

- LEGEND**
- CRITICAL ROOT ZONE
 - TREE PROTECTION FENCING
 - SURVEYED TREE TO BE RETAINED
 - UN-SURVEYED TREE TO BE RETAINED
 - TREE TO BE REMOVED

- NOTES**
- 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.
 - 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.
 - 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)
 - Any construction activities or grade changes within the Root Protection Zone must be approved by the project arborist.
 - 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).
 - 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.

- Arborist Notes Regarding Tree01:**
- Removal of any existing materials within TPZs (including trees Tree01, 11013) must occur under arborist supervision.
 - Proposed pathways within TPZs of trees Tree01, 11013, as well as proposed parking stall and parking stop within TPZ of Tree01 must be built under arborist supervision, above grade, using zero-excavation and low impact methods.
 - TPZ fencing to be rebuilt prior to any works within.



- REFERENCE DRAWINGS**
- Base Survey and Design Plans provided by Hapa Collaborative.

Arborist Report

For:

University of British Columbia Properties Trust

Site Location:

Beaty Biodiversity Addition

University of British Columbia



Submitted to:

Shawn Rodgers

Development Manager

UBC Properties Trust

University of British Columbia

2210 West Mall

Vancouver, BC, V6T 1Z4

Date: June 20, 2022

Submitted by:



The following Diamond Head Consulting staff conducted the on-site tree inventory and prepared or reviewed the report.

All general and professional liability insurance and staff accreditations are provided below for reference.

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Please contact us if there are any questions or concerns about the contents of this report.

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Scope of Assignment:

Diamond Head Consulting Ltd. (DHC) was retained to complete an arboricultural report to supplement the proposed development application for the UBC Beatty Biodiversity Addition. This report contains an inventory of protected on and off-site trees and summarizes management recommendations with respect to future development plans and construction activities. Off-site trees are included because pursuant to municipal bylaws, site owners must include the management of off-site trees that are within the scope of the development. This report is produced with the following primary limitations, detailed limitations specified in Appendix 7:

- 1) Our investigation is based solely on visual inspection of the trees during our last site visit. This inspection is conducted from ground level. We do not conduct aerial inspections, soil tests or below grade root examinations to assess the condition of tree root systems unless specifically contracted to do so.
- 2) Unless otherwise stated, tree risk assessments in this report are limited to trees with a *high* or *extreme* risk rating in their current condition, and in context of their surrounding land use at the time of assessment.
- 3) The scope of work is primarily determined by site boundaries and local tree-related bylaws. Only trees specified in the scope of work were assessed.
- 4) Beyond six months from the date of this report, the client must contact DHC to confirm its validity because site base plans and tree conditions may change beyond the original report's scope. Additional site visits and report revisions may be required after this point to ensure report accuracy for the municipality's development permit application process. Site visits and reporting required after the first submission are not included within the original proposal fee and will be charged to the client at an additional cost.

The client is responsible for:

- Reviewing this report to understand and implement all tree **risk**, removal and protection requirements related to the project.
- Understanding that we did not assess trees off the subject property and therefore cannot be held liable for actions you or your contractors may undertake in developing this property which may affect the trees on neighboring properties.
- Obtaining a tree removal permit from the relevant municipal authority prior to any tree cutting.
- Obtaining relevant permission from adjacent property owners before removing off-site trees and vegetation.
- Obtaining a timber mark if logs are being transported offsite.
- Ensuring the project is compliant with the tree permit conditions.
- Constructing and maintaining tree protection fencing.
- Ensuring an arborist is present onsite to supervise any works in or near tree protection zones.

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1.0 Introduction

1.1 Site Overview

The University of British Columbia Beaty Biodiversity building is adjacent to an area of greenspace with a variety of trees. Most of the trees are in a grove of planted native conifers, including western redcedar (*Thuja plicata*) and Douglas-fir (*Pseudotsuga menziesii*). These are growing as a group and form a small forest, with approximately 30 stems. An existing paved path bisects this forest, with paths and paved surfaces also surrounding. In addition, the site includes several planted ornamental cherry trees, which are east of the forest and are growing as individual trees.

1.2 Proposed Land Use Changes

The proposed development consists of an addition to the existing Beaty Biodiversity building.

