

EAST COAST Fire Management Area

Fire Protection Plan

2014-2015

Document Control

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Document Endorsement

Chair – Lindsay White

Date:

Accepted by State Fire Management Council



Chairman – Ian Sauer

Date: 13/1/15

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Glossary

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| Asset | A term used to describe anything valued by the community that may be adversely impacted by bushfire. This may include residential houses, infrastructure, agriculture, industry, environmental and heritage sites. |
| Bushfire | Unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective. ¹ |
| Bushfire hazard | The potential or expected behaviour of a bushfire burning under a particular set of conditions, i.e. the type, arrangement and quantity of fuel, the fuel moisture content, wind speed, topography, relative humidity, temperature and atmospheric stability. |
| Bushfire risk management | A systematic process to coordinate, direct and control activities relating to bushfire risk; with the aim of limiting the adverse effects of bushfire on the community. |
| Consequence | The outcome or impact of a bushfire event. |
| Human Settlement Area (HSA) | A spatial data set that defines an area where people live or work. |
| Likelihood | The chance of something occurring. |
| Risk | The effect of uncertainty on objectives. ² (Note: Risk is often expressed in terms of a combination of the consequences of an event and the associated likelihood of occurrence.) |
| Risk acceptance | The informed decision to accept a risk, based on the knowledge gained during the risk assessment process. |
| Risk analysis | The application of consequence and likelihood to an event in order to determine the level of risk. |
| Risk assessment | The systematic process of identifying, analysing and evaluating risk. |
| Risk criteria | Standards (or statements) by which the results of risk assessments can be assessed. They relate quantitative risk estimates to qualitative value judgements about the significance of the risks. They are inexact and should be seen as guidelines rather than rules. ³ |
| Risk evaluation | The process of comparing the outcomes of risk analysis to the risk criteria in order to determine whether a risk is acceptable or tolerable. |
| Risk identification | The process of recognising, identifying and describing risks. |
| Risk treatment | A process to select and implement appropriate measures undertaken to modify risk. |

¹ Australasian Fire and Emergency Service Authorities Council 2012, *AFAC Bushfire Glossary*, AFAC Limited, East Melbourne, Australia

² Standards Australia 2009, Risk management – Principles and guidelines, AS/NZS 31000:2009, Standards Australia, Sydney, Australia

³ Emergency Management Australia 1998, Australian Emergency Manuals Series – Manual 3 Australian Management Glossary, Emergency Management Australia, Dickson, Australia

Acronyms

| | |
|------|---|
| FIAT | Forest Industry Association Tasmania |
| FMAC | Fire Management Area Committee |
| FPP | Fire Protection Plan |
| FT | Forestry Tasmania |
| MFMA | Midlands Fire Management Area |
| PWS | Parks and Wildlife Service |
| REMC | Regional Emergency Management Council |
| SEMC | State Emergency Management Committee |
| SFMC | State Fire Management Council |
| TFGA | Tasmania Farmers and Graziers Association |
| TFS | Tasmania Fire Service |

Chapter 1 Introduction

1.1 Background

Under Section 20 of the *Fire service Act 1979*, fire management area committees are required to submit to SFMC, on an annual basis, a fire protection plan for its fire management area commencing on 1 October.

It is a requirement of the fire protection plan that it is consistent with the State Fire Protection Plan and the State Vegetation Fire Management Policy.

1.2 Aim and Objectives

The **aim** of this FPP is to document a coordinated and efficient approach towards the identification and treatment of bushfire-related risk within the East Coast Fire Management Area (ECFMA).

The **objective** of this FPP is to effectively manage bushfire related risk within the ECFMA in order to protect people, assets and other things valuable to the community. Specifically, the objectives of this plan are to:

- Guide and coordinate a tenure blind bushfire risk management program over a five (5) year period;
- Document the process used to identify, analyse and evaluate risk, determine priorities and develop a plan to systematically treat risk;
- Facilitate the effective use of the financial and physical resources available for bushfire risk management activities;
- Integrate bushfire risk management into the business processes of Local Government, land managers and other agencies;
- Ensure integration between stakeholders;
- Clearly and concisely communicate risk in a format that is meaningful to stakeholders and the community; and
- Monitor and review the implementation of the Plan, to ensure enhancements are made on an on-going basis.

1.3 Policy, Standards and Legislation

The following policy, standards and legislation were considered to be applicable to the development and implementation of the FPP.

- Tasmanian Emergency Management Plan
- State Fire Protection Plan
- State Vegetation Fire Management Policy
- State Strategic Fuel Management Plan

Standards

- AS/NZS ISO 31000:2009 - Risk Management – Principles and Guidelines

Legislation

- *Aboriginal Relics Act 1975 (soon to be replaced)*
- *Fire Service Act 1979*
- *Emergency Management Act 2006*
- *National Parks and Reserve Management Act 2002*
- *Nature Conservation Act 2002*
- *Crown Lands Act 1976*
- *Forestry Act 1920*
- *Threatened Species Protection Act 1995*
- *Environmental Management and Pollution Control Act 1994*
- *Local Government Act 1993*
- *Forest Practices Code 2000*
- *Tasmanian Electricity Code*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Weed Management Act 1999*
- *Historic Cultural Heritage Act 1995*

Chapter 2 Establishing the Context

2.1 Description of the East Coast Fire Protection Plan Area

2.1.1 Location, Boundaries and Land Tenure

The plan area covers approximately 393,000ha and follows the coastline from the Tasman Peninsular in the South, to Bicheno in the North, and extends inland approximately 35km at its widest point. Altitude varies from sea level along the coast to 742m above sea level at Moaners Tier, located just to the east of Tooms Lake.

Over half of the area (55%) consists of private property (Figure 2.2; Table 2.1). National Parks and Reserves (occupying approximately one quarter of the area), and Permanent Timber Production Zone occupying the majority of the remaining lands.

| Land Manager/Agency | % of Land Managed within the FMA |
|--|----------------------------------|
| Private Property | 55 |
| DPIPWE (including Parks and Wildlife Service and Crown land Services) | 26 |
| Forestry Tasmania | 15 |
| Other | 4 |

Table 2.1: Overview of land tenure in the ECFMA.

Figure 2.1: Location of the ECFMA.

Figure 2.2: Land tenure across the ECFMA.

2.1.2 Climate and Bushfire Season

For much of the year Tasmania's weather is dominated by westerly weather patterns. This results in moist air being forced over rugged mountains in western and central areas of Tasmania causing heavy rainfall in these areas as the air moves eastward. The result is relatively dry air reaching eastern parts of Tasmania. The exception to this is the East Coast Low that forms in the Tasman Sea and brings moist easterly winds, often causing heavy localised rainfall events. Falls in excess of 100mm in a 24 hour period are not uncommon. On average one or two of these events is experienced each year. Within the ECFMA average rainfall varies from 593mm at Swansea to 1148mm at Palmers lookout on the Tasman Peninsula.

The ECFMA can experience long periods of dryness with the Soil Dryness Index (SDI) being above 100mm for much of the year. Fire seasons can begin in October and continue to the end of April, with the peak occurring between December and March.

Temperatures at coastal sites are moderated by the maritime influence with areas further inland experiencing more extremes of temperature.

Relevant BoM weather stations within the ECFMA:

- Bicheno
- Swansea
- Orford
- Dunalley
- Friendly Beaches
- Maria Island
- Spring Bay
- Tasman Island

Figure 2.3: Mean annual rainfall across Tasmanian Fire Management Areas.

2.1.3 Vegetation

The ECFMA is dominated by dry Eucalypt forest (55%) and agricultural areas (23%). Wet Eucalypt forests (10%) exist on more productive soils in higher rainfall areas which are predominately located around the Tasman Peninsula and higher elevations of the Eastern Tiers. Highly flammable coastal complexes are particularly prevalent around Coles Bay, the Freycinet Peninsular and the Tasman Peninsular.

The vegetation in the ECFMA can be categorised into 11 broad groups that represent broad vegetation or landscape types, as shown in Figure 2.4. A description of these vegetation groups is provided in Appendix 7.

Figure 2.4: Vegetation types across the ECFMA (based on grouped TASVEG vegetation mapping units).

2.1.4 Population and Demographics

The ECFMA has a low total population and low population densities across the area (Figure 2.5). The entire area has a total permanent population of around 8,000 people (Australian Bureau of Statistics – ABS, 2011), with highest densities occurring around towns and in the southwest corner of the area, closest to the outer settlements of Hobart. Many areas within the ECFMA experience an increase in visitation during the summer tourism period.

The low and dispersed population correlates with the major land uses, particularly the large proportion of agricultural land and reserved areas. The major towns within the ECFMA include:

- Nubeena
- Dunalley
- Dodges Ferry
- Sorell,
- Orford
- Triabunna
- Swansea
- Coles Bay

- Bicheno.

The main areas of growth are focussed around Dodges Ferry and Sorell with many new residential housing developments occurring in these areas.

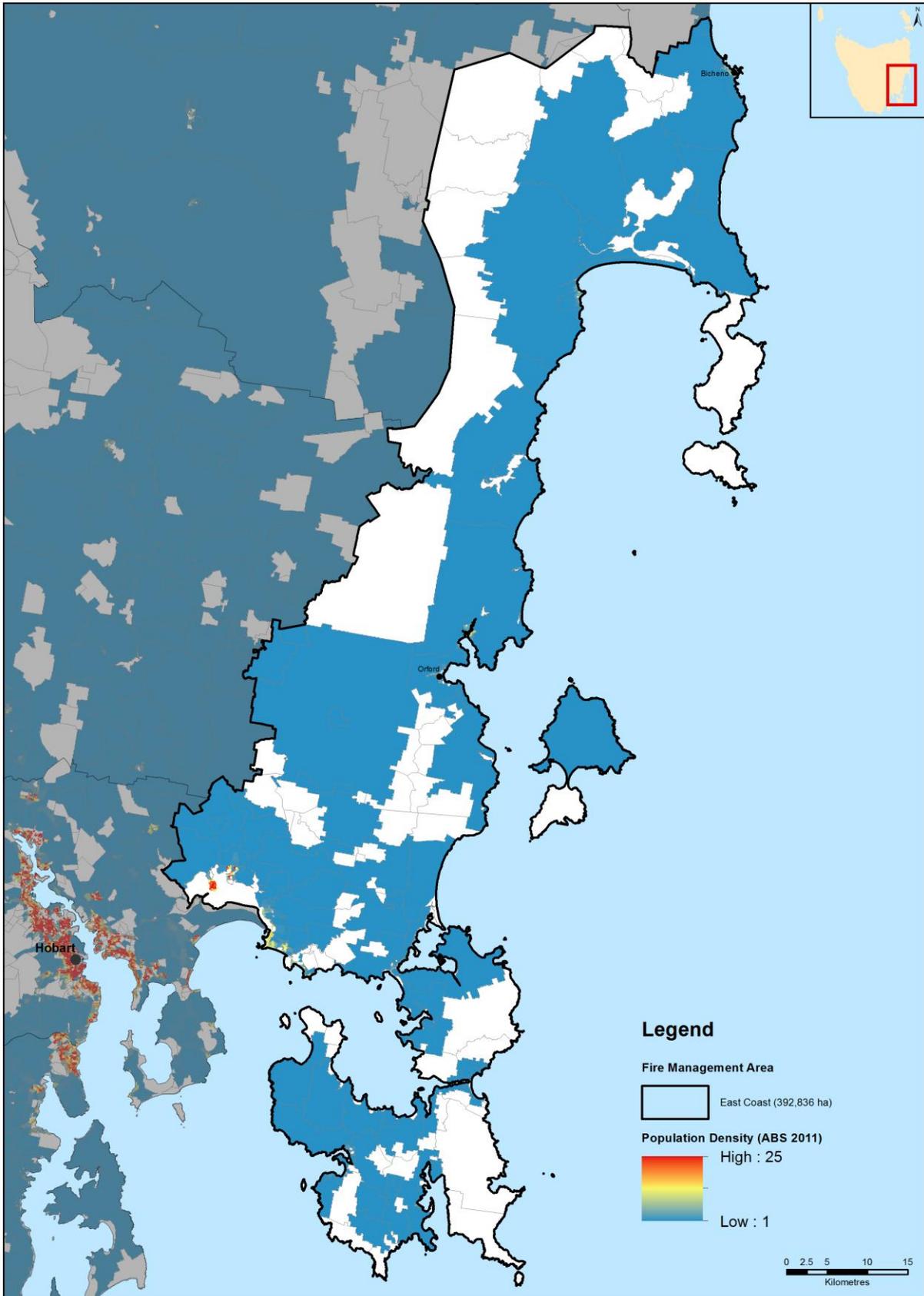


Figure 2.5: Population statistics in the ECFMA – No. of residents per ha (Australian Bureau of Statistics 2011).

