Healy Community Wildfire Protection Plan 2024

Appendix C - Methodology

This should be read with the respective CWPP documents for Denali Borough, Cantwell, McKinley Village, Healy and Anderson, including the Appendices A, B and D.

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Community Hazard Rating Methodology

Purpose

The purpose of this appendix is to provide an overview of the methodology used to determine Community hazard ratings for this CWPP and a brief description of the two tools principally involved. (1) Interface/Intermix Community Hazard Rating (ICHR) which generates a composite score derived from integrating an on-the-ground assessment of structural ignitability and Home Ignition Zone (HIZ) hazards with computer modeling. ICHR is used to determine the adjective hazard rating class for each of the Communities of the study area. (2) IFTDSS (Interagency Fuel Treatment Decision Support System) which models several aspects of predicted fire behavior and Burn Probability (LBP), the likelihood of a significant wildfire start. IFTDSS outputs and a GIS spatial analysis of physical factors, such as Community topography and distance to fire stations and water supply, are incorporated into the ICHR scores. IFTDSS is a product of the USFS Missoula Fire Sciences Laboratory.[1]

Introduction

The primary outcome of the hazard study performed for this CWPP is to identify and quantify wildland fire hazards in the most heavily populated Wildland-Urban Interface (WUI) and Wildland Intermix (WI) residential areas. WUI/WI portions of the study area are grouped into Communities for hazard analysis and prioritization of mitigation recommendations. For the purposes of this study Community boundaries are based on areas of residential development that represent similar dominant wildfire hazards and are geographically contiguous, rather than political, HOA, or traditional neighborhood boundaries. Non-residential land such as large commercial or government-owned tracts have been excluded.

The WUI is also known as the Urban Edge Ember Zone. It is the area where encroaching wildland fuels could create a fire hazard to what would be an urban or suburban development in a different setting. The WI consists of communities where wildland fuels surround homes. Several authorities including the US Fire Administration, the International Wildland-Urban Interface Code (IWUIC) and the National Fire Protection Association (NFPA) also recognize an "Occluded" category of interface communities that includes developed areas surrounding wildland fuel islands of less than 1,000 acres.[2] In terms of hazard analysis and mitigation these Communities are treated and defined as similar to WUI Communities, therefore it is unnecessary for the purposes of this study to create a separate class for them.

ICHR Methodology

ICHR was developed specifically to evaluate Communities within the WUI/WI for their relative wildfire hazard using the field experience and knowledge of ignition management and wildfire hazard mitigation professionals. ICHR combines physical infrastructure such as structure density, road access and water supply with the fire behavior and LBP outputs from IFTDSS. Elements of NFPA 1140 have been integrated into this methodology to ensure compatibility with national standards. Aspects of NFPA 1142 regarding water supply for rural and suburban firefighting are also included in the assessment by evaluating proximity and capacity of water for fire suppression. In 2023 this methodology was revised using information from NIST Technical Note 2205 (*WUI Structure/Parcel/Community Fire Hazard Mitigation Methodology*, March, 2022).

ICHR is an enhancement of a system commonly used by wildland firefighters to perform structural triage on a threatened community in the path of an advancing wildfire using predicted fire behavior for expected conditions on a fire season day. The ICHR survey and fuel model ground-truthing are completed by field assessors with WUI/WI fire experience. ICHR data collected in the field is analyzed by a Wildland Fire Mitigation Specialist who verifies and integrates it with the computer modeling data and adjusts the final ratings if necessary. ICHR ratings are related to what is customary for the area. For example, a “High” hazard Community in the tall grass prairies of Kansas will not look like a “High” hazard Community in the Sierra Nevada mountains of California. The system creates a relative ranking of Community hazards in relation to other Communities in the study area. ICHR generates a total hazard score of 0 to 100 points where a 0 represents the lowest possible hazard and 100 the greatest. This numeric score is used to sort Communities into one of five adjective hazard classes: Low, Moderate, High, Very High or Extreme. Not all categories are found in every study. The ICHR range of hazard factors is so broad it is common for Extreme and Low hazard communities to not simultaneously exist in any one study. Adjective ratings for ICHR numeric scores **in this study** are as follows: 30 or less = Low, 31-50 = Moderate, 51-70 = High, 71-90 = Very High and >90 = Extreme. **Table 1** shows the ICHR ratings for the Communities of this study area.

