McElhanney

CANADA BEST MANAGED COMPANIES

Timber Evaluation, Tree Risk Assessment and Cultural Modified Trees Identification, Initial Data Collection and Reporting

Gulf Islands National Park Reserve of Canada, Canal Road, Pender Island, B.C.

2023-01-11 | Revision #1

Submitted to: Ministry of Transportation and Infrastructure Contract: 851 CS 1013A
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REVISION	DESCRIPTION	DATE (YYYY-MM-DD)	ISSUED BY	REVIEWED BY
0	ORIGINAL	2022-04-11	LS	JP
1	TO ADD THE TIMBER ASSESSMENT AND SOIL SAMPLES INFORMATION	2023-01-11	LS	JP

Contents

Appendices

A: Tree Management Plans

- Property Acquisition Plan with clearing and grubbing boundaries
- LIDAR – Tree Canopy Height Model
- Danger Trees and Soil Samples Location

B: Site photographs

C: WDTA reference forms (Forest Activities and Parks and Recreations Sites)

1. Introduction & Project Understanding

McElhanney Ltd. was asked to complete an initial Timber Evaluation, Tree Risk Assessment and a Cultural Modified Trees (CMT) Identification for an approximate 3 hectares of a natural forested area located upslope (South) of the Canal Road on South Pender Island, B.C (see Figure 1).

During our March 22nd and November 16th, 2022, site visits, and in conjunction with the inventory, trees were assessed for risk, on a limited visual assessment basis. This initial Tree Risk Assessment was completed using the "Parks and Recreation Sites" module standards before the active construction begins. For the construction phase and for the removal of the forest cover the new created forest edge shall be re-assessed for safety at that time and using the "Forest Activities Module".
The initial Cultural Modified Trees Assessment was completed using the Culturally Modified Trees of British Columbia A Handbook.

This assignment is designed to support the upslope realignment and emergency recovery of the Canal Road due to a potential landslide. The pavement cracks are being monitored and the traffic on this section of Canal Road is restricted to single lane alternate traffic (SLAT) during the load restriction period, one car only at the time (see Figure 2). This potential landslide and the pavement cracks are located near the Gulf Islands National Park Reserve of Canada boundary (latitude: 48.75938; longitude: -123.22617), but the proposed road realignment location is inside the park boundary and into a private lot to the West.

The proposed construction works will include forest cover removal, rock basting, excavations, soil grading and construction of the new section of the Canal Road.

Figure 1. Canal Road on South Pender Island, BC with area of interest outlined in red (Google Image - North oriented, not to scale).

Figure 2. Canal Road on South Pender Island, BC - image of the longitudinal pavement crack and steep terrain above the road (view from the West to the East).

2. Definitions

- **DBH** – diameter at breast height. The diameter of trunk measured to the nearest centimetre at 1.4 metres above ground level.
- **Dripline** – Indicates the radius of the crown spread, measured in metres, from the centre of the tree to the dripline of the longest limbs.
- **Dangerous tree** – "means a tree that is a hazard to a worker due to its location or lean, its physical, damage, overhead conditions, deterioration of its limbs, stem or root system, or any combination of these conditions."
- **Suspect trees –** "are any live or dead tree with a visible defect which could cause failure of the tree, either whole or in part, for the applicable level of disturbance."
- **Common tree species names and codes:**
    - Douglas fir – Fd
    - Western red cedar – Cw
    - Western hemlock – Hw
    - Bigleaf maple – Mb
    - Red alder - Dr

Definitions are as per Wildlife/Dangerous Tree Assessor's Course Workbook, Parks & Recreation Site and Forest Activities Course Module, Ministry of Environment & Climate Change Strategy.

Descriptive information for each polygon with identified timber stands and danger tree is recorded in the tree inventory tables (*Table 1 and 2*). The proposed clearing areas and the locations of the assessed trees are represented on the attached Tree Management Plan in *Appendix A*.

3. Methodology

TIMBER EVALUATION FOR PROPOSED CLEARING AREAS

The trees located in the clearing and grubbing areas within the MoTI ownership were grouped into two separate areas, one North and one South of the Canal Road. The rest of the trees located in the clearing and grubbing areas were divided into separate polygons: “Property Acquisition”, “Dedicated Road” and “Licence to Construct” areas and recorded in the tree inventory table. Specification of these areas are presented on the project maps and the Tree Management Plans (Appendix A).

LIDAR, remote analysis and ground proofing methodology was used to assess the timber volume associated with sections being cleared. These timber removals are necessary for rock blasting, excavations, gradings and construction of this section of Canal Road.

TREE RISK ASSESSMENT

For the purpose of this report, we assessed the tree size, structural condition, class and activity level of disturbance (LOD). Based on these characteristics and the Wildlife/Dangerous Tree Assessor’s Course Workbook criteria, we assigned an overall risk rating and management action to each assessed tree.

Trees located in the clearing areas or within 5 m from these areas were assessed using the Forest Activities modules. For the danger trees located more than 5m from the clearing boundaries but within 1.5 tree heights from the proposed construction site or from the highway traffic were assessed using the Parks and Recreation Sites module (see Tree Management Plans Appendix A).

For ease of identification in the field, orange timber mark paint and blue ribbon were used to each tree (see tree photos). Each tree was visually examined on a limited visual assessment basis. The following information was included in the tree inventory table (*Table 1*).

- Tree ID Tag #
- Tree location Onsite / Offsite"
- Species, Common Name and Botanical Name
- DBH (cm), Crown Radious (m), Est. Ht (m)
- Wildlife value (L, M, H)", Wildlife Use
- Heritage tree
- Distance to target (m)
- Decay Class Tree, Level of Disturbance (LOD)
- Insecurely Lodged or Hung-up Limbs / Tops, Highly Unstable Tree
- Tree Defects Comments
- Management Action Retain / Remove

CULTURALLY MODIFIED TREES (CMT)

Using the Culturally Modified Trees of British Columbia Handbook specification, a walkthrough of the assessment area was completed for a Level I CMT Recording which includes CMT location, type, and frequency. As per Culturally Modified Trees Guidelines, the Level I record is appropriate for preliminary investigation and inventories with the following steps:

- Pre-field Assessment and Permit Applications
    - Regional Archaeological Overview Assessments (AOAs), which may include predictive modeling
    - CMT modeling
    - Previous archaeological assessments.
    - Forest-stand data
    - Orthophotography demonstrating previous disturbances.
- Identification
- Recording
- Survey Sampling and Field Collection and
- Reporting

The factors considered in the impact rating include but are not limited to:

- Quantity of root volume removed versus overall root volume (estimated by species, age, size, soil condition).
- Tree species, age, size, and existing condition.
- Previous root pruning/removals associated with historic construction activities.
- Pre-existing condition factors such as decay, pruning, leans, stress indicators, etc.
- Quantity and quality of the rooting space.

Figure 3. *Spotted areas with old growth characteristics were identified.*

Tree Inventory Table 1. Detailed timber evaluation table

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
					Species code	#		Gross	Merch
CLGR_North	MoTI	Cw65%Fd34%Bg1%	10-20	15	Fd	1	30	0.3	0.2
CLGR_North	MoTI		10-20	15	Cw	11	30	3.3	2.3
CLGR_North	MoTI		21-30	25	Fd	6	50	7.8	5.5
CLGR_North	MoTI		21-30	25	Cw	6	55	9.2	6.5
CLGR_North	MoTI		21-30	25	Bg	1	50	1.3	0.5
CLGR_North	MoTI		31-40	35	Fd	3	70	10.2	7.9
CLGR_North	MoTI		31-40	35	Cw	2	80	8.7	6.1
Notes:	Totals					30		40.8	28.9

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
					Sp	#		Gross	Merch
CLGR_South	MoTI	Fd88%Cw5%Mb5%Dr2%	10-20	15	Fd	8	27	2.0	1.4
CLGR_South	MoTI		10-20	15	Cw	2	26	0.5	0.3
CLGR_South	MoTI		10-20	15	Mb	4	22	0.7	0.3
CLGR_South	MoTI		21-30	25	Fd	14	37	10.7	7.5
CLGR_South	MoTI		21-30	25	Cw	1	60	1.8	1.3
CLGR_South	MoTI		21-30	25	Mb	4	32	2.4	1.6
CLGR_South	MoTI		21-30	25	Dr	2	24	0.7	0.5
Notes:	Totals					35		18.7	12.9

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
					Sp	#		Gross	Merch
PropertyAcq	MoTI	Fd80%Cw20%	10-20	15	Cw	5	30	1.5	1.1
PropertyAcq	MoTI		21-30	25	Fd	1	60	1.8	1.3
PropertyAcq	MoTI		21-30	25	Fd	9	40	7.9	5.5
PropertyAcq	MoTI		21-30	25	Fd	6	50	7.8	6.1
PropertyAcq	MoTI		31-40	35	Fd	1	80	4.3	3.4
PropertyAcq	MoTI		31-40	35	Fd	3	60	7.8	6.1
Notes:	Totals					25		31.1	23.4

ID polygon	Ownership	Overall stand	Height class (m)	Median HtC (m)	Estimated # of trees	DBH (cm)	Estimated Volume (m3)

