



Bushfire Development Report

for the Kialla West Growth Corridor

Prepared for the
City of Greater Shepparton

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Cover image: Looking south-west into the precinct from Raftery Road.

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TABLE OF CONTENTS

GLOSSARY	1
1 INTRODUCTION	3
2 BUSHFIRE PLANNING AND BUILDING CONTROLS	6
2.1 PLANNING PROVISIONS	6
2.1.1 <i>Clause 13.01-1S Natural hazards and climate change</i>	6
2.1.2 <i>Clause 13.02-1S Bushfire Planning</i>	6
2.1.3 <i>Clause 44.06 Bushfire Management Overlay</i>	8
2.1.4 <i>Clause 71.02-3 Integrated Decision Making</i>	9
2.2 BUSHFIRE PRONE AREA (BPA)	9
2.3 OTHER CONTROLS	10
2.3.1 <i>Zoning</i>	10
2.3.2 <i>Overlays</i>	10
3 BUSHFIRE HAZARD ASSESSMENT	11
3.1 LANDSCAPE CONDITIONS	12
3.1.1 <i>Study area location</i>	12
3.1.2 <i>Broader landscape to 20km</i>	13
3.1.3 <i>Landscape conditions within 5km</i>	15
3.1.4 <i>BMO landscape risk typologies</i>	15
3.2 REGIONAL BUSHFIRE ASSESSMENTS AND STRATEGIES	20
3.2.1 <i>Regional Bushfire Planning Assessment (RBPA) Hume Region</i>	20
3.2.2 <i>Hume Bushfire Management Strategy 2020</i>	20
3.2.3 <i>Municipal Emergency Management Plan (MEMP) and Fire Management Strategy (MFMS) 20</i>	20
3.3 LOCAL AND NEIGHBOURHOOD CONDITIONS	21
3.4 SITE SCALE CONDITIONS	24
3.4.1 <i>Vegetation</i>	24
3.4.2 <i>Grassland</i>	28
3.4.3 <i>Excluded vegetation and non-vegetated areas</i>	30
3.4.4 <i>Topography</i>	31
3.5 FIRE WEATHER	31
3.5.1 <i>Fire weather analysis (wind speed and direction)</i>	33
4 PLANNING AND DESIGN RESPONSE	36

4.1	SETTLEMENT FORM AND STRUCTURE	36
4.1.1	<i>Considering the bushfire hazard in directing growth</i>	36
4.1.2	<i>The distribution of land uses in the settlement</i>	40
4.1.3	<i>Lot sizes in settlement layout</i>	40
4.1.4	<i>Vegetated areas within a settlement</i>	41
4.2	THE SETTLEMENT INTERFACE	41
4.2.1	<i>Applying the required development setbacks</i>	41
4.2.2	<i>Designing the settlement interface</i>	43
4.2.3	<i>Designing access and egress</i>	43
4.3	BUSHFIRE PROTECTION MEASURES ACROSS A SETTLEMENT	44
4.3.1	<i>Vegetation management</i>	44
4.3.2	<i>Building construction standards</i>	45
4.3.3	<i>Fences and other localised fuel sources</i>	45
5	CLAUSE 13.02-1S BUSHFIRE PLANNING	46
5.1.1	<i>Protection of human life strategies</i>	46
5.1.2	<i>Bushfire hazard identification and assessment strategies</i>	47
5.1.3	<i>Settlement planning strategies</i>	50
5.1.4	<i>Areas of high biodiversity conservation value</i>	51
5.1.5	<i>Use and development control in a Bushfire Prone Area</i>	52
6	CONCLUSION	53
7	APPENDICES	56
7.1	APPENDIX 1: BAL CONSTRUCTION STANDARDS	56
7.2	APPENDIX 2: FRAMEWORK PLANS SHOWING GROWTH CONSTRAINTS AROUND SHEPPARTON.....	57
7.2.1	<i>Environmental significance and soil drainage</i>	57
7.2.2	<i>Flood controls</i>	58
7.2.3	<i>Land uses</i>	59
7.2.4	<i>Water infrastructure</i>	60
8	REFERENCES	61

INDEX OF MAPS

Map 1 – Study area.....	5
Map 2 – Bushfire hazard landscape assessment plan to 5km.	14
Map 3 - Bushfire hazard landscape assessment plan to 5km.....	18
Map 4 - BMO Broader Landscape Types in the surrounding landscape.....	19
Map 5 - Local and neighbourhood hazard assessment map.	22
Map 6 - Bushfire hazard site assessment plan.	23
Map 7 – Development setbacks in relation to the Villawood Properties Framework Masterplan.	39

INDEX OF FIGURES

Figure 1 – Study area location	4
Figure 2 – Wide landscape context of the study area	13
Figure 3 - Woodland along Seven Creeks	26
Figure 4 – Woodland in the Shepparton Regional Park.....	27
Figure 5 – Looking at vegetation in the Shepparton Regional Park.....	27
Figure 6 – Woodland in the Shepparton Regional Park to the north-west of the study area	28
Figure 7 – Looking north across the study area from Bennetts Road	29
Figure 8 – Looking south-east from Teasdale Crescent at Grassland	29
Figure 9 - Looking west along Bennetts Road.....	30
Figure 10 – Shepparton Airport wind rose	35
Figure 11 – Reproduction of ‘Plan 6 Residential Growth Corridors’.....	38
Figure 12 - Example of building-classified vegetation setback	42
Figure 13 - Illustration of a perimeter road to provide required development setbacks.....	44

INDEX OF TABLES

Table 1 - Landscape risk typologies	16
Table 2 - Fire Danger Ratings.....	33
Table 3 - Summary of Shepparton Airport BOM station and data attributes.....	34
Table 4 – Potentially applicable building-vegetation setbacks for BAL-12.5.....	42

Glossary

BAL	<i>Bushfire Attack Level</i> - A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire e.g. a building constructed to a BAL-12.5 standard is designed to be exposed to radiant heat not exceeding 12.5 kW/m ² .
BMO	<i>Bushfire Management Overlay</i> - A planning scheme provision used to guide the development of land in areas of high bushfire hazard. The BMO applies to areas where there is potential for extreme bushfire behaviour, such as a crown fire and extreme ember attack and radiant heat
BPA	<i>Bushfire Prone Area</i> - An area that is subject to, or likely to be subject to, bushfire attack as determined by the Minister for Planning.
Bushfire	An unplanned fire burning in vegetation; sometimes referred to as wildfire. A generic term which includes grass fires, forest fires and scrub fires.
Bushfire attack	Attack by wind, burning embers, radiant heat or flame generated by a bushfire.
Bushfire hazard	A specific source of potential damage or harm, typically consisting of three key elements; vegetation, weather and topography.
Bushfire risk	The chance or probability of damage or harm if exposed to a bushfire hazard and the severity of the impact i.e. consideration of the likelihood and consequences of impacts from bushfire.
Classified vegetation	Vegetation deemed to be a bushfire hazard in accordance with the Bushfire Management Overlay (BMO) and/or AS 3959-2018 <i>Construction of buildings in bushfire prone areas</i> .
CFA	<i>Country Fire Authority</i>
Defendable space	An area of land around a building where vegetation is modified and managed to reduce the effects of flame contact and radiant heat associated with bushfire.
DELWP	<i>Department of Environment, Land, Water and Planning</i> .
Effective slope	The slope of the land (gradient, measured in degrees) under the classified vegetation which most influences the bushfire attack. The slope is determined based on the fire moving towards the building and the rate of spread of the fire and not solely on the basis of the relative elevation of the vegetation.

Ember attack	Attack by smouldering or flaming windborne debris that can enter or accumulating around a building, and that may ignite the building or other combustible materials and debris.
EVC	<i>Ecological Vegetation Class</i> - The standard unit for classifying vegetation types in Victoria. EVCs are described through a combination of floristics, lifeforms and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Each EVC includes a collection of floristic communities (i.e. lower level in the classification) that occur across a biogeographic range and, although differing in species, have similar habitat and ecological processes operating.
FFDI	<i>Forest Fire Danger Index</i> – A numerical index representing the chance of a fire starting, its rate of spread, its intensity and the difficulty of its suppression, according to various combinations of air temperature, relative humidity, wind speed and both the long- and short-term drought effects.
GSCC	<i>Greater Shepparton City Council.</i>
KWGC	<i>Kialla West Growth Corridor.</i>
PBP	<i>Place Based Plan</i> - Plan showing the extent and location of all proposed land uses across a precinct.
PSP	<i>Precinct Structure Plan</i> - PSPs are strategic masterplans for local areas that usually cater for between 5,000 and 30,000 people, 2,000 to 10,000 jobs or a combination of both. They are the ‘blueprint’ for localised development and investment that will occur over many years and will incorporate any relevant directions already outlined in a higher level Framework Plan.
RHF	<i>Radiant heat flux</i> - The heat transfer rate per unit area from thermal (electromagnetic) radiation, expressed as kilowatts per metre squared. Calculated or measured for a specific surface to determine the radiant heat received by that surface from flames associated with a bushfire.
UGB/A	<i>Urban Growth Boundary/Area</i>
VPA	<i>Victorian Planning Authority</i>

1 Introduction

This Bushfire Development Report has been prepared for the Greater Shepparton City Council (GSCC). It assesses the bushfire risk to future development in the Kialla West Growth Corridor (KWGC).

The KWGC (henceforth referred to as the 'study area') is identified as a 'medium term' (5-10yrs) residential growth area in the *'Shepparton and Mooroopna 2050 Regional City Growth Plan'*, with the potential to provide for an additional 800 dwellings (VPA, 2021). However, key constraints for low or standard residential densities are identified, including flooding, bushfire, access and servicing (VPA, 2021). GSCC is undertaking background studies and analysis of the corridor to inform the preparation of a Precinct Structure Plan (PSP) and Development Contributions Plan (DCP) to facilitate residential development.

The study area comprises 473ha of land, the majority of which is currently either Rural Living Zone (RLZ), Urban Flood Zone (UFZ) or Farm Zone – Schedule 1 (FZ1) (see Map 1). Amendment C239 in the Greater Shepparton Planning Scheme proposes to rezone the RLZ land to Urban Growth Zone (UGZ).

The aim of this report is to identify how future development within the study area can respond to the bushfire risk and the applicable Victorian planning and building controls that relate to bushfire. In particular, the objective and applicable strategies of Clause 13.02-1S *Bushfire planning* in the Planning Policy Framework (PPF) (Greater Shepparton Planning Scheme, 2018a) and DELWP guidance for settlement planning at the bushfire interface (DELWP, 2020a).

This report also aims to provide the 'further consideration' requested by CFA in their response to the Draft report titled *'Strategic Bushfire Risk Assessment for the Kialla Growth Area'* which was prepared for GSCC by Ecology and Heritage Partners (EHP) (EHP, 2021). The CFA reviewed and commented on the draft EHP report and stated that *'...CFA is of the view that the Bushfire Assessment has not adequately understood the bushfire landscape or the complexities of the likely bushfire scenarios to be able to demonstrate the bushfire constraints can be overcome'* (CFA, 2021).

The CFA also stated that *'Further consideration is required to demonstrate why this area is appropriate to encourage an increase in residential population in this location from a bushfire perspective. It is CFA's view that there are lower risk bushfire environments in Shepparton that are more appropriate to encourage development. CFA recommends that Council reviews its settlement position from a bushfire perspective to determine whether the Kialla West Corridor is an appropriate location to encourage growth'* (CFA, 2021).

The whole study area is designated as a Bushfire Prone Area (BPA), and the BMO applies to relatively small areas around the periphery of the KWGC to the north-west and south-west and to a larger section in the north-west of the study area (see Map 1).

This report assesses the bushfire hazard in and around the study area to identify how planning for the design and layout of the precinct and future development that will occur within it, can appropriately mitigate any bushfire risk; including, responding to and complying with the applicable bushfire planning and building controls. This report has been prepared in accordance with applicable guidance for the assessment of and response to bushfire risk provided in:

- *Design Guidelines Settlement Planning at the Bushfire Interface* (DELWP, 2020a);
- *Bushfire State Planning Policy Amendment VC140*, Planning Advisory Note 68 (DELWP, 2018);
- *Local planning for bushfire protection*, Planning Practice Note 64 (DELWP, 2015);
- *AS 3959-2018 Construction of buildings in bushfire prone areas* (Standards Australia, 2020); and
- *Planning Permit Applications Bushfire Management Overlay Technical Guide* (DELWP, 2017).

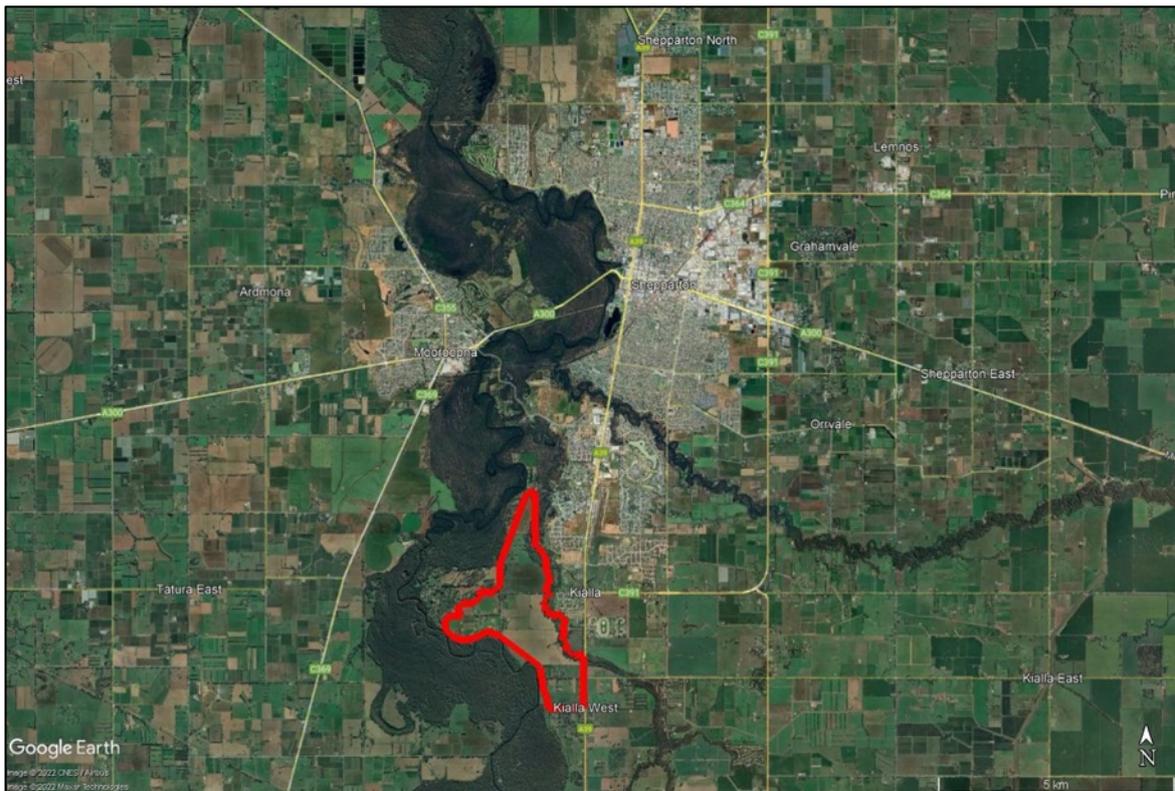
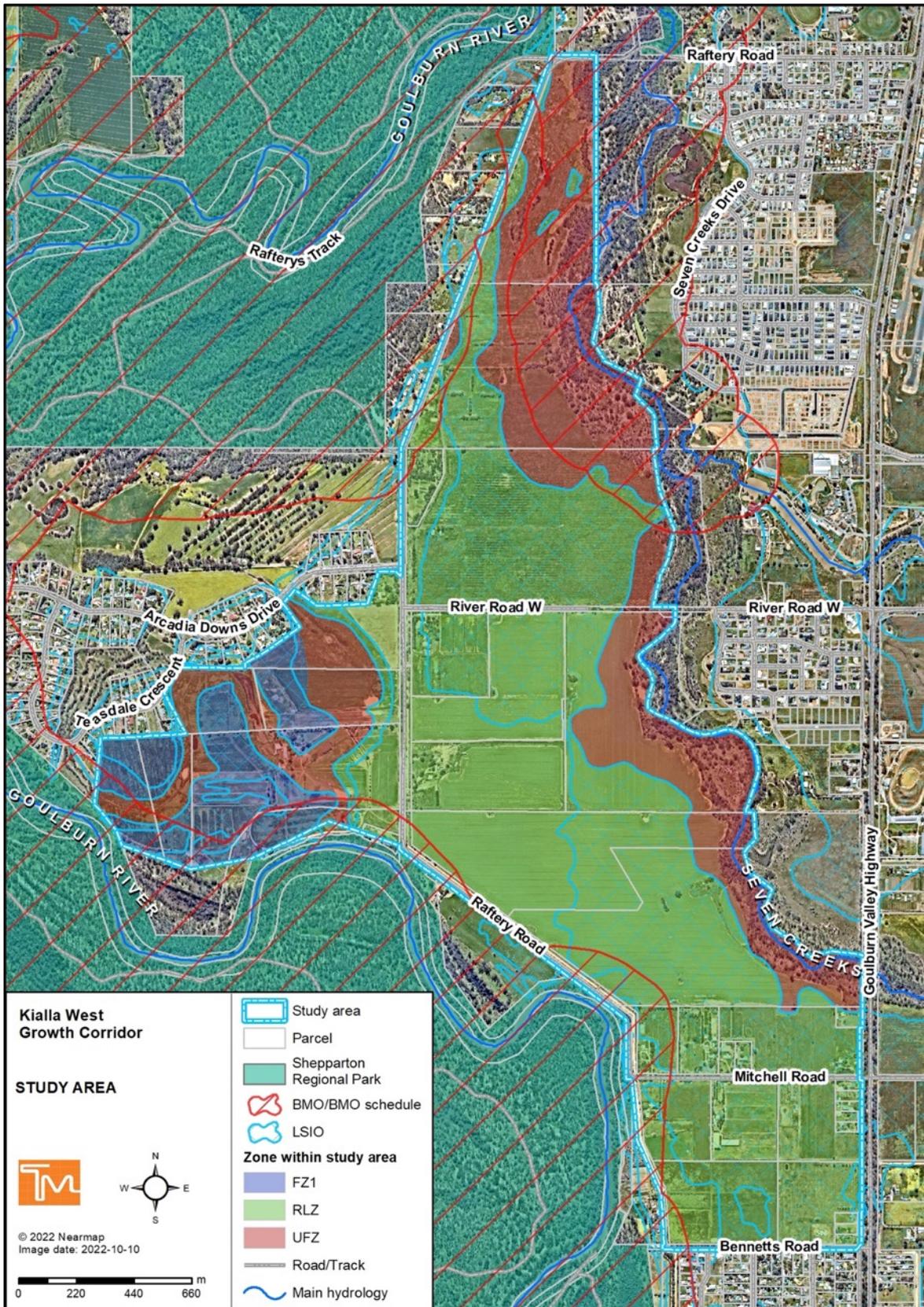


Figure 1 – Study area location (in red outline; Google Earth imagery dated 2022-08-26).



