2020 Wildfire Threat Assessment Guide and Worksheets

Sub-component and descriptor definitions

Version 4, June 2020

This version of the Wildfire Threat Assessment Guide and Worksheets was edited and produced by the:

Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
BC Wildfire Service

Acknowledgements

The British Columbia Wildfire Service (BCWS) would like to thank and acknowledge the previous work completed in the 2008 "*Rating Interface Wildfire Threats in British Columbia*" and the 2013 "*Wildland Urban Interface Wildfire Threat Assessments in B.C.*" authored by Bruce Morrow, Kelly Johnston, and John Davies. (not available online, can be made available upon request). These documents have been time tested to meet the needs of the Community Resilience Investment program (CRI) in terms of rating relative wildfire threat to communities in B.C. This *Wildfire Threat Assessment Guide and Worksheets* document builds on the knowledge base of the previous documents and updates the process with the inclusion of the 2019 Provincial Strategic Threat Analysis (PSTA). The feedback and contributions of the BCWS and the SWPI working group is also acknowledged in preparation of this document.

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1.0 Introduction

An effective wildfire risk reduction fuel program is a key element of British Columbia's proactive wildfire threat reduction approach. Wildfire risk reduction fuel treatments involve the manipulation or reduction of living or dead vegetation to reduce the likelihood of ignition and the potential for extreme fire behaviour resulting in negative impacts to values. Wildfire risk reduction fuel treatments can require extensive resources and therefore must be carefully planned and prioritized in order to identify treatment units that will have the greatest impact. The *Wildfire Threat Assessment Guide and Worksheets* provide an updated approach to assessing fuel hazard in the Wildland Urban Interface (WUI) in order to inform wildfire risk reduction fuel treatment planning and quantify wildfire threat reduction at the post treatment stage.

Any fire mitigation strategy must examine the true drivers of fire behaviour: fuel, weather and topography. The BC Wildfire Service (BCWS) released the 2019 *Provincial Strategic Threat Assessment* (PSTA) to provide a relative wildfire threat rating at a provincial level, to communities, resource managers and practitioners planning wildfire risk mitigation activities. The goal of the PSTA is to provide spatially-explicit tools for understanding the variables that contribute to wildfire threat including: fire density, spotting impact, and head fire intensity. These inputs were combined to produce an overall fire threat analysis layer that integrates many different aspects of fire hazard and risk. The PSTA provides a strategic level assessment to identify areas of relative wildfire threat across the landscape while wildfire threat assessments are utilized to assess fuel hazard at the individual stand level. This stand level information is used to update the PSTA.

Previous wildfire threat assessment guides and worksheets including the 2008 "*Rating Interface Wildfire Threats in British Columbia*" and the 2013 "*Wildland Urban Interface Wildfire Threat Assessments in B.C.*," were intended to assign relative threat ratings to forest stands in the WUI in B.C. The new *Wildfire Threat Assessment Guide and Worksheets* was developed to help validate, qualify, or ground truth the PSTA threat rating and define specific fuel stratum within forest stands and rangelands. This will ensure the wildfire threat rating and pre-stand attributes are quantified prior to the wildfire risk reduction fuel prescription stage. This allows for a consistent standard of quantifying wildfire threat in B.C. As in the previous threat assessment guides, this update does not address issues with actual structures (building materials, windows, porches, etc.). FireSmart, or some other recognized assessment system, should be utilized to address structural issues. Rating house or structure survivability is outside the area of practice of most forest professionals and should be left to those specializing in that field, such as structural firefighting professionals.

The Wildfire Threat Assessment (WTA) process was developed to be consistent with wildfire behaviour principles from the Canadian Forest Fire Danger Rating System (CFFDRS). The goal is to assess the forest fuel hazard immediately adjacent to values and extend outwards into the landscape. There is a reduced focus on weather and topography components due to the level they are currently represented at in the PSTA. The WTA process builds upon the solid foundation provided in the 2013 "*Wildland Urban Interface Wildfire Threat Assessments in B.C.*," and the supporting materials within that document are still applicable for the components described here. This document will explain the updated components and processes as well as describe the linkages between the WTA Guide and Worksheets and the 2020 Community Resiliency Program As wildfire threat knowledge increases, the WTA guide will be reviewed.

1.1 Experience and Knowledge Required to Complete Wildfire Threat Assessments

The WTA process was developed for use by forest professionals to validate or verify the wildfire threat rating from the PSTA while also collecting detailed data on key forest stand attributes. The wildfire threat assessor is a forest professional working within their scope of practice in terms of wildfire response and fire behaviour experience. This has changed from previous threat assessments guides which were oriented towards forest professionals with limited wildfire experience, local government or provincial staff, or members of a local fire department with very basic forestry skills. Completing an accurate wildfire threat assessment facilitates wildfire risk reduction fuel prescription development and requires knowledge and expertise in surveying practices, as well extensive familiarity with the CFFDRS.

1.2 The Practice of Professional Forestry in B.C.

The Association of British Columbia Forest Professionals' (ABCFP) position is that the skills and knowledge required for completing wildfire threat assessments in B.C. fall under the practice of professional forestry. The Association's position and guidance can be found in *Appendix A - The ABCFP Position on Rating Interface Wildfire Threats in British Columbia.* Additionally, any forest professional undertaking wildfire threat assessments must ensure they are operating within their scope of practice and have the appropriate experience and knowledge as outlined in the *ABCFP Interim Guidelines – Fire and Fuel Management*. Practitioners should be familiar with the guidance provided within this document.

1.3 How to Use This Guide

This WTA Guide is intended for use by wildfire threat assessors in completing the WTA Worksheets and developing the local risk class assessments for a Community Wildfire Resiliency Plan(CWRP).

There are two WTA Worksheets. Each WTA Worksheet is comprised of several components and sub-components. Each sub-component has 4-5 choices for selection.

The **Wildfire Threat Assessment Worksheet - Priority Setting Scoring** examines topography, site level and previous mitigation activities within the area of interest. Only one of these will need to be completed per treatment unit or area of interest. This assessment will not be added to the plot level assessment score but is a stand-alone score which assists in prioritization of treatment areas or areas requiring more detailed review.

The **Wildfire Threat Assessment Worksheet - Fuel Assessment (Site Level)** portrays a full fuel stratum for the forest stand by examining the ground fuel, surface fuel, ladder fuel and crown or aerial fuel. One worksheet will be completed for each plot within the area of interest treatment unit. The final survey methodology will be determined by the qualified professional in the field.
A reference copy of the worksheets can be found in *Appendix B - Wildfire Threat Assessment Worksheets.*
A working version of the worksheets can be found on the UBCM website.

1.4 Provincial Strategic Threat Analysis - Wildfire Threat Analysis

The 2019 *PSTA* is designed to assess and map relative wildfire threat to values on the B.C. landscape;

including communities, infrastructure, and natural resources. Values, in the context of the PSTA refer to natural resources or man-made structures or features that have measurable or intrinsic worth and could be impacted by wildfire. Cultural values, species and ecosystems at risk, community watersheds, old growth management areas (OGMAs), wildlife habitat areas (WHAs), and timber are examples of values that may be negatively impacted by wildfire.

The PSTA was developed using geographic modelling tools and a wide range of data to assess various wildfire threat elements, including vegetation types, historical wildfire data, forest fuel classification, fire behaviour patterns, geography and other factors. The relative wildfire threat was determined in large part by evaluating three distinct elements: fire occurrence (fire density), suppression difficulty and fire impacts under severe fire weather conditions (head fire intensity under the 90th percentile fire weather), and spotting potential (where embers are blown ahead of the main fire and start new fires). The final PSTA wildfire threat maps indicate relative wildfire threat across the province, using a 10-level threat scale (with 1 being the lowest risk and 10 being the highest risk). The PSTA is grouped into four threat classes of Extreme (9/10), High (7/8), Moderate (4/5/6), and Low (1/2/3).

The PSTA was conducted at a provincial scale to assess the broad threat presented by wildfire across the geographic extent of B.C. The PSTA should be considered dynamic and will be updated as required to capture changes occurring on the land base. The *Provincial Strategic Threat Analysis Report* speaks to areas of higher threat as: *"The 10 Fire Threat Classes represent increasing levels of overall fire threat. Class 7 (with values from 33.1 to 40) is a threshold and the most severe overall threat classes are Class 7 and higher. Areas of the province that fall into these higher classes are most in need of mitigation, where it is feasible to do so."* PSTA rating of 7 or above represents a high or extreme wildfire threat and should be prioritized for further review. The *PSTA Report* provides details regarding the assumptions and limitations of the PSTA and should be reviewed by practitioners prior to completing a threat assessment. An overview of improvements made in the 2019 PSTA can be viewed in the *2019 PSTA Overview*.

1.5 Designing Local Wildfire Threat Assessment and Scoring

The goal of the 2020 WTA Process is to link the PSTA to updated fuel typing so the PSTA will reflect a local wildfire threat. Consistency in the approach to updating the PSTA for a local wildfire threat is a fundamental outcome. The entire area of interest would have to be assessed and confirmed during the process. The subsequent local wildfire risk classification process builds from the local wildfire threat score to include additional fire behavior and values information gathered through the WTA process.

The PSTA is a starting point meant to aid in the identification of areas requiring further review. Updating the PSTA to produce the local wildfire threat score is predominately linked to fuel type updating. The BCWS, through the development of the BCWS Fuel Type Mapping and Summary Document has developed a set of principles that are used to assign a fuel type to all polygons in B.C. Detailed information on the approach, assumptions and principles is provided in the *BC Fuel Type Map Document.*

Identifying stand structure attributes and the local fuel hazard information from the WTA worksheets will help to identify fuel type changes and aid in the final wildfire risk classification. Key information gathered from the WTA Worksheets is used to inform the local wildfire risk classification including the proximity (proximity of fuel treatment area to value/interface), fire spread patterns (predominant wildfire spread direction), slope position of value and slope percent components. The 'local fuel hazard' as defined through the Fuel Assessment Site Level Scoring process of the WTA is also part of the final wildfire risk class assignment described in the document "*Determining Wildfire Threat and Risk at a local Level*" . The final wildfire risk class is based on the local wildfire risk score and the local fuel hazard as determined through the Fuel Assessment (Site Level) final score (E/H/M/L). The final decision on how to assign within these components is left to the professional's judgement. Where local factors are enough to justify changes to the local wildfire risk values provided a rationale is required.

