

Diamond Head Consulting Ltd. Arborist Report

For:

**1946-1998 Glenaire Dr
North Vancouver, BC**

July 28, 2017

To be submitted with Tree Protection Plan
Dated: July 28, 2017

Submitted to:

**PC Urban
Suite 880, 1090 West Georgia Street
Vancouver, BC V6E 3V7**

Submitted by:




**DIAMOND HEAD
CONSULTING LTD.**

**3551 Commercial Street
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The following Diamond Head Consulting staff performed the site visit and prepared the report. All general and professional liability insurance and individual accreditations have been provided below for reference.



Mike Coulthard
RPF (#3772) RPBio (#1338)

This report summarizes the planned management of trees on the site. If there are any questions or concerns as to the contents of this report, please contact us at any time.

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Insurance Information

WCB: # 657906 AQ (003)
General Liability: Northbridge General Insurance Corporation - Policy #CBC1935506,
\$5,000,000
Errors & Omissions: Lloyds Underwriters – Policy #1010615D, \$1,000,000

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1.0 Introduction

Diamond Head Consulting Ltd. (DHC) was asked to complete an assessment of the trees on and adjacent to the following proposed development:

Civic address:	1946-1998 Glenaire Dr North Vancouver, BC
Client name:	Robert Spencer PC Urban
Date of site visit:	Oct 19, 2015

The objective of this report is to ensure the proposed development is in compliance with District of North Vancouver Bylaws that applies to tree retention. These requirements are covered in the Tree Protection Bylaw (#7671). Protected trees as defined by this bylaw include:

- a. Any *tree* on land owned by or in the possession of the *District*, including, without limitation, a *tree* in a park or on a boulevard, road or lane allowance;
- b. Any *tree* within a *protected area*;
- c. Any *tree* on *sloping terrain*;
- d. Any *replacement tree*;
- e. Any *retained tree*;
- f. Any *heritage tree*;
- g. Any *wildlife tree*;
- h. Any *tree* located on *wetland* or *waterfront*;
- i. Any *tree* of the following species:
 - i. Arbutus (*Arbutus menziesii*);
 - ii. Garry Oak (*Quercus garryana*);
 - iii. Oregon Ash (*Fraxinus* spp);
 - iv. Pacific Yew (*Taxus brevifolia*);
 - v. Western White Pine (*Pinus monticola*); or
 - vi. Yellow-cedar (*Chamaecyparis nootkatensis*).

Replacement trees for the removal of large diameter trees (over 75cm) are required if the subject lot will have less than 20% canopy cover remaining after the removal of the large diameter tree. If the canopy cover is over 20% after the removal, no replacement tree is required.

- If the subject lot is less than 420 square meters in area, one replacement tree for every large-diameter tree must be planted.
- If the subject lot is over 420 square meters in area, three replacement trees for every large-diameter tree must be planted.

All trees (>20cm in diameter) on and immediately adjacent to the site were assessed, including: species, diameter at breast height (dbh) measured to the nearest 1 cm at 1.4 m above tree base, estimated height and general health and defects. Critical root zones were calculated for each of the trees with the potential for development impacts. Tree hazards were assessed according to International Society of Arboriculture and WCB standards. Suitability for tree retention was evaluated based on the health of the trees and their location in relation to the proposed building envelopes and infrastructure.

1.1 Limits of Assignment

- Our investigation is based solely on our visual inspection of the trees on Oct 19 and Aug 27, 2015. Our inspection was conducted from ground level. We did not conduct soil tests or root examination to assess the condition of the root system of the trees.
- Only the trees specified in the scope of work were assessed and assessments were performed within the limitations specified.
- This report does not provide any estimates to implement the proposed recommendations provided in this report.
- This report is valid for six months from the date of submission. Additional site visits and report revisions are required after this point to ensure accuracy of the report for the District's development permit application process.

1.2 Purpose and Use of Report

- Provide documentation pertaining to on and off site trees to supplement the proposed development permit application.



Figure 1. Location of site – 1946-1998 Glenaire Dr.

2.0 Observations

2.1 Site Overview

The site consists of five residential lots. The proposed development includes a row of townhouses to be built. Capilano River runs along the north edge of the development site. The majority of trees have been cleared from the existing developed lots. There is an open band of mature trees that is currently growing from the north property lines down to the high water mark of the River. Tree species found in this area include a mix of native and non-native species. The largest trees include native black cottonwood (*Populus trichocarpa*). Other native species found in this area include western redcedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*) and Douglas-fir (*Pseudotsuga menziesii*). There are a number of non-native trees species within the assessment area including Horse chestnut (*Aesculus hippocastanum*).

