

Bushfire Management Plan



Eden Beach Subdivision

Formally Lot 9 Marmion Avenue, Jindalee
City of Wanneroo

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Prepared for: Satterley Property Group
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EXECUTIVE SUMMARY

This Bushfire Management Plan (BMP) has been prepared to support the Eden Beach subdivision and future subdivision stages. The proposal is to subdivide the site as shown in **Appendix B** which includes creating 1408 residential lots, a primary school and 10 Public Open Space (POS) areas.

This area is herein referred to as “the site” and is currently 90% cleared and approximately 50% developed. It contains some small areas of grassland and shrubland vegetation and one centrally located public open space area will retain shrubland vegetation. The site is located in Jindalee, between Marmion Avenue and the coastal foreshore reserve. Land to the north and south of the site are currently under residential development. The site location is shown in **Appendix A**.

The site is zoned ‘Urban Development’ under the City of Wanneroo’s District Planning Scheme No.2. A Local Structure Plan (LSP) was lodged with the City of Wanneroo in 2011.

The effective slope around the perimeter of the site is influenced by the sand dune landscape and varies between flat/upslope to downslope 10° around the perimeter.

All areas within 100 metres (m) of the site boundary have been assessed for vegetation classification (**Appendix C**) and bushfire hazard rating levels (**Appendix E**). It has been determined that the proposed subdivision of the site has an exposure level that falls within the acceptable level of risk. A temporary and permanent Asset Protection Zone (APZ) are proposed to respond to temporary bushfire hazard north and south of the site and the permanent hazard in the coastal foreshore reserve.

The predicted Bushfire Attack Levels (BALs) have been assessed with the existing conditions (**Appendices F and H**) and broader post development site conditions (**Appendices G and I**).

It is expected that the implementation of this BMP will reduce the threat to site occupants, visitors and fire fighters in the area associated with this BMP.

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1 INTRODUCTION

1.1 Purpose of Plan

This Bushfire Management Plan (BMP) has been prepared to respond to support the Eden Beach subdivision development and current and future subdivision stages. It is likely the development of a Bushfire Management Plan will be requested for future subdivision applications and this BMP can be applied across the entire site as subdivision stages are progressed.

The BMP presented here has been developed to address these anticipated planning conditions.

The purpose of this BMP is also to provide guidance on how the potential bushfire threat at the site can be mitigated to acceptable levels using land use planning and building controls.

1.2 Background

The site is currently 90% cleared and approximately 50% developed. It contains some small areas of grassland and shrubland vegetation and one centrally located public open space area will permanently retain remnant shrubland vegetation. All other POS areas are already landscaped or proposed to be landscaped.

Residential developments are progressing north and south of the site and remnant vegetation and bushfire hazard in these areas are temporary.

Permanent vegetation will also be retained in the coastal foreshore reserve posing a permanent bushfire hazard and threat onto the site.

Short-term retained vegetation is adjacent to the northern and southern interface of the site and negotiations are underway to remove and manage the bushfire threat in these zones.

The site is owned by Ocean Springs Pty Ltd and was formally described as Lot 9 Marmion Avenue, Jindalee. The site plan showing the location is in **Appendix A**.

1.3 Accreditation

This BMP has been prepared by Bushfire Safety Consulting. Bushfire Safety Consulting is owned and operated by Rohan Carboon and Ken Strahan. Rohan and Ken have provided all technical input and review for this bushfire assessment.

Rohan has undergraduate degrees in Environmental Management and postgraduate qualifications in Bushfire Protection and has been providing bushfire risk and hazard assessment and mitigation advice to the urban planning and development industry for more than 7 years. He first worked professionally in community bushfire safety education in 1999 and has been involved in land management including bushfire suppression since 1993.

Ken Strahan has twenty years experience in emergency management research for a number of major emergency management organisations including the Victorian Country Fire

Authority, the Office of the Emergency Services Commissioner (Victoria), Country Fire Service (SA) Office of Premier and Cabinet (NSW) and a large number of local councils. His work was cited extensively by the Black Saturday Bushfire Royal Commission. He is currently completing a PHD thesis researching community responses during bushfire events including the Perth Hills bushfire in 2014.

Bushfire Safety Consulting is a Corporate Bronze Member of the Fire Protection Association of Australia. Rohan and Ken are both in the process of obtaining BPAD Level 2 accreditation under the Fire Protection Association of Australia's new accreditation scheme. Rohan will also apply for Level 3 accreditation in 2016.

1.3.1 The Development Proposal

This Bushfire Management Plan (BMP) has been prepared to support current subdivision activities and future subdivision applications.

The proposed subdivision outlined in **Appendix B** indicates how the site is proposed to be developed. The proposal includes creating 1408 residential lots, a primary school and 10 Public Open Space (POS) areas.

The site is serviced by scheme water and has an extensive public road network.

1.3.2 PLANNING CONTEXT (STATUTORY AND POLICY FRAMEWORK)

The following key legislation, policies and guidelines are relevant to the preparation of BMPs.

1.3.2.1 1.3.2.1 Fire and Emergency Services Act 1998

Areas within Western Australia have now been designated as bushfire prone by the Fire and Emergency Services (FES) Commissioner, through the release of the *Map of Bush Fire Prone Areas* (OBRM 2015). The *Fire and Emergency Services Act 1998* (FES Act) enables the statutory delineation of Bushfire Prone Areas, which are areas within 100 m of classified bushfire prone vegetation or 50 m from grassland. In turn, Bushfire Prone Areas enable the implementation of the regulations and guidelines outlined below.

1.3.2.2 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 Wanneroo publishes an annual Fire Regulations Notice that can be downloaded from:

http://www.wanneroo.wa.gov.au/info/20035/community_health_and_safety/195/firebreaks

1.3.2.3 Planning and Development (Local Planning Scheme amendment) Regulations 2015

The Planning and Development (local planning Scheme amendment) Regulations 2015 (WAPC 2015a) (the Regulations) include deemed provisions which reference the FES Commissioner’s power to designate bushfire prone areas, and provide a mechanism to apply State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2015) and the assessment requirements through planning and development decisions.

1.3.2.4 Building Regulations

All building work in Western Australia is required to comply with the Building Code of Australia (BCA). The Building Regulations recognise that properties that are located within a designated bushfire prone areas may require additional assessment for bushfire risk and for construction of dwellings to be in accordance with the Australian Standard (AS) 3959-2009 construction of buildings in bushfire prone areas (Standards Australia 2009)

1.3.2.5 State Planning Policy (SPP) 3.7: Planning in Bushfire Prone Areas

SPP 3.7 provides the overarching policy for bushfire planning throughout the State. The policy refers to the relevant guidelines and standards that must be addressed in land use planning decisions and the design of proposed developments in areas identified as bushfire prone.

Policy measure 6.2 in SPP 3.7 applies to subdivision applications within designated bushfire prone areas relating to land that has a Bushfire Hazard Level above low and/or where a BAL rating above BAL-LOW applies, are to comply with the policy measures.

A subdivision development application in an area to which policy measure 6.2a) applies that has or will on completion have BAL-12.5-BAL-29 rating may be considered for approval where it can be undertaken in accordance with policy measures 6.3, 6.4 or 6.5.

Policy measure 6.4 outlines the information to accompany a subdivision application including the preparation of a Bushfire Management Plan.

1.3.2.6 State Bushfire Prone Map

The Office of Bushfire Risk Management (OBRM) has established a single data standard for mapping bushfire-prone areas that has been adopted by all State and Local Government Areas. A bushfire-prone area is an area defined as an area that is subject to, or likely to be subject to, bushfire attack.

This declaration is being undertaken for the purposes of initiating application of AS3959-2009 Construction of Buildings in Bushfire Prone Areas (Standards Australia 2009 as amended), and State Planning Policy 3.7: Planning for Bushfire Risk Management. The entire site is declared ‘bushfire prone’ under this process.

1.3.2.7 Guidelines for Planning in Bushfire Prone Areas (2015)

The Department of Planning have recently released the *Guidelines for Planning in Bushfire Prone Areas (2015)*. The requirements of this document are accommodated within this BMP.

The *Guidelines for Planning in Bushfire Prone Areas (2015)* 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 planning.

The *Guidelines for Planning in Bushfire Prone Areas (2015)* 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.

1.3.2.8 AS3959-2009: Construction of buildings in bushfire-prone areas (Standards Australia 2009, as amended) and the Building Code of Australia (BCA)

These documents set out the construction requirements for buildings in bushfire-prone areas. AS 3959-2009 has six categories of Bushfire Attack Level, namely BAL-LOW, BAL-12.5, BAL19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds. The method for determining the BAL involves a site assessment of vegetation, setback distances and local topography. The assumed Fire Danger Index (FDI) for Western Australia is 80. The BAL identifies the appropriate construction standard that applies as a minimum standard in AS 3959-2009.

2 OBJECTIVES

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

The BMP objectives are to:

- Achieve consistency with objectives and policy measures of SPP3.7, the Guidelines for Planning for Bushfire Prone Areas and local planning scheme provisions;
- Understand and document the extent of bushfire risk for the site;
- Prepare bushfire risk management measures for bushfire management of the site, with due regard to people, property, infrastructure and the environment;
- Nominate individuals and organisations responsible for fire management and associated works within the plan area; and
- Define an assessment procedure which will evaluate the effectiveness and impact of proposed bushfire risk management measures and strategies.

Achievable and measurable goals of this plan include ensuring:

- Development is located in an area where the bushfire hazard assessment classification is or will be moderate or low, and the risk can be managed;
- The siting and design of the development and land use (including paths and landscaping) is appropriate to the level of risk that applies to the site and minimises the bushfire risk to people, property and infrastructure;
- The internal layout, design and construction of public and private vehicular access in the development allows emergency and other vehicles to move through it easily and safely at all times;
- The development is provided with a permanent and secure water supply that is sufficient for fire-fighting purposes.