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
		composition (%)			Sp	#		Gross	Merch
DedicatedRd	Parks Canada	Cw66%Fd34%	10-20	15	Cw	7	30	2.1	1.5
DedicatedRd	Parks Canada		21-30	25	Fd	1	25	0.4	0.3
DedicatedRd	Parks Canada		21-30	25	Cw	10	60	18.0	14.1
DedicatedRd	Parks Canada		21-30	25	Fd	7	40	6.1	4.3
DedicatedRd	Parks Canada		21-30	25	Cw	5	50	6.5	4.5
DedicatedRd	Parks Canada		21-30	25	Cw	12	40	10.5	7.3
DedicatedRd	Parks Canada		21-30	25	Fd	1	60	1.8	1.3
DedicatedRd	Parks Canada		31-40	35	Fd	7	80	30.3	24.1
DedicatedRd	Parks Canada		31-40	35	Cw	5	80	21.6	15.1
DedicatedRd	Parks Canada		31-40	35	Fd	11	55	24.5	17.8
DedicatedRd	Parks Canada		31-40	35	Cw	14	60	36.3	26.6
Notes:	Totals					80		158.1	116.9

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
					Sp	#		Gross	Merch
LicConstruct (clear-cut)	Private	Fd78%Cw22%	10-20	15	Cw	4	35	1.6	1.1
LicConstruct (clear-cut)	Private		21-30	25	Fd	3	30	1.6	1.1
LicConstruct (clear-cut)	Private		21-30	25	Cw	1	50	1.3	0.9
LicConstruct (clear-cut)	Private		31-40	35	Fd	11	50	20.6	16.8
LicConstruct (clear-cut)	Private		31-40	35	Fd	3	80	13.0	10.4
Notes: Clear-cut portion of the private property	Totals					22		38.1	30.3

ID polygon	Ownership	Overall stand composition (%)	Height class (m)	Median HtC (m)	Estimated # of trees		DBH (cm)	Estimated Volume (m3)	
					Sp	#		Gross	Merch
LicConstruct (no cut)	Private	Fd67%Cw33%	21-30	25	Fd	8	40	7.0	4.9
LicConstruct (no cut)	Private		21-30	25	Cw	1	34	0.7	0.5
LicConstruct (no cut)	Private		21-30	25	Cw	3	60	5.4	3.8
LicConstruct (no cut)	Private		31-40	35	Fd	2	60	5.2	4.1
LicConstruct (no cut)	Private		31-40	35	Cw	1	60	2.6	2.0
Notes: Above clear cut	Totals					15		20.8	15.2

Table 2. Danger Tree Inventory – before construction phase.

Tree ID #	Tree location Onsite / Offsite	Species Common Name	Species Botanical Name	DBH (cm)	Crown Radious (m)	Est. Ht (m)	Wildlife value (L, M, H)	Wildlife Use	Heritage tree	Target / Distance (m)	Decay Class Tree	Level of Disturbance (LOD)	Insecurely Lodged or Hung - up Limbs / Tops	Highly Unstable Tree	Tree Defects	Comments	Danger / Safe (for recorded LOD)	Management Action Retain / Remove
1	Onsite	Western redcedar	*Thuja plicata*	32	N/A	14	L	Feeding	No	Assessment area	4	Very low risk	No	No	Dead tree	Tree located at the western side in the Property Acquisition section of the project which is proposed for clearing. Anticipate this tree will be removed at that time.	Safe	**No action required / Retain**
2	Onsite	Douglas fir	*Pseudotsuga menziesii*	30	3	12	L	Feeding	No	Assessment area and Road / 6m	2	2	No	No	Tree lean Dislocated root plate	Tree rooted on the shallow soils on top of the rock. Tree leaning N on the near tree over the road	Danger	**Remove**
3	Onsite	Douglas fir	*Pseudotsuga menziesii*	42	N/A	24	M	Feeding	No	Assessment area	5	2	No	Yes	Tree lean Decayed roots	Tree is leaning SW on the adjacent tree. We recommend removal concurrent with tree #2.	Danger	**Remove**
4	Parks	Douglas fir	*Pseudotsuga menziesii*	58	N/A	16	H	Feeding Perching	No	Assessment area	6	Very low risk	No	No	Broken and missing top Dead limbs Fungal fruiting bodies	This tree has a high value wildlife value and can be retained until stand removal.	Safe	**No action required / Retain**
5	Parks	Douglas fir	*Pseudotsuga menziesii*	48	5	26	M	Perching	No	Assessment area	2	Very low risk	No	No	Tree lean	Tree rooted in the rock with and associated of phototropic and unstable terrain 60 % lean W but corrected and live appears stable now.	Safe	**No action required / Retain**
6	Parks	Western redcedar	*Thuja plicata*	48	4	24	L	Perching	No	Assessment area	2	Very low risk	No	No	Tree leans and partially dislocated root plate	Tree rooted in the shallow soil and associated of phototropic and unstable terrain 60 % lean NE but corrected and live appears stable now. Re-assess at the forest clearing time.	Safe	**No action required / Retain**

NOTES:

- Subject trees were marked with orange timber marking paint and with blue ribbon attached around the lower trunk.
- Identified trees were triangulated for their location by the project forester and were not legally surveyed

4. Site Information

The subject site that is approximately 3 hectares in size consists of a second growth natural regenerated forest stand in the Coastal Douglas-fir Biogeoclimatic zone, Moist Maritime (mm) subzone with a combination of 01, 04 and 06 variants (Land Management Handbook 28, 1994). The terrain is variable sloping 10 to 150% North, with some areas appears to be unstable. The soil is in general shallow on the steeper sections and deeper at the base of slope near the road at the eastern half. As requested by the MoTI representative, six (6) soil samples were collected along the existing road into the natural area. These soil samples were assessed for a basic soil fertility by Pacific Soil Analysis Inc. The result of this analysis is presented in a table format below. Soil sample location is presented in the Appendix A.

The overall multi-layer forest stand characteristics is presented in detail above in a tabular format. The estimated age of the stand is more than 90 years with some trees acquiring old growth characteristics (see Figure 3). This stand appears to be spot burned more than 90 years ago (estimated).

During the site visit I observed signs of unstable terrain like trees with “pistol butts” and large pieces of rock that appear have rolled from above (see figures 4 and 5).

Signs of laminated root rot, Schweinitzii root and butt rot were also identified. This aspect needs to be taken in consideration when selecting trees to be retained along the proposed new forest edge.

All inventoried trees with their biophysical characteristics are recorded in the Tree Inventory Tables above. Sample images of the site conditions and trees were also included in this report.

Figure 4 and 5. *Trees with their structure and overall form that has been impacted by unstable terrain.*

Pacific Soil Analysis Inc.

#5-11720 Voyageur Way, Richmond, B.C V6X 3G9 604-273-8226

Client: McElhanney

Date: November 30, 2022

Sample Received on: November 22, 2022

								Total	Total		AVAILABLE				
		Estimated		>	<			Organic	Kjeldahl	Carbon	P	K	Ca	Mg	Na
	pH	E.C.		2mm	2mm			Matter	Nitrogen	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Sodium
Sample		mmhos/cm		(%)	(%)			(%)	(%)	Ratio	PPM				
Site 1	5.9	0.26		63.1	36.9			8.8	0.14	36.4	107	110	2300	615	55
	OK	OK		VH				OK	VL	OK	OK	OK	OK	H	OK
Site 2	6.0	0.28		93.6	6.4			11.0	0.19	33.6	23	200	3900	790	70
	OK	OK		VH				OK	VL	OK	L	OK	SH	H	OK
Site 3	6.0	0.20		53.5	46.5			9.6	0.17	32.8	143	395	2500	305	50
	OK	OK		VH				OK	VL	OK	OK	OK	OK	SH	OK
Site 4	6.1	0.32		39.0	61.0			15.9	0.29	31.8	86	425	3750	465	60
	OK	OK		H				OK	M	OK	OK	OK	SH	SH	OK
Site 5	5.6	0.34		38.8	61.2			12.6	0.23	31.8	124	275	2650	365	65
	OK	OK		H				OK	L	OK	OK	OK	OK	SH	OK
Site 6	5.8	0.26		22.3	77.7			11.2	0.19	34.2	125	535	2500	420	60
	OK	OK		SH				OK	VL	OK	OK	OK	OK	SH	OK

1 The fertility status will be greatly reduced if the gravel content is not screened out.

2 The >2mm portion for sites 1 and 2 were mostly rock. The remaining sites were birds-eye, pea and pebble sized gravel.

Nutrient Legend	VL= Very Low	L= Low	M= Moderate	OK= Adequate	SH= Slightly High		H= High	VH= Very High	VVH=Very Very High

5. Timber Evaluation

All trees proposed for removal were separated into five (5) polygons:

- Clearing and grubbing North (MoTI),
- Clearing and grubbing South (MoTI)
- Property acquisition (from Parks Canada to MoTI)
- Dedicated road (Parks Canada)
- Licence to construct on private property. This section will be partial clear-cut.

A preliminary LIDAR analysis was used to determine the approximate number of trees for different height classes from 10 – 20, 21 – 30, 31 – 40, 41 – 50, 51 – 60 and 60+ metres, then a field proofing count was completed (Appendix A).