There are two large mature conifers growing in the front yards including an open grown Douglas-fir and a Western redcedar that has been previously topped. Smaller non-native trees are found in the landscaped back yards of 1946 and 1958. There is also a dense row of native cedar, hemlock as well as non-native hornbeam growing along the eastern boundary of 1998.

A windfirm boundary assessment was completed for the trees growing along the Capilano River. This identified edge trees that must be retained and protected in order to comply with the Provincial Riparian Areas Regulation. The windfirm boundary that has been identified includes those mature trees that are growing along the backs of these lots.

2.2 Tree Inventory

The following is an inventory of assessed trees, each of which was marked with a numbered tag. The trees that are protected under the District Tree Bylaw have been highlighted in red. Tree species, characteristics, comments, recommendations and required root protection zones have been suggested (Table 1). Their locations are illustrated on the accompanying map.

Overall Health and Condition Rating

- **Excellent** = Tree of possible specimen quality, unique species or size with no discernible defects. Or a heritage tree.
- **Normal** = These trees are in fair to good condition, considering its growing environment and species.
- **Poor** = These trees have low vigour, with noted health and/or structural defects. This tree is starting to decline from its typical species growth habits.
- **Very poor** = These trees are in serious decline from its typical growth habits, with multiple very definable health and/or structural defects.
- **Dead/Dying** = These trees were found to be dead, and/or have severe defects and are in severe decline.
- **High Risk** = These trees have been deemed hazardous by a Certified Tree Risk Assessor utilizing CTRA methods. They have a probability of failure of 3 or higher with a total overall risk rating of 8 (Moderate 3) or above.

Tree Retention Suitability Ratings

- **Unsuitable** = Not suitable for retention in context of the proposed project design and land use changes. These trees have pre-existing health and structural defects. There is a significant chance that these trees will not survive or may become a hazard given the proposed future land use.
- **Moderate** = These trees have moderate structural defects or health issues. The retention of this class of trees is not always successful or viable due to their pre-existing structural defects or health issues; however these trees may be viable for retention with the use of special measures.
- **Suitable** = These trees have no obvious structural defects or health issues, and are worthy of consideration for retention in the proposed development.
- **Suitable as group** = These trees have grown up in groups (groves) of other trees, and have not developed the type of trunk and root structure that will allow them to be safely retained on their own. These trees should only be retained in groups.

Tree Risk Assessment

Tree Risk Assessment

The risk assessment has been completed following the methods in the Tree Risk Assessment Manual, published in 2013 by the International Society of Arboriculture. This is the current industry standard for assessing tree risk. This method assigns risk based on the likelihood of failure, the likelihood of impact and the severity of consequence if a failure occurs. The risk rating matrix used to calculate risk is found in Appendix A. The tree risk assessment findings summarized in **Table 2**. The possible targets that the trees could strike if all or parts of the trees failed include: the new homes, the access road and bridge.

2.3 Photographs



Photo 1. View north over existing residences at mature trees growing adjacent to the backs of the lots.



Photo 2. View of riparian buffer from the river.



Photo 3. View of tree 3947



Photo 4. View of tree 3982



Photo 5. View of trees 3948-3952



Photo 6. View of tree 472 with tree house

Table 1. Tree Inventory.

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
466	Western Hemlock	<i>Tsuga heterophylla</i>	51	20	80-89%	Good	Suitable	Full crown. Open grown. This is a natural edge tree. No other mature trees exist to the south. Windfirm riparian edge tree. This tree is in conflict with the proposed parkade excavation.	Remove	5.1	5.3
471	Western White Pine	<i>Pinus monticola</i>	34	22	70-79%	Good	Suitable	Inside active yard space. The only other mature trees north of this include two cottonwoods along the high water mark of the river. Windfirm riparian edge tree.	Retain	3.4	3.6
472	Western Redcedar	<i>Thuja plicata</i>	69	21	70-79%	Good	Suitable	Inside active yard space. A tree house has been built around the base of this tree. However it has caused no major damage and can be removed. There are no other mature trees to the south. Windfirm riparian edge tree.	Retain	6	6.4
3947	Douglas-fir	<i>Pseudotsuga menziesii</i>	104	41	70-79%	Excellent	Suitable	Open grown full crown. Between two driveways with roots cracking asphalt to the west. Large size tree. This tree is in conflict with the proposed parkade excavation.	Remove	8	8.5
3954	Western Hemlock	<i>Tsuga heterophylla</i>	33	15	50-59%	Poor	Unsuitable	Previously topped at 8m. Decay at crotch of old topping. 1m from shed. This tree is in conflict with the proposed parkade excavation.	Remove	3.3	3.5
3955	Western Hemlock	<i>Tsuga heterophylla</i>	31	14	60-69%	Poor	Unsuitable	Previously topped at 8m. Decay at crotch of old topping. 1m from shed. This tree is in conflict with the proposed parkade excavation..	Remove	3.1	3.3