2.1.5 Bushfire Frequency and Causes of Ignition

Fire frequency is defined as the total number of fires that occurred in the same area. Fire frequency records for the ECFMA have been obtained from records provided by the Tasmania Fire Service, Parks and Wildlife Service and Forestry Tasmania but the records are incomplete. Figure 2.6 below indicates the areas affected by fire and the number of times that area has been affected.

Fire Ignition Cause

The causes of fire, either through ignition by lightning or caused by human actions have not been well documented prior to 1990.

Of the most recent fire records available for the ECFMA, the ignition cause for the majority of fires was classed as unknown (17%), recreation (17%), arson (16%), escapes from planned burns (15%), Accidental (4%), and undetermined (3%)

| Fire Name | Area Burnt (ha) |
|------------------------|-----------------|
| Inala Rd 2013 | 23400 |
| Oakwood Hill 2003 | 4500 |
| Watersmeeting 1994 | 12400 |
| Baldy Hill 1994 | 6900 |
| Thirty Acre Creek 1995 | 4000 |
| Kellevie 2006 | 16000 |

Table 2.2: Major Fires in the ECFMA since 1982.

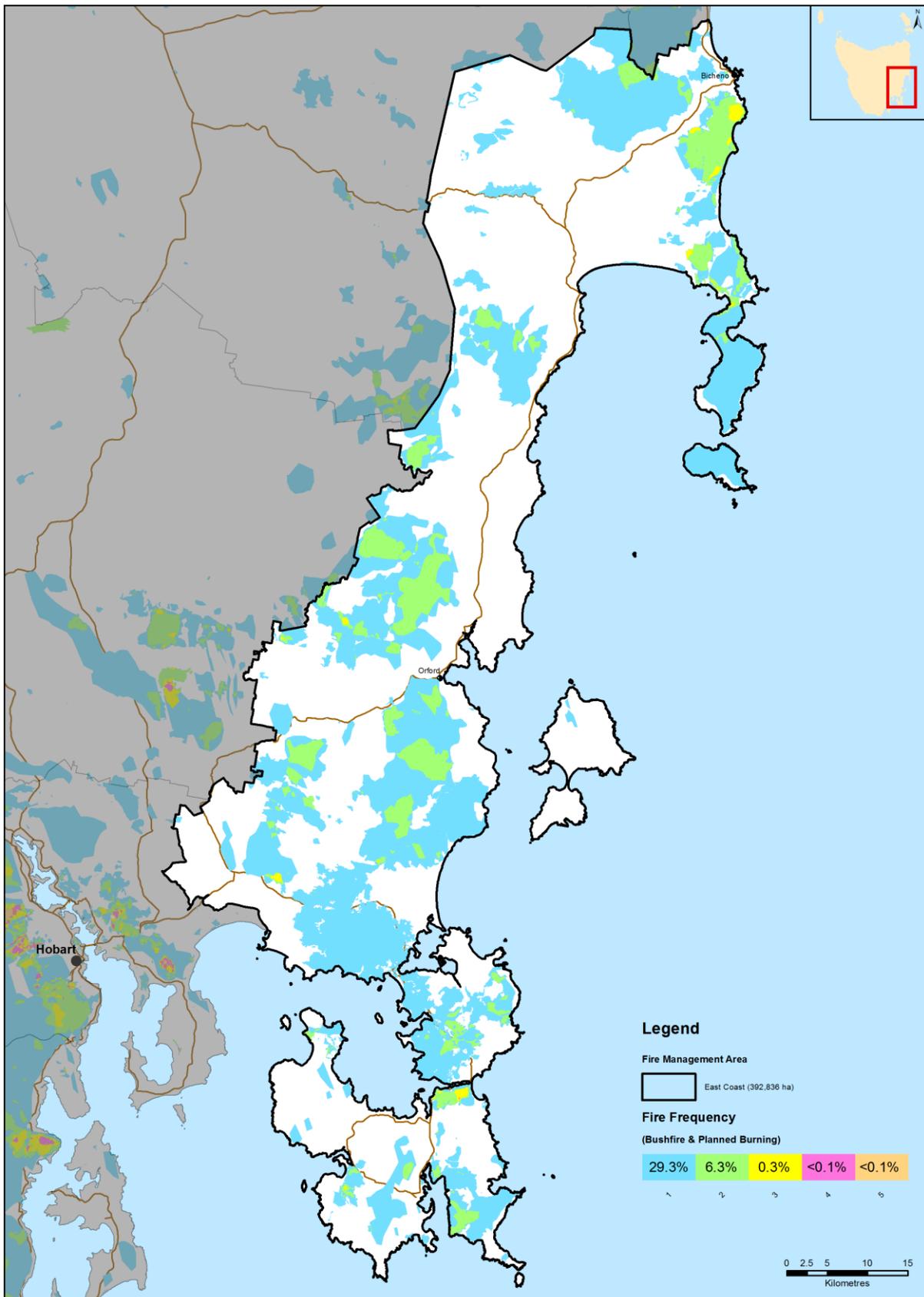


Figure 2.6: Areas affected by fire

Chapter 3 Analysing and Evaluating Bushfire Risk

3.1 Analysing Bushfire Risk

Following the Australian Standard of risk (ISO 3100) bushfire risk has been considered spatially, assessing a combination of likelihood and consequence (PWS 2011). The Bushfire Risk Assessment Model (BRAM), model data run of February 2014 was used to analyse the landscape level risk for this plan. For a full analysis of the model, see Appendix 2.

To determine overall risk the NERAG (National Emergency Risk Assessment Guidelines August 2009) document (see Appendix 3) was used. The level of risk is determined by combining consequences and likelihood (see Appendix 3).

It must be noted that the BRAM and therefore the consequences, likelihood and risk outputs are based on available spatial data. The analysis has been undertaken on a statewide basis, and maps are presented as complete for Tasmania. There are however gaps in the data inside and outside areas of public land. This includes fire history information, particularly on private land, which contributes to ignition potential information (likelihood), and many of the agricultural values have not been well captured (consequence). Notwithstanding these limitations, the model does provide an objective spatial analysis of bushfire risk in a landscape context.

3.2 Likelihood

Likelihood is defined as a qualitative method to assess the likelihood rating to the consequences occurring. The likelihood of an event was generated by calculating ignition potential, suppression capabilities and fire behaviour potential, followed by assigning these output values to categories in a likelihood matrix. This is taken to mean the likelihood of a fire occurring in a specific area which surpasses the ability of the fire agencies to contain within the first 24 hours.

3.3 Consequence (values at risk)

Consequences are defined as a qualitative rating of damage from fire to values. The consequences were taken directly from the output generated through the Values at Risk spatial layer output.

While the values layer identifies a wide range of values in the ECFMA, including critical infrastructure, agricultural land including grasslands and their economic significance are largely not part of the analysis (except where they are mapped as native grasslands). The agricultural grassland community is of particular importance with the loss of extensive grass impacting on the immediate viability of farming enterprises, which can have a major impact on the economy of the area.

3.4 Overall Risk

A representation of risk (see Appendix 4) is developed when you combine the factors of likelihood and consequence. The generated output map of risk shows qualitative areas of risk, not areas of perceived risk.

The model assists in objectively defining areas where genuine risk is present. In-depth analysis will indicate what factor is driving the risk for a given area.

3.5 Risk Analysis for the East Coast Fire Management Area

The bush fire risk Model BRAM, discussed above, was utilised to examine risk across the ECFMA. The results of this risk analysis are shown in Figure 3.1. Areas of highest risk identified are located in the southeast and northwest parts of the area, with scattered patches throughout.

In addition Phoenix Rapidfire, a bush fire simulator, developed by the University of Melbourne (Kevin Tolhurst and Derek Chong) was used to model the risk of fires impacting on communities present in the ECFMA. This modelling was done as part of the state wide strategic fuel management assessment. The process involved modelling potential ignition points, incorporating severe fire weather components and examining fire behaviour based on current fuel loads to identify the potential impact on human settlement areas. Figure 3.2 shows potential ignition points that may impact on communities in the ECFMA with areas (ha) of impact under current fuel loads.

An understanding of the location of potential ignition points that may impact on communities is crucial. It must be understood that such analysis has many limitations but does provide an indication of where communities may be under risk as well as identify areas where strategic burning will assist in changing fire behaviour.

Strategic fuel reduction burning is one treatment to reduce risk to communities throughout the ECFMA. However, not all vegetation and land use types are treatable through burning. Figure 3.3 shows treatability of fuels through fuel reduction burning in the ECFMA. In summary, 63% of fuels are treatable by burning, while 37% are untreatable through burning.

The distinction between treatable and untreatable fuel was determined by considering the TASVEG flammability attributes and gives a general indication of suitability. At an operational level the distinction between treatable and untreatable fuels will need to be determined in the field.

The untreatable portion (37% of the area) includes agricultural land. This is primarily because whilst agricultural land will burn, it is not generally targeted for fuel reduction burning as the risk can be seasonally variable. It is likely that the dryland agricultural land through the region does contain areas of grasslands that are treatable through burning, however current TASVEG mapping does not break the agricultural land mapping unit into different categories. Land use mapping may be incorporated into future risk analyses as data becomes available allowing refinement of this category.

Note: Bushfire Risk Assessment Maps are also provided in Appendix 5.

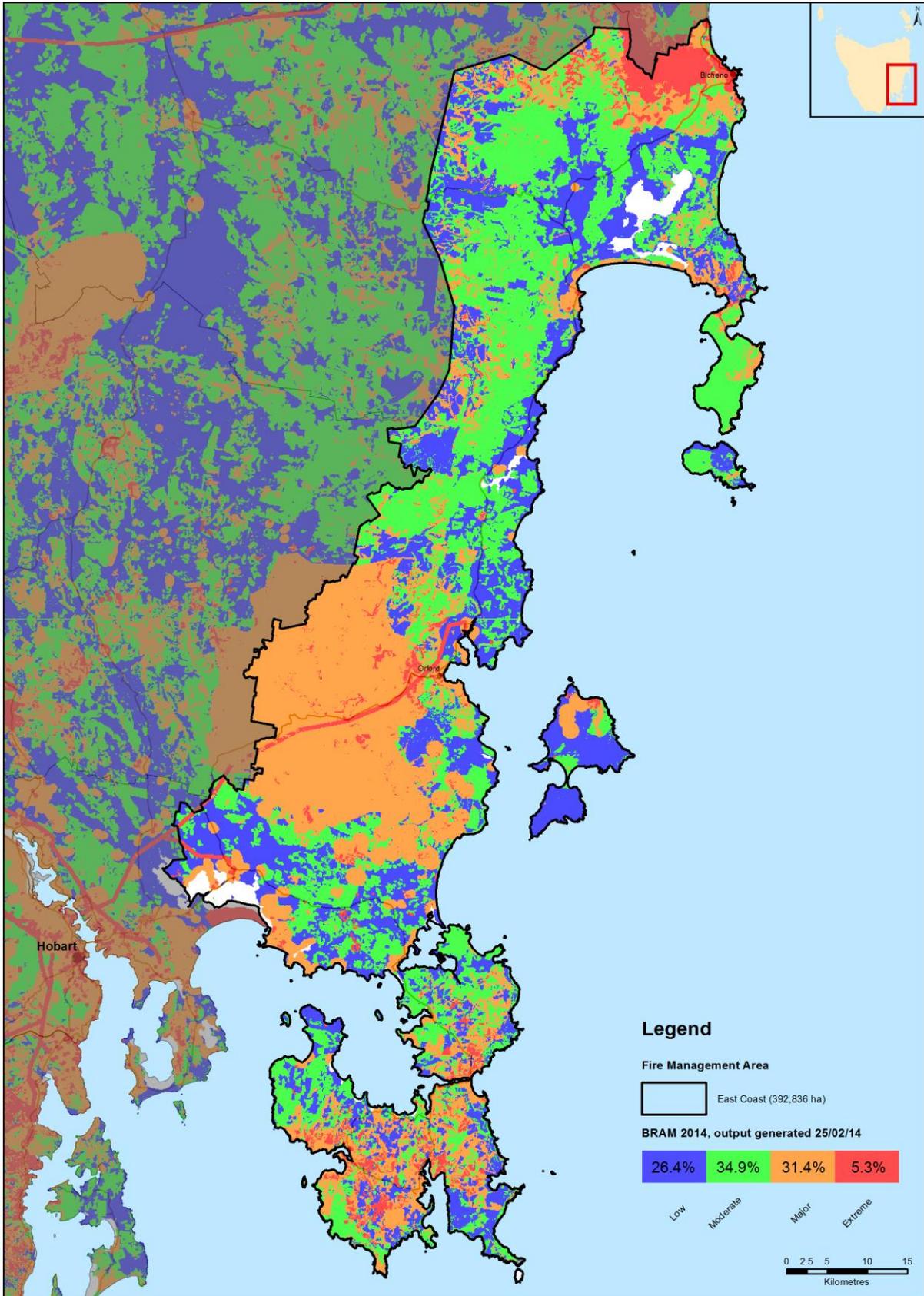


Figure 3.1: BRAM Bushfire risk across the ECFMA.

