School of Earth and Environment GEOG309-24S2 Research for Resilient Environments and Communities Assignment 5 Group Report

Understanding Rural-Urban Interfaces in the Port Hills New Zealand

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Executive Summary

- ¶ This research project investigates fire risk at the rural-urban interface (RUI) in the Port Hills, a region characterized by high wildfire vulnerability due to its topography, vegetation, and proximity to human habitation. As climate change continues to exacerbate extreme weather conditions, understanding the fire risks at the RUI is critical for safeguarding both natural ecosystems and residential areas.
- ¶ The project aims to understand what defensible space looks like at RUI properties and how various characteristics interact to reduce or increase fire risk.
- ¶ Identification of key themes such as RUI and defensible space definitions, indigenous knowledge and perspectives, vegetation types on the Port Hills, and history of wildfire informed our focus for reviewing existing literature and research.
- ¶ The project involved the creation of a fire risk matrix designed to assess multiple variables, including topography, proximity to fuel sources, building materials, and emergency response access. A weighted score was allocated to each variable in relation to its severity and impact on fire risk.
- ¶ By applying the matrix to a set of homes across wider Canterbury including Port Hills and Christchurch City we classified properties from high to low risk based on their unique characteristics.
- ¶ Key limitation was the inconsistency of data collection, with varied processes taken in field work on the Port Hills compared to urban flats. Impacts results due to subjectivity of fire risk perception.
- ¶ Future implications of this projects are varied. With additional time and funding the creation of GIS and remote sensor maps can provide a physical description of defensible space at the RUI. Implementation into building codes or the RMA to regulate fire risk and educational opportunities.

Introduction

Recently New Zealand has had an increased risk of wildfires. Wildfires are becoming a greater threat to communities in the Rural Urban Interface, particularly in places like Worsley's Road on the Port Hills, as seen on the Port Hills in 2017 and again in 2024. These disasters left the neighbourhood traumatized, caused extensive damage, and destroyed homes. These incidents highlight the Rural Urban Interfaces susceptibility to wildfire hazards, particularly with climate change and growing urbanisation. The risk of wildfires in these locations is increased by variables such as flammable vegetation, fuels, rising temperatures and topography. To effectively address these challenges, a deeper understanding of the rural urban interface's features is necessary, as well as the development of efficient mitigation strategies that protect people and their property.

The term rural urban interface is used to define the area where naturally occurring flammable vegetation meets and interacts with people and properties. The Port hills is a rural their is positioned and maintained around people's homes can provide defensive space. This is achieved through careful selection, placement, and maintenance of vegetation around homes.

Fire History on the Port Hills found the risks of wildfires are becoming increasingly dangerous, which highlights the importance of impacts on urban development, government initiatives, and community preparedness. It is found that increased government accountability, improved fire safety, with a more integrated approach to urban planning that considers the growing risk of wildfires are all necessary. The research on Mātauranga Māori found how fire risk management can benefit from incorporating Māori knowledge, particularly through an approach that recognizes the interconnectedness of people, land, and ecosystems. Research on defensible space emphasizes how crucial defensible space is to lower the risk of wildfires, reducing vegetation within 10-30 meters of buildings significantly deduces their risk of damage.

Research Objective

The research question for this project was developed based on literature reviews of past research.

Hills, concentrating on standardizing definitions of defensible space and investigating further strategies to enhance wildfire resistance is key.