Map 1 – Study area (n.b. only the BMO and Land Subject to Inundation Overlay (LSIO) are shown, other overlay controls also apply).

2 Bushfire planning and building controls

This section identifies and summarises the applicable planning and building controls that relate to bushfire.

2.1 Planning provisions

Clause 13 *Environmental Risks* in the Planning Policy Framework (PPF) has two key provisions pertinent to bushfire.

2.1.1 Clause 13.01-15 Natural hazards and climate change

The objective of this Clause is to minimise the impacts of natural hazards and adapt to the impacts of climate change through risk-based planning. Strategies to achieve the objective are:

- *‘Respond to the risks associated with climate change in planning and management decision making processes.*
- *Identify at risk areas using the best available data and climate change science.*
- *Integrate strategic land use planning with emergency management decision making.*
- *Direct population growth and development to low risk locations.*
- *Develop adaptation response strategies for existing settlements in risk areas to accommodate change over time.*
- *Ensure planning controls allow for risk mitigation and climate change adaptation strategies to be implemented.*
- *Site and design development to minimise risk to life, health, property, the natural environment and community infrastructure from natural hazards’ (Greater Shepparton Planning Scheme, 2022a).*

Since the 1950’s, southern and eastern Australia, has had an increase in the length of the fire weather season and a greater number of higher risk days associated with climate change (CSIRO/BOM, 2020). The Australasian Fire and Emergency Service Authorities Council (AFAC) identify that a failure of building codes and land use planning to adequately adapt to climate change is a significant risk (AFAC, 2018).

Climate change trends associated with the risk of bushfire, support the adoption of a precautionary and conservative approach in identifying and responding to the risk. Climate change in relation to fire weather is discussed further in the hazard assessment in Section 3.5 of this report.

2.1.2 Clause 13.02-15 Bushfire Planning

Clause 13.02-15 has the objective *‘To strengthen the resilience of settlements and communities to bushfire through risk based planning that prioritises the protection of human life’ (Greater*

Shepparton Planning Scheme, 2018a). The policy must be applied to all planning and decision making under the Planning and Environment Act 1987, relating to land which is:

- Within a designated BPA;
- Subject to a BMO; or
- Proposed to be used or developed in a way that may create a bushfire hazard.

Clause 13.02-1S requires priority to be given to the protection of human life by:

- *'Prioritising the protection of human life over all other policy considerations.*
- *Directing population growth and development to low risk locations and ensuring the availability of, and safe access to, areas where human life can be better protected from the effects of bushfire.*
- *Reducing the vulnerability of communities to bushfire through consideration of bushfire risk in decision-making at all stages of the planning process'* (Greater Shepparton Planning Scheme, 2018a).

Key strategies are stipulated that require strategic planning documents, planning scheme amendments and development plan approvals to properly assess bushfire risk and include appropriate bushfire protection measures. In a BPA this also applies to planning applications for uses and developments that are:

- Subdivisions of more than 10 lots;
- Accommodation;
- Child care centre;
- Education centre;
- Emergency services facility;
- Hospital;
- Indoor recreation facility;
- Major sports and recreation facility;
- Place of assembly; and
- Any application for development that will result in people congregating in large numbers.

This study assesses the hazard in accordance with the hazard identification strategies of Clause 13.02-1S and identifies the bushfire protection measures that will be required for future development in the study area. It is considered that development can appropriately prioritise the protection of human life, and meet the objectives of Clause 13.02-1S, by an appropriate design and layout that amongst other things, ensures development is sited away from areas of hazard and future dwellings will not be exposed to RHF above 12.5kW/m², which is commensurate with a BAL-12.5 construction standard.

The maximum 12.5kW/m² safety threshold is required in settlement planning as the upper limit for acceptable risk. Responsible authorities must *'Not approve 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 3959-2009¹ (Greater Shepparton Planning Scheme, 2018a).

A response to each applicable strategy of Clause 13.02-1S is provided in Section 5 of this report.

2.1.3 Clause 44.06 Bushfire Management Overlay

The purposes of Clause 44.06 *Bushfire Management Overlay (BMO)* are:

- *'To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To ensure that the development of land prioritises the protection of human life and strengthens community resilience to bushfire.*
- *To identify areas where the bushfire hazard warrants bushfire protection measures to be implemented.*
- *To ensure development is only permitted where the risk to life and property from bushfire can be reduced to an acceptable level'* (Greater Shepparton Planning Scheme, 2018b).

The BMO largely applies to patches of treed vegetation greater than 4ha in size, where head fire intensity has been modelled to be 30,000kW/m or more. It also extends over land 150m around those areas, based on research into house loss from bushfires which has found that 92% of house loss occurs within 150m of the bushfire hazard (DELWP, 2019).

The BMO requires a planning permit for all subdivision of land, and buildings and works associated with the following uses (some exemptions apply):

- Accommodation (including a dependent person's unit);
- Child care or Education centre;
- Hospital;
- Industry;
- Leisure and Recreation;
- Office;
- Place of assembly;
- Retail premises;
- Service station;
- Timber production; and
- Warehouse.

A BMO application must be accompanied by:

¹ AS 3959-2009 has been superseded by AS 3959-2018, which was invoked in the National Construction Code (NCC) in May 2019, therefore all references to AS 3959-2009 should be read as the most recent version of the Standard.

- A *Bushfire hazard site assessment*, including a plan that describes the bushfire hazard within 150m of the site in accordance with the site assessment methodology of AS 3959-2018 *Construction of buildings in bushfire-prone areas* and Clause 44.06;
- A *Bushfire hazard landscape assessment*, including a plan that describes the bushfire hazard of the general locality more than 150m from the site; and
- A *Bushfire management statement*, detailing how the development responds to the bushfire risk and the requirements and objectives of Clauses 44.06 and 53.02.

Terramatrix understands that most, or all, areas of future residential development are proposed to be outside those parts of the site covered by the BMO.

Clause 53.02 Bushfire Planning applies to BMO applications and contains:

- **Objectives:** An objective describes the outcome that must be achieved in a completed development.
- **Approved measures:** An approved measure meets the objective.
- **Alternative measures:** An alternative measure may be considered where the responsible authority is satisfied that the objective can be met. The responsible authority may consider other unspecified alternative measures.
- **Decision guidelines:** The decision guidelines set out the matters that the responsible authority must consider before deciding on an application, including whether any proposed alternative measure is appropriate.

There are no identified obstacles to achieving BMO compliance and meeting the objectives and measures of Clause 53.02, for any development that may occur in areas covered by the BMO.

2.1.4 Clause 71.02-3 Integrated Decision Making

Clause 71.02-3 states that planning and responsible authorities should endeavour to integrate the range of planning policies relevant to the issues to be determined, and balance conflicting objectives in favour of net community benefit and sustainable development. However, in bushfire affected areas, it states that they must prioritise the protection of human life over all other policy considerations (Greater Shepparton Planning Scheme, 2022b).

2.2 Bushfire Prone Area (BPA)

BPAs are those areas subject to or likely to be subject to bushfire, as determined by the Minister for Planning. The study area is wholly within a BPA. Immediately to the south is a small area of land outside of the BPA, as is most of the land to the east-north-east that comprises reliably low threat or non-vegetated and urbanised areas of Shepparton, which are also sufficiently distant from a bushfire hazard. Figure 2 and Map 3 show the extent of BPA (and BMO) coverage around the KWGC and in the surrounding landscape.

In a BPA, the Building Act 1993 and associated Building Regulations 2018, through application of the National Construction Code (NCC), require bushfire protection standards for class 1, 2 and 3² buildings, 'Specific Use Bushfire Protected Buildings'³ and associated class 10A buildings⁴ or decks. The applicable performance requirement in the NCC is:

'A building that is constructed in a designated bushfire prone area must, to the degree necessary, be designed and constructed to reduce the risk of ignition from a bushfire, appropriate to the —

- (a) potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire; and*
- (b) intensity of the bushfire attack on the building'* (ABCB, 2020).

Compliance with AS 3959-2018 *Construction of buildings in bushfire prone areas* (Standards Australia, 2020) or the NASH Standard *NS 300 Steel Framed Construction in Bushfire Areas 2021* (NASH, 2021) is 'deemed-to-satisfy' the performance requirement.

Applicable classes of buildings in a BPA must be constructed to a minimum Bushfire Attack Level (BAL)-12.5, or higher, as determined by a site assessment, planning permit or planning scheme requirement. A BAL is a means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact. There are six BALs defined in AS 3959-2018, which range from BAL-LOW, which has no construction requirements, to BAL-FZ (Flame Zone) where flame contact with a building is expected (see Appendix for an explanation of BALs).

2.3 Other controls

2.3.1 Zoning

The proposed change from RLZ to UGZ has no inherent implications for bushfire safety, however it will facilitate a significantly more intensive residential use of the area, based on the removal of the existing 8ha minimum lot size in the RLZ. Standard residential densities will be considered in the PSP if flooding, access, bushfire and servicing constraints can be resolved (VPA, 2021).

2.3.2 Overlays

Apart from the BMO, none of the overlays have any direct implications for bushfire safety.

² Class 1, 2 and 3 buildings are defined in the Building Code of Australia (BCA), and are generally those used for residential accommodation, including houses and other dwellings, apartments, hotels and other buildings with a similar function or use.

³ Specific Use Bushfire Protected Buildings are defined in the Victorian *Building Regulations 2018*, they generally comprise 'vulnerable' uses and include schools, kindergartens, childcare facilities, aged care facilities and hospitals.

⁴ Class 10a buildings are defined in the BCA as non-habitable buildings including sheds, carports, and private garages.

3 Bushfire hazard assessment

One of the bushfire hazard identification and assessment strategies in Clause 13.02-1S, is to use the best available science to identify the hazard posed by vegetation, topographic and climatic conditions (Greater Shepparton Planning Scheme, 2018a). The basis for the hazard assessment should be:

- *'Landscape conditions - meaning the conditions in the landscape within 20 kilometres and potentially up to 75 kilometres from a site;*
- *Local conditions - meaning conditions within approximately 1 kilometre from a site;*
- *Neighbourhood conditions - meaning conditions within 400 metres of a site; and*
- *The site for the development'* (Greater Shepparton Planning Scheme, 2018a).

The BMO also requires an assessment of risk within, and beyond, a 150m site assessment area around a development site.

This section includes an assessment of the hazard posed by vegetation and topography at the:

- Broader landscape scale, considering conditions beyond 1km and up to 20km around the site;
- The local and neighbourhood scale up to 1km around the site; and
- The site scale up to 150m around the site boundaries, including classifying vegetation and topography to determine future BAL construction standards that could be achieved within the site.

In relation to climatic conditions, the frequency and severity of bushfire wind conditions has been analysed, using historical fire weather data from the Bureau of Meteorology (BOM) weather station at Shepparton Airport (see Section 3.5).

The topography was analysed by site assessment and using publicly available 10m contour data.

The BPA coverage invokes AS 3959-2018 *Construction of buildings in bushfire prone areas* to determine an applicable BAL(s), which requires assessment of the vegetation and topography up to 100m around a building or site (Standards Australia, 2020). The BMO requires a 150m site assessment area and for vulnerable uses and larger developments in a BPA a 150m assessment zone may also be required (DELWP, 2018).

In accordance with Clause 13.02-1S hazard identification strategies, Map 2 shows the hazard in the broader landscape extending at least 20km around the study area (as recommended in Planning Practice Note 64 (DELWP, 2015)). Map 3 comprises a bushfire hazard landscape assessment plan (as required by a BMO application) and shows the landscape and bushfire hazard information up to 5km around the site. Map 4 identifies the broad landscape types that occur on and around the study area in comparison with other identified growth areas. Map 5 shows the 1km local and 400m neighbourhood assessment areas and Map 6 comprises a bushfire

hazard site assessment plan (as required by a BMO application) showing classified vegetation within the 150m site assessment area.

3.1 Landscape conditions

3.1.1 Study area location

The study area is located approximately 1km south-west of Kialla and 5km south-west of the city centre of Shepparton (see Map 3). It comprises 473ha of generally flat, rural residential and agricultural land. It is a more or less linear, north-south oriented corridor of land between the Goulburn River riparian corridor to the west, and the smaller Seven Creeks riparian corridor to the east (see Map 1 and Map 5).

The Goulburn River corridor comprises extensive areas of remnant vegetation largely associated with the Shepparton Regional Park. The Seven Creeks corridor similarly comprises remnant vegetation along a waterway, however it is much narrower, ranging from approximately 300m wide along the north-eastern boundary of the study area, to less than 100m wide along the south-eastern study area boundary. It poses a lesser hazard due to its size and that it is to the east of the study area.

At its widest point along the mid-western boundary, the study area abuts the established low density residential precinct of 'Arcadia Downs'. This residential development offers a sizeable area of low threat and non-vegetated land separating the broadest middle section of the study area from the hazard posed by the Goulburn River Corridor and Shepparton Regional Park west of the study area.

Along the south-west study area boundary, the Shepparton Regional Park abuts Raftery Road. Along the north-west boundary several RLZ/UFZ properties occur between Raftery Road and the Shepparton Regional Park, providing some separation between the park and the study area, although the properties retain remnant vegetation on them (see Map 5 and Map 6).

Access and egress for the study area is poor, with vehicle access to Shepparton only available to the north, via a one-lane bridge⁵ on Raftery Road (which is subject to flooding) and to the south, via Mitchell Road or Bennetts Road to the east. There is no access currently available, nor Terramatrix understands will any be proposed in the PSP, centrally through the study area to the east across Seven Creeks via River Road West.

⁵ Terramatrix understands the bridge will be proposed to be upgraded to two lanes in the PSP.

3.1.2 Broader landscape to 20km

Within 20km of the study area, the landscape is generally flat and, except for the townships that occur, is dominated by rural living and often irrigated agricultural/horticultural land. The Goulburn River corridor runs north-south and supports remnant treed vegetation up to approximately 2km wide in places. The BMO coverage mainly reflects the Goulburn River corridor and extends east in places as narrower ‘fingers’ of coverage over vegetated tributaries including Broken River, Castle Creek and sections of Seven Creeks.

Most of the land in the Shepparton, Mooroopna, Tatura and Kialla townships is not designated as BPA, and neither are large areas of irrigated land west of Mooroopna and north-east of Shepparton (see Map 2).

There is no history of large bushfires or grassfires having occurred within 20km of the study area, although multiple small fires are recorded, mainly along the Goulburn River corridor, which also has a high incidence of reported fire ignitions.

The first potential bushfire fire scenario in the landscape is a grassfire, the intensity and size of which would be affected by the degree of curing of the grass and the wind strength and direction. The second scenario is a bushfire in the river corridor, which under dry conditions and strong winds could generate higher intensities, smoke and ember attack. The risk associated with these scenarios is, however, likely to be relatively localised and neither is likely to result in extreme bushfire behaviour with widespread destruction of property.