Figure 3.2: Potential ignition points that may impact on communities in the ECFMA with areas (ha) of impact under current fuel loads, using Phoenix Rapidfire simulation modelling, State Fire Management Council.

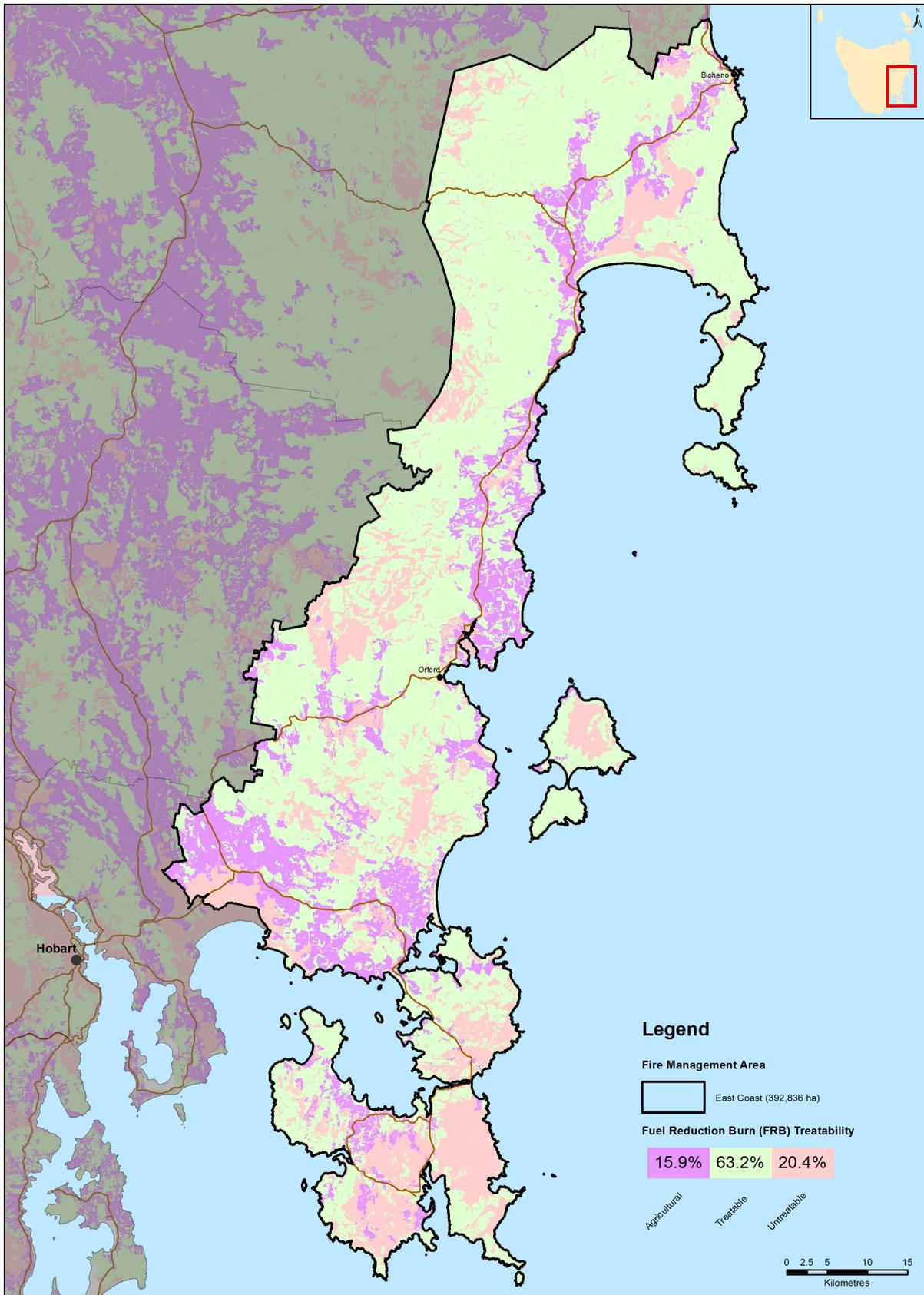


Figure 3.3: Treatability of fuels through fuel reduction burning in the ECFMA.

Chapter 4 Bushfire Risk Treatment

4.1 Region Wide Controls

The following controls are currently in place across the ECFMA to assist in the strategic management of bushfire related risk:

- Legislative controls – including abatements, fire restrictions etc.
- Public education campaigns and the use of TFS and SFMC state-wide programs tailored to suit local needs; (eg Private land burning; Community Protection Planning; Bushfire Ready Neighbourhoods)
- State-wide arson prevention programs developed in conjunction with TAS Police and TFS;
- Setting of appropriate land subdivision and building standards in line with State Bushfire Prone Area Building Standards;
- Performance monitoring and reporting of FPP outcomes to the relevant Emergency Management Council and State Fire Management Council as required by the Tasmanian Emergency Management Plan and the Fire Service Act.

4.2 Asset Specific Treatment Strategies

There are five broad asset specific treatment strategies that have been used to manage the bushfire risks identified in the Community Risk Assessment. They include:

- Fuel management – Treatments include the reduction / modification of bushfire fuels through manual, chemical and prescribed burning methods;
- Ignition management - Treatments aim to reduce the occurrence of human induced ignitions in the landscape;
- Preparedness – Treatments focus on providing suitable access and water supply arrangements that will assist with fire fighting operations;
- Planning – Treatments relate to the development of plans that will improve the ability of firefighters and the community to respond to bushfire; and
- Community Engagement – Treatments seek to build relationships, raise awareness and change behaviours relating to the management of bushfire related risks within the community.

4.3 Community Assessment

Strategic assessment tools have been used to conduct a broad scale assessment across the ECFMA to identify communities vulnerable to bushfire, that require more detailed assessment using more locally specific processes.

These communities were then prioritised in accordance with the *Strategic Fuel Management Plan*. The results of the strategic assessment for the ECFMA are outlined in table 4.1. A number of communities already have specific plans in place, these are summarised in Appendix 5.

| Community | FMAC Assessment Rating |
|--------------------------------|------------------------|
| Coles Bay | HIGH |
| Buckland | HIGH |
| Orford/Shelly Beach | HIGH |
| Bicheno | HIGH |
| Eaglehawk Neck/Doo Town | HIGH |
| Port Arthur | MED |
| Nubeena | MED |
| Dolphin Sands | MED |
| Taranna | MED |
| Lewisham/Dodges Ferry/Primrose | LOW/MED |

See locality maps in Appendix 1

Table 4.1: Priority communities identified in the strategic assessment process in the ECFMA.

In addition to the above communities, areas of strategic importance were also identified, shown in Table 4.2. These areas were identified through a process that utilised and combined local knowledge, BRAM risk assessment and phoenix ignition potential modelling. A sub-group of the ECFMA Committee, consisting of members with specific fire expertise and knowledge across the area contributed to the identification of both the communities at risk and the broader strategic areas for potential actions.

| Area |
|-------------------------------|
| Eastern Tiers west of Swansea |
| Triabunna/Orford |
| Nugent/Orielton/Forcett |
| Tasman/Forestier |

See locality maps in Appendix 1

Table 4.2: Strategic areas for potential treatment in the ECFMA.

It is important to note that these areas identified give a general location only. They will require field investigation to determine what mitigation options are available. To allow mitigation treatments to be carried out safely and effectively other areas not currently highlighted may need to be included.

In addition there may be Fuel Reduction Burning currently planned in areas that are not listed above which may provide some protection to communities and critical infrastructure.

Note: Mitigation options include:

- Fuel Reduction Burning
- Fire trail construction and maintenance
- Water point construction

- Other prescribed activities

4.4 Treatment Selection and Priorities

The strategic bushfire risk assessment undertaken for the entire ECFMA, described above, was used to identify key communities and assets considered to be at risk of bushfire and prioritise the preparation and implementation of different treatment strategies. These are also outlined in appendix 6.

Priority Communities and Treatments:

Coles Bay

PWS have undertaken some burning on land under their control on the Coles Bay peninsular. TFS community protection and response plans are in place. Fire management planning needs to be revisited to reflect changing needs and further mitigation options investigated.

Buckland

Investigate mitigation options for the forested areas surrounding Buckland. This may be included in a larger plan that covers Triabunna, Orford and the Thumbs. Dept of Defence (DoD) have a current fire management plan for the Buckland Military Training Area (BMTA).

Orford/Shelly Beach

TFS community response and protection plans are in place for these areas. Mitigation options should be investigated to cover the forested areas surrounding Orford and Triabunna. This may be incorporated into a larger plan covering the Thumbs, Alma Tier, and parts of the BMTA.

Bicheno

TFS community response, protection, and mitigation plans are in place. PWS are currently in the early planning stages of a burn in an area north of Bicheno that encompasses a section of the Douglas Apsley National Park. Appropriate support to be provided by SFMC to ensure that planned activities occur.

Port Arthur

Investigate mitigation options for this area. TFS community response and protection plans to be prepared for this area. The Port Arthur area has large numbers of tourists during the peak bushfire season. This should be considered in preparing these plans.

Nubeena

TFS community response and protection plans need to be developed for Nubeena and surrounding areas. Investigate mitigation options for this area.

Dolphin Sands

TFS community response and protection plans are currently in place. Investigate mitigation options.

Eaglehawk Neck/Doo Town

TFS community response and protection plans to be developed. PWS have undertaken some burning in this area and have more planned. Investigate further mitigation options.

Taranna

TFS community response and protection plans to be prepared. Investigate mitigation options. Similar issues to Port Arthur exist with tourist visitation during the peak bushfire season. This needs to be considered when preparing these plans.

Lewisham/Dodges Ferry/Primrose

Investigate the requirements for TFS community response and protection plans.

Strategic Areas and Treatments:

Greater Swansea area

Investigate mitigation options for the forested area to the west of Swansea in the ranges of the Eastern Tiers

Triabunna/Orford

Investigate mitigation options. This should include The Thumbs, Buckland, and parts of the BMTA.

Nugent/Orielton/Forcett

Investigate mitigation options for these areas.

Tasman/Forestier

Investigate mitigation options for these areas.

Note: Mitigation options include:

- Fuel Reduction Burning
- Fire trail construction and maintenance
- Water point construction
- Other prescribed activities

4.5 Annual Works Programs

The annual program of works is identified in the *Treatment Schedule* at Appendix 6. Land managers and fire agencies identified as responsible for completion of the treatments identified in the *Treatment Schedule* will be consulted with negotiation for incorporation of the works into their respective annual works programs and planning processes. The *Treatment Schedule* in Appendix 6 also includes other existing works programs of agencies and organisations with land management responsibilities in the ECFMA, as represented on the ECFMA Committee.

4.6 Implementation

When the treatments identified in this FPP are implemented there are a number of issues that need to be considered by the responsible agency including environmental impact, smoke management and prescribed burn plans.

