Diamond Head Consulting Ltd.
Arborist Report

For:

Lot 8
Nobel Residences at UBC
Vancouver, BC
September 26, 2017
Updated Oct 12, 2017 to address reasons for tree removals offsite.

To be submitted with Tree Retention Plan
Dated: September 26, 2017

Submitted to:

Polygon Homes Ltd.
900 - 1333 West Broadway,
Vancouver, BC V6H 4C2

Submitted by:

3551 Commercial Street
Vancouver, BC
V5N 4E8
604 733-4886

The following Diamond Head Consulting staff performed the site visit and prepared the report.

Trevor Cox, MCIP, RPP
ISA Certified Arborist (PN-1920A)
ISA Qualified Tree Risk Assessor (TRAQ)
BC Parks Wildlife and Danger Tree Assessor

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.

Contact Information

Phone: 604-733-4886
Fax: 604-733-4879
Email: trevor@diamondheadconsulting.com
Website: www.diamondheadconsulting.com

Insurance Information

WCB: # 657906 AQ (003)

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1.0 Introduction

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. 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.

1.1 Limits of Assignment

- Our investigation is based solely on our visual inspection of the trees on our last site visit for the inventory. Our inspection was conducted from ground level. We did not conduct soil tests or below root examination to assess the condition of the root system of the trees.
- 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 City's development permit application process.
- Tree Risk Assessments were completed following ISA Standards to the accepted industry standard of care. However, trees that do not have signs of visible weakness can fail under abnormal weather conditions and wind events.
- See additional limitations at the end of this report.

1.2 Purpose and Use of Report

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

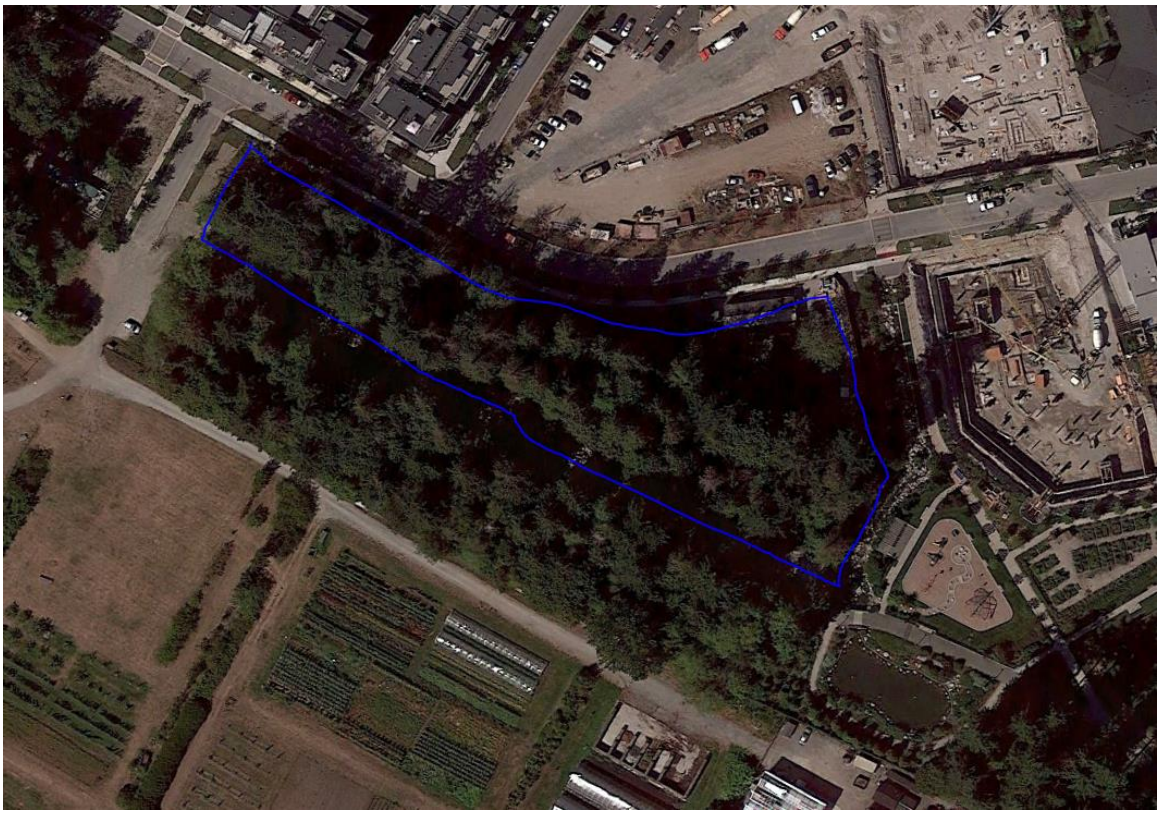


Figure 1. Approximate location of subject site – Lot 8 UBC South Campus on Ross Road (Photo from Google Earth).

