IPSWICH
CITY
COUNCIL

AGENDA

of the

ENVIRONMENT COMMITTEE

Held in the Council Chambers
2nd floor – Council Administration Building
45 Roderick Street
IPSWICH QLD 4305

On Tuesday, 3 December 2019
At 11.30 am or within any period of time up to a maximum of 10 minutes after the conclusion of the Communities Committee.

<table>
<tr><th colspan="2"><u>MEMBERS OF THE ENVIRONMENT COMMITTEE</u></th></tr>
<tr><td>Interim Administrator
Greg Chemello (Chairperson)</td><td></td></tr>
</table>

ENVIRONMENT COMMITTEE AGENDA

11.30 am or within any period of time up to a maximum of
10 minutes after the conclusion of the Communities Committee, on
Tuesday, 3 December 2019
Council Chambers

Item No.	Item Title	Page No.
1	Natural Area Network Fire Management Program Update	5

** Item includes confidential papers

ENVIRONMENT COMMITTEE NO. 12

3 DECEMBER 2019

AGENDA

1. NATURAL AREA NETWORK FIRE MANAGEMENT PROGRAM UPDATE

This is a report concerning an update on the current Natural Area Network Fire Management Program.

RECOMMENDATION

That the Interim Administrator of Ipswich City Council resolve:

That the report be received and the contents noted.

** Item includes confidential papers

and any other items as considered necessary.

Doc ID No: A5904678

ITEM: 1

SUBJECT: NATURAL AREA NETWORK FIRE MANAGEMENT PROGRAM UPDATE

AUTHOR: PLANNING OFFICER (NATURAL ENVIRONMENT)

DATE: 15 NOVEMBER 2019

EXECUTIVE SUMMARY

This is a report concerning an update on the current Natural Area Network Fire Management Program.

RECOMMENDATION/S

That the Interim Administrator of Ipswich City Council resolve:

That the report be received and the contents noted.

RELATED PARTIES

No conflicts of interest have been identified.

ADVANCE IPSWICH THEME

Caring for the environment

PURPOSE OF REPORT/BACKGROUND

In 2015 Council undertook a review of the bushfire management program. Upon internal evaluation of this program, a number of gaps and potential improvements were identified. These included:

- Clarification around the criteria and prioritisation method for intervention and works
- Clarification of the links between fuel load monitoring data and prescribed burn selection
- Update priorities and objectives of the management program with contemporary fire knowledge and methodology
- Improve readiness for the onset of new housing developments adjacent to significant bushland areas

2016 Independent Review

In 2016, Ecological Australia was engaged to conduct an independent review of Council's Fire Management Program and provide recommendations going forward – Refer Attachment 1. This review was presented at City Works, Parks, Sport and Environment Committee No. 2016(03) of 20 June 2016 and Council Ordinary Meeting of 28 June 2016. Key recommendations included:

- Create a new fire management strategy and reserve specific plans
    - Completed – Fire Management Strategic Plan 2017
- Develop a fire referral group to prioritise areas for prescribed burns
    - On-going – internal stakeholders meeting regularly to discuss fire management within the Natural Area Estate
- Modernise fuel load assessments and integrate them into decision making
    - Completed – Fire Monitoring Program update 2018
- Modernise spatial information relating to fire to proactively plan for fire risk, particularly in urban interface areas
    - Completed – decision prioritisation tool on QGIS

2017 Fire Management Strategic Plan

Consultants GHD were engaged to produce a Fire Management Strategy for Council in 2017 – Refer Attachment 2. This strategic plan was adopted at City Works, Parks, Sport and Environment Committee No. 2017(05) of 22 May 2017 and Council Ordinary Meeting 30 May 2017. This strategy covers Council's Natural Area Estate (NAE), which includes city wide and district level Conservation Estates and Reserves. The strategy sets out the following:

- An analysis of factors that make an area susceptible to bushfire impacts enabling different areas of the NAE to be given a priority rating
- A bushfire risk dashboard created around a multi criteria analysis with weightings reflecting the necessary prioritisation of risk to life and property, to balance with ecological and other outcomes. The outputs include evaluations of:
    - Unmitigated risk - if no actions are implemented in an area to address vulnerabilities
    - A residual risk - after the implementation of management actions
    - The residual risk - following actions coordinated with shared responsibility partners including neighbours and QFES

- Individual risk maps and plans for the various Estates and Reserves

These three outputs allow Council to meet its core objectives of:

- Prioritising works and prescribed burns to areas of greatest vulnerability
- Setting objectives and clear direction for specific geographic areas
- Modernising Councils fuel monitoring program and integrating it into decision making

<u>2018 Update of the Fire Monitoring Program</u>

Following adoption of the Fire Management Strategy, Council wanted to further develop a means for meeting recommendations 3 and 4 of the 2016 Independent Review. Council engaged fire specialists Ten Rivers to further modernise Council's fire monitoring program and spatial decision making to assist operational works – Refer Attachment 3.

Ten Rivers produced a numbers of outputs with the key deliverable being a highly sophisticated data analysis and decision tool for site prioritisation. The tool is geospatially based and incorporates fuel load data, vegetation condition and risk across the NAE.

<u>OPERATIONAL DELIVERY OF THE FIRE MANAGEMENT STRATEGY</u>

The principles of the Strategy have been applied through a spatial analysis to quantify and identify areas for hazard reduction actions and wildfire mitigation infrastructure.

Since the adoption of the Fire Management Strategy the following actions have occurred in line with the strategic and operational recommendations:

- Approximately 350,000 m2 of fuel reduced zones have been installed in areas prioritised through the updated risk assessment matrix
- 43 ha of prescribed burns have been completed, with an additional 90 ha planned for this financial year targeted in areas deemed most appropriate based upon the updates and best knowledge
- Annual fuel monitoring has been undertaken since 2016
- The first round using updated fuel monitoring program methods to be rolled out in this financial year
- Fire management zones for each conservation estate and reserve completed based on strategic prioritisation and risk assessments

LEGAL/POLICY BASIS

This report and its recommendations are consistent with the following legislative provisions: *Queensland Fire and Emergency Services Act (1990), Sustainable Planning Act (2009), Nature Conservation Act (1992), Environmental Protection Act (1994), Local Government Act (2009), Local Laws*

RISK MANAGEMENT IMPLICATIONS

Council mitigates the risk posed to the public and infrastructure by fire in its natural areas by remaining current with assessment and mitigation strategies. This is managed by engaging internal and external reviews and recommendations as and when required and in response to research and evolving understanding of best management practises.

At times council has to prioritise the methods and locations of works when conditions and resources dictate. This is informed by condition and fuel load assessments and the risk management matrixes.

FINANCIAL/RESOURCE IMPLICATIONS

The current budget for the Fire Management Program in 2019-2020 is $90 000 under the Enviroplan Levy. This budget is specifically for prescribed burns.

This year, additional funding has been redirected from Council's Conservation Works Program to be used for wildfire mitigation (approximately $120,000), primarily for the purpose of manual fuel reduction and the creation of fuel reduced zones around the highest risk areas.

With increasing proximity of new development, reduced planned burn windows and predictions of hotter drier weather it is envisaged that spending on fire management will be required to increase into the future.

COMMUNITY AND OTHER CONSULTATION

- Manager, Environment and Sustainability

Council is also a contributing member of the South East Queensland Fire and Biodiversity Consortium; a representative group of SEQ Local Governments, relevant State Agencies, Utility providers, and the regional Natural Resource Management group. The Consortium provides cross-boundary coordination, and access to contemporary research and data on fire management in natural areas.

CONCLUSION

Following a review in 2015 of Council's Natural Area Network Fire Management Program, a number of gaps and potential improvements were identified. To address this Council has carried out works through external consultants to inform of improvements which has resulted in the production of the following reports:

- 2016 Independent Review
- 2017 Fire Management Strategic Plan
- 2018 Update of the Fire Monitoring Program

Recommendations, actions and outputs from the documents listed above have assisted Council to make informed decisions around its fire management planning and risk mitigation strategies.

Council continues to manage the risk of wildfire in natural areas through the principles outlined in the 2017 Fire Management Strategic Plan.

ATTACHMENTS AND CONFIDENTIAL BACKGROUND PAPERS

1.	Independent Fire Program Review (2016) ⇩
2.	Strategic Fire Plan (2017) ⇩
3.	Fire Monitoring Program (2018) ⇩

John Young
PLANNING OFFICER (NATURAL ENVIRONMENT)

I concur with the recommendations contained in this report.

Phil Smith
ACTING PRINCIPAL OFFICER (NATURAL RESOURCES)

I concur with the recommendations contained in this report.

Kaye Cavanagh
MANAGER, ENVIRONMENT AND SUSTAINABILITY

I concur with the recommendations contained in this report.

Charlie Dill
GENERAL MANAGER - INFRASTRUCTURE AND ENVIRONMENT

"Together, we proudly enhance the quality of life for our community"

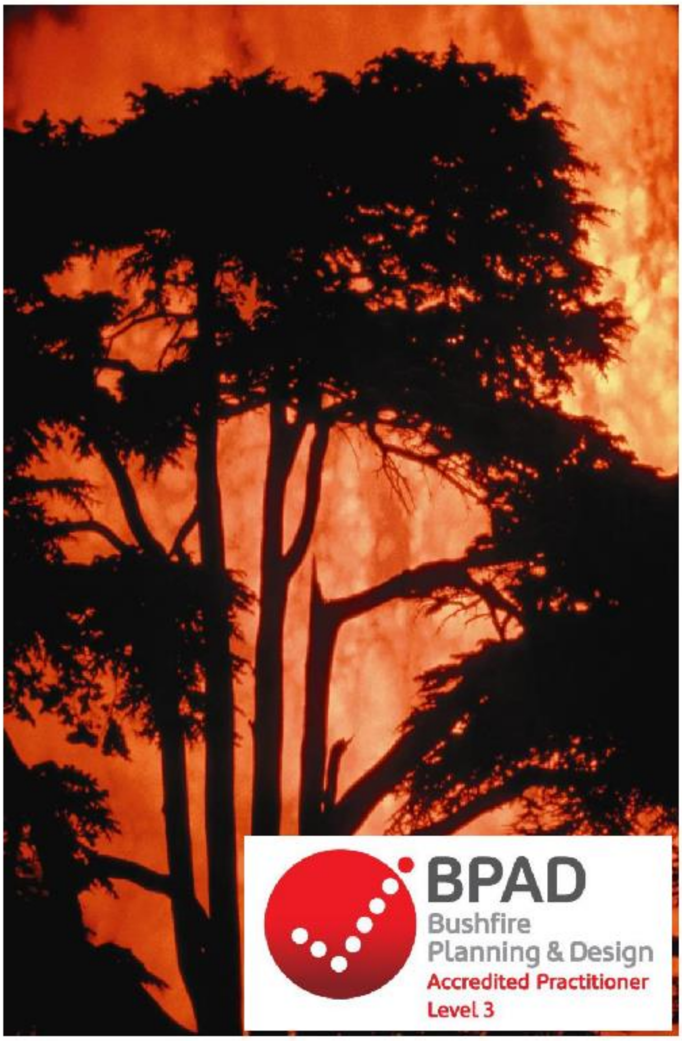
eco
logical
AUSTRALIA

Independent Review

Fire Management Program – Natural Area Estate

Prepared for
Ipswich City Council

23 May 2016



DOCUMENT TRACKING

Item	Detail
Project Name	Review of Fire Management Plans and Processes
Project Number	3406
Project Manager	Miles Yeates GPO Box 2040 BRISBANE QLD 4001
Prepared by	Miles Yeates, Adrian Pyrke, Alastair Patton and Alysha Sjarif
Reviewed by	Rod Rose
Approved by	Rod Rose
Status	Final
Version Number	2
Last saved on	23 May 2016

This report should be cited as 'Eco Logical Australia 2016. *Independent Review – Fire Management Plans and Processes – Natural Area Estate*. Prepared for Ipswich City Council.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd. We extend our thanks to several Council staff who assisted with site inspections and the provision of information for review.

Contents

Executive summary v

1 Introduction 6
1.1 Background 6
1.2 Context of review 6
1.3 Terms of reference 8
1.4 Review method 8
1.5 Structure of this report 8

2 Overview of Current Fire Management arrangements 10

3 Effectiveness of existing fire management plans and processes 12
3.1 Overview 12
3.2 Fire management planning 12
3.2.1 Structure of documentation 12
3.2.2 Currency of plans 16
3.2.3 Objectives 16
3.3 Implementation of fire management program 17
3.4 Programming and prioritising prescribed burns 19
3.5 Offset planting areas 20

4 Opportunities for Improvement 22
4.1 Documentation 22
4.2 Environmental outcomes 22
4.3 Planning tools 22

5 Synthesis of Findings and Recommendations 24
5.1 Findings 24
5.2 Recommendations to improve management arrangements 25

References 26

Appendix A Summary of Review Findings 27

Appendix B Photos from Site Inspections 30

Appendix C Fuel Accumulation Curves 33

Appendix D Fire Decision Support Model 34

List of figures

Figure 1 Map showing the location of Council's Natural Area Estate 7

Figure 2 Recommended framework for Ipswich City Council's fire management program 15

List of tables

Table 1 Summary of the total area within the Natural Area Estate affected by bushfire and prescribed burns 2009-2016 17

Abbreviations

Abbreviation	Description
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
ELA	Eco Logical Australia
FDI	Fire Danger Index
ICC	Ipswich City Council
QFES	Queensland Fire and Emergency Services
QPWS	Queensland Parks and Wildlife Service

Executive summary

Eco Logical Australia (ELA) was engaged by Ipswich City Council (ICC) to conduct an independent review of fire management plans, processes and documentation applied by Council in its management of the Ipswich Natural Area Estate. Findings and recommendations arising from the review will assist Council to provide a robust framework for the management of fire within its Natural Area Estate.

ELA established a team of internal staff with significant experience in the assessment of bushfire risk and in managing fire for conservation purposes. The review was completed over a period of six weeks, and involved an assessment of Council's fire management plans, processes and associated documentation. An inspection of selected locations within the Natural Area Estate was completed with Council staff on 15 and 16 March 2016.

Council's Natural Area Estate is currently comprised of approximately 6,400 ha of high value conservation land spread across eleven major conservation estates and reserves. Council has developed and is actively implementing a structured fire management program within the estate boundaries. Parts of the program are appropriate to meet Council's needs and legal responsibilities as a land manager. There is evidence of effective planning, on-ground implementation, monitoring and consultation with key stakeholders in delivering the fire management program. However, some fundamental shortcomings exist, most notably the lack of a total prescribed burning target each year.

ELA has identified several areas where the existing fire management program could be improved and better align with best practice. Some key examples include:

- Improved strategic fire management documentation, including a new strategic fire management plan and revised reserve-specific plans that are regularly reviewed and updated, with clear objectives. A framework for ICC's future fire management activities is recommended.
- Developing a fire referral group within Council to prioritise areas for prescribed burning, through the development and annual review of a rolling program for prescribed burns.
- Adoption of recent advancements in techniques for assessing fuel load risks and in achieving environmental outcomes through fire management programs. This could include the application of fuel accumulation curves and predictive spatial tools, which will more efficiently utilise the significant resources currently deployed to monitor fuel loads.
- Utilising recent advancements in landscape scale spatial tools to predict, proactively plan for and manage fire risk within residential areas adjacent to the Natural Area Estate.

A more detailed synthesis of findings and recommendations is provided in Section 5 of this report.

With some revisions to the existing fire management program, Council could make some modest advancements which would closely align its program with best practice. Opportunities to apply advanced tools for the assessment of bushfire risk have also been discussed.

1 Introduction

1.1 Background

Eco Logical Australia (ELA) was engaged by Ipswich City Council (ICC) to conduct an independent review of fire management plans, processes and documentation applied by Council in its management of the Ipswich Natural Area Estate.

Objectives of the project were to:

- Review exiting fire management plans and the fire management program currently implemented by Council
- Assess the effectiveness of implementation of the fire management plans and program to date
- Review methodology for programming and prioritising prescribed burns for hazard reduction and ecological outcomes, and
- Consider tree planting (offset) areas within the Natural Area Estate with regard to the management of fire

Findings and recommendations arising from the review will assist Council to provide a robust framework for the management of fire within its Natural Area Estate.

1.2 Context of review

Ipswich has a long history of promoting nature conservation, with the first Nature Conservation Strategy developed by Council in 2000. Approximately 23% of the City is currently being managed with conservation outcomes in mind, through a range of initiatives including the Ipswich Enviroplan and the Ipswich Planning Scheme (ICC 2015).

The acquisition of land parcels with large tracts of native vegetation is a key aspect of Council's Nature Conservation Strategy. The Enviroplan program is funded through an environment levy paid by the ratepayers of Ipswich City and assists in funding the acquisition and management of land with conservation value. Council's Natural Area Estate is currently comprised of approximately 6,400 ha of high value conservation land spread across eleven estates and reserves (Figure 1).

ICC has a system of management in place across its Natural Area Estate which provides for public outdoor recreation opportunities and the conservation of biodiversity. Among Council's responsibilities and goals in implementing its management system is that an appropriate fire management program is in place which:

- Promotes the protection of life and property from the effects of bushfires on Council's estate, and
- Utilises fire as a management tool to improve conservation or biodiversity outcomes

The continuation and improvement of Natural Area Estate planning and management is recognised as vital to the conservation of Ipswich's environmental values (ICC 2015).

Item 1 / Attachment 1.

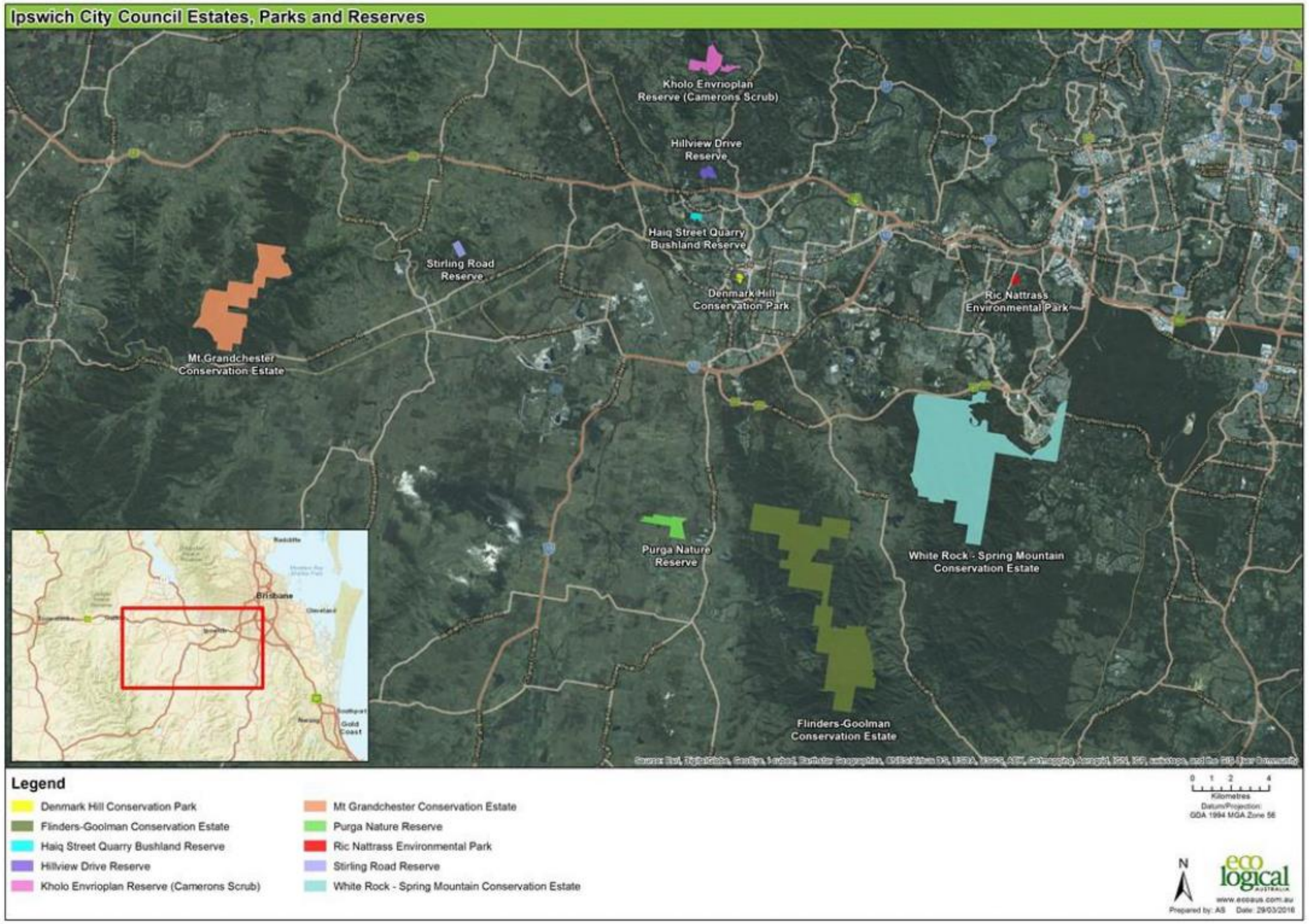


Figure 1 Map showing the location of Council's Natural Area Estate

1.3 Terms of reference

The terms of reference for the review are summarised as follows:

- Review Council's existing fire management framework and associated documentation
- Review the following documentation:
  - Council's Natural Area Estate Management Plans (11 in total)
  - Natural Area Estate Fire Management documentation including:
    i. Annual programming of prescribed burns (excel spreadsheet)
    ii. Fuel load monitoring methodology and data sheet
    iii. Fuel load monitoring data (excel spread sheet and graphs), and
    iv. Fire management and environmental spatial data.
- Provide recommendations arising from the assessment of the above material with a view to a robust fire management framework and process in place.
- Determine the effectiveness of implementation of the fire management plans and program to date.
- Provide an assessment of Council's current prescribed burn methodology including fuel load monitoring procedures, other mitigation techniques and selection processes for fire management blocks.
- Take into consideration Council's fire management program including ecological burns and offset planting areas.

1.4 Review method

ELA established a team of internal staff with significant experience in the assessment of bushfire risk and in managing fire for conservation purposes. The review was completed over a period of six weeks, and involved an assessment of Council's fire management plans, processes and associated documentation, as described in Section 1.3. An inspection of selected locations within the Natural Area Estate was completed with Council staff on 15 and 16 March 2016. This included visits to four reserves to examine examples of key Council infrastructure (e.g. day use areas, board walks), fire monitoring plots, bushland areas abutting residential development and fire management blocks with recent burn activity. Discussions were also held with Council staff responsible for overseeing and implementing the fire management program, as a means of collecting information.

Council's fire management program and associated documentation was assessed in relation to recognised approaches for successful fire management. During the project, the review team held regular internal meetings and discussions regarding findings and the development of recommendations for improved management. Where necessary, the review team requested additional information from Council to assist in assessing the effectiveness of the existing fire management program.

1.5 Structure of this report

This report presents the findings of the independent review in the following sections:

- Overview of current management arrangements of Council (Section 2)
- Effectiveness of existing fire management program (Section 3)
- A summary of opportunities for improvement (Section 4)

Findings and recommendations arising from the review are collated in Section 5. A summary of ELA's assessment of various aspects of Council's existing fire management program is also provided in Appendix A. Photographs from the site inspection are provided in Appendix B. Examples of predictive tools that are recommended to improve efficiency and outcomes from the fire management program are described in Appendix C and Appendix D.

2 Overview of Current Fire Management arrangements

The objective of the Natural Area Estate Fire Management Program, as specified in Council's Fire Management Policy (ICC 2013) is "that Council's Natural Area Estate will be managed to protect life and property from wildfire while planning, manipulating and utilising fire to maintain or enhance environmental values".

Specific aims of the fire management program, as outlined within Council's policy, are to:

- Protect life, property and the environment
- Minimise the risk of fire entering or leaving the estate and impacting upon the estate or adjoining property
- Maintain ecologically appropriate fire frequencies, distribution, seasonality and intensity
- Ensure the long term viability and survival of populations of native plants and wildlife
- Ensure cultural heritage and historic values within and around the estate are protected
- Minimise social impacts and hazards associated with smoke

Staff responsible for management of the Natural Area Estate work across a variety of disciplines including visitor management, asset management, community engagement, public education, asset maintenance, incident response and pest management. Fire management tasks are therefore one component of the work program for staff, and include:

- Developing and implementing fire management plans and associated procedures
- Assessing fuel loads every six months at several sites located within the Natural Area Estate
- Engaging contractors to maintain the condition of fire trails and other infrastructure located within the Natural Area Estate
- Identifying areas for future prescribed burns
- Monitoring fire danger indexes (FDI's) and implementing a management response (e.g. restricting public access) in extreme conditions
- Assessing the success of prescribed burns in achieving environmental priorities
- Monitoring the effects of fire on wildlife and their habitat
- Maintaining an incident response system
- Assisting staff and contractors to manage offset plantings in the Natural Area Estate to reduce the risk of fire within such areas
- Working with neighbouring landholders to assess and manage fire risks
- Active membership of the South East Queensland Fire and Biodiversity Consortium, supporting ongoing research in fire management, attending workshops and participating in professional development and community events.

