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 urban interface, because of this, the area is highly vulnerable to fire outbreaks that quickly spread. More properties are being built in these high-risk areas as a result of the expanding urban region and growing population, which raises the possibility of significant damage as well as the chance of fires. The interactions between vegetation, fire behaviour, and human activity make it imperative to create management plans to lower the risk of wildfires at the rural urban interface.

Literature Review

New Zealand faces significant wildfire risks that differ from other countries. There are gaps in our understanding of rural urban interfaces. Through our literature reviews of Vegetation types, Defensible Space, Mātauranga Māori, Fire History and Defining RUI / WUI it was found that many studies on fire risk in this area have been carried out in other countries. The Defining RUI review found that New Zealand lacks consistent terminology and detailed local knowledge. We discovered that New Zealand’s understanding of rural urban interfaces remains limited due to the complexity of defining these areas. The literature shows that the term rural urban interface is often used inconsistently, which can lead to confusion. However, there is a clear pattern in the methods used to identify these areas. The literature on defensible space found that the idea that vegetation cannot be used around infrastructure is incorrect. However, the kind of vegetation and the way it 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. The research question is: What is defensible space and how can it reduce fire risk for properties located at the RUI? This research has two distinct objectives. The first primary objective of the research is to identify defensible space in the context of New Zealand and determine the most effective techniques for creating and preserving this buffer around homes. Defensible space, which includes careful planning and control of vegetation and other fuels, is essential to decreasing the risk of fire and creating a safe environment. The other objective is to create a risk matrix to assess the many types of fuel, vegetation, topography, and accessibility to water supplies. That all affects the risk and severity of a fire. The matrix offers a thorough method for evaluating each property's total susceptibility by giving these factors weighted scores.

Wildfires present significant risks to both rural and urban communities and in particular areas like the Port Hills, New Zealand, which form part of the rural-urban interface. Defensible space is an area around a structure where flammable vegetation and objects are managed or removed. Although defensible space has been widely endorsed as a crucial technique for mitigating wildfires, there is still a notable absence of international standardization (Syphard et al., 2014). Focusing on the role of defensible space in wildfire risk mitigation in the Port Hills, particularly in high-risk zones characterized by steep terrain and dense vegetation is of importance in our research.

Defensible space is a buffer zone around a property where combustible vegetation is removed to mitigate the spread of wildfires. This area surrounds a structure in a range of 10 to 30 meters (*refer to figure 1*). Defensible space has been successfully promoted by Fire Smart initiatives in the US and Canada as part of a larger fire management plan (Johnson et al., 2008). The implementation of fire-resistant building materials, community education, and defensible space has enhanced these locations' ability to withstand wildfires. But there are considerable difficulties when implementing these methods in areas with distinctive geography and vegetation like the Port Hills. The dense and flammable vegetation of New Zealand's Port Hills differs significantly from the environments in North America, necessitating a tailored approach to defensible space in this area (Ondei et al., 2024). Our research approach to assessing the role of defensible space in wildfire mitigation was aided through visiting a range of properties in the rural urban interface in the Port Hills and two other properties in the suburban area. During the visits we were able to gather community perceptions of fire risk and an analysis of each property's defensible space. The likelihood of surviving a wildfire event was increased for properties with well-maintained defensible space. But defensible space must be a part of a larger strategy. As highlighted by Johnson et al. (2008) the significance of combining sprinkler systems and defensible space with other fire management tactics, particularly in regions with intense fire behaviour.

The Port Hills, with its steep topography and dense vegetation, is particularly susceptible to wildfires, so creating and maintaining defensible space is essential for reducing fire risk in this region. However, local policies and community engagement must be strengthened to ensure more consistent application of fire mitigation strategies. Defensible space, when combined with fire-resistant building materials and community education programs, can significantly enhance the region's resilience against wildfires.

