

Appendix C

North East Victoria & Gippsland Bushfire Rapid Risk Assessment Team report from the 2013 Alpine fires

Appendix C is available on the WSAA website

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Appendix%20C%20-%20Nort%20East%20Victoria%20and%20Gippsland%20BRRAT%20Report.pdf](http://wsaa.asn.au/sites/default/files/publication/download/Appendix%20C%20-%20Nort%20East%20Victoria%20and%20Gippsland%20BRRAT%20Report.pdf)

2013 Alpine Fires

North East Victoria & Gippsland

February 2013

RISK IDENTIFICATION

Endorsement

This Bushfire RRAT report informs the approach to bushfire recovery following the 2013 Alpine bushfire of 21 January 2013 to 27 February 2013. The aim of this report is to provide the public land manager/s with a snap shot of priority risks to public assets or values identified following this bushfire event. This report assists with the transition from response to emergency stabilisation and initial recovery in accordance with the Code of Practice for Bushfire Management on Public Land (2012).

A bushfire recovery plan for this fire will consider the risks identified in this Bushfire RRAT report (as deemed appropriate by the land manager). The identified risks in this report are endorsed for consideration by the public land manager in their recovery planning.



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Disclaimer

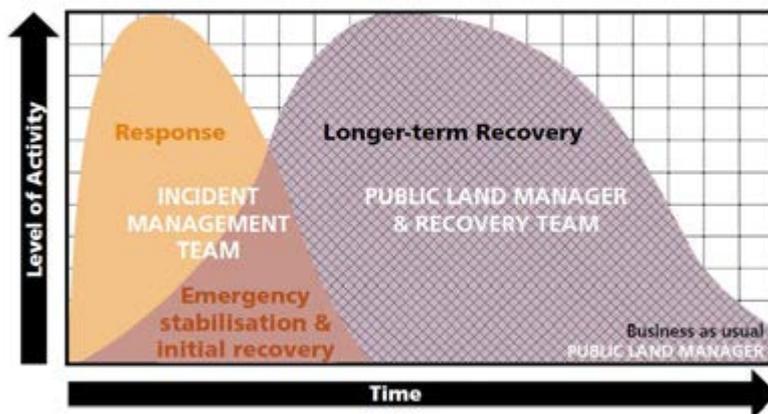
This report is a rapid assessment and is not intended to be a comprehensive report. It has been prepared for the State of Victoria through the Department of Environment and Primary Industries (DEPI) and Parks Victoria (PV), for the purposes of rapid risk assessment to public assets or values following a bushfire event. It may be provided to other agencies for the purposes of information only. It is not to be taken as comprehensive or final. Agencies other than the DEPI and PV rely on this report at their own risk, and should obtain their own advice.

Purpose of this report

This Bushfire Rapid Risk Assessment Team (Bushfire RRAT) report is a rapid assessment completed in five to seven days and is not intended to be a comprehensive report. It is being provided to the recipient for information only and the recipient is advised to obtain their own advice as they see fit.

This report focuses on assessments of potential risk to life and property, critical infrastructure and the environment on public land, including impacts on immediate neighbours.

The Bushfire RRATs are providing intelligence to the 'emergency stabilisation and initial recovery' phase of a bushfire event. They will use the information and data collected during the 'response' phase of the fire, in conjunction with field observations and post fire imagery, to develop the Bushfire RRAT report. The content of this report feeds into 'response' phase work and will inform the development of a recovery plan.



Emergency Stabilisation planning was underway at both Ovens and Swifts Creek Incident Control Centres (ICC), in parallel to the development of this report. Teams are assessing the state of roads, tracks and new control lines and determining the works required. Repair has already been completed in priority areas at risk of erosion (after first rainfall), e.g. East Ovens. The teams are also making an assessment of strategic lines required to be maintained for access for future fire management.

Executive Summary

This Bushfire Rapid Risk Assessment Team (Bushfire RRAT) report documents a rapid risk assessment of the 2013 Alpine Fires: Harrietville-Alpine North and South; Catherine Station- Razor Track and Dargo-Mathesons Track. The report was prepared for DEPI and Parks Victoria as the land managers. Any other agencies using this report do so at their own risk and should obtain their own advice. The risk identification was completed in a week and thus this document is not intended to be a comprehensive report.

The 2013 Alpine Fires started on 21 January and burnt 38,518ha across multiple tenures. Eighty percent of the area, 31,884ha, was in parks and reserves, mainly the Alpine National Park. 6539ha of state forest, 176 ha of private land and a small proportion of the Mt Hotham Alpine resort was also burnt. The fire intensity was patchy across the fire area with an estimated 5011 ha of full crown burn.

This report provides a snapshot of the risks identified following the 2013 Alpine Fires. The assessment is of potential risk to life and property, critical infrastructure and environmental values on public land, including impacts on immediate neighbours.

Emergency Stabilisation planning and repair of priority areas is underway in the Alpine North /Catherine Station and Alpine South fire/ Dargo areas, through the Ovens and Swifts Creek Incident control Centres respectively. Work beyond this phase, which will need to be funded as 'recovery', is therefore included in this assessment. The management of the response to fire is greatly improved on previous years, and thus the need for repair works, and therefore resources, is reduced.

The priority risks are represented on Map 2 and described in Table 1 – *Priority risks*. The top priority risks identified as extreme or high and requiring immediate action are:

- Risks to public safety due to hazardous trees, particularly related to roads and tracks.
- Economic risks associated with decreased tourism due to lack of access to the National Park.
- Risks to public health and the environment from water quality loss, debris flow and erosion
- Potential loss of species or key populations for Dargo Galaxias and Long-footed Potoroo

Other risks of a longer term nature or lower rating include:

- Loss of habitat for National and State listed species including Spotted Tree-frog;
- Loss of Alpine Ash, and other native hardwood trees, and their regeneration capacity.
- Weed invasion by new and emerging pest plant species, and spread of existing weeds.
- Effects of too-frequent fire on certain ecosystems and fire-sensitive flora species.

Should you require further information about the Bushfire RRATs or this report please email bushfire.rrat@dse.vic.gov.au



Sue Berwick
Team Leader
Bushfire Rapid Risk Assessment Team

Date: 1 March 2013

Priority risks

This Bushfire RRAT report identifies risks and has been developed as a result of the **Harrietville-Alpine fire (North & South)**, **Catherine Station-Razor Track** and **Dargo-Matheson Track** fires.

This report identifies potential risk to life and property, critical infrastructure and the environment with a focus on public land and its immediate neighbours. It provides a snapshot of the identified risks following a bushfire event.

See *Figure 1 – Fire location* below for the location of the 3 fires, covered in this report, in Victoria.

See *Figure 2– Fire Overview*, Page 6, for the outline of each fire area, and key geographic features.

See *Figure 3– Priority risks*, Page 7, for the location of most of the priority risks (some cannot be represented at this scale). The ‘Risk ID’ refers to the unique identifier in the first column of Table 1, pages 8 and 9, and the relevant discipline section. The risks on the map are colour coded as extreme (red), high (yellow) and moderate (green). These represents the priority risks identified during this Bushfire RRAT deployment.

Figure 1– Fire location

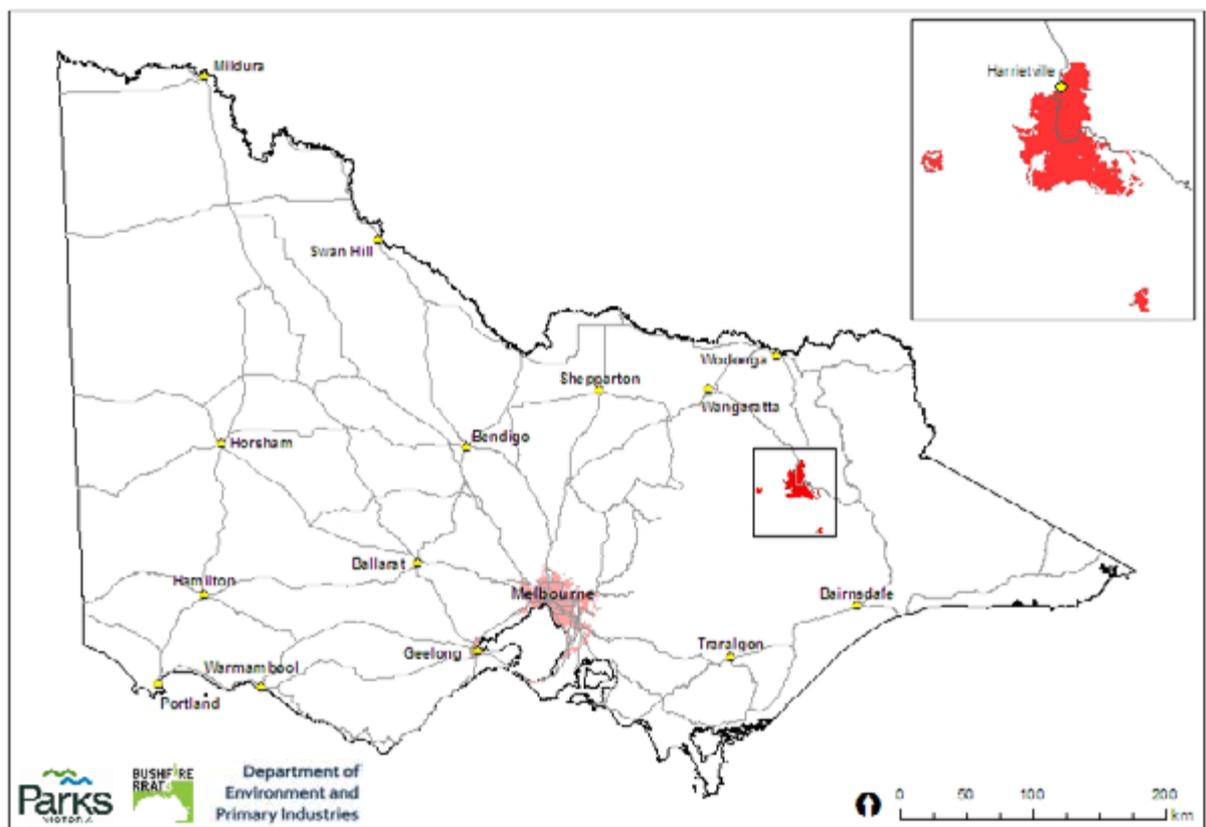


Figure 2– Fire Overview

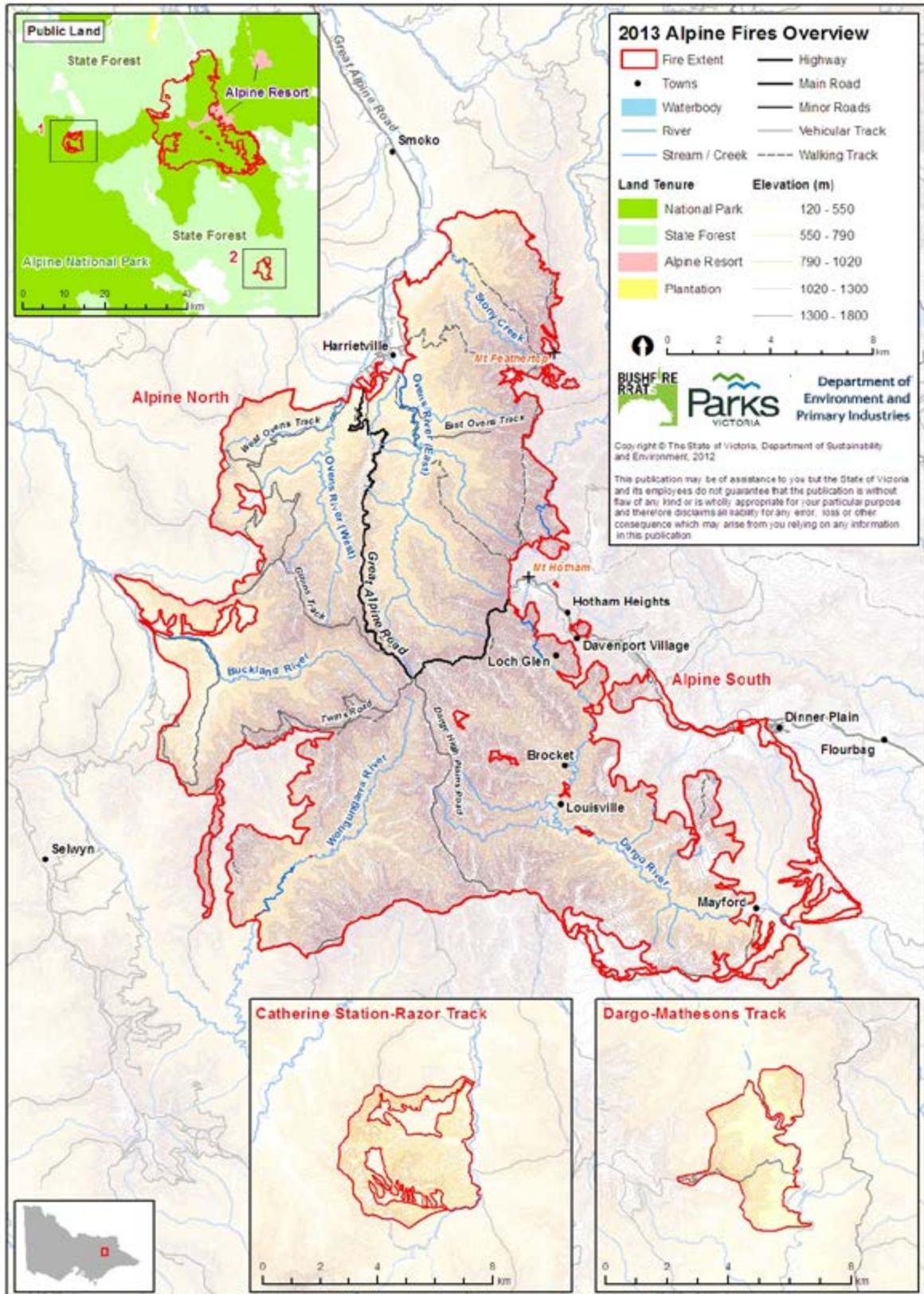


Figure 3 – Priority Risks

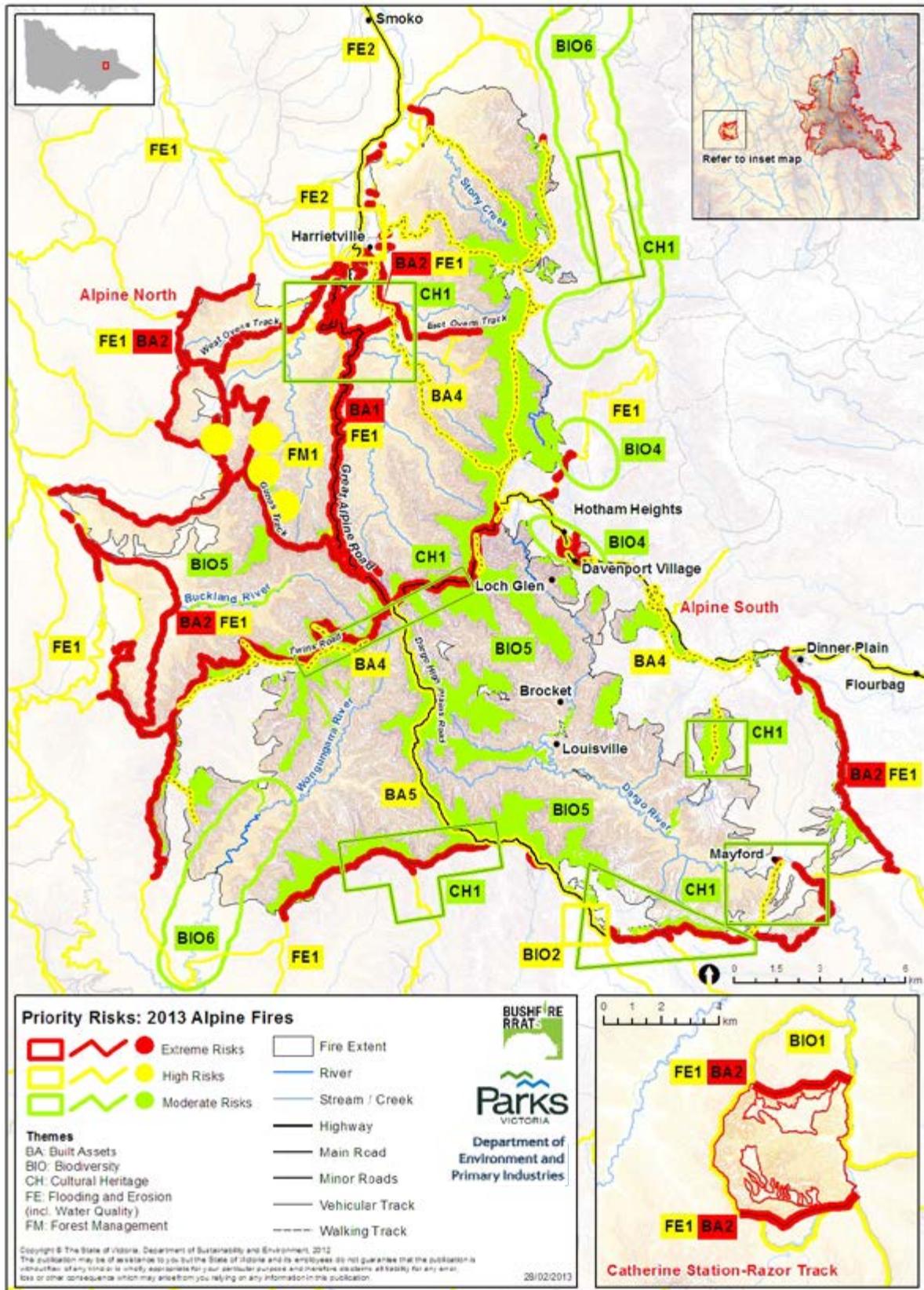


Table 1 – 2013 Alpine Fires Priority risks

Please refer to Appendix 1 – Bushfire RRAT risk tool for a detailed analysis of the risks identified, assessed, prioritised and evaluated.

