

# FIRE MANAGEMENT PLAN

## Local Structure Plan

Lots 746-750 Baldivis Road  
Baldivis  
City of Rockingham

March 2015  
Prepared for Mirvac (WA) Pty Ltd  
(Revision D)

This report has been prepared by Bushfire Safety Consulting in collaboration with Emerge Environmental Services Pty Ltd (trading as Emerge Associates).

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**Prepared by:** Vanessa Keating  
Environmental Consultant – Emerge Associates

Rohan Carboon B. App. Sci. G. Cert. (Bushfire Protection)  
Managing Director – Bushfire Safety Consulting

**Reviewed by:** Chrystal King  
Senior Environmental Consultant – Emerge Associates

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**Prepared for:** Mirvac (WA) Pty Ltd

**Site:** Lots 746-750 Baldivis Road, Baldivis

**Front cover photo:** Aerial photograph of development site.

Bushfire Safety Consulting Pty Ltd  
PO Box 84  
STONEVILLE WA 6081

Tel: 0429 949 262  
Email: [enquiries@bushfiresafety.net](mailto:enquiries@bushfiresafety.net)  
Web: [www.bushfiresafety.net](http://www.bushfiresafety.net)

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## EXECUTIVE SUMMARY

This Fire Management Plan (FMP) has been prepared to support the preparation of a Local Structure Plan (LSP) for Lots 746-750 Baldivis Road, Baldivis. This area is herein referred to as “the site” and its location is shown in **Appendix 1**. The site is approximately 30.5 hectares (ha) in size and is located approximately 44 km south of the Perth Central Business District (CBD) within the City of Rockingham. The LSP also includes Lot 545 Baldivis Road (herein referred to as “Lot 545”) which is located immediately north of the site, and has been included in this FMP. Lot 545 is approximately 6.5 ha in size.

The site and Lot 545 have historically been cleared for broad scale agricultural purposes and are now largely characterised by extensive coverage of pasture weed species and limited remnant vegetation (as shown in **Appendix 2**). The site is bounded by the City of Rockingham’s Tramway Reserve to the west, the Kwinana Freeway to the east, and by land zoned ‘Urban’ and intended for future urban development to the north and south.

The purpose of the FMP is to outline potential bushfire risk that is likely to apply to the site and determine whether the LSP provides for future development that will support acceptable solutions and responses to the bushfire risk.

The proposed LSP (shown conceptually in **Appendix 3**) provides a guide for urban development within the site and creates a framework for the future urban subdivision of the site into anticipated residential lots, part of a school site and areas of public open space (POS).

There are separate structure planning processes currently underway for landholdings immediately north and south of the site, consistent with the broader East Baldivis District Structure Plan (DSP).

The site is currently zoned “Rural” under the City of Rockingham’s Town Planning Scheme No. 2 (TPS No. 2) and “Urban” under the Metropolitan Region Scheme (MRS).

Following development, the site will be completely cleared of vegetation to facilitate development and the majority of remnant vegetation surrounding the site to the east and west will remain and will therefore pose varying bushfire hazards to dwellings within the site. Landholdings to the north and south of the site are intended for future urban development in accordance with the approved East Baldivis DSP and therefore pose only temporary bushfire hazard considerations.

All areas within 100 metres (m) of the site boundary have been assessed for vegetation classification and bushfire hazard rating levels. It has been determined, through an indicative Bushfire Attack Level (BAL) assessment, that all proposed future dwellings arising from the LSP will fall within the acceptable level of risk. Permanent bushfire hazard considerations are posed by the remnant vegetation within the Tramway Reserve adjacent to the western boundary of the site, and by vegetation within the Kwinana Freeway road reserve adjacent to the eastern boundary of the site. It is understood that more detailed plans and implementation budgets are currently being prepared by the City of Rockingham for the entire length of the Tramway Reserve which will outline specific landscaping and vegetation retention outcomes, however the post development hazard assessment in this report has been based on the following scenario: remnant woodland/forest vegetation currently within the reserve is effectively retained/enhanced as per existing site conditions

and all other areas are treated and maintained by the City of Rockingham as managed parkland and therefore a low bushfire hazard.

Future management of the Tramway Reserve may alter the hazard ratings associated with this area of vegetation (should fuel loads be increased or decreased) and mitigation responses may need to be revisited as part of future subdivision applications. Ongoing discussions with the City of Rockingham regarding the management of fuel loads within the Tramway Reserve aims to ensure that development within the site is not exposed to any long term preventable risk.

Any new dwellings constructed within 100 m of identified classified vegetation will require consideration of the need for increased construction requirements to address AS3959 *Construction of Buildings in Bushfire Prone Areas*. In order to pre-empt this requirement, a detailed and site specific BAL assessment will be undertaken as part of the subdivision process to confirm the final BAL ratings for each individual new lot created. Final BAL ratings **should not** be determined for future lots at the LSP stage, as the ultimate lot locations/boundaries will be determined through the subdivision process, and temporary hazards (or even hazards that were expected to be permanent) may not remain at that time, particularly within neighbouring sites currently undergoing separate planning and approvals processes for future urban development as well as within the adjacent Tramway Reserve and Kwinana Freeway reserve. An indicative BAL assessment has been included in this report in order to demonstrate that no areas within the proposed LSP are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29).

If subdivision proceeds within those areas of the site designated as Bushfire Prone due to temporary bushfire hazards, prior to the hazards being removed, bushfire hazard management measures (i.e. increased construction standards to meet increased BAL ratings) will be required. Therefore a detailed and specific BAL assessment will be completed at the subdivision approval stage for all lots currently determined to be within “Bushfire Prone Areas” (see **Appendix 10**). The temporary and permanent Building Protection Zones (BPZ) requirements have been assessed and shown in **Appendix 11**. The future BAL assessment will outline specific BAL ratings for site based on the classified vegetation remaining at the time of subdivision, therefore providing a more accurate assessment of the post development hazards posed to future dwellings than can be achieved at this stage of planning.

As part of the subdivision process, any lots deemed to require fire management responses through the detailed BAL assessment, will be subject to a notification pursuant to section 70A of the *Transfer of Land Act 1893* placed on the certificate(s) of title indicating that the lot is subject to the requirements of a Fire Management Plan (i.e. increased construction standards to meet increased BAL ratings).

An acoustic wall is to be constructed at the eastern interface of the site with the Kwinana Freeway reserve, as a response to the acoustic implications of the adjacent freeway. This acoustic wall will also form a non-combustible barrier between the site and the adjacent hazard, and will provide a shielding effect from the radiant heat flux of a fire within classified vegetation east of the site. A BPZ has been accommodated at this interface to ensure future residents plan and manage their garden vegetation to reduce the likelihood of embers igniting vegetation adjacent to a dwellings and localised flames threatening the building



envelope. This setback is not required to reduce predicted radiant heat levels as this is provided by the shielding benefits of the acoustic wall.

It is expected that the implementation of this FMP will reduce the threat to future residents, visitors and fire fighters in the areas proposed for urban development associated with this FMP.

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## 1 INTRODUCTION

This Fire Management Plan (FMP) has been prepared for Mirvac (WA) Pty Ltd (Mircvac) to support the preparation of a Local Structure Plan (LSP) for Lots 746-750 Baldivis Road, Baldivis. This area is herein referred to as “the site” and its location is shown in **Appendix 1**. Lot 545, located immediately north of the site, does not form part of the Mirvac landholdings but has been included in the LSP design, and forms part of this assessment. The site is approximately 30.5 hectares (ha) in size and is located approximately 44 km south of the Perth Central Business District (CBD) within the City of Rockingham. Lot 545 is approximately 6.5 ha in size.

The site and Lot 545 have historically been cleared for broad scale agricultural purposes and are now characterised by high coverage of pasture weed species and limited remnant vegetation (as shown in **Appendix 2**). The site is bounded the City of Rockingham’s Tramway Reserve to the west, Kwinana Freeway to the east, and by land zoned ‘Urban’ and intended for future urban development to the north and south.

The site and Lot 545 are currently zoned “Rural” under the City of Rockingham’s Town Planning Scheme No. 2 (TPS No. 2) and “Urban” under the Metropolitan Region Scheme (MRS). An amendment of the City of Rockingham’s TPS No. 2 is currently underway to rezone the site and Lot 545 (and surrounding areas) from “Rural” to “Development”, and imminent formal approval is expected.

Urban zoned land to the north and south of the site are progressing with a separate LSP processes for the urban development of this area in accordance with the East Baldivis DSP.

## 2 AIM

The aim of this FMP is to reduce the occurrence of and minimise the impact of bushfires within the site, thereby reducing the threat to life, property and the environment.

## 3 STATUTORY AND POLICY FRAMEWORK

The following key legislation, policies and guidelines are relevant to the preparation of fire management strategies and plans.

### 3.1 Bush Fires Act 1954

The *Bush Fires Act 1954* sets out provisions to reduce the dangers resulting from bushfires; prevent, control and extinguish bushfires; and for other purposes. The Act addresses various matters including prohibited burning times, enabling Local Government to require landowners and/or occupiers to plough or clear fire breaks, to control and extinguish bushfires and establish and maintain Bush Fire Brigades.

Accordingly, the City of Rockingham publishes annual Fire Control Notices that can be downloaded from: <http://www.rockingham.wa.gov.au/Residents/Home-safety-and-security/Fire-safety.aspx>.

### 3.2 State Planning Policy No. 3.4 Natural Hazards and Disasters

The objectives of the *State Planning Policy No. 3.4 Natural Hazards and Disasters Policy* are to:

- Include planning for natural disasters as a fundamental element when preparing all statutory and non-statutory planning documents, specifically town planning schemes and amendments, and local planning strategies.
- Use these planning instruments to minimise the adverse effects of natural disasters on communities, the economy and the environment.

The Policy determines those areas that are most vulnerable to bushfire and where development is appropriate and not appropriate. The provisions and requirements contained in *Planning for Bush Fire Protection Guidelines - Edition 2* (WAPC *et al.*, 2010) are used in this determination.

### 3.3 Planning for Bush Fire Protection Guidelines (2010)

The *Planning for Bush Fire Protection Guidelines - Edition 2* was prepared by the Department of Fire and Emergency Services (DFES), the Western Australian Planning Commission (WAPC) and the Department of Planning and Infrastructure. The guidelines are the foundation for fire risk management planning on private land in Western Australia.

The guidelines address important fire risk management and planning issues and set out performance criteria and acceptable solutions to minimise the risk of bushfires in new subdivisions and developments. The guidelines also address management issues including location, design, the development site, setback requirements, Bushfire Attack Level (BAL) ratings, vehicular access and water.

### 3.4 Draft State Planning Policy 3.7 Planning for Bushfire Risk Management and draft Planning for Bushfire Risk Management Guidelines (2014)

The Department of Planning (DoP) and WAPC have recently released draft *State Planning Policy 3.7 Planning for Bushfire Risk Management* (2014) and the draft *Planning for Bushfire Risk Management Guidelines* (2014). Although currently in draft form, the relevant requirements of these documents have been accommodated within this FMP.

The draft *State Planning Policy 3.7 Planning for Bushfire Risk Management* (2014) is intended to inform and guide decision makers, referral authorities and proponents to achieve acceptable bushfire protection outcomes, including expectations at the different stages of the planning process.

The draft *Planning for Bushfire Risk Management Guidelines* (2014) provides an update on *Planning for Bush Fire Protection Guidelines - Edition 2* (WAPC *et al.*, 2010) to ensure necessary bushfire management measures are incorporated into proposed development.

### 3.5 Lots 746-750 & 545 Baldivis Road, East Baldivis Local Structure Plan (CLE 2014)

This FMP has been prepared to support the Local Structure Plan for Lots 746-750 & 545 Baldivis Road, East Baldivis (CLE 2014), as outlined in Part 1 of the LSP documentation. Part 1 states that any land falling within 100 metres of a 'Moderate' or 'Extreme' bushfire hazard,

as identified in this FMP, is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.

## 4 PROPOSAL AND OBJECTIVES

The proposed LSP provides a framework for urban development within the site (see **Appendix 3**).

Community bushfire safety is a shared responsibility between state and local governments, fire agencies, communities and individuals. The planning and building controls outlined in this FMP, when implemented, will reduce the risk to people and property within the site. How future residents interpret the risk, prepare and maintain their properties and buildings and what decisions and actions they take (i.e. evacuate early or stay and defend or other) will greatly influence the consequences of any bushfire.

The objective of this FMP is to address bushfire management issues within the proposed urban LSP. If there is a bushfire within or near the site, implementing this FMP will reduce the threat to residents, property and emergency response personnel.

Achievable and measurable goals of this plan include ensuring:

- Development is located in an area where the bushfire hazard does not present an unreasonable level of risk to life and property.
- Vehicular access to the development is safe if a bushfire occurs.
- Water is available to the development, so that life and property can be protected from bushfire.
- The development is sited to minimise the effects of a bushfire.
- The development design will minimise the effects of a bushfire.

This document sets out the roles and responsibilities of the developer (Mirvac), future residents and the City of Rockingham. It is important that the measures and procedures outlined in this FMP are adopted across the various stages of the land use planning and dwelling construction approvals processes.

This FMP includes:

- A description of the site, the surrounding area, fire climate and bushfire history.
- A summary of research into the related effects of a bushfire.
- A bushfire hazard assessment.
- Means of addressing vehicular access.
- Siting of buildings to include building protection and hazard separation zones.
- Water supply.
- Maps and plans of fire reduction measures.

A detailed BAL assessment will be undertaken for the site at subdivision stage in order to accurately assess the post development hazards posed to the development, and to determine specific exposure levels for lots within 100m of classified vegetation.