This BMP sets out the roles and responsibilities of the developer, future owners of the site and the City of Wanneroo. It is important that the measures and procedures outlined in this BMP are adopted across the various stages of the land use planning and approvals processes.

3 DESCRIPTION OF SUBJECT AREA

3.1 General

The site has been progressively cleared and developed since 2012 and is currently 90% cleared of vegetation and approximately 50% developed. It contains some small areas of grassland and shrubland vegetation and one centrally located public open space area which will permanently retain remnant shrubland vegetation. All other POS areas are already landscaped or proposed to be landscaped.

Residential developments are progressing north and south of the site and remnant vegetation and bushfire hazard in these areas are temporary. The site is bounded to the east by Marmion Avenue and to the west by the coastal foreshore reserve.

The effective slope (that is the slope that will affect the behaviour of an approaching bushfire) changes around the perimeter of the site and varies considerably due to the sand dune dominated landscape. Some average downslopes achieve a maximum of 10 degrees on the western side of the development but there are also many interface zones with an effective upslope adjacent to the site.

The site is serviced by mains water and is connected to a grid public road system.

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 BMP, when implemented, will reduce the risk to people and property within the site. How future managers of the site interpret the risk, prepare and maintain the property and buildings and what decisions and actions they take (i.e. evacuate early or relocate to a safer place) will greatly influence the consequences of any bushfire.

3.2 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.

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.

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 website¹ states that extreme fire weather conditions in the Perth region typically occur with strong easterlies or north easterly winds associated with a strong high to the south of the state and a trough offshore. Easterly winds represent about 60 per cent of extreme fire weather days (events) compared to less than 5 per cent associated with southerly winds. About 15 per cent 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 Bureau of Meteorology research station at Swanbourne (42 km south 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 degrees Celsius in February to 18 degrees Celsius in July.

The site is adjacent to the coast and is significantly influenced by land and sea breezes. These are created by the daily heating and cooling of the land surface next to the ocean. The sea breeze occurs when the air over the land heats up and becomes more buoyant and rises, denser moist air over the ocean then flows inland. Sea breezes can strengthen prevailing wind, reduce it or even reverse it, depending on the strength and direction of the two airstreams (Cheney and Sullivan 2008).

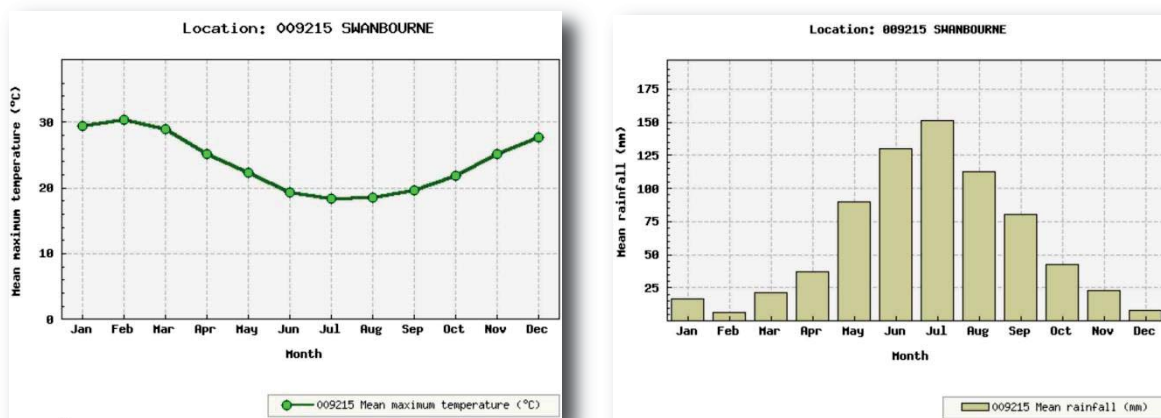


Figure 1: Mean maximum recorded temperatures and mean rainfall for Swanbourne Meteorology Station between 1993 and 2010

Data from the Bureau of Meteorology weather station at Swanbourne indicate that the predominant winds in the summer months at 3pm near the study site are south-westerly (Figure 2). Wind strength, direction and frequency of the south-west wind are clearly

¹ www.bom.gov.au/weather/wa/sevwx/perth/bushfires.shtml

dominant and occur 70-80 per cent of the time. Winds from the west and south-east occur approximately less than 10% of the time.

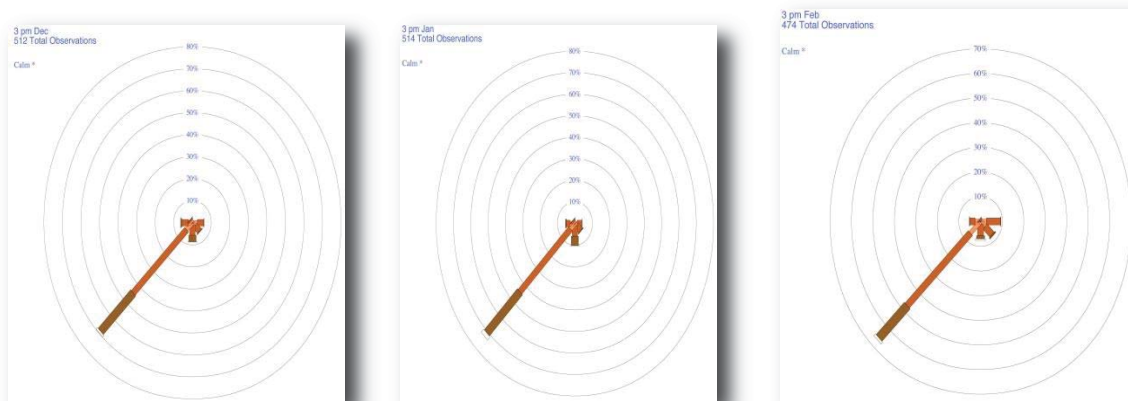


Figure 2: Rose of wind direction and wind speed in km/hr for December, January and February between 1993 and 2010 at Swanbourne Bureau of Meteorology Station

Interpreting – wind speed vs. direction plot

Wind roses summarize 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

4 BUSHFIRE ASSESSMENT

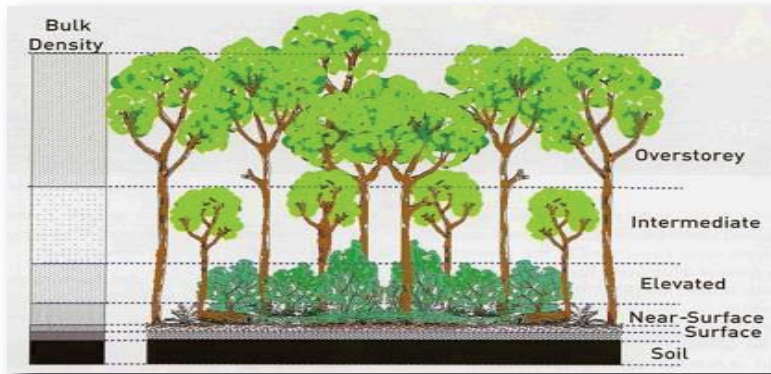
Bushfires are common in the City of Wanneroo and local brigades respond to numerous bushfires in the district annually.

Given that bushfires are common in the area this BMP plays a critical role in ensuring that the development of the land appropriately mitigates the risk from bushfire.

4.1 Bushfire Hazard Assessment

The methodology used to assess bushfire hazard is outlined in the *Guidelines for Planning in Bushfire Prone Areas (2015.)* Assessing bushfire hazards at the site specific 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 C**. 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

4.1.1 Vegetation Type and Structure

The subdivision site is largely cleared of vegetation and has a mineral earth sand surface. This extensive zone is classed as Exclusion clause 2.2.3.2(e) in AS3959-2009. Small isolated areas of shrubland occur within the site and only two areas will permanently retain vegetation. The low shrubland in the centrally located POS areas (**Figure 4**), averages less than 1 metre in height and only short fire runs are possible due to its small size and isolation from other bushfire fuels.

Shrubland is also the most common vegetation type in the coastal foreshore reserve and is characterised by plants and canopy fuels less than 2 metres in height (**Figure 5**). Scrub vegetation occurs in small areas usually in the protected dune swales and is characterised by vegetation with greater than 30% foliage cover that exceeds 2 metres in height. The most common genus in the scrub vegetation are Acacia species (**Figure 6**).

An area of low banksia vegetation occurs south of the site, but does not exceed 6 metres in height and contains connected ladder fuels meaning it is typical of a scrub structured rather than woodland vegetation. All fires in the surrounding landscape will be wind driven fires unlike woodland or forest that are more influenced by fuel loads. (cf. AS34959 fire modelling).

The dominant vegetation class north and south of the site is similarly shrubland which does not exceed 2 metres in height apart from a few isolated plants (**Figure 7**).



Figure 4: Shrubland in internal POS area



Figure 5: Shrubland in foreshore reserve



Figure 6: Small areas of scrub occur in the foreshore reserve



Figure 7: Shrubland south of the site.

4.1.2 Slope

The topography in the surrounding sand dune landscape changes significantly on a local scale. On a broader fire behaviour scale there are average slopes that approach a maximum of 10 degrees downslope toward the Indian Ocean. There are also a number of areas of upslope around the perimeter of the site

The effective slope (that is the slope that will affect the behaviour of an approaching bushfire) around the perimeter of the site has been assessed using contour data and measured in the field with the results outlined in **Appendix D**.

4.1.3 Bushfire Hazard Assessment – Existing Site Conditions

The vegetation class map (**Appendix C**) outlines the existing vegetation classifications on and around the study site including the surrounding 100 m assessment area as required in AS 3959:2009. Descriptions of the vegetation types, structure and fuel layers were outlined in Section 4.1.