ID	Asset at risk	Risk description	Emergency Stabilisation / Initial Recovery activities required*
EXTREME RISKS			
BA1	Great Alpine Road	Risk to life & property - trees falling on road, debris flow across road	YES
BA2	Vehicle Tracks	Risk to life & property by trees falling, debris flow, damaged infrastructure	YES
BA3	Tourism	Economic loss - from lack of access, & fire impacts	NO
HIGH RISKS			
FE1	Road Network	Risk to life, property and environment due to sedimentation post extreme rainfall event	YES
BA4	Walking Tracks	Public safety from hazardous trees and damage to tracks	YES
BA5	Dargo High Plains Rd	Risk to life and property by trees falling, damage to infrastructure	YES
Bio2	Dargo Galaxias	Loss of species due to fire or suppression impacts	NO
Bio1	Long-footed Potoroo	Environmental loss – predation nationally listed species	NO
MODERATE RISKS			
FM1	Young Alpine Ash	Economic and environmental loss – inability to regenerate	NO
FE2	Harrietville infra-structure	Economic loss - damage to bridges, infrastructure by floods debris.	NO
Bio3	Ecosystem (weeds)	Environmental loss- weed invasion by Broom, Willow and new species	NO
Bio4	Alpine Fauna	Environmental Loss – habitat impacts for threatened spp.	NO
Bio5	Fire-sensitive flora	Environmental loss – ecosystem change due to too frequent fire in fire sensitive vegetation	NO
Bio6	Threatened Frogs	Environmental loss from suppression, sedimentation	NO
CH1	Aboriginal Artefacts	Loss from suppression activities and erosion	NO

* As defined in the Code of Practice for Bushfire Management on Public Land (2012)

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Introduction

Bushfire RRAT deployment

The Bushfire RRATs were deployed to the 2013 Alpine Fires following a Resource Request from the Ovens IMT (Incident Management Team) Incident Controller to the State Control Centre (SCC) on 20 February 2013.

The objective of this Bushfire RRAT deployment was to assess the risks to public assets or values arising from the fires in the Alpine areas of Mt Hotham, Dargo and Dinner Plain that commenced on 21 January 2013. This deployment was unique in that the Bushfire RRATs team was embedded within the Ovens IMT which enabled greater stakeholder engagement and involvement of local expertise.

After discussions with the IMTs at both Ovens and Swifts Creek, and key Land Manager representatives it was agreed that this assessment would cover the fires known as:

- Alpine-Harrietville North
- Alpine-Harrietville South
- Catherine Station – Razor Track
- Dargo – Matheson Spur

Bushfire RRAT disciplines

The Bushfire RRAT deployed to the Harrietville-Alpine bushfire performed the following tasks, in consultation with land manager and other agencies with fire responsibilities:

- Team leadership – Maintain communication with host agency, team management and report delivery.
- GIS – Develop, maintain and analyse maps and spatial data for Bushfire RRAT field work, risk assessment and reporting.
- Flooding and erosion – Identify flooding, water quality and erosion risks that have emerged as result of the bushfire.
- Built assets – Identify built assets that have been burnt by the bushfire or affected by suppression activities, or are at subsequent risk.
- Biodiversity – Identify the positive and negative effects of the bushfire and suppression activities on flora and fauna. Determine risks that have emerged, or are at subsequent risk
- Cultural Heritage – Identify cultural heritage (both indigenous and European) sites or places that have been affected by the bushfire and/or suppression activities. Determine risks that exist or may emerge.
- Forest management – Identify forest management risks.
- Support and logistics – Provide logistical support for the team and ensure communication is maintained with Bushfire RRATs Coordinator.

Bushfire RRAT personnel

The Bushfire RRAT report for the 2013 Alpine Fires was prepared by the following people.

Table 2 – Bushfire RRAT team members

Discipline	Person	Agency
Team Leader	Sue Berwick	DEPI
Deputy Leader	Robert Marsh	DTPLI
GIS specialist	Andrew Mellor	DEPI
GIS specialist	Shannon Whitty	OAAV
Flooding and Erosion	Charlie Showers	DEPI
Built assets	Kevin Cosgriff	PV
Biodiversity	Jerry Alexander	DEPI
Cultural Heritage	Russell Mullet	OAAV
Forest Science	Shaun Sutor	DEPI
Support and logistics	Jana Boulet	OAAV

DEPI – Department of Environment and Primary Industries

PV – Parks Victoria

DTPLI - Department of Transport, Planning and Local Infrastructure

OAAV – Office of Aboriginal Affairs Victoria

Acknowledgements

The Bushfire RRATs would like to acknowledge the following people and organisations who contributed to the development of this report.

DEPI

Stephen Salathiel, Leith McKenzie, Neil Wilson, Stephen Deed, Ben Rankin, Brett Whitfield, Cath Smith, Carolyn Slijkerman, Mark Lutze, Lionel Dukakis, Glen Johnson, Mary Titcumb, Ryan Incoll, Stephen Henry, Gabrielle Mitchell, Michael Sherwen, Donna Mitsch, John Steer, Nick Clemann, and Tarmo Raadik, Michael Douthat

Parks Victoria

Peter Jacobs, Charlie Pascoe, Mike Dower, Dan Jamieson, Adam Whitchurch, Dave Foster, and Jenny Edwards

VicForests

Bryan Nicholson

North East Catchment Management Authority (NECMA)

Terry McCormack, Tim Loeffler

North East Water (NERWA)

Trent Newton

University of Melbourne

Gary Sheridan

Mount Hotham Alpine Resort Management Board

Georgina Boardman



Fire location and history

Fire description

The fire area and associated analysis in tables 3-6 is as of 25 February 2013 and will differ slightly from the operational size as reported by the Incident Management Team.

Table 3 – 2013 Alpine Fires statistics

Fire location:	15 km south of Bright, north-east Victoria
Fire area (ha):	38518 ha, comprising: 1. Alpine North (35087 ha) 2. Alpine South (820 ha) 3. Dargo-Matheson Track (1112 ha) 4. Catherine Station-Razor Track (1498 ha) 1-4 are collectively named: "2013 Alpine Fires"
Fire start date:	Monday, 21 January 2013
Date fire declared contained:	Thursday, 27 February 2013
% of area within fire boundary burnt:	Nearly 100%

Table 4 – Area burnt by land tenure

Tenure	Area Burnt (ha)	Area Burnt (%)
National Park	30,657	80%
State forest	6,539	17%
Alpine Resort	1,127	3%
Private Land	176	< 1%
Other (including Natural Features Reserve and uncategorised public land)	20	< 1%
Total	38,518	

Table 5 – Area burnt by fire severity class.

Fire Severity Class	Area (ha)
Crown Scorch	11,605
Understorey/Ground Burn	11,387
Burnt (unclassified)*	10,515
Crown Burn	5,011
Total	38,518

* includes cloud/cloud shadow and uncaptured image areas

Land management areas

Table 6 – Land management areas included in the bushfire area

Land management agency type	Agency in the fire area
Parks Victoria	East Region, Alpine District
DEPI	DEPI North East Region
Indigenous groups	GunaiKurnai Aboriginal Land & Waters Corporation Native Title Claim and Mogullumbidj (From Victorian Aboriginal Language Corporation Map)

Suppression methods used

The following control methods were used in the suppression of the 2013 Alpine Fires:

- Suppression (direct attack) using aircraft, tankers and hose lines
- D7 and D8 bulldozers constructed firebreaks and tracked the fire edge
- Widening of existing roads or tracks by bulldozers and excavators
- Hand trails and hose lays prepared by ground crews (mainly on fire edge)
- IMT authorised back-burning initiated by ground crews
- Continuing mop up and patrol until fire declared safe.

Relevant Legislation, Regulations, and Codes of Practice

The following state and commonwealth legislation imposes legal obligations on practices in the fire area:

- *Code of Practice for Bushfire Management on Public Land (2012)*
- *Forest Act 1958*
- *National Parks Act 1975*
- *Heritage Rivers Act 1992*
- *Water Act 1989*
- *Land Act 1958*
- The *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides for the protection and management of threatened native flora and fauna and to enable and promote the conservation of native flora and fauna

Methods

Preparation for the deployment was initiated by the Ovens IMT. A mission statement was developed by the Team Leader with input from Regional Director DEPI North East and Land Managers (PV, Land & Fire). The DEPI Bushfire RRAT Coordinator, Wayne Buckman, organised the deployment.

The assessment was conducted at the Ovens Incident Control Centre (ICC), near Myrtleford, with team members deployed between 5 and 7 days. The Ovens IMT hosted the team and provided logistics support.

Peter Jacobs, Planning Officer, and Tony Long, Incident Controller, at the Ovens ICC briefed the team on 25 February about the history of the fire. The Bushfire RRAT discipline members were introduced to the Ovens IMT and the team's objectives and the purpose of the deployment explained.

An Emergency Management Team (EMT) meeting was held on 26 February at the Ovens ICC. Stakeholder representatives included Alpine Shire, NE CMA, NERWA, Victoria Police, Mt Hotham Alpine resort and Tourism North East. The rapid risk assessment process was presented and input sought.

Each discipline identified public assets or 'values' which were considered to be of highest priority and which may have been directly, or indirectly, affected by the fire and/or suppression activities. Information was obtained from corporate data sources; staff in DEPI, PV, NE CMA, EMT representatives and a variety of reports and local sources.

Air reconnaissance, on 3 separate days, enabled some assessment of the accuracy of the Fire Severity map and Debris Flow map, the extent of burnt regenerating forests, and to identify additional risks. Team members were generally unable to conduct fieldwork due to the weather conditions. Team members discussed the value of the assets and potential risks with the relevant stakeholders.

Each discipline identified main risks areas and labelled these with an individual Risk ID. Descriptions were prepared in tables in the report template. The risks were entered into the Bushfire RRAT 'Risk Tool', with the likelihood and consequence ratings.

A moderated discussion was held between the disciplines on 27 February to agree on the priorities, and amalgamate risks where they intersected two or more discipline areas. A following meeting was held with stakeholders, including North East CMA and land managers, which further improved the assessment of the risks, consequence and likelihood.

More detailed methods for each discipline can be found in the Risk identification and assessment section of this report and Appendix 2. Further exclusions, assumptions, information gaps and field templates can also be found in the appendices for each discipline.

Spatial data

Spatial data for this deployment was supplied by DEPI, Parks Victoria and the Office of Aboriginal Affairs Victoria. Additional topographic data was sourced from Geoscience Australia. Fire severity mapping was prepared by the Bushfire RRAT Rapid Fire Severity Tool (see next section) using RapidEye Imagery, by Steven Salathiel.

The analysis was rapid in nature which imposed some limitations on the assessment. Limited metadata was available for all datasets.

Fire Severity mapping

Fire severity mapping forms the basis of the risk analysis for all disciplines, and in this deployment was only available for the Harrietville-Alpine Fire (North and South). The map product is designed to be an indicative spatial representation of relative severity of the burn across the fire extent.

RapidEye imagery was acquired to undertake the rapid fire severity assessment for the 2013 Alpine fires. RapidEye images have a spatial resolution of approximately 5 m and the product has ISO 9001:2000 certification. The fire severity analysis classification for the 2013 Alpine fires was derived from pre-fire (15/01/2013) and post-fire (25/02/2013) level 3A RapidEye imagery. Within the delineated fire boundary, Normalised Differential Vegetation Indices (NDVI) for pre-fire and post-fire images were generated and compared to visually threshold the post-fire image into three fire severity classes: canopy burn, canopy scorch and understorey burn.

RapidEye imagery was unavailable for approximately 15% of the fire area. A further ~5% of imagery was covered by clouds and cloud shadow. These areas were all assigned to the class burn 'unclassified'.

Key limitations of the 2013 Alpine Fire severity product were associated with recent (2003 and 2007) bushfires in the area. This affected the clear discrimination of crown and understorey burnt areas – particularly in areas of previously crown-burnt Sub-alpine (Snowgum) and Alpine Ash forests. The fire severity mapping for 2013 tended to over predict canopy burn with the presence of standing dead trees.

Information and Data storage

Data and information collated in this assessment are stored on DEPI's shared computer directory, 'R-drive' under the directory for Recovery, in the Bushfire RRAT sub-directory. The report, maps and appendices are also stored in this repository.

Results - Risk identification and assessment

Bushfire RRAT members of the five disciplines and assisted by local staff and subject matter experts identified a large number of potential risks. These risks were entered into the Bushfire RRAT 'Rapid Risk Tool' software.

An open discussion to discuss the nature and likelihood of the risks was held with Bushfire RRAT members and representatives from

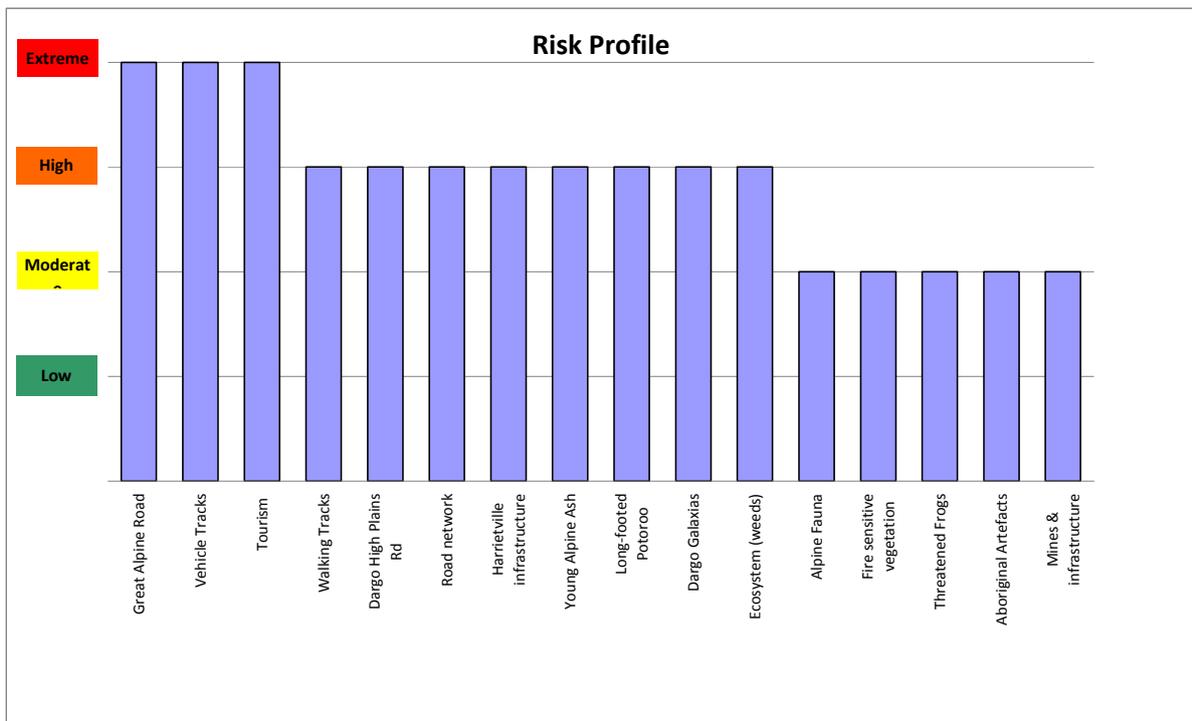
- North East CMA
- Parks Victoria Alpine District
- DEPI Emergency Stabilisation Coordinator Ovens
- DEPI Biodiversity
- DEPI Invasive Species
- Incident Controller and Planning Manager Ovens District

Eleven major (extreme and high) risk areas were identified. The number of major risks in each discipline is: Built assets 5, Biodiversity 6, Cultural Heritage 2, Flooding and Erosion 2, Forestry 1. The group discussed and ranked the relative likelihood and consequence for each risk.

The Bushfire RRAT 'Rapid Risk Tool' output of the risks identified and assessed is recorded in Figure 4.

Three of the risks were assessed to be extreme or high and should be addressed as a matter of priority. Rehabilitation of control lines and minor silt control works has commenced.

Figure 4 – Risks identified and assessed



Each risk assessed is represented by a bar, and the height of the bar indicates the risk (a combination of consequence and likelihood). The risk analysis, and component likelihood and consequence ratings follow the standards in DEPI's Risk Management Guidelines (2012).

Details of each risk assessed are described by discipline on the following pages.