Chapter 5 Monitoring and Review

Monitoring and review processes are in place to ensure that the FPP remains current and valid. These processes are detailed below to ensure outcomes are achieved in accordance with the *Project Plan* and *Treatment Schedule*.

5.1 Review

This FPP, including appendices, will be subject to a comprehensive after five (5) years from the date of approval, unless significant circumstances exist to warrant earlier review. This would include:

- Changes to the FPP area, organisational responsibilities or legislation;
- Changes to the bushfire risk in the area; or
- Following a major fire event.

5.2 Monitoring

The *Treatment Schedule* at Appendix 6 is a living document and progression towards completion of the treatments will be monitored and reviewed at least every six (6) months. The *Treatment Schedule* will be updated as treatments are progressed and completed.

5.3 Reporting

A report detailing progress towards implementation of this FPP will be provided annually.

References

Parks and Wildlife Service (unpublished). Bushfire Risk Assessment Model Project Business Process Model (2008). Department of Primary Industries, Parks, Water and Environment, Hobart.

Parks and Wildlife Service (unpublished). Tasmanian Bushfire Risk User Guide (2010). Department of Primary Industries, Parks, Water and Environment, Hobart.

Parks and Wildlife Service (unpublished). Tasmanian Bushfire Risk Assessment Model V?? (2013). Department of Primary Industries, Parks, Water and Environment, Hobart.

NERAG Risk Assessment Guidelines.

Appendices

Appendix 1 – Maps displaying ECFMAC selected priority areas

Appendix 2 - BRAM

Appendix 3 – NERAG risk assessment approach

Appendix 4 – Bushfire Risk Assessment Maps

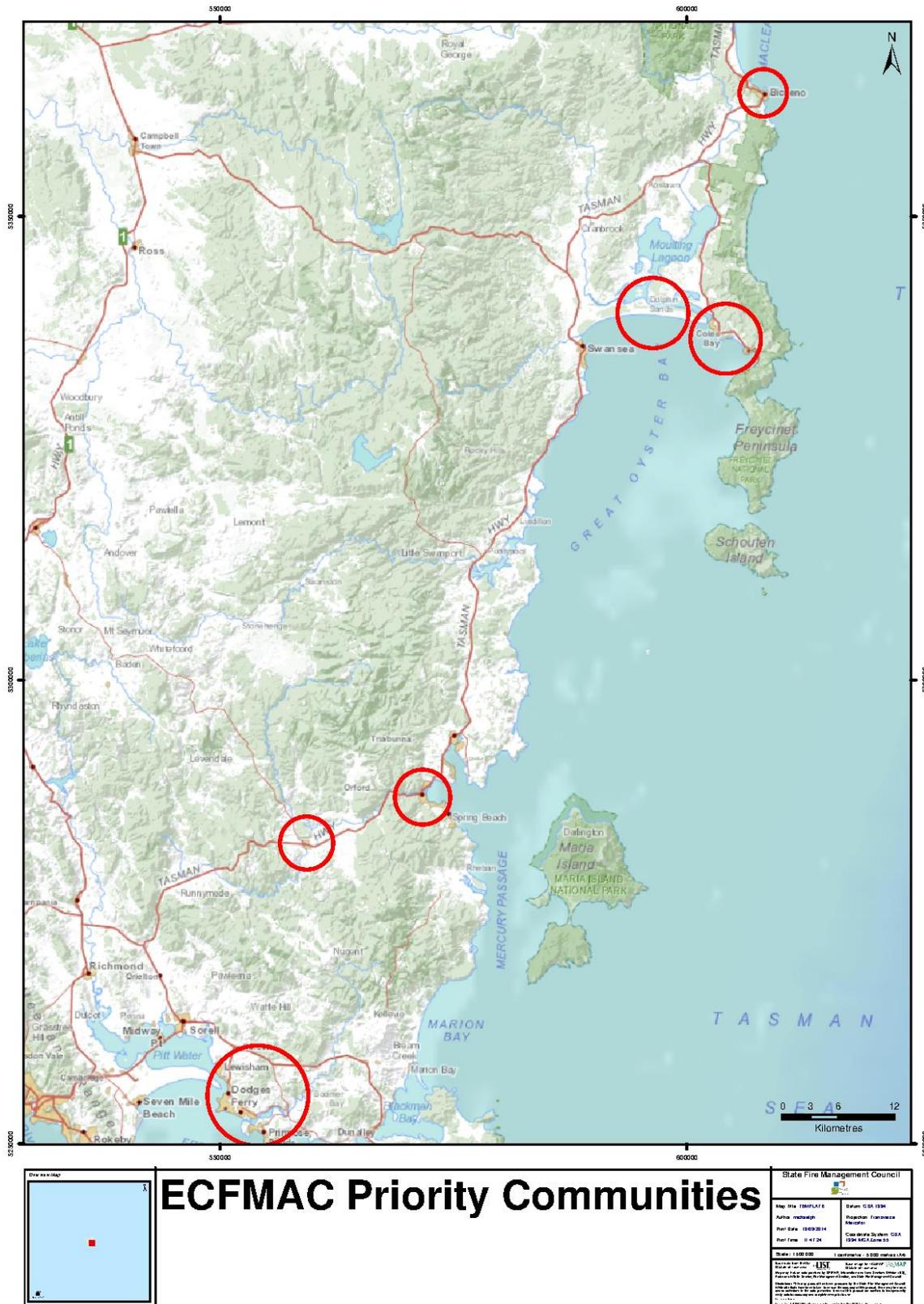
Appendix 5 – Community specific plans already in place

Appendix 6 – Treatment schedule - annual works program

Appendix 7 – Description of vegetation communities

Appendix 1 – Maps of ECFMAC selected priority areas

It must be noted that the areas circled on these maps are to indicate the general area to be targeted for investigation and do not represent the boundaries of mitigation works. The actual boundaries for mitigation works will be determined after field investigations are undertaken.



ECFMAC Priority Communities



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| Author: [unclear] | Project: [unclear] |
| Year: 2014 | Client: [unclear] |
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ECFMAC Priority Communities

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| Map File: 1504PLA76 | Status: 05.01.2016 |
| Source: 1504PLA76 | Revision: 1/2016 |
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ECFMAC Strategic Areas - Orielton/Nugent

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| Map Title: 1200PLAT 6 | Scale: 1:50,000 |
| Author: 1200PLAT 6 | Revision: 1200PLAT 6 |
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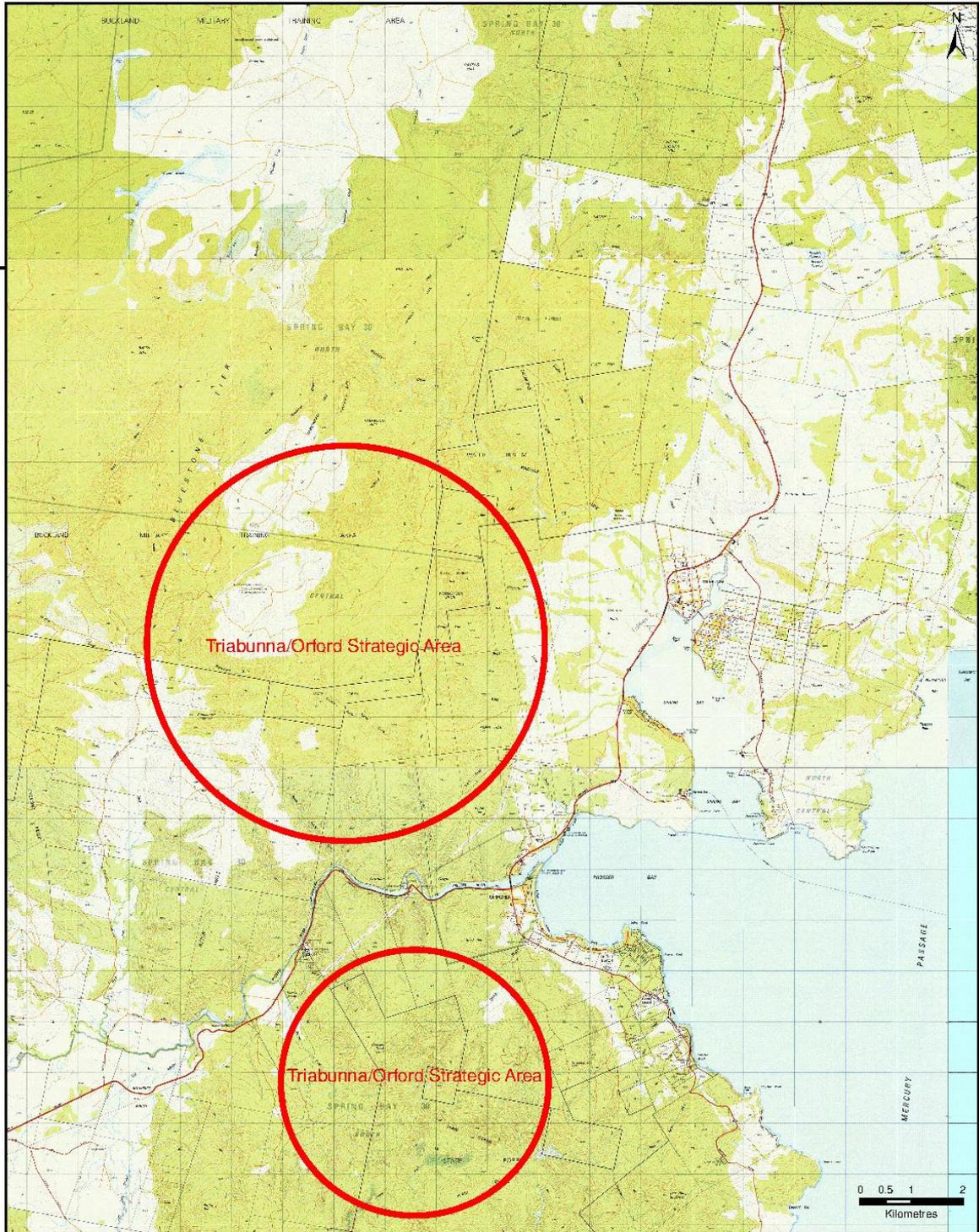


ECFMAC Strategic Areas - Orielton/Nugent

State Fire Management Council

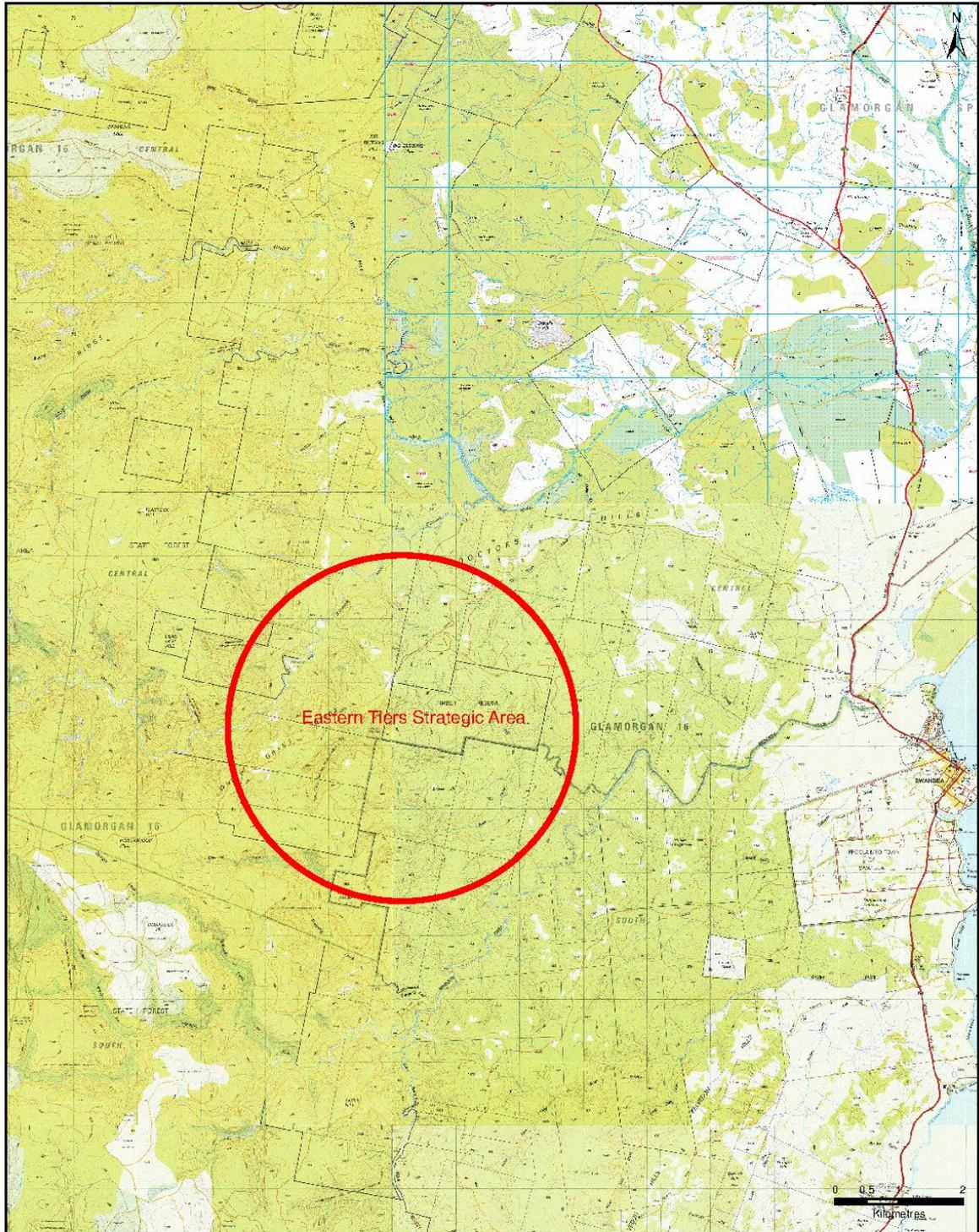
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ECFMAC Strategic Areas - Triabunna/Orford