2.0 Observations

2.1 Site Overview

The subject site consists of a well forested site of mature Western redcedar and Douglas-fir trees with an understory of Bigleaf maple, Red alder and scattered Western hemlock and Cherry trees. The area is predominantly flat in the western section of the site but becomes sloped at about 20% to the south in the eastern quarter of the site.

In the context of the proposed development there is no opportunity for tree retention based on full site occupancy. There is a proposed underground parkade that will occupy the entire site boundary. Tree attributes, critical root zones and recommendations for the trees are listed below in **Table 2**.

2.2 Tree Inventory

The following is an inventory of assessed trees, each of which is identified on the accompanying map. There are numerous trees that were not identified on the tree survey but were gathered in the tree assessment. Due to the lack of time available to gather this information for a submission, only the general attributes of these trees were collected (diameter and species).

These tree have been highlighted on the accompanying map with a unique label showing their species code followed by their diameter (eg. Dr35 would be a red alder tree with a 35cm diameter at breast height).
Tree species, characteristics, comments, recommendations and required root protection zones have been provided in **Error! Reference source not found.** for most of the trees that are located n the survey. Their locations are illustrated on the accompanying map.

Overall Health and Structure Rating

- **Excellent =** Tree of possible specimen quality, unique species or size with no discernible defects, or heritage tree.
- **Normal =** Tree is in good condition with no significant structural weaknesses or health concerns, considering its growing environment and species.
- **Moderate =** Tree has noted health and/or minor structural weaknesses, however, treatments may be recommended to improve the health or structural condition of the tree.
- **Poor =** Tree is in serious decline from its typical growth habits and has multiple very definable health and/or structural weaknesses. These trees may have difficulty adapting to land use changes.
- **Dead/Dying =** Tree was found to be dead, and/or has severe defects and is in severe decline.

Tree Retention Value Rating

This rating provides guidance for tree retention planning and takes into account the tree's species profile and its growing conditions.

- **High =** Trees are worthy of consideration for retention. This typically includes dominant trees in a stand as well as open grown individual trees.
- **Medium** = Trees may be considered for retention with limitations and/or treatments. This may include trees growing within groves, on moderately difficult topography for root system expansion, recently exposed trees or trees with minor structural defects that can be mitigated through pruning.
- **Low** = Trees with structural/health defects that are not currently high risk or imminent for failure. Trees should not be considered for retention if within striking distance of a high value target. These includes poor species profiles* for long term viability. Trees growing in poor locations such as dense stands of trees with high height to diameter ratios, recently exposed edge trees or areas with high water tables leading to shallow constricted rooting.
- **Nil** = Trees should not be considered for retention due to high risk condition or extenuating circumstances that have led to the tree being at high risk of failing and dead or dying trees.

*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.

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 adjacent homes/buildings, Ross Road, and the trail system.

2.3 Photographs

Photo 1. View of the northern edge in the middle of the lot. Note the number of young cedar trees growing in the understory.

Photo 2 and 3. The pathway at the south end of the site. Note that there are very large trees along this edge. A number of trees on the left side of photo 2 will need to be removed as their root plates will be cut to accommodate the parking garage. With the removal of many of these edge trees there will be a need to remove a number of smaller intermediate trees in behind them as they have very high height to diameter ratios and or leans toward the future development site.

Photo 3. At the west end of the site there are many young western redcedar trees growing below the large Douglas-fir trees.

Photo 4. Some of the dominant Douglas-fir trees are over 35m tall. This tree is in decline due to a root pathogen.

2.4 Tree Inventory Table

Table 1. Tree Inventory.