An important part of preventing wildfires is defensible space, but it works best when paired with other mitigation strategies as mentioned previously; sprinkler systems, fire-resistant building materials, and community involvement. Disparities in wildfire readiness in the Port Hills are partly caused by regional differences in the understanding and maintenance of defensive spaces. In future, it will be important to create customized fire mitigation plans that take into account the distinct community and environmental circumstances in the area. In high-risk locations such as the Port

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

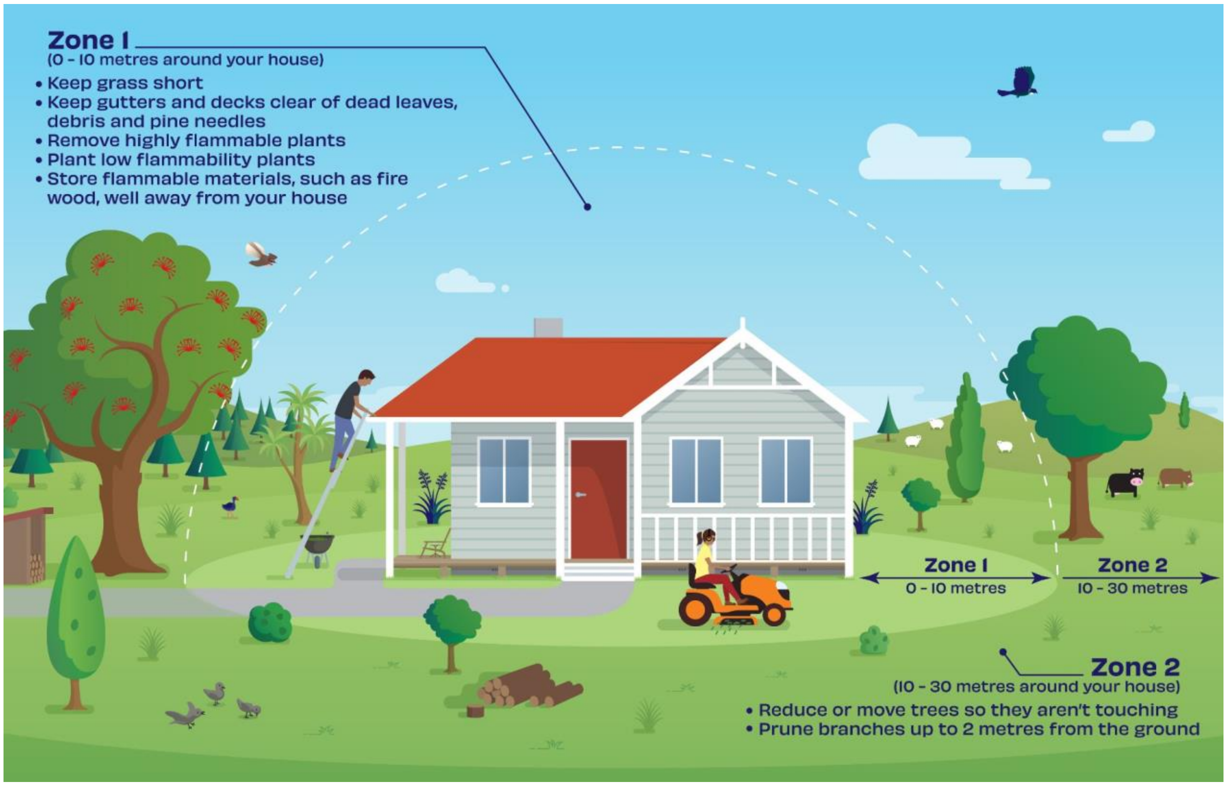

Figure 1. Recommended defensible zones around a structure (retrieved from FENZ, 2021)

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, particularly in high-risk areas, can significantly enhance a property's resilience against wildfires.

Results

After applying the risk matrix to properties in the Port Hills and urban areas, they were classified using a risk scale, ranging from low to high risk.

Property A on the Port Hills was identified as low-medium risk, with a score of 63. The combined factors of wood piles, decks, severe sloping, and close proximity to neighbors increased its fire risk. However, the property had an advanced sprinkler system, providing several mitigation credits, along with being well-maintained and having a minimal number of ignition fuels (refer to Appendix 2.1 – Table 1).

Property B on the Port Hills was also classified as low-medium risk, scoring 69. This was due to the presence of ignition fuels such as outdoor furniture and a pizza oven, as well as its sloping location. The spacing of vegetation further increased the risk due to areas of concentrated bush. Nevertheless, the property had good access to water, appropriate space for fire trucks, and inflammable paved areas, which reduced the risk (refer to Appendix 2.1 – Table 2).

Property E, the first flat analyzed, scored 65, classifying it as low-medium risk. Low maintenance of vegetation, cluttered guttering, and the impact of neighbors and the community contributed to the risk. While few variables were considered in the high-risk range, the house's proximity to structures within the 1m, 10m, and 30m distances was considerably high-risk. Several low-risk 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 presence of wooden structures further increased the risk. However, the brick construction of the house and the inflammable paved area at the back helped lower the score (refer to Appendix 2.1 – Table 4).

When comparing Rural-Urban Interface (RUI) properties with urban areas, there is notable variation in the results, which can be broken down into key factors:

- Fuel type and load: In RUI areas, fuel types and loads are often higher due to the presence of vegetation, while urban areas typically have lower fuel loads with more non-flammable infrastructure.
- Access and egress: Urban areas generally have well-established roads, facilitating quick emergency response, whereas RUI areas may have limited or obstructed access due to natural terrain, complicating firefighting efforts.
- Fire behavior: Fires in RUI properties are often more unpredictable due to natural landscapes, while urban fires tend to be more contained and mitigated more quickly due to clear fire breaks like roads and buildings.
- Infrastructure: Urban areas usually have better firefighting infrastructure, including hydrants and nearby fire stations, whereas RUI properties are more isolated and lack immediate fire suppression resources.

Defensible space plays a significant role in fire risk management. In the RUI properties analyzed, defensible spaces of 10 to 30 meters around structures were common, while urban properties, being more tightly packed, typically lacked large clear spaces, making fire spread between structures more likely.

The risk matrix used was specifically designed to assess property risk in RUI areas, considering the unique characteristics of these environments—such as larger defensible spaces, different fuel loads, and more challenging access routes. However, when applied to urban properties, the matrix did not fully capture the factors unique to urban environments. In terms of impact, urban properties had a good number of mitigation credits due to denser infrastructure, better access routes, and more fire suppression resources.

Discussion

How Defensible Space Influences Fire Behaviour: An Investigation at Lake Ōhau Village

Brief Overview of the 2020 Lake Ōhau Fire

To build an understanding of the concept of defensible space, the focus group examined the 2020 Lake Ōhau fire. The fire started on the 4th of October with an initial 111 call being made by a local dog walker at approximately 3am. The fire was caused by a fault in powerlines located several kilometers north from the main Ōhau township (FENZ, 2024). Typically, nightfall is good for fighting fires as local wind systems die down with atmospheric stability. However, on this night, this was not the case. Unfortunately, the topography of an alpine basin paired with unstable conditions experienced on this evening, caused strong downslope winds to travel across the lake at speed towards the village, spreading the fire at a rapid rate. Over 5000 hectares of land was damaged and just under 50% (48/100) homes were lost (FENZ, 2024). Thankfully, no one lost their lives.

The characteristics of the fire were patchy and ember driven. Most buildings that were exposed to embers and didn't have firefighter intervention, typically ended up damaged. The main reasons a house survived this fire was down to four key reasons:

1. Embers not landing near the property because it wasn't as exposed on the fire front
2. Firefighter intervention stopped it form escalating
3. Micro reasons within a property (green grass patches stopped ember, concrete prevented it)
4. Luck was also a factor

Fuels and Defensible Space at Lake Ōhau

Firefighters involved in the investigation of the fire identified many key sources of fuel around properties. These included things such as wooden decks and firewood stacked close to the house which acted as failure modes, causing houses to catch fire. Secondly, dry grasses/vegetation that 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 image shows where the fire burnt. The other images show significant burning of fuels up against the house. Photos supplied by FENZ, (2024).

Figure 5 below shows a property that also survived. However, this house is an extreme example of 'defensible space' given that was ¾ scraped bare and had no receptive vegetation, with the other quarter being green grass (not receptive to embers). The house received significant radiant heat from the property next door which was fully lost (as shown by the melted downpipes and broken double glazed windows).

Figure 5. Post fire images of property D at Lake Ōhau with significant defensible space. The red arrow indicates the direction that the fire travelled in. Photos supplied by FENZ, (2024).

Whilst some houses with fully vegetated areas and very minimal defensible space zones survived the fire, it is important to note that it was likely due to firefighter intervention. This shows how significant defensible spaces are at reducing fire risk and damage to properties. Sometimes, 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 Future Recommendations

The project offered valuable insights in terms of understanding defensible space at rural urban interfaces, however there were several limitations. The 12-week period was a relatively short amount of time to develop initial ideas in terms of GIS mapping and remote sensing data, and the limited skill range available within the research group made it unviable.

During data collection, several limitations arose regarding the availability and quality of localised data, specifically for Ōhau properties, as minimal pre-fire records were available. Reliance on FENZ data was necessary to fill the matrix due to the inability to visit Ōhau in person. Data collection was also inconsistent throughout the project; while the Port Hills properties were assessed collectively, the flat properties were assessed individually. This introduced a level of uncertainty in the data collected from these properties, as the perception of risk is subjective, and having only one opinion may have affected the results gathered.

Our aspirations for the project and risk matrix are widespread. Currently, there are no policies implemented into the Resource Management Act (RMA) that ensures property owners must have defensible space zones around their property. As already outlined in this report, neighbouring houses can have a significant effect on your own property and hinder your defensible space. For example, having policies in place to eliminate or restrict pine/wild vegetation plantations from being too close to nearby houses such as those on Worsely's Road. Or having set distances that large plantations must be from urban areas, would significantly reduce fire risk, especially at RUI boundaries.

With more time and funding invested into this project, it would allow for further data to be analysed and inputted into the matrix such as comprehensive GIS analysis of defensible space on a national scale. Furthermore, having the contribution of the fire weather index to strengthen the weather and climate section of the risk matrix would also be beneficial. As shown below in Figure 6, Canterbury experiences the greatest number of fire weather days in the country (Brody-Heine et al., 2023), which is why having a strong understanding of how weather and climate can influence fire behaviour, is critical for the risk matrix.

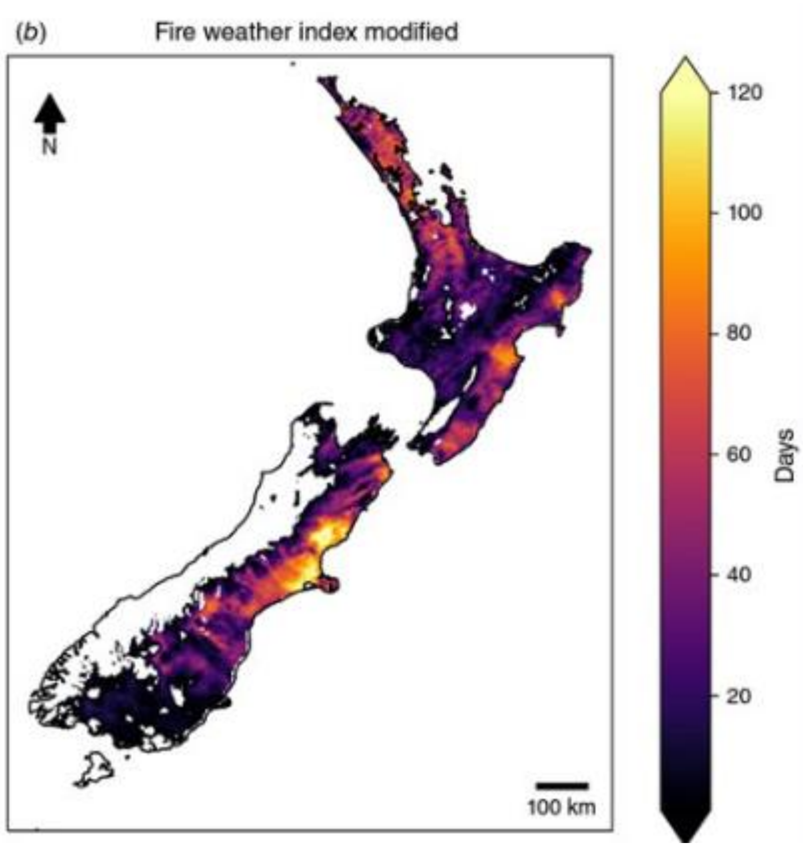

Figure 6. Fire weather index map of New Zealand. Areas in yellow highlight regions that experience significant fire weather such as strong winds and droughts. Areas in white experience very little fire weather due to heavy rainfall. Christchurch, and the wider Canterbury Region experience significantly more fire weather days than any other area in the country. Retrieved from Brody-Heine et al. (2023).

One key learning from this project was regarding sprinkler systems. Most sprinkler systems are made from plastic pipes which can melt from fire or radiant heat. This project highlights the need for further technological developments such as fire-resistant sprinkler systems to improve their effectiveness.

It is also important to increase public education and awareness about fire hazards, especially in Canterbury where dry weather is prominent during summer months. Very few people understand the terms ‘defensible space’ and ‘RUI’.

Conclusion

This project investigated how defensible space can reduce fire risk at rural-urban interfaces with a key focus on Worsley's Road, located on the Port Hills. This project took the opportunity to create a risk matrix that homeowners can use to identify and rate their defensible space. It was deemed essential to create a risk matrix as there was no resource like this that could be applied in New Zealand. The hope of this research is to spark further investigation into this area within New Zealand and advises any other researchers who wish to work in this space, to consider the limitations and recommendations that this report outlines to strengthen their research.

Acknowledgements

We would like to express our thanks to all of those involved in this project. Thank you to our Fire and Emergency community partners Grant Pearce and Wayne Hamilton for all your support and wealth of knowledge that you shared with us. Thank you to Ben Fairweather for showing us the Ōhau GIS datasets so we could further our understanding of defensible space at a different RUI location. Thank you to our project supervisor Marwan Katurji for offering advice and ensuring our project was being steered in the right direction. Lastly, we would like to say a huge thank you to the members of the public living on Worsley's Road who so kindly let us visit their properties and fully immersed themselves in our research, despite the fires being a traumatic event for them to revisit and talk about. We couldn't have done this without all of you.

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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.

Figure 2. Sprinkler system on the rear of Property A on the Port Hills. Sprinklers could wet the wooden slats on the sides of the house to prevent them from burning in a fire.

1.2 Port Hills Property B

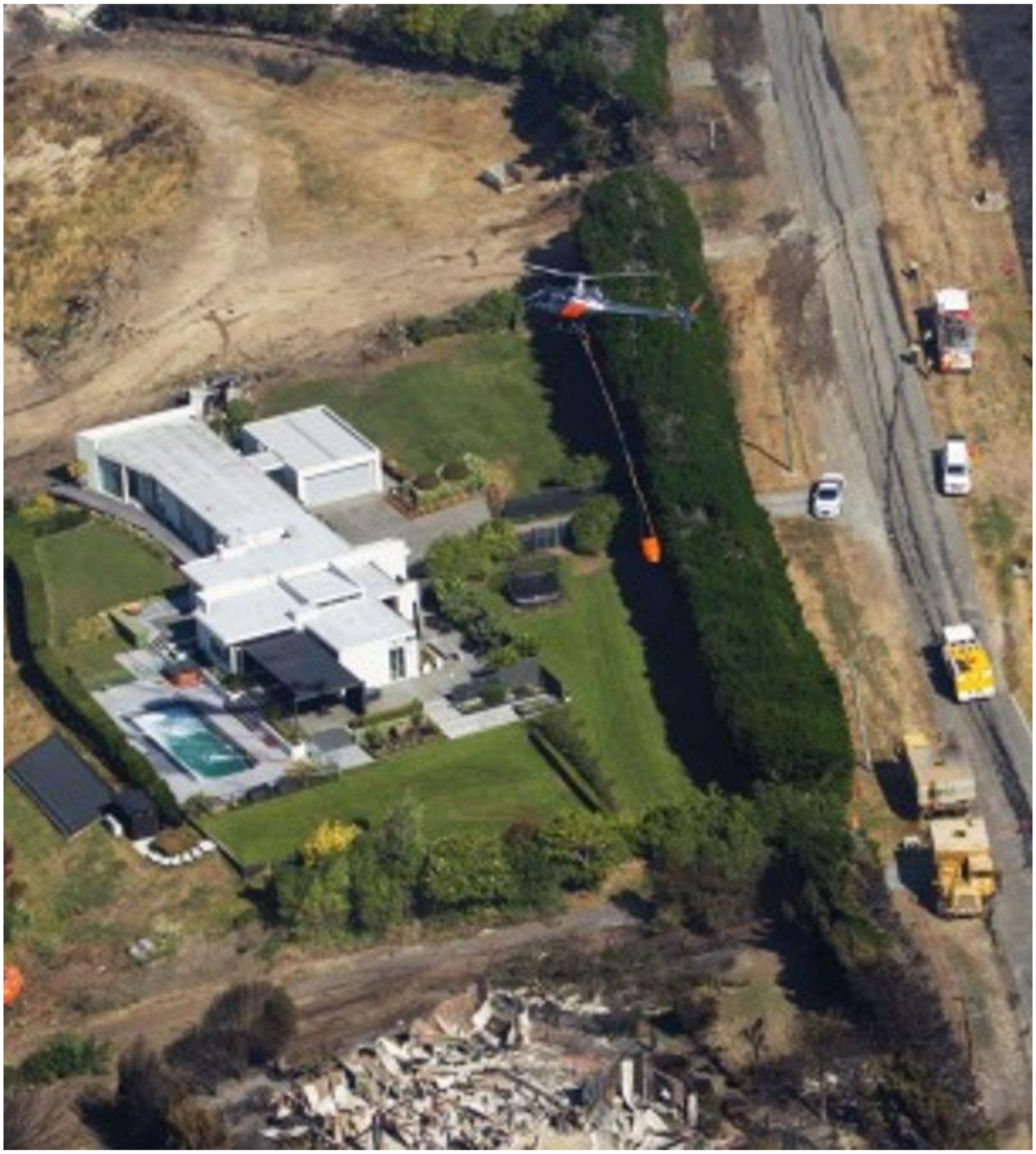

Figure 3. Aerial shot of Property B on the Port Hills. The swimming pool was actively used by helicopters to mitigate the fire and reduce the spread.

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, outdoor furniture	1-3	4-6	7-9	2
- Maintenance ie leaves	1-3	4-6	7-9	1
- Wooden structures ie wood pile, fences, decks	1-3	4-6	7-9	7
(Fuels) Vegetation				
- Flammability	1-3	4-6	7-9	4
- Clumping/spacing of vegetation	1-3	4-6	7-9	3
- Proximity to structures (1m, 10m, 30m)	1-3	1-3	1-3	3, 1, 3
Other Fire Behaviour Factors				
- Slope	2-4	5-7	8-10	10
- Climate	2-4	5-7	8-10	8
Infrastructure				
- Building material	1-3	4-6	7-9	5
Community & Neighbours	2-4	5-7	8-10	8
Mitigation Credits / Defendability	**Good**	**Medium**	**Bad**	
- Access to water / water availability	1-3	4-6	7-9	1
- Sprinkler	1-3	4-7	8-10	1
- Water tanks/Pool	1-3	4-6	7-9	1
- Reticulated water	1-3	4-6	7-9	1
- Driveways (access for firefighters/trucks 4x4)	1-3	4-7	8-10	1
- Paved / Gravel (inflammable area)	1-3	4-6	7-9	3
SCORE				**63**

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

Variables	Low risk	Medium risk	High risk	SCORE
Fuels				
- Ignition sources ie hot tub, pizza oven, outdoor furniture	1-3	4-6	7-9	9
- Maintenance ie leaves	1-3	4-6	7-9	1
- Wooden structures ie wood pile, fences, decks	1-3	4-6	7-9	7
(Fuels) Vegetation				
- Flammability	1-3	4-6	7-9	4
- Clumping/spacing of vegetation	1-3	4-6	7-9	7
- Proximity to structures (1m, 10m, 30m)	1-3	1-3	1-3	1, 3, 3
Other Fire Behaviour Factors				
- Slope	2-4	5-7	8-10	10
- Climate	2-4	5-7	8-10	8
Infrastructure				
- Building material	1-3	4-6	7-9	2
Community & Neighbours	2-4	5-7	8-10	6
Mitigation Credits / Defendability	**Good**	**Medium**	**Bad**	
- Access to water / water availability	1-3	4-6	**7-9**	1
- Sprinkler	1-3	4-7	8-10	3
- Water tanks/Pool	1-3	4-6	7-9	1
- Reticulated water	1-3	4-6	7-9	1
- Driveways (access for firefighters/trucks 4x4)	1-3	4-7	8-10	1
- Paved / Gravel (inflammable area)	1-3	4-6	7-9	1
SCORE				**69**

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

Variables	Low risk	Medium risk	High risk	SCORE
Fuels				
- Ignition sources ie hot tub, pizza oven, outdoor furniture	1-3	4-6	7-9	3
- Maintenance ie leaves	1-3	4-6	7-9	8
- Wooden structures ie wood pile, fences, decks	1-3	4-6	7-9	2
(Fuels) Vegetation				
- Flammability	1-3	4-6	7-9	3
- Clumping/spacing of vegetation	1-3	4-6	7-9	6
- Proximity to structures (1m, 10m, 30m)	1-3	1-3	1-3	3,3,2
Other Fire Behaviour Factors				
- Slope	2-4	5-7	8-10	2
- Climate	2-4	5-7	8-10	2
Infrastructure				
- Building material	1-3	4-6	7-9	2
Community & Neighbours	2-4	5-7	8-10	7
Mitigation Credits / Defendability	**Good**	**Medium**	**Bad**	
- Access to water / water availability	1-3	4-6	7-9	3
- Sprinkler	1-3	4-7	8-10	4
- Water tanks/Pool	1-3	4-6	7-9	7
- Reticulated water	1-3	4-6	7-9	4
- Driveways (access for firefighters/trucks 4x4)	1-3	4-7	8-10	3
- Paved / Gravel (inflammable area)	1-3	4-6	7-9	1
SCORE				65

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

Variables	Low risk	Medium risk	High risk	SCORE
Fuels				
- Ignition sources ie hot tub, pizza oven, outdoor furniture	1-3	4-6	7-9	2
- Maintenance ie leaves	1-3	4-6	7-9	8
- Wooden structures ie wood pile, fences, decks	1-3	4-6	7-9	6
(Fuels) Vegetation				
- Flammability	1-3	4-6	7-9	5
- Clumping/spacing of vegetation	1-3	4-6	7-9	5
- Proximity to structures (1m, 10m, 30m)	1-3	1-3	1-3	2,3,3
Other Fire Behaviour Factors				
- Slope	2-4	5-7	8-10	2
- Climate	2-4	5-7	8-10	2
Infrastructure				
- Building material	1-3	4-6	7-9	2
Community & Neighbours	2-4	5-7	8-10	5
Mitigation Credits / Defendability	**Good**	**Medium**	**Bad**	
- Access to water / water availability	1-3	4-6	7-9	3
- Sprinkler	1-3	4-7	8-10	7
- Water tanks/Pool	1-3	4-6	7-9	9
- Reticulated water	1-3	4-6	7-9	3
- Driveways (access for firefighters/trucks 4x4)	1-3	4-7	8-10	4
- Paved / Gravel (inflammable area)	1-3	4-6	7-9	1
SCORE				**72**