An acoustic wall is to be constructed at the eastern interface of the site with the Kwinana Freeway reserve, as a response to the acoustic implications of the adjacent freeway. This acoustic wall will also form a barrier between the site and the adjacent hazard, and will

provide a shielding effect from the radiant heat flux of a fire within classified vegetation east of the site. Through the subdivision application process, accurate details regarding the height of dwellings in relation to the acoustic wall and management of Freeway vegetation will be produced, allowing for a detailed examination of the vertical shielding provided by the acoustic wall. This will form part of the detailed and specific BAL assessment undertaken at subdivision stage, and will influence the predicted radiant heat flux exposure of dwellings adjacent to the eastern boundary.

## 5 DESCRIPTION OF THE AREA

### 5.1 General

The site has historically been subject to systematic and intensive clearing associated with agricultural land uses, and vegetation remaining within the site is in 'Completely Degraded' condition (in accordance with the Bush Forever scale) over the majority of its area. The dominant vegetation of the site and surrounding areas (including Lot 545) was weedy grassland, with planted non-native trees and scattered remnant native *Eucalyptus rudis*, *Melaleuca preissiana* and *M. raphiophylla* trees.

The proposed LSP over the site (as shown conceptually in **Appendix 3**) proposes future urban development and associated uses within the site. The LSP creates a framework for the future subdivision of the site into anticipated residential lots, part of a school site and areas of public open space (POS). There are separate structure planning processes currently underway for landholdings immediately south of the site and north of Lot 545, consistent with the broader East Baldivis District Structure Plan (DSP).

### 5.2 Climate and Fire Weather

The behaviour of bushfires is significantly affected by weather conditions and they burn more aggressively when high temperatures combine with low humidity and strong winds. In Perth and surrounding coastal areas, the fire risk is greatest from summer through autumn when the moisture content in vegetation is low. Summer and autumn days with high temperatures, low humidity and strong winds are particularly conducive to the spread of fire. This threat is increased if thunderstorms develop, accompanied by lightning and little or no rain.

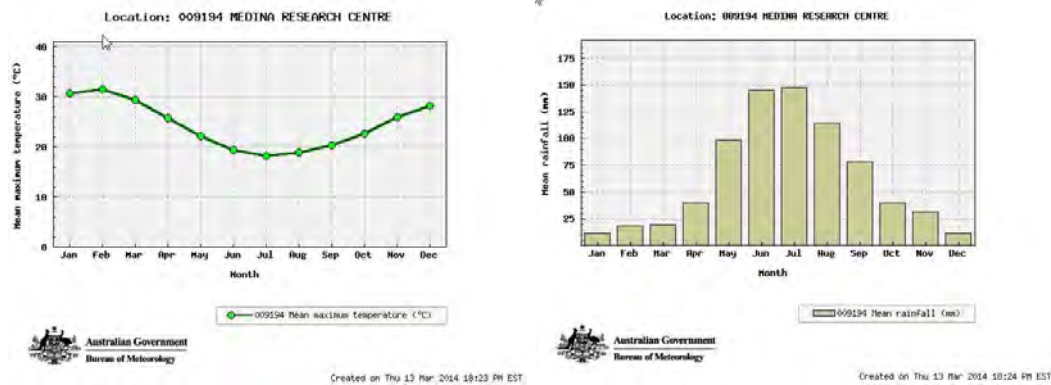
Research indicates that virtually all house losses occur during severe, extreme or catastrophic conditions (i.e. when the Fire Danger Index is over 50) (Blanchi *et al.*, 2010).

The Bureau of Meteorology (2014) states that extreme fire weather conditions in the Perth region typically occur with strong easterly or north-easterly winds associated with a strong high to the south of the state and a trough offshore. Easterly winds represent approximately 60% of extreme fire weather days (events) compared to fewer than 5% associated with southerly winds. About 15% of Perth events occurred in a westerly flow following the passage of a trough.

Very dangerous fire weather conditions often follow a sequence of hot days and easterly winds that culminate when the trough deepens near the coast and moves inland. Winds can change from easterly to northerly and then to westerly during this sequence of climatic events.



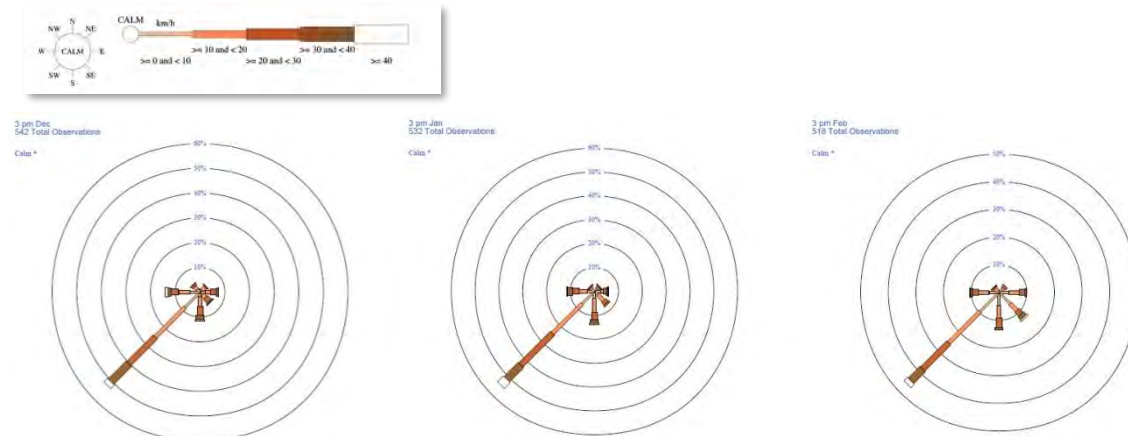
Data from the Medina Research Centre (approximately 10 km northwest of the study site) indicate the area experiences warm dry summers and cool wet winters (**Figure 1**), and is classified as a Mediterranean climate. Mean maximum temperatures vary from 31°C in February to 19°C in July.



Source: Bureau of Meteorology

*Figure 1: Mean maximum recorded temperatures and mean rainfall for Medina Research Centre Bureau of Meteorology Station between 1983 and 2014*

Data from the weather station indicate that the predominant winds near the study site in the summer months at 3 pm are south-westerly (**Figure 2**). Easterly and south-easterly winds are more common in February. Wind strength, direction and frequency from the west and south-west are dominant and occur 45-50 per cent of the time.



Source: Bureau of Meteorology

*Figure 2: Rose of wind direction and wind speed in km/h for December, January and February between 1944 and 2010 at the Medina Research Centre Bureau of Meteorology Station*

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#### *Interpreting Figure 2 – wind speed vs. direction plot*

*Wind roses summarise the occurrence of winds at a location, showing their strength, direction and frequency. The percentage of calm conditions is represented by the size of the centre circle - the bigger the circle, the higher is the frequency of calm conditions. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Eight directions are used. The branches are divided into segments of different thickness and colour, which represent wind speed ranges in that direction. Speed ranges of 10 km/h are used. The length of each segment within a branch is proportional to the frequency of winds blowing within corresponding range of speeds from that direction (BOM, 2010).*

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### 5.3 Topography

The landscape is generally flat and low lying across most of the site. Site elevations range from the highest point of 8.5m Australian Height Datum (AHD) in the west of the site to 3.5-4.5m AHD across the remaining area of the site (see in **Appendix 5**). The low point within the site is in the central corridor, generally associated with the agricultural drain that runs through the centre of the site.

Contours within Lot 545 range from 8.5m AHD in the west of the lot to 4.5m AHD in the east. Elevation dips to 3m AHD into the agricultural drain which runs through the centre and south of the lot before cutting through the site. Elevations within Lot 545 are shown in **Appendix 5**.

### 5.4 Bushfire Fuels

The dominant vegetation within the site and surrounding area is grassland (introduced grassy weed species), with planted non-native trees and scattered remnant native *Eucalyptus rudis*, *Melaleuca preissiana* and *M. raphiophylla* trees. From an intactness point of view, vegetation across the site is in 'Completely Degraded' condition (based on the Bush Forever scale), as the original vegetation structure has been completely altered (i.e. is absent) due to historic clearing and grazing activities associated with agricultural land uses.

There are several areas of vegetation surrounding the site that pose bushfire hazards to the LSP. These areas include remnant 'Forest' and 'Woodland' vegetation within the Tramway Reserve west of the site, 'Forest' vegetation along an open drain line immediately north of the site (within Lot 545), 'Woodland' and grassland vegetation within existing rural lots south of the site (to be developed for urban purposes), and 'Scrub' and 'Shrubland' vegetation within the Kwinana Freeway road reserve east of the site. The implications arising from these areas are discussed further in **Section 6.3.1**.

### 5.5 Land Use

The site is currently undeveloped, having been historically used for agricultural purposes. Until recently there was one existing residential property located on the western boundary

of the site. Vegetation within the site is in ‘Completely Degraded’ condition, dominated by grassland (of introduced grassy weed species) with planted non-native trees and scattered remnant native *Eucalyptus rudis*, *Melaleuca preissiana* and *M. raphiophylla* trees.

The site is currently zoned “Rural” under the City of Rockingham’s Town Planning Scheme No. 2 (TPS No. 2) and “Urban” under the Metropolitan Region Scheme (MRS). Landholdings immediately north and south of the site are zoned “Urban” under the MRS and are proposed for urban development as per the East Baldivis DSP. Vegetation will likely be removed or significantly modified in these areas as part of this process.

The Tramway Reserve adjacent to the western boundary of the site is zoned “Parks and Recreation” under both the MRS and the City of Rockingham TPS No. 2. Informal discussions with the City of Rockingham regarding the likely future treatments of the Tramway Reserve areas indicate that there is some degree of uncertainty regarding the timing, available budgets and funding mechanisms and ultimate physical treatments for the Tramway Reserve landscape works. It is likely however that the City will seek to retain remnant vegetation and add to this wherever possible through strategic revegetation. Existing remnant vegetation within the Tramway Reserve and any requirements to revegetate areas within the Tramway Reserve is likely to pose differing bushfire hazard considerations to the LSP and to future development within the site.

The Kwinana Freeway reserve is managed by Main Roads and the DFES *Information Note: Construction standards of new homes at the edge of the freeway* (Information Note) (DFES 2014), attached in **Attachment 1**, outlines the appropriate approach to bushfire hazard mitigation within developments adjacent to the freeway reserve. This is discussed further in **Section 7** of this FMP.

## 5.6 Assets

In accordance with the proposed LSP the site will support the development of mainly residential lots, a high school and several areas of POS. Once completed, the site will be an urban community.

Dwellings exposed to any bushfire hazard will be those located around the perimeter of the site and within 100 m of classified vegetation that is likely to remain in the medium and long term.

## 5.7 Access

Informal access into the site is currently available from Baldivis Road across the Tramway Reserve via a driveway to the residence previously located within the site.

The LSP design shows the main point of access into the site from Baldivis Road, and multiple roads extending north and south into adjacent proposed urban developments. Internally, the site has an interconnected road system to ensure all residents and fire fighters have at least two access options at all times. The extensive road system under the proposed LSP design is shown spatially in **Appendix 3**.

If development has not progressed within areas adjacent to the site at the creation of Titles within the site, temporary turnaround areas will be created (as per **Appendix 3**) and a second temporary access way will be created in the south-west of the site through a cleared area of the Tramway Reserve to Baldivis Road. This will be undertaken in consultation with

the City of Rockingham, in order to provide appropriate turning points and an alternative access way for residents and emergency services personnel until such a time as internal roads connect with adjacent developments and to provide additional points of access to the site.

## 5.8 Water Supply

Reticulated water will be provided to the entire development. Fire hydrants will be spaced according to Water Corporation and DFES standards and provide emergency services with access to an adequate water supply.

Public/commercial buildings such as schools will require the proponent to outline the compliance with current standards. The process to determine hydrant coverage and compliance for public/commercial buildings with Australian and DFES standards is outlined in DFES guideline No: GL-07 titled "Submission of documents to DFES for assessment" which can be downloaded at:

<http://www.dfes.wa.gov.au/regulationandcompliance/buildingplanassessment/Guidelines/GL-07-SubmissionOfDocumentsToDFESForAssessment.pdf>.

School buildings are Class 9 buildings in the Building Code of Australia (BCA) and require compliance with the BCA, in particular E1.5 including the Specifications and AS 2118.4 together with 2419.1 – also noting that hydraulic water supplying both systems (hydrant and sprinklers) will need to achieve flow rates simultaneously.

## 6 FIRE CONSIDERATIONS

### 6.1 Bushfire History

Fires have been common on the Swan Coastal Plain for thousands of years; the anthropological and historical evidence suggests that Aboriginal people regularly burnt this area (Hallam, 1975; Abbott, 2003).

A recent study has concluded that bushfires may have been in the Australian landscape for 50 million years longer than previously thought. The adaption of eucalypts that allows them to recover from bushfires has been traced back more than 60 million years (Crisp *et al.*, 2011), indicating fire has been in the Australian landscape since that time.

Bushfires are common in the City of Rockingham. As land use intensification occurs and urban development replaces rural land and/or areas of native vegetation, bushfire hazards are removed thereby reducing areas that can carry a bushfire. At the same time however, the number of people and assets in the community increases thereby increasing the risk at the bushland interface.

On January 12<sup>th</sup>, 2014, and 16<sup>th</sup> March, 2014, the Tamworth Swamp fire and Millar Road Fire occurred respectively on days with a Low-High Fire Danger Rating (FDR) and typical coastal sea breezes. The Miller Road fire occurred north of the site on the eastern side of the intersection of Millar and Baldivis Roads. The cause of both fires is unknown however they are suspicious.