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
3956	Western Redcedar	Thuja plicata	39	16	70-79%	Poor	Unsuitable	Co-dominant stems from 1m (17cm, 22cm). One stem topped at 8m but not hazardous. Growing 1m from shed. This tree is in conflict with the proposed parkade excavation.	Remove	3.9	4.1
3957	Western Redcedar	Thuja plicata	50	17	70-79%	Poor	Suitable	Co-dominant stems from base (24cm, 26cm). Growing 1m from shed. Ropes tied around stem starting to girdle it. This tree is in conflict with the proposed parkade excavation.	Remove	5	5.3
3958	Western Redcedar	Thuja plicata	57	15	60-69%	Normal	Suitable	Co-dominant stems from base but no included bark (28cm, 29cm). Growing 1m from shed. This tree is in conflict with the proposed parkade excavation.	Remove	5.7	6
3959	Western Redcedar	Thuja plicata	23	15	60-69%	Normal	Suitable	Growing 1m from shed. Roots conflict with building envelope. This tree is in conflict with the proposed parkade excavation.	Remove	2.3	2.4
3960	Western Redcedar	Thuja plicata	28	15	80-89%	Normal	Suitable	Growing 2m from shed. Roots conflict with building envelope. This tree is in conflict with the proposed parkade excavation.	Remove	2.8	2.9
3961	Western Redcedar	Thuja plicata	19	13	70-79%	Normal	Suitable	Suppressed by adjacent cedars. Growing 1m from shed. This tree is in conflict with the proposed parkade excavation.	Remove	1.9	2
3962	Western Redcedar	Thuja plicata	44	17	70-79%	Normal	Suitable	Growing 0.5m from shed. Ropes tied around stem. This tree is in conflict with the proposed parkade excavation.	Remove	4.4	4.6
3966	Cypress	Cupressaceae	26	8	<20%	Dead/dying	Unsuitable	Almost dead. 10% live crown. This tree is in conflict with the proposed parkade excavation.	Remove	2.6	2.7

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
3968	Western Redcedar	Thuja plicata	61	9	30-39%	Poor	Unsuitable	5 stems growing from the base (16cm, 6cm, 12cm, 13cm, 14cm). Low live crown. Growing on top of 1m retaining wall. Poor structure but not hazardous. This tree is in conflict with the proposed parkade excavation.	Remove	2	2.1
3969	Western Redcedar	Thuja plicata	49	8	60-69%	Poor	Suitable	3 stems growing from base (19cm, 17cm, 13cm). Growing on top of 1m retaining wall. Poor structure but not hazardous. This tree is in conflict with the proposed parkade excavation.	Remove	2	2.1
3970	Western Redcedar	Thuja plicata	35	9	80-89%	Normal	Suitable	Growing on top of 1m retaining wall. This tree is in conflict with the proposed parkade excavation.	Remove	3.5	3.7
3971	Cypress	Cupressaceae	18	14	70-79%	Normal	Suitable	Growing in a row. This tree is in conflict with the proposed parkade excavation.	Remove	1.8	1.9
3972	Cypress	Cupressaceae	14	13	70-79%	Normal	Suitable	Growing in a row. This tree is in conflict with the proposed parkade excavation.	Remove	1.4	1.5
3973	Cypress	Cupressaceae	13	13	50-59%	Normal	Suitable	Growing in a row. This tree is in conflict with the proposed parkade excavation.	Remove	1.3	1.4
3974	Cypress	Cupressaceae	15	13	50-59%	Normal	Suitable	Growing in a row.	Retain	1.5	1.6
3975	Cypress	Cupressaceae	13	12	50-59%	Normal	Suitable	Growing in a row.	Retain	1.3	1.4
3976	Cypress	Cupressaceae	13	12	50-59%	Normal	Suitable	Growing in a row.	Retain	1.3	1.4
3977	Shorepine	Pinus contorta	16	12	30-39%	Poor	Unsuitable	Leaning 5 degrees. Thin crown. Cannot reach target.	Retain	1.6	1.7
3979	Western Redcedar	Thuja plicata	31	15	80-89%	Poor	Suitable	Wire grown into stem at 1.5m but no sign of health effects.	Retain	3.1	3.3
3980	Sitka Spruce	Picea sitchensis	18	6	50-59%	Poor	Unsuitable	Girdled at 2m. Leaning 5 degrees. Crown mostly on south side. This tree	Remove	1.8	1.9