The bushfire hazard assessment levels were determined using Appendix 2 of the *Guidelines for Planning in Bushfire Prone Areas (2015)*.

All areas that are excluded by virtue of Clause 2.2.3.2 (e) – non-vegetated areas, have a low bushfire hazard rating due to the land management and low fuel loads except where they are within 100 metres of a moderate or extreme hazard area.

The small areas of scrub around the perimeter of the site are classified as extreme bushfire hazard. Shrubland, which is the most common vegetation type around the perimeter of the site, is classified as a medium hazard level.

Existing hazards surrounding the site are shown in **Appendix E**.

4.1.4 BAL Contour Map – Post Development Conditions

A post development BAL contour plan has been prepared (**Appendix F**) which shows the site when fully developed with managed POS areas except where remnant vegetation is to be permanently retained.

The existing temporary conditions north and south of the site pose a current but temporary threat to the development and will continue to be a threat until the vegetation and fuel loads are removed/reduced. Interface lots on the northern and southern boundary cannot be developed until the adjacent bushfire hazard is permanently removed. These lots effectively become a temporary Asset Protection Zone in this interim period as outlined in **Appendix H**.

A temporary and permanent Asset Protection Zone (APZ) (**Appendix H**) is incorporated into the design to ensure all future dwellings are sited within acceptable exposure limits (i.e. BAL-12.5, BAL-19 and BAL-29). The temporary APZ occupies the 20m zone along the northern and southern interface to ensure no buildings will be exposed to BAL-40 or BAL-FZ (see section 4.2.2.1.).

4.1.5 BAL Contour Map – Post Surrounding Developments

The surrounding developments north and south of the site are progressing and large areas of vegetation have been removed adjacent to the northern interface. As development progresses on adjacent land holdings the bushfire fuels and threat will be reduced and ultimately removed.

The permanent BAL considerations for the site are outlined in **Appendix G** and the developer is working with adjacent land owners to resolve the issue of temporary BAL ratings on these interface areas.

4.2 FIRE MITIGATION STRATEGIES

This report adopts an acceptable solution of control for each bushfire protection criteria. This approach is consistent with Appendix 4 of the *Guidelines for Planning in Bushfire Prone Areas (2015)*. The management issues are:

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

Acceptable solutions are proposed for all of the bushfire protection criteria and each illustrates a means of satisfactorily meeting the corresponding performance criteria.

Land use planning bushfire risk mitigation strategies are comprehensively 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 *Guidelines for Planning in Bushfire Prone Areas (2015)*. The compliance checklist is attached as **Appendix K**.

4.2.1 Element 1: Location of the Development

4.2.1.1 Intent

To ensure that development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

4.2.1.2 Acceptable Solution

The development is located in an area that will, on completion of the subdivision, be subject to a BAL rating of BAL-29 or lower. All exposed lots and dwellings (**Appendix G**) are rated to a maximum of BAL-19. The overwhelming majority of lots are exposed to BAL-LOW.

4.2.2 Element 2: Siting of the Development

Intent

To ensure that the siting and design of development minimises the level of bushfire impact.

Background

The extent of post-development classified vegetation and hazard surrounds the site.

4.2.2.1 Acceptable Solution A2.1: Asset Protection Zone (APZ)

One of the most important fire protection measures influencing the safety of people and property is to create an Asset Protection Zone (APZ) around buildings. The APZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, mown and slashed grasslands, gardens, driveways and roads can form parts of an APZ.

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).

The creation of the APZ areas will ensure the predicted radiant heat flux exposure levels remains at or below BAL-29 for the proposed subdivision.

Managing vegetation in the APZ 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.

The proposed subdivision contains temporary and permanent APZ considerations. A temporary APZ (**Appendix H**) is used as a planning tool to ensure residential development on the northern and southern interface does not occur until the adjacent hazard is removed. Once the adjacent vegetation is removed there is no requirement to retain the temporary APZ.

The permanent APZ is located within the road along the entire western perimeter of the site and surrounds the internal POS area containing remnant shrubland. A small section of Marmion Avenue provides low fuel separation from shrubland vegetation located north-east of the site (**Appendix I**).

The temporary and permanent APZ occupies the zone between classified vegetation (i.e. bushfire hazard) and the development lots.

The APZ will meet the following requirements. (Table 1)

Table 1: Asset Protection Zone requirements

Width:	20 metres minimum measured around the perimeter of the site including the landscaped sections of POS at the western end of the site and internal PSO area as outlined in Appendices H and I. The width is a minimum of 20 metres and BAL-19 is never exceeded.
Location:	Within the boundaries of the development site
Fine Fuel load:	Reduced to and maintained at two tonnes per hectare
Trees (crowns):	Are minimum distances of ten metres apart. A small group of trees within close proximity to one another may be treated as one crown provided the combined crowns do not exceed the area of a large or mature crown size for that species
Tall shrubs or trees:	No tall shrubs or trees located within two metres of a building
Overhanging trees crowns:	No tree crowns overhang the building
Fences:	Fences within the APZ are constructed using non-combustible materials (e.g. iron, brick, limestone, metal post and wire)
Sheds:	Sheds within the APZ should not contain flammable materials

4.2.2.2 Building Siting and Predicted Bushfire Attack Levels

AS 3959:2009 *Construction of buildings in bushfire prone areas* 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.

4.2.2.3 Methodology and Assumptions

The following indicative BAL assessment has been undertaken to demonstrate that the proposed dwellings will fall within acceptable levels of risk. This indicative BAL assessment

was undertaken by assessing the permanent classified vegetation and effective slope. The criteria to determine the BAL is outlined as follows:

Designated FDI:	80
Flame Temperature:	1090
Slope:	Flat/ Upslope and downslope 10
Vegetation Class:	Scrub, Shrubland
Setback distances:	Shown in Table 2 below

4.2.2.4 BAL Outcome

The following indicative BAL assessment was determined for the site.

The BAL assessment was undertaken on the post subdivision site conditions because this reflects what the site will be exposed to once the Asset Protection Zone is established.

Table 2 shows the BAL assessment outcomes for the development interface.

Table 2: Indicative Bushfire Attack Level assessment for proposed buildings

Perimeter of site	Vegetation Class	Setback Distance	Effective Slope (°)	BAL Rating
North and North East	Class C Shrubland	20-<100 metres	Upslope	BAL-12.5
	Class D Scrub	20-<29 metres	Upslope	BAL-19
	Class D Scrub	29-<100 metres	Upslope	BAL-12.5
South and West and internal POS	Class C Shrubland	20-<100 metres	upslope	BAL-12.5
	Class C Shrubland	20-<22 metres	Downslope 0-5°	BAL-19
	Class C Shrubland	22-<100 metres	Downslope 0-5°	BAL-12.5
	Class C Shrubland	20-<25 metres	Downslope 5-10°	BAL-19
	Class C Shrubland	25-<100 metres	Downslope 5-10°	BAL-12.5
	Class D Scrub	20-<27 metres	Flat/Upslope	BAL-19
	Class D Scrub	27-<100 metres	Flat/Upslope	BAL-12.5

Note: See Appendix F for the BAL Contour Plan.

The proposed subdivision has an exposure level of BAL-19 or less.

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/m². There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959:2009). The recommended construction sections in the Australian Standard 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/m². There is a risk of ember attack and burning debris ignited by wind borne embers and a

likelihood of exposure to radiant heat (AS 3959:2009). The recommended construction sections in Australian Standard are 3 and 5.

Any new dwellings constructed within 100 m of classified vegetation will require consideration of the need for increased construction requirements to address AS3959 ‘Construction of Buildings in Bushfire Prone Areas’.

4.2.2.5 Acceptable Solution A2.2: Hazard Separation Zone (HSZ)

An HSZ is not required because an adequate APZ is sited around the proposed development and the BAL rating for all future dwellings does not exceed BAL-19.

4.2.3 Element 3: Vehicular Access

Intent

To ensure that the vehicular access serving a subdivision or development is available and safe during a bushfire event.

Background

The site is adjacent to Marmion Avenue and is accessible at two intersections. The Vehicular Access Plan (see **Appendix J**) shows the existing and proposed loop road system and the two public road intersections with Marmion Avenue.

4.2.3.1 Acceptable Solution A3.1: Two Access Routes

The development contains numerous loop roads providing every lot with two access options and two separate destinations to Marmion Avenue. Five additional public roads will connect with future developments to the north and south.

4.2.3.2 Acceptable Solution A3.2: Public Road

Minimum public road standards for existing and proposed internal roads will comply with the following standards:

Minimum trafficable surface (m)	6
Horizontal clearance (m)	6
Vertical clearance (m)	4.5
Maximum grade < 50 metres	1 in 10
Minimum weight capacity (t)	15
Maximum crossfall	1 in 33
Curves minimum inner radius (m)	8.5

4.2.3.4 Acceptable Solution A3.3: Cul-de-sac / Dead End Road

One permanent cul-de-sac exists and if temporary cul-de-sacs are proposed they will achieve the following standards:

Minimum trafficable surface (m)	6
Horizontal clearance (m)	6
Vertical clearance (m)	4.5
Maximum grade < 50 metres	1 in 10
Minimum weight capacity (t)	15
Maximum crossfall	1 in 33
Curves minimum inner radius (m)	8.5
Maximum length	200 metres
Turn-around area	A 17.5 metre diameter head is provided at the end of road

4.2.3.5 4.2.3.3 Acceptable Solution A3.2: Battle Axe

No battle axe access way is proposed in this development.

4.2.3.6 Acceptable Solution A3.5: Private Driveway longer than 50 metres

No private driveway longer than 50 metres is proposed in this development.

4.2.3.7 Acceptable Solution A3.6: Emergency Access Way

No emergency access way is proposed in this development.