The local threat assessment (updated PSTA) and wildfire risk class are meant to highlight areas for more focused review and aid in the final fuel treatment design. The PSTA, updated fuel types, local wildfire threat, final wildfire risk classification are all key drivers of final fuel treatment design as well as any additional relevant local and professional knowledge. Treatment areas should be anchored, logical and driven by key fire behavior characteristics including wind spread direction. The final wildfire risk class, in combination with professional judgment, should drive the design of tactical fuel treatments or fuel breaks to address each unique wildfire risk situation.

2.0 Completing the Wildfire Threat Assessment Worksheets

The significant change for this version of the WTA is the focus on stand attribute data, and the removal of supporting fire weather and fire behaviour components as these are contained in the PSTA. As a result, the worksheets concentrate on fuel structure components.

Completing a WTA involves documenting the ability of a unique area of forestland to support a wildfire. The WTA is designed to provide a view of the forest structure which is then used to quantify the rating of the PSTA by updating the fuel types. Usually areas of interest are located adjacent to, surrounding or abutting communities or values at risk on the landscape.

2.1 Designing the Wildfire ThreatAssessment

An initial review of the entire area will be required using the PSTA as the starting point for determining where to focus the WTA. Areas of highest priority for detailed review will have a threat rating of PSTA greater than 7 (or 6 in some cases). However, if the underlying fuel typing is not representative of the stand or polygon that an update will result in the PSTA score being increased significantly (6 or greater) then the next step is to update accordingly.

The process is an iterative one where the data can be reviewed though an aerial or orthophoto/imagery exercise to focus on priority areas for further review. The review could include low to moderate areas targeted for assessment or high and extreme areas to ensure that no areas are left out of the process based on their initial PSTA rating. Much of the work could be done through an imagery review or aerial survey consistent with past approaches described in previous threat guides to determining threat over a larger area such as the WUI. The intent is to focus the updating process only on areas where the change to threat is significant, as in resulting in a change to the PSTA Threat Classes. That decision is left to the professional.

Key information required to complete an accurate assessment include air photo, forest cover, PSTA rating, fuel type, aspect, topography, maps, and imagery at the right scale for the areas of interest. Section 3 Assessment Procedure of the *"Wildland Urban Interface Wildfire Threat Assessment in B.C."* provides a summary of an assessment approach that could be used for reference. It describes a polygon-based approach where areas of relatively homogenous forest cover and/or fuel type can be assessed through a combination of office and field review. There will be variation between polygon size attributed to the size of the study area and the targeted intensity of the assessment.

The WTA worksheets should be completed where it is required to confirm that the area has the correct PSTA rating, based on fuel information. Project proponents will determine which polygons are required to be stratified and assessed based on the experience of the forest professional. This would be done to ensure that all polygons rated high are captured. The **Fuel Assessment (Site Level) Worksheets** are where the detailed per hectare data can be collected to aid in fuel treatment prioritization and design as well as field verified fuel typing. The data required for fuel updates and threat assessment could be gathered at the same time.

2.2 Fuel Typing

There is a requirement to determine areas where fuel type mapping appears to be inaccurate and develop a quality assurance process to validate and provide a summary of local fuel types within and around the community on Crown land using the *Field Guide to the Canadian Forest Fire Behaviour Prediction System* (Special Report 11). The final recommendations for fuel type are left to the qualified professional with the appropriate rational and should be submitted to BCWSPrevention@gov.bc.ca for review. In addition, practitioners should also review the *BCWS Fuel Typing Summary Document*.

Fuel typing updates can be correlated over larger areas with similar fuel attributes; with the final fuel type update form identifying associated polygons. The assessor should determine where field work is required to support a rationale and where it is not. An office review can be used for areas that are easily typed such a clear cuts or non-fuel areas of new development that are clearly non-fuel. Grass fuel types are assumed to be cured. The form would then include images (google earth, orthographic maps) instead of photos with the appropriate rationale and have attached a representative photo and/or image that support the fuel type rationale change. The final spatial submissions standards outlined in the *2019 Program Guide for the Fuel Type* layer describes the required polygon attribute information for the final fuel layer associated with only the updated polygons.

2.3 Field Planning

The **Fuel Assessment (Site Level) Worksheet** could be completed several times for each area, based on the survey intensity prescribed and stratified in accordance with the *Silviculture Survey Procedures Manual*. The requirement for sampling methodology, design and intensity is left to the field practitioner. BCWS is currently working on developing survey standards for wildfire risk reduction fuel work/ evaluations. Upon the release of this document, that document will take precedence over the Silviculture Survey Procedures Manual.

The Silviculture Survey manual includes ranges and alternative survey methodologies including high level walk through, aerial overview and ocular approaches consistent with the stated survey objective as well as stratification principles. This could include a full ocular or spatial review. It is up to the qualified professional to determine the most useful approach. There will be different intensities based on the survey objective. For example, at the fuel typing update level it may be rather coarse and include a combination of aerial imagery and field work and refined to a higher sampling intensity once the treatment areas have been confirmed.

As discussed in the "*Wildland Urban Interface Wildfire Threat Assessments in B.C.*" guide, assessments are best completed under snow free conditions when vegetation has fully flushed in order to accurately measure the duff, surface fuel, and vegetation sub-components. Heavy snow loading can limit the threat assessors' ability to accurately estimate or measure the sub-components listed in the worksheets.

To account for regional differences in forest stand structure, there is different scoring (low, moderate, high, and extreme) by Eco provinces. This scoring is not necessary to apply for funding to treat an area under the Community Resiliency Initiative (CRI), but can be used as a supporting rationale will be evaluated for treatment funding. The Fuel Assessment - Site Level worksheet can be used to score the treatment areas in terms of prioritization and aid in the final assignment of risk class.

Note: This WTA methodology was not developed as a fuel hazard rating tool for licensees to meet *Wildfire Act* hazard assessment and abatement requirements.

2.4 Photo Standards

When fuel typing is based on a site review, photographs must accompany the fuel type rationale and the **Fuel Assessment (Site Level) Worksheet** and are collected as part of the plot and fuel typing information gathering. The purpose of this is to visually document the wildfire threat and fuel stratum in a pre-treatment condition.

The wildfire threat assessor must take at least three photos of each plot. These photos should document the fuel stratum of the plot area by including photos of the surface fuel, ladder fuel (whether present or absent) and the crown or aerial fuel. The wildfire threat assessor should note the cardinal direction in which the photos were taken and note any other comments on the assessment sheet. Where possible there should be some type of reference in the photo for scale. *Appendix C - Robel Pole Construction* has instructions for constructing a "Robel" pole for photo scale. *Appendix D - Photo Guide Template* includes a photo guide template for completing a photo series for each plot.

The following is an example of the type of photo to provide at each plot point.

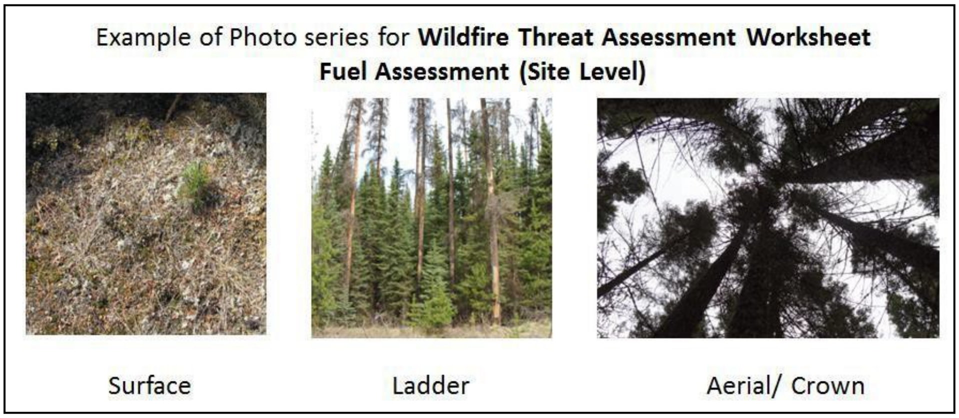


Figure 1: Example Photo Series

3.0 Worksheet Components and Sub-components

3.1 Wildfire Threat Assessment Worksheet – Priority Setting Scoring

The **Priority Setting Scoring Worksheet** describes the strategic non-fuel factors that influence the importance of a specific fuel treatment area to mitigate an identified wildfire threat. The scoring from this sheet will not be part of the overall threat calculation but may be used to form a priority setting score at a local level.

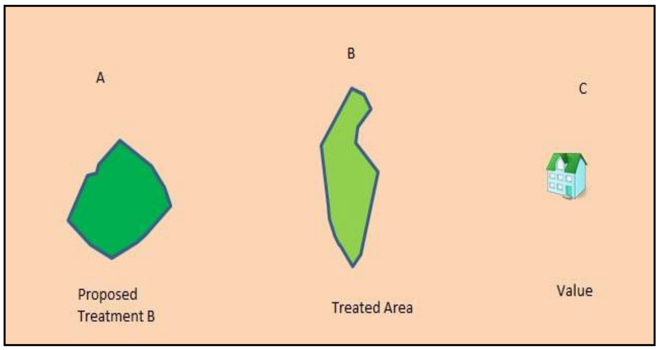
3.1.1 Worksheet descriptions

Item	Description
Location	Geographical location or can be indicated by a cardinal direction for clarification (i.e. NW of Pleasantville)
Date	Date of assessment
Assessor / Professional Designation	Assessor's name and professional designation
Coordinates	Coordinates of the treatment area (usually a single point at the access point)
Coordinate System Used and Format	Coordinate system used and format i.e. Lat./ Long – DD MM.MMM
PSTA Threat Rating	What is the PSTA rating for the area being assessed?
FBP Fuel Type	Fuel type from the FBP fuel map
Assessor's FBP Fuel type	If the assessor thinks the mapped FBP fuel type is incorrect. Fill out FBP Fuel Type Rationale form in *Appendix E - FBP Fuel Type Rationale*
Ownership	Ownership – crown, private etc.
Assessor's Fuel Type Rationale	Rationale for the Assessor's FBP fuel type (include photos)
Value Description	What is the value(s) that this threat mitigation will be protecting?

3.1.2 Worksheet Components

1. Proximity of Fuel Treatment Area to Value

Using FireSmart principles, this component classifies the overall location of treatments and their ability to mitigate wildfire threat to values. Fuel closest to the value usually represents the highest hazard. A treatment placed further from a value allows for a wildfire to build in intensity and rate of spread before impacting a value. If a treatment is placed further from the value but there is another treatment closer and in line with the value, this would be the distance to the next treated area as shown in Figure 2: Distance to Value. In situations where an existing completed treatment area or non-fuel/fuel free area exists between the proposed treatment unit and the value, use that distance rather than the distance from the proposed treatment to actual value.