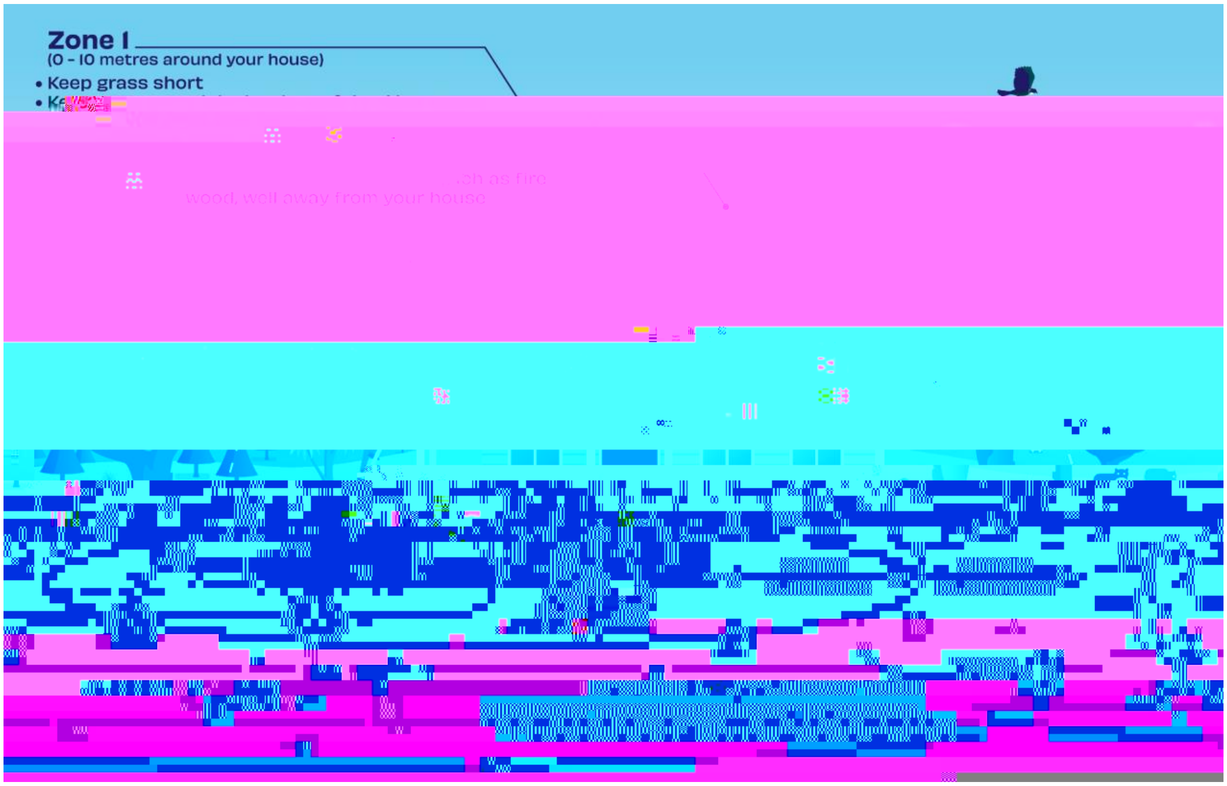

Figure 1. Recommended defensible zones around a structure (retrieved from FENZ, 2021)

Methods

This study aimed to develop a quantitative method for assessing the wildfire risk of properties located in wildfire-prone areas or (rural urban interfaces). To achieve this, a risk matrix was created to assign numerical values to various factors contributing to a property's overall wildfire risk. This matrix was then applied to real-world properties affected by wildfires, allowing for refinement and validation of the assessment tool.

Risk Matrix Development

The risk matrix was designed to incorporate key variables related to both a property's defensible space and its overall ‘defendability’. These variables were categorized as follows:

1. Vegetation**:** This category considers factors such as the type and density of vegetation surrounding the property, its flammability, and its proximity to structures. Dense, dry vegetation in close proximity to a house was recognized as a significant fuel source for wildfires (Scott et al., 2014).
2. Other Fuels**:** This category includes any combustible materials located on the property or in its immediate surroundings, such as firewood, propane tanks, and outbuildings. The presence of such fuels can increase the intensity and spread of a wildfire (Fernandes & Botelho, 2013).
3. Environmental Conditions: This category encompassed factors such as wind direction and intensity, as well as the topography of the surrounding land. Steep slopes can accelerate fire spread uphill, while wind can carry embers long distances, igniting spot fires (Sullivan, 2009).
4. Infrastructure and Materials: This category assessed the construction materials used in the building and surrounding structures, such as roofing material, siding, and decking. Certain materials, like wood shingles and untreated timber, are more susceptible to ignition than others.
5. Local Community: The condition of neighboring properties was considered in this category. A poorly maintained property with excessive vegetation or combustible materials can increase the risk for the entire area (Cohen, 2000).
6. Mitigation Strategies: This category evaluated the presence and effectiveness of wildfire mitigation measures, such as sprinklers, firebreaks, accessibility for fire trucks, and access to reticulated water. These measures can significantly reduce the risk of property damage or loss (Mell et al., 2010).

Each variable within these categories was assigned a score range, and importantly, these variables were weighted based on their perceived relative importance in influencing wildfire risk. For example, the variable "slope" was assigned a higher maximum score than "other fuels" due to the significant impact of slope on fire behavior (Finney, 2005). This weighting system allowed the matrix to prioritize the most influential factors in determining wildfire risk.