Flooding and erosion

Description

The 2013 Alpine Fire areas occurred exclusively within the East Victorian Uplands of the Great Dividing Range, burning lower slopes and foothills around 400m above sea level within the upper reaches of the Ovens Valley through to the alpine peaks of Mt Feathertop, Mt Smyth, Mt St Bernard and The Twins - each over 1700m above sea level - through to components of the Dargo Plateau around 1500m above sea level, to lower foothills within the Dargo Valley south of the Great Dividing Range around 800m above sea level. The East Victorian Upland landscape is typically dominated by long steep slopes, narrow valleys and ridges and spurs with narrow crests (Jenkins, 1991).

Geology is dominated by Silurian and Ordovician marine sediments that were uplifted in a series of mountain-building events complete by the late Cretaceous 65 million years ago. Typical rock types of this area are mudstones, shales, schists and sandstones. There are isolated areas of Tertiary volcanic basalt flows around Hotham Heights and the Dargo High Plains that form upland plateaus due to differential erosion.

Soils in the burnt area are typical of those derived from the sedimentary and metamorphic geologies of the East Victorian Uplands. Clay loam textured Red or Brown Dermosols dominate the fire area with some Dermosols in the Basalt geologies. Soil profile depth varies markedly across the fire area with the higher elevated wet forest areas typically seeing soil depths of 1 – 3m with a well structured profile consisting of a deep organic black loamy A horizon overlaying a light clay B horizon. These soils are capable of high infiltration rates. (Nyman et al, 2010). Soils in the lower elevations, typically associated with dry forest areas are shallower and less well developed with a stony brown loam A horizon typically overlaying a generally stony B horizon. Soil depths are generally shallow around 0.2 – 1m on hillslopes with outcropping rock common on upper hillslopes and ridgelines such as the Razorback Spur and Mt Feathertop (Nyman et al, 2010). Alpine bogs are common in the basaltic plateau areas, commonly exhibiting deep peat soils that are snow covered for much of the year.

The fire burnt 100% of Harrietville's water supply catchment, the East Ovens River. Runoff from this catchment has already resulted in compromised water quality to the point where the treatment system has been taken off line, necessitating water cartage from an external source. Bright, 25km downstream from Harrietville, has also experienced water quality in the Ovens River beyond a treatable rate due to a rainfall event on 28 February. This necessitated Bright's town supply to be augmented with groundwater.

Methods

The general methods used for flooding and erosion risk assessment have been developed specifically for the upland area of Victoria (Sheridan et al, 2009). The three areas considered include:-

- Debris flow – a GIS tool was developed for the Victorian Uplands using slope, fire severity, catchment position and Victorian Ecological Vegetation Classes to identify risk. This risk assessment is based on extensive research by the University of Melbourne on post-fire debris flows (Nyman et al, 2010)
- Water quality – observations of the intactness of the riparian vegetation and burn severity of the catchment data was analysed to identify potential areas of sedimentation. Riparian vegetation can act as a filter strip to trap and limit sediment movement. The response of streams to previous fires were also used to aid the assessment.
- Flooding - Assessment of the vegetation burn severity and morphology of catchment/sub-catchment and analysis of results from previous fire events.

Risk Identification

Assets at risk

The following assets have been assessed as potentially being at risk from flooding and erosion processes:

- The West Ovens track and a section of the Great Alpine Road from debris flow (see built assets section for detail)
- Roads, forest operation tracks and containment lines from generalised runoff erosion
- Potable water supply in Harrietville, Bright and Dargo
- General infrastructure in Harrietville susceptible to flood inundation
- Aquatic Fauna – Macquarie Perch, Trout Cod, Spotted Tree Frog and Dargo Galaxias (see biodiversity section for detail).

Threat & Trigger

A relatively low amount of rainfall can trigger erosion processes and water quality issues. Rainfall totals of less than 10mm in one day have already created water quality issues for Harrietville's town supply from the East Ovens catchment. Rainfall totals of approximately 40mm in Harrietville and 88mm at Mt Hotham on the 27 February triggered a debris flow in the West Ovens catchment and a significant movement of debris (logs and ash) and suspended sediment downstream into the Ovens River.

Result of threat

Post fire debris flows have been witnessed recently after all major fires in upland Victoria. They require a relatively common rainfall event (2-5 year annual recurrence interval) to initiate the mass movement of soil, rock, ash and vegetative debris in areas of risk. Debris flows pose a threat to life for those in their immediate path and a subsequent risk to water quality as a slug of hyper-concentrated contaminated water is passed downstream.

Surface runoff and erosion from roads, forest operation tracks and containment lines does lead to severely compromised water quality if not properly rehabilitated. Additionally, if road and track drainage structures are not repaired, rehabilitated and maintained the road network itself can be damaged or in parts destroyed.

Post-fire rainfall events and subsequent impacts on water quality can compromise potable water supply in downstream towns. Harrietville and Bright's domestic water supply has already been impacted on by poor water quality post the 2013 Alpine Fires.

The flood risk to Harrietville has been greatly magnified due to both catchment areas of the East and West Ovens tributaries being impacted on by fire, resulting in much higher surface runoff for a given rainfall amount.

Aquatic Fauna may be impacted including Spotted Tree Frog and Dargo Galaxias (see biodiversity section for more detail).

The following risks have been considered and are not thought to be greatly increased as a result of the fire:

- Dargo Water Supply – there is no reticulated town supply in Dargo and although many households utilise extraction from the Dargo Creek most now have rainwater tanks post the 2003 fires that saw water quality in the Dargo creek compromised (Adam Whitchurch personal communication). The local council, Wellington Shire Council, provide a free water tanker for those reliant on the Dargo River for domestic use. Due to the size of the Dargo River catchment there is no mitigation option available to improve water quality.

- Flooding in the Dargo and Wongungarra Rivers – Large areas of these catchments remain unburnt, and there are limited assets in the upper catchment areas at risk from flooding.

Assumptions and gaps

The Matheson’s Tracks and Mt Catherine Stations fires had no fire severity mapping undertaken which limits the amount of spatial analysis that can be done in regards to debris flow risk mapping. It is important to note though that within each of these fire areas there are extensive areas of dry forest, with slopes greater than 25 degrees at catchment headwaters, that if burnt severely will pose a highly probable debris flow risk (1:10 to 1:100 chance) if there is an intense rainfall event.

Risk Assessment and Evaluation

ID: FE1	Asset at Risk: Road Network	
Consequence: Moderate Harm		Likelihood: Almost Certain
Risk level: High		Timeframe: Emergency (0-3 months)
Location Whole fire area and access roads to the fire area		GPS:
General description:		
<p>Within the fire area there is approximately 215km of existing access roads and tracks that were used as containment lines and 70km of newly constructed containment lines in previously undisturbed areas.</p> <p>The existing roads and tracks have been significantly impacted on, resulting in unstable road surfaces and poor drainage. This may, unless rehabilitated, result in extensive damage to the road and track network through erosion processes from rainfall events. Newly constructed containment lines, in previously undisturbed land, likewise need to be rehabilitated to reduce erosion and maintain soil coverage to facilitate the revegetation process. In particular existing tracks and new containment lines created in the East Ovens catchment will need to be thoroughly repaired and rehabilitated as the East Ovens River is the water supply catchment for the township of Harrietville.</p> <p>The ongoing maintenance of culverts and drains by removal of ash and sediment post each rainfall event may assist to protect these assets as blocked culverts can result in further damage to the road surface and potentially complete road washout.</p> <p>The management of runoff and erosion from containment lines and the road network may also reduce the risk of water quality impacts, in particular impacts on the quality of Harrietville’s water supply and aquatic fauna.</p>		
Maps and other documentation: See Appendix 4 and Map 5		

ID: FE2	Asset at Risk: Harrietville Infrastructure Flooding	
Consequence: Moderate Harm	Likelihood: Almost Certain	
Risk level: High	Timeframe: Medium (3-6 months)	
Location Harrietville Township and immediate downstream properties	GPS:	
<p>General description:</p> <p>Both the West and East branches of the Ovens River were impacted on by the Alpine Fire with varying degrees of fire severity. The upper catchment areas were the most severely burnt with extensive crown burning. The lower elevation areas were generally of lower burn severity with only the understorey burning whilst some wet gullies remained unburnt.</p> <p>Harrietville is highly susceptible to flooding even when the catchment areas are unburnt, so the addition of fire in the catchment area magnifies the flood risk to Harrietville significantly. A rainfall event that once may have created a 1 in 10 year flood event may create a 1 in 50 year flood event until the catchment vegetation has re-established.</p> <p>Debris such as burnt logs, sediment and ferns will be, and already have been, washed down the East and West Ovens tributaries, banking up against bridges and damaging the towns water off-take point. The ongoing removal of such debris from bridges and other assets will be an issue for up to 6 months.</p>		
Maps and other documentation: Appendix 4 and Map 5		

Built assets

Description

Man-made assets, or infrastructure, considered in this assessment included: buildings, recreation facilities (such as signs, walking tracks and picnic grounds), roads and vehicle tracks and associated 'furniture' (e.g. gates, signs). The Harrietville-Alpine Fire had the greater proportion of built assets and these are in the National Park, State Forest and Mount Hotham Alpine Resort.

Methods

Methods used to obtain information regarding built assets include:

- Briefing with IMT members (Ovens and Swifts) to ascertain and note critical assets in the fire area and issues that would result from their damage or loss
- Discussion with IMT members about critical roads and bridges in the network affected by the fire
- Noting of tenure mapping to determine private and public land interests
- Aerial inspection of the fire area during flights by Bushfire RRAT members
- Cross-referencing information with asset databases (recreation assets, road network database)

Assumptions and gaps

Specific assessment and identification of hazardous trees has not been undertaken.

Risk Identification

Assets at risk

The following assets have been assessed as being potentially at risk:

- Great Alpine Road, Dargo High Plains Road, vehicle tracks and walking tracks within the fire area at risk from hazardous trees;
- Great Alpine Road and some vehicle tracks within the fire area at risk from landslides;
- Tourism – regional economy will suffer as a result of restricted access, loss of amenity and fear of fire impacts;
- Park and forest recreation infrastructure, such as way-finding signs and gates damaged.

Threat & Trigger

There is a threat to public safety (life and property) from falling trees due to the large amount of burnt trees, combined with the large amount of previously fire-killed Alpine Ash (burnt in 2003), now burnt again. Main areas at risk are along the Great Alpine Road, Dargo High Plains Road and other vehicle and walking tracks within the fire area. The likelihood of these trees falling in the next 3 months is almost certain. There is also the threat of landslides in some sections of the Great Alpine Road, and on some vehicle tracks within the fire area, if a rain event of 20-30mm occurs.

The threat to public safety from the damage to recreation assets, such as way-finding signs is likely.

Result of threat

Hazardous trees present an extreme risk to public safety on the Great Alpine Road, Dargo High Plains Road, vehicle tracks and walking tracks within the fire area. The Great Alpine Road is a major thoroughfare from North East Victoria to Gippsland. These trees will need to be treated in accordance with current departmental hazardous tree policies and guidelines. Public firewood

collection of trees that are fallen during the management of hazardous trees will also require investigation and management, to ensure safety of the public when collecting firewood.

The closure of the Great Alpine Road, the threat of fire and its impact, restricted access to recreation areas and the loss of amenity will also have an impact on regional economy.

Retaining closures on other vehicle tracks within the fire area until the tree risk is managed will have minimal impact on the public or other users.

Details of the Built Assets Risk Assessment follow the Tourism section, as the two are interconnected.

Tourism

Description

The Alpine National Park covers 646,000 hectares and is the State's largest park. It forms a significant nature-based element of Victoria's High Country and Gippsland Tourism regions with Mount Bogong, Mount Feathertop and the rolling high plains being the best known features. Victoria's High Country has a tourism intensive economy worth around \$300 million per year. The park offers excellent camping and hiking, as well as a range of other activities and highlights.

Extensive snowfields are the primary winter attraction, with the warmer months bringing stunning wildflower displays and opportunities for bushwalks, four wheel driving and fishing.

The park is home to more than 1100 native plant species, 12 of which (including the Bogong daisy bush and silky daisy) are endemic, or only found there. Among its fauna is the rare mountain pygmy-possum, the world's only exclusively alpine marsupial, which stores food to last through the winter.

The Alpine National Park is a major contributor to the regions economy. It contains significant natural, cultural, recreational and scenic values that attract over 500,000 visitors each year. Of Victoria's six Alpine resorts, two are adjacent to the Alpine National Park: Falls Creek and Mt Hotham Alpine Resorts. These two resorts make a considerable investment into attracting visitors through marketing campaigns and promotional activities.

Methods

Fire event impacts were determined by a mixture of field observations, knowledge of previous event impacts and desktop analysis. Interviews were conducted with stakeholders, a literature search was undertaken, statistics analysis and a desk top assessment of likely and known impacts on tourism in the region was also undertaken.

Assets at risk

The following assets have been assessed as being potentially at risk:

- Natural amenity
- Built infrastructure ie. walking tracks
- Access to the area
- Reputation of the area as a pristine safe environment

Risks

The main tourism and economic risks arise from a lack of visitor access to the park and damage to infrastructure. The built assets section identifies risks to access and infrastructure.

- Regional economic loss:
Experience from the 2006 fires has demonstrated that limiting access to key visitor assets

within the Alpine National Park has significant and lasting impacts on the regions economy, community well-being and can have longer term impacts on the brand value.

- **Loss of park tourism:**
Accommodation and service businesses within the region rely upon park based attractions for both visitation and maximising length of stay.
- **Loss of visitor experience:**
The reduction in accessible visitor sites and experiences impacts on visitor experience, whilst the increased visitation at remaining accessible sites will have impacts on natural and cultural values.

Assumptions and gaps

Many visitor sites are inaccessible and have not been formally assessed. Satellite and aerial survey have been used to assess impacts and damage.

Risk Assessment and Evaluation

See tables on the following pages for the five main built assets risks, including the National Park-related tourism issue.

ID: BA1	Asset at Risk: Great Alpine Road	
Consequence: Major	Likelihood: Almost certain	
Risk level: Extreme	Timeframe: Emergency (0-3 months)	
Location Harrietville to Mt Hotham Village	GPS: N/A	
<p>General description: Burnt trees along both sides of the road, particularly dead Alpine Ash trees, have the potential to fall on the road impacting on the road surface, and life and property. The road should remain closed until the trees are removed, or made safe. Restricted access will have an economic impact on the surrounding towns as through-traffic is lost. Some areas, particularly around the Meg and the Sambas Mine Track, are also at risk of land slides following a rain event of 20-30mm or more. VicRoads is the responsible authority, in consultation with DEPI and PV for the trees on park or state forest land.</p>		

ID: BA2	Asset at Risk: Vehicle tracks	
Consequence: Serious	Likelihood: Almost certain	
Risk level: Extreme	Timeframe: Emergency (0-3 months)	
Location whole fire area	GPS: N/A	
<p>General description:</p> <p>Burnt trees along roads and tracks within the fire area, particularly previously burnt Alpine Ash trees have the potential to fall on the road, impacting on the road surface, on life and property (vehicles), particularly as emergency stabilisation works continue on tracks. Trees felled as a result of these works will pose a risk to future public firewood collection (fallen trees being in places not appropriate or safe to collect as firewood), management options may consider firewood collection strategies, such as wood collection points.</p> <p>Some recreational assets, such as way-finding signage, visitor information signage, management gates and guide posts are also damaged.</p> <p>A risk of landslides on some vehicle tracks within the fire area also exists. These risks have been identified on the West Ovens Track and on the northern end of the Gunns Creek Track.</p>		

ID: BA3	Asset at Risk: Tourism	
Consequence: Major	Likelihood: Almost certain	
Risk level: Extreme	Timeframe: Emergency (0-3 months)	
Location whole fire area	GPS: N/A	
<p>General description:</p> <p>Tourism visitation in and around the fire affected area has ceased during the emergency response phase of suppressing the fire. This is due to restricted access, loss of amenity, and fear of fire and its impact. This will likely continue in the short to medium term. This loss has a negative flow on impact in the local and regional economy.</p>		

ID: BA5	Asset at Risk: Dargo High Plains Road	
Consequence: Serious		Likelihood: Likely
Risk level: High		Timeframe: Medium term (3-6 months)
Location Mt Hotham Road to Blue Rag Track		GPS: N/A
<p>General description: Burnt trees along both sides of the road, particularly previously burnt Alpine Ash trees have the potential to fall on the road, impacting on the road surface, on life and property (vehicles). The road surface has also suffered damage.</p>		

ID: BA4	Asset at Risk: Walking tracks	
Consequence: Serious		Likelihood: Likely
Risk level: High		Timeframe: Medium term (3-6 months)
Location Mt Feathertop area, and Australian Alps Walking Track		GPS: N/A
<p>General description: Walking tracks in the Mt Feathertop area and the Australian Alps Walking Track in the Twins area have been impacted by fire. Dangerous trees exist along walking tracks. Track surfaces are damaged, wooden steps and drainage have been impacted, and trees have fallen across tracks. Some way-finding and visitor information signage is also damaged, as well as some park furniture (picnic tables, BBQ's).</p>		

Biodiversity

Description

The 2013 Alpine Fire area encompasses a broad range of vegetation types including Heathy Dry Forest at the lower elevations to Alpine Coniferous Shrubland; a suite of natural values including Commonwealth and State listed threatened flora and fauna species (see Appendix 6); and threatened vegetation communities including Alpine Sphagnum Bogs and Associated Fens Ecological Community have been recorded from the area. The predominant bioregions are Victorian Alps, Highlands – Northern Fall and Highlands – Southern Fall. Occurrences of Endangered and Rare Ecological Vegetation Classes (EVCs) can be found within the fire area, for example: Sub-alpine Wet Heathland (Endangered, 26 ha) and Alpine Grassy Heathland (Rare, 309 ha). Fire sensitive flora recorded from within the fire area are listed in Appendix 6.

