ROAD BUSHFIRE RISK ASSESSMENT GUIDELINE AND RISK MAPPING METHODOLOGY

Report Commissioned by VicRoads

State Government Victoria

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1 FORWARD

Following the devastating fires of February 2009 the Victorian Bushfires Royal Commission (VBRC) was established to investigate the causes and responses to the bushfires. VicRoads was not exempt from scrutiny. The VBRC recommended that VicRoads implement a systematic state wide program of bushfire risk assessment for all roads for which it is responsible to ensure that they are meeting their obligations under *Section43(1)* of the *CFA Act (1958)*.

VicRoads is committed to the protection of life and property and sees the fire management contribution made by road authorities as an important component of an integrated planning system that aims to manage bushfire risk across the broader landscape. This Guideline is developed for VicRoads staff with fire management responsibilities and can be used as a guide for other road authorities in assisting them in implementing a consistent bushfire risk assessment program across the state of Victoria.

The Bushfires Royal Commission Implementation Monitor (BRCIM) concluded that 'the development of this Guideline and its application to all roads throughout Victoria as a valuable means of ensuring uniform assessment of risk and treatments' (BRCIM Final Report 2012, pg 195). The Guideline has been independently evaluated by Pricewaterhouse Coopers and has been approved by the State Fire Management Planning Committee (SFMPC).

The development and implementation of the Guideline has been a direct result of the work undertaken by VicRoads with the support of the Country Fire Authority (CFA), Department of Sustainability and Environment (DSE), Municipal Association of Victoria (MAV) and associated municipalities. VicRoads thanks those involved for their contribution to creating safer communities.

2 INTRODUCTION

VicRoads manage over 23,000 kilometres of roads comprising freeways, major highways and arterial roads in urban, regional and remote rural locations and approximately 80,000 hectares of roadside.

Road corridors are managed for multiple objectives. As well as their transport function, road corridors contain essential infrastructure, significant environmental and cultural assets and are managed to enhance transport safety, efficiency, amenity and the environment. Each aspect is governed by a raft of legislation (see Section 4).

In regard to bushfire, VicRoads, as a public authority, has statutory obligations under s43 CFA Act to:

'Take all practicable steps (including burning) to prevent the occurrence of fires on, and minimise the danger of the spread of fires on or from:

(a) any land vested in it or under its control or management; and

(b) any road under its care and management'.

As VicRoads is responsible for managing a significant number of roads it is essential to establish which roads pose the highest risk to life and property in terms of potential fire ignitions and spread of fire in the landscape. Consideration also needs to be given to managing the safety of road users before and after a fire and the needs of the fire services for strategic fire fighting. In regard to ignition and spread VicRoads commissioned the development of Road bushfire risk mapping that assists with the assessment and prioritisation of bushfire risk on roadsides. The methodology behind the road bushfire risk mapping is shown as Appendix 4 and discussed throughout this Guideline.

This Guideline assists VicRoads staff with fire management responsibilities to meet the requirements of the CFA Act. It should be read in conjunction with *CFA's Roadside Fire Management Guidelines (2001)*.

3 PURPOSE

The purpose of the Guideline is to:

- Confirm road bushfire management objectives;
- Outline processes for assessing risk in regards to each objective;
- Determine the priority for bushfire mitigation works on particular roads;
- Provide guidance on selecting appropriate risk treatments; and
- Provide VicRoads with the opportunity to access the fire protection exemption under Clause 52.17.6 (Fire Prevention) Victoria Planning Provisions

The Guideline also facilitates the integration of road bushfire safety within the broader fire managment planning environment and the VicRoads road maintenance planning process.

4 REGULATORY CONTEXT

Road managers must take into account the implications of the regulatory framework when planning for and undertaking works on road corridors. The most influential legalisation in the current regulatory environment includes:

- *Transport Safety Act 2010*
- *Road Management Act 2004*
- *Road Safety Act 1986*
- *Country Fire Authority Act 1958*
- *Metropolitan Fire Brigades Act 1958*
- *Flora and Fauna Guarantee Act 1988*
- *Forests Act 1958*
- *Planning and Environment Act 1987*
- *Electricity Safety Act 1998*
- *Summary Offences Act 1966*
- *Environment Protection and Biodiversity Conservation Act 1999*

5 ROAD FIRE MANAGEMENT OBJECTIVES

The CFA Roadside Fire Management Guidelines (CFA, 2001) list fire management objectives agreed by a range of stakeholders. These were supported by the VBRC.

Five objectives are provided:

1 Prevent fires on roadsides

2 Contain roadside fires

3 Manage safety or road users

4 Provide control lines

5 Recovery from roadside fires

This Guideline considers objectives 1 to 4. Following is a summary of the four management objectives addressed throughout the Guideline.

Objectives 1 and 2 relates to prevention and containment of bushfires. These objectives are central to VicRoads s.43 obligations under the CFA Act. As such VicRoads leads planning for them across the VicRoads road network. Road Bushfire Risk Mapping developed as part of the Road Bushfire Risk Assessment process is designed to assess and prioritise the risk of a fire starting and spreading from the roadside. **This mapping is only related to Objectives 1 and 2.**

Objective 3 relates to managing the safety of road users before and after a fire front passes. This objective identifies specific locations that need additional treatment programs to ensure the safest possible access and entry to and from locations at high risk from bushfire. High risk locations are likely to be those with Community Information Guides (CIG), Local Response Plans (LRP), Neighbourhood Safer Places (NSP's), fire refuges and other public shelter options. Treatment programs may include traffic management, education, evacuation in some locations and vegetation management solutions. VicRoads, along with its key stakeholders, will identify these locations through the Municipal Fire Management Planning Committee (MFMPC).

Objective 4 relates to the provision of strategic control lines required to support fire suppression activities of brigades prior to and/or during a fire event. These strategic control lines are negotiated and confirmed through the MFMPC.

Objective 5 recovery from roadside fires, is important but risk assessment for it occurs through other planning processes undertaken by each infrastructure owner.

6 PLANNING FOR FIRE MANAGEMENT OBJECTIVES

6.1 MEETING OBJECTIVES 1 AND 2 - PREVENT IGNITION AND SPREAD

6.1.1 Context

In addressing Objectives 1 and 2 consideration needs to be given to risk and vulnerabilities. The primary objective of managing bushfire risk is to protect lives and property. In this context, risk is the chance or probability that a person or property will be harmed if exposed to a bushfire hazard. Vulnerability can be defined as the degree to which people or property are likely to experience harm due to exposure to the hazard (Kasperson et al. 2002). To read more about how risk and vulnerability are considered in regard to the prevention of ignitions and spread of bushfire see the Risk Mapping Methodology at Appendix 4.

Roads can be a source of ignition due to their high level of use and the presence of power lines and other potential ignition sources. The ability for a fire to spread significantly is determined largely by the nature of the landscape downwind of the road. The overall consequence of a bushfire started on a road is determined by the amount, type and vulnerability of assets on the road reserve and beyond the road reserve in the potential path of the fire.

6.1.2 Risk assessment

In order to understand the level of risk and vulnerability of assets (including people and property), VicRoads along with CFA have developed a mapping product. Referred to as the Road Bushfire Risk Mapping, the maps quantify factors that influence the likelihood and consequence of a bushfire starting and spreading from the road network. It does not assess risk in relation to Objectives 3 or 4.

The Road Bushfire Risk Mapping assesses the likelihood of an ignition in the road corridor, and the likelihood of fire spread beyond the road reserve. It also assesses the consequence of fire on the road reserve and the consequence of fire spread beyond the road reserve. A range of contributing factors is assessed. These factors are weighted to reflect their relative importance in determining the bushfire risk. Figure 1 describes the considerations made when assessing roadside bushfire risk. More detail is provided in the Risk Mapping Methodology at Appendix A.