1.3 Report Objective

The objective of this report is to ensure the proposed development is in compliance with the development permit application rules for tree inventories at the University of British Columbia (UBC). Trees over 15cm in diameter at breast height were assessed, including: species, diameter at breast height (dbh) measured to the nearest 1 cm at 1.4 m above natural grade (tree's 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 for the time of assessment. 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. This report outlines the existing condition of the trees on and adjacent to the property, summarizes the proposed tree removals and retention trees as well as suggested guidelines for protecting the remaining trees during the construction process.

This report outlines the existing condition of protected trees on and adjacent to the property, summarizes the proposed tree retention and removal, and suggests guidelines for protecting retained trees during the construction process.

2.0 Process and Methods

Conor Corbett of DHC visited the site on August 20, 2021. The following methods and standards are used throughout this report.

2.1 Tree Inventory

Trees on site and trees shared with adjacent properties were marked with a numbered tag and assessed for attributes including: species; height measured to the nearest meter; and, diameter at breast height (DBH) measured to the nearest centimeter at 1.4 m above grade. The general health and structural integrity of each tree was assessed visually and assigned to one of five categories: *excellent*; *good*; *moderate*; *poor*; or *dying/dead*. Descriptions of the health and structure rating criteria are given in Appendix 3.

Tree retention value, categorized as *high*, *medium*, *low*, or *nil*, was assigned to each tree or group of trees based on their health and structure rating, and potential longevity in a developed environment. Descriptions of the retention value ratings are given in Appendix 4.

2.2 Tree Risk Assessment

Tree risk assessments were completed following methods of the ISA Tree Risk Assessment Manual¹ published in 2013 by the International Society of Arboriculture, which is the current industry standard for assessing tree risk. This methodology assigns risk based on the likelihood of failure, the likelihood of impact and the severity of consequence if a failure occurs. Only on-site hazard trees that had *high* or *extreme* risk ratings in their current condition and in context of their surrounding land use were identified and reported in section 3.2. Appendix 5 gives the likelihood and risk rating matrices used to categorize tree risk. DHC recommends that on-site trees be re-assessed for risk after the site conditions change (e.g. after damaging weather events, site disturbance from construction, creation of new targets during construction or in the final developed landscape).

¹ Dunster, J.A., Smiley, E.T., Matheny, N. and Lilly, S. (2013). Tree Risk Assessment Manual. *International Society of Arboriculture*. Champaign, Illinois.

3.0 Findings: Tree Inventory and Risk Assessment

3.1 Tree Inventory

The tree inventory is summarized in Table 1 and the complete tree inventory is given in Appendix 1.

Forty-three (43) trees were inventoried identified as potentially being impacted by the proposed development. The approximate development area was identified through a pre-work meeting and a supplied drawing depicting building footprint and dimensions. This has been used to guide this report and accompanying tree plan.

Trees in the grove area are generally in moderate condition. They have typical form, structure, and health of native conifers growing in a group. There are some isolated defects, and some trees may be unstable if retained individually. Edge trees and large trees in particular are important to maintaining the overall stability and long term health of the stand, as they are protecting interior and smaller trees from the full effects of high winds. The ornamental cherry trees outside the grove are in poor condition; they have been heavily pruned, and many have signs of decay typical of cherry trees of this age. Tree

Risk Assessment

There were no trees on this site that posed a *high* or *extreme* risk at the time of assessment.

4.0 Tree Retention and Removal

14 trees are recommended for removal to accommodate the proposed addition to the Beaty Biodiversity Building. Nine of these trees are all in conflict with the proposed building location, which overlaps with the eastern extent of the grove. An additional 4 trees are recommended for removal as they conflict with the required excavation and construction access. All trees recommended for removal are in a mix of moderate and poor condition.

Twenty nine trees are recommended for retention as part of this development. This represents most of the trees in the grove area, and includes many of the large, dominant trees. These trees are mostly moderate in health and structure. Tree protection fencing is required during excavation and construction and has been delineated on the attached tree management plan. In addition, the following recommendations should guide development planning:

- 1) Tree fencing must be installed as per the attached Tree Management Plan. This fencing will exceed a 6x multiplier of tree diameters at breast height, and will surround the tree stems. No activity whatsoever is permitted inside these Tree Protection Zones without arborist consultation and direction.
- 2) Site must be accessed from paved surfaces surrounding site. Machinery operation and materials storage is not permitted inside Tree Protection Zones.