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Overall Condition	Comments	Retain/ Remove	Tree Retention Comments	Root Protection Zone (m)**
1	Douglas-fir	*Pseudotsuga menziesii*	110	31	Normal	Large dominant tree on edge	Remove	Within the proposed development footprint.	6.6
10	Western Redcedar	*Thuja plicata*	77	26	Poor	Codominant class. 3 stems at 18m with cracking	Remove	Within the proposed development footprint.	4.6
11	Douglas-fir	*Pseudotsuga menziesii*	94	33	Normal	Single stem with -40% crown. Some large branch breakage due to exposure	Remove	Within the proposed development footprint.	5.6
12	Western Redcedar	*Thuja plicata*	65	18	Poor	Dead top	Remove	Within the proposed development footprint.	3.9
13	Western Redcedar	*Thuja plicata*	64	19	Poor	Dead top	Remove	Within the proposed development footprint.	3.8
14	Western Redcedar	*Thuja plicata*	68	20	Poor	Dead top	Remove	Within the proposed development footprint.	4.1
15	Western Redcedar	*Thuja plicata*	106	28	Moderate	2 stems from base with moderate inclusion. Dying tops	Remove	Within the proposed development footprint.	6.4
17	Western Redcedar	*Thuja plicata*	107	30	Normal	Single stem with no defects	Remove	Within the proposed development footprint.	6.4
18	Western Redcedar	*Thuja plicata*	97	33	Moderate	Large stem but thinning crown	Remove	Within the proposed development footprint.	5.8
19	Western Redcedar	*Thuja plicata*	83	30	Moderate	Large stem but thinning crown and leaning away from hemlock to road	Remove	Within the proposed development footprint.	5
2	Douglas-fir	*Pseudotsuga menziesii*	68	27	Normal	Inbehind tree 1 requires it for wind firmness	Remove	Within the proposed development footprint.	4.1
20	Western Hemlock	*Tsuga heterophylla*	90	33	Moderate	Large stem but thinning crown	Remove	Within the proposed development footprint.	5.4
21	Western Redcedar	*Thuja plicata*	88	32	Moderate	Amongst group requiring for stability	Remove	Within the proposed development footprint.	5.3
22	Western Redcedar	*Thuja plicata*	22	16	Normal	Intermediate class	Remove	Within the proposed development footprint.	2

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Overall Condition	Comments	Retain/ Remove	Tree Retention Comments	Root Protection Zone (m)**
23	Western Redcedar	*Thuja plicata*	97	30	Normal	Larg dominant tree	Remove	Within the proposed development footprint.	5.8
24	Western Redcedar	*Thuja plicata*	55	25	Normal	Intermediate requires group	Remove	Within the proposed development footprint.	3.3
25	Western Redcedar	*Thuja plicata*	36	16	Poor	Intermediate class with broken top	Remove	Within the proposed development footprint.	2.2
2506	Western Redcedar	*Thuja plicata*	116	32	Normal		Remove	Within the proposed development footprint.	7
2519	Western Redcedar	*Thuja plicata*	120	31	Normal		Remove	Within the proposed development footprint.	7.2
2521	Bigleaf Maple	*Acer macrophyllum*	20	10	Moderate	; Heavy lean	Remove	Within the proposed development footprint.	2
2554	Douglas-fir	*Pseudotsuga menziesii*	75	31	Moderate	Thinning	Remove	Within the proposed development footprint.	4.5
2560	Western Redcedar	*Thuja plicata*	45	25	Normal		Remove	Within the proposed development footprint.	2.7
2573	Douglas-fir	*Pseudotsuga menziesii*	56	33	Moderate	Ht to diameter ratio is high. Phellinus fruiting body at base	Remove	Within the proposed development footprint.	3.4
26	Western Redcedar	*Thuja plicata*	44	25	Normal	Single stem requires the group	Remove	Within the proposed development footprint.	2.6
2627	Western Redcedar	*Thuja plicata*	75	26	Normal		Remove	Within the proposed development footprint.	4.5
2676	Western Redcedar	*Thuja plicata*	48	24	Normal		Remove	Within the proposed development footprint.	2.9
27	Western Redcedar	*Thuja plicata*	32	16	Normal	Intermediate class; Under fir	Remove	Within the proposed development footprint.	2
28	Douglas-fir	*Pseudotsuga menziesii*	75	32	Normal	Large sweep at base. Dominant tree	Remove	Within the proposed development footprint.	4.5
29	Douglas-fir	*Pseudotsuga menziesii*	81	34	Excellent	Dominant tree - anchor	Remove	Within the proposed development footprint.	4.9