The following prescriptions were developed for the key threatened species and incorporated into planning and operations during the fire suppression operation.

Mountain Pygmy-possum (*Burramys parvus*)

- All Type 1 and Type 2 habitat should be identified on the ground so that all machinery and vehicles are excluded;
- Amalgamate habitat patches into one polygon so that suppression works do not create any soil disturbance within the polygons; and
- If feasible, water bombing could occur on some of the key population sites (e.g. Mt Loch, Mt Higginbotham).

Spotted Tree Frog (*Litoria spenceri*)

- No off-track soil disturbance / dozer line construction;
- Use water for suppression; and
- No foam / retardant application near waterways.

Long-footed Potoroo (*Potorous longipes*)

- No new tracks to be constructed;
- Minimise earthworks wherever possible; and
- Minimise crown scorch during back-burning operations.

Dargo Galaxias (*Galaxias* sp.6)

- Exclude phoscheck from catchment and machinery from riparian areas.

Methods

Information was sought on threatened species, vegetation communities and other natural value assets within the fire area, as well as fire severity and history. Flora and fauna records were obtained from the Victorian Biodiversity Atlas. Vegetation information was from the DEPI Corporate GIS layer of EVCs.

Discussions with local Parks Victoria and DEPI Biodiversity staff and other specialists identified several key fire-sensitive species within the lists, and also identified other relevant sources of information

Mapped data of threatened species (Mountain Pygmy-possum, Long-footed Potoroo and Spotted Tree Frog) habitat provided detailed information on areas to be assessed. Dan Jamieson provided valuable insight into the interpretation of the Tolerable Fire Interval dataset. Mary Titcumb did the analysis on the fire sensitive flora species.

No field assessments were undertaken during the deployment.

Consultation with staff from Parks Victoria, Arthur Rylah Institute, Land and Fire DEPI and Mt Hotham Alpine Resort Management Board provided valuable background and advice.

Assumptions and gaps

No field inspection was possible during the deployment, so many of the assumptions have been extrapolated from mapped information.

Detailed data are available on taxa that have had recent investigation (e.g. Mountain Pygmy-possum, Spotted Tree Frog and Long-footed Potoroo) and mapped information of known sites. This knowledge has allowed for a more accurate assessment of the possible effects of the fire. Post-fire studies like that initiated on the alpine reptiles have made it easier to comprehend where immediate management actions may be required. The occurrence of other species, such as Spotted-tailed Quoll, is less well known.

The Alpine Sphagnum Bog community is known to occur within the fire area, but will need field assessment to confirm if it has been impacted by the fire.

Several flora species are expected to re-sprout or respond reasonably well to fire and are not considered high risk.

Risk Identification

Assets at risk

The data for the fire area identified a total of 30 threatened fauna and 127 threatened flora species. Of these the following assets have been assessed as being potentially at risk (see Appendix 6):

- 15 threatened fauna species (8 EPBC listed and all FFG listed);
- One community listed under the EPBC Act;
- 12 EVCs categorised as either Endangered or Rare (500 metre buffer applied to the fire area);
- 19 fire sensitive flora species (utilising Victorian vital attributes and NSW data).

The fire burnt 39,500 ha of the Alpine National Park including FFG listed alpine vegetation communities.

The following assets have been assessed as being potentially at risk:

- Long-footed Potoroo Great Dividing Range population (BIO1);
- Dargo Galaxias (*Galaxias* sp.6) (BIO2);
- Alteration to the ecosystem due to weed invasion (BIO3);
- Alpine fauna, including Mountain Pygmy-possum, Alpine She-oak Skink, Guthega Skink, Alpine Tree Frog, Alpine Water Skink, Alpine Bog Skink (BIO4);
- Alteration to the ecosystem due to too frequent fire (BIO5); and
- Spotted Tree Frog catchment (BIO6).
- Macquarie Perch and Trout Cod (cross reference to FE1).

Threat & Trigger

There is a threat of sedimentation into the waterways negatively impacting on aquatic values, this includes threatened species downstream of the fire area such as Macquarie Perch and Trout Cod. This has been exacerbated in areas where control lines have impinged on drainage lines or there has been excessive native vegetation removal. Loss of cover and shelter sites increase predation levels on threatened species. Too frequent fire does not allow for natural regeneration to occur. Chytrid fungus may be a threat to aquatic values. Increased browsing by introduced herbivores will negatively impact on the fire regeneration.

Result of threat

The major risks concern loss of habitat for threatened species, loss of significant species, weed and pathogen invasion, vegetation communities burnt outside of their tolerable interval and increased browsing on post-fire regeneration. It should also be noted that some species may benefit from the fire; e.g. regeneration of several flora species.

A preliminary analysis has revealed that about 80% of the total area has now been burnt outside of the recommended Tolerable Fire Interval (TFI). Of the EVCs considered to be most sensitive to fire (E.g. Montane Riparian Thicket, Shrubby Damp Forest, Sub-alpine Woodland) have mostly been burnt outside of their TFI.

Risk Assessment and Evaluation

ID: BIO 1	Asset at Risk: Long-footed Potoroo – Great Dividing Range population	
Consequence: Important		Likelihood: Almost certain
Risk level: High		Timeframe: Short to Long term
Location Barry Mountains – Great Dividing Range		GPS:
<p>General description: The Great Dividing Range encompasses one of three extant populations of the Nationally Endangered Long-footed Potoroo. Part of its habitat was burnt during the 2003 Bushfire with additional habitat burnt in 2006/2007. Some of this area has been burnt twice.</p> <p>Detailed studies were initiated to evaluate the efficacy of the previous reserve system, baiting program and impacts due to the effects from the fires. Long-footed Potoroos were found to be strongly negatively associated with the occurrence of Red Foxes and were detected in a higher proportion of unburnt or lightly scorched sites compared with the more severely burnt sites (Lumsden <i>et al.</i> in prep¹). The fox baiting program has had to be postponed until the fire ground is suitable for resurrection of bait stations.</p> <p>Primary Long-footed Potoroo Habitat (Damp Forest, Wet Forest and Riparian Forest EVCs) and an area of high predicted probability of occupancy have been impacted by the 2013 Alpine Fire. Removal of shelter, breeding and critical foraging sites by the fire is almost certain to result in lower population viability and the species becoming even more vulnerable to predation.</p> <p>Isolated historic and recent detection sites, including Primary Habitat, have been burnt by the main fire. The Catherine Station Razor Track Fire has impacted on the highest density of historic sites. Anecdotal accounts of sightings were reported back to IMT during the suppression operation.</p> <p>Long-footed Potoroo feed almost solely on underground fungi that are influenced by disturbances such as fire. The change to the food source after fire is currently not well understood.</p>		
Maps and other documentation See Appendix 6 and Map 2		

¹ Lumsden, L., Scroggie, M., Chick, R., Howard, K., Woodford, L., Alexander, J. Pascoe, C. and Gillespie, G. (in prep). Assessing management strategies and wildfire impact on Long-footed Potoroos in the Great Dividing Range, Eastern Victoria.. Arthur Rylah Institute for Environmental Research Technical Report Series No. xxx. Department of Sustainability and Environment, Heidelberg, Victoria

ID: BIO 2	Asset at Risk: Dargo Galaxias (Galaxias sp.6)	
Consequence: Catastrophic	Likelihood: Possible	
Risk level: Extreme	Timeframe: Short (0-3 months)	
Location Lightbound Creek which drains the Dargo High Plains into the Dargo River	GPS:	
<p>General description: The global distribution for Dargo Galaxias is in the headwaters of the Lightbound Creek found upstream and downstream of where it crosses the Dargo High Plains Road (-37.10906 147.16121), extending downstream about 3 km to a large set of falls (Tarmo Raadik pers.comm.). Lightbound Creek runs next to Lankey Plain Hut and so any fire retardant used on that structure is likely to have entered the waterway via the small drainage channels - the creek itself is only about 50 m from the hut in a downhill direction.</p> <p>Any suppression works in the Lightbound Creek catchment, for example fire breaks, will need to be assessed for potential erosion. Swampy soaks upstream of the Dargo High Plains are also part of the catchment for Lightbound Creek and may be impacted by the use of fire retardant or other physical disturbance.</p>		
Maps and other documentation See Appendix 6 and Map 2		

ID: BIO 3	Asset at Risk: Ecosystem (weeds)	
Consequence: Serious	Likelihood: Likely	
Risk level: High	Timeframe: Short to Long term (6+months)	
Location 2013 Alpine Fire	GPS:	
<p>General description:</p> <p>Any soil disturbance or removal of vegetated cover would result in greater susceptibility to weed invasion. This includes potential damage to the Nationally Endangered Alpine Sphagnum Bogs and Associated Fens Ecological Community. Vehicle hygiene standards may have varied during the suppression operation.</p> <p>Close, on-going monitoring will be required across the entire fire area to detect weed invasion and outbreaks of new and emerging weeds.</p> <p>The Wongungarra catchment was considered to be blackberry free prior to the 2013 Alpine Fire and will need special attention during any post fire surveys.</p> <p>Investigation of the Alpine Sphagnum Bogs and Associated Fens Ecological Community will be required to determine extent and degree of impact from the fire.</p>		
Maps and other documentation See Appendix 6 and Map 2		

ID: BIO 4	Asset at Risk: Threatened Alpine Fauna habitat	
Consequence: Serious	Likelihood: Likely	
Risk level: High	Timeframe: Short to Long Term (6 months plus)	
Location Mt Hotham, Dargo High Plains	GPS:	
General description:		
Threatened Alpine Fauna includes Mountain Pygmy-possum, Alpine She-oak Skink, Guthega Skink, and Alpine Tree Frog.		
Mountain Pygmy-possum habitat in the Mount Hotham, Little Mount Higginbotham area may have been burnt - impacts to be confirmed by Georgina Boardman MHARMB.		
A spot fire burnt a patch on 30 January 2013 (29.1 ha), below the CFA fire station. Another smaller patch (0.6 ha) burnt to the north west of Little Mount Higginbotham. These areas will need to be ground-checked for fire severity.		
Detailed mapping for Mountain Pygmy-possum (Type 1 and Type 2 habitat) is available.		
Standardised survey protocol has been developed for all species.		
Other species potentially affected by loss of habitat include Alpine Water Skink and Alpine Bog Skink. These species may also be more vulnerable to predation due to loss of cover.		
Maps and other documentation See Appendix 6 and Map 2		

ID: BIO 5	Asset at Risk: Fire Sensitive Flora	
Consequence: Serious	Likelihood: Possible	
Risk level: Moderate	Timeframe: Short to Medium Term (6 months plus)	
Location Whole fire area	GPS:	
General description:		
Too frequent occurrence of bushfire can cause ecosystem changes as fire-sensitive flora is unable to regenerate naturally and being burnt below their minimum tolerable fire interval. This is in part due to the fact the soil seed bank has not had time to recover from previous fire events. This can increase the risk of local species extinction, increase the spread of weeds, and reduce the viability of the vegetation in the fire impacted area. There are multiple rare and endangered flora-species and communities in the fire area.		
Maps and other documentation See Appendix 6 and Map 2		

ID: BIO 6	Asset at Risk: Threatened Spotted Tree-frog habitat	
Consequence: Important	Likelihood: Likely	
Risk level: Moderate	Timeframe: Short to Long term (6+ months)	
Location Wongungarra River and West Kiewa catchments.	GPS:	
<p>General description:</p> <p>Spotted Tree Frog habitat in the Wongungarra catchment will need immediate investigation to ascertain the degree of impact by the fire suppression operation.</p> <p>The Wongungarra catchment will need to be assessed for weed invasion, sedimentation and retardant contamination and treatments initiated as required.</p> <p>Chytrid fungus is known to adversely impact on Spotted Tree Frog populations and has been implicated in local extinctions. Machinery and human movement may cause the inadvertent spread of the chytrid fungus into Spotted Tree Frog catchment.</p> <p>Refer to “Procedures for minimising the transfer of chytrid fungus between frog populations” prepared by Peter Lawrence and Jenny Edwards, Parks Victoria, East Region with assistance from Nick Clemann (Arthur Rylah Institution, DEPI).</p> <p>Control lines have been built in the catchment to the west of the West Kiewa, but effects on Spotted Tree Frog habitat may be negligible. West Kiewa is as at a lesser risk from direct impacts of the fire suppression and hence future sedimentation following a rainfall event.</p>		
Maps and other documentation See Appendix 6 and Map 2		

Cultural Heritage

Description

There are 13 Aboriginal Places registered within the fire extent, another 65 Aboriginal Places are registered on roads/tracks that were being utilised for fire containment lines. There are six registered historic sites within the fire affected area; these sites are associated with mining.

The most common cultural site types in the region are isolated artefacts, artefact scatters, possible caves, rock shelters, ceremonial areas and historic sites associated with the mining and timber industries. The nature of the cultural heritage values is closely linked to the topography, elevation, vegetation and geology of the area.

Aboriginal groups associated with the area are the GunaiKurnai and Mogullumbidj tribes. Tribal boundaries associated with water flow from the Great Divide can be loosely used to separate the Clans, although shared boundaries are common practices.

A significant difference from the way past fires have been managed is the utilisation of Cultural Values Officers (Department of Environment and Primary Industries) and Technical Advisors (Office of Aboriginal Affairs Victoria) who provided data and advice for Planning Units in the IMT. This reduced the risk of harm that fire and fire suppression methods pose to cultural heritage.

Methods

A desktop analysis of the fire area assessed the following:

- Areas where registered Aboriginal Places are located, sensitivity mapping and predictive archaeological statements from the Victorian Aboriginal Heritage Register
- Areas where registered historic sites are located
- Likely impact of fire and fire suppression activities on cultural site types using the fire severity map and mapping of fire containment lines.
- Information received from the Cultural Values Officers (CVOs)

Analysis focussed on areas where there was high burn severity leading to severe vegetation loss, constructed fire control lines in areas of registered Aboriginal Places, areas of high archaeological potential and registered Historic sites. Areas of high potential that were subject to low fire severity and no fire control lines were excluded from the assessment.

Additional information received from CVOs identified five locations where there was a high risk that cultural sites have been affected by the fire or suppression activities. No field assessment has been carried out in these locations.

Assumptions and gaps

Predictive modelling for the study area points to Aboriginal Places being in sheltered areas associated with water, good solar radiation such as northern facing slopes, locations above cool air drainage and above frost hollows. Travel routes are from the lower, warmer valleys to the high plains via ridgelines leading to the areas of the high Alps associated with Bogong moth habitats.

The major impact from fire is the loss of vegetation, followed by erosion leading to loss of spatial and temporal integrity. High fire temperature can affect the structure of stone tools, causing spalling and glazing, but little loss of information. Fire damages and destroys built cultural assets, and loss of vegetation can lead to exposure of historic sites to collectors and fossickers. Fire suppression activities such as the construction of control lines can result in major damage and destruction to Aboriginal Places.

Targeted field assessments need to be undertaken with Traditional Custodians and Aboriginal Community members to:

- locate registered Aboriginal Places and document specific management requirements;

- record any Aboriginal Places that may have been revealed through reduction of vegetation cover or exposed as a result of fire suppression activities and document specific management requirements.

Risk Identification

Assets at risk

The following assets have been assessed as being potentially at risk:

- Aboriginal Places comprising isolated artefacts and artefact scatters, and potential for new discoveries of rock shelters listed in Appendix 7.1 (Map Areas 1-7)
- Aboriginal landscapes that have spiritual and cultural significance
- Historic sites listed in Appendix 7.1 (Map Areas 8/9)

NOTE: Access to specific location information is restricted.

Threat & Trigger

The following events may cause harm to cultural heritage values and hence a cultural and spiritual loss to Traditional Custodians and Aboriginal community's knowledge:

- Traditional travel routes, camp sites and ceremonial areas, that may have been directly impacted by fire or fire suppression activities
- Aboriginal stone artefact scatters that are associated with the above site types that may be disturbed or destroyed by emergency stabilisation or rehabilitation activities;
- Post –contact heritage sites that have been exposed by loss of vegetation;
- Unrecorded or unrealised cultural heritage values;
- Public safety issues where vegetation loss will exposure mining sites.



Photo: Blue Rag Range containment line (Traditional Travel Route)

Result of threat

The major impact from fire is loss of vegetation, followed by erosion leading to loss of spatial and temporal integrity. Fire suppression activities can result in major damage and destruction to Aboriginal cultural heritage. Fire damages and destroys built cultural assets, and loss of vegetation can lead to exposure of historic sites for example: mine shafts / adits which can, potentially be, a very high risk to public safety and be open to collectors and fossickers.

The *Aboriginal Heritage Act 2006* provides protection for Aboriginal cultural heritage sites regardless of their registration status, meaning that both disturbed and undisturbed Aboriginal places have the same legal protection. Emergency stabilisation or rehabilitation works may have the potential to impact on cultural heritage values, and actions to protect places needs to occur as part of the works planning.