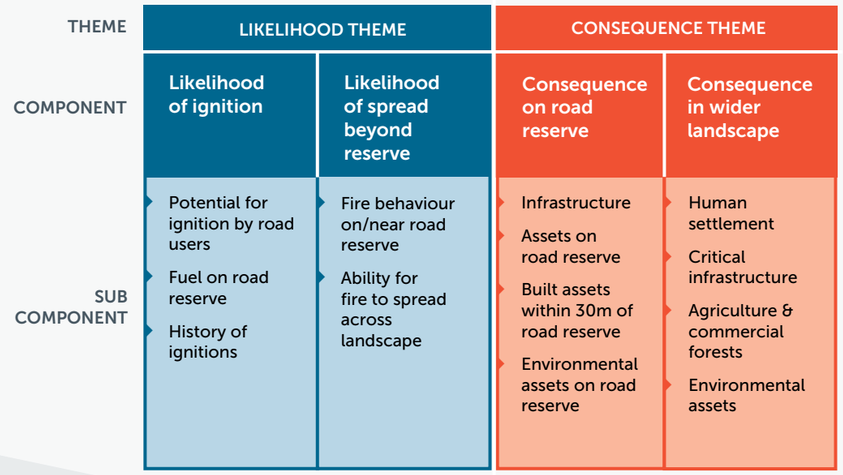


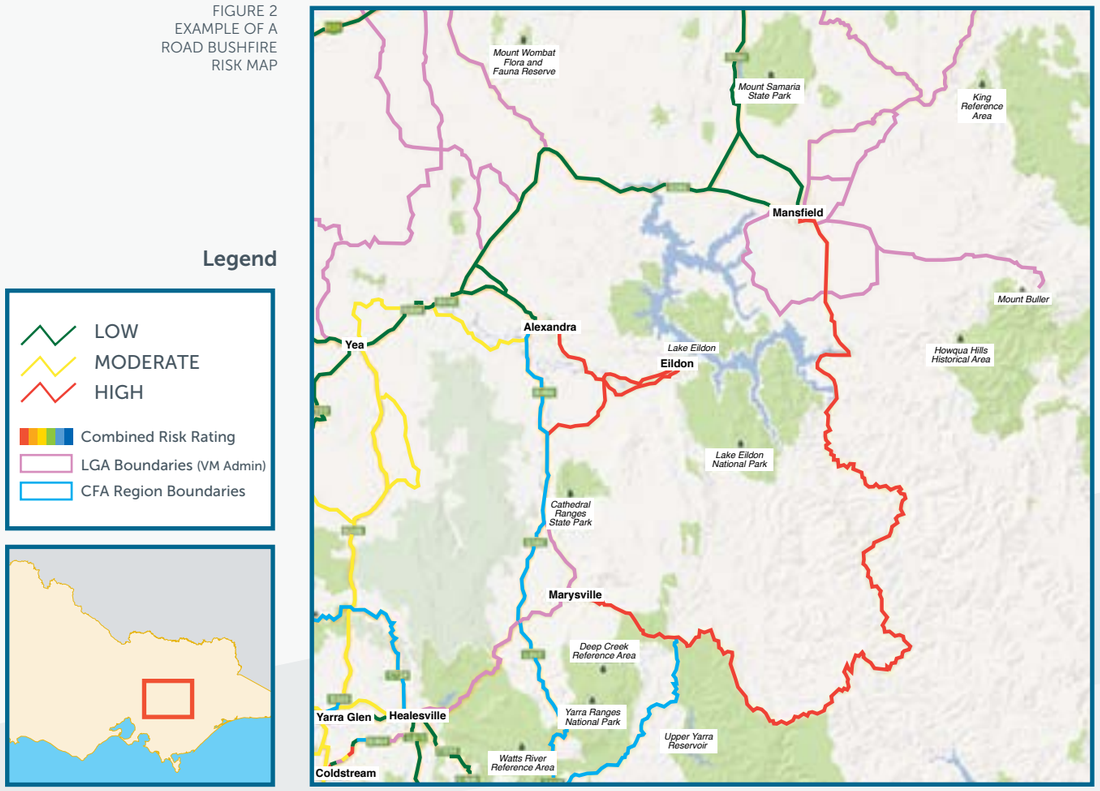
FIGURE 1
BUSHFIRE RISK PRIORITISATION MODEL

The output of the risk assessment is a map consisting of roads classified into three groups according to the level of risk.

- **Low risk roads** (marked in Green on the maps) are those where the level of bushfire risk does not warrant specific bushfire mitigation works, however may still include the standard routine maintenance program;
- **Moderate risk roads** (marked in Yellow on the maps) will receive the standard suite of treatments from the routine maintenance program; and
- **High risk roads** (marked in Red on the maps) require additional detailed assessment and may warrant additional fire risk mitigation treatments. As the risk cannot be managed on the roadside alone consideration needs to be given to broader treatments.

Figure 2 provides an example of a road bushfire risk map.

FIGURE 2
EXAMPLE OF A
ROAD BUSHFIRE
RISK MAP



The Road Bushfire Risk Mapping is accessible through the VicRoads File Plan and through the Victorian Bushfire Decision Support Tools dropbox where you can also access the Victorian Fire Risk Register (VFRR) datasets. The VFRR is maintained by CFA and identifies assets at risk from bushfire and assesses their level of risk. These data sets are also used in the development of the maps. For a detailed description of the Road Bushfire Risk Maps see the methodology at Appendix 4.

The Road Bushfire Risk Maps are the commencement of a broader process. A multiagency working group must be established to verify and prioritise the mapping via a desktop validation exercise. Here they should also discuss the safe access and egress of road users in and out of high fire risk locations (Objective 3) and strategic fire fighting requirements to support suppression activities (Objective 4) and incorporate the outcomes of these discussions.

Once roads have been prioritised a field inspection is undertaken to ground truth the ratings, reprioritise the road if required and discuss effective management solutions to reduce the risk posed by the roadside. A works plan is developed containing relevant treatments including non-vegetation management solutions. Other treatment options are outlined in 6.1.3.

6.1.3 Potential mitigation treatments

- Regulation
- Enforcement
- Education
- Fuel-free shoulder maintained during fire danger period
- Vertical separation between fuel and vehicle (Standard Section 750 Routine maintenance (schedule of rates) & Standard section 752 Routine roadside maintenance (vegetation)
- Bare earth fuel break to contain small ignitions
- Fuel reduction burning
- Fuel management around assets adjacent to the road and in the path of potential fire spread
- Bushfire scenario operational planning and preparedness

In addition, works may be required to manage trees on roadsides to prevent ignitions. See the *Draft VicRoads Vegetation Management Plan for Electric Line Clearance (2012)* for the management of trees around power lines.

6.2 MEETING OBJECTIVE 3 - MANAGE THE SAFETY OF ROAD USERS

6.2.1 Context

It is important to recognise that it is not possible to ensure safe travel on roads during and after a bushfire. The safest option is to leave early on days of high fire risk. Driving during a bushfire should be a last resort. Vehicles offer little protection from radiant heat, smoke over roads and emergency vehicles responding to a fire increases the risk to road users. It is not feasible to make a road safe during the passage of the fire front.

Although it is strongly advised not to travel on roads during a bushfire, unfortunately it is inevitable that this will occur. The VBRC acknowledged that individuals' capacity to escape from fire is compromised if roads are impassable, poorly maintained or blocked by fallen trees. The most effective method for reducing the risk to road users is to reduce the likelihood of them travelling on roads during a fire. **Supporting and promoting leave early messaging should be the primary focus in treating this objective.**

The other main approach to managing road user safety considered in addressing this objective is providing egress/evacuation routes from high risk locations that are as safe as practicably possible for the community. High risk locations are identified by the MFMPC and could include townships with CIGs and LRPs, NSP's or other shelter options.

NSPs are community areas that may provide some protection from radiant heat, and are designed to be used as places of last resort when all other bushfire plans have failed. Shelter options are a term used to describe the range of options available to the public to shelter during the passage of fire. These may include public bunkers, community fire refuges, NSPs and other places of last resort. The potential for evacuation is determined as part of the LRP process and if appropriate will be implemented by the Incident Controller/Victoria Police.

LRPs provide operational information for fire managers. CIGs provide advice and guidance, including suggested exit routes from high risk locations, to the local community and visitors.

Access and egress roads are identified within CIGs and LRPs where limited roads are available thus making a township particularly vulnerable to being isolated in a bushfire.

6.2.2 Risk assessment

In order to determine the priority for roads requiring management to provide access and egress the criteria outlined in Figure 3 is applied:

FIGURE 3
ACCESS EGRESS CRITERIA

ACCESS ARRANGEMENTS	PRIORITY RATING	
	SHELTER OPTION AVAILABLE	NO SHELTER OPTION
Single access/ egress road	**High** (on access route to shelter option)	**High** (on single access/ egress road)
Multiple access/ egress roads	**Moderate** (on access route to Shelter Option)	**Moderate** (on multiple roads)
	Low (all other roads)	

6.2.3 Potential mitigation treatments

In order to practically manage this objective, along with all of the other roadside management objectives, priority must be given to roads that are the only access and egress route from high risk locations (as deemed by the MFMPC). VicRoads will prioritise treatments based on the level of risk, the location and the practicality of treatment options. Treatment options will be determined on a case by case basis, given both physical and financial constraints. Should vegetation management treatments be required the primary function of this work in managing the safety of road users, is to reduce the likelihood of trees blocking the road in the weather that precedes a fire event.

For Objective 3, the priority rating equates directly to a standard of vegetation management. Each road should be assessed to establish the correct level of treatment according to the criteria set out in Figure 3, and then the level of vegetation management determined from Figure 4.