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Overall Condition	Comments	Retain/ Remove	Tree Retention Comments	Root Protection Zone (m)**
3	Western Redcedar	*Thuja plicata*	42	19	Normal	Intermediate class	Remove	Within the proposed development footprint.	2.5
30	Western Redcedar	*Thuja plicata*	31	18	Normal	Single stem requires the group - under fir	Remove	Within the proposed development footprint.	2
31	Bigleaf Maple	*Acer macrophyllum*	160	31	Moderate	5 stems emanate from base; Poor unions at base	Remove	Within the proposed development footprint.	9.6
32	Douglas-fir	*Pseudotsuga menziesii*	85	30	Normal		Remove	Within the proposed development footprint.	5.1
4	Western Redcedar	*Thuja plicata*	35	20	Normal	Intermediate class	Remove	Within the proposed development footprint.	2.1
4808	Western Hemlock	*Tsuga heterophylla*	31	15	Moderate	Suppressed tree	Remove	Within the proposed development footprint.	2
4811	Western Redcedar	*Thuja plicata*	67	25	Poor	Almost dead from root impacts from trail	Remove	Within the proposed development footprint.	4
5	Western Redcedar	*Thuja plicata*	68	25	Moderate	3 stems emerge at 18m; Inclusion	Remove	Within the proposed development footprint.	4.1
6	Western Redcedar	*Thuja plicata*	72	26	Poor	Dying top from sidewalk-5m to east	Remove	Within the proposed development footprint.	4.3
6636	Western Redcedar	*Thuja plicata*	110	24	Moderate	5 stems	Remove	Within the proposed development footprint.	6.6
7	Bigleaf Maple	*Acer macrophyllum*	95	26	Moderate	Large laterals split at 2m -significant inclusion. Seam in south stem at base	Remove	Within the proposed development footprint.	5.7
7263	Douglas-fir	*Pseudotsuga menziesii*	104	33	Normal	Dominant edge tree	Remove	Within the proposed development footprint.	6.2
7265	Bigleaf Maple	*Acer macrophyllum*	46	21	Moderate	Lacking rooting on south due to cedar. Lift prune to reduce end weight. Offsite tree.	Retain	Can be pruned to retain.	2.8
7309	Western Redcedar	*Thuja plicata*	41	23	Moderate	Broken top in past 1m growth	Remove	Within the proposed development footprint.	2.5

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Overall Condition	Comments	Retain/ Remove	Tree Retention Comments	Root Protection Zone (m)**
7348	Douglas-fir	*Pseudotsuga menziesii*	110	33	Moderate	Thinning crown, sap flow. Phellinus fruiting body at base	Remove	Within the proposed development footprint.	6.6
7388	Western Redcedar	*Thuja plicata*	93	26	Moderate	Broken top	Remove	Within the proposed development footprint.	5.6
7390	Douglas-fir	*Pseudotsuga menziesii*	95	33	Normal	Dominant tree on edge. Likely damage from path too in root zone	Remove	Within the proposed development footprint.	5.7
7390	Douglas-fir	*Pseudotsuga menziesii*	110	33	Normal	Dominant tree on edge. Scar at base. Likely damage from path too in root zone	Remove	Within the proposed development footprint.	6.6
7391	Western Redcedar	*Thuja plicata*	35	17	Normal	Two stems from base on raised mound	Remove	Within the proposed development footprint.	2.1
7395	Douglas-fir	*Pseudotsuga menziesii*	65	30	Normal		Remove	Within the proposed development footprint.	3.9
7396	Bigleaf Maple	*Acer macrophyllum*	92	33	Normal	Large scaffold branching- may be some decay at unions- large spreading crown	Remove	Within the proposed development footprint.	5.5
7425	Western Redcedar	*Thuja plicata*	62	25	Normal	Single stem requires the group	Remove	Within the proposed development footprint.	3.7
7427	Western Redcedar	*Thuja plicata*	66	23	Normal	Single stem requires the group	Remove	Within the proposed development footprint.	4
7430	Sitka Spruce	*Picea sitchensis*	63	32	Moderate	Single stem requires the group - root failure with correction well in past	Remove	Within the proposed development footprint.	3.8
7264	Western Redcedar	*Thuja plicata*	92	28	Normal	In development edge	Remove	Within the proposed development footprint.	5.5
8	Western Redcedar	*Thuja plicata*	58	19	Moderate	2 stems at base- combined dbh-with stilt roots	Remove	Within the proposed development footprint.	3.5
9	Douglas-fir	*Pseudotsuga menziesii*	65	28	Normal	Single stem with -40% crown. Historic stem damage at base	Remove	Within the proposed development footprint.	3.9