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
								is in conflict with the proposed parkade excavation.			
3981	Western Redcedar	Thuja plicata	22	8	30-39%	Normal	Suitable	Lift pruned. This tree is in conflict with the proposed parkade excavation.	Remove	2.2	2.3
3982	Western Redcedar	Thuja plicata	95	19	80-89%	Poor	Suitable	Tree was topped at 19m. Growing in a 0.3m tall wall around base. Conflict with building envelope. Large diameter tree.	Remove	7	7.5
3983	Amabilis Fir	Abies amabilis	27	9	80-89%	Normal	Suitable	Growing in landscaped area. Rocks and retaining wall over root zone.	Retain	2.7	2.8
3985	Shorepine	Pinus contorta	33	9	70-79%	Normal	Suitable	Growing in landscaped area. Rocks, gravel and retaining wall over root zone.	Retain	3.3	3.5
3986	Western Hemlock	Tsuga heterophylla	17	9	80-89%	Normal	Suitable	In landscape area 0.5m to pavers. This tree is in conflict with the proposed parkade excavation.	Remove	1.7	1.8
3987	Bigtooth Aspen	Populus grandidentata	13	12	80-89%	Normal	Suitable	Variety uncertain. Growing in landscaped area, 0.5m to pavers. This tree is in conflict with the proposed parkade excavation.	Remove	1.3	1.4
3988	Bigtooth Aspen	Populus grandidentata	12	1	80-89%	Normal	Suitable	Variety uncertain. Growing in landscaped area, 0.5m to pavers. This tree is in conflict with the proposed parkade excavation.	Remove	1.2	1.3
3989	Western Redcedar	Thuja plicata	96	28	60-69%	Poor	Suitable	Was topped at 18m with multiple stems. Has poor structure. Aerial assess for risk if retained. Large diameter tree. This tree is in conflict with the proposed parkade excavation.	Remove	7	7.5
Off Site 465	Douglas-fir	Pseudotsuga menziesii	50	25	70-79%	Good	Suitable	Minor deadwood in lower 1/3 of crown. This is a natural edge tree. No other mature trees exist to the south.	Remove	5	5.3

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
								Windfirm riparian edge tree. This tree is in conflict with the proposed parkade excavation.			
Off Site 467	Black Cottonwood	Populus balsamifera ssp. trichocarpa	68	24	50-59%	Good	Suitable as group	This is a mature dominant tree with full crown. It is open grown. All trees to the south include 8-15m tall cedars. Windfirm riparian edge tree. This tree is in conflict with the proposed parkade excavation.	Remove	6	6.3
Off Site 468	Horsechestnut	Aesculus hippocastanum	20	11	80-89%	Fair	Suitable as group	Minor signs of drought stress. There are no other mature trees in this area. Two similar size bigleaf maples exist to the west. Windfirm riparian edge tree.	Retain	3	3.1
Off Site 469	Horsechestnut	Aesculus hippocastanum	32	13	80-89%	Fair	Suitable as group	Minor signs of drought stress. There are no other mature trees in this area. This is the only tree between the river and edge of property. Windfirm riparian edge tree.	Retain	3.2	3.4
Off Site 470	Black Cottonwood	Populus balsamifera ssp. trichocarpa	66	33	80-89%	Good	Suitable	This is the only mature tree between the river and edge of property. Windfirm riparian edge tree.	Retain	6	6.3
Off Site 473	Black Cottonwood	Populus balsamifera ssp. trichocarpa	140	28	70-79%	Fair	Suitable	Large trees with 2 co-dominant stems from base the base. The north most stem has decay in the base and has a broken top. It is hwoever leaning towards the river and not a risk to the development site. This is the only mature tree between the river and the property. Windfirm riparian edge tree.	Retain	8	8.7
Off Site 8358	Black Cottonwood	Populus balsamifera ssp. trichocarpa	80	33	80-89%	Good	Suitable	Growing at the top of a steep bank. Leaning towards the river. Location not surveyed. Windfirm riparian edge tree.	Retain	7	7.4