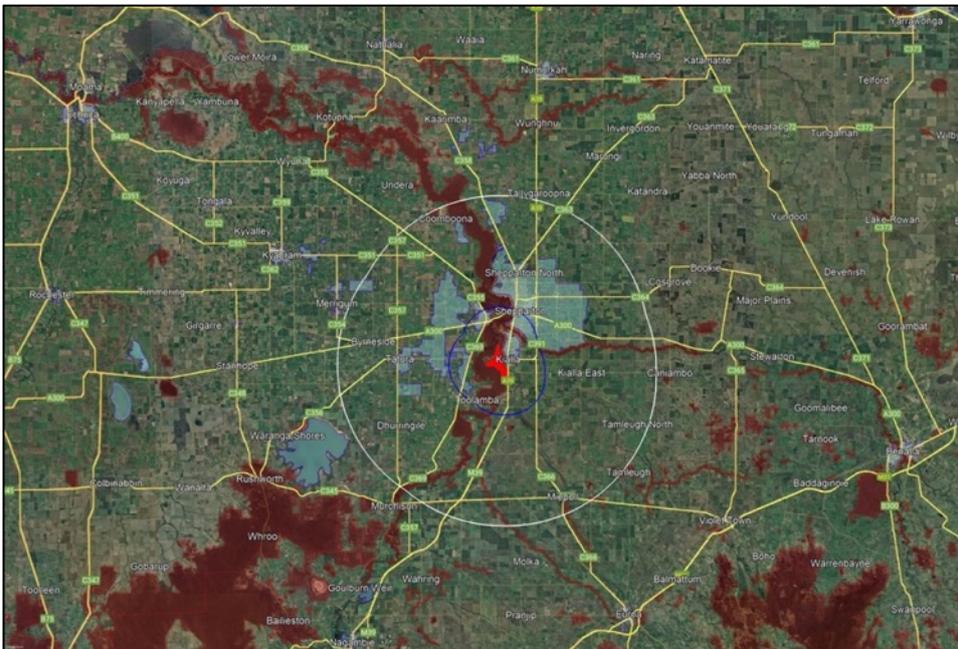
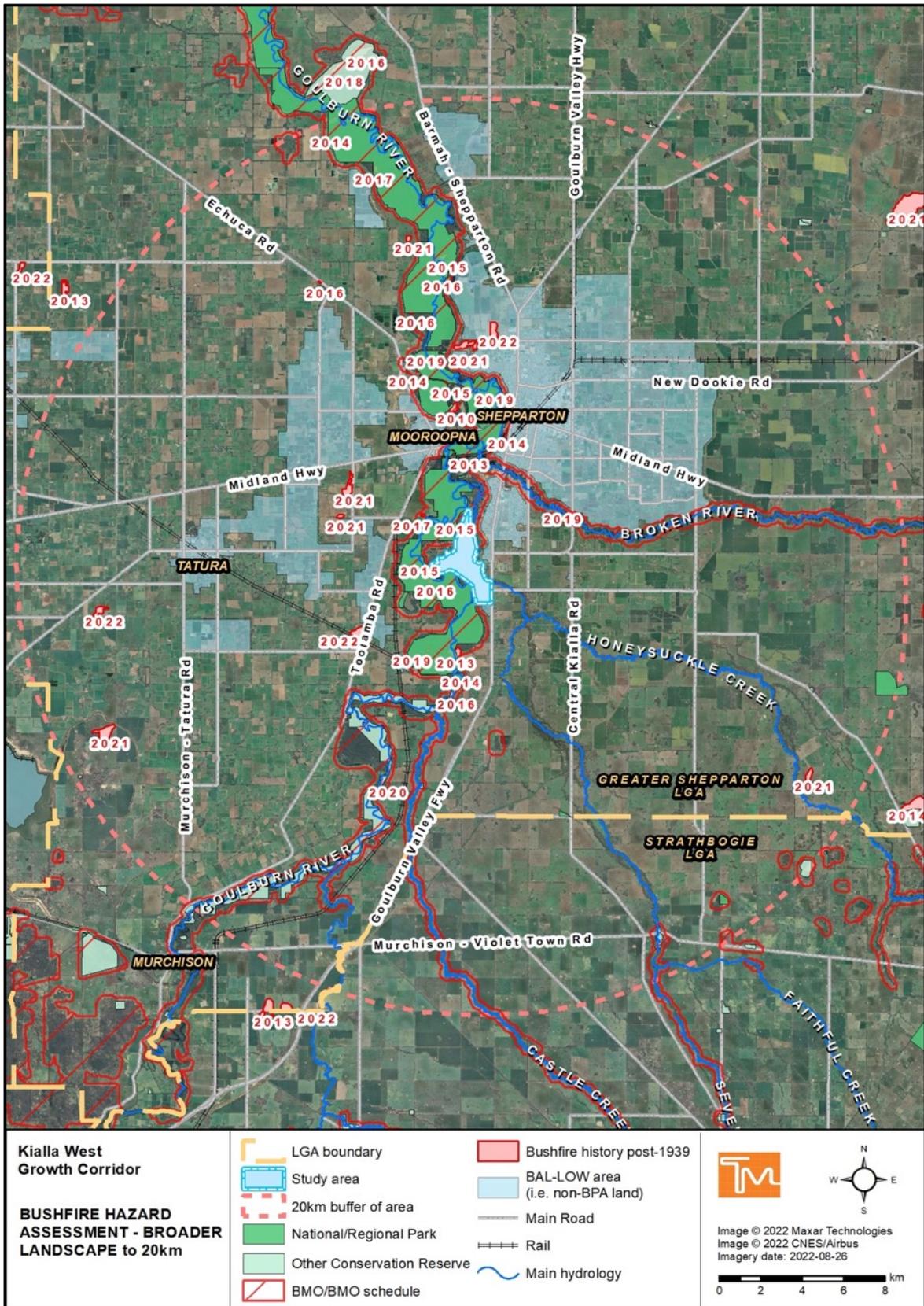


Figure 2 – Wide landscape context of the study area (KWGC shown in red; a 5km buffer of the area is shown in blue outline and a 20km buffer is shown in white outline). Land not designated as a BPA (i.e. BAL-LOW) is shown in semi-transparent blue shading and BMO coverage is shown in semi-transparent red.



Map 2 – Bushfire hazard landscape assessment plan to 5km.

3.1.3 Landscape conditions within 5km

The landscape risk within 5km is similar to that in the broader landscape to 20km. The topography is largely flat and therefore benign from a bushfire perspective. There are relatively large areas of land to the north-west, north-east and west of the site that are not designated as bushfire prone, which to some extent will buffer the study area from a large landscape scale fire approaching from these directions (see Map 3).

Closer to, and in places abutting, the study area in the the north-west, west and south-west, is the hazard posed by the remnant vegetation in the Shepparton Regional Park along the Goulburn River. A smaller fire could occur in vegetation along the Seven Creeks riparian corridor, to the east of the KWGC. The vegetated Goulburn River corridor is approximately 1.5km wide, whilst the Seven Creeks corridor is up to 300m wide (see Map 3 and Map 5). It should be noted that any fire in the Seven Creeks corridor will likely pose a lesser risk as it is to the east, a direction not typically associated with approach of severe fire weather in Victoria (Long, 2006). This is supported by the wind analysis presented in Section 3.5.

3.1.4 BMO landscape risk typologies

To assist in assessing landscape risk, four 'Broader Landscape Types' (BLTs), representing different landscape risk levels, are described in the DELWP technical guide *Planning Applications Bushfire Management Overlay*. These are intended to streamline decision-making, and support more consistent decisions based on the landscape risk (DELWP, 2017).

The four types range from lower risk landscapes, where there is little hazardous vegetation beyond 150m of a site except grasslands and extreme bushfire behaviour is not credible, to extreme risk landscapes with limited or no evacuation options and where fire behaviour could exceed BMO/AS 3959-2018 presumptions (see Table 1).

Table 1 - Landscape risk typologies (from DELWP, 2017).

Broader Landscape Type 1	Broader Landscape Type 2	Broader Landscape Type 3	Broader Landscape Type 4
<ul style="list-style-type: none"> • There is little vegetation beyond 150 metres of the site (except grasslands and low-threat vegetation). • Extreme bushfire behaviour is not possible. • The type and extent of vegetation is unlikely to result in neighbourhood-scale destruction of property. • Immediate access is available to a place that provides shelter from bushfire. 	<ul style="list-style-type: none"> • The type and extent of vegetation located more than 150 metres from the site may result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to a site. • Bushfire can only approach from one aspect and the site is located in a suburban, township or urban area managed in a minimum fuel condition. • Access is readily available to a place that provides shelter from bushfire. This will often be the surrounding developed area. 	<ul style="list-style-type: none"> • The type and extent of vegetation located more than 150 metres from the site may result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to a site. • Bushfire can approach from more than one aspect. • The site is located in an area that is not managed in a minimum fuel condition. • Access to an appropriate place that provides shelter from bushfire is not certain. 	<ul style="list-style-type: none"> • The broader landscape presents an extreme risk. • Evacuation options are limited or not available. • Fires have hours or days to grow and develop before impacting.
			

Map 4 shows an indicative delineation of the BLTs that occur in and around the study area, including for other growth areas designated in the strategic framework plans in the Greater Shepparton Municipal Planning Strategy.

The surrounding landscape within 5km and 1km has characteristics of BLTs 1, 2 and 3. To the north-west, west and south-west, which are the directions of most likely bushfire threat under elevated fire weather conditions, the landscape characteristics match those of BLT 3. A bushfire could occur in the Shepparton Regional Park and threaten the study area under the influence of the dominant winds associated with elevated fire danger weather (see Section 3.5).

To the north-east, east and south, however, the landscape is more commensurate with BLT 2 and BLT 1. Whilst some of the study area is affected by the BMO, the coverage is relatively minor and generally only comprises the 150m ember attack zone associated with delineating the BMO mapping coverage (DELWP, 2019). It is also noted that the proposed UGZ area will be almost entirely outside the BMO coverage of the study area. Therefore, the study area itself is considered to be largely a BLT 2 landscape, if developed in a low threat state with egress available to places of relative safety from bushfire within and outside the precinct.

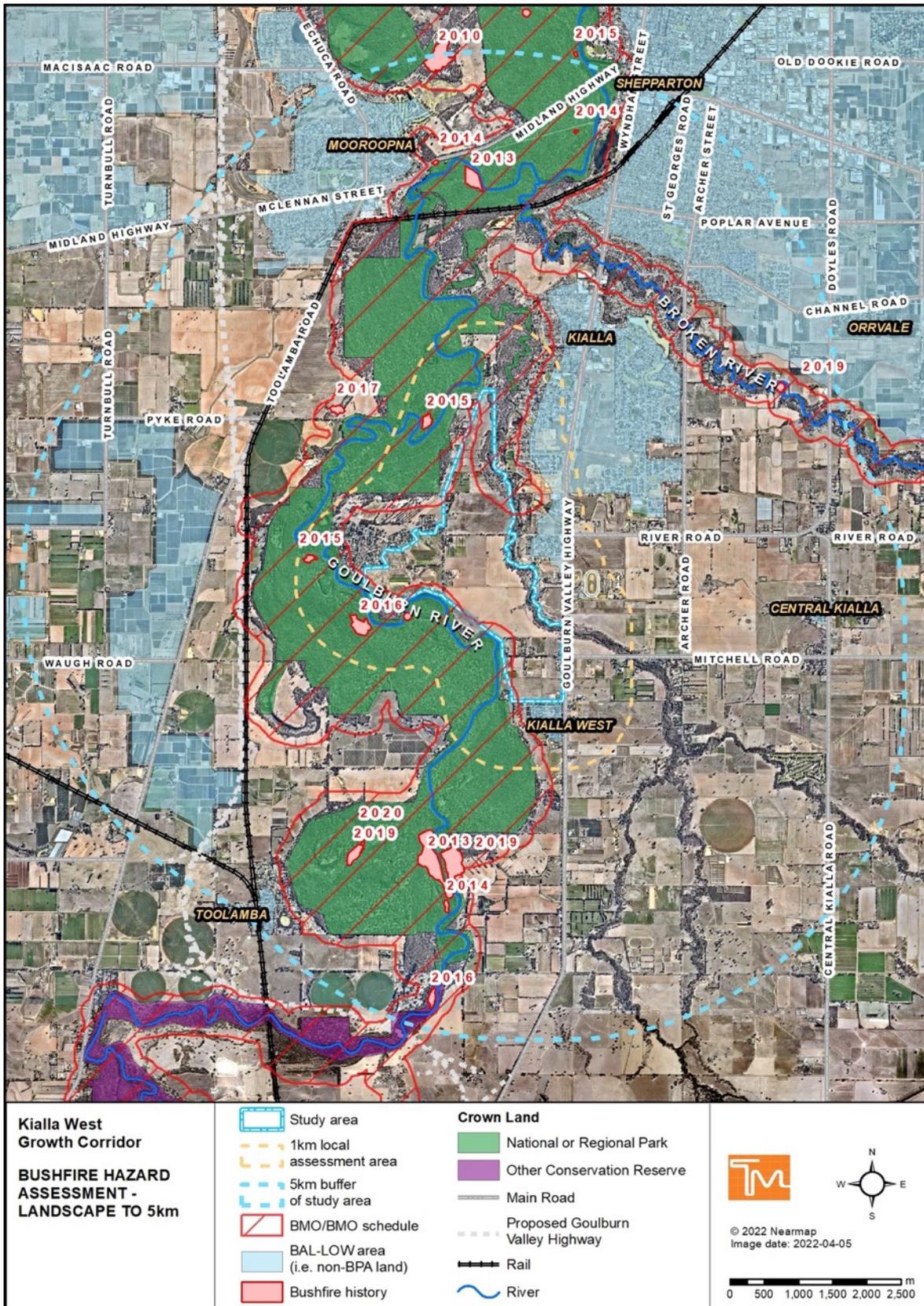
Note that Map 4 delineates BLT 3 and 4 as land covered by the BMO, because BMO areas are, by definition, areas of very high to extreme fire hazard with the potential for extreme fire behaviour (DELWP, 2019). However, given the generally lesser fuel hazard and benign topography, (largely grassy woodland on flat land) BLT 4 is not considered to occur. All four characteristics of BLT 3 in Table 1 above are considered applicable to the BLT 3 areas in Map 4.

BLT 1 areas are defined as least risk and comprise all BAL-LOW (non-BPA) land, as these areas are where the extent, configuration and/or management of vegetation results in low potential for bushfire spread. All four characteristics of BLT 1 are considered applicable to the BLT 1 areas in Map 4.

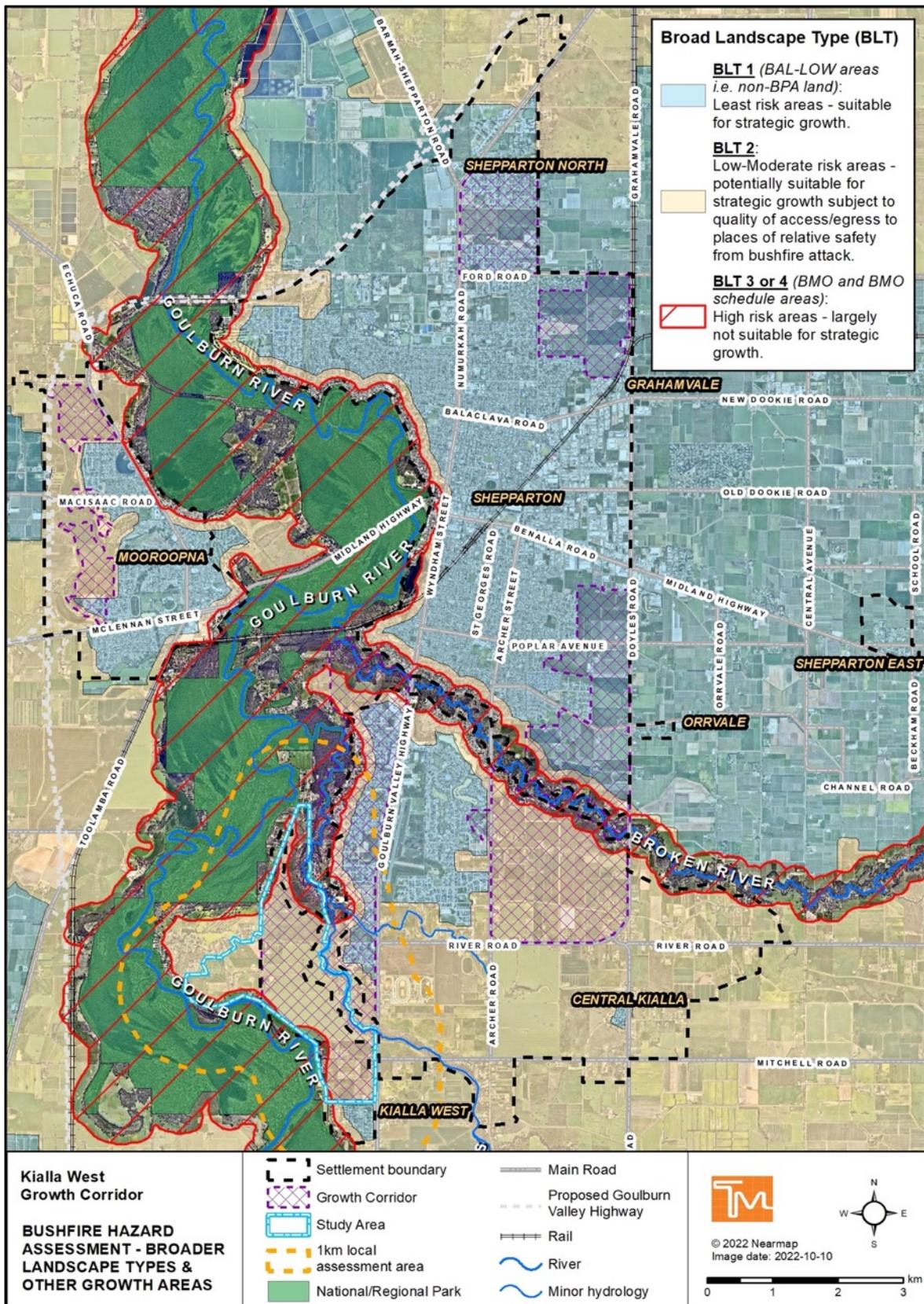
BLT 2 areas in Map 4 are those not defined as BLT 3 or BLT 1, and are locations with the potential for all characteristics of BLT 2 to apply, subject to an appropriate development scenario that establishes a suburban, township or urban area in a reliably minimum fuel condition; and which creates or provides access to a place/s that provides shelter from bushfire.

Note that the BLT mapping is 'broad brush' for strategic planning purposes only, therefore the boundaries of the BLTs shown should be seen as indicative only.

Overall, it is considered that the bushfire risk is not high enough to preclude development. If an appropriate precinct design is achieved, including perimeter roads and development setbacks, good access and egress to places of relative safety from bushfire within and outside the precinct, a reliable water supply for fire fighting is provided, and BALs and vegetation management controls are implemented to ensure low threat vegetation occurs across the precinct, then it is considered the risk can be acceptably mitigated.



Map 3 - Bushfire hazard landscape assessment plan to 5km.



Map 4 - BMO Broader Landscape Types in the surrounding landscape and comparison with other potential growth areas.

3.2 Regional bushfire assessments and strategies

3.2.1 Regional Bushfire Planning Assessment (RBPA) Hume Region

As part of the response to the 2009 Victorian Bushfires Royal Commission, Regional Bushfire Planning Assessments (RBPAs) were undertaken across six regions that cover the whole of Victoria. The RBPAs provide information about ‘identified areas’ where a range of land use planning matters intersect with a bushfire hazard to influence the level of risk to life and property from bushfire. The RBPAs state that *‘This information should be addressed as part of strategic land use and settlement planning at the regional, municipal and local levels’* (DPCD, 2012).

The *Regional Bushfire Planning Assessment – Hume Region* covers the City of Greater Shepparton LGA. It notes that the natural landscape of the municipality and wider region has been modified significantly by pastoral and irrigation activities and that areas of remnant native vegetation are primarily limited to watercourses, road reserves and public land, including residential lots that directly adjoin riparian corridors. It identifies that the bushfire hazard associated with remnant vegetation along the Goulburn River and on the floodplain, directly interfaces with residential lots. It also states that rural-residential subdivision between Rafferty Road and the Goulburn River floodplain is in close proximity to remnant vegetation patches along the Goulburn River corridor and associated bushfire hazard area. (DPCD, 2012).