The ICHR ratings, as described above, have also been included in the hazard summaries of the Communities found in *Appendix A: Communities* in each of the four individual CWPPs covering Communities within the Denali Borough.

Fire Behavior and Burn Probability Analysis

The CWPP hazard analysis begins by modeling wildfire behavior within the study area boundary. This is done using an industry-standard, fire-behavior modeling package known as IFTDSS (v3.10). IFTDSS uses maps of fuel characteristics and topography, along with information about past weather patterns to predict the severity of wildfire. The 90th and 97th percentile weather (top 10% and 3% of fire weather days) are used to calculate fuel moistures and winds during a high and extreme fire danger day. Predominant wind directions and speeds are then calculated from the frequency distributions of the Remote Automatic Weather Stations (RAWS) records. That information is used to measure how any given vegetation will burn across the study area under the same weather conditions.

Current fire behavior models treat man-made structures as non-burnable due to their inability to model the wide variation of fire behavior when structures are the primary carrier of fire. The on-the-ground survey of structural ignitability and home ignition zone hazards is added to the fire behavior outputs and a GIS analysis of physical factors to capture hazards due to structural ignitability and conditions in the HIZ. The resulting composite ICHR score determines the hazard rating class of the Communities of the study area.

Landscape Fire Behavior Simulation Inputs:

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- Fuel Model
- Canopy Cover
- Stand Height
- Canopy Base Height
- Canopy Bulk Density
- Topographic Position (Aspect, Slope and Elevation)
- Initial fuel moistures
- Wind speed and direction

Landscape Fire Behavior Simulation Outputs:

- Flame Length
- Rate of Spread
- Fireline Intensity
- Heat per Unit Area
- Crown Fire Activity

Landscape Fire Behavior Modeling Procedure

The study area is broken down into grid cells with dimensions of 30 meters × 30 meters; fire behavior is predicted for each cell based on input topographic, fuel, and weather information. Data from the LANDFIRE dataset provided the topographic (aspect, slope, and elevation) and fuel (surface fuels, canopy closure [CC], canopy height [CH], canopy base height [CBH], and canopy bulk density [CBD]) information that is required for the model to run. Reference weather and fuel moisture information are obtained from one or more Remote Automated Weather Station (RAWS) sites. In the case of the Denali Borough study area the Denali Visitor Center RAWS (500626) maintained by the National Park Service was used for weather data.

Model Inputs

The 40 Scott and Burgan Fire Behavior Fuel Model (FBFM40) layer is obtained from the most current LANDFIRE dataset for that region and represents distinct distributions of fuel loading found among surface fuel components, size classes, and fuel types; this layer served as the baseline for the fuel's inputs to the fire behavior model. LANDFIRE fuel models for the state of Alaska were updated in 2023 and a custom model has been developed for Alaska to model regeneration in burned areas, so confidence in their accuracy at the resolution intended is high.

Predominant wind directions and speeds are calculated from the frequency distributions of the RAWS records. For the flame length, rate of spread, crown fire activity, and fireline intensity model runs, an upslope wind direction is used (i.e., the fire is assumed to burn uphill always). This simulates the worst-case scenario (winds aligned with slopes) and is considered to be the best scenario to run for preplanning. Both live and dead fuel moistures for each landscape cell are calculated by the model based on the topography (slope, aspect and elevation) and shading from forest canopy and clouds, as well as the recorded weather (precipitation, high and low temperatures, and high and low relative humidity) for the previous 3 days that lead up to the date chosen to get the best representation of the standard conditions.

Model Outputs

Rate of spread values generated by the simulation are classified into four categories based on standard ranges: less than 20, 20.0–40.0, 40.1–60.0, and greater than 60 chains per hour (Ch/h). A chain is a logging measurement that is equal to 66 feet; 1 mile equals 80 chains, 1 Ch/h equals approximately 1 foot/minute, and 80 chains per hour equals 1 mile/hour. A high rate of spread does not necessarily indicate severe fire effects in all portions of the study area. Fire will move very quickly across short grass fields but will not burn very hot and may not cause any major damage to the soil or man-made features. See **Figure 1**.

Crown fire activity values generated by the simulation are classified into four categories based on standard descriptions: active, torching, surface, and noncombustible. In the surface fire category, little or no tree torching will be expected. During passive crown fire activity, isolated torching of trees or groups of trees will be observed, and fire movement through the canopy will be limited to short distances. During active crown fire, sustained fire movement through the canopy is probable. See **Figure 2**.