Council officers do not actively participate in conducting prescribed burns or bushfire response activities; such tasks are completed by specialised contractors (generally the Queensland Fire and Emergency Services; QFES). Council officers provide a planning and support function to QFES staff (or contractor) working on the Natural Area Estate, assisting to achieve prescribed burn objectives and to combat bushfires.

Council's Planning and Development Department also plays a role in the management of fire risk to residential and commercial buildings, through mechanisms in the Ipswich Planning Scheme and the assessment of development applications for land located within bushfire hazard areas and adjacent to the Natural Area Estate.

3 Effectiveness of existing fire management plans and processes

3.1 Overview

Council has developed and is actively implementing a structured fire management program within the Natural Area Estate. Parts of the program are generally appropriate to meet Council's needs and legal responsibilities as a land manager. There is evidence of effective planning, on-ground implementation, monitoring and consultation with key stakeholders in delivering the fire management program. Key strengths of the program include:

- A system for the staged restriction of public access to reserves during periods of high fire danger, reducing risks to visitor safety
- Qualified and experienced staff who have a strong local knowledge of the Natural Area Estate and its management
- A standardised, long-term monitoring program for fuel load assessment throughout the Natural Area Estate
- Effective relationships with a range of stakeholders including QFES and neighbouring land owners
- A desire to achieve continual improvement in fire management practices

However, some fundamental shortcomings exist, most notably the lack of a total prescribed burning target each year. In this context, ELA has identified a range of improvements to the existing fire management program that would assist Council to better manage its risks and determine whether the program is achieving its intended objectives. Many of the recommendations involve only minor changes to the existing program.

Some advances in the tools available to support fire management activities of land managers may also benefit Council in certain circumstances and have been discussed in this report. The adoption of such measures can be evaluated in light of the resources available, acceptable levels of residual risk and the relative priority given to fire management over other aspects of Council's environmental program.

3.2 Fire management planning

3.2.1 Structure of documentation

Fire management plans and an overall fire management strategy are important aspects of any fire management program involving multiple reserves. Within these documents, objectives and responsibilities for fire management are described and fire management activities and standards are outlined. The documents are utilised as a resource during implementation by operational staff and are often available to interested stakeholders, including adjacent landholders and conservation groups. A well written and complete collection of fire management plans forms a solid basis for implementing a successful fire management program.

ICC has established fire management plans for 11 reserves within Council's Natural Area Estate. They cover the reserves of Grandchester, Woolshed Creek, Cameron's Scrub, Denmark Hill, Flinders Goolman, Haig Street Quarry, Hillview Drive, Purga, Ric Nattrass Environmental Park, Stirling Road Reserve, White Rock Spring Mountain and Woodend. The fire management plans have a generally consistent, but not identical format, and cover an appropriate range of topics related to the management of fire on the Natural Area Estate.

The fire management plans would significantly benefit from an overarching strategic plan that they can sit underneath. While a bushland fire policy is in place at a strategic level, this does not contain the detail that should be included within a strategic plan. The advantage of a strategic plan is that it creates standards and consistency in the fire management approach that can be applied across all reserves and can prioritise risk between reserves. Some of the content within the existing fire management plans for individual reserves is repeated in each plan (e.g. trail specifications) and would be more efficiently articulated in a single strategic plan, where it can be standardised to all reserves.

The naming and objectives of fire management zones is not consistent across all fire management plans. Zoning schemes are aligned with whichever consultant prepared the fire management plan. A standardised approach would allow individual reserve fire management plans to focus on site-specific issues.

A strategic plan that sits above Council's fire management plans for individual reserves would include the following:

- A standard fire zoning model for all land within the Natural Area Estate, specifying objectives for each zone category and if applicable, standards for fuel hazard management.
- For Asset Protection Zones, the width and fuel load specifications with a description of the basis for determining these.
- A clearer statement of Council's expectations for prescribed burning, including objectives, constraints (such as operating budgets) and priorities of zones in relation to fuel hazard management vs maintaining ecological diversity.
- Information summarising ecological values of the Natural Area Estate in the context of fire, including risks to biodiversity (e.g. inappropriate fire regimes – too much fire in riparian and rainforest habitats, too little fire in grassy forests), threatened species and strategies to manage these across the Natural Area Estate. A synthesis of best available knowledge to identify appropriate fire regimes for vegetation communities across the estate would also be provided.
- A description of the risk assessment method that Council applies to determine zoning requirements and priorities to protect people and built assets. For example, fire intensity mapping, fire scenario modelling and fire weather history analysis.
- A description of the evaluation methods and reporting associated with fire plan implementation.
- Specifications for fire trail categories.
- A risk ranking across reserves, assessing life, property and environmental risks.

Council could also develop guidelines and procedures that are either stand-alone documents or included within the strategic plan that cover:

- Guidelines and training requirements for prescribed burning practitioners, which relate to the standards of burn implementation that ICC requires.
- Guidelines for monitoring of fuels and ecological values.
- Procedures for Council fire preparedness and response to bushfires.

A recommended framework for a revised ICC fire management program is presented in Figure 2. Modifying the existing program to fit within this framework would require some changes to documentation at the strategic level, but would otherwise be a straightforward process to implement.

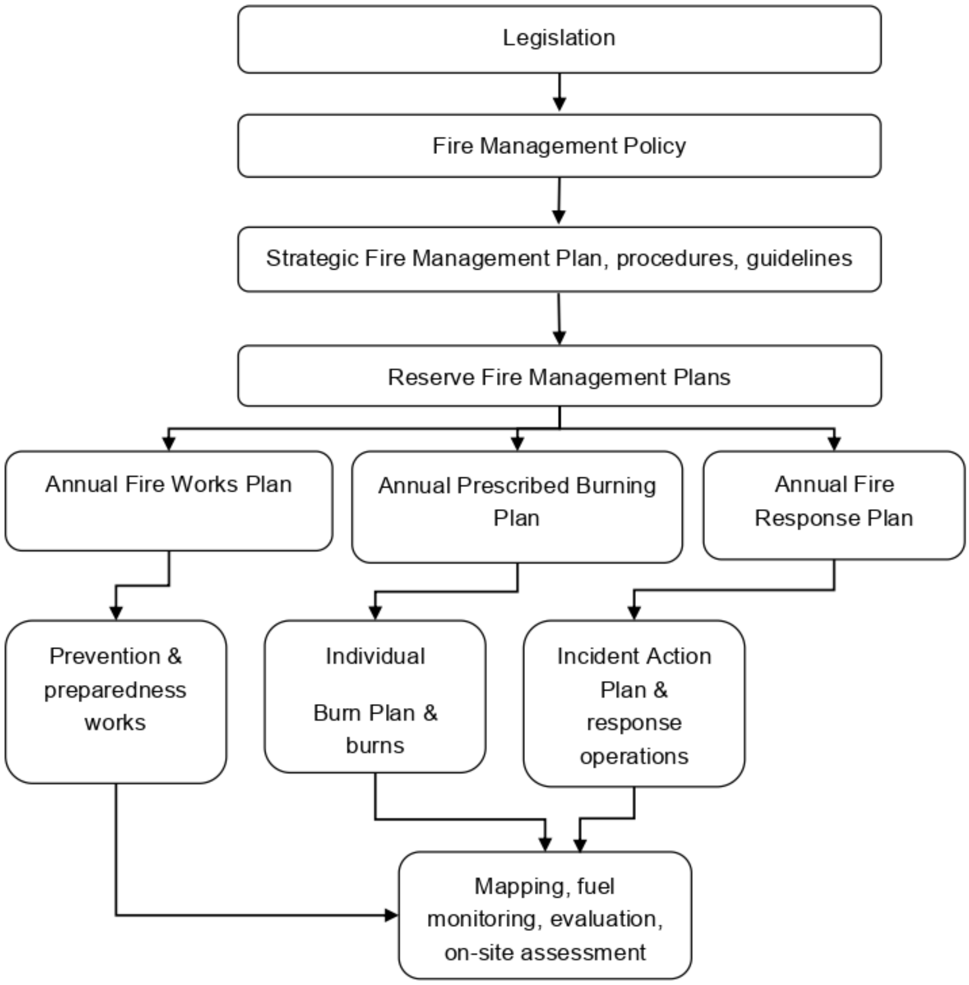


Figure 2 Recommended framework for Ipswich City Council's fire management program

3.2.2 Currency of plans

Collectively, Council's existing fire management plans form an important foundation for the fire management program, describing the approach to fire management in each reserve. The plans would benefit from more regular reviews and updates in response to changes in estate boundaries, the establishment of new offset plantings or other changes that affect fire management activities, either in a planning context or 'on the ground'. The ICC fire management policy states that plans will be updated 'on a five year cycle'. However more regular reviews and updates would be appropriate, and indeed some plans are older than the five years that Council has specified.

One example is the fire management plan for Grandchester Reserve, which has not been updated since major expansions of this reserve through the acquisition of new land. While the expanded estate was observed during the site inspections to be under active management by Council staff, excluding new areas of the Natural Area Estate from the fire management planning framework has an element of risk for Council. A process of regular review and revisions of fire management plans is recommended over infrequent major revisions, so that plans remain current and can be applied by staff and contractors in an effective manner. It is usual for prescribed burning priorities to change slightly from year to year based upon the success or otherwise of burning programs and wildfire history. Annual revisions therefore enable timely updates of priorities.

3.2.3 Objectives

One of the most important aspects of any fire management plan is the provision of measurable objectives. Objectives also clarify what the land manager is trying to achieve by implementing the plan and require evaluation of the success of fire management activities (by assessing whether measureable components of the objectives have been achieved). Within ICC's fire management plans, there are some measurable objectives for the Asset Protection Zone (APZ), which is generally located adjacent to built infrastructure. Characteristics of the APZ are also described. This approach reflects an emphasis on the protection of life and property.

However, objectives for other areas within the Natural Area Estate, which are presumably more focussed on achieving environmental outcomes, are not specified and are therefore unclear. In particular, in those plans that have a Bushfire Zone, there is no objective for this zone, which is by far the most extensive within the Natural Area Estate. It is therefore difficult to assess whether management activities within zones (other than the APZ), are being successfully implemented to meet their objectives, nor is it clear whether fuel management takes precedence over environmental objectives.

Significant guidance on the management of biodiversity through fire is available to Council in the 'Planned Burn Guidelines of South East Queensland Bioregion', published by the Queensland Parks and Wildlife Service (QPWS 2013). This reference is considered to be best practice for achieving environmental outcomes in the habitats of the South East Queensland Bioregion, within which Ipswich City is located. The guidelines could be used to inform an enhancement of Council's fire management program in the majority of locations where environmental outcomes are being sought.

In particular, the guidelines are focussed on maintaining healthy ecosystems based on field assessment of vegetation health, rather than adherence to a defined formula for fire interval. There is an emphasis on implementing mosaic burns to maintain healthy open forests and woodlands. The guidelines provide an opportunity for Council to realign its fire management practices to achieve better environmental outcomes.

3.3 Implementation of fire management program

Council has spatial data showing records of fire history within its Natural Area Estate and adjacent areas. The data consist of shape files with notes on whether the fire was a prescribed burn or bushfire. This is an important data source maintained by Council and provides useful information to assist in prioritising areas for future prescribed burning and in assessing the ecological values of areas within the estate following fire.

ELA undertook a review of Council's fire history spatial data to determine the geographic extent of prescribed burns and bushfires in recent years (from 2009 to 2016). The area within the Natural Area Estate that has been burnt either by prescribed burn or bushfire was calculated, for the past 6 years as data from this period is most likely to reflect the fire management program currently in place (Table 1).

Table 1 Summary of the total area within the Natural Area Estate affected by bushfire and prescribed burns 2009-2016

Year	Bushfire Area (ha)	Prescribed Burn Area (ha)	Total Area Burnt (ha)
2009	18.2	0	18.2
2010	6.6	445.8	452.3
2011	12.1	0	12.1
2012	2762.7	138.1$	2900.8
2013	0	43.2	43.2
2014	15.5	0	15.5
2015	0.4	47.8	48.2
2016#	-	97.0	-

$ includes 5.5 ha that was not marked as either a prescribed burn or bushfire

year to date (bushfire) and planned program (prescribed burns)

With an estate of more than 6,000 ha, Council would generally need to be planning to burn between 300 and 600 ha (~5-10% of the estate) each year to achieve the desired burn intervals outlined within the collective fire management plans. Such an objective would involve burning a mix of blocks where relatively frequent burning was required for fuel reduction purposes, and less frequent burns were implemented every 7-20 years for environmental purposes.

However, for most years examined, less than 100 hectares of land within the Natural Area Estate has been burned. Such an approach increases the risk of severe bushfires, with greater potential impact on life, property and the environment. The loss of large areas of the reserves in a single fire event is also ecologically undesirable. This occurred in 2012, when approximately 85% of the White Rock-Spring Mountain Conservation Estate and 30% of the Flinders-Goolman Conservation Estate were burnt by wildfire.

It is possible that prescribed burns since 2012 have been limited to small areas, in part due to the large area of land affected by bushfires in 2012. However, discussions with Council staff indicate that other factors have also contributed to the small scale of prescribed burning, including a lack of resources, unsuitable weather conditions and logistical difficulties. Under-burning is not desirable for either the protection of life and property nor for biodiversity management objectives. Scheduling a larger total area of prescribed burns each year is recommended, as part of a broader initiative to strategically prioritise areas for prescribed burning (see Section 3.4).

The Natural Area Estate does not appear to have had extensive areas affected by bushfire during most of the recent years examined. The exception to this is 2012, when large sections of the White Rock-Spring Mountain Conservation Estate were burnt. While bushfires have occurred in parts of the estate during most years, they have generally been restricted to an area of less than 20 ha. It is unclear precisely what mechanisms most affect these results but it is likely to be a combination of suppression action, fuel conditions and an absence of ignition under the most adverse weather conditions.

There are a large number of relatively small fire management blocks across the Natural Area Estate. This will be helpful for Council in achieving a fine grain mosaic of burns, which improves ecological outcomes and wildfire mitigation. However, there can be increased costs of burning a large number of small blocks. One strategy to increase the area being burnt through prescribed burning would be to burn larger areas (more blocks) in small patches (blocks that are not adjacent to each other), to achieve a mosaic of burnt and unburnt areas in the landscape. While there may be a temptation to combine adjacent blocks to increase burning efficiency, this rarely results in a fine grain mosaic, reducing the benefits of burning.

Council has an extensive fuel load monitoring program in place, which involves the calculation of fuel loads at established monitoring plots throughout the Natural Area Estate. Sites are assessed every six months by trained internal staff; an exercise that takes approximately 2 weeks to complete. Results of the fuel load monitoring are graphed and monitored by staff. Fire management plans refer to a fuel load of greater than 10 t/ha as being a trigger for potential prescribed burn activity. The review team noted the following issues with this approach:

- The 10 t/ha fuel load has been superseded by an overall fuel hazard methodology, which takes into account the fuel arrangement and structure (Hines *et al*. 2010), and leads to a more comprehensive assessment of fuel hazard. In this context the current approach applied by Council is outdated, but could be amended with some changes to be consistent with the preferred approach.
- Discussions with Council staff indicated that there is not currently a direct link between the results of fuel load monitoring, the objective for the fire management zone within which monitoring is conducted, and the prioritisation of prescribed burns. The extensive efforts to monitor fuel loads throughout the estate are well intended. However, better utilisation of this information in prioritising and scheduling prescribed burns is recommended.
- There are opportunities for Council to optimise the current fuel load monitoring system, to be more focussed on outcomes and free up resources to be applied elsewhere within the fire management program. With the implementation of a standard fire management zone scheme, some fuel monitoring plots may turn out to be located in a zone where fuel management is not the priority and may therefore be redundant. A redistribution of monitoring sites may also be warranted, given new acquisitions and the location of some fuel monitoring locations in close proximity to others. Additionally, the collection of fuel load information every six months is unnecessary for most sites, and reducing the assessment to an annual frequency in spring would free up resources to apply to other areas of the program.
- In the long-term, Council could develop and apply GIS tools to reduce the intensive fuel assessment program currently in place. This could be replaced with pre-burn fuel assessments (confirmation of model predictions) and the application of fuel accumulation

curves based upon fire history. Such an approach provides a reliable means of estimating fuel loads with less field monitoring and data collection. Further information about this method is presented in Appendix C.

3.4 Programming and prioritising prescribed burns

The process used by land managers to program and prioritise areas for prescribed burns is important for managing risks and to achieve objectives of a fire management program. Some areas adjacent to urban infrastructure may require relatively frequent (every few years) burning or alternative management to reduce the risks of bushfires, for the protection of life and property. However other locations of higher conservation value may benefit from burn intervals of 15 years or more, or the exclusion of fire altogether (e.g. rainforest or riparian areas). The desirability of burning a particular block may change throughout a year in response to factors such as weather conditions, budget constraints, fire history (on site or nearby), acquisitions to the Natural Area Estate or the manual removal of fuel loads.

There was little information available to facilitate a review of the approach taken by Council to prioritise and program areas for prescribed burns. Discussions with Council staff indicated that in the past, areas have been prioritised by a staff member with fire management responsibilities based on a range of factors, including the regional ecosystem type, recommended fire intervals and a range of subjective factors available to staff at the time. However, the extent of consultation with internal and external stakeholders and the reasons for prioritising certain areas over others were generally not documented or available for review.

We recommend that Council initiate a more formal annual assessment of priorities for future prescribed burning. The process of prioritisation should be based upon quality base layer data and involve a range of staff and stakeholders with knowledge of Council's fire management program, operational constraints and on site conditions within the Natural Area Estate.

The recommended process is summarised as follows:

- A fire referral group is established within Council, comprising a mix of planning, management and operational staff involved in managing the Natural Area Estate. External agencies involved in fire management activities (e.g. QFES) may also be invited to participate.
- The fire referral group meets in November or December each year, to review information available on the fire history, fuel load, on ground conditions and potential resources for the upcoming prescribed burn season. Prior to the meeting, a Council staff member has prepared relevant information to be available on the day, including latest information on regional fire history and proposed burn programs, results of fuel load monitoring collected in spring (or GIS based predictions), on-ground assessments of health and condition of vegetation and spatial information showing the location of fire blocks.
- The fire referral group assess the data available for each block within each reserve and make a recommendation on whether the block should be prioritised for a prescribed burn. Staffs are encouraged to provide information for the assessment and participate in the discussion about the timing of future prescribed burns, considering factors such as on ground conditions. If the block is not prioritised for a burn in the approaching fire season, it is allocated a future year on a rolling program when it is likely to be due for burning, based on the zone, fuel load and fire history data.
- After working through each block within each reserve, a rolling program of prescribed burns is developed, showing burns planned for the approaching year and those scheduled

for future years. The rolling burn program is then detailed in a report and presented to Council for adoption.

- During implementation of the burn program, it may be desirable to defer some burns scheduled for that year or to bring forward other burns scheduled for future years due to local weather conditions (e.g. lack of or too much rainfall) or new information becoming available.
- Once the initial rolling burn program has been established, the annual meeting is primarily focussed on reviewing the rolling program and making necessary amendments to bring forward or defer burns on the basis of new information (e.g. bushfire during the previous year, new fuel load data available or budget constraints).
- Outcomes of the fire referral meeting are documented, and where possible represent the collective view of the participants. An updated prescribed burn program is prepared annually, based on the conclusions of the meeting, indicating priorities and timing constraints and presented to Council.

The above process provides a permanent record of the decisions made by Council in prioritising areas for prescribed burns and the reasons for those decisions. Importantly, people with a range of responsibilities and priorities are involved in the decision making process and have a broader understanding of the basis for prioritising areas for prescribed burns.

A similar but more advanced process could be based upon a GIS based Fire Decision Support model (Rose and Lang 2001), which can be provided if required. An overview is presented in Appendix D.

3.5 Offset planting areas

Council's Natural Area Estate contains several tree planting areas which have been established as part of an environmental offset arrangement with third parties. Under the arrangement, an area within the Natural Area Estate that would benefit from offset planting is identified. Trees are planted by a third party contractor who works on behalf of the offset proponent. The contractor is also responsible for ongoing maintenance and care of the planting area up until a period of sign off, after which management of the planting is devolved to Council.

While the planting is being established and maintained, Council has obligations in relation to management of the general area, which vary according to the agreements. ELA has reviewed examples of the obligations for Council under some of the agreements, which include:

- A 5 m fire break will be established along the perimeter of the project site
- A fire management strategy for the area shall be implemented
- The offset proponent must be notified as soon as practicable upon Council becoming aware of a bushfire within 5 km of the planted area
- Council must not light a fire within the planted area without the prior written consent of the offset proponent
- If Council causes or allows any fire to be lit on the planted area or land and the fire becomes an uncontrolled fire, Council must immediately notify the appropriate fire service and undertake all reasonable actions to suppress and extinguish the fire at its cost.

Offset planting areas are generally established in locations requiring revegetation where there is not extensive remnant vegetation, although densely vegetated areas may be nearby. The maintenance of fuel loads within and immediately adjacent to the planting that reduce impacts to an agreed level is therefore a key strategy for the planting area. Fire trails surrounding the plantings should also be adequate to help reduce the risk of fire from adjacent areas impacting on the planting areas.

Operational aspects of Council's existing fire management program appear aligned to meeting the contractual obligations outlined in the agreements reviewed by ELA. Council officers in operational roles were observed to have a good local knowledge of plantings and their management arrangements. However, the management of fire in and around offset planting areas warrants more specific attention in the fire management plans prepared and implemented by Council. Given the significant investments of third parties in the offset plantings and the obligations of Council to manage the impacts of fire in these areas, there is an important need to identify planting areas within all fire management plans and outline objectives and management strategies to achieve compliance with Council's contractual obligations.

Recently established plantings at Grandchester Reserve for example (Appendix B) are not identified within the existing fire management plans for Grandchester or Woolshed reserves. Additionally, recent land acquisitions which link the former Grandchester and Woolshed reserves occur adjacent to offset plantings and are not currently covered by any fire management plan of Council. Such gaps highlight the importance of regular reviews and updates of fire management plans to clearly specify how Council will apply its fire management program to meet the commitments it has made to the proponents of offset plantings.

Risk reduction strategies for the planting areas should be based upon an acceptable level of residual risk. For example, the number of days per year that (should a fire occur) strategies are likely to prevent fire impact on plantings, and/or analysis of the likelihood of ignition and impact. When the acceptable residual risk is agreed to, strategies and actions can be defined that achieve that residual risk. The lower the residual risk sought, the higher the cost of achieving it and the greater the potential environmental impacts of management measures.

4 Opportunities for Improvement

This section identifies opportunities for Council to improve its existing fire management program, mindful of the resources and other responsibilities that staff have as part of the broader environmental program.

4.1 Documentation

A restructure of Council's fire management documentation is recommended, involving the development of an overarching strategic fire management plan and the updating of fire management plans for each reserve. The strategic plan and fire management plans are fundamental to all aspects of Council's fire management program. While existing documentation is in place, unclear objectives and gaps in the coverage of key areas (e.g. new acquisitions) and issues (e.g. offset planting areas) have the potential to limit the effectiveness of the program.

Prioritising areas for prescribed burns is a key area in which Council staff and stakeholders can directly influence fire management outcomes within the Natural Area Estate. A clear process that identifies priorities, based on the latest information, using consensus derived from the collective expertise within Council and key stakeholders would be of significant value. A Fire Decision Support style of assessment is desirable. Documentation is also important to provide an auditable trail of the decision making processes.

4.2 Environmental outcomes

Council has a clear objective to achieve environmental outcomes within the Natural Area Estate while facilitating outdoor recreation activities. Council staffs have a sound local knowledge of the environmental values of the City and the importance of the Natural Area Estate in maintaining biodiversity. Fire is an important management tool that can help or hinder Council in achieving its environmental objectives. There would be significant benefits in Council further developing the objectives for fire management in the Bushfire Zone within the Natural Area Estate, and then prioritising prescribed burns to achieve these objectives. Recent publications are available to assist Council in adapting its program to achieve improvements (e.g. QPWS 2013).