4.2.3.8 Acceptable Solution A3.7: Fire Service Access Route

No fire service access route is proposed in this development

4.2.3.9 Acceptable Solution A3.8: Firebreak width

Compliance with the City of Wanneroo Firebreak Notice is required at all times.

4.2.4 Element 4: Water

4.2.4.1 Intent

To ensure that water is available to the subdivision to enable people, property and infrastructure to be defended from bushfire.

4.2.4.2 Acceptable Solution A4.1: Reticulated Water

Fire services require ready access to an adequate water supply during fire emergencies.

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

The Water Corporation is responsible for all hydrant repairs.

5 Bushfire Risk Management Measures

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 beyond the scope of this report to detail a comprehensive bushfire risk assessment according to AS/NZS ISO 31000:2009; however, a comprehensive bushfire hazard assessment is outlined in **Section 4.1**. The threat level has been assessed for all proposed new buildings in previous sections by determining the Bushfire Attack Levels (BALs) for all new structures in the development.

The vulnerability of assets such as buildings 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 3959:2009 *Construction of buildings in bushfire-prone areas* (Standards Australia 2009) are more likely to survive a bushfire than buildings that do not conform to construction standards; however, building survival is not guaranteed.

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

Vulnerability, consequence and likelihood ratings are all determined using a risk assessment matrix which is beyond the scope of this report.

5.1 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 Wanneroo provides bushfire safety advice to residents available from their website www.wanneroo.wa.gov.au. It also provides details on how to become a volunteer at the local volunteer Bush Fire Brigades. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in bushfire prone areas.

5.2 Fire Safer Areas

There are no designated Community Fire Refuges in the City of Wanneroo, however, at the time of an emergency, the relevant authorities can select an evacuation centre and DFES, the City of Wanneroo and Police will provide this information to site managers and people accommodated on the site.

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.

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.

5.3 Assessment of Fire Management Strategies

The permanent bushfire hazard that could threaten this development occurs to the west of the site in the foreshore reserve which contains moderate fuel loadings. Temporary bushfire hazard occurs north and south of the site and poses a hazard until such time as it is permanently removed.

Exposed dwellings will be constructed to bushfire standards consistent with AS3959 and BAL-29, BAL-40 and BAL-FZ are not exceeded at the site with the proposed strategies.

Landscaping of the cleared internal POS areas within the site to AS3959 Exclusion Clause 2.2.3.2(f) will ensure parklands are not revegetated to a condition whereby fuel loads and fuel structure can support a significant fire front.

A temporary and permanent APZ on all bushfire threat interface areas will ensure construction standards mitigate the threat to acceptable levels.

The fire management strategies include acceptable access arrangements, water for fire-fighting and home defence and the dwelling construction standards being acceptable for the predicted radiant heat levels exposed at the site.

5.4 Implementing the Bushfire Management Plan

5.4.1 Developer's Responsibilities

To maintain a reduced level of risk from bushfire, the developer's responsibilities are to:

- Comply with the City of Wanneroo Fire Control Notice as published.
- Withhold development of residential dwellings within the temporary APZ until such time as the adjacent hazard is permanently removed.
- Liaise with adjacent landowners to the north and south of the site to resolve the issue of temporary bushfire hazard and bring these fuel loads under management in the 100m zone until such time as the vegetation or fuel is permanently removed prior to creating titles on the interface lots.
- Landscape POS areas adjacent to the foreshore reserve with species identified in the DFES publication "Plant guide within the Building Protection Zone for the Swan coastal Plain of Western Australia". This zone must comply with AS3959 exclusion clause 2.2.3.2(f) and be established and managed as a maintained public reserve and parkland. Under these circumstances it will also fulfil the role of an Asset Protection Zone (APZ)
- A Notification, pursuant to Section 165 of the Planning and Development Act 2005 is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor. Notice of this notification is to be included on a diagram or plan or survey (deposited plan). The notification to state as follows:

"This land is within a bushfire prone area as designated by an order made by the Fire and Emergency Services Commissioner and may be subject to a Bushfire Management Plan."

- Establish and maintain the APZs within the site to standards as specified in this document
- Construct public roads and the temporary cul-de-sac head to standards outlined in this document.
- Install fire hydrants to standards outlined in this document.

5.4.2 Property Owner Responsibilities

The owners of the site, as created by the development approval 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. Site owners will be responsible for:

- Ensuring the site complies with the City of Wanneroo Fire Control Notice as published.
- Maintaining the APZ in good order to minimise the exposure of buildings and people to bushfire attack.
- Ensuring construction of buildings complies with AS 3959:2009.
- If buildings are subject to additional construction in the future, such as renovations, AS 3959:2009 compliance is required.
-

5.4.3 City of Wanneroo's Responsibilities

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

The City of Wanneroo 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.
- Monitoring bush fuel loads in road reserve sites and liaising with relevant stakeholders to maintain fuel loads at safe levels.
- Maintaining public roads to appropriate standards and ensuring compliance with the City of Wanneroo's Firebreak Notices.
- Reviewing the BMP every 5 years.

5.4.4 Water Corporation's Responsibilities

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

6 CONCLUSIONS

This Plan provides acceptable solutions and responses to the bushfire protection criteria that fulfil the intent of the bushfire hazard management issues outlined in the *Guidelines for Planning in Bushfire Prone Areas (2015)*. However, community bushfire safety is a shared responsibility between governments, fire agencies, communities and individuals.

The site, being located in a bushfire prone area (i.e. within 100 m of classified vegetation) will have the risk mitigated via compliance with AS 3959:2009 standards. The proposed subdivision will be exposed to an acceptable level of risk. BAL-19 is not exceeded and a temporary and permanent APZ is incorporated into the site perimeter where adjacent to bushfire hazard. Vehicular access complies with performance criteria and reticulated water supply and hydrants are provided.

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8 GLOSSARY

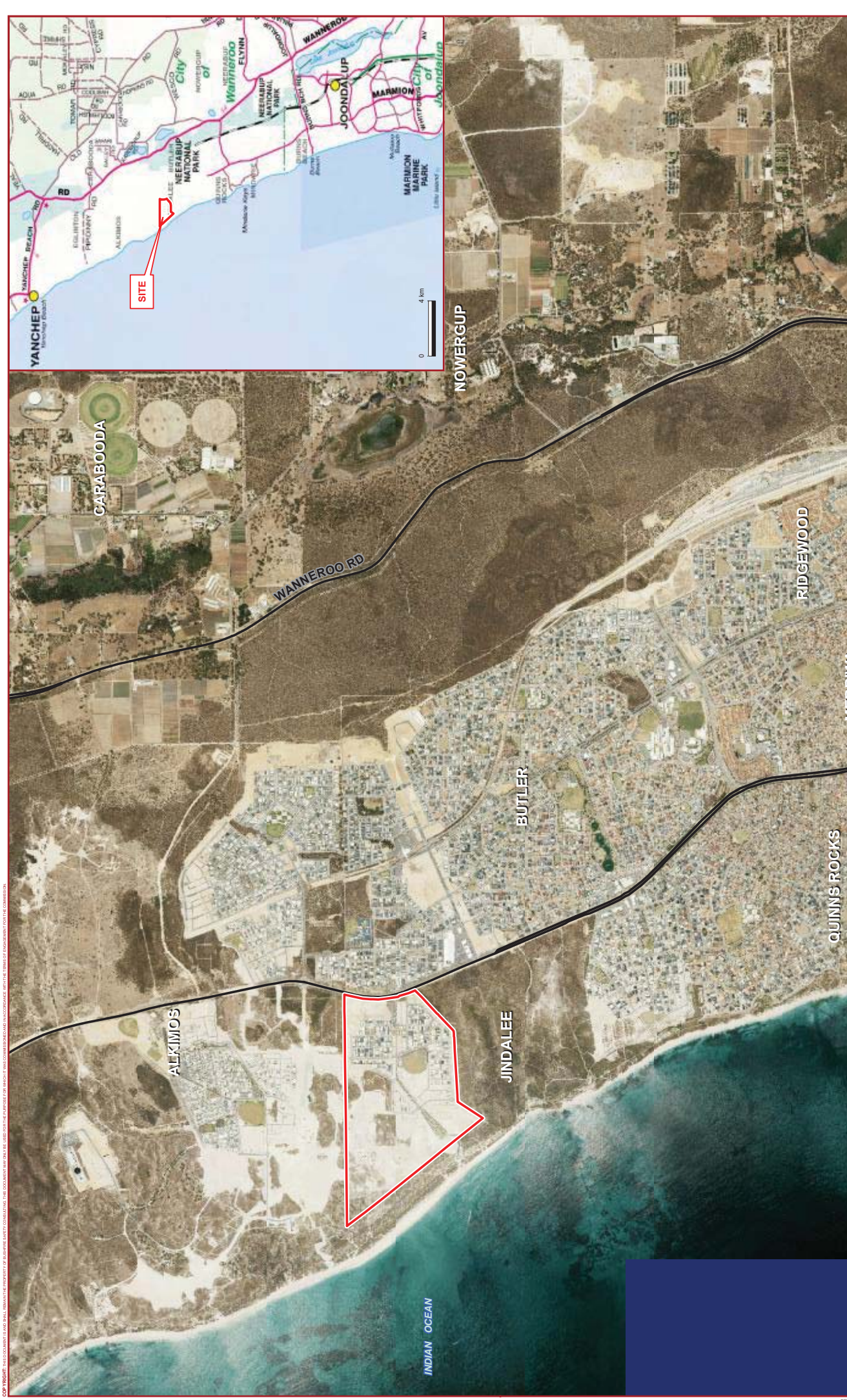
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BCA	Building Code of Australia
BOM	Bureau of Meteorology
DFES	Department of Fire and Emergency Services (was FESA)
FESA	Fire and Emergency Services (now DFES)
HSZ	Hazard Separation Zone
TPS	Town Planning Scheme
VBRC	Victorian Bushfires Royal Commission
WAPC	Western Australian Planning Commission