- 3) Tree removals should occur after Tree protection barriers have been installed. This will ensure that equipment does not enter Tree Protection Zones of retained trees.
- 4) Tree removals should be conducted by ISA certified Arborists. This is to ensure damage does not occur to retained trees during the removal operations.
- 5) Any pruning for clearance or access should be conducted under the supervision of the project arborist.

5.0 Bird Nest Survey Requirements

The objective of a bird nest survey is to determine, to the best possible standard, if any active bird nests are present at the sites prior to undertaking operational work. This assessment would keep UBC Properties Trust compliant with the federal Migratory Birds Convention Act [1994] and attendant Migratory Birds Regulation [1994] that protects migratory birds, their eggs and nests. Also, Section 34(a), (b), and (c) of the provincial Wildlife Act [1996 chap 488] prohibits the taking of birds, eggs, and nests. Nests of eagle, peregrine falcon, gyrfalcon, osprey, heron, and burrowing owl are specifically protected whether or not they are active. Note that under the BC Wildlife Act, Designation and Exemption Regulation (1990), B.C. Reg. 168/90, Section 11.3 (2), a person is exempt from Section 34 of the Wildlife Act with respect to taking, injuring, molesting or destroying a bird or its egg or a nest occupied by a bird or its egg if the bird is listed in Schedule C.

Nesting surveys are to be conducted in accordance with the guidelines established in "Inventory Methods for Forest and Grassland Songbirds, Standards for Components of British Columbia's Biodiversity No. 15" (1999, MSRM Environment Inventory Branch for the Terrestrial Ecosystems Task Force, Resources Inventory Committee) and "Inventory Methods for Raptors, Standards for Components of British Columbia's Biodiversity No. 11" (2001). Typically for relatively small areas, the survey area is traversed on foot to identify birds, nests, and other signs of nesting activity. All visual and vocal signs of bird activity is recorded.

When a nest or possible nest is detected, it is observed until the surveyor is able to determine if it is active or not. Active nests that are identified with flagging and a no disturbance buffer is marked around the nest.

The federal government provides nesting calendars that show the variation in nesting intensity by habitat type and nesting zone. Nesting intensity is the proportion of species that are estimated to be actively nesting at a given date from March to September. The lower mainland falls within nesting zone A1. Figure 2 illustrates the nesting intensity for this zone. Additional information can be found at the following website: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html#_zoneA_calendar.

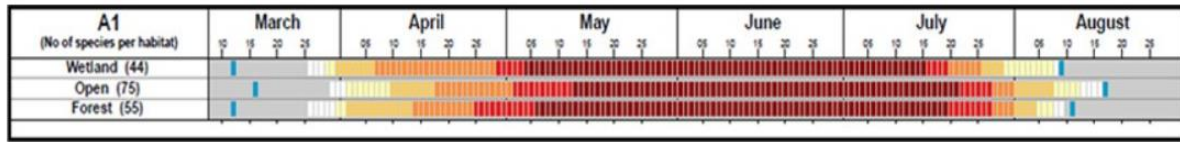


Figure 1. Government of Canada nesting calendar for the lower mainland (zone A1).

Nesting season in Metro Vancouver for most birds occurs between March 1 and August 30, as directed by the BC Ministry of Environment in ***Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia***. Tree removal during this period may affect nests and nesting behaviour of some birds. If possible, all tree removal and maintenance activities should occur outside of this period. Tree removal must occur as soon as possible after the survey.

Appendix 1 Complete Tree Inventory Table

Tag #	Species	DBH (cm)	Height (m)	Dripline Radius	Health and Structure Rating	Comments	Retention Value Rating	Retain/ Remove	Retention/TPZ Comments	*TPZ
273	Cedar (T. plicata)	55	15	3	Poor	Two stems from 3m, acute union with inclusion. Despite this poor structure the tree has good vigor. Road 3m south possibly limiting roots. Tagged by DHC, no survey tag	Low	Remove	Tree in conflict with proposed building	3.6
274	Cedar (T. plicata)	51	15	3	Poor	Small decay cavity at base. Multi stemmed from 4m, acute union with inclusion. Good vigor. Tagged by DHC, no survey tag	Low	Remove	Tree in conflict with proposed building	3.3
7805	Cherry (P. serrulata)	59	5	4	Poor	Asymmetric and him crown, clearance pruned for road 2m north. Decay in pruning site.	Low	Retain	Protect as required	3.8
7806	Cherry (P. serrulata)	41	3	4	Poor	Asymmetric and thin crown, pruned for road 2m north. Decay in branches, mechanical wounding to roots.	Low	Retain	Protect as required	2.7
7807	Cherry (P. serrulata)	60	4	4	Poor	Three stems at breast height, 15, 15, and 30 cm. Thin asymmetric crown, clearance pruned for road 2m north.	Low	Retain	Protect as required	3.9
7808	Cherry (P. serrulata)	56	4	4	Poor	Two stems at breast height, 33 and 23 cm. Thinning, asymmetric crown. Clearance pruned for road with decay evident.	Low	Retain	Protect as required	3.6