4.3 Planning tools

Council currently has a relatively small proportion of the Natural Area Estate located directly adjacent to residential development. Reserves in urban locations close to the City centre (e.g. Denmark Hill) are completely surrounded by residential development. However, their small area, suitability for intensive management activities such as mechanical removal of fuel and accessibility for urban fire fighters mean that fire risks can potentially be managed to an appropriate level. Larger reserves outside the urban fringe such as Purga Nature Reserve have a small number of rural residences that are located in close proximity to the boundary. Strategies that complement the protection of these assets and those located upon the reserve should be a high priority.

There is increasing levels of residential development occurring on the fringe of the White Rock – Spring Mountain Conservation Estate, with subdivisions and building occurring in locations such as Springfield Lakes and Springfield Central. Council is likely to face increasing pressure to manage fire within the adjacent reserves to a standard that minimises the risk of bushfire impacting on new and existing residences in these areas.

There are a range of factors important in determining the risk of bushfire on residences adjacent to the Natural Area Estate, many of which are outside of Council's control. They include geographical aspect, slope, climatic conditions, the presence of managed buffers between the estate and houses and access arrangements for fire fighters. Each development may have different exposure to these variables and a range of mitigation measures in place to reduce the risk of bushfire on residences.

Council's development assessment unit will play an important role in determining what level of exposure to bushfire risk is acceptable, often under the guidance of the Ipswich Planning Scheme and bushfire studies commissioned by the proponents of developments. While beyond the scope of this project, ELA has observed that Council is currently requiring some proponents of development to assess bushfire risk as part of the development assessment process, using a range of landscape modelling tools available. A clear position on the extent to which Council will contribute to the community bushfire risk reduction is imperative. This should include the development of Bushfire Attack Level (BAL) targets and the self-protection measures expected of private land owners.

Such tools are also available to Council to evaluate the current and future risks associated with managing fire within the urban environment on the fringe of the Natural Area Estate. Application of such tools can provide a scientific basis upon which answers can be provided to various questions land managers face, such as:

- On average, how many days of the year will a bushfire in this area be uncontrollable?
- What is the target BAL that Council will manage its reserves for and the buffer widths between the Natural Area Estate and residences to achieve this target?
- What is the BAL construction standard required for new and existing development?

Another valuable fire management tool is the Fire Decision Support model. It has been summarised in Appendix D as an example of a useful way to determine annual priorities for prescribed burning and an aid in fire suppression decisions. The map outputs are updated each year with fire history and the annual increment of time since last fire, which affects the need for prescribed burning to achieve the objectives of the fire management plan. The model provides a figure that condenses all of the somewhat complex inputs into a simple map displaying one of the following four fire management requirements of the plan for each grid cell e.g. 25 m square:

- Fire Exclusion
- Has not reached the fire interval required (Pre)
- Within the required fire interval
- Beyond the required fire interval

The model provides a simple and accurate way to determine prescribed burning program variations each year and would be most applicable to larger reserves such as Flinders Goolman and the White Rock – Spring Mountain Conservation Estate.

5 Synthesis of Findings and Recommendations

5.1 Findings

The review has made the following findings on the adequacy of ICC's fire management program:

1. Council has developed and is actively implementing a structured fire management program within the Natural Area Estate. Parts of the program are appropriate to meet Council's needs and legal responsibilities as a land manager. However, some fundamental shortcomings exist, most notably the lack of a total prescribed burning target each year.
2. Fire management plans cover a broad range of topics related to the management of fire on the Natural Area Estate. Some fire management zones lack clear objectives, and plans have not been reviewed and updated frequently enough to remain current regarding changes in estate boundaries and offset planting arrangements.
3. There is currently no overarching strategic plan within the fire management program that reserve-specific plans sit underneath. This has resulted in some inconsistency and duplication across the various fire management plans in place and no risk ranking between the reserves and their works programs.
4. Council is not consistently conducting prescribed burns within the Natural Area Estate over a sufficiently large total area to achieve the objectives within the fire management plans. Under-burning is not desirable for either the protection of life and property nor for biodiversity management objectives.
5. There are a large number of relatively small fire blocks across the Natural Area Estate. This increases the cost of burning, but is desirable from a biodiversity and fire mitigation perspective by allowing a finer scaled mosaic to be achieved.
6. There are a large number of fuel load monitoring sites across the Natural Area Estate, which are monitored every six months. The number of plots, their location and the frequency of monitoring could be revised to better align with Council's management objectives and available resources. Development and application of fuel accumulation curves could significantly reduce the cost of fuel monitoring.
7. The 10 t/ha surface fine fuel load criterion applied by Council for prioritising prescribed burning has been superseded by an overall fuel hazard methodology. The newer approach, which has not yet been adopted by Council, takes into account the fuel arrangement and structure, leading to a more comprehensive assessment of fuel hazard.
8. There is not currently a direct link between the results of fuel load monitoring, the objective of fire management zones within which they are located, and the prioritisation of prescribed burns. Fuel load monitoring data could be linked to Plan objectives better and as a pre-burn evaluation of the need to implement a scheduled prescribed burn.
9. There is insufficient documentation and involvement of relevant Council staff and stakeholders in the process of reviewing and prioritising areas for prescribed burns.
10. The management of fire in and around offset planting areas warrants more specific attention in the fire management plans prepared by Council. The obligations of Council to manage fire in these areas are not adequately reflected in fire management plans. Target risk reduction levels should be used to design protection strategies.
11. There are increasing levels of residential development on the fringe of Council's Natural Area Estate, particularly in the White Rock – Spring Mountain area. There are a range of predictive

and decision making tools available to Council to assist in planning for these changes and managing existing risks to life, property and the environment.

5.2 Recommendations to improve management arrangements

Recommendations to improve Council's existing fire management program are as follows:

1. Develop an overarching strategic plan for fire management. The advantage of a strategic plan is that it creates standards and consistency in the fire management approach that can be applied across all reserves and enables prioritisation of actions between reserves.
2. Review and revise fire management plans to achieve a consistent format, describe consistent zones with clear objectives, remove strategic information that applies to all reserves (this belongs in the strategic plan), include risk ranking across all reserves and management activities for newly acquired land within reserve boundaries and tree planting areas.
3. Form a fire referral group within Council of relevant staff and external stakeholders and meet to develop a rolling prescribed burn program for the Natural Area Estate. Consider and document a range of relevant information when prioritising blocks for burning, such as fuel loads, on ground conditions, fire history and available resources. Tools such as Fire Decision Support maps should be considered.
4. Increase the area of Council's Natural Area Estate where prescribed burns are conducted to achieve the objectives in the fire management plans. As a guide, between 5 and 10% of the estate should be targeted each year and prioritised according to reserve management plans and the strategic plan.
5. Burn multiple fire blocks in a single day in a mosaic to increase the area to be burnt and achieve cost efficiency, where such an approach is consistent with available resources and fire plan objectives.
6. Review the number and location of fuel load monitoring sites, with a view to including one monitoring site within blocks where there are clear links between zone objectives and fuel load. Utilise resources more efficiently by reducing the frequency of fuel load monitoring to ultimately pre-burn validation of fuel loads and annual programs based upon fuel accumulation curve predictions.
7. Modify the fuel load monitoring method to reflect that of Hines *et al.* (2010), which is focussed on the overall fuel hazard, based on arrangement and structure. Discontinue the use of metric fuel loads as a trigger for prescribed burning, as outlined in fire management plans. Alternatively, focus more on fuel hazard (life and property) and environmental conditions (biodiversity) as reflected in the fire management plan objectives and strategies.
8. Include the commitments of Council within the various offset planting agreements within fire management plans. Develop specific actions to increase the likelihood of complying with these commitments and managing risk to an agreed measurable target.
9. Consider the application of various spatial modelling tools illustrated in this report to the assessment of bushfire risk along the urban fringe of the Natural Area Estate. The degree to which Council proceeds with such studies will in part depend on the level of responsibility Council decides to accept for bushfire risk to residences adjacent to the Natural Area Estate and the resources available. The planning and development Department of Council will also play a role in achieving outcomes in this area.

References

Hines F, Tolhurst K G, Wilson A G, McCarthy GJ (2010). Overall Fuel Hazard Assessment Guide 4th Edition July 2010. Fire and Adaptive Management Report Number 82. Published by the Victorian Department of Sustainability and Environment.

ICC (2013). Natural Area Estate Fire Management Policy Version 1. Ipswich City Council.

ICC (2015). Ipswich Nature Conservation Strategy 2015. Ipswich City Council. http://www.ipswich.qld.gov.au/__data/assets/pdf_file/0018/43083/nature_conservation_strategy.pdf

QPWS (2013). Planned Burn Guidelines – Southeast Queensland Bioregion of Queensland. Department of National Parks, Recreation, Sport and Racing. ISBN 978-1-7423-0926 http://www.nprsr.qld.gov.au/managing/pdf/pbg-seq.pdf

Rose R, Lang S (2001). Fire decision support – a significant improvement to the practical application of GIS in fire management and planning. Conference Presentation New Zealand.

Appendix A Summary of Review Findings

Aspect of Fire Management	Observations of Council's Existing Program	Opportunities for improvement
Strategic Planning	A Strategic Fire Management Plan is not in place. A short Fire Management Policy has been established and strategic information is repeated in every fire management plan.	Develop a detailed Strategic Fire Management Plan.
Fire Management Plans	Plans are in place for each of Council's Natural Area Estate reserves. However, plans are infrequently reviewed and do not cover some recently acquired land.	Include objectives for each of the zones, and specifically the Bushfire Zone, within a detailed Strategic Fire Management Plan. Relocate information that is not reserve-specific to a detailed Strategic Fire Management Plan. Review and update fire management plans annually.
Policies and procedures	A high level policy is in place outlining Council's approach to fire management.	More detailed policies and procedures could be developed for issues such as training, monitoring and fire preparedness.
Fuel load monitoring	A large number of sites within the Natural Area Estate are monitored every 6 months.	The method currently applied is outdated, including the 10 t/ha criterion for prioritising prescribed burns. A similar method of evaluated risk should be implemented (Hines *et al*. 2010) and would require minimal refinement of the existing approach. Monitoring could be reduced to annually. In the long-term, Council could apply predictive models to substantially reduce the resources involved in fuel load monitoring, and achieve improved outcomes (see Appendix C).
Prioritising areas for prescribed burns	Minimal documentation is available on the procedure or approach applied by Council to prioritise areas for prescribed burns. It is unclear to what extent information collected on fuel loads informs the selection of areas for	A fire referral group be established and meet each year in November or December to develop a rolling program of prescribed burns for each fire block. Fire history, fuel loads, budget constraints and on site conditions are considered by

Aspect of Fire Management	Observations of Council's Existing Program	Opportunities for improvement
	prescribed burns (despite this being a trigger in fire management plans).	the group when prioritising areas for burning. Outcomes of the meeting are documented. In the long-term, a Fire Decision Support Model could be applied to assist in prioritising areas for prescribed burns (see Appendix D).
Offset planting areas	Sites inspected by ELA appear to be well managed by both Council and rehabilitation contractors.	More emphasis within fire management plans is required for the offset planting areas. Some reserves with offset planting areas have outdated fire management plans where these areas are not identified (e.g. Grandchester). Objectives and management standards should be developed for offset planting areas, in accordance with Council's obligations for managing fire under relevant agreements.
On ground implementation	Operational staff are qualified, experienced and have a detailed knowledge of the Natural Area Estate. QFES and specialised contractors are engaged to maintain infrastructure and complete prescribed burns and combat bushfires.	A larger proportion of the Natural Area Estate (5-10%) could be targeted for prescribed burning each year. This would assist in protecting life and property as well as achieving environmental outcomes.
Partnerships	Council is a proactive member of the South East Queensland Fire and Biodiversity Consortium and the West Moreton Fire Management Group. These groups facilitate the assessment of regional fire risk and the sharing of information. Officers have a good understanding of management issues affecting neighbouring land holders. Council works effectively with QFES to conduct prescribed burns and bushfire response.	None identified.
Managing visitation risk	A Natural Area Estate Visitor and Fire Management Decision Matrix has been established to manage visitor	A brief written procedure describing the implementation of the decision matrix by staff would be a useful addition to a

Aspect of Fire Management	Observations of Council's Existing Program	Opportunities for improvement
	access during varying Fire Danger Ratings. This is an important tool in managing the risk of fire to reserve visitors.	Strategic Fire Management Plan.

Appendix B Photos from Site Inspections

White Rock – Spring Mountain Conservation Estate Top – The Natural Area Estate bordering Wild Iris Terrace adjacent to a new housing estate. Bottom – bushland approximately 100 metres east of Wild Iris Terrace in the reserve adjacent to a designated walking track.

Purga Nature Reserve – Top – Tea Tree Boardwalk Circuit. Bottom – Offset planting area (background) viewed from public road and neighbouring grazing property (foreground).

Grandchester Reserve Top – Recently mown internal vehicle track and offset planting area within the Natural Area Estate. Bottom – Fire monitoring (fuel load) plot within a fire management block burnt in 2011.

Appendix C Fuel Accumulation Curves

Prediction of fuel hazard across the Natural Area Estate could be undertaken using GIS models from visual fuel assessment data and proposed fuel accumulation curves. The monitoring will enable more reliable prediction of fire behaviour and appropriate fire regimes within the Natural Area Estate.

The GIS models require the 'time since last fire' data to be updated and the application of fuel hazard data for the prediction of current fuel hazard (and loads) for each vegetation community. The following steps are required to develop a GIS based fuel load prediction.

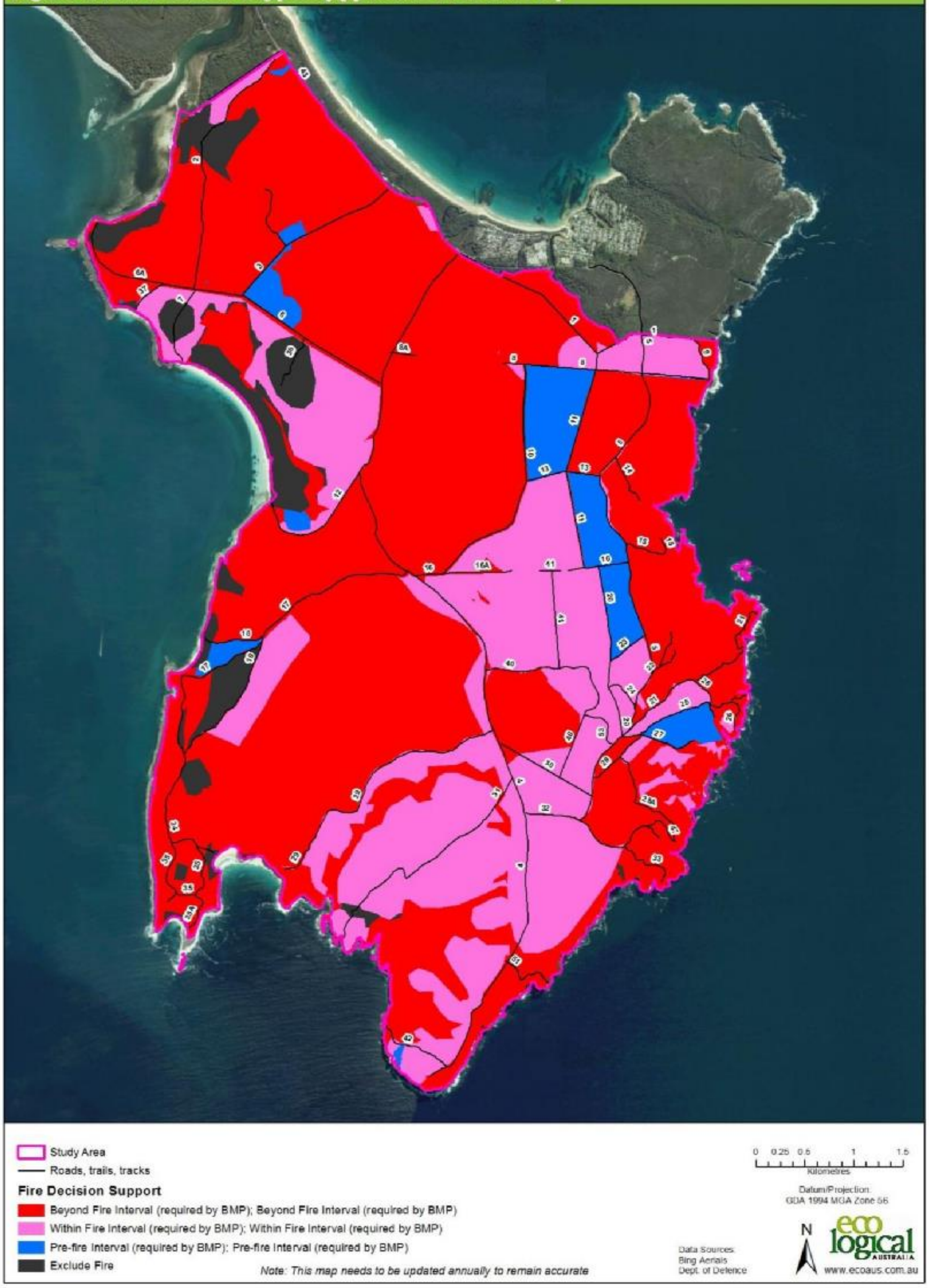
- Use GIS to stratify the larger reserves within the Natural Area Estate based on vegetation type, site productivity (aspect, elevation, geology) and fire history.
- Use GIS to identify strata that do not have any fuel hazard assessment data that can be used for modelling.
- Undertake literature search and discussion with recognised experts in the field to identify fuel hazard assessment data or existing models that may be used to overcome strata that do not have any fuel hazard assessment data.
- Identify strata where fuel hazard data and/or models are still lacking and field assessment is required to provide the data. Identify readily accessible locations for fuel hazard assessment within these locations.
- Identify a number of easily accessible locations across a range of strata for collecting fuel hazard data that will be used to test the model that is developed.
- Undertake Overall Fuel Hazard Assessments at the identified locations in accordance with the descriptions provided in Hines *et al*. (2010).
- Use models and available data from existing fuel accumulation curves, and data gathered from field work to develop models that will enable Overall Fuel Hazard to be estimated based on the characters used to undertake the stratification.
- Use the test data collected during field assessments to test the performance of the model.
- Use GIS modelling to predict current Overall Fuel Hazard across the Natural Area Estate and produce maps as required for guiding prescribed burning and bushfire control strategies.

Appendix D Fire Decision Support Model

Map outputs from the Fire Decision Support Model (see example on following page) are updated each year with fire history and the annual increment of time since last fire, which affects the need for prescribed burning to achieve the objectives of the fire management plan. The map condenses all of the somewhat complex inputs into a simple map displaying one of the following four fire management requirements of the plan for each grid cell e.g. 25 m square:

- Fire Exclusion
- Has not reached the fire interval required (Pre)
- Within the required fire interval
- Beyond the required fire interval

Figure 8: Fire Decision Support (applicable in 2012/2013)



Item 1 / Attachment 1.

eco logical AUSTRALIA

ISO 14001 Environmental Management

AS/NZS 4801:2001 Occupational Health and Safety Management

ISO 9001 Quality Management

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

BRISBANE
Suite 1 Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7191
F 07 3854 0310

HUSKISSON
Unit 1 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 4443 6655

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

1300 646 131
www.ecoaus.com.au

Ipswich City Council

Ipswich Fire Management Strategic Plan

April 2017

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Table of contents

1. Glossary and Definitions 5

2. Introduction 9
   2.1 Background 9
   2.2 Plan Context 10
   2.3 Natural Area Estate 10

3. Strategic Approach 11
   3.1 Strategic Framework 11
   3.2 Bushfire vulnerability and risk assessment 13
   3.3 Review of plan 15

4. Bushfire Vulnerability Factor Appraisal 16
   4.1 Ecological asset bushfire sensitivity risk 17
   4.2 Ecological health risk 19
   4.3 Fire severity risk 21
   4.4 Bushfire attack level risk 23
   4.5 Access Risk 25
   4.6 Housing stock risk 26
   4.7 Fire vulnerable asset and smoke sensitive receptor risk 27
   4.8 Surrounding landscape vegetation cover risk 29
   4.9 Fire suppression success risk 30

5. Risk Dashboard 31
   5.1 Unmitigated and residual risk classification 31
   5.2 Shared responsibilities for risk management 32

6. Fire management zones 33

7. Fire Mitigation Actions 35
   7.1 Hazard mitigation works 35
   7.2 Shared responsibility partners 36

8. Bushfire Assets and Advantages 40
   8.1 Water supply 40
   8.2 Fire trails 40

9. Summary 42

10. References 43

Table index

Table 1 Management areas with ICC Natural Area Estate 10

Table 2 Example Access Vulnerability factor rating 14

Table 3 Ecological asset bushfire sensitivity risk 18

Table 4 Planned Fire Exclusion-Vegetation Degradation Risk 20

Table 5 Classification of potential bushfire prone areas (adapted from Leonard *et al* 2014). 22

Table 6 Bushfire attack level (BAL) risk 24

Table 7 Access risk 25

Table 8 Housing stock risk 26

Table 9 Fire vulnerable assets and smoke sensitive receptor risk 28

Table 10 Landscape vegetation cover risk 29

Table 11 Fire suppression success risk 30

Table 12 Residual risk approach 31

Table 13 Fire management zone types 33

Table 14 Shared responsibilities for bushfire risk mitigation 37

Table 15 Fire trail types 40

Table 16 Previous significant bushfire events 49

Table 17 Vegetation hazard classes within the ICC NAE 54

Figure index

Figure 1 Classification of vulnerability factors and residual risk for each fire management block 12

Figure 2 Risk matrix for considering bushfire risk to assets 15

Figure 3 Radiant heat exposure from *Very High*, *High*, *Medium** and *Low* bushfire intensity State mapping classes. Adapted from (Leonard et al 2014) 22

Figure 4 Annual planned burning preparation process 36

Figure 5 Amberley AMO mean maximum and minimum temperature 52

Figure 6 Amberley AMO mean rainfall 52

Figure 7 Very high fire danger index days for Brisbane Airport and Amberley 53

Appendices

Appendix A – A1 Map Based Risk Dashboard Sub-Plans

Appendix B – Fire History Overview

Appendix C – Climate and weather risk factors

Appendix D – Vegetation Groups and Maximum Potential Fuel Loads

Appendix E – Vegetation Maps

Appendix F – Considerations for smoke management

Appendix G - Fuel Hazard Sampling sheet and recommendations

1. Glossary and Definitions

The following glossary and definitions are generally sourced from the Australasian Fire and Emergency Services Authorities Council (AFAC) bushfire glossary[1], from the State Planning Policy (DSDIP 2016a[2]) and State Planning Policy state interest guideline – natural hazards, risk and resilience (DSDIP 2016b[3]). Definitions provided by GHD are annotated with GHD

4WD	Four wheel drive
AFAC	Australasian Fire and Emergency Service Authorities Council
AIIMS	Australian Inter-service Incident Management System - A nationally adopted structure to formalise a coordinated approach to emergency incident management
APZ	Asset Protection Zone An area between an asset and a bushfire hazard where bushfire fuel has been reduced significantly to protect the asset
AS3959	Australian Standard 3959 – 2009 Construction of Buildings in Bushfire-prone Areas
Bark fuel	The flammable bark on tree trunks and upper branches
BoM	Bureau of Meteorology
Bushfire	An uncontrolled fire burning in forest, scrub or grassland vegetation
Bushfire attack	Attack by burning debris, radiant heat or flame generated by bushfire which might result in ignition and subsequent destruction of a building
BAL	Bushfire attack level (as defined in AS3959:2009)
Bushfire hazard area	Means a medium, high or very high bushfire hazard area shown on the SPP Interactive Mapping System as being a bushfire hazard area. It is land that is potentially affected by significant bushfires, including: • Vegetation likely to support a significant bushfire; and • Adjacent land that could be subject to impacts from a significant bushfire (i.e. potential impact buffer).
Bushfire chemicals	Class A foams (also known as BFFF), fire retardants and gel are chemical bushfire suppressants that provide enhanced suppression effectiveness than could otherwise be achieved by using water alone. Does not include Class B foams (also known as AFFF).
Bushfire hazard	A fuel complex, defined by volume, type, condition, arrangement and location that determine the degree of ease of ignition and of resistance to control. Bushfire hazards are variable in their severity, with severity levels usually measured in terms of fire intensity (kW/m) arising from the hazard. The methodology for assessing bushfire hazard is provided in Appendix 5 of DSDIP (2016c[4]).
Bushfire management	All activities directed to the prevention, detection, damage mitigation and suppression of bushfires, and recovery after bushfire events. It includes bushfire policy, administration, law enforcement, community education, training of fire fighters, planning, communication systems, equipment, research, and the multitude of field operations undertaken by land managers and emergency services personnel relating to bushfire control and the use of fire to meet land management goals and objectives.
Bushfire-prone area	An area that can support a bushfire or is likely to be subject to bushfire attack

1 http://www.afac.com.au/services/glossary/bushfire

2 DSDIP (Department of State Development, Infrastructure and Planning (2016a)) State Planning Policy. DSDIP, Queensland Government Brisbane

3 DSDIP (2016b) State Planning Policy state interest guideline – natural hazards, risk and resilience. Version: April 2016, DSDIP, Queensland Government Brisbane

4 DSDIP (2016c) State Planning Policy state interest guidance – natural hazards, risk and resilience technical manual evaluation report: Bushfire hazards. Version April 2016, DSDIP, Queensland Government Brisbane

Crown fire	A fire that advances through the crowns or tops of trees
DILGP	Queensland Government Department of Infrastructure, Local Government and Planning, formerly part of the Department of State Development, Infrastructure and Planning (DSDIP)
Elevated fuel	The standing and supported combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stem, bark and creepers
Environment	The term environment includes: a. Ecosystems and their constituent parts, including people and communities; b. Natural and physical resources; c. The qualities and characteristics of locations, places and areas; d. Heritage value of places; and e. The social, economic and cultural aspects of a thing mentioned in (a)-(c).
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FDI	Fire Danger Index (see also FDR) A relative number denoting an evaluation of rate of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed. The numbers range from 1 to 100.
FFDI	Forest Fire Danger Index (see FDI)
FDR	Fire Danger Rating A relative class denoting an evaluation of rate of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed, indicating the relative evaluation of fire danger. Rated as low-moderate (FDI 0-11), high (FDI 12-24), very high (25-49), severe (50-74), extreme (75-99) or catastrophic / code red (100+).
Fine fuel	Fuel such as grass, leaves, bark and twigs (dead plant material less than 6mm and live plant material less than 3mm in diameter) that ignite readily and are burnt rapidly when dry
Fireline or Fire Control Advantage	A natural (such as a creek line) or constructed barrier (such as a trail or mineral earth break), or treated fire edge, used in fire suppression and prescribed burning to limit the spread of fire
Fire regime	The history of fire in a particular vegetation type or area including the frequency, intensity and season of burning. It may also include proposals for the use of fire in a given area.
Fire vulnerable assets	Establishments that have an elevated level of vulnerability because of a reduced capacity of the residents or building users to react quickly and respond to potential bushfire and smoke impacts. This may be for a number of reasons including that persons residing on-site are: — Not independent and able bodied; — Of restricted mobility due to age, disability, health or other incapacity; — Require direction and full supervision such as children or young adults at a day care centre, educational facility or university; — Unfamiliar with the area and may be visiting as part of a large group (such as a church or other place of worship, conference, event or function); or — In short term accommodation and are potentially unfamiliar with the area.
FMB	Fire Management Block
Fuel	Any material such as grass, leaf litter and live vegetation which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare. Related Terms: Available fuel, bark fuel, coarse fuel, dead fuel, elevated fuel, fine fuel, ladder fuels, surface fuels, near-surface fuel, overall fuel hazard.