FIGURE 4
VEGETATION MANAGEMENT CRITERIA

PRIORITY RATING	TREATMENT	TREATMENT STANDARD
High	**Permanent**	**Permanently** treated roads are managed to the current VicRoads maintenance standards specified in maintenance contracts (Standard Section 750 & 752) **plus** identified annual fire mitigation treatments which may include removal of hazardous trees or limbs that are likely to fall on a road in high wind events **plus** any other treatment as agreed to by all agencies involved in IFMP.
Moderate	**Periodic**	**Periodically** treated roads are managed to the current VicRoads maintenance standards specified in maintenance contracts (Standard Section 750 & 752) **plus** identified annual fire mitigation treatments which may include removal of hazardous trees or limbs that are likely to fall on a road in high wind events.
Low	**Routine**	**Routinely** treated roads are managed to the current VicRoads maintenance standards specified in maintenance contracts (Standard Section 750 & 752).

The length of road requiring treatment should be determined on a case-by-case basis. However the distance should not be longer than a 4 minute drive from a shelter option. A qualified arborist should identify hazardous trees/limbs in this area and recommend appropriate treatments.

Other potential treatments include:

- Planning (including Municipal Emergency Management Plans (MEMP) and fire service operational plans)
- Education
- In depth fuel management to reduce flame height, intensity and radiant heat in the vicinity of the road
- Traffic management during and after bushfire
- Victoria Police evacuation planning

6.3 MEETING OBJECTIVE 4 – PROVIDE CONTROL LINES

6.3.1 Context

A control line is a natural or constructed barrier or treated fire edge used in fire suppression and prescribed burning to limit the spread of fire *(CFA Roadside Fire Management Guidelines, 2001)*. Control lines are only likely to be effective if they are supported by suppression activities and hence need to be in areas of low fuel. In many instances control lines are installed tactically in advance of a major fire.

Careful consideration needs to be given to the placement of control lines if they are to be effective, and because they can involve significant and ongoing vegetation management which can degrade environmental and heritage values.

6.3.2 Risk assessment

Preparatory fuel management works on fire control lines should be considered when:

- There is historical evidence to suggest a large fire is likely;
- The use of the roadside is the best way to strategically suppress a fire in low fuel areas;
- Spread of fire beyond the control line will impact upon assets; and
- It is probable that the road will be used as an anchor point for prescribed burning on adjacent land.

High priority is given to roads agreed to be control lines.

6.3.3 Potential mitigation treatments

- Planning (road must be identified in fire service operational plans)
- In depth fuel management to reduce fire intensity and spotting in vicinity of the control line
- Education linked to operational training

The relevant fire service will advise VicRoads of its requirements for control lines. This is generally done through the Regional Strategic Fire Management Committee (RSFMC) or MFMPC. More detailed information on fire control lines can be found in the DSE/CFA *Guideline for Planning and Designing Fire Control Lines* (DSE & CFA, 2008) and the *Roadside Fire Management Guideline (CFA, 2001).*

The standard of vegetation management works where practicable should be agreed with the relevant fire service.

7 DESIGNING A TREATMENT REGIME

The previous section discussed how bushfire risk is identified and analysed across the VicRoads network, and how roads are prioritised for treatment. It also provided lists of treatments that might be applicable to each objective.

This section provides principles to consider when designing a treatment regime for a particular segment of road.

7.1 PRINCIPLES OF TREATMENT SELECTION

It is important to recognise that none of the fire management objectives can be achieved through works on the roadside alone. There needs to be a broad approach that utilises programs and services from across government and the community.

In selecting a risk treatment you should:

- Be clear about what risk the road poses (i.e. what objectives are being managed for);
- Have assessed the level of risk as it is important that the degree of treatment is commensurate to the risk;
- Have regard to both assets immediately adjacent and critical assets in the possible path of a fire;
- Ensure that the works being proposed address one or more of the risk factors present on the particular road segment;
- Assess the issue at a landscape scale and consider what treatments on and beyond the road reserve may be most effective;
- Consider whether the potential benefits of the treatment justify the economic, environmental and aesthetic costs of the works;
- Consider the current legislative framework and ensure that all appropriate permits and permissions have been obtained;
- Consider synergies in objectives for roadside management; and
- Consider alternative treatments such as community education, emergency management arrangements etc. which may be more appropriate in some circumstances.

More detailed descriptions of the range of treatments available, plus commentary on their purpose, efficacy and impacts, is provided in the *Roadside Fire Management Guidelines* (CFA, 2001). The *Roadside Fire Management Guidelines* should be used in conjunction with this Guideline.

7.2 ROAD BUSHFIRE TREATMENT SELECTION TOOL (RBTST) AND ASSESSMENT

The RBTST is designed for use in the field on roads identified as High or Moderate risk by the Bushfire Risk Map, or nominated as High priority as control lines or for managing the safety of road users through the multi-agency desktop process. Refer to Appendix 2-1 'Risk Worksheet' and Appendix 2-2 'Treatment Worksheet'.

The focus of the tool is identifying those risk factors, affecting either likelihood or consequence of fire ignition and spread, that are present on a particular segment of road, and thus guiding the selection of treatments that address those factors present.

Inspection of high priority roads and selection of treatments should occur as a multi-agency process to ensure a balanced approach and to enable the full range of agency bushfire safety programs to be considered. This group could include VicRoads, Municipal Fire Prevention Officer, Council Environmental Officer, CFA Vegetation Management Officer, DSE Fire Prevention Planner and Biodiversity Officer and Operational Officers from the relevant fire services.

8 MONITORING AND REVIEW

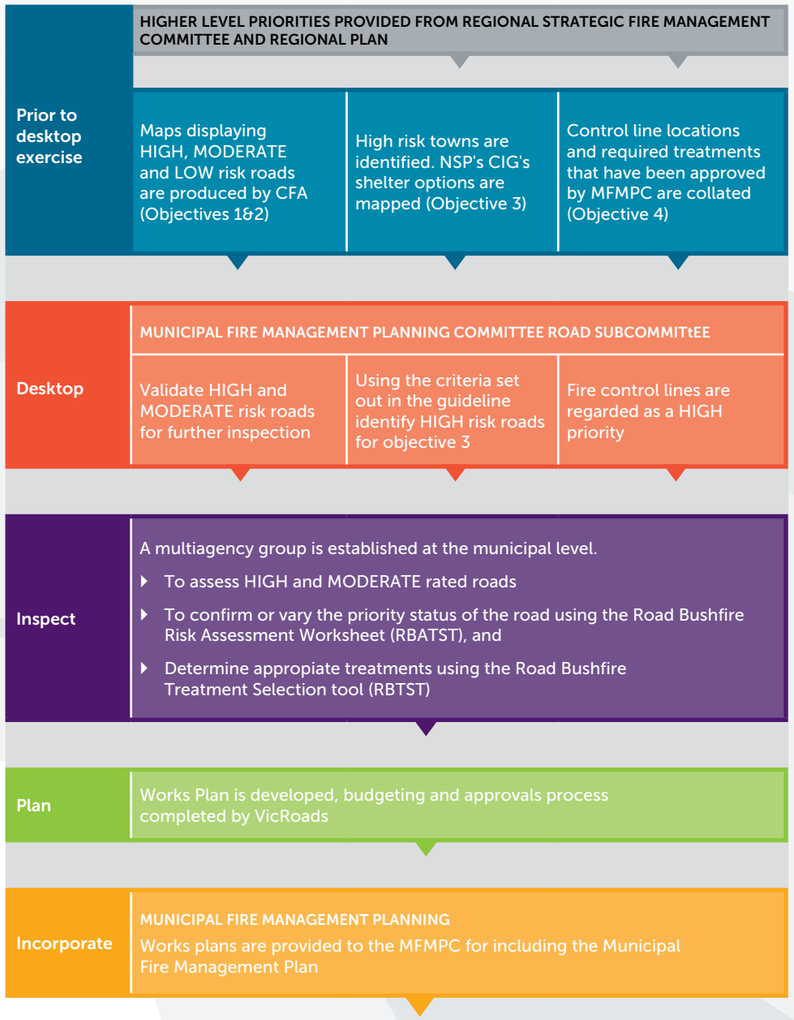
Ongoing monitoring and review is essential to ensure that the treatment recommendations remain relevant. Risk analysis represents a snap shot in time, whilst bushfire risk is dynamic and will be influenced by changes to hazard, exposure and vulnerability over a range of time scales as well as any contextual changes such as amendment of objectives or change to risk appetite.

9 VICROADS BUSHFIRE ASSESSMENT AND TREATMENT PROCEDURE

9.1 BUSHFIRE MANAGEMENT PLANNING PROCESS

Figure 5 is provided to assist road managers to understand the planning process required to implement the Guideline within the regulatory, operational and planning regimes.