** - Root protection zone is measured from the outer edge of the stem of the tree. If using these measurements for planning/mapping purposes this needs to be taken into account: and ½ the trees diameter added to the distance to accommodate the survey point being in the center of the tree.

Inventory of Offsite Trees to be Removed or Relocated

Tag #	Common Name	Botanical Name	DBH (cm)	Ht (m)	Overall Condition	Comments	Retain/ Remove	Tree Retention Comments	Root Protection Zone (m)**
UBC 1	Maple	*Acer rubrum 'Armstrong*	10	6	Normal	Recently planted. Work with UBC to relocate this tree.	Relocate		
2506	Western redcedar	*Thuja plicata*	111	30	Normal	Large dominant tree on edge	Remove	Roots will be severed by cut for underground garage	7.0
2519	Western redcedar	*Thuja plicata*	121	33	Normal	Large dominant tree on edge	Remove	Roots will be severed by cut for underground garage	7.0
2542	Western redcedar	*Thuja plicata*	40	26	Normal	At edge of development. Trunk is on edge of property line.	Remove	Roots will be severed by cut for underground garage	2.8
2567	Western redcedar	*Thuja plicata*	75	26	Normal	Tagged as 2567 but labelled on map and survey as 2627. Large edge tree.	Remove	Roots will be severed by underground garage	4.6
2585	Bigleaf maple	*Acer macrophyllum*	38	24	Moderate	Heavy lean to the north. Canopy will interfere with construction and higher potential for failure.	Remove	Future hazard, will interfere with construction.	
4769	Douglas-fir	*Pseudotsuga menziesii*	120	35	Excellent	Dominant tree on edge. Largest tree on site. Great vigour. Roots will be cut by parkade.	Remove	Roots will be severed by underground garage	7.5
4770	Western Redcedar	*Thuja plicata*	70	30	Normal	Roots severed by parkade cut	Remove	Roots will be severed by underground garage	4.2
6636	Western redcedar	*Thuja plicata*	75	30	Normal	At edge of development. Trunk is on edge of property line.	Remove	Roots will be severed by cut for underground garage	4.9
6644	Red alder	*Alnus rubra*	33	18	Moderate	At edge of development. Trunk is on edge of property line.	Remove	Roots will be severed by cut for underground garage	2.3
7254	Douglas-fir	*Pseudotsuga menziesii*	44	25	Moderate	Prone to windthrow- lack of rooting on south side	Remove	Within the proposed development footprint.	2.6
7264	Western redcedar	*Thuja plicata*	106	30	Normal	At edge of development. Large dominant tree.	Remove	Roots will be severed by cut for underground garage	7.0
7298	Western redcedar	*Thuja plicata*	38	20	Normal	At edge of development. Trunk is on edge of property line.	Remove	Roots will be severed by cut for underground garage	2.8
Dr30	Red alder	*Alnus rubra*	30	18	Moderate	At edge of stand prone to windthrow from prevailing winds from south and southwest	Remove	Remove due to potential for blow down.	2.0

Tree Risk Assessment Table

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**. With the proposed development there may different scenarios in which each tree could strike a target and this will need to be assessed once the development concept has been determined and work is to begin. At that time a project arborist will need to be engaged to ensure there is a safe worksite.

There are no trees that were inventoried on the subject site that have a high-risk rating.

3.0 Summary

The site inventory identified 158 on-site trees, 28 off-site trees and 15 City street trees that were to be identified in the arborist report. UBC requires that replacement trees be planted for trees that are removed. UBC will decide the quantities of required replacement trees. 171 trees are proposed for removal in this development application.