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| Ref Date: 1999/2014 | Case Study: [unclear] |
| Ref Title: [unclear] | 15th MCA Case 03 |
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ECFMAC Strategic Areas - Eastern Tiers

| | |
|---|---------------------------|
| State Fire Management Council | |
| Map Title: ECFMPLAT 6 | Scale: 1:50,000 |
| Author: Information | Project: Fire Management |
| Rev Date: 19/09/2014 | Case Study: Eastern Tiers |
| Rev Time: 12:55:51 | 1:50,000 Scale |
| Scale: 1:50,000 | 1:50,000 Scale |
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Appendix 2 - The Bush Fire Risk Model (BRAM)

Background

The Bushfire Risk Assessment Model (BRAM) is a software product that was developed by the Fire Management Section of the Parks and Wildlife Service (Department of Primary Industries, Parks, Water and Environment). The aim of the model is identify bush fire risk at a strategic level as well as to identify the elements driving actual bush fire risk.

A stakeholder group was set up to oversee the process. Stakeholders involved in developing the process included:

- Parks and Wildlife Service;
- Tasmania Fire Service;
- Forestry Tasmania;
- Tasmanian Farmers and Graziers Association;
- State Emergency Service;
- Forest Industries Association of Tasmania;
- Local Government Association of Tasmania;
- Resource management and conservation , DPIPWE;
- NRM ;
- Tasmanian Aboriginal land and Sea Council;

Additional working groups were set up to advise on specialist areas such as values at risk, suppression capabilities, ignition potential, and fire behaviour.

The process is aligned to the Australian/New Zealand Standard AS/NZS 4360:2004 Australian Standard Risk Management and the updated standard AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*. Risk is defined as the " effect of uncertainty on objectives" with a focus of the effect on the objectives

The process

The model is built in a geographic information system that utilizes various spatial orientated data, fire behaviour and fuel accumulation models and climate records. The data and values were developed by consensus of a range of stakeholders

The process applies the same set of assessment rules to the data contained in the model , thus it can be applied across the state. The process is tenure blind

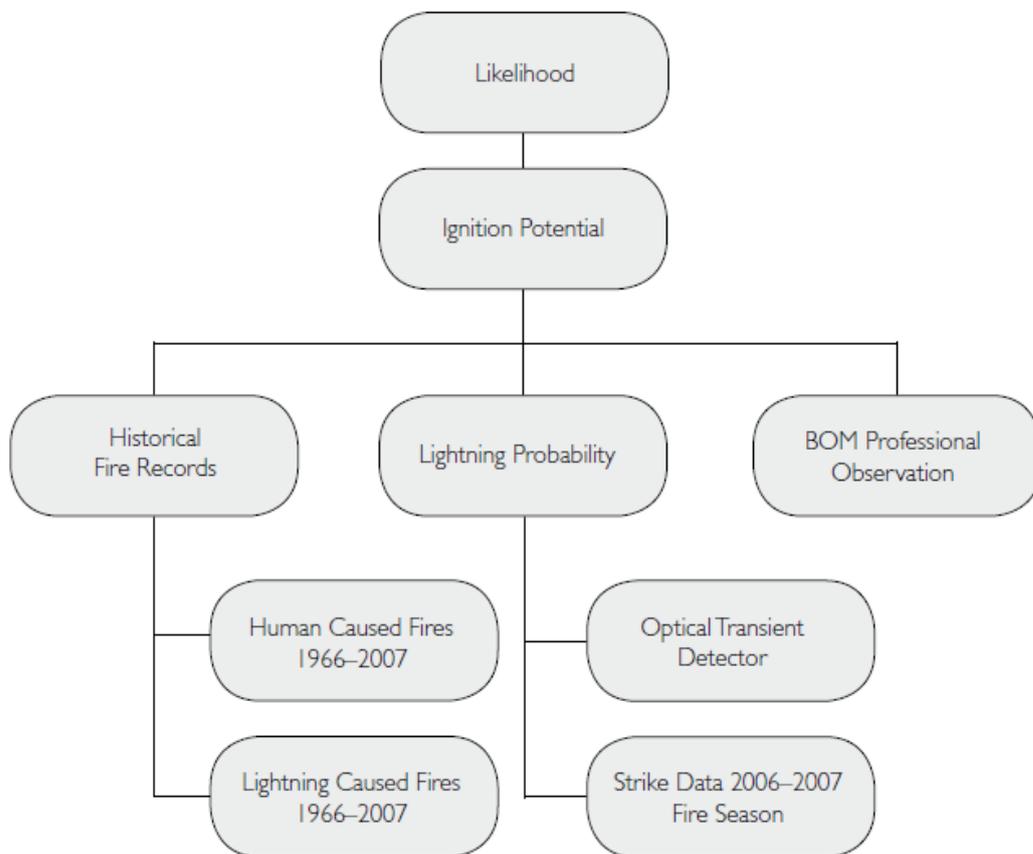
The BRAM identifies the **likelihood and consequence of a fire** at a particular point. The risk is determined through the use of a qualitative risk matrix incorporating likely hood and values at risk (consequences). The process identifies the actual risk at that point not the perceived risk. The output is in the form of layers identifying the likelihood, values at risk and actual risk

The model uses 4 major areas to calculate risk

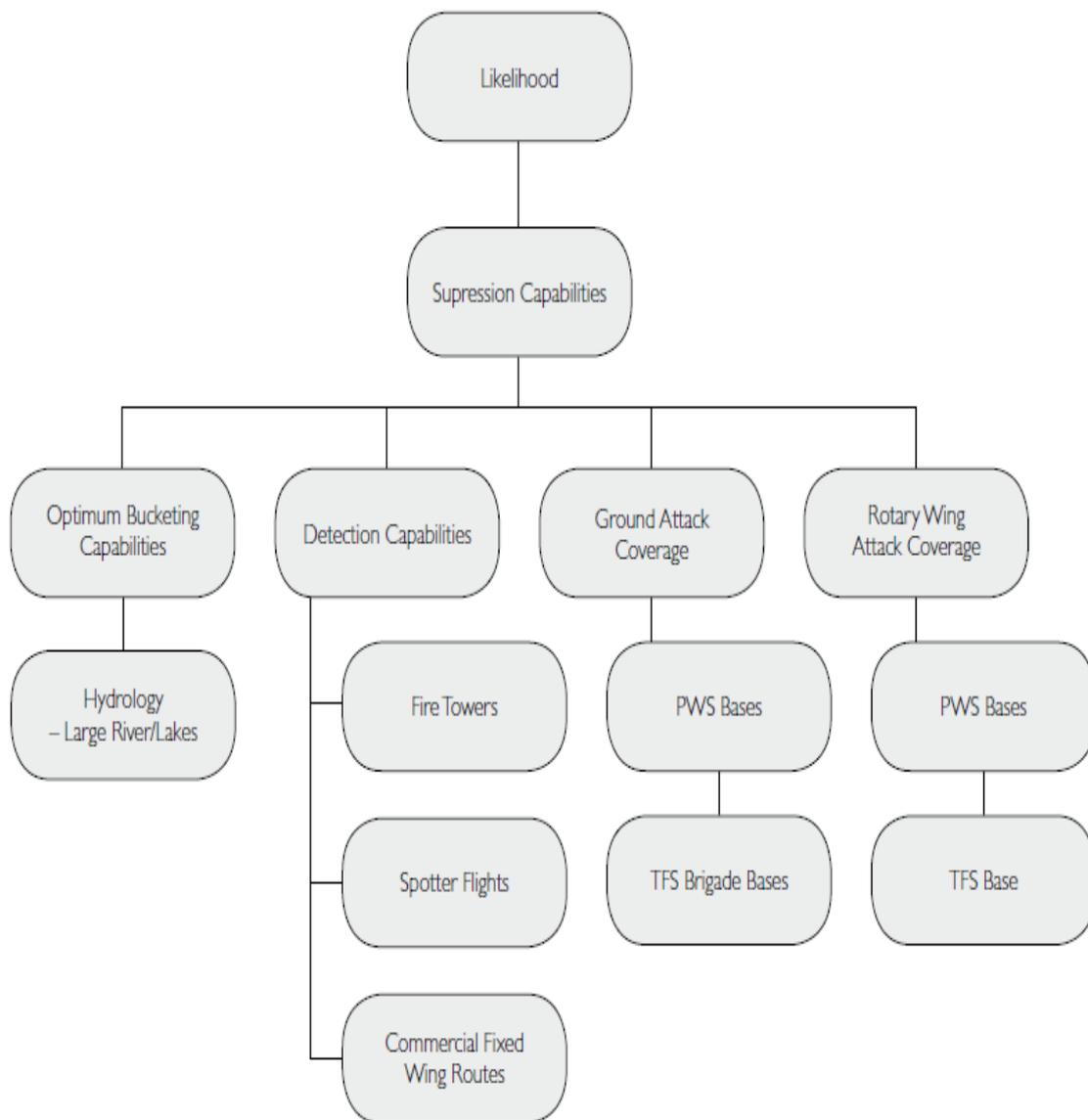
- Fire behaviour potential - the manner in which fuel ignites, flame develops, and fire spreads and exhibits other related phenomena (likelihood).