Distance from Treatment area (A) to Value (C). If an existing treatment (B) is applicable, then the distance is from A to B.

This component is measured from the cleared (e.g. FireSmart) or previously treated area around the value outward to the closest edge of the treatment boundary.

Figure 2: Distance to Value

Table 1: Proximity to Value

Level	Descriptor*	Explanation
A	0 - 100 m	Treatment would modify the wildfire behaviour near or adjacent to the value.
B	101 - 500 m	Treatment would affect wildfire behaviour approaching a value, as well as the wildfire's ability to impact the value with short - to medium - range spotting; would also provide suppression opportunities near a value.
C	501 - 1000 m	Treatment would be effective in limiting medium to long range spotting but short to medium range spotting would fall short of the value and may cause a new wildfire ignition that would affect a value; could provide suppression opportunities near value.
D	1001 - 2000 m	Marginal treatment value for threat mitigation. Lofted embers Have a lower likelihood of reaching the value but could cause a new wildfire near a value. Reduced benefit to suppression.
E	>2000 m	Treatment is relatively ineffective for threat mitigation to a value, unless used to form a part of a larger fuel break / treatment.

*Distances are based on spotting distances of high and moderate fuel type spotting potential and threshold to break crown fire potential (100m).

2. Vegetation Management Practices

This category will assess the ability of a proposed wildfire risk reduction fuel treatment to be added value to mitigating an advanced wildfire by further breaking up the fuel continuity on the landscape. The value-added piece is that it would work with an existing fuel treatment to break the landscape fuel continuity.

Table 2: Vegetation Management Practices

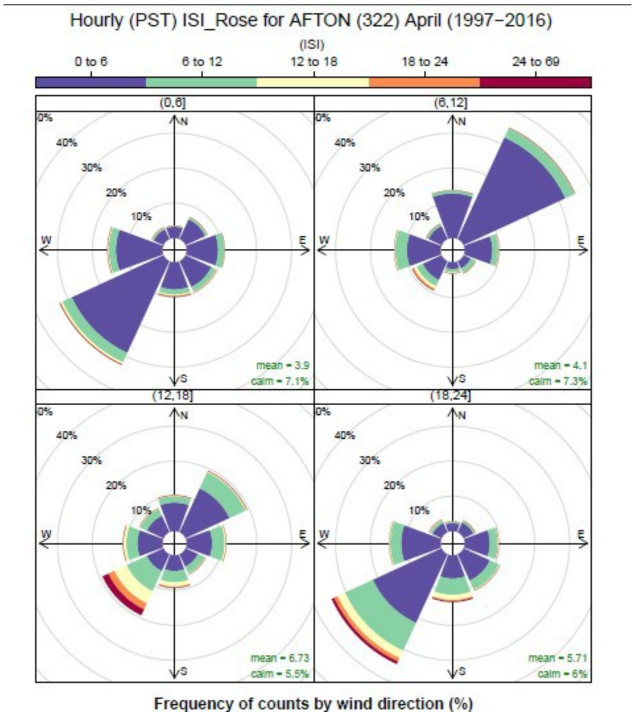
Level	Descriptor	Explanation
A	Yes	"Work from the value out to the wildfire threat." Will this proposed treatment add extra value in wildfire mitigation?
B	No	Flammable fuel is left untreated between the value and the proposed treatment area, this could allow a wildfire to make a full run towards a value. No suppression options near a value. (usually greater than 500m away from value(s))

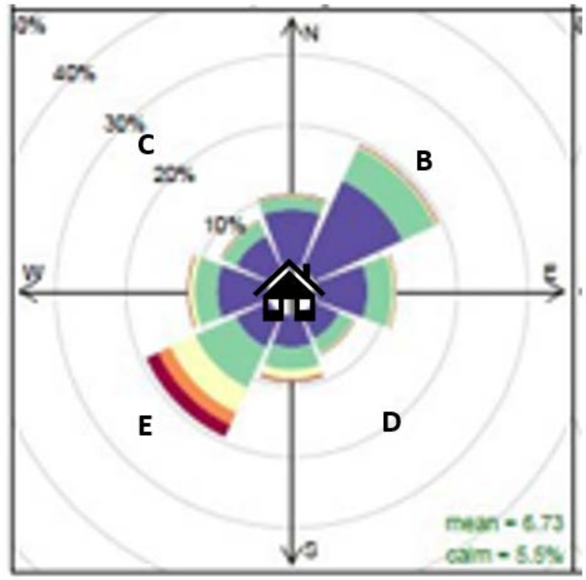
3. Predominant Wildfire Spread Direction

Wind speed, wind direction, and fine fuel moisture condition influences wildfire trajectory and rate of spread, and is summarized in the *Initial Spread Index (ISI) Roses* from the local representative BCWS weather station(s) throughout the province. Wildfire that occurs upwind of a value poses a much more significant threat to that value than a fire that occurs downwind. These ISI Roses can provide users with a static look at the prevailing wind direction and wind speed for the representative wildfire weather stations. ISI Roses are an example of the tools that could be used to determine the "Predominant Wildfire Spread Direction." If there is no representative ISI Roses or if the area around the community is affected by topographical influences, the assessor will have to use professional judgement and local knowledge to arrive at the "Predominant Wildfire Spread Direction."

The hourly roses were completed by month (April to October). The daily period was broken into four time periods 0000 - 0600hrs (0, 6), 600 - 1200hrs (6, 12), 1200 - 1800hrs (12, 18) and 1800 - 2400hrs (18, 24). Figure 3 below shows an ISI Rose for the Afton weather station. Each ISI Rose shows the frequency of counts by wind direction with the frequency of the ISI values during that time period. The upper limits of the ISI are based on the highest recorded ISI for the station; in the example below, the upper limit is 24 - 103 with 103 being the highest recorded ISI for this station.

These ISI Roses will have numerous uses such as planning the placement of fuel treatments to help mitigate wildfire threat to values by showing the predominant wildfire spread direction. It should be noted however that significant wildfire runs can occur in directions other than the predominate spread direction. Historical wildfire perimeters can also provide valuable information as well.





The letters represent the Treatment location,
The value is in the center of the rose
Prevailing wind and highest ISI values are in the SW

Figure 3: Initial Spread Index (ISI) Roses and example of the scoring values

In the example ISI Roses above, treatments placed SW of the value may offer the most mitigation from an approaching wildfire. To complete the table below the local ISI Rose is reviewed. If the available weather station's ISI Roses are not representative, then the approach is to gather wind data from a more representative source along with the FFMC and use this data to inform the final predominant wildfire spread direction table. Scores could change based on the ISI rose. In the example above the scoring could be altered as; E is the first priority /highest score, B would be second priority and second highest score, C and D would be equal as the third priority and score.

Table 3: Predominant Wildfire Spread Direction

Level	Descriptor	Explanation / Example
A	NA	
B	Downwind	Wind blowing from the value to the treatment area with a high to extreme ISI value (>18) (value would be impacted by backing wildfire).
C	90 degree offset to prevailing wind (i.e. SW - 225^0, offset is NW - 315^0)	Wind blowing at an offset to the value location with a high to extreme ISI value (>18) (value would be impacted by flanking wildfire).
D	270 degree offset to prevailing wind (i.e. SW - 225^0, offset is SE - 135^0)	Wind blowing at an offset to the value location with a high to extreme ISI value (>18) (value would be impacted by flanking wildfire).
E	Upwind	Wind blowing from the treatment area to the value with a high to extreme ISI value (>18) (value impacted by head wildfire).

4. Distance to Nearest Vehicle Access

This component rates the length of access to the treatment area. Access should wherever possible be linked to or integrated with the treated area. The nearer the access to the treatment area, the quicker multiple types of resources could access and use this area as a fuel break. For example, fire suppression crews may also designate a road as an anchor point used in their safety plan. The distance from the treatment may be considered as part of the travel time necessary for their escape route. The example below is of fire fighter travel time research from FP Innovations. This helps to show the ability of a fire fighter to access the treatment area to suppress any wildfire that is creeping into the treatment area, but it is not the definitive rational for assigning levels.

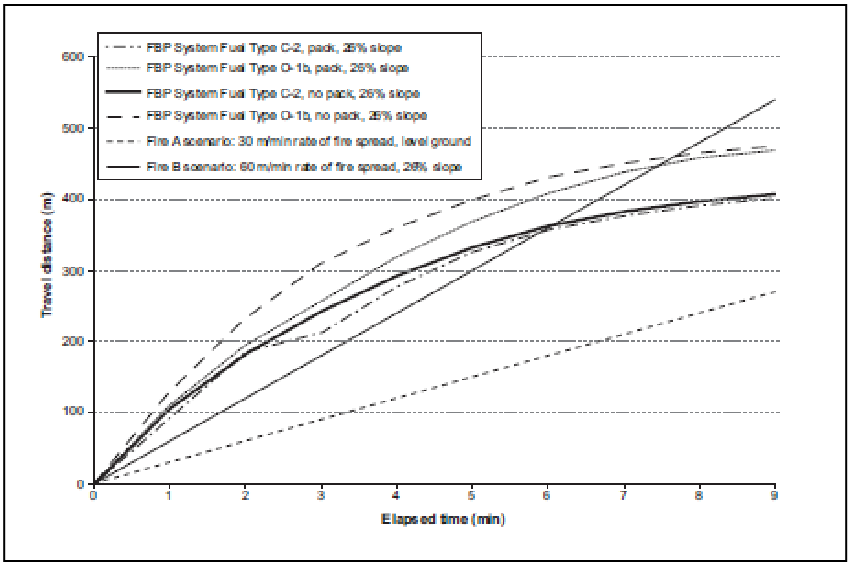


Figure 4: Fire Fighter Travel Time

The component is measured from the nearest part of the treatment boundary to the edge of the road. Access is defined as an active road (not de-activated) which a four by four vehicle could travel with relative ease. This access must have a canopy clearance (side to side) of > 20 m.

Table 4: Distance to Nearest Vehicle Access

Level	Descriptor	Explanation
A	NA	
B	0 - 200 m	Quick access, minimal amount of equipment needed (6-7 lengths of hose).
C	201 - 400 m	Good access, reach of crews packing equipment in a timely fashion.
D	401 - 1000 m	Minimal timely accesses, stretching the limit of crews escape route time to safety zone.
E	>1000 m	Equipment needed to move equipment to target area.