Site Tree Inventory

	Sum of Existing	Sum of Retain	Sum of Remove
Deciduous			
Red Alder	24	0	24
Cherry	5	0	5
Bigleaf Maple	4	0	4
Coniferous			
Douglas-fir	39	0	39
Sitka Spruce	1	0	1
Western Hemlock	7	0	7
Western Redcedar	78	0	78
Grand Total	**158**	**0**	**158**

Off Site Tree Inventory*

	Sum of Existing	Sum of Retain	Sum of Relocate	Sum of Remove
Deciduous				
UBC Maple	15	14	1	0
Red Alder	2	0		2
Bigleaf Maple	1	0		1
Coniferous				
Douglas-fir	2	0		2
Western Redcedar	8	0		8
Grand Total	**28**	**14**	**1**	**13**

* Note there are many trees to be retained offsite and their root protection zones have been assessed and delineated on the tree protection map. Their condition and attributes have been generally assessed and will be assessed in more detail once a greenway plan concept is further discussed.

The location of protected trees, their Tree Protection Zones (TPZ) as well as those trees to be removed have been illustrated on the accompanying Tree Retention Plan.

3.1 Tree Retention Discussion

The opportunity for retention viability is very limited on this site due to the proposed development footprint or site occupancy. Trees that were found unsuitable were not considered for retention, and trees that were found to have moderate or suitable retention viability have been retained if possible and were project design conflicts could be reasonably resolved, this only occurs offsite. For tree retention offsite the following are recommendations for proper protection during construction:

- **Off-site UBC trees along Ross Road:** 1 tree is proposed for removal and 14 are to be retained. Tree protection barriers are recommended at a 2.5m distance from the tree except where hardscapes do no permit.
- **Off-site trees to the south of the project boundary:** Arborist supervision of the proposed excavation along the southern boundary will be necessary to determine the extent of root damage to trees to be retained. Minor adjustments may be required during excavation to accommodate trees including watering, leaving roots hanging or in place.
- b) The proposed path connections must be constructed using low impact methods above the existing grade. The design and construction methods of the path must be approved by the project arborist prior to construction. On-site arborist supervision will be required during the construction of the path. Materials like gravel, or porous concrete, a resin based gravel or other alternatives should be explored.

4.0 Trees on Adjacent Properties

Once the scope of work is delineated there will likely be trees on the subject property that are outside the proposed development. These trees will have to be protected where they are adjacent to the development or have the potential to be impacted by construction activities, vehicle parking or the storage of materials. Root protection zones for the trees have provided within Table 1. Tree Inventory.

Note: the developer or subject site owner must verify that all off-site trees within or that could be affected by the scope of construction are identified and surveyed for location whether they are identified by DHC or not. Any off site trees that are recommended for removal will require the adjacent property owner's permission and may require additional permits.

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 to eight times the diameter was used in consideration to determine the optimal root protection zone (RPZ) and Tree Protection Zone (TPZ) setbacks, and adjusted to suit the specific needs of the tree and site conditions. **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://vancouver.ca/your-government/protection-of-trees-bylaw.aspx

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.

Fertilization

Fertilization or root zone enhancement treatments may be recommended by the project arborist during the construction phase.

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.

2. This report has been prepared, and the work undertaken in connection herewith has 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 in light of 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 as at the date of this report. Except as expressly stated in this report, the findings, conclusions and recommendations set out in this report 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**", 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.

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 by-laws, 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.

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

All trees are to be removed within the development parcel

All UBC Street Trees to have 1.5m root protection fencing installed or up to hardscape, whichever is less.

ROSS DRIVE

UBC 1

LEGEND

- TREE PROTECTION ZONE
- TREE PROTECTION FENCE
- SURVEYED TREE
- UN-SURVEYED TREE
- TREE TO BE REMOVED
- Pr CHERRY
- Dr RED ALDER
- Hw WESTERN HEMLOCK
- Mb BIGLEAF MAPLE
- Cw WESTERN REDCEDAR
- Fd DOUGLAS FIR

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. (½ 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.