Application and Refinement of the Risk Matrix

The application of numerical values was solely down to our own opinions. We assessed the properties and differing features surrounding and scaled the scores from a ‘good’ or ‘high’ value to a ‘bad’ or ‘low’ value.

To test and refine the risk matrix, a collaborative approach was adopted. Community members who had been directly affected by the Port Hills fires in 2017 and 2024 were partnered with. Site visits were conducted to these properties, where researchers listened to residents' experiences and applied the risk matrix to assess their level of risk. This practical application proved invaluable in highlighting areas for improvement within the matrix.

Initially, the matrix included a single score for "defensible space." However, through the site visits and feedback from residents, it became apparent that differentiating between the various defensible space zones – the 1-meter, 10-meter, and 30-meter zones – was crucial for a more accurate assessment. The matrix was revised accordingly, incorporating separate scores for each zone to better reflect the varying levels of risk within these areas.

Furthermore, the process of applying the matrix to real-world scenarios and receiving feedback from affected residents led to the removal of a variable that proved less influential than initially thought. This streamlining process enhanced the matrix's efficiency and clarity.

Case Studies: Properties A and B on the Port Hills

Two specific properties, designated as Property A and Property B, provided crucial insights for refining the risk matrix and understanding the impact of mitigation strategies.

Property A, located in a high-risk area with steep slopes, potential fuel sources, and vulnerable neighboring properties, was initially assessed as low-medium risk despite the fire coming perilously close to the house. This seemingly contradictory assessment highlighted the critical role of mitigation techniques. The property owners had implemented an extensive sprinkler system, covering both the garden and the fences surrounding the house (refer to Appendix 1.1, Figures 1 and 2). This system, though not perfect, likely played a crucial role in preventing the fire from igniting the property. This observation underscored the significant impact of mitigation strategies in reducing wildfire risk, even in high-risk areas.

Property B further reinforced the importance of mitigation strategies. This property featured a swimming pool that served as a readily available water source for firefighters during the wildfire (refer to Appendix 1.2, Figure 3). The pool's self-refilling feature ensured a constant water supply, which likely contributed to saving the house.

The analysis of these two properties emphasized the crucial role of effective mitigation strategies in reducing wildfire risk. While maintaining defensible space through vegetation management is essential, the presence of robust mitigation techniques, part variables, such as a lack of slope and paved areas surrounding the house, also factored into the score (refer to Appendix 2.1 – Table 3).

The final property analyzed was flat F, which scored 72 on the risk matrix, classifying it as medium risk. This higher risk, compared to other properties, resulted from low maintenance around the property and dense clustering of vegetation. The absence of surrounding water tanks and the

could burn up to properties and decks/wooden structures also caused houses to catch. It is important to note that not often is a house receptive to fire however, but something very close to/next to it is receptive to catching alight.

After analysing a FENZ GIS dataset showing property damage to the Lake Ōhau Village due to the fire, a couple properties stood out as very interesting. Figure 4 below shows a property that survived, despite having significant fuels burned right up to the foundation. Other houses with wooden foundations, in similar situations, had been lost.

Figure 4. Post fire images of property C at Lake Ōhau. Area highlighted in brown in the top

firefighters are unable to save every house despite their best efforts. For this reason, having defensible space around properties or fire reduction/mitigation strategies in place such as sprinklers, is in the best interest to prevent significant damage and loss, in case firefighters are unable to intervene.