5. Distance to Non-fuel Polygons near the Assessment Area

This component builds on the ability to strengthen the fuel break using the treatment area and non-fuel polygons to mitigate the wildfire threat to a value. The outcome of this sub-component is the selection of distance itself to represent the level of connectivity between the proposed treated areas and non-fuel polygons. Below is a description of why it is important to understand the time to connect areas in a wildfire situation. It is noted that machinery can construct a fire line at a much faster rate, but the logistics of getting machinery to that location is not always preferred or possible in the context of a fast-moving wildfire. The following chart is an example of fireline construction rates for 20 person crews using hand tools in meters per hour.

Sustained Line Production Rates (hand tools) of 20-Person Crews in Meters per Hour				
	Crew Type and Method of fireline attack			
Fire Behavior Fuel Model	Type I Direct	Type I Indirect	Type II & II IA Direct	Type II & II IA Indirect
C-5 /C-7	210m (180-240m)	138m (120-156m)	135m (112-136m)	115m (77-137m)

Adapted from: Wildland Fire Incident Management Field Guide, A publication of the National Wildfire Coordinating Group, PMS 210, April 2013

Figure 5: Fireline Construction Rates

The component is measured from the nearest part of the non-fuel polygon to the nearest treatment boundary. In this component, non-fuel polygon is defined as an area with no organic material present. An example would be rock screes, gravel pits, lakes and wide creeks or rivers (i.e. minimum 20 m in width) or deciduous stands and moist bogs or fens.

Table 5: Distance to Non-Fuel Treated Area

Level	Descriptor	Explanation
A	NA	This section will rate treatment ability to strengthen the fuel break using the treatment area and non-fuel polygons to form a larger continuous break in the fuel on the landscape and mitigate the wildfire threat to a value.
B	0 - 200 m	
C	201 - 400 m	
D	401 - 1,000 m	
E	>1000 m	

6. Topography: Slope

Wildfire will spread faster uphill due the convective pre-heating of fuel in front of the wildfire, as well as the flame angle bathing the flame into the fuel ahead of the wildfire. Slope will change the flame angle causing the flame/fire to bathe into the fuel more readily.

The up slope should be the average slope angle within the polygon, measured in percent with a clinometer or other slope measuring device. This should be the angle of the main face or most of the area. Side slopes in gullies should not be included unless they are their own polygon. Slopes are always measured in 1% increments. The length of a slope to be assessed should be longer than 150 m in length as well as somewhat uniform and continuous to capture the macro conditions. This definition is found in the *Silviculture Prescriptions Field Methods Book, Interpretive Guide for Data Collection, Stratification, and Sensitivity Evaluation for Silviculture Prescriptions Order No. SIL411*

This component is used to measure slope percentage from a treatment area to a value. If the treatment area is uphill from the value, the scoring would be A <20%. If there are multiple values whether uphill or downhill from treatment area (i.e. community) or if there are any values uphill, score as such (use the full scoring suite).

Table 6: Topography: Slope Percent

Level	Descriptor	Explanation
A	<20%	Very little flame and fuel interaction caused by slope, normal rate of spread.
B	21 - 30%	Flame tilt begins to preheat fuel, increased rate of spread.
C	31 - 45%	Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread.
D	46 - 60%	Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread.
E	>60%	Flame tilt preheats fuel and bathes flames into fuel well upslope, extreme rate of spread.

In the FBP system, upslope wildfire potential is giving a wind speed to account for slope, based on different fuel types.

7. Topography: Aspect

Aspect is scored to the differing moisture regime and fuel conditions found of the different aspects. North aspects are usually moister and more heavily fueled than south and west aspects that have drier and lighter fuel. Figure 6 below shows the relationship between fuel temperature and fire behaviour.

The aspect (sometimes referred to as exposure) is measured using a compass or other device that provides the direction in degrees or cardinal direction. The aspect is best measured by facing away from the slope and using the compass to locate the direction you are facing and as described: North - 316 to 45 degrees, East - 46 to 135 degrees, South - 136 to 225 degrees, and West - 226 to 315 degrees.

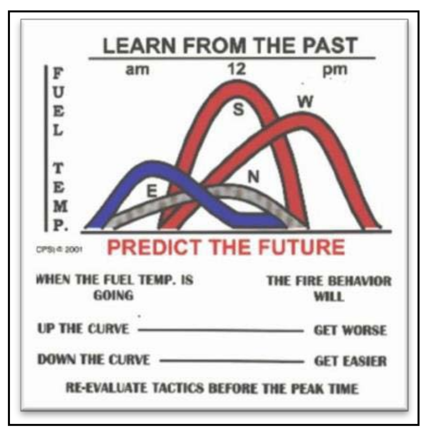


Figure 6: Fuel Temperature and Fire Behaviour

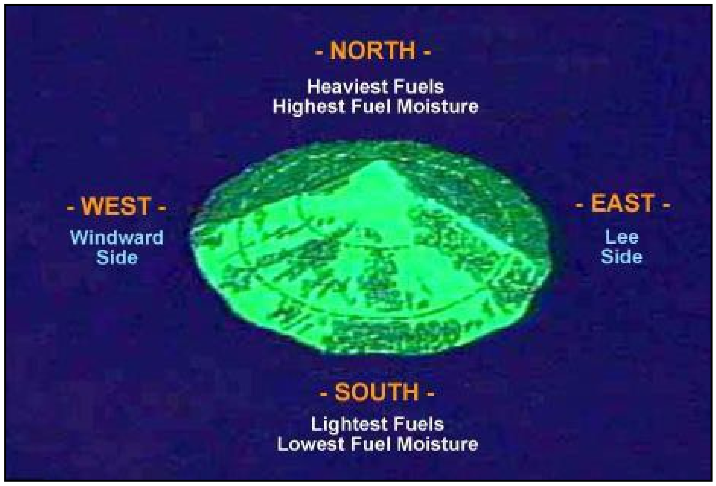


Figure 7: Aspect and Fuel

Figure 7 above shows the relationship between aspect and fuel with the heaviest and wettest fuels on the north aspects and lightest and driest fuels on the south aspect.

Table 7: Topography: Aspect

Level	Descriptor	Explanation
A		
B	North	Higher moisture content, heavy fuel loads. Very little impact from solar radiation.
C	East / Flat	Slightly drier than North Aspect, moderate fuel load. Only real impact from solar radiation is the morning sun.
D	West	Light dry fuel, good sun exposure for solar radiation.
E	South	Light dry fuel, impacted by solar radiation is the longest of any aspect.

8. Slope Position of Value

This component scores the position of a value on a slope. The scoring relates to the ability of a wildfire to gain momentum during an uphill run. A value at the bottom of the slope would be impacted in a fashion like a value on flat ground. A value on the upper 1/3 of the slope would be impacted by high preheating and faster rates of spread than a value on flat ground.

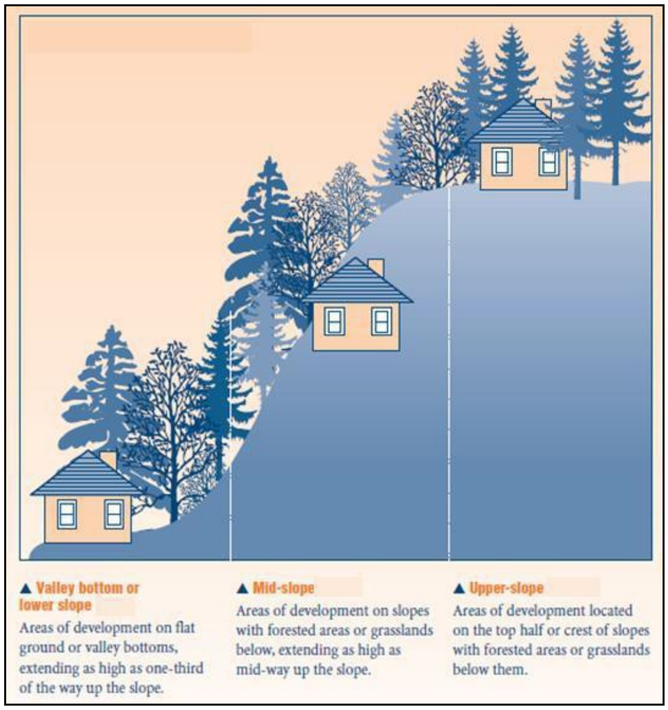


Figure 8: FireSmart Slope Position of Value

Table 8: Slope Position of Value

Level	Descriptor	Explanation
A	NA	
B	Bottom of Slope/ Valley Bottom	Impacted by normal rates of spread.
C	Mid Slope- Bench	Impacted by increase rates of spread. Position on a bench may reduce the preheating near the value. (Value is offset from the slope).
D	Mid slope – continuous	Impacted by fast rates of spread. No break in terrain features affected by preheating and flames bathing into the fuel ahead of the fire.
E	Upper 1/3 of slope	Impacted by extreme rates of spread. At risk to large continuous fire run, preheating and flames bathing into the fuel.

3.1.3 Wildfire Threat Assessment - Priority Setting Scoring Summary

This worksheet is not used to stratify an area as low /moderate / high or extreme on its own, instead certain components are utilized to help rate the final local wildfire risk classification. It can also be utilized to help rank different treatment areas in order of priority. An example would be a community or land management agency is proposing four different treatment areas, the highest scoring area using this worksheet would be the top priority to treat. This worksheet helps to tie in landscape attributes that help set that priority.

3.2 Wildfire Threat Assessment Worksheet - Fuel Assessment (Site Level)

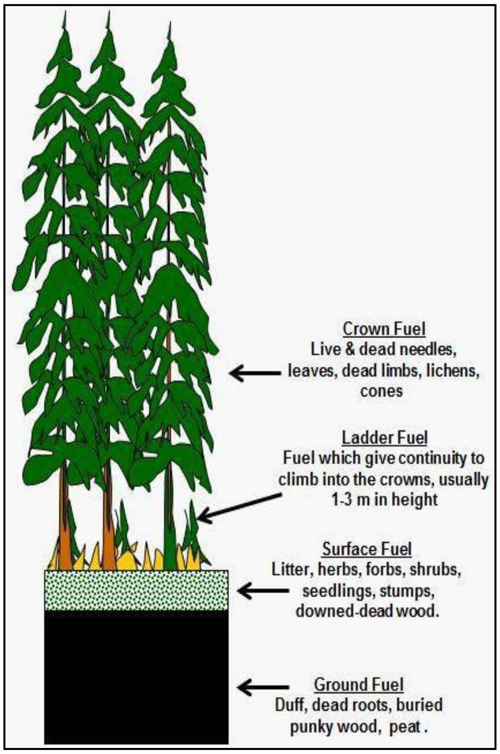


Figure 9: Forest Stand Layer and Fuel Descriptors

The **Fuel Assessment (Site Level) Worksheet** assesses the fuel propagation potential at the fuel type assessment and/or the treatment unit level through multiple site level attributes. This worksheet is designed to assess the fuel stratum of a fuel type. Once the initial threat assessment process has been completed, and areas have been identified for further review as potential fuel treatment areas, then any additional plot level assessments should be completed for each plot within the treatment unit.