FIGURE 5
BUSHFIRE MANAGEMENT PLANNING PROCESS FLOWCHART

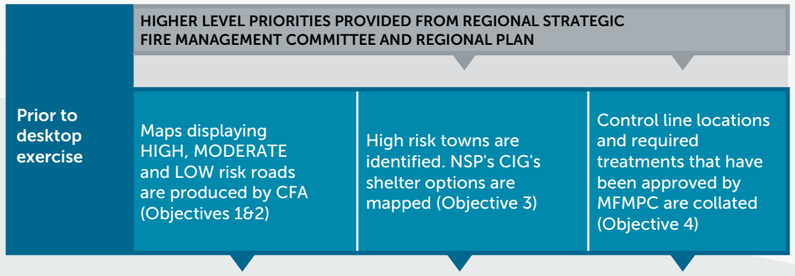


VicRoads will proactively assess and treat roads for Objectives 1 and 2 in order to meet their requirements under *s.43* of the CFA Act. VicRoads will actively participate in wider fire management planning in relation to Objectives 3 and 4 where it involves their road network.

The Road Bushfire Risk Assessment Planning process was first commenced in bushfire season 2012/13 after a trial period in 2011/12. The plans that have been developed in 2012 will run for 3 years in line with MFMP. In three years the assessment process will be re-run to take into account previous mitigation works and new risks in the landscape. When undertaking this planning process ensure that adequate time is allocated for each phase of the process.

9.2 STEP BY STEP

9.2.1 Gather the information



1 Access the VicRoads Bushfire Risk Maps

The VicRoads Bushfire Risk Maps are available and accessible via the VicRoads internal server or CFA's drop box administered by the Victorian Fire Risk Register team (VFRR). The maps enable users to zoom in to better identify segments. The maps can be opened in any GIS software and the appropriate attributes should be selected that represent the region required. These roads relate directly to fire prevention requirements (objective 1 & 2).

2 Access the TPPs/CIGs/LRPs

Objective 3 requires that consideration be given to access and egress around high risk locations. High risk locations are deemed by the MFMPC and could include townships with CIGs, LRPs, NSP's or other shelter options. Prior to the desktop exercise a list of locations should be requested from the MFMPC for further discussion at the validation session. Towns with CIGs, LRPs, NSP's and shelter options are constantly under review.

3 Understand fire control lines and ask for clarification

Most MFMP's have appendices that include Fuel Breaks, Primary Fire Breaks, and Secondary Fire Breaks etc. that can provide a 'control line'. Some may be fuel reduced areas for fire prevention purposes. It will be useful to reassess Objective 4 from a Regional perspective and then the Municipal level to ensure consistency in language and purpose. Fire control line requirements should be agreed at the RSFMC with a list being provided for incorporation into the validation session. Fire control line requirements should be agreed at the RSFMC with a list being provided for incorporation into the validation session.

9.2.2 Validate High risk roads at the Municipal level

	MUNICIPAL FIRE MANAGEMENT PLANNING COMMITTEE ROAD SUBCOMMITTEE		
Desktop	Validate HIGH and MODERATE risk roads for further inspection	Using the criteria set out in the guideline identify HIGH risk roads for objective 3	Fire control lines are regarded as a HIGH priority

1 Arrange the session

Request that the MFMPC establish a roads subcommittee for the municipal district to commence discussions around the roads risk assessment process to enable the Committee's municipal concerns and recommendations to be considered and implemented by VicRoads and other road authorities.

Ensure that all relevant stakeholders can attend. Attendees should include relevant VicRoads staff (especially those undertaking the inspections), CFA operations and vegetation management officers, DSE biodiversity and fire management if required and the Municipal Fire Prevention Officer (MFPO) or assistant.

2 Conduct the validation session

A validation session could be conducted across each municipal district in order to confirm or vary the maps produced for Objective 1 and 2 and to work through the Objective 3 and 4 requirements.

- **Establish roads that need treating for Objective 1 and 2 – prevent ignition and spread**

The Bushfire Risk Maps identify High, Moderate and Low risk roads according to the likelihood and consequence of fire ignition and spread in the landscape as described in Section 6.1. Each road needs to be carefully considered by the group to validate or vary the status of the road for further inspection.

- **Establish roads that need treating for Objective 3 – Manage safety of road users**

Refer to Figure 3 and work through the roads within each CIG/LRP against the criteria to establish the priority of each road. Many of these roads within the urban area may be municipal roads, and where the road transitions to a rural road responsibility may shift to VicRoads.

- **Establish roads that need treating for Objective 4 – Provide control lines**

As fire control lines are important for suppression activities and for fire fighter safety it is deemed that fire control lines will be treated as a High priority.

A draft map should be produced by the group encompassing all Objectives and priorities.

9.2.3 Assess the roadside

Inspect	A multiagency group is established at the municipal level. ▸ To assess HIGH and MODERATE rated roads ▸ To confirm or vary the priority status of the road using the Road Bushfire Risk Assessment Worksheet (RBATST), and ▸ Determine appropiate treatments using the Road Bushfire Treatment Selection tool (RBTST)

1 Complete preparatory work

It is important to understand the land being managed.

- Check the Planning Scheme overlays applicable to the High risk segments of road being inspected, as some overlays may restrict fuel/vegetation management activities. This can be done on the Internet at http://planningschemes.dpcd.vic.gov.au/ or ask VicRoads or Council environmental staff.
- Check the DSE's Biodiversity Interactive Maps to ensure there are no threatened flora and/or fauna. Print maps if threatened species are present and take them to the site inspection for discussion with environmental officers. (http://mapshare2.dse.vic.gov.au/MapShare2EXT/imf.jsp?site=bim)

2 Organise on site inspections of High risk roads

A multi-stakeholder participatory site inspection will ensure a balanced approach to roadside vegetation management and access expert advice on managing the balance between bushfire safety and environmental sustainability.

This group could include VicRoads officers, MFPO, Council Environmental Officer, CFA Vegetation Management Officer, DSE Fire Prevention Planner and biodiversity staff operational officers from the relevant fire services.

The RBTST should be used to maintain consistency across the network and provide a record for future reference.

The tool will assist in identifying risk factors present on a segment of road, and in determining what treatments can be put in place to reduce the likelihood of ignition or the consequence of fire occurrence. In the event that, upon inspection, a roadside does not appear to be High risk the RBTST allows a simple re-assessment through identification of the risk factors actually present.

3 Select an appropriate treatment

The RBTST supports the selection of treatments for roads nominated as High priority for prevention of ignition and spread of fire, as control lines or access/egress roads. Often management of multiple fire management objectives requiring a variety of complementary treatments will be required.

If there is a major conflict between proposed fire prevention works and other values such as environmental, cultural or heritage values there may be other management solutions available that do not involve vegetation management. Education and planning treatments can also be effective.

Education solutions could include expanding on fire agency key messages in summer about travelling on roads during bushfire, incorporating specific concerns about local roads into Fire Ready Victoria sessions, or a specific summer road safety campaign. Driving licence testing could incorporate questions around driving during bushfires.

Planning treatments can be applied that could provide traffic management options such as traffic being able to run contra flow when there is sufficient time to evacuate prior to a bushfire arriving. Road closures could be planned for specific predetermined locations. Portable traffic signals can be deployed to allow traffic to travel more smoothly. Treatments such as these will be determined by the Municipal Emergency Management Planning Committee (MEMPC).

Once the roads have all been prioritised and ground truthed new maps can be created by changing the electronic maps to include the roads that had been upgraded or downgraded through the process. This map can be incorporated into the Municipal Fire Management Plan (MFMP).

9.2.4 Prioritisation, budget and approval

Plan	Works Plan is developed, budgeting and approvals process completed by VicRoads

Based on the prioritisation and assessment of roads through this process a risk-based bid can be developed to reflect the requirements of the *S7 – Fire Management Asset Management Guideline*.

In accordance with the *VicRoads Roadside Asset Management Guideline*, fire management activities must be included in MFMP's, within approved VicRoads processes and have given consideration to other management priorities identified in the Roadside Management Strategy 2011.

9.2.5 Include works plans in the Municipal Fire Management Plan

Incorporate	MUNICIPAL FIRE MANAGEMENT PLANNING Works plans are provided to the MFMPC for including the Municipal Fire Management Plan

1 Content for the Municipal Fire Management Plan

The MFMP may require some broad information relating to the activities undertaken on roadsides by VicRoads. These will be related to the objectives being treated. Examples of this could be:

Activity: Identify roads with High risk of ignition and fire spread

Treatment: Create and validate VicRoads Bushfire Risk Mapping

Timeframe: September 2013/2014

Responsible parties: MFMPC Roads sub committee

Activity: Assess and treat High priority roads for managing the safety of road users

Treatment: Undertake inspections of the townships with TPP's or CIG's and run a local education campaign on the dangers of driving during bushfire.

Timeframe: November 2013/2014

Responsible parties: VicRoads, CFA, Municipality

MFMP's differ across the state and each RSFMC may have diferent methods of including VicRoads information. The completed road bushfire risk map and works plan should be provided to the MFMPC for inclusion through either appending the information or referencing it in the plan.