- Ignition potential - the probability or chance of fire starting as determined by the presence of causative agents (likelihood).
- Suppression capability - the factors and limitations that are related to the ability to contain a bushfire upon detection (likelihood).
- Values at risk - a specific or collective set of natural resources and man-made improvements and/or developments that have measurable or intrinsic worth, and which could potentially be destroyed or otherwise altered by fire in any given area (consequence)

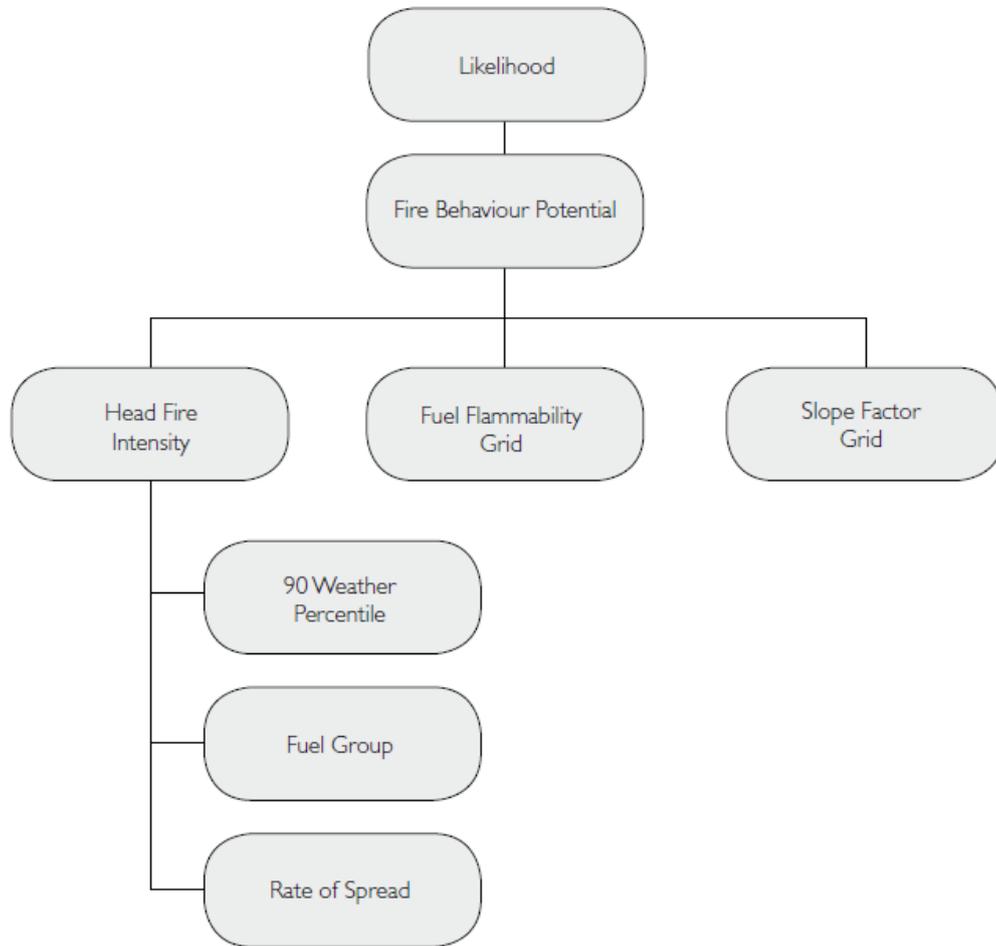
Ignition potential



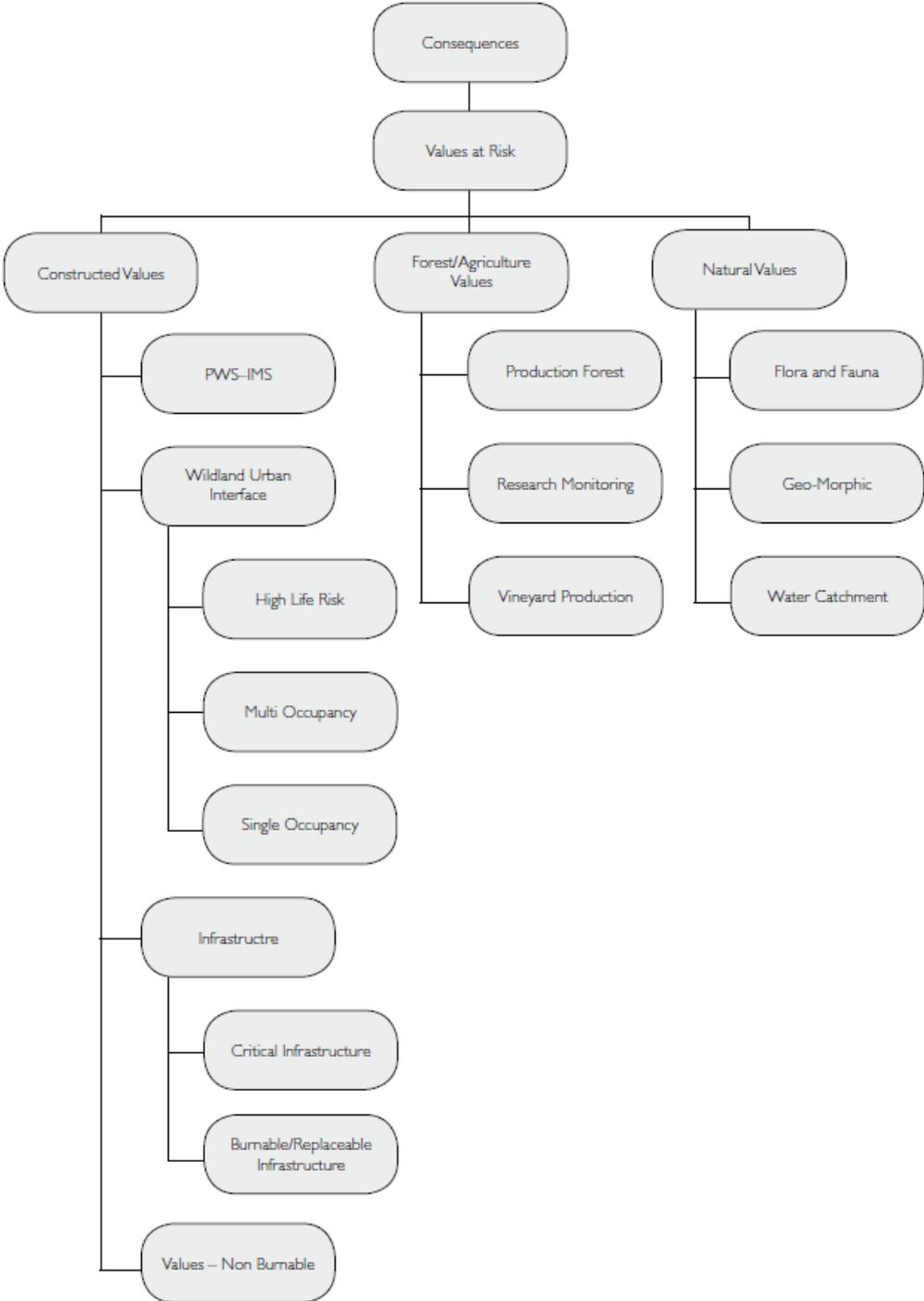
Suppression capabilities



Fire Behaviour Potential



Values at risk



Limitations of the process

- BRAM **does not** incorporate the likelihood and consequence **at the same point** from a fire occurring in an adjacent area.
- BRAM does not display the risks posed by an area adjacent to a particular point.
- Mitigation works undertaken on adjacent areas do not change the risk at a particular point.
- The process is based on available data, there are significant gaps in data eg fire history on private lands,
- Untested assumptions – may over/underestimate risk

Appendix 3 – NERAG risk assessment approach

(Derived from the National Emergency Management Committee (2010), *National Emergency Risk Assessment Guidelines*, Tasmanian State Emergency Service, Hobart)

The NERAG provide a methodology to assess risks from emergency events and are principally concerned with risk assessment. The NERAG methodology was utilised in development of the BRAM to develop the final risk profile

The guidelines are not intended to address the entire risk management framework or the risk management process as outlined in AS/NZS ISO 31000:2009. However, because they focus on the assessment of risks from emergency events, they ultimately direct the management of emergency risks in line with the international standards for risk management.

The guidelines aim to provide a risk assessment methodology that:

- enables focus on risks in small (e.g. municipal) or large (e.g. regional and/or state and/or national) areas
- is useable for both risk 'from' and risk 'to' (e.g. risk from bushfire, risk to infrastructure from all or specific sources of risk)
- uses a scenario-based approach
- samples risk across a range of credible consequence levels
- identifies current risk under existing controls and residual risk assuming implementation of additional controls or control improvements
- provides base-line qualitative risk assessments and triggers for more detailed analysis
- allows risk evaluation at varying levels of confidence
- Provides outputs that are comparable, which rate risk and suggests means to reduce risk.

Risk analysis is the element in the process through which the level of risk and its nature is determined and understood. Information from risk analysis is critical to rank the seriousness of risks and to help decide whether risks need to be treated or not. In this phase, control opportunities are also identified. The analysis involves consideration of possible consequences, the likelihood that those consequences may occur (including the factors that affect the consequences), and any existing control that tends to reduce risks. During this phase the level of confidence in the analysis is assessed by considering factors such as the divergence of opinion, level of expertise, uncertainty, quality, quantity and relevance of data and information, and limitations on modelling. At the conclusion of this step, all identified risks are categorised into risk levels and given a risk rating, and statements concerning existing controls and their adequacy are made.

NERAG takes an all hazards approach and provides a method that is suitable for considering other sources of risk beside fire

Consequence table

| Consequence level | People | Environment | Economy | Public Administration | Social Setting | Infrastructure |
|-------------------|--|---|---|--|--|---|
| Catastrophic | Widespread multiple loss of life(mortality > 1 in ten thousand), Health systems unable to cope, Displacement of people beyond a ability to cope | Widespread severe impairment or loss of ecosystem functions across species and landscapes, irrecoverable environmental damage | Unrecoverable financial loss > 3% of the government sector's revenues, asset destruction across industry sectors leading to widespread failures and loss of employment | Governing body unable to manage the event, disordered public administration without effective functioning, public unrest, media coverage beyond region or jurisdiction | Community unable to support itself, widespread loss of objects of cultural significance, impacts beyond emotional and psychological capacity in all parts of the community | Long term failure of significant infrastructure and service delivery affecting all parts of the community, ongoing external support at large scale required |
| Major | Multiple loss of life (mortality > 1 in One hundred Thousand), Health system over stressed, Large numbers of displaced people(more than 24 hours) | Serious impairment or loss of ecosystem functions affecting many species or landscapes, progressive environmental damage | Financial loss 1-3% of the governments sector's revenues requiring major changes in business strategy to (partly) cover loss, significant disruptions across industry sectors leading to multiple business failures and loss of employment | Governing Body absorbed with managing the event, public administration struggles to provide merely critical services, loss of public confidence in governance, media coverage beyond region jurisdiction | Reduces quality of life within the community, significant loss or damage to objects of cultural significance, impacts beyond emotional and psychological capacity in large parts of the community | Mid- to long term failure of significant infrastructure and service delivery affecting large parts of the community, initial external support required |
| Moderate | Isolated cases of loss of life (mortality > 1 in one million), Health system operating at maximum capacity, isolated cases of displacement of people(less than 24 hours) | Isolated but significant cases of impairment or loss of ecosystem functions, intensive efforts for recovery required | Financial loss 0.3 – 1% of the governments sector's revenue requiring adjustments to business strategy to cover loss, disruptions to selected industry sectors leading to isolated cases of business failures and multiple loss of employment | Governing body manages the event with considerable diversion from policy, public administration functions limited by focus on critical services, widespread public protests, media coverage within region or jurisdiction. | Ongoing reduced services within community, permanent damage to objects of cultural significance, impacts beyond emotional and psychological capacity in some parts of the community | Mid-term failure of(significant) infrastructure and service delivery affecting some parts of the community, widespread inconveniences |
| Minor | Isolated cases of serious injury, health system operating within Normal parameters | Isolated cases of environmental damage, one off recovery efforts required | Financial loss 0.1-0.3% of the governments sector's revenues requiring activation of reserves to cover loss, disruptions at business level leading to isolated cases of loss of unemployment | Governing body manages the event under emergency regime, Public administration functions with some disturbances, isolated expressions of public concern, media coverage within region or jurisdiction | Isolated and temporary cases of reduced services within the community, repairable damage to objects of cultural significance, impacts within emotional and psychological capacity of the community | Isolated cases of short- to mid-term failure of infrastructure and service delivery. Localised inconveniences |
| Insignificant | Near misses or minor injuries, no reliance on health system | Near miss or incidents without environmental damage , no recovery efforts required | Financial loss , 0.1% of the governments sector's revenues to be managed within standard financials provisions, inconsequential | Governing body manages the event within normal parameters, public administration functions without disturbances, public confidence | Inconsequential short-term reduction of services, no damages to objects of cultural significance, no adverse emotional and psychological | Inconsequential short-term failure of infrastructure and service delivery, no disruption to the public services |

| | | | | | | |
|--|--|--|-------------------------------|-----------------------------------|---------|--|
| | | | disruptions at business level | in governance, no media attention | impacts | |
|--|--|--|-------------------------------|-----------------------------------|---------|--|