3.2.2 Hume Bushfire Management Strategy 2020

Strategic bushfire management planning in Victoria is jointly delivered by Forest Fire Management Victoria (FFMVic), Country Fire Authority (CFA), Emergency Management Victoria (EMV) and local governments. A key output is a Bushfire Management Strategy for the six planning regions that cover the state. Each strategy informs more detailed operational-level planning, including municipal fire management planning, the CFA and FFMVic Joint Fuel Management Program, and readiness and response planning.

The City of Greater Shepparton is covered by the Hume Bushfire Management Strategy. No specific mention is made of Kialla or the study area. The bushfire behaviour and house loss modelling in the strategy shows Shepparton, including the study area, as being in the least risk category for potential house loss (DELWP, 2020).

3.2.3 Municipal Emergency Management Plan (MEMP) and Fire Management Strategy (MFMS)

The Greater Shepparton City Council MFMS (GSCC, 2022) aligns with regional fire management objectives for fire management. There is no specific information in the strategy pertinent to the study area.

The MEMP rates the risk of a large regional bushfire as 'High', based on a Consequence rating of 'Moderate' and a Likelihood rating of 'Possible/Likely' (GSCC, 2019). The MEMP recognises though, that in recent history there have only been a small number of major fires in the municipality (GSCC, 2019).

3.3 Local and neighbourhood conditions

The hazard within the 1km and 400m assessment areas is largely Woodland vegetation associated with the Shepparton Regional Park to the north-west, west and south-west, Seven Creeks to the east, and Woodland and Grassland within the 150m site hazard assessment area (see Map 5 and Map 6).

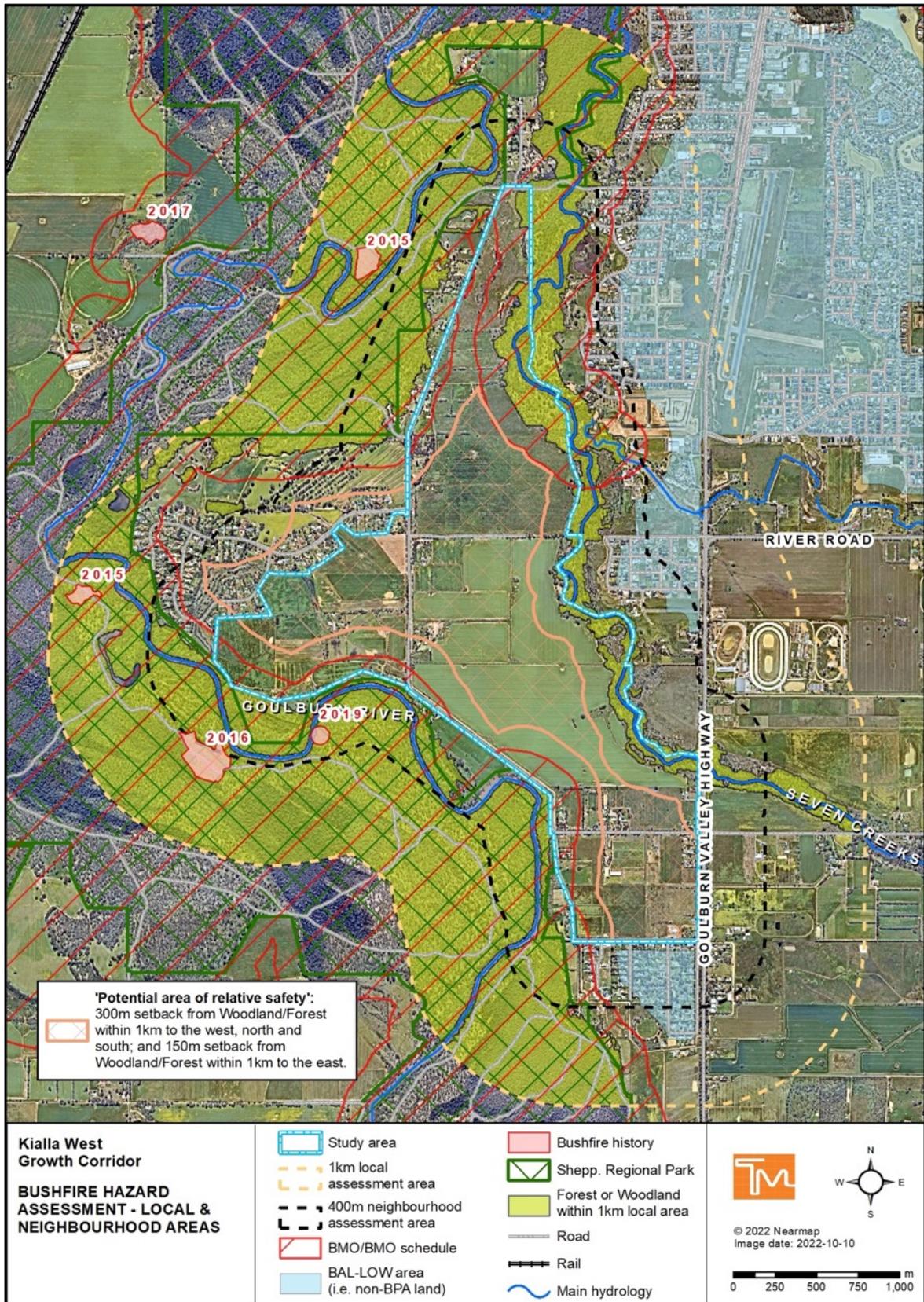
A fire associated with this vegetation could generate a significant level of smoke and some ember attack, with potential for elevated levels of radiant heat if there is insufficient separation between future development and vegetation.

As identified above, the vegetated Goulburn River corridor is approximately 1.5km wide, whilst the Seven Creeks corridor is up to 300m wide (see Map 3 and Map 5). An approach of bushfire from the east, north-east or south-east is not typically associated with significant fire risk in Victoria, as the direction of the wind on days of elevated fire danger is usually from the north, north-west, west or south-west (Long, 2006). This is evidenced by the fire weather analysis and wind rose for Shepparton Airport (see Figure 10), which show the dominance of winds from the west, north and north-west and, to a lesser extent, the south under days of elevated fire danger.

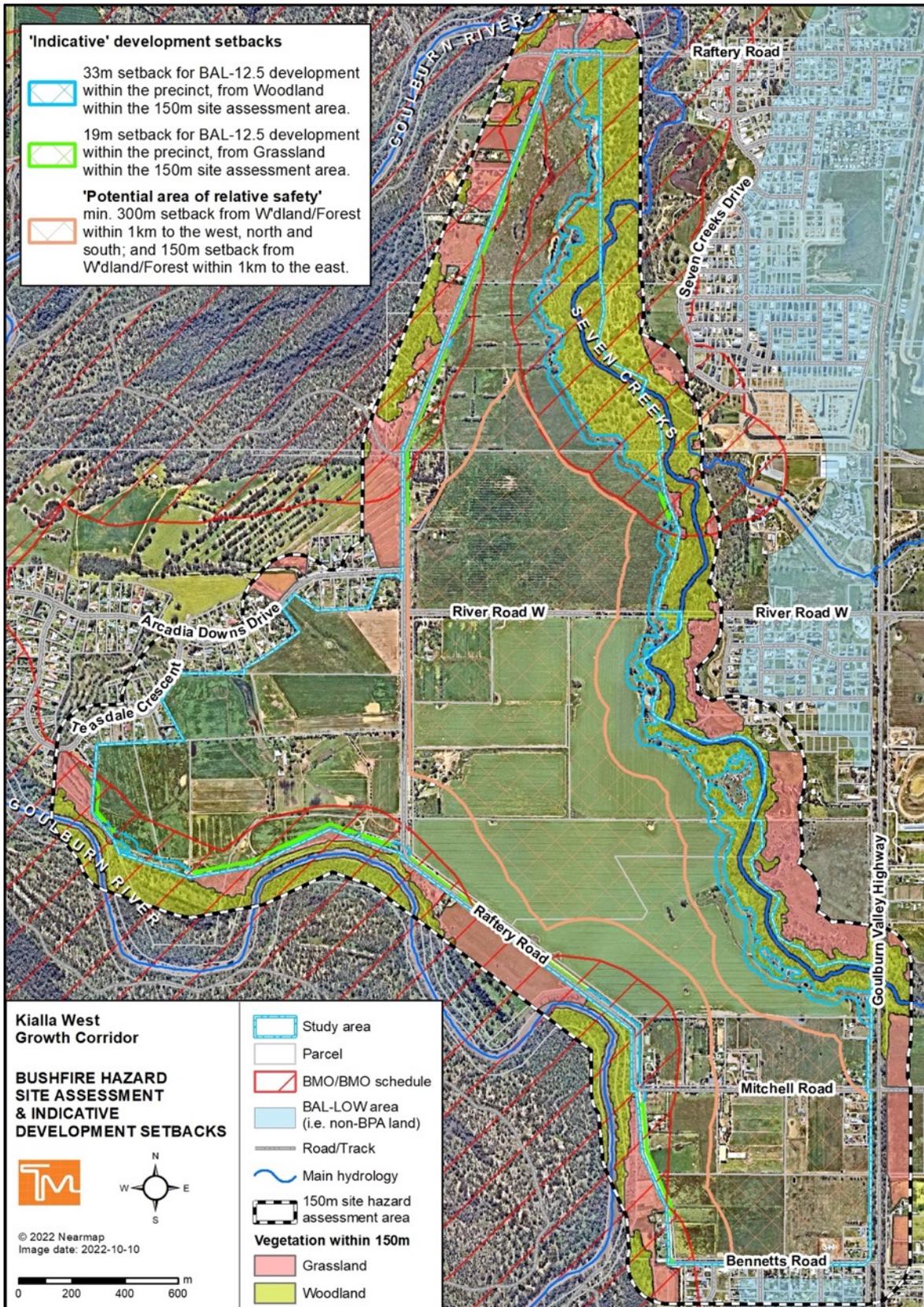
The analysis was based on historical weather records obtained for the closest Bureau of Meteorology (BOM) station considered representative of weather conditions, which is at Shepparton Airport, 1km to the east of the site. The analysis confirmed that the most frequent direction of winds, under elevated fire danger conditions, was from the west, to a lesser extent the north and north-west, and to an even lesser extent the south (see Section 3.5).

The topography is benign, being generally flat, and will not exacerbate fire behaviour. The short, steeper embankments of the Goulburn River and Seven Creeks are not long enough to significantly influence fire spread.

With appropriate setbacks, the impacts associated with a bushfire in the Shepparton Regional Park would be limited to smoke, relatively low levels of embers and lesser levels of radiant heat (see Sections 4.1.1 and 4.2.1 for a discussion about potentially applicable setbacks).



Map 5 - Local and neighbourhood hazard assessment map.



Map 6 - Bushfire hazard site assessment plan.

3.4 Site scale conditions

The AS 3959-2018 site assessment methodology is invoked by Clause 13.02-1S to assess the bushfire risk at the site scale, and by the building regulations to determine BAL construction standards for defined classes of buildings in a BPA. It requires classification of the vegetation and topography within 100m of a site or building to determine a BAL, whilst in BMO areas a 150m assessment area is applied.

As a precautionary approach, the BMO 150m site assessment area has been applied around the study area to classify vegetation and topography. This is consistent with BMO requirements and DELWP guidelines that state for vulnerable uses and larger developments in a BPA, a 150m assessment zone may be required (DELWP, 2018).

3.4.1 Vegetation

Classified vegetation is vegetation that is deemed hazardous from a bushfire perspective and is classified in accordance with the AS 3959-2018 methodology.

The classification system is not directly analogous to Ecological Vegetation Classes (EVCs) but uses a generalised description of vegetation based on the AUSLIG (Australian Natural Resources Atlas: No. 7 - Native Vegetation) classification system. The classification should be based on the likely fire behaviour that it will generate and, for settlement planning purposes, the long-term structure of the vegetation in its mature state.

The classification is shown in Map 6.

Woodland

Areas of remnant treed vegetation, where the overall foliage cover is greater than 10%, are considered to accord best with the AS 3959 Woodland group, which typically comprises: *'Trees to 30 m high; 10%–30% foliage cover dominated by eucalypts and/or callistris with a prominent grassy understorey. May contain isolated shrubs'* (Standards Australia, 2020).

Some areas of Woodland areas have a variable assemblage of understorey shrubs that may indicate a Forest classification but, overall, a Woodland classification is considered most representative of the fuel hazard.

The Woodland classification is supported by DELWP modelled Ecological Vegetation Class (EVC) mapping, which identifies six main EVCs as occurring within 150m of the site. The following descriptors of these EVCs are from the applicable Victorian Riverina bioregional EVC benchmarks and are generally consistent structurally with the typical characteristics of Woodland in AS 3959. It is important to note that the floristic based EVC name (e.g. Forest or Woodland) does not necessarily reflect or correlate with an AS 3959 Forest or Woodland structural classification.

EVC 803 Plains Woodland (Victorian Riverina) - 15% benchmark tree canopy cover.

'An open, eucalypt woodland to 15 m tall occurring on a number of geologies and soil types. Occupies fertile clays and clay loam soils on flat or gently undulating plains at low elevations in areas with <600 mm annual rainfall. The understorey consists of a few sparse shrubs over a species-rich grassy and herbaceous ground layer and chenopods are often present' (DSE, 2004a).

EVC 814: Riverine Swamp Forest – 30% benchmark tree canopy cover of River Red-gum.

'Open eucalypt forest to 25 m tall with understorey dominated by obligate wetland species (or opportunistic annuals during sustained dry periods) and can range from closed sedgeland or herbland to grassy-herbaceous or extremely sparse and with cover primarily leaf-litter, black water or exposed alluvium. Occupies low-lying areas subject to reasonably regular flooding, typically flood-prone lower river terraces and low-lying areas adjacent to floodways through or within riverine forest' (DSE, 2004b).

EVC 816: Sedgy Riverine Forest – 30% benchmark tree canopy cover of River Red-gum.

'Riverine Sedgy Forest occurs on the floodplain of major rivers in areas of frequent flooding. The overstorey is a tall forest of River Red Gum to 25 m tall. The groundlayer is dominated by flood-related grass and sedge species. Depending on time of year and flooding level, associated water plants may be present.' (DSE, 2004c).

EVC 56: Floodplain Riparian Woodland – 20% benchmark tree canopy cover of River Red-gum and Yellow Box.

'An open eucalypt woodland or open forest to 20 m tall over a medium to tall shrub layer with a ground layer consisting of amphibious and aquatic herbs and sedges. Occurs along the banks and floodplains of the larger meandering rivers and major creeks, often in conjunction with one or more floodplain wetland communities. Elevation and rainfall are relatively low and soils are fertile alluviums subject to periodic flooding and inundation.' (DSE, 2004d).

EVC 68: Creekline Grassy Woodland – 15% benchmark tree canopy cover of River Red-gum.

'Eucalypt-dominated woodland to 15 m tall with occasional scattered shrub layer over a mostly grassy/sedgy to herbaceous ground-layer. Occurs on low-gradient ephemeral to intermittent drainage lines, typically on fertile colluvial/alluvial soils, on a wide range of suitably fertile geological substrates. These minor drainage lines can include a range of graminoid and herbaceous species tolerant of waterlogged soils, and are presumed to have sometimes resembled a linear wetland or system of interconnected small ponds' (DSE, 2004e).

EVC 295: Riverine Grassy Woodland – 20% benchmark tree canopy cover of River Red-gum.

'Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a ground layer dominated by graminoids. Occasional tall shrubs present' (DSE, 2004f).

Note that whilst the EVC description states Floodplain Riparian Woodland may develop a medium to tall shrubby understorey, which could indicate a Forest rather than Woodland classification, the site assessment confirmed a Woodland classification for all treed vegetation in the 150m assessment area was appropriate.



Figure 3 - Woodland along Seven Creeks (and Grassland in rear of image) at the Raftery Road one lane bridge near the north-east corner of the study area.



Figure 4 – Woodland in the Shepparton Regional Park abutting the south-west corner of the study area.



Figure 5 – Looking at vegetation in the Shepparton Regional Park, across the Goulburn River, west of Greater Shepparton Road.



Figure 6 – Woodland in the Shepparton Regional Park to the north-west of the study area, beyond the 150m site assessment area.

3.4.2 Grassland

Areas of grassy vegetation with an overstorey foliage cover of less than 10% are classifiable in the Grassland group of AS 3959-2018, which is defined as *'All forms (of vegetation except tussock moorlands) including areas with shrubs and trees, if the overstorey foliage cover is less than 10%'* (Standards Australia, 2020). Grassland includes open woodland, pasture and cropland other than non-curing crops. Grassland vegetation is considered hazardous, and therefore classifiable, when it is unmanaged i.e. >100mm tall. Areas of pasture/grass that have been classified as Grassland within the 150m site assessment area around the study area boundary are shown in Map 6.

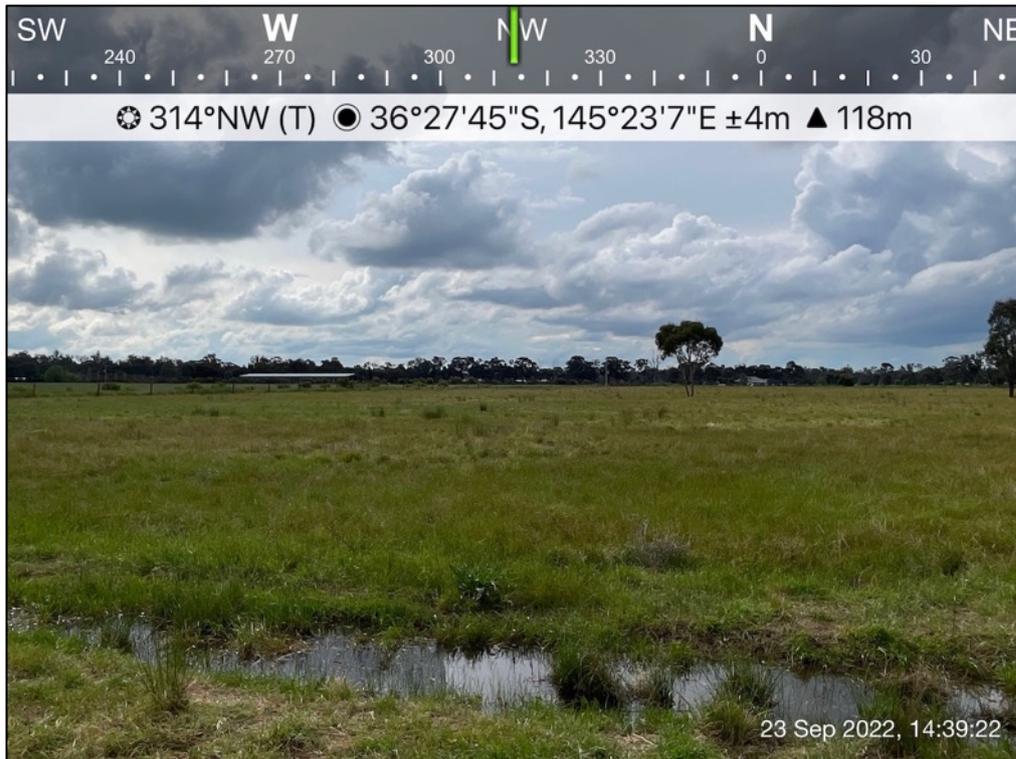


Figure 7 – Looking north across the study area from Bennetts Road, which forms the southern boundary.