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
Off Site 3948	Hornbeam	Carpinus Sp	14	8	70-79%	Normal	Suitable	Growing up against driveway. Minor decay in stem at base. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	1.4	1.5
Off Site 3949	Hornbeam	Carpinus Sp	17	9	70-79%	Normal	Suitable	Growing up against driveway. Minor decay in stem at base. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	1.7	1.8
Off Site 3950	Hornbeam	Carpinus Sp	17	9	70-79%	Normal	Suitable	Growing up against driveway. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	1.7	1.8
Off Site 3951	Hornbeam	Carpinus Sp	19	9	70-79%	Normal	Suitable	Growing up against driveway. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	1.9	2
Off Site 3952	Hornbeam	Carpinus Sp	24	9	80-89%	Normal	Suitable	Growing up against driveway. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	2.4	2.5
Off Site 3953	Western Redcedar	Thuja plicata	15	8	70-79%	Normal	Suitable	0.5m from shed and walkway. Suppressed by adjacent trees. District owned tree. This tree is in conflict with the proposed parkade excavation.	Remove	1.5	1.6
Off Site 3963	Liquid Amber	Liquidambar styraciflua	16	8	80-89%	Normal	Suitable	Growing 1m from sidewalk. District owned tree.	Retain	1.6	1.7
Off Site 3964	Liquid Amber	Liquidambar styraciflua	13	8	80-89%	Normal	Suitable	Growing 1m from sidewalk. District owned tree.	Retain	1.3	1.4
Off Site 3965	Red Alder	Alnus rubra	21	10	50-59%	Poor	Unsuitable	Leaning 25 degrees over road. Minor decay in stem. Poses a hazard to the road. District owned tree.	Remove	2.1	2.2

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Live Crown Ratio (%)	Overall Condition	Suitability	Comments	Retain/Remove	Tree Protection Zone (m) from center of tree	Tree Protection Zone (m) from outer edge of tree
Off Site 3967	Western Hemlock	Tsuga heterophylla	37	20	40-49%	Normal	Suitable as group	Supressed by adjacent cottonwood. In riparian zone.	Retain	3.7	3.9
Off Site 3984	Black Spruce	Picea mariana	28	14	80-89%	Normal	Suitable	Growing in landscaped area.	Retain	2.8	2.9
Off Site 1	Western Hemlock	Tsuga heterophylla	70	21	80-89%	Poor	Suitable	4 co-dominant stems from 4m. Off-site riparian tree. Not assessed for risk. Requires protection during construction. Edge of excavation will impact <20% of critical root zone.	Retain	7	7.4
Off Site 2	Douglas-fir	Pseudotsuga menziesii	80	25	80-89%	Poor	Suitable	3 co-dominant stems from 4m. Off-site riparian tree. Not assessed for risk. Requires protection during construction.	Retain	7	7.4

2.4 Tree Risk Inventory

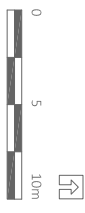
Only trees that had an overall risk rating of High or above are included in the following table. The remainder of the trees on the subject site are a moderate risk rating or lower and are suitable for retention in their current land use and condition.

Table 2. Tree Risk Assessment.

Tree #	Likelihood of failure	Likelihood of impacting the target	Likelihood of failure & impact (From Matrix 1)	Consequence of failure	Tree Risk Rating (From Matrix 2)
3954	Possible	High	Likely	Significant	High
3954	Possible	High	Likely	Significant	High
3966	Possible	High	Likely	Significant	High

Tree not surveyed,
location to be
confirmed

Tree protection fence to be
placed as close as possible
from the excavation line.