Risk Assessment and Evaluation

ID: CH1	Initial Risk: Moderate
Risk Title: Damage or destruction to Aboriginal Cultural Heritage and historic sites	
Locations: As shown in Appendix 7.1(Area 1-7)	Timeframe: Short to long term
General description: Vegetation loss and erosion resulting in loss of integrity in Aboriginal Places; Fire suppression activities resulting in exposure and damage to Aboriginal Places; Exposure and scavenging in historic sites; A field survey will identify, prioritise and document management recommendations for sites most at risk.	
Maps and other documentation See Appendix 7 and Map 4	

Forest Management

Description

The forests in this region contain important environmental and cultural values and economic resources that form the basis of a thriving tourism and sustainable timber industry. They also provide minor forest produce and valuable water resources.

The predominant forest types in the burnt area in both the Alpine State forest and the Alpine National Park include Alpine Ash, Mixed Species, Peppermint Gum and Snow Gum. A significant proportion of the fire affected area was previously burnt in 2003, and again in 2007.

The Alpine Ash, which is of particular importance to the timber industry, has relatively thin bark, and as a result is killed by hot fires. Fire causes most damage to immature Alpine Ash forests that are too young to produce seed, or in older stands that are not carrying a sufficient seed crop when they are burnt. In the absence of the regeneration capability exhibited by the non-ash eucalypts, ash forests killed under these circumstances require human intervention to ensure their regeneration.

Due to its vulnerability, inability to self regenerate, and timber value, immature fire-killed ash regrowth is the highest priority for DEPI's forest recovery programs.

Ash forests are not the only type susceptible to fire, young stands of all species are susceptible to fire damage and may not have the ability to self-regenerate. This is particularly relevant to Snow Gum stands, which in some cases have suffered three severe burns in ten years.

Methods

A desktop analysis of verbal, photographic, and spatial information provided by local DEPI forest managers and Parks Victoria staff, was undertaken to determine the impact of the 2013 Alpine Fires on National Park and State forest regeneration, forestry activities, firewood supply, apiary sites and the recreational use of forests.

Assumptions and gaps

This work was done as a desktop analysis and definitive data on the fire severity of this, and of past fires, was not available. Therefore extensive field verification is needed to determine the actual impact and subsequent level of remediation activities required.

Assets at risk

The fire burnt over a significant area of young and mature forest, much of which was also burnt in the 2003 and 2007 fires in the Alpine State forest and the Alpine National Park. The fire also burnt over a number of apiary sites within the fire area, and may impact sites outside the fire footprint. Additional details of the apiary impacts are detailed in FM3.

Risks

Risk 1) Loss of young Alpine Ash

The fire burnt over 1,600 ha of Alpine Ash in the Alpine State forest and 9,000 ha (early analysis suggests that 6,000 ha may be fire killed) of Alpine Ash in the Alpine National Park. Large portions of this forest were also burnt in 2003 and 2007.

Frequent high intensity fire events in this area will result in the death of significant areas of Alpine Ash and possibly Snow Gum forest. Due to the frequency of fires in the last ten years in these areas being greater than the species' tolerable fire intervals, it is unlikely that these communities will regenerate naturally. This may result in these areas converting to shrublands or potentially even grasslands.

There is an additional risk that if all suitable areas are not sown within the first winter following the fire, the areas will need to be cleared and mechanically disturbed before it is sowed due to the regrowth of other plants that may out compete the sown species.

Also, approximately 200,000 tonnes of carbon may have been lost to the atmosphere as a result of the 2013 Alpine Fire. Note that these calculations have been made assuming that all forest burnt was mature. Considering that large areas of these forests were burnt in 2003 and 2007, this figure should be treated with caution and a more detailed analysis factoring in forest age, is required.

Risk 2) Loss of mature Alpine Ash forest in Alpine State forest

There is <200ha around the Gunns Creek Track which may be fire-killed. This forest is of commercial interest and needs to be harvested before it becomes un-merchantable in approximately two years.

Risk 3) Fire affected apiary sites

Five apiary sites are within the fire affected area and seven are within 500 metres of the burn area. The fire will also have a significant impact on floral resources for the near future. There may also be access issues for some sites outside the fire affected area.

Risk Assessment & Evaluation

ID: FM1	Initial Risk: High
Risk title: Loss of young Alpine Ash and other vegetation communities	
Location: Alpine State forest	Timeframe: Short to long term (6 months)
<p>General description:</p> <p>Alpine Ash is generally killed by moderate fire intensity, and young forests have a higher susceptibility to fire. Areas of less than 25 years of age generally have an inability to regenerate because of an insufficient seed crop in the canopy and soil.</p> <p>The fire burnt over 1,600 ha of Alpine Ash in State forest and over 9,000 ha in national park (of which up to 6,000 ha may be fire killed). This forest was also burnt in 2003 and 2007. Over half of this area was either crown scorch or crown burn and will likely require artificial regeneration.</p> <p>Around 3,700 ha of Snow Gum stands in the Alpine National Park, with an additional 200 ha in the State forest, were also burnt at a high intensity in 2013. Many of these areas were also burnt in 2003 and 2007; subsequently they may suffer regeneration issues. Before 2003, these areas had not been burned since the 1939 Black Friday fires.</p> <p>There are ecological consequences of high intensity fires burning so frequently in tall mountain forests. A situation could arise where vegetation is converted to a type which perpetuates frequent fire. The forests' environmental services – such as water, carbon and habitat – are severely compromised or at least heavily modified.</p> <p>Applied to the example here, it can be argued that at least 7,500 ha of Alpine Ash forest is likely to be converted to shrublands or potentially even grasslands, unless the area is actively replanted.</p> <p>It also raises questions whether, presently and in the future, human intervention is required and certain ecosystems actively managed to ensure they retain their desired values.</p> <p>There is currently no policy position on the regeneration of fire killed forests in national parks.</p> <p>There is also the additional risk that that if all suitable areas of Alpine Ash are not sown within the first winter, the site will need to be cleared and mechanically disturbed before it is sowed.</p>	
Maps and other documentation: See Appendix 8 and Map 6	

ID: FM2	Initial Risk: unrated
Risk title: Loss of mature Alpine Ash forests within State forest, which may require salvaging	
Location: Alpine State forest, Gunns Creek Track	Timeframe: Short to long term
General description:	
<p>Much of this forest is young due to recent fires, and a lot is not of commercial interest due to the terrain. However, there is <200ha around the Gunns Creek Track which may be fire killed and of commercial interest.</p> <p>The responsibility for the timber harvesting is with Vic Forests, and hence this issue is not progressed in the assessment or report.</p>	
Maps and other documentation: See Appendix 8 and Map 6	

ID: FM3	Initial Risk: Low
Risk title: Fire affected apiary sites	
Location: Alpine National Park and Alpine State forest	Timeframe: Short to long term
General description:	
<p>Five apiary sites are within the burn area and seven are within 500 metres of the burn area. This will also have a significant impact on floral resources for the near future. There may also be access issues for some unaffected sites.</p> <p>This issue is of a relatively minor nature, and thus is not progressed in the report.</p>	
Maps and other documentation: See Appendix 8 and Maps 5	

Glossary and acronyms

Term	Explanation
Assess	Phase of risk management where risks are assessed (consequence v likelihood)
Asset	Recognised feature of the land that has community value. This includes buildings, infrastructure (roads, bridges, etc.), regenerating forests, forest produce (sawlogs, pulpwood, firewood, honey, etc.) and conservation and cultural heritage values. It may include impacts to community (job loss).
Bushfire RRAT	Bushfire Rapid Risk Assessment Team
Consequence	The benefit or harm should it occur
DEPI	Department of Environment and Primary Industries
Emergency	A sudden, urgent, usually unexpected occurrence requiring immediate action.
Emergency stabilisation and initial recovery	Short term recovery phase. Can commence as soon as resources are available and before the IMT closes.
Evaluate	Phase of risk management where risks are evaluated. Practical treatment solutions and approximate costs derived.
Identify	Phase of risk management where risks are identified
IMT	Incident Management Team - A group comprising the Incident Controller and the personnel responsible for operations, planning and logistics.
Likelihood	The probability that the benefit or harm will occur.
Long	A phase of fire management recovery that follows the short term (emergency stabilisation and initial recovery) recovery phase. There is no urgency to manage these risks.
Longer term recovery	Managed by the land manager once the Response phase is finished and the IMT has closed.
Medium	Management of these risks is not urgent but should be managed once the 'emergency stabilisation and initial recovery' actions have been managed.
NECMA	North East Catchment Management Authority
NERWA	North East Water
OAAV	Office of Aboriginal Affairs Victoria
PV	Parks Victoria
Response phase	The processes, procedures and actions taken to combat the fire. Active suppression of the fire.
Risk	The potential for future harm to life, critical infrastructure or the environment caused by the event. Multiplication of likelihood and consequence.

Map list

Map 1 – Fire Severity

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Map 3 – Built assets

Map 4 – Cultural heritage

Map 5 – Flooding and erosion

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Appendix List

Appendix 1 – Bushfire RRAT risk tool – Identification, Assessment, Prioritisation and Evaluation

Appendix 2 – Risk assessment methods

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Appendix 4 – Flooding and erosion field assessment photos

Appendix 5 – Asset management further information

Appendix 6 – Biodiversity further information

Appendix 7 – Cultural Heritage further information

Appendix 8 – Forest Management further information

Appendix 1 – Bushfire RRAT risk tool

Risk Identification					Risk Analysis				
ID	Discipline	Asset/value at risk	Hazard / Trigger	Risk category	Risk description	Location	Consequence	Likelihood	Risk Level
BA1	Built Assets	Great Alpine Road	Trees falling on road; land-slide potential exacerbated by tree removal works	People (public safety)	Injury or fatality; financial loss due to loss of access.	Harrietville to Dinner Plain	Major	A. Almost Certain (Annually)	Extreme
BA2	Built Assets	Vehicle Tracks	Trees falling on tracks; debris flow; firewood collection	People (public safety)	Suppression impacts - new control lines, brushed up tracks; Loss of access, signs and road furniture; public safety risk	Whole fire area, Blue Rag & Long Spur extensions	Serious	A. Almost Certain (Annually)	Extreme
BA3	Built Assets	Tourism	Loss of access to public land and recreational sites	Economy	Loss of amenity of public land; lack of visitation; fear of the fire impacts	Alpine National Park	Major	A. Almost Certain (Annually)	Extreme
BA4	Built Assets	Walking Tracks	Trees falling on tracks	People (public safety)	Loss of access and public safety	As marked	Serious	B. Likely	High
BA5	Built Assets	Dargo High Plains Rd	Fire suppression impacts, Trees falling on road	People (public safety)	Damage to gates, camp sites Injury due to accidents	Dargo High Plain	Serious	B. Likely	High
FE1	Flooding & Erosion	Water quality and roads	Rain on damaged roads and containment lines rainfall of 30mm; unauthorised access by public	Infrastructure	Water quality loss and infrastructure damage, exacerbated by public	Harrietville, Dargo and Whole fire area	Important	A. Almost Certain (Annually)	High
FE2	Flooding & Erosion	Harrietville infrastructure	Flood water	Infrastructure	Damage to bridges and private. Reputational risk	Harrietville West and east Ovens	Important	A. Almost Certain (Annually)	High
FM1	Forest Mgt	Young Alpine Ash	2nd & 3rd Fire	Economy	Inability to regenerate	Whole fire area	Serious	B. Likely	High

Appendix 1 – Bushfire RRAT risk tool continued

Risk Identification				Risk Analysis					
ID	Discipline	Asset/value at risk	Hazard / Trigger	Risk category	Risk description	Location	Consequence	Likelihood	Risk Level
BIO1	Biodiversity	Long-footed Potoroo	Predation	Environment	Local extinction	Catherine-Razor Tk	Important	A. Almost Certain (Annually) D. Unlikely	High
BIO2	Biodiversity	Dargo Galaxias	Waterway contamination, suppression Weed invasion	Environment	Local extinction	Lankey Plain	Catastrophic		High
BIO3	Biodiversity	Ecosystem (weeds)		Environment	Ecosystem degradation. - BB,broom, willow, soft rush and new-emerging ; Cobungra headwaters Poor adherence to vehicle hygiene protocols Local extinction	Whole fire area, Dargo Plain - soft rush, Alpine Sphagnum Bog Whole fire area	Serious	B. Likely	High
BIO4	Biodiversity	Alpine Fauna	Fire/Suppression	Environment	Local extinction	Whole fire area	Serious	C. Possible	Moderate
BIO5	Biodiversity	Fire sensitive vegetation	Too frequent fire	Environment	Ecosystem change - loss of resilience, temporary reduction in carbon sink	Whole fire area	Serious	C. Possible	Moderate
BIO6	Biodiversity	Spotted Tree-Frog	Rain sedimentation, Chytrid fungus spread thru machinery and general	Environment	Local extinction	Wongungarra River, Dargo HP in ANP	Important	B. Likely	Moderate
CH1	Cultural Heritage	Aboriginal Artefacts	Fire - intense burns, suppression activities, subsequent erosion	Social Setting	Loss of heritage places	Whole fire area, Blue Rag & Basalt Knob North Tk	Serious	C. Possible	Moderate
CH2	Cultural Heritage	Mines & infrastructure	Fire/Suppression	People (public safety)	Unsafe mines and pilfering	Whole fire area, north Mayford Track	Important	C. Possible	Moderate

Appendix 2 – Risk assessment methods

Each discipline undertakes analysis and risk assessment according to specific methodologies. These are described in the discipline appendices. A key feature is contact with other experts and importantly local staff to refine knowledge and better understand local and historic conditions.

In order to establish consistency and clarity, all disciplines contribute to the risk assessment methodology.

The Bushfire RRAT ‘Rapid Risk Tool’ software is a strategic risk assessment tool that has been designed to assist the department to meet its obligations under the Code of Practice for Bushfire Management on Public Land (2012), through undertaking all bushfire management planning within a risk analysis framework.

The model enables staff to document risk events, evaluate their likelihoods and consequences, evaluate risk levels, print outputs (risk profiles, risk maps) and input and output tables, and facilitates development of targeted risk reduction strategies. Before embarking on a risk analysis process it is important to establish the context, purpose and desired outcome of the risk assessment process.

Once each discipline populates the ‘Rapid Risk Tool’ template, all information is graphed and all Bushfire RRAT members review the likelihoods, consequences, risk levels and mitigation strategies. The assumptions and levels are moderated by the team to test reliability. Once agreed, the Rapid Risk Tool is finalised.

The ‘Rapid Risk Tool’ process directs disciplines to explicitly describe their reasoning, this information informs the final Bushfire RRAT report.

Appendix 3 – Fire severity mapping methods

The Bushfire RRAT Rapid Fire Severity Assessment Tool determines fire severity through the use of indices derived from hyper-spectral imagery (red, near-infrared and shortwave infrared wavelengths). The tool currently accepts imagery from LANDSAT, RapidEye and SPOT satellite platforms.

Determining the severity of a bushfire event generally requires imagery to be captured before and after the bushfire event. This imagery is assessed using either Normalised Difference Vegetation Index (NDVI) for RapidEye imagery, or Normalised Burn Ratio (NBR) for LANDSAT and SPOT imagery. These indices both respond similarly to changes in vegetation health, so assuming burnt vegetation is 'unhealthy vegetation', we can use the indices to make inferences on fire severity. The tool evaluates vegetation health before and after the bushfire event and then determines regions showing the largest negative changes in vegetation health, which can then be classified as 'severely burnt'.

The Bushfire RRAT Rapid Fire Severity Assessment Tool returns two severity classes derived from the satellite imagery - Canopy Scorched and Canopy Burnt. These classes are complemented by a fire extent dataset which has been derived from aerial photography. This dataset provides important context to the two severity classes, showing them within the overall fire.

It is important for anyone who uses the Bushfire RRAT Rapid Fire Severity Assessment Tool, or interprets the outputs, to be aware of its limitations. The outputs are to be treated as approximate as no ground truthing or validation has been undertaken. Limited or no information is available on the impact of fire on the understorey, except where the canopy is sparse. Use of Bushfire RRAT Rapid Fire Severity Assessment Tool outputs is at the risk of the user. To obtain more accurate results, a more comprehensive fire severity assessment must be undertaken.

Appendix 4 – Flooding and erosion field assessment photos

<p><i>Containment line constructed through previously undisturbed land. Note lack of structured drainage and high susceptibility to erosion.</i></p> <p><i>Buckland Sector</i></p> <p><i>Photo: Charlie Showers 25 February 2013</i></p>	
<p><i>Existing track used as a containment line with native vegetation cleared within 30m on the left hand side.</i></p> <p><i>Photo: Charlie Showers 25 February 2013</i></p>	

Debris flow that occurred across the Great Alpine Road, on 27th February 2013. This photo shows the Great Alpine Road being cleared of rubble just above the Sambas Mine, approx 4km from Harrietville.

Photo: Charlie Showers 28 February 2013



Debris flow that occurred across the Great Alpine Road, on 27th February 2013. This photo shows the impact on the Sambas Mine, with the partial burial of a mine building and complete burial of machinery. Approx 4km from Harrietville.

Photo: Charlie Showers 28 February 2013



Debris flow that occurred across the Great Alpine Road, on 27th February 2013. This photo shows the impact on Sambas Mine infrastructure.