Figure 8 – Looking south-east from Teasdale Crescent at Grassland within the UFZ and FZ1 western-most part of the study area, west of Raftery Road. This area is likely to remain as Grassland.



Figure 9 - Looking west along Bennetts Road, with non-BPA land just out of view to the left of image.

3.4.3 Excluded vegetation and non-vegetated areas

Areas of low threat vegetation and non-vegetated areas can be excluded from classification and be deemed non-hazardous for determining BALs, in accordance with Section 2.2.3.2 of AS 3959-2018, if they meet one or more of the following criteria:

- (a) *Vegetation of any type that is more than 100m⁶ from the site.*
- (b) *Single areas of vegetation less than 1 ha in area and not within 100m of other areas of vegetation being classified vegetation.*
- (c) *Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified vegetation.*
- (d) *Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.*
- (e) *Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.*
- (f) *Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana*

⁶ 150m in BMO areas.

plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

NOTES:

- 1 *Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (recognizable as short-cropped grass for example, to a nominal height of 100 mm).*
- 2 *A windbreak is considered a single row of trees used as a screen or to reduce the effect of wind on the leeward side of the trees' (Standards Australia, 2020).*

All areas not shown as Woodland or Grassland in Map 6 are either low threat or non-vegetated.

3.4.4 Topography

AS 3959-2018 requires that the 'effective slope' be identified to determine the BAL and applicable development setback distances from classified vegetation. This is the slope of the land under classified vegetation that will most significantly influence the bushfire attack on a building. Two broad types apply:

- Flat and/or Upslope - land that is flat or on which a bushfire will be burning downhill in relation to the development. Fires burning downhill (i.e. on an upslope) will generally be moving more slowly with a reduced intensity.
- Downslope - land on which a bushfire will be burning uphill in relation to the development. As the rate of spread of a bushfire burning on a downslope (i.e. burning uphill towards a development) is significantly influenced by increases in slope, downslopes are grouped into five classes in 5° increments from 0° up to 20°⁷.

The topography on the site and in the surrounding 150m assessment area is benign, being generally flat, without any significant changes in elevation that would appreciably influence bushfire behaviour. Embankments and gradual slopes either side of the Goulburn River or Seven Creeks are not considered a contributor to the effective slope, as they are short or gently sloping and would not appreciably influence the rate of spread of a fire.

Therefore, for the purposes of determining BALs and building-vegetation setback distances for future development, the applicable slope class throughout the study area is likely to be 'All upslopes and flat land'.

3.5 Fire weather

The Forest Fire Danger Index (FFDI) and the Grassland Fire Danger Index (GFDI) represent the level of bushfire threat based on weather (and fuel) conditions. An FFDI 100/GFDI 130 is applied

⁷ For downslope gradients over 20° and up to 30°, the detailed 'Method 2' procedure of AS 3959-2018 is used to determine the BAL.

in non-alpine areas of Victoria by the building system, to establish a BAL based on building setback distances from classified vegetation in accordance with AS 3959-2018.

The FFDI and GFDI indices can also be used for predicting fire behaviour, the difficulty of suppression and were used for forecasting daily Fire Danger Ratings (FDRs). FFDI/GFDI were replaced by the Fire Behaviour Index (FBI) for the new Australian Fire Danger Rating System (AFDRS) adopted by all jurisdictions on 1st September 2022. Table 2 displays the new FDRs, their FBI range, the anticipated fire behaviour and recommended actions for each FDR.

The new AFDRS and FBIs do not correlate directly with the FFDI/GFFDI indices that are still applied in the planning and building system. However, the benchmark FFDI 100 used to represent a 'one size fits all' model of extreme fire weather conditions (and the threshold for the previous 'Code Red' FDR), is considered analogous to the new FBI 100 'Catastrophic' FDR. Note that these extreme conditions have been exceeded during significant fire events, including at some locations in Victoria on 'Black Saturday' 2009 and are not necessarily the *worst-case* conditions for any particular location, including Kialla West.

Additionally, as identified in Section 2.1.1, in southern and eastern Australia, since the 1950's there has been an increase in the length of the fire season and an increase in extreme fire weather (CSIRO/BOM, 2020). The trend of a longer fire season and increased number of elevated fire weather days is projected to continue. Climate change is contributing to these changes in fire weather, including increases in temperature, reduced relative humidity and associated reductions to fuel moisture content (CSIRO/BOM, 2020).

The Hume Bushfire Management Strategy states that in Victoria climate change is expected to extend the length of the fire danger period, increase the frequency of days of elevated fire danger with potential for larger more severe and frequent bushfires (DELWP, 2020b).

The latest climate projections for the Murray Basin cluster, that the site is in, state that there is a 'very high confidence' level that average temperatures in all seasons will continue to increase, with more hot days and warm spells combined with a decline in mean annual rainfall. There is a 'high confidence' in a harsher fire weather climate in the future, although a 'low confidence' in the magnitude of the change (CSIRO/BOM, 2022).

Climate change trends associated with the risk of bushfire, support the adoption of a precautionary and conservative approach in identifying and responding to the risk. However, as CFA and DELWP have no published policy on FFDI recurrence intervals. there is no compelling reason to apply a different FFDI/GFDI from the FFDI 100/GFDI 130 threshold used throughout non-Alpine areas of Victoria in the planning and building system⁸.

⁸ In Alpine areas of Victoria an FFDI 50 applies for determining BALs using Method 1 of AS 3959-2018.

Table 2 - Fire Danger Ratings (source: Victoria State Government; BoM 2022).

Forest Behaviour Index	Fire Danger Rating (FDR)	Fire Behaviour	Action
>=100	Catastrophic	If a fire starts and takes hold, lives are likely to be lost.	<ul style="list-style-type: none"> ○ These are the most dangerous conditions for a fire. ○ Your life may depend on the decisions on you make, even before there is a fire. ○ For your survival, do not be in bushfire risk areas. ○ Stay safe by going to a safer location early in the morning or the night before. ○ If a fire starts and takes hold, lives and properties are likely to be lost. ○ Homes cannot withstand fires in these conditions. You may not be able to leave and help may not be available.
50-99	Extreme	Fires will spread quickly and be extremely dangerous.	<ul style="list-style-type: none"> ○ These are dangerous fire conditions. ○ Check your bushfire plan and that your property is fire ready. ○ If a fire starts, take immediate action. If you and your property are not prepared to the highest level, go to a safer location well before the fire impacts. ○ Reconsider travel through bushfire risk areas. ○ Expect hot, dry and windy conditions. ○ Leaving bushfire risk areas early in the day is your safest option.
24-49	High	Fires can be dangerous.	<ul style="list-style-type: none"> ○ There is a heightened risk. Be alert for fires in your area. ○ Decide what you will do if a fire starts. ○ If a fire starts, your life and property may be at risk. The safest option is to avoid bushfire risk areas.
12-23	Moderate	Most fires can be controlled.	<ul style="list-style-type: none"> ○ Stay up to date and be ready to act if there is a fire.

3.5.1 Fire weather analysis (wind speed and direction)

Analysis of weather data was undertaken by Terramatrix to determine wind speed and direction on days of elevated fire danger (and therefore the direction/s of highest threat, e.g. most likely direction/s of approach of a possible bushfire).

The analysis is based on a calculated 'historical' FFDI, using data obtained for the closest Bureau of Meteorology (BOM) station considered representative of weather conditions for the study area, which is the BOM Automatic Weather Station (AWS) at Shepparton Airport (BOM Station No. 81125), located just 1km to the north-east. The analysis is based on synoptic weather data records available for all days during an extended fire season period (September-April), using records that had all the required relative humidity, temperature and wind speed inputs for

calculating the FFDI. The drought factor, which is also required to calculate FFDI, was assumed to be 10⁹. Table 3 summarises the attributes of the station and data.

Table 3 - Summary of Shepparton Airport BOM station and data attributes.

Attribute	Shepparton Airport
Distance and direction from site	1km to north-east
Elevation	113.9m
BOM Station No.	081125
BOM district name	Upper North
Opened	1996
Data available	Synoptic
Date of oldest record with all inputs*	1/9/1996
Date of most recent record with all inputs*	6/9/2022
No. of records with all inputs*	49,510
% of records with all inputs*	99.1%
No. of years of data	26

*Record with all inputs = record that has all three attributes i.e. relative humidity, temperature and wind speed.

The data were sorted to retain only those records for which all three inputs were available to calculate the FFDI, i.e. relative humidity (%), temperature (°C) and wind speed (km/h at 10m above ground level, averaged for the 10min period before the reading). Only those records for days during the fire season period (i.e. 1st September – 30th April) were used.

The FFDI analysis was undertaken to assist in analysing the hazard posed by the weather and does not necessarily equal the actual FFDI or fire weather conditions that may have occurred¹⁰.

As wind speed and direction is a major influence on fire behaviour, a wind rose was generated to show the frequency of wind speed and direction on days of elevated fire danger (i.e. days when calculated maximum daily FFDI was > or = 50) during the fire danger period. The results are shown in Figure 10.

⁹ The drought factor (DF) is a numerical scale from 1-10, which represents an estimate of the proportion of fine fuels available to be consumed in a fire, based on seasonal weather conditions and time since last rainfall. DF=10 means driest fuel conditions with 100% of fine fuels available to be burnt.

¹⁰ Uncertainty values associated with *forecast* FFDIs are significant, reflecting the imprecision of the input values, and may cross a number of FDR classes (Yeo *et al.*, 2014; AFAC, 2017).

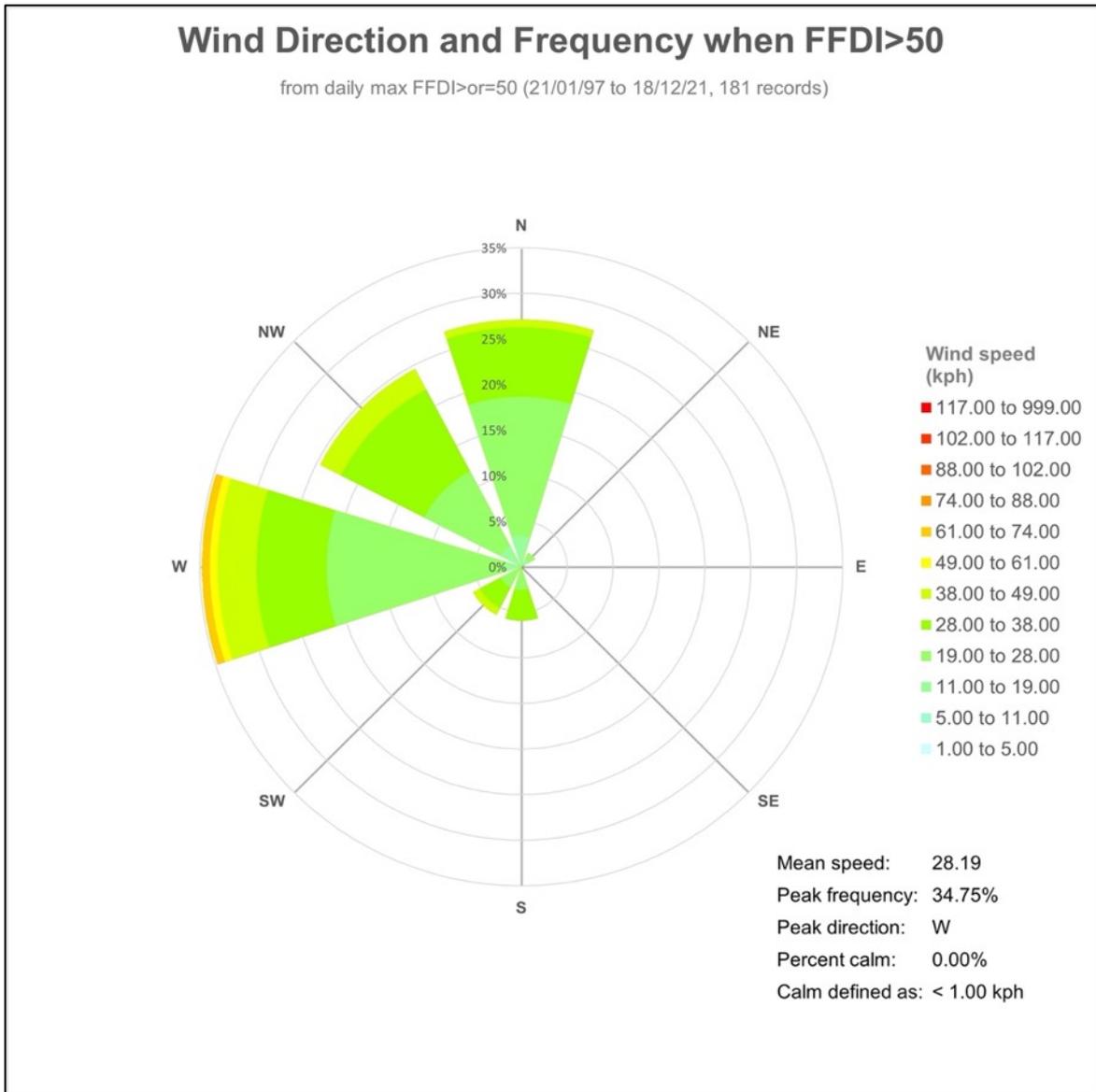


Figure 10 – Shepparton Airport wind rose showing direction, frequency and strength of winds during the fire season months when calculated maximum daily FFDI was \geq 50.

The results show the dominance of westerly winds with a prevalence also of northerly or north-westerly winds on days of elevated fire danger. The wind rose data supports the contention that the site is least likely to be exposed to direct bushfire attack from the east, north-east or south-east.

4 Planning and design response

This section identifies how the PSP could be designed so that future development in the KWGC responds appropriately to the bushfire risk, including the requirements of Clause 13.02-1S, published CFA and DELWP guidance and the planning and building regulations applicable to construction in the BPA or BMO. The section structure follows DELWPs *Design Guidelines for Settlement Planning at the Bushfire Interface* (DELWP, 2020a).

4.1 Settlement form and structure

4.1.1 Considering the bushfire hazard in directing growth

Clause 13.02-1S requires the protection of human life be prioritised and that population growth and development must identify the bushfire hazard, assess the risk and direct growth to low risk areas, with safe access to locations where human life can be better protected from bushfire (Greater Shepparton Planning Scheme, 2018a).

Due to the precinct's location adjacent to the Shepparton Regional Park, the study area is considered a higher risk than the other growth areas identified in the Greater Shepparton Municipal Planning Strategy framework plans and the *Shepparton and Mooroopna 2050 Regional City Growth Plan* (see Figure 11 and Map 4).

However, the State Planning Policy for bushfire does not require that settlement growth be directed to areas of least risk, rather that it be directed to areas of low risk, which are defined by a key settlement planning strategy at Clause 13.02-1S as '*...those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009)*' (Greater Shepparton Planning Scheme, 2018a).

Map 6 and Map 7 show that virtually all of the study area can meet this RHF safety threshold¹¹ and, therefore, be deemed a low risk location. This requires a minimum 33m setback of development from Woodland along the Seven Creeks corridor in the east of the study area and from Woodland to the west, and a 19m minimum setback from any areas of classified Grassland adjacent to or within the KWGC. The landscape risk analysis and assessment of the fuel hazard posed by the vegetation, fire weather and topography, also justifies that the location is a low enough risk.

Map 5, Map 6 and Map 7 also show a greater setback area identified as a 'Potential area of relative safety' within the precinct. The setback is based on statewide BMO and BPA hazard mapping criteria, including a minimum 300m setback from classifiable treed vegetation within

¹¹ Which is commensurate with a BAL-12.5 construction standard.

1km to the north, west and south of the study area, and a lesser 150m setback from classifiable treed vegetation within 1km to the east of the site. The lesser 150m eastern setback is considered justified based on the limited area of hazard to the east and the lesser likelihood and intensity of bushfire attack that could credibly be expected from the east.

The BMO mapping criteria include a 150m ember protection buffer (setback) from large contiguous areas of forest, based on house loss research which indicates that 92% of house loss occurs within 150m of the bushfire hazard (DELWP, 2019). The BPA mapping applies a more conservative 300m ember protection buffer around areas of hazardous vegetation >4ha (DELWP, 2019). 300m is also the approximate distance from the hazard, within which 90% of houses were lost in the 2003 Canberra fires at Duffy (Chen and McAneney, 2010), when extreme ember attack resulted in significant house loss in a densely developed suburban area. The 300m setback distance has been applied in this study to help show the variable risk within the study area based on proximity to hazardous vegetation and to identify a place of relative safety, or lesser risk, within the precinct. Note that land more than 300m from large areas of forest hazard and 60m from a grassland hazard is typically eligible for excision from the BPA, i.e. BAL-LOW areas.

Additionally, with a 300m setback from Forest, the radiant heat flux (RHF) would be reduced to 1.1kW/m^2 , using the precautionary inputs for flame temperature of 1200K and FFDI of 120^{12} , which is more conservative than the current BMO/AS 3959 'default' inputs. Note that a RHF exposure of 2kW/m^2 is the maximum threshold for an Open Space Neighbourhood Safer Place (NSP), i.e. for sheltering in the open rather than in a building (note that this does not account for localised flaming sources and assumes there is no fire within the 300m setback). The 2kW/m^2 RHF threshold is considered non-fatal although an unprotected person will likely suffer pain after 1 minute (RFS, 2010).