Tag #	Species	DBH (cm)	Height (m)	Dripline Radius	Health and Structure Rating	Comments	Retention Value Rating	Retain/ Remove	Retention/TPZ Comments	*TPZ
7814	Cherry (P. serrulata)	47	4	4	Poor	Road 1m north limiting roots. Decay in main stem, insect activity evident. Minor mechanical root damage.	Low	Retain	Protect as required	3.1
7815	Cherry (P. serrulata)	44	3	4	Poor	Heavily Clearance pruned for road 1m north, root zone limited by road. Extensive decay throughout.	Low	Retain	Protect as required	2.9
7816	Cherry (P. serrulata)	40	4	4	Poor	Asymmetric crown, retaining wall 3m away limiting rooting to NW. Clearance pruned for adjacent road, decay in pruning sites. Mechanic damage to roots	Low	Retain	Protect as required	2.6
7824	Cherry (P. serrulata)	61	35	3	Poor	Deformed and asymmetric stem near base. Poorly pruned near branch tips. Decay in stem.	Low	Remove	Tree in conflict with proposed building	4
11001	Douglas-fir (P. menziesii)	52	24	3	Moderate	Codominant edge tree. Slightly crooked stem, unable to assess top 1/3 but appears normal. Critical edge tree.	Medium	Retain	Protect as required	3.4
11002	Cedar (T. plicata)	27	12	3	Moderate	Suppressed by larger adjacent trees. Asymmetric crown.	Medium	Retain	Protect as required	1.8
11003	Cedar (T. plicata)	67	22	5	Good	Open grown. Full healthy crown. Minor clearance pruning.	High	Retain	Protect as required	4.4
11004	Spruce (P. sitchensis)	32	14	4	Poor	Crooked form, thinning lower crown. Path 1 m east. Health is moderate.	Low	Retain	Protect as required	2.1
11007	Douglas-fir (P. menziesii)	37	20	5	Moderate	Asymmetric, protected by trees south. Clearance pruned.	Medium	Retain	Protect as required	2.4

Tag #	Species	DBH (cm)	Height (m)	Dripline Radius	Health and Structure Rating	Comments	Retention Value Rating	Retain/ Remove	Retention/TPZ Comments	*TPZ
11008	Douglas-fir (P. menziesii)	40	24	5	Moderate	Asymmetric, protected by trees south. Somewhat poor taper. Two leaders. Clearance pruned.	Medium	Retain	Protect as required	2.6
11009	Douglas-fir (P. menziesii)	52	20	5	Good	Edge tree. Healthy, minor clearance pruning. Critical edge tree. Removal may destabilize trees east.	High	Retain	Protect as required	3.4
11010	Cedar (T. plicata)	50	18	5	Moderate	Edge tree, asymmetric crown. Clearance pruned lower laterals. Good vigor.	Medium	Retain	Protect as required	3.3
11012	Cedar (T. plicata)	70	26	6	Good	Codominant in stand. Edge tree with good vigor, slightly asymmetric lower crown. Clearance pruned lower laterals	Medium	Retain	Protect as required	4.6
11013	Douglas-fir (P. menziesii)	48	23	5	Moderate	Dominant edge tree. Slightly asymmetric crown due to edge effect and clearance pruning. Two leaders in top 5m, unable to assess union.	Medium	Retain	Protect as required	3.1
11014	Cedar (T. plicata)	39	17	3	Moderate	Edge tree of stand. Asymmetric crown. Road in root zone 2m south and southeast. Pruned subdominant stem at base, but minimal decay at pruning site.	Medium	Retain	Protect as required	2.5
11015	Cedar (T. plicata)	53	18	4	Moderate	Edge tree of stand. Asymmetric crown. Good health and structure otherwise.	Medium	Retain	Minor pruning may be required for access	3.5
11016	Spruce (P. sitchensis)	39	13	3	Moderate	Edge tree of stand. Asymmetric crown. Road in root zone 2m east. Lots of dead wood in lower canopy due to shade.	Medium	Remove	Conflicts with excavation and construction access.	2.5
11017	Cedar (T. plicata)	40	20	4	Moderate	Asymmetric crown, tight spacing. Should not be retained alone.	Medium	Remove	Conflicts with excavation and construction access.	2.6