Fire weather conditions were typical coastal south-west sea breezes which pushed the head fires to the north-west. Both fires had ember attack causing spot fires ahead of the head fire and outside of the eventually contained fire ground.

The Tamworth Swamp was difficult for fire fighters to access due to the vegetation for both combat and eventual creation of control lines. Thankfully the wind direction was favourable for this fire which significantly aided suppression activities. The Millar Rd fire had rapid forward rate of spread and the ground fire quickly developed into a canopy fire.

Both fires required multi agency resources and were of a prolonged duration, requiring road closures. No major infrastructure damage or property was loss.

On 27<sup>th</sup> January 2015 a fire started on the eastern side of Baldivis Road and south of Millar Road (north of the site), and moved north towards Johnson Road. The Kwinana Freeway was closed in both directions between the Mortimer Road and Safety Bay Road exits. Flame heights reached approximately 10 metres and over 200 firefighters were involved in suppressing the fire.

Given that bushfires are common in the City of Rockingham, this FMP plays an important role in ensuring that the development of the land appropriately mitigates the risk and threat posed from bushfire.

## 6.2 Bushfire Risk

The risk management process described in AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* is a systematic method for identifying, analysing, evaluating and treating emergency risks.

Bushfire risk is determined by assessing:

- Bushfire hazard (i.e. vegetation).
- Threat level (i.e. proximity of the hazard to assets and people).
- Vulnerability of the asset.
- Consequence rating (i.e. a rating for the potential outcome once the 'incident' has occurred).
- Likelihood rating (i.e. the chance of an event).

It is not necessary to undertake a comprehensive bushfire risk assessment according to AS/NZS ISO 31000:2009 for this FMP, however a comprehensive bushfire hazard assessment that has been undertaken is outlined in **Section 6.3**. The threat level is assessed in later sections by determining the indicative Bushfire Attack Levels (BALs) for exposed areas of the development.

The vulnerability of assets such as dwellings is impacted by several factors. Some relate to the way a bushfire behaves at a site, others to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leonard (2009) identified the following factors:

- Terrain (slope).
- Vegetation (overall fuel load, steady state litter load, bark fuels, etc.).
- Weather (temperature, relative humidity and wind speed).
- Distance of building from unmanaged vegetation.



- Individual elements surrounding the building that are either a shield or an additional fuel source.
- Proximity to surrounding infrastructure.
- Building design and maintenance.
- Human behaviour (ability to be present and capacity to fight the fire).
- Access to the building and how that influences human behaviour.
- Water supply for active and/or passive defence.
- Power supply.

It is likely that buildings are lost because of their vulnerability to the mechanisms of bushfire attack. Buildings constructed to AS 3959 *Construction of buildings in bushfire-prone areas* (Standards Australia 2009), herein referred to as AS 3959, are more likely to survive a bushfire than buildings that do not conform to these construction standards, although building survival is not guaranteed.

The vulnerability of people is determined by several factors, including age, fitness levels, gender, level of preparation, and number of occupants who can actively defend a property.

The development is comprised of residential dwellings, part of a school site and areas of POS, however, there are no other vulnerable assets proposed, such as day care centres or aged care centres. It is expected the school will develop an appropriate Bushfire Risk Management Plan in line with DFES and Department of Education policies and guidelines.

### 6.3 Bushfire Hazard

Assessing bushfire hazards at a strategic level takes into account the predominant class of vegetation on the site and surrounding area for a minimum of 100 m, as shown in **Appendix 6**. Fuel layers in a typical forest environment can be broken-down into five segments as illustrated in **Figure 3** below. These defined fuel layers are used in the following descriptions regarding vegetation types, fuel structure and bushfire hazard levels.



Source: Gould et al. (2007)

Figure 3: The five fuel layers in a forest environment that could be associated with fire behaviour

### 6.3.1 Vegetation Type and Structure

Vegetation within the site and Lot 545 has been subject to high levels of historical clearing, stock grazing and weed invasion, and as a result was in 'Completely Degraded' vegetation condition (in accordance with the Bush Forever scale) over the majority of its area.

The dominant vegetation of the site and surrounding areas was grassland (of introduced grassy weed species) (**Figure 4**), with planted non-native trees and scattered remnant native *Eucalyptus rudis*, *Melaleuca preissiana* and *M. raphiophylla* trees (**Figure 5**). The concentration of trees is insignificant to form a distinct vegetation class and is classified according to the understorey vegetation which is grassland at this site.



Figure 4: Grassland vegetation is dominant across the site



Figure 5: Scattered remnant native trees

A small area of marginally more intact vegetation in 'Degraded' condition occurred along the northern edge of the site adjacent to a drainage line outside of the site boundary (within Lot 545). This area contained *Eucalyptus rudis* open forest over weeds (**Figure 6**) which extends through Lot 545 and further landholdings to the north. The strip of open forest is isolated from other areas of classified vegetation and contains minimal intermediate and elevated fuel layers. Landholdings to the north (including Lot 545) and south of the site have been similarly disturbed, and contain little intact remnant vegetation, largely dominated by grasses with planted non-native trees and scattered native trees. The difference in grassland fuel loads between the two areas is directly attributable to the amount of existing grazing pressure. A small patch of *Melaleuca raphiophylla* open woodland was however present within 100m to the south of the site.

The adjacent Tramway Reserve to the west of the site contained some intact areas of *Corymbia calophylla*, *Eucalyptus marginata*, *Eucalyptus gomphocephala* and *Allocasuarina fraseriana* open woodland to open forest over low woodland of *Banksia* spp. over open shrubland of *Acacia pulchella*, *Jacksonia furcellata* and *Macrozamia riedlei* (see **Figure 7**). The southern portions of the Tramway Reserve tended to be in 'Completely Degraded' to 'Degraded' condition, whereas the northern portions were in 'Good' to 'Very Good' condition.



Figure 6: Vegetated drainage line north of the site



Figure 7: Vegetated Tramway Reserve

The eastern Kwinana Freeway interface area was dominated by strips of vegetation between the site boundary and the vegetated area east of the freeway lanes (see **Figure 8**). Within the 100 metre assessment area east of the site, there are a number of sealed vehicle access ways including a bike path and freeway lanes. The vegetation between these access ways is dominated by shrubland and scrub vegetation (see **Figure 9**) which has been planted to revegetate the roadside edges after the construction of the freeway. Planted species include *Eucalyptus rudis*, *Hakea trifurcata*, *Melaleuca lanceolata*, *Jacksonia furcellata* and *Adenanthos cygnorum*. This vegetation is generally in a 'Degraded' condition.



Figure 8: Vegetated Freeway reserve at eastern interface



Figure 9: Vegetated Freeway reserve at eastern interface

### 6.3.2 Vegetation in Public Open Spaces

There are five areas of POS within the LSP, as shown in **Appendix 3**. Landscape concept plans are currently being prepared for the POS areas and all POS and drainage areas will be landscaped and designed to a 'Low Threat' standard under AS3959 classifications and therefore pose no hazard to development within the site.

### 6.3.3 Vegetation in the Tramway Reserve

The Tramway Reserve contains areas of remnant woodland vegetation that may be retained adjacent to the site. It is understood that more detailed plans and implementation budgets are currently being prepared by the City of Rockingham for the entire length of the Tramway



Reserve which will outline specific landscaping and vegetation retention outcomes, however the hazard assessment below (**Section 6.3.6**) has been based on the following potential Tramway Reserve treatment scenario: remnant woodland/forest vegetation currently within the reserve is effectively retained/enhanced as per existing site conditions and all other areas are treated as managed parkland and therefore low threat vegetation types.

#### 6.3.4 Vegetation in the Kwinana Freeway reserve

The dominant vegetation type in the reserve is planted scrub and shrubland of *Eucalyptus rudis*, *Hakea trifurcata*, *Melaleuca lanceolata*, *Jacksonia furcellata* and *Adenanthos cygnorum*, with areas of grassland fuels. Although some Eucalypt trees were present, the dominant vegetation and fuel layer existed in the elevated scrub and shrubland vegetation. At the time of inspection, dead plant material and dry grass fuels were common throughout the reserve.

#### 6.3.5 Effective Slope

The effective slope under areas of classified vegetation surrounding the site is shown in **Appendix 5**, and is in the range of 0-5 degrees upslope adjacent to the western and eastern boundaries, and effectively flat adjacent to the northern and southern boundaries of the site. The landscape of the site has a westerly aspect, with its highest elevation along the western boundary, sloping down to an effectively flat expanse in the central and eastern portions of the site. There are no effective downslope areas which would influence an approaching bush or grassfire.

The effective slope under areas of classified vegetation north of Lot 545 ranges from downslope 0-5 degrees in the north-west, to effectively flat in the north-east.

#### 6.3.6 Bushfire Hazard Assessment – Existing Site Conditions

The vegetation class map shown in **Appendix 6** outlines the existing vegetation classifications on the study site and in the surrounding 100 m assessment area as identified in AS 3959. Descriptions of the vegetation types, structure and fuel layers are outlined in **Section 6.3.1**.

The bushfire hazard assessment levels were determined using Appendix 1 of the *Planning for Bushfire Protection Guidelines - Edition 2* (WAPC et al., 2010).

All areas within the site have a low bushfire hazard rating due to the extensive presence of grassland vegetation. The site and surrounding areas to the north and south have been historically cleared for agricultural purposes and as such, remnant vegetation is scattered with a weedy grassland understorey dominant. Extreme and moderate hazards are associated with surrounding classified vegetation within Lot 545 to the north of the site, the Tramway Reserve to the west of the site, and within the Kwinana Freeway road reserve east of the site.

Existing hazards surrounding the site can be seen in **Appendix 7**.

#### 6.3.7 Bushfire Hazard Assessment – Post Development Site Conditions

The Post Development Site Conditions vegetation mapping for the site is shown in **Appendix 8**, and outlines the dominant vegetation types that will remain within the site and surrounding area within 100m after development within the site has been completed.

The bushfire hazard assessment levels were determined using Appendix 1 of the *Planning for Bushfire Protection Guidelines - Edition 2* (WAPC et al. 2010).

The post-development bushfire hazard rating changes substantially compared to the pre-development conditions due to the removal of all vegetation within the site to accommodate the development.

The post development hazard assessment (shown in **Appendix 9**) has been based on the scenario of the forest and woodland vegetation within the adjacent Tramway Reserve to be retained in its current condition/s and all other areas to be maintained as Managed Parkland and therefore a low threat vegetation. Hazards posed by vegetation within the Kwinana Freeway reserve will be mitigated using the methodology outlined in DFES Information Note (see **Attachment 1**). Vegetation surrounding the site to the north and south, and north of Lot 545, will pose only a temporary hazard to the site due to the temporary nature of the vegetation. These areas are subject to future urban development in accordance with the approved East Baldivis DSP, and once vegetation is removed to accommodate development, the hazard will no longer apply.

## 6.4 Bushfire Threat

Bushfires are common in the City of Rockingham and there is a possibility of a bushfire impacting the site primarily from the Tramway Reserve west of the site and the Freeway reserve east of the site, unless these hazards are managed and/or reduced. Vegetation north and south of the site will also be a potential source of bushfire until such time as the vegetation (and therefore the hazard) is removed as part of future urban development.

The bushfire threat for the LSP has been determined by undertaking an indicative BAL assessment (**Section 7.2.4**) to ensure no areas within the design are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29). The maximum long-term predicted radiant heat flux exposure for a small number of dwellings in this development is BAL-29. The indicative BAL assessment provided in **Section 7.2.4** below does not include consideration of the shielding to be provided by the future acoustic wall to be located along the length of the eastern interface, between the site and Kwinana Freeway. The acoustic wall, in addition to its acoustic shielding, will reduce the effect of radiant heat flux on the site from any fire within the Freeway reserve vegetation. A vertical shielding assessment will be undertaken on the Freeway interface at subdivision stage, allowing for the height of future dwellings to be determined and the predicted exposure to be accurately measured.

## 6.5 Summary of Bushfire Potential Issues

At the completion of this development and the surrounding urban estates to the north and south of the site, the bushfire hazard will be concentrated entirely to the west and east of the site associated with the vegetation in the adjacent Tramway Reserve and Kwinana Freeway. This is shown in **Appendix 9**.

# 7 FIRE MITIGATION STRATEGIES

This report adopts an acceptable solution and performance-based system of control for each bushfire hazard management issue. This approach is consistent with Appendix 2 of the

*Planning for Bushfire Protection Guidelines - Edition 2* (WAPC et al., 2010). The management issues are:

- Location of the development
- Vehicular access.
- Water.
- Siting of the development.
- Design of the development.

Acceptable solutions are proposed for four out of the five management issues and each illustrates a means of satisfactorily meeting the corresponding performance criteria. A performance-based approach is proposed for the remaining management issue.

## 7.1 Hazard Management

There are some pasture grass hazards presently within the site. Slashing of the grass fuels within 100 m of the internal development stages prior to the bushfire season will ensure any excessive grass fuel loads are maintained and managed to result in low bushfire fuel levels.

The mitigation of hazards within areas proposed as POS will be largely addressed through the detailed design of the landscaping and the selection of suitable species, utilising the DFES species list (DFES, 2011). The City of Rockingham will manage the long term maintenance of the parkland and reserves that fall within POS areas.

## 7.2 Bushfire Risk Management

It is not necessary to detail a comprehensive bushfire risk assessment as per AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*.