Fuel layer	Fuel layers within dry eucalypt forests that can be linked to fire behaviour. The four main fuel layers consist of Surface fuel (including fine fuel), Near surface fuel, Elevated fuel and Bark fuel.
GFDI	Grassland Fire Danger Index
GIS	Geographic Information System
ICC	Ipswich City Council
ICS	Incident Command System
Incident Controller	The individual responsible for the management of all incident control activities across a whole emergency incident
Interface[GHD]	Retained areas of native vegetation that can carry fire into built-up residential areas. While some direct flame contact and radiant heat impacts may occur, a significant number of house losses may result from ember attack (as occurred with the 2003 Canberra fires). For the purposes of this assessment a distance of 100 m from the hazard is considered the 'at-risk' zone within this asset class.
Intermix[GHD]	Semi-rural communities and businesses which are interspersed with agricultural lands, forested areas and bushland reserves/remnants. Of particular risk are those rural residential / peri-urban properties in intermix areas that are not prepared at least annually for bushfire and through poor site preparation are not defendable. The relatively long frequency between bushfire events contributes to this circumstance, as where there is little memory or no experience of the previous bushfire event, there may be low personal motivation shown by landholders (owner or tenant) to make their properties fire ready. The size of the properties and the capacity of residences to reduce fuels is also a significant factor.
I-zone [GHD]	Urban-rural interface areas which are subject to specialised planning by Queensland Fire and Emergency Services
LGA	Local Government Area
NAE	Natural Area Estate
Natural Area Estate	Citywide Conservation Estates and District Conservation Reserves managed by ICC
Natural hazard area	Means a naturally occurring situation or condition, such as a flood, bushfire or coastal hazard, including erosion – prone areas and storm tide inundation areas, with the potential for loss or harm to the community, property or environment
Near-surface fuel	Live and dead fuel, including suspended leaves, bark, or twigs, effectively in touch with the ground but not lying on it, with a mixture of vertical and horizontal orientation
Overall fuel hazard	A subjective assessment of fuel using the OFHG that takes into account the fuel arrangement, continuity and amount of fine dead material; this information is used to rate the fuel hazard related to difficulty of fire suppression and fire behaviour potential. The fuel hazard rating systems provide a systematic method for rating fuel hazard, and a rating of low, moderate, high, very high, or extreme is assigned to each fuel layer (strata) by visual assessment against the key attributes
OFHG	Overall Fuel Hazard Guide (*Overall fuel hazard assessment guide* 4th edition July 2010 Fire and adaptive management, report no. 82 by Francis Hines, Kevin G Tolhurst, Andrew AG Wilson and Gregory J McCarthy)
Prescribed Burning	The controlled application of fire under specified environmental conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. It is undertaken in specified environmental conditions; and Fires lit purposefully for fuel reduction or land management purposes.
QFES	Queensland Fire and Emergency Services
ROS	Rate of Spread
SPP Interactive Mapping System	Means the State Planning Policy (SPP) Interactive Mapping System, as amended from time to time, published by the DILGP (formerly Department of State Development, Infrastructure and Planning) and located at http://www.dlg.qld.gov.au/local-government/planning-ilgp/spp-interactive-mapping-system.html

Surface fuel	Litter fuels made up of leaves, twigs, bark and other fine fuel lying on the ground, predominately horizontal in orientation
Tanker – small appliance	A single or dual cabin light commercial four wheel drive primarily used for initial attack and mop up, with a water capacity of 300-800 litres
Tanker – large appliance	A double or single cabin heavy four wheel drive truck with a water capacity of 3000-4000 litres
Intolerable Risk	A situation where people or property are exposed to a predictable hazard event that may result in serious injury to, loss of life, failure of community infrastructure, or property damage that would make a dwelling unfit for habitation
Water point	Any natural or constructed supply of water that is readily available for fire control operations
Wildfire	See *bushfire*

2. Introduction

2.1 Background

Ipswich City Council (ICC) has made a significant investment in nature conservation programs over the past decades, including:

- Identifying and purchasing areas of high environmental value, through the *Enviroplan* program;
- Preparing and updating its overarching Nature Conservation Strategy (ICC 2015a) as well as other strategies relating to its natural areas;
- Developing and implementing planned burning and biodiversity monitoring programs; and
- Actively managing natural areas with a range of specialty ICC staff, works teams and land management programs.

Active fire management through planned burning is a key risk mitigation activity employed by ICC to reduce the potential for life, property and environmental impacts from bushfire. Council's Fire Management Policy (ICC 2013a) specifically identifies:

"*that Council's NAE will be managed to protect life and property from wildfire while planning, manipulating and utilising fire to maintain or enhance environmental values*".

This Fire Management Strategic Plan recognises these key objectives of life and property risk mitigation, as well as maintaining healthy and resilient ecosystems. The NAE includes a range of vegetation communities, many of which are maintained by fire and require periodic fire for their regeneration and persistence. Historically these communities were managed with fire by Aboriginal communities as a means of active land management to stimulate grasses for hunted food resources, to open the landscape for access, for ceremonial or spiritual purposes, for protection from bushfires and for a range of other purposes.

Once non-Aboriginal people began to occupy parts of the country such as south-east Queensland the fire regime changed from deliberate, purposeful and continuous low-intensity burning throughout the year, to a policy of fire exclusion and suppression, leading to a fire regime characterised by higher intensity and more extensive fires occurring at a lower frequency (AFAC 2016). A failure to apply low intensity fire regularly within fire maintained ecosystems, coupled with an infrequent regime of high intensity bushfire (often occurring during dry or drought periods when ecosystems are most stressed), is a worst case scenario ecologically. It is identified that one of the main fire management issues in the open forest and woodland communities of south-east Queensland is the overabundance of saplings (such as wattles and rainforest pioneers) from a bushfire then fire exclusion fire regime (State of Queensland 2013). This regeneration in the mid-stratum, which reduces the health and diversity of shrubs and grasses, leads to an eventual decline in the overstorey species.

In recent decades there has been an enhanced emphasis on prescribed burning to reduce bushfire intensity and rate of spread, and enhance the ecosystem health of fire maintained communities.

ICC undertakes an active prescribed burning program to reduce the potential for high intensity fires which occur periodically within the Ipswich LGA (see Appendix B – Fire History Overview). Planned burning is also used as a tool to maintain functioning and healthy ecosystems.

2.2 Plan Context

This strategic plan was prepared following a review of the ICC fire management policy and planning framework and previous ICC NAE fire management plans, which identified a need to develop a new strategic fire management plan and revised reserve-specific plans for the ICC NAE. The intended objectives of this strategic plan are to provide:

1. *An overarching and streamlined fire management strategic approach that addresses the way the NAE is to be managed for fire in relation to risk profiles and ecological outcomes*
2. *A methodology for prioritising planned burns across the NAE accounting for both wildfire risk and ecological outcomes*
3. *An updated field monitoring sheet that incorporates the 4th edition of the 'Overall fuel hazard assessment guide[5]'.*

The strategic plan identifies a number of vulnerability factors that influence the risk from bushfires for ten ICC NAE management areas (as shown in Table 1). The plan sets out the methodology for the application of the vulnerability factors across the ICC NAE and also provides a risk dashboard that demonstrates the residual risks after mitigation actions have been undertaken by ICC and shared responsibility partners. The methodology is applied and presented in map-based sub-plans (*Risk Dashboards*) for each NAE management area (see Appendix A).

2.3 Natural Area Estate

ICC manages approximately 6,672 hectares of conservation land within its Natural Area Estate (NAE) (Table 1). This bushland incorporates a range of vegetation communities including unique semi-evergreen vine thickets, eucalypt and corymbia forests, and endangered vegetation communities such as swamp tea-tree and Brigalow (ICC 2015b). Many of these vegetation communities require fire to regenerate and stay healthy, and an absence of fire or a too frequent regime of high intensity fires, can result in undesirable environmental impacts.

Table 1 Management areas with ICC Natural Area Estate

Management area	Location	Hectares
Denmark Hill Conservation Reserve	Urban	12
Haig Street Quarry Conservation Reserve	Urban	23
Hillview Drive Reserve	Urban	37
Ric Nattrass Environmental Park	Urban	14
Purga Nature Reserve	Peri-urban	138
Cameron's Scrub Conservation Estate (Kholo Enviroplan Reserve)	Peri-urban	160
Stirling Road Reserve	Peri-urban	33
White Rock –Spring Mountain Conservation Estate	Peri-urban	2992
Flinders-Goolman Conservation Estate	Rural	2200
[6]Mt Grandchester Conservation Estate	Rural	973
	Total	**6672***

*Another 90 ha is included in the NAE estate but not included in this Strategic Plan.

5 Hines *et al* (2010)

6 Includes Long Gully Road Reserve, Woolshed Creek Reserve and Grandchester Reserve

3. Strategic Approach

ICC's Fire Management Policy (ICC 2013a) states: "*that Council's NAE will be managed to protect life and property from wildfire while planning, manipulating and utilising fire to maintain or enhance environmental values*". The approach taken with this updated Fire Management Strategic Plan is to develop an overarching strategy that meets the objectives of the fire management policy by understanding and assessing risk in a multi-dimensional way across the NAE. At the same time, a shared responsibility approach has been taken which means that other land holders that have an influence on the risk profile of the NAE are considered in terms of what actions they may undertake to reduce the risk of the NAE.

The following strategy identifies a number of factors which contribute to fire behaviour and risk, termed vulnerability factors, that address key objectives of life and property, as well as maintaining healthy and resilient ecosystems. ICC local knowledge and monitoring data, along with mapping inputs and asset identification are used to allocate a risk rating to each vulnerability factor in each of the NAE reserves. Each vulnerability factor is explained in Section 4.

The strategy also includes a risk dashboard that incorporates risk mitigation actions that ICC can undertake to produce a residual risk and further actions that a shared responsibility partner can undertake to further reduce the risk in the NAE. The result is the risk dashboard, that sets out all the mitigation actions that both ICC and shared responsibility partners can undertake and the residual risk scores. The risk mapping and ratings can be found in Appendix A.

3.1 Strategic Framework

The strategic plan considers the ICC NAE by assessing each individual fire management block (FMB) in terms of risk. The FMBs are typically defined by the track and trail network throughout the NAE and enable ICC to manage the estates in a more practical way.

The strategic framework for fire management set outs the following:

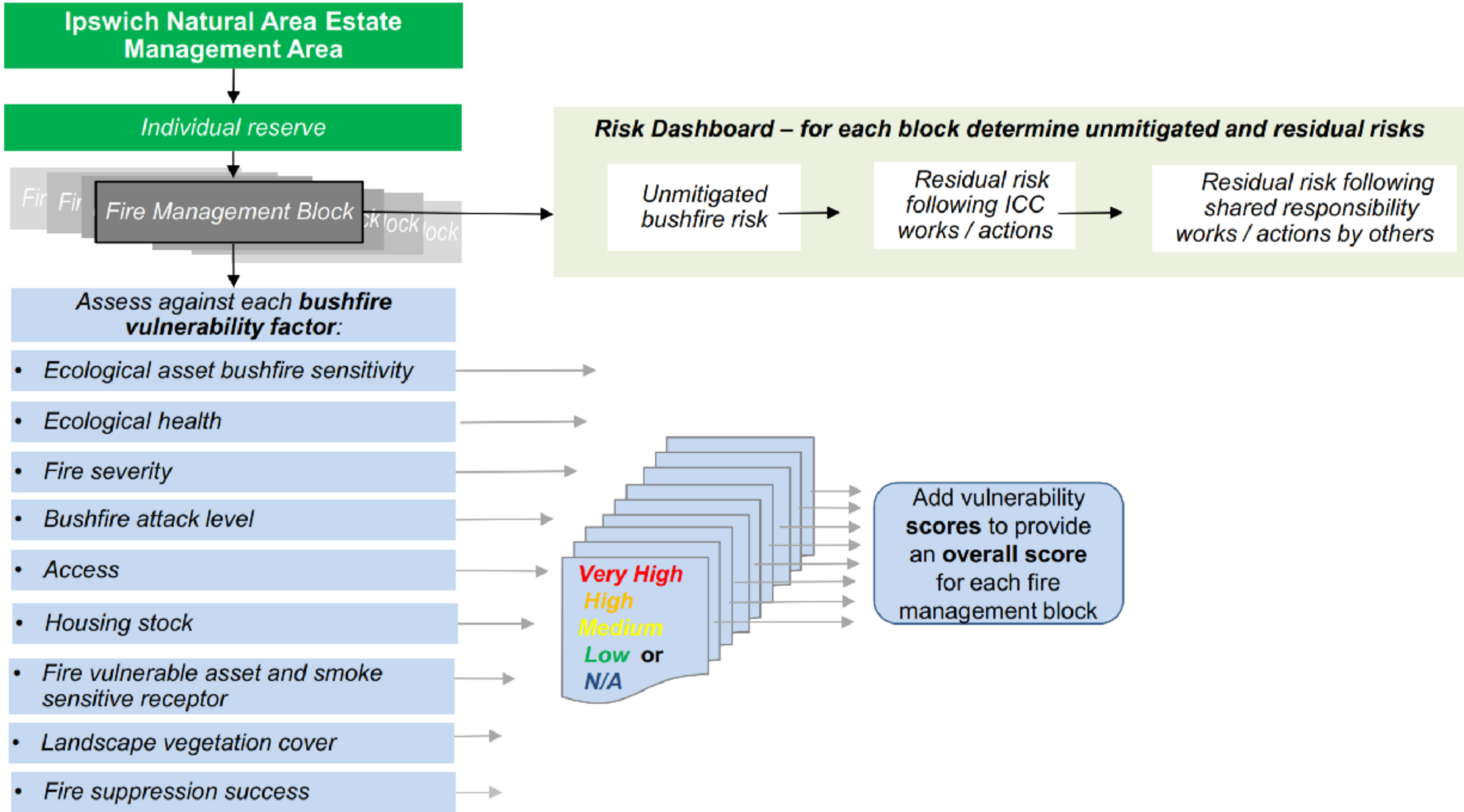
- An analysis of the vulnerability factors which may make an area susceptible to bushfire impacts to identify a priority rating of ICC's most to least susceptible NAE FMBs; and
- A bushfire risk dashboard showing:
  - The unmitigated risk if no actions are implemented in an FMB to address these vulnerabilities;
  - The residual risk following actions by ICC within an FMB; and
  - The residual risk following actions completed by shared responsibility partners - adjoining neighbours, land/infrastructure managers or adjacent fire authorities.

In completing this strategic plan, ICC is able to meet its strategic objectives for bushfire management, with the strategy allowing Council to:

- Prioritise works in those areas of greatest vulnerability to bushfire impacts and those areas where it is able to most influence the residual risk;
- Classify it's NAE into different management zones corresponding with how it intends to manage fuels and planned and unplanned burns; and
- Implement a fuel monitoring program to determine when a trigger point is reached requiring an action by ICC or others in a shared responsibility approach.

The methodology applied to complete the vulnerability analysis and prepare the risk dashboard is described in the following section and shown schematically in Figure 1.

Figure 1 Classification of vulnerability factors and residual risk for each fire management block



3.2 Bushfire vulnerability and risk assessment

3.2.1 Vulnerability analysis methodology

A number of *vulnerability* factors are used in this plan to rank the vulnerability of a fire management block to bushfire impacts. The vulnerability factors applied in this plan are listed as follows (and described in more detail in Section 4 of this plan):

- Ecological asset bushfire sensitivity;
- Ecological health;
- Fire severity;
- Bushfire attack level;
- Access;
- Housing stock;
- Fire vulnerable assets and smoke sensitive receptors;
- Surrounding landscape vegetation cover; and
- Fire suppression success.

Every fire management block within the ICC NAE management areas was assigned a class of *Not applicable, Low, Moderate, High* or *Very High* for each factor, based on the descriptions provided in Section 4. The values for each vulnerability factor were then added together to provide a total score for the fire management block. This overall score allows each fire management block to be ranked relative to the other blocks within the NAE management areas, with those blocks with the highest numbers being potentially the most vulnerable, and a higher priority for mitigation works. This assessment process is shown in Figure 1.

The information is used to prioritise mitigation treatments such as prescribed burning, to address potential risk to life, property and natural assets from bushfires, and derive a residual risk rating following works. Greater detail of the how the vulnerability factors are ranked and how residual risk is determined is provided in Section 4

Overtime these rankings may require adjustment as updated monitoring data or research findings become available, or to reflect changes in the landscape (such as new housing developments or assets). The ICC local government area is projected to almost triple in population from 2011 to 2036, from 172,000 to 485,000 people (Queensland Treasury 2015). Such an increase in population may potentially increase the extent of urban interface areas along reserve boundaries (such as around Springfield Lakes), as well as changes to demographics, altering current the risk and highlighting the need to review this plan at regular intervals (Section 3.3).

Table 2 Example Access Vulnerability factor rating

Vulnerability Risk	*Description*	*Numeric value assigned*
Very high	*Single lane natural surface dead end trail traversing vegetation with no / very few passing bays and turn around points*	*4*
High	*Single or two laneway dead end sealed or unsealed access traversing vegetation with passing bays and turn-around point*	*3*
Moderate	*Two lane (or greater) sealed access with sporadic vegetation exposure and alternative access routes*	*2*
Low	*Freeway and major road access with significant vegetation separation*	*1*
Not applicable	*Factor not applicable*	*0*

3.2.2 Bushfire risk assessment

The DSDIP (2016b) defines natural hazard risk with reference to the AS/NZS ISO 31000 *Risk Management – Principles and Guidelines* as

> *the chance of something happening that will have an impact on objectives… it is measured in terms of consequences and likelihood. Risk is based upon the consideration of the consequences of the full range of natural hazard events on communities and their social settings, and the natural and built environment*

The level of risk to an asset or community is considered as outlined in Figure 2. Some principles reflected in Figure 2 are that:

- *Likelihood* refers to the potential that a bushfire might affect someone or something through completing a sequence of steps (such as its initial ignition, spread and its ability to enter an area where impacts may result). The likelihoods of each step occurring is uncertain, and depends on local environmental factors, fuel availability and management and suppression success, which can all vary spatially; and
- *Consequence* refers to the potential adverse outcomes associated with a bushfire's impact. Direct impacts may include fatalities or severe injuries, or loss or damage to assets and significant environmental values. Indirect impacts might occur on the local economy through loss of work, investments or primary production. The level of consequence can also vary depending on the preparedness and resilience of the persons, communities or assets impacted.

The level of risk to an asset or group of assets in a particular locality from bushfire depends on a number of vulnerability factors that can vary spatially and/or temporally (such as terrain, slope /aspect, ignition patterns, fuel characteristics and frequency of adverse weather).

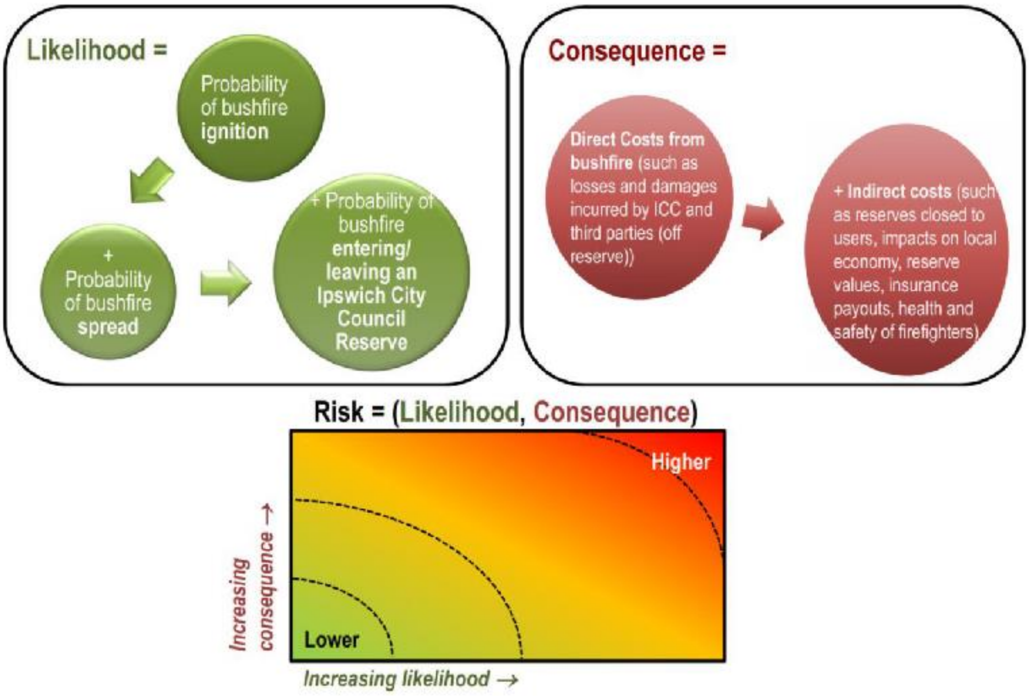


Figure 2 Risk matrix for considering bushfire risk to assets

3.3 Review of plan

The initial review of this fire management strategy is five years after the date of publication. Subsequent reviews should be at periods not exceeding five years. The strategy and associated NAE risk profiles should be reviewed and updated as necessary after any bushfire-related incident, end of season review or where an activity significantly changes the risk profile of an ICC reserve.

4. Bushfire Vulnerability Factor Appraisal

Bushfire is a significant and established natural hazard in the ICC local government area owing to:

- Fire prone vegetation that can produce low to moderate intensity fires (which occur periodically) with the potential for life and property impacts (large higher intensity landscape type bushfires are uncommon);
- Adverse fire weather coinciding with dry seasonal periods when vegetation is fire prone, and although days of 'Severe' to 'Extreme' Forest Fire Danger are not common, when they do occur, serious life-threatening fires can and do result;
- A high proportion of the native vegetation becomes combustible on a seasonal basis;
- Bushfires reaching intensity levels, rates of spread and proportions that they are beyond the capacity of fire and emergency services to control, resulting in life and property impacts as has occurred historically (see *Fire History Overview* (Appendix B)); and
- Large, intense bushfires that have burnt extensive areas, caused high property and economic losses, and threatened human life have occurred previously.