Timber evaluation summary and totals split by property are presented below in a table format.

Tree Removal Volume - Totals

Specifications	Total Estimated Number of Remove Trees	Total Estimated Gross Volume (m3) Remove Trees	Merchantable Volume (m3)
Deciduous MoTI (North and South)	10	3.8	2.4
Conifer MoTI	55	54.7	39.4
Total MoTI	65	58.5	41.8
Deciduous Property Acquisition	0	0.0	0.0
Conifer Property Acquisition	25	31.1	23.5
Total Property Acquisition	25	31.1	23.5
Deciduous Dedicated Road	0	0.0	0.0
Conifer Dedicated Road	80	158.1	116.9
Parks Canada (Dedicated Road)	80	158.1	116.9
Deciduous Licence to Construct	0	0.0	0.0
Conifer Licence to Construct	22	38.1	30.3
Total Licence to Construct	22	38.1	30.3
TOTAL GENERAL	192	285.8	212.5

Tree Removal Summary per Species

Trees Proposed for Removal - Volume Analysis / Canal Road, Pender Island Project December 5, 2022			
Forest Inventory Zone (FIZ) A to L	**Stand Age Type (M-mature) (I-immature)**	**Stump Height (m)**	**Top Diameter (cm)**
B (Vancouver Island and Golf Islands)	**M**	**0.3**	**10**
Remove trees from MoTI R/W (Polygons CLGR_Soth&North)			
Species	**Estimated number of trees**	**Est. Gross Volume (m3)**	**Merch. Volume m3**
Douglas fir (Fd)	32	31.0	22.5
Western red cedar (Cw)	22	22.4	16.4
Grand fir (Bg)	1	1.3	0.5
Bigleaf maple (Mb)	8	3.1	1.9
Red alder (Dr)	2	0.7	0.5
Totals	**65**	**58.5**	**41.8**
Remove trees from Private Property			
Species	**Estimated number of trees**	**Est. Gross Volume (m3)**	**Merch. Volume m3**
Douglas fir (Fd)	20	29.6	22.4
Western red cedar (Cw)	5	1.5	1.1
Totals	**25**	**31.1**	**23.5**
Remove trees from Parks Canada (Dedicated Road)			
Species	**Estimated number of trees**	**Est. Gross Volume (m3)**	**Merch. Volume m3**
Douglas fir (Fd)	27	63.1	47.8
Western red cedar (Cw)	53	95.0	69.1
Totals	**80**	**158.1**	**116.9**
Remove trees from Licence to Construct (Private Property)			
Species	**Estimated number of trees**	**Est. Gross Volume (m3)**	**Merch. Volume m3**
Douglas fir (Fd)	17	35.2	28.3
Western red cedar (Cw)	5	2.9	2.0
Totals	**22**	**38.1**	**30.3**
Totals	**192**	**285.8**	**212.5**

6. Tree Risk Assessment and Recommendations

As stated in the introduction of this report, the initial tree risk assessment was designed to cover the period before the clearing and construction begin and was completed using the “Parks and Recreation Sites Module” standards. Due to its proximity to the existing road, the project area was assessed for a “Level of Disturbance 2” (LOD 2). This level of disturbance is appropriate for trees in striking distance of frequent-use paved roads such as this section of Canal Road. For the same period and before forest clearing and construction activity begins. Park area, with trees not in the 1.5X striking distance to the Canal Rd. where planned activities are site assessments and surveys the level of disturbance adopted was “Very Low Risk” (see Appendix C).

During my site visit, and considering the above, I identified six (6) suspect trees that present visible defects.

These trees were assessed for risk, on a limited visual assessment basis, and in the context of the current land uses. Two trees were deemed to be danger trees that would require hazard abatement to eliminate present and/or future risks (within a 1-year timeframe of the tree inventory or before any significant storm event) (see Figures 6 & 7).

- **Remove tree #2** with a dislocated root plate and leaning over the road.
- **Remove tree #3** with a pronounced lean and decayed roots. This tree is leaning SW on the adjacent tree. We recommend removal concurrent with tree #2

Figure 6 and 7. *Tree #2 and tree #3 proposed for removal.*

For clear-cutting of the trees from area ”A”, the harvesting contractor will remove all trees, so there is no need to apply this tree risk assessment for that phase.

For the active construction phase the newly created forest edge along the northern boundary of the area “B” shall be assessed for safety before the rock blasting, excarnation and soil grading activities begin. For that phase, the tree risk assessment shall use the “Forest Harvesting and Silviculture Module” with a LOD 3&4. This new created forest edge shall be also wind proofed to ensure trees retained along this new section of the road will be stable with a reduced risk of them being up rooted or bent over the road.

7. Cultural Modified Trees (CMT) Assessment

During the site visit, both tree assessment areas “A” and “B” were surveyed for CMTs. The large component of mature Western redcedar and the proximity to the ocean is favorable for creation of CMTs, however I was not able to identify with certainty any trees that qualify under this category. I identified Western redcedar trees with similar scars as CMTs, but in my opinion those scars were produced by partial root rot and surface fires or other mechanical factors like falling trees or rolling rocks. Some trees present scars that were completely closed so, I was not able to identify any marks produced by tools. To document these findings, I attached photographs taken during my site visit (see Figure 8, 9, 10 and 11).

Figure 8 and 9. *Trees with their structure and overall form that has been impacted by responses to historical damage and stress, no conclusive CMT identified.*

Figure 10 and 11. *Trees with their structure and overall form that has been impacted by responses to historical damage and stress, no conclusive CMT identified.*

Figure 12. *Image of the interior of the forest stand with a large Western redcedar component.*

8. Conclusion and Recommendations

Some construction activities requiring blasting, excavation, or grade changes within the Critical Root Zone (CRZ) of retained trees shall be supervised by the project forester/arborist, and any root pruning required shall be performed by the project forester/arborist. The construction impact of the tree's overall health and/or structural condition for each subject tree will be based on the professional opinion of the project forester/arborist.

Timber Evaluation

An estimated total 285.8 m^3 of gross volume with an estimated 212.5 m^3 merchantable timber will be produced from tree clearing for this project. For further details, data, and breakdown, see section 5 above.

Tree Risk Assessment

A total of 6 suspected danger trees were identified and assessed. Two (2) of these trees will require removal or abatement prior to the start of construction. For more details, see section 6 above.

For the active construction phase and for the newly created forest edge along both sides of new Canal Road re-alignment shall be re-assessed for safety before the rock blasting, excavation and soil grading activities begin. This newly created forest edge shall be also wind-proofed to ensure trees retained along this new section of the road will be stable with a reduced risk of them being up-rooted or bent over the road.

Culturally Modified Trees

During our site visits, no CMTs were identified on the proposed project area or vicinity.

9. Limitations of Report

This field review report was prepared by McElhanney for the exclusive use of the Client and may not be reproduced, used, or relied upon, in whole or in part, by a party other than the Client without the prior written consent of McElhanney. Any unauthorized use of this report, or any part hereof, by a third party, or any reliance on or decisions to be made based on it, are at the sole risk of such third parties. McElhanney accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report, in whole or in part.

Foresters/arborists are professionals who examine trees and use their training, knowledge, and experience to recommend techniques and procedures that will improve a tree's health and structure or to mitigate associated risks. Trees are living organisms whose health and structure change and are influenced by age, continued growth, climate, weather conditions, and insect and disease pathogens. Indicators of structural weakness and disease are often hidden within the tree structure or beneath the ground. The arborist's review is limited to a visual examination of tree health and structural condition, without excavation, probing, resistance drilling, increment coring, or aerial examination. There are inherent limitations to this type of investigation, including, without limitation, that some tree conditions will inadvertently go undetected. The arborist's review followed the standard of care expected of arborists

undertaking similar work in British Columbia under similar conditions. No warranties, either express or implied, are made as to the services provided and included in this report.

The findings and opinions expressed in this report are based on the conditions that were observed on the noted date of the field review only. The Client recognizes that passage of time, natural occurrences, and direct or indirect human intervention at or near the trees may substantially alter discovered conditions and that McElhanney cannot report on, or accurately predict, events that may change the condition of trees after the described investigation was completed.

It is not possible for a forester/arborist to identify every flaw or condition that could result in failure, nor can he/she guarantee that the tree will remain healthy and free of risk. The only way to eliminate tree risk entirely is to remove the entire tree. All trees retained should be monitored on a regular basis. Remedial care and mitigation measures recommended are based on the visible and detectable indicators present at the time of the examination and cannot be guaranteed to alleviate all symptoms or to mitigate all risk posed.

Immediately following land clearing, grade changes or severe weather events, all trees retained should be reviewed for any evidence of soil heaving, cracking, lifting or other indicators of root plate instability. If new information is discovered in the future during such events or other activities, McElhanney should be requested to re-evaluate the conclusions of this report and to provide amendments as required prior to any reliance upon the information presented herein.

10. Company Information

WorkSafe BC #	200094159
General Liability	ACE INA Insurance Company, Policy No: CGL 524064: $3,000,000
Errors & Omissions	Certain Underwriters at Lloyds as arranged by Lockton Companies LLP, Policy No: GLOPR 1601496: $3,000,000
City of Surrey Inter-Municipal Business License (Metro West)	148615, expires November 26, 2023.