Land use planning bushfire risk mitigation strategies are detailed in the following sections by providing responses to the performance criteria that fulfil the intent of the bushfire hazard management issues outlined in the *Planning for Bushfire Protection Guidelines - Edition 2* (WAPC et al., 2010).

The compliant checklist is attached as **Appendix 12**.

### 7.2.1 Element: Location of the Development

#### Intent

To ensure that development/intensification of land use is located in areas where bushfire hazard does not present an unreasonable level of risk to life and property.

#### Acceptable Solution

The majority of the site has a 'Low' bushfire hazard rating due to the expansive areas of grass and weeds. Areas of 'Moderate' and 'Extreme' bushfire hazard located within 100m of the site have an appropriate setback distance applied to them to ensure that the maximum BAL predicted for the site is BAL-29. The majority of proposed dwellings will be rated BAL-LOW, followed by BAL-12.5, BAL-19 and BAL-29. BAL-40 and BAL-FZ ratings are not achieved across the site in any areas.

The exposed dwellings located within 100 m of classified vegetation will have the threat mitigated by ensuring those dwellings are compliant with AS 3959 construction standards and BAL-29 will not be exceeded.

The site will be provided with an adequate water supply and has adequate vehicular access for residents and fire fighters.

### 7.2.2 Element: Vehicular Access

#### Intent

To ensure vehicular access serving a subdivision development is safe if a bushfire occurs.

#### Background

The indicative road network of the proposed LSP is shown spatially in **Appendix 3**. The network integrates with the existing Baldivis Road west of the Tramway Reserve, and with the road networks of proposed future urban developments to the north and south of the site.

Loop roads are common, providing two access routes, and the interconnected roads create a permeable grid-like pattern. The proposed road network also reflects the anticipated traffic volumes.

#### Acceptable Solution A2.1: Two Access Routes

The interconnected loop road system provides all residents and fire fighters with two road options at all times. The LSP shows one major intersection with Baldivis Road (across the Tramway Reserve), four with proposed future development to the south of the site, and three with proposed future development north of the Lot 545, which will provide alternative routes if one option is threatened by fire.

If development has not progressed within adjacent areas at the creation of Titles within the site, a second temporary emergency access way will be created (to the standards outlined below) in the south-west of the site through a cleared area of the Tramway Reserve to Baldivis Road (as shown in **Appendix 3**). This will be undertaken in consultation with the City of Rockingham, in order to provide an alternative access way for residents and emergency services personnel until such a time as internal roads connect with adjacent developments.

#### Acceptable Solution A2.2: Public Roads

Surrounding public roads and all new public roads and laneways within the site will comply with the minimum standards. The public road standards which will be achieved are:

- Minimum trafficable surface: 6 metres.
- Horizontal clearance: 6 metres.
- Vertical clearance: 4 metres.
- Maximum grades: 1 in 8.
- Maximum grades over <50 metres: 1 in 5.
- Maximum average grade: 1 in 7.
- Minimum weight capacity: 15 tonnes.
- Maximum crossfall: 1 in 33.
- Minimum inner radius of curves: 12 metres.

### Acceptable Solution A2.3: Cul-de-sacs

If development has not progressed within adjacent areas at the creation of Titles within the site, and the indicative road network of the site has not been connected to those of adjacent developments, temporary turnaround areas will be created in order to provide appropriate turning areas for emergency and service vehicles. These turnaround areas will be built to the following standards:

- Maximum length: 200 metres (if emergency access is provided between cul-de-sac heads or to another public road, maximum length can be increased to 600 metres provided no more than 8 lots are serviced).
- Minimum trafficable surface: 6 metres.
- Horizontal clearance: 6 metres.
- Maximum grades: 1 in 8.
- Maximum grade over <50 metres: 1 in 5.
- Maximum average grade: 1 in 7.
- Minimum weight capacity: 15 tonnes.
- Maximum crossfall: 1 in 33.
- Curves minimum inner radius: 12 metres.
- As per turn around area requirements – including 21 metre diameter head.

### Acceptable Solution A2.6: Emergency Access Ways

Emergency access ways, providing alternative links to public roads during emergencies meet the following requirements:

- Minimum trafficable surface: 6 metres.
- Horizontal clearance: 6 metres.
- Vertical clearance: 4 metres.
- Maximum grades: 1 in 8.
- Maximum grade over <50 metres: 1 in 5.
- Maximum average grade: 1 in 7.
- Minimum weight capacity: 15 tonnes.
- Maximum crossfall: 1 in 33.
- Curves minimum inner radius: 12 metres.
- Must be signposted.

### 7.2.3 Element: Water

#### Intent

To ensure water is available to the development to enable life and property to be defended from bushfire.

### Acceptable Solution A3.1: Reticulated Water

The development is located within an Emergency Services Levy (ESL) Category 3 area. Fire services require ready access to an adequate water supply during fire emergencies.

The area is provided with a reticulated water supply, together with fire hydrants that will meet the specifications of Water Corporation Design Standard DS 63 and DFES. Fire

hydrants on land zoned as residential are required to be sited at or within 200 m of residential dwellings (Class 1a).

Public/commercial buildings such as schools will require the proponent at the time of development to outline the compliance with current standards. The process to determine hydrant coverage and compliance for public/commercial buildings with Australian and DFES standards is outlined in DFES guideline No: GL-07 titled “Submission of documents to DFES for assessment” which can be downloaded at:

<http://www.dfes.wa.gov.au/regulationandcompliance/buildingplanassessment/Guidelines/GL-07-SubmissionOfDocumentsToDFESForAssessment.pdf>.

School buildings are Class 9 buildings in the Building Code of Australia (BCA) and require compliance with the BCA, in particular E1.5 including the Specifications and AS 2118.4 together with 2419.1 – also noting that hydraulic water supplying both systems (hydrant and sprinklers) will need to achieve flow rates simultaneously.

The Water Corporation is responsible for all hydrant maintenance and repairs.

#### **7.2.4 Element: Siting of the Development**

##### **Intent**

To ensure the siting of the development minimises the level of bushfire impact.

##### **Background**

The extent of post-development classified vegetation (**Appendix 8**) is restricted to the following main areas:

- Forest and woodland vegetation to the west of the site within the Tramway Reserve. Vegetation within the Tramway Reserve is subject to potential future development for public recreation purposes, and fuel loads may change.
- Shrubland and scrub vegetation within the Kwinana Freeway road reserve east of the site.

Classified vegetation north and south of the site, and north of Lot 545, will pose only temporary bushfire hazards to the site. These areas are subject to future urban development in accordance with the approved East Baldivis DSP, and once vegetation is removed to accommodate development, the hazard will no longer apply.

Vegetation that does not trigger a BAL assessment according to AS 3959 includes the following:

- Vegetation of any type more than 100 m from the site.
- Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
- Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site or each other.
- Strips of vegetation less than 20 m wide (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.
- Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.

- Low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parkland, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and wind breaks.

### Building Siting and Predicted Bushfire Attack Levels

AS 3959 has six categories of Bushfire Attack Level, namely BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds.

### Methodology and Assumptions

The following indicative BAL assessment has been undertaken to determine the maximum heat flux to which future lots will be exposed once surrounding land has been developed, and has been carried out based on the post development vegetation classification and effective slopes.

The criteria to determine the BAL is outlined as follows:

Designated FDI:	80
Flame Temperature:	1090
Slope:	Flat or upslope
Vegetation Class:	Forest, Woodland, Scrub
Setback distances:	As per Table 2 in <i>Planning for Bush Fire Protection - Edition 2</i> (WAPC, 2010) and DFES Information Note (DFES 2014).

### BAL Outcome

BAL ratings for the majority of exposed areas of the development were determined using the methodology in Appendix A of AS 3959. This methodology is also outlined in the *Planning for Bush Fire Protection - Edition 2* (WAPC, 2010). The BAL implications for the eastern interface of the site with the Kwinana Freeway reserve were determined by implementing the DFES Information Note attached in **Attachment 1**. This is discussed further below.

There are no areas in the development exposed to a BAL rating above BAL-29. An assessment of BAL-29 means 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 (AS 3959). The risk is considered to be high. It is expected that the construction elements will be exposed to a heat flux not greater than 29 kW/m<sup>2</sup>. In this case, the recommended construction sections in AS 3959 are 3 and 7.

An assessment of BAL-19 means the risk is considered to be moderate. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 19 kW/m<sup>2</sup>. There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 6.

An assessment of BAL-12.5 means the risk is considered to be low. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 12.5 kW/m<sup>2</sup>. There is a risk of ember attack and burning debris ignited by wind borne embers and a



likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 5.

DFES outlines the specific approach to be applied to hazard mitigation for sites adjacent to freeway reserves in their Information Note (see **Attachment 1**). The standardised approach is dependent on the placement of an acoustic wall at the freeway interface with the site, which will act as a shield against radiant heat flux levels produced by a bushfire within the vegetation of the reserve. The Information Note specifies that with an appropriate acoustic wall, BAL-12.5 can be achieved from 0-35m, with an altered form of BAL-LOW from 35-100m from the acoustic wall. This altered form of BAL-LOW (referred to as BAL-LOW (plus)) and provides for increased construction standards to the roof of dwellings only, in order to protect from ember attack up to 100 m (see **Attachment 1** for further details).

Any new dwellings constructed within 100 m of identified classified vegetation will require consideration of the need for increased construction requirements to address AS 3959. In order to pre-empt this requirement, a detailed and specific BAL assessment will be undertaken as part of the subdivision process to confirm the final BAL ratings for each individual new lot created (lots adjacent to the freeway reserve will be subject to construction standards as outlined in DFES Information Note). Final BAL ratings **should not** be determined for future lots at the LSP stage, as the ultimate lot locations/boundaries will be determined through the subdivision process, and temporary hazards (or even hazards that were expected to be permanent) may not remain at that time, particularly within neighbouring sites currently undergoing separate planning and approvals processes for future urban development as well as within the adjacent Tramway Reserve and Kwinana Freeway reserve. The indicative BAL assessment was undertaken as part of this FMP in order to demonstrate that no areas within the proposed LSP are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29).

If subdivision proceeds within those areas of the site designated as Bushfire Prone due to temporary bushfire hazards, prior to the hazards being removed, bushfire hazard management measures (i.e. increased construction standards to meet increased BAL ratings) will be required. Therefore a detailed and specific BAL assessment will be completed at the subdivision approval stage for all lots currently determined to be within “Bushfire Prone Areas” (see **Appendix 10**). The future BAL assessment will outline specific BAL ratings for site based on the classified vegetation remaining at the time of subdivision, therefore providing a more accurate assessment of the post development hazards posed to future dwellings than can be achieved at this stage of planning.

As part of the subdivision process, any lots deemed to require fire management responses through the detailed BAL assessment, will be subject to a notification pursuant to section 70A of the *Transfer of Land Act 1893* placed on the certificate(s) of title indicating that the lot is subject to the requirements of a Fire Management Plan (i.e. increased construction standards to meet increased BAL ratings).

### Landscaping Considerations

All plants will burn under the right conditions and plants do not attain a ‘fire resistance level’ that meets requirements of the Building Code of Australia (BCA). Placing plants too close to a building, under timber decks or next to windows will provide a direct threat to the building. Having a clearance around the building will achieve the desired effect of creating a break



between the vegetation and the building. A pathway around buildings may be one way to achieve this requirement. Landscaping can then be established at a suitable distance from the building.

Detailed landscape design is currently underway for the LSP, and will be finalised at subdivision stage.

#### **Acceptable Solution A4.4: Hazard Separation Zone**

A Hazard Separation Zone (HSZ) is an additional fuel managed zone to create further separation between dwellings and bushfire hazard. It can extend out to 100 metres from buildings. In the case of subdivision within the site, the provision of a HSZ is not the ideal method to respond to relevant bushfire hazards. The need for a HSZ is avoided through an appropriate increase in construction standards and compliance with AS 3959, and in this regards BAL-29 would not be exceeded within the site.

The above BAL assessment demonstrates that a Building Protection Zone (BPZ, discussed further below) combined with increased dwelling construction standards will achieve acceptable levels of risk for the development.

By taking this approach it will be possible to construct dwellings to an appropriate standard (i.e. BAL-29 or less) under AS 3959.

#### **Acceptable Solution A4.3: Building Protection Zone**

One of the most important fire protection measures influencing the safety of people and property is to create a BPZ around buildings. The BPZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, gardens, driveways and roads can form parts of a BPZ.

Recent research into land management and house losses during the 'Black Saturday' Victorian bushfires concluded that the action of private landholders who managed fuel loads close to their houses was the single most important factor in determining house survival when compared with other land management practices, such as broad scale fuel reduction burning remote from residential areas (Gibbons et al., 2012).

This FMP provides for two important BPZ considerations. The first involves the provision of an adequate perimeter BPZ where lots are within close proximity to an external bushfire hazard. Providing for an appropriate perimeter BPZ will ensure vegetation and fuels within close proximity to buildings are able to be managed to reduce radiant heat flux in the case of a bushfire, improving the likelihood of building survival.

The second involves the management of risk at each future stage of development. Each development stage is provided with acceptable setbacks from temporary bushfire hazards to reduce bushfire attack mechanisms impacting on any completed dwellings. Creating a temporary BPZ during each internal stage of the development will ensure dwellings on the perimeter of each stage are not exposed to unnecessary risk from a temporary hazard.

The establishment of the temporary and permanent perimeter BPZs in the north and west of the site will ensure the predicted radiant heat flux exposure levels remains at or below BAL-29 for all future dwellings. The proposed acoustic wall that will form the eastern interface between the site and the Kwinana Freeway reserve will provide shielding from radiant heat

flux and reduce the potential for direct flame contact from any fire within the Freeway reserve (DFES 2014).