Impact Category Definitions

| Impact Category Definitions | |
|-----------------------------|---|
| People | <p>Relates to the direct impacts of the emergency on the physical health of people/ individuals and emergency services(i.e. health systems) ability to manage</p> <p>Mortality defined as the ration of deaths in a an area of the population to the population of that area; expressed as per 1000 per years</p> |
| Environment | Relates to the impacts of the emergency and its effects on the ecosystem of the area, including fauna and flora |
| Economy | Relates to the economic impacts of the emergency on the governing body as reported in the annual operating statement for the relevant jurisdiction, and industry sectors as defined by the Australian Bureau of statistics |
| Public Administration | Relates to the impacts of the emergency on the governing body's ability to govern |
| Social setting | Relates to the impacts of the emergency on society and its social fabric, including its cultural heritage, resilience of community |
| Infrastructure | <p>Relates to the impacts of the emergency on the areas infrastructure/ lifelines/utilities and its ability to service the community</p> <p>Long term failure = repairs will take longer than 6 months</p> <p>Mid-to long term failure = repairs may be undertaken in 3 to 6 months</p> <p>Mid-term failure = repairs may be undertaken in 3 to 6 months</p> <p>Short to mid term failure = repairs may be undertaken in 1 week to 3 months</p> <p>Short-term failure = repairs may be undertaken in less than 1 week</p> |

Likelihood table

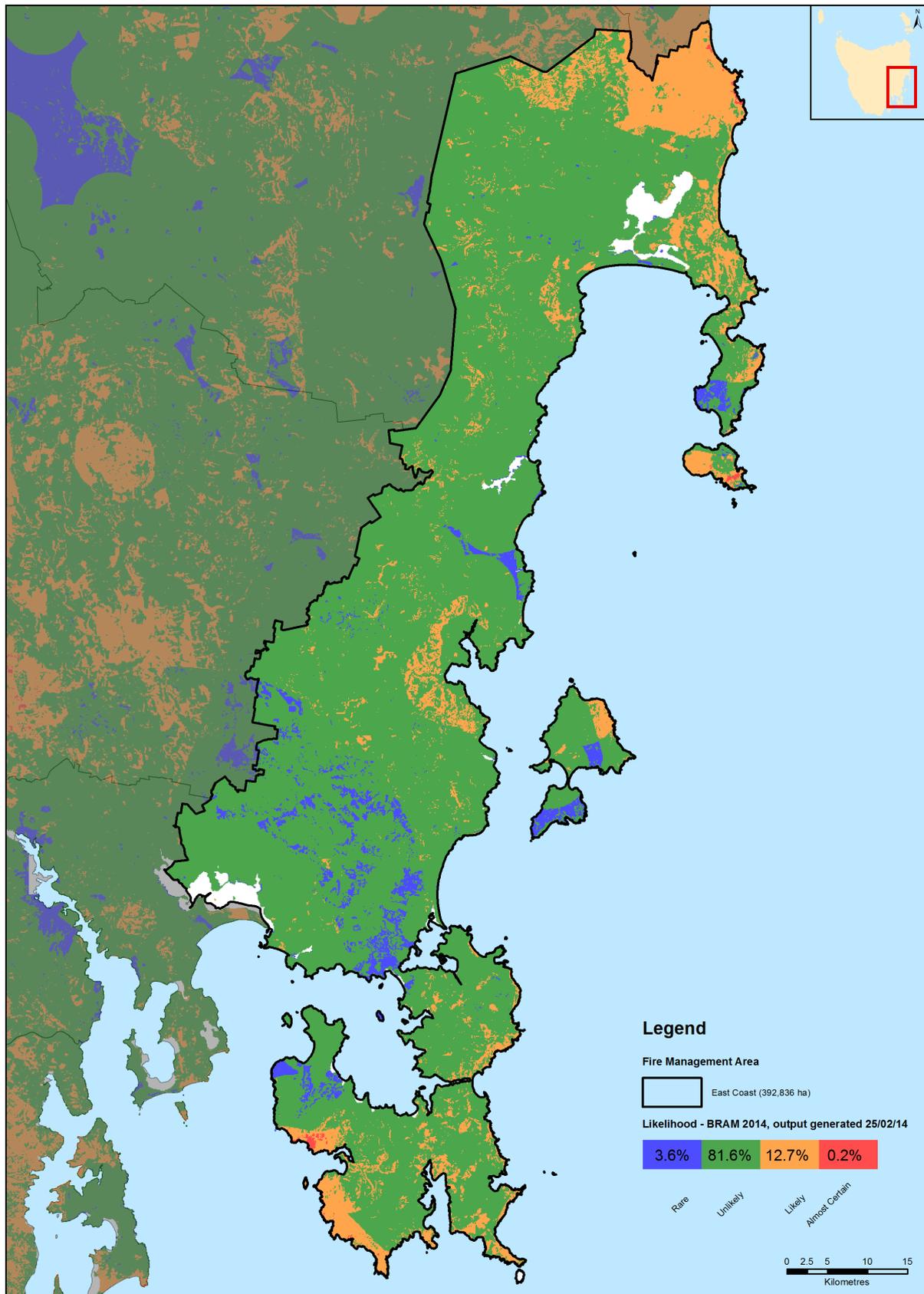
| Likelihood level | Frequency | Average Recurrence Interval | Annual Exceedance probability |
|-------------------|---------------------------------|-----------------------------|-------------------------------|
| Almost certain | One of more per year | < 3 years | .03 |
| Likely | Once per 10 years | 3 – 30 years | 0.031 – 0.3 |
| Possible | Once per one hundred years | 31- 300 years | 0.0031 – 0.03 |
| unlikely | One per thousand years | 301 – 3,000 years | 0.00031 – 0.003 |
| Rare | One per ten thousand years | 3,001 – 30,000 years' | 0.000031 – 0.0003 |
| Very Rare | Once per hundred thousand years | 30,001 - 300,000 years | 0.0000031 – 0.0003 |
| Almost Incredible | Less than one per million years | >300,000 years | <0.0000031 |

Qualitative risk matrix

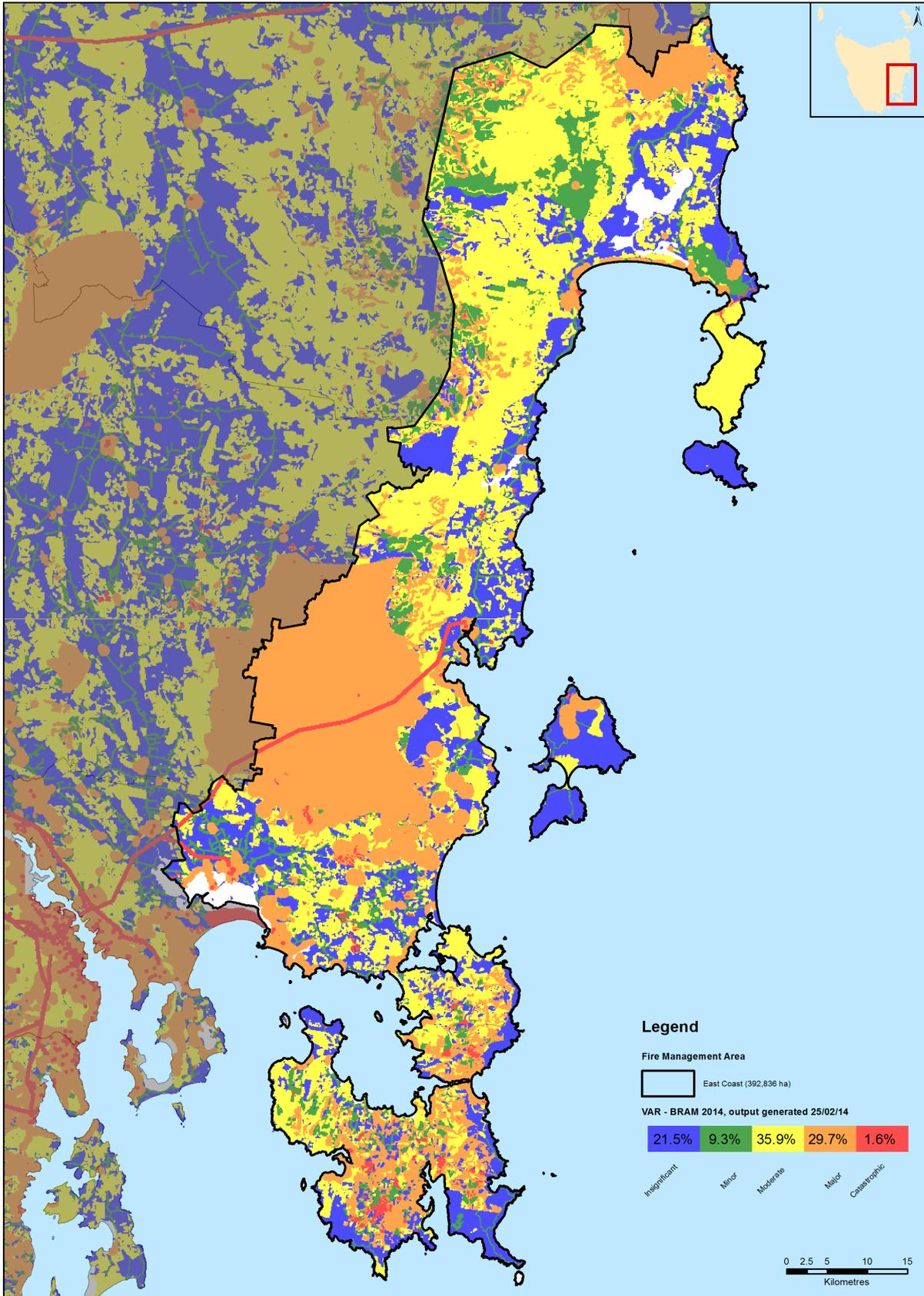
The qualitative risk matrix combines a level of consequence with a level of likelihood to determine a level of risk. The risk level, together with the confidence in the overall assessment process and other factors, will determine the need for detailed analysis and inform the treatment of risks

| Likelihood level | Consequence level | | | | |
|-------------------|-------------------|--------|----------|---------|--------------|
| | Insignificant | Minor | Moderate | Major | Catastrophic |
| Almost certain | Medium | Medium | High | Extreme | Extreme |
| like | Low | Medium | High | High | Extreme |
| Possible | Low | Low | Medium | High | High |
| Unlikely | Low | Low | Medium | Medium | High |
| Rare | Low | Low | Low | Medium | Medium |
| Very Rare | Low | Low | Low | Low | Medium |
| Almost incredible | Low | Low | Low | Low | low |

Appendix 4 – Bushfire Risk Assessment Maps



BRAM Likelihood map of the ECFMA



BRAM values at risk for the ECFMA

Appendix 5 – Community specific plans already in place

| Town/Area | Current Plans |
|---------------------------------|--|
| Coles Bay | PWS local fire management Strategy TFS Response & Protection plans |
| Bicheno | TFS Bushfire Mitigation, Response & Protection plans |
| Swansea | Glamorgan Spring Bay strategic fire zone/plan TFS Response & Protection plan |
| Triabunna | Glamorgan Spring Bay fire zone/plan TFS Response & Protection plans (includes Orford) |
| Nugent/Orielton/Forcett | Sorell strategic fire zone/plan |
| Tasman/Forestier | Tasman strategic fire zone/plan |
| Dolphin Sands | TFS Response & Protection plans Council fire mitigation work |
| Cranbrook | TFS Response & Protection plans |
| Eaglehawk Neck | PWS fire management plan |
| PWS managed land with the ECFMA | PWS Southern Region Strategic Fire Management Plan |

Explanation of plans:

1. Community Bushfire Response Plan:

- The purpose of a Community Bushfire Response Plan, (CBRP) is for emergency managers to better protect communities and their assets during bushfire emergencies.

2. Community Bushfire Protection Plan

- The purpose of a Community Bushfire Protection Plan, (CBPP) is for community members to be provided with local information to assist with bushfire preparation and survival.

3. Community Bushfire Mitigation Plan

- The purpose of a Community Bushfire Mitigation Plan is to provide guidance regarding bushfire fuel management; to increase community bushfire safety and provide protection to important community assets.