11. In Closing

We trust that this report meets your needs. Should there be any questions regarding the information within this report, please do not hesitate to contact the undersigned.

Yours truly,

McELHANNEY LTD.

Prepared by:

Project Forester / Arborist
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Parks & Recreation & Forest Activities Modules
Tree Risk Assessment Qualification
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12. References

Bulletin 27 – Culturally Modified Trees Guidelines, V1 March 22, 2017, Government of BC.

Culturally Modified Trees of British Columbia Handbook for the Identification and Recording of Culturally Modified Trees / Prepared by Archaeology Branch B.C. Ministry of Small Business, Tourism and Culture for the Resources Inventory Committee March 2001 Version 2.0.

Dunster, J.A., E.T. Smiley, N. Matheny, and S. Lily. 2017. Tree Risk Assessment Manual, International Society of Arboriculture (ISA).

Green, R.N., Klinka, K. 1994. A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region. Land Management Handbook Number 28. Province of British Columbia Ministry of Forests.

Site Index Estimates by BEC Site Series (SIBEC) / Site Index Estimates By Site Series: Report by Region Ministry of Forests, Lands and Natural Resource Operations

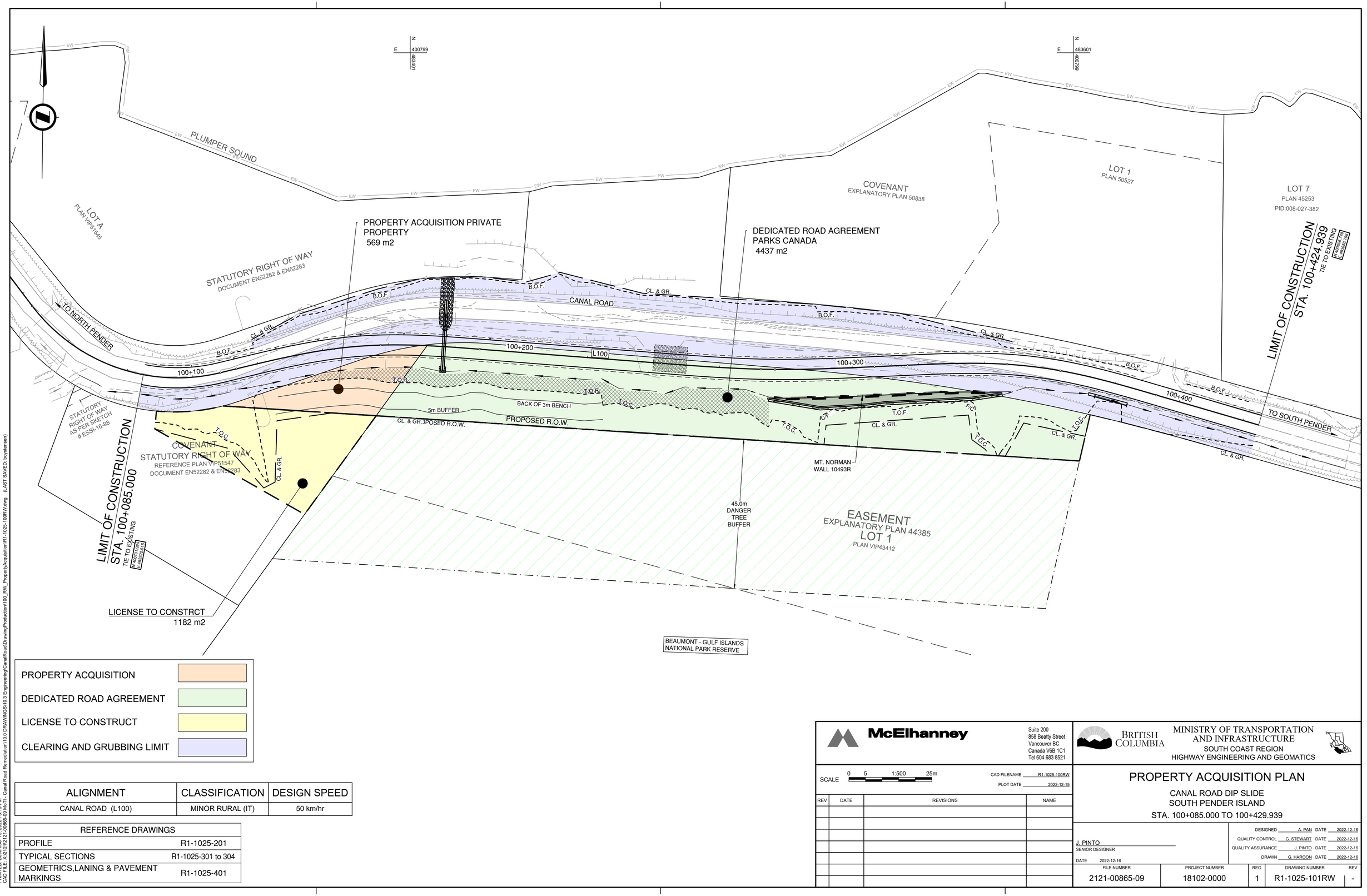
Cruise Compilation Manual / Height-Diameter Equations Ministry of Forests, Lands and NRO

Wildlife/Dangerous Tree Assessor's Course Workbook, Parks & Recreation Site and Forest Activities Course Modules, Ministry of Environment & Climate Change Strategy.

APPENDIX A:

TREE MANAGEMENT PLANS

- PROPERTY ACQUISITION PLAN
  WITH CLEARING AND GRUBBING BOUNDARIES
- LIDAR – TREE CANOPY HEIGHT MODEL
- DANGER TREES AND SOIL SAMPLE LOCATION



PROPERTY ACQUISITION	
DEDICATED ROAD AGREEMENT	
LICENSE TO CONSTRUCT	
CLEARING AND GRUBBING LIMIT	

ALIGNMENT	CLASSIFICATION	DESIGN SPEED
CANAL ROAD (L100)	MINOR RURAL (IT)	50 km/hr

REFERENCE DRAWINGS	
PROFILE	R1-1025-201
TYPICAL SECTIONS	R1-1025-301 to 304
GEOMETRICS,LANING & PAVEMENT MARKINGS	R1-1025-401

McElhanney
Suite 200
858 Beatty Street
Vancouver BC
Canada V6B 1C1
Tel 604 683 8521

SCALE 0 5 1:500 25m

CAD FILENAME R1-1025-100RW

PLOT DATE 2022-12-15

REV	DATE	REVISIONS	NAME

BRITISH COLUMBIA
MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
SOUTH COAST REGION
HIGHWAY ENGINEERING AND GEOMATICS

PROPERTY ACQUISITION PLAN

CANAL ROAD DIP SLIDE
SOUTH PENDER ISLAND
STA. 100+085.000 TO 100+429.939

J. PINTO
SENIOR DESIGNER
DATE 2022-12-16

DESIGNED A. PAN DATE 2022-12-16
QUALITY CONTROL G. STEWART DATE 2022-12-16
QUALITY ASSURANCE J. PINTO DATE 2022-12-16
DRAWN G. HAROON DATE 2022-12-16

FILE NUMBER	PROJECT NUMBER	REG	DRAWING NUMBER	REV
2121-00865-09	18102-0000	1	R1-1025-101RW	-

PRINTED: December 15, 2022 - 3:15 PM
CAD FILE: X:\2121\21-00865-09 MoTI - Canal Road Remediation\10.0 DRAWINGS\10.13 Engineering\CanalRoad\DrawingProduction\100_RW_PropertyAcquisition\R1-1025-100RW.dwg (LAST SAVED: boyatsensen)

CANAL ROAD

CANAL ROAD

CLGR_North

CLGR_South

PropertyAcquisition

DedicatedRoadAgreement

LicenceToConstruct

DangerTreeBuffer

McElhanney

TITLE

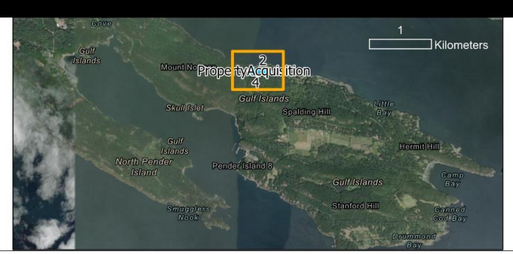
LIDAR - TREE CANOPY HEIGHT MODEL

Canal Road, South Pender Island |
McElhanney Project 2110-00001-14
Spatial Reference
Name: NAD 1983 UTM Zone 10N
Date: 2022 Nov 03

30 Meters

N

INSET



LEGEND

Canopy Height (m)
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 48
- Tree Tops All - 3m window
- Polygons

Lower Right: 123°10'17"W 48°44'N

X:\2110\Projects\2110-00001-14 McTI - Canal Road Pender Island - Danger Tree Assessment\9.0 ENVIRONMENTAL SERVICES\Forestry\GIS\Canal_Road_Pender_Island.aprx