- LEGEND**
- TREE PROTECTION ZONE
 - - - NO-BUILD ZONE
 - TREE PROTECTION FENCE
 - TREE TO BE RETAINED
 - UN-SURVEYED TREE
 - ✗ TREE TO BE REMOVED

NOTES

1. The location of un-surveyed trees on this plan is approximate. Their location and ownership cannot be confirmed without being surveyed by a Registered BC Land Surveyor.
2. All tree protection fencing must be built to the relevant municipal bylaw specifications. The dimensions shown are from the outer edge of the stem of the tree.
3. The tree protection zone shown is a graphical representation of the critical root zone, measured from the outer edge of the stem of the tree ($\frac{1}{2}$ the trees diameter) was added to the graphical tree protection circles to accommodate the survey point being in the center of the tree).
4. Any construction activities or grade changes within the Root Protection Zone must be approved by the project arborist.
5. This plan is based on a topographic and tree location survey provided by the owners' Registered British Columbia Land Surveyor (BCLS) and layout drawings provide by the owners' Engineer (P Eng).
6. This plan is provided for context only, and is not certified as to the accuracy of the location of features or dimensions that are shown on this plan. Please refer to the original survey plan and engineering plans.

REFERENCE DRAWINGS

1. Base Survey by:

Drawing No: 001
Date: 2017/07/27
Drawn by: GD
Page Size: TABLOID 11"x17"



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Drawing title: Tree Retention and Removal Plan
Project address: 1946-1998 Glenaire Drive
Client: PC Urban



3.0 Summary

The site inventory identified 54 trees on or directly adjacent to the property that are greater than 10cm in diameter. 34 total trees are proposed to be removed for the development. This is due to conflicts with the excavation for the parkade. 25 of these trees to be removed are on site while 9 are off site.

3.1 Tree Retention and Removal by Species

Table 3. Tree species summary for on an off site trees

Tree Species	Total Number of Trees	Total Retained	Total Removed
Amabilis Fir	1	1	
Bigtooth Aspen	2		2
Black Cottonwood	4	3	1
Black Spruce	1	1	
Cypress	7	3	4
Douglas-fir	3	1	2
Hornbeam	5		5
Horsechestnut	2	2	
Liquid Amber	2	2	
Red Alder	1		1
Shorepine	2	2	
Sitka Spruce	1		1
Western Hemlock	6	2	4
Western Redcedar	16	2	14
Western White Pine	1	1	
Total	54	20	34

Table 4. Tree species summary for on site trees

Tree Species	Total Number of on site Trees	Total on site Trees Retained	Total on site trees Removed
Amabilis Fir	1	1	
Bigtooth Aspen	2		2
Black Cottonwood			
Black Spruce			
Cypress	7	3	4
Douglas-fir	1		1
Hornbeam			
Horsechestnut			
Liquid Amber			
Red Alder			
Shorepine	2	2	
Sitka Spruce	1		1
Western Hemlock	4		4
Western Redcedar	15	2	13
Western White Pine	1	1	
Total	34	9	25

Table 5. Tree species summary for off site trees

Tree Species	Total Number of off site Trees	Total off site Trees Retained	Total off site trees Removed
Amabilis Fir			
Bigtooth Aspen			
Black Cottonwood	4	3	1
Black Spruce	1	1	
Cypress			
Douglas-fir	2	1	1
Hornbeam	5		5
Horsechestnut	2	2	
Liquid Amber	2	2	
Red Alder	1		1
Shorepine			
Sitka Spruce			
Western Hemlock	2	2	
Western Redcedar	1		1
Western White Pine			
Total	20	11	9

4.0 Trees on Adjacent Properties

20 trees found growing on the adjacent properties are included in the inventory and retention plan. Most are on District owned land to the east and north of the development. 9 trees along the eastern boundary are requested to be removed as they conflict with the proposed parkade excavation. The remaining trees require root protection where the root protection zone (RPZ) extends onto the development site. Root protection zones for the trees have provided within Table 1 Tree Inventory.

5.0 Construction Guidelines

The following are recommendations for risk mitigation and proper tree protection during the construction phase of the project.

Tree Retention Zones

Six times the diameter was used to determine the optimal root protection zone (RPZ). **The optimal root protection zone is to be measured in the field from the outer edge of the stem of the tree.** The RPZ is the area around the tree in which no grading or construction activity may occur without project arborist approval, and is required for the tree to retain good health and vigor.

The following are tree preservation guidelines and standards for the RPZs:

- No soil disturbance or stripping;
- The natural grade shall be maintained within the protection zone;
- No storage, dumping of materials, parking, underground utilities or fires;
- Any plan affecting trees should be reviewed by a consultant including demolition, erosion control, improvement, utility, drainage, grading, landscape, and irrigation;
- Special foundations, footings and paving designs are required if within the tree protection zone;
- Utilities should be routed around the RPZ;
- Excavation within the tree protection zone should be supervised by a consulting arborist;
- Surface drainage should not be altered so as to direct water into or out of the RPZ; and
- Site drainage improvements should be designed to maintain the natural water table levels within the RPZ.