Note that forest fire is responsible for most house loss, and therefore the setbacks are shown from the forest/woodland edge; however, it must be recognised that grassfires also pose a threat. Grass fires can develop and spread rapidly and impact with little warning. Management of the potential grassfire risk associated with any undeveloped land within the precinct would therefore be required.

The 'lesser risk' setbacks defining the large 'Potential area of relative safety' within the precinct is also shown in relation to the *Villawood Properties May 2022 Framework Masterplan* for the area, in Map 7, along with the 'low risk' setbacks required for BAL-12.5.

It is also noted that Greater Shepparton has significant other constraints limiting the options for land to accommodate residential growth; including flooding risk, lack of sewerage/drainage infrastructure and competing land uses e.g. agriculture and horticulture (see Appendix 2).

¹² 'Forest' fuel loads, which are higher than 'Woodland' and hence more precautionary, were also used in the calculation.

These constraints mean that lesser risk bushfire areas may not be available for development.

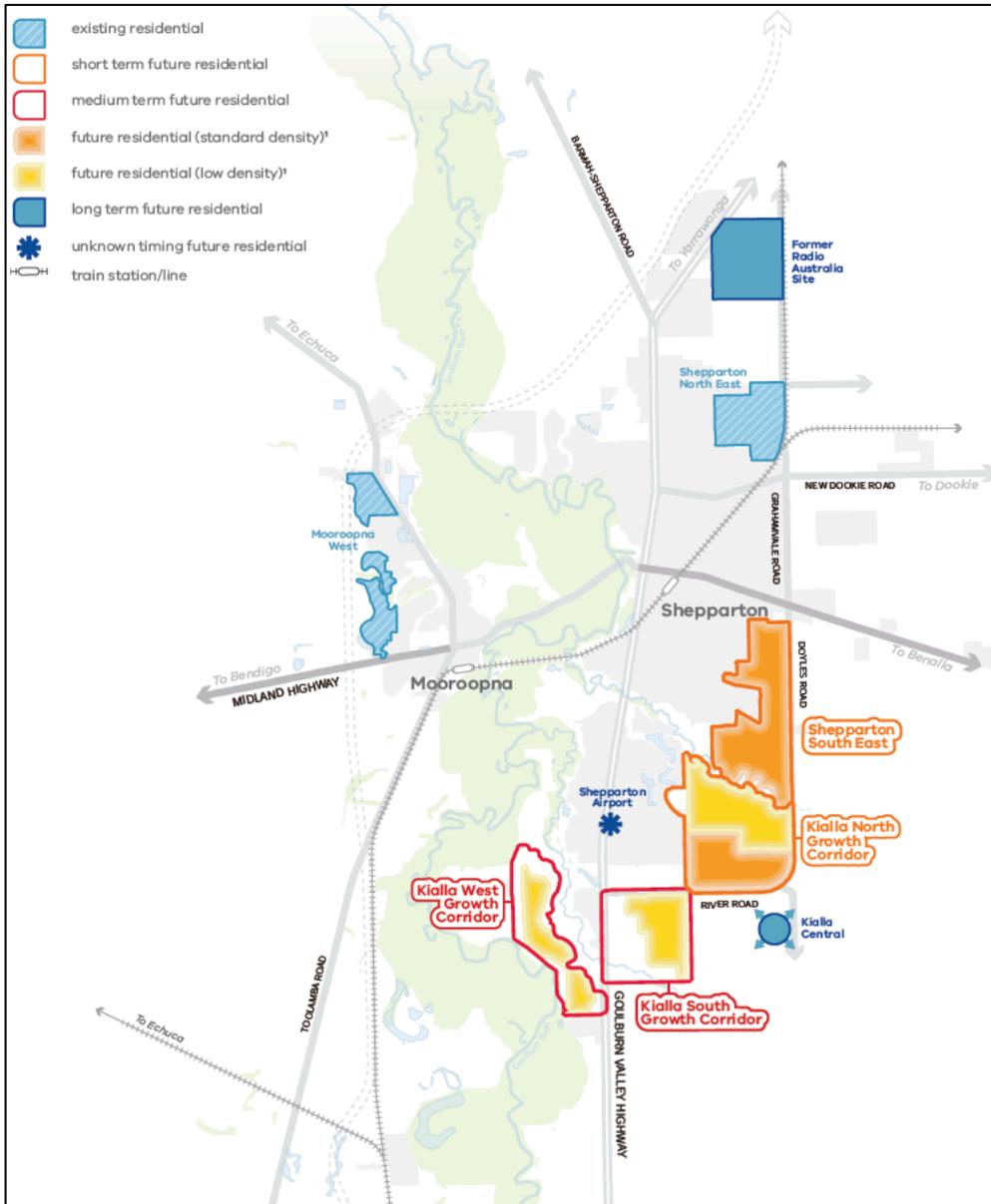
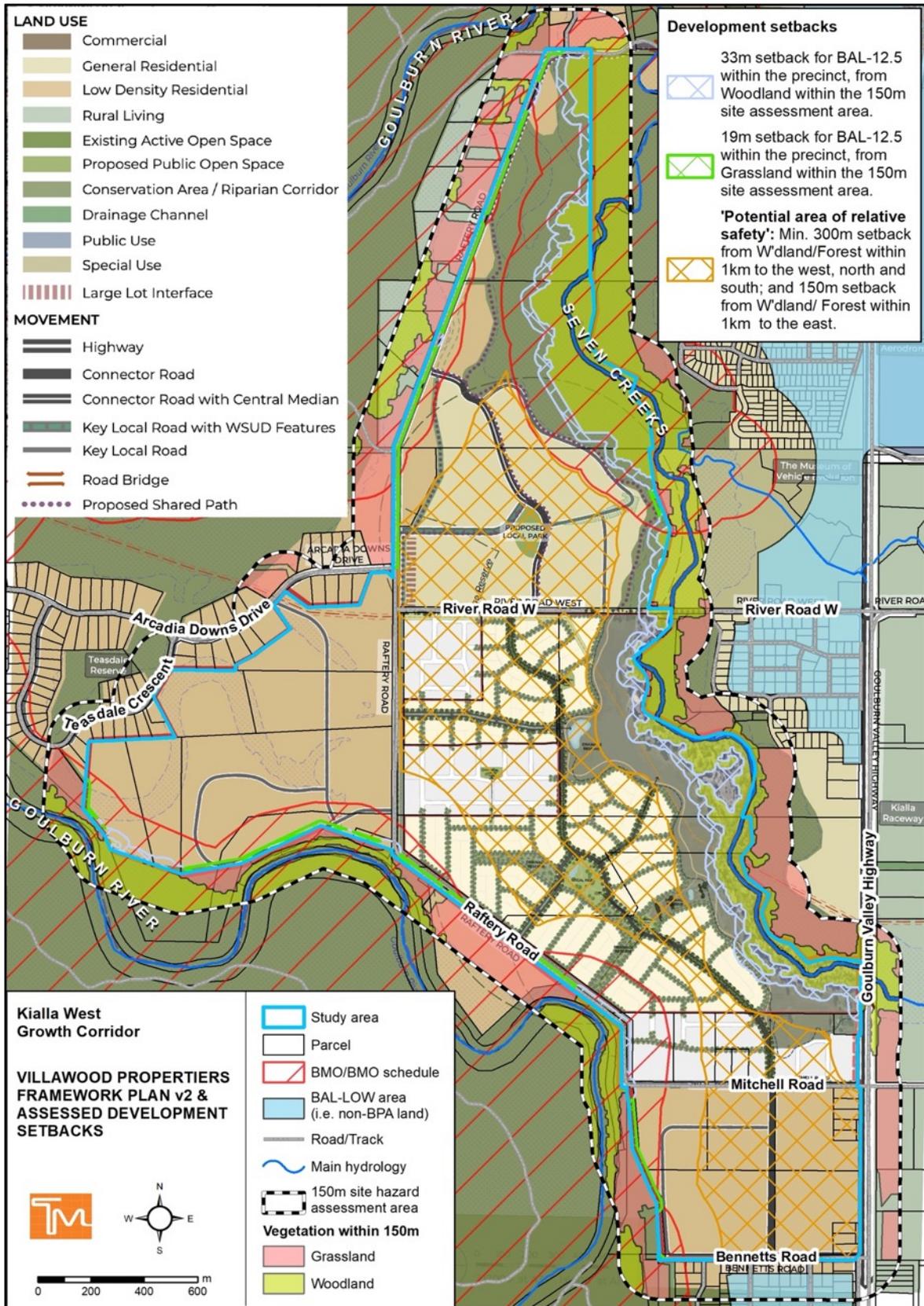


Figure 11 – Reproduction of ‘Plan 6 Residential Growth Corridors’ in the *Shepparton and Mooroopna 2050 Regional City Growth Plan (VPA, 2021)*.

Overall, the hazard and resultant bushfire risk are not considered significant enough to preclude development in the lesser risk parts of the precinct; and the existing planning and building controls are adequate to mitigate the risk. If the development layout responds to the bushfire risk and future buildings are setback sufficiently from hazardous vegetation it is considered the risk can be deemed to be acceptable. However, this is predicated on there being good egress to places of relative safety. Currently the road network provides limited and constrained opportunities to leave the area in the event of a bushfire and for emergency services to enter and move freely around the area.



Map 7 – Development setbacks in relation to the Villawood Properties Framework Masterplan.

4.1.2 The distribution of land uses in the settlement

Terramatrix understands only residential uses are proposed within the precinct and this is supported. More vulnerable uses should be directed to lower risk areas.

4.1.3 Lot sizes in settlement layout

Smaller lot sizes can offer bushfire safety advantages if the lot size is small enough that it creates a 'dense' urban area that contains only low threat vegetation and non-vegetated areas, with a resultant limited potential for bushfire to spread through it. March *et al.* (2011) found that lot size influenced both the level of bushfire penetration into the urban fringe at Bendigo on Black Saturday 2009, and the likelihood of house loss¹³:

- Semi-rural (>4,000m²) lots – 95% area burnt and 35% houses destroyed;
- Large residential (800-3999m²) lots – 47% area burnt and 23% houses destroyed; and
- Residential (<799m²) lots – 16% area burnt and 5% houses destroyed (March *et al.*, 2011).

March *et al.* (2011) concluded that the small residential lots acted as a barrier to fire penetration as there was much greater fragmentation of bushfire fuels by non- or low-flammability features, such as domestic use areas, driveways, paths, roads, cultivated gardens etc. The semi-rural (>4,000m²) lots offered no such advantage, and the performance of the large residential (800-3,999m²) lots was closer to the semi-rural than to the residential lots. Site coverage was also a significant influence on outcomes in that study. Lots unaffected by fire penetration had an average site coverage of 37 %, while those with property damage had 24% average site coverage, and lots where dwellings were destroyed had an average site coverage of 19% (March *et al.*, 2011).

Conversely, studies have found a correlation between house loss in a bushfire and proximity to other houses, due to the potential for heavy 'urban' fuels to increase flame, radiant heat and ember attack on adjacent or nearby dwellings (Price and Bradstock, 2013; Bianchi and Leonard, 2005).

DELWP guidelines consider that in interface areas lot sizes between 800m² and 1,200m² provide a good balance between the risk of larger lots retaining more vegetation within a residential area, and smaller lots providing an increased risk of house-to-house ignitions or increased house losses from ember attack due to the higher housing density (DELWP, 2020a).

To this end, average lot densities of approximately 1,000m² should be considered in KWGC areas that interface with a bushfire hazard, in accordance with the DELWP guidelines and to provide separation between dwellings (a minimum 10m separation is recommended). Higher density conventional residential lots should be concentrated more centrally within the KWGC.

¹³ A total of 58 dwellings were destroyed.

It is also desirable to consider the need for vegetation controls or guidelines to be applied to areas with an interface with a higher bushfire hazard, to ensure vegetation on larger lots is maintained as low threat. To this end, a requirement in the draft PSP should specify that vegetation within 150m of an identified hazard be managed in accordance with the defensible space requirements of Table 6 to Clause 53.02-5. This measure will assist to minimise the risk for fire spread into and within the precinct.

4.1.4 Vegetated areas within a settlement

Vegetated areas within the precinct that may pose a hazard should be identified in the PSP and setbacks from them defined to enable BAL-12.5 development. Note that some vegetated areas may be able to be designed to meet one or more of the small patch or narrow strips criteria for exclusion as non-hazardous vegetation, and therefore be deemed 'low threat' with no need for a development setback or where a lesser development setback can apply.

It is recognised, however, that at the strategic and settlement planning stage it may be difficult to define the future vegetated state. In this case, statutory controls should be put in place to ensure, at the subdivision design and approval stage, that any areas of hazardous vegetation are identified, and commensurate development setbacks incorporated, with appropriate certainty about ongoing management of vegetation within a setback area.

It is presumed that any local parks and sports reserves will comprise only managed grassland and low threat landscaped areas from which no setbacks will be required.

4.2 The settlement interface

4.2.1 Applying the required development setbacks

To satisfy key settlement planning strategies of Clause 13.02-1S, future dwellings and other buildings requiring a BAL (see Section 2.2), should be sufficiently setback¹⁴ from classified vegetation to enable a BAL-12.5 construction standard. These strategies aim to strengthen the resilience of settlements and communities and prioritise protection of human life, including by:

¹⁴ The setback distance is measured from the edge of the classified vegetation to the external wall of the building, or for parts of the building that do not have external walls (including carports, verandas, decks, landings, steps and ramps), to the supporting posts or columns. The following parts of a building are excluded:

- a) Eaves and roof overhangs.
- b) Rainwater and domestic fuel tanks.
- c) Chimneys, pipes, cooling or heating appliances or other services.
- d) Unroofed pergolas.
- e) Sun blinds (Standards Australia, 2020).

- ‘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 metre¹⁵ under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009).
- 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 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009)’ (Greater Shepparton Planning Scheme, 2018a).

The BAL-12.5 setbacks potentially required in response to Grassland and Woodland, based on the hazard assessment in Section 3 and determined using the simple Method 1 procedure of AS 3959-2018, are shown in Table 4 below.

Table 4 – Potentially applicable building-vegetation setbacks for BAL-12.5.

Vegetation	Slope class	Vegetation setback distance (defendable space)
Grassland	All upslopes and flat land	19m
Woodland		33m

Map 6 and Map 7 show the BAL-12.5 setbacks that would be required for future dwellings within the precinct from Woodland and Grassland vegetation as identified in the hazard assessment in Section 3.4.

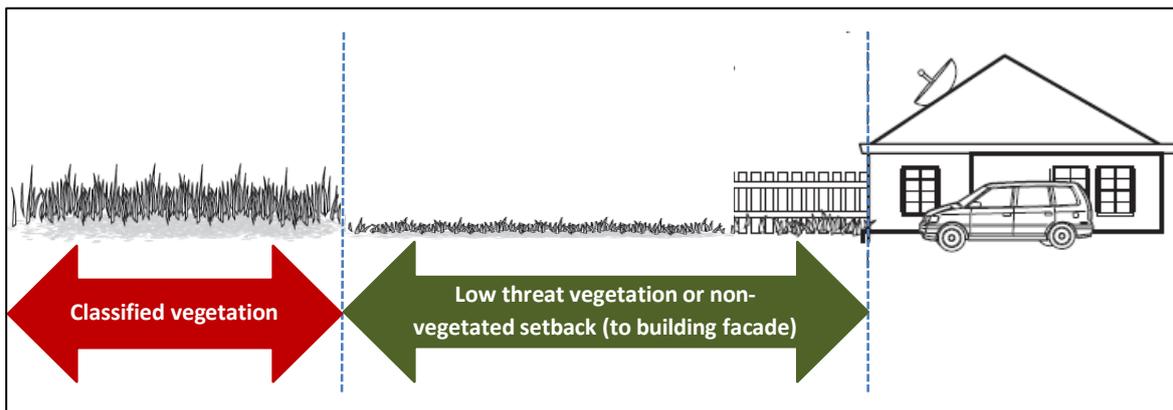


Figure 12 - Example of building-classified vegetation setback (adapted from CFA, 2013). Any roads, pathways and shared trails could be sited within the setback.

¹⁵ Note that the first strategy is to ensure RHF is less than 12.5kW/m² (author’s emphasis). The second strategy stipulates a maximum BAL-12.5 construction standard (which requires that RHF not exceed 12.5kW/m²). It is assumed the intent of both strategies to ensure that BAL-12.5 is a maximum construction standard for settlement planning, which is consistent with the wording of the latter strategy and the criteria and setback distances for BAL-12.5 in AS 3959-2018.

The setbacks shown are indicative, because at this stage the final location, size and future state of vegetation within the precinct, is not definitively determined.

4.2.2 Designing the settlement interface

Lower density residential lots of 800m² to 1,200m² would ideally be located in interface areas, as discussed in Section 4.1.3 above.

Similarly, the interface between any Conservation area/Riparian corridor and residential development is important and should aim to maximise setbacks from the hazard, achieve at least BAL-12.5 defensible space setbacks with appropriate lot sizes, provide good access and egress away from the hazard to safer locations to the east and south, and facilitate fire fighting and property defence. There should be requirements and guidelines in the PSP to achieve these outcomes.

A scaled, illustrative design cross section for areas that interface a hazard, should be prepared to show the interface layout with development setbacks, including any proposed roads and landscaping.

4.2.3 Designing access and egress

Perimeter roads are a highly desirable design feature; to achieve or contribute to BAL setbacks, separate future development from hazardous vegetation with a 'hard' non-vegetated edge and facilitate property protection and fire fighting (see Figure 13).

Perimeter roads should be incorporated along the boundaries of the precinct and any areas of hazardous vegetation to provide separation from adjacent residential areas, this is especially important along the interface with the river and creek corridors. The PSP should include a requirement to this end.

There should be no obstacles to future subdivision providing appropriate access/egress within the precinct for emergency vehicles and residents via a conventional residential road network in accordance with the requirements for roads in a residential subdivision at Clause 56.06.