CANAL ROAD

CLGR_North

CANAL ROAD

CLGR_South

Soil sample 1

Soil sample 2

Soil sample 3

Soil sample 4

Soil sample 5

Soil sample 6

1

2

3

4

5

6

PropertyAcquisition

DedicatedRoadAgreement

LicenceToConstruct

Maxar, Microsoft, Earthstar Geographics

TITLE

DANGER TREE & SOIL SAMPLES LOCATION

Canal Road, South Pender Island |
McElhanney Project 2110-00001-14
Spatial Reference
Name: NAD 1983 UTM Zone 10N
Date: 2022 Nov 03

30 Meters

N

INSET

LEGEND

- Canal Road Polygons
- Danger Trees
- Soil Samples

Lower Right: 123°10'17"W 48°44'N

X:\2110\Projects\2110-00001-14 McTi - Canal Road Pender Island - Danger Tree Assessment\5.0 ENVIRONMENTAL SERVICES\Forestry\GIS\Canal_Road_Pender_Island.aprx

APPENDIX B:
SITE PHOTOGRAPHS


Photos 1 & 2. *Tree #1 images of the lower trunk and top.*


Photo 3 & 4. *Tree #4 lower trunk and top images. High value wildlife tree.*

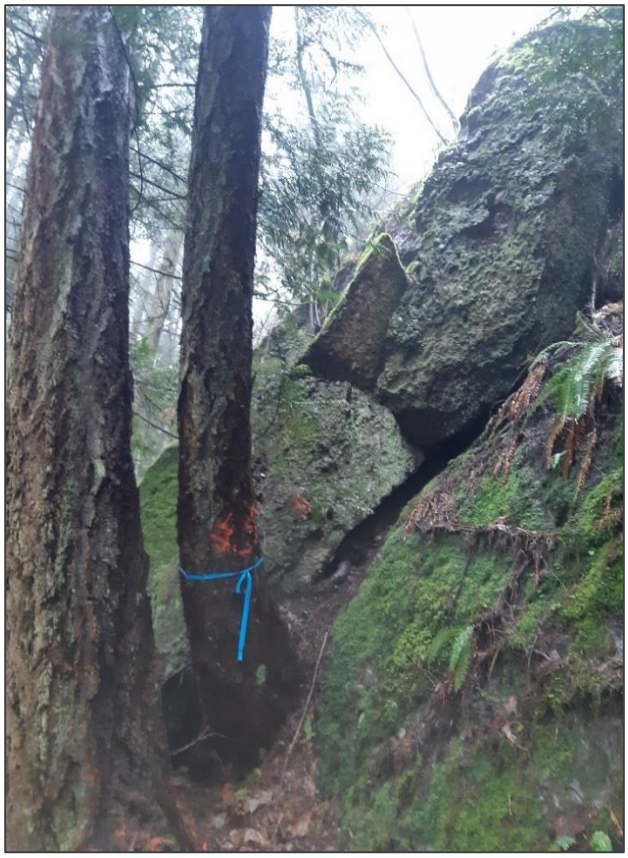



Photo 5 & 6. *Tree #5 images of the base of trunk anchored in the rock and leaning trunk (corrected).*

Photo 7 & 8. *Tree #6 images of the lower and upper trunk leaning but corrected.*

Photo 9 & 10. Signs of Schweinitzii root and butt rot were identified.

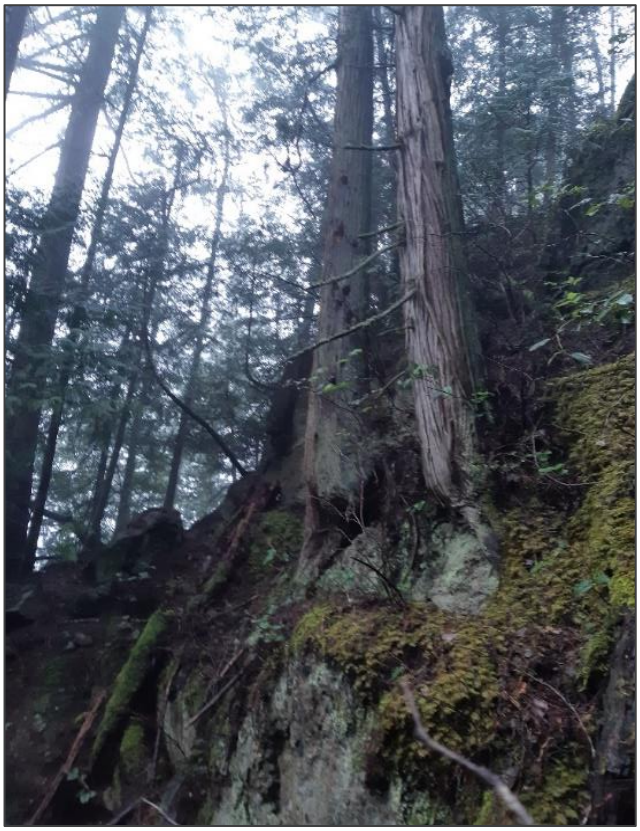


***Photo 11 & 12.** Trees growing on superficial soil, overview image.*

APPENDIX C:
WDTA REFERENCE FORMS

- FOREST ACTIVITIES FORMS
- PARKS AND RECREATION SITES FORMS

WDTAC – Forest Activities Module

Table 1. Levels of Disturbance for Unprotected Workers in Various Work Activities

Level of Disturbance*	Example Types of Work Activities in Harvesting & Silviculture Activities	Example Types of Work Activities in Geophysical Projects
Very Low Risk (No Pre-work DT Assessment)**	• Forest surveys, stand recce, tree marking, road & cutblock layout, foot travel • General light vehicle travel (pickups, ATV/UTV)	• Walking, surveying, safety egress (heads up work) • General light vehicle travel (pickups, ATV/UTV, snow sleds)
1 (Table 3) WIND: <40km/hour	• Tree planting • Brushing & Weeding, firewood bucking • Tree pruning (stems <20 cm dbh) • Use of light-duty machinery (e.g., weed whips, brush saws) • Road travel with heavy vehicles (>5500 kg GVWR) on a constructed and maintained resource road • Fire control with hand tools and/or water hoses	• Placing/retrieving recording lines (e.g., geophones) • Power tool brushing/slashing • Bucking logs (any size), or downed trees <15cm dbh • Seismic blasting <4kg charges (properly placed) • Seismic line rehabilitation (manual works, light duty machinery) • Road travel with heavy vehicles (>5500 kg GVWR) on constructed and maintained resource roads
2 (Table 4) WIND: <40km/hour	• Road travel with heavy vehicles (>5500 kg GVWR) on a trail or overgrown road • Maintenance or construction activities without heavy equipment (e.g., small machines such as "bobcats") • Tree pruning (stems >20 cm dbh) • Juvenile spacing or slashing (stems <15 cm dbh) • Tree bucking (root plate attached)	• Road travel with heavy vehicles (>5500 kg GVWR; e.g., LIS Drills, Vibes) on seismic line or overgrown road • Light duty equipment (e.g., LIS drills, small cats) • Bucking downed trees >15cm dbh (e.g., wind thrown trees with full root wad attachment) • Seismic line construction (stems <15cm dbh) with chainsaws*** • Seismic blasting >4kg charges (properly placed) • Road maintenance activities without excavations (e.g., brushing, ditch clearing)
3* (Table 4A) WIND: 40-65km/hour**	• Tree falling (any tree >15 cm dbh)**** • Cable yarding • Ground skidding • Mechanical harvesting and forwarding • Helicopter logging with NO workers exposed to rotor wash • Use of light and intermediate helicopters where workers are exposed to rotor wash (e.g., helipads) • Mechanical site preparation, maintenance, and construction activities with heavy machinery	• Tree falling (any tree >15cm dbh)**** • Mechanical harvesting and ground skidding • Use of light and intermediate helicopters where workers are exposed to rotor wash (e.g., slinging geophone bags) • Land clearing and site preparation/ deactivation with heavy machinery • Road maintenance or construction activities with heavy equipment
4 (Table 5) WIND: >65km/hour	• Trees adjacent to corridors in partial-cut cable logging operations • Harvesting operations in structurally damaged stands (e.g., wildfire burns) • Surface rock blasting • Helicopter logging with workers exposed to rotor wash • Use of medium and heavy lift helicopters where workers are exposed to rotor wash	• Use of medium and heavy lift helicopters where workers are exposed to rotor wash (e.g., slinging Heli seismic drill into position) • Surface blasting (e.g., road construction)

* A dangerous tree assessment is only valid for the lowest level of disturbance at which the assessment has been done.

** VLR activities are based upon the expectation that workers have been trained and mentored how to be situationally aware of the hazards expected in their workplace under a variety of forest and weather conditions.

*** If trees CANNOT be safely felled and yarded away from adjacent standing timber (i.e., there is a chance that felled or yarded timber will strike adjacent standing "leave timber"), then default to Level 4 disturbance.

**** Does not include dangerous tree falling and/or line slashing for fallen tree hazard mitigation. Falling of dangerous trees does not require reassessment to LOD3; the falling process must be in accordance with the BC Faller Training Standard and adherence to safe falling practices. Slashing and bucking to remove fallen hazards after mulcher line clearing does not require reassessment to LOD2.

