examinations involving excavation were not undertaken.

Notwithstanding the recommendations and conclusions made in this report, it must be realised that trees are living organisms, and their health and vigour constantly changes over time. They are not immune to changes in site conditions, or seasonal variations in the weather.

While reasonable efforts have been made to assess the two trees, no guarantees are offered, or implied, that these trees, or all parts of them, will remain standing. It is both professionally and practically impossible to predict with absolute certainty the behaviour of any single tree -- or group of trees -- , or all their component parts, in all given circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure in the event of adverse weather conditions, and this risk can only be eliminated if the tree is removed. Although every effort has been made

to ensure that this assessment is reasonably accurate, the trees should be re-assessed periodically. In accordance with standard practice, the assessment presented in this report is valid at the time it was undertaken. It is not a guarantee of safety.

2 Notwithstanding the recommendations made in this report, Dunster & Associates Environmental Consultants Ltd. accept no responsibility for the implementation of all or any part of this plan, unless we have specifically been requested to examine said implementation activities. Approval and implementation of this plan in no way implies any inspection or supervisory role on the part of Dunster & Associates Environmental Consultants Ltd. In the event that inspection or supervision of all or part of the implementation of the plan is requested, said request shall be in writing and the details agreed to in writing by both parties. Any on site inspection or supervisory work undertaken by Dunster & Associates Environmental Consultants Ltd. shall be recorded in written form and submitted to the client as a matter of record.

3 This report was prepared by Dunster & Associates exclusively for the City of Nanaimo. The contents reflect Dunster & Associates' best assessment of the tree in light of the information available to it at the time of preparation of this report. Any use which a third party makes of this report, or any reliance on or decisions made based upon this report, are made at the sole risk of any such third parties. Dunster & Associates accepts no responsibility for any damages or loss suffered by any third party or by the Client as a result of decisions made or actions based upon the use or reliance of this report by any such party.

4 The report has nine pages and shall be considered a whole, no sections are severable, and the report shall be considered incomplete if any pages are missing. The original report has colour illustrations. If the reader has a black and white copy the report shall be considered incomplete and any interpretation of the report may be incorrect in the absence of a full colour copy. Dunster & Associates accepts no responsibility for any such misinterpretations.

On Behalf of Dunster & Associates Environmental Consultants Ltd.

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