Spotting and Embers – Embers are a major cause of structure loss. Thousands of burning embers, or “firebrands”, can be carried by the wind and rain down on structures. These embers can be parts of twigs or branches, pinecones, bark, or wood shingles and other flammable debris torn from burning roofs or debris piles. While any vegetation can create embers, trees are the most problematic since they travel the furthest distance. The distance they travel is dictated by several factors.

- The source, size, and number of firebrands.
- The distance the firebrand is carried downwind.
- The probability of igniting a new fire at the downwind location.

While there is currently no model that can predict home to home ignition, it is well documented that when multiple structures are burning under strong wind conditions, they will continue to generate viable embers that will land on structures ahead of the fire. The distance the fire will penetrate into urban/suburban areas will be dictated by the windspeeds and the intensity of the fire. It is safe to say there will be impacts beyond where the model shows ember cast in the results.

Other model outputs are available in the *IFTDSS Landscape Fire Behavior* reports provided as part of the deliverables of this CWPP project.

Landscape Burn Probability Model (LBP)

Landscape Burn Probability Model (LBP), which evaluates the likelihood a fire will occur, along with fire severity predictions from fire-behavior modeling, are employed to determine the contextual threat of wildfire to the Communities of the study area.

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The Burn Probability output (BP) quantifies the likelihood of a fire occurring under a fixed set of weather and fuel moisture conditions.

In addition to BP, LBP also models Conditional Flame Length (CFL). CFL is an estimate of the average flame length for all fires that burn at a given point on the landscape under a fixed set of weather and fuel moisture conditions. This number is lower than the Landscape Fire Behavior Flame Length output because it averages head, flank and backing for each pixel instead of just the head fire.

The most relevant product of the LBP analysis for hazard mitigation planning is Integrated Hazard. Integrated Hazard combines BP with CFL into a single characteristic that can be mapped.

GIS Zonal Analysis

A zonal analysis of physical geography affecting wildfire hazard threats to the communities is also integrated into the ICHR Community ratings. For each of the Communities of the study area the following factors are calculated:

- Minimum, maximum and mean distance to the nearest fire station
- Minimum, maximum and mean distance to the nearest dip/draft water supply that can be used for fire suppression
- Minimum, maximum and mean elevations existing within the Community
- Minimum, maximum and mean slope grades existing within the Community

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Figure 1 Denali Borough Predicted Rate of Spread (90th percentile)

ICHR Composite Rating

LBP Integrated Hazard along with Landscape fire behavior outputs and the GIS Zonal Analysis described above are added to the on-the-ground field survey of structural ignitability and HIZ/Community hazard factors and entered into the ICHR rating scale to generate an adjective rating of the Communities. The Community hazard ratings are used to recommend and

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prioritize mitigations actions presented in the CWPP report. The ICHR ratings of the Communities in the Denali Borough are shown in **Table 1**. For a hazard summary of each of these Communities see *Appendix A: Communities* in the area CWPP covering that Community.