Table 1A. Influence of Wind Speed on Level of Disturbance

Wind Speed (km/h)	Description	Level of Disturbance Equivalency
0 – 40	**light breeze** (dust and loose paper raised; small branches move) to **fresh breeze** (small trees sway; tops of large trees sway)	1 – 2
40 – 65	**strong breeze** (small branches fly in the air; whole tree in motion; resistance felt when walking against wind)	3
65+	**gale** (branches broken off trees; walking impeded)	4

Table 1B. Helicopter Types

Helicopter Category	Passenger Capacity	Lift Capacity
Type 1 (Heavy)	15+	Exceeds 2720 kg (6000 lbs)
Type 2 (Medium)	9 – 14	1135 – 2720 kg (2500 – 6000 lbs)
Type 3 (Intermediate)	5 – 8	680 – 1134 kg (1500 – 2500 lbs)
Type 4 (Light)	1 – 4	Not exceeding 680 kg (1500 lbs)

The following listing provides examples of common aircraft by helicopter type, and is a useful guide when determining the appropriate level of disturbance for the type of aircraft being used.

Light Category: Jet Ranger (Bell 206), Hughes 500, Hiller 12, EC 120, R22 & R44

Intermediate Category: Long Ranger, A-Star (AS350), Bell 407, EC 130

Medium Category: K-Max, Bell 204, 212, 205

Heavy Category: Bell 214, Kamov, Sikorsky 61 & 64, BV 107 & 234

What is a Dangerous Tree?

defined in the *Operational Health and Safety Regulation* section 26.1

A dangerous tree is any tree (regardless of size) that is hazardous to people or facilities because of:

- location or lean,
- physical damage,
- overhead hazards,
- deterioration of limbs, stem or root system, or
- a combination of the above.

Steps Required to Determine Tree Danger Rating:

1. **Determine the level of ground disturbance and exposure** (refer to Tables 1, 1A, 1B)
2. **Conduct a site assessment overview** (refer to Table 2)
3. **Conduct tree assessments** (refer to Tables 3, 4, 4A and 5)
4. **Make the appropriate safety decision** (Safe or Dangerous)
5. **Provide documentation and communicate safety procedures**

Summary of Assessment Requirements

All work activities EXCEPT those defined as "very low risk" require a pre-work inspection by a qualified person to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below.

- **Very Low Risk (VLR) Activities** – No pre-work site inspection is required.
- **Level 1 Disturbance Activities** – A pre-work inspection by a qualified person is required. If trees with significant tree hazards (see Table 3) are observed, the appropriate safety procedures must be taken before work activities begin. A certified danger tree assessor is required for structurally damaged or high stem density (>500sph) stands.
- **Level 2, 3 or 4 Disturbance Activities** – A pre-work inspection by a qualified person is required. If "suspect" trees (see Table 4, 4A, 5) are identified by a qualified person, then further assessment by a certified danger tree assessor is required and the appropriate safety procedures must be taken BEFORE work activities begin.

Common Tree Species Name and Codes

Tree Species	Code Symbol	Tree Species	Code Symbol	Tree Species	Code Symbol
Douglas -fir	Fd	Sitka spruce	Ss	Western redcedar	Cw
Western larch	Lw	Spruce hybrid	Sx	Yellow cedar	Yc
Lodgepole pine	Pl	Black spruce	Sb	Black cottonwood	Ac
Yellow pine (Ponderosa pine)	Py	Subalpine fir	Bl	Trembling aspen	At
Western white pine	Pw	Amabilis fir	Ba	Paper birch	Ep
White spruce	Sw	Grand fir	Bg	Red alder	Dr
Engelmann spruce	Se	Western hemlock	Hw	Bigleaf maple	Mb

Table 2. Site Assessment Overview (for all tree species)

Site/Stand Factors	Hazard Indicators / Influences
Stand history and condition	• evidence of past tree failure • disturbance history (natural or human-caused, including wildfire damage; age, condition and location of mechanically harvested "stubs") • general age, condition and density • tree species composition • evidence of root and/or stem diseases
Common rain, snow and ice conditions	• high snow or ice loading • high rain fall periods
Flooding	• high water table • evidence of water damaged/decayed roots • area prone to flooding
Windthrow potential	• topography • prevailing winds • evidence of significant windthrow • area of high or recent exposure • stems with height/diameter ratio >100 or small live crown (<20% tree height) (i.e., very tall, slender stems) • saturated soils; fine textured soils • shallow soils, restricted rooting depth
Crown condition (i.e., common root disease indicators)	• stress cone crop • thinning foliage and/or chlorosis • rounded crown
Resinosis	• higher than normal stem or basal pitch flow (e.g., from butt rot, mechanical damage, root disease)
Tree lean	• trees recently leaning due to windstorm, root damage, shifting root mat or other causes
Additional site-specific factors	• based on local knowledge (e.g., soil or slope instability)

Table 3. Dangerous Tree Assessment Process for Level 1 Disturbance Activities – Significant Hazard Indicators

D = Dangerous	**D if tree has one or more of the following significant tree hazard indicators that are at risk of imminent failure*:** • **Insecurely lodged trees or insecure hang-ups:** i) Insecurely lodged trees (a tipped tree that is likely to shake free of the support trees and fall to the ground); **or** ii) Dislodged but hung-up limbs or tops (consider size and height above ground) at risk of shifting free during light winds or other tree motion • **highly unstable tree:** Examples: i) >50% tree cross-sectional area damaged or decayed; **or** ii) Spongy snags with heart rot conks along the majority of the length of the stem (e.g., class 5 – 6 conifers or class 4 deciduous) or soft snags (e.g., class 7 – 8 conifers or class 5 deciduous); **or** iii) >50% lateral roots damaged or with advanced decay • **recent lean** toward work area AND decayed root system (>50% of roots have advanced decay) or damaged and lifting anchoring soil layer (consider soil conditions and anchoring)
S = Safe	all other trees

* Imminent failure: there is a high likelihood of failure during the operational period while workers are exposed

Wildlife Tree Value Rating

Wildlife Tree Value	Characteristics
HIGH NOTE: If a tree has an active nest then automatically default to high value, regardless of tree size. Culturally Modified Trees (CMT's) and Special Trees (defined by regulation) are also to be regarded as High Value.	• A tree with rare or uncommon habitat characteristics for the site. (e.g., large brooms, cavities, loose bark, dead tops, broken tops, perch site) • A tree protected by policy or special management practices (e.g., CMT, Special Tree, monumental trees, veteran trees, etc.) • Tree with active or recent wildlife use (feeding, nesting, denning, perching, roosting, etc.) • Tree structure suitable for wildlife use (suitable for large stick nest, hunting perch sites, bear den, fisher den, etc.) • Largest tree for site (height and/or diameter) or rare tree species • Habitat characteristics suited for locally important wildlife tree user species
MEDIUM	• Large, stable trees that will likely develop into a wildlife tree (e.g., recent split, broken top, death from insects) • A wildlife tree that has deteriorated and has diminishing viability for continued use
LOW	• Trees not covered by high or medium categories • Trees which are highly unstable and unlikely to remain standing beyond an operational period (e.g., advanced root disease, leaners, soft wood decay class)

Note: Under section 34 of the *Wildlife Act*, no tree with an active nest, or the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl can be disturbed.

Wildlife Tree Uses: The following codes can be used to document types of recent uses observed:
CN – Cavity Nest ON – Open nest F – Feeding M – Mark tree D – Denning P – Perching

Safety Procedures *for "suspect" trees that have been assessed*

S = Safe	**tree safe to work around, retain tree — no removal or modification necessary:** • mark tree as **Safe** (tag, paint or flagging as appropriate) • monitor tree if appropriate
D = Dangerous	**manage tree:** • remove dangerous part(s) of tree • install flagged no-work zone (Hazard Area) • mark tree as **Dangerous** (tag, paint or flagging) if marking is required for work activity or site • inform workers of location of no-work zones and trees marked as **Dangerous**
Alternate Safe Work Procedures for Aspen	• If a stand of LIVE trembling aspen trees has visible *Phellinus tremulae* conks (a heart rot fungi), apply the alternate safe work procedures. • Conduct a site assessment overview to determine the general health of the live aspen in the work site. • Review failed stems (presumed to have been live trees) to determine the presence and number of conks. • Document the conk distribution of each failed tree to develop a risk table for this stand; aspen in better condition will be regarded as SAFE. • If there are no failed aspen with conks, then all LIVE aspen with these conks will be regarded as SAFE for all LODs. • These steps only apply to LIVE aspen with *Phellinus tremulae*. If an aspen tree has other visible hazards, then assess the tree according to the applicable LOD hazard tables and manage accordingly.

Table 4. Dangerous Tree Criteria for Level 2 Disturbance Activities

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 disturbance. Trees with lesser defects can be rated SAFE for level 2 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Hazardous top (HT)	• **Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident; OR** • **Class 4 and 5 trees: Defective Top** (e.g., secondary top) >30% of tree height	**Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident**
Dead limbs (DL)	• Dead limbs >10 cm diameter **with structural weakness** * Hung-up limbs	• Dead limbs >15 cm diameter **with structural weakness** * Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	n/a
Split trunk (ST) (includes frost, lightning, wind- and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >50% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire, machine, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred or fractured	>50% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch and ponderosa pine)	**Class 6 – 8 trees:** Large pieces of bark or sapwood separated and sloughing from bole of tree*	• Bark n/a • Long slabs of sloughing sapwood hanging from bole of tree
Butt and stem cankers (CA)	>50% of butt or stem circumference as a perennial canker face	n/a
Fungal fruiting bodies (CM) ** (conks and mushrooms)	• **Any heartrot fungus present** **Exception:** For veteran and dominant trees, if *Porodaedalea pini* conks present BUT NO other visible defects/damage to stem that allow oxygen exchange (e.g., broken top, scarring, nest cavity, etc.) = SAFE • Sap-rotting fungi present on any tree <30 cm dbh where saprot depth is >5 cm	n/a
Tree lean (TL) (for class 1 – 3 trees)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Tree lean (TL) (for class 4 – 8 trees)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST) ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars or woodpecker cavities.