Tag #	Species	DBH (cm)	Height (m)	Dripline Radius	Health and Structure Rating	Comments	Retention Value Rating	Retain/ Remove	Retention/TPZ Comments	*TPZ
11018	Douglas-fir (P. menziesii)	31	20	4	Poor	Asymmetric crown, tight spacing. Multiple crooks in crown, poor structure. Should not be retained alone.	Low	Retain	Protect as required	2
11019	Cedar (T. plicata)	72	21	5	Moderate	Multiple stems from 1m, unions are moderate. Despite poor structure, tree has good vigor. Retention possible alone, but not recommended.	Medium	Retain	Minor pruning may be required for access	4.7
11020	Douglas-fir (P. menziesii)	31	21	4	Poor	Poor taper, unstable if retained alone. High crown with low Live crown ratio.	Low	Retain	Protect as required	2
11021	Douglas-fir (P. menziesii)	36	22	4	Moderate	Tall with high crown. Questionable stability if retained alone.	Medium	Retain	Protect as required	2.3
11022	Alder (A. rubra)	32	21	4	Moderate	Good health, asymmetric crown. Not typically a long lived tree, typically poor long term retention tree in urban environments.	Low	Retain	Protect as required	2.1
11023	Douglas-fir (P. menziesii)	23	12	3	Poor	Previously failure at 4m, stem growing at failure site with likely decay.	Low	Retain	Protect as required	1.5
11024	Cedar (T. plicata)	31	12	3	Moderate	Twisted trunk, phototropic lean. Unstable if retained alone. Path 1m west.	Medium	Retain	Protect as required	2
11025	Cedar (T. plicata)	34	18	5	Moderate	Normal form. Slightly thin crown. Path 2m to north.	Medium	Retain	Protect as required	2.2
11026	Douglas-fir (P. menziesii)	29	18	5	Moderate	Edge tree, asymmetric crown.	Medium	Retain	Protect as required	1.9
11027	Sorbus (S. aucuparia)	65	15	5	Poor	Two stems, 31 and 34 cm DBH. Union acute, crack and inclusion present, but some response growth. Not critical edge tree.	Low	Retain	Minor pruning may be required for access	4.2

Tag #	Species	DBH (cm)	Height (m)	Dripline Radius	Health and Structure Rating	Comments	Retention Value Rating	Retain/ Remove	Retention/TPZ Comments	*TPZ
11028	Cedar (T. plicata)	52	22	5	Moderate	Codominant in stand. Two stems from 8m, acute union with inclusion. Asymmetric lower crown.	Medium	Retain	Minor pruning may be required for access	3.4
11029	Spruce (P. sitchensis)	35	23	4	Moderate	Asymmetric crown, tight spacing. Poor taper, one of taller trees in grove. Should not be retained alone.	Medium	Remove	Tree in conflict with proposed building	2.3
11030	Cedar (T. plicata)	34	17	3	Moderate	Asymmetric crown, tight spacing. Should not be retained alone.	Medium	Remove	Tree in conflict with proposed building	2.2
11031	Cedar (T. plicata)	67	20	5	Moderate	Healthy and vigorous, good structure. Asymmetric crown due to trees to west. Unsurveyed, located 4m from apex of curve in path. 2m due west of surveyed sign.	Medium	Remove	Tree in conflict with proposed building	4.4
11032	Cedar (T. plicata)	61	20	5	Moderate	Healthy and vigorous, good structure. Slightly Asymmetric crown due to trees to west. Road 30cm east of stem.	Medium	Remove	Tree in conflict with proposed building	4
11033	Douglas-fir (P. menziesii)	29	20	5	Moderate	Very asymmetric crown due to two large adjacent cedars. Should not be retained alone.	Medium	Remove	Tree in conflict with proposed building	1.9
11034	Cedar (T. plicata)	59	20	5	Moderate	Healthy and vigorous, good structure. Slightly Asymmetric crown due to adjacent trees.	Medium	Remove	Tree in conflict with proposed building	3.8
11035	Fir (A. grandis)	29	18	3	Moderate	Moderate exposure with slight crown asymmetry. Good vigor.	Medium	Remove	Conflicts with excavation and construction access.	1.9
11036	Cedar (T. plicata)	33	15	4	Moderate	Edge tree, slightly asymmetric crown. Slightly thinning.	Medium	Remove	Conflicts with excavation and construction access.	2.2