This section identifies those factors that may be influencing the vulnerability a specific fire management block. This appraisal excludes weather and climate factors, as they do not vary considerably between each reserve and each fire management block (ie are not site specific). However, as climate and weather remain some of the most significant factors influencing bushfire potential, a summary of these factors in the context of the ICC area is provided in Appendix C. The following site specific vulnerability factors are considered for each fire management block:

- Ecological asset bushfire sensitivity;
- Ecological health;
- Fire severity;
- Bushfire attack level;
- Access;
- Housing stock;
- Fire vulnerable assets and smoke sensitive receptors;
- Surrounding landscape vegetation cover; and
- Fire suppression success.

4.1 Ecological asset bushfire sensitivity risk

Background

The vulnerability of ecological assets to fire management activities within and adjacent to the ICC NAE has a significant bearing on the planning outcomes. While the Ipswich LGA supports a diverse range of flora and fauna (1,651 species with 31 of these species listed under the *Nature Conservation Act 1992* and 65 species, with the potential to occur, listed under the Federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (ICC 2015b)), the majority have evolved with both low and high intensity fire.

In the operational planning for activities such as prescribed burning, recognition is given to the presence of fire sensitive ecological assets, to reduce potential impacts on or provide enhancements to the health of, fire sensitive vegetation and species, as well as promoting a favourable environment that conserves the heterogeneity of fire dependent vegetation and species. Ecological assets considered at the operational level include:

Fire sensitive vegetation and species, such as rainforest, wetland and dry vine scrub communities, that are adapted to low or no fire environments. While these communities generally do not support fire, they are susceptible to scorching, which may decrease the health of fire sensitive vegetation and species. For rainforest and vine scrub communities, repeated scorching of the edges of the communities may allow fire tolerant vegetation (including pest plant species) to encroach into and replace these fire sensitive ecosystems. Areas with a higher abundance of hollow trees or offset plantings managed by ICC, may also be susceptible to fire impacts. However, prescribed burning from the margins of these communities, or from mineral earth breaks around individual hollow trees, may afford them greater protection from future unplanned bushfire events.

Fire dependent vegetation and species. Much of the bushland vegetation in Ipswich and surrounds, particularly those dominated by *Eucalyptus*, *Corymbia* and *Angophora* species, have strong associations with fire and require periodic fire events for regeneration. Ongoing implementation of burning regimes that maintain the ecological diversity of these fire dependent vegetation types, recruit fire dependent species and provide breaks around fire sensitive vegetation is important in maintaining the characteristics and health of the vegetation types and species present. The timing of burning should also promote variable intensity fires and/or fire mosaics

Prescriptions within an operational burn plan can be developed and implemented to mitigate potential impacts during planned burning operations, however it is important that at the strategic level, consideration is given to those ecological assets where a high intensity bushfire event may create a long lasting or permanent negative impact on a fire sensitive ecological asset. Mitigation measures, including planned burning, are applied to reduce the potential for high intensity fire impacts. Not all ecological assets require identification at the strategic level, particularly those important ecological values which are most effectively managed by site specific prescription at an operational planning level (such as protection of habitat trees or individual locations of threatened species). Examples of ecological assets that should be identified within a strategic level plan, with specific mitigation actions to reduce potential impacts of high intensity bushfire include:

- Pockets of dry rainforest and vine scrub forest;
- Large threatened bat maternity or over-wintering caves;
- Epiphytic communities growing on rock faces;
- Significant patches of obligate seeders (such as *Callitris* species); or
- *Melaleuca irbyana* stands within Purga Nature Reserve (and surrounds)

Actions to mitigate the risks to these ecological assets may include low intensity burning around the perimeter to limit the potential for high intensity fire entry or planned burning to improve the health of an ecological asset and assist with regeneration (such as *Melaleuca irbyana*). Vulnerability risk descriptions used to characterise bushfire sensitive ecological assets are provided in the table below.

Table 3 Ecological asset bushfire sensitivity risk

Vulnerability Risk	*Description*	ICC context
Very high	*The ICC reserve block contains, or directly adjoins, a fire sensitive ecological asset which contains a substantial proportion of the overall ecological asset (>25%). The fire sensitive ecological asset is either not tolerant of fire or is highly susceptible (itself or its critical habitat requirements) to altered fire regimes (including high intensity bushfires)*	18.6%
High	*The ICC reserve block contains, or directly adjoins, a fire sensitive ecological asset which contains a moderate proportion of the overall ecological asset (10-25%). The fire sensitive ecological asset is either not tolerant of fire or is highly susceptible to altered fire regimes (including high intensity bushfires)*	12.4%
Moderate	*The ICC reserve block contains, or directly adjoins, a fire sensitive ecological asset which contains a moderate proportion of the overall ecological asset (<10%). The fire sensitive ecological asset is either not tolerant of fire or is highly susceptible to altered fire regimes (including high intensity bushfires)*	8.8%
Low	*The ICC reserve contains species which are tolerant of altered fire regimes and infrequent low, moderate through to high intensity fire.*	60.2%

Risk Factor Summary: The majority of reserves attract a Low rating. Those rated as Very High are blocks within Mount Grandchester and Purga Nature Reserves containing mixed species plantings, Dry Rainforest areas within Flinders Goolman Conservation Reserve around Mount Blaine and Mount Elliott, Vine Forest in Kholo and Stirling Road Reserves, and endangered swamp tea-tree communities in Purga Nature Reserve. These areas will require further consideration at the operational burn plan phase.

All blocks within Kholo Enviroplan are rated as Very High as it contains sensitive dry vine forest. Haig Street Quarry, Ric Nattrass, Denmark Hill and White Rock- Spring Mountain FMB are all rated as Low.

4.2 Ecological health risk

Background

A number of factors are identified which have the potential to threaten open grass dominated woodland and forest communities (AFAC 2016, State of Queensland 2013,Butler 2008[7]) including:

- Rainforest and weed incursion (through fire exclusion, infrequent prescribed burning or historically poorly planned prescribed burning) resulting in hoop pine, rainforest species and weeds (such as *Lantana*) establishing upslope from wet gullies. The absence of fire permits the incursion of hoop pine and *Lantana* into grassy eucalypt forests, shading out kangaroo grass and other grasses and herbs. The reduction in grass fuels also constrains the opportunity for future low intensity burning to restore grasses;
- *Acacia* and shrub thickening (through mass germination from high intensity fires) resulting in dominance of a single or small number of species with a high stocking. As with rainforest and weed incursion this may result in a loss of diversity of grasses and herbs; and
- Bell miner associated dieback of eucalypts, following the loss of an open understorey through thickening and regeneration of woody mid-storey species.

The early reintroduction of low intensity burning to vegetation communities that may have become degraded through an absence of mosaic burning or homogenised through a high intensity bushfire, before fuels build up, provides a cost effective means to retain and protect values safely and keep the ecosystems in heterogeneous, diverse and healthy condition. Planned burning should be prioritised in areas where the mid stratum is starting to thicken or shrub up, before it passes the point where prescribed fire cannot be applied. In some areas planned burning may not be possible (ie due to coal deposits) and manual vegetation removal or weed control may need to be utilised instead.

Application

The following classes are adapted from the QPWS Vegetation Condition Assessment Framework (AFAC 2016) which is used to classify vegetation into ecosystem health classes. The table identifies a risk priority for planned burning, with those areas falling into the Very High and High categorisation in the relative healthiest condition, and in which planned burning should be prioritised to maintain the health of this vegetation. Continual vegetation monitoring by ICC staff will identify areas where the risks have increased or decreased.

[7] Butler D 2008, Assessing native vegetation condition in Queensland: BioCondition and beyond, case study prepared for the National Land & Water Resources Audit, Canberra ACT.

Table 4 Planned Fire Exclusion-Vegetation Degradation Risk

Vulnerability Risk	Description	ICC context
Very high	Vegetation has tree crowns with very low levels of dieback <10%, with mostly full crown and little epicormic growth. Clear and open understorey, easy to walk through, minimal or no *Lantana*. Native grasses are >50% and mostly >80%. Planned fire of low/moderate severity is the key management option to prevent degradation of ecosystem health and limit threatening process	5.3%
High	Vegetation has tree crowns with emergent levels of dieback <25%, with mostly full crown and little epicormic growth. Understorey is comprised of monocultures of high intensity fire generated even aged shrubs, mostly without *Lantana*. Some native grasses are present, 50% - 80%. Planned fire of low/moderate severity is the key management option to prevent further degradation of ecosystem health and limit threatening process such as bell miner dieback.	85.8%
Moderate	Vegetation has tree crowns with established levels of dieback >25% or <25% of severe levels of dieback, with crown contraction and moderate epicormic growth (~50% of crown). The healthy grassy understorey has been significantly invaded by shrubs (up to 60% cover), including *Lantana*, high intensity fire generated monocultures and other weeds (up to 50%). Some native grasses are present 25%-50%. Planned fire of low/moderate severity is still a management option to prevent further degradation of ecosystem health and limit threatening process such as bell miner dieback.	8.8%
Low	Vegetation has tree crowns with severe/irreversible levels of dieback, with crown contracted, leaves sparse, dead branches and mostly epicormic growth. Understorey is shrubby (> 60% cover), including *Lantana* and other weeds (> 50%). Native grasses are sparse or absent. Planned fire of low/moderate severity is unlikely to be a management option for further prevention of threatening process such as bell miner dieback.	0%

Risk Factor Summary: The majority of reserves attract a High vegetation degradation rating. Lantana incursion is an issue in some of the larger reserves as is the advent of monocultures after high intensity bushfires, namely in Mount Grandchester and Flinders Goolman Reserves.

None of the FMB's are classed as Low. Those classed as Moderate are around the Paperbark flats picnic area in White Rock and all of Denmark Hill, as this is a fire exclusion area. A number of FMB within Purga Nature Reserve are classed as Very high due to the endangered swamp teatree.

4.3 Fire severity risk

In bushfire prone areas of Ipswich, bushfire can present a risk to the safety of communities, with the bushfire hazard within the ICC NAE contributing to this risk. The Queensland Government has developed a new methodology with the CSIRO (Leonard *et al* 2014[8]) for State-wide bushfire hazard mapping. It is based on the McArthur (1967[9]) forest fire behaviour model and Byram's fire-line intensity formula (Byram 1959[10]). The Queensland State Government bushfire hazard mapping was used to assess the fire severity risk of bushland within the ICC NAE for this report.

The State methodology identifies three potential bushfire intensity classes (*very high, high* and *medium*) in addition to a *potential impact buffer* class, *grassfire prone areas* and *low hazard areas* (Table 5). These potential bushfire intensity classes, as measured by potential fire-line intensity, are calculated by combining the:

- Maximum fuel load of vegetation (assumed to be at maximum overall fuel hazard levels though it is recognised that there is likely to be significant variation between the maximum potential and actual fuel hazard levels at any time),
- Maximum landscape slope[11]; and
- Fire weather severity.

These datasets are used to generate a hazard class or *fire line intensity* class[12]. Further details of this methodology are described in Leonard *et al.* (2014).

Fire-line intensity is a measure of the energy being released within a fire and is a useful indicator of the difficulty of fire suppression. The greater the fire-line intensity, the larger the buffer distance required to reduce the risks of bushfire impact. Figure 3 shows the potential maximum radiant heat exposure levels for areas identified *very high, high* and *medium* bushfire intensity classes (as used in State-wide mapping). It also indicates the radiant heat level at which human health impacts will occur based on distance from the flame front. Note that for consistency within this Plan, the *medium* intensity class has been renamed as *moderate*.

Application

Fire management blocks within the ICC NAE are categorised based on the dominant potential bushfire intensity class mapped within each block. The classes are as shown in Table 5.

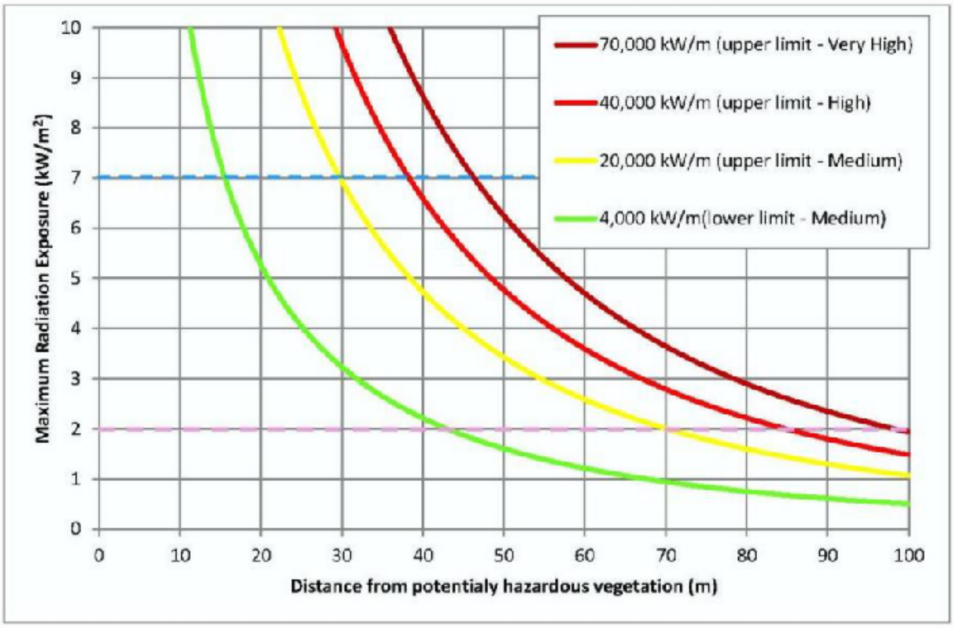
[8] Leonard, J., Newnham, G., Opie, K., and Blanchi, R. (2014) A new methodology for state-wide mapping of bushfire prone areas in Queensland. CSIRO, Australia.

[9] McArthur, A. G. (1967). Fire behaviour in eucalypt forests. Leaflet No. 107., Comm. of Australia For. & Timber Bureau

[10] Byram, G. M. (1959). Combustion of forest fuels, In Davis K.P. Byrma G.M. Krumm W.R. Forest fire – Control and use. McGraw-Hill Book Co., New York.

[11] Note: referred to as Average Landscape Slope in the previous SPP methodology

[12] Derived using the methodology as detailed in: Leonard, J., Newnham, G., Opie, K., and Blanchi, R. (2014) A new methodology for state-wide mapping of bushfire prone areas in Queensland. CSIRO, Australia.



Pink line (- - - -) indicates the point at which human skin becomes damaged and will suffer pain (from 1 minute exposure) (2kW/m2) Blue line (- - - -) indicates the point at which a fully uniformed fire fighter can withstand a short duration of radiant heat and which is likely to be fatal to an unprotected person after a few minutes (7kW/m2).

Figure 3 Radiant heat exposure from *Very High, High, Medium and *Low* bushfire intensity State mapping classes. Adapted from (Leonard et al 2014)**

Table 5 Classification of potential bushfire prone areas (adapted from Leonard *et al* 2014).

Intensity class	Potential bushfire intensity	ICC context (per cent of reserves)
Very high	40,000+kW/m potential bushfire intensity	28.3%
High	20,000 – 40,000kW/m potential bushfire intensity	47.8%
Moderate*	4,000 – 20,000kW/m (*Note: this *Moderate* field is identified as *Medium* in SPP state based mapping)	20.4%
Low	Potential impact buffer (area adjacent to areas of very high, high and medium Potential) or an area that can support a significant grassfire	3.5%
N/A	An area that is unlikely to support a significant bushfire or grassfire	0%

Risk Factor Summary: The majority of reserves attract a High potential bushfire intensity rating. No blocks are classed as N/A and only four Fire Management Blocks are classed as Low, in Kholo and Mount Grandchester Reserves. Flinders Goolman Reserve is the highest rated with 21 FMB classed as Very High.

The mapped intensity classes are based on maximum fuel loads for each vegetation community, and therefore active fuel reduction will reduce the potential fire intensity of bushfires starting on the ICC NAE in areas where fuel reduction has taken place.

4.4 Bushfire attack level risk

Inadequate maintenance of cleared areas (protection zones) around residences or important assets to keep them free of flammable vegetation and other hazards (eg gas bottles) is a risk factor for all built assets regardless of the buildings age. Inadequate maintenance may be:

- Purposeful, where the owner prefers revegetation of cleared areas for environmental, privacy or aesthetic reasons;
- Negligent, where there is not a willingness to pay for maintenance or the tenants / owners do not consider this a priority;
- Unfeasible due to practical difficulties maintaining areas such as steep slopes; or
- Unachievable due to a limited capacity of the owner to complete the maintenance (such as age or financial situation).

These property management issues are a matter for individual property owners to address as their shared responsibility for mitigating their bushfire risk. While mitigation works on some the ICC NAE may compliment private mitigation works, there are large parts of the interface where no reasonable amount of mitigation work within the ICC NAE will mitigate the residual risk to neighbours where vegetation remains unmanaged and houses are not prepared for bushfires.

An estimation of the Bushfire Attack Level (BAL) (from AS3959:2009) can be used as a generic guide to indicate the vulnerability of structures to bushfire impacts based on the vegetation group and topographical characteristics surrounding the structure (Table 6). It can also be used as a guide for establishing setback distances within residential properties to enhance bushfire resistance.

While BAL classes were developed under AS3959:2009 to improve the resilience of newly constructed residences, they can also be applied to existing residences and non-residential structures. For example, it could be used as a guide to improve vegetation separation distances for assets ICC identifies as important (such as major picnic areas, cabins, fire water tanks, timber structures, bridges, boardwalks, viewing decks and visitor centres located adjacent to bushland).

Table 6 Bushfire attack level (BAL) risk

Vulnerability Risk	*Description*	Approximate separation distance of residence from hazard based on ***vegetation*** and *slope class*				ICC context (% of reserves)
		Woodland		***Forest***		
Very high	*Direct flame contact, radiant heat and ember attack on residential structure [BAL 40 and Flame Zone]*	*Flat land*	< 9 m	*Flat land*	< 13 m	18.6%
		0-5 degrees	< 11 m	*0-5 degrees*	< 16 m	
		5-10 degrees	< 13 m	*5-10 degrees*	< 20 m	
		10-15 degrees	< 16 m	*10-15 degrees*	< 25 m	
		15-20 degrees	< 21 m	*15-20 degrees*	< 31 m	
High	*Radiant heat and ember attack on residential structure [BAL 19 – 29]*	*Flat land*	9-19 m	*Flat land*	13-28 m	8.0%
		0-5 degrees	11-23 m	*0-5 degrees*	16-34 m	
		5-10 degrees	13-28 m	*5-10 degrees*	20-41 m	
		10-15 degrees	16-35 m	*10-15 degrees*	25-36 m	
		15-20 degrees	21-42 m	*15-20 degrees*	31-59 m	
Moderate	*Ember attack on residential structure [BAL12.5]*	*Flat land*	19-100 m	*Flat land*	28-100 m	15.9%
		0-5 degrees	23-100 m	*0-5 degrees*	34-100 m	
		5-10 degrees	28-100 m	*5-10 degrees*	41-100 m	
		10-15 degrees	35-100 m	*10-15 degrees*	49-100 m	
		15-20 degrees	42-100 m	*15-20 degrees*	59-100 m	
Low	*Potential minor fire (smoke and ember) impacts*	100-300 m from hazard on all slope types		100-300 m from hazard on all slope types		15.9%
N/A	*No potential bushfire impacts on residential structures, 300+ m from hazard*					41.6%

Note: These calculations are based on forest vegetation class only and require adjustment for other classes of vegetation.

Risk Factor Summary: The majority of reserves considered in this fire management strategy adjoin either rural or peri-urban blocks, with only a small amount of urban interface around Springfield Lakes, and adjoining the urban reserves within central Ipswich (such as Haig Street and Denmark Hill reserves). These small areas of urban interface have the potential to receive high or very high risk bushfire impacts, including direct flame contact and radiant heat. Without household preparedness and vegetation management actions by the owners/occupants, these properties would be highly susceptible to bushfire impacts and potentially not defendable. In many cases the residual risk to the homeowner would not be influenced by mitigation actions by ICC but more reliant on their own actions.

ICC also has assets under its care which may be susceptible to high or very high bushfire impacts. For some of these assets (such as some wooden structures, visitor centres, horse-yards, lookouts and water tanks) BAL estimates may be used as a guide to improve separation distances between the asset and vegetation, and reduce potential bushfire impacts. For other structures it may be appropriate to accept the residual risk without additional works.

Very High and High Risks are spread across many of the reserves however White Rock poses a high risk due to the potential fire run towards Springfield Lakes housing development and the high proportion of interface within FMBs WR_17-20.

4.5 Access Risk

Access for responding emergency vehicles and for evacuation using the public road network[13] is a key consideration in establishing the risk to communities living around the ICC NAE. The communities that are at most risk are those that might have a single access in and out of their property that is located within areas of vegetation hazard and may be susceptible to being cut off by fire or fallen tree as a consequence of fire. ICC can do little to mitigate this risk fully for the ICC NAE and homeowners in these areas would be recommended to 'leave early' on days of elevated fire danger. The access risk factors for the ICC NAE are shown in Table 7 below:

Table 7 Access risk

Vulnerability Risk	*Description*	ICC context (% of reserves)
Very high	*Single lane natural surface dead end trail traversing vegetation with no / very few passing bays and turn around points*	8.8%
High	*Single or two laneway dead end sealed or unsealed access traversing vegetation with passing bays and turn around points*	46.0%
Moderate	*Two lane (or greater) sealed access with sporadic vegetation exposure and alternative access routes*	20.4%
Low	*Freeway and major road access with significant vegetation separation*	1.8%
N/A	*Not applicable – access constraints do not apply*	23.0%

Risk Factor Summary: The majority of blocks are classed as High, as most blocks have fire trails surrounding or adjacent to them. A number of the reserves are small and situated in urban environments and therefore have access to the public road network. Around a quarter of the reserves are classed in the N/A category as they do not contain any houses or other fire vulnerable assets. Stirling Road Reserve has the highest access risk with all three blocks rated as Very High due to few fire trails and little access to the public road network.

13 The public road network in this context also includes the ICC trail network where it provides primary access to resident or key asset.

4.6 Housing stock risk

The vulnerability of an asset to bushfire will be a function of the design and construction features of the asset, and the combination of how close a building is to a bushfire hazard, what type of hazard it is and how the slope of the terrain may exacerbate or reduce the degree of hazard.

Some the ICC NAE are located in urban and rural-residential (*intermix*) landscapes and have a significant level of interface with private properties (Appendix A). A proportion of these neighbours live in 'legacy' buildings which were constructed before contemporary provisions and the introduction of the *Australian Standard 3959 – Construction of Buildings in Bushfire Prone Areas* (AS 3959:2009). These legacy developments may be more vulnerable than buildings constructed to Australian Standard 3959:2009 owing to the:

- Construction techniques and materials used;
- Location of the residence and its layout in relation to the particular bushfire hazard on site;
- Provision of setbacks and defendable space for fire fighters; and
- Capacity for safe access and egress.

Areas where developments and residential properties have been constructed in the past that do not comply with current planning provisions and building standards are likely to be at substantially higher bushfire risk than areas developed to contemporary bushfire planning and building requirements (Table 8). It is noted that once a development is approved there are no ongoing mandatory compliance requirements for the property owner to maintain bushfire mitigation measures that may have been an approval condition.

Table 8 Housing stock risk

Vulnerability Risk	*Description*	ICC context (% of reserves)
High	*Residential cluster, precinct or subdivision for which development approval was given prior to 2010 (ie prior to application of AS3959:2009)*	40.7%
Low	*Residential cluster, precinct or subdivision for which development approval was given after 2010 (ie housing stock constructed to AS3959:2009)*	6.2%
Not applicable	*No residential structures located within 100 metres of a reserve*	53.1%

Risk Factor Summary: Houses built prior to application of AS3959:2009 are likely to be at greater risk of bushfire impacts and should exercise additional vigilance to reduce their bushfire attack level (Section 4.4). In many cases the residual risk to the homeowner would not be influenced by mitigation actions within the ICC NAE but more reliant on their own actions. Those reserves which are located in the Urban and Peri-urban areas pose the highest risk. Most housing surrounding the NAE reserves was constructed prior to 2010 and in many cases vegetation growth and lack of maintenance has reduced protection afforded in the original design.