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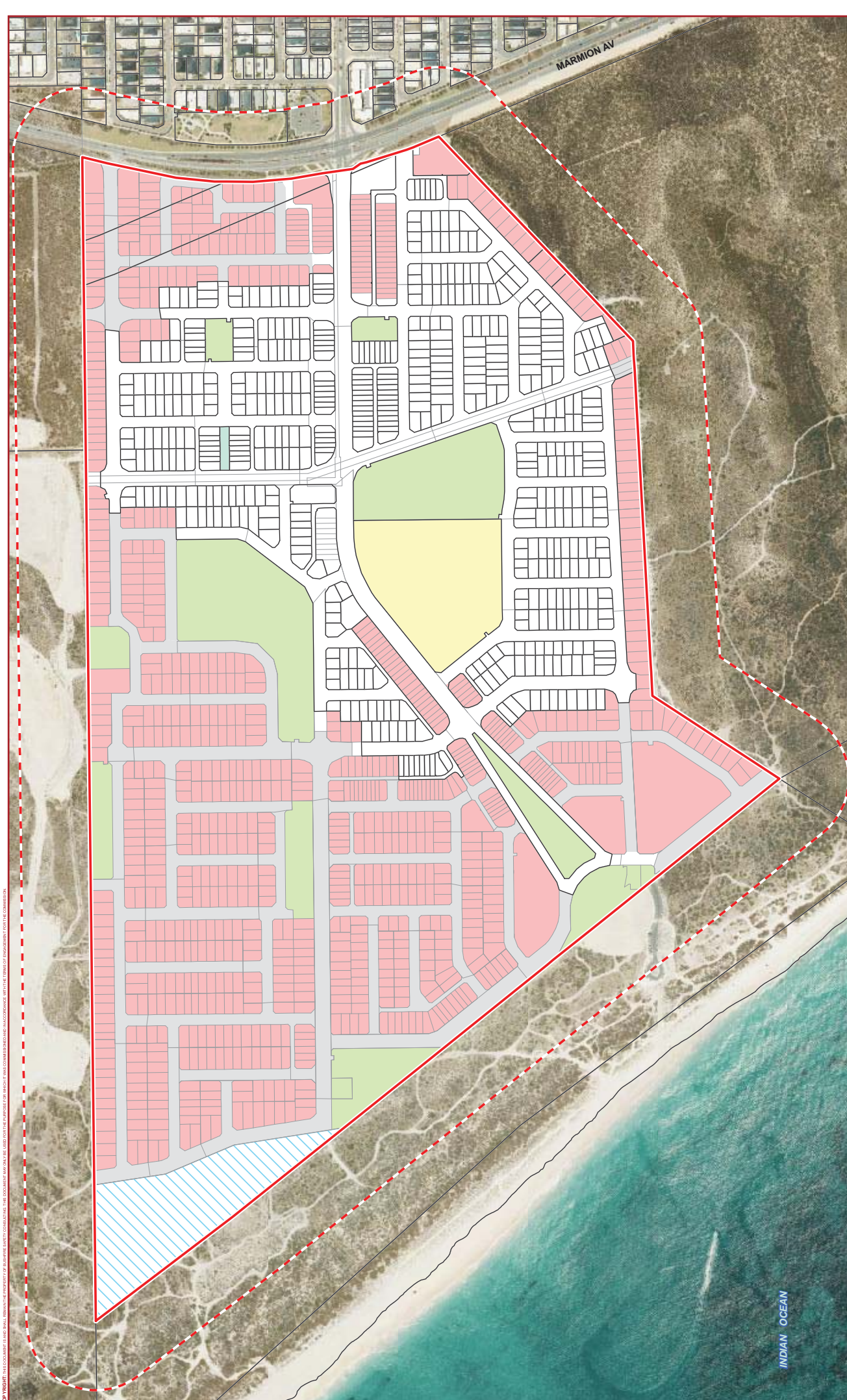


APPENDICES



- Appendix A: Site Location Plan*
- Appendix B: Subdivision Proposal*
- Appendix C: AS3959 Vegetation Classification*
- Appendix D: Effective Slope*
- Appendix E: Bushfire Hazard Level Rating*
- Appendix F: Post Development BAL Contour Plan*
- Appendix G: BAL Contour Plan - Post Surrounding Developments*
- Appendix H: Temporary and Permanent Asset Protection Zone*
- Appendix I: Permanent Asset Protection Zone*
- Appendix J: Vehicular Access Plan*
- Appendix K: Bushfire Management Plan Checklist*



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LEGEND

-  Site Boundary
-  100m Site Boundary Buffer
-  Existing Cadastre
-  Proposed Cadastre
-  Foreshore Reserve
-  Proposed Residential
-  Proposed School
-  Proposed PAW
-  Proposed POS

Source: Cadastre - Landgate, 2016
Orthophoto - Landgate, Feb, 2016
Proposed Cadastre - IMG 9470046-AM, 27.04.16

APPENDIX B
SUBDIVISION PLAN

LOT 9 MARMION AVENUE, JINDALEE
EDEN BEACH ESTATE

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APPENDIX C

AS3959 VEGETATION CLASSIFICATION

LOT 9 MARMION AVENUE, JINDALEE
EDEN BEACH ESTATE

- LEGEND**
- Site Boundary
 - 100m Site Boundary Buffer
 - Existing Cadastre
- AS3959 Vegetation Classification**
- 1: Class D Scrub
 - 2: Class C Shrubland
 - 3: Exclusion Clause 2.2.3.2 (f)
 - 4: Class G Grassland
 - 5: Exclusion Clause 2.2.3.2 (e)