Appendix 2 Site Photographs



Photo 1. Facing west at grove of conifers. Cherries in foreground.



Photo 2. Cherry trees.



Photo 3. East edge of grove.



Photo 4. Facing east at grove. Note the large Oaks in foreground are well outside of the development scope.

Appendix 3 Tree Health and Structure Rating Criteria

The tree health and structure ratings used by Diamond Head Consulting summarize each tree based on both positive and negative attributes using five stratified categories. These ratings indicate health and structural conditions that influence a tree's ability to withstand local site disturbance during the construction process (assuming appropriate tree protection) and benefit a future urban landscape.

Excellent: Tree of possible specimen quality, unique species or size with no discernible defects.

Good: Tree has no significant structural defects or health concerns, considering its growing environment and species.

Moderate: Tree has noted health and/or minor to moderate structural defects. This tree can be retained, but may need mitigation (e.g., pruning or bracing) and monitoring post-development. A moderate tree may be suitable for retention within a stand or group, but not suitable on its own.

Poor: Tree is in serious decline from previous growth habit or stature, has multiple defined health or structural weaknesses. It is unlikely to acclimate to future site use change. This tree is not suitable for retention within striking distance of most targets.

Dying/Dead: Tree is in severe decline, has severe defects or was found to be dead.

Appendix 4 Tree Retention Value Rating Criteria

The tree retention value ratings used by Diamond Head Consulting provide guidance for tree retention planning. Each tree in an inventory is assigned to one of four stratified categories that reflect its value as a future amenity and environmental asset in a developed landscape. Tree retention value ratings take in to account the health and structure rating, species profile*, growing conditions and potential longevity assuming a tree's growing environment is not compromised from its current state.

High: Tree suitable for retention. Has a good or excellent health and structure rating. Tree is open grown, an anchor tree on the edge of a stand or dominant within a stand or group. Species of *Populus*, *Alnus* and *Betula* are excluded from this category.

Medium: Tree suitable for retention with some caveats or suitable within a group**. Tree has moderate health and structure rating, but is likely to require remedial work to mitigate minor health or structural defects. Includes trees that are recently exposed, but wind firm, and trees grown on sites with poor rooting environments that may be ameliorated.

Low: Tree has marginal suitability for retention. Health and structure rating is moderate or poor; remedial work is unlikely to be viable. Trees within striking distance of a future site developments should be removed.

Nil: Tree is unsuitable for retention. It has a dying/dead or poor health and structure rating. It is likely that the tree will not survive, or it poses an unacceptable hazard in the context of future site developments.

* The species profile is based upon mature age and height/spread of the species, adaptability to land use changes and tree species susceptibility to diseases, pathogen and insect infestation.

** Trees that are 'suitable as a group' have grown in groups or stands that have a single, closed canopy. They have not developed the necessary trunk taper, branch and root structure that would allow them to be retained individually. These trees should only be retained in groups.

Appendix 5 Risk Rating Matrices

Trees with a *probable* or *imminent* likelihood of failure, a *medium* or *high* likelihood of impacting a specified target, and a *significant* or *severe* consequence of failure have been assessed for risk and included in this report (Section 3.2). These two risk rating matrices showing the categories used to assign risk are taken without modification to their content from the International Society of Arboriculture Tree Risk Assessment Qualification Manual.

Matrix 1: Likelihood

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

Likelihood of Failure and 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

Appendix 6 Construction Guidelines

Tree management recommendations in this report are made under the expectation that the following guidelines for risk mitigation and proper tree protection will be adhered to during construction.