4.7 Fire vulnerable asset and smoke sensitive receptor risk

There may be establishments located adjacent to the ICC NAE that have an elevated level of vulnerability because of a reduced capacity of the residents or building users to react quickly and respond to potential bushfire impacts. This may be for a number of reasons including persons residing on-site are:

- Not independent and able bodied;
- Of restricted mobility due to age, disability, health or other incapacity;
- In need of direction and full supervision such as children or young adults at a day care centre, educational facility or university or alternately persons being held within a correctional facility;
- Unfamiliar with the area and may be visiting as part of a larger group (such as a church or other place of worship, conference, event, function, visitors centre, airport); or
- In short term accommodation and are potentially unfamiliar with the area.

These facilities require an elevated level of protection in developing mitigation actions as such facilities will take a longer time to evacuate, requiring the assistance of fire and other emergency services authorities. As such these fire vulnerable assets will need to be specifically addressed in QFES I-Zone planning.

Fire vulnerable assets may also include critical infrastructure (such as water treatment plants, telecommunications towers, energy substations, freeways and major roads) which if impacted may have elevated consequential impacts or long recovery times (having flow on impacts to the broader community).

Other fire vulnerable assets may include environmental plantings for which ICC is responsible (plantings less than 5 m high and <10 years old), or historic coal mining areas present on the ICC NAE which contain areas with coal fines, exposed seam outcrops or coal heaps that have the potential to catch fire.

In terms of ICC actions, where fire vulnerable assets are located adjacent to, or within the ICC NAE, the following actions may require consideration:

- Creation of vegetation setbacks and fuel reduced areas. This includes fuel reduction around essential emergency access and egress routes to such facilities;
- Prescribed burning to reduce the intensity and rate of spread of bushfires impacting a facility and associated emergency access and egress routes. This includes prescribed burning to reduce the potential for ember attack on facilities; and
- Smoke management strategies in prescribed burning planning and delivery to mitigate smoke impacts on sensitive receptors.

The table below can be used to broadly classify risk to fire vulnerable assets and smoke sensitive receptors located in and around the ICC NAE. Depending on the asset type and its location (within, directly adjoining a reserve, outside a reserve) site specific actions for mitigation works by ICC may be required.

Table 9 Fire vulnerable assets and smoke sensitive receptor risk

Vulnerability Risk	*Description*	ICC context
Very high	*Fire vulnerable asset directly adjoins an ICC reserve with little vegetation separation and a significant potential for direct flame contact, radiant heat, ember attack and maximum smoke concentrations*	31.9%
High	*Fire vulnerable asset, including critical access and egress, is located within 100 metres of a reserve and may be susceptible to ember attack and elevated smoke concentrations*	9.7%
Moderate	*Fire vulnerable asset is located within 1 km of the reserve and potentially may experience smoke*	2.7%
Low	*Fire vulnerable asset is located more than 1 km from reserve, with only minor smoke impacts possible*	55.8%

Risk Factor Summary: Those reserves and blocks rated as Very high and High will require consideration in the development and delivery of the operational burn plan (which includes site specific smoke mitigation actions). A number of reserves contain mixed planting blocks or nature reserves that are rated as Very High. Brassall Retirement village is located adjacent to Haig Street Quarry Reserve and will impact on the management action available at this reserve. Note that due to Ipswich General Hospital located North East of Denmark Hill Conservation Reserve, all blocks within Denmark Hill are classed as Very high.

Mount Grandchester Reserve is the lowest rated with all FMB classed as low.

4.8 Surrounding landscape vegetation cover risk

The landscape location where vulnerable assets are situated will have the most significant impact on bushfire risk. The land cover and condition of land adjacent to assets, particularly in the direction from which adverse weather comes, influences fire risk heavily.

Fires in forests and woodlands are in general much more difficult to contain and keep contained than fires in open country dominated by pasture and crops. Therefore, those ICC NAE reserves adjoining extensive forest cover will be at significantly higher fire risk than reserves adjacent to grassland, urban intermix or agricultural areas. Landscapes within the ICC area that are of particular relevance to bushfire management include Interface, Intermix, agricultural land uses and natural vegetation types.

The landscape vegetation cover risk is considered from the most adverse fire weather side (the direction from which large fires are most likely to come from) (from north anti-clockwise through to south-west). The scale below was used to assess the landscape vegetation cover risk factor for ICC NAE management areas (Table 10).

Table 10 Landscape vegetation cover risk

Vulnerability Risk	*Description*	ICC context
Very high	*Land cover dominated by extensive, mature, fire prone vegetation. During drought the local landscape has previously supported large fires. Clearings within the extent of forest are relatively small and easily crossed by short distance spotting (<500 m)*	42.5%
High	*Roughly equal mix of cleared agricultural lands (or urban intermix lands) and remnant vegetation - forested areas are large enough to support running high intensity fire and spread to other forest areas through short distance spotting (< 500 m)*	24.8%
Moderate	*Mostly cleared or urbanised landscape with small and/or regularly grazed or burnt forest remnants. Forest areas/linear features not sufficiently large or continuous enough to support large, high intensity fires*	20.4%
Low	*Extensively cleared agricultural or urbanised landscape with only isolated clumps or linear features with trees, or a more extensive forest area which has highly modified understorey (such as mown grass, low flammability, reticulated gardens)*	12.4%

Risk Factor Summary: the ICC NAE contain a wide variety of vegetation communities with varying levels of land cover. Areas that have been rated as very high include White Rock – Spring Mountain Conservation Estate, Flinders-Goolman Conservation Estate and Mt Grandchester Conservation Estate. These reserves are dominated by extensive, fire-prone, eucalypt and corymbia communities. Where land cover is dominated by extensive fire-prone vegetation, there is a high risk of large bushfires building up within it and/or spreading through the reserve to/from adjoining bushland. It is very difficult for ICC to mitigate this risk in high to very high reserves without the assistance of adjoining land managers.

Landscapes which contain private intermix allotments such as, Hillview Drive, Stirling Road and Kholo Enviroplan Reserves, may contain unmanaged elevated fuel hazards. These could support bushfire spread through the landscape under adverse conditions.

ICC may be able to reduce the potential significant impacts of bushfires on adjoining communities through maintaining fuels within the ICC NAE at lower levels through controlled and low intensity fuel reduction burning on a rotational basis.

The majority of the ICC NAE are considered to have moderate or low landscape vegetation cover risk as many of the reserves are partially or completely surrounded by non-fire prone areas including urban land uses, roads and industrial areas.

4.9 Fire suppression success risk

The topography and accessibility within and adjacent to the ICC NAE has a significant bearing on the likelihood of fire suppression success. Steep areas where fires can develop quickly on uphill runs, where access for firefighters to engage in initial attack is limited, will have a much higher difficulty for early fire control than areas that have good access and gentler topography. The topography and associated access factors for ICC are summarised in Table 11 below:

Table 11 Fire suppression success risk

Vulnerability Risk	*Description*	ICC context (% of reserves)
Very high	*Rough topography with relatively limited access making initial attack by ground crews difficult*	14.2%
High	*Rough topography but with reasonable road/trail access such that fires starting on low to high FDR days are usually contained within 1 -2 days*	48.7%
Moderate	*Undulating/hilly topography with reasonably good access – fires starting on low to high FDR days are almost always contained by initial attack resources*	12.4%
Low	*Gentle topography with good road/trail access and surrounding landscape visibility*	24.8%

Risk Factor Summary: The landscape across the majority of the ICC NAE is low or undulating/hilly topography with reasonably good access, and fires starting on low-moderate and high FDR days are almost always able to be contained by initial attack resources. A smaller number of reserves, including White Rock –Spring Mountain Conservation Estate, Flinders-Goolman Conservation Estate and Mt Grandchester Conservation Estate contain rough topography, which limits the fire suppression ability of ground crews. The ICC prescribed burning program may target areas of high topography risk to reduce fire intensity and rate of spread if fire was to start in or traverse these areas, although many would remain susceptible to fires spreading into the reserve from adjoining areas.

5. Risk Dashboard

5.1 Unmitigated and residual risk classification

Separately to the classification of a fire management block's *vulnerability risks*, the *residual risk* for each block is also assessed, (as also shown in Figure 1), in three phases as represented in Table 12. At each phase the likelihood and consequence impacts are assessed using the methodology identified by the *National Emergency Management Committee (2010)* for the People, Environment and Infrastructure risk categories. This assessment produces an *Acceptable*, *Tolerable* or *Intolerable*[14] risk for each risk category. Blocks assessed to have an 'Intolerable' unmitigated bushfire risk will require mitigation actions to be taken by ICC (mitigation actions are outlined in Section 7). The residual risk is assessed following ICC actions and may or may not be reduced. It is also the responsibility of other parties (see Sections 5.2 and 7.2) to undertake mitigation actions on their lands or jurisdictions, in a shared responsibility approach. The final residual risk is then assessed.

Table 12 Residual risk approach

Unmitigated bushfire risk	▶	Residual risk following works and activities by ICC on its land	▶	Residual risk after shared responsibility actions are implemented by others
The unmitigated risk if no fire management mitigation or response actions are completed by ICC, other land managers, fire services and the community. Note that this would be a highly unlikely scenario as there are various legal and policy obligations that will not allow a 'do-nothing' approach.	*ICC Actions*	*Classifies the residual risk of bushfires to ICC and surrounding assets following works on the ICC NAE. In some instances ICC may not be able to achieve a residual risk reduction, and may be reliant on shared responsibility partner actions to reduce the risk further*	*Shared Responsibility Actions*	*Classifies the residual risk of off-reserve actions. In some instances, the success of reducing the bushfire risk within the ICC NAE and in surrounding communities is dependent on adjoining landholders and authorities meeting their shared responsibility obligations (see next section).*

[14] These classes are as referenced in the State Planning Policy (2016b) and defined as follows:

—Acceptable risk: A risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk further. Individuals and society can live with this risk without feeling the necessity to reduce the risks any further.

—Tolerable risk: A risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce risk. Society can live with this risk but believe that as much as is reasonably practical should be done to reduce the risks further.

—Intolerable risk: A risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk and measures are to be put in place to reduce risks to at least a tolerable level.

This qualitative evaluation of risks is broadly based on the risk evaluation approach identified in the National Emergency Risk Assessment Guidelines (National Emergency Management Committee 2010[15]). The *As Low As Reasonably Practical* (ALARP) Framework is used to categorise residual risks for the ICC NAE based on the *Low Confidence Level Evaluation Table* in the National Emergency Management Committee (2010) guidelines.

For some fire management blocks and at risk reserves, ICC may not be able to influence the residual risk at all or only slightly (i.e. after its actions the residual risk still is high [*intolerable*]). In such areas it may be an inefficient use of funds, impractical or physically impossible to attempt to reduce the residual risk on the ICC NAE to a lower class. In these instances, an alternate emphasis is required on encouraging other shared responsibility partners to implement mitigation measures on lands they are responsible for (see Table 14) to reduce the risk class (to medium [*tolerable*] or low [*acceptable*]).

5.2 Shared responsibilities for risk management

Amongst fire and emergency services, and many of their partners, bushfire risk management is widely regarded as a **shared responsibility**. With this management principle comes an obligation, and a significant challenge to educate the community, in particular about the important role that individuals have in managing bushfire risk and personal safety. Whilst ICC has a key share of the responsibility for bushfire risk management, as both a land manager, and custodian of local knowledge about bushfire risks and local community safety issues, it does not own or have responsibilities for all areas of natural hazards, as ICC NAEs are 'islands' in the larger fuel landscape. The management of bushfire fuels on individual allotments is the responsibility of the owner.

The National Bushfire Management Policy Statement for Forests and Rangelands (FFMG 2014[16]) identifies shared responsibility as:

*Bushfire mitigation and management is a **shared responsibility** between the community, industries and firms, land and bushfire management agencies and governments where all take individual action and responsibility in an integrated way. Well informed and prepared individuals and communities, complement the roles of land and bushfire management agencies. A partnership approach is the best way to minimise bushfire risks to lives, property and social and environmental assets.*

---

[15] National Emergency Management Committee (2010) National Emergency Risk Assessment Guidelines, Tasmanian State Emergency Service, Hobart.

[16] Forest Fire Management Group (2014) National Bushfire Management Policy Statement for Forests and Rangelands. Prepared by the Forest Fire Management Group for The Council of Australian Governments

6. Fire management zones

Reviewing the bushfire vulnerability factors for each fire management block (Section 4) provides a basis to identify an appropriate fire regime to apply in a block or group of blocks. Fire management zones can provide a means to broadly characterise the type of fire regime which should be applied in an area based on the natural values as well as the constructed life and property values within it and the immediate surrounds.

Fire management zones that are applied in this plan (and shown on each NAE sub-plan – *see Appendix A*) are based on those identified by Queensland Parks and Wildlife Service (DNPRSR 2013b) and consist of the classes shown in the table below. For *Protection* and *Wildfire Mitigation* zones the overall fuel hazard (OFH) (based on *Hines et al* 2010) or overall fuel load (tonnes per hectare based on DNPRSR 2012) is used as a trigger to determine when treatment is required, as informed by fuel monitoring. The fuel monitoring sheet used by ICC and recommendations for potential improvements are provided in Appendix G:

Table 13 Fire management zone types

Zone Class	Description (adapted from DNPRSR 2013a and DNPRSR 2013b)	Areas of ICC reserve
Protection	To provide a high level of protection to life, property and infrastructure. Fuels should be maintained at relatively low levels by planned burning (as often as fuel levels allow) or other means (such as mechanical). Fuel reduction is scheduled when overall fuel hazard (OFH) exceeds **low to moderate OFH** (based on *Hines et al* 2010) or **5 tonnes per hectare** (based on DNPRSR 2012). Area treated target is 90%	ICC fire vulnerable assets (see Appendix A)
Wildfire Mitigation	To increase the likelihood of controlling a wildfire in strategically important areas within a reserve Planned burning is used to simplify the structure, and reduce the quantity of fuel to mitigate flame height, spread and intensity; and therefore improve wildfire controllability. Planned burns are completed generally at the lower end of a recommended fire frequency to maintain fuels at an **OFH < HIGH or ≤ 8 tonnes per hectare** Area treated target is 60-80% of the block	White Rock – Spring Mountain Conservation Estate, Mount Grandchester Conservation Estate, Haig Street Reserve, Flinders Goolman Conservation Estate
Conservation	To maintain the natural role of fire as an ecological process	Kholo Enviroplan Reserve, White Rock – Spring Mountain Conservation Estate, Mount Grandchester Conservation Estate, Haig Street Reserve, Flinders Goolman Conservation Estate

Sustainable Production	To maintain sustainable production and use of forest products (such as timber, foliage, pasture, carbon, off set plantings)	Purga Nature Reserve, Mount Grandchester Conservation Estate
Rehabilitation	To combat a threatening process that cannot be addressed by the usual fire management practices	Nil NAE
Reference	To monitor long-term effects of fire regimes, wildfires or fire exclusion on nature conservation values	Purga Nature Reserve
Exclusion	To exclude fire totally (and actively). This may include areas such as former mining sites where there is the potential for coal tailings to be ignited or ecologically sensitive areas which are very susceptible to planned and unplanned fire impacts.	Denmark Hill Conservation Reserve, Flinders-Goolman Conservation Estate, Stirling Road Reserve

Summary: The zoning of the ICC NAE into different zones provides a strategic means to identify fuel management objective in a specific area. Regular fuel hazard monitoring provides a means to monitor fuel hazard and identify when fuel loads within an area require treatment.

7. Fire Mitigation Actions

7.1 Hazard mitigation works

Prescribed burning is a key mitigation strategy to reduce the rate of spread and intensity of bushfires in the naturally fire maintained vegetation communities of south-east Queensland. As highlighted by the Victorian Bushfires Royal Commission, prescribed burning makes communities safer by reducing the amount of combustible fuel, thereby reducing fire intensity, rate of spread and bushfire risk, and protects flora and fauna from destructive high intensity fires by preferentially applying a low intensity fire regime under controlled conditions. Prescribed burning reduces the potential for a fire to start within and move from an ICC reserve by reducing its intensity and rate of spread. Planned burning is identified as a means to maximise diversity within fire adapted ecosystems (DNPRSR 2013a). It is a key mitigation action used in ICC NAE management areas (see Dashboards in Appendix A and Figure 4).

In addition to planned burning other hazard mitigation techniques include:

- Hand removal to reduce vegetation – used surrounding buildings where larger equipment is not accessible or where careful and selective removal is required (such as where threatened flora may be present in the treatment area). Hand removal may also be applied in fire exclusion zones such as former coal mining areas (Denmark Hill) where planned burning has the potential to ignite coal seams or fines and, due to the assets being located nearby, fuel reduction is required;
- Mulching / flail mowing – used in place of slashing in locations where the overstorey vegetation is to be maintained but the mid and understorey is to be modified including being mulched and left in situ;
- Slashing / mowing / pruning – used predominantly in strategic and built asset zones in the landscape, to maintain Protection Zones and fire trails;
- Maintaining public roads to provide QFES access to NAE management areas;
- Closing reserves on Total Fire Ban days

Crash grazing by domestic livestock to reduce biomass and trample fuel structure is not permitted within ICC natural areas including the ICC NAE because of potential impacts on biodiversity and weed management.

Prescribed burning treatments are developed on an annual basis and should be guided by the highest risk priority areas on each map risk plan and the zoning (Appendix A), and informed by fuel monitoring.

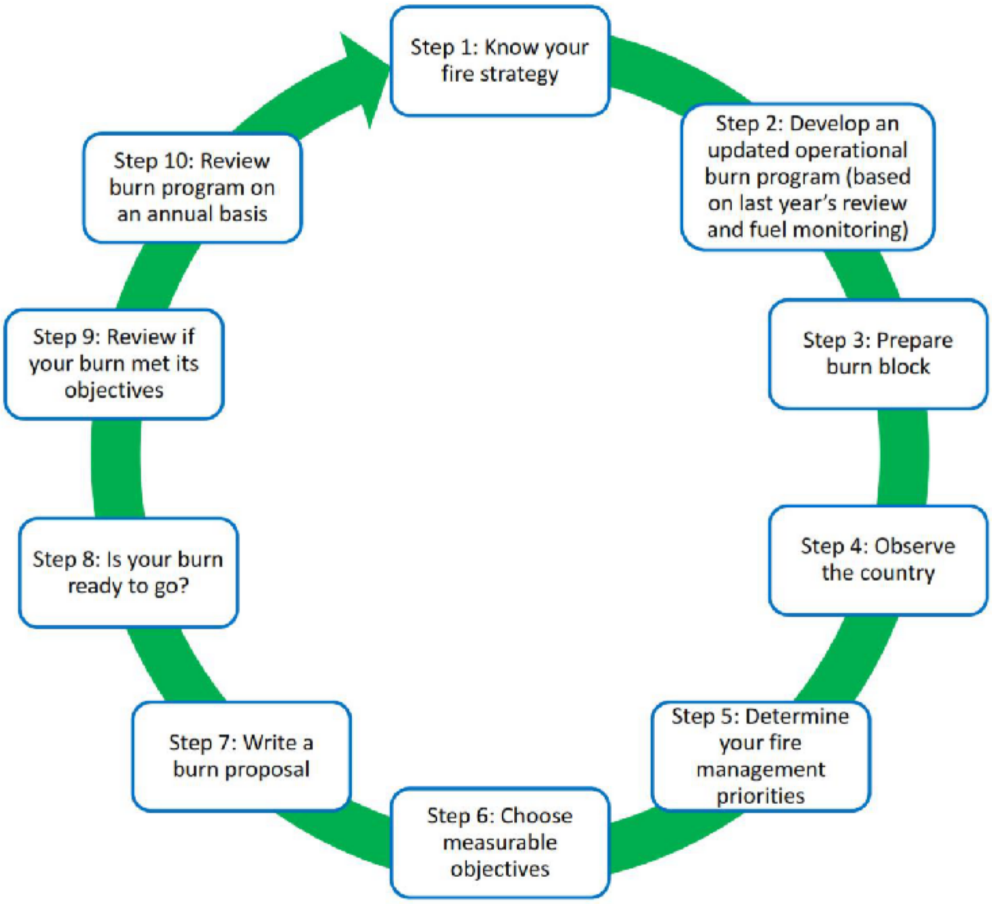
In Queensland, planned burn development is directed by bioregional burn guidelines, such as the *Planned Burn Guidelines – Southeast Queensland Bioregion of Queensland* (State of Queensland 2013) and a range of supporting documents to assist field practitioners to prepare and implement a planned burn including:

- QPWS Vegetation Condition Assessment Framework
- QPWS planned burn fire behaviour tables (State of Queensland 2012a)
- QPWS planned burn guidelines – how to assess if your burn is ready to go (State of Queensland 2012b)

The steps identified in these guidelines to plan a prescribed have been adapted in the figure which follows.

Risk Summary: Prescribed burning is an essential and cost effective means to reduce fuel levels within the ICC NAE, thereby reducing the ability of fires to establish and the intensity and rate at which they will spread. Applying low intensity burning across the reserves which ICC manages is an essential means by which Council can meet its shared responsibility obligation of mitigating the bushfire risk to surrounding communities.

Figure 4 Annual planned burning preparation process



7.2 Shared responsibility partners

The effective mitigation of bushfire risk within the ICC NAE, is a shared responsibility and requires an integrated approach involving development planning and building standards, consideration of fire risk in land management, fire and emergency service delivery, and importantly, bushfire awareness, preparedness and survival planning by home owners, occupiers and others (such as businesses and facility managers). Within a broader, integrated approach to bushfire risk mitigation, the ICC legislated planning provisions also play an important role in reducing bushfire risk in new developments adjoining the ICC NAE.

There are a number of partners in the 'shared responsibility' model for bushfire risk management for the ICC, with key areas of responsibility shown in Table 14.

Table 14 Shared responsibilities for bushfire risk mitigation

Responsible organisation/ individual	Responsibilities
Queensland Fire and Emergency Services (QFES)	• Build and maintain fire and rescue service delivery capability, providing 24/7/365 service provision, appropriate to the levels of risk. • Design and deliver community safety/preparedness policies and programs aimed at reducing the occurrence of preventable bushfires, and increasing the resilience and safety of communities at risk from bushfire (this includes developing appropriately researched bushfire safety policy approaches, consistent messages for use across QFES and by program delivery partners, and appropriate self-help systems and advice for community use). • Design and develop programs to assist those in the community who are unable, or less able, to engage in self-help preparedness activities. • Issue advice and warnings to communities regarding seasonal and daily fire danger, and fire threat warnings when fires occur. • Respond to bushfire events as they occur, to manage public safety and minimise adverse fire consequences. • Provide advice to ICC in relation to bushfire safety requirements for developments in the iZone (fire prone land). • Community education.
Department of Infrastructure, Local Government and Planning (DILGP)	• Maintain State Planning Policy (DSDIP 2016a) and implementation guidelines for mitigating the adverse impacts of bushfires (and other natural hazards including floods and landslides) (DSDIP 2016b). • Community education.
Ipswich City Council (and other councils) (see also Land Managers)	• Implement State Planning Policy (DSDIP 2016a). • Manage fuels and bushfire risk on Council managed lands. • Maintain a resilient natural environment and biodiversity within Council managed lands. • Take appropriate measures to inform local communities about bushfire risks in the Council area, and raise awareness regarding the suite of self-help actions land owners and occupiers can take to reduce their bushfire and smoke inhalation risk (tailored to the locally prevailing risks), and where to obtain information about how to undertake such self-help actions. • Community education (in support of QFES).

Responsible organisation/ individual	Responsibilities
Members of local communities - property owners/occupiers and individuals	• Make appropriate efforts to understand the level of bushfire risk in their area. • Plan how they will respond in the event of becoming aware that a bush fire poses a potential threat to their property (such as go early plan, or prepare stay and defend plan). • Those who value their home/business and wish to maximise its chances of survival in a bushfire should maintain their home (including their tenanted properties) and property/garden in a condition such that the likelihood of garden/house ignition during a bushfire is minimised (this is regardless of whether the occupants plan to prepare, stay and defend or go early). • Make efforts to understand what actions can be taken to reduce the health risk to people sensitive to smoke. • Take appropriate action to stay informed about daily fire danger levels and fire activity in their area.
Land Managers (such as Local Government, Queensland Parks and Wildlife Service, Seqwater, Department of Transport and Main Roads)	• Maintain fire risk management infrastructure in a condition that it is safe and effective to use in the event of a fire (eg maintaining fire trails in an appropriate condition). • Manage fuels on their property such that they do not pose unacceptable risks to others, or to firefighters that may need to enter their land to contain/extinguish fires. This includes monitoring (fuel and moisture levels) and preparing areas identified for prescribed burning, participating in and supporting fire authorities in prescribed burning, mop up and patrol, and undertaking post fire recovery actions on lands for which they are responsible. • Take reasonable measures to minimise the occurrence and spread of fires from their land.
Lifeline infrastructure managers (such as communication, electricity, water utilities, gas and access)	• Take reasonable measures to prevent their infrastructure from starting fires, and becoming unserviceable or dangerous in the event of fire. • Plan ahead for lifeline infrastructure service restoration in the event that services are disrupted by fires. • Maintain vegetation and infrastructure in accordance with Industry standards.