* In Douglas-fir and ponderosa pine, treat sloughing sapwood according to the bark failure potential criteria.

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating. Where *Porodaedalea pini* is present, if the stem has structural damage such as a broken top or scarring which allow oxygen exchange or other stress indicators (e.g., resinosis, damaged roots), **OR** if there are conks distributed along the bole length, then default to Dangerous rating.

Table 4. Dangerous Tree Criteria for Level 2 Disturbance Activities (concluded)

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 disturbance. Trees with lesser defects can be rated SAFE for level 2 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Hemlock, true firs	**Broad-leaved deciduous**
Hazardous top (HT)	• **Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident; OR** • **Class 4 and 5 trees: Defective Top** (e.g., secondary top) >20% of tree height	• **Class 2 to 5 trees: Defective Top** (any size) as a fork, co-dominant or multiple stem **where structural weakness is evident; OR** • Where a dead top is >20% of the tree height
Dead limbs (DL)	• Dead limbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Dead limbs >10 cm diameter **with structural weakness** • Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on dead branches with evidence of decay, cracking or failure (dead branches and brooms may be on the ground)	n/a
Split trunk (ST) (includes frost, lightning, wind- and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire, machine, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred or fractured	>25% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to cottonwood >50 cm dbh)	n/a	**Class 5 trees:** Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	n/a	>50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	• **Any heartrot fungus present** • Sap-rotting fungi present on any tree <30 cm dbh where saprot depth is >5 cm	• **Any heartrot fungus present** **Exception:** *Phellinus tremulae* on live trembling aspen; apply alternate safe work procedures; • Sap-rotting fungi present on any trees <30 cm dbh where saprot depth is >5 cm
Tree lean (TL) (for class 1 – 3 trees)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Tree lean (TL) (for class 4 – 8 trees)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >50% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST) ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars or woodpecker cavities.

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating.

Table 4a. Dangerous Tree Criteria for Level 3 Disturbance Activities

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 3 disturbance. Trees with lesser defects can be rated SAFE for level 3 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Hazardous top (HT)	• **Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident; OR** • **Class 4 and 5 trees: Defective Top** (e.g., secondary top) >30% of tree height	**Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident**
Dead limbs (DL)	• Dead limbs >10 cm diameter **with structural weakness** • Hung-up limbs	• Dead limbs >15 cm diameter **with structural weakness** • Hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches AND with evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind- and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	• **Class 2 and 3 trees:** Crack or split >2 cm wide extending >50% of tree diameter into stem **AND** evidence of decay in surrounding stemwood • **Class 4 – 8 trees:** Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire, machine, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred or fractured	• **Class 2 and 3 trees:** >50% of tree cross-sectional area damaged, burned, scarred or fractured • **Class 4 – 8 trees:** >25% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch and ponderosa pine)	Large pieces of bark or sapwood separated and sloughing from bole of tree	• Bark n/a • Long slabs of sloughing sapwood hanging from bole of tree
Butt and stem cankers (CA)	>50% of butt or stem circumference as a perennial canker face	n/a
Fungal fruiting bodies (CM) *** (conks and mushrooms)	• **Any heartrot fungus present** **Exception:** For veteran and dominant trees, if *Porodaedalea pini* conks present BUT NO other visible defects/damage to stem that allow oxygen exchange (e.g., broken top, scarring, nest cavity, etc.) = SAFE • Sap-rotting fungi present on any tree <30 cm dbh where saprot depth is >3 cm	n/a
Tree lean (TL) (for class 1 – 3 trees)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	• Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope) • For candelabra-branched trees, where candelabras are predominantly on lean side of tree – lean >10% toward target/work area and tree has rooting problems
Tree lean (TL) (for class 4 – 8 trees)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST) ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars or woodpecker cavities.

*** Footnotes can be found on Page 9 (on reverse)

Table 4a. Dangerous Tree Criteria for Level 3 Disturbance Activities (concluded)

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 3 disturbance. Trees with lesser defects can be rated SAFE for level 3 – take care to not brush trees and to fall and yard away if possible.

Defect Category	Species Group	
	Hemlock, true firs	**Broad-leaved deciduous**
Hazardous top (HT)	• **Class 2 to 5 trees: Defective Top** (any size; e.g., secondary top) **where structural weakness is evident; OR** • **Class 4 and 5 trees: Defective Top** (e.g., secondary top) >20% of tree height	• **Class 2 to 5 trees: Defective Top** (any size as a fork, co-dominant or multiple stem **where structural weakness is evident; OR** • Where a dead top is >20% of the tree height
Dead limbs (DL)	• Dead limbs >10 cm diameter **with structural weakness** • Cracked, decayed, broken or hung-up limbs	• Dead limbs >10 cm diameter **with structural weakness** • Cracked, decayed, broken or hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches AND evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind- and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood	Crack or split >2 cm wide extending >25% of tree diameter into stem **AND** evidence of advanced decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire, machine, and animal damage or butt rot)	>25% of tree cross-sectional area damaged, burned, scarred or fractured	>25% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to cottonwood >50 cm dbh)	n/a	Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	n/a	• >20% of butt or stem circumference as a perennial canker face* • >50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	• **Any heartrot fungus present** • Sap-rotting fungi present on any tree <60 cm dbh where saprot depth is >6 cm	• **Any heartrot fungus present** **Exception:** *Phellinus tremulae* on live trembling aspen; apply alternate safe work procedures; • Sap-rotting fungi present on any trees <60 cm dbh where saprot depth is >6 cm
Tree lean (TL) (for class 1 – 3 trees)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Tree lean (TL) (for class 4 – 8 trees)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots	Occurrence of any of the following; root pull; lifting root mat; visible decay or damage to roots affects >25% of lateral roots
Detailed Tree Assessments	STEM TEST: Average sound stemwood shell thickness <30% of tree radius (i.e., AST < RST) ROOT TEST: More than half of the roots are >50% decayed or rotten	

NOTE: Structural weakness includes visual evidence of decay, cracking, breakage, embedded bark or cracking at forks or multiple stem unions, presence of conks, stem scars or woodpecker cavities.

* Perennial cankers are generally circular to lens-shaped cankers that can persist for years, and slowly expand at about the same rate as the radial growth of the affected live tree. They gradually take on a sunken appearance as tissues under the dead cambium do not grow along with the surrounding wood. They are sometimes called "exploding cankers".

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating. Where *Porodaedalea pini* is present on Douglas-fir, larch, pines and spruces, if the stem has structural damage such as a broken top or scarring that allow oxygen exchange or other stress indicators (e.g., resinosis, damaged roots), OR if there are conks distributed along the bole length, then default to Dangerous rating.

Table 5. Danger Tree Assessment Process for Level 4 Disturbance Activities

When conducting Level 4 disturbance assessments, only the following four types of trees are rated safe. All other trees will be rated Dangerous for Level 4 activities

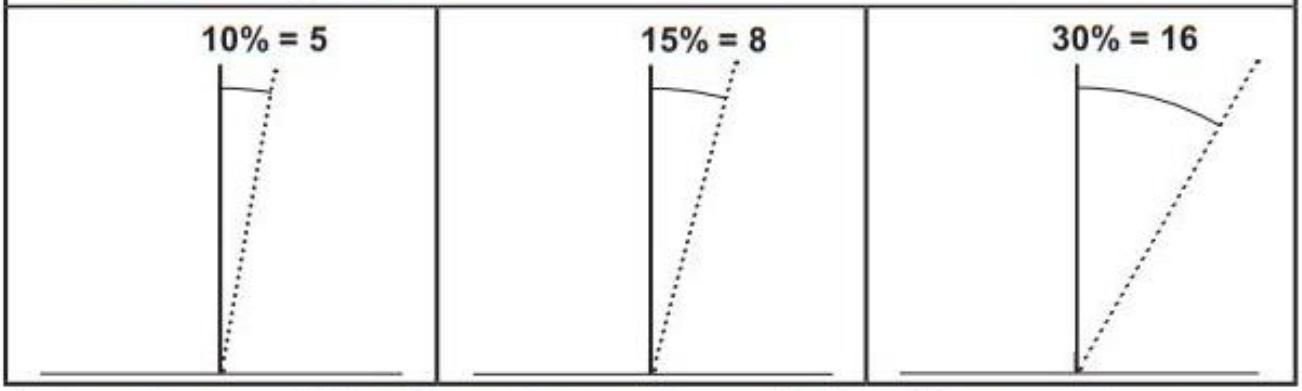
Level 4 disturbance	
S = Safe	**S if tree is of the following:** • class 1 tree (all species) • class 2 trees with NO structural defects (all species) (usually wind- or snow-snapped green trees, very light fire scorching) • class 2 **cedars** with LOW failure potential defects (**refer to table below**) • class 3 **conifers** with NO structural defects (tree recently killed by insects, climate or light intensity fire — these will have no structural damage or decay)
D = Dangerous	all other trees (fall tree; create a no-work zone; or remove hazardous parts)