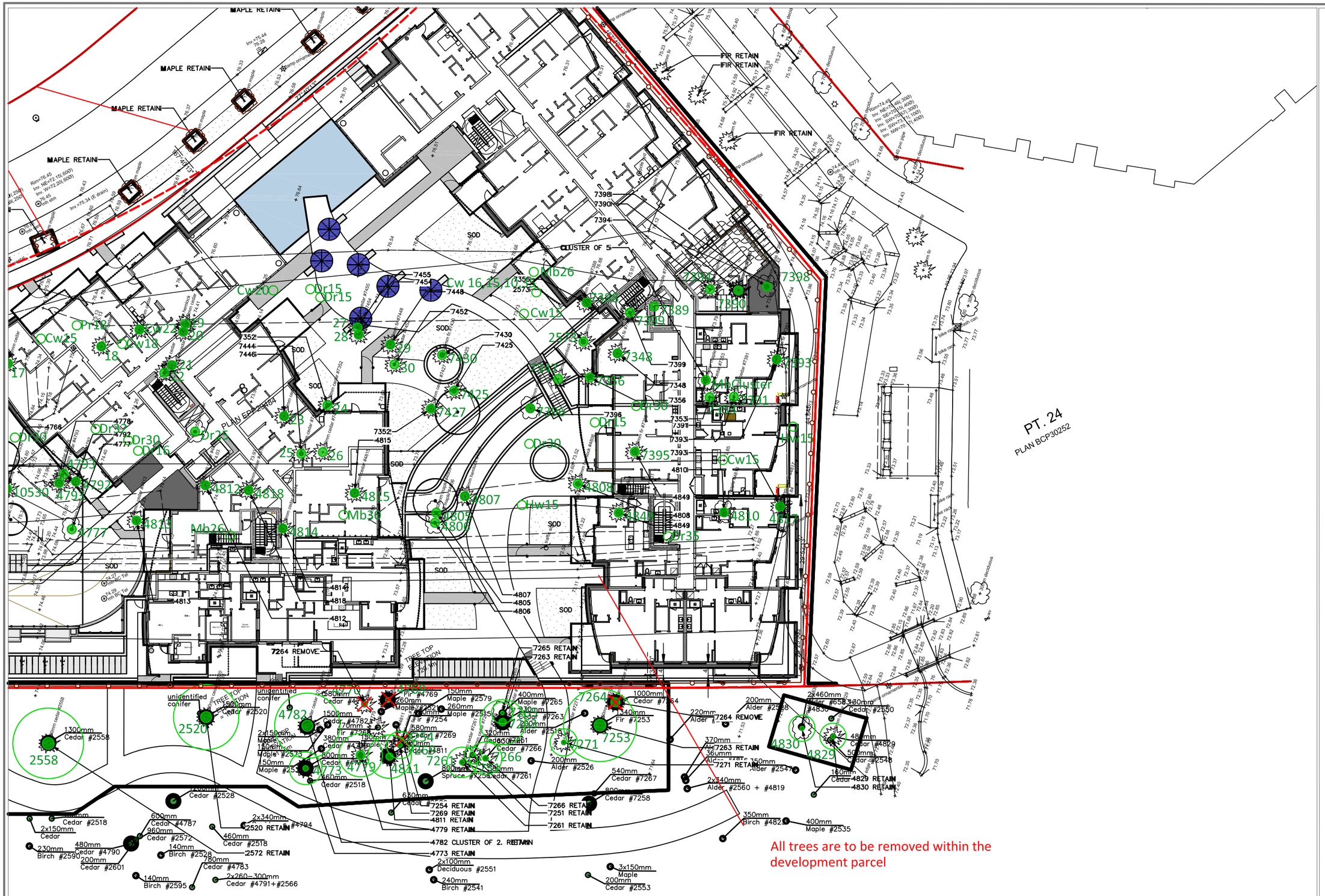
REFERENCE DRAWINGS

1. Base Survey by:

DIAMOND HEAD
3551 COMMERCIAL STREET
VANCOUVER BC | V5N 4E8
T 604.733.4886 | F 604.733.4879

Drawing title: Tree Retention and Removal Plan
Project address: UBC Lot 9
Client: Polygon

Drawing No: XXX
Date: 2017/10/12
Drawn by: KW
Page Size: TABLOID 11"x17"



LEGEND

- TREE PROTECTION ZONE
- TREE PROTECTION FENCE
- TREE TO BE RETAINED
- UN-SURVEYED TREE
- TREE TO BE REMOVED

Pr	CHERRY
Dr	RED ALDER
Hw	WESTERN HEMLOCK
Mb	BIGLEAF MAPLE
Cw	WESTERN REDCEDAR
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