VicRoads detailed works plans for submission to the MFMPC should include the objective being managed, the location, treatments, who is responsible for managing them and when the works are expected to be completed. This plan can also be used to access the fire protection exemption Clause 52.17.6 (Fire Prevention) Victoria Planning Provisions. See an example of a Road Bushfire Risk Works Plan in Appendix 3.

In order for any roadside works to be undertaken by CFA brigades they must be included in or appended in the MFMP in line with their Roadside Fire Management Works (CFA Guidelines and Procedures) and in accordandance with the CFA/VicRoads agreed roadside fire management responsibilities – works planning. This agreed set of responsibilities is provided in Appendix 1.

When the MFMP is complete it is endorsed by the MFMPC and then sent to the RSFMPC for comment. It is then sent to Council for adoption. This provides a level of formal endorsement of VicRoads' approach to managing the bushfire risk.

2 Municipal Fire Management Planning Committees (MFMPC's)

Most MFMPC's meet four times a year however some, in more rural locations, may only meet once a year, prior to the fire danger period (FDP) around October and in April after the FDP has been lifted.

The role of the MFMPC is to:

- Plan burning or clearing of fire breaks;
- Advise appropriate authorities as to the existence of and steps to be taken for the removal of fire hazards within the municipal district;
- Advise and make recommendations to the municipal council in the preparation of the MFMP;
- Recommend to CFA or to the appropriate authorities any action which they deem necessary or expedient to be taken to reduce the risk of an outbreak of fire or for suppressing any fire;
- Advise the MFPO concerning the removal of fire hazards under section 41 of the CFA Act;
- Refer to the RSFMC for consideration all matters which in the opinion of the committee should be referred; and
- Carry out such functions as are conferred or imposed upon MFMPC's by regulations made upon recommendations of the CFA.

10 ACRONYMS

BRCIM	Bushfires Royal Commission Implementation Monitor
CFA	Country Fire Authority
CIG	Community Information Guide
DSE	Department of Sustainability and Environment
FDP	Fire Danger Period
IFMP	Integrated Fire Management Planning
LRP	Local Response Plan
MAV	Municipal Association Victoria
MEMP	Municipal Emergency Management Plan
MEMPC	Municipal Emergency Management Planning Committee
MFB	Metropolitan Fire Brigade
MFPO	Municipal Fire Prevention Officer
MFMP	Municipal Fire Management Plan
MFMPC	Municipal Fire Management Planning Committee
NSP	Neighbourhood Safer Place
PwC	Pricewaterhouse Coopers
RBTST	Road Bushfire Treatment Selection Tool
RSFMC	Regional Strategic Fire Management Committee
SFMPC	State Fire Management Planning Committee
TPP	Township Protection Plan
VBRC	Victorian Bushfires Royal Commission
VFRR	Victorian Fire Risk Register

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APPENDIX 1

OVERVIEW OF CFA AND VICROADS RESPONSIBILITIES FOR FIRE MANAGEMENT

Overview of CFA and VicRoads Responsibilities for fire management

PART D OF CFA ROADSIDE FIRE MANAGEMENT WORKS, GUIDELINES AND PROCEDURES

CFA AND VICROADS FIRE MANAGEMENT RESPONSIBILITIES - WORKS PLANNING

Objective - Complete Fire Management Roadside works in accordance with an agreed plan in a safe, envirionmentally responsible and efficient manner.

VICROADS RESPONSIBILITIES	CFA RESPONSIBILITIES
Ensure agreed Traffic Management Plans and Memorandum of Authorisation applications	Traffic Control training for local brigades
VicRoads to identify any FFG and EPBC and other environmental requirements	CFA Area to prepare Roadside Fire Management Works Program with brigades (These should originate or be included into Municipal Fire Management Plans)
VicRoads issue bulk and individual Memorandums of Authorisation (where required) and Road Use Consent for a period of six months and Schedule 12 Permits to Burn where required	CFA to request 1 Memorandum of Authorisation 2 Road use Consent 3 Schedule 12 Permit to Burn (where required)
VicRoads to undertake random audits of CFA roadside operations and TMP implementations	CFA to distribute to brigades 1 Memorandum of Authorisation 2 Road Use Consent 3 Schedule 12 Permit to Burn (where required) 4 Traffic Mangement Plans 5 Relevant Environmental Permits (if required)
	Brigades to notify VicFire and VicRoads Traffic Management Centre four hours prior to fire management activities

- Risk to public, CFA volunteers and to traffic is greatly increased if Traffic Management Plans are not used during road side works
- The effectiveness of fire prevention programs is greatly reduced and the risk to the public is significatly increased if roadside works in line with Municipal Fire Management Plan do not occur

APPENDIX 2-1

ROAD BUSHFIRE TREATMENT SELECTION TOOL - RISK WORKSHEET

Risk worksheet

N W E S Facing (circle)

Photos:

Date:
Assessors:

Road name:
Road maintenance category
Segment (from - to):
Length of segment:
Distance from Brigade:

Adjacent | Road Reserve | Shoulder | Traffic lane | Shoulder | Road Reserve | Adjacent

Aerial bundled cable 5 Y / N
Bare conductors 9 Y / N

width____ m
Fire place present 5 Y / N

Predominant land use
1 ☐ Transport
4 ☐ Cropping
1 ☐ Grazing
9 ☐ Forest
9 ☐ Plantation
9 ☐ Residential
7 ☐ Industrial/commercial

Topography
1 ☐ Rugged
4 ☐ Gentle

Potential for fire spread
9 H 5 M 3L

Assets within 30m
High value 9 Y/N
Moderate value 7 Y/N
Low value 5 Y/N

Fuel break 3Y/5N

History of ignitions
☐ 9 > 20% above median
☐ 3 Within 20% of median
☐ 1 > 20% below median

SCORE TOTAL:

Vegetation Grass 5 ☐ Forest 9 ☐ Wood 7 ☐ Heath ☐ Non-vegetated 0 ☐

Dries out 6 Every year / 3 Most / 1 Rarely

Fuel Hazard M H VH Ext
Surface/nr surface 1 ☐ 3 ☐ 5 ☐ 9 ☐
Elevated 2 ☐ 4 ☐ 7 ☐ 9 ☐
Bark 3 ☐ 6 ☐ 9 ☐ 9 ☐

Conservation status H / M / L

Assets present Y / N
Road furniture Y / N
Rest area 4 Y / N
Power Y / N
Water Y / N
Telecoms 2 Y / N

SCORE TOTAL:

APPENDIX 2-2

ROAD BUSHFIRE TREATMENT SELECTION TOOL - TREATMENT WORKSHEET

Scores

Total Score for adjacent land (both sides) = x 7 =

Total Score for road reserve (both sides) = x 3 =

+

=

Treatment worksheet

If the total score is over 400 continue to treat the road as it is considered HIGH risk

Physical works
Planned burn
☐ _____
Fire Prevention Notice
☐ _____
Bare earth fuel break
☐ _____ m

Potential works
Spray shoulder ☐ _____ m
Grade shoulder ☐ _____ m
Other (Specify) ☐ _____

Physical works
Planned burn
☐ _____
Fire Prevention Notice
☐ _____
Bare earth fuel break
☐ _____ m

Physical works

Planned burn	☐	_____
Slash (10cm height)	☐	_____ m
Spray	☐	_____ m
Power line clearance	☐	_____
Bare earth fuel break - linear	☐	_____ m
Bare earth around ignition sources	☐	_____ m
"Fuse" break	☐	_____ m
Tree - pruning	☐	
Tree - removal	☐	
Other (specify)	☐	_____

Complementary approaches

Fire investigation	☐
Public awareness	☐
Patrol & enforcement	☐
Traffic management plan	☐

Physical works

Planned burn	☐	_____
Slash (10cm height)	☐	_____ m
Spray	☐	_____ m
Power line clearance	☐	_____
Bare earth fuel break - linear	☐	_____ m
Bare earth around ignition sources	☐	_____ m
"Fuse" break	☐	_____ m
Tree - pruning	☐	
Tree - removal	☐	
Other (specify)	☐	_____

Complementary approaches

Fire investigation	☐
Public awareness	☐
Patrol & enforcement	☐
Traffic management plan	☐