This worksheet has been developed by focusing on the forest fuel availability and arrangement using the rationale for describing a forest stand in terms of the progression of a wildfire from a surface fire (organic and surface fuels involvement), to a passive crown fire[1] (organic, surface and ladder fuel involvement) to an active crown fire[2] (all fuel involved).

[1] **Passive Crown Fire:** A type of crown fire in which the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods. Passive crown fire encompasses a wide range of crown fire behaviour, from occasional torching of isolated trees to nearly active crown fire. Passive crown fire is also called torching or candling. A fire in the crowns of the trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface fires (Scott and Reinhardt 2007).

[2] **Active Crown Fire:** A crown fire in which the entire fuel complex is involved in flame, but the crowning phase remains dependent on heat released from surface fuel for continued spread. An active crown fire may also be also called a running crown fire or continuous crown fire. An active crown fire presents a solid wall of flame from the surface through the canopy fuel layers. Flames appear to emanate from the canopy as a whole rather than from individual trees within the canopy. Active crown fire is one of several types of crown fire and is contrasted with passive crown fires which are less vigorous types of crown fire that do not emit continuous, solid flames from the canopy (Scott and Reinhardt 2007).

The scoring system on the **Fuel Assessment (Site Level) Worksheet** will differ by location in the province due to coarse scale climatic influences. The scoring system will be based on the Eco province boundaries within B.C. For example, in the Southern Interior Eco province, a high score may be 80-100 points, while a high score in the Taiga Plains Eco province may be > 60 points. Each score will be based on a percentage of the applicable score available for that Eco province. The final score can be used to determine the final local wildfire risk. This scoring is not necessary to apply for treatment funding but can be used as a supporting rationale (i.e. treating a low score area to form a large continuous treatment area.

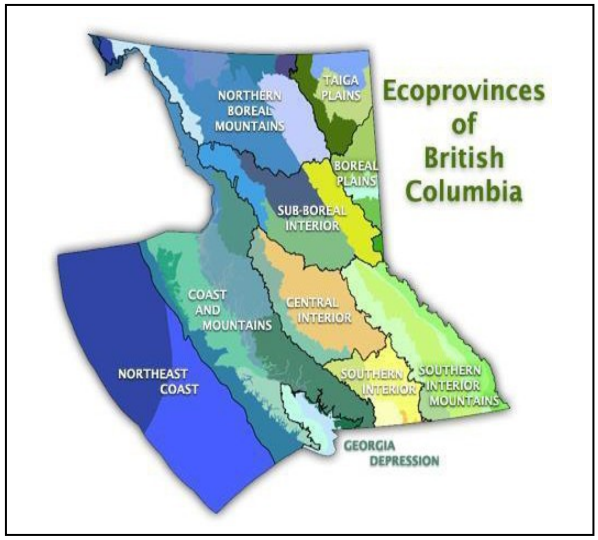


Figure 10: Eco provinces of BC

3.2.1 Worksheet descriptions

Item	Description
Location	Geographical location or can be indicated by a cardinal direction for clarification (i.e. NW of Pleasantville)
Date	Date of assessment
Assessor / Professional Designation	Assessor’s name and professional designation
Coordinates	Coordinates (usually a single point at the center of the assessment plot area)
Coordinate System Used and Format	Coordinate system used and format i.e. Lat./ Long (Degrees/Decimal Minutes)

3.2.2 Worksheet Components

1. Depth of the Organic Layer

Duff and litter are often referred to as the LFH (litter, fermenting, humidified) layer. Duff depth is the average thickness, measured in centimeters, of the litter, needles, and semi-decomposed material that constitute the forest floor within the assessment polygon. The measurements of duff and litter depth should include rotten materials that are more than 50% buried in the LFH layer.

The depth of the organic layer is a function of moisture and fuel available for consumption. The concept of surface and organic layer consumption is based on the Buildup Index (BUI). Although the BCWS wildfire weather station network may not be representative of all areas, the network should provide a good representative of an area's moisture regime as well as the Biogeoclimatic (BEC) zone and subzone indicators. Figure 11 shows a measurement of the depth of the organic layer.

Figure 11: Measuring the Depth of the Organic Layer

Table 9: Depth of the Organic Layer

Level	Descriptor	Explanation
A	1 - 1.9 cm	Usually found in drier ecosystems. Usually supports light fuel (grass / shrubs).
B	2.0 - 4.9 cm	Usually found in drier ecosystems. Usually supports trees and light fuel (grass / shrubs).
C	5.0 - 9.9 cm	Found in drier ecosystems, still able to dry out completely. Moss and needle beds are common. Support abundant growth of vegetation.
D	10.0 - 20.0 cm	Found in moister ecosystems, tends not to dry out. Deeper beds of moss / lichens and needle beds are common. Can support deep combustion in extended drought conditions.
E	>20.0 cm	Found in wet ecosystems, only top layer dries out. Very deep beds of moss / lichens. Usually dense canopy forest.

Measurement of the duff and litter can be made by using a shovel or an axe to create a duff profile in a minimum of four random locations within the polygon. The profile should be measured with a ruler to determine depth to within 0.5 cm. The duff and litter depth should be the average depth of the four (or more) measured profiles.

2. Surface Fuel Composition

The surface fuel composition is the dominant surface species that is covering the plot area. It includes mosses, lichens, grasses, herbs, shrubs, and fresh needle litter (not included in the Duff Depth and Moisture Regime above). Low flammability surface fuels, including many noxious weeds, are not included in this cover tally.

Figure 12: Surface Fuel

The surface fuel resides on top of the organic layer to a height of approximately 1.0 m. Surface fuels usually have contact with the ground and don't grow tall enough to be considered ladder fuel.

Table 10: Surface Fuel Composition

Level	Descriptor	Explanation
A	Moss, Herbs and Deciduous Shrubs	Indicative of a moister site with green lush vegetation for most of the summer months. This lush vegetation maintains a moist organic layer. Not that flammable, fire moves slowly in the surface fuel.
B	Lichen, Conifer Shrubs	This vegetation can maintain a moister site but if there are drought type condition and the organic layer can maintain fire combustion, these surface fuels can be consumed, thus increasing fire intensity and rate of spread.
C	Dead fines (Leaves, Needles or fine branch material) fuel (<1 cm)	This material can readily ignite or be consumed in a flaming front. Moist content in this material tends to be low. This material has a short time lag from saturated to dry. The combustion of this material adds to fire intensity, flame length and rate of spread.
D	Pinegrass	This material is very flammable depending on the percentage of curing. Fuel consumption is usually 100%, adding to the fire intensity, flame length and rate of spread.
E	Sagebrush, Bunchgrass, Juniper and Scotch broom	The chemical composition of these species lends them to rapid rates of spread, high fire intensity and increased flame length.

3. Dead and Down Material Continuity ≤ 7 cm (% cover)

Fine woody debris continuity is a site attribute that plays a significant role in a wildfires rate of spread. It is a measure of the percentage of the area that is covered by woody debris that is less than or equal to 7 cm in diameter (should be contacting the surface fuel bed). The material should be greater than 25% sound (or a solid outer shell). Conifer needles and deciduous leaves lying on the ground as litter should not be included in the assessment. Figure 13 below shows an example of fine woody debris.

Figure 13: Example of dead and down material

Debris with more than 50% of its circumference buried in the duff and litter layers should not be included. Descriptor chosen should be the highest end of the range for the assessment area and not necessarily the average.

Dead and downed material >7 cm in diameter (contacting the surface fuel bed) is not factored into fuel consumption of a spreading wildfire in the Canadian Forest Fire Behaviour Prediction System. This size fuel is normally consumed in smoldering combustion after the flaming front has passed. As fuel treatments are not meant to stop smoldering combustion, as such the fuel >7 cm is not assessed as part of the surface fuel in this worksheet.

These facts were confirmed in the Mountain Pine Beetle (MPB) experimental burns conducted at Carrott Lake in the Vanderhoof Natural Resources District during the summer of 2013. The pre and post burn woody debris plots showed very little consumption of the >7 cm class fuel within two hours of the flaming front passage. The following figure is a time/temperature plot of the Carrott Lake burns. Note the temperature drops considerably after the passage of the flaming front but remains above the lethal scorch temperature of 90^{0}C for 24-28 minutes (thinned plot).

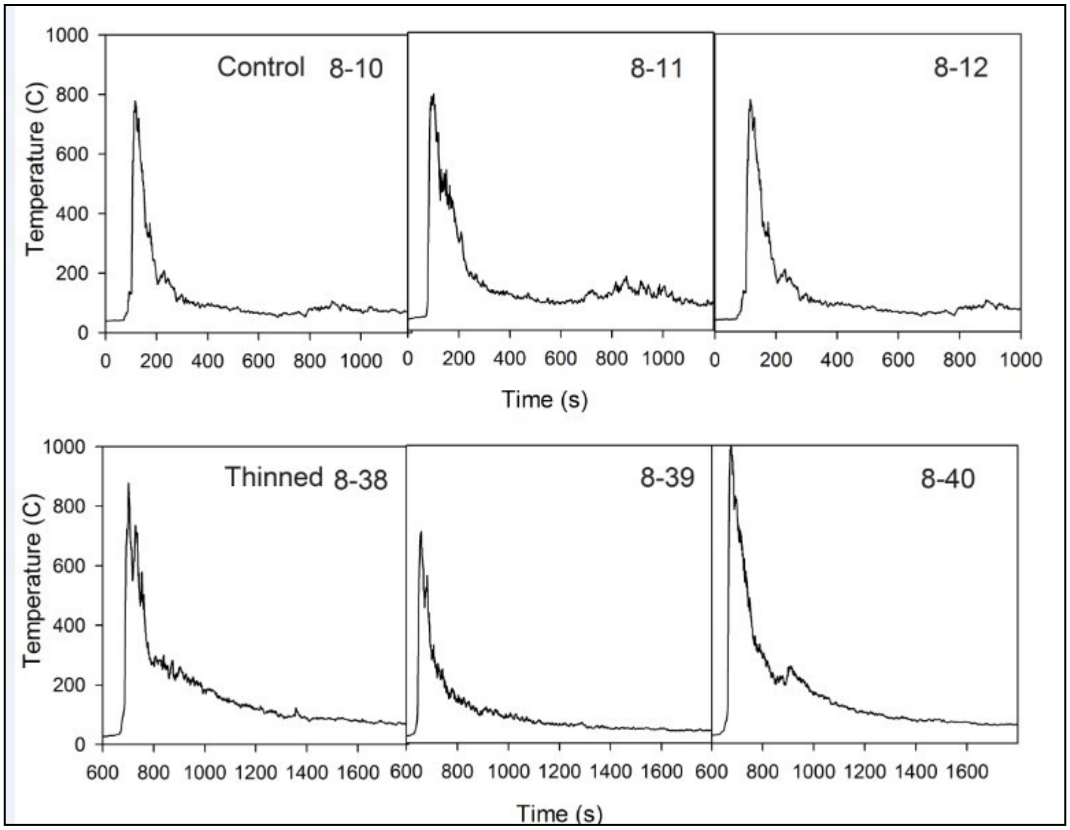


Figure 14: Time/temperature plot from thermocouple in the MPB experimental burns (Carrott Lake)