The road layout should provide at least two access and egress routes out of the precinct to the south and east. The proposed new central boulevard road to the south (see Map 7) and the widening and upgrading of Raftery Road to the south would achieve this. Both roads would connect to Mitchell and Bennetts Roads to the east.

Ideally access to the east would also be provided via a bridge over Seven Creeks to enable access and egress via River Road west. However, it is noted that this may be unviable due to cost and ecological constraints. Given the limited access, egress from the precinct should be in the form of wide 'boulevard style' roads.

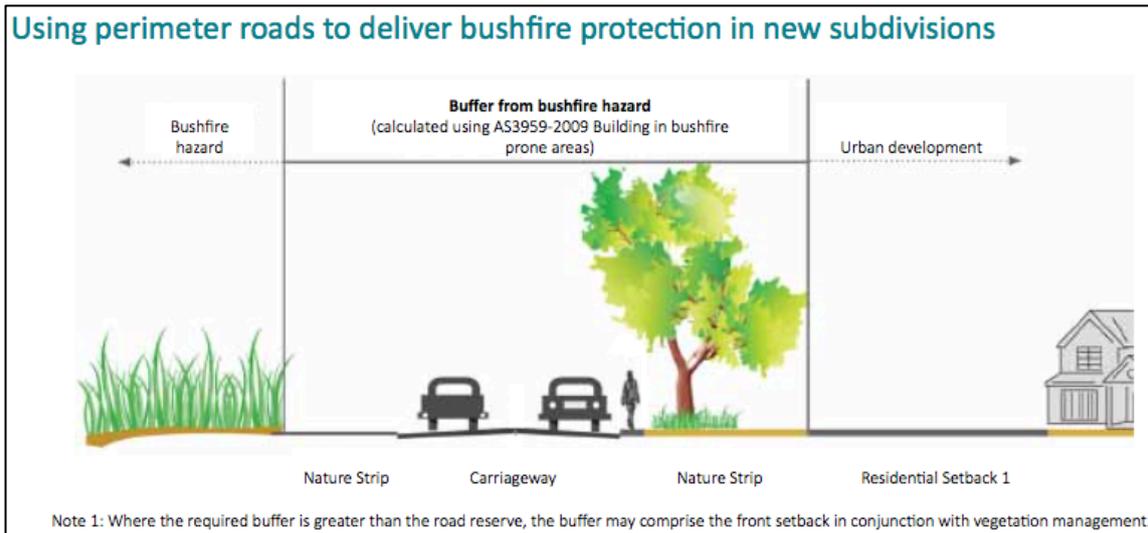


Figure 13 - Illustration of a perimeter road to provide required development setbacks (DELWP, 2015a).

4.3 Bushfire protection measures across a settlement

4.3.1 Vegetation management

All landscaping of road reserves, communal areas and other managed open space should be low threat and therefore excludable. Additionally, locating any low threat open space areas at the periphery of the development, between dwellings and any hazardous vegetation, can contribute to development setbacks.

If management plans are being developed for any new reserves that may contain potentially hazardous vegetation, such as in the Seven Creeks corridor; or for setback areas that new development is reliant upon to achieve a BAL-12.5 rating, they should specify the appropriate vegetation maintenance standards for those areas to provide assurance they will be managed in a low threat state in perpetuity. Alternatively, adequate setbacks for development from these reserves would need to be provided outside of the reserve.

The Municipal Fire Management Plan (MFMP), or other appropriate plan, could specify ongoing management standards for any other areas, such as road reserves, that are required to be maintained in a low threat state. Any review and future version of the MFMP should note any other bushfire protection measures that are implemented for the study area, if they require ongoing maintenance.

Any retarding basins or WSUD features may be non-vegetated or low threat if they will have open water or reliably wet areas with little or no vegetation. However, larger, seasonally inundated wetlands or WSUD features that may be dry and vegetated during the fire danger period, could comprise classifiable Grassland (or higher hazard vegetation if they have shrubs and/or trees).

A guideline could be included in the PSP for landscape design and plant selection in open spaces, including waterways and drainage corridors that ensures a low risk of bushfire i.e. comprise low threat vegetation in accordance with AS 3959-2018.

As identified above, a requirement in the draft PSP could specify that vegetation within 150m of an identified hazard be managed in accordance with the defensible space requirements of Table 6 to Clause 53.02-5.

4.3.2 Building construction standards

The precinct should be designed with setbacks from hazardous vegetation based on the minimum BAL-12.5 that applies in a BPA. The development setbacks required for BAL-12.5 in response to the Grassland and Woodland identified in the hazard assessment in Section 3, were determined using the simple Method 1 procedure of AS 3959-2018, and are provided in Table 4 above.

Note that one of the key settlement planning strategies of Clause 13.02-1S is that strategic plans and policies, planning scheme amendments and settlement planning must not facilitate development exceeding a BAL-12.5 standard.

4.3.3 Fences and other localised fuel sources

It is desirable to discourage, restrict or prohibit the use of combustible fences such as non-bushfire resistant timber fences and brush fences, especially in interface parts of the precinct.

Accordingly, a guideline could be included in the draft PSP for all fencing adjoining fire hazard areas to be of non-combustible materials.

5 Clause 13.02-1S Bushfire planning

The applicable strategies stipulated in Clause 13.02-1S are identified below. And a summary response to each of them is provided in the following sections.

5.1.1 Protection of human life strategies

Priority must be given to the protection of human life.

Prioritising the protection of human life over all other policy considerations

As identified in the landscape hazard assessment in Section 3.1, the KWGC area overall is best characterised as a low-moderate risk Landscape Type 2, although due to the area's relatively narrow linear shape; and its proximity to the Shepparton Regional Park along most of its western boundary and areas of native vegetation in the Seven Creeks corridor along its eastern boundary, it has some attributes of the higher risk Landscape Type 3, especially along the north-western interface.

However, as identified in this report, the landscape risk is not considered significant enough to preclude growth in the lesser risk parts of the precinct. The dominant hazard in the 150m assessment zone is Woodland with some patches of Grassland, and the topography is benign from a bushfire behaviour perspective.

The protection of human life can be prioritised by bushfire resilient design in the PSP and layout of development that ensure sufficient setbacks from hazardous vegetation as identified in this report. A key measure is the need to ensure multiple access and egress routes are available to the south and east, i.e. away from the likely direction of bushfire attack.

Directing population growth and development to low risk locations and ensuring the availability of, and safe access to, areas where human life can be better protected from the effects of bushfire.

Whilst parts of the western interface of the study area have a higher risk than other growth areas around Shepparton, appropriate design can ensure that future development is setback sufficiently from any hazardous vegetation, such that it will not be exposed to RHF above 12.5kW/m² and, therefore, the risk will be mitigated to an acceptably low level. A large, part of least risk land has been identified in the centre of the KWGC, that once developed with reliably low threat and non-vegetated areas, may meet the criteria for future excision from the BPA, and therefore become BAL-LOW.

Apart from this central area within the precinct once it has been developed, the nearest other locations where human life can be better protected from the effects of bushfire are the existing urban areas immediately south and east of the precinct, that are not in the BPA. Good precinct design to ensure multiple egress routes to these locations is required.

Reducing the vulnerability of communities to bushfire through consideration of bushfire risk in decision-making at all stages of the planning process

This report provides the basis for incorporating bushfire risk into decision making associated with planning for development in the precinct. DELWPs settlement planning guidance for bushfire interface areas has been considered in Section 4 to help inform the PSP preparation. Additionally, the CFA has been and will continue to be consulted and their comments can be incorporated into the PSP preparation.

It is noted that the CFA consider community resilience to bushfire will be strengthened (and hence, presumably, vulnerability to bushfire will be reduced) when a strategic planning proposal demonstrates that Clause 13.02-1S strategies have been applied, and where a proposal takes advantage of existing settlement patterns so that new development will not expose the community to increased risk from bushfire.

The CFA provide principles to respond to Clause 13.02-1S including that settlement planning decisions should:

- *‘Direct development to locations of lower bushfire risk.*
- *Carefully consider development in locations where there is significant bushfire risk that cannot be avoided.*
- *Avoid development in locations of extreme bushfire risk.*
- *Avoid development in areas where planned bushfire protection measures may be incompatible with other environmental objectives’ (CFA, 2015).*

If good access and egress is designed, development of low risk parts of the precinct can satisfy the objective and all strategies of Clause 13.02-1S, which aim to prioritise protection of human life and will, therefore, meet the CFA strategic planning principles for bushfire.

5.1.2 Bushfire hazard identification and assessment strategies

Clause 13.02-1S-1 requires that the bushfire hazard be identified, and appropriate risk assessment be undertaken.

Applying the best available science to identify vegetation, topographic and climatic conditions that create a bushfire hazard.

This report identifies the potential hazards in accordance with the commonly accepted methodologies of AS 3959-2018 and, as appropriate, additional guidance provided in *Planning Practice Note 64 Local planning for bushfire protection* (DELWP, 2015), *Planning Advisory Note 68 Bushfire State Planning Policy Amendment VC140* (DELWP, 2018) and *Planning Permit Applications – Bushfire Management Overlay, Technical Guide* (DELWP, 2017).

The type and extent of potentially hazardous vegetation within and around the KWGC has been identified. Classification is based on the anticipated long-term state of the vegetation, aerial imagery, site assessment, analysis of modelled EVCs present, published guidance on vegetation assessment for bushfire purposes and experience with the fuel hazard posed by the vegetation types that occur within the region.

Publicly available 10m contour data for the area was accessed, which along with the site assessment, determined the topography and potentially applicable slope classes.

In relation to climatic conditions and fire weather, the AS 3959-2018 default FFDI 100/GFDI 130 benchmark used in the Victorian planning and building system, has been applied as discussed in Section 3.5.

Considering the best available information about bushfire hazard including the map of designated bushfire prone areas prepared under the Building Act 1993 or regulations made under that Act.

The extent of BPA coverage has been considered (see Section 2.2) and is shown in Map 2, Map 3 and Figure 2. This is based on the most recent BPA mapping, which was gazetted 17th August 2022.

Applying the Bushfire Management Overlay in planning schemes to areas where the extent of vegetation can create an extreme bushfire hazard.

BMO coverage reflects current mapping in the Greater Shepparton Planning Scheme. Some relatively small sections of the study area are affected by the BMO, largely at the periphery of the precinct in the south-west and north (see Map 1 and Map 3). The BMO coverage is not proposed to be changed and there are no obstacles to future development in these parts of the precinct complying with the objectives and measures of the BMO and accompanying Clause 53.02 *Bushfire Planning*.

Considering and assessing the bushfire hazard on the basis of:

- ***Landscape conditions - meaning the conditions in the landscape within 20 kilometres and potentially up to 75 kilometres from a site;***
- ***Local conditions - meaning conditions in the area within approximately 1 kilometre from a site;***
- ***Neighbourhood conditions - meaning conditions in the area within 400 metres of a site; and***
- ***The site for the development.***

The hazard has been assessed and described at the broader landscape, local, neighbourhood and site scales (see Sections 3.1, 3.3 and 3.4).

The characteristics in the landscape, between 1km and out to at least 20km around the site, have been considered in accordance with guidance about assessing risk for planning scheme amendments provided in the Planning Advisory Note 68 (DELWP, 2018) and Planning Practice Note 64 (DELWP, 2015) (see Map 2 and Map 3). Additionally, BMO landscape risk typologies have been indicatively identified in and around the study area to allow comparison of the landscape risk with other growth areas (see Map 4).

Local and neighbourhood conditions have been assessed at distances of 1km and 400m around the precinct respectively (see Map 5).

At the site scale, a 150m assessment area has been applied around the precinct boundary. The site assessment follows the BMO and AS 3959-2018 methodology for classifying vegetation and topography (see Map 6 and Map 7).

Consulting with emergency management agencies and the relevant fire authority early in the process to receive their recommendations and implement appropriate bushfire protection measures.

As identified above, the CFA has been consulted to inform this assessment and will continue to be during the preparation of the draft PSP.

Further consultation will occur with all agencies when they are referred this report and comments and feedback received will inform the final PBP and bushfire content in the PSP document.

Ensuring that strategic planning documents, planning scheme amendments, planning permit applications and development plan approvals properly assess bushfire risk and include appropriate bushfire protection measures.

DELWP advisory and practice notes, Clause 13.02-1S and the planning and building controls invoked by the BMO and BPA coverage, specify the general requirements and standards for assessing the risk. These have been used in this report as appropriate and bushfire protection measures have been identified commensurate with the risk. Relevant regional bushfire plans and strategies have been identified, reviewed and incorporated into this assessment (see Section 3.2).

Not approving development where a landowner or proponent has not satisfactorily demonstrated that the relevant policies have been addressed, performance measures satisfied or bushfire protection measures can be adequately implemented.

The risk can be deemed to be acceptably mitigated such that development can proceed if the objective and strategies of Clause 13.02-1S, the DELWP settlement planning guidelines, and compliance with BPA and BMO measures are successfully implemented as identified in this report. These can be incorporated into bushfire requirements and guidelines in the draft PSP.

Note that the CFA specify that areas where development should not proceed could include:

- *'Isolated settlements where the size and/or configuration of the settlements will be insufficient to modify fire behaviour and provide protection from a bushfire.*
- *Where bushfire protection measures will not reduce the risk to an acceptable level.*
- *Where evacuation (access) is severely restricted.*
- *Where the extent and potential impact of required bushfire protection measures may be incompatible with other environmental objectives or issues, e.g. vegetation protection, land subject to erosion or landslip' (CFA, 2015).*

With well-considered and bushfire responsive siting and layout of development in the PSP, and good access/egress provided, none of these problematic characteristics will be applicable to the KWGC area. The detail of the protection measures will however, need to be clearly specified in the draft PSP and potentially with bushfire related content in associated ordinance e.g. application requirements in a Schedule to the UGZ and potential DDO controls.

5.1.3 Settlement planning strategies

Settlement planning must strengthen the resilience of settlements and communities and prioritise protection of human life.

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 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009).

Applicable distances for dwellings and other development to be setback from classifiable vegetation, such that RHF is calculated to not exceed 12.5kW/m² and where, therefore, BAL 12.5 buildings could potentially be sited, have been identified (see Map 6, Map 7 and Table 4).

Ensuring the availability of, and safe access to, areas assessed as a BAL-LOW rating under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009) where human life can be better protected from the effects of bushfire.

The nearest locations where human life can be better protected from the effects of bushfire are the existing developed areas immediately adjacent to the precinct, including large areas that are not in the BPA (see Map 3 and Map 5). Good access to these areas from the KWGC area needs to be ensured via the precinct design.

Once developed with reliably low threat and non-vegetated areas, a large central area of the precinct can likely meet the criteria for future excision from the BPA, creating more easily accessible areas of relative safety from bushfire attack for future residents.

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 reduce bushfire risk overall.

The development will not result in an increase in risk to existing or future residents, their property or community infrastructure. The risk to existing residents will be reduced by the development of additional low threat or non-vegetated land that would accompany development of the precinct.

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.

As identified previously, this report appropriately assesses and addresses the risk at a range of scales.

Assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis.

Detailed assessment of multiple alternative low risk locations is beyond the scope of this report, as is a regional bushfire risk assessment. However, as part of this assessment, BMO landscape risk typologies have been indicatively identified and mapped in and around the study area to allow comparison of the landscape risk with other designated growth areas around Shepparton (see Map 4). Constraints to alternative locations, such as flood risk and competing land uses are also identified (see Framework Plans in Appendix 2).

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 3959-2009’.

If the setback distances from hazardous vegetation identified in this report are implemented, then development will be able to achieve BAL setbacks commensurate with BAL-12.5 construction.

5.1.4 Areas of high biodiversity conservation value

Ensure settlement growth and development approvals can implement bushfire protection measures without unacceptable biodiversity impacts by discouraging settlement growth and development in bushfire affected areas that are of high biodiversity conservation value.

Terramatrix is not aware of any biodiversity impacts associated with the proposal to develop the precinct, nor if any biodiversity/ecological studies have commenced.

5.1.5 Use and development control in a Bushfire Prone Area

Clause 13.02-1S requires that *'In a bushfire prone area designated in accordance with regulations made under the Building Act 1993, bushfire risk should be considered when assessing planning applications for the following uses and development:*

- Subdivisions of more than 10 lots.
- Accommodation.
- Child care 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' (Greater Shepparton Planning Scheme, 2018a).

It further states that:

'When assessing a planning permit application for the above uses and development:

- Consider the risk of bushfire to people, property and community infrastructure.
- Require the implementation of appropriate bushfire protection measures to address the identified bushfire risk.
- Ensure new development can implement bushfire protection measures without unacceptable biodiversity impacts' (Greater Shepparton Planning Scheme, 2018a).

There are no apparent significant barriers to bushfire planning and building compliance being achievable, for future development applications that trigger this use and development control strategy.

6 Conclusion

This report has assessed the bushfire hazard in and around the KWGC in accordance with the hazard identification strategies of Clause 13.02-1S *Bushfire Planning* and the assessment methodologies of AS 3959-2018 *Construction of buildings in bushfire prone areas* and the BMO. The report identifies how planning for the design and layout of the precinct, and the future development that will occur within it, can appropriately mitigate any bushfire risk, including compliance with the applicable bushfire planning and building controls.

The whole study area is designated as a BPA, and the BMO applies to relatively small areas around the periphery of the KWGC to the north-west and south-west, and a larger section in the north-west of the study area. However, as development progresses, reliably low threat or non-vegetated areas will be created that will result in the central part of the precinct likely to qualify for excision from the BPA.

The landscape risk within 5km and 20km is similar. The topography is largely flat and benign from a bushfire perspective. There are relatively large areas of land to the north-west, north-east and west of the study area that are not designated as bushfire prone, which to some extent, will 'buffer' the study area from any large landscape scale fire that might approach from these directions.

To the north-west, west and south-west, close to or abutting the study area is the hazard posed by the large areas of remnant vegetation in the Shepparton Regional Park along the Goulburn River, and to a lesser along the Seven Creeks riparian corridor to the east.