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

Tree Protection Zones

A Tree protection zone (TPZ) is determined using either dripline or a DBH multiplier to define a radius measured in all directions from the outside of a tree's trunk. It is typically determined according to local municipal bylaw specifications and may be modified based on professional judgement of the project arborist to accommodate species specific tolerances and site specific growing conditions. For retained trees, the TPZ and fencing indicated in this report are proposed as suitable in relation to the level of disturbance proposed on the site plan provided to the project arborist. Arborist consultation is required if any additional work beyond the scope of the plans provided is proposed near the tree. Work done in addition to the proposed impacts discussed in this report may cause the tree to decline and die.

Tree Protection Fencing: Tree protection zones (TPZs) will be protected by Tree Protection Fencing except where site features constrict roots (e.g., retaining walls or roads), where continual access is required (e.g., sidewalks), or when an acceptable encroachment into the TPZ is proposed, in which case the fencing will be modified. Tree Protection Fencing is shown on the Tree Protection Plan and, where it varies from the TPZ, the rationale is described in the inventory table in Section 3.1.

Within a TPZ, no construction activity, including materials storage, grading or landscaping, may occur without project arborist approval. Within the TPZ, the following are tree preservation guidelines based on industry standards for best practice and local municipal requirements:

- No soil disturbance or stripping.
- Maintain the natural grade.
- No storage, dumping of materials, parking, underground utilities or fires within TPZs or tree driplines.
- Any planned construction and landscaping activities affecting trees should be reviewed and approved by a consulting arborist.
- Install specially designed foundations and paving when these structures are required within TPZs.
- Route utilities around TPZs.
- Excavation within the TPZs should be supervised by a consultant arborist.
- Surface drainage should not be altered in such a way that water is directed in or out of the TPZ.

- Site drainage improvements should be designed to maintain the natural water table levels within the TPZ.

Prior to any construction activity, Tree Protection Fencing must be constructed as shown on the Tree Protection Plan. 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. Tree Protection Fencing must be constructed prior to tree removal, excavation or construction and remain intact for the entire duration of construction.

Tree Crown Protection and Pruning

All heavy machinery (excavators, cranes, dump trucks, etc.) working within five meters of a tree's crown 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 a tree's crown, a line of colored flags should be suspended at eye-level of the machinery operator for the length of the protected tree area. Any concerns regarding the clearance required for machinery and workers within or immediately outside tree protection zones should be referred to the project arborist so that a zone surrounding the crowns can be established or pruning measures undertaken. Any wounds incurred to protected trees during construction should be reported to the project arborist immediately.

Unsurveyed Trees

Unsurveyed trees identified by DHC in the Tree Retention Plan have been hand plotted for approximate location only using GPS coordinates and field observations. The location and ownership of unsurveyed trees cannot be confirmed without a legal survey. 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 to transport logs from privately-owned land in BC. It is property owner's responsibility to apply for a timber mark prior to removing 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

Excavation and construction activities adjacent to TPZs can influence the availability of moisture to protected trees. This is due to a reduction in the total root mass, changes in local 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 root protection zones should be monitored during hot and dry weather. When soil moisture is inadequate, supplemental irrigation should be provided that penetrates soil to the depth of the root system or a minimum of 30 cm.
- Any planned changes to surface grades within the TPZs, including the placement of mulch, should be designed so that any water will flow away from tree trunks.

- Excavations adjacent to trees can alter local soil hydrology by draining water more rapidly from TPZs more rapidly than it would prior to site changes. It is recommended that when excavating within 6 m of any tree, the site be irrigated more frequently to account for this.

Root Zone Enhancements and Fertilization

Root zone enhancements such as mulch, and fertilizer treatments may be recommended by the project arborist during any phase of the project if they deem it necessary to maintain tree health and future survival.

Paving Within and Adjacent to TPZs

If development plans propose the construction of paved areas and/or retaining walls close to TPZs, measures should be taken to minimize impacts. Construction of these features would raise concerns for proper soil aeration, drainage, irrigation and the available soil volume for adequate root growth. The following design and construction guidelines for paving and retaining walls are recommended to minimize the long-term impacts of construction on protected trees:

- Any excavation activities near or within the TPZ should be monitored by a certified arborist. Structures should be designed, and excavation activities undertaken to remove and disturb as little of the rooting zone as possible. All roots greater than 2 cm in diameter should be hand pruned by a Certified Arborist.
- The natural grade of a TPZ should be maintained. Any retaining walls should be designed at heights that maintain the existing grade within 20 cm of its current level. If the grade is altered, it should be raised not reduced in height.
- Compaction of sub grade materials can cause trees to develop shallow rooting systems. This can contribute to long-term pavement damage as roots grow. Minimizing the compaction of subgrade materials by using structural soils or other engineered solutions and increasing the strength of the pavement reduces reliance on the 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 TPZs