Managing vegetation in the BPZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front.
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front passes.

Proposed lots within the site that are situated in close proximity to identified bushfire hazards have an internal (within the site) BPZ applied to them as shown in **Appendix 11**. Vegetation currently within the Tramway Reserve triggers BPZ requirements along the western boundary for which the LSP has allowed for a 20-21m BPZ (based on the adjacent classified vegetation, as outlined in **Table 1** below) through the placement of a road reserve and front of lot setbacks, to account for the worst case future hazards associated with the Tramway Reserve. The fuel managed areas of future road and drainage reserves will also become BPZ areas because the City of Rockingham grass slashing program will ensure hazard remains low.

A standard back-of-lot setback (6m) BPZ has been accommodated at this interface to ensure future residents plan and manage their garden vegetation to reduce the likelihood of embers igniting vegetation adjacent to a dwellings and localised flames threatening the building envelope. This setback is not required to reduce predicted radiant heat flux levels as this is provided by the shielding benefits of the acoustic wall as per DFES modelling (see **Attachment 1**).

This approach has been developed by DFES specifically for those development areas adjacent to the Kwinana Freeway, as per their published Information Note attached in **Attachment 1**.

The BPZ must be established and maintained to the following standards:

- Width: as identified in **Appendix 11** and **Table 1** below.
- Fuel load: reduced to and maintained at 2 tonnes per hectare.
- All tree crowns (or clumps of crowns) are a minimum of 10 metres apart.
- All trees to have lower branches pruned to a height of 2 metres.
- All tall shrubs or trees are not to be located within 2 metres of a building (including windows).
- No tree crowns or foliage (including existing trees and shrubs and new plantings) is to be within 2 metres of any building.
- All fences are constructed of non-combustible materials (i.e. Brick or limestone).
- All sheds are constructed of non-combustible materials (i.e. Brick or limestone) and, if located within 6m of the main residence, are subject to increased AS 3959 construction standards.
- All shrubs to contain no dead material within the plant.
- No tall shrubs are to be in clumps within 3 metres of any building.
- No trees are to contain dead material in the crown or on the bole.

It is the responsibility of the developer to ensure the BPZ is created by appropriate design, and that construction of buildings is restricted within the identified zone.

Table 1: Building protection zone widths

Area of classified vegetation	Vegetation Class	BPZ width	Effective Slope
Western interface	Forest	21 metres	Flat or upslope
	Woodland	20 metres	Flat or upslope
Northern interface	Forest	21 metres	Flat or upslope
	Woodland	20 metres	Flat or upslope
Eastern interface	N/A	6 metres	N/A

## 7.2.5 Element: Design of the Development

### Performance Criteria

The design of the development is appropriate to the level of bushfire hazard that applies to the site.

### Acceptable Solution A5.2: Performance Criterion P5 Compliance

The development complies with AS 3959 and BAL-29 is not exceeded for any dwelling.

## 7.3 Future Development

This FMP is expected to inform the detailed BAL assessment that will be prepared and implemented as part of the future subdivision approval stage. The post-development Bushfire Prone Areas map (**Appendix 10**) will be used to guide the requirement for further BAL assessment.

## 7.4 Access and Fire Breaks

Compliance with the City of Rockingham Fire Control Notice is required across the entire site and public road access must provide two access options at all stages of development.

## 7.5 Public Education and Community Awareness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. *Prepare. Act. Survive.* (DFES, 2012) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from <http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx>.

The City of Rockingham provides bushfire safety advice to residents available from their website <http://www.rockingham.wa.gov.au/Residents/Home-safety-and-security/Fire-safety.aspx>. It also provides details on how to become a volunteer at either of the local volunteer Bush Fire Brigades. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas.

## 7.6 Fire Safer Areas

There are no designated Community Fire Refuges in the City of Rockingham, However, at the time of an emergency, the relevant authorities can select an evacuation centre and DFES, the City of Rockingham and Police will provide this information to residents.

A predetermined centre cannot be nominated, because there are no purpose-built structures (such as bunkers) designed to withstand the impacts of a bushfire. This means that the location of an evacuation centre is not determined until the position of the fire and the characteristics of a specific event are considered by authorities. There would be nothing more dangerous than sending residents to a centre which is in the direct path of a fire.

The safest place to be during a bushfire is away from it. Where to go is an important element when people are relocating during a time of emergency (NSW Rural Fire Service, 2004). The preferred option for residents is to designate a destination that is not in a bushfire-prone area and will be safe to travel to before a bushfire attack.

Those who find themselves threatened by a bushfire need options (VBRC, 2009). This may be because their plan to leave is no longer possible, because they cannot reach a place away from the fire front, or their plan to defend their property fails. Residents may also be caught away from their home when a bushfire threatens.

The concept of a 'Neighbourhood Safer Place' and 'Neighbourhood Safer Precincts' has arisen from recommendations by the Victorian Bushfire Royal Commission into the Black Saturday bushfires.

There are many areas within this site and within the City of Rockingham that are not bushfire-prone, including landscaped open spaces and urban areas, but they have not been declared. Obviously a non-bushfire-prone area can provide a safe location for people during a bushfire, but there are no official criteria in Western Australia to determine these areas. As there is no specific criteria to guide this process, DFES's general advice is that when household bushfire survival plans have failed, residents should go to a safer place such as a local open space or building to seek shelter from a bushfire (DFES, 2012).

## 7.7 Assessment of Fire Management Strategies

The bushfire hazard that could threaten this development is concentrated in the forest and woodland vegetation located within the Tramway Reserve west of the site, and the scrub and shrubland vegetation within the Kwinana Freeway road reserve east of the site.

Bushfire hazard posed by vegetation within the Kwinana Freeway reserve will be mitigated through the use of standard rear-lot setbacks (to provide a low fuel environment consistent with a BPZ) and increased construction standards as per DFES Information Note (attached in **Attachment 1**).

Vegetation surrounding the site to the north and south is subject to clearing associated with proposed future urban development and therefore will not pose long term considerations.

Grasslands fuels in the public roadside reserves west of the Tramway Reserve (Baldivis Road) will be managed through City of Rockingham's roadside slashing program. Fuels in POS and drainage areas will be managed at a low threat level.

Fire response operations will utilise the reticulated water supply and the extensive loop road network to defend property and life.

## 7.8 Implementing the Fire Management Plan

### 7.8.1 Developer's Responsibilities

To achieve an acceptable level of risk from bushfire, the developer's responsibilities arising from this FMP are to:

- As part of the subdivision approval or Detailed Area Plan preparation process (whichever comes first) undertake a specific BAL assessment for any proposed lots that fall partly or entirely within Bushfire Prone Areas as shown on the structure plan and/or on **Appendix 10**, with assessment recommendations to be submitted to the City of Rockingham and accommodated in the lot clearances and/or Detailed Area Plan outcomes.
- For each new lot created within Bushfire Prone Areas exposed to a BAL rating exceeding BAL-LOW, lodge a Section 70A Notification on the Certificate of Title in order to alert purchasers and successors in title of the existence of the overarching FMP and specifically the requirements associated with meeting the AS 3959 construction standards.
- Install the public roads to standards outlined in **Section 7.2.2**.
- On all vacant land, comply with the City of Rockingham Fire Control Notices as published.
- Install reticulated water supply and hydrants to Water Corporation, DFES and the City of Rockingham standards.
- Design and landscape all managed POS areas with DFES-approved species to create a low threat environment.
- Establish and maintain the BPZs within the site to standards as specified in this document, and liaise with the City of Rockingham regarding the management of fuel loads within the adjacent Tramway Reserve.
- Ensure 100 m of vegetation is managed from the perimeter of each construction stage within the overall development site to ensure temporary hazard does not threaten any subdivision stage. Liaise with surrounding landowners and the City of Rockingham to ensure the management of vegetation within surrounding sites and the adjacent Tramway Reserve to ensure these hazards do not threaten any subdivision stage.
- At subdivision approval stage, the developer is to provide detailed hydrant plans to the City of Rockingham and DFES local fire station for monitoring.
- Make a copy of this FMP available to each lot owner subject to AS 3959 construction standards, along with the *Homeowners Bush Fire Survival Manual, Prepare, Act, Survive* (or similar suitable documentation) and the City of Rockingham's Fire Control Notice.

### 7.8.2 Property Owner/Occupier's Responsibilities

The owners/occupiers of future individual residential lots within this site, as created by the subdivision process, are to maintain a reduced level of risk from bushfire, and will be responsible for undertaking, complying and implementing measures to protect their own assets (and people under their care) from the threat and risk of bushfire. Property owners and occupiers will be responsible for:

- Ensuring that all lots comply with the City of Rockingham Fire Control Notices as published.
- Maintaining each property in good order to minimise bushfire fuels, and maintaining BPZ areas (where applicable) in accordance with the requirements outlined in this FMP.
- Ensuring that where hydrants are located, they are not obstructed and remain visible at all times.
- Ensuring construction of dwellings complies with AS 3959, if required.
- If dwellings are subject to additional construction in the future, such as renovations, AS 3959 compliance is required.

### 7.8.3 City of Rockingham's Responsibilities

The responsibility for compliance with the law rests with individual property owners and occupiers, and the following conditions are not intended to unnecessarily transfer some of the responsibilities to the City of Rockingham.

The City of Rockingham shall be responsible for:

- Providing fire prevention and preparedness advice to landowners upon request, including the *Homeowners Bush Fire Survival Manual, Prepare, Act, Survive* (or similar suitable documentation) and the City of Rockingham's Fire Control Notice.
- Ensuring bushfire hazard remains low in the internal POS areas and roadside grassland vegetation is slashed in the annual roadside slashing program.
- Monitoring bush fuel loads in road reserve sites and liaising with relevant stakeholders to maintain fuel loads at safe levels.
- Ensuring emergency response is provided via the Baldivis Volunteer Bush Fire Brigade.
- Monitoring and maintaining grass fuel loads within the Tramway Reserve to a low hazard level as per the City of Rockingham *Baldivis Tramway Management Plan* (2014).
- Maintaining public roads to appropriate standards and ensuring compliance with the City of Rockingham Fire Control Notices.

### 7.8.4 Water Corporation's Responsibilities

The Water Corporation is responsible for the repair of water hydrants, as needed.

## 8 CONCLUSIONS

This FMP provides acceptable solutions and responses to the performance criteria that fulfil the intent of the bushfire hazard management issues outlined in *Planning for Bushfire Protection Guidelines - Edition 2* (WAPC *et al.*, 2010), and is expected to inform the BAL assessment that will be prepared and implemented as part of the future subdivision approval stage.

Dwellings located in the bushfire prone area (i.e. within 100 m of classified vegetation) will have the risk mitigated via compliance with AS 3959 standards. The indicative BAL assessment included in this report demonstrates that BAL-29 is not exceeded and a BPZ is incorporated into the entire western boundary to allow for hazards posed by unknown

development within the adjacent Tramway Reserve. DFES modelling has confirmed predicted radiant heat flux exposure levels adjacent to the acoustic wall will not exceed BAL-12.5. A standard rear-lot setback BPZ within those lots adjacent to the Kwinana Freeway will provide a low fuel environment to prevent ember ignition in the vicinity of future dwellings. Loop roads and reticulated water supply and hydrants are provided. The proposed development will fall within the acceptable level of risk.

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## 10 GLOSSARY

AS	Australian Standard
AHD	Australian Height Datum
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BOM	Bureau of Meteorology
BPZ	Building Protection Zone
DFES	Department of Fire and Emergency Services (was FESA)
ESL	Emergency Services Levy
FESA	Fire and Emergency Services (now DFES)
FMP	Fire Management Plan
HSZ	Hazard Separation Zone
LPS17	Local Planning Scheme No. 17
LSP	Local Structure Plan
POS	Public Open Space
TPS	Town Planning Scheme
VBRC	Victorian Bushfires Royal Commission
WAPC	Western Australian Planning Commission

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## APPENDICES

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*Appendix 1: Location Plan*

*Appendix 2: Site Plan*

*Appendix 3: Proposed LSP*

*Appendix 4: Local Context and Surrounding Land Uses*

*Appendix 5: Site Topography and Effective Slope*

*Appendix 6: Existing Site Conditions - AS3959 Vegetation Classification*

*Appendix 7: Existing Site Conditions - Bushfire Hazard Assessment*

*Appendix 8: Post Development Site Conditions – AS3959 Vegetation Classification*