APPENDIX 3

EXAMPLE VICROADS WESTERN REGION ROAD BUSHFIRE RISK WORKS PLAN

	Road Name	From	To	Risk (H,M,L)	Treatment	Responsible Party	When
RAINBOW	Fire Prevention						
	Birchip-Rainbow Road (C243)	Dimboola Road – Rainbow Road, Rainbow (C227)	Clarke Road, Rainbow	H	Slash, 3 meters behind guide post*	VicRoads	Dec 12
	Taverner Street (C227)	Birchip-Rainbow Rd (C243)	Sanders Street, Rainbow	H	Slash, 3 meters behind guide post*	VicRoads	Dec 12
	Access/Egress						
	Three Chain Road, Rainbow	Liesfield Rd, Rainbow	Rainbow-Nhill Road, Rainbow	H	Thin 60% of understory, remove overhanging tree branches	VicRoads	Dec 12
	Rainbow-Nhill Road, Rainbow	Murray Road, Rainbow	Three Chain Road	M	Periodic treatment	VicRoads	Nov 13
	Fire Control Lines						
	Dimboola – Rainbow Road (C227)	Western Hwy (A8), Dimboola	Tullyvea Street, Rainbow	H	Slash, fence to fence	VicRoads	Nov 12
	Hopetoun-Rainbow Road (C227)	Wheatlands Road, Rainbow	Shire boundary, Albacutya Road, Albacutya	H	Bare earth break	CFA	Nov 12

APPENDIX 4

MAPPING METHODOLOGY

(SEE INSERT)

METHODOLOGY

METHODOLOGY

1 BACKGROUND

This methodology is attached to the Road Bushfire Risk Assessment Guideline that has been developed by a multi-agency Project Team lead by VicRoads. This project addressed the recommendation of the 2009 Victorian Bushfires Royal Commission's Final Report that VicRoads implement a systematic statewide program of bushfire risk assessment for all roads for which it is responsible, to ensure conformity with the obligations in s.43 of the Country Fire Authority Act 1958 and with the objectives expressed in the VicRoads 1985 Code of Practice[1] (VBRC, 2010 - Recommendation 62).

The Guideline is supported by Road Bushfire Risk Mapping that focuses on Objectives 1 and 2 as listed in the CFA Roadside Fire Management Guidelines[2] (CFA, 2001). These guidelines discuss the risk of a fire starting on a road reserve and spreading beyond it and aligns with VicRoads' obligations under s.43 of the CFA Act.

The Road Bushfire Risk Mapping quantifies factors that influence the likelihood and consequence of a bushfire starting on the road network.

CFA have produced the Road Bushfire Risk Mapping for the entire State using authoritative and commonly accepted datasets to ensure alignment with current fire management planning (e.g. Victorian Fire Risk Register, CFA Precincts, Powerline Low Fire Hazard areas etc.).

This document provides a summary of the mapping methodology. It should be read in conjunction with Road Bushfire Risk Assessment Guideline.

1 VBRC (2010). 2009 Victorian Bushfires Royal Commission Final Report. Victorian Bushfires Royal Commission, Melbourne.

2 CFA (2001). Roadside Fire Management Guidelines. Country Fire Authority, Melbourne.

2 OVERVIEW OF MODEL DESIGN

The objectives being considered in this risk mapping methodology are:

1 **Prevent fires on roadsides; and**

2 **Contain roadside fires.**

The protection of assets immediately adjacent to the road reserve and which may be impacted upon by fire burning on the road reserve was considered to be part of Objective 2.

Preventing an established fire from crossing a road/roadside was considered to be beyond the scope of Objective 2 and better considered under the auspices of Objective 4 Provide control lines.

The Road Bushfire Risk Mapping identifies the presence and, where possible, quantifies factors that influence the likelihood and consequence of wildfire starting on the road network.

The likelihood theme is made up of two components; the likelihood of ignition and the likelihood of fire spread beyond the road reserve. The consequence theme is also made up of two components; the consequence of fire on the road reserve and consequence of fire spread beyond the road reserve.

The two risks being analysed are inherently linked. That is, a fire cannot spread from the road reserve and do damage (risk 2) unless there has been an ignition (risk 1). Thus the likelihood of the second risk is conditional on the likelihood of the first risk, and in the model the likelihood ratings are multiplied.

The consequences are cummulative. That is the potential for damage to assets by fire on the road reserve is added to the potential for damage beyond the road reserve.

Likelihood and consequence of each risk is assessed separately and then combined to give the overall risk of road-generated wildfire (see Figure 1). This allows greater flexibility in the analysis and lends itself to targeting treatments to different aspects of the overall risk.

FIGURE 1
APPROACH TO ASSESSING ROAD-GENERATED WILDFIRE RISK

$$(L_i \times L_s)(C_{rr} \times C_i) = R$$

where: L_i is the likelihood of ignition;

L_s is the likelihood of spread beyond the road reserve;

C_{rr} is the consequence of fire burning on the road reserve;

C_l is the consequence of fire burning in the wider landscape; and

R is the risk rating assigned.

Each component is made of contributory sub-components (see Figure 2).

Each sub-component is rated on a scale of 0-10 for each road/segment of road. At the component level the rating for each road/segment of road is calculated as the weighted sum of all its sub-components. Similarly at the overall theme level, the likelihood and consequence rating for each road/segment of road is calculated as the weighted sum of both its components.

Weightings are applied to sub-components and components as it is recognized that not all have equal effect on the level of risk. The weightings applied were developed by Terramatrix and refined through consultation with road and fire management personnel, in particular CFA's VFRR team.

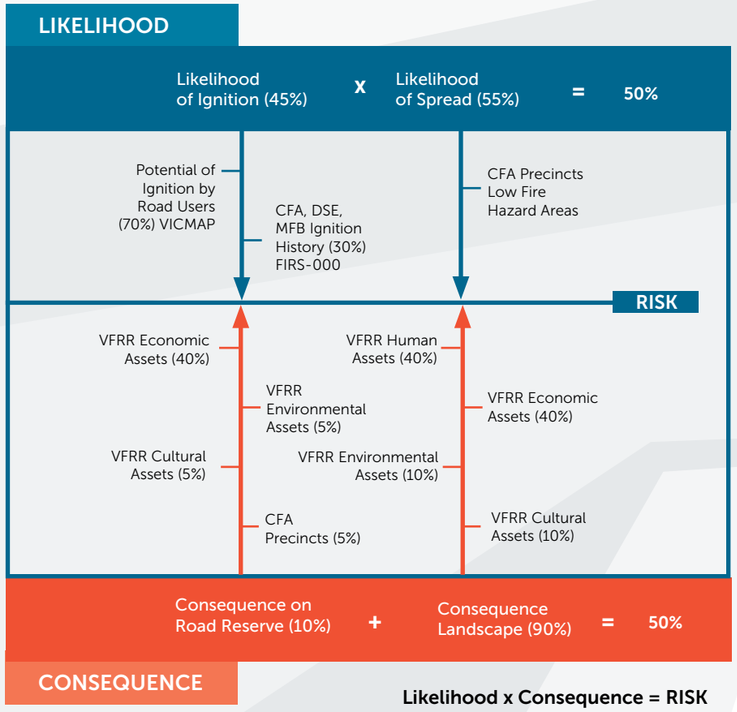

FIGURE 2
ALTERNATIVE VIEW OF BUSHFIRE RISK PRIORITISATION MODEL STRUCTURE

3 COMPONENTS AND SUB-COMPONENT RATING SCHEMA

3.1 Likelihood theme

The likelihood rating is derived from two major components:

- Likelihood of ignition
- Likelihood of spread beyond the reserve.

3.1.1 Likelihood of ignition component

The likelihood of ignition component is divided into two sub-components:

- Potential for ignition by road users
- History of ignitions.

The sub-component rating scales and weightings are shown in Figure 3.

FIGURE 3
LIKELIHOOD OF IGNITION SUB-COMPONENT RATING SCALES AND WEIGHTINGS

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Potential for ignition by road users	Road classification	Category M & A	10	70%
History of ignitions	Number of vegetation, undefined, vehicle and DSE ignitions within 1 km grid in last 10 years	Category B	6	30%
		Category C	4	
		Category N	2	
		> 3	10	
		1-2	6	
		0	4	

3.1.2 Likelihood of fire-spread from the reserve component

The likelihood of fire-spread from the reserve is comprised of one sub-component:

- Ability for fire to spread across the landscape.

The sub-component rating scales and weightings are shown in Figure 4.

FIGURE 4
LIKELIHOOD OF FIRE SPREAD SUB-COMPONENT RATING SCALES AND WEIGHTINGS

Ability for fire to spread across landscape	Precinct type (not in power line low hazard area)	Bush & Parks,	10	100%
		Farming & Rural Living	8	
		Interface Living	6	
		Industry & State Infrastructure, Township & Suburban Living	2	
		Business & Community Activity Centres, MFB,	1	
	Power line low hazard areas	Power line low hazard areas	1	
	Water	Water body	0	

Precinct mapping is Level 2 (verified) for CFA and DSE areas, and Level 1 (unverified) for the MFB area. Methodology considers adjacent land use and assigns the 'worst' side of the road to the road as a whole.

3.2 Consequence theme

The consequence rating is derived from two major components:

- Land use adjacent to road
- Consequence of spread beyond the reserve.