Photo: Charlie Showers 28 February 2013



<p><i>The East Ovens tributary which has its catchment area in the alpine and sub alpine areas below the Razorback Ridge was severely burned. This shot is taken from North East Water's offtake point for Harrietville's town supply. This rainfall event resulted in water being carted for Harrietville town supply and degraded water quality in the Ovens River at Bright to the point where groundwater was used to augment their domestic water supply.</i></p> <p><i>Photo: Charlie Showers 27 February 2013</i></p>	
<p><i>Sediment traps on the Champion Track Spur Track in the East Ovens tributary.</i></p> <p><i>Photo: Charlie Showers 25 February 2013</i></p>	

References

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Nyman, P., Sheridan, G., Smith, H., Lane, P. (2010), Evidence of debris flow occurrence after wildfire in upland catchments of south east Australia, *J. Geomorphology* 125

Sheridan, G.J., Lane, P.N., Smith, H., Nyman, P. (2009). A rapid risk assessment procedure for post-fire hydrologic hazards; 2009/10 fire season. Technical report produced for the Department of Sustainability and Environment. The Department of Forest and Ecosystem Science, The University of Melbourne, Australia.

Appendix 5 – Asset management further information

Appendix 5.1 Built asset assessment form (XL Format)

The Excel spread sheet template on the next page is intended to be modified to suit each deployment. Drop down menus assist with data input and can be readily changed. All field assessments can be recorded on this form which also enables cost and risk details to be recorded. Information acquired using the single asset management form is normally transferred to this template. This form is available electronically.

Appendix 5.2 Photograph of hazardous trees

Appendix 5.3 Photograph of walking track

Appendix 5.4 Photograph of infrastructure assets

Appendix 5.5 Cost estimates

Appendix 5.1 Built assets assessment form (Excel format)

Bushfire RRAT Asset Management										Bushfire RRAT Built Asset Assessment Sheet										Bushfire RRAT Assessment		
Fire	Alpine Fires			Location			Date	GPS Location			Asset Description										Type	Risk
No	Locality	Address	Park/Forest/Reserve or Asset name	Park/Forest/Reserve or Asset ID	Tenure/Reserve	Start	End	Location	Photo	Class	Category	Description	Heritage	Area/Length	m ² /km	Condition	Cause	Remediation / Mitigation	Risk			
1	Harriéville	Great Alpine Road	Alpine National Park							Infrastructure	Road	Roads 5A (Primary)	No	30 Km	3 P partially destroyed	Event	Hazard to Public	Deny/Restrict access	Remove			
			State Forest															Safety Risk - Dangerous Trees	Remove			
			Vic Roads															Loss of Access	Signage			
2	Harriéville	Bungalow Spur Walking Track	Alpine National Park		PV Asset No.					Infrastructure	Recreation	Trail	No	12 km	3 P partially destroyed	Event	Loss of Access	Repair				
																		Safety Risk - Dangerous Trees	Remove			
																		Hazard to Public	Deny/Restrict access			
3	Harriéville	Tom Kneen Track (North West Spur)	Alpine National Park		PV Asset No.					Infrastructure	Recreation	Trail	No	8 Km	3 P partially destroyed	Event	Loss of Access	Repair				
																		Safety Risk - Dangerous Trees	Remove			
																		Hazard to Public	Deny/Restrict access			
4	Harriéville	Bon Accord Walking Track	Alpine National Park		PV Asset No.					Infrastructure	Recreation	Trail	No	11 km	3 P partially destroyed	Event	Loss of Access	Repair				
																		Safety Risk - Dangerous Trees	Remove			
																		Hazard to Public	Deny/Restrict access			
5	Razorback	Razorback Walking Track	Alpine National Park		PV Asset No.					Infrastructure	Recreation	Trail	No	12 km	3 P partially destroyed	Event	Loss of Access	Repair				
																		Safety Risk - Dangerous Trees	Remove			
																		Hazard to Public	Deny/Restrict access			
6	MT Murray	Australian Alps Walking Track	Alpine National Park		PV Asset No.					Infrastructure	Recreation	Trail	No	5 km	3 P partially destroyed	Event	Loss of Access	Repair				
																		Safety Risk - Dangerous Trees	Remove			
																		Hazard to Public	Deny/Restrict access			
7	Blue Rag Sector	Dargo High Plains Road	Alpine Shire							Infrastructure	Road	Roads 5B (Secondary)	No	9 Km	3 P partially destroyed	Event	Hazard to Public	Deny/Restrict access				
																		Safety Risk - Dangerous Trees	Remove			
																		Loss of Access	Signage			
8	Whole Fire area	Alpine National Park	Parks Victoria							Infrastructure	Signage	Signage	No		3 P partially destroyed	Event	Hazard to Public	Replace				
																		Structural collapse	Replace			
9	Whole Fire area	Alpine National Park	Parks Victoria							Infrastructure	Fencing	Gates	No		3 P partially destroyed	Suppression						
																		Hazard to Public	Remove			
10	Whole Fire area	Alpine National Park/State Forest	Parks Victoria/DEPI							Infrastructure	Visitor	Trees	No		3 P partially destroyed	Event	Hazard to Public	Remove				
																		Safety Risk - Dangerous Trees	Remove			
																		Structural collapse	Repair			
	Harriéville		Vicroads							Infrastructure	Visitor	Roads 5A (Primary)	No		2 Minor damage	Event	Structural collapse	Repair				

Appendix 5.2 Photograph of hazardous trees



Hazardous Trees along vehicle tracks. Photo Sue Berwick 26 February 2013

Appendix 5.3 Photograph of walking tracks burnt



Razorback Walking Track – route of track exposed, with potential for lack of definition. Track definition works required. Photo: Sue Berwick, 26 February 2013.

Appendix 5.4 Photograph of infrastructure assets



*MUMC Hut and toilet – damage to signage in the vicinity and steps of toilet.
Photo: Sue Berwick, 26 February 2013.*

Appendix 6 – Biodiversity further information

Appendix 6.1 Threatened species & communities or fire sensitive species recorded within the fire area

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
Fauna				
Mountain Pygmy-possum (<i>Burramys parvus</i>)	EN	Damage to Type 1 or 2 habitat	Loss of habitat (and likely reduction in recruitment)	Victorian FFG Act (1988) http://www.dse.vic.gov.au/data/assets/pdf_file/0018/103149/002_Mountain_Pygmy-possum_1991.pdf Australian EPBC Act (1999) Draft Recovery Plan
Alpine Tree Frog (<i>Litoria verreauxii alpina</i>)	VU	Damage to ephemeral aquatic habitat	Loss of isolated population	
Spotted Tree Frog (<i>Litoria spenceri</i>)	EN	Sedimentation into the stream	Disruption to the breeding success	FFG Action Statement http://www.dse.vic.gov.au/data/assets/pdf_file/0007/103201/112_spotted_tree_frog_2000.pdf
		Weed invasion	Reduction to habitat quality and the introduction of weeds into the Wongungarra, East Ovens and Upper Dargo catchments.	Detailed information provided by <u>Glen Johnson</u> :

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
		Toxicity from retardants	Loss of viability at the tadpole life stage	
		Intensity and extent of the fire	Change to the best habitat quality in the state following fire.	
Smoky Mouse (<i>Pseudomys fumeus</i>)	EN ce	Disruption to optimal fire regime	Loss of isolated population	FFG Action Statement http://www.dse.vic.gov.au/data/assets/pdf_file/0012/103152/196_Smoky_Mouse_2003.pdf
Long-footed Potoroo (<i>Potorous longipes</i>)	EN en	Damage to primary habitat	Shelter, breeding and critical foraging sites lost from the landscape and species becoming even more vulnerable to predation.	FFG Action Statement http://www.dse.vic.gov.au/data/assets/pdf_file/0017/103148/058_Long-footed_Potoroo_2009.pdf Robely <i>et al.</i> 2005, Lumsden <i>et al.</i> 2007a, 2007b, 2012 various ARI fire reports
Spot-tailed Quoll (<i>Dasyurus</i>)	EN en	Loss of foraging habitat		FFG Action Statement http://www.dse.vic.gov.au/

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
<i>maculatae maculatae</i>)				data/assets/pdf_file/0014/103154/015_spot_tailed_quoll_revised_2003.pdf
Broad-toothed Rat (<i>Mastacomys fuscus mordicus</i>)		Cat and fox predation	Loss of population	Charlie Pascoe pers. Comm.
Eastern Pygmy Possum (<i>Cercartetus nanus</i>)				
Powerful Owl (<i>Ninox strenua</i>)	vu	Loss of hollow-bearing trees	Critical breeding and foraging areas disappear from the landscape.	FFG Action Statement http://www.dse.vic.gov.au/data/assets/pdf_file/0019/103177/092_powerful_owl_1999.pdf
Sooty Owl (<i>Tyto tenbricosa</i>)		Loss of hollow-bearing trees	Critical breeding and foraging areas disappear from the landscape	
Guthega Skink (<i>Egernia Guthega</i>)	EN	Fire impacts on habitat Predation	Damage to habitat	
Alpine Water Skink (<i>Eulamprus kosciuskoi</i>)	ce	Fire impacts on bog sites. Predation. Phoscheck in vicinity of bogs.	Damage to habitat	FFG Action Statement http://www.dse.vic.gov.au/data/assets/pdf_file/0003/103188/114_Alpine_Water_Skink_2001.pdf

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
Alpine Bog Skink (<i>Pseudemoia cryodroma</i>)	en	Fire impacts on bog sites. Predation. Phoscheck in vicinity of bogs.	Damage to habitat	
Alpine She-oak Skink	EN	Loss of habitat (alpine grassland) Predation	Loss of habitat	http://www.dse.vic.gov.au/data/assets/pdf_file/0020/103187/113_Alpine_She-oak_Skink_2001.pdf
Dargo Galaxias (<i>Galaxias</i> sp. 6)		Increased stream bank erosion due to reduction in vegetation cover and increased peak flows		Raadik, T.A. and Nicol, M.D. (2012) ² . Undescribed species, known from only few sites Eg north of King Spur Track “The global distribution for Dargo Galaxias is Lightbound Creek, which drains the Dargo High Plains into the Dargo River. The galaxiids are found in the headwaters of the creek, upstream and downstream of where it

² Raadik, T.A. and Nicol, M.D. (2012). Assessment of the post-fire status and distribution of the Dargo Galaxias (*Galaxias* sp. 6), affected by the White Timber Spur fire, upper Dargo River system: Black Saturday Victoria 2009 – Natural values fire recovery program. Department of Sustainability and Environment, Heidelberg, Victoria.

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
				crosses the Dargo High Plains Road (~37.10906 147.16121), extending downstream about 3 km to a large set of falls." Tarmo Raadik pers comm..
		Increased sediment load and reduced water quality		
		Phoscheck in the waterways		
Threatened Flora Species Sensitive to Frequent Fire [based on vital attributes sourced from Victorian & NSW database – Mary Titcumb pers.comm.]				
Frequently burnt vegetation communities	e, v, r	Likely to be susceptible to particular fire regimes, particularly if fire occurs too frequently, , thus preventing maturation of some species, soil seed bank accumulation.	Loss of significant vegetation types and flora species Weed or plant pathogen invasion	Victorian FFG Act (1988)
Common Spleenwort (<i>Asplenium</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate.	

Species: Common and (Scientific) name	Conservati on status	Threats	Risk	References
<i>trichomanes</i>)				
Alpine Boronia (<i>Boronia algida</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Long Podolepis (<i>Podolepis hieracioides</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Swamp Violet (<i>Viola caleyana</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Catkin Wattle (<i>Acacia dallachiana</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Alpine Sundew (<i>Drosera arcturi</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Chinese Lespedeza (<i>Lespedeza juncea</i> subsp. sericea)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Fog Club-sedge (<i>Isolepis montivaga</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Silver Caraway (<i>Oreomyrrhis argentea</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Austral Trefoil (<i>Lotus australis var. australis</i>)	pk	Sensitive to frequent fire.	Unable to naturally regenerate	
Slender Tick-trefoil (<i>Desmodium varians</i>)	pk	Sensitive to frequent fire.	Unable to naturally regenerate	
Velvet Apple-berry (<i>Billardiera</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	

Species: Common and (Scientific) name	Conservation status	Threats	Risk	References
<i>scandens</i> s.s.)		fire.	regenerate	
Reddish Bog-Heath (<i>Epacris glacialis</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Alpine Bootlace Bush (<i>Pimelea axiflora</i> subsp. <i>Alpine</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Australian Anchor Plant (<i>Discaria pubescens</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Dusty Daisy-bush (<i>Olearia phlogopappa</i> var. <i>flavescens</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Alpine Westringia (<i>Westringia senifolia</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Mountain Needlewood (<i>Hakea lissosperma</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Spinning Gum (<i>Eucalyptus perriniana</i>)	ra	Sensitive to frequent fire.	Unable to naturally regenerate	
Alpine Sphagnum Bogs and Associated Fens Ecological Community	En	Fire impacts	Change to floristic integrity	Victorian Alpine Peatlands Spatial Action Plan DRAFT (McMahan <i>et al.</i> 2012)
Loss of hollow-bearing trees		Fire and suppression impacts	Reduced faunal habitat (breeding and refugia)	FFG Act threatening process

Species: Common and (Scientific) name	Conservati on status	Threats	Risk	References
SIGNIFICANT ECOLOGICAL VEGETATION CLASSES				
Sub-alpine Wet Heathland	En	Fire impacts	Loss of ecological integrity.	
Sub-alpine Wet Heathland / Alpine Valley Peatland Mosaic	En	Fire impacts	Loss of ecological integrity.	
Alpine Damp Grassland	Ra	Fire impacts	Loss of ecological integrity.	
Alpine Grassland	Ra	Fire impacts	Loss of ecological integrity.	
Alpine Grassy Heathland	Ra	Fire impacts	Loss of ecological integrity.	
Alpine Rocky Outcrop Heathland / Alpine Dwarf Heathland Mosaic	Ra	Fire impacts	Loss of ecological integrity.	
Montane Riparian Thicket	Ra	Fire impacts	Loss of ecological integrity.	
Riparian Shrubland	Ra	Fire impacts	Loss of ecological integrity.	
Rocky Outcrop Shrubland	Ra	Fire impacts	Loss of ecological integrity.	

Species: Common and (Scientific) name	Conservati on status	Threats	Risk	References
Sub-alpine Treeless Vegetation	Ra	Fire impacts	Loss of ecological integrity.	

Australian Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
Victorian Flora and Fauna Guarantee Act 1988 (FFG Act)

CR = Critically Endangered under EPBC Act
EN = Endangered under EPBC Act
VU = Vulnerable under EPBC Act
ce = Critically Endangered under FFG Act
en = Endangered under the FFG Act
vu= Vulnerable under FFG Act
ra = Rare under FFG Act
pk = Poorly Known under FFG Act

- Lightbound Creek runs next to Lankey Plain Hut and so any fire retardant used on that structure will potentially enter the waterway and into the creek via the small drainage channels - the creek itself is only about 50 m from the hut in a downhill direction.
- The swampy soaks upstream of the Dargo High Plains are also part of the catchment for Lightbound Creek and should be protected from the use of fire retardant or other physical disturbance.

Appendix 7.2 Desktop assessment of the priority risk locations

Location	Landform	Fire Severity	Control lines	Nearest water (m)	Geology	Vegetation	Sensitivity rating	Known sites	Predicted site type	Slope	Existing Disturbance	Tenure	Access
Area 1 Blue Rag Range	Ridge	Outside	Yes	0-200	No information	Alpine/Sub Alpine	Moderate to high	Yes	Artefact Scatters Ceremonial area	Gentle-steep	Likely	Parks	Track
Area 2 The Twins Mts Saint Bernard/Little Baldy	Ridge	Inside Fire edge	No	600	Ordovician	Alpine	Moderate to high	Yes	Small Scatters	gentle to steep	Erosion	Park	Great Alpine Road
Area 3 King Spur	Plateau	Edge	Yes	0-200	Basalt Plains	Alpine	High	Yes	Artefact scatters	Flat undulating	Some assessment	Parks	Dargo High Plains Road
Area 4 Matheson Spur	Ridge	Inside Fire edge	Yes	0-500	Basalt	Montaine forest	Low to moderate	No	Artefact scatters	Gentle to steep	Unknown	Parks	Off Dargo High Plains Road
Area 5 Mount Tabletop	Ridge plateau	Inside Fire edge	No	0-200	Basalt	Sub Alpine	Low to moderate	Yes	Artefact Scatters	Gentle to steep	Unknown	Parks	Great Alpine Road
Area 6 West Kiewa River	Valley	Edge	Yes	0-50	River alluvial	Montaine forest	Low to moderate	Yes	Scar Trees	Gentle to steep	Unknown	Parks/DEPI	Kiewa Logging Track
Area 7 Catherine Station Razor Area	Ridge	Inside Fire	?	0-200	No Information	Sub alpine	Low to moderate	No	Artefact scatter	Gentle to steep	Unknown	Parks/DEPI	Abbeyards Road
Area 8 Historic places	River valley	Inside Fire edge	No	0-200	alluvial	Montaine forest	Low to moderate	Yes	Adit/mine shaft	Gentle to steep	Unknown	Parks/DEPI	Great Alpine Road
Area 9 Mayford	River valley	Inside Fire	No	0-200	alluvial	Montaine forest	Low to moderate	Yes	Adit/mine shaft	Gentle to steep	Unknown	Parks	Dargo High Plains Rd

Appendix 7.3 Legislation and policies considered in Cultural Heritage Section

Act or Policy	Detail
<i>Aboriginal Heritage Act. 2006</i>	Victorian State Act. Legislates the protection and management of Aboriginal heritage places. Currently under review
<i>Aboriginal and Torres Strait Island Heritage Protection Act 1984</i>	Commonwealth Act. Legislates the protection of Aboriginal heritage places in Australia and may override the State Acts on occasions
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Applies protection where heritage places are listed on the National, Commonwealth, Overseas, and World Heritage Lists
<i>Protection of Movable Heritage Act 1986</i>	Commonwealth Act protects artefacts and heritage objects from inappropriate movement and sale
<i>Australia ICOMOS, The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (The Burra Charter), 1999</i>	Sets the overall standards for management and conservation of all heritage places and items in Australia

Appendix 8 – Forest Management further information

Table 1: Forest type (State Forest Resource Inventory) by burn severity.