For ICC, meeting the reasonable obligations under 'shared responsibility' arrangements entails:

- Having in place appropriate staff training programs and quality assurance systems that ensure that the State Planning Policy (DSDIP 2016a) is applied appropriately to new development;
- Maintaining in-house capacity or engaging external services to develop appropriate fire risk management plans for ICC Conservation Estates, Conservation Reserves or Nature Reserves; and capacity to implement planned activities including fuel reduction burning;
- Developing and making available locally relevant information that assists residents and businesses to develop awareness about local bushfire risks, and make wise decisions about preparedness for, and response to bushfires. This includes providing areas where local residents wishing to 'go early' can safely assemble, information on safe routes to get there, information on smoke impacts and how to reduce exposure, and how to maintain awareness of bushfire situation development. Equally important as developing the

information is taking appropriate measures to ensure such information is communicated to residents at risk; and

- Building and maintaining professional relationships and inter-operability protocols/procedures with 'shared responsibility' partners to facilitate smooth response operations when high-tempo emergency incidents occur.

Shared responsibility is a key component of the 'risk dashboard', acknowledging that the ICC cannot fully influence or mitigate the bushfire risk within the landscape through its own activities.

8. Bushfire Assets and Advantages

The following bushfire assets and advantages are maintained within the ICC NAE and significantly contribute to risk mitigation through enhancing the ease of prescribed burning and options for suppression.

8.1 Water supply

Water supply points suitable for bushfire fighting include overhead standpipes, hydrants with suitable fittings, self-filling water tanks, dams accessible to vehicles and dams suitable for helicopters. Water supplies within some parts of ICC are limited to a number of dams of low capacity, supplemented by water tanks.

In parts of ICC with limited water supply, fire suppression or efficient prescribed burning may be compromised as fire tankers have to leave an area being prescribed burnt or being subjected to fire suppression to replenish water supplies. Within this period, if a fire or prescribed burn is unattended, it may spot over or grow beyond a level where direct control is not possible.

An ongoing program to improve water resources across the ICC NAE will provide for more efficient prescribed burning and more effective suppression operations.

Summary: Quick access to dedicated water supplies is essential for the efficient delivery of prescribed burning programs and for fire suppression operations. The network of water supply points should be maintained and expanded commensurate with risk.

8.2 Fire trails

A well planned and maintained network of access roads and tracks specifically for fire mitigation and suppression activities will provide for a significant level of risk reduction across the ICC reserve network. Fire trails also play a significant role as a fire control line for suppression and prescribed burning operations. Locations and designations of fire trails will be determined by ICC in consultation with relevant stakeholders. The following are classes of trails for application at the ICC NAE (as based on the ICC manual).

Table 15 Fire trail types

Type	Description	Vehicle	Areas of ICC reserve
A	Used in forest, woodland and grassland communities for direct attack operations. Can be used to conduct back-burning operations. Slopes <5°, width >6 m	Large appliance	White Rock, Ric Nattrass, Flinders-Goolman, Haig Street
B	Multi-purpose track used in shrubby and grassy woodland communities providing a suitable break for conducting fire prevention and suppression activities (low to medium intensity fire). Slopes 5-10°, width <6 m with additional disturbance zone <1 m either side	Small to large appliances (Large appliances need to check passing areas.)	White Rock, Flinders-Goolman

C	Multi-purpose track used in forest, woodland and grassland communities providing a suitable break for conducting fire prevention and suppression activities (low intensity fire). Slopes >10°, width <3 m	Small appliance	Purga, White Rock, Hillview, Ric Nattrass, Camerons Scrub, Flinders-Goolman, Stirling Road, Denmark Hill, Haig Street

Summary: Safe emergency access and egress within the ICC NAE is essential for the efficient delivery of prescribed burning programs and for fire suppression operations. The fire trail network also serves as established control lines from which safe controlled burning (during suppression or prescribed burning) can be completed.

9. Summary

ICC has made a significant investment in nature conservation programs over the past decades. Its NAE covers 6,672 hectares of conservation land containing a range of vegetation communities, many of which require fire to regenerate and stay healthy. Some of the reserves interface with urban centres, thus active fire management is required to manage risk appropriately. ICC undertakes prescribed burning to reduce bushfire intensity and rate of spread, and enhance the ecosystem health of fire maintained communities. In some areas, ICC actions may not reduce the risks of a FMB to a tolerable level. In this case, owners of neighbouring properties or assets are required to undertake mitigation actions (shared responsibility) to reduce the risk to a tolerable or acceptable level.

The strategy addresses a number of vulnerability risk factors. After analysing the NAE management areas it was found that FMBs with the highest risks are located in large areas of native vegetation (high fire severity), interfacing with residential areas (BAL), within vegetation of declining ecological health or containing fire vulnerable or smoke sensitive assets.

Certain reserves / FMBs may have an intolerable residual risk, due to human health risks. This is the case for Denmark Hill and Haig Street Quarry due to the proximity of the hospital and retirement village to these reserves. The residual risk after ICC actions, shown in the risk dashboards, highlights the need for shared responsibility actions to reduce the risk of bushfire impacts.

10. References

AFAC (2010) AFAC Submission to the Senate Select Committee on Agricultural and Related Industries Inquiry into Bushfires in Australia. Australasian Fire and Emergency Service Authorities Council (AFAC), Melbourne

AFAC (2012). *Bushfire Glossary*. Prepared by Rural and Land Management Group for AFAC agencies. Australasian Fire and Emergency Service Authorities Council

AFAC (2015) *Risk Management Framework – Smoke Hazard and Greenhouse Gas Emissions*. Report for National Burning – Sub-project 3. Australasian Fire and Emergency Services Authorities Council Limited, Melbourne.

AFAC (2016) *National guidelines for prescribed burning operations*. Report prepared by GHD for the National Burning Project – Subproject 4. Australasian Fire and Emergency Services Council Limited, Melbourne Victoria

Atkinson, D, Chladil, M, Janssen, V and Lucieer, A (2010) 'Implementation of quantitative bushfire risk analysis in a GIS environment', *International Journal of Wildland Fire*, 19, 649-658

Blanchi, R., Lucas, C., Leonard, J. and Finkele, K. (2010). 'Meteorological conditions and wildfire-related house loss in Australia'. *International Journal of Wildland Fire*, 19, 914-926

BOM 2016. Amberley AMO site data; Australian Government Bureau of Meteorology. Accessed 12 October 2016.

Bradstock, R and Gill, A (2001) 'Living with fire and biodiversity at the urban edge: in search of a solution to the human protection problem in southern Australia', *Journal of Mediterranean Ecology*, 2, 179-185

Bryant, C (2008) *Understanding bushfire: trends in deliberate vegetation fires in Australia*. Technical and background paper no. 27 Canberra: Australian Institute of Criminology, January 2008

Butler D (2008). *Assessing native vegetation condition in Queensland: BioCondition and beyond*, case study prepared for the National Land & Water Resources Audit, Canberra ACT

Byram, G. M. (1959). *Combustion of forest fuels*, In Davis K.P. Byrma G.M. Krumm W.R. Forest fire – Control and use. McGraw-Hill Book Co., New York.

CSIRO / Australian Bureau of Meteorology (2007). *Climate change in Australia: technical report*, CSIRO, Australia

DNPRSR (2012) *Planned burn guidelines: How to assess if your burn is ready to go.* Department of National Parks, Recreation, Sport and Racing; Queensland Government Brisbane

DNPRSR (2013a) *Planned burn guidelines: Southeast Queensland Bioregion of Queensland,* Department of National Parks, Recreation, Sport and Racing; Queensland Government Brisbane

DNPRSR (2013b) *Fire management: Managing parks and forests.* Queensland Parks and Wildlife Service, Department of National Parks, Recreation, Sport and Racing; Queensland Government Brisbane

DSDIP (2016a)) *State Planning Policy*. DSDIP, Queensland Government Brisbane, Department of State Development, Infrastructure and Planning

DSDIP (2016b) *State Planning Policy state interest guideline – natural hazards, risk and resilience*. Version: April 2016, DSDIP, Queensland Government Brisbane, Department of State Development, Infrastructure and Planning

DSDIP (2016c) *State Planning Policy state interest guidance – natural hazards, risk and resilience technical manual evaluation report: Bushfire hazards*. Version April 2016, DSDIP, Queensland Government Brisbane, Department of State Development, Infrastructure and Planning

Eco Logical Australia 2016. *Independent Review – Fire Management Plans and Processes – NAE*. Prepared for Ipswich City Council.

Environment Protection and Biodiversity Conservation Act 1999

Fire and Emergency Services Act 1990 (QLD)

Forest Fire Management Group (2014). *National Bushfire Management Policy Statement for Forests and Rangelands*. Prepared by the Forest Fire Management Group for The Council of Australian Governments

Friend, R. (2011). *Grandchester Reserve – Fire Management Plan*, Prepared by Rob Friend & Associates Pty Ltd for Ipswich City Council

Friend, R. (2011). *Woolshed Creek Reserve – Fire Management Plan*, Prepared by Rob Friend & Associates Pty Ltd for Ipswich City Council

Hines, F., Tolhurst, K. G., Wilson, A. AG., McCarthy, G. J. (2010). *Overall fuel hazard assessment guide*, 4th edition July 2010; Fire and adaptive management, report no. 82. Victorian Government Department of Sustainability and Environment, Melbourne

Ipswich City Council (ICC) (2013a). *NAE Fire Management Policy* Version 1. Ipswich City Council.

ICC (2013b). *Standards and Guidelines for the Construction and maintenance of Service Tracks and Firebreaks within the Natural Area Network*. Draft. Ipswich City Council.

ICC (2015a) *Ipswich Nature Conservation Strategy 2015*. Prepared by ICC Works Parks and Recreation Department, March 2015

ICC (2015b) *Ipswich Nature Conservation Strategy 2015 – Background Report*. Ipswich City Council

Leonard, J., Newnham, G., Opie, K., and Blanchi, R. (2014). *A new methodology for state-wide mapping of bushfire prone areas in Queensland*. CSIRO, Australia.

McAlister, B. (2010). *Denmark Hill Conservation Park Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. (2010). *Haig Street Quarry Reserve Park Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. (2010). *Hillview Drive Reserve Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. (2011). *Kholo Enviroplan Reserve (Camerons Scrub Reserve) Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. *Purga Nature Reserve Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. (2010). *Ric Nattrass Environmental Park Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. (2010). *Stirling Road Reserve Fire Management Plan*, Prepared by Succession Planning for Ipswich City Council

McAlister, B. *White Rock – Spring Mountain Conservation Estate Fire Management Plan,* Prepared by Succession Planning for Ipswich City Council

McArthur, A. G. (1967). *Fire behaviour in eucalypt forests*. Leaflet No. 107., Comm. of Australia For. & Timber Bureau

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

Nature Conservation Act 1992 (QLD)

Queensland Fire and Rescue (2008). *Foundations of the Queensland Fire and Rescue Service*. Report prepared QFRS, Kedron Queensland.

Queensland Treasury (2015) Queensland Government Population Pojections, 2015. Queensland Government Statisticians Office, Queensland Treasury, Brisbane

SEQ Fire and Biodiversity Consortium (2001). *The role and use of fire for biodiversity conservation in south-east Queensland: Fire management guidelines derived from ecological research*. Prepared by the SEQ Fire and Biodiversity Consortium, Brisbane.

Standards Australia (2009). *Construction of buildings in bushfire-prone areas (AS 3959:2009)*

Standards Australia (2009). *Risk management: Principles and guidelines (AS/NZS ISO 31000:2009)*

Tolhurst, K and Cheney, N P (1999) *A Synopsis of the knowledge used in prescribed burning in Victoria,* Department of Natural Resources and the Environment, Victoria

Tolhurst, K, Shields, B and Chong, D (2008) 'Phoenix: development and application of a bushfire risk management tool', *The Australian Journal of Emergency Management*, 23(4), 47-54

2009 Victorian Bushfires Royal Commission & Teague, Bernard (2010) 2009 Victorian Bushfires Royal Commission : final report 2009 Victorian Bushfires Royal Commission, http://www.royalcommission.vic.gov.au/Commission-Reports

West Moreton Fire Management Group 2016. *Operation cool burn 2016 Bushfire Risk Mitigation Plan; First Draft.* Prepared for Ipswich City Council.

Appendices

Appendix A – A1 Map Based Risk Dashboard Sub-Plans

- Denmark Hill Conservation Reserve
- Haig Street Quarry Conservation Reserve
- Hillview Drive Reserve
- Ric Nattrass Environmental Park
- Purga Nature Reserve
- Cameron's Scrub Conservation Estate (Kholo Enviroplan Reserve)
- Stirling Road Reserve
- White Rock –Spring Mountain Conservation Estate
- Flinders-Goolman Conservation Estate
- Mt Grandchester Conservation Estate

Attachment 1: Denmark Hill Conservation Reserve
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Bushfire Vulnerability Factor	Column
Ecological Asset Bushfire Sensitivity Risk	A
Ecological Health Risk	B
Fire Severity Risk	C
Bushfire Attack Level Risk	D
Access Risk	E
Housing Stock Risk	F
Fire Vulnerable and Smoke Sensitive Asset Risk	G
Landscape Vegetation Cover Risk	H
Fire Suppression Risk	I

Risk Summary

Historically, Denmark Hill Conservation Reserve (12 ha) was extensively cleared and mined for coal. Exposed coal is present in the reserve, any fire which starts would be difficult to extinguish. Ipswich General Hospital is north east of the reserve, therefore all blocks receive a *Very High* fire vulnerable and smoke sensitive asset risk rating. A school lies to the west of the reserve and houses surround the reserve, a number would be vulnerable to direct flame or radiant heat, ember attack and smoke impacts. Water storage facilities and communications tower are contained within the northern section of the reserve, also vulnerable to heat, ember and smoke impacts from a fire in the reserve.

The reserve is surrounded by housing, a small patch of unmanaged vegetation to the south. Fire is to be excluded from the reserve. Risks can only be reduced after property owners and fire emergency services undertake mitigation actions.

The main factors driving bushfire risk at Denmark Hill Conservation Reserve are:
- **Fire Sensitive Asset risk** (proximity to Ipswich General Hospital and the School drives this risk);
- **Housing Stock and Bushfire Attack Level risks** (houses are pre-2010 and built up tot eh boundary of the reserve); and
- **Fire severity risk** (All blocks are rated as *High*).

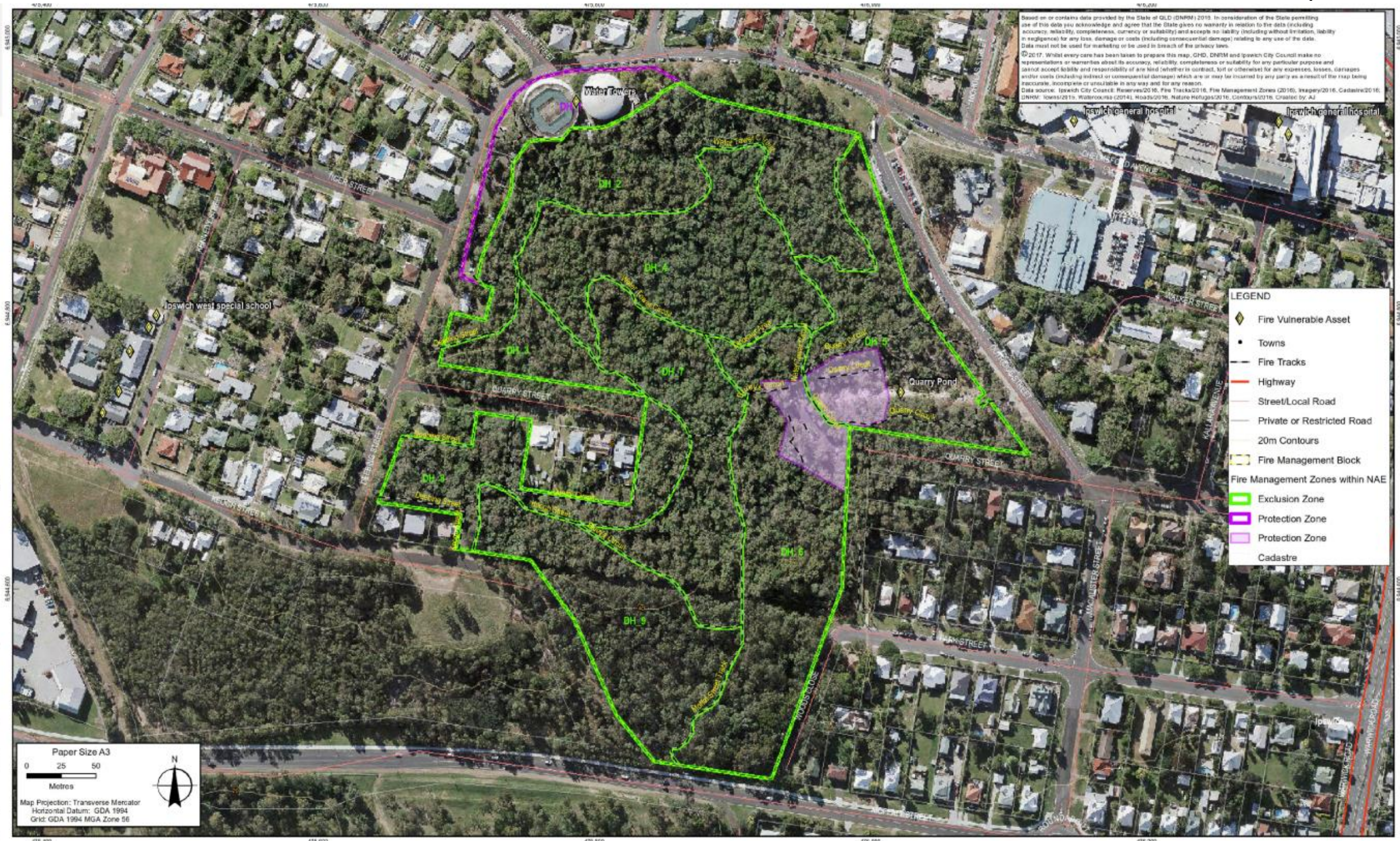
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
Denmark Hill Conservation Reserve DH_1	0.63	*Low*	*Moderate*	*High*	*Very High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	20	DH_1 is bounded by firetrails and public roads. It contains water storage facilities and communications tower and carpark. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the assets and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_2	1.9	*Low*	*Moderate*	*High*	*Very High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	20	DH_2 is bounded by firetrails. It is adjacent to the water storage facilities and communications tower, residences lie west of the block. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the assets and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_3	0.44	*Low*	*Moderate*	*High*	*High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	19	DH_3 is bounded by firetrails and a public road. Residences lie south of the block. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may generate smoke impacts on the residences and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_4	1.8	*Low*	*Moderate*	*High*	*Moderate*	*Moderate*	*High*	*Very High*	*Low*	*Low*	18	DH_4 is bounded by firetrails. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may smoke impacts on the hospital and surounding residential buildings.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_5	1.47	*Low*	*Moderate*	*High*	*Moderate*	*Moderate*	*High*	*Very High*	*Low*	*Low*	18	DH_5 is bounded by firetrails and a public road. It contains walking tracks. Ipswich general hospital sits north east of the reserve. The reserve may support a short lived fire run which may smoke impacts on the hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_6	2.2	*Low*	*Moderate*	*High*	*High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	19	DH_6 is bounded by firetrails and public roads. Residential buildings lie east of the block. Ipswich general hospital sits north east of the reserve. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the residences and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_7	1.42	*Low*	*Moderate*	*High*	*Moderate*	*Moderate*	*High*	*Very High*	*Low*	*Low*	18	DH_7 is bounded by firetrails. Residences lie west of the block. Ipswich general hospital sits north east of the reserve. The reserve may support a short lived fire run which may generate smoke impacts on the residences and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_8	0.93	*Low*	*Moderate*	*High*	*Very High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	20	DH_8 is bounded by firetrails and public roads. Residential buildings lie north and south of the block. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the residences and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Denmark Hill Conservation Reserve DH_9	1.5	*Low*	*Moderate*	*High*	*High*	*Moderate*	*High*	*Very High*	*Low*	*Low*	19	DH_9 is bounded by firetrails and public roads. Residential buildings bound the north west boundary. Ipswich general hospital sits north east of the reserve and a school lies to the west. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the residences and hospital.	*High [intolerable]*	PZ, FT, PR, CR, VR, CF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*

Item 1 / Attachment 2.

Attachment 2: Haig Street Quarry Bushland Reserve Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/ facility areas.

Bushfire Vulnerability Factor	Column
Ecological Asset Bushfire Sensitivity Risk	A
Ecological Health Risk	B
Fire Severity Risk	C
Bushfire Attack Level Risk	D
Access Risk	E
Housing Stock Risk	F
Fire Vulnerable and Smoke Sensitive Asset Risk	G
Landscape Vegetation Cover Risk	H
Fire Suppression Risk	I

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Risk Summary

Brassall Retirement Village is east of Haig Street Quarry Bushland Reserve. Residential buildings bound the north and east with rural residential blocks on the western and southern boundaries. A water tank and telecommunications tower are located within the reserve. The dwellings and facilities are vulnerable to bushfire impacts (radiant heat, ember attack, smoke impact). The 23 hectare reserve contains a Picnic area and some walking tracks. A sealed road runs to the Quarry Pond.

The reserve is surrounded by residential housing and rural-residential blocks. Though it is unlikely that a fire will start within Haig Street Quarry Bushland Reserve, the reserve is capable of supporting a small fire run and susceptible to fires burning into the reserve from adjoining areas to the west.

The main factors driving bushfire risk at Haig Street Quarry Bushland Reserve are:
- **Fire Vulnerable and Smoke Sensitive Asset risks** (Brassall Retirement Village is in close proximity and other facilities are located within the reserve);
- **Bushfire Attack Level and Housing Stock risk** (pre-2010 housing is located within 50m of the reserve and vulnerable to bushfire impacts); and
- **Ecological Health risk** (all blocks are rated as *High*).