Fuel >7 cm in size that form part of surface fuel are considered "coarse woody debris" in this process and will be dealt with under the *appropriate guidelines* issued by the Chief Forester of British Columbia. Ensure consideration is placed to the section of the document that concerns fire hazard rating;

> *"Lower amounts of CWD are more appropriate where fire hazard rating is high. Fuel loading resulting from logging debris is a concern where the fire hazard rating is high and areas in/next to the wildland urban interface. These areas are not likely candidates for high levels of CWD."*

The fuel > 7cm (elevated) are assessed in this worksheet in category 11 "Dead and Dying, "but will fall under the "Stand Structure and Composition" heading as most of these fuels are found elevated (no connection to surface fuel) within stands. A good example of this is the MPB affected stands with standing dead and partial down fuel. In time this fuel will fall to the ground and form part of the assessment of this fuel stratum

Table 11: Dead and Downed Material Continuity ≤7 cm

Level	Descriptor	Explanation
A	Absent	Fine woody debris is present but not significant. Debris is rarely in contact with other pieces. Debris is in close contact with the ground.
B	Scattered <10 coverage	Fine woody debris occurs irregularly, is not usually in contact with other debris and is in close contact with the ground. Debris may be patchy in nature with small piles or grouped in one portion of the rating area.
C	10 - 25% coverage	Fine woody debris occurs patchy throughout much of the rating area. Debris may be clumped or accumulated in certain areas. Accumulations are likely the result of regular shedding of branch wood or minor wind events.
D	26 - 50% coverage	Fine woody debris occurs regularly throughout much of the rating area. Debris may be clumped or accumulated in certain areas. Accumulations are likely the result of regular shedding of branch wood, minor wind events or harvested areas with regular skid trails.
E	>50% Coverage	Fine woody debris occurs regularly throughout much of the rating area and has minimal depth. Debris may be accumulations resulting from the shedding of branch wood from consistent winds or past moderate wind events. Accumulations may also be a result of past forest treatment (spacing, pruning, tree removal, selective harvesting, etc.).

4. Ladder Fuel Composition

Ladder fuels allow a wildfire to climb from a surface fire into the crown to initiate a crown fire. Ladder fuels are usually approximately 1.0 to 3.0 m in height. This component scores ladder fuel based on flammability. Figure 15 shows an example of ladder fuels.

Figure 15: Ladder Fuels (Live and Dead)

Table 12: Ladder Fuel Composition

Level	Descriptor	Explanation
A	Deciduous (<25% conifer)	Deciduous species, chemically less flammable thanconifer species. In most cases deciduous species are a fuel break in wildfire spread.
B	Mixwood (<75% conifer)	Although there is a mixture of conifer species in a Mixwood stand, the ability for continuous spread in the ladder fuels would be hampered by the mixture of the less flammable deciduous.
C	Other conifer	Other conifers are typically wet belt species: cedar, hemlock and larch. These species are usually associated with a lush green understory. If these species are found on a dry site (BEC Climate Zone), use the Spruce/Fir/Pine scoring to represent the appropriate scoring. Make an appropriate note in the comment section.
D	Elevated dead fuel	Elevated dead fuel is found in the ladder fuel space (1-3m). There should be a fair amount of finer material (<7cm in diameter) to carry fire from the surface fuel towards the crown fuel (less than a 45^0 angle). If flaky bark and lichen are present and could be considered as a ladder fuel, they would be considered in this category.
E	Spruce/Fir/Pine	The most flammable conifer species found in B.C., usually associated with drier sites and higher potential to spread fire to the crown fuel.

5. Ladder Fuel Horizontal Continuity

This component scores ladder fuel based on continuity.

Table 13: Ladder Fuel Continuity

Level	Descriptor	Explanation
A	Absent	No ladder fuel present.
B	Sparse	Less than 10% coverage of the representative plot area is covered with ladder fuel.
C	Scattered	10-39% coverage of the representative plot area is covered with ladder fuel.
D	Patchy	40-60% coverage of the representative plot area is covered with ladder fuel.
E	Uniform	Greater than 60% coverage of the representative plot area is covered with ladder fuel.

The following figure can be used to estimate percent cover of crown closure and to support ladder fuel continuity coverage estimates.

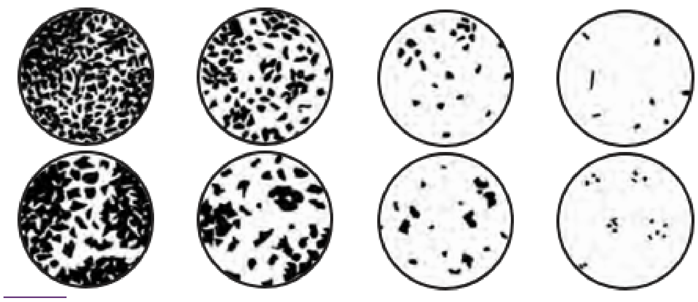


Figure 16: Visual Estimates of Percent Cover

6. Stems Per Hectare (Understory)

Understory conifers provide ladder fuels that allow a wildfire to move from the surface into the main forest canopy causing candling or crown wildfire initiation. Ladder fuels are correlated to the density of live and dead understory conifers. This sub-component quantifies the average number of stems per hectare (sph) of immature conifers within the assessment polygon. The tree layer is not measured in the overstory crown closure (sub-component 7) and these trees are typically regeneration, smaller diameter suppressed, or shade tolerant trees, with live or dead crowns starting at less than two meters from the ground.

All understory fuels play a role in a stand's ability to support a crown fire. Any understory fuel that forms a bridge between the surface fuel and crown fuels should be eliminated. Any understory fuel that occupies a forest opening and is a safe distance (2-2.5 times the height of the understory fuel's height in horizontal distance) away from crown fuel is acceptable.

Table 14: Stems per Hectare

Level	Descriptor	Explanation
A	0 - 500 sph	~4.4 m average stem spacing
B	501 - 800 sph	~3.5-4.4 m average stem spacing
C	801 - 1200 sph	~2.8-3.5 m average stem spacing
D	1201 - 1500 sph	~2.6-2.8 m average stem spacing
E	>1500 sph	<2.6 m average stem spacing

Note: sph – Stems per ha

Care must be taken to just count the understory stems (do not include overstory stems in category # 9

An example of how this can be measured is using fixed radius plots when large numbers of trees are involved. The number of plots required to accurately estimate these conifer ladder fuels within a polygon will vary with polygon size and variability. In general, at least four representative plots should be used to roughly estimate the coniferous ladder fuels. Additional plots increase the accuracy of the conifer ladder fuel estimate. The plots can be 3.99 meters or 5.64-meter radius, which provides 50 square meters or 100 square meter plot areas respectively. To calculate stems per hectare using these two plot radii the following calculations can be used:

1. 3.99 m radius plot (50 m^2) Average trees per plot X 200 = stems perhectare
2. 5.64 m radius plot (100 m^2) Average trees per plot X 100 = stems per hectare

7. Overstory Composition/Crown Base Height

This component scores species composition for the ability of the forest stand to develop and support a crown fire. Deciduous overstory compositions tend to act as a shade for cool and moister conditions in the forest stand and provide very little potential for crown fire. Conifer stands will also act as shade breaks to the understory depending on the stand density but have potential to develop and support large crown fire runs. The conifer categories are broken into crown base height to further categorize the crown fire potential. Mixed stands are categorized by the percent of conifer in the stand composition.

Table 15: Overstory Composition/Crown Base Height (CBH)

Level	Descriptor	Explanation
A	Deciduous (< 25% conifer)	Low flammability canopy.
B	Mixwood (% Conifer)	Canopy flammability based on the percent of conifer composition.
C	Conifer with high CBH (>10m)	High canopy flammability but needs very high surface fire. intensity to interact with crown (CSI[3] > 5149 kW/m)
D	Conifer with moderate CBH (5 – 9m)	High canopy flammability but needs high surface fire intensity to interact with crown (CSI > 3345 kW/m).
E	Conifer with low CBH (<4m)	High canopy flammability but needs very little surface fire intensity to interact with crown (CSI > 1820 kW/m).

* CBH is measured to the greatest full meter (i.e. measured of 5.4-meter CBH would fit into the tables as 6 meter CBH)

CBH is a measure, in meters from the ground, of the average height of the live or dead crown in the veteran, dominant and co-dominant coniferous canopy layers throughout the assessment polygon. Dead crowns are only measured when they are of enough density to allow vertical wildfire to spread. Individual dead limbs should not be considered. Full whorls of dead limbs, especially with needles and fine branches or volatile mosses or lichens, should be identified in this sub-component.

8. Crown Closure

Within this component, crown closure is related to crown bulk density. The calculation of crown bulk density (kg/m^2) requires species-specific crown foliage weight vs. Diameter Base Height (DBH), stems per hectare and

[3] Critical Surface Intensity using Field Guide to the Canadian Forest Fire Behavior Prediction System value of 97% foliar moisture content.

tree height; a complicated process. To establish a relative relationship of crown bulk density in the field we have assumed that the percent crown closure relates to crown bulk density (kg/m^3) relative to the same species composition with a lower percent crown closure (i.e. an increase in percent crown closure is indicative of an increase in crown bulk density). However, once the crown approaches 100% increase in-stand humidity and reduced in-stand wind velocity, this creates conditions that will hinder crown fire initiation and spread.