*Appendix 9: Post Development Site Conditions – Bushfire Hazard Assessment*

*Appendix 10: Post Development Site Conditions – Bushfire Prone Areas*

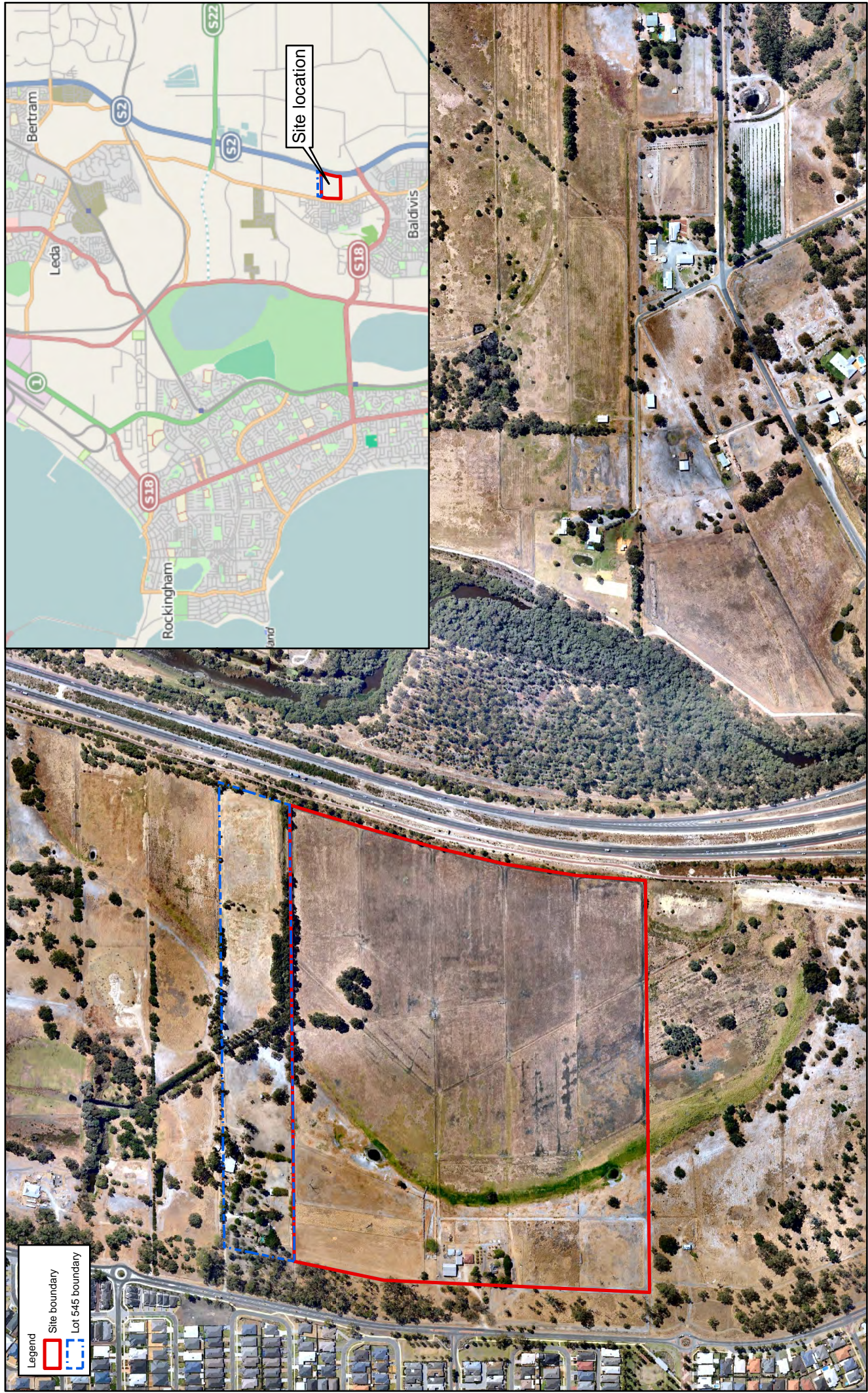
*Appendix 11: Post Development Site Conditions – Building Protection Zone Requirements*

*Appendix 12: Compliance Checklist*

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Approved:	CKK	Date:	30/09/14
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Appendix 1: Location Plan

Project: Fire Management Plan  
Lots 746-50 Baldvis Road, Baldvis

Client: Mirvac (WA) Pty Ltd





**Legend**

- Site boundary
- Lot 545 boundary
- Existing cadastral boundaries

**Appendix 2: Site Plan**

**Project:** Fire Management Plan  
Lots 746-50 Baldvis Road, Baldvis

**Client:** Mirvac (WA) Pty Ltd

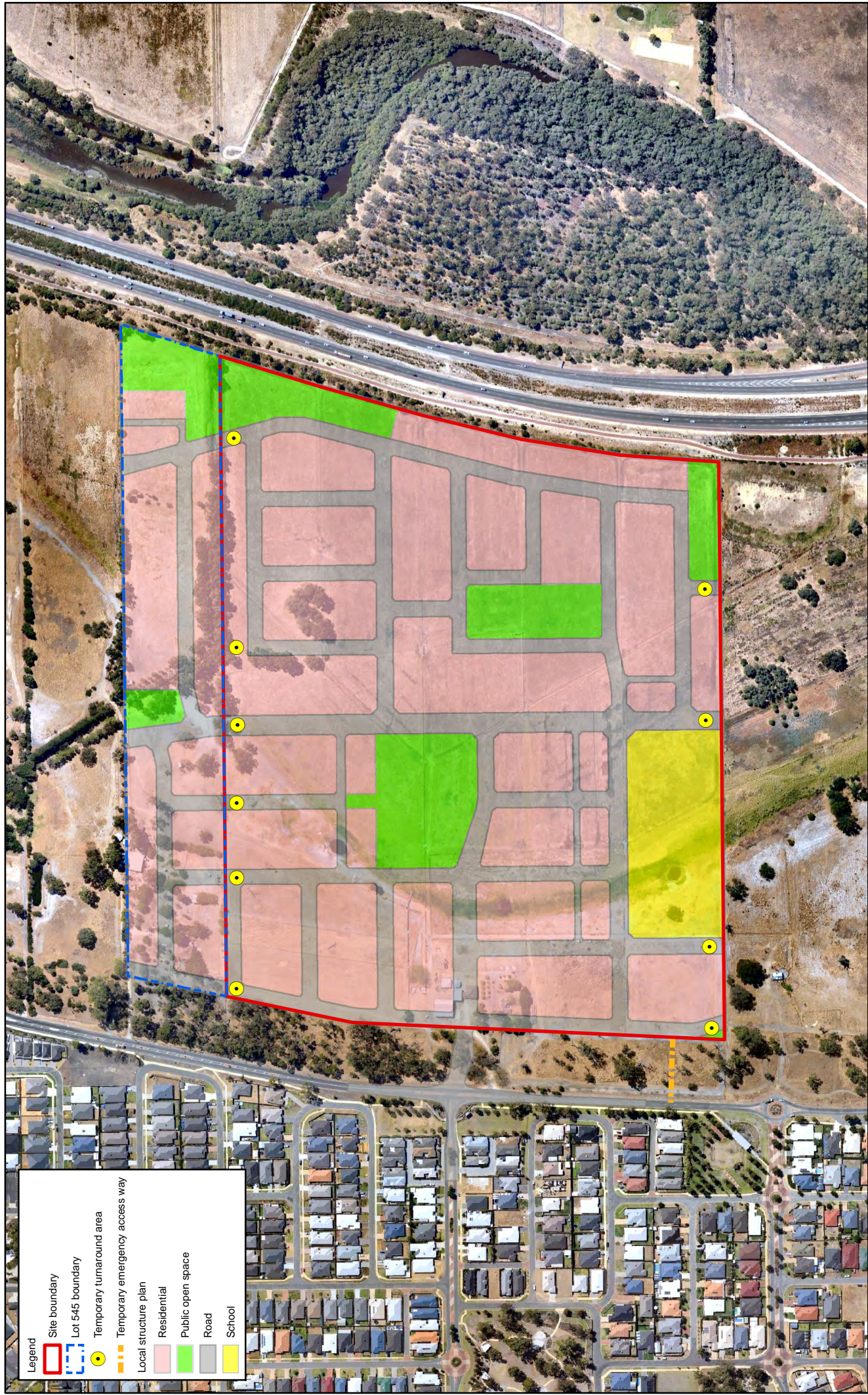


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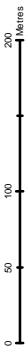
- Site boundary
- Lot 545 boundary
- Temporary emergency access way
- Local structure plan
- Residential
- Public open space
- Road
- School



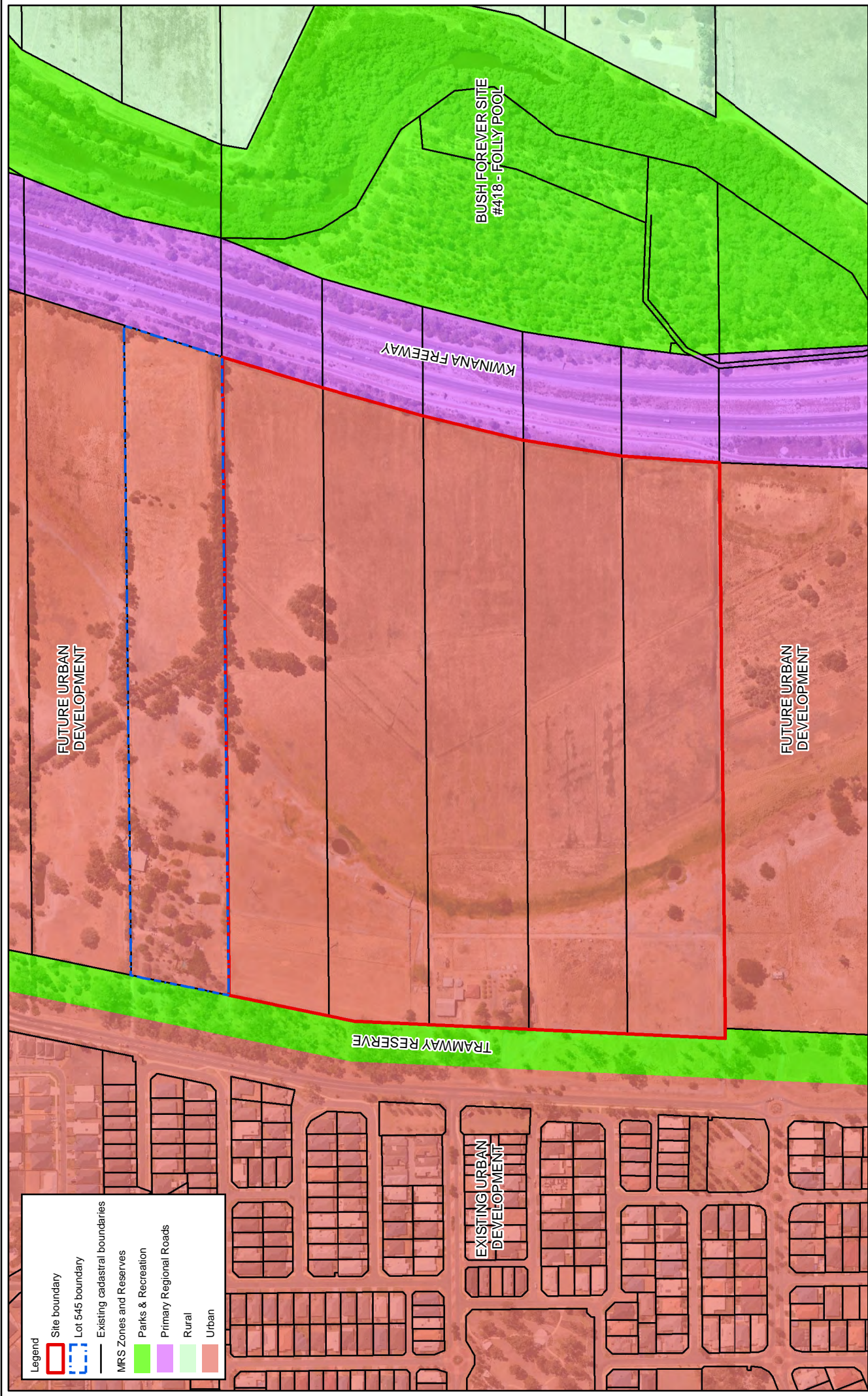
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Appendix 3: Proposed LSP	
Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd







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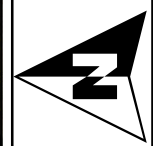
Appendix 4: Local Context and Surrounding Land Uses

Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd

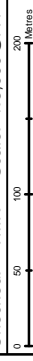




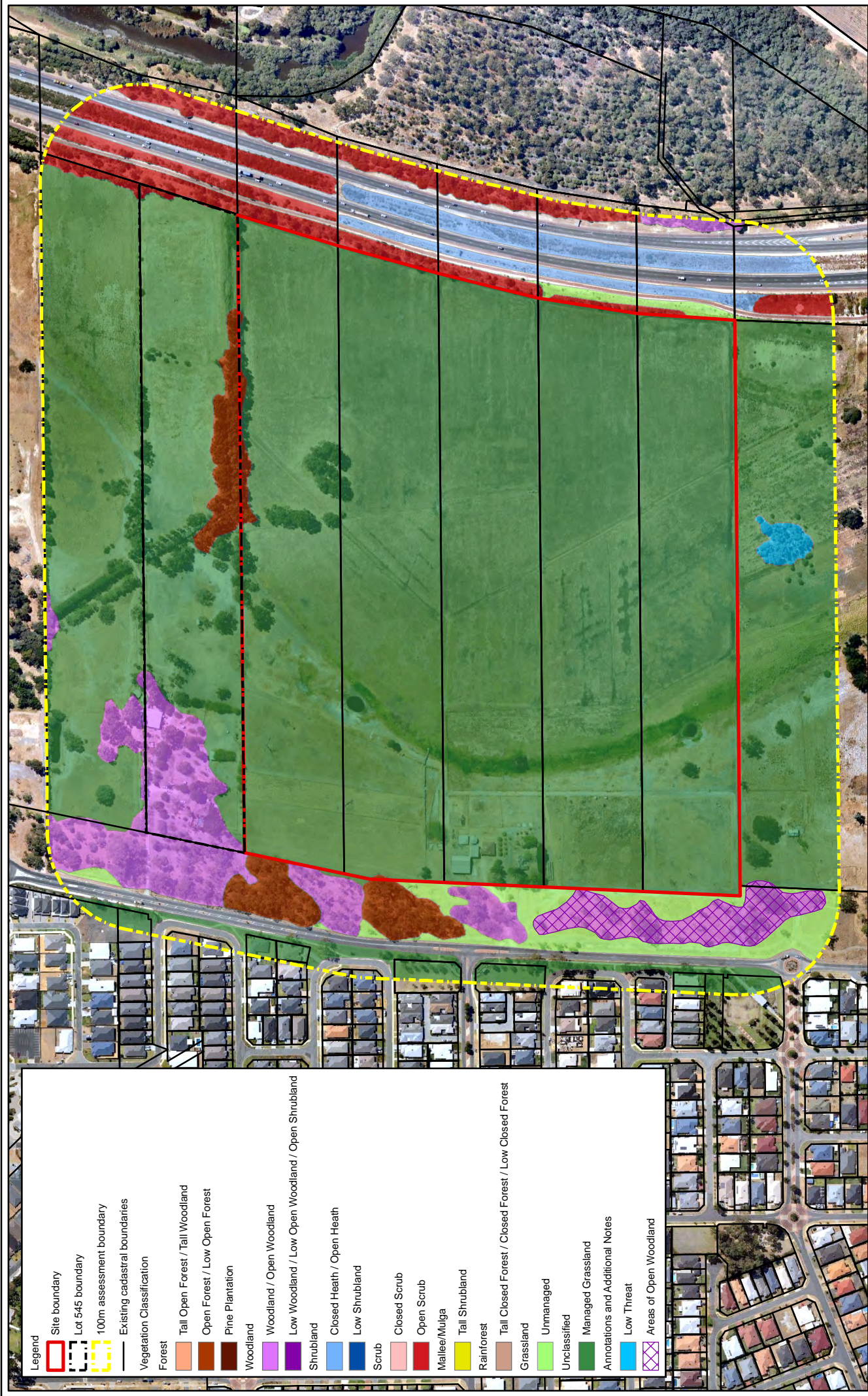
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Appendix 5: Site Topography and Slope	
Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd







- Legend**
- Site boundary
  - Lot 545 boundary
  - 100m assessment boundary
  - Existing cadastral boundaries
  - Vegetation Classification
  - Forest
    - Tall Open Forest / Tall Woodland
    - Open Forest / Low Open Forest
    - Pine Plantation
  - Woodland
    - Woodland / Open Woodland
    - Low Woodland / Low Open Woodland / Open Shrubland
  - Shrubland
    - Closed Heath / Open Heath
    - Low Shrubland
  - Scrub
    - Closed Scrub
    - Open Scrub
  - Mallee/Mulga
  - Tall Shrubland
  - Rainforest
  - Tall Closed Forest / Closed Forest / Low Closed Forest
  - Grassland
  - Unmanaged
  - Unclassified
  - Managed Grassland
  - Annotations and Additional Notes
  - Low Threat
  - Areas of Open Woodland

Appendix 6: Existing Site Conditions - AS3959 Vegetation Classifications

Project: Fire Management Plan  
Lots 746-50 Baldvis Road, Baldvis

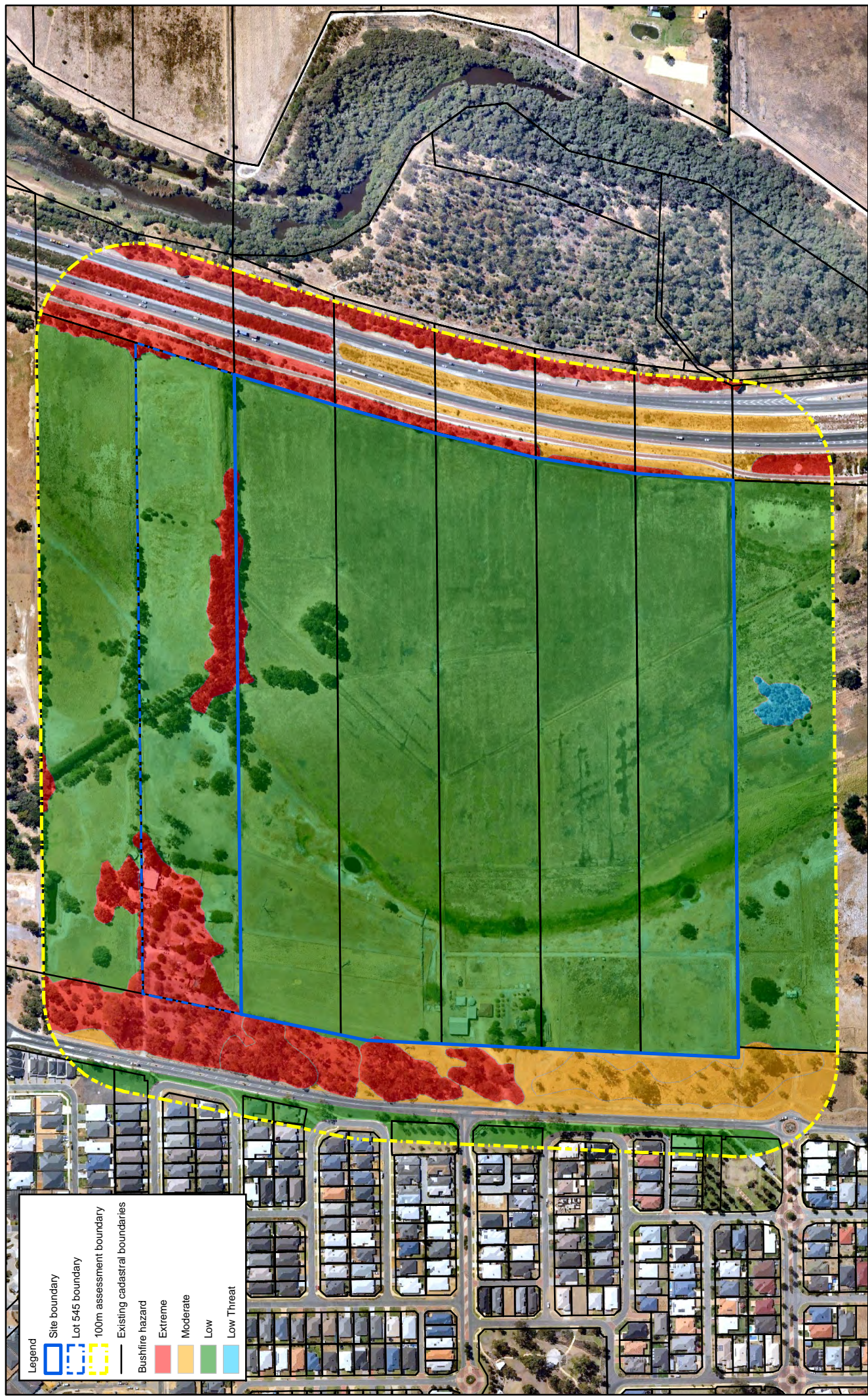
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Approved:	CKK	Date:	27/01/15
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Appendix 7: Existing Site Conditions - Bushfire Hazard Assessment	
Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd

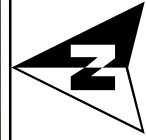






**Appendix 8: Post Development - AS3959 Vegetation Classifications**

Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd
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Drawn:	CKK Date: 11/03/15
Approved:	VMK Scale: 1:5,000 @ A4
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**Legend**

- Site boundary
- 100m assessment boundary
- Local structure plan
- Existing cadastral boundaries
- Temporary hazard subject to future urban development
- Bushfire hazard
  - Low threat
  - Extreme
  - Moderate
  - Low

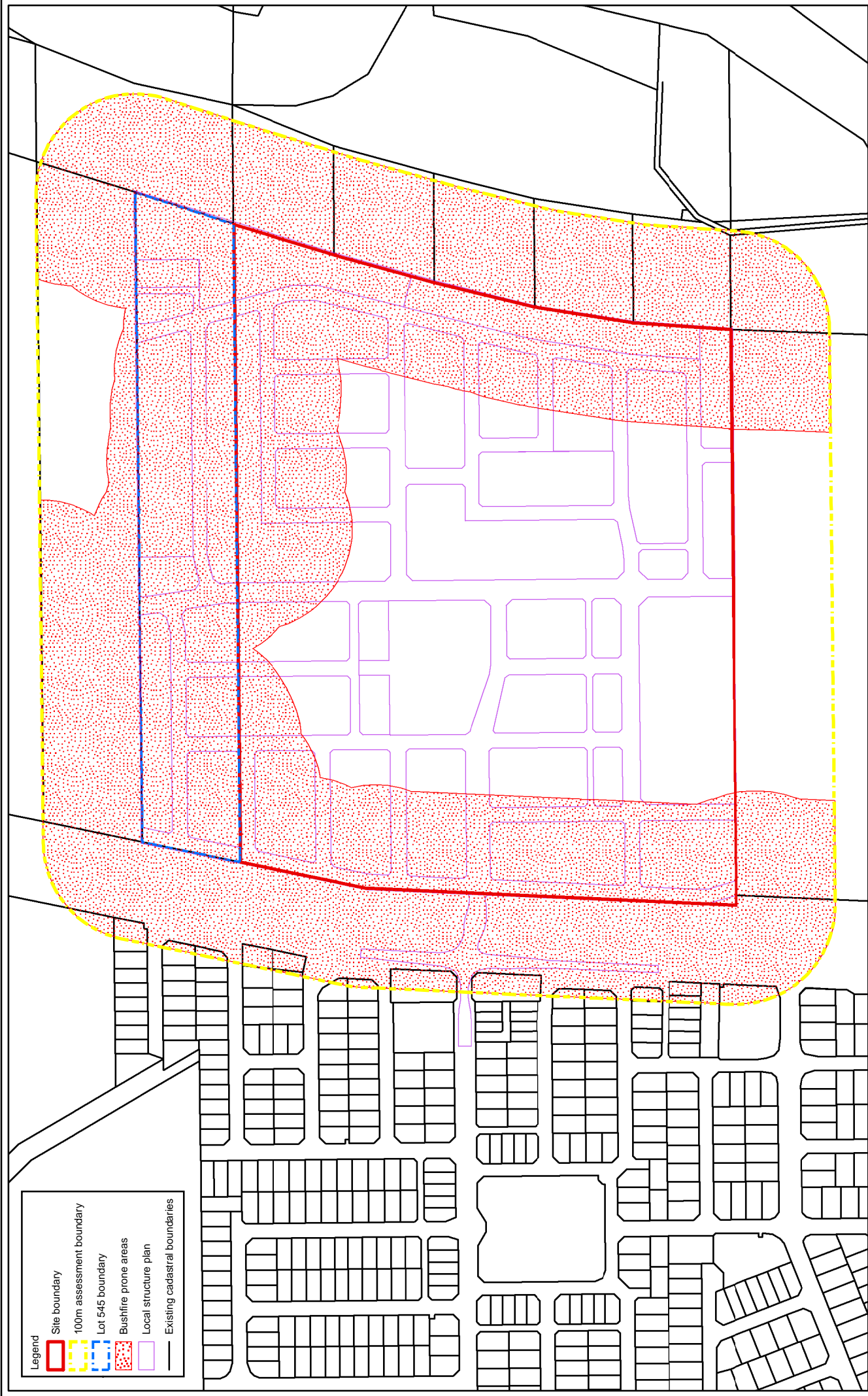


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Appendix 9: Post Development - Bushfire Hazard Assessment	
Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd





- Legend**
- Site boundary
  - 100m assessment boundary
  - Lot 545 boundary
  - Bushfire prone areas
  - Local structure plan
  - Existing cadastral boundaries



Plan Number: EPI4-011(01)-AP11d			
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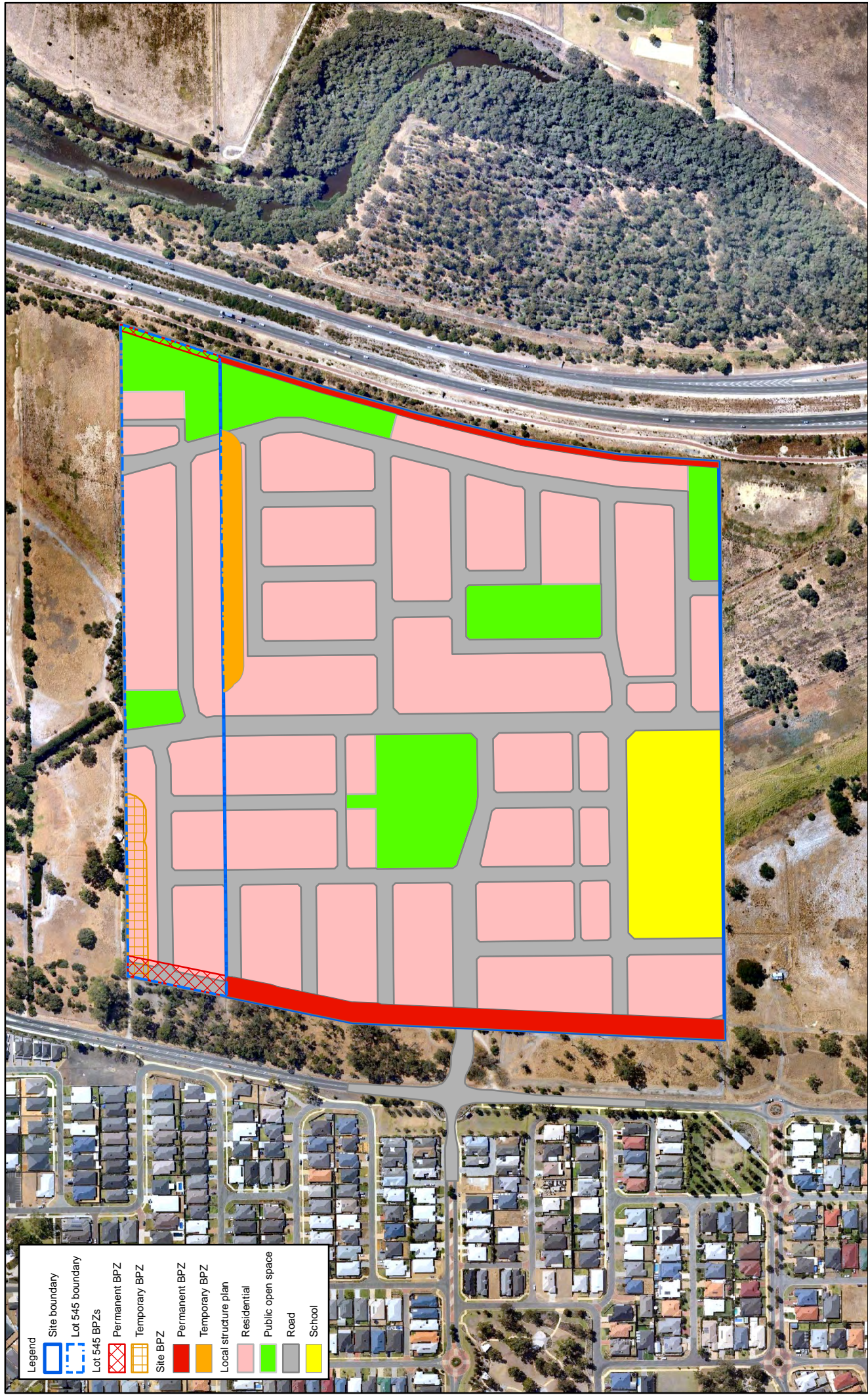