Structural Weakness includes visual evidence of decay, cracking, breakage, embedded (included) bark or cracking at forks or multiple stem unions, presence of conks, stem scars or woodpecker cavities

Class 2 Cedar Trees are SAFE for LOD4 if they fit the Following Criteria

Defect Category	Western Redcedar, Yellow-cedar Low Failure Potential
Hazardous top (HT)	Defective Top (e.g. secondary top, spike) <30% of tree height with no evidence of decay, cracking, failure or other structural weakness
Dead limbs (DL)	Dead limbs (no size limit) with no evidence of decay, cracking or failure
Split trunk (ST) (includes frost, lightning and wind-induced cracks; does not include dry checking)	Crack or split >2 cm wide extending <50% of tree diameter into stem; no evidence of decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, animal damage or butt rot)	<50% of tree cross-sectional area damaged, scarred or fractured with no evidence of decay in remaining stemwood
Tree lean (TL)	Lean <30% (16°) toward target/work area and tree has no rooting problems
Tree lean (TL) — candelabra branched trees (where candelabras are predominantly on lean side of tree)	Lean <10% (5°) toward target/work area and tree has no rooting problems
Root inspection (RI)	**No visible problems:** no root pull or lifting root mat. Any visible structural damage to roots only affects <25% of lateral roots (remaining roots undamaged)
Average stemwood shell thickness (for Detailed Tree Assessment if required)	Total sound stemwood shell thickness >30% of tree radius

Tree Lean Comparisons



* Sweep is where a LIVE tree is curved because of competition for sunlight, snow pack or steep slope conditions (live tree sweep is NOT lean).

** Tree lean is documented as -% if towards workers, and +% if away from workers.

Special Considerations

Conks	Extend the dangerous decay level 3m below the location of the lowest conk.
Cavity nests	Extend the dangerous level of decay 1m below the lowest cavity hole.
No Work Zones (NWZ)	Must be flagged on the ground; generally, 1.5 times the length of the longest dangerous defect, adjusted (larger or smaller) based upon site specific conditions.
Reassessment	Reassessment is needed: • if an intervening winter or site altering event occurs (e.g., extensive windthrow, fire, flood, ice storm, landslide, etc) since the assessment was completed, **OR** • the LOD has changed from the original assessment.
Mechanically cut stubs	If stub wildlife trees are mechanically created from Class 1 – 3 stems, these DO NOT require a dangerous tree assessment for any forest activity.
Documentation	When documenting the assessment, enter: • "**–**" for defects/hazards that don't exist, • "**S**" for the defect seen and it is safe, • "**D**" for the defect seen and it is dangerous, • "**?**" for a defect seen but a detailed assessment was performed.
Structurally damaged stand	• Stands which have been severely and extensively damaged (e.g., wildfire, windthrow, advanced root disease) are complex and require an assessment by a Certified Dangerous Tree Assessor, even if performing LOD1 activities, before work commences. • If there are >500 stems per hectare, then an application to WorkSafeBC will be required to develop a Points of Control safe work strategy in accordance with OHS Regulation 26.11(3) before work commences.

Decay Class Comparison for Conifers and Hardwoods

	LIVE TREES		DEAD TREES					DEAD FALLEN	
			Hard →		Spongy →			Soft	
Decay class	CLASS 1	CLASS 2	CLASS 3	CLASS 4	CLASS 5	CLASS 6	CLASS 7	CLASS 8	CLASS 9
									

	LIVE TREES		DEAD TREES			DEAD FALLEN
Decay class	CLASS 1	CLASS 2	CLASS 3 (Hard)	CLASS 4 (Spongy)	CLASS 5 (Soft)	CLASS 6
						

WDTAC – Parks and Recreation Sites

Table 1. Levels of Disturbance for Workers and Visitors at Recreation Sites

Level of Disturbance*	Example Types of Work Activities	Wind Speed Equivalency (km/h)	Example of Target & Exposure Levels
Very Low Risk (No Pre-work site inspection required)	• Forest surveys, stand recce, tree marking, road & cutblock layout, foot travel • General light vehicle travel (pickups, ATVs)	N/A	• Hiking trails (e.g., Backcountry trails)
1 (Table 3)	• Tree planting and brushing • Campsite maintenance • Tree pruning (stems <20 cm dbh) • Use of light-duty machinery (e.g., weed whips, brush saws, lawn mowers, bobcats where there will be no digging which could disturb tree root systems/stability) • Heavy (>5500kg GVWR) vehicle travel on a constructed and maintained resource road • Trail construction with hand tools • Fire control with hand tools and/or water hoses	<40	• Hiking trails with interpretive signs • Motorized trail use (ATV, snowmobile) • Trail lookouts and viewpoints • Rest stops alongside hiking trails • Wheel chair trails
2 (Table 4)	• Heavy (>5500kg GVWR) vehicle travel on a trail or overgrown road • Maintenance or construction activities without heavy equipment (e.g., small machines such as "bobcats") • Tree pruning (stems >20 cm dbh) • Spacing or slashing (stems <15 cm dbh) • Tree bucking		• Parking lots (paved or compacted roads) • Day use picnic sites • Public beach/swimming areas • High-use trails (e.g., tour bus groups) • Roadside viewpoints, rest stops • Portable/temporary toilet facilities • Portable/seasonal kiosks • RV sani-stations
3** (Table 4A)	• Tree falling (any tree >15 cm dbh) • Tree yarding (winching or other ground system) • Use of light and intermediate helicopters where workers are exposed to rotor wash (e.g., helipads) • Maintenance or construction activities with heavy equipment (including rubber tire backhoe where digging could affect tree root systems/stability)	40 - 65	• Campgrounds and amenities • Playgrounds • Permanent buildings/ facilities
4 (Table 5)	• Trees adjacent to corridors in partial-cut cable logging operations • Harvesting operations in structurally damaged stands (e.g., wildfire burns) • Surface rock blasting • Helicopter logging with workers exposed to rotor wash • Use of medium and heavy lift helicopters where workers are exposed to rotor wash	+65	

* A dangerous tree assessment is only valid for the lowest level of disturbance at which the assessment has been done.

** If trees CANNOT be felled and yarded away from adjacent standing timber, then default to Level 4 disturbance.

Table 1A. Influence of Wind Speed on Level of Disturbance

Wind Speed (km/h)	Description	Level of Disturbance Equivalency
0 – 40	**light breeze** (dust and loose paper raised; small branches move) to **fresh breeze** (small trees sway; tops of large trees sway)	1 – 2
40 – 65	**strong breeze** (small branches fly in the air; whole tree in motion; resistance felt when walking against wind)	3
65+	**gale** (branches broken off trees; walking impeded)	4

Table 1B. Helicopter Types

Helicopter Category	Passenger Capacity	Lift Capacity
Type 1 (Heavy)	15+	Exceeds 2720 kg (6000 lbs)
Type 2 (Medium)	9 – 14	1135 – 2720 kg (2500 – 6000 lbs)
Type 3 (Intermediate)	5 – 8	680 – 1134 kg (1500 – 2500 lbs)
Type 4 (Light)	1 – 4	Not exceeding 680 kg (1500 lbs)

The following listing provides examples of common aircraft by helicopter type, and is a useful guide when determining the appropriate level of disturbance for the type of aircraft being used.

Light Category: Jet Ranger (Bell 206), Hughes 500, Hiller 12, EC 120, R22 & R44

Intermediate Category: Long Ranger, A-Star (AS350), Bell 407, EC 130

Medium Category: K-Max, Bell 204, 212, 205

Heavy Category: Bell 214, Kamov, Sikorsky 61 & 64, BV 107 & 234

Summary of Assessment Requirements

All work activities EXCEPT those defined as "very low risk" require a pre-work inspection by a qualified person to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below.

- **Very Low Risk (VLR) Activities** – No pre-work site inspection is required.
- **Level 1 Disturbance Activities** – A pre-work inspection by a qualified person is required. If trees with significant tree hazards (see Table 3) are observed, the appropriate safety procedures must be taken before work activities begin.
- **Level 2, 3 or 4 Disturbance Activities** – A pre-work inspection by a qualified person is required. If "suspect" trees (see Table 4, 4A, 5) are identified by a qualified person, then further assessment by a certified danger tree assessor is required and the appropriate safety procedures must be taken BEFORE work activities begin.

Steps Required to Determine Tree Danger Rating:

1. **Determine the level of ground disturbance and exposure** (refer to Tables 1, 1A, 1B)
2. **Conduct a site assessment overview** (refer to Table 2)
3. **Conduct tree assessments** (refer to Tables 3, 4, 4A and 5)
4. **Make the appropriate safety decision** (Safe or Dangerous)
5. **Provide documentation and communicate safety procedures**

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CANADA BEST MANAGED COMPANIES