Source:
Cartiere - Landgate, 2016
Orthophoto - Landgate, Feb. 2016

Job: 1516-1104-BAL-EB Date: 9/06/2016

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

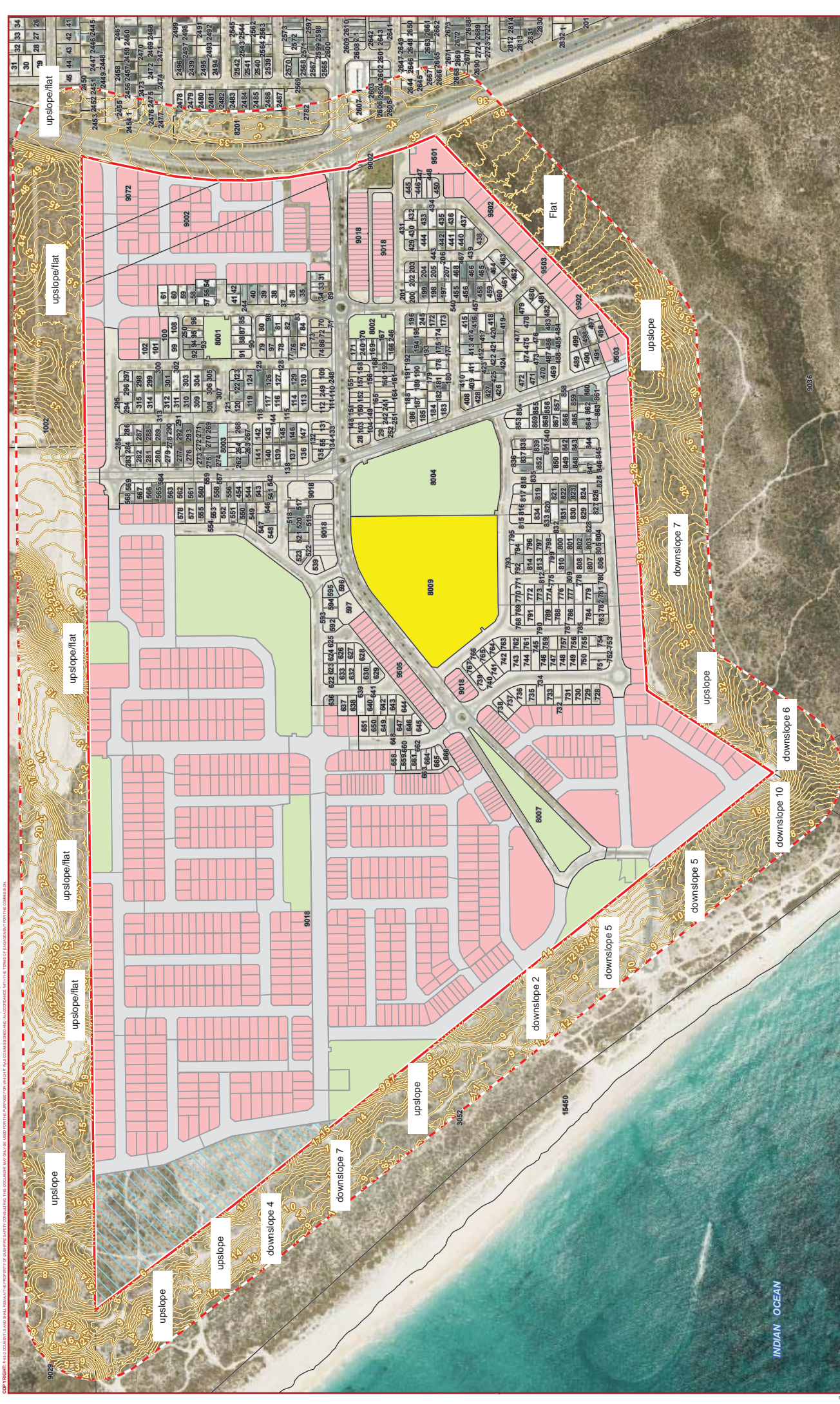
0 50 100 150 m

Bushfire Safety
CONSULTING

P.O. BOX 84, Stoneville WA, 6081
Ph: 0429 949 262
www.bushfiresafety.net

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LEGEND

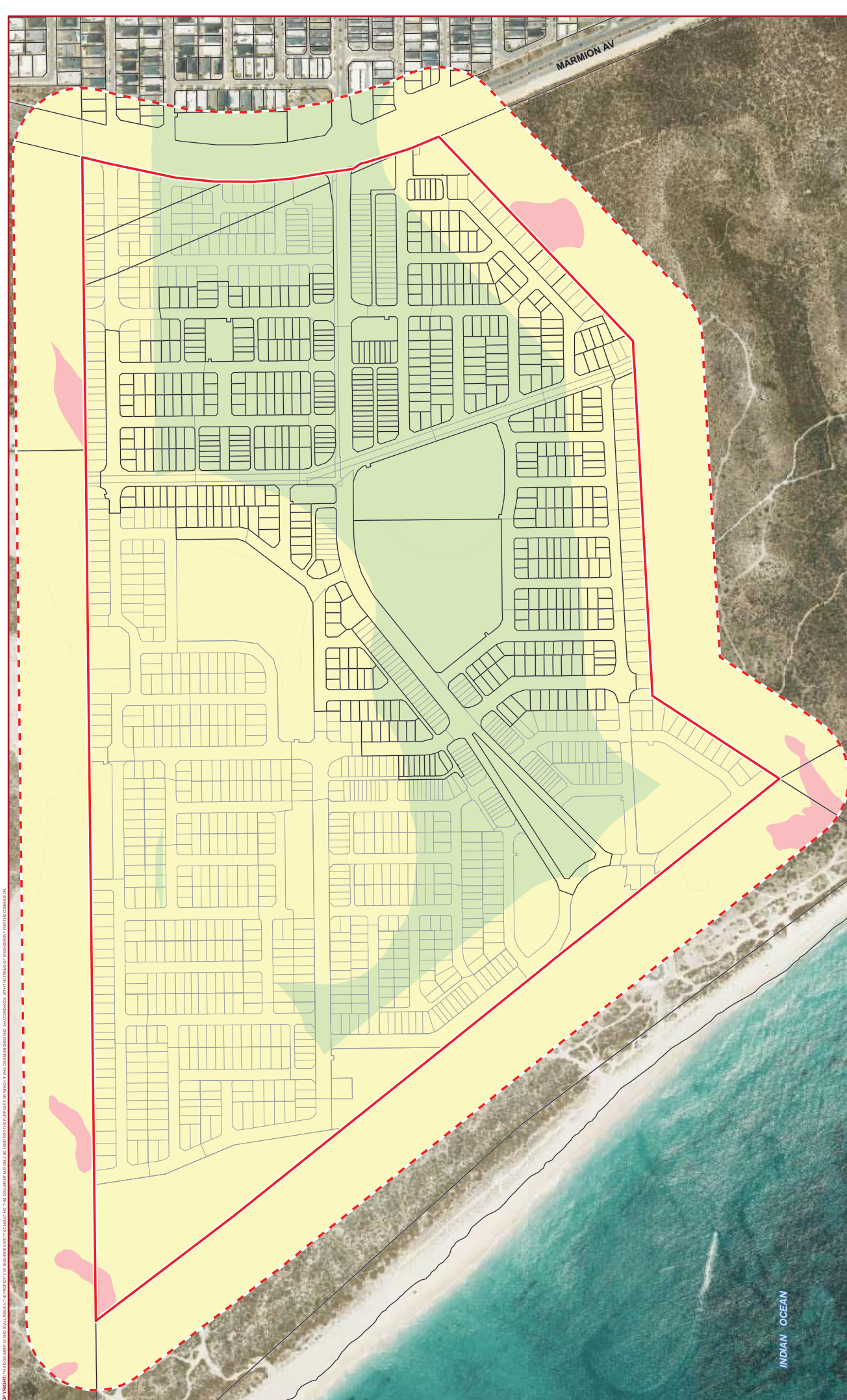
- Site Boundary
- 100m Site Boundary Buffer
- Existing Cadastre
- Contour (mAHD)
- Proposed Cadastre
- Foreshore Reserve
- Proposed Road
- Proposed Residential
- Proposed School
- Proposed PAW
- Proposed POS

Scale: 1:5,000 @ A3
GDA 1994 MGA Zone 50

0 60 120 180 m

Source: Cadastre - Landgate, 2016
Orthophoto - Landgate, Feb. 2016
Proposed Cadastre - MNG 94070406-AM, 27.04.16

Job: 1516-1104-BAL-EB Date: 2/05/2016



LEGEND

	Site Boundary		Extreme
	100m Site Boundary Buffer		Moderate
	Existing Cadastre		Low
	Proposed Cadastre		