Appendix 6 – Treatment schedule - annual works program

| Location | Summary | Tenure | Previous Treatment including current plans | Action required | Project implementation | Timeframe for completion | Overall FMAC Priority rating |
|--------------------------------|--|--|---|--|--|--------------------------|------------------------------|
| COMMUNITIES | | | | | | | |
| Coles Bay | Popular tourist town. Many shacks and holiday units as well as permanent residents. Gateway to Freycinet Peninsula. | Private Property and PWS managed land | TFS Community Protection and Response Plans. PWS have a local fire management strategy in place and have completed some burning | Investigate mitigation options in a tenure blind approach. | SFMC to provide advice on procedures to be used when planning and undertaking burning on Private Property | | High |
| Buckland | Surrounding forested areas pose a risk to the town, but also are strategically important to East Coast fire management. | Combination of Private Property, PWS managed land, Dept of Defence (DoD) and Permanent Timber Production Zone. | DoD have a fire management plan covering the BMTA. | Implement current DoD fire management plan. Investigate mitigation options areas surrounding Triabunna and Orford | SFMC to provide necessary support to DoD to allow current plan to be implemented. SFMC to provide advice on procedures to be used when planning and undertaking burning on Private Property | | High |
| Orford/Shelly Beach | Popular seaside town in close proximity to dry forest. | Private Property. PWS managed land. | TFS Community Protection and Response Plans. | Investigate mitigation options for the forested areas surrounding this location. This may cover a large area including the Thumbs reserve, Alma Tier and parts of the BMTA | SFMC to provide advice on procedures to be used when planning and undertaking mitigation works on Private Property. | | High |
| Bicheno | Popular seaside town in close proximity to dry forest. | Private Property and PWS managed land | TFS Community Protection, Response and Mitigation plans. Small FRBs are currently being planned by the local TFS Brigade. PWS are in the process of planning a FRB for Autumn 2015 that includes Private Property and part of the Douglas Apsley National Park. | Continue investigating mitigation options and undertaking mitigation works. | SFMC to provide support to ensure that planned mitigation activities occur. | | High |
| Eaglehawk Neck/Doo Town | Popular coastal town with many shack and holiday homes. Permanent residents and several accommodation providers. High visitation during tourism season. Surrounded by heavily forested areas and coastal vegetation. | Private Property and PWS managed land | PWS have a current fire management plan for this area. Some FRB's have been undertaken and more are planned. | Develop TFS Community protection and response plans. Investigate tenure blind mitigation options. PWS to continue with planned FRB's in the area. | TFS CPP unit to prepare Protection and Response plans for this area. SFMC to provide advice on procedures to be used when planning and undertaking burns on Private Property. Appropriate support to be provide to allow PWS to continue implementing current fire management plans. | | High |
| Nubeena | Main town for the Tasman Peninsula. Location of important community facilities. | Private Property and PWS managed land | No current plans exist for this area. | Develop TFS Community protection and response plans. Investigate mitigation options. | TFS CPP unit to prepare Protection and Response plans for this area. SFMC to provide advice on procedures to be used when planning and undertaking burns on Private Property. | | Med |
| Port Arthur | Popular tourist destination. Surrounding vegetation has limited opportunities for large scale fuel reduction burning. | Private Property and PWS managed land | No current plans exist for this area. | Develop TFS Community protection and response plans. Investigate mitigation options. | TFS CPP unit to prepare Protection and Response plans for this area. SFMC to provide advice on procedures to be used when planning and undertaking burns on Private Property. | | Med |
| Taranna | Small town that is a popular point for tourists. Has had fires impact on areas adjacent to the town in the past. | Mainly Private Property with some PWS managed land and Permanent Timber Production Zone | No current plans exist for this area. | Prepare TFS community protection and response plans. Investigate mitigation options | TFS CPP unit to prepare Protection and Response plans for this area. SFMC to provide advice on procedures to be used when planning and undertaking burns on Private Property. | | Med |

| | | | | | | | |
|---------------------------------------|---|---|---|--|--|---------------------------------|-------------------------------------|
| Dolphin Sands | Small coastal community surrounded by dry forest types and coastal vegetation. | Mainly Private Property with some PWS managed land | TFS protection and response plans are currently in place. | Investigate mitigation options for this area. | SFMC to provide advice on procedures to be used when planning and undertaking mitigation works on Private Property. | | Med |
| Lewisham/Dodges Ferry/Primrose | Large community, predominately surrounded by grass lands and some dry forest. | Mainly Private Property with some PWS managed land | No current plans exist for this area. | Investigate the requirement to develop TFS community response and protection plans | TFS CPP unit to investigate the need for further planning. | | Low/Med |
| Location | Issue | Tenure | Previous Treatment including current plans | Action required | Project implementation | Timeframe for completion | Overall FMAC Priority rating |
| Strategic Areas | | | | | | | |
| Eastern Tiers west of Swansea | Strategically important in overall fire management of the East Coast FMA | Private Property, PWS managed land and Permanent Timber Production Zone | No current plans exist for this area. | Investigate mitigation options for this area. | SFMC to provide further advice in relation to resourcing for large scale FRB planning and implementation. | | High |
| Triabunna/Orford | Strategically important to provide protection to communities of Triabunna and Orford | Private Property, PWS managed land | BMTA has current fire management plans in place. | Implement current BMTA plans and consider including private property where appropriate. Investigate further mitigation options . | SFMC to provide appropriate support to allow existing plans to be implemented. SFMC to provide advice on procedures to be used when planning and undertaking mitigation works on Private Property. | | High |
| Nugent/Orielton/Forcett. | Mainly dry forest and grass lands with many residences locate throughout the area. Many rural holdings are also located in these areas. | Private Property and PWS managed land | No current plans exist for this area. | Investigate mitigation options for this area. | SFMC to provide advice on procedures to be used when planning and undertaking burning on Private Property | | High |
| Tasman/Forester | Strategically important to provide protection to communities on the Tasman Peninsular. Mixture of vegetation types, including Eucalypt plantations. | Private Property, PWS managed land, Permanent Timber Production Zone | No current plans exist for this area. | Investigate mitigation options for this area. | SFMC to provide advice on planning and implementation of multi tenure mitigation activities. | | Med |

NOTE:

Mitigation options include:

- Fuel Reduction Burning
- Fire trail construction and maintenance
- Water point construction
- Other prescribed activities

Appendix 7 – Description of vegetation types

Description of broad veg community types contained in the TASVEG mapping dataset:

Agricultural, urban and exotic vegetation

This broad vegetation group is mainly non-native vegetation and includes agricultural land, marram grassland, *Spartina* marshland, plantations for silviculture, regenerating cleared land, urban areas and weed infested areas. It also includes *Pteridium esculentum* fernland which is dominated by the native bracken fern, and Permanent easements, which may be occupied by native vegetation.

Dry sclerophyll forests

Dry sclerophyll forests and woodlands are typically dominated by eucalypts under 40 m in height, and have a multi-layered understorey dominated by hard-leaved shrubs, including eucalypt regeneration. Dry sclerophyll forests are mainly found on dry, infertile and exposed sites and are largely confined to coastal areas.

Highland Treeless Vegetation

Highland treeless vegetation communities occur within the alpine zone where the growth of trees is impeded by climatic factors. Alpine vegetation is generally treeless, although there may be some widely scattered trees, generally less than two metres high. The altitude above which trees cannot survive in the north-east highlands of Tasmania can be as high as 1400m. Fire is, at present, the most serious threat to Highland treeless vegetation in Tasmania.

Moorland, sedgeland, rushland, and peatland

This group contains moorland, rushland, sedgeland and peatland predominantly on low-fertility substrates in high rainfall areas. Fire is a defining factor for the vegetation communities in this group, with both its intensity and frequency largely dictating the form of the vegetation.

Tasmanian buttongrass moorland is a unique vegetation type in a global context: it is the only extensive vegetation type dominated by hummock-forming tussock sedge (*G. sphaerocephalus*). Buttongrass moorland is at the interface of terrestrial and wetland systems, with much of it seasonally waterlogged.

Native Grasslands

Native grasslands are defined as areas of native vegetation dominated by native grasses with few or no emergent woody species. Different types of native grassland can be found in a variety of habitats, including coastal fore-dunes, dry slopes and valley bottoms, rock plates and subalpine flats. The lowland temperate grassland types have been recognised as some of the most threatened vegetation communities in Australia.

Some areas of native grassland are human-induced and exist as a result of heavy burning, tree clearing or dieback of the tree layer in grassy woodlands.

There are seven grassland communities recognised by TASVEG: one is coastal, four are lowland, one is highland, and one is found in both highland and lowland areas. Floristic differences, altitudinal distribution and environmental situation are used to define the communities.

Non eucalypt forest and woodland

These forest and woodland communities are grouped together either because they are native forests and woodlands not dominated by eucalypt species or because they do not fit into other forest groups. If there is a functional attribute most share, it is the widespread initiation of even-aged stands by fire and the ability of many of them to form closed-canopy forests. Some of these communities have been referred to as “dry rainforests”.

Other natural environments:

This mapping unit includes land which is largely bare of vegetation such as sand, mud, water, or sea. Natural rocky areas such as scree slopes, boulders and exposed bedrock (and associated lichen species) are also included in this broad vegetation community type.

Rainforest and related scrub

Tasmanian rainforest is structurally and floristically variable and it is defined by the presence of species of any of the genera *Nothofagus*, *Atherosperma*, *Eucryphia*, *Athrotaxis*, *Lagarostrobos*, *Phyllocladus* or *Diselma*. Occasionally some understorey species, for example *Anodopetalum biglandulosum* or *Richea pandanifolia*, may occur as dominants (Jarman & Brown 1983). Much rainforest falls within the structural definition of closed-forest (Specht 1970) but some types, such as scrub rainforest and subalpine rainforests, do not fit this category.

Rainforest occurs from sea level to about 1 200 m. Tasmanian cool temperate rainforest has affinities with rainforests in south-east Australia, New Zealand and the Andean region of southern Chile and Argentina. One notable difference is that Tasmanian rainforest has a lower diversity of tree species.

Saltmarsh and Wetland

Wetlands are among the most productive ecosystems on earth, fulfilling many environmental and socio-economic functions. They act as breeding grounds for many species of fish, water birds, amphibians and insects. Many wetlands are important as stopover points for migratory bird species. Plant communities in wetlands filter water and disperse heavy flow in times of flood.

Saltmarshes are saline types of wetlands. They occur predominantly on low-energy coastlines where wave action does not hinder the establishment of vascular plants. In Tasmania the best examples can be seen in sheltered inlets and bays on the east and south coasts, with other large areas present in the far north-west of the State and on some of the Bass Strait islands.

Scrub, heathland and coastal complexes

Scrubs, heathlands and the diverse complexes that they may form are, with a few notable exceptions, dominated by scleromorphic species. The canopy structure of the woody plants in these communities varies from 30 to 100% solid crown cover and is usually 5 m or less in height. While this height is the arbitrary divide between forest (including woodland) and scrub (Specht 1970), taller vegetation is included in these mapping units when it maintains a dense scrubby structure and/or a floristic composition indistinguishable from communities typically 5 m or less in height.

Scrub and heathland communities typically have only two strata; a dominant layer of shrubs comprising one to many species; and a ground layer of herbs, orchids, prostrate shrubs, ferns and occasionally grasses and/or sedges. Some heath and scrub vegetation also includes emergent trees, but where present, these never form more than 5% solid crown cover.

Wet Sclerophyll Forest communities:

Wet sclerophyll forests are typically dominated by eucalypts and have an understorey dominated by broad-leaved (soft-leaved) shrubs. Trees in mature forest generally exceed 40 m in height. As with the related mixed forest, wet sclerophyll forests typically contain only one or two eucalypt age classes - these relate to period since fire or other major disturbance (including intensive logging and regeneration burning). Often only one species of eucalypt is present. The shrub understorey is dominated by broad-leaved shrubs and is generally dense, preventing continuous regeneration of shade-intolerant species such as eucalypts. Ferns are often prominent in the ground layer.

Source:

1. Forest Practices Authority (2005). Forest Botany Manual. Forest Practices Authority, Tasmania:
2. Kitchener, A. and Harris, S. (2013). From Forest to Fjaeldmark: Descriptions of Tasmania's Vegetation. Edition 2. Department of Primary Industries, Parks, Water and Environment, Tasmania