Respecting these guidelines will prevent changes to the soil and rooting conditions, wounding of the trees and contamination due to spills and waste. Any plans for work or activities within the RPZ that are contrary to these guidelines should be discussed with the project arborist so that mitigation measures can be implemented.

Tree Protection Fences

Prior to any construction activity on site, tree protection fences must be constructed at the specified distance from the tree trunks. The protection barrier or temporary fencing must be at least 1.2 m in height and constructed of 2 by 4 lumber with orange plastic mesh screening. This must be constructed prior to tree removal, excavation or construction and remain intact throughout the entire period of construction. Further standards for fencing construction can be found at:

<http://www.dnv.org/upload/pcdocsdocuments/16kw01!.pdf>

Unsurveyed Trees

Trees that are identified by DHC on the Tree Retention Plan, and within this report as unsurveyed trees have been hand plotted for approximate location only. Their location and ownership cannot be confirmed without being surveyed. The property owner or project developer must ensure that all relevant on and off site trees are surveyed by a legally registered surveyor, whether they are identified by DHC or not.

Removal of logs from sites

Private timber marks are required for the transporting logs from private-owned land in the province of BC. It is the owner of the properties responsibility to apply for a timber mark prior to the removal of any merchantable timber from the site. Additional information can be found at:

<http://www.for.gov.bc.ca/hth/private-timber-marks.htm>

Regulation of Soil Moisture and Drainage

The excavation and construction activities adjacent to the RPZs can influence the moisture availability to the subject trees. This is due to a reduction in the total rooting mass, changes in drainage conditions and changes in exposure including reflected heat from adjacent hard surfaces. To mitigate these concerns the following guidelines should be followed:

- Soil moisture conditions within the tree protection zones should be monitored during hot and dry weather. When soil moisture conditions are dry, supplemental irrigation should be provided. Irrigation should wet the soil to the depth of the root system (approximately 30 cm deep).
- Any planned changes to the surface grades within the RPZ, including the placement of mulch, should be designed so that the water will flow away from the tree trunks.
- Excavation adjacent to trees can alter the soils hydrological processes by draining the water faster than it had naturally. It is recommended that when excavating within 6 m of any tree, the site be irrigated more frequently to account for this.

Tree Pruning

All heavy machinery (excavators, cranes, dump trucks, etc.) working within five meters of tree crowns should be made aware of their proximity to the tree. If there is to be a sustained period of machinery working within five meters of the tree crowns, a line with colored flags should be suspended at the height of the crowns along the length of the protected tree area. If there are concerns regarding the clearance required for machinery and workers within the tree protection zone, or just outside of it, the project arborist should be consulted so that a pruning prescription can be developed or a zone surrounding the crowns can be established. Any wounds incurred to the subject trees during construction should be reported to the project arborist immediately.

Paving Within and Adjacent to Tree Protection Zones

If the development plans propose the construction of paved areas and/or retaining walls close to the proposed tree protection zones measures should be taken to minimize impacts. Construction of these features would raise concerns regarding proper aeration, drainage, irrigation and opportunities for adequate root growth. The following design and construction guidelines are recommended be followed to minimize the long-term impacts to trees if any paving or retaining walls are necessary:

- Any excavation activities near the TPZ (tree protection zone) should be monitored by a Certified Arborist. Excavation should remove and disturb as little of the rooting zone as possible and all roots greater than 2 cm in diameter should be hand pruned.
- The natural grade of the rooting zone should be maintained. Any retaining walls should be designed at heights that will maintain the existing grade to within 20 cm of its current level. If the grade is altered, it should be raised not reduced in height.
- The long-term health of the tree is directly dependent on the volume of available, below ground growing space. If the RPZ must be compromised, the planned distance of structures from the trunks of the subject trees should not be closer than 50% of the RPZ on more than two sides of the tree.
- Compaction of sub grade materials can cause the trees to develop shallow rooting systems. This can contribute to long-term damage to pavement surfaces as the roots grow. Minimizing the compaction of sub grade materials using structural soils and increasing the strength of the pavement reduces the reliance on sub grade for strength.
- If it is not possible to minimize the compaction of sub grade materials, subsurface barriers should be considered to help direct roots downward into the soil and prevent them from growing directly under the paved surfaces.