Table 16: Crown Closure

Level	Descriptor	Explanation
A	<20%	Crown closure relates to continuity / spacing in the crown fuel. If there is continuity, the ability of a stand to sustain a crown fire is increased considerably. If the stand is low crown closure the ability is limited to carry a crown fire unless stronger winds are present at the time. Level A is used for any deciduous crown closure class.
B	20 - 40% and Deciduous overstory	
C	41 - 60%	
D	61 - 80%	
E	>80%	

The following figure can be used to estimate percent cover of woody debris, plant coverage or crown closure.

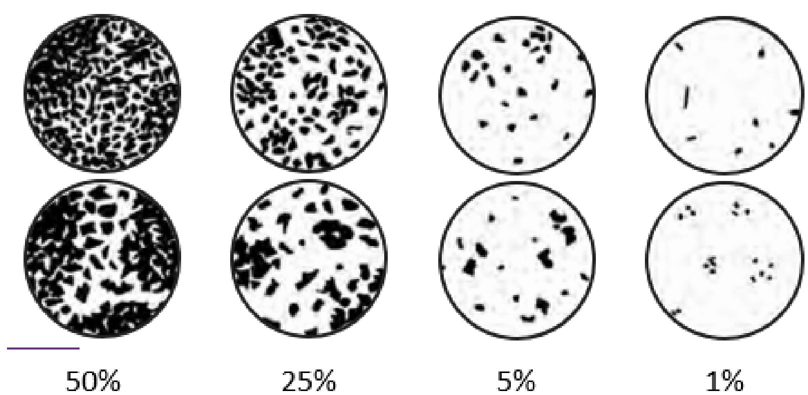


Figure 17: Visual Estimates of Percent Cover

9. Fuel Strata Gap

Fuel stratum gap is the distance, in meters, between the top of the average height of the ladder fuel to the average green crown in the crown fuel. This gap represents the ability of flame to move from the ladder fuel to impact or initiate the crown fuel into a crown fire. The larger the gap the less likelihood of a crown fire in the stand.

This component is very similar to component 7 “Overstory Composition/Crown Base Height” except now the CSI is engaging another fuel stratum of the ladder fuel, thus increasing the intensity and enabling the fire to reach the crown fuel.

Table 17: Fuel Strata Gap

Level	Descriptor	Explanation
A	NA	
B	>10m	No crown fuel involvement.
C	6 - 9m	With a CSI[1] of greater than 2322 kW/m Crown fuel will be engaged (8.0m flame height).
D	3 - 6m	With a CSI of 825 - 2331 kW/m Crown fuel will be engaged (6.0m flame height).
E	<3m	With a CSI of less than 824 kW/m Crown fuel will be engaged (4.0m flame height).

Note: kW/m values are representative of a foliar moisture content of 95%

Critical Surface fire intensity can be meet with a combination of crown base height and surface fuel loading reduction

10. Stems per Hectare (Overstory)

Consistent with the information captured in component 8 “Crown Closure,” this component will help capture the crown bulk density of the forest stand by placing the number of stems per ha into classes.

Table 18: Stems per Hectare (Overstory)

Level	Descriptor	Explanation
A	< 400 stems	Average stem spacing/ha of 5.0m
B	401 - 600 stems	Average stem spacing/ha of 4.5m
C	601 - 900 stems	Average stem spacing/ha of 3.7m
D	901 - 1200 stems	Average stem spacing/ha of 3.1m
E	>1200 stems	Average stem spacing/ha of < 2.9m

Care must be taken to just count the overstorey stems (do not include ladder/ understorey stems in category #6

11. Dead and Dying

Dead and dying is a measure of the dead standing component of the stand resulting from abiotic or biotic events that contribute to tree or whole stand mortality. The assessment is a visual estimate of the percent of the veteran, dominant and co-dominant stems that are either dead standing or partly fallen and elevated (greater than 45^0 angle and still may have contact with crown fuel). Figure 18 below is an example of standing dead fuel.

[4] CSI - Critical Surface Intensity

This material is not previously quantified in the fine woody debris sub-components. Stands with less than 20 percent of the stems per hectare of veteran, dominant or co-dominant conifers as standing dead or partly elevated, should be assessed as Level B.

Figure 18: Standing Dead Fuel

Table 19: Dead and Dying Fuel

Level	Descriptor*	Explanation
A	NA	
B	Standing Dead/ Partly Down <20%	Percent cover of representative plot area impacted by dead standing or downed trees with or without needles. The total polygon area is less than 20% impacted with dead, dying and downed trees that do not have a significant amount of needles remaining.
C	Standing Dead/ Partly Down 21 –50%	Percent cover of representative plot area impacted by dead standing or partly downed trees. Includes trees without needles affecting between 21 - 50% of the polygon.
D	Standing Dead/ Partly Down 51-75%	Percent cover of representative plot area impacted by dead standing or partly downed trees. Includes trees without needles affecting between 51 - 75% of the polygon.
E	Standing Dead/ Partly Down >75%	Percent cover of representative plot area impacted by dead standing or partly downed trees. Includes trees without needles affecting greater than 75% of the polygon.

3.2.3 Wildfire Threat Assessment – Site Level Scoring

The **Fuel Assessment (Site Level) Worksheet** will be completed as required in the area of interest or a treatment area based on the survey intensity prescribed by the qualified professional. Each sheet will be scored, and each sheet's score averaged for the overall area score. This scoring is not necessary to apply for funding to treat an area, supporting rationale will be evaluated for treatment funding (i.e. treating a low score area to form a large continuous treatment area). Once a score is derived from the survey an appropriate fuel assessment rating will be found using the following table:

Table 20: Site Level Scoring

	Fuel Assessment Rating (Max Score 100)			
Eco – province	Low	Moderate	High	Extreme
Coast and Mountains, Georgia Depression	0 - 41	42 - 57	58 - 69	70 - 100
Central Interior	0 – 43	44 - 60	61 - 72	73 - 100
Southern Interior	0 - 47	48 - 65	66 - 79	80 - 100
Southern Interior Mountains	0 - 47	48 - 65	66 - 79	80 - 100
Sub Boreal Interior	0 – 43	44 - 60	61 - 72	73 - 100
Boreal Plains	0 - 39	40 - 53	54 - 7264	65 - 100
Northern Boreal Mountains, Taiga Plains	0 - 39	40 - 53	54 - 64	65 - 100

The Northeast Coast Eco province is a marine eco province with no land mass. Follow this link for description of each Eco Province. The following will give generalized descriptions of the "Fuel Assessment Rating" classes:

Table 21: General description of fuel and wildfire potential

Low	Fires may start and spread slowly. There will be minimal involvement of deeper fuel layers or larger fuels.
Moderate	Forest fuels are drier and there is an increased risk of surface fires starting. There will be involvement of the organic layer but larger dead material will not readily combust.
High	Forest fuels are very dry, new fires may start easily, burn vigorously; aerial fuel will be engaged in the flaming front. Most fuel in the organic layer will be consumed and larger dead fuel will be consumed in the smoldering combustion.
Extreme	Extremely dry forest fuel, new fires will start easily, burn vigorously; all aerial fuel will be engaged in the flaming front. Most fuel in the organic layer will be consumed and larger dead fuel will be consumed in the smoldering combustion.

These generalized descriptions are also based on the climatic conditions for the appropriate Eco province. A comparison of the fuel assessment scores across Eco provinces is not appropriate and should not be undertaken. The fuel composition will further refine the classes. In general, confer dominant fuel will fit into the higher classes with mixedwood and deciduous dominated fuel in the lower classes. These rating will be used when the proponent is defining "Wildfire Risk" in a CWPP or a landscape value at risk.

Developing a New Wildfire Threat score for the Assessed Area

Once the above assessment and scoring has been completed you can develop a new value for the PSTA for that area. You will need to acquire the PSTA scoring for wildfire density and spotting impact. These scoring do not change because of the vegetation changes in the assessed polygon, these scores are based on landscape assessments.

Once you have acquired the scores for wildfire density and spotting impact you will need to have a score for the headfire intensity layer. This scoring will be based on your class for the fuel assessment rating as follows:

Table 22: Fuel assessment rating scoring

Fuel Assessment Rating	Score used for Headfire Intensity
Low	2
Moderate	5
High	8
Extreme	10

The values will then be placed in the appropriate category to calculate the "new" PSTA for the assessed area. To help with this process the Crosswalk of the PSTA Scoring spreadsheet can be used.

This example shows an assessed area with a **high score** form the Wildfire Threat Assessment Worksheet – Fuel Assessment and values for the wildfire density and spotting impact:

Table 23: Example of new PSTA score from the crosswalk table

	Crosswalk of PSTA scoring			
Polygon #	Head Fire Intensity	Wildfire Density	Spotting Impact	Revised PSTA Score
1	8	3	7	6.4

Questions

If you have any questions regarding this guide or the associated worksheet, please contact Dana Hicks at dana.hicks@gov.bc.ca

4.0 Bibliography

Forestry Canada, Fire Danger Group. 1992. Development and Structure of the Canadian Forest Fire Behaviour Prediction System Information Report ST-X-, Forestry Canada – Science and Sustainable Development Directorate Ottawa 1992

Merrill, D. F.; Alexander, M.E. 1987. Glossary of forest fire management terms. 4th ed. Natl. Res. Council. Can., Comm. For. Fire Management Ottawa, Ontario. Publ. NRCC 26516

Ministry of Forests, Lands and Natural Resource Operations. Biogeoclimatic ecosystem classification program website. http://www.for.gov.bc.ca/hre/becweb/ resources/codes-standards/index.html. Accessed May 2012

Morrow, Bruce, Johnston, Kelly and Davies, John. 2013. Wildland Urban interface Threat Assessments in B.C. Ministry of Forests, Lands and Natural Resource Operations.

Partners in Protection. 2003. FireSmart: protecting your community from wildfire. Second edition. Partners in Protection. Edmonton, AB.

Scott, J. H.; Reinhardt, E. D., compilers. 2007. FireWords: Fire science glossary. Version 1.0, [Online]. Missoula, MT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.firewords.net/ [2009, June 11].

Taylor, S.W.; Pike, R.G.; Alexander, M.E. 1997. Field guide to the Canadian forest fire behaviour prediction (FBP) system. Special report 11. Natural Res. Can. 60p

Toledo, D., Abbott, L.B., Herrick, J.E. 1997 Cover pole design for easy transport, assembly, and field use. Journal of Rangeland Management, 72: 564-576.