Forest type	Fire severity	Area (ha)	Total (ha)
Alpine Ash	Crown burn	1842	
Alpine Ash	Crown scorch	4067	
Alpine Ash	Understorey/ground burn	3181	
Alpine Ash	Burnt (unclassified)	1422	9090
Blue Gums	Crown scorch	1	
Blue Gums	Understorey/ground burn	8	
Blue Gums	Burnt (unclassified)	1	10
Box / Ironbarks	Burnt (unclassified)	132	132
Candlebark / Mountain Gum	Crown burn	44	
Candlebark / Mountain Gum	Crown scorch	142	
Candlebark / Mountain Gum	Understorey/ground burn	100	
Candlebark / Mountain Gum	Burnt (unclassified)	134	420
Eucalypt Unclassified	Crown burn	1538	
Eucalypt Unclassified	Crown scorch	3651	
Eucalypt Unclassified	Understorey/ground burn	3772	
Eucalypt Unclassified	Burnt (unclassified)	2610	11571
Manna Gum	Crown burn	45	
Manna Gum	Crown scorch	162	
Manna Gum	Understorey/ground burn	236	
Manna Gum	Burnt (unclassified)	355	798
Messmate	Burnt (unclassified)	639	639
Mixed Species - General commercial	Crown burn	158	
Mixed Species - General commercial	Crown scorch	450	
Mixed Species - General commercial	Understorey/ground burn	503	
Mixed Species - General commercial	Burnt (unclassified)	519	1630
Mixed Species - Major commercial	Crown burn	8	
Mixed Species - Major commercial	Crown scorch	90	
Mixed Species - Major commercial	Understorey/ground burn	47	
Mixed Species - Major commercial	Burnt (unclassified)	84	229
Non-eucalypt	Crown burn	18	
Non-eucalypt	Crown scorch	34	
Non-eucalypt	Understorey/ground burn	17	
Non-eucalypt	Burnt (unclassified)	184	253
Peppermints	Crown burn	212	
Peppermints	Crown scorch	1476	
Peppermints	Understorey/ground burn	2802	
Peppermints	Burnt (unclassified)	3328	4490
Silvertop	Burnt (unclassified)	271	271
Snow Gums	Crown burn	1136	
Snow Gums	Crown scorch	1475	
Snow Gums	Understorey/ground burn	670	
Snow Gums	Burnt (unclassified)	618	3899
White Stringybark	Burnt (unclassified)	11	11

Waypoint / description	FM photographs
<p><i>Fire killed Alpine Ash 2007 regrowth (FM1)</i></p> <p><i>Photo: Sue Berwick, 26 February 2013</i></p>	
<p><i>Fire killed Alpine Ash (FM2)</i></p> <p><i>Photo: Sue Berwick, 26 February 2013</i></p>	

Waypoint / description	FM photographs
<p><i>Fire killed Alpine Ash and Snow Gums (FM1) Dargo Creek Area</i></p> <p><i>Photo: Sue Berwick, 26 February 2013</i></p>	
<p><i>Fire killed Snow Gums (FM1), Blue Rag Range area</i></p> <p><i>Photo: Sue Berwick, 26 February 2013</i></p>	

Alpine Fires 2013 Fire Severity (Alpine North and South)

Severity Class

- Burn (unclassified)
- Understorey/Ground Burn
- Crown Scorch
- Crown Burn

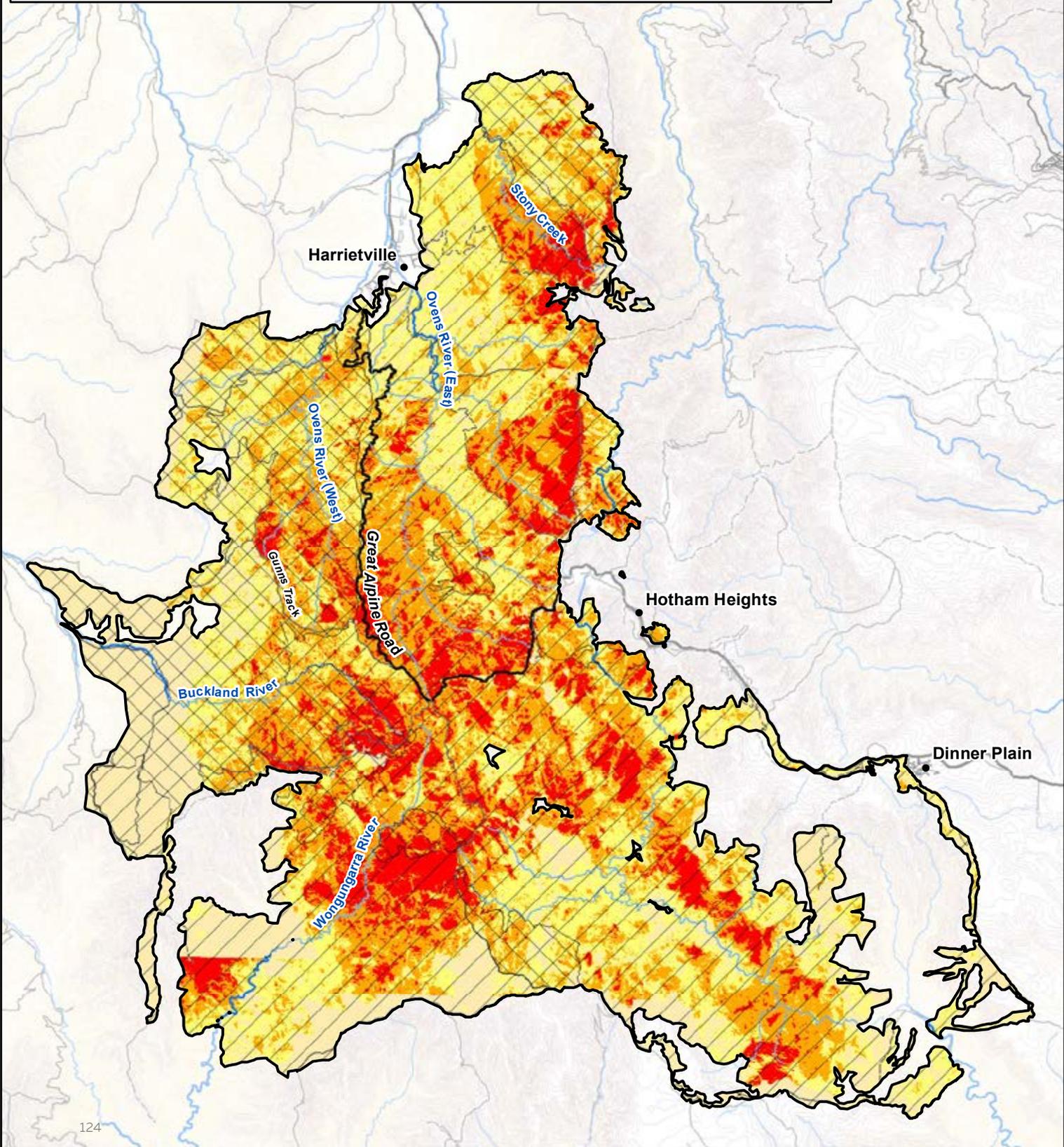
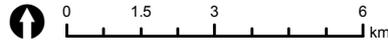
Previous (recent) fires

- 2003
- 2007

- Highway
- Main Road
- Minor Roads
- Vehicular Track
- Walking Track
- River
- Stream / Creek

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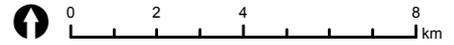


Biodiversity

-  Fires Extent
-  Fire Sensitive Vegetation Burnt Outside of Tolerable Fire Interval

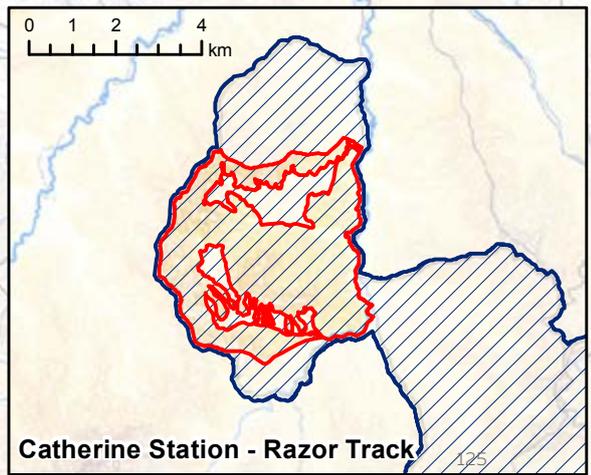
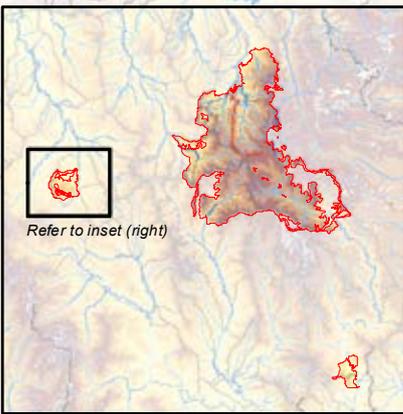
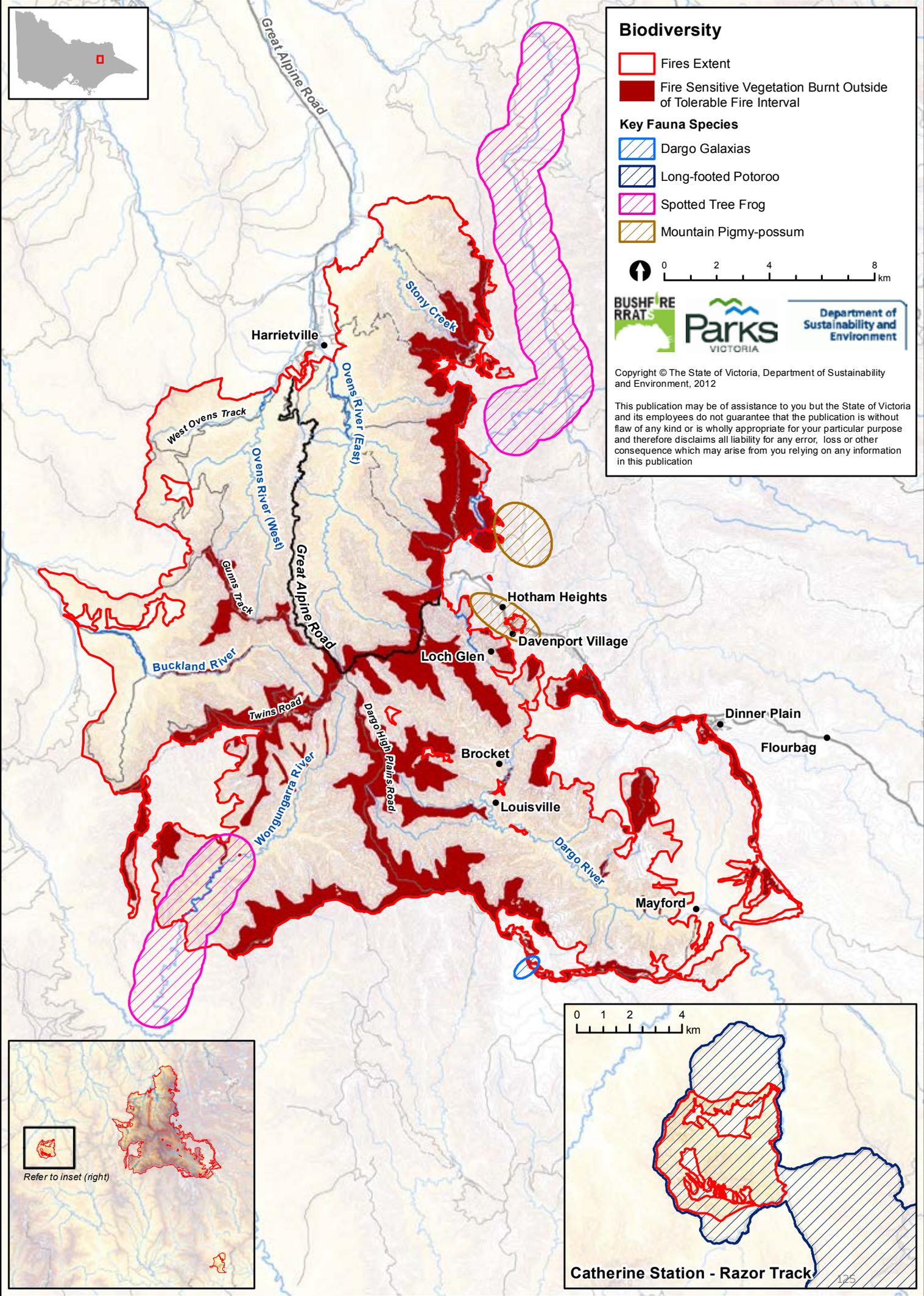
Key Fauna Species

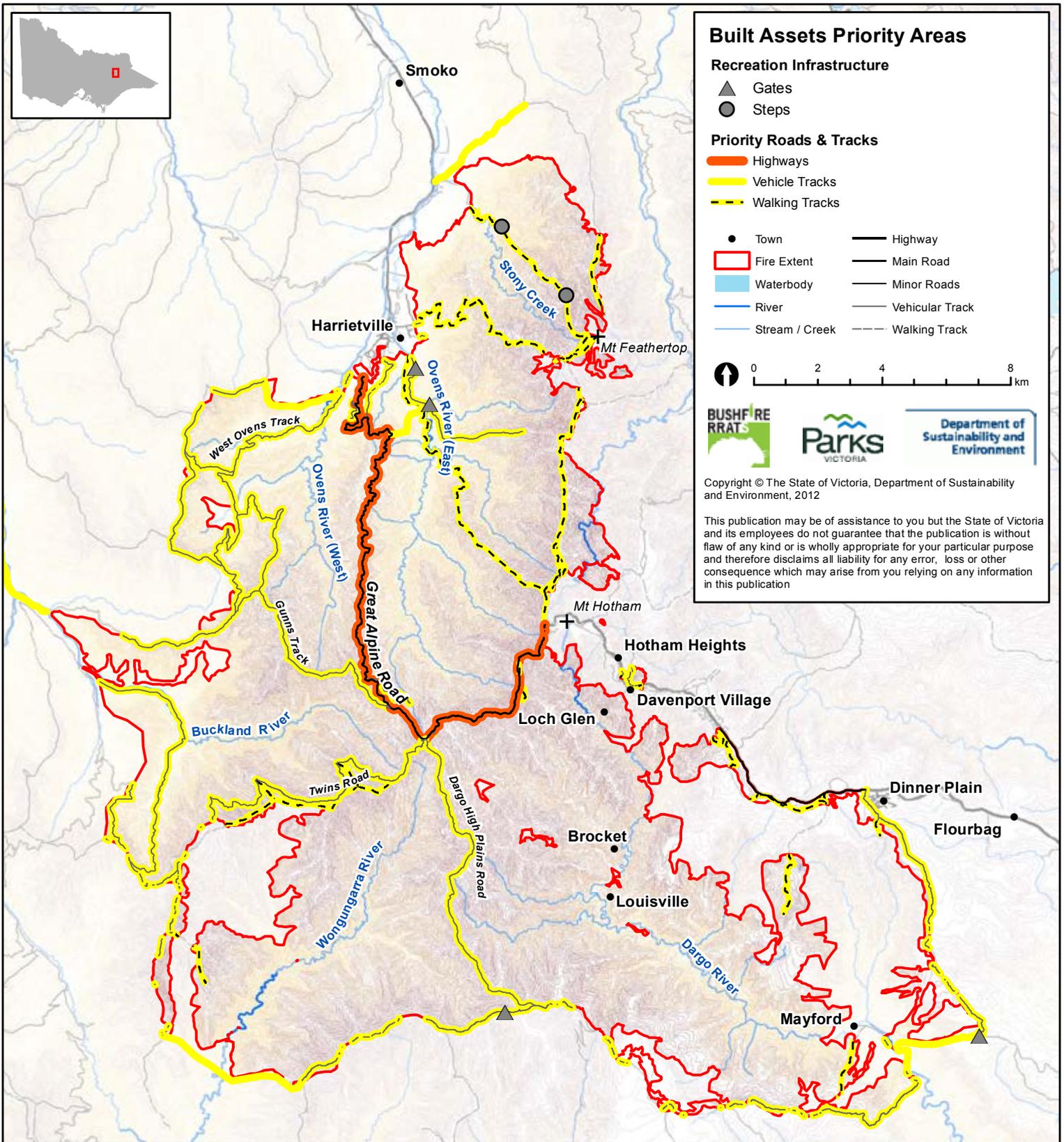
-  Dargo Galaxias
-  Long-footed Potoroo
-  Spotted Tree Frog
-  Mountain Pigmy-possum