Data on the presence of assets on the road reserve and in the wider landscape is drawn heavily from the Victorian Fire Risk Register (VFRR). The VFRR notes the presence of assets, assigns them a criticality score, and assesses the likelihood of a bushfire reaching them (see Figure 5) and its possible impact upon them. Thus it goes beyond a simple register of assets but rather attempts to account for the vulnerability of each asset in the face of the level of hazard to which it could be credibly exposed. (See Figure 6)

FIGURE 5
VFRR LIKELIHOOD RATING SCHEMA

SUB-COMPONENT	FIRES ARE EXPECTED TO SPREAD AND REACH ASSETS	FIRES ARE NOT EXPECTED TO SPREAD AND REACH ASSETS
Fires occur frequently	Almost certain	Possible
Fires occur infrequently	Likely	Unlikely

FIGURE 6
VFRR CONSEQUENCE SCHEMA

THREAT/ VULNERABILITY	LOW	MEDIUM	HIGH	VERY HIGH
High	Minor	Moderate	Major	Catastrophic
Moderate	Minor	Moderate	Moderate	Major
Low	Minor	Minor	Moderate	Moderate

FIGURE 7
VFRR PRIORITY TABLE

CONSEQUENCE/ LIKELIHOOD	MINOR	MODERATE	MAJOR	CATASTROPHIC
Almost certain	3D	2C	1C	1A
Likely	4	3A	2A	1B
Possible	5	4	3B	2B
Unlikely	5	5	4	3C

Within the prioritisation matrix (see Figure 7), the risk levels are identified numerically from 1-5 and prioritised from highest risk to lowest risk (e.g. 1 represents an extreme risk which has the highest priority). Where there is a need to prioritise within the risk levels a letter indicates the priority level (e.g.A, B, C or D). For example 3A reflects the higher priority given to a particular asset within the high risk level and 3D reflects the lower priority given to a particular asset within the same high risk level.

3.2.1 Consequence of ignition on and adjacent to the road reserve

The consequence of ignition and fire on the road reserve is divided into four sub-components:

- Land use adjacent to the road reserve;
- Economic assets on and within 50m of the road reserve;
- Environmental assets on and within 50m of the road reserve; and
- Cultural heritage assets on and within 50m of the road reserve.

The sub-component rating scales and weightings are shown in Figure 8.

FIGURE 8
CONSEQUENCE ON AND ADJACENT TO ROAD RESERVE SUB-COMPONENT RATING SCALES AND WEIGHTINGS

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Environmental	VFRR Locally Important Environmental assets on road reserve or within 50m	VFRR priority 1A -1C	4	5%
		VFRR priority 2A-2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Endangered Environmental assets on road reserve or within 50m	VFRR priority 1A -1C	7.5	
		VFRR priority 2A-2C	5	
		VFRR priority 3A – 3D	2.5	
		VFRR priority 4	0.5	
		VFRR priority 5	0	
	VFRR Vulnerable Environmental assets on road reserve or within 50m	VFRR priority 1A -1C	10	5%
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
Cultural Heritage	VFRR Aboriginal significance cultural heritage assets on road reserve or within 50m	VFRR priority 1A -1C	4	
		FRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Non indigenous cultural heritage assets on road reserve or within 50m	VFRR priority 1A -1C	4	
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Other cultural heritage assets on road reserve or within 50m	VFRR priority 1A -1C	4	
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	

FIGURE 8
CONTINUED

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Land use adjacent to road	Precinct type	Business & Community Activity Centre, Industry & State Infrastructure	10	50%
		Township & Suburban Living, Interface Living	5	
		Farming & Rural Living, Bush & Parks	1	
		Water body	0	
Economic	VFRR Infrastructure assets on road reserve or within 50m	VFRR priority 1A -1C	10	40%
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
	VFRR Agriculture assets on road reserve or within 50m	VFRR priority 1A -1C	7.5	
		VFRR priority 2A – 2C	5	
		VFRR priority 3A – 3D	2.5	
		VFRR priority 4	0.5	
		VFRR priority 5	0	
	VFRR Commercial assets on road reserve or within 50m	VFRR priority 1A -1C	10	
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
	VFRR Tourist & Recreational assets on road reserve or within 50m	VFRR priority 1A -1C	4	
		FRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Mines assets on road reserve or within 50m	VFRR priority 1A -1C	8	
		VFRR priority 2A – 2C	6	
		VFRR priority 3A – 3D	4	
		VFRR priority 4	2	
		VFRR priority 5	0	
	VFRR Commercial Forests assets on road reserve or within 50m	VFRR priority 1A -1C	8	
		VFRR priority 2A – 2C	6	
		VFRR priority 3A – 3D	4	
		VFRR priority 4	2	
		VFRR priority 5	0	
	VFRR Drinking Water Catchments assets on road reserve or within 50m	VFRR priority 1A -1C	10	
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	

3.2.2 Consequence of fire spread beyond the road reserve component

The consequence of fire spread beyond the road reserve is divided into four sub-components:

- **Human assets;**
- **Economic assets;**
- **Environmental assets; and**
- **Cultural assets.**

The sub-component rating scales and weightings are shown in Figure 9.

In order to limit the off-reserve consequence a distance of 30km from the road was selected beyond which exposed assets were not considered. A 30km radius was selected as indicative of potential fire spread over the first two hours from ignition under Code Red conditions. It should be noted that a range of factors including fire type, vegetation type, weather conditions and topography would determine the actual extent of spread during this time period.

Assets exposed were also limited to those directions from the road towards which typical fire weather winds (i.e. from the N-NW or SW) would drive a fire.

FIGURE 9
CONSEQUENCE OF FIRE SPREAD IN THE LANDSCAPE SUB-COMPONENT RATING SCALES AND WEIGHTINGS

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Human settlement	VFRR Residential assets within 30km 'down wind' of road	VFRR priority 1A -1C		40%
		VFRR priority 2A – 2C		
		VFRR priority 3A – 3D		
		VFRR priority 4		
		VFRR priority 5		
	VFRR Other assets within 30km 'down wind' of road	VFRR priority 1A -1C		
		FRR priority 2A – 2C		
		VFRR priority 3A – 3D		
		VFRR priority 4		
		VFRR priority 5		
	VFRR Special Fire Protection assets within 30km 'down wind' of road	VFRR priority 1A -1C		
		VFRR priority 2A – 2C		
		VFRR priority 3A – 3D		
		VFRR priority 4		
		VFRR priority 5		

FIGURE 9
CONTINUED

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Economic	VFRR Infrastructure assets within 30km 'down wind' of road	VFRR priority 1A -1C	10	40%
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
	VFRR Agriculture assets within 30km 'down wind' of road	VFRR priority 1A -1C	7.5	
		FRR priority 2A – 2C	5	
		VFRR priority 3A – 3D	2.5	
		VFRR priority 4	0.5	
		VFRR priority 5	0	
	VFRR Commercial assets within 30km 'down wind' of road	VFRR priority 1A -1C	10	
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
	VFRR Tourist & Recreational assets within 30km 'down wind' of road	VFRR priority 1A -1C	4	
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Mines assets within 30km 'down wind' of road	VFRR priority 1A -1C	8	
		VFRR priority 2A – 2C	6	
		VFRR priority 3A – 3D	4	
		VFRR priority 4	2	
		VFRR priority 5	0	
	VFRR Commercial Forests assets within 30km 'down wind' of road	VFRR priority 1A - 1C	8	
		VFRR priority 2A - 2C	6	
		VFRR priority 3A – 3D	4	
		VFRR priority 4	2	
		VFRR priority 5	0	
	VFRR Drinking Water Catchments assets within 30km 'down wind' of road	VFRR priority 1A - 1C	10	
		VFRR priority 2A - 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	

FIGURE 9
CONTINUED

SUB-COMPONENT	INDICATOR	MAGNITUDE	RATING	WEIGHTING
Environmental	VFRR Locally Important Environmental assets within 30km 'down wind' of road	VFRR priority 1A -1C	4	10%
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Endangered Environmental assets within 30km 'down wind' of road	VFRR priority 1A -1C	7.5	
		FRR priority 2A – 2C	5	
		VFRR priority 3A – 3D	2.5	
		VFRR priority 4	0.5	
		VFRR priority 5	0	
	VFRR Vulnerable Environmental assets within 30km 'down wind' of road	VFRR priority 1A -1C	10	
		VFRR priority 2A – 2C	7.5	
		VFRR priority 3A – 3D	5	
		VFRR priority 4	2.5	
		VFRR priority 5	0.5	
Cultural Heritage	VFRR Aboriginal significance cultural heritage assets within 30km 'down wind' of road	VFRR priority 1A -1C	4	10%
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Non indigenous cultural heritage assets within 30km 'down wind' of road	VFRR priority 1A -1C	4	
		VFRR priority 2A – 2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	
	VFRR Other cultural heritage assets within 30km 'down wind' of road	VFRR priority 1A -1C	4	
		VFRR priority 2A -2C	3	
		VFRR priority 3A – 3D	2	
		VFRR priority 4	1	
		VFRR priority 5	0	

The vulnerability of each asset class will also impact on the potential consequence, however as the vulnerability of most asset classes to bushfire has not been quantified, it is assumed that all exposed assets may be damaged or destroyed.