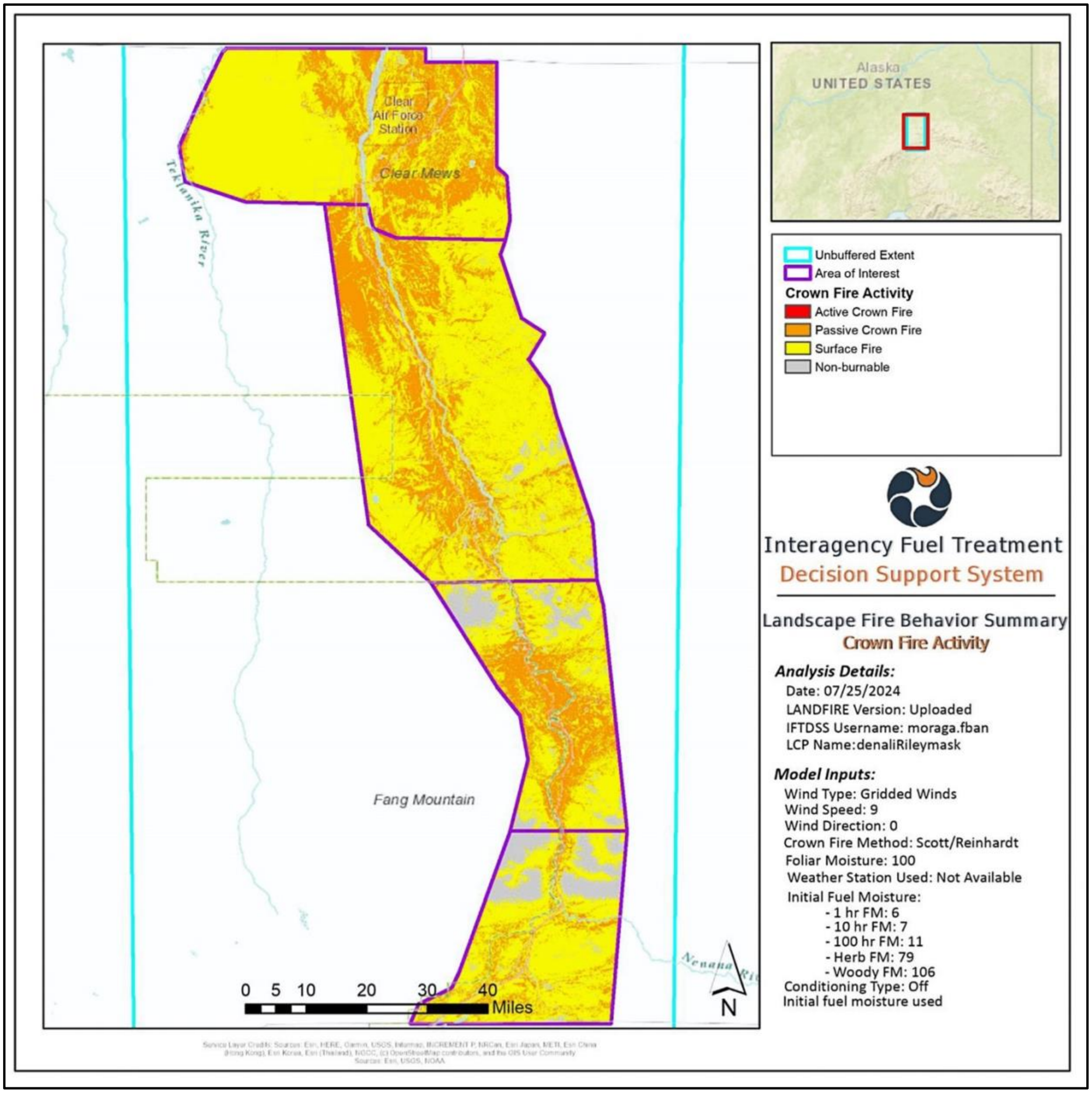

Figure 2 Denali Borough Predicted Crown Fire Activity

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Table 1 - ICHR Community Hazard Ratings

Denali Borough ICHR Ratings (2024)		
Community Name	**Score**	**Adjective Rating**
Anderson Alaska CWPP		
Rexana/Windy Hills	72	Very High
Parks Hwy, Clear Sky Area	69	High
Kobe	68	High
Anderson City	60	High
Clear Space Force Station (ASI)	33	Moderate
Healy Alaska CWPP		
Ridgetop	86	Very High
June Creek/Bear Creek	73	Very High
Stampede/Lignite	68	High
Ferry	60	High
Nenana River Canyon	57	High
Rock Creek	52	High
Central Healy	47	Moderate
Otto Lake	45	Moderate
McKinley Village Alaska CWPP		
Karma Ridge	78	Very High
Carlo Creek/Perch Road	71	Very High
Husky Homestead	62	High
Deneki Lakes	56	High
Denali Airstrip	48	Moderate
Cantwell Alaska CWPP		
Cantwell Heights	68	High
The Nation	66	High
Drashner Lake North	47	Moderate
Central Cantwell	42	Moderate
Drashner Lake South	37	Moderate
Denali Borough Areas of Special Interest		
Denali NP (front country)	55	High
Kantishna	0	Insufficient Data for ICHR
Rating Categories: Low < 30; Moderate 31-50; High 51-70; Very High 71-90; Extreme > 90.		

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References/Citations

[1] https://iftdss.firenet.gov/landing_page/about.html
[2] National Institute of Standards and Technology Technical Note 2205, March 2022, page 3 (footnote 1)