**Appendix 10: Post Development Site Conditions - Bushfire Prone Areas**

Project: Fire Management Plan  
Lots 746-50 Baldvis Road, Baldvis

Client: Mirvac (WA) Pty Ltd





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Appendix 11: Building Protection Zone Requirements	
Project:	Fire Management Plan Lots 746-50 Baldvis Road, Baldvis
Client:	Mirvac (WA) Pty Ltd







## Appendix 12: Compliance Checklist

Element/Question	Response
<b>1: Location</b>	
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	Yes.
<b>2: Vehicular access</b>	
Does the proposal comply with the performance criteria by applying acceptable solution A2.1?	Yes.
Does the proposal comply with the performance criteria by applying acceptable solution A2.2?	Yes.
Does the proposal comply with the performance criteria by applying acceptable solution A2.3?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.4?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.5?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.6?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.7?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.8?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.9?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A2.10?	Not applicable.
<b>3: Water</b>	
Does the proposal comply with the performance criteria by applying acceptable solution A3.1?	Yes.
Does the proposal comply with the performance criteria by applying acceptable solution A3.2?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.3?	Not applicable.
<b>4: Siting of the Development</b>	
Does the proposal comply with the performance criteria by applying acceptable solution A4.1?	No. However, the proposal does comply with the performance criterion P4, because building construction standards will be increased to comply with the reduced BPZ consistent with AS 3959. BAL-29 is not exceeded.

Element/Question	Response
Does the proposal comply with the performance criteria by applying acceptable solution A4.2?	No. However, the grassland vegetation is classed as low hazard and is expected to be slashed prior to the fire season each year to maintain a low hazard in perpetuity.
Does the proposal comply with the performance criteria by applying acceptable solution A4.3?	No. However, the proposal does comply with the performance criterion P4, because building construction standards will be increased to comply with the reduced BPZ consistent with AS 3959. BAL-29 is not exceeded.
Does the proposal comply with the performance criteria by applying acceptable solution A4.4?	No. However, the performance criteria P4 is achieved, because all dwellings within 100 m of classified vegetation will comply with AS 3959, and BAL-29 is not exceeded.
Does the proposal comply with the performance criteria by applying acceptable solution A4.5?	Not applicable.
<b>5: Design of the Development</b>	
Does the proposal comply with the performance criteria by applying acceptable solution A5.1?	No. However, the proposal does comply with the performance criterion P5, because building construction standards will be increased to comply with AS 3959 to offset the requirement for a HSZ. BAL-29 is not exceeded.
Does the proposal comply with the performance criteria by applying acceptable solution A5.2?	Yes.

### Applicant Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:



Name: Rohan Carboon

Date: 11/03/2015





## ATTACHMENTS

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*Attachment 1: Information Note: Construction standards of new homes at the edge of the freeway (DFES 2014)*

---



## Information Note

December 2014

# Construction standards of new homes at the edge of the freeway

### Key Points

- Homes within 100 metres of the vegetation adjacent to the freeway need to have an increased construction standard.
- The road reserve prevents the bushfire from spreading at the quasi-potential rate and therefore at a reduced fire intensity, rate of spread and potential for ember distribution and distance.
- Between the vegetation and the subdivision there will be a non-combustible noise abatement wall.
- There are numerous subdivisions currently being developed within the freeway precinct and more will occur in the future.
- As the fire behaviour is diminished it is reasonable to reduce the construction standard and costs without compromising community safety.
- Homes in the zone zero metres to 35 metres from the freeway vegetation are still required to be constructed to BAL-12.5 and the zone 35 metres to 100 metres is within the modified zone of Freeway BAL-Low (plus) construction standard (ember proof).

## The construction standards of new homes in subdivisions in bushland adjacent to the freeway

**The freeway has revegetated zones that range in width, but are basically wider than 20 metres and are predominantly continuous. This makes these areas a 'threat' vegetation as the revegetation is either classified as scrub or shrubland. As a 'threat' vegetation (as described in AS 3959) all homes within 100 metres of the vegetation need to have an increased construction standard.**

The freeway is a four lane highway, two lanes each direction with a train line of two tracks between the freeway road surface and within the road reserve. This prevents the bushfire from spreading at the quasi-potential rate and therefore at a reduced fire intensity, rate of spread and potential for embers to be carried significant distances.

### Rate of spread

The Vesta fire spread model predicts that the fires with a head fire width of around 100 metres when the wind speed is less than 20 km/hr, and 300 metres wide in stronger winds, would reach the maximum potential head fire rate of spread. Additional research suggest that a head fire width of more than 75 m<sup>1</sup> in grasslands and 200 m<sup>2</sup> in woodlands are required to achieve spread rates within 10% of the potential maximum head fire rate of spread with wind conditions in the open of around 20 km/hr. As the pockets of remnant vegetation within the BPZ are relatively small (smaller than that which would permit a fire to develop a head fire width of 75 metres in grass, 200 metres in woodlands or 300 metres in forest) the fire would not achieve the potential maximum rate of spread.

### Bushfire Attack Level (BAL)

There are numerous subdivisions currently being developed within the freeway precinct and more will occur in the future. Currently, as a consequence of the revegetation along the freeway edge, the homes being built up to 100 metres from the freeway are required to be constructed to BAL-12.5.

'BAL-12.5 is primarily concerned with protection from ember attack and radiant heat up to and including 12.5 kW/m<sup>2</sup> where the site is less than 100 m from the source of bushfire attack' (AS 3959, page 44).

This criteria effectively means that under the strictest interpretation of BAL-12.5 no radiant heat should be able to attack the building.

<sup>1</sup> N P Cheney & J S Gould, 1995, 'Fire growth in Grassland Fuels,' International Journal of Wildland Fire 5(4):237-247, USA.

<sup>2</sup> J S Gould, N P Cheney, L McCaw, S Cheney 2003, 'Effects of Head Fire Shape and Size on Forest Fire Rate of Spread,' AFAC Wildland Fire Conference paper, Sydney.

For calculating the Bushfire Attack Level (BAL), AS 3959—*Construction of buildings in bushfire-prone areas* utilises a head fire width of 100m. It is estimated that a fire in the freeway zone will not achieve a head fire width exceeding 50m because of the break-up of the fuels, as the fuels are discontinuous as a consequence of the freeway road surface and the associated clearing. The freeway basically runs north–south and the prevailing summer winds have a westerly or easterly component (which is non-pure not absolute but rather fluctuates several degrees either way north and south). This effectively means that bushfires attacking these homes will be below their potential maximum head fire rate of spread and therefore fire behaviour, including spotting distances, will be less than a landscape scale fire.

## Construction standards

The strict interpretation of AS 3959 is potentially imposing an excessive onus on the homes constructed at some distance from the scrub (vegetation) within the freeway road reserve. If it assumed that there is an opportunity for a bushfire run in the suburb to be reduced so that the BAL onto the buildings at 35 metres from the vegetation the BAL for 50 metres wide fire fronts are less than 5 kW/m<sup>2</sup>. Homes in the zone zero metres to 35 metres are still required to be constructed to BAL-12.5 and the zone 35 metres to 100 metres is within the modified zone of Freeway BAL-Low (plus).

Running adjacent to the freeway for most of the areas described above is a ‘noise abatement wall’. This wall is of varying heights and made from non-combustible materials. This significantly reduces the potential direct flame contact and radiant heat that can attack a house adjacent to the freeway. The roofs in many of these houses are above the wall height and can potentially be subject to direct flame contact and radiant heat, depending on the flame angle. It is the combination of the potential direct flame contact, radiant heat and the embers that a fire may generate that necessitates the first 35 metres from the freeway be at the standard BAL-12.5 construction standard.

## Freeway BAL-Low (plus) construction

Freeway BAL-Low (plus) construction would require the following:

- Floors: concrete slab on the ground.
- External walls: Masonry, mud brick or concrete.
- Joints: in external walls shall be covered, sealed, overlapped backed or butt jointed to prevent gaps greater than 3 mm.
- Vents and weepholes: on external walls shall be screened with a mesh of maximum aperture of 2 mm.
- Glazing:
  1. Windows and doors shall be screened<sup>1</sup> with a maximum aperture of 2 mm.
  2. Frames shall be metal or bushfire-resisting timber.
- Doors:
  1. Shall be tight-fitting to the door frame and to an abutting door.

- Roofs:
  1. Non-combustible material.
  2. Roof/wall junction shall be sealed to prevent opening greater than 3 mm.
  3. Roof ventilation openings shall be fitted with ember guards with a maximum aperture of 2 mm.
  4. Roofs shall be fully sarked.<sup>3</sup>
  5. Roof penetrations shall be adequately sealed to prevent gaps greater than 3 mm.
- Evaporative air conditioners are screened to prevent opening greater than 3 mm.
- Building protection zone (BPZ) will be developed and maintained to meet the standard DFES recommendation.
- Plants (shrubs) to be placed 3 times their mature height from the house.

## Heat flux

Unless a running fire, which is based on the landscape fire characteristics, is around 15 metres from the building, the heat flux from a freeway vegetation fire would not produce a heat flux of 13kW/m<sup>2</sup> (ignition of timber after a long period). Greater than 35 metres between the freeway vegetation and the houses the radiant heat flux is estimated to be less than or close to 5kW/m<sup>2</sup>, depending on the head fire width. This heat flux will cause pain to a human after a short period 10–20 seconds but will not ignite a house or building. It must be noted that a fire in the freeway road verge vegetation will not achieve the fire behaviour of the landscape vegetation scale and structure bush fire.

It is highly probable that any fire in the freeway vegetation will not be running at its maximum rate of spread nor intensity. Therefore these fires will have a diminished heat flux output and reduced propensity to long distance spotting. Coupled with the reduction in suitable long spotting vegetation species in the freeway revegetation it is expected that the potential bushfire attack in this zone will be significantly reduced.

Placing paths or other non-flammable materials close to the house will reduce the heat flux onto the house, so that it does not have the opportunity to reach 13kW/m<sup>2</sup> and ignite the building.

## Proviso

This proposal is dependent on two things:

1. Ensuring that the house is ember proof.
2. Ensuring that a suitable BPZ is established and maintained.

If both of these components are in place then the Freeway BAL-Low (plus) option will reduce housing costs and not diminish community safety or resilience.

**By building houses to an ember proof standard, such as Freeway BAL-Low (plus) and maintaining a BPZ will significantly enhance that house's ability to withstand a bushfire attack.**

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<sup>3</sup>Screens and sarking must be made of materials as described in AS 3959.

## Typical radiant heat intensities<sup>4</sup>

**Table 1:** Typical radiant heat intensities for various phenomena

Phenomena	kW/m <sup>2</sup>
Pain to humans after 10 seconds to 20 seconds	4
Pain to humans after 3 seconds	10
Ignition of cotton fabric after a long time (piloted) (see Note 2)	13
Ignition of timber after a long time 13 (piloted) (see Note 2)	13
Ignition of cotton fabric after a long time (non-piloted) (see Note 3)	25
Ignition of timber after a long time (non-piloted) (see Note 3)	25
Ignition of gaberdine fabric after a long time (non-piloted) (see Note 3)	27
Ignition of black drill fabric after a long time (non-piloted) (see Note 3)	38
Ignition of cotton fabric after 5 seconds (non-piloted) (see Note 3)	42
Ignition of timber in 20 seconds (non-piloted) (see Note 3)	45
Ignition of timber in 10 seconds (non-piloted) (see Note 3)	55

### Notes:

1. Source AS 1530.4—2005.
2. Introduction of a small flame to initiate ignition.
3. Flame not introduced to initiate ignition.

<sup>4</sup> Standards Australia, 2009, *Australian Standard S 3959 (incorporating Amendments Nos 1, 2 and 3) Construction of buildings in bushfire-prone areas*, Standards Australia, Sydney.



**For more information contact the Environmental Protection Branch on 9395 9300, email: [environment@dfes.wa.gov.au](mailto:environment@dfes.wa.gov.au) or visit [www.dfes.wa.gov.au](http://www.dfes.wa.gov.au)**