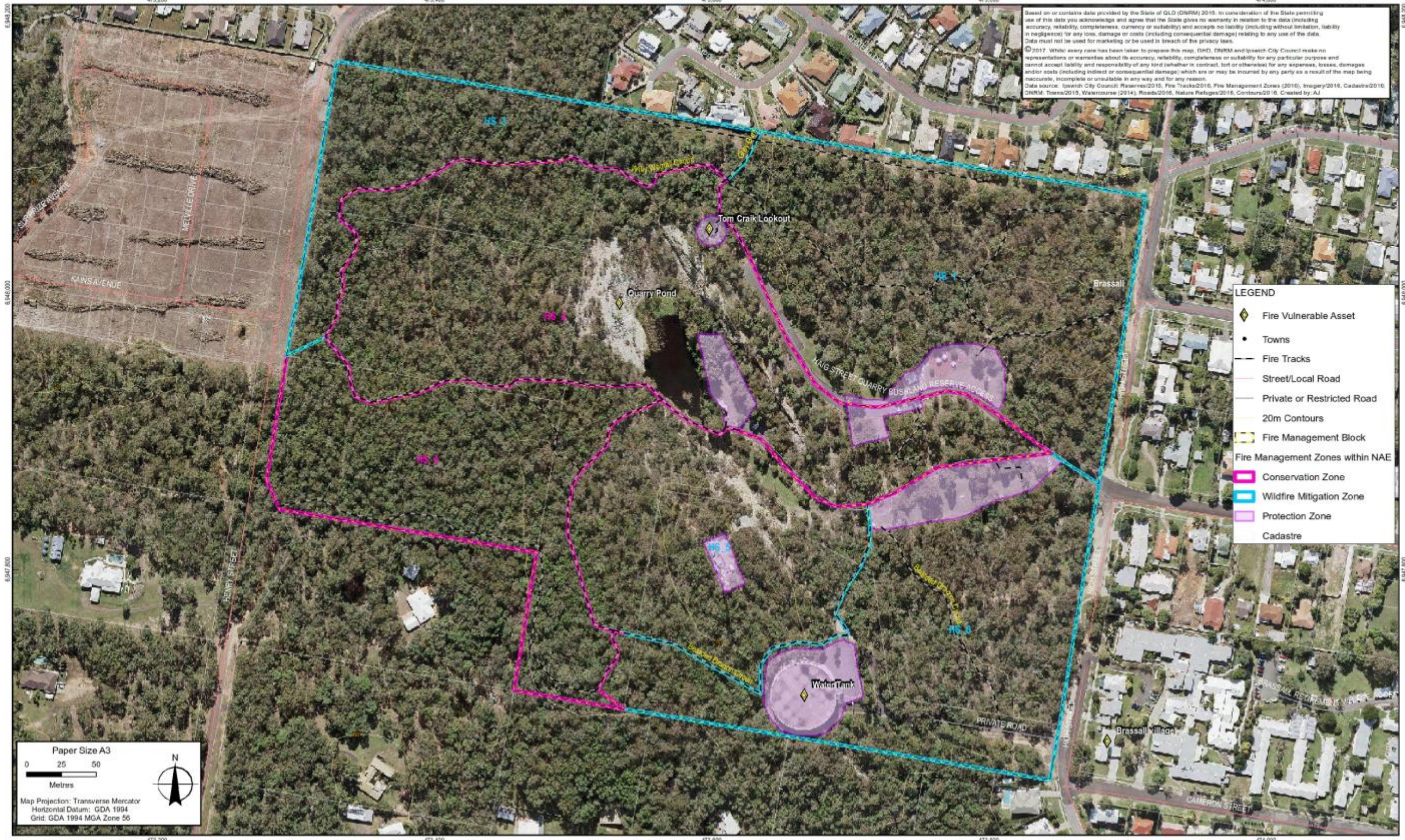
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
Haig Street Quarry HS_1	4.85	Low	High	High	Very High	High	High	Very High	Low	Low	22	This block is bounded to the North and East by public roads and residential buildings. Grey Gum Picnic Area and gardens are contained within the block along with walking tracks. There is some sensitive riparian vegetation along the creek line. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	High [intolerable]	PZ, FT, PR, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Haig Street Quarry HS_2	5.98	Low	High	High	High	High	High	High	Low	Low	20	Block 2 is located west of the Quarry Pond bound by the Willy Wagtail Circuit and the rocky area along the high bank of the Quarry Pond. This block contains walking tracks. The reserve may support a short lived fire run; smoke may impact on the nearby residences.	Medium [tolerable]	PZ, FT, PR, PB, CR, VR	Medium [tolerable]	RA, BSP, PZ, CE	Low [acceptable]
Haig Street Quarry HS_3	2.06	Low	High	High	Very High	High	High	High	Low	Low	21	Residential housing is located to the North and West of this block. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	High [intolerable]	PZ, FT, PR, PB, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Haig Street Quarry HS_4	3.16	Low	High	High	High	High	High	Very High	Moderate	Low	22	This block contains a number of fire trails. There is a rural resdiential building within 50 m of the FMB. A telecommunication tower and water storage facilities are located east of the block. Any short lived fire run may impact this residence through radiant heat and smoke impacts.	High [intolerable]	PZ, FT, PR, PB, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Haig Street Quarry HS_5	2.93	Low	High	Moderate	Moderate	High	High	Very High	Low	Low	19	A telecommunication tower is located within this block and water storage facilities are located to the south. These facilities could be impacted from any short lived fire run. A retirement village located on High Street to the East could be impacted by smoke.	High [intolerable]	PZ, FT, PR, CR, VR	Medium [tolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Haig Street Quarry HS_6	4.33	Low	High	High	Very High	High	High	Very High	Low	Low	22	Block 6 contains water storage facilties and is directly adjacent to Brassall Village Retirement Living. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	High [intolerable]	PZ, FT, PR, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]

Attachment 3: Hillview Drive Reserve
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

	Bushfire Vulnerability Factor	Column
	Ecological Asset Bushfire Sensitivity Risk	A
	Ecological Health Risk	B
	Fire Severity Risk	C
	Bushfire Attack Level Risk	D
	Access Risk	E
	Housing Stock Risk	F
	Fire Vulnerable and Smoke Sensitive Asset Risk	G
	Landscape Vegetation Cover Risk	H
	Fire Suppression Risk	I

Risk Summary

Hillview Drive Reserve (37 ha) contains some fire intolerant vegetation. A fire trail runs through the reserve and public roads bound the reserve. A number of rural residential dwellings surround the reserve, mostly to the south. Bushfire intensity mapping shows the reserve and surrounding area as *Medium* to *High* potential. The residences are vulnerable to bushfire impacts (radiant heat, ember attack, smoke impact).

The reserve is surrounded by rural-residential blocks, some of which are no longer actively cleared or managed to reduce fuel loads. Though it is unlikely that a fire will start within Hillview Drive Reserve, the reserve is capable of supporting a fire run and susceptible to fires burning into the reserve from adjoining areas.

The main factors driving bushfire risk at Hillview Drive Reserve are:
- **Ecological health risks** (both blocks are rated as *High*);
- **Access risk** (some residences have limited escape options); and
- **Housing Stock risk** (the houses are pre-2010 standard).

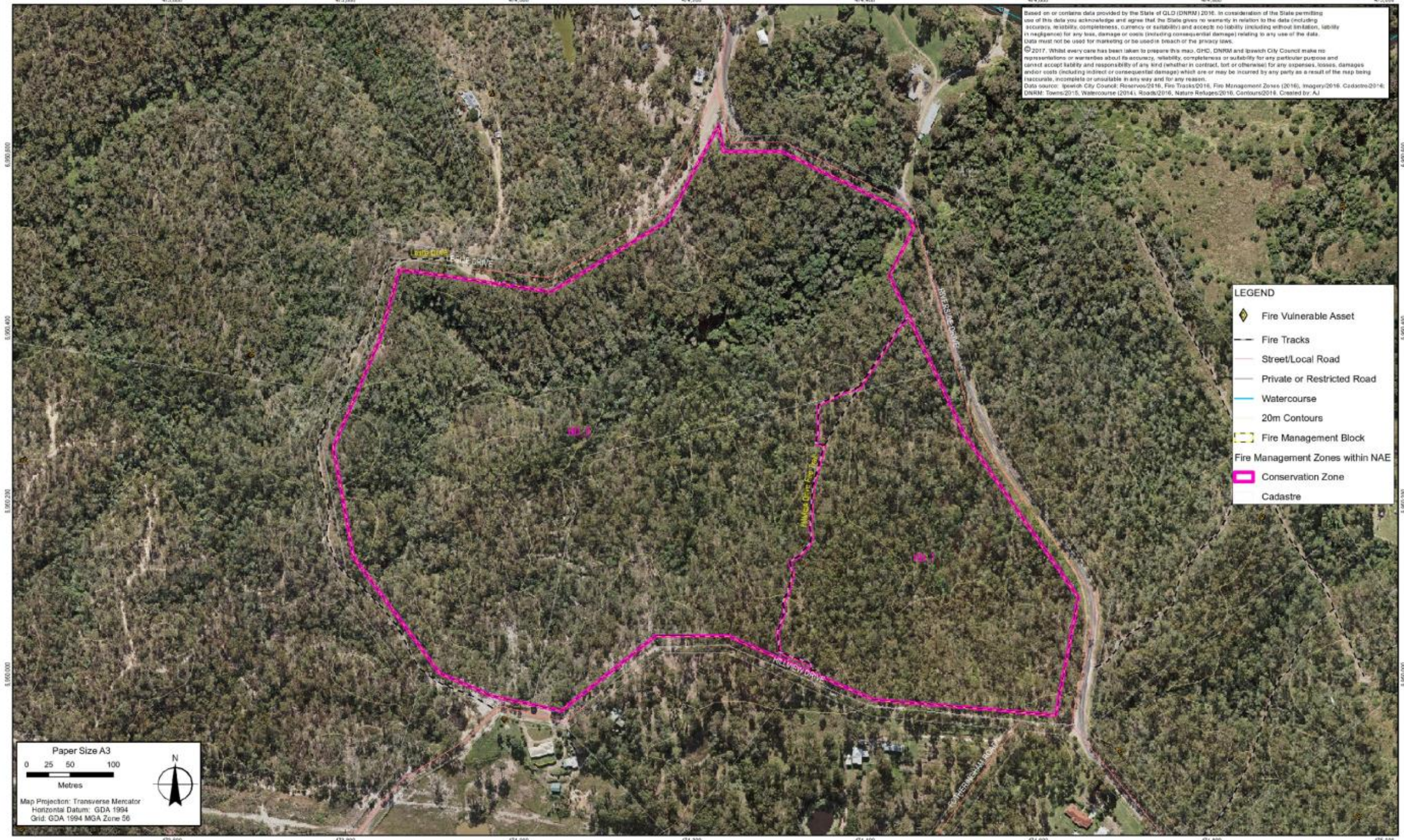
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	*Unmitigated risk*	ICC Mitigation Strategy	*Residual Risk after ICC actions*	Property owner and Fire Emergency Service Actions	*Residual Risk after shared responsibility actions*
Hillview Drive Reserve HD_1	9.67	*Moderate*	*High*	*High*	*Moderate*	*High*	*High*	*Low*	*High*	*Moderate*	21	This block is bounded to the west by Riverside Drive (public road). Rural-residential blocks lie South of the block. A fire trail divides the two FMB's north to south. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	*Medium [tolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
Hillview Drive Reserve HD_2	27.63	*High*	*High*	*Moderate*	*High*	*High*	*High*	*Low*	*High*	*Moderate*	22	This block is bounded by public roads and firetrail. Rural-residential blocks lie north and south of the block. A fire trail divides the two FMB's north to south. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	*Medium [tolerable]*	FT, PR, PB, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*

Attachment 4: Ric Nattrass Environmental Park
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

	Bushfire Vulnerability Factor	Column
	Ecological Asset Bushfire Sensitivity Risk	A
	Ecological Health Risk	B
	Fire Severity Risk	C
	Bushfire Attack Level Risk	D
	Access Risk	E
	Housing Stock Risk	F
	Fire Vulnerable and Smoke Sensitive Asset Risk	G
	Landscape Vegetation Cover Risk	H
	Fire Suppression Risk	I

Risk Summary

Ric Nattrass Environmental Park is a 13.7 hectare reserve bounded to the south by a transmission line and to the north by residential houses to the north. Houses directly abut the reserve in the north east corner. A water storage facility, communications tower and associated infrastructure are located in the north west corner of the reserve. These dwellings and structures are vulnerable to bushfire impacts (radiant heat, ember attack, smoke impact). Bertha Street runs down the western boundary. A number of walking tracks are located within the reserve.

The reserve is surrounded by rural-residential blocks, some of which are not managed to reduce fuel loads. The area immediately west of the reserve is dominated by *High* Bushfire Intensity vegetation. Areas to the south contain vegetation connecting to larger vegetation reserves near Springfield; therefore the reserve is capable of supporting a fire run and susceptible to fires burning into the reserve from adjoining areas.

The main factors driving bushfire risk at Ric Nattrass Environmental Park are:
- **Fire Vulnerable and Smoke Sensitive Asset risks** (the proximity of the housing and facilities within the reserve);
- **Access risk** (fire trails are the only access throughout most of the reserve though public roads bound the northern and western boundaries); and
- **Ecological Health risk** (all blocks are rated as *High*).

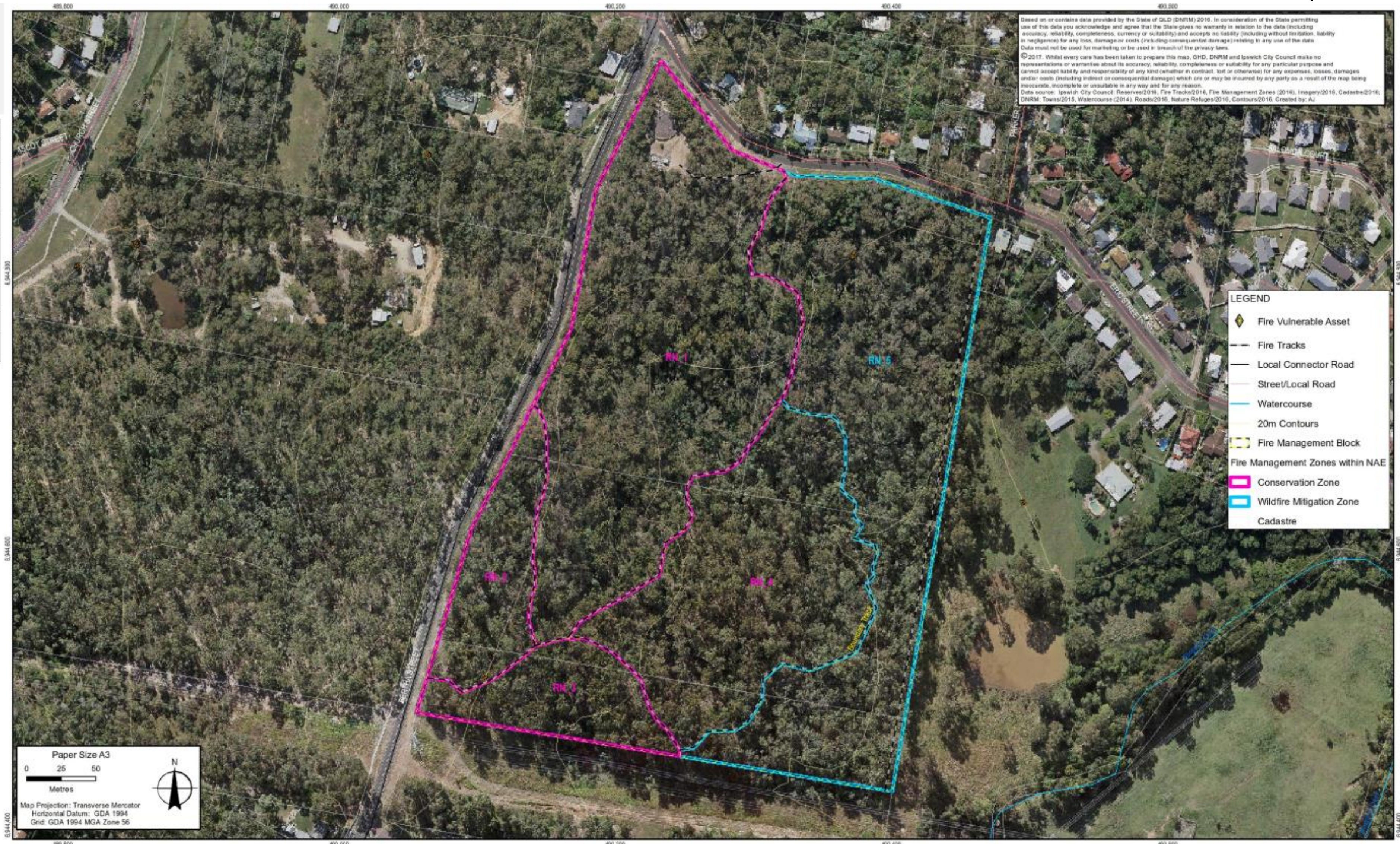
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	*Unmitigated risk*	ICC Mitigation Strategy	*Residual Risk after ICC actions*	Property owner and Fire Emergency Service Actions	*Residual Risk after shared responsibility actions*
Ric Nattrass Environmental Park RN_1	4.71	*Low*	*High*	*High*	*Very high*	*High*	*High*	*Very High*	*Moderate*	*Moderate*	24	RN_1 contains a water storage facility and communications tower and associated infrastructure. A Service Track and walking tracks are also contained within the block. This block has a steep slope running up to residential houses on Eric Street. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	*High [intolerable]*	PZ, FT, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Ric Nattrass Environmental Park RN_2	0.91	*Low*	*High*	*Moderate*	*Low*	*High*	*N/A*	*High*	*Moderate*	*Low*	16	Bertha Street bounds this block to the West beyond which is mostly uncleared vegetation which may support a fire run into the reserve. A transmission line runs south of the block. The reserve may support a short lived fire run which may generate smoke impact on the surrounding residences.	*Medium [tolerable]*	PZ, PR, PB, CR, VR	*Medium [tolerable]*	BSP, PZ, CE	*Medium [tolerable]*
Ric Nattrass Environmental Park RN_3	0.86	*Low*	*High*	*Very High*	*Moderate*	*High*	*Low*	*High*	*Moderate*	*Low*	20	A transmission line runs parralel to the southern boundary beyond which are residential buildings. The reserve may support a short lived fire run which may generate smoke impact on the transmission line and residences.	*Medium [tolerable]*	PZ, PR, PB, CR, VR	*Medium [tolerable]*	RA, BSP, PZ, CE, TL	*Medium [tolerable]*
Ric Nattrass Environmental Park RN_4	2.89	*Low*	*High*	*High*	*Moderate*	*Very high*	*Low*	*High*	*Moderate*	*Low*	20	RN_4 is bounded by walking tracks. The transmission line runs to the south of the block. The reserve may support a short lived fire run which may generate smoke impact on the transmission line and residences.	*Medium [tolerable]*	PZ, PR, PB, CR, VR	*Medium [tolerable]*	RA, BSP, PZ, CE, TL	*Medium [tolerable]*
Ric Nattrass Environmental Park RN_5	4.33	*Low*	*High*	*High*	*Very high*	*High*	*High*	*High*	*Moderate*	*Low*	22	This block's western boundary is a walking track which runs north to south through the reserve. A transmission line runs south of the block, Woogaroo Creek lies to the east (outside of the reserve). Residences directly abut the reserve in the North East corner. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences.	*High [intolerable]*	PZ, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE, TL	*Medium [tolerable]*

Attachment 5: Purga Nature Reserve
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Bushfire Vulnerability Factor	Column
Ecological Asset Bushfire Sensitivity Risk	A
Ecological Health Risk	B
Fire Severity Risk	C
Bushfire Attack Level Risk	D
Access Risk	E
Housing Stock Risk	F
Fire Vulnerable and Smoke Sensitive Asset Risk	G
Landscape Vegetation Cover Risk	H
Fire Suppression Risk	I

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Risk Summary

Purga Nature Reserve (138 ha) contains 23.3 hectares of critically endangered Swamp Tea-tree. This area of the reserve also contains a public access road, carpark, visitors centre and education boardwalk. There are three residences in close proximity to the reserve which (along with the visitors centre) are vulnerable to bushfire impacts (radiant heat, ember attack, smoke impact). The remaining reserve area contains Greenfleet plantings (planted 2008) which need to be managed to exclude fire until the plantings are of sufficient growth to withstand fire.

The reserve is surrounded by rural-residential blocks, some of which are no longer actively cleared or managed to reduce fuel loads. Though it is unlikely that a fire will start within Purga Nature Reserve, the reserve is capable of supporting a fire run and susceptible to fires burning into the reserve from adjoining areas.

The main factors driving bushfire risk at Purga Nature Reserve are:
- **Ecological asset and Health risks** (the swamp tea-tree could benefit from a low intensity patchy burn);
- **Access risk** (single access to reserve to the west; fire trails are the only access throughout most of the reserve); and
- **Fire Sensitive Asset risk** (the visitor centre and facilities, and third-party environmental plantings, drives this risk).

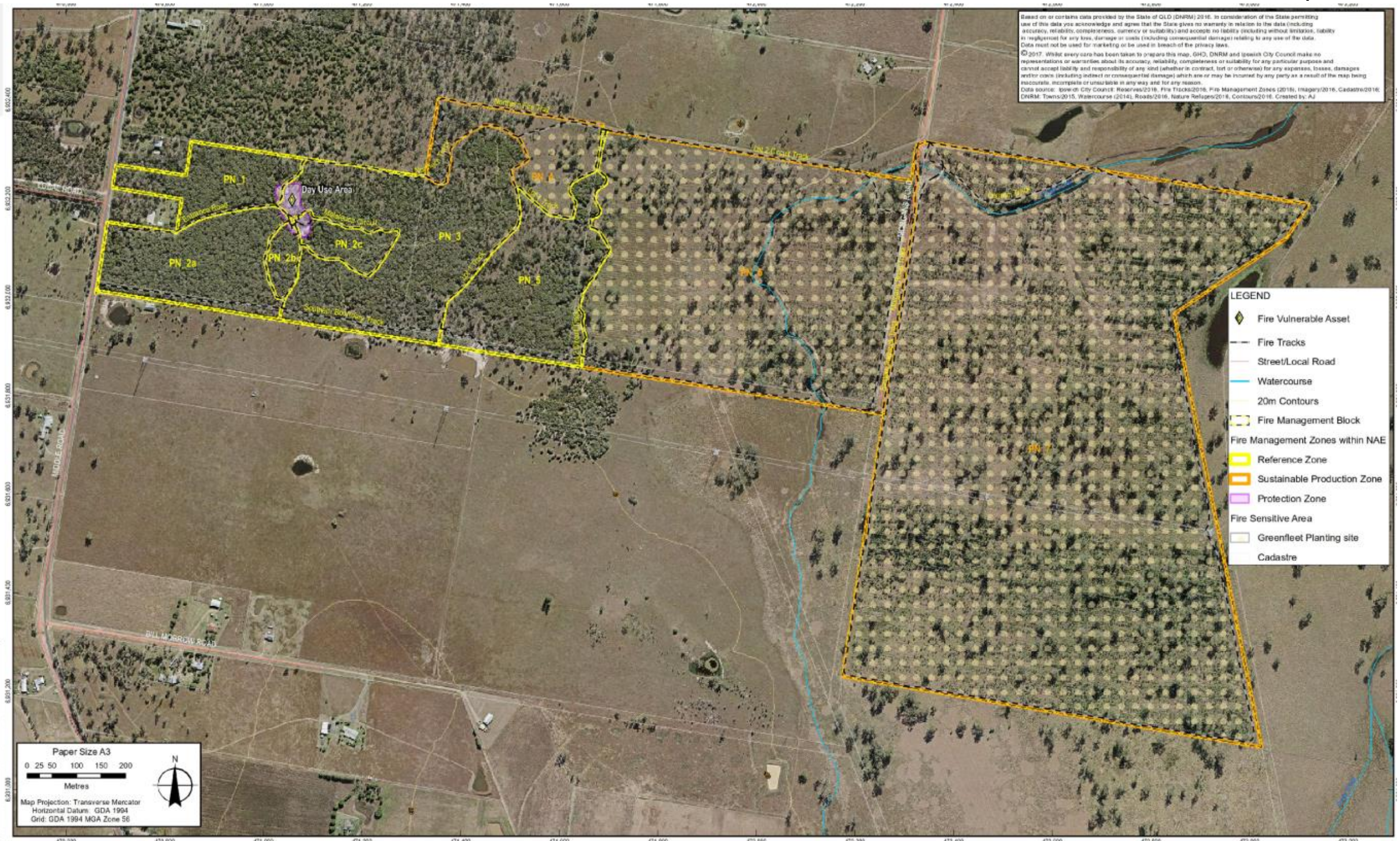
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
Purga Nature Reserve PN_1	3.49	Very high	Very high	Moderate	Very high	High	High	Very High	Moderate	Low	26	PN_1 contains critically endangered Swamp Tea-tree and is separated from Block 2 and 2a by fire trail/public access road. It is adjacent to two residential properties, car park and visitor centre facilities. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residences and ecologically sensitive vegetation.	High [intolerable]	PZ, FT, PR, PB, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Purga Nature Reserve PN_2a	6.1	Very high	Very high	Moderate	Very high	High	High	Very High	Moderate	Low	26	PN_2a contains critically endangered Swamp Tea-tree. The northern boundary is formed by a public road and the southern boundary is formed by a Fire Trail. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the two adjoining residences (located north and south of the block) and the ecologically sensitive vegetation.	High [intolerable]	PZ, FT, PR, PB, CR, VR	High [intolerable]	RA, BSP, PZ, CE	Medium [tolerable]
Purga Nature Reserve PN_2b	0.81	Very high	Very high	Moderate	Moderate	High	High	Very High	Moderate	Low	24	PN_2b contains critically endangered Swamp Tea-tree. An educational boardwalk bounds the block. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the visitor centre and facilities and may damage the boardwalk and ecologically sensitive vegetation.	High [intolerable]	PZ, FT, PB, CR, VR	Medium [tolerable]	BSP, PZ, CE	Low [acceptable]
Purga Nature Reserve PN_2c	1.44	Very high	Very high	Moderate	Moderate	High	High	Very High	Moderate	Low	24	PN_2c contains critically endangered Swamp Tea-tree. An educational boardwalk bounds the reserve. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the visitor centre and facilities and may damage the boardwalk and ecologically sensitive vegetation.	High [intolerable]	PZ, FT, PB, CR, VR	Medium [tolerable]	BSP, PZ, CE	Low [acceptable]
Purga Nature Reserve PN_3	12.87	Very high	Very high	Moderate	Very high	High	High	Very High	Moderate	Low	26	PN_3 contains critically endangered Swamp Tea-tree. The eastern boundary is formed by an access track which runs north south roughly along the ecotone between the Swamp Tea-tree and the grassy eucalypt community. The visitor centre and facilities are contained within this block. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on visitor centre and ecologically sensitive vegetation.	High [intolerable]	PZ, FT, PB, CR, VR	Medium [tolerable]	BSP, PZ, CE	Low [acceptable]
Purga Nature Reserve PN_4	3.96	High	High	Moderