

**Bushfire Risk Assessment
Creswick Township Structure Plan**



December 2022

Bushfire Risk Assessment for Creswick Township Structure Plan

December 2022

Report by Daniel Casullo and Julian Drummond

Mapping by Ali Nia and Julian Drummond

PRACTICAL ECOLOGY Pty Ltd

ACN: 082 911 377 ABN: 88 082 911 377

PO Box 228 Preston VIC 3072

(2B Stott Street Preston Vic 3072)

P: 9484 1555F: 9484 9133

www.practicalecology.com.au

Prepared for: Hepburn Shire Council
 Contact: Caroline Reisacher
 Strategic Planner
 Hepburn Shire Council
 PO Box 21, Daylesford, Victoria, 3460
 T: 03 53216154
 E: creisacher@hepburn.vic.gov.au

PE project number: HEP 3413
 PE file location: R:\Hepburn\Creswick Township Structure
 Plan Bushfire Assessment

Version	Date	Authors	Reviewer:	Version notes
0.0	29/06/2022		Julian Drummond	Pre-draft internal review
0.1	29/06/2022	Daniel Casullo & Julian Drummond	Caroline Reisacher	Draft for Hepburn Shire Council
0.2	21/12/2022		Caroline Reisacher	Updated in response to CFA comments
1.0	22/12/2022			Final for Hepburn Shire Council

© Copyright

Unless otherwise agreed in writing, this report is the intellectual property of Practical Ecology Pty Ltd. It is designed to be used exclusively by the person or organisation that commissioned it. Permission must be sought prior to reproduction of any portion of this document, and every effort made to ensure proper referencing of this document.

Contents

1.	INTRODUCTION	7
1.1	Scope	7
1.2	Clause 13.02–1S Bushfire Planning	8
1.3	Bushfire Risk Determination	11
1.3.1	Low Risk/Hazard	12
1.3.2	Medium Risk/Hazard	13
1.3.3	High Risk/Hazard	14
1.4	Limitations	15
2.	DISTRICT BUSHFIRE RISK ASSESSMENT	17
2.1	Clunes	17
2.1.1	Landscape	17
2.1.2	Bushfire history	17
2.1.3	Evacuation and refuge	18
2.1.4	Potential bushfire scenarios and conditions	18
2.2	Creswick	20
2.2.1	Landscape	20
2.2.2	Bushfire history	20
2.2.3	Evacuation and refuge	20
2.2.4	Potential bushfire scenarios and conditions	20
2.3	Daylesford and Hepburn Springs	22
2.3.1	Landscape	22
2.3.2	Bushfire history	22
2.3.3	Evacuation and refuge	22
2.3.4	Potential bushfire scenarios and conditions	22
2.4	Trentham	24
2.4.1	Landscape	24
2.4.2	Bushfire history	24
2.4.3	Evacuation and refuge	24
2.4.4	Potential bushfire scenarios and conditions	24
2.5	Discussion and conclusions	26
3.	INVESTIGATION AREA 2A	27
3.1	Bushfire Hazard Landscape Assessment	28
3.1.1	Local landscape	28
3.1.2	Wider landscape	28
3.1.3	Bushfire History	29
3.1.4	Landscape bushfire scenarios	29
3.2	Ground–truthing Assessment	29
3.2.1	Observed conditions	29
3.2.2	Access	30
3.3	Victorian Fire Risk Register	30
3.4	Site analysis	30
3.5	Summary of Findings and Recommendations	39
4.	INVESTIGATION AREA 2B	41
4.1	Bushfire Hazard Landscape Assessment	41
4.1.1	Local landscape	42
4.1.2	Wider landscape	42
4.1.3	Bushfire History	42
4.1.4	Landscape bushfire scenarios	43
4.2	Ground–truthing Assessment	43

4.2.1	Observed conditions	43
4.2.2	Access	44
4.3	Victorian Fire Risk Register	44
4.4	Site analysis	44
4.5	Summary of Findings and Recommendations	52
5.	INVESTIGATION AREA 3A	53
5.1	Bushfire Hazard landscape assessment	53
5.1.1	Local landscape	54
5.1.2	Wider landscape	54
5.1.3	Bushfire History	55
5.1.4	Landscape bushfire scenarios	55
5.2	Ground-truthing Assessment	55
5.2.1	Observed conditions	55
5.2.2	Access	56
5.3	Victorian Fire Risk Register	56
5.4	Site analysis	57
5.5	Summary of Findings and Recommendations	65
6.	INVESTIGATION AREA 3B	67
6.1	Bushfire Hazard Landscape Assessment	67
6.1.1	Local landscape	68
6.1.2	Wider landscape	68
6.1.3	Bushfire History	69
6.1.4	Landscape bushfire scenarios	69
6.2	Ground-truthing Assessment	69
6.2.1	Access	70
6.3	Victorian Fire Risk Register	70
6.4	Site analysis	70
6.5	Summary of Findings and Recommendations	79
7.	INVESTIGATION AREA 3C	80
7.1	Bushfire Hazard Landscape Assessment	80
7.1.1	Local landscape	81
7.1.2	Wider landscape	81
7.1.3	Bushfire History	82
7.1.4	Landscape bushfire scenarios	82
7.2	Ground-truthing Assessment	82
7.2.1	Observed conditions	82
7.2.2	Access	83
7.3	Victorian Fire Risk Register	83
7.4	Site analysis	83
7.5	Summary of Findings and Recommendations	90
8.	INVESTIGATION AREA 3D	91
8.1	Bushfire Hazard Landscape Assessment	92
8.1.1	Local landscape	92
8.1.2	Wider landscape	92
8.1.3	Bushfire History	93
8.1.4	Landscape bushfire scenarios	93
8.2	Ground-truthing Assessment	93
8.2.1	Observed conditions	93
8.2.2	Access	94
8.3	Victorian Fire Risk Register	94
8.4	Site analysis	94

8.5	Summary of Findings and Recommendations	103
9.	REFERENCES	104
APPENDIX 1. FUEL HAZARD ASSESSMENTS		105
TABLES		
Table 1.	Defendable space requirements.	29
Table 2.	Defendable space requirements.	43
Table 3.	Defendable space requirements.	56
Table 4.	Defendable space requirements.	69
Table 5.	Defendable space requirements.	83
Table 6.	Defendable space requirements.	93
Table 7.	Fuel Load Assessments	106
FIGURES		
Figure 1.	Figure 1. Risk management process as per ISO 31000:2018	12
Figure 2.	Bushfire Hazard Landscape Assessment for Clunes	19
Figure 3.	Bushfire Hazard Landscape Assessment for Creswick	21
Figure 4.	Bushfire Hazard Landscape Assessment for Daylesford and Hepburn Springs	23
Figure 5.	Bushfire Hazard Landscape Assessment for Trentham	25
Figure 6.	Planning zones within and surrounding Investigation Area 2a	27
Figure 7.	Landscape surrounding Investigation Area 2a	28
Figure 8.	Bushfire Hazard Landscape Assessment for Investigation Area 2a	35
Figure 9.	Observed Conditions within Investigation Area 2a	36
Figure 10.	Determined Bushfire Risks within Investigation Area 2a	37
Figure 11.	Determined Bushfire Hazards within Investigation Area 2a	38
Figure 12.	Investigation Area 2b zoning	41
Figure 13.	Landscape surrounding Investigation Area 2b	42
Figure 14.	Bushfire Hazard Landscape Assessment within Investigation Area 2b	48
Figure 15.	Observed conditions within Investigation Area 2b	49
Figure 16.	Determined Bushfire Risks within Investigation Area 2b	50
Figure 17.	Determined Bushfire Hazards within Investigation Area 2b	51
Figure 18.	Investigation Area 3a	53
Figure 19.	Landscape surrounding Investigation Area 3a	54
	61	
Figure 20.	Bushfire Hazard Landscape Assessment within Investigation Area 3a	61
	62	
Figure 21.	Observed conditions within Investigation Area 3a	62
Figure 22.	Determined Bushfire risks within Investigation Area 3a	63
Figure 23.	Determined Bushfire Hazards within Investigation Area 3a	64

Figure 24.	Investigation Area 3b	67
Figure 25.	Landscape surrounding Investigation Area 3b	68
Figure 26.	Bushfire Hazard Landscape Assessment within Investigation Area 3b	75
Figure 27.	Observed conditions within Investigation Area 3b	76
Figure 28.	Determined bushfire risks within Investigation Area 3b	77
Figure 29.	Determined bushfire hazards within Investigation Area 3b	78
Figure 30.	Investigation Area 3c zoning.	80
Figure 31.	Landscape surrounding Investigation Area 3c	81
Figure 32.	Bushfire Hazard Landscape Assessment within Investigation Area 3c	86
Figure 33.	Observed conditions within Investigation Area 3c	87
Figure 34.	Determined bushfire risks within Investigation Area 3c	88
Figure 35.	Determined bushfire hazards within Investigation Area 3c	89
Figure 36.	Zoning surrounding and within Investigation Area 3d.	91
Figure 37.	Landscape surrounding Huntly East	92
Figure 38.	Bushfire Hazard Landscape Assessment within Investigation Area 3d	99
Figure 39.	Observed conditions within Investigation Area 3d	100
Figure 40.	Determined bushfire risks within Investigation Area 3d	101
Figure 41.	Determined bushfire hazard within Investigation Area 3d	102

1. INTRODUCTION

Practical Ecology have been commissioned by Hepburn Shire Council to provide bushfire consultancy services as to inform the Creswick Township Structure Plan. It is understood that the Minister for Planning has approved the Hepburn Shire C80Hepb Planning Scheme Amendment. As such, Hepburn Shire Council is now looking to progress Township Structure Plans for the Townships of Creswick, Clunes, Daylesford/Hepburn Springs and Trentham. The following assessment will focus on Investigation Areas 2 and 3 of the Creswick Structure Plan.

With regard to the management of bushfire risk, the Structure Plan that is prepared will need to consider the sweeping changes to policy and statutory controls related to managing bushfire risk across Victoria that were made following the 2009 Bushfire Royal Commission. These changes were built around the principle that the prioritisation of human life takes precedent over all other planning considerations. Other important policy considerations flowing from this determination were that:

- the Township of Creswick was the most suitable for expansion considering the bushfire hazards across Hepburn Shire;
- future growth should be directed to lower risk locations in the first instance;
- where there is risk from bushfire, measures needed to be put in place to mitigate that risk; and
- areas of future growth need to be able to achieve a radiant heat flux of less than 12.5 kilowatts per square metre (BAL-12.5)

The findings of this assessment will subsequently inform the contents of the Structure Plan by identifying the scale of bushfire risk present across the Investigation Areas which would then influence which areas are likely to be ruled out from further consideration or identify areas or identify areas for further investigation as a Growth Area.

1.1 Scope

The overall purpose of this Bushfire Risk Assessment is to:

- review the bushfire across Hepburn Shire to establish whether Creswick is the most suitable for further expansion
- determine the bushfire risks within each of the Investigation Areas
- provide recommendations regarding proposed development in these areas, and
- provide an indication of policy and legislative implications of future development within these areas.

In order to respond to the above objectives, the process as listed below was followed:

- a desktop review of the landscape bushfire conditions across Hepburn Shire to determine the bushfire hazards present and determine whether the proposed expansion with Creswick was appropriate compared to other towns.

- a desktop review of information relevant bushfire risk prior to ground-truthing of Creswick, inclusive of:
 - determining the likely vegetation types, fuel loads and slopes present within each Investigation Area from available desktop information; identifying potential mechanisms to achieve Bushfire Attack Level (BAL) 12.5 ratings for proposed infrastructure to meet the requirements of relevant bushfire related policy; and reviewing State Planning Policy at Clause 13.02–1S in particular, and determining the implication of this Clause within each of the Investigation Areas
 - preliminary mapping of each Investigation Area with available desktop-based information to initiate the process of site-based ground-truthing
- ground-truthing of information collated during the desktop review to refine data, which focussed on:
 - confirming vegetation types and fuel load levels based on *Australian Standards 3959–2018: Construction of Buildings in Bushfire Prone Areas* (AS3959–2018); confirming slopes; undertaking strategic fuel load assessments as per the *Overall Fuel Hazard Assessment Guide* (Hines *et al.* 2010); and identifying the feasibility of implementing mechanisms to reduce bushfire risk.
- reporting and mapping to:
 - outline the methods implemented and present the findings of the desktop review process and results of ground-truthing
 - provide an overview of the policy and legislation that that forms the basis for decisions and approvals as they relate to bushfire risk at Commonwealth and State levels
 - identify opportunities and constraints associated with potential future development within Hepburn Shire and each of the Investigation Areas within Creswick.
 - provide recommendations to balance future development with pre-determined ecological values and bushfire risk, and highlight the suitability of each Investigation Area for future development.

1.2 Clause 13.02–1S Bushfire Planning

This Clause is specifically relevant to this study and future development within the Investigations Areas, particularly in relation to directing population growth and development to low-risk locations.

The primary objective of this Clause is to strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life. This is achieved through assessing applications against multiple strategies, one of these include the ‘Use and development control in a Bushfire Prone Area’ and states that the following uses need to consider bushfire risk at the planning level:

- subdivisions of more than 10 lots
- accommodation
- childcare centre

- education centre
- emergency services facility
- hospital
- indoor recreation facility
- major sports and recreation facility
- place of assembly
- any application for development that will result in people congregating in large numbers.

When assessing a planning permit application for the above uses and development it is necessary to:

- Consider the risk of bushfire to people, property and community infrastructure
- Require the implementation of appropriate bushfire protection measure to address the identified bushfire risk
- Ensure new development can implement bushfire protection measure without unacceptable biodiversity impacts

As bushfire analysis of the Investigation Areas is predominantly about establishing residential areas and associated facilities, the majority of the developments stemming from this strategy will need to address the provisions of Clause 13.01–1S. The other strategies within this Clause include:

- protection of human life
- bushfire hazard identification and assessment
- settlement planning
- areas of biodiversity conservation value
- policy guidelines
- policy documents.

The ways in which each of the strategies in Clause 13.01–1S have been addressed by this current study, and are expected to also be through future planning as outlined below.

Relevance to this study

The protection of human life forms the basis of this study as it has related to bushfire risk, by providing recommendations that aim to outline the kinds of development which can safely and responsibly proceed within the Investigation Areas being considered.

The requirements under ‘bushfire hazard identification and assessment’ can and have also been addressed through the assessment approach completed as part of this study. ‘Areas of biodiversity conservation value’ have and are being considered by the ecological assessment being undertaken separately as part of the structure plan. This overall study addressing bushfire risk is expected to influence subsequent strategic documents associated with the Investigation Areas from this point forward, such that to an extent the requirements of ‘policy guidelines and documents’ of Clause 13.02–1S is also addressed to a degree by this study.

‘Settlement planning’ is designed to promote higher resilience in new and existing settlements through planning and the prioritisation of the protection of human life. Addressing this strategy at this current point as part of this study is therefore essential to ensure that the types of development being proposed within Creswick are appropriate with the hazards present here and in other towns and within each proposed Growth Area are appropriate for the hazards present. The key points to address with regard to settlement planning are as follows:

- directing population growth and development to low-risk locations, being those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959–2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia 2018)
- ensuring the availability of, and safe access to, areas assessed as a BAL-LOW rating under AS 3959–2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia 2018) where human life can be better protected from the effects of bushfire
- ensuring the bushfire risk to existing and future residents, property and community infrastructure will not increase as a result of future land use and development
- achieving no net increase in risk to existing and future residents, property and community infrastructure, through the implementation of bushfire protection measures and where possible reducing bushfire risk overall
- assessing and addressing the bushfire hazard posed to the settlement and the likely bushfire behaviour it will produce at a landscape, settlement, local, neighbourhood and site scale, including the potential for neighbourhood-scale destruction
- assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis
- not approving any strategic planning document, local planning policy, or planning scheme amendment that will result in the introduction or intensification of development in an area that has, or will on completion have, more than a BAL-12.5 rating under AS 3959–2018 Construction of Buildings in Bushfire-prone Areas (Standards Australia 2018).

The above have largely formed the basis for recommendations presented as part of this study related to bushfire risk. This includes ensuring that Creswick is the most appropriate location for the expansion proposed when other towns within Hepburn Shire are considered and ensuring all developments within each Investigation Area can achieve BAL-12.5 through ensuring there are setbacks guaranteed through managed road reserves and/or managed setbacks, but this is only a small part of it. The assessment of the other Townships within Hepburn Shire is from a bushfire perspective only but will need to consider items apart from adjacent bushfire hazards.

Things such as access to infrastructure and utilities, the zoning present and the existing size of the communities also need to be considered. This will ensure that we can find the right balance between mitigating the bushfire hazard and ensuring the developed communities are one’s people want to settle in. It is important to note that although Creswick has been identified as the township most likely to absorb residential growth in the shire, other key towns and settlements will also experience pressure for expansion and growth in the future and will also need more detailed bushfire risk assessments.

Recommending that an area within Creswick is developed into higher density residential or similar means ensuring that access in and out is readily available, and that there is a broader connection to other residential areas which can therefore be considered BAL-LOW. Although, this can also be attained through developing larger areas which become BAL-LOW as a result. The provision of development within land adjacent to existing settlements also has the potential to reduce the overall risk through associated reduction in fuel loads and upgrade of road network.

However, the risk to adjacent areas also has to be considered since, even though denser residential development normally results in a managed terrain which will not support a fire, a higher population means more people need to be evacuated, which can cause associated resources to become stretched. If the risk to an existing residential area is already considered high, then adding another development to an area with similar risk levels increases the hazard to both areas, which may be considered unacceptable. Developing at lower densities or different uses, and/or directing the population away from currently strained areas in the case of an emergency, could be used to reduce this hazard.

An area where the risk is too high to support higher density populations does not mean no development can occur. Lower-density residential properties, urban/rural interfaces such as smaller farming properties and industrial developments can be proposed. The provision of development within land adjacent to existing settlement also has the potential to reduce the overall risk through associated reduction in fuel loads and upgrade of road network.

Such development provides a reason to provide the required infrastructure, meaning that some fuel management will occur, and there will be a lower population which can be quickly evacuated without increasing the strain on adjacent areas. Some areas will still be too high-risk to recommend certain types of development, and recommendations made in this study have identified these accordingly. These areas can still provide for growth, though must be appropriate for the present risk and therefore may mean that high-density residential developments are not suitable.

These points are further explored in subsequent sections of this report, and form the basis for assessing the planning requirements of each of the Investigation Areas and providing recommendations for future use and management of these areas.

1.3 Bushfire Risk Determination

The Investigation Areas were divided into sub-sections or areas based on the observed risk/existing conditions weighed against the ecological constraints determined alongside this assessment. These smaller areas were determined through observed changes in the land usage and the likely bushfire conditions which would be present. Hazards were identified through the International Standards Organisation's (ISO) 31000 – Risk management – Guidelines (2018) in order to provide the best possible risk identification and response (see Figure 1).

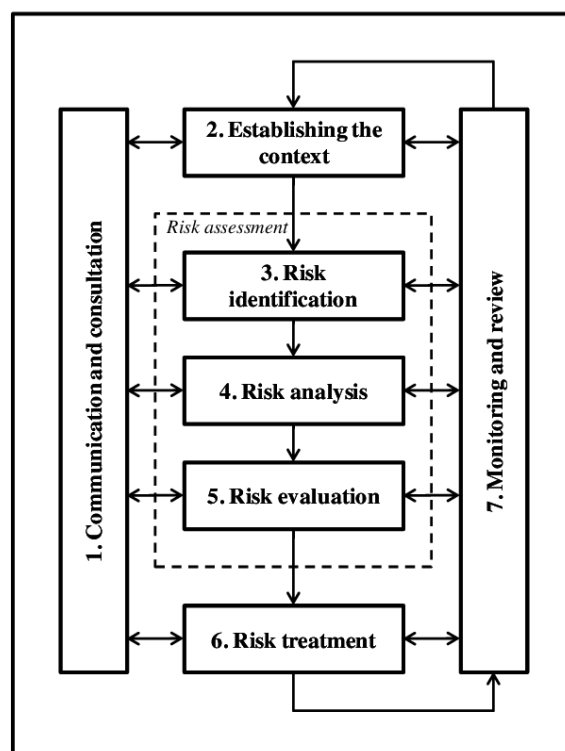


Figure 1. Figure 1. Risk management process as per ISO 31000:2018

An area's risk is how threatened it is from a bushfire (the chances of a bushfire igniting there and the potential impacts of the area burning) while the hazard is the danger posed to adjacent areas from the area itself (what are the chances of this area igniting and how will it impact the surroundings).

The risk and hazard categories; Low, Medium and High were determined through the following criteria which, ideally, can be applied to other areas in future to determine the appropriate development and usages. The criteria for each category are detailed below:

1.3.1 Low Risk/Hazard

This category is applied to areas where there can be minimal restrictions on the types of development proposed within it. Areas in this category can consider risk and hazard simultaneously since the chances of them igniting and sustaining a bushfire which cannot be addressed before it threatens adjacent areas is low. These should not require any planning or additional management which cannot be addressed through subsequent planning applications. The criteria for an area to be considered Low Risk are as follows:

1. At least three of the following statements regarding bushfire risk can be considered accurate:
 - the area cannot be directly subjected to the determined primary bushfire threat or threats to the overall Growth Area
 - the area has been urbanized with high-density residential development and associated infrastructure, and/or commercial development
 - the area is managed for purposes other than conservation and is either predominately free of vegetation or is actively managed (farmland, industrial areas, larger residential properties, etc.)

- less than 20% of this area contains classified vegetation other than Grassland as per AS3959-2018
- the area has good access and/or the high potential for access; the potential for access is determined through the area's ability to accommodate a full road network with multiple entry points and clear egress to more developed areas
- the area is not within the Bushfire Management Overlay and is not likely to be placed within the Bushfire Management Overlay based on this assessment.

Particular combinations of the above statements being considered to not apply to a Investigation Area can potentially result in a Medium Risk/Hazard rating. We therefore recommend considering the Medium Risk/Hazard criteria as the default, before considering the area High or Low Risk.

2. The area does not contain any ecological values of high quality or significance, as determined by a qualified Ecologist or similar environmental professional that could pose a significant bushfire threat
3. The area is not adjacent to another area which has a Medium or High hazard rating or is considered large enough to mitigate the hazard generated from the adjacent. Areas which do not meet this criteria should be considered Medium or High Risk but should not be considered anything above Low Hazard since the hazard is not coming from this area.

The criteria for an area to be considered a Low Hazard are as follows:

1. A bushfire cannot move into the area from the adjacent landscape under prevailing conditions (determined through landscape scale assessments).
2. The area is deemed to be too small to sustain a bushfire from a localised ignition and/or contains too much managed vegetation to sustain a bushfire.
3. There is access present through vegetated areas which can be utilised by emergency services.

1.3.2 Medium Risk/Hazard

Medium Risk areas have a clearly defined risk which can be addressed. These areas will receive the most recommendations in regard to proposed usage and measures which should be incorporated into subsequent planning applications as they will be expected to act as a buffer between the Low Risk and High Hazard areas (the full extent of this buffer will need to be defined on a case-by-case basis).

It should be noted that a Medium Risk/Hazard rating cannot always be brought down to Low Risk/Hazard as it may not be possible to remove the feature which creates this rating (placement within surrounding vegetation, high value habitat present, limited access, etc.). Note that some areas which have been classified as High Risk/Hazard could be reduced to Medium due if the risk/hazard can be managed in perpetuity.

The criteria for an area to be considered Medium Risk are as follows:

1. ANY of the following statements regarding bushfire risk can be considered accurate:
 - The area can be directly subjected to a full bushfire front from classified vegetation other than Grassland as per AS3959–2018.
 - There is sufficient vegetation within the area that a bushfire could develop based on a localized ignition.
 - The area is adjacent to densely vegetated areas on more than one aspect.
 - The area has a High to Very High–Risk Rating within the VFRR.

AND, at least one of the statements below can be considered accurate:

- The area is predominately vacant due to the presence of public land, farmland or largely unoccupied residential or rural areas.
 - The majority of the area is managed and/or the vegetation present is present within residential areas.
 - The area has good access and/or the high potential for access. The potential for access is determined through the area’s ability to accommodate a full road network with multiple entry points and clear egress to more developed areas.
 - The area is separated from adjacent areas which carry a Medium or High Hazard rating either by managed vegetation or by a Low Hazard area
2. The area contains any ecological values of high quality or significance, as determined by a qualified Ecologist or similar environmental professional.

The criteria for an area to be considered a Medium Hazard are as follows:

1. A bushfire has the potential to move into the area through this area under prevailing conditions (determined through the landscape scale assessments).
2. The area contains sufficient vegetation to sustain a large fire from a localised ignition.
3. There is access present through vegetated areas which can be utilised by emergency services.

1.3.3 High Risk/Hazard

High Risk/Hazard areas are designed to identify areas where the risk is considered extreme or there are factors which prevent it from being addressed. Our primary goal with these areas is to reduce them to Medium Risk as opposed to Low Risk as the amount of management and works required to achieve this is not considered feasible and the reasons an area was considered High Risk need to be remembered and addressed in perpetuity.

Some areas cannot be reduced from High Risk/Hazard however due to their status as public land managed for conservation which works from this perspective since these areas will not be developed.

The criteria for an area to be considered High Risk are as follows:

1. MORE THAN ONE of the following statements regarding bushfire risk can be considered accurate:
 - the area can be directly subjected to a full bushfire front from classified vegetation other than Grassland as per AS3959–2018
 - there is sufficient vegetation within the area that a bushfire could develop based on a localised ignition
 - the area is adjacent to densely vegetated areas on more than one aspect
 - the area has a Very–High to Extreme–Risk Rating within the VFRR.

AND, none of the statements below can be considered accurate:

- the area is predominately vacant due to the presence of public land or largely unoccupied residential or rural areas
 - the majority of the area is managed and/or the vegetation present is present within residential areas
 - the area has good access and/or the high potential for access. The potential for access is determined through the area’s ability to accommodate a full road network with multiple entry points and clear egress to more developed areas
 - the area is separated from adjacent areas which carry a Medium or High Hazard rating either by managed vegetation or by a Low Hazard area.
2. The area contains any ecological values of high quality or significance, as determined by a qualified Ecologist or similar environmental professional.

The criteria for an area to be considered a High Hazard are as follows:

1. The area can be considered Medium to High Risk.
2. A bushfire has the potential to move into the area through this area under prevailing conditions (determined through the landscape scale assessments).
3. The area contains sufficient vegetation to sustain a large fire from a localised ignition.
4. Access in and around this area is limited (predominately dirt trails and/or minimal boundary tracks separating vegetation from developed areas).

1.4 Limitations

Ground–truthing was completed through a vehicular–based inspection of each of the six Investigation Areas from publicly accessible roads, with no private land sites accessed as part of this process. As it largely aimed to clarify, refine and confirm data collected as a desktop exercise beforehand, the following considerations should therefore be made regarding the limitations of the assessment as it relates to the information captured during ground–truthing.

- it was undertaken during winter when there is a higher moisture content which can impact the results of the fuel load assessments (higher moisture content means less surface fuels and more greenery)

- the assessments were performed over a limited period which was enough time to gather the information required but limited the time available to assess the Investigations Areas in great detail
- some of the Investigation Areas had a limited amount of access and/or were only viewable from roads where the potential to stop within certain areas was limited due to heavy traffic and/or hazardous conditions.
- due to limited access, Fuel Load Assessments were performed on public land meaning that larger vegetation patches on private land could not be assessed (such assessments are best performed within larger vegetation patches away from managed areas).
- the assessment of other Townships was limited to a desktop review so while we can make several assumptions regarding the bushfire risks and access conditions, we cannot provide a more in-depth assessment as has been provided for the Investigation Areas.

2. DISTRICT BUSHFIRE RISK ASSESSMENT

As stated previously, in order to provide an adequate assessment of the Settlement Planning Strategies within Clause 13.02-1S, we need to consider all of the alternatives for population growth.

Since this assessment is being performed by Hepburn Shire Council, the alternative locations include all of the existing towns within Hepburn Shire and Council are currently progressing Township Structure Plans for the Townships of Creswick, Clunes, Daylesford/Hepburn Springs and Trentham. A more in-depth assessment would be required for every township and district within the shire so our assessment will focus on these four at present. A bushfire hazard landscape assessment has been provided for all four townships in the sections below along with a discussion of the requirements under Clause 13.02-1S.

Since there are other factors present when considering expansion of these townships, we will be focusing on what is appropriate for the risk present as opposed to stating which townships should and shouldn't be expanded based on the bushfire hazards (unless the townships are at a high to extreme risk). As stated previously, it is important to note that although Creswick has been identified as the township most likely to absorb residential growth in the shire, other key towns and settlements will also experience pressure for expansion and growth in the future and will also need more detailed bushfire risk assessments.

2.1 Clunes

An overview of the bushfire hazards around the Township of Clunes is provided in the sections below and is displayed in Figure 2.

2.1.1 Landscape

The landscape around Clunes is predominantly open paddocks with a few scattered vegetation patches to the north-west and west. These patches consist of the Dunach Nature Conservation Reserve to the north-west and the Mount Beckworth S.R. to the west. There is also a larger patch of vegetation to the south-west directly adjacent to town and a reserve along the Creswick Creek which runs through the town. There are several main roads leading to Creswick to the south-east, Dunach and Talbot to the north-west and Miners Rest to the south which completely avoids the Creswick Regional Park and Plantations to the south-east and connects to the Western Highway.

2.1.2 Bushfire history

The town has a long history of bushfire with the landscape to the north-west being extensively burnt 1985, 1998, 2007 and 2020. The largest bushfire was in 1985 and it is not expected to be on this scale again considering the amount of cleared farmland present but the recent bushfires show that the risk is still present. The landscape to the north-east and south-east was also burnt in 1969 and 1977. Like the 1985 bushfires, these fires originated from larger vegetation patches in the wider landscape which are no longer present so we do not expect a bushfire on this scale again. The planned burning around the reserves to the north-west also indicates bushfire controls are being undertaken which reduce the risk.

2.1.3 Evacuation and refuge

This township is very well placed in terms of providing refuge and providing safe egress for those who wish to evacuate. There is a Neighbourhood Safer Place present and a significant amount of open paddock around the township which indicates that residents can take refuge here if they choose to. If they want to leave however, they can proceed south-east into Creswick which has more development and may be able to provide better refuge or proceed south to Miners Rest where there is immediate access to the Western Highway. Heading towards Talbot is not recommended due to the number of vegetation patches around this town.

2.1.4 Potential bushfire scenarios and conditions

Bushfires are propelled by powerful north-westerly winds before a cooler, south-westerly change occurs which can propel a bushfire from this direction or potentially turn an existing bushfire which can result in multiple fronts or a single, very wide bushfire front. Based on the layout of vegetation around Clunes, the most likely scenario would be a grassfire from the north-west or a bushfire through the adjacent vegetation patch to the south-west. The town is fairly open plan based on aerial images so a bushfire or grassfire could spread into it if not contained quickly so residents may be threatened from direct flame contact or embers based on their position.

Leaving early would be recommended for those looking to leave since grassfires move very quickly and could easily block off one or more of the access routes out of town. There are multiple options however and the centre of town can provide suitable refuge. The township is smaller compared to Creswick or Daylesford so the infrastructure required to sustain a larger population during an emergency may not be present but, if growth is being considered within this area, it can proceed with the knowledge that the bushfire risk is present but can be easily managed through proper planning from Council and emergency services.

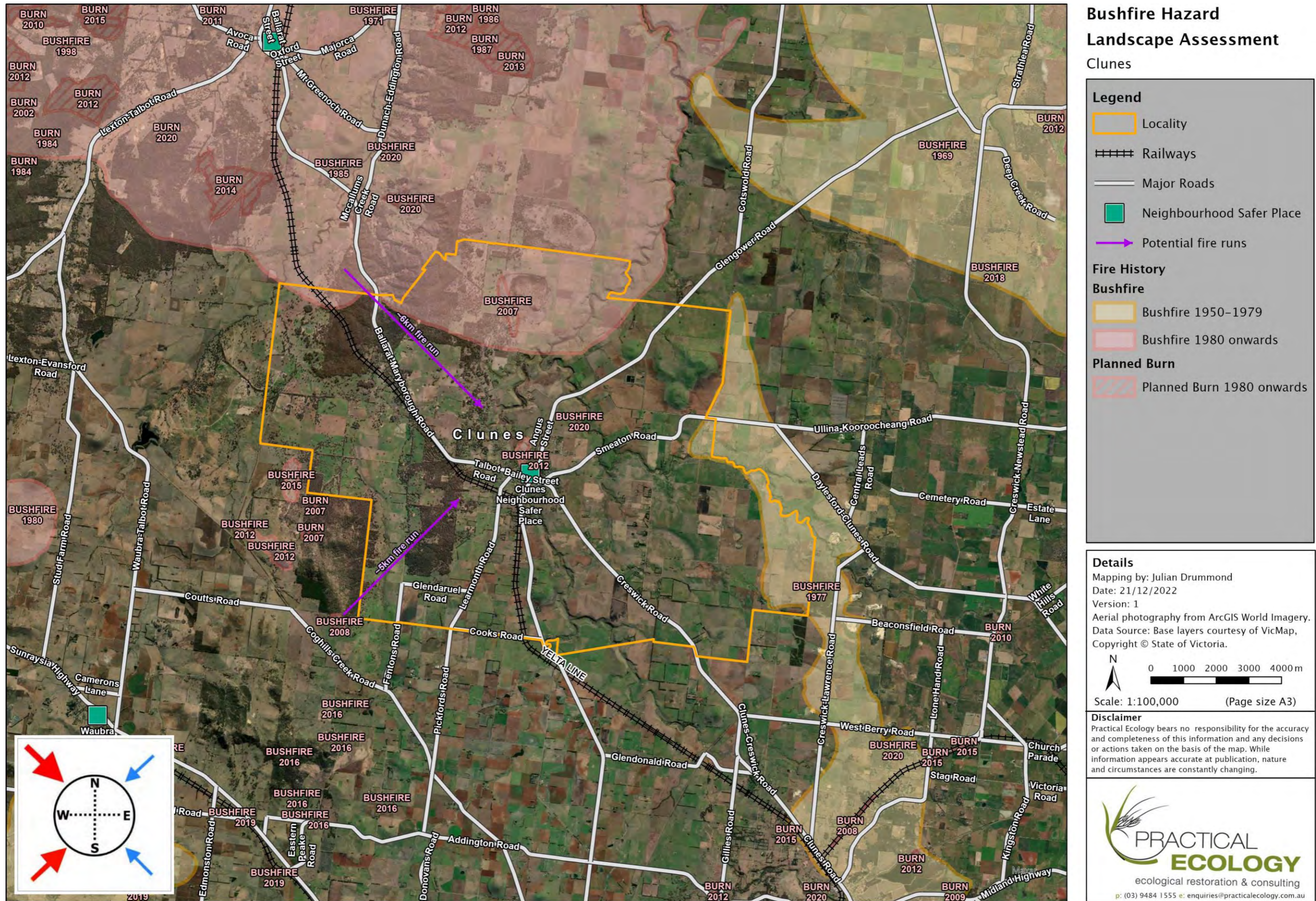


Figure 2. Bushfire Hazard Landscape Assessment for Clunes

2.2 Creswick

An overview of the bushfire hazards around the Township of Creswick is provided in the sections below and is displayed in Figure 3.

2.2.1 Landscape

The landscape surrounding Creswick consists of open paddock in the wider landscape and to the immediate north-west of town while the landscape separating this town from Ballarat and other towns to the south contains dense vegetation within the Creswick Regional Park, the Creswick Plantation and a number of other reserves and State Forests. The township itself is a reasonable size with a well-established town centre and a lot of older colonial buildings. There are several main roads leading through the large vegetation patch to the south but also a fair few proceeding to the north which means access around the larger vegetation patches is available.

2.2.2 Bushfire history

The majority of the vegetation to the east and south of Creswick was burnt in 1977 in a large bushfire which extended to the north through areas which are no longer vegetated. There have also been large fires in the vegetation to the south of Creswick in 1997, 1999 and 2013 along with some scattered smaller fires. The landscape south of Creswick has been subject to several planned burns over the decades although these are focused on the reserve areas and not the plantations which have their own bushfire protection measures.

2.2.3 Evacuation and refuge

There is a neighbourhood Safer Place in the centre of Creswick at the Visitor Information Centre which residents within the centre of town and to the south would need to utilise during a bushfire since a lot of the structure present are older and/or are around or amongst the vegetation. Residents wishing to evacuate would want to proceed to the north-west towards Clunes due to the amount of open paddock in this direction and the clear access around the larger vegetation patches to the south which should not be driven through during an emergency.

2.2.4 Potential bushfire scenarios and conditions

Bushfires are propelled by powerful north-westerly winds before a cooler, south-westerly change occurs which can propel a bushfire from this direction of potentially turn an existing bushfire which can result in multiple fronts or a single, very wide bushfire front. The north-western scenarios are considered more likely due to the hotter, drier winds from this direction and this lowers the risk within Creswick substantially as the landscape to the north-west opens up into farmland and limits the scenarios to grassfires.

The vegetation to the south does pose a high risk but there is management present and bushfire scenarios are more likely to be pushed past the township as opposed to towards it. Development adjacent to this vegetation is still not recommended though although development within the open areas to the north-west can potentially proceed with the proper planning.

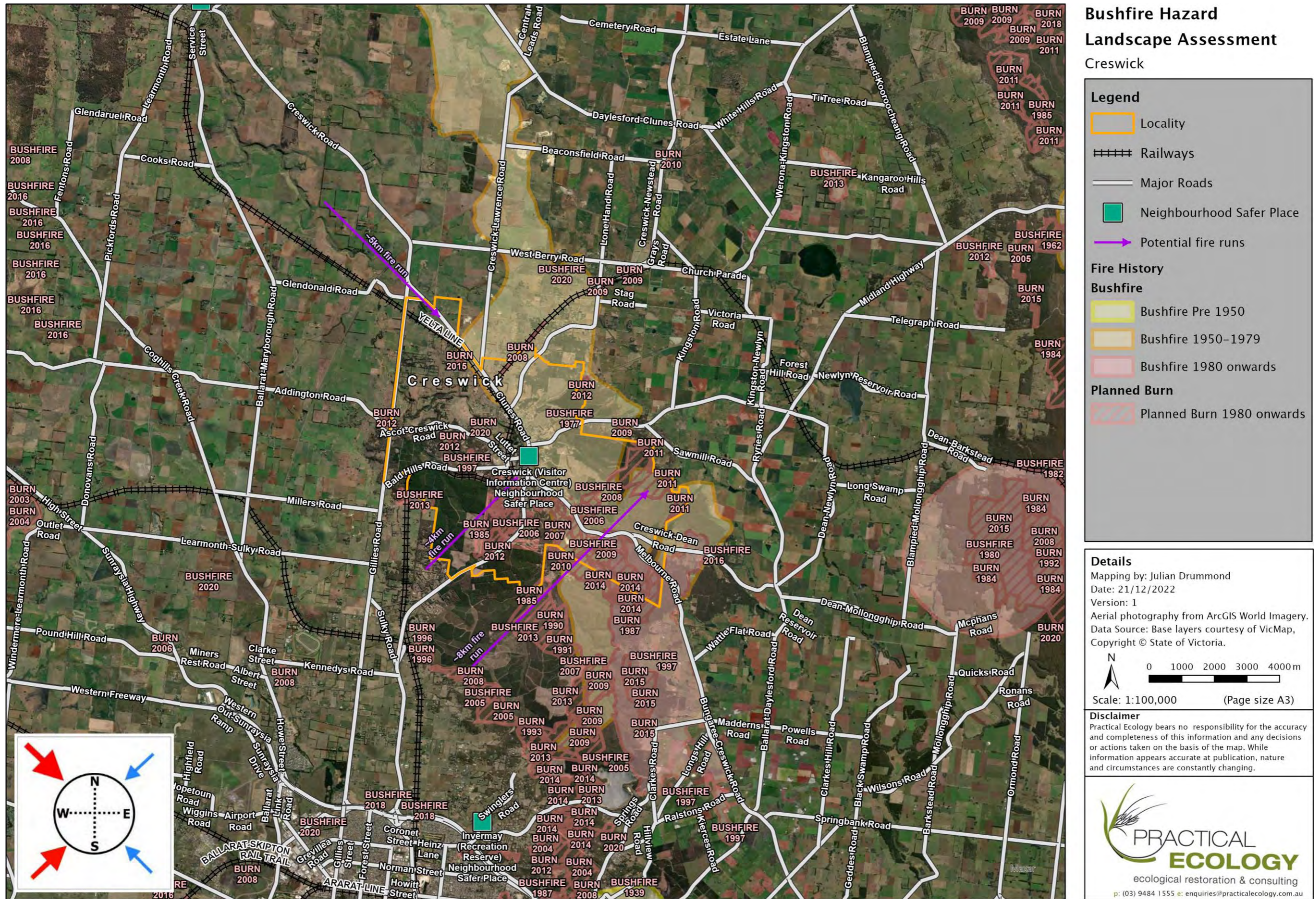


Figure 3. Bushfire Hazard Landscape Assessment for Creswick

2.3 Daylesford and Hepburn Springs

An overview of the bushfire hazards around the Townships of Daylesford and Hepburn Springs is provided in the sections below and is displayed in Figure 4.

2.3.1 Landscape

The landscape around Daylesford and the Hepburn Springs which is immediately to the north of Daylesford consists of large, dense vegetation patches on all sides although there is an open area of paddock to the east before reaching another vegetation patch. These patches are a primarily conservation reserves including the Hepburn Regional Park, the Wombat State Forest and the Lerderderg State Park to the south-east. The township is reasonably large with a lot of colonial buildings within a dense town centre. There is egress available to the north, east, south and west but they all move through vegetation with the shortest out into open farmland being to the west.

2.3.2 Bushfire history

There have been several bushfire within the vegetated areas surrounding these townships in 1961, 1962, 1969, 1972, 1980, 1982, 1985, 1995, 2008, 2009 and 2020. There has also been an extensive amount of planned burning which indicates a significant amount of management is being undertaken to protect these townships although the hazards are still present.

2.3.3 Evacuation and refuge

The evacuation options within these townships are limited unless residents plan ahead and leave early. There is a Neighbourhood Safer Place within Hepburn Springs but the amount of vegetation around and within this township indicates that no-one should be present during an emergency and residents should proceed into Daylesford. The amount of planning present within the surrounding landscape indicates that there would be sufficient resources within Daylesford to provide for residents during an emergency but the amount of vegetation present and the number of older structures does make the risk very high. Proceeding out of town is recommended but should only be attempted before conditions escalate.

2.3.4 Potential bushfire scenarios and conditions

Bushfires are propelled by powerful north-westerly winds before a cooler, south-westerly change occurs which can propel a bushfire from this direction of potentially turn an existing bushfire which can result in multiple fronts or a single, very wide bushfire front. This is unlikely but could occur around Daylesford along with several other scenarios from the north-west and south-west. Residents will likely be exposed to direct flame contact and embers based on their position within both townships and not have many options for egress.

The farmland immediately to the east is lower risk but should not be considered for expansion since a population increase is not supportable within this town outside of low-density or rural residential development. This development would also place residents closer to vegetation patches to the east which would result in another front for emergency services to address.

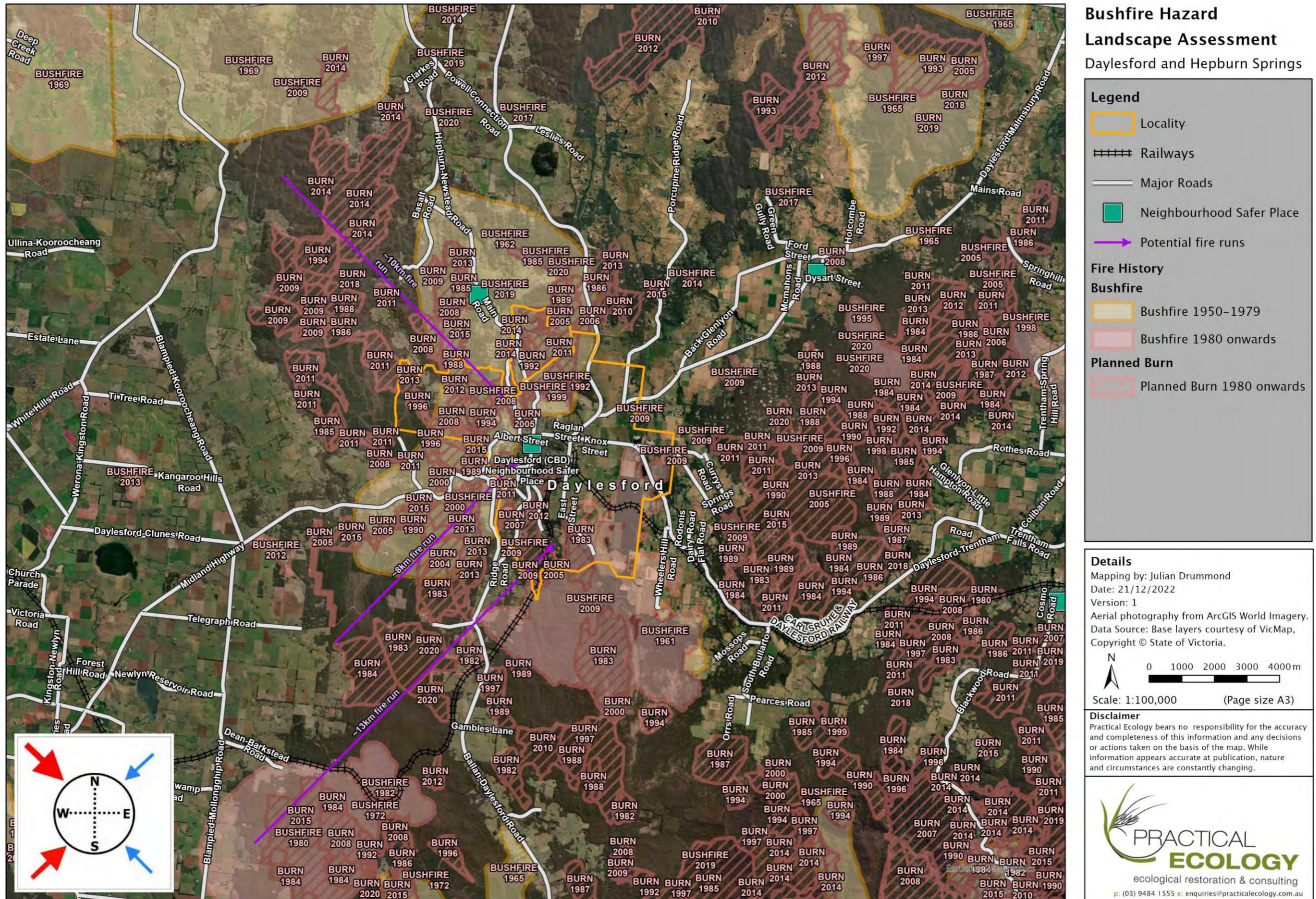


Figure 4. Bushfire Hazard Landscape Assessment for Daylesford and Hepburn Springs

2.4 Trentham

An overview of the bushfire hazards around the Township of Trentham is provided in the sections below and is displayed in Figure 5.

2.4.1 Landscape

Trentham is to the east of Daylesford and is adjacent to the same vegetation patches within reserve, State Forests and timber plantations. These extend to the south and the west with the landscape to the north-east opening up into farmland with main roads connecting to Kyneton to the north-east and Woodend to the east. There is a road to the south which moves through the Lerderderg State Forest to Blackwood, Greenvale and Ballan along the Western Freeway to the south.

2.4.2 Bushfire history

The majority of the landscape to the south-east was burnt in a very large bushfire in 1983 and there was a large fire to the north in 1998. Other bushfires also occurred in the adjacent vegetation in 1939, 1961, 1965, 2009 and 2020. The landscape to the south and west has also been extensively burnt over the last few decades as part of the bushfire protection measures around Daylesford and the adjacent district.

2.4.3 Evacuation and refuge

The only real option for evacuation is to the north-east because of the vegetation patches to the south and west where a bushfire is likely to be present. This route is relatively reliable though and provides direct access through open farmland to Kyneton or Woodend which can provide refuge and immediate access to the Calder Freeway. There is a Neighbourhood Safer Place within Trentham if conditions become too hazardous to leave town but early planning and evacuation are recommended considering the proximity to the larger vegetation patches.

2.4.4 Potential bushfire scenarios and conditions

Bushfires are propelled by powerful north-westerly winds before a cooler, south-westerly change occurs which can propel a bushfire from this direction of potentially turn an existing bushfire which can result in multiple fronts or a single, very wide bushfire front. This can potentially occur within the Lerderderg State Park to the south and result in a very powerful bushfire front approaching from this aspect. A bushfire can also approach from the north-west but would be more separated from the Township by open farmland and poses less risk.

All of these scenarios have the potential to threaten the township with direct flame contact and embers. The hazards here are similar to Creswick with a large bushfire hazards on one aspect and open access on another but the risk is higher here than at Creswick since a bushfire can still approach from the north-west in Trentham and the hazard to the south is much larger. This area could maybe handle a small population increase to the north-east but, considering the lower risk conditions in Clunes and Creswick, these areas should be the primary focus.

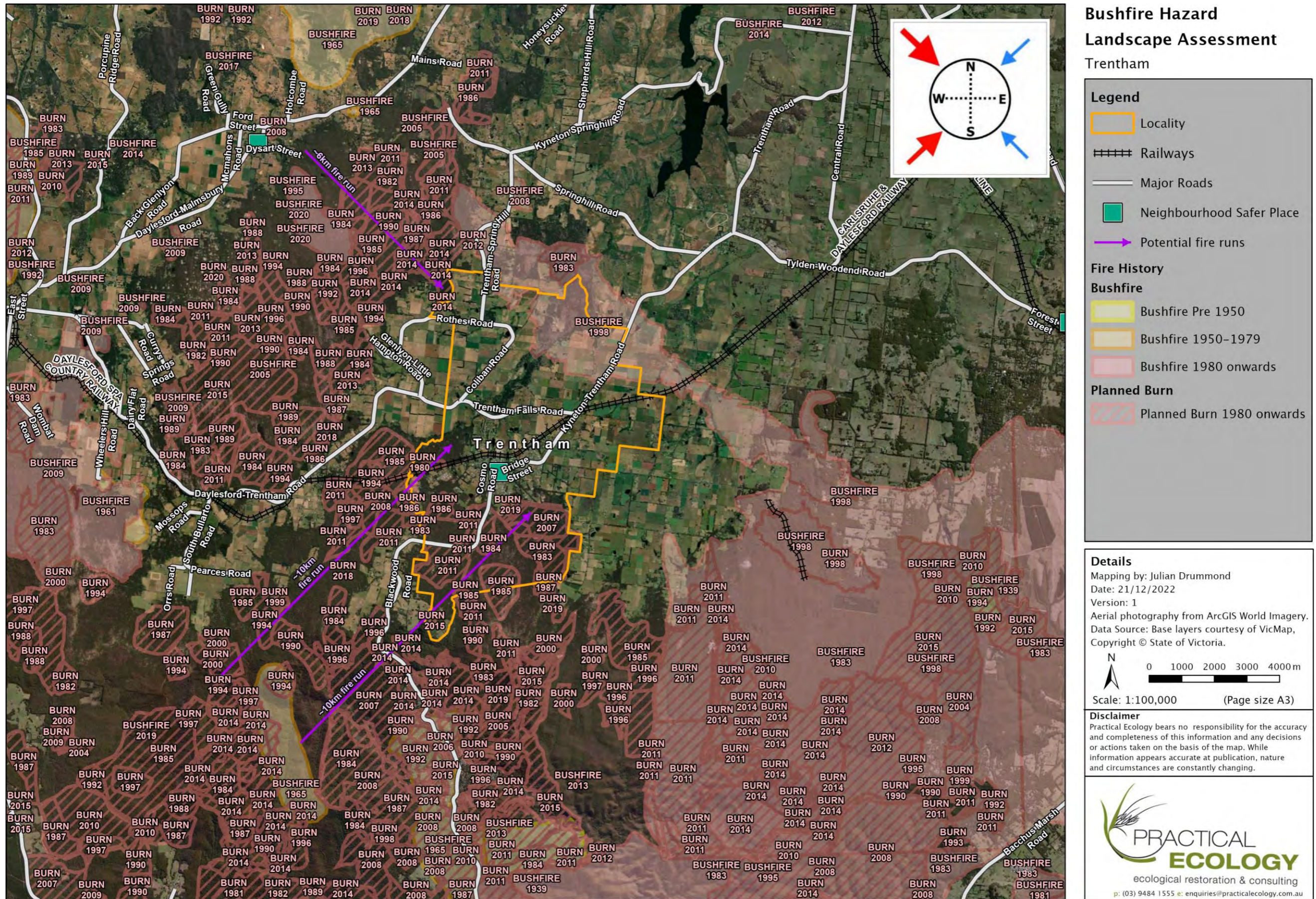


Figure 5. Bushfire Hazard Landscape Assessment for Trentham

2.5 Discussion and conclusions

Based on this preliminary assessment of the townships undertaking Township Structure Plans, we can conclude that Daylesford and Hepburn Springs are at the highest risk, followed by Trentham, Creswick and with Clunes as the lowest risk. This does not mean population growth should be focused entirely on the towns in this order but it should be a main factor when considering if/how the towns will be managed in future.

First and foremost, Creswick should still be able to accommodate the proposed population growth as dictated in the Township Structure Plan. There are hazards present to the south-west, the town does contain a lot of older structures in close proximity to the vegetated areas and it is not the lowest risk town currently being reviewed by a structure plan but the risks are not high enough to reconsider Council's desire to develop this township. The open farmland to the north-west means the only fires which can approach from this aspect (the most likely approach aspect during bushfire season) are grassfires which can be addressed through proper planning.

The Township of Clunes is isolated from bushfire hazards in the wider landscape and has clear access to refuge which doesn't involve moving through dense vegetation. It is also a smaller township which may require a lot of development to provide the resources required for a larger population. This would be expensive and, most likely, not what Council or the existing residents want. Increasing the population of Clunes is an option for future consideration when the desired growth (based on Council estimates and the CFA's review of the bushfire risk) has been achieved in Creswick. It would be best to keep this option open since expansion will likely be required in the future and may not be an option within Trentham or Daylesford/Hepburn Springs.

These townships are in very high-risk positions amongst several large reserves which essentially cut them off from services to the south. Trentham is lower risk in that it has clear access to the north but this is not really sufficient to justify significant population growth. Significant expansion is not recommended for Daylesford or Hepburn Springs which have no clear access and are still at high risk despite the amount of bushfire mitigation works being undertaken. Placing a capacity limit on how much growth can occur here should be considered and this should assist in future planning since a buffer of lower-density residential areas and rural residential areas may be suitable and will help separate the townships from adjacent hazards.

In terms of meeting the Settlement strategies of Clause 13.02-1S, we hope that this review provides an adequate assessment of 'assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis'. Our assessment found that Creswick and Clunes were the most suitable options at the regional scale with both being able to provide BAL-12.5 separation within the open farmland around them. The remaining levels outlined in this strategies are addressed in the sections below.

Clunes was considered lower risk than Creswick but these strategies also require assurances that there will be no net risk to existing residents and infrastructure. Creswick is the larger town with more resources and is better able to facilitate a population increase. Further assessments can be performed to determine whether Clunes can facilitate a population increase but any future growth should be shelved for the moment since Creswick appears to be fully prepared.

3. INVESTIGATION AREA 2A

Investigation Area 2a is approximately 504 ha and consists primarily of open paddocks with scattered trees. The majority of vegetation present is restricted to the north-eastern corner of the site and surrounds the existing dwellings. Fragmented patches of vegetation are also located along the eastern boundary. The Investigation area is located within the Farming zone and is not covered by the Bushfire Management Overlay. The Investigation Area is however within a Bushfire Prone Area.

The planning zones located within and surrounding the area are present below on Figure 6.

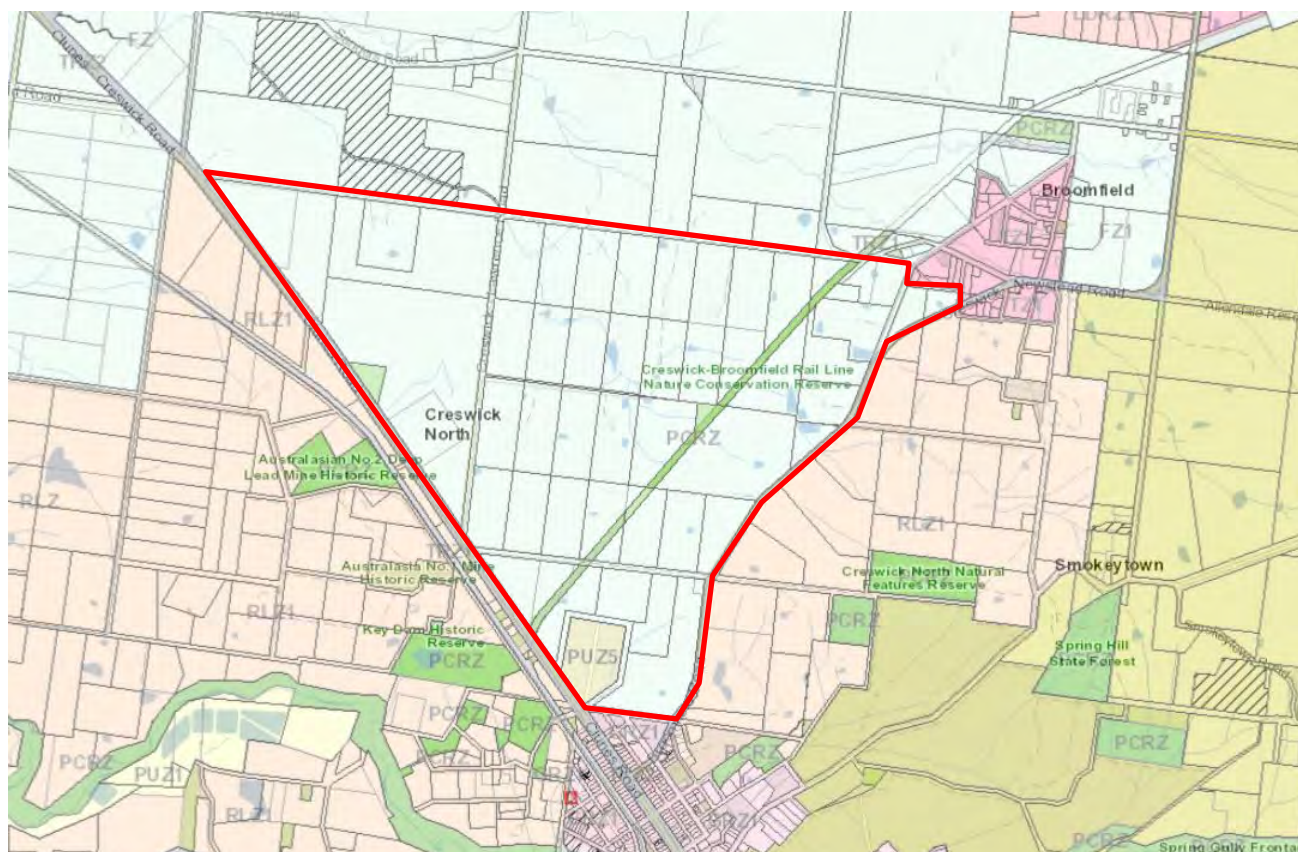


Figure 6. Planning zones within and surrounding Investigation Area 2a

3.1 Bushfire Hazard Landscape Assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away. The surrounding landscape is displayed on Figure 7 and the Bushfire Hazard Landscape Map is displayed on Figure 8.

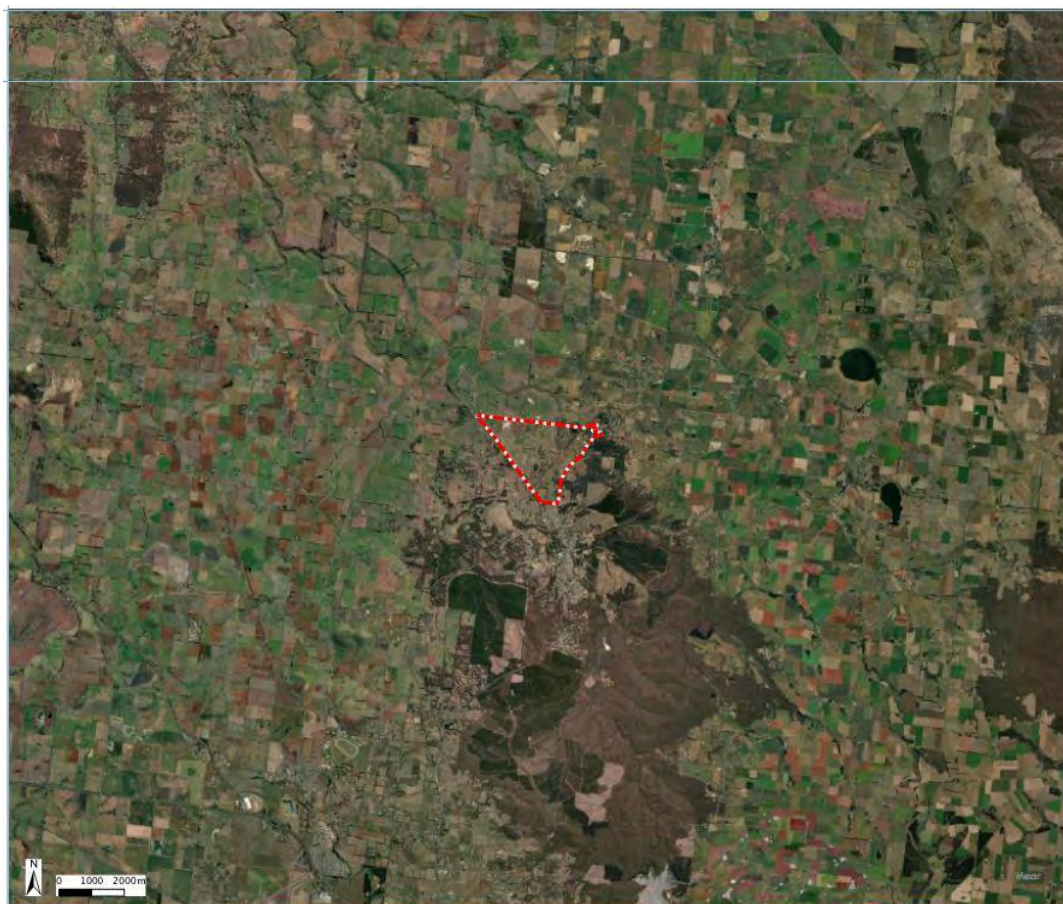


Figure 7. Landscape surrounding Investigation Area 2a

3.1.1 Local landscape

Investigation Area 2a is located to the north of Creswick and adjoins to large grazed paddocks to the north and comparatively smaller paddocks amongst low-density development to the west. Forest/Woodland vegetation is present to the east of the site and covers a considerable amount of land through to Smokeytown further east. Pine plantation is located south of this area along with the Township of Creswick.

3.1.2 Wider landscape

The wider landscape consists primarily of farmland to the north and west and further east of the vegetated areas between the site and Smokeytown. The landscape to the south around Creswick is a mixture of native vegetation and large timber plantations which continue south towards the City of Ballarat. There are other large patches of vegetation to the north-east and south-east in the wider landscape but they're too far away to have a significant impact.

3.1.3 Bushfire History

The majority of the site was burnt in 1977 in a large bushfire which extended to the north and south through the large patch of vegetation to the east of the site. There have also been large fires in the vegetation to the south of Creswick in 1997, 1999 and 2013 along with some scattered smaller fires. The landscape south of Creswick has been subject to several planned burns over the decades but only a few burns have occurred in the landscape to the east.

3.1.4 Landscape bushfire scenarios

The landscape risk is relatively low despite the proximity to a large patch of vegetation due to the position of this vegetation to the east. Prevailing conditions result in bushfires being driven by powerful north-westerly and south-westerly winds so a bushfire within this vegetation would threaten the site but would also be pushed away from this area. The only fires which would be pushed towards this area are grassfires from the west.

The north-westerly scenario is considered higher risk because of the hot dry winds driving it while the south-westerly scenario is driven by cooler and more humid air from over the Southern Ocean. The south-westerly scenario has more vegetation to move through so it may pose an ember risk but there is also more development so it is more likely to be contained before reaching the site. In fact, both scenarios are considered low risk for this reason.

3.2 Ground-truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Growth Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 9, Figure 10, and Figure 11.

3.2.1 Observed conditions

Refer to Figure 9 for a summary of the bushfire conditions.

Investigation Area 2a is composed primarily of open paddocks which can be considered Grassland vegetation with some Forest/Woodland vegetation located within the north-eastern corner of the site and patches along the eastern boundary within private property. The Creswick-Broomfield Rail line also passes through the centre of the area and consists of a mixture of Forest/Woodland vegetation

Slopes within this area were predominately level. As per AS3959-2018, Table 1 below provides the distances required to meet the defendable space requirements for BAL-12.5.

Table 1. Defendable space requirements.

Vegetation type	Woodland	Forest	Grassland
Slope (up/down)	Level	Level	Level
Slope (degrees)	0-2°	0-2°	0-2°
Defendable space required for BAL 12.5 (m)	33	48	19

A fuel hazard Assessment was not performed within this Investigation Area as excluding the Grassland present, all other fuel loads were located on private property and were therefore inaccessible. The vegetation present through the Creswick–Broomfield Rail Line Nature Conservation Reserve did not warrant a fuel load assessment as it was only a thin banned that was mostly degraded.

3.2.2 Access

Clunes road provides access along the southern boundary, Creswick–Newstead Road along the eastern boundary and Wrigleys Road along the northern boundary all of which combine to provide adequate perimeter access. Creswick–Lawrence Road provided access through the site north–west and Holton–Barbys Road provide access to the east of this road. Provided the location of the Investigation Area amongst open pasture, the area does have the capacity to implement additional roads to ensure adequate internal access if development is to occur.

3.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 10 and Figure 11.

The VFRR has categorised two locations adjacent to the Investigation Area, one to the north–west and one to the south. The VFRR has categorised the area to the north west as Very High risk due to its proximity to the vegetated area to the south which has the potential to carry a fire front and impact this area. The threat has been considered High here due to the vegetation present although it is managed within private lots.

The area to the south of the site which covers the northern developed extent of Creswick has been categorised as High Risk likely due to the surrounding fuel loads which could see fire front impact to the township. The Threat has been considered Medium due to the development present and associated minimal fuel loads.

3.4 Site analysis

Considering all of the results above, Investigation Area 2a was divided into a number of areas based on the conditions and usage observed and determine the risk posed to each zone and the hazard it poses to the surrounding areas.

The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 6 and Figure 7

Investigation Area 2a

Area 1

Location	Open paddocks covering the majority of the zone on the north–western side between Clunes Road and Wrigleys Road.
Risk category	Low
Hazard category	Medium
Details	<p>The north–western side of Investigation Area 2a is open farmland, scattered dwellings, agricultural infrastructure and some open cut mining areas which extends out into the wider landscape to the north. A grassfire has the potential to move into this area from the wider landscape but the risk is low due to the amount of management present.</p> <p>Farmland is considered Grassland under AS3959–2018 but it is periodically grazed/cropped and has plenty of access and fire can be quickly addressed before it enters this area. The area is considered a Medium hazard however due to the size and the position to the north–west of other, more populated areas. A grassfire can start in this area and have sufficient room to build strength and whether or not it can be contained in time is dependent on the proximity to adjacent areas.</p>

Area 2

Location	The Creswick–Broomfield Rail Line Nature Conservation Reserve and vegetation along track to the south–west of this reserve.
Risk category	Medium
Hazard category	Low
Details	<p>The Creswick–Broomfield Rail Line Nature Conservation Reserve consists of a thin band of vegetation running along the previously existing rail line. The risk is considered to be Medium because of the ecological values present and pre–existing protection meaning it will be present in perpetuity. It is also parallel to the Grassland within Area 1 so a bushfire would be pushed towards it under prevailing conditions.</p> <p>This parallel placement also means the hazard from this area is Low since the vegetation would burn quickly but would not easily spread. The presence of several adjacent roads means a fire can also be quickly addressed before it threatens other areas and any remaining hazard can be addressed through adequate setbacks from adjacent developments.</p>

Area 3

Location	Open paddocks on the south-eastern side of the area between the Creswick-Broomfield Rail Line Nature Conservation Reserve and Broomfield Road.
Risk category	Low
Hazard category	Medium
Details	This area is almost identical to Area 1 with open paddocks, scattered dwellings and agricultural infrastructure present throughout. The risk is lower than Area 1 since it would require a fire to be present within Area 1 to be directly threatened and, as mentioned previously, the chances of this are low. The hazard posed is also reduced by the presence of Broomfield Road which creates a fuel break for the areas to the south-east but the amount of Grassland present and the potential for localised ignitions means we still need to consider this a Medium hazard.

Area 4

Location	Densely vegetated properties on the north-western side of the area containing dwellings and accommodation.
Risk category	Medium
Hazard category	Medium
Details	This area contains dense vegetation on private properties which also contain accommodation and low-density residential dwellings. The area can be subjected to a grassfire from the wider landscape and there is enough vegetation present to pose a hazard to adjacent area if it was ignited so the hazard and risk can be considered Medium. It is an isolated patch however with plenty of access so neither the risk or hazard are considered to be High.

Area 5

Location	Open paddocks on the north-eastern side of the assessment area north of Broomfield.
Risk category	Low
Hazard category	Low
Details	This area on the north-eastern side of the assessment area surrounding the Investigation Area could have a grassfire move through and threaten areas within Broomfield but the chances of this fire reaching the township before being contained and/or starting within this area are greatly reduced due to the management and access present so the risk and hazard are considered to be Low.

Area 6

Location	Low density residential areas on the north-eastern side of the Investigation Area within the Township of Broomfield.
Risk category	Medium
Hazard category	Medium

Details	The Township of Broomfield consists of low-density residential properties containing managed portions but also a lot of scattered vegetation. There is a fully developed road network however and a greatly reduced risk from the northern vegetation so the risk does not exceed Medium. The hazard would be considered Low since the risk of a fire spreading from this area is reduced and there are no adjacent developed areas to be threatened at present but the large vegetated areas to the south-east could be ignited from here and threaten the wider landscape so we have considered the hazard Medium as a result.
---------	--

Area 7

Location	Denser vegetation on the eastern side of Broomfield Road
Risk category	Medium
Hazard category	High
Details	<p>The terrain to the east and south of Broomfield Road consists of dense Forest and Woodland vegetation on private properties and within State Forest. It is separated from the bushfire hazards within Broomfield and the adjacent paddocks by Broomfield Road and the majority of the surrounding vegetation is Grassland so the ember risk is reduced and the risk to this area is considered to be Medium.</p> <p>This area connects to larger Forested areas to the south-east however on a mixture of private properties, State Forest, conservation reserves and timber plantations so a fully developed bushfire in here would threaten the Township of Creswick within this Investigation Area and areas to the south. The hazard from this patch igniting is therefore considered to be High.</p>

Area 8

Location	Denser vegetation on the eastern side of Broomfield Road
Risk category	Medium
Hazard category	Medium
Details	<p>The terrain to the east of Broomfield Road consists of dense Forest and Woodland vegetation on private properties and within State Forest. This vegetation is separated from the portions of Area 7 within the assessment area by managed farmland within Area 3 and has roads running adjacent to the north and west. The risk of ignition is still Medium from a Grassfire within Area 3 but there is considered to be more opportunity of containment before it spreads into more vegetated areas to the east so the hazard is also considered Medium.</p>

Area 9

Location	Open paddocks and the northernmost residential areas of Creswick on the southern side of the assessment area
Risk category	Low
Hazard category	Low
Details	This area contains the last open paddocks before the northern end of Creswick is reached and the landscape becomes residential and urban development. It is separated from the vegetation within Area 3 by a main road and is also blocked from scenarios to the north but the managed vegetation within Area 10 so the risk and hazard are Low.

Area 10

Location	Creswick Cemetery
Risk category	Low
Hazard category	Low
Details	This area contains managed vegetation and is surrounded by paddocks on the southern side of the so it is well separated from a scenario to the north-west and the risk and hazard are considered to be Low.

Area 11

Location	Open paddocks on the western side of the assessment area between Clunes Road and the Yelta Rail Line
Risk category	Low
Hazard category	Low
Details	While there are open paddocks containing Grassland within this area, the majority consists of the Clunes Road Reserve, managed vegetation along the Yelta Rail Line and several low-density residential properties containing managed vegetation. The risk of ignition from a scenario to the north-west is present but is considered to be Low and the presence of the road reserve also reduces any hazard to Low.

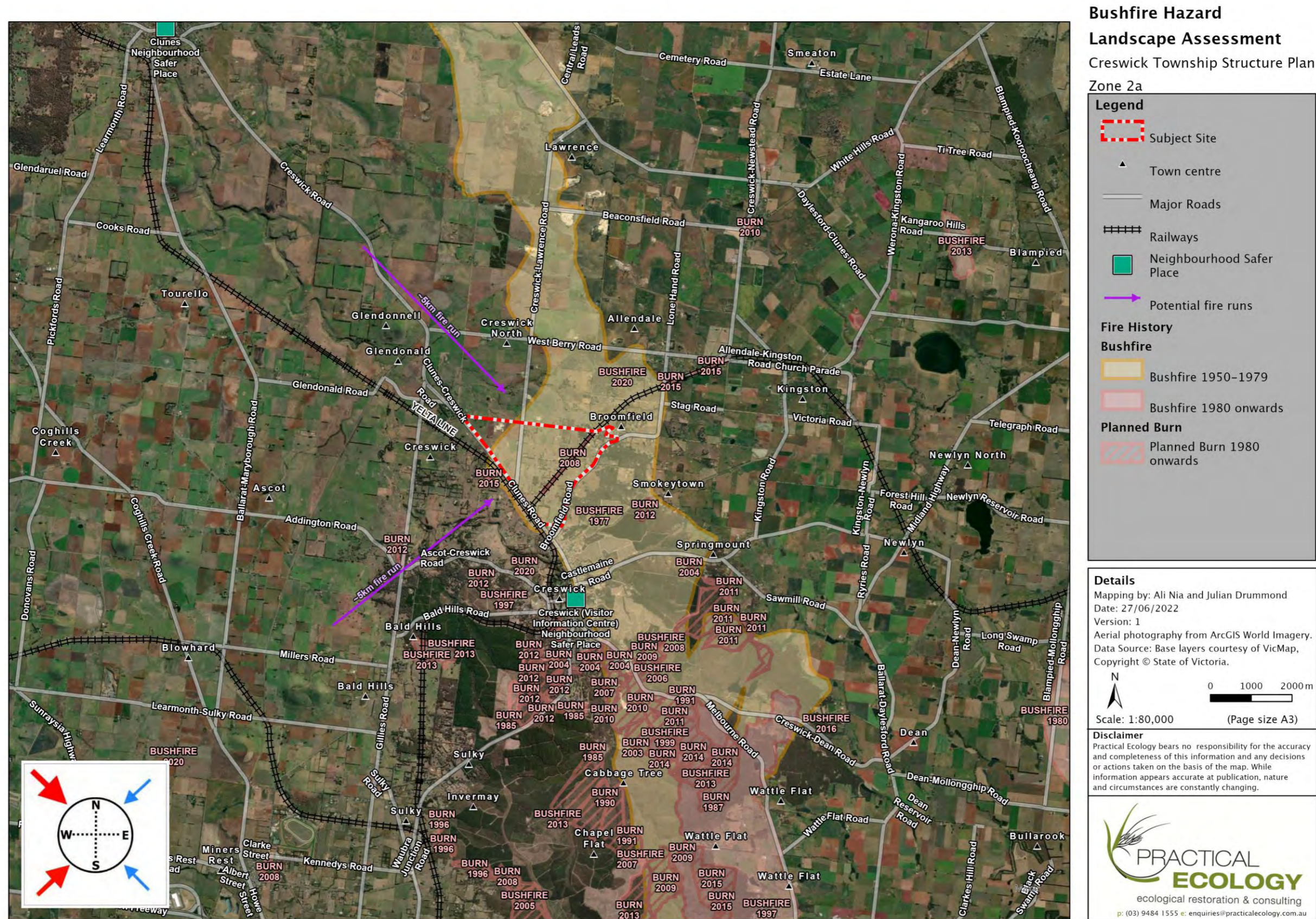


Figure 8. Bushfire Hazard Landscape Assessment for Investigation Area 2a

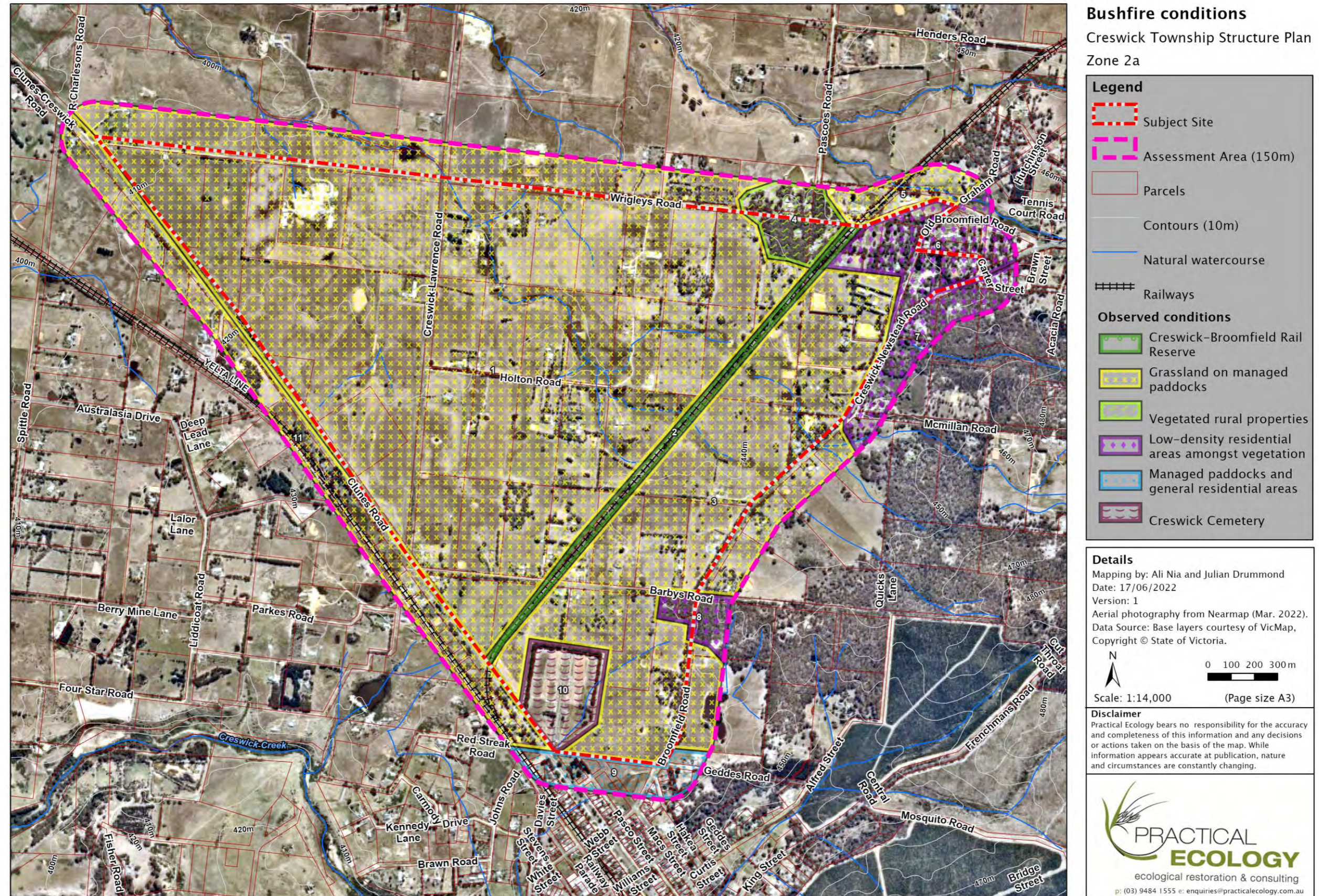


Figure 9. Observed Conditions within Investigation Area 2a

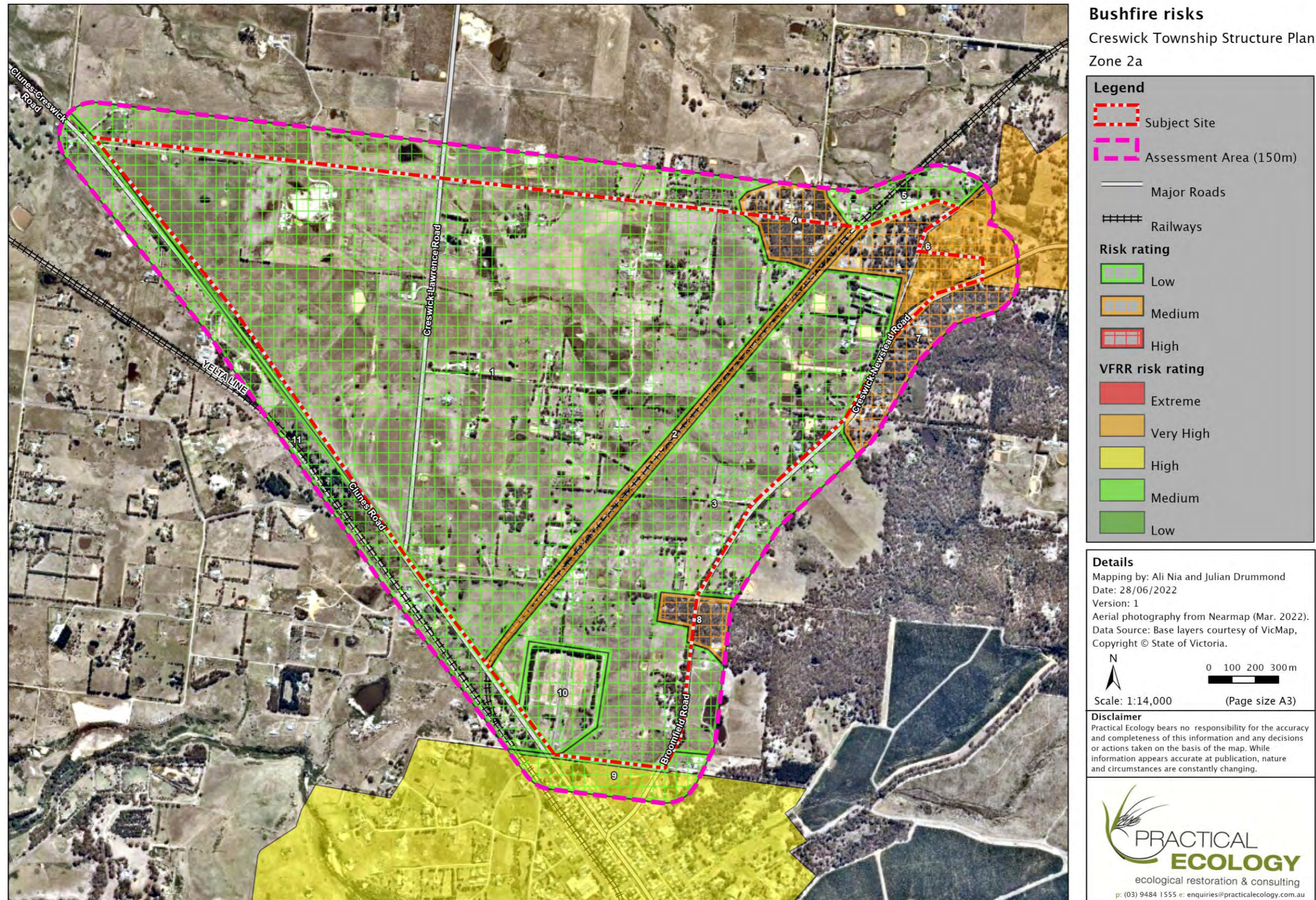


Figure 10. Determined Bushfire Risks within Investigation Area 2a

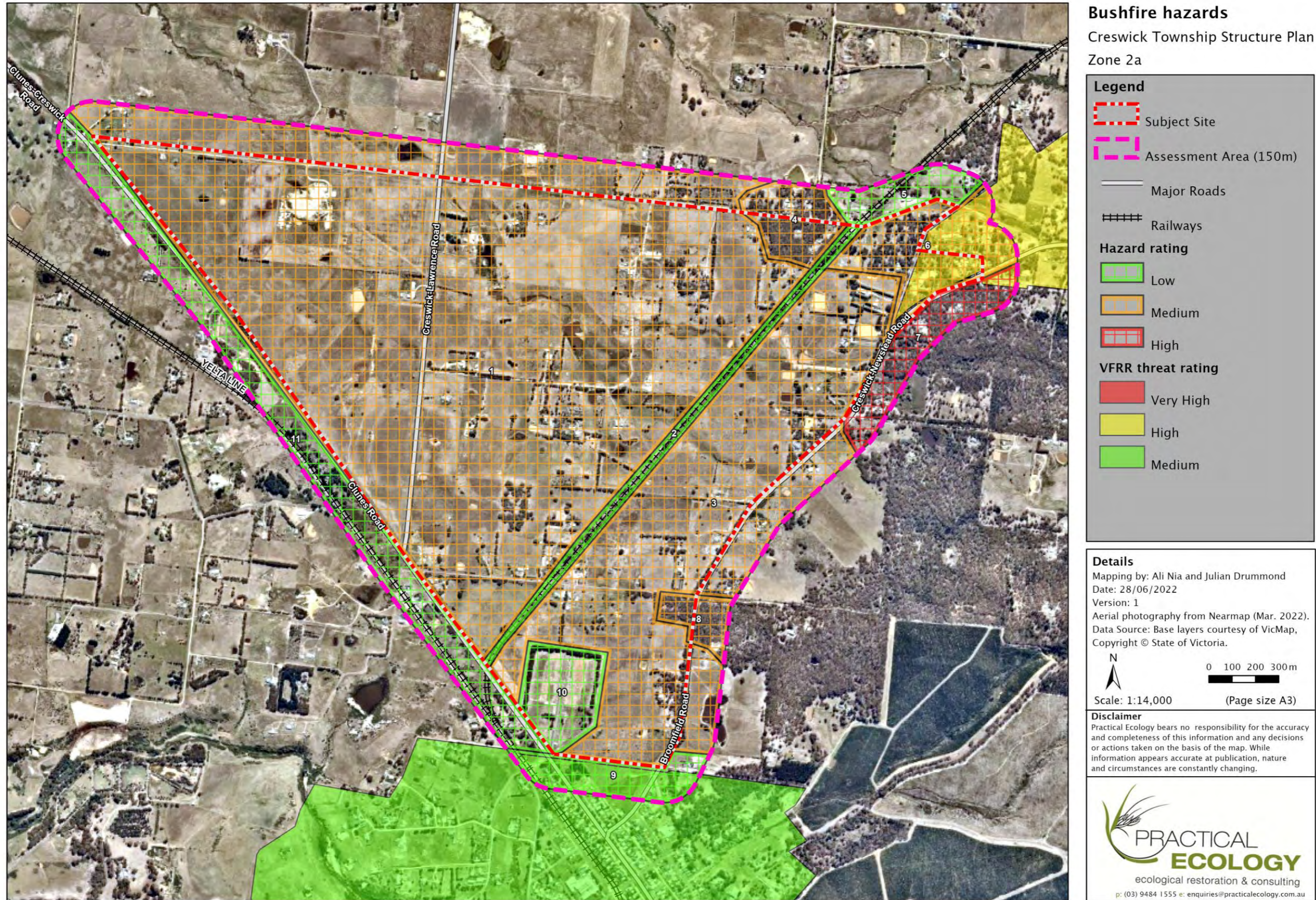


Figure 11. Determined Bushfire Hazards within Investigation Area 2a

3.5 Summary of Findings and Recommendations

This area is well designed to meet the Settlement Planning strategies of Clause 13.02-1S. It is primarily composed of open paddocks with no large vegetation patches outside of a thin reserve which cannot support a full fire front and the larger vegetation patches within the wider landscape are to the east so a fire within these areas will burn away from the Investigation Area. There is the potential for grassfires approaching from the west but the risk from this can be addressed and the amount of development in this landscape means the fire is likely to be contained before it threatens the area.

Despite the position of the vegetation to the east which places it away from a bushfire under prevailing conditions, caution is advised around Broomfield Road and Creswick–Newstead Road. Area 3 can potentially have some higher density residential areas but they should be focused to the west and north with properties along Broomfield Road to remain rural or to consider low-density residential since it will result in a lower population and more open managed space adjacent to a bushfire hazard.

This approach is also recommended for Area 1 where the majority of development is recommended. This area should consider higher density residential development extending out from Creswick to the south and progressing into low-density residential and then into rural residential before reaching farmland again. This staged development creates a lower population buffer as mentioned previously while also retaining the rural character of the landscape (no dense residential areas directly adjacent to open paddocks).

The ecological assessment determined that some areas of native grassland of moderate and above quality were present within the paddocks. If retainment of these grassland patches is to occur than development must enforce the appropriate setback as per AS3959-2018. Vegetated properties and the rail reserve have ecological values present but are smaller and isolated so maintaining the proper separation required under AS3959-2018 for BAL-12.5 should be sufficient to offset any hazard present within them.

The following recommendations are based on the identified areas within the Investigation Area:

- Area 1 had the most potential for supporting residential development. The extent of this development will depend on how council are willing to expand the township but should proceed with general residential areas at the southern end, low-density residential areas adjacent to these to the north and rural residential areas north of these before proceeding onto farmland. This creates a buffer of lower population but managed areas between the bushfire hazard and the more populated areas to the south but, since the risk is from farmland and is reduced as a result, we can afford to have the rural residential areas which do reduce the hazard and allow more gradual progression from farmland to township.

- By contrast, Area 3 should also have low-density residential areas adjacent to higher density residential areas to the west but should not progress into rural residential areas before reaching the vegetated areas within Areas 7 and 8. The main reason for this is low-density residential creates the lower population buffer but limits the size of the properties so there is less chance of having unmanaged terrain on properties. When the properties are adjacent to open farmland, the risk is low enough that we can have unmanaged properties separating the higher density populations from the bushfire hazard but here it is best to have a controlled population with more managed terrain as a buffer.
- Area 2 and Area 4 are potential bushfire hazards but they can be considered isolated enough to not warrant any additional measures. As long as the proper precautions are taken by future developments (sufficient separation for BAL-12.5 as per AS3959-2018 and boundary roads) then the hazard posed can be considered addressed.
- The developed areas within Broomfield (Areas 5 and 6) are already low-density residential areas adjacent to the larger vegetation patches to the south. This development and the level of vegetation management observed is a good example of what can be present within Area 3 and, considering the proximity to higher risk vegetation, should not be considering any increases in population density.
- Areas 7 and 8 contain dense vegetation connected to the larger vegetated properties to the east and managing them enough to remove the bushfire hazard from this area would result in significant ecological impacts. Therefore, no development is recommended within them and no higher-density development is recommended immediately around them.

4. INVESTIGATION AREA 2B

Investigation Area 2b consists primarily of vegetation with some open paddocks fragmenting this vegetation. The Township of Broomfield is present within the northern extent of the area. The investigation area is predominately zoned Rural Living Zone – Schedule 1 with the northern most extent within Broomfield zoned Township Zone – Schedule 1.

The Bushfire Management Overlay covers the majority of the Investigation Area excluding the northern extent within Broomfield and the farmland area adjacent to Broomfield Road.

The planning zones within and Surrounding Investigation Area 2b are presented within Figure 8 below.

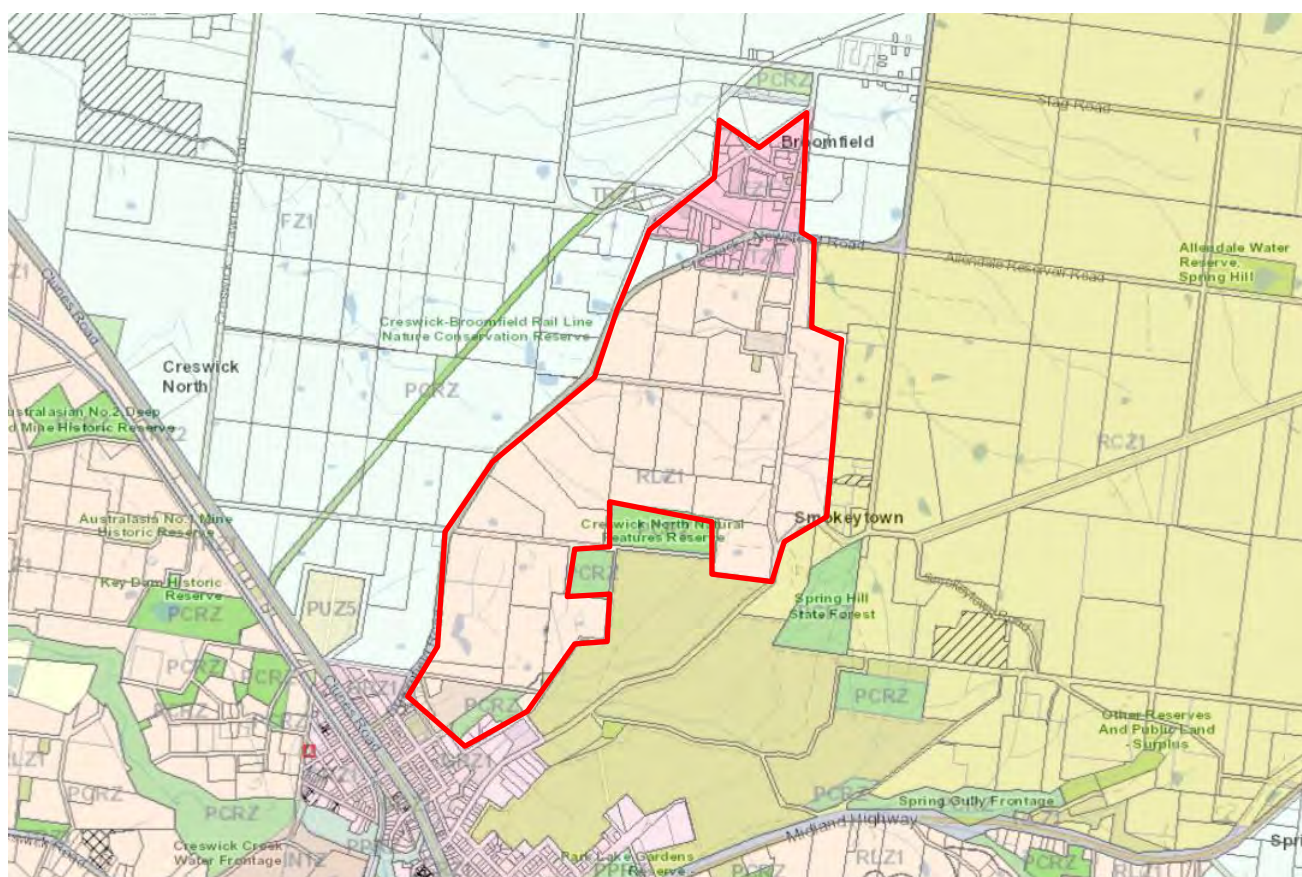


Figure 12. Investigation Area 2b zoning

4.1 Bushfire Hazard Landscape Assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away from the Investigation Area. The surrounding landscape is displayed on Figure 13 and the Bushfire Hazard Landscape Assessment is displayed on Figure 14.

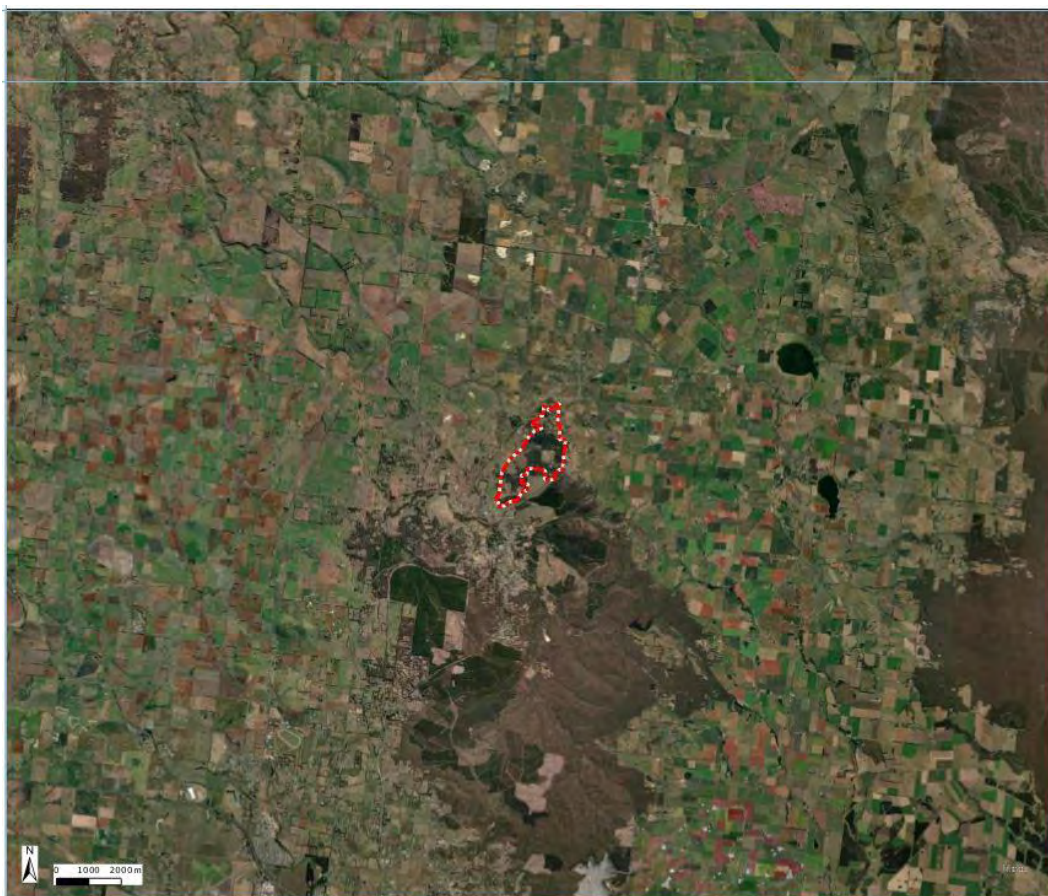


Figure 13. Landscape surrounding Investigation Area 2b

4.1.1 Local landscape

The site forms the northernmost point of a large patch of vegetation which extends further to the south to the east of the Township of Creswick. This vegetation is contained within the sites boundaries with open paddocks containing low-density residential development to the east and west. The Township of Broomfield is in the northern point of the site and extends a short distance beyond this before extending into open farmland to the north.

4.1.2 Wider landscape

The wider landscape to the north, east and west consists of open farmland while the vegetation onsite continues to the south past Creswick and into a larger patch of native vegetation and timber plantations to the south of Creswick and extending almost all the way to the City of Ballarat. There are other large patches of vegetation to the north-east and south-east in the wider landscape but they're too far away to have a significant impact.

4.1.3 Bushfire History

The entire site was burnt in 1977 in a large bushfire which extended to the north and south through the large patch of vegetation onsite. There have also been large fires in the vegetation to the south of Creswick in 1997, 1999 and 2013 along with some scattered smaller fires. The landscape south of Creswick has been subject to several planned burns over the decades but only a few burns have occurred in the vegetation in and around the site.

4.1.4 Landscape bushfire scenarios

Grassfires can approach the site from the north–west and the south–west under prevailing conditions and while the chances of one of these scenarios reaching the site is low due to the amount of management and access present in these areas, the impact these scenarios could have on the site is very high. Once a fire has ignited the vegetation onsite, there is the potential for a very large bushfire extending south past Creswick through the uninterrupted vegetation.

The north–western scenario is considered the higher risk here since it is more likely to occur under prevailing conditions, can potentially occur from a local ignition within Broomfield and would spread unimpeded through the vegetation to the south and threaten Creswick and other adjacent areas. The south–western scenario can also occur through localised ignitions within Creswick and could threaten Broomfield if it cannot be contained.

4.2 Ground–truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Investigation Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 14, Figure 15 and Figure 16.

4.2.1 Observed conditions

Refer to Figure 15 for a summary of the bushfire conditions.

Investigation Area 2b is composed primarily of native vegetation which can be considered as Forest vegetation. This area is somewhat fragmented through the provision of open paddocks which are considered as Grassland vegetation. Scattered dwellings are present throughout with a higher density of development within the northern point of the Investigation Area within Broomfield although these properties are not dense enough to be considered general residential.

The vegetation observed within the assessment area was Forest/ Woodland vegetation and Grassland. Slopes within this area were predominately level with some downslopes present throughout. As per AS3959–2018, Table 2 below provides the distances required to meet the defensible space requirements for BAL–12.5.

Table 2. Defendable space requirements.

Vegetation type	Woodland	Forest	Grassland
Slope (Level)			
Defendable space required for BAL 12.5 (m)	33	48	19
Slope (5–10° downslope)			
Defendable space required for BAL 12.5 (m)	50	69	25

A Fuel Hazard Assessment as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines et al. 2010a) was performed not performed within the Investigation Area although was performed within the 150m assessment area nearby the eastern extent of the site. This area was considered representative of surrounding fuel loads.

The results obtained were typical of what is standard for Forest type vegetation as per AS3959-2018 (see Appendix 1 for the results). The canopy cover was 30% which falls within the expected 30-70% foliage cover for Forest vegetation. The understory fuel load was 22 tonnes/ha with a total fuel load (including the canopy) of 28 tonnes/ha which is similar to the standard 25/35 tonnes/ha for Forest vegetation which can be expected to occur during higher risk conditions.

4.2.2 Access

Creswick-Newstead Road provides access along the western boundary of the investigation area and is the main access route from Creswick. Frenchmans Road and Smokeytown Road provide access along the southern and eastern boundaries respectively. With the exception of Broomfield to the north, Internal Road access is currently limited to narrow dirt roads with poor connectivity.

4.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 16 and Figure 18.

The same two polygons as detailed within Investigation Area 2a cover this Investigation Area (the northern point within Broomfield and the southern end which adjoins to Creswick).

The VFRR has categorised the risk to the north within Broomfield as Very High likely attributed to the proximity to the vegetation to the south within the Investigation Area. The threat has also been considered High within this same Area.

To the south the land within Creswick has been considered as High risk due to the surrounding fuel loads. The threat has been considered Medium due to the development present and associated minimum fuel loads.

4.4 Site analysis

The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 15, Figure 16 and Figure 17.

Area 1

Location	Open farmland east of Broomfield Road
Risk category	Low
Hazard category	Medium
Details	This farmland is separated from greater bushfire hazards to the west by Broomfield Road and, since the majority of the vegetation to the north-west is Grassland, the risk from embers is reduced. We can therefore consider this area as Low risk but the hazard is Medium since the area is large enough to support a grassfire and if the larger vegetated areas within Area 2 and Area 4 are ignited then it could result in a landscape scale bushfire event.

Area 2

Location	Dense vegetation on private land on the south-western side of the assessment area.
Risk category	Medium
Hazard category	High
Details	This area contains Forest and Woodland vegetation spread across private properties of reasonable ecological significance so management will be difficult. The adjacent vegetation to the west is mostly Grassland and there are several road reserves separating it from a scenario from this direction so the risk is only considered to be Medium. The hazard from this patch burning is considered High however since a bushfire event will be able to spread through the terrain east of Creswick and threaten the majority of the surrounding landscape.

Area 3

Location	Open farmland east of Broomfield Road
Risk category	Low
Hazard category	Medium
Details	This area is very similar to Area 1 in that it is open paddocks east of Bloomfield Road and is adjacent to the denser vegetation within Area 2 and Area 4 . This area is larger and has less access available than Area 1 however so while the risk and hazard ratings are the same, it is considered a higher risk and hazard as a result.

Area 4

Location	Dense vegetation on private land on the south-western side of the assessment area.
Risk category	High
Hazard category	High
Details	<p>This area is very similar to Area 2 as it is dense Woodland and Forest vegetation on mostly private properties and with reasonable to high ecological significance. A bushfire moving through this area will have a substantial impact on the surrounding landscape so the hazard is considered to be High as with Area 2.</p> <p>In this case the risk is also considered to be High because it is directly adjacent to the Township of Broomfield to the north which means bushfire can move from this township into this area more easily than from paddock and there are also additional ignition risks from the populated areas. This area also contains several rural residential properties with dwellings scattered throughout the vegetated areas and with minimal access present (primarily dirt tracks). This increases the risk since there are residents to consider as part of the emergency services response plan.</p>

Area 5

Location	Low density residential areas on the northern side of the Investigation Area within the Township of Broomfield.
Risk category	Medium
Hazard category	Medium
Details	<p>The Township of Broomfield consists of low-density residential properties on primarily cleared blocks but with a significant amount of vegetated present. There is also a fully developed road network so the majority of bushfire hazards can be addressed quickly but the presence of people within a vegetated area and the potential for a scenario from the north-west and the south-west places this town as a Medium risk.</p> <p>The presence of dense vegetation within Area 4 directly to the south also makes a bushfire within this township hazardous but this is reduced by the presence of Broomfield Road and the access present around Broomfield. The first priority during bushfire conditions would be to defend this township to stop the fire from spreading into Area 4. The reduced risk and potential to achieve this allows us to consider this area as a Medium hazard.</p>

Area 6

Location	Open paddocks on the eastern side of the assessment area to the west of Smokeytown Road.
Risk category	Medium
Hazard category	Low
Details	<p>This area consists of open paddocks to the east of the larger vegetated areas within Area 4. There are no access roads separating these areas so the hazard posed is considered to be Medium. The hazard is reduced however since the bushfire scenarios in this area would be moving a fire away from other areas and out into open paddocks to the east under prevailing conditions. The terrain to the east is also more open paddocks and has Smokeytown Road to act as a staging area so the hazard is considered to be Low.</p>

Area 7

Location	Open paddock with scattered sheds, dwellings and associated infrastructure in the centre of the dense vegetated areas.
Risk category	High
Hazard category	Medium
Details	<p>These open paddocks are surrounded by dense Forest and Woodland within Area 4 on all sides which pose a significant threat if a bushfire moved through as they would directly threaten this area and remove most means of access. The paddocks are managed and can be considered a Low Hazard but the presence of people within this vegetated area creates additional hazards for emergency services so we need to consider this area as a Medium hazard.</p>

Area 8

Location	Dense vegetation on the southern side of the assessment area within conservation reserves and timber plantations
Risk category	High
Hazard category	High
Details	This area is similar to Area 2 and Area 4 in that it is primarily Forest and Woodland but, unlike these areas, this vegetated is within conservation reserves and timber plantations so there are existing protection measures for the vegetation and assurance that they will not be managed with bushfire safety as a top priority. This increases the risk and hazard substantially since a bushfire approaching this area through Area 2 and/or Area 4 would already be of considerable strength and could pass through this area despite the presence of a fuel break around the timber plantations. Both the risk and hazard are considered High as a result.

Area 9

Location	Vegetated paddocks on rural residential properties on the southern side of the assessment area
Risk category	High
Hazard category	Medium
Details	These properties contain some management and several dwellings on large properties but there was a significant amount of vegetation present within these paddocks (several of which connected to or were part of Area 2) and, considering the risk from the vegetation to the north, these areas can be considered at High risk. The amount of management present reduces the hazard from this area to Medium since it does create a buffer between the vegetated areas and the more populated areas to the south. The access within this area could be improved but it currently serves as an effective fuel break for the Township of Creswick.

Area 10

Location	Residential areas at the northern end of Creswick
Risk category	Medium
Hazard category	Medium
Details	These residential areas are separated from the more vegetated areas to the north by rural and low-density residential properties within Area 9 but they are still fairly close to a larger hazard within the wider landscape so they are considered at Medium risk. This area can be considered managed to minimal fuel conditions but the presence of a larger population does create additional hazards for emergency services so we need to consider this a Medium hazard area.

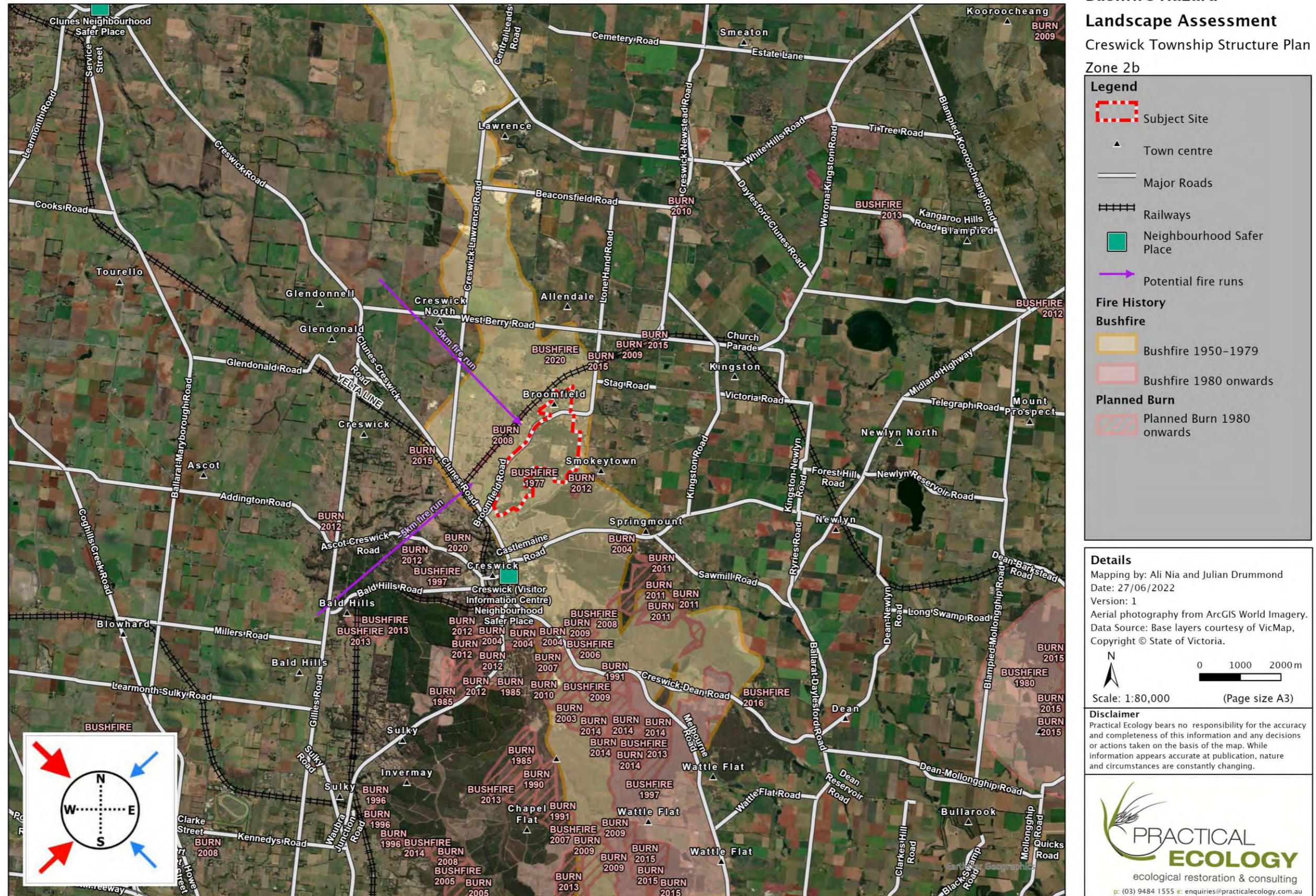


Figure 14. Bushfire Hazard Landscape Assessment within Investigation Area 2b

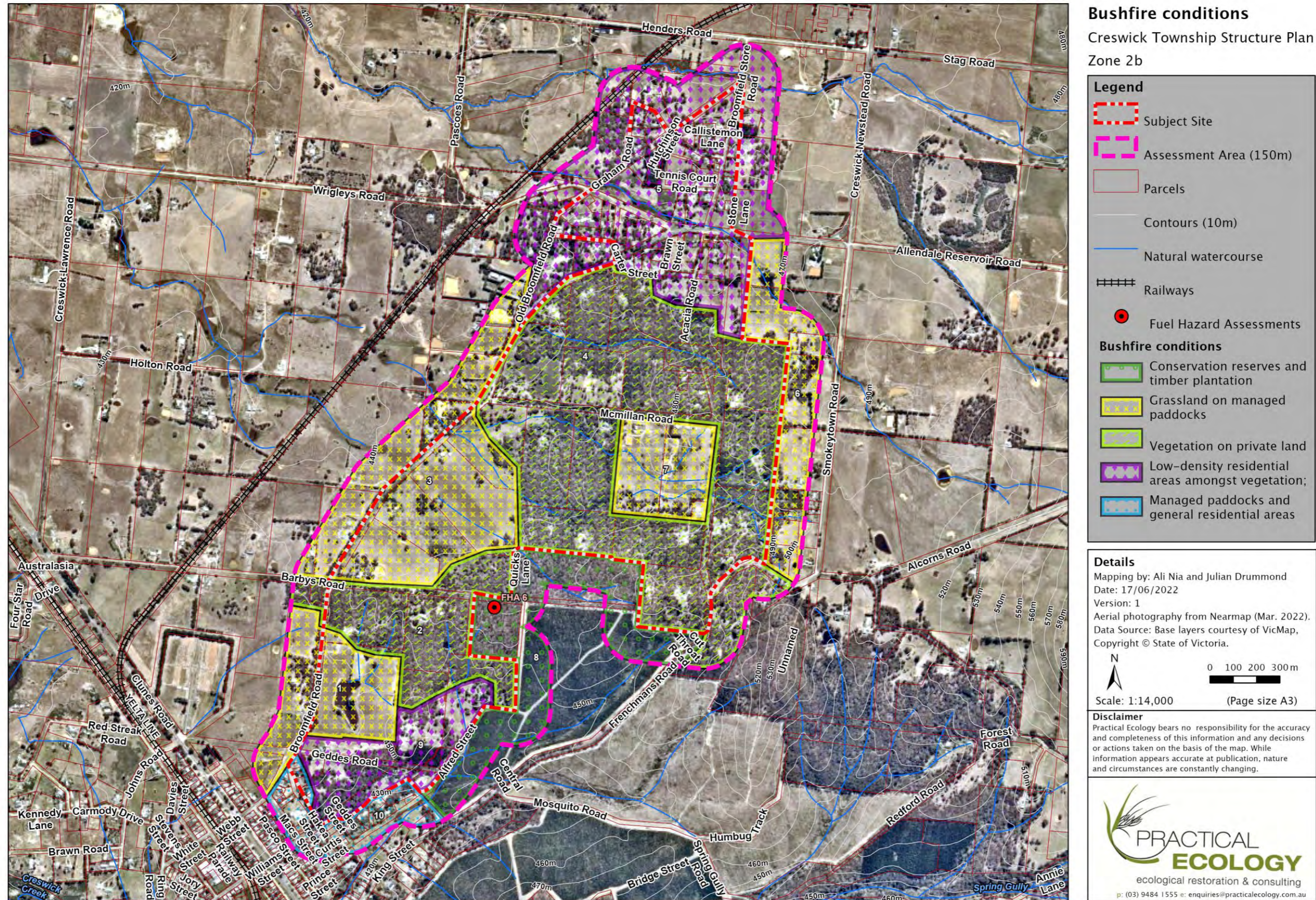


Figure 15. Observed conditions within Investigation Area 2b

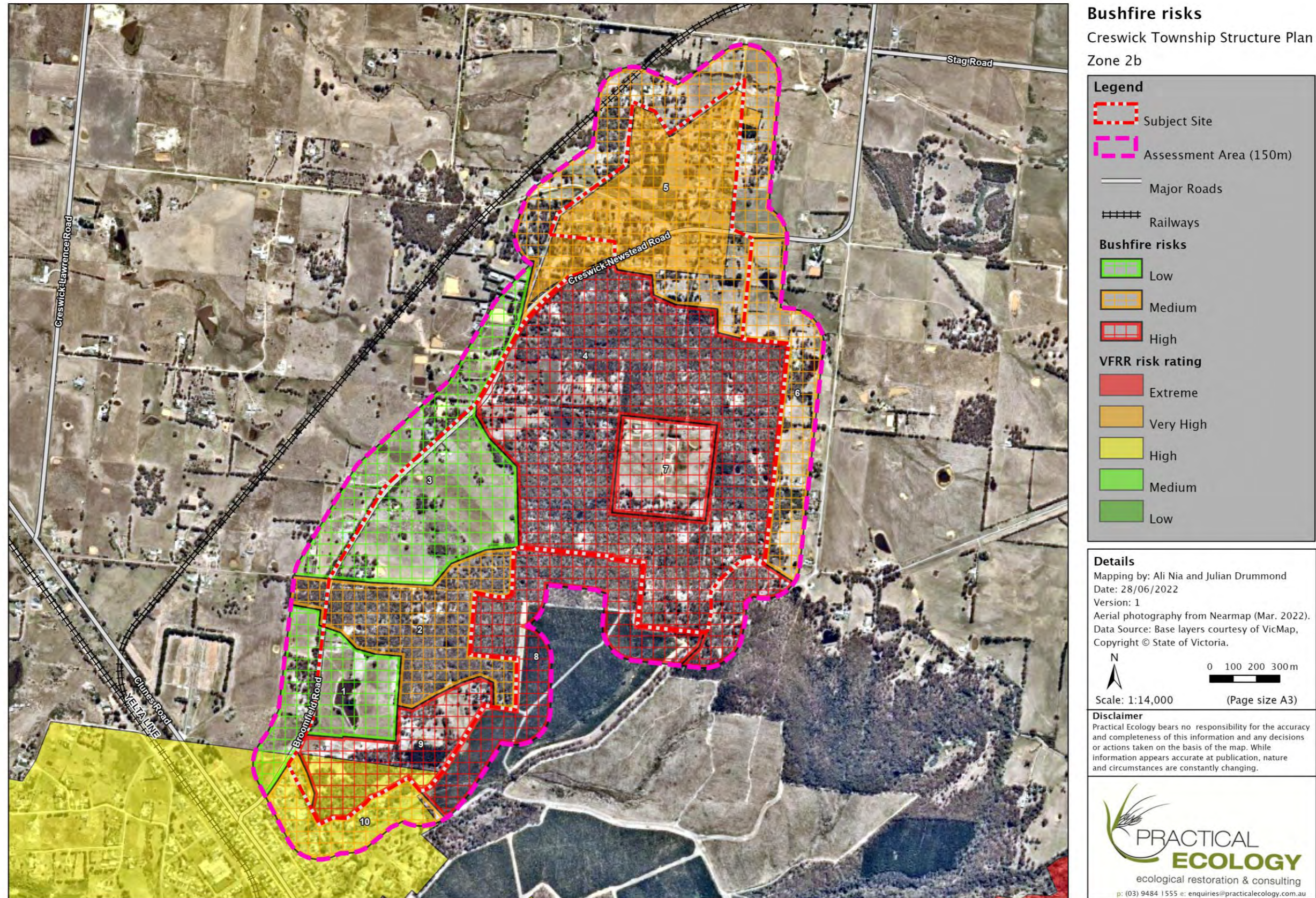


Figure 16. Determined Bushfire Risks within Investigation Area 2b

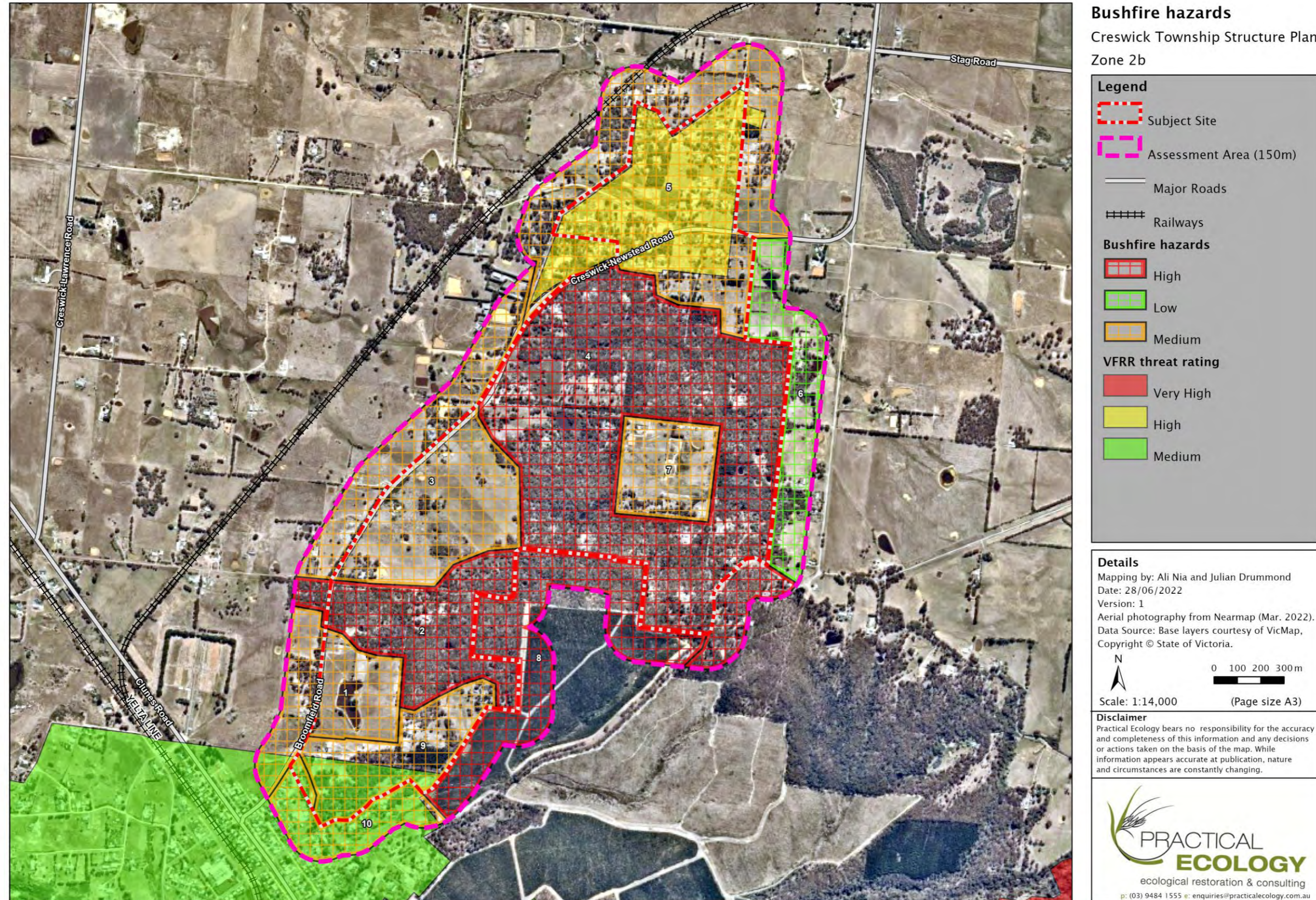


Figure 17. Determined Bushfire Hazards within Investigation Area 2b

4.5 Summary of Findings and Recommendations

This area does have some potential for residential development but only around the edges and only for low-density residential development or other forms of development which will result in a lower-population density. The majority of this area is a large patch of dense Forest within private properties, timber plantations and on conservation reserves. In order to reduce the bushfire risk from this patch in any meaningful way, you would need to remove the majority of the vegetation present which would have far too high a cost on the biodiversity to meet Clause 13.02-1S.

Areas 1 and 3 are the only locations where development can occur and this is mainly due to the need to protect potential residential areas to the west and south. Having a buffer of low-population residential or urban development means fewer people being placed at risk along with larger managed properties providing a buffer for residential areas within Creswick. Having low-density residential areas as opposed to rural residential is recommended since we want to strike the correct balance between a reduced population and having all of the vegetation within properties managed.

The Township of Broomfield (Area 5) contains the kind of development which can be considered suitable for areas adjacent to the higher risk vegetation within Areas 2, 4 and 8, low-density residential areas with sufficient access and, despite a reasonable amount of vegetation being present, the majority can be considered managed enough for bushfire safety. This does mean that this township cannot really be expanded significantly since we need to consider the use of surrounding areas and the potential ignition risk to the vegetated areas to the south.

The following recommendations are based on the identified areas within the Investigation Area:

- Areas 1 and 3 can potentially sustain a low-density residential similar to what is present within the Township of Broomfield (Area 5). This will create an area of managed terrain with a reduced population separating the higher risk vegetation from existing and potential residential areas to the west and south-west. A higher population within the Township of Broomfield is also not recommended due to the proximity to the vegetated areas to the south. It is however understood that through the ecological assessment being currently undertaken, patches of moderate quality Grassland have been identified within Area 3 and therefore any development here what have to account for the appropriate Grassland setbacks if this vegetation is to be retained.
- Areas 2, 4 and 8 should not be altered despite the hazard the pose because the amount of vegetation management which would be required to reduce the bushfire risk from these areas would result in significant ecological impacts. Since there are also patches of conservation reserve and timber plantations present within these areas, bushfire risk management within the privately owned properties can be considered redundant. Ensuring there are adequate buffer zones and the requirements of Clause 13.02-1S and the Bushfire Management Overlay are enforced within and around these areas is the best option at present.
- Areas 7 and 9 should not have any more development present within them as they are located between two large vegetation patches and can be considered isolated from adjacent areas of refuge. The current developments within them should therefore not be expanded upon and a higher population within these areas is not recommended.

5. INVESTIGATION AREA 3A

The Investigation Area is approximately 927ha and consists primarily of paddocks amongst lower density residential development. The majority of vegetation present is limited to along Creswick Creek to the south and also further south to this with some fragmented patches of vegetation spread amongst existing development. The Long Point Bushland Reserve is also located within the south-western corner of the site and consists of Forest vegetation.

The following planning zones occur within the Investigation Area as shown on Figure x

- Rural Living Zone - Schedule 1 (RLZ1)
- Public Conservation Resource Zone
- Public Use Zone - Schedule 1 (PUZ1)

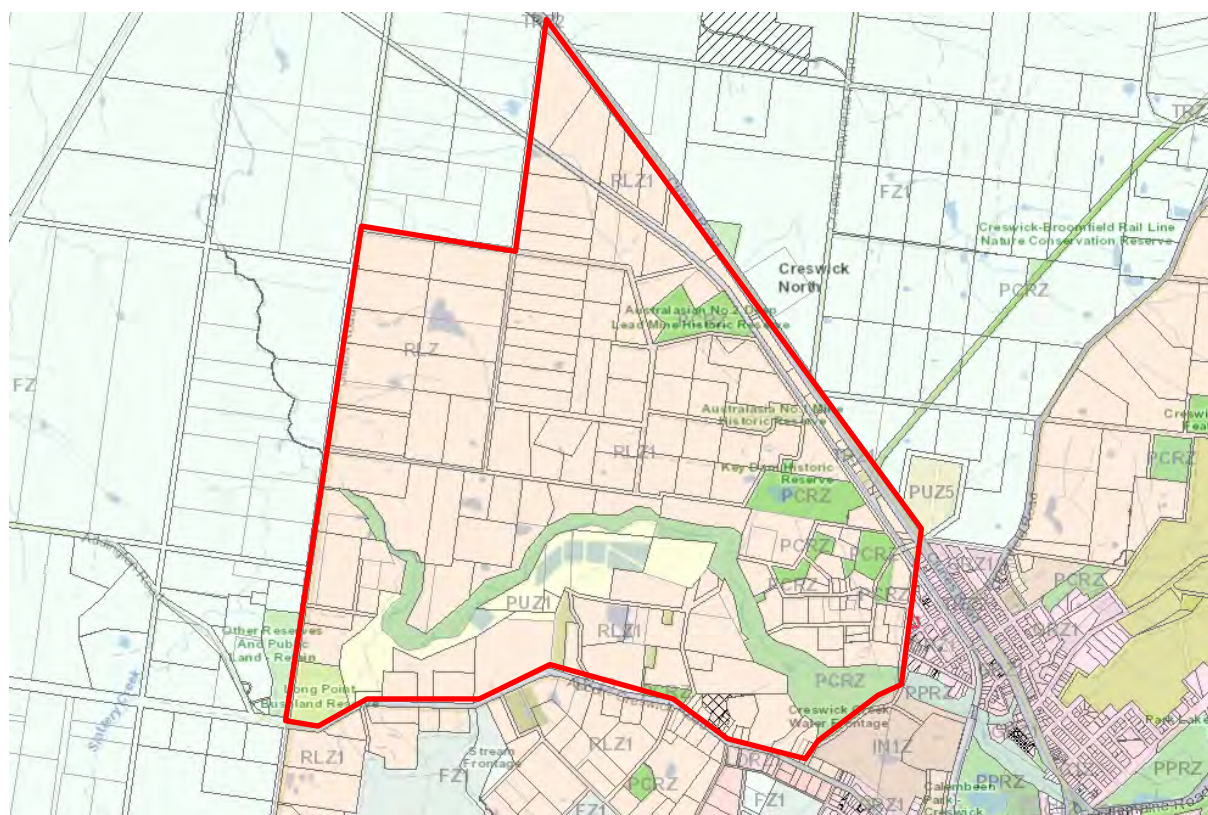


Figure 18. Investigation Area 3a

5.1 Bushfire Hazard landscape assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away from the Growth Area. The surrounding landscape is displayed on Figure 19 and the Bushfire Hazard Landscape Assessment is displayed on Figure 20.



Figure 19. Landscape surrounding Investigation Area 3a

5.1.1 Local landscape

The Investigation Area is located to the north-west of Creswick, positioned between the higher density development within Creswick and open farmland further north. The area borders farmland to the north, east and west with some fragmented patches of vegetation positioned along the western boundary. Low density housing is present to the south of the area which sees a significantly higher proportion of vegetation comparatively. The understorey is mostly managed within these private lots although the fuel load can still be considered high. Pine plantation is present further south adjacent this area and extends further south through the Creswick Plantation.

5.1.2 Wider landscape

The site is located to the north-west of higher density development within Creswick. At the wider scale, the town centre is positioned within a densely vegetated landscape consisting of both Pine Plantation and the native vegetation throughout Creswick Regional Park.

The Creswick Pine Plantation is located to the east of the town centre and extends on either side of the Midland Highway covering a large proportion of the vegetated area through to Smokeytown/Springmount. Plantation is also located to the south west and extends further south beyond the Township of Sulky.

The Creswick Regional Park covers much of the landscape to the south-east on an undulating topography with connective vegetation present through to Ballarat further south. Beyond this, the broader landscape is dominated by open farmland for many kilometres to the north, east and west. The city of Ballarat is located approximately 12km to the south of Creswick.

5.1.3 Bushfire History

A bushfire in 1977 impacted a large portion of the eastern extent of Creswick including the land adjacent to the eastern boundary of the assessment area. Smaller scale bushfires have also occurred to the south of the site in 1997 and more recently in 2013 within the Creswick Plantation. Prescribed burns have occurred nearby the southern boundary of the site in 2012 and 2020 and also to the south of Creswick between 2004–2012.

5.1.4 Landscape bushfire scenarios

Fire runs from the north west or south-west, occurring west of Gillies Road would progress through open farmland considered as Grassland. Grassfires tend to be less intense and produce fewer embers although are still able to generate a significant amount of radiant heat especially if the fuel load has been left unmanaged. Provided the extent of Grassland to the north-west, there is a sufficient distance for a grassfire to generate intensity although the existing road network including Gillies Road would act as a buffer from this aspect and aid in suppression efforts.

The main threat to the area would be from bushfire approaching from the south or south-west. Shorter fire runs could occur between Bald Hills Road and the site which would transect through the Pine plantation and through the vegetation located amongst the lower density residential development. The density of vegetation within this area could support a fire front approaching the site although the fragmented nature of the fuel load and Ascot-Creswick Road would act as a buffer.

There is also the potential for longer fire runs to progress from the south and harbour intensity through Creswick Plantation. A fuel break is in position along the northern perimeter of the plantation although under extreme conditions a significant number of embers could be generated causing spot fires ahead of the fire front and supporting progression through to impact to the site.

5.2 Ground-truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Investigation Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 19, Figure 20 and Figure 21.

5.2.1 Observed conditions

Refer to Map 7 and Map 8 for this Growth Area for a summary of the bushfire conditions.

The investigation area consists of paddocks amongst scattered dwellings which are considered as Grassland vegetation. There are some lots containing a higher density of vegetation and would be considered as Woodland/Forest.

Riparian vegetation is present along Creswick Creek which runs through the southern portion of the site and is considered as Forest vegetation.

Long point Bushland Reserve is located in the south-eastern corner of the site and consist of Forest vegetation. There are also patches of vegetation scattered along the southern boundary of the site and within the 150m assessment area further south which are considered a mixture of Forest/Woodland vegetation.

Slopes within this area were predominately level. As per AS3959–2018, Table 3 below provides the distances required to meet the defensible space requirements for BAL–12.5.

Table 3. Defendable space requirements.

Vegetation type	Woodland	Forest	Grassland
Slope (up/down)	Level	Level	Level
Slope (degrees)	0–2°	0–2°	0–2°
Defendable space required for BAL 12.5 (m)	33	48	19

A Fuel Hazard Assessment as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines et al. 2010a) was performed at the eastern extent of which Creswick Creek passes through the Area (within the 150m assessment area). The results obtained were typical of what is standard for forest type vegetation as per AS3959–2018 (see Appendix 1 for the results).

The canopy cover was 60% which falls within the expected 30–70% foliage cover for Forest vegetation. The understorey fuel load was 22 tonnes/ha with a total fuel load (including the canopy) of 31 tonnes/ha which is similar to the standard 25/35 tonnes/ha for Forest vegetation. A fuel load assessment was also undertaken within Long Point Bushland Reserve within the south-western corner of the site with a result of 26/34 tonnes/ha.

5.2.2 Access

Perimeter access is provided for via Gillies Road along the western boundary, Ascot–Creswick Road along the southern boundary and Clunes Road along the eastern boundary. an internal road network provides access to the residential development north of Creswick creek. Access is comparatively less south of the creek with few roads available which still have restricted access to the north. The ring road provides access over Area 8 and then over Creswick Creek.

The investigation area has the potential to cater for additional access provided the existing conditions. There is however limited access crossing Creswick Creek which may require consideration if higher density development is proposed within this southern portion of the investigation area.

5.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 22 and Figure 23

The VFRR only categorised the land within the south-eastern portion of the Investigation Area which then extends into Creswick. The risk is considered High due to the proximity to the vegetated landscape to the south and the threat is considered Medium due to the minimal vegetation present within this developed area.

5.4 Site analysis

Considering all of the results above, Investigation Area 3a was divided into a number of areas based on the conditions and usage observed and determine the risk posed to each area and the hazard it poses to the surrounding areas. The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 22 and Figure 23.

Area 1

Location	Open farmland North of Creswick River
Risk category	Low
Hazard category	Medium
Details	This area is surrounded primarily by open farmland although does border the riparian vegetation through Creswick Creek to the south. The risk is considered low as a grassfire approaching under prevailing conditions would be buffered by the existing road network. A bushfire approaching through Creswick Creek would transition to a lower intensity grassfire and there is sufficient access into the site for emergency service vehicles to address a threat. The hazard is considered Medium as the site is large enough for a grassfire to move through and impact Area 4 although the hazard is reduced due to the management present and due to the ample access for emergency service vehicles for suppression efforts.

Area 2

Location	Open farmland along the western boundary of the site
Risk category	Medium
Hazard category	Low
Details	Consists of open paddocks to the west of the site within the 150m assessment area. A grassfire approaching under prevailing conditions would transect the landscape largely unimpeded hence the medium risk. The hazard is however considered low due to Gillies and Moores Road acting as a fuel break between this area and the subject site.

Area 3

Location	Open farmland east of Clunes Road
Risk category	Low
Hazard category	low
Details	Similar to Area 2 consisting of open farmland located outside of the Investigation Area although within the assessment area. The risk is considered low as grassfire approaching under prevailing conditions is less likely. The hazard is considered low due to Clunes Road acting as a sufficient buffer between this area and the site.

Area 4

Location	Creswick creek running through the centre of the site
Risk category	Medium
Hazard category	High
Details	Consists of the riparian vegetation along Creswick Creek. A grassfire approaching under prevailing conditions through Area 1 could ignite this area although the risk is reduced due to the existing road network. The hazard is considered High as a fire within this area could cause ignition to Area 5 which could then progress further south. This same scenario could also occur to Area 10 although is less likely under prevailing conditions.

Area 5

Location	South of Creswick Creek adjacent to Fisher Road
Risk category	High
Hazard category	High
Details	Patch of vegetation that runs between Creswick Creek and Ascot-Creswick Road. A fire run from the north-west could propagate through Creswick Creek and into this area. A fire run from the south-west could begin south of Ascot-Creswick Road within pine plantation and progress to the north where connective vegetation is present through to and within the area. The hazard is also considered high given the fuel load present within the site that could support fire progression.

Area 6

Location	Narrow area of farmland between Creswick Creek and Ascot-Creswick Road
Risk category	High
Hazard category	Medium
Details	This area is surrounded by vegetation from the majority of aspects. A fire front could impact the site from the south transecting through pine plantation and the fuel loads south of Ascot-Creswick Road. Fire runs can also approach from the north-west through Creswick Creek with no real buffers present. Egress from this area is also limited to the south. The hazard is considered medium as the farmland here could support a grassfire although there is a degree of management present and the area is comparatively small.

Area 7

Location	Farmland between Creswick Creek and Gillies Road.
Risk category	Medium
Hazard category	Medium

Details	Consists of open paddocks with Creswick Creek to the east and Long Point Bushland Reserve to the south. Under prevailing conditions Grassfire could approaching from the north-west through adjacent paddocks to the west or a bushfire through Creswick Creek. In either event approach would be buffered by Gillies Road which is a main bitumen road. Approach from the south or south-west would also be buffered by the road network. Ember attack still poses a risk which could ignite the grassland within the site which could have the capacity to support fire if left within an unmanaged state.
---------	--

Area 8

Location	Farmland within the south-eastern corner portion of the site
Risk category	Medium
Hazard category	Medium
Details	Borders Creswick Creek to the north and Ascot-Creswick Road to the south. Grassfire could approach from the north-west then intensify through Creswick Creek but impact to the site would see a transition back to a lower intensity grassfire. The road network to the north-west would also buffer grassfire approaching from within the broader landscape. There is connective vegetation present from the south-west along existing residential development along Ascot-Creswick Road which would buffer fire runs from this aspect. There is however the risk of spot fires through embers igniting grassland within the site.

Area 9

Location	South-western corner of the assessment area.
Risk category	High
Hazard category	High
Details	Consists of vegetation amongst some scattered dwellings. This area is adjacent to Addington Creswick Road Dowling Forest with no real buffer present. The hazard is also considered high due to the high fuel load present within the site.

Area 10

Location	South-western corner within the subject site
Risk category	High
Hazard category	High
Details	Consists of the Long Point Bushland Reserve. The area is nearby the plantation to the west and vegetation to the south so the risk is considered high. The hazard is also considered high due to the present fuel load within the reserve.

Area 11

Location	Southern boundary of the assessment area
Risk category	High
Hazard category	Medium

Details	Lower density development along Ascot–Creswick Road. Connective vegetation from the main hazard to the south is present through to this area so a full fire front could impact. The hazard is considered medium as vegetation is present within the smaller lots although is managed throughout the majority.
---------	---

Area 12

Location	Centre of the site's southern boundary
Risk category	Medium
Hazard category	High
Details	Patch of vegetation neighbouring Area 8 . Connective vegetation is present through to the south so a fire front approach from this aspect could cause ignition to this area and conversely a grassfire from the north–west could ignite this area and threaten adjacent areas. The risk is however reduced through existing development and road network to the south acting as a buffer.

Area 13

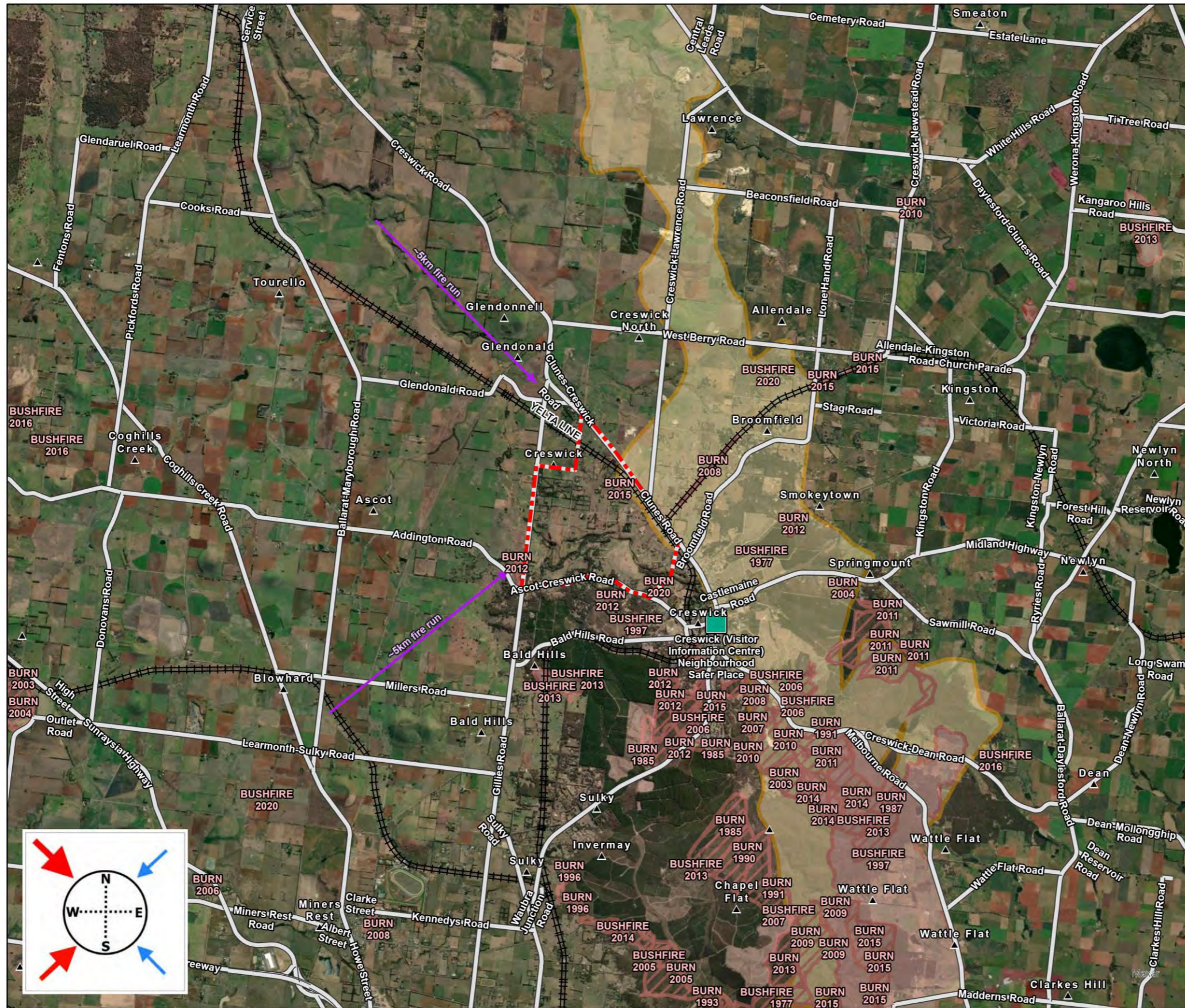
Location	South–eastern portion of site
Risk category	Medium
Hazard category	Low
Details	Lower density residential development north of Ascot–Creswick Road. The risk is medium as there is the potential for fire front impact from the south west being the main bushfire hazard although approach would be buffered from existing development to the south and the existing road network. The hazard is low as little vegetation is present and is being managed.

Area 14

Location	East of the Ring Road below Creswick Creek
Risk category	Low
Hazard category	Medium
Details	Creswick Landfill. The risk is low as fire impact is largely restricted to shorter length grassfires due to the surrounding development acting as a buffer from larger scale fire runs in the broader landscape. The Grassland vegetation within the area could however support fire progression into adjacent areas.

Area 15

Location	Most eastern extent of the assessment area
Risk category	Low
Hazard category	Low
Details	Existing higher density development within Creswick North. The area is located nearby grassland vegetation to the west although amongst smaller lot sizes with an internal road network so the risk is reduced to low. The hazard is considered low given the minimal vegetation present amongst the higher density development.



Bushfire Hazard Landscape Assessment
Creswick Township Structure Plan
Zone 3a

Legend

- Subject Site
- Town centre
- Major Roads
- Railways
- Neighbourhood Safer Place
- Potential fire runs

Fire History

Bushfire

- Bushfire 1950–1979
- Bushfire 1980 onwards

Planned Burn

- Planned Burn 1980 onwards

Details
Mapping by: Ali Nia and Julian Drummond
Date: 27/06/2022
Version: 1
Aerial photography from ArcGIS World Imagery.
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

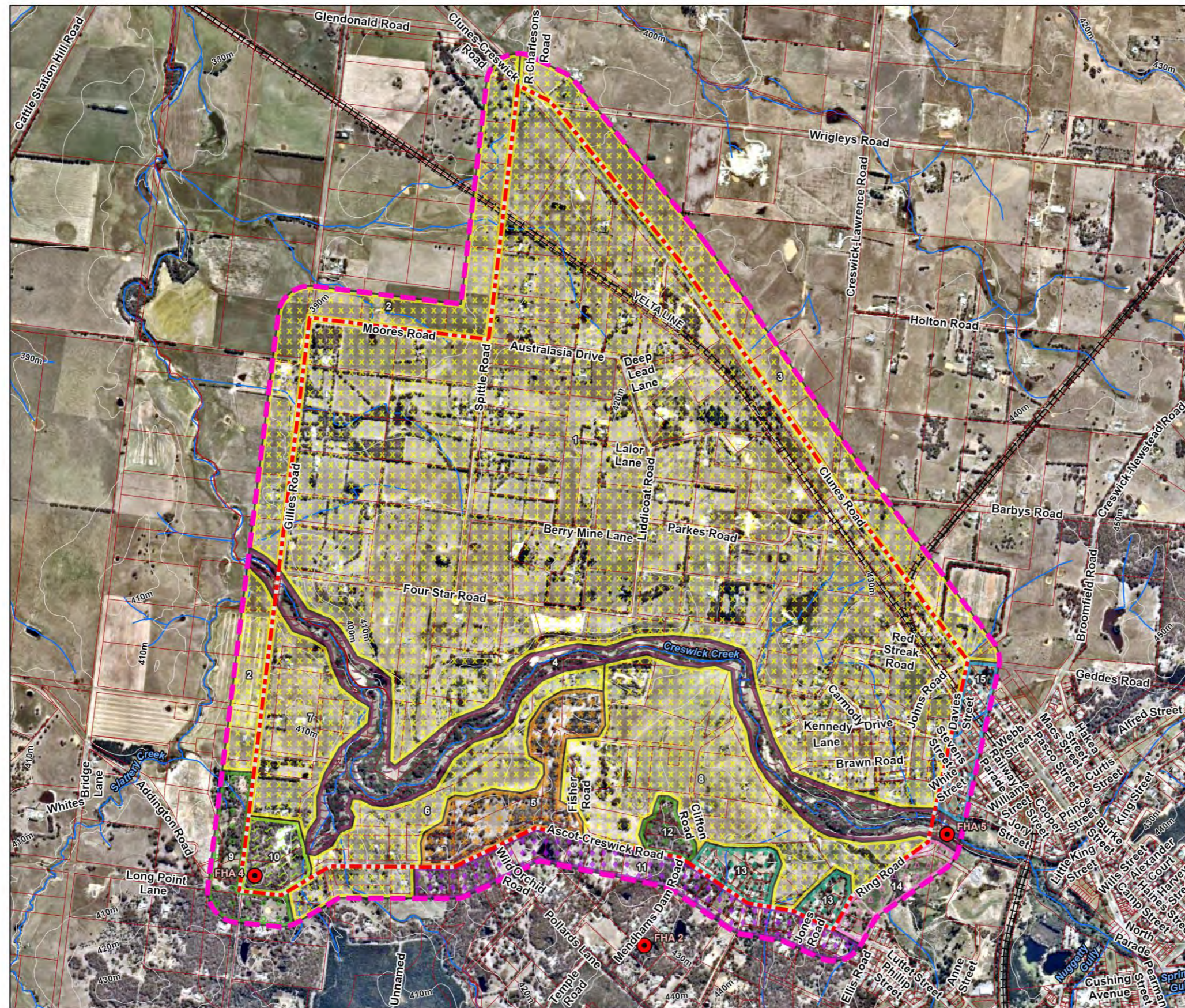
N
0 1000 2000 m

Scale: 1:80,000 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.



Figure 20. Bushfire Hazard Landscape Assessment within Investigation Area 3a



Bushfire conditions
Creswick Township Structure Plan
Zone 3a

Legend

- Subject Site
- Assessment Area (150m)
- Parcels
- Contours (10m)
- Roads (don't display in legend)
- Natural watercourse
- Railways
- Fuel Hazard Assessments

Bushfire conditions

- Vegetation on private land
- Low density development amongst vegetation
- Low-density development
- Managed paddocks
- Managed paddocks with some vegetation
- Residential development
- Long Point Bushland Reserve
- Creswick Creek
- Creswick Landfill

Details

Mapping by: Ali Nia and Julian Drummond
Date: 29/06/2022
Version: 1
Aerial photography from Nearmap (Mar. 2022).
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

N

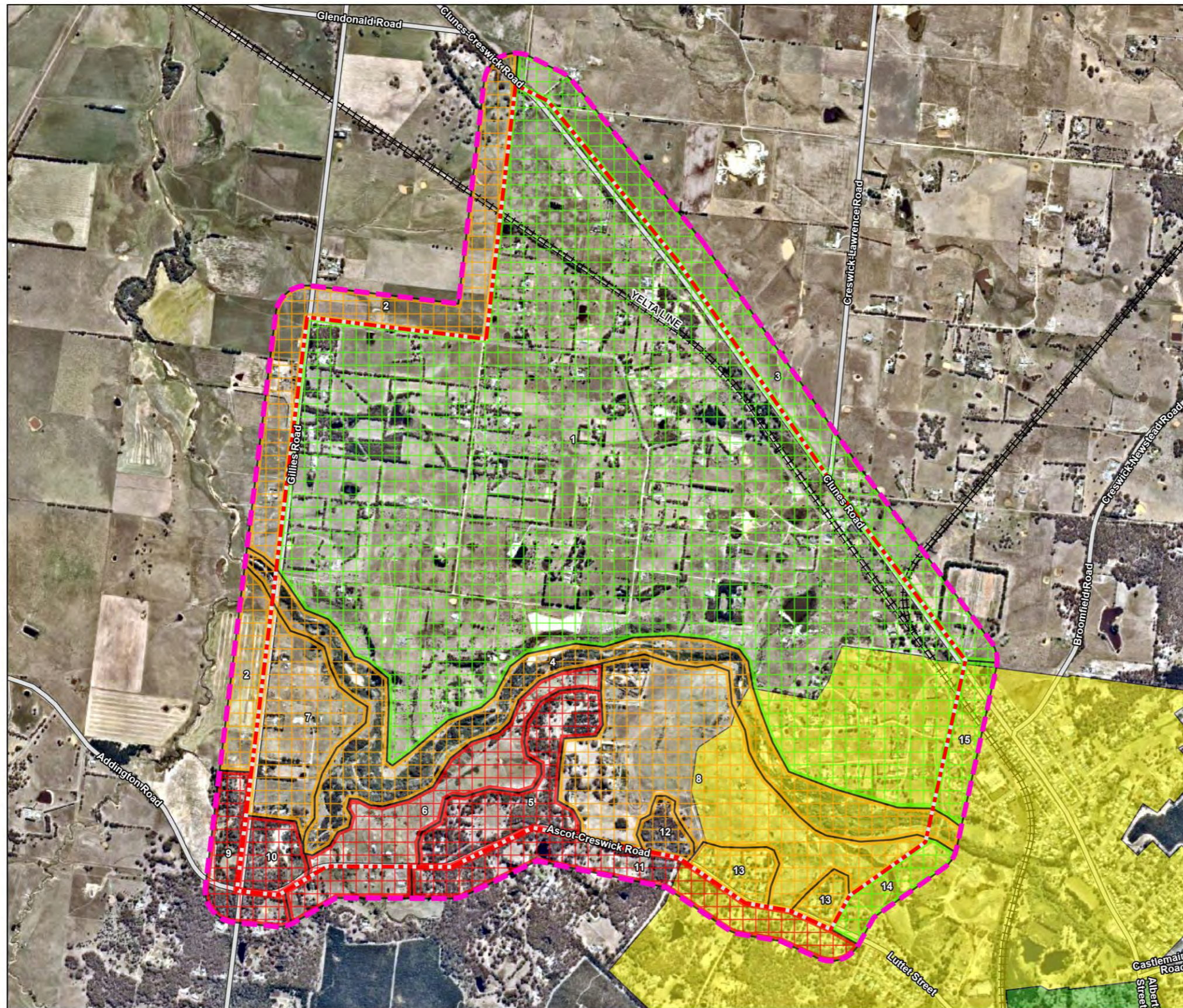
0 100 200 300 m

Scale: 1:17,300 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

PRACTICAL ECOLOGY
ecological restoration & consulting
p: (03) 9484 1555 e: enquiries@practicalecology.com.au

Figure 21. Observed conditions within Investigation Area 3a



Bushfire risks

Creswick Township Structure Plan
Zone 3a

Legend

- Subject Site
- Assessment Area (150m)
- Major Roads
- Railways

Bushfire risks

- High
- Medium
- Low

VFRR risk rating

- Extreme
- Very High
- High
- Medium
- Low

Details

Mapping by: Ali Nia and Julian Drummond
Date: 29/06/2022
Version: 1
Aerial photography from Nearmap (Mar. 2022).
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

N
0 100 200 300 m

Scale: 1:17,300 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

PRACTICAL ECOLOGY
ecological restoration & consulting
p: (03) 9484 1555 e: enquiries@practical-ecology.com.au

Figure 22. Determined Bushfire risks within Investigation Area 3a

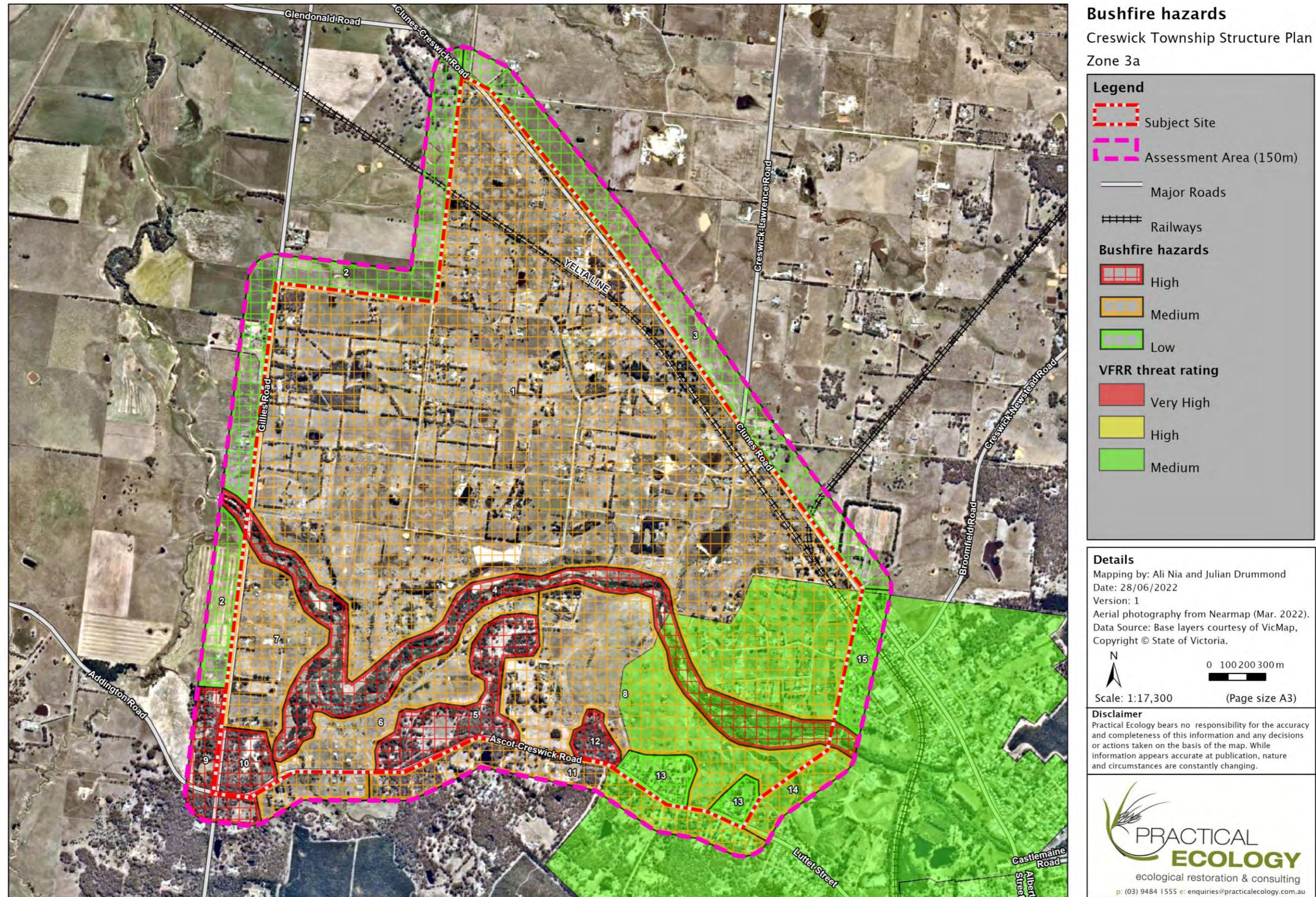


Figure 23. Determined Bushfire Hazards within Investigation Area 3a

5.5 Summary of Findings and Recommendations

Regarding Clause 13.02–1S Bushfire Planning, overall, Investigation Area 3a does have the capacity for certain areas to support population growth and meet the requirements under the ‘Settlement Planning’ Strategy. The investigation area is positioned to the north–west of Creswick away from the main bushfire hazard further south. The majority of the area is void of any large vegetated areas that could pose a risk so the main threat here is from grassfire within the site that has the capacity to be addressed through development. Creswick Creek does run through the centre although it would be unable to support a full fire front and emergency service vehicles would have easy access during suppression efforts. The predominately cleared landscape also allows for the provision of additional internal roads where required to ensure immediate access and egress in an emergency situation.

The ecological assessment did determine that there were some patches of native grassland of varied quality throughout the Investigation Area along with some patches of vegetation to the south of the creek that should ideally be retained to ensure vegetation connectivity further south. Development will therefore have to ensure appropriate setbacks under AS3959–2018 are enforced in response to any retained patches of vegetation.

The following recommendations are based on the identified areas within the Investigation Area:

- Area 1 within the northern portion of the Investigation Area allows for sufficient separation from the main bushfire risk to the south whilst still ensuring suitable access and egress options via the surrounding perimeter roads which also act as a buffer from grassfire approach under prevailing conditions. It would be recommended to place lower density development adjacent to Creswick creek before a transition to higher density development further north. This creates a buffer of lower population but managed areas between the bushfire hazard (Creswick Creek) and the more populated areas to the north. Development will have to ensure that the appropriate setback is put in place from the forest vegetation throughout Creswick Creek, the Forest vegetation within Long Point Bushland Reserve and any vegetated area proposed for retainment.
- Additionally, within Area 1, lower density development would be recommended along the interface between Area 2 and Area 3 as to act as a buffer from the farmland present and associated grassfire runs. This would reduce the overall hazard and allow for a more gradual progression from farmland to township
- To the south of the Creek the risk is increased due to the proximity to the main bushfire risk to the south. Area 7 has the capacity to support lower density development as fire runs under prevailing conditions would be buffered by the surrounding road network which also provides for immediate access to the north via Gillies Road away from the main hazard to the south. Development must ensure appropriate setbacks from the Forest vegetation through Creswick Creek and from the Bushland reserve to the south.

- Area 8 and 12 also have the capacity to support lower density development similar to what is existing within Area 13 as there is enough room here to provide for sufficient separation from Creswick Creek and from the hazard to the south. Ascot-Creswick Road also allows for immediate access into Creswick to the south although it would be recommended to provide additional access to the north over Creswick creek to ensure access and egress is made available away from bushfire approach from the south. The ecological assessment identified the vegetation within Area 12 to be of lower quality so if this was to be removed the risk would be reduced, if not the appropriate setback would have to be applied
- Area 6 is considered of higher risk due to the smaller area available which is nestled between Creswick creek to the north, Long Point Bushland Reserve to the west and Area 5 to the east which has been considered of higher ecological value due to the vegetation connectivity it provides. Application of setbacks may be difficult here and access is currently limited to the south. A fire run from the south-west would transect largely unmanaged vegetation as opposed to the land to the south of Area 8 which sees more management due to the residential development, this consequently increases the risk of fire front impact.

6. INVESTIGATION AREA 3B

Investigation Area 3b is approximately 129 ha and consists of lower density residential development amongst patches of vegetation. The area is located between Ascot-Creswick Road and Creswick Plantation to the south. The following zones apply as shown on Figure 24.

- Rural Living Zone – Schedule 1 (RLZ1)
- Low Density Residential Zone – Schedule 1 (LDRZ1)

The Bushfire Management Overlay covers the majority of the Investigation Area.

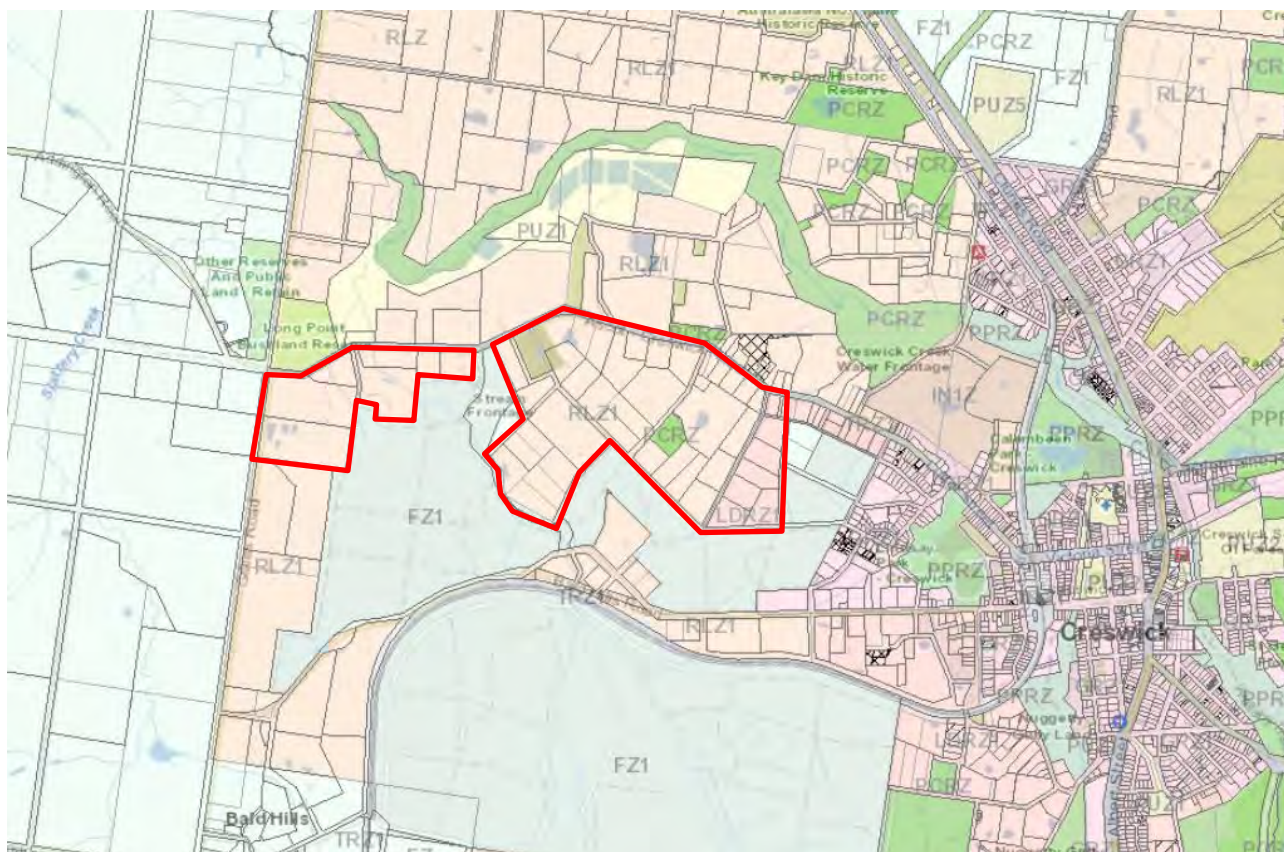


Figure 24. Investigation Area 3b

6.1 Bushfire Hazard Landscape Assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away from the Growth Area. The surrounding landscape is displayed on Figure 25 and the Bushfire Hazard Landscape Assessment is displayed on Figure 26.

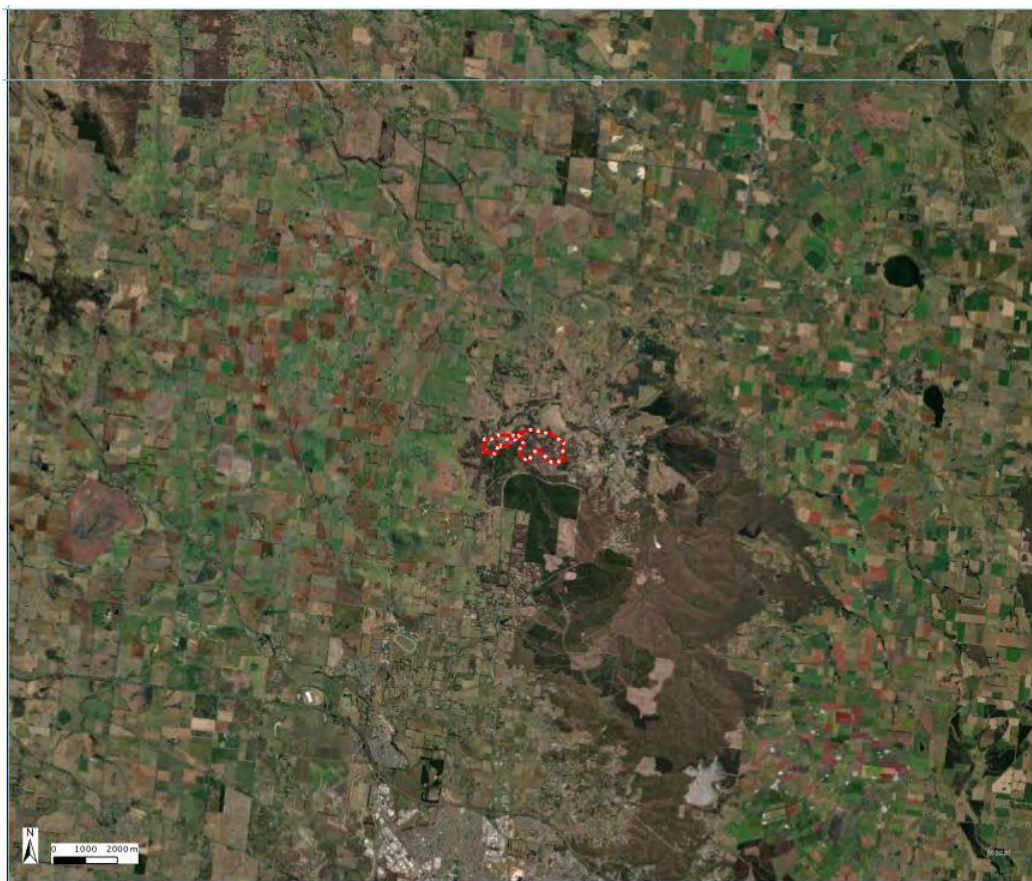


Figure 25. Landscape surrounding Investigation Area 3b

6.1.1 Local landscape

Paddocks are present to the north with scattered dwellings and patches of vegetation present throughout. Pine plantation adjoins the area immediately to the south and extends through as part of the Creswick Pine Plantation. Gillies Road marks the western boundary of the site with some vegetation present adjacent to this boundary although it does shortly transition to open farmland further west. The higher density development of Creswick is present to the east of the site.

6.1.2 Wider landscape

The site is located to the north-west of higher density development within Creswick and is the transitional point between the pine plantation to the south and the more open farmland to the north. At the wider scale, the town centre is positioned within a densely vegetated landscape consisting of both pine plantation and the native vegetation throughout Creswick Regional Park.

The Creswick Pine Plantation is located to the east of the town centre and extends on either side of the Midland Highway covering a large proportion of the vegetated area through to Smokeytown/Springmount. The plantation is also located to the south-west and extends further south beyond the Township of Sulky. The Creswick Regional Park covers much of the landscape to the south-east on an undulating topography with connective vegetation present through to Ballarat further south.

Beyond this, the broader landscape is dominated by open farmland for many kilometres to the north, east and west. The city of Ballarat is located approximately 12km to the south of Creswick.

6.1.3 Bushfire History

A large bushfire impacted much of the eastern side of Creswick in 1977 although did not impact the Investigation area. a bushfire did however impact the south–eastern corner of the Investigation Area in 1997. A bushfire also occurred to the south of the site in 2013 within the Pine plantation. Many prescribed burns have occurred within the surrounding area including within Mendham’s Dam Reserve in 2012 located at the centre of the Investigation Area.

6.1.4 Landscape bushfire scenarios

Fire approaching from the north–west would transect a mixture of Grassland and Forest/Woodland fuel loads as it approaches closer to the site. An ignition within Long Point Bushland Reserve or the other smaller patches of vegetation along Ascot–Creswick Road could aid in the transmission of fire into the site through ember attack. There is also the risk of approach from the north–west igniting Addington Creswick Road, Dowling Forest which is a pine plantation.

An ignition within this area could propagate through the plantation and enter the canopy via the vertical fuel continuity associated with pine species. Addington and Gillies Road to the west of the site would act as a fuel break from this aspect although ember attack is a significant threat which could cause spotting within the site and subsequently propagate fire further south–east.

The main risk however is from bushfire approach from the south or south–west due to the extent of the Creswick Plantation through this area. The continuity of fuels is able to support the transmission of a full fire front into the site and the current fuel load within the site has the capacity to further support progression.

6.2 Ground–truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Growth Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 27, Figure 28 and Figure 29 Observed conditions

Refer to Figure 29 for a summary of the bushfire conditions.

The vegetation observed within the assessment area was Forest/Woodland and Grassland. As per AS3959:2018, Pine plantation is also considered as Forest vegetation. Slopes within this area were predominately level. As per AS3959–2018, Table 4 provides the distances required to meet the defensible space requirements for BAL–12.5.

Table 4. Defendable space requirements.

Vegetation type	Woodland	Forest	Grassland
Slope (up/down)	Level	Level	Level
Slope (degrees)	0–2°	0–2°	0–2°
Defendable space required for BAL 12.5 (m)	33	48	19

A Fuel Hazard Assessment as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines et al. 2010a) was performed within the Mendhams Dam Recreation Reserve. The results obtained were typical of what is standard for forest type vegetation as per AS3959–2018 (see Appendix 1 for the results). The canopy cover was 40% which falls within the expected 30–70% foliage cover for Forest vegetation. The understorey fuel load was 27 tonnes/ha with a total fuel load (including the canopy) of 33 tonnes/ha which is similar to the standard 25/35 tonnes/ha for Forest vegetation.

6.2.1 Access

The main form of access from Creswick would be Ascot–Creswick Road which lines the northern boundary of the site. This road also adjoins to Gillies Road to the west which marks the western boundary of the area. A combination of roads provides for access along the southern boundary. These gravel roads run across the boundary of the plantation to the south and double as a fuel break between fuel loads. All roads to the south pass-through vegetated areas.

6.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 28 and Figure 29

The VFRR only categorised the land to the east of the Investigation Area closer into Creswick. The risk has been categorised as High due to the proximity to the fuel load to the south and the Hazard has been considered as Medium due likely to the higher degree of management occurring within the vegetated areas here.

6.4 Site analysis

Considering all of the results above, Investigation Area 3b was divided into a number of areas based on the conditions and usage observed and determine the risk posed to each area and the hazard it poses to the surrounding areas. The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 28 and Figure 29

Area 1

Location	Western extent of the assessment area
Risk category	High
Hazard category	High
Details	Area of dense vegetation along Gillies Road with a single dwelling located within. Connective vegetation extends to the south west and pine plantation located to the north–west so the risk is considered high as a full fire front could impact. The fuel load within the area could also support the progression of fire to impact adjacent areas.

Area 2

Location	Western extent of the subject site
Risk category	High
Hazard category	High
Details	Single dwelling amongst Forest and Woodland vegetation. Provided the amount of vegetation in the adjacent area a fire front could approach under prevailing bushfire conditions and impact the area. The existing road network would act as a buffer although ember attack could ignite the fuel load within the site which could in turn support fire progression to impact adjacent areas.

Area 3

Location	Bushland reserve on the corner of Gillies Road and Ascot-Creswick Road
Risk category	High
Hazard category	High
Details	Long Point Bushland Reserve consisting of Forest vegetation. This area is located nearby to the pine plantation to the west. Fire runs from either aspect under prevailing conditions could see fire front impact to the area and the fuel load present within would support fire progression through to other areas.

Area 4

Location	Pine plantation along the southern extent of the assessment area
Risk category	High
Hazard category	High
Details	A portion of Creswick Pine Plantation that adjoins the southern boundary of the site. Fire runs from the south or potentially south-west could propagate through the pine plantation and cause a full fire front to impact the site. There is a fuel break along Railways Road providing somewhat of a buffer from the larger area of plantation to the south although given the high fuel load and associated intensity of fire within Pine Plantation and the likelihood of embers causing spot fires further north, the hazard is considered High.

Area 5

Location	Mixture of farmland and managed low-density development between Creswick plantation and Ascot-Creswick Road.
Risk category	High
Hazard category	Medium
Details	This areas proximity to Creswick Plantation to the south warrants a High-Risk categorisation given the ability of a full fire front from the south to impact the area. The hazard is considered medium as there is some woodland/Forest vegetation although it is predominately farmland subject to a degree of management.

Area 6

Location	Open Farmland north of Ascot Creswick Road within the assessment area
Risk category	Medium
Hazard category	Medium
Details	Open farmland with scattered dwellings which adjoins Long Point Bushland Reserve to the west. Fire runs approaching under prevailing conditions could impact the site although the fragmented nature of the fuel load and existing road network acting as a buffer reduced the risk somewhat. A fire front from the south through Creswick Plantation could be buffered by Area 5 and Ascot-Creswick Road. The area could support the progression of a grassfire although some management is present which would aid in suppression efforts.

Area 7

Location	Forest/Woodland vegetation running between the sites within the assessment area
Risk category	High
Hazard category	High
Details	Consists of Forest/Woodland vegetation and includes the vegetated drainage line that runs between the plantation and Area 11 . The risk is considered High as a full fire front approaching from the south-west could impact this site with few buffers present to mitigate this. The fuel load within the area has the capacity to support the progression of a fire front and then impact adjacent areas, specifically Areas 11 and 9 .

Area 8

Location	Patches of Forest/Woodland vegetation amongst farmland south of the site within the assessment area
Risk category	Medium
Hazard category	Medium
Details	The area contains fragmented patches of vegetation amongst farmland along Ascot-Creswick Road. The area is separated from the pine plantation to the south via the existing lower density development. The fuel load within this area could still however support a fire front moving from the south although the fuel load is fragmented and Ascot-Creswick Road would additionally act as a buffer. The hazard is considered medium as the patches of Forest/Woodland are fragmented by paddocks and there is a degree of management.

Area 9

Location	The Log Cabin School Camp
Risk category	High
Hazard category	Medium

Details	The extent of the Log Cabin Camp which contains patches of Forest/Woodland amongst managed areas associated with the camp facilities. There is the potential for a full fire front to impact the site from the south or south-west. There are buffers in place although under extreme conditions the amount of connective vegetation through to the south could support a fire front and spot fire through embers attack. Fire runs from the north-west could also impact although the vegetation is more fragmented through this aspect. The fuel load within the area is relatively high although management occurs throughout which reduces the hazard it creates to adjacent areas.
---------	---

Area 10

Location	Adjacent to the Log Cabin Camp. Lower density development along Ascot-Creswick Road.
Risk category	High
Hazard category	High
Details	Similar to Area 9 in the sense that a fire run from the south-west from the plantation has the potential to impact this area due to the connective vegetation present. The fuel load here is fragmented but there is a relatively larger patch to the east with less management occurring comparatively which could support fire progression

Area 11

Location	Lower density development adjoining the drainage line running along the southern boundary of the site.
Risk category	High
Hazard category	High
Details	This area adjoins the riparian vegetation along the creek which then transitions to pine plantation shortly after. This area could be impacted by a full fire front from the south-west with little buffers present to mitigate this. Fire could then progress through the fuel load within the site to impact adjacent areas.

Area 12

Location	Pine Plantation South of Pollards Lane within the assessment area
Risk category	High
Hazard category	High
Details	Pine plantation located along the southern boundary of the site which borders the lower density development to the north. Fire runs from the south west could ignite this area and additionally cause spot fires through ember attack. There is a fuel break along Railway Road although given the size of the plantation a fire run through this area has the capacity to generate in intensity and produce a considerable amount of embers causing spot fires further north. The plantation within the area would also support/intensify fire progression.

Area 13

Location	Between Mendhams Dam Road and Pollards Lane
Risk category	High
Hazard category	High
Details	This area consists of lower density development amongst vegetation and the Mendhams Dam Recreation Reserve which consist of Forest vegetation. The area adjoins to Area 12 to the south so there is a high risk from fire front impact from the south-west. The reserve and the fuel loads with the residential areas would also support fire progression through the area to impact adjacent areas.

Area 14

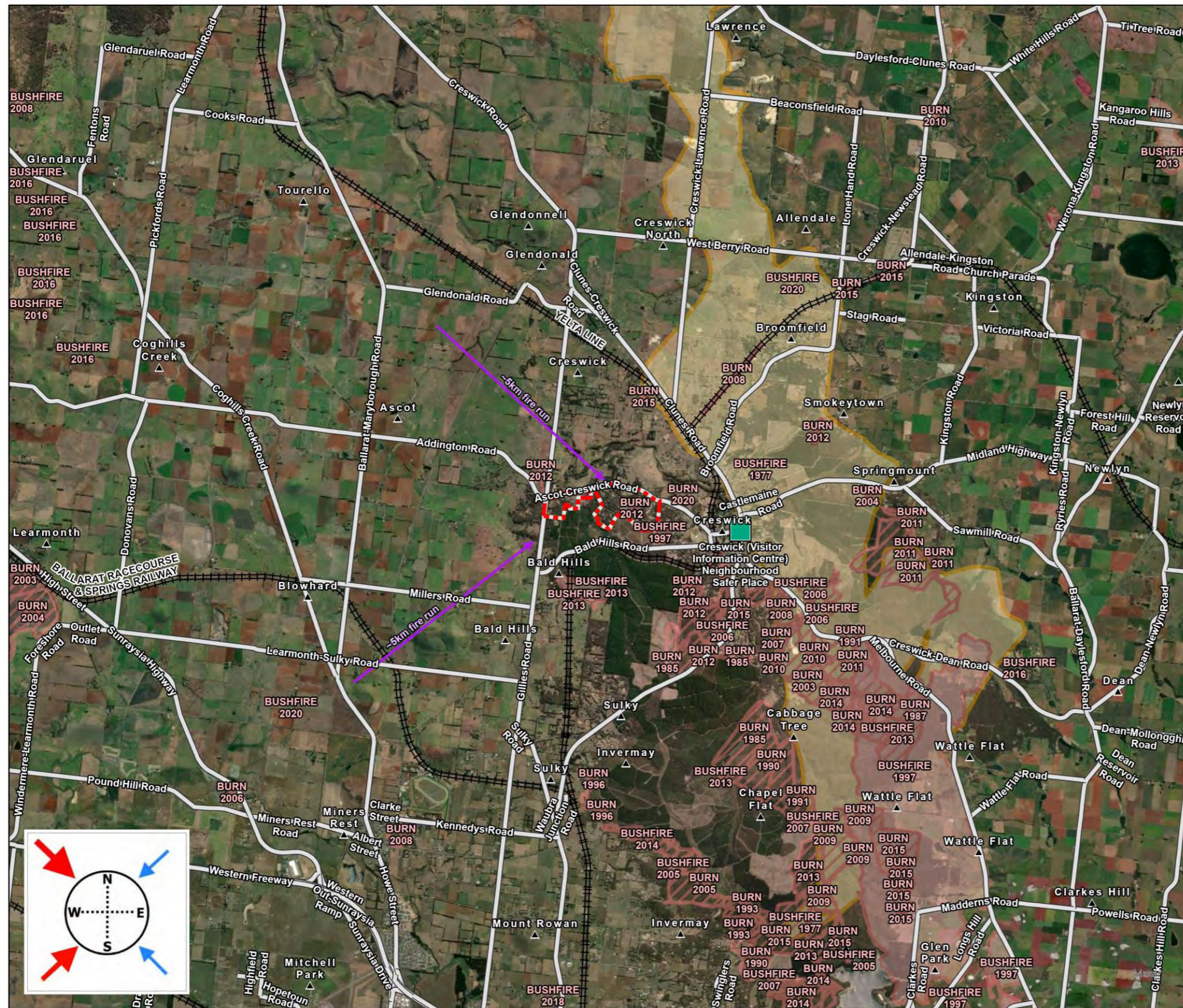
Location	Eastern extent of the assessment area
Risk category	High
Hazard category	High
Details	Farming zone consisting of Forest/Woodland vegetation which adjoins plantation to the south where a full fire front can impact from. Ignition to the area would present a significant hazard due to the residential development present on the fringes with no buffer/fuel break present between the two areas.

Area 15

Location	Lower density development on the eastern extent of the site along Ascot-Creswick Road
Risk category	High
Hazard category	Medium
Details	This area adjoins Area 13 to the south with similar lower density development. Fire runs from the south-west could pass through Areas 12 and 13 and impact the site. Area 14 also poses a risk here as no fuel break is separating this area from the development within the eastern half of Area 15 . The hazard is reduced as vegetation within this smaller lots is subject to a greater deal of management which supports a reduced fuel load.

Area 16

Location	North-eastern corner of the assessment area
Risk category	Medium
Hazard category	Low
Details	Lower density residential development similar to Area 15 . The risk is slightly reduced in this area as Area 13 and 15 provide separation from the main hazard to the south. There is still the possibility of fire front impact although the fragmented nature of the fuel load to the south along with Ascot-Creswick Road acting as a fuel break reduces the risk to medium. The hazard is considered medium due to the development of the areas and associated vegetation management.



Bushfire Hazard Landscape Assessment
Creswick Township Structure Plan
Zone 3b

Legend

- Subject Site
- Town centre
- Major Roads
- Railways
- Neighbourhood Safer Place
- Potential fire runs

Fire History

Bushfire

- Bushfire 1950-1979
- Bushfire 1980 onwards

Planned Burn

- Planned Burn 1980 onwards

Details

Mapping by: Ali Nia and Julian Drummond
Date: 27/06/2022
Version: 1
Aerial photography from ArcGIS World Imagery.
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

N
0 1000 2000m
Scale: 1:80,000 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

PRACTICAL ECOLOGY
ecological restoration & consulting
p: (03) 9484 1555 e: enquiries@practicalecology.com.au

Figure 26. Bushfire Hazard Landscape Assessment within Investigation Area 3b

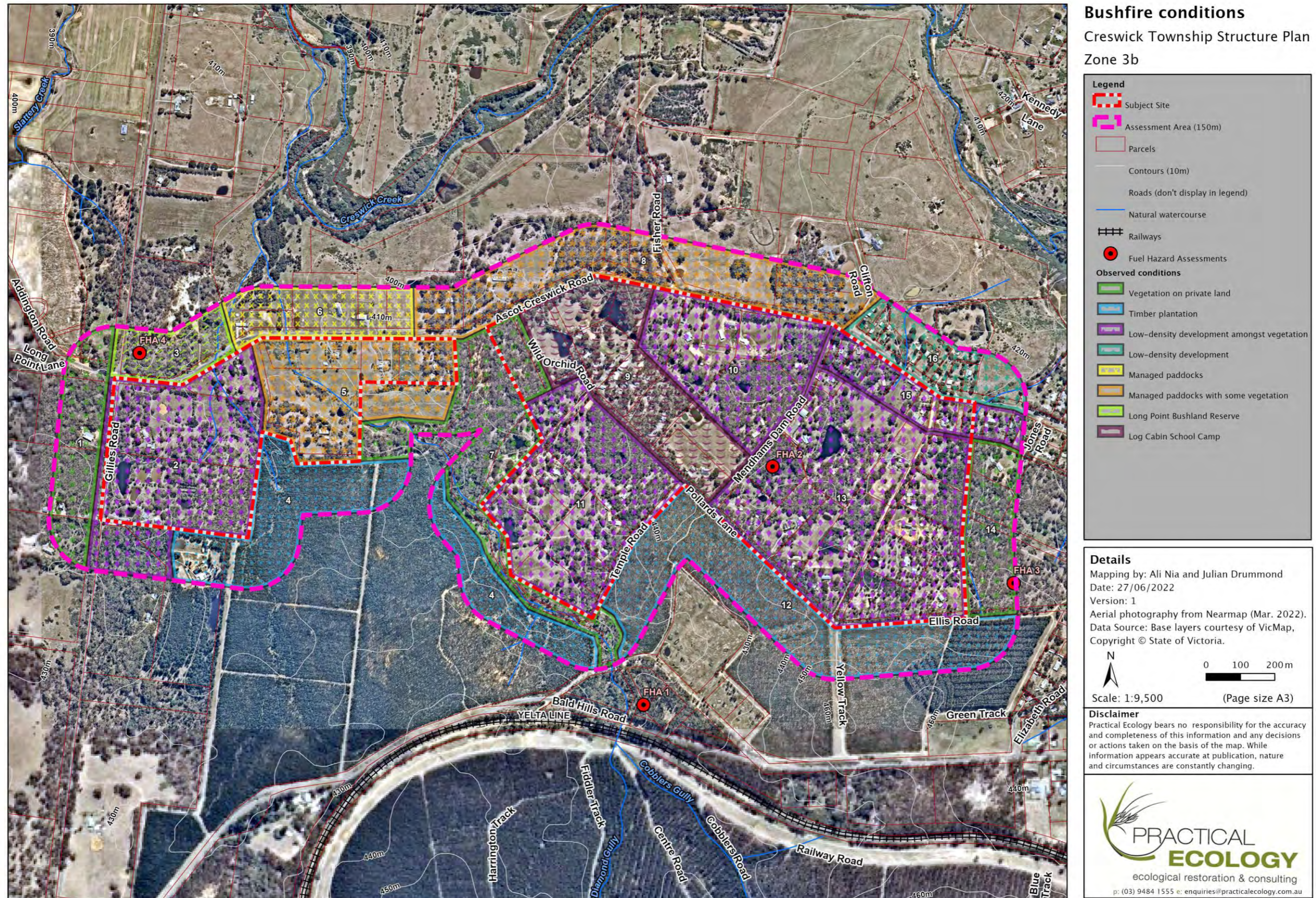


Figure 27. Observed conditions within Investigation Area 3b

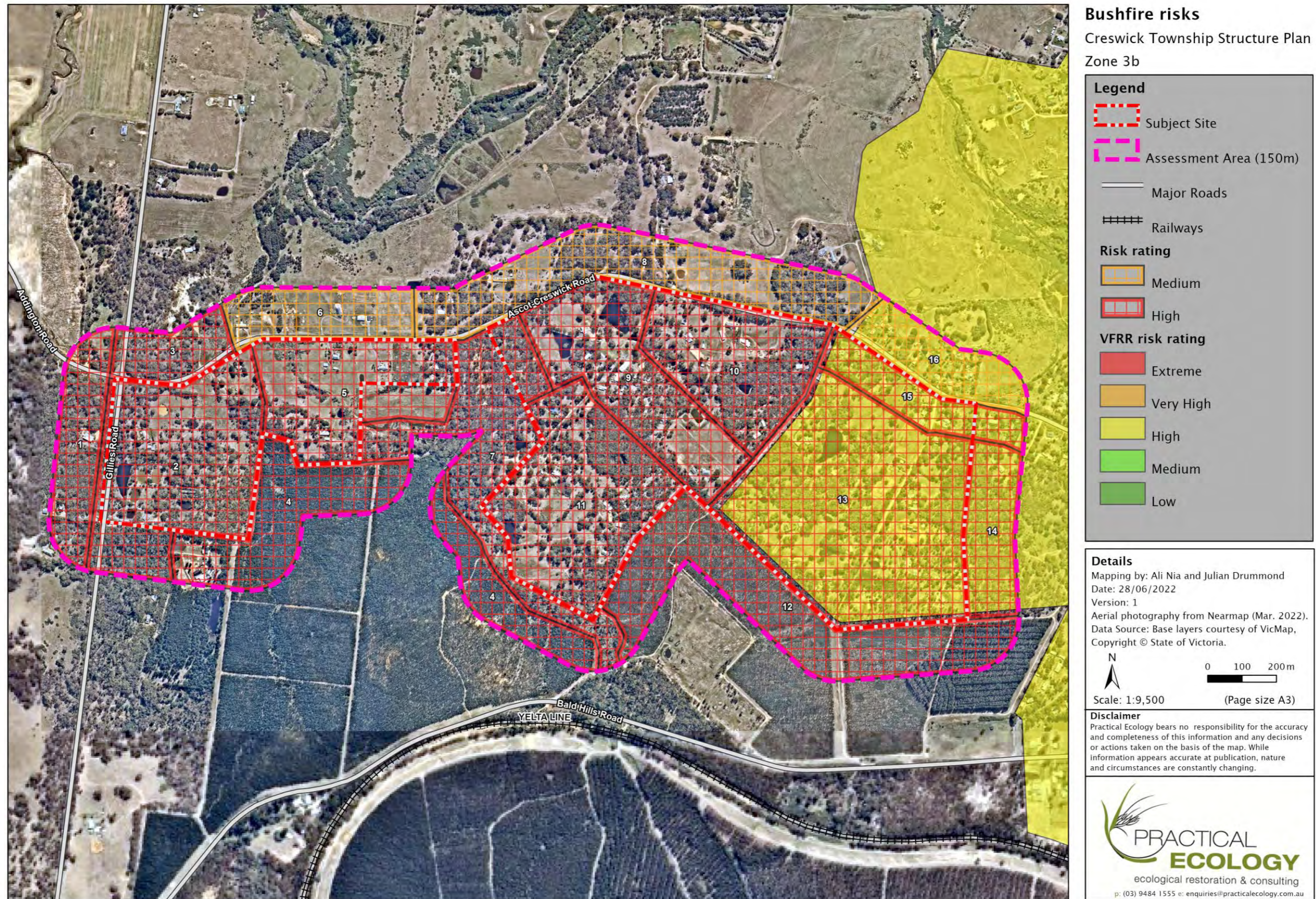


Figure 28. Determined bushfire risks within Investigation Area 3b

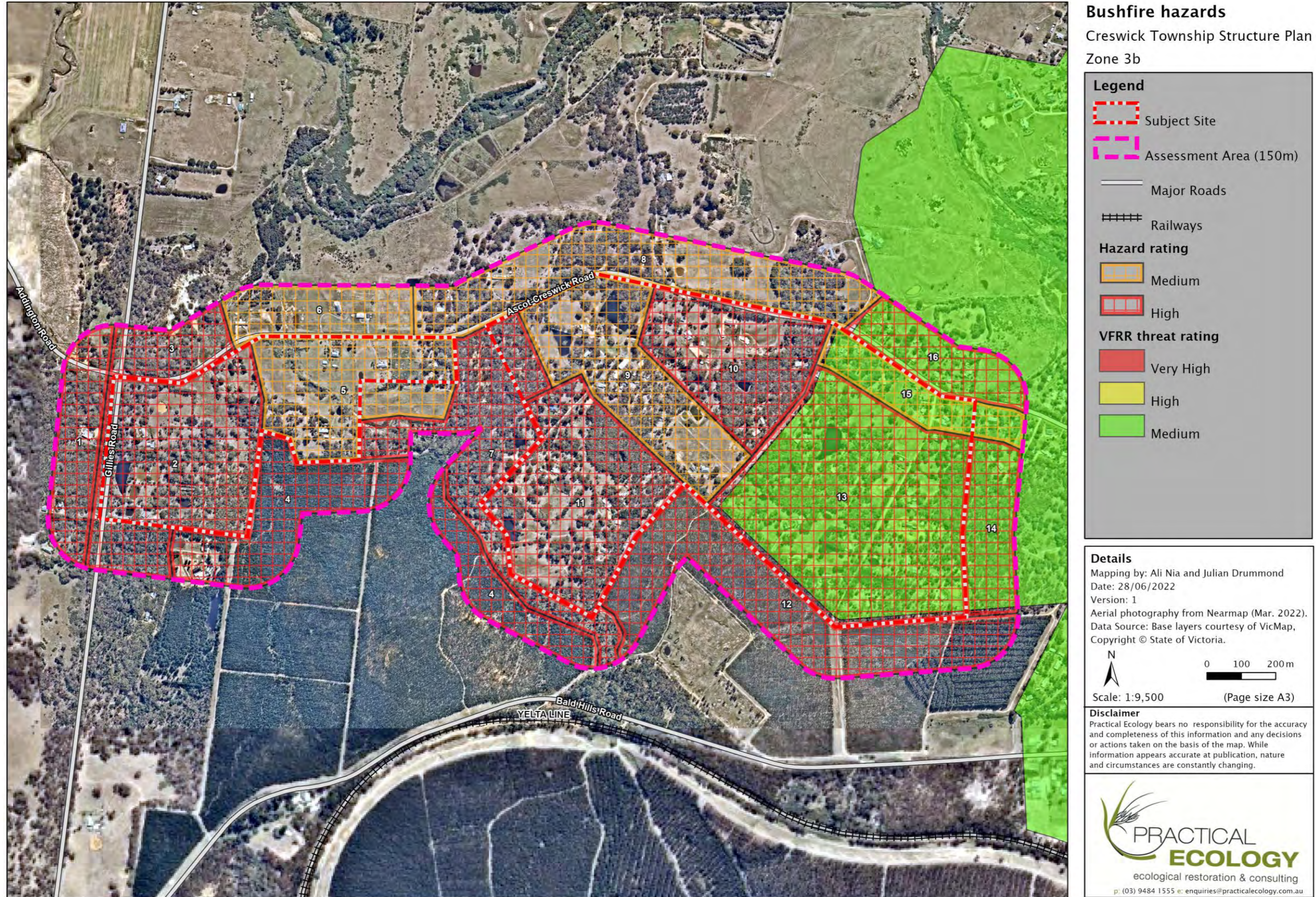


Figure 29. Determined bushfire hazards within Investigation Area 3b

6.5 Summary of Findings and Recommendations

Due to the Investigation Area being within a Bushfire Prone Area (BPA) and due to the presence of the Bushfire Management Overlay (BMO), bushfire risk needs to be considered at the planning level under Clause 13.02-1S Bushfire Planning.

Overall, the entirety of Investigation Area 3b has been considered of High risk. The positioning of this Area nearby the plantation to the south could conversely see a fire front move through the landscape from the south and cause fire front impact. A fuel break surrounds the larger extent of Creswick Plantation to the south although due to the associated intensity of plantation fires and the number of embers than can be produced, progression of fire could easily progress further north and see fire front impact to the site and/or spot fires through embers attack within the site.

Additionally, the Ecological assessment has determined that the vegetation located within the private lots is of moderate and above quality so removal of this vegetation to reduce bushfire risk is unlikely and would cause ecological impact above the threshold of what is considered acceptable under clause 13.02-1s. Considering this, it has been determined that this Investigation Area is not suitable for an increase in population density in any form because of both the hazard present within the site and from the proximity of Creswick Plantation to the south.

7. INVESTIGATION AREA 3C

Investigation Area 3c is approximately 33 ha and consists almost entirely of vegetation with the exception of a patch of cleared land within the northern most extent of the area. The land is zoned Rural Living Zone – Schedule 1 and is covered by the Bushfire Management Overlay (BMO). The following planning zones surround and occur within Investigation Area 3c as shown on Figure 26 below.

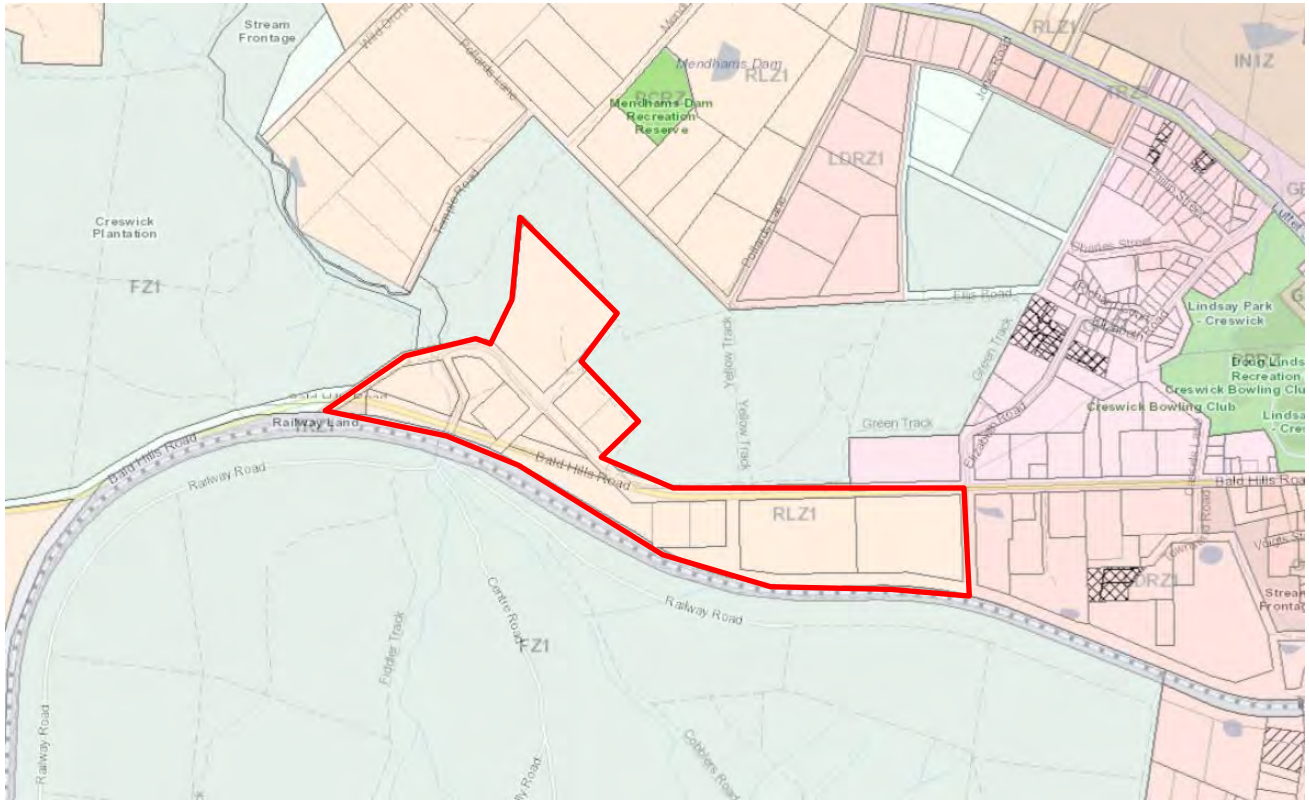


Figure 30. Investigation Area 3c zoning.

7.1 Bushfire Hazard Landscape Assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away from the Investigation Area. The surrounding landscape is displayed on Figure 27 below and the Bushfire Hazard Landscape Assessment is displayed on Figure 32.

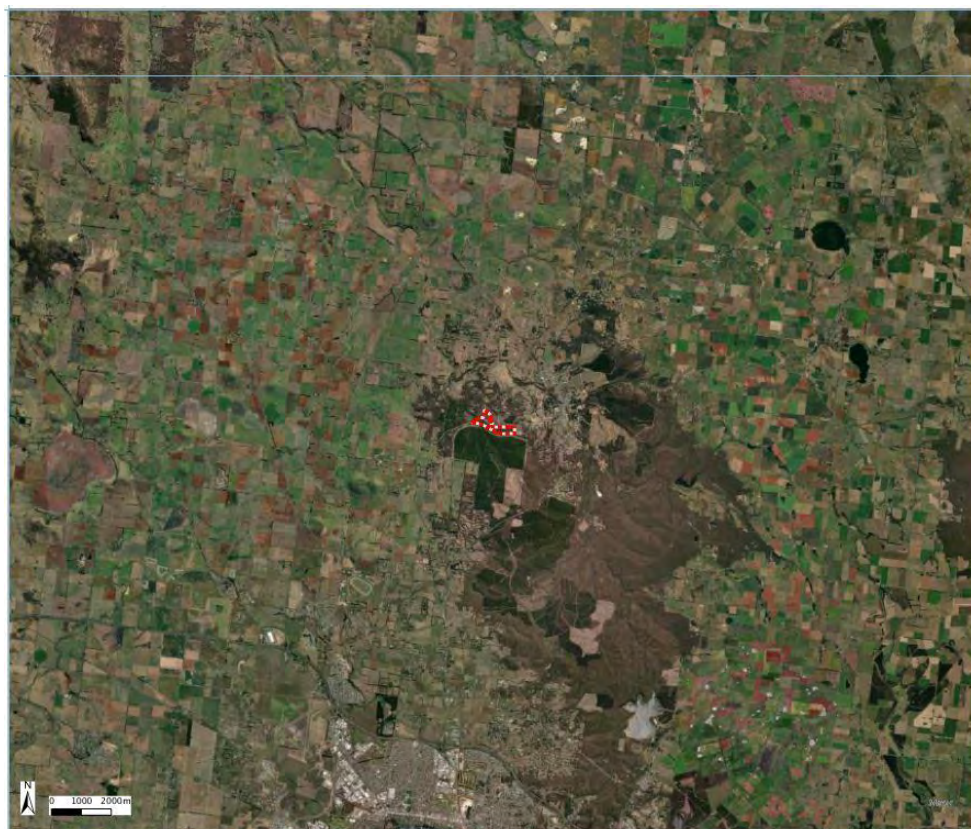


Figure 31. Landscape surrounding Investigation Area 3c

7.1.1 Local landscape

Pine plantation surrounds the immediate area to the north, south and west with existing development of Creswick to the east. A fire break is present to the south located between the plantation and the investigation area which also doubles as Railway Road.

The pine plantation to the north extends for approximately 200m before transitioning to lower density residential development amongst vegetation. Similarly, the plantation to the west extends for approximately 1km before a transition to the Rural Living Zone which sees larger mostly vegetated residential lots.

7.1.2 Wider landscape

The site is located to the west of higher density development within Creswick and is positioned between stands of pine plantation adjacent to Bald Hills Road. At the wider scale, the Investigation Area is positioned within a densely vegetated landscape consisting of both Pine Plantation and the native vegetation throughout Creswick Regional Park.

The Creswick Pine Plantation is located to the east of the town centre and extends on either side of the Midland Highway covering a large proportion of the vegetated area through to Smokeytown/Springmount. Plantation is also located to the south west and extends further south Beyond the township of Sulky. The Creswick Regional Park covers much of the landscape to the south-east on an undulating topography with connective vegetation present through to Ballarat further south.

Beyond this, the broader landscape is dominated by open farmland for many kilometres to the north, east and west. The city of Ballarat is located approximately 12km to the south of Creswick.

7.1.3 Bushfire History

No Bushfires have occurred within the Investigation Area. Relatively small bushfires have occurred to the north of the area in 1997 and to the south within pine plantation in 2013. Prescribed burns have occurred throughout the surrounding landscape with a particularly higher density of burns occurring to the south of Creswick between 2004–2010.

7.1.4 Landscape bushfire scenarios

Under prevailing conditions if a fire run from the north–west is to propagate south of Ascot–Creswick Road then the high density of vegetation amongst the residential development does have the capacity to support fire progression. This could then cause ignition to the pine plantation north of the site. If this is to occur then a full fire front could impact the site. This risk is however reduced from this aspect as Ascot Creswick Road would act as a buffer from longer fire runs and there is a degree of management occurring amongst the vegetation through the residential area.

The main threat however is fire approach from the south or south–west which would progress through Creswick Plantation. Provided the high fuel loads associated with pine plantations, a fire run through here would harbour sufficient intensity to pose a significant threat and cause fire front impact. Ember attack is also a risk given the fuel load present within the investigation area that could support spot fires and ignite adjacent area.

7.2 Ground–truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Growth Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 33, Figure 34 and Figure 35.

7.2.1 Observed conditions

Refer to Figure 33 for a summary of the bushfire conditions.

Investigation Area 3c consists almost entirely of Forest vegetation which covers the southern portion of the area. The Forest vegetation here is standards to the classification as per AS3959–2018 although due to the proximity of the surrounding pine plantation, pine trees have seeded within the area with some mature individuals present. This consequently increases the overall fuel load.

Upon site inspection the northern portion of the site was cleared and would be considered as Grassland vegetation. Analysis of google earth imagery through to 2005 confirms this area has remained cleared for some time. Calculated slopes from contour mapping show some minor slopes although these are largely upslope relative to the area. As per AS3959–2018, Table 5 below provides the distances required to meet the defendable space requirements for BAL–12.5.

Table 5. Defendable space requirements.

Vegetation type	Forest	Grassland
Slope (up/down)	Level/Upslope	Level/Upslope
Slope (degrees)	0–2°	0–2°
Defendable space required for BAL 12.5 (m)	48	19

A Fuel Hazard Assessment as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines et al. 2010a) was performed within western extent of the site which consisted of both native vegetation and some pine trees scattered throughout. The results obtained were typical of what is standard for Forest type vegetation as per AS3959–2018 (see Appendix 1 for the results). The canopy cover was 50% which falls within the expected 30–70% foliage cover for Forest vegetation. The understorey fuel load was 25 tonnes/ha with a total fuel load (including the canopy) of 32 tonnes/ha which is similar to the standard 25/35 tonnes/ha for Forest vegetation.

7.2.2 Access

Bald Hills Road runs through the centre of the site and is the main access route from Creswick. Temple Road, Pollards Lane and Yellow track provide access along the pine plantation to the north and Pollards Lane then extends further north to adjoin Ascot–Creswick Road. Bald Hills Road also extends further west to adjoin Gillies Road.

7.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 34 and Figure 35

The VFRR only categorised the land to the north–east of the Investigation Area through the existing low–density development. The risk has been categorised as High due to the proximity to the fuel load to the south and the Hazard has been considered as Medium which is questionable provided the relatively high fuel load throughout the area.

7.4 Site analysis

Considering all of the results above, Investigation Area 3c was divided into a number of areas based on the conditions and usage observed and determine the risk posed to each area and the hazard it poses to the surrounding areas. The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 34 and Figure 35.

Area 1

Location	Centre of the site
Risk category	High
Hazard category	High
Details	The vegetation present is a mixture of standard Forest vegetation with some Pine trees spread throughout. The Yelta Train Line and associated vegetation passes along the southern extent of this area. The area is surrounded by vegetation at all aspects with potential for fire runs to cause fire front impact from the north-west through the vegetated lower density developed areas or from the south-west through pine plantation. The hazard is also high provided the high fuel load present within the site.

Area 2

Location	Northern extent of site
Risk category	High
Hazard category	Medium
Details	This area was of open grassland upon site assessment. It is unclear of the current use although it can be assumed that it does not form part of the pine plantation cycle due to the Rural Living Zone present. The risk is high as the area adjoins vegetation at all aspects and is susceptible to fire front impact under prevailing conditions. The hazard is medium as if ignition is to occur within the site a fire could progress and ignite Area 2 or Area 3 .

Area 3

Location	Pine plantation located along the northern extent of the assessment area.
Risk category	High
Hazard category	High
Details	Pine plantation area that could see impact from a fire front under prevailing conditions. The Pine plantation poses a high hazard particularly as progression through the area could see impact to the residential development to the north or to the south-east and ignite the larger plantation south of Railway Road.

Area 4

Location	Pine plantation west of the site within the assessment area
Risk category	High
Hazard category	High
Details	Area of plantation to the west of the site that extends further west. Ignition to this plantation could see fire front impact to the area from the north-west or impact could occur from the south stemming from the larger plantation to the south. Ignition to this area would support a fire front which could then go on to ignite Area 2 and surrounds.

Area 5

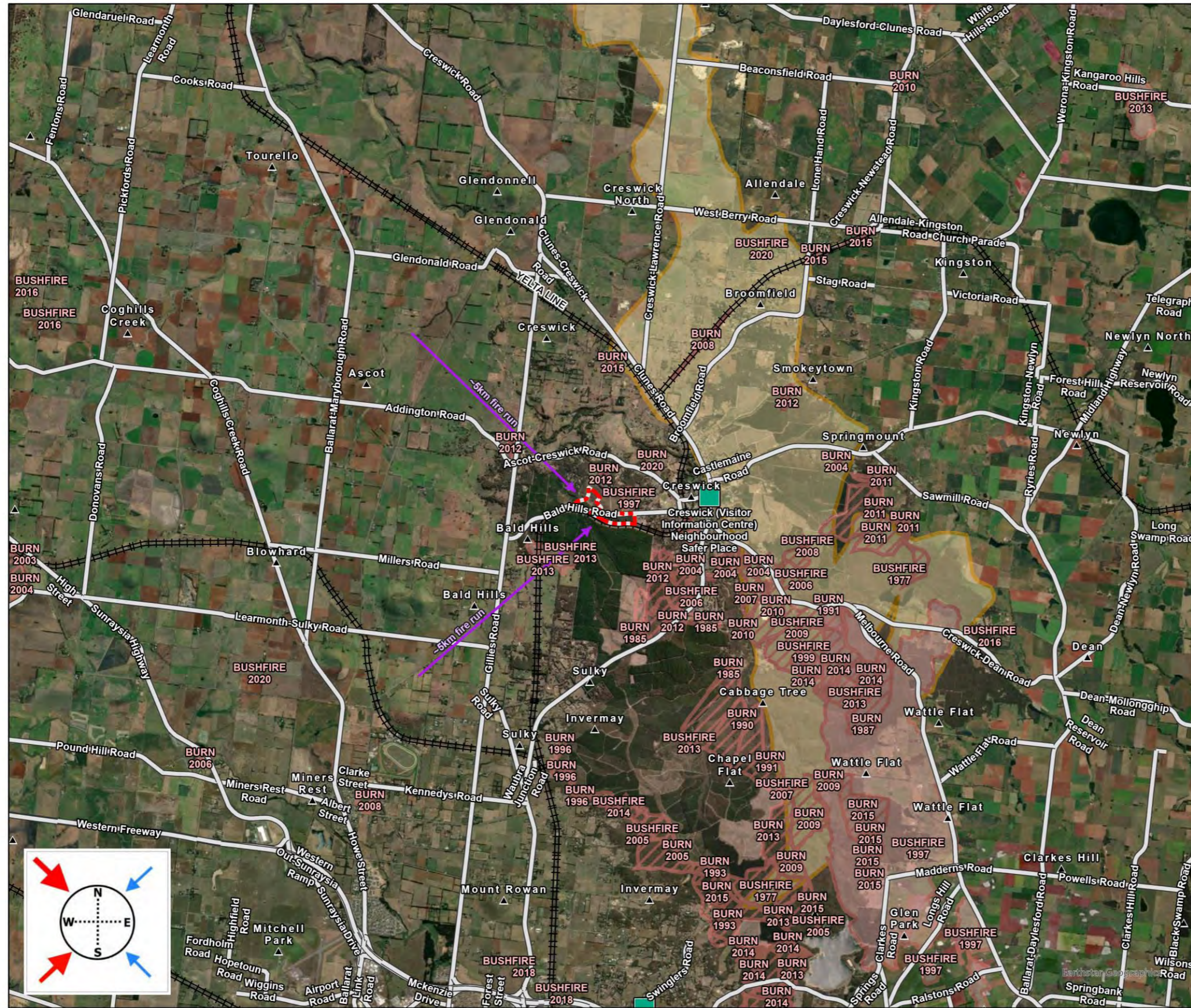
Location	Plantation south of the site
Risk category	High
Hazard category	High
Details	Plantation to the south which forms the main bushfire hazard to the site. a fuel break is positioned along the northern boundary of the plantation separating it from the railway line. Ember attack stemming from a progressing fire front could however ignite fuel loads further north allowing continues progression of a fire front into the site.

Area 6

Location	Paddock within the north-eastern extent of the assessment area
Risk category	High
Hazard category	Medium
Details	The risk is considered high given the surrounding fuel loads and potential for fire front impact and spotting through ember attack. The grassland fuel load currently within the site could support transmission of a fire into the adjacent pine plantation also the likelihood is reduced given the fuel breaks in place and the proximity of the area to Bald Hills Road.

Area 7

Location	Residential development within the eastern extent of the assessment area.
Risk category	High
Hazard category	Low
Details	Residential development at the western extent of Creswick. The risk is considered high as there is the potential for long fire runs from the south-west through pine plantation that can cause fire front impact to the site. The hazard is low as the majority of vegetation within these smaller lot sizes is managed and possess a lower hazard to adjacent areas.



Bushfire Hazard Landscape Assessment
Creswick Township Structure Plan

Zone 3c

Legend

- Subject Site
- Town centre
- Major Roads
- Railways
- Neighbourhood Safer Place
- Potential fire runs

Fire History

Bushfire

- Bushfire 1950-1979
- Bushfire 1980 onwards

Planned Burn

- Planned Burn 1980 onwards

Details

Mapping by: Ali Nia and Julian Drummond
Date: 27/06/2022
Version: 1
Aerial photography from ArcGIS World Imagery.
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

N
0 1000 2000 m

Scale: 1:80,000 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

PRACTICAL ECOLOGY
ecological restoration & consulting
p: (03) 9484 1555 e: enquiries@practicalecology.com.au

Figure 32. Bushfire Hazard Landscape Assessment within Investigation Area 3c

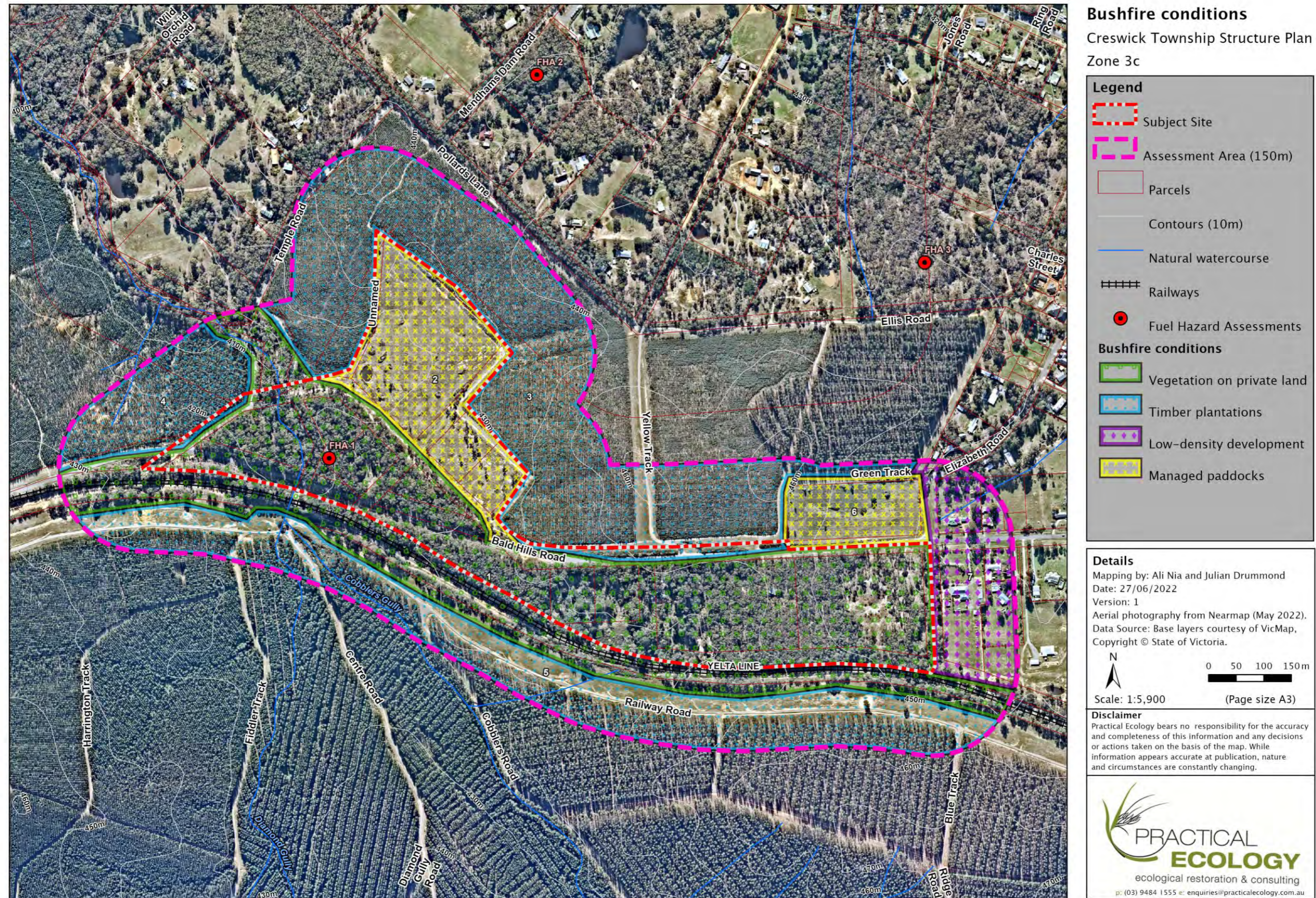


Figure 33. Observed conditions within Investigation Area 3c

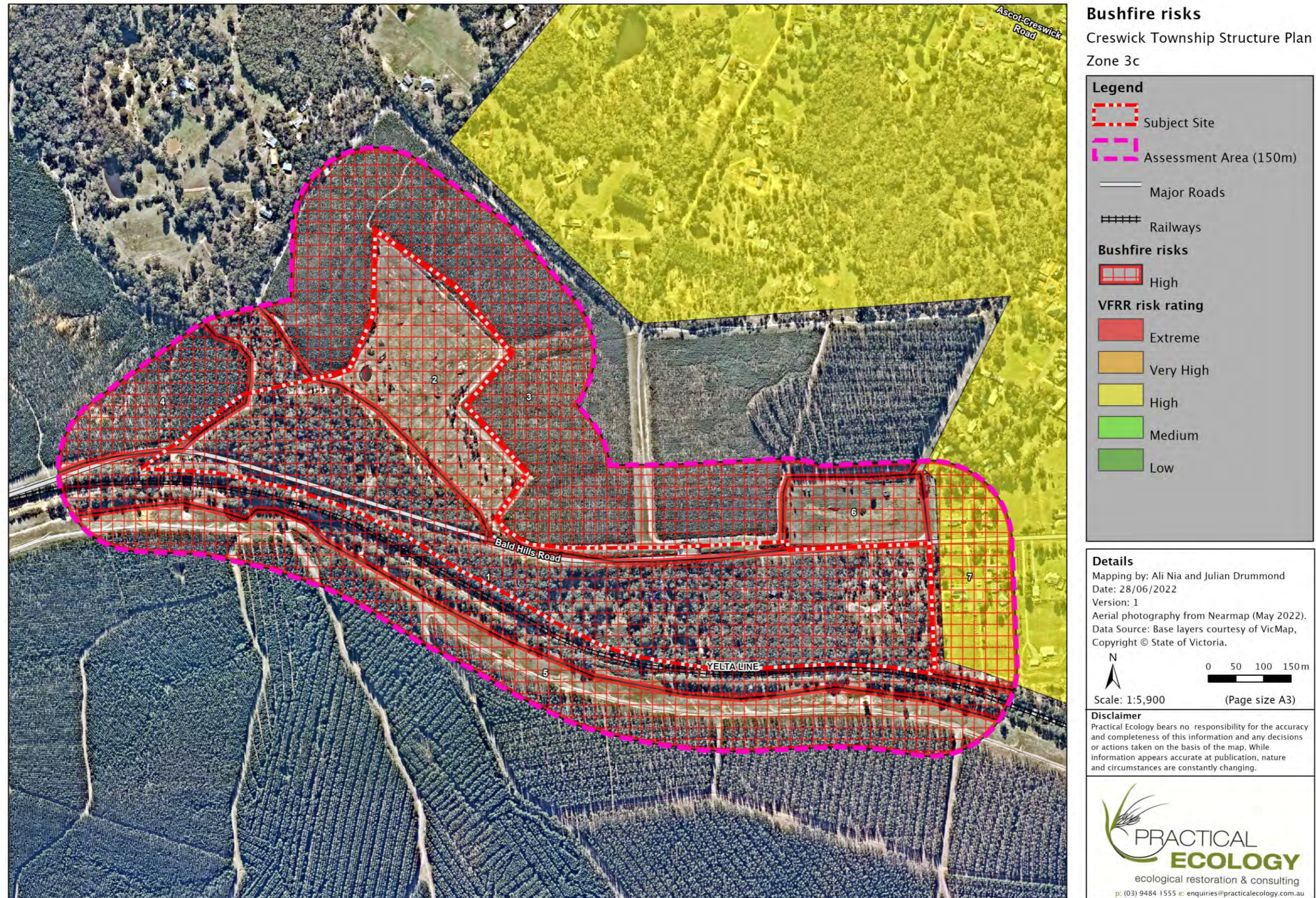


Figure 34. Determined bushfire risks within Investigation Area 3c

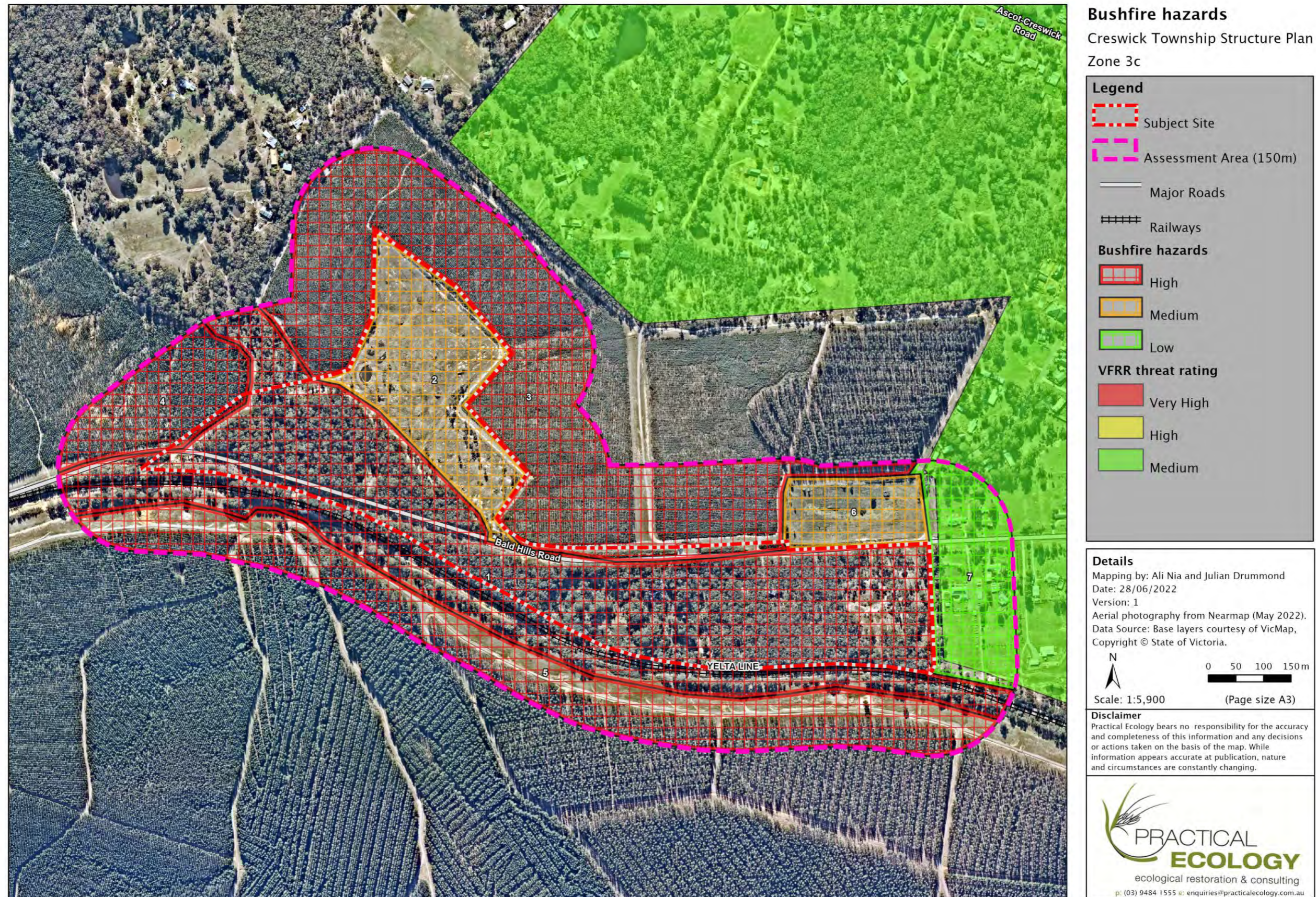


Figure 35. Determined bushfire hazards within Investigation Area 3c

7.5 Summary of Findings and Recommendations

Due to the presence of both the Bushfire Management Overlay and the Bushfire Prone Area (BPA), bushfire risk needs to be considered at the planning level under Clause 13.02–1S Bushfire Planning.

Overall, the entirety of Investigation Area 3c is considered of high risk due to its proximity to the surrounding pine plantation and potential for the area to be directly impacted by a fire front particularly from the south/south west provided the extent of the Creswick plantation through this aspect. The ecological assessment has identified the majority of vegetation present as low – moderate quality with the exception of the riparian vegetation along the waterway which is of moderate quality. If all vegetation was removed here excluding the riparian vegetation the risk would be somewhat reduced although not enough to warrant the recommendation of residential development (or any development which increases population density) as the greater landscape risk cannot be mitigated.

Additionally, access and egress are limited primarily to Bald Hills Road which passes through dense vegetation so in an event of bushfire approaching from the south–west access and egress for emergency service vehicles may be limited.

8. INVESTIGATION AREA 3D

Investigation Area 3c is approximately 99 ha and consists almost entirely of vegetation some scattered dwellings and associated managed vegetation throughout. The following zones apply within the Investigation Area:

- Rural Living Zone – Schedule 1
- Public Conservation Resource Zone (running through the centre of the site adjacent to a drainage line).

The entire area is covered by the Bushfire Management Overlay (BMO)

The following planning zones surround and occur within Investigation Area 3d as shown on Figure 32.

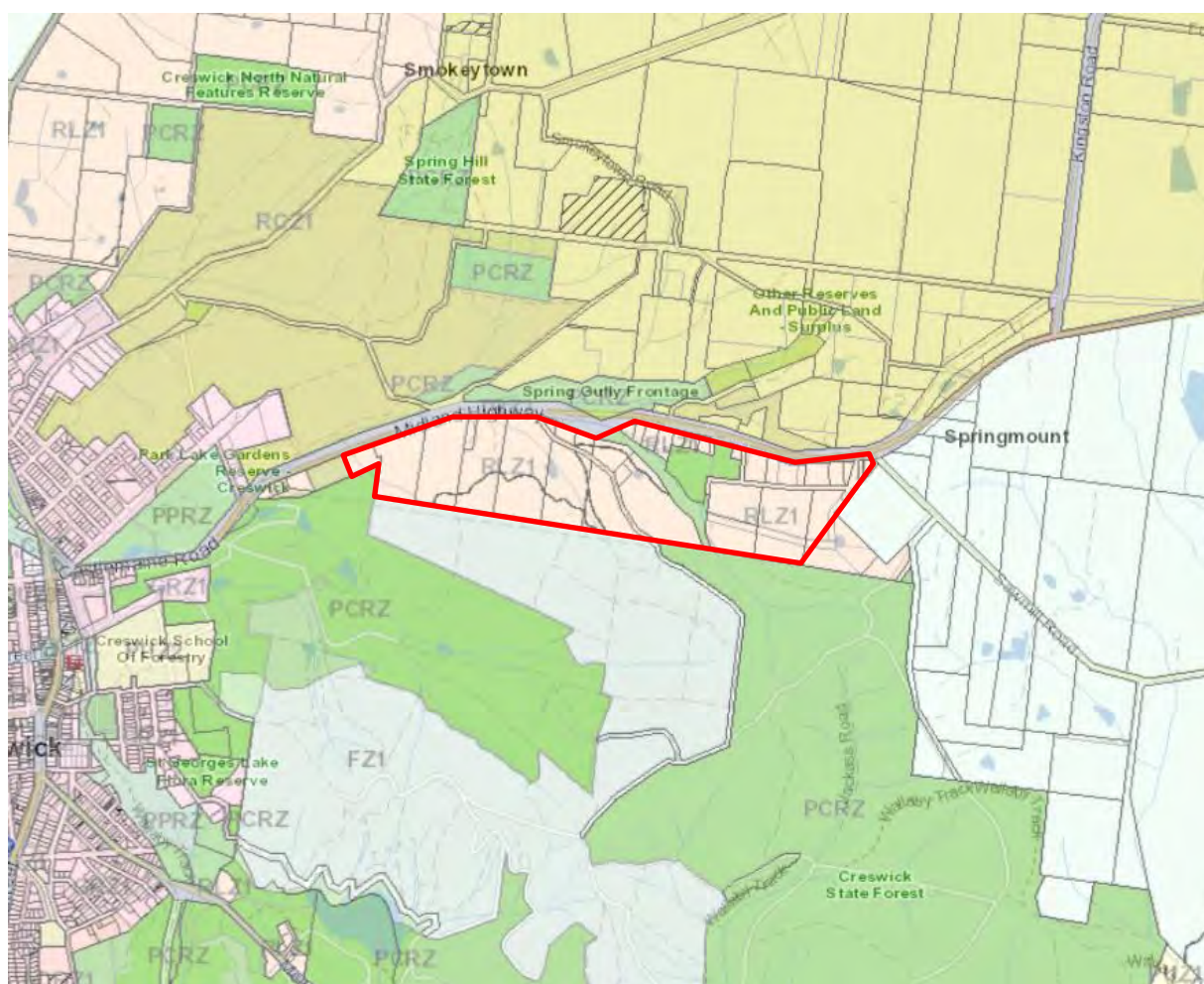


Figure 36. Zoning surrounding and within Investigation Area 3d.

8.1 Bushfire Hazard Landscape Assessment

The bushfire hazard landscape assessment provides information on the bushfire hazard more than 150 m away from the Investigation Area. The surrounding landscape is displayed on Figure 37 and the Bushfire Hazard Landscape Assessment is displayed on Figure 38.



Figure 37. Landscape surrounding Huntly East

8.1.1 Local landscape

This investigation area is within densely vegetated terrain with native vegetation and timber plantations extending to the north and south. The local landscape to the west opens up into low-density residential areas and open farmland and the landscape to the east consists of similar vegetation for a short period before entering the Township of Creswick. The Midland Highway runs east to west along the northern boundary of this area.

8.1.2 Wider landscape

The wider landscape has vegetation similar to what was observed in the immediate landscape extending north to Broomfield and south through native vegetation and large timber plantations almost to the City of Ballarat. The landscape to the east is primarily open farmland while the Township of Creswick extends to the west along with more vegetation and timber plantations. These open up into more open farmland approximately 4km west of the site.

8.1.3 Bushfire History

The entire site was burnt in 1977 in a large bushfire which extended to the north and south through the large patch of vegetation onsite. There have also been large fires in the vegetation to the south of Creswick in 1997, 1999 and 2013 along with some scattered smaller fires. The landscape south of Creswick has been subject to several planned burns over the decades and there was a planned burn within the site in 2009 but there have not been many planned burns in the terrain to the north.

8.1.4 Landscape bushfire scenarios

This investigation area can be considered at high to extreme risk because of the amount of vegetation extending to the north-west and south-west. A bushfire approaching the site would have a reduced run but would be pushed through dense Forest and Woodland vegetation under prevailing conditions and would be able to continue through the site unimpeded considering the amount of vegetation present on it.

The north-western scenario is considered the higher risk since the hotter, drier north-westerly winds will be pushing it and most of the vegetation to the north is privately owned so there are not much fuel management present. A south-westerly scenario is lower risk due to the cooler and more humid winds from over the Southern Ocean and the recently harvest timber plantations but the risk is present and the chances of a localised ignition from within Creswick is much higher.

8.2 Ground-truthing Assessment

The bushfire hazard assessment provides information on the bushfire hazard within the Investigation Area and within 150m of the boundary as per the requirements of the Bushfire Management Overlay (BMO). The assessed bushfire conditions and the results of this assessment are displayed on Figure 39, Figure 40 and Figure 41.

8.2.1 Observed conditions

Refer to Figure 39 for a summary of the bushfire conditions. Investigation Area 3c consists almost entirely of Forest/Woodland vegetation amongst low density residential development. A patch of pine plantation is also present within the eastern portion of the site.

As the site was on private land access was restricted to the surrounding perimeter roads. the determination of slopes has therefore been relied upon through contour mapping calculations which show an undulating topography due largely due to the drainage lines running through the site and surrounding area. The slopes range largely between 10–15° downslope and the required setback for a BAL-12.5 construction standard as per AS3959-2018 is detailed within Table 6 below.

Table 6. Defendable space requirements.

Vegetation type	Woodland	Forest	Grassland
Slope (Level)			
Defendable space required for BAL 12.5 (m)	33	48	19
Slope (10–15° downslope)			
Defendable space required for BAL 12.5 (m)	60	82	28

A Fuel Hazard Assessment as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines et al. 2010a) was performed to the south-west of the site. The location was technically outside of the 150m assessment area as we were restricted by access although this area was considered representative of the surrounding fuel loads. The results obtained were slightly less than what is standardised as per AS3959-2018 (see Appendix 1 for the results). The understorey fuel load was 17 tonnes/ha with a total fuel load (including the canopy) of 27 tonnes/ha. This is still however greater than the standardised fuel load for Woodland so the vegetation is still considered Forest.

8.2.2 Access

Access is very limited throughout the site with only narrow dirt roads providing access along the southern boundary and through the site. The site can be reached from Creswick via the Midland Highway which is currently the only bitumen road in the vicinity of the area. The development of additional access through the site if development was proposed would also be restricted due to the drainage lines present and associated slopes.

8.3 Victorian Fire Risk Register

The risk and threat ratings recorded within the VFRR are displayed on Figure 40 and Figure 41.

The VFRR has categorised the Investigation Area and the land further east as Extreme Risk. This can be attributed to the surrounding fuel loads including pine plantation which extends to the south for many Kilometres through to the Creswick Regional Park and also to the north-west through to Smokey Town. A fire front can therefore approach from both the north-west or south-west under prevailing conditions. The threat has also been categorised as Very High due to the high surrounding fuel loads which can support the progression of a fire front.

8.4 Site analysis

Considering all of the results above, Investigation Area 3d was divided into a number of areas based on the conditions and usage observed and determine the risk posed to each area and the hazard it poses to the surrounding areas. The following areas present within the site and assessment area have been distinguished from one another due to unique use and bushfire threat. These areas are displayed on Figure 40 and Figure 41.

Area 1

Location	Timber plantations and Creekline vegetation to the north of the Midland Highway
Risk category	High
Hazard category	High

Details	This area at the northern end of the assessment area consisted of timber plantations and vegetation along a Creekline which will be difficult to manage due to ecological and erosion planning restrictions. This vegetation extends further north into the wider landscape so a bushfire could be approach with considerable strength. The presence of the Midland Highway does reduce the hazard somewhat but considering the amount of vegetation and the terrain, we cannot consider anything below High for the hazard rating.
---------	---

Area 2

Location	The Midland Highway Road reserve
Risk category	High
Hazard category	Medium
Details	The road reserve itself is well maintained and would not itself be on fire but the amount of vegetation in the wider landscape means the area would be at significant risk during a bushfire event, especially if it is considered an evacuation route. The cleared road reserve would slow a bushfire and not be ignited so it can be considered a Medium hazard with the higher rating being due to the potential for high traffic during an emergency.

Area 3

Location	Timber plantations and Creekline vegetation on the western side of the assessment area south of the Midland Highway
Risk category	High
Hazard category	Medium
Details	As with Area 1 , a bushfire could approach this area with considerable strength and pass through it despite the presence of the Midland Highway and the fuel breaks around the timber plantations. The hazard is reduced to Medium because there are not many developments directly adjacent or in the terrain to the south so the fire will only be threatening more timber plantations.

Area 4

Location	Low-density and rural properties in the centre of the assessment area south of the Midland Highway
Risk category	High
Hazard category	High
Details	These properties consist of dense vegetation on partially managed properties with a few scattered paddocks. There is some road access with Springmount Drive and Slade Road providing driveway access so only some of the properties need to directly access the Midland Highway. If a bushfire has enough strength to cross the highway, then there is very little stopping it from burning through these properties and continuing south. A scenario approaching from the south is also a possibility, albeit less likely than the northern scenario. The risk is considered High because of this and the hazard is also high because of the people present on these properties.

Area 5

Location	A managed fuel break along Blue Gum Road on the southern side of the assessment area.
Risk category	High
Hazard category	Medium
Details	This fuel break separates the vegetated properties to the north from the timber plantations to the south and contains a gravel road which accesses the Midland Highway at either end of the Investigation Area. The area is at high risk because of the bushfire hazard to the north and the road is unlikely to be utilised as an evacuation route due to the condition so it only serves as fuel break for less likely scenarios from the south which could also threaten the properties to the north. These timber plantations are regularly monitored and contain fuel breaks and other protection measures so the chances of this scenario are much lower than the Forest to the north.

Area 6

Location	Recently harvested timber plantations on the southern side of the assessment area.
Risk category	High
Hazard category	Medium
Details	This area is an open timber plantation which was recently harvested and now contains only juvenile trees. There is a fuel break along Blue Gum Road but a fire within enough strength to cross the Midland Highway and the properties to the north could easily cross this and spread into the plantation. There is not much besides other plantations to the south but a southern scenario would move through this vegetation towards Area 4 . The risk of a southern scenario occurring is low due to the controls within the timber plantations so the hazard does not exceed Medium.

Area 7

Location	State Forest and Timber Plantations on the south-eastern side of the assessment area
Risk category	High
Hazard category	High
Details	<p>This area contains native vegetation of reasonable to good quality extending south of the assessment area and some vegetation and timber plantations on private property. As with Area 3, Area 4 and Area 6, a bushfire with enough strength to pass over the Midland Highway will continue right through this area with minimal impediment.</p> <p>Like Area 6, there is not much further south of this area other than more vegetation and some farmland and the prevailing conditions will carry the fire away from the Township of Creswick so the hazard from this scenario is reduced. A southern scenario however would carry bushfire directly towards Area 4 and Area 9 so the hazard is considered High despite the reduced chance of this scenario.</p>

Area 8

Location	Timber plantation adjacent to vegetated properties
Risk category	High
Hazard category	High
Details	Unlike other timber plantations observed, this one does not have clear access or fuel breaks around it and is sitting among the vegetated but occupied properties within Area 4 and Area 9 . A bushfire from the north or the south would have a devastating impact on this area and the adjacent areas so the risk and hazard are considered to be High.

Area 9

Location	Low-density residential properties immediately south of the Midland Highway
Risk category	High
Hazard category	Medium
Details	This area contains managed residential properties on larger lots immediately south of the Midland Highway with immediate driveway access onto the Highway or via Brewing Lane. The hazards from a northern or southern scenario places these dwellings at High Risk with the management present on these properties reducing the hazard to Medium although this management is unlikely to stop a fully developed bushfire.

Area 10

Location	Low-density and rural properties on the eastern side of the assessment area south of the Midland Highway
Risk category	High
Hazard category	High
Details	This area is similar to Area 4 in that it consists of primarily vegetated properties with dwellings and some cleared paddocks present. This area is at greater risk from a southern bushfire scenario since the Midland Highway and the managed properties within Area 9 provide some additional protection but, if ignited, it is considered a High hazard to the majority of the surrounding areas.

Area 11

Location	Partially vegetated paddock on the eastern side of the assessment area south of Sawmill Road
Risk category	High
Hazard category	Medium
Details	This area consists of a single open paddock attached to a larger farm to the south-east. A bushfire can threaten this area from the north and the south under prevailing conditions but would be slowed by the Grassland present on the site so the risk is considered to be High while the hazard is only considered to be Medium.

Area 12

Location	Low-density residential properties immediately north of the Midland Highway
Risk category	High
Hazard category	Medium
Details	This area is similar to Area 9 in that it consists of managed residential properties on larger lots immediately north of the Midland Highway with immediate driveway access onto the Highway. A scenario from the north would directly impact these properties and places them at High risk. a southern scenario could also threaten them but this scenario is less likely and would need to cross the Midland Highway. The lots themselves have some management and would only pose a Medium hazard.

Area 13

Location	Low-density residential properties immediately north of the Midland Highway.
Risk category	Medium
Hazard category	Medium
Details	This area is similar to Area 12 in that it consists of managed residential properties on larger lots immediately north of the Midland Highway with immediate driveway access onto the Highway. A scenario from the north would directly impact these properties and would place them at High risk if not for the immediate access to open farmland to the east which does reduce the risk with additional access. The management present on these properties places them as a Medium hazard.

Area 14

Location	Rural residential properties on the eastern side of the assessment area between the Midland Highway and Sawmill Road.
Risk category	Medium
Hazard category	Low
Details	This area contains vegetation around dwellings and associated infrastructure but does not extend far outside of the assessment area (vegetation thins into open paddock). The proximity to much more open terrain and the presence of two road reserves to the north-west and south-west reduces the risk to this property to Medium. The prevailing conditions also mean that a fire would be moving away from the assessment area and the Township of Creswick is this area was ignited so the hazard is considered to be Low.



Figure 38. Bushfire Hazard Landscape Assessment within Investigation Area 3d

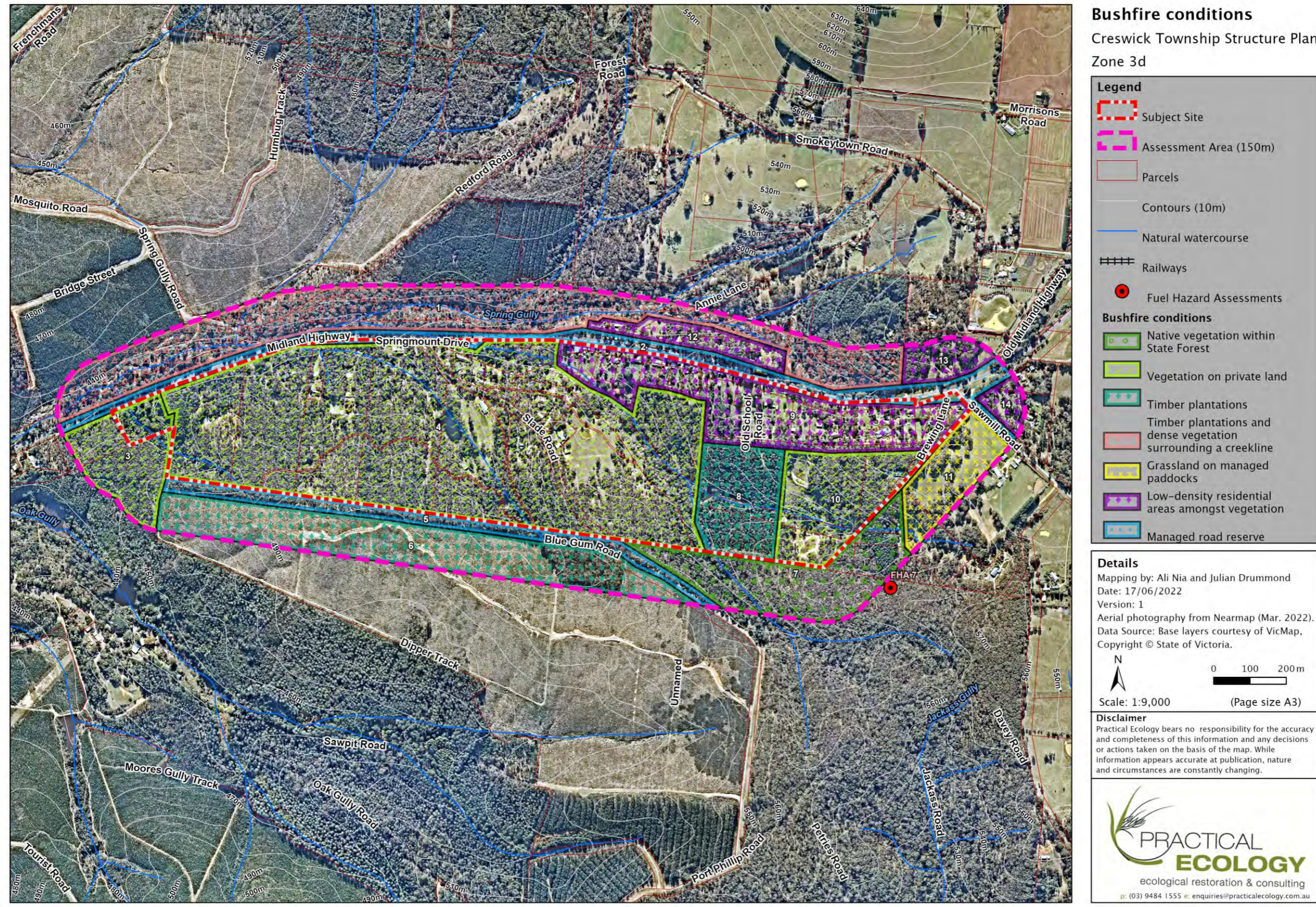


Figure 39. Observed conditions within Investigation Area 3d

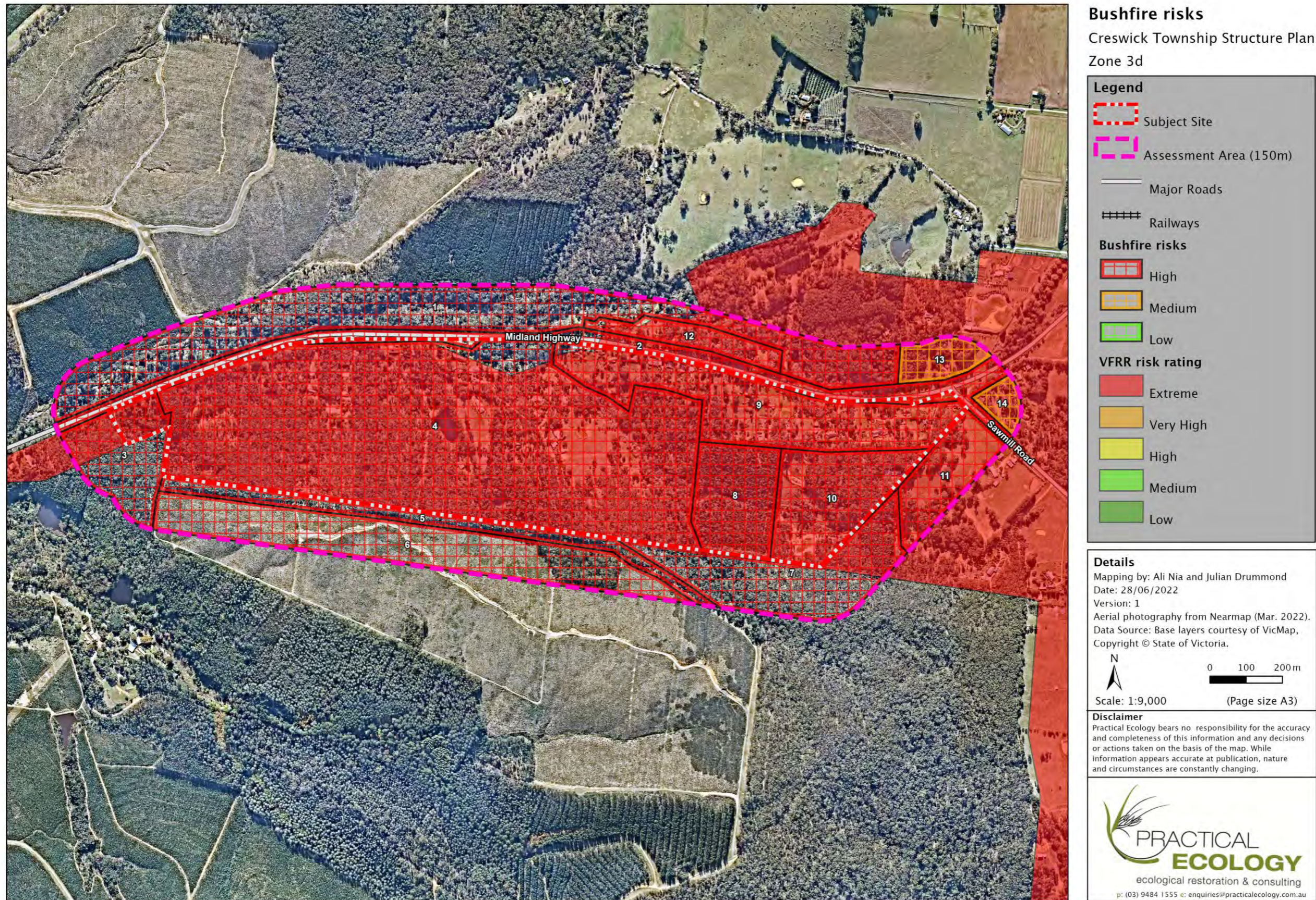
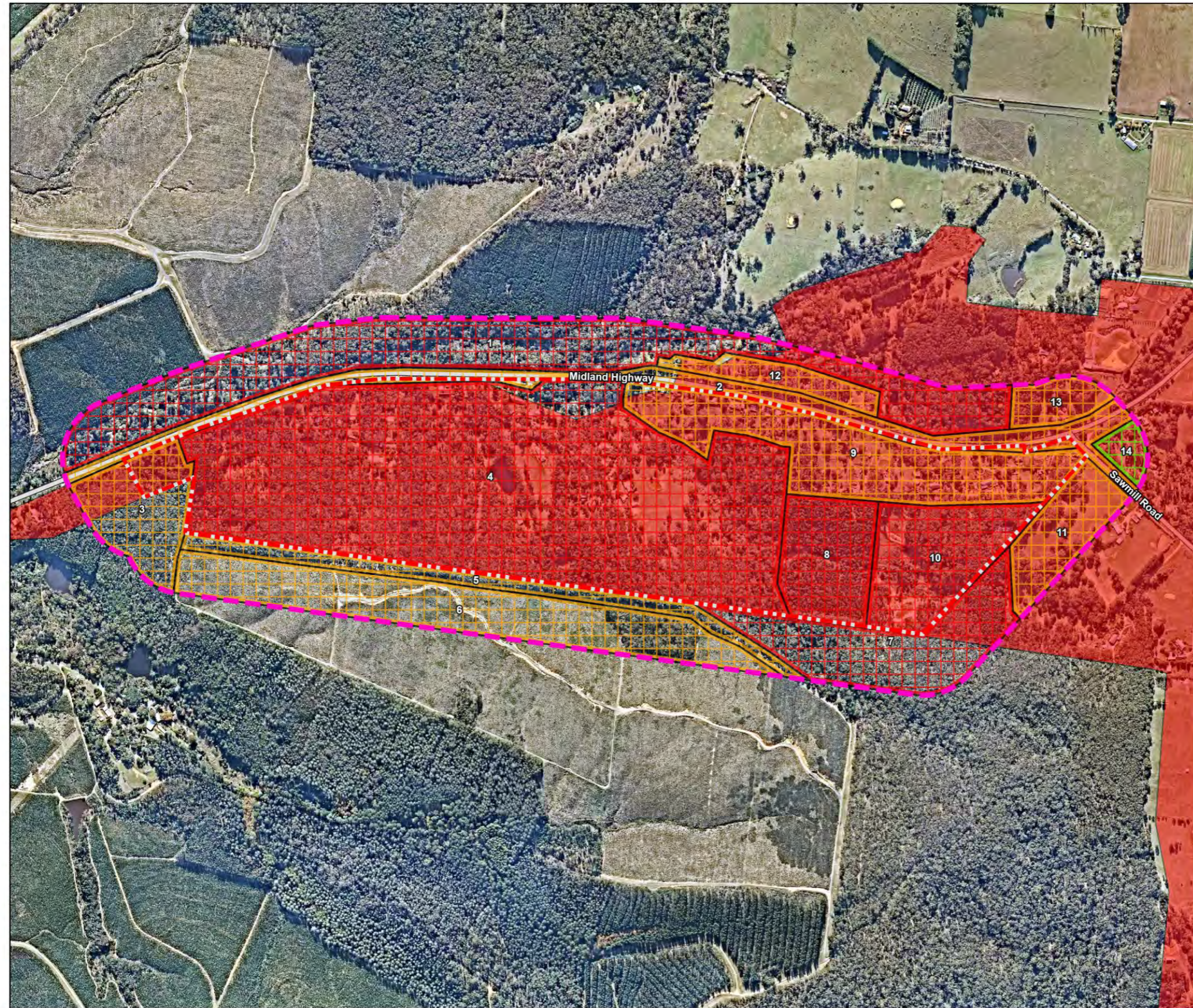


Figure 40. Determined bushfire risks within Investigation Area 3d



Bushfire hazards

Creswick Township Structure Plan
Zone 3d

Legend

- Subject Site
- Assessment Area (150m)
- Major Roads
- Railways

Bushfire hazards

- High
- Medium
- Low

VFR threat rating

- Very High
- High
- Medium

Details

Mapping by: Ali Nia and Julian Drummond
Date: 28/06/2022
Version: 1
Aerial photography from Nearmap (Mar. 2022).
Data Source: Base layers courtesy of VicMap,
Copyright © State of Victoria.

N
0 100 200m
Scale: 1:9,000 (Page size A3)

Disclaimer
Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

PRACTICAL ECOLOGY
ecological restoration & consulting
p: (03) 9484 1555 e: enquiries@practical-ecology.com.au

Figure 41. Determined bushfire hazard within Investigation Area 3d

8.5 Summary of Findings and Recommendations

This Investigation Area is not suitable for residential development in any form because of the hazards present. The position of this area means a bushfire can approach from the vegetated areas to the north or the south and while these areas are primarily pine plantations, the hazard is still present and is too high to consider increasing the population in this area. The current low-density residential properties and rural residential properties can remain but should not be expanded upon in any way that would result in a population increase.

Area 4 and Area 10 contain residential properties on large lots which, while meeting the requirements of the BMO, are too large to have management present which would lower the bushfire risk. Clearing all of the vegetation within these areas along with Area 8 would be too high an ecological impact to consider and would not remove the bushfire hazards to the north or the south so a population increase could not be justified. Some subdivision in these areas could be performed to allow a few more properties but residents would need to be made aware of the hazards.

Area 9 has direct access onto the Midland Highway and enough management to meet the requirements of the BMO but having more areas like this would create more hazards as it would increase the traffic along an already hazardous road and increase the number of people needing to move through more hazardous areas to the west to seek shelter. Large rural lots the size of or slightly smaller than the properties within Area 4 is the only development which can be considered and this can be seen as a compromise for landowners who have the right to develop their own properties.

A Neighbourhood Safer Place should be considered for the Springmount or some of the other townships to the east and residents within this area should not be encouraged to attempt to enter Creswick considering the amount of higher risk vegetation separating them from BAL-LOW areas within this town.

9. REFERENCES

CFA (2012) *Planning for Bushfire Victoria – Guidelines for Meeting Victoria's Bushfire Planning Requirements*. Country Fire Authority.

Hines, F., Tolhurst, K. G., Wilson, A. A. G. & McCarthy, G. J. (2010) *Overall fuel hazard assessment guide*. Victoria, T. S. o., Department of Sustainability and Environment, Melbourne.

Standards Australia (2018) *Australian Standard 3959–2018 Construction of buildings in bushfire-prone areas (incorporating Amendment No. 1)*. SAI Global, Sydney.

Appendix 1. Fuel Hazard Assessments

Fuel Hazard Assessments as per as per DSE's *Overall Fuel Hazard Assessment Guide* (Hines *et al.* 2010) were performed at various locations at each Investigation area where it was possible/feasible to do so. Limited access reduced the number of locations where fuels could be reviewed (it is recommended that tests are performed within the middle of a vegetation patch so roadsides were not assessed). Assessments were also limited to areas within public land.

Forest vegetation as per AS3959-2018 consists of a canopy layer between 10-30m high (can be taller) with foliage cover of between 30-70%. There is also an elevated fuel layer of shrubs along with groundstory fuels (grasses and herbs). Woodland vegetation consists of a canopy less than 30m tall with between 10-30% coverage and an open understory. How open the understory is can allow for a denser canopy but still be enough to consider the vegetation Woodland.





One of the key differences between Forest and Woodland is the ability of the vegetation to support a canopy fire. This requires a significant amount of heat being generated in the understory which allows the canopy to burn as a separate front ahead of the main front which makes is significantly hotter and more dangerous. Woodland will burn with considerable strength but lacks the ability to create this bushfire due to a more open canopy or insufficient understory coverage to generate the required heat. The majority of vegetation within and immediately surrounding the investigation areas has been assessed as Forest type vegetation.

The vegetation surrounding Creswick is unique in that due to the surrounding pine plantation, much of the areas of native vegetation assessed did contain scattered pine trees which are assumed to have self-seeded. The presence of pine consequently increases the fuel load as pine species act as ladder fuels due to the vertical fuel continuity associated with the species.




AS3959-2018 assumes set fuel loads when determining their radiant heat levels and Forest has an understory fuel load of 25 tonnes/ha with a total fuel load (including the canopy) of 35 tonnes/ha which was in the range of the assessed results excluding FHA 3 within the Long Point Bushland reserve which had an estimated understorey fuel load of 14 tonnes/ha with a total fuel load of 20 tonnes/ha. This can be likely attributed to the management occurring within the reserve including weed management.

Further details regarding specific fuel conditions are provided in the relevant sections above.

Table 7. Fuel Load Assessments

Fuel Hazard Assessment	1	2	3	4
Investigation Area	3c	3b	3b	3b/3a
Indicative photo				
Canopy				
% cover	50%	40%	40%	30%
Ave. height top (m)	15	18	18	15
Ave. height base (m)	9	10	10	11
Estimated fuel load (t/ha)	7	6	6	8
Bark fuel				
Stringybark fuel hazard	VH	M	NP	NP
Ribbon bark fuel hazard	NP	NP	M	M
Other bark fuel hazard	M	M	H	H
Bark fuel hazard	VH	M	H	H
Estimated fuel load (t/ha)	5	1	2	2
Elevated fuel				
% cover	30%	30%	60	40%
% dead	<10%	20%	<10%	70%
Ave. height (m)	2	1.5	1	1
Elevated fuel hazard	H	M	H	H
Estimated fuel load (t/ha)	3	2	2	3
Near-surface fuel				
% cover	70%	60%	40	70%
% dead	<10%	20%	<10%	20%
Ave. height (cm)	10	10	10	10
Near-surface fuel hazard	M	H	H	M
Estimated fuel load (t/ha)	3	4	3	3
Surface fuel				
% cover	90%	90%	50%	90%
Ave. depth (mm)	10	30	15	30
Surface fuel hazard	H	VH	M	E
Estimated fuel load (t/ha)	14	20	7	18
Combined results				
Combined Surface Fuel Hazard	VH	E	H	E
Estimated surface fuel load (t/ha)	17	24	10	21
Overall Fuel Hazard	E	H	M	VH
Overall/total estimated fuel load (t/ha)	25/32	27/33	14/20	26/34

Bushfire Risk Assessment for the Creswick Township Structure Plan

Assessment ID	5	6	7
Investigation area	3a	2b	3d
Indicative photo			
Canopy			
% cover	60%	30%	30%
Ave. height top (m)	26	18	17
Ave. height base (m)	10	6	12
Estimated fuel load (t/ha)	9	6	10
Bark fuel			
Stringybark fuel hazard	NP	E	H
Ribbon bark fuel hazard	H	NP	NP
Other bark fuel hazard	M	M	H
Bark fuel hazard	H	E	H
Estimated fuel load (t/ha)	2	7	5
Elevated fuel			
% cover	70%	60%	20%
% dead	<10%	<10%	<10%
Ave. height (m)	2	1	4
Elevated fuel hazard	VH	H	L
Estimated fuel load (t/ha)	5	3	1
Near-surface fuel			
% cover	80%	80%	80
% dead	<10%	<10%	<10%
Ave. height (cm)	20	20	30
Near-surface fuel hazard	VH	VH	VH
Estimated fuel load (t/ha)	5	5	5
Surface fuel			
% cover	40%	60%	60%
Ave. depth (mm)	30	20	15
Surface fuel hazard	H	M	M
Estimated fuel load (t/ha)	10	7	6
Combined results			
Combined Surface Fuel Hazard	VH	VH	VH
Estimated surface fuel load (t/ha)	15	12	11
Overall Fuel Hazard	VH	E	H
Overall/total estimated fuel load (t/ha)	22/31	22/28	17/27