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Built Assets Priority Areas

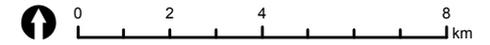
Recreation Infrastructure

- ▲ Gates
- Steps

Priority Roads & Tracks

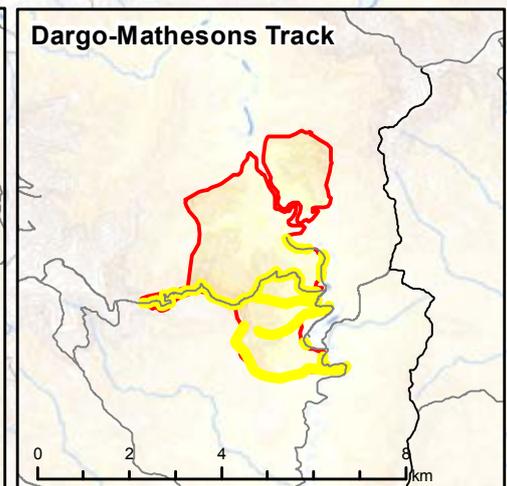
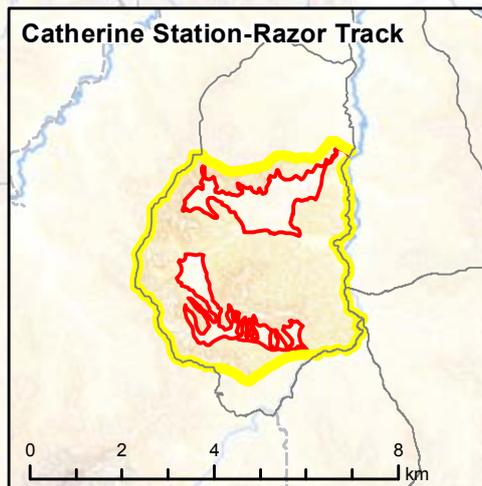
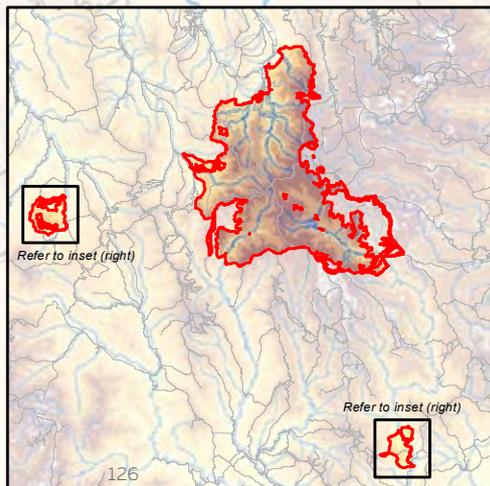
- Highways
- Vehicle Tracks
- Walking Tracks

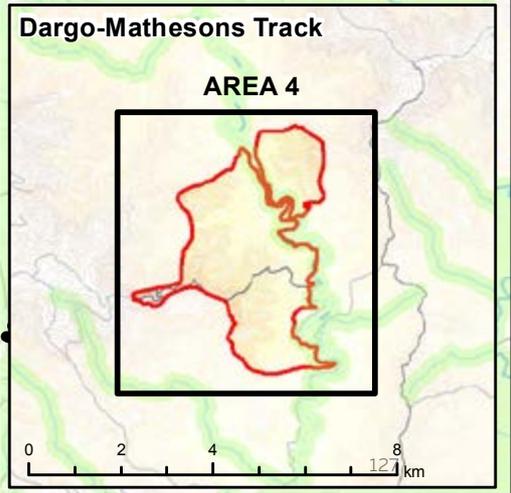
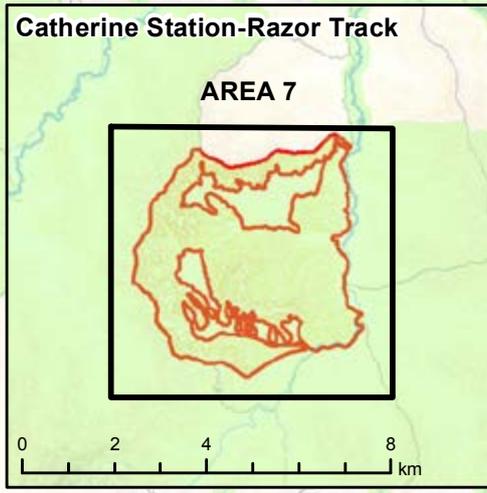
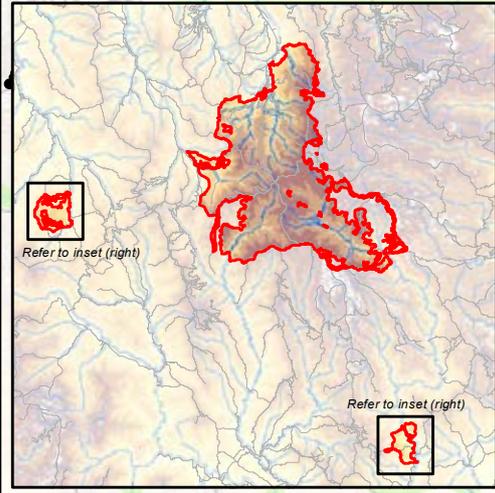
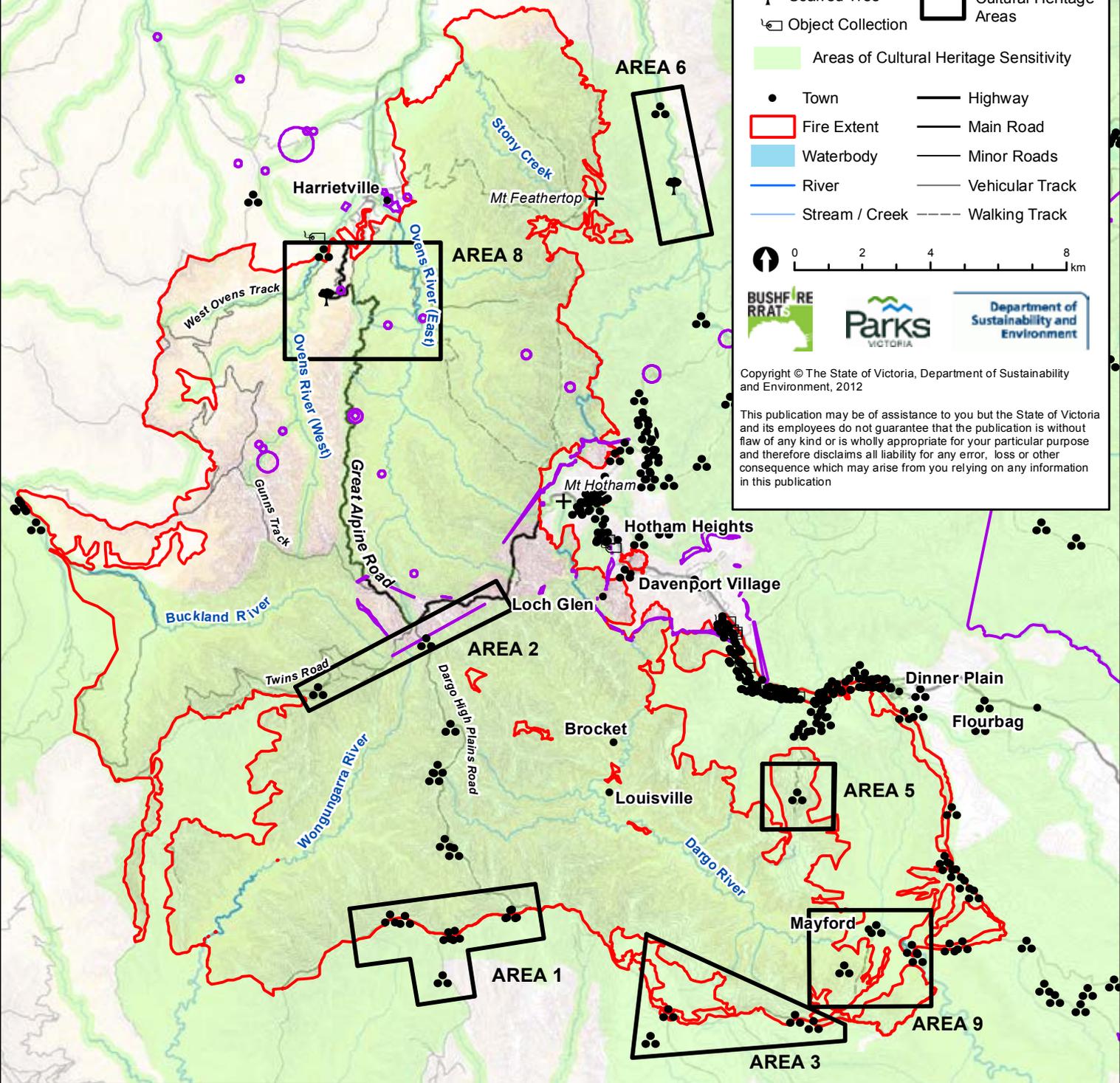
- Town
- Highway
- Main Road
- Minor Roads
- Vehicular Track
- Walking Track



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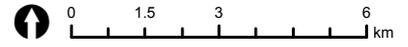


Flooding, Erosion and Water Quality

- Debris Flow Risk Area
- Flooding and Erosion Risk Area
- Water Quality Risk Area
- Fires Extent

Watercourse (major)

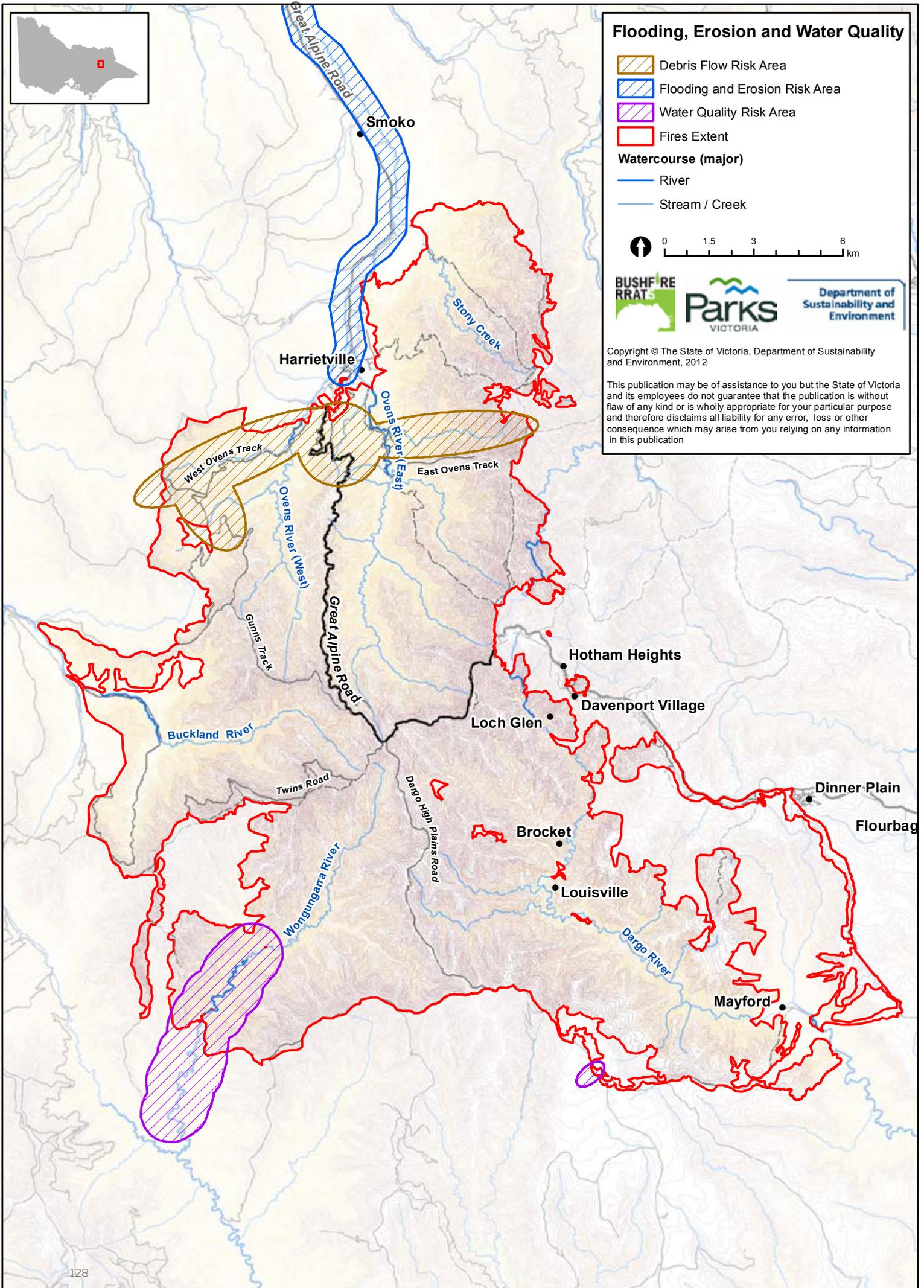
- River
- Stream / Creek

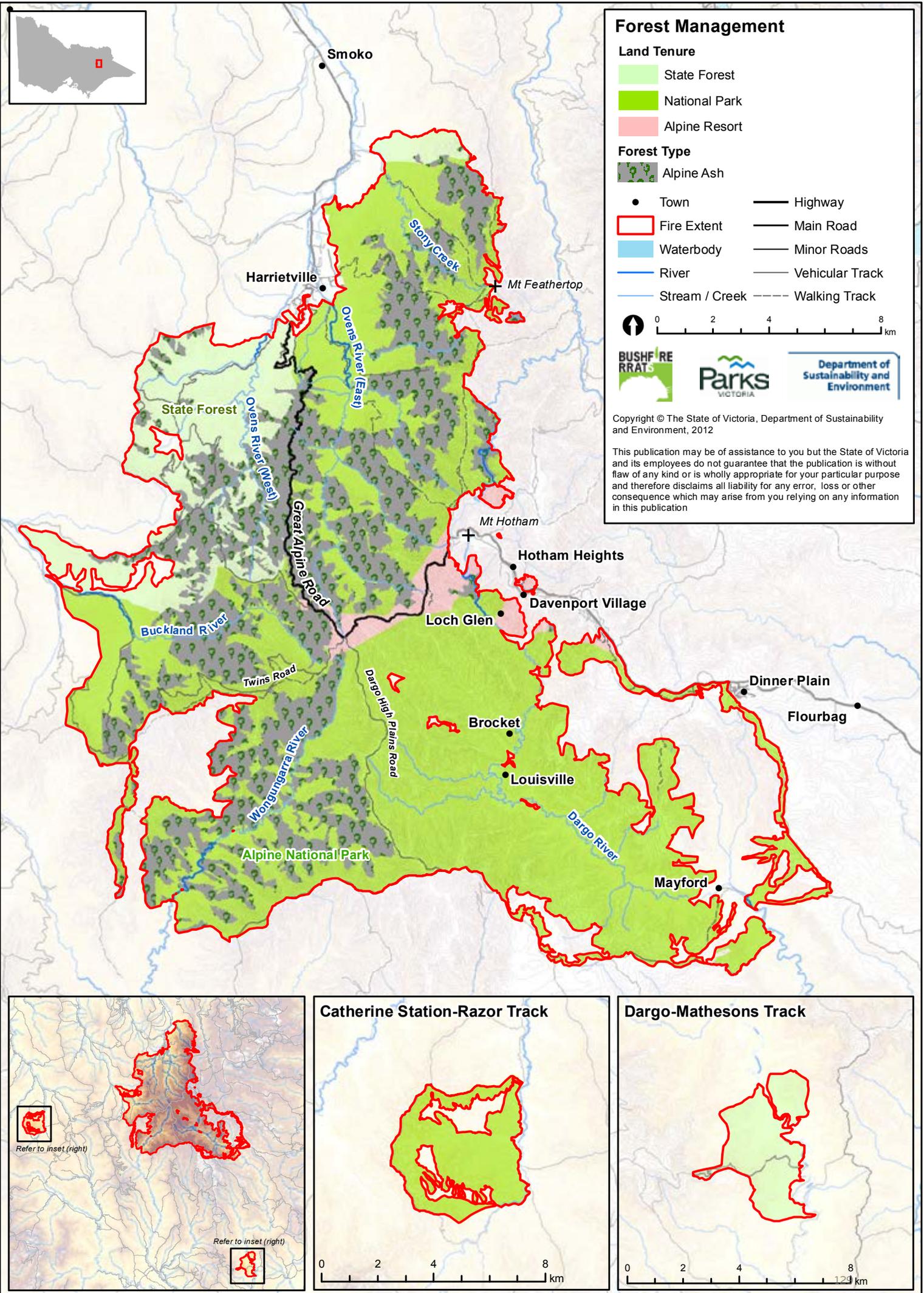


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Forest Management

- Land Tenure**
- State Forest
 - National Park
 - Alpine Resort
- Forest Type**
- Alpine Ash
- Town — Highway
 □ Fire Extent — Main Road
 ■ Waterbody — Minor Roads
 — River — Vehicular Track
 — Stream / Creek - - - Walking Track
- 0 2 4 8 km



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