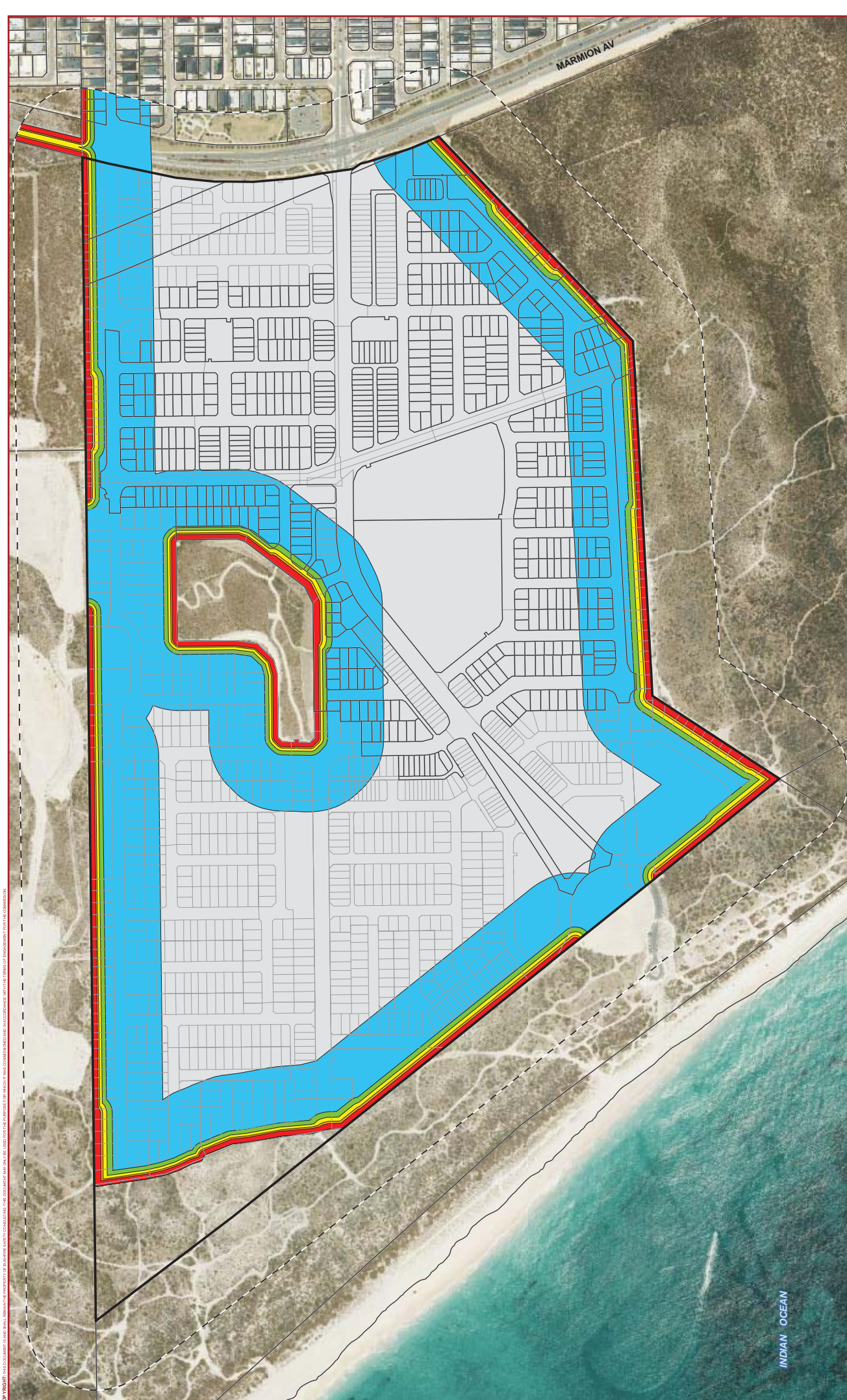
Bushfire Hazard Level Rating

APPENDIX E

BUSHFIRE HAZARD LEVEL RATING

LOT 9 MARMION AVENUE, JINDALEE
EDEN BEACH ESTATE

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LEGEND

	Site Boundary
	100m Site Boundary Buffer
	Existing Cadastre
	Proposed Cadastre

BAL RATING

	BAL FZ
	BAL 40
	BAL 29
	BAL 19
	BAL 12.5

APPENDIX F
BAL CONTOUR PLAN
 LOT 9 MARMION AVENUE, JINDALEE
 EDEN BEACH ESTATE

Bushfire Safety
 CONSULTING

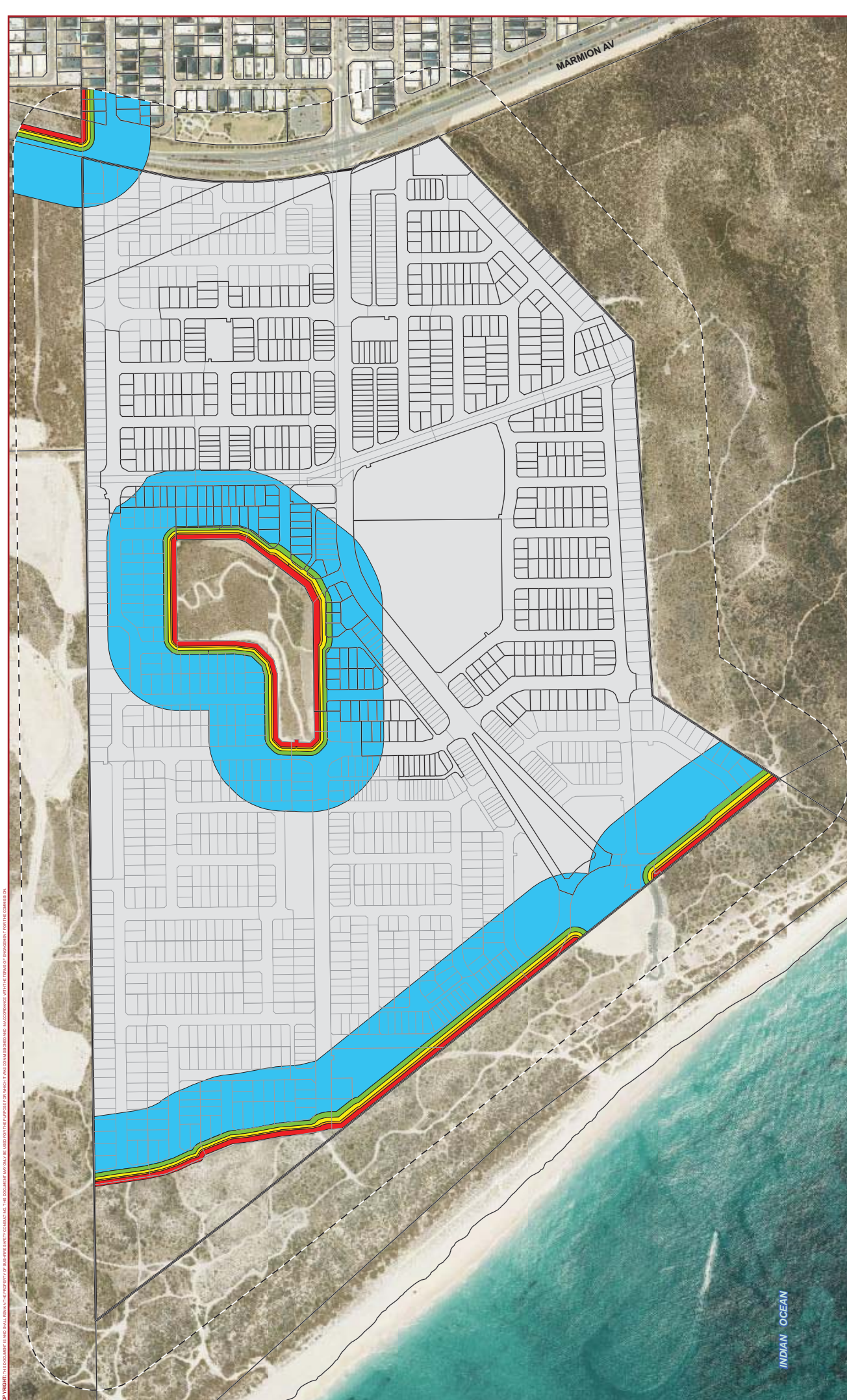
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 www.bushfiresafety.net

Scale: 1:5,000 @ A3
 GDA 1994 MGA Zone 50

Date: 9/06/2016

Source: Cadastre - Landgate, 2016
 Orthophoto - Landgate, Feb, 2016
 Proposed Cadastre - MNG 947/046-AM, 27.04.16
 Job: 1516-1104-BAL-EB

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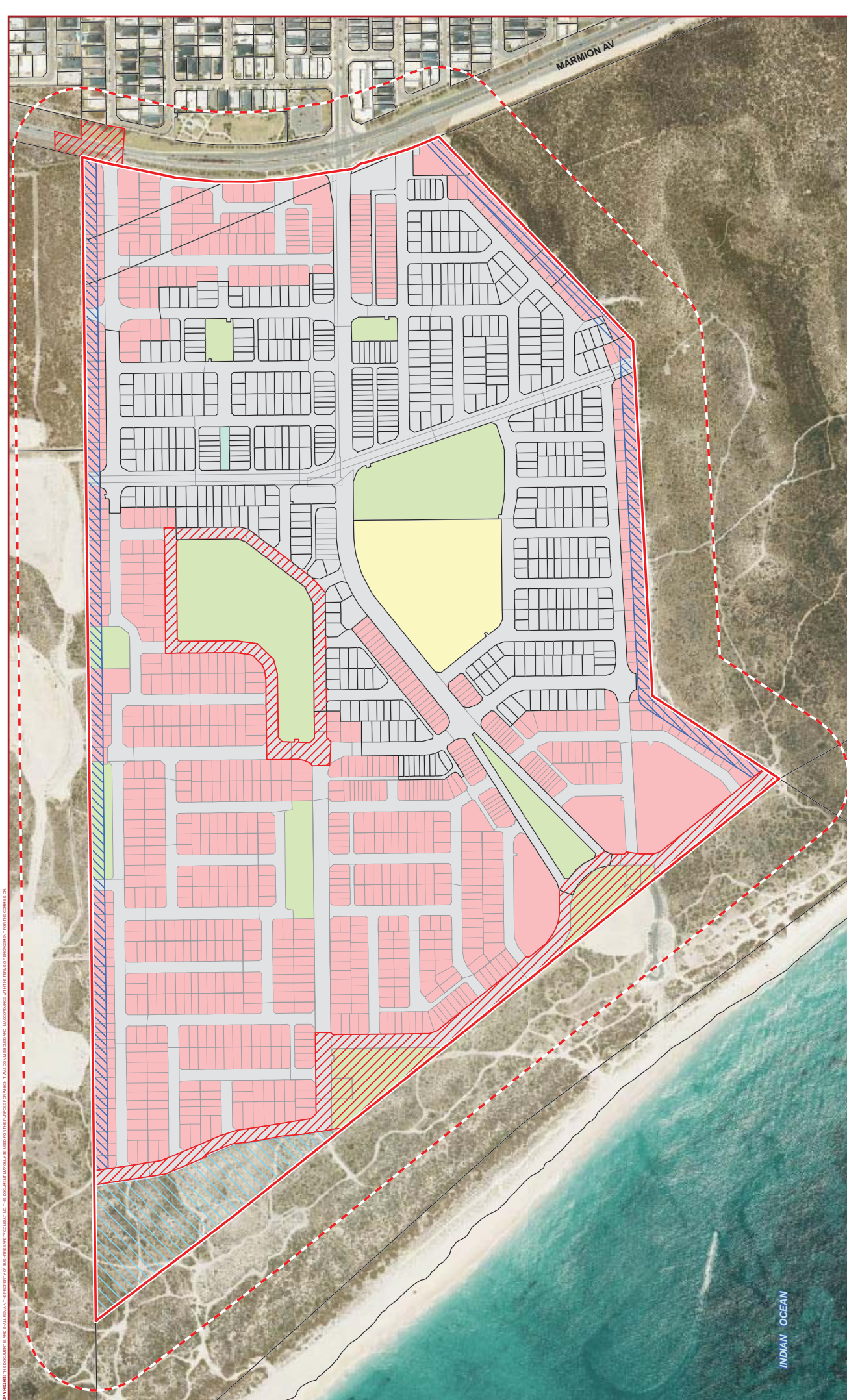
LEGEND

	Site Boundary		BAL FZ
	100m Site Boundary Buffer		BAL 40
	Existing Cadastre		BAL 29
	Proposed Cadastre		BAL 19
			BAL 12.5

APPENDIX G
BAL CONTOUR PLAN - POST SURROUNDING DEVELOPMENTS

LOT 9 MARMION AVENUE, JINDALEE EDEN BEACH ESTATE

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Scale: 1:5,000 @ A3
GDA 1984 MGA Zone 50