A bushfire in the Goulburn River corridor, under dry conditions and strong winds, could develop quickly, generate relatively high fire intensity, with smoke and ember attack, and potentially result in the loss of houses neighbouring the park. The risk associated with these scenarios is, however, as evidenced by the fire history, likely to be relatively localised and unlikely to result in extreme bushfire behaviour with widespread destruction of property. With appropriate setbacks, the potential impacts of a bushfire in the Shepparton Regional Park would be limited to smoke, relatively low levels of embers and lesser levels of radiant heat.

There is no history of large established bushfires or grassfires having occurred within 20km of the study area, although multiple small fires are recorded, mainly along the Goulburn River corridor.

Whilst some of the study area is affected by the BMO, the coverage is relatively minor and generally only comprises the 150m ember attack zone associated with delineating the BMO mapping coverage. It is also noted that the proposed UGZ area will be almost entirely outside the BMO coverage of the study area. Therefore, with respect to landscape risk, the study area itself is largely commensurate with the BMO Broader Landscape Type 2, if developed in a low threat

state with egress made available to places of relative safety from bushfire within and outside the precinct.

At the site scale, vegetation within a 150m assessment zone around the study area was classified to identify likely BAL setback distances and RHF exposure for future buildings in the precinct. Areas of remnant treed vegetation, where the overall foliage cover is greater than 10%, are considered to accord best with the AS 3959 Woodland group. In places some Woodland areas have a variable assemblage of understorey shrubs that may indicate a Forest classification, but overall the less hazardous Woodland classification is considered best representative of the fuel hazard. The Woodland classification is supported by DELWP modelled Ecological Vegetation Class (EVC) mapping.

Areas of grassy vegetation with an overstorey foliage cover of less than 10% were classified as Grassland.

The topography on the site and in the surrounding 150m assessment area is benign, being generally flat, without any significant changes in elevation that would appreciably influence bushfire behaviour. Embankments and gradual slopes either side of the Goulburn River or Seven Creeks are not considered a contributor to the effective slope as they are short or gently sloping and would not appreciably influence the rate of spread of a fire.

Therefore, for the purposes of determining BAL-12.5 building-vegetation setback distances for future development, the applicable slope class throughout the study area is likely to be 'All upslopes and flat land'. A BAL-12.5 outcome satisfies the State Planning Policy for bushfire 12.5kW/m² RHF safety threshold, for a location to be deemed low risk. This requires a minimum 33m setback of development from Woodland along the Seven Creeks corridor in the east of the study area and from the Woodland to the west, and a 19m minimum setback from any areas of classified Grassland adjacent to or within the precinct.

Analysis of weather data was undertaken by Terramatrix to determine wind speed and direction on days of elevated fire danger and, therefore, the direction/s of highest threat e.g. most likely direction/s of approach of a possible bushfire. The results show the dominance of westerly winds with a prevalence also of northerly or north-westerly winds on days of elevated fire danger. The wind rose data shows the study area is least likely to be exposed to direct bushfire attack from the east, north-east or south-east.

Due to the precinct's location adjacent to the Shepparton Regional Park, the study area is considered a higher risk than the other growth areas identified in the Greater Shepparton Municipal Planning Strategy framework plans and the *Shepparton and Mooroopna 2050 Regional City Growth Plan*. However, the State Planning Policy for bushfire does not require that settlement growth be directed to areas of least risk, rather that it be directed to areas of low risk.

Overall, it is considered the risk is not high enough to preclude development, and if an appropriate precinct design is achieved, including perimeter roads and development setbacks, good access and egress to places of relative safety from bushfire within and outside the precinct, a reliable water supply for fire fighting is provided, and BALs and vegetation management controls are implemented to ensure low threat vegetation occurs across the precinct, then it is considered the risk can be acceptably mitigated to a low level. However, this is predicated on there being good egress to places of relative safety.

Currently the road network provides limited and constrained opportunities to leave the area in the event of a bushfire and for emergency services to enter and move freely around the area. Road layouts should provide at least two access and egress routes out of the precinct to the south and east. Ideally, access to the east would be provided via a bridge over Seven Creeks to enable access and egress via River Road west. Given the limited access routes, egress from the precinct should be in the form of wider 'boulevard style' roads.

Perimeter roads should be incorporated along the boundaries of the precinct and around any areas of hazardous vegetation to provide separation from adjacent residential areas, this is especially important along the interface with the river and creek corridors. A requirement for this should be provided in the PSP.

A large, least risk 'Potential area of relative safety' within the precinct was identified, which may meet the criteria for excision for the BPA and therefore become an area of BAL-LOW. Higher density conventional residential lots should be concentrated in these more central areas of the precinct. Average lot densities of approximately 1,000m² should be considered in precinct areas that interface with a bushfire hazard, in accordance with DELWP guidelines and to provide separation between dwellings (a minimum 10m separation is recommended).

It is desirable to consider the need for vegetation controls or guidelines to be applied to areas with an interface with a higher bushfire hazard, to ensure vegetation on larger lots is maintained as low threat. To this end a requirement in the draft PSP should specify that vegetation within 150m of an identified hazard be managed in accordance with the defensible space requirements of Table 6 to Clause 53.02-5 or similar. This measure will assist to minimise the risk for fire spread into and within the precinct.

A scaled, illustrative design cross section for areas that interface a hazard, should be prepared to show the interface layout with development setbacks, including any proposed roads and landscaping.

It is desirable to discourage, restrict or prohibit the use of combustible fences such as non-bushfire resistant timber fences and brush fences, especially in interface parts of the precinct. Accordingly, a guideline could be included in the draft PSP for all fencing adjoining fire hazard areas to be of non-combustible materials.

7 Appendices

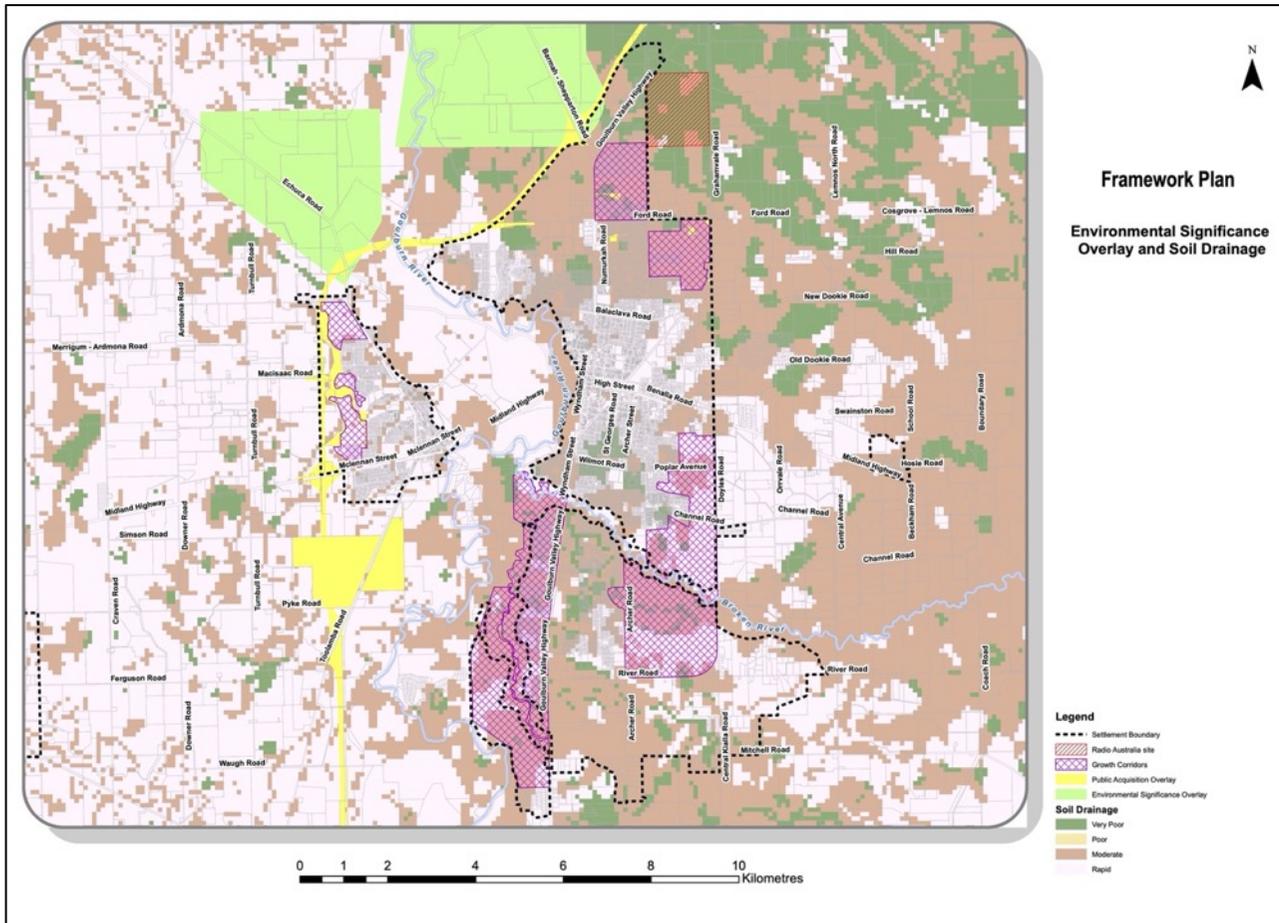
7.1 Appendix 1: BAL construction standards

Bushfire Attack Level (BAL)	Risk Level	Construction elements are expected to be exposed to...	Comment
BAL-Low	VERY LOW: There is insufficient risk to warrant any specific construction requirements but there is still some risk.	No specification.	At 4kW/m ² pain to humans after 10 to 20 seconds exposure. Critical conditions at 10kW/m ² and pain to humans after 3 seconds. Considered to be life threatening within 1 minute exposure in protective equipment.
BAL-12.5	LOW: There is risk of ember attack.	A radiant heat flux not greater than 12.5 kW/m ²	At 12.5kW/m ² standard float glass could fail and some timbers can ignite with prolonged exposure and piloted ignition.
BAL-19	MODERATE: There is a risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to radiant heat.	A radiant heat flux not greater than 19 kW/m ²	At 19kW/m ² screened float glass could fail.
BAL-29	HIGH: There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat.	A radiant heat flux not greater than 29 kW/m ²	At 29kW/m ² ignition of most timbers without piloted ignition after 3 minutes exposure. Toughened glass could fail.
BAL-40	VERY HIGH: There is a much increased risk of ember attack and burning debris ignited by windborne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front.	A radiant heat flux not greater than 40 kW/m ²	At 42kW/m ² ignition of cotton fabric after 5 seconds exposure (without piloted ignition).
BAL- FZ (Flame Zone)	EXTREME: There is an extremely high risk of ember attack and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front.	A radiant heat flux greater than 40 kW/m ²	At 45kW/m ² ignition of timber in 20 seconds (without piloted ignition).

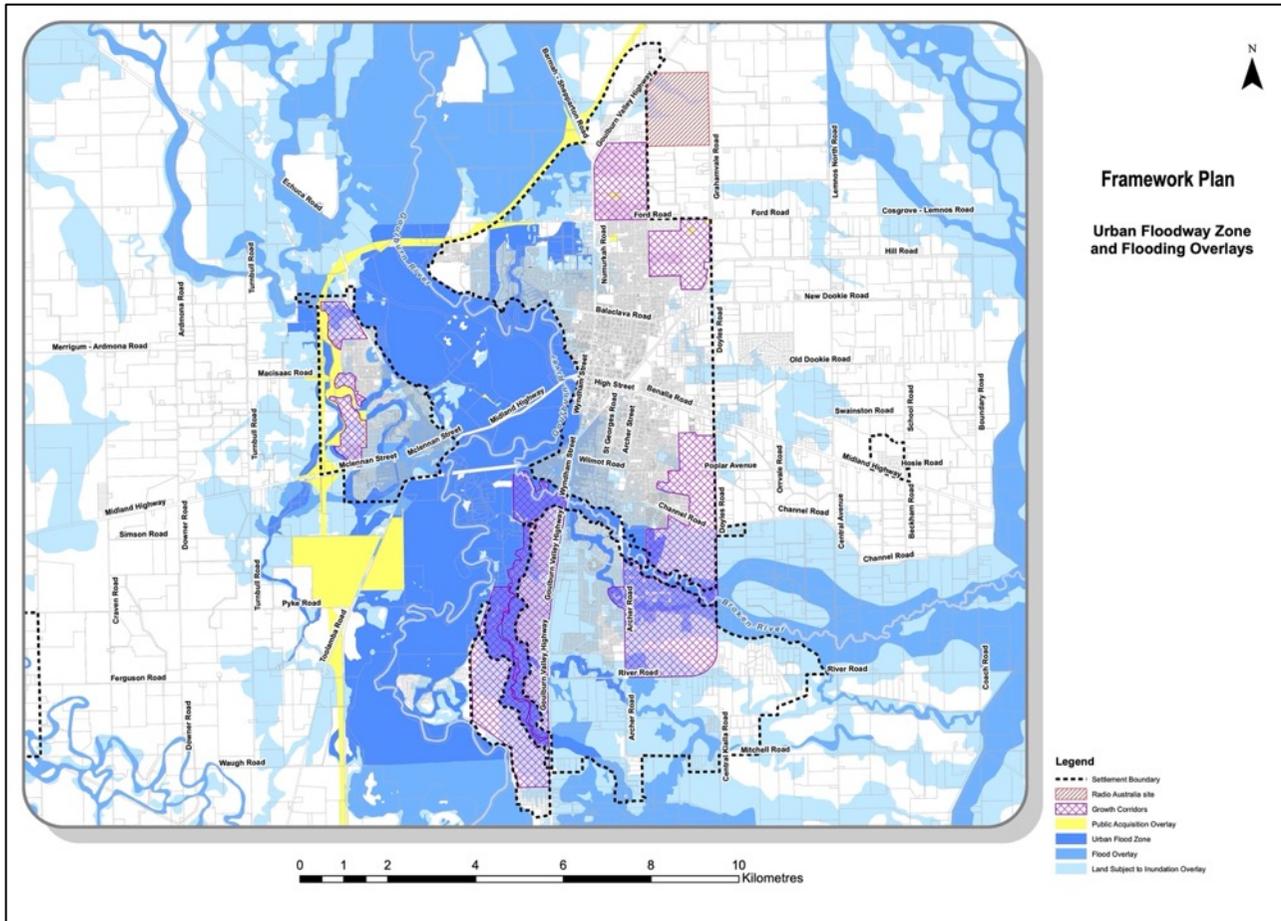
Adapted from Standards Australia (2020).

7.2 Appendix 2: Framework Plans showing growth constraints around Shepparton.

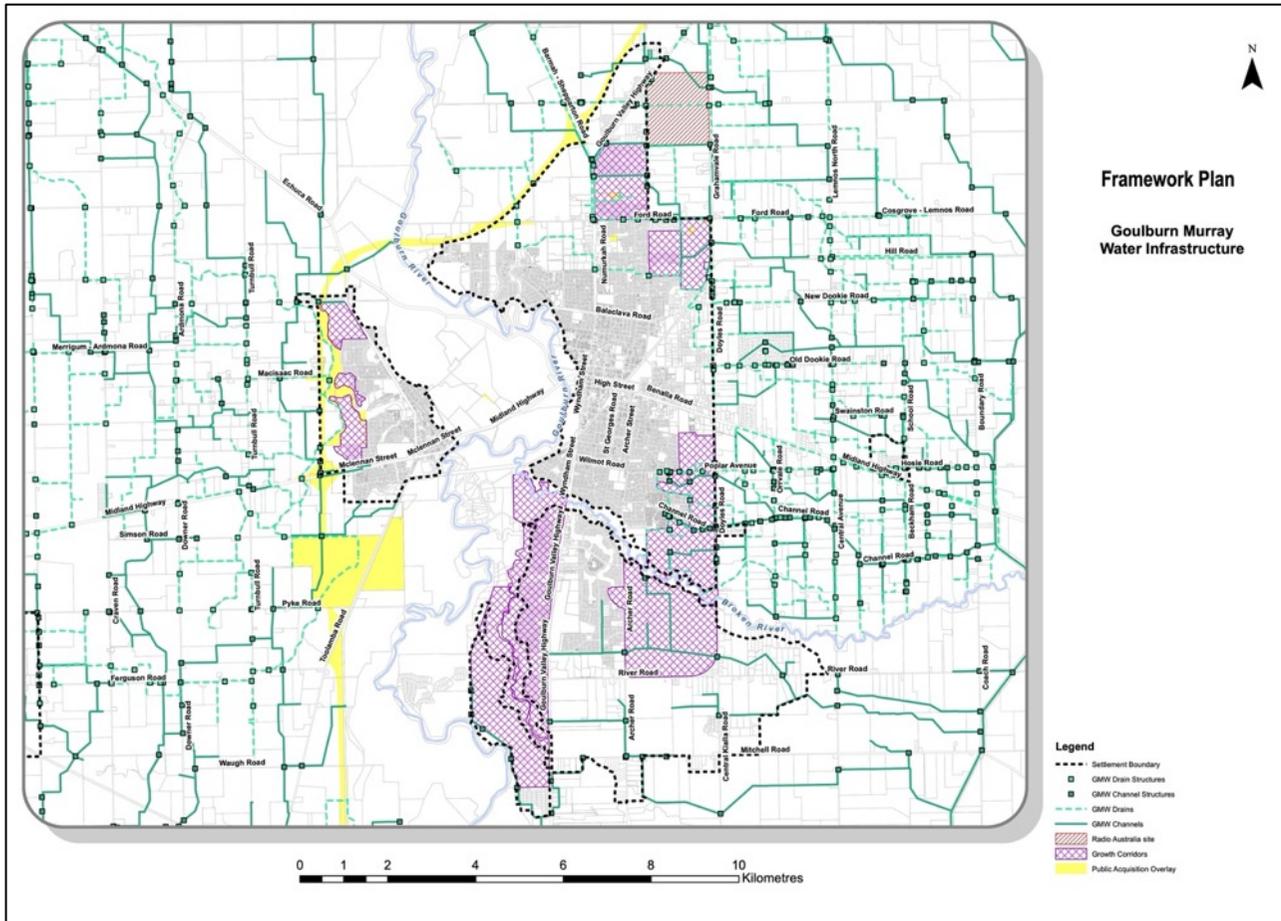
7.2.1 Environmental significance and soil drainage



7.2.2 Flood controls



7.2.4 Water infrastructure



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