Any plans to landscape the ground within the TPZ should implement measures to minimize negative impacts on the above or below ground parts of a tree. Existing grass layer in TPZs should not be stripped because this will damage surface tree roots. 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, but new topsoil layer should not be greater than 20 cm deep on top of the original grade. Planting should take place within the newly placed topsoil mixture and should not disturb the original rooting zone of the trees. A two-meter radius around the base of each tree should be left unplanted and covered in mulch; a tree's root collar should remain free from any amendments that raise the surface grade.

Monitoring during construction

Ongoing monitoring by a consultant arborist should occur for the duration of a development 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 by a consulting arborist:

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

Appendix 7 Report Assumptions and Limiting Conditions

- 1) Unless expressly set out in this report or these Assumptions and Limiting Conditions, Diamond Head Consulting Ltd. (“Diamond Head”) makes no guarantee, representation or warranty (express or implied) regarding this report, its findings, conclusions or recommendations contained herein, or the work referred to herein.
- 2) The work undertaken in connection with this report and preparation of this report have been conducted by Diamond Head for the “Client” as stated in the report above. It is intended for the sole and exclusive use by the Client for the purpose(s) set out in this report. Any use of, reliance on or decisions made based on this report by any person other than the Client, or by the Client for any purpose other than the purpose(s) set out in this report, is the sole responsibility of, and at the sole risk of, such other person or the Client, as the case may be. Diamond Head accepts no liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm (including without limitation financial or consequential effects on transactions or property values, and economic loss) that may be suffered or incurred by any person as a result of the use of or reliance on this report or the work referred to herein. The copying, distribution or publication of this report (except for the internal use of the Client) without the express written permission of Diamond Head (which consent may be withheld in Diamond Head’s sole discretion) is prohibited. Diamond Head retains ownership of this report and all documents related thereto both generally and as instruments of professional service.
- 3) The findings, conclusions and recommendations made in this report reflect Diamond Head’s best professional judgment given the information available at the time of preparation. This report has been prepared in a manner consistent with the level of care and skill normally exercised by arborists currently practicing under similar conditions in a similar geographic area and for specific application to the trees subject to this report on the date of this report. Except as expressly stated in this report, the findings, conclusions and recommendations it sets out are valid for the day on which the assessment leading to such findings, conclusions and recommendations was conducted. If generally accepted assessment techniques or prevailing professional standards and best practices change 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 if generally accepted assessment techniques and prevailing professional standards and best practices change.
- 4) Conditions affecting the trees subject to this report (the “Conditions”, include without limitation, structural defects, scars, decay, fungal fruiting bodies, evidence of insect attack, discolored 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. 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 any trees recommended for retention are both healthy and safe, no guarantees, representations or warranties are made (express or implied) that those trees will not be subject to structural failure or decline. The Client acknowledges that it is both professionally and practically impossible to predict with absolute certainty the behavior 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.

- 5) Nothing in this report is intended to constitute or provide a legal opinion and Diamond Head expressly disclaims any responsibility for matters legal in nature (including, without limitation, matters relating to title and ownership of real or personal property and matters relating to cultural and heritage values). Diamond Head makes no guarantee, representation or warranty (express or implied) as to the requirements of or compliance with applicable laws, rules, regulations, or policies established by federal, provincial, local government or First Nations bodies (collectively, “Government Bodies”) or as to the availability of licenses, permits or authorizations of any Government Body. Revisions to any regulatory standards (including bylaws, policies, guidelines an any similar directions of a Government Bodies in effect from time to time) referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary. Diamond Head expressly excludes any duty to provide any such modification if any such regulatory standard is revised.
- 6) Diamond Head shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.
- 7) In preparing this report, Diamond Head has relied in good faith on information provided by certain persons, Government Bodies, government registries and agents and representatives of each of the foregoing, and Diamond Head assumes that such information is true, correct and accurate in all material respects. Diamond Head accepts no responsibility for any deficiency, misinterpretations or fraudulent acts of or information provided by such persons, bodies, registries, agents and representatives.
- 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.