Proposed School
Proposed PAW
Proposed POS

Proposed Subdivision
Foreshire Reserve
Proposed Road
Proposed Residential

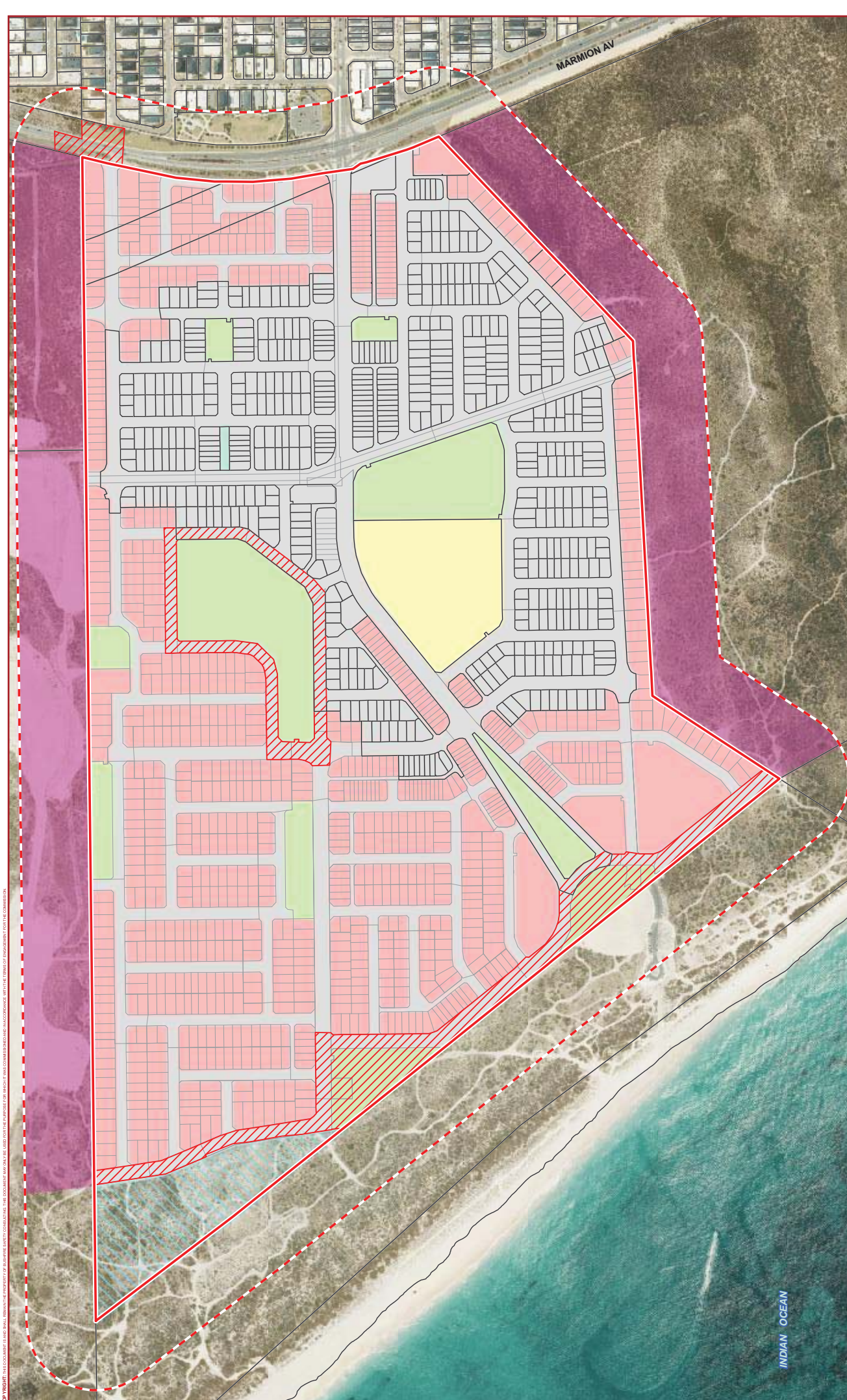
Site Boundary
100m Site Boundary Buffer
Existing Cadastre
Proposed Cadastre
Permanent Asset Protection Zone
Temporary Asset Protection Zone

Source: Cadastre - Landgate, 2016
Orthophoto - Landgate, Feb, 2016
Proposed Cadastre - MNG 9470-046-AM, 27.04.16













APPENDIX H
TEMPORARY AND PERMANENT APZ PLAN

LOT 9 MARMION AVENUE, JINDALEE EDEN BEACH ESTATE

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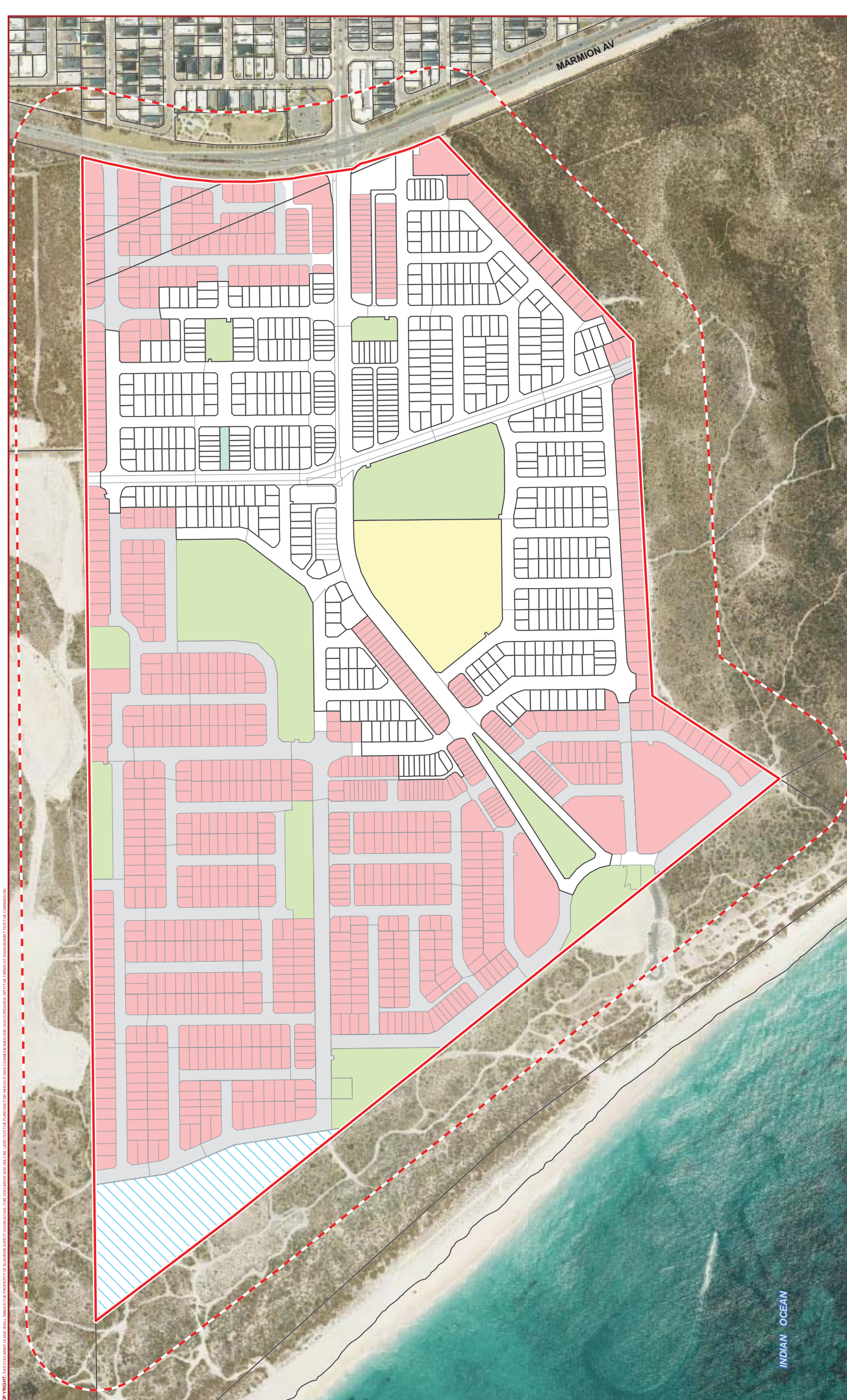


LEGEND


	Site Boundary		Proposed Subdivision		Proposed School
	100m Site Boundary Buffer		Foreshore Reserve		Proposed PAW
	Existing Cadastral		Proposed Road		Proposed POS
	Vegetation Managed to Exclusion Clause 2.2.3.2(f) Standards		Proposed Residential		
	Permanent Asset Protection Zone				

Source: Cadastre - Landgate, 2016
Ordnophoto - Landgate, Feb, 2016
Proposed Cadastre - IMG 9470-046-AM, 27.04.16

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LEGEND

-  Site Boundary
-  100m Site Boundary Buffer
-  Existing Cadastre
-  Proposed Cadastre
-  Foreshore Reserve
-  Proposed School
-  Proposed PAW
-  Proposed POS
-  Proposed Road
-  Proposed Residential

Source: Cadastre - Landgate, 2016
Orthophoto - Landgate, Feb, 2016
Proposed Cadastre - MNG 947/046-AM, 27.04.16

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8.1.1.1 Appendix K: Bushfire Management Plan Checklist

Criteria	Response
1 Background Information	Details on skills, expertise, qualifications and accreditation provided.
2. Spatial Consideration of Bushfire Threat	Aerial photography and maps are provided outlining spatial distribution of vegetation and bushfire hazard on the site and within 100 metres of the site boundary
3. Proposal Compliance	The proposal to undertake a subdivision meets the objectives of SPP 3.7
3.1 Location of Development	
Does the proposal comply with the performance criteria by applying acceptable solution A1.1?	Yes. The subdivision is located in an area that will on completion be subject to a BAL rating of BAL-29 or lower for the entire site.
3.2: Siting of Development	
Does the proposal comply with the performance criteria by applying acceptable solution A2.1?	Yes. An APZ is accommodated within the development site that provides sufficient setback from bushfire fuels to ensure all future dwellings be subject to a BAL rating of BAL-29 or lower
Does the proposal comply with the performance criteria by applying acceptable solution A2.2?	Yes. A HSZ is not required because the entire site is contained within an APZ. The BAL rating for all future dwellings do not exceed BAL-29.
3.3: Vehicular Access	
Does the proposal comply with the performance criteria by applying acceptable solution A3.1?	Yes, two access ways are provided on public roads for all lots
Does the proposal comply with the performance criteria by applying acceptable solution A3.2?	Yes
Does the proposal comply with the performance criteria by applying acceptable solution A3.3?	Yes, existing and temporary cul-de-sac heads (if required) will be established
Does the proposal comply with the performance criteria by applying acceptable solution A3.4?	Not applicable
Does the proposal comply with the performance criteria by applying acceptable solution A3.5?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.6?	Yes
Does the proposal comply with the performance criteria by applying acceptable solution A3.7?	Not applicable.
Does the proposal comply with the performance criteria by applying acceptable solution A3.8?	Yes, compliance with fire control notice can be achieved
Does the proposal comply with the performance criteria by applying acceptable solution A3.9?	Not applicable.

Bushfire Management Plan – Formally Lot 9 Marmion Avenue, Jindalee

Criteria	Response
4: Water	
Does the proposal comply with the performance criteria by applying acceptable solution A4.1?	Yes
Does the proposal comply with the performance criteria by applying acceptable solution A4.2?	Not applicable
Does the proposal comply with the performance criteria by applying acceptable solution A4.3?	Not applicable

Applicant Declaration

We declare that the information provided is true and correct to the best of our knowledge.

Signature:



Name: Rohan Carboon

Date: 08/06/2016

Signature:



Name: Ken Strahan

Date: 08/06/2016