Plantings Within the TPZs

If there are plans to landscape the ground within the TPZ, measures should be taken to minimize impacts. It is not recommended that the existing grass layer be stripped, as this will damage the

surface roots. The grass layer should be covered with mulch at the start of the project, which will gradually kill the grass while moderating soil moisture and temperatures. Topsoil should be mixed with the mulch prior to planting of shrubs; however the depth of this new topsoil layer should not exceed 20 cm. Planting should take place within the newly placed topsoil mixture and should not disturb the original rooting zone of the trees. Two meters around the base of each tree should be left unplanted and covered in mulch.

Monitoring During Construction

Ongoing monitoring should be provided for the duration of the project. Site visits should be more frequent during activities that are higher risk, including the first stages of construction when excavation occurs adjacent to the trees. Site visits will ensure contractors are respecting the recommended tree protection measures and will allow the arborist to identify any new concerns that may arise.

During each site visit the following measures will be assessed and reported on:

- The integrity of the Tree Protection Zone and fencing;
- Changes to TPZ limits including: overall maintenance, parking on roots, and storing or dumping of materials within TPZ. If failure to maintain and respect TPZ is observed, suggestions will be made to ensure tree protection measures are upheld;
- Review and confirmation of recommended tree maintenance including root pruning, irrigation, mulching and branch pruning;
- Health and condition of each tree;
- Damage to trees that may have resulted from construction activities will be noted, as will the health of branches, trunks and roots of protected trees. Recommendations for remediation will follow;
- Changes to soil moisture levels and drainage patterns; and
- Factors that may be detrimentally impact the trees.

All findings and recommendations will be documented in a summary report. All concerns will be highlighted along with recommended mitigation measures.

6.0 Limitations

1. Except as expressly set out in this report and in these Assumptions and Limiting Conditions, Diamond Head Consulting Ltd. (“**Diamond Head**”) makes no guarantee, representation or warranty (express or implied) with regard to: this report; the findings, conclusions and recommendations contained herein; or the work referred to herein.
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4. Conditions affecting the trees subject to this report (the “**Conditions**”, including without limitation structural defects, scars, decay, fungal fruiting bodies, evidence of insect attack, discoloured foliage, condition of root structures, the degree and direction of lean, the general condition of the tree(s) and the surrounding site, and the proximity of property and people) other than those expressly addressed in this report may exist. Unless otherwise stated: information contained in this report

covers only those Conditions and trees at the time of inspection; and the inspection is limited to visual examination of such Conditions and trees without dissection, excavation, probing or coring. While every effort has been made to ensure that the trees recommended for retention are both healthy and safe, no guarantees, representations or warranties are made (express or implied) that those trees will remain standing or will not fail. The Client acknowledges that it is both professionally and practically impossible to predict with absolute certainty the behaviour of any single tree, or groups of trees, in all given circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure and this risk can only be eliminated if the risk is removed. If Conditions change or if additional information becomes available at a future date, modifications to the findings, conclusions, and recommendations in this report may be necessary. Diamond Head expressly excludes any duty to provide any such modification of Conditions change or additional information becomes available.

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8. Sketches, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.
9. Loss or alteration of any part of this report invalidates the entire report.

7.0 Appendix 1 – Overall risk rating and action thresholds using TRAQ

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

8.0 Appendix A - Requirement for Tree Protection Barrier as per Tree-Protection Bylaw 7671

8. A person performing *work* on lands containing one or more *retained trees* shall:

a) install a *tree protection barrier* around any *retained tree* or group of *retained trees* at the *drip line* of the outermost *tree*, the outside boundary of the *critical root zone* of the outermost *tree*, or 5 metres from the stem of the outermost *tree*, whichever is greatest;

b) ensure that such *tree protection barrier* is constructed of chain link or plywood fastened to solid wood or equivalent framing with railings along the tops, sides and bottom, or is constructed of materials otherwise satisfactory to the *Environmental Protection Officer*;

c) display signage indicating that the area within the *tree protection barrier* is a “protection zone,” and stating that no encroachment, storage of materials or *damage* to *trees* is permitted within the “protection zone;”

d) arrange for inspection by the *Environmental Protection Officer* before any *work* commences, and refrain from commencing *work* until the *Environmental Protection Officer* has approved the *tree protection barrier*; and

e) ensure that the *tree protection barrier* remains in place until written approval of its removal is received from the *Environmental Protection Officer*.

9. No *work* is permitted within the “protection zone” referred to in section 11(c) except in accordance with plans and procedures authorized by a *tree permit*.