Potential consequence in the 30km 'down wind' is assigned to stretches of road by buffering back from each asset point as illustrated in Figures 10 and 11.

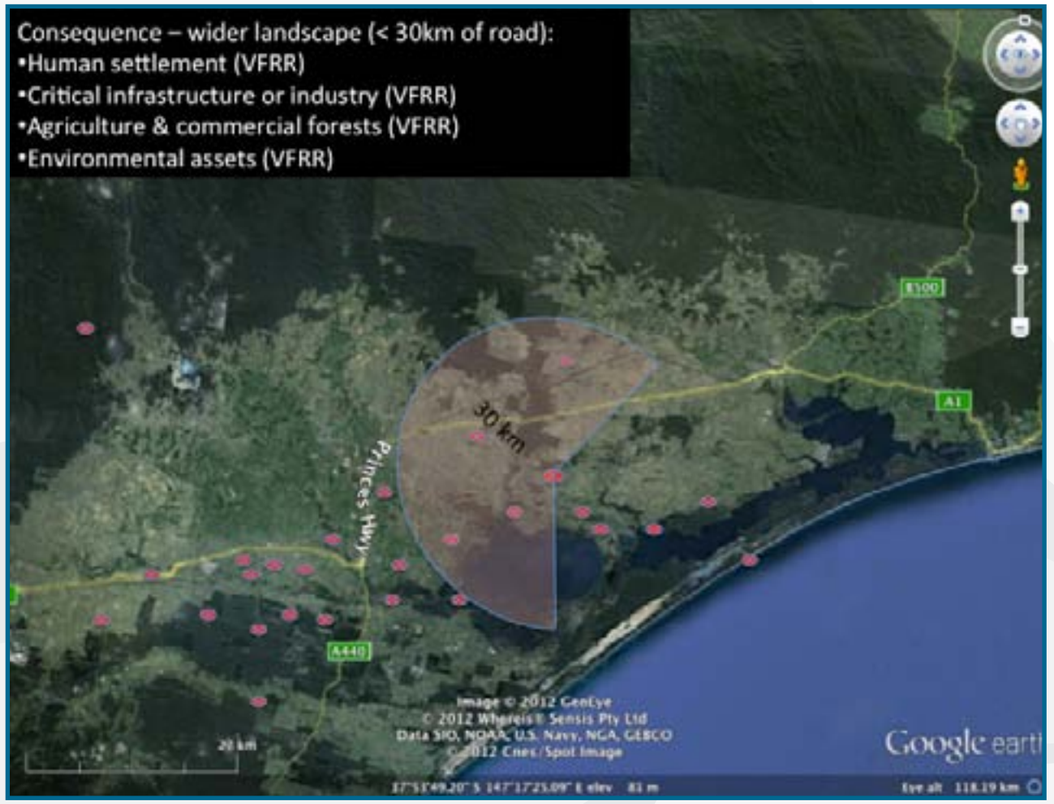

FIGURE 10
HYPOTHETICAL VFRR ASSET ASSIGNED AS CONSEQUENCE TO ROADS WITHIN 30KM ARC.

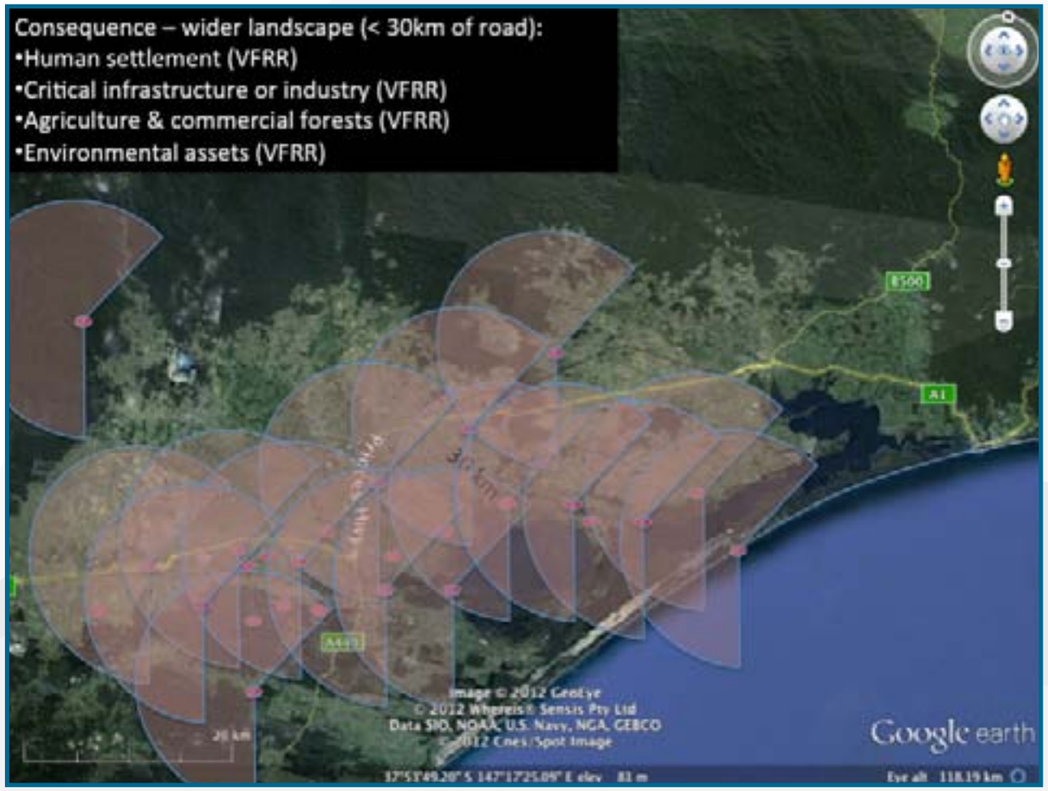

FIGURE 11
MULTIPLE VFRR ASSETS ASSIGNED TO ROAD NETWORK ILLUSTRATING HOW THE TOTAL LANDSCAPE CONSEQUENCE IS ACCUMULATED

4 RISK RATING

The consequence ratings for the reserve and landscape are expressed as a cumulative score of the weighted sub-component scores.

Weightings have been applied to the consequence ratings of fire ignition and fire spread beyond the road reserve. That rationale for this is that the value of assets on and immediately adjacent to the road reserve (i.e. within 50m) is by definition a subset of the assets in the wider landscape.

The weightings applied are:

C_{rr} 10%

C_{l} 90%

The likelihood ratings are expressed as probabilities where 1 is certainty that the event will occur and 0 is certainty that it will not.

The likelihood ratings for ignition and spread have also been weighted, with the ability to spread considered slightly more important to the final outcome. This results in:

L_{i} 45%

L_{s} 55%

5 RISK EVALUATION

Risk evaluation is the process of comparing risk against risk criteria to determine whether the risk requires treatment.

The Road Bushfire Risk Assessment Guideline proposes that road managers evaluate roads in relation to three risk criteria, or levels of risk at which specific actions are triggered.

These are:

- **Low risk roads** (marked in Green on the maps) are those where the level of bushfire risk does not warrant specific bushfire mitigation works, however may still include the standard routine maintenance program;
- **Moderate risk roads** (marked in Yellow on the maps) will receive the standard suite of treatments from the routine maintenance program; and
- **High risk roads** (marked in Red on the maps) require additional detailed assessment and may warrant additional fire risk mitigation treatments. As the risk cannot be managed on the roadside alone consideration needs to be given to broader treatments.

Standard deviation classification was used in the development of the maps. Thus the methodology emphasises how much each road segment varies from the mean value in the area being mapped (i.e. Regional or Municipal footprint). This was selected as the State dataset was "skewed" with a large number of roads with low score due to being in non-bushfire prone areas such as metropolitan Melbourne. A future refinement of the mapping may be required to exclude these from analysis.

The mapping should be seen as an input into road bushfire planning rather than as indicating a definitive requirement to implement a certain set of treatments or standard of works. The maps are designed to help road managers prioritise sections of road for more detailed analysis and treatment planning.

6 MAPPING PRODUCTS

6.1 THEMATIC REPRESENTATION OF RISK

The maps show the relative risk of bushfire ignition and spread across the road network within the sample area.

Rating

- LOW
- MODERATE
- HIGH

6.2 VIEWS

A variety of PDF maps have been produced for stakeholder feedback. Variants include:

Scale/sample area – State, Region, Municipality; and

Coverage – VicRoads network, Municipal network.

Other views can be generated to meet particular needs. At present the production of maps requires the CFA VFRR team. Future development could include a web map interface that enables road managers to both design and produce their own map, and to interrogate the underpinning data both the derived risk, likelihood and consequence ratings and theprimary data sources).