Trowbridge, R.; Hawkes, B.; Macadam, A.; Parminter, J., 1989. Field handbook for prescribed fire assessments in British Columbia: logging slash fuels. FRDA number 001. Government of Canada and Province of British Columbia. Victoria, BC. 63p.

United States Department of Agriculture. Fire effects information system. http://www.fs.fed.us/database/feis/. .Accessed May, 2012.

Van Wagner, C.E. 1977b. Effects of slope on fire spread rate. Environ. Can., Can.For. Ser. Bi-Mon. Res. Notes 33. pp. 7-8.

Van Wagner, C.E. 1985. Development and structure of the Canadian Forest Fire Weather Index System. Can. For. Serv. Ottawa, Ont. For. Tech. Rep. 35. 37p.

Appendix A - The ABCFP Position on Rating Interface Wildfire Threats in British Columbia

The Association of British Columbia Forest Professionals (ABCFP) was provided with the 2010 "Rating Interface Wildfire Threats in BC" document and requested to provide feedback and their position on whether these assessments fall into the practice of professional forestry. The ABCFP Professional Practice Committee returned the following comments[4] :

"A review committee of the association's Professional Practice Committee agrees that the practice of professional forestry does occur within the document's threat rating process, including the Biogeoclimatic Ecosystem Classification component and some of the fuel components, and that the use of hazard assessment ratings to develop associated treatment plans is also the practice of professional forestry."

"We suggest it is important for the document to be clear when it is referring to forest professionals, and when it is referring to other natural resource professionals or fire-fighting professionals. Use of the term "professional" in this document can be made more specific and be improved to provide greater clarity of the intent. Use of the term "qualified professional" is not recommended except if a clear and precise definition for the term is included in the text. In reference to the practice of professional forestry, a suggestion for wording is: "a registered forest professional, or a person working under the supervision of a registered forest professional".

"In our role as regulator for the practice of professional forestry in BC, it is important to the ABCFP that documents which refer to the need for a forest professional include reference to the Foresters Act. Such a reference will flag for readers that this is another area of legislation that applies to the actions and assessments outlined in the "rating" document. Reference to Foresters Act requirements in the introductory text and within appropriate sections of the document will also help individuals and employers who use this interface wildfire threat rating system, to understand the need to engage a forest professional who has expertise in this area of practice. To support this, copies of the pertinent sections of the Foresters Act (Section 1: definition of the practice of professional forestry, Section 20: requirement that only a member of the ABCFP practice professional forestry engage in the practice of professional forestry) can be included in an Appendix and [Cited]"

[5] Extracted from email correspondence received on March 5, 2012 from Jackie Hipwell, RFT- Resource Associate, Professional Practice and Forest Stewardship - Association of BC Forest Professionals

Appendix B – Wildfire Threat Assessment Worksheets

Updated June 2020

Wildfire Threat Assessment Worksheet - Fuel Assessment (Site Level)[3]		Plot #
Location:	Date:	Assessor/ Professional Designation:
Coordinates (Lat/Long – Degrees/Decimal minutes):		

Component/ Sub-Component		Levels/Classes				
		Forest Floor and Organic Layer				
1	Depth of organic layer (cm)	1- < 2 1	2- < 5 3	5- < 10 5	10-20 3	> 20 2
		Surface and Ladder Fuel (0.1 – 3.0 meters in height)				
2	Surface fuel composition	Moss, herbs, deciduous shrubs 4	Lichen, conifer shrubs 6	Dead fines fuel[4] (<1 cm) 8	Pinegrass 10	Sagebrush, Bunch grass, Juniper, Scotch broom 15
3	Dead and down material continuity (< 7cm)	Absent 0	Scattered < 10 coverage 4	10-25% coverage 8	26-50% coverage 12	> 50% coverage 15
4	Ladder fuel composition	Deciduous/ None 0	Mixwood 5	Other conifer 8	Elevated dead fuel 10	Spruce, Fir, Pine 15
5	Ladder fuel horizontal continuity	Absent 0	Sparse < 10% coverage 2	Scattered 10-39% coverage 8	Patchy 40-60% coverage 10	Uniform > 60% coverage 15
6	Stem/ha (understory)[5]	< 500 2	501-800 4	801-1 200 6	1 2501-1 5 000 8	> 1 500 10
		Stand Structure and Composition (Dominant and co-dominant stems)				
7	Overstory composition/ Crown Base Height (CBH)	Deciduous (< 25% conifer) All CBH 0	Mixwood (% conifer) 25% 50% 75% 0 2 3	Conifer with high CBH (> 10m) 3	Conifer with moderate CBH (5-9m) 4	Conifer with low CBH (< 4m) 5
8	Fuel strata gap[6] (m)		> 10 0	6-9 1	3-6 3	< 3 5
9	Stems/ha (overstory)[7]	< 400 0	401-600 2	601-900 3	901-1 200 4	> 1 200 5
10	Crown closure	< 20% 0	20-40% or Deciduous Overstory (any closure) 1	41-60% 2	61-80% 5	> 80% 4
11	Dead and dying (% of dominant and co-dominant stems)		Standing dead/ Partial down < 20% 2	Standing dead/ Partial down 21-50% 5	Standing dead/ Partial down 51-75% 8	Standing dead/ Partial down > 75% 10

Total Score[8]:	
Eco Province scoring used:	
Fuel Assessment Rating: (low, high etc.)	

Comments:

Updated March 2017

Wildfire Threat Assessment Worksheet – Priority Setting Scoring (complete one for entire proposed treatment area)		
Location:	Date:	Assessor/ Professional Designation:
Coordinates (Lat/Long – Degrees/Decimal Minutes):		
PSTA Threat:		FBP Fuel Type:
Assessor's FBP Fuel Type:		Ownership:
Assessor's Fuel Type Rationale[1]:		
Value Description (include type of value and distance to the value from the proposed treatment area):		

Landscape Assessment					
Proximity of fuel treatment area to value (m)	0-100 25	101-500 20	501- 1,000 15	1 000- 2,000 5	> 2,000 0
Existing Fuel Mgmt. treatment area in place between the proposed treatment area and the value(s)	Yes 5	No 0			
Treatment Placement: using the predominant wind direction/ fire spread pattern, what is the treatment location in relationship to the value(s) location?		Downwind 0	270° offset to prevailing wind/ highest ISI values 7	90° offset to prevailing wind/ highest ISI values 10	Upwind/ highest ISI values 15
Distance to nearest vehicle access (m)		0-200 5	201-400 3	401- 1,000 1	> 1,000 0
Distance to non-fuel / treated[2] area near the assessment area (m)		0-200 5	201-400 3	401- 1,000 1	> 1,000 0

Topographical Factors					
Topography: Slope	< 20% 0	21-30% 1	31-45% 3	46-60% 4	> 60% 5
Topography: Aspect (> 20% slope)		North 0	East/Flat 3	West 4	South 5
Slope position of value (only applies if slope is > 20%)		Bottom of slope/ valley bottom 0	Mid slope - bench 1	Mid slope - continuous 3	Upper 1/3 of slope 5

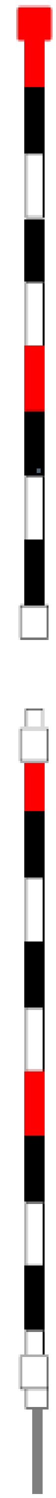
Total Score:	

Comments:

[1] *Must include three photos for each plot (one of forest floor, one of surface and ladder fuel, one of overstory)*
[2] *Fuel management type treatment where wildfire threat has been mitigated*

Appendix C - Robel Pole Construction

These instructions are borrowed from Toledo, Abbott and Herrick (1997).



Materials

- 1 piece of schedule 40 polyvinyl chloride (PVC) pipe, 2 m long, 2.54 cm diameter
- 1 threaded male PVC connector, 2.54 cm diameter
- 2 threaded female PVC connectors, 2.54 cm diameter
- 1 threaded male plug, 2.54 cm diameter
- 1 flat headed spike, 20 cm long, 1.3 cm diameter
- 1 PVC cap, 2.54 cm diameter
- PVC cleaner, primer and glue
- Epoxy
- Enamel or PVC paint in black, white and red

Instructions

1. Cut the PVC pipe into two 1-m-long pieces.
2. Use the PVC cleaner and primer on the inside walls of the unthreaded male and female connectors.
3. Use the PVC cleaner and primer to prepare one end of one piece of PVC pipe and both ends of the other piece of the PVC pipe. These pieces will become the top and bottom halves of the Robel pole respectively.
4. Glue a female connector to a prepared end of each piece of pipe.
5. Glue the male connector to the remaining prepared end of the bottom pipe.
6. Drill a 1.3 cm hole in the center of the flat end of the threaded male plug. Insert the spike through the hole until the spike head is firmly seated against the inside of the plug. Inject epoxy into the plug, covering the spike head and filling the plug. Ensure that the spike is straight and allow the epoxy to harden.
7. Assemble the Robel pole by screwing the top and bottom halves together and screw the plug with the spike into the female end of the bottom pipe. Tighten connections until they are snug, but do not over tighten. Attach the remaining PVC cap (unglued) to the open end of the top of the pole.
8. Measure the cover pole and mark the top end at the 2-m mark.
9. Remove the cap and trim the open end of the top pipe to produce a 2-m-long (cap to plug) pole.
10. Reassemble the pole. Paint alternating 10-cm white and black segments, with every fifth segment painted red as depicted in the diagram to the left.

Appendix D - Photo Guide Template

SITE INFORMATION **Plot #**

Date Sampled:
Coordinates: General Location: N xxº xx' xx.xx", W xxº xx' xx.xx"

Photo Direction:

FBP Fuel Type:

Slope (%):

Aspect (deg.):

Elevation (m):

Canopy Closure (%):

Average Forest Floor Depth (cm):

Surface
[Photo] (with link to large size for details)
Ladder
[Photo] (with link to large size for details)
Crown
[Photo] (with link to large size for details)

Appendix E - FBP Fuel Type Change Rationale

FBP Fuel Type Change Rationale

Location	Date	Assessor/ Professional Designation
Coordinates:		Coordinate system used and format
PSTA Threat		FBP Fuel Type
Assessor's FBP Fuel Type:		Ownership:
Assessor's Fuel Type Rationale:		

Attach at least six representative photos and/or images (google earth, orthographic maps) that support the fuel type rationale change. If a field review has occurred; there should be at least two photos of each part of the forest stratum: surface fuel, ladder fuel (present or absent) and the crown fuel.