Limitations and F

References

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Appendices

Appendix 1: Images of Properties on the Port Hills

1.1 Port Hills Property A

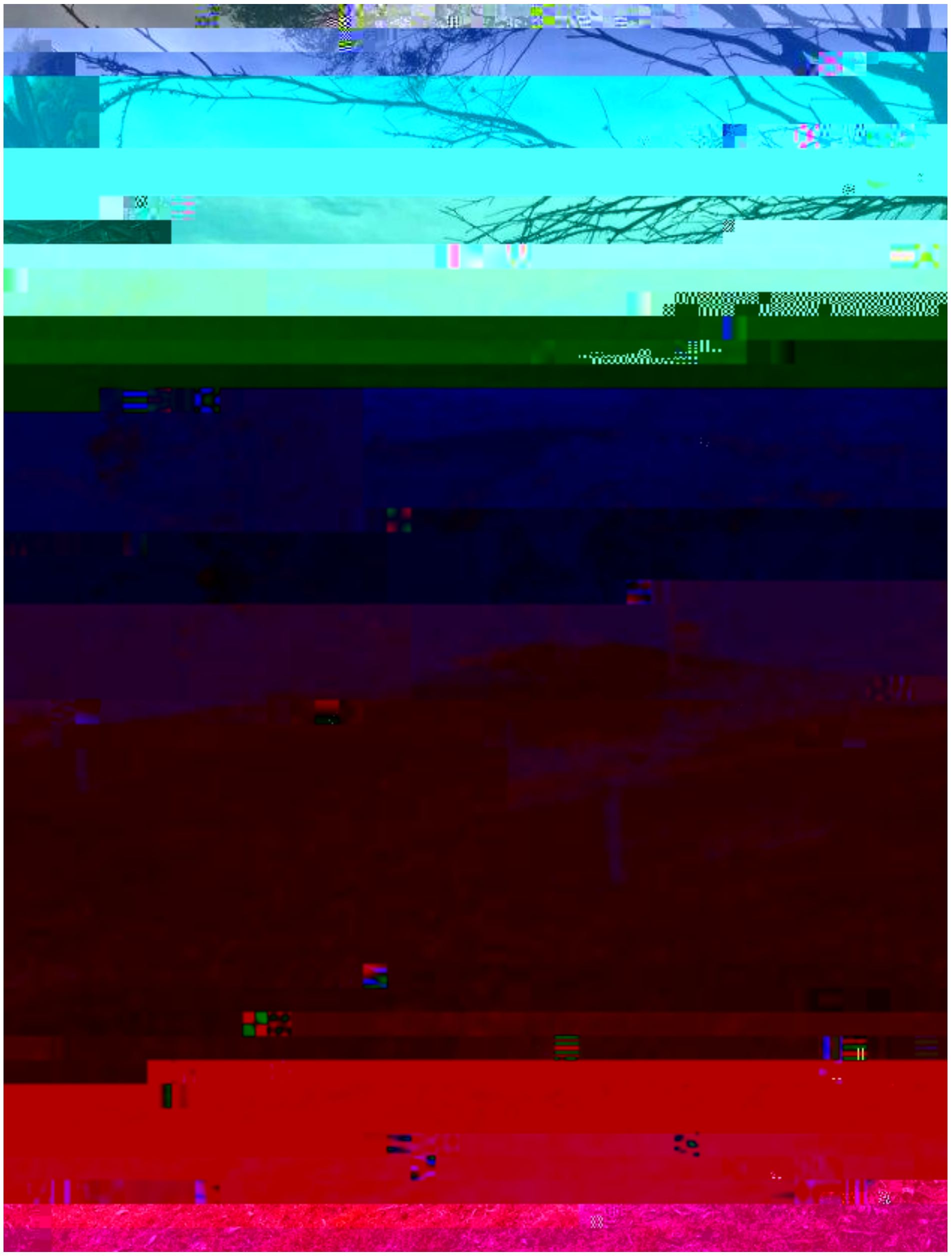

Figure 1. Sprinkler system along the fence line of Property A on the Port Hills.

1.2 Port Hills Property B

Figure 3. Aerial shot of Property B on the Port Hills. The swimming pool was actively used by helicopters to mitigate the fire and reduce the spread.

Appendix 2: Results from Risk Matrix

2.1 Different risk matrix tables for each property anaylsed

Table 1. Risk Matrix and score for Property A on the Port Hills

Variables	Low risk	Medium risk	High risk	SCORE
Fuels				
- Ignition sources ie hot tub, pizza oven [illegible]	1-3	4-6	7-9	2
[illegible]	1-3	4-6	7-9	[illegible]
- Wooden structures ie wood pile, fences, decks	1-3	4-6	7-9	[illegible]
Fuels Vegetation				
- Flammability	1-3	4-6	7-9	4
- Clumping/spacing of [illegible]	1-3	4-6	7-9	[illegible]
- Proximity of structures (1m, 10m, 30m)	1-3	[illegible]	[illegible]	[illegible]
Behavioural Factors				
Other Fire [illegible]	[illegible]	5-7	8-10	[illegible]
- Climate	2-4	5-7	8-10	8
Infrastructure				
- Building material	1-3	4-6	7-9	[illegible]
Community & Neighbours	2-4	[illegible]	8-10	[illegible]
Mitigation Credits / Defendability	Good	Medium	Bad	
- Access to water/water [illegible]	1-3	4-6	7-9	1
[illegible]	1-3	4-7	8-10	[illegible]
[illegible]	1-3	[illegible]	[illegible]	[illegible]
- Water sources [illegible]	1-3	4-6	7-9	[illegible]
- Driveways (accession for fire trucks/[illegible])	1-3	4-7	8-10	1
- Paved / Gravel ([illegible])	1-3	4-6	7-9	[illegible]
SCORE				[illegible]

Table 2. Risk Matrix and score for Property B on the Port Hills

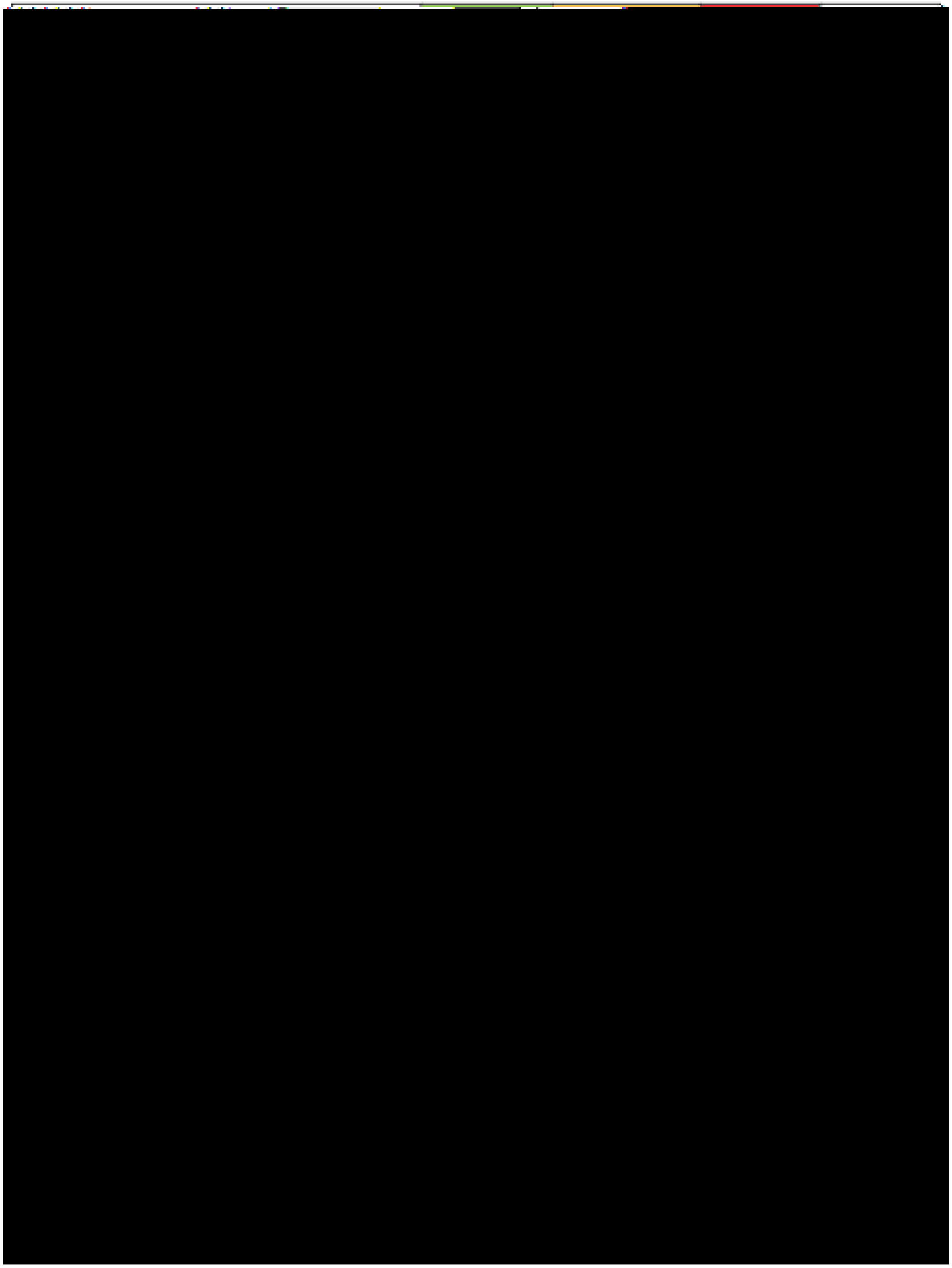

Table 3. Risk Matrix and score for Property E in Ilam

[redacted]

Table 4. Risk Matrix and score for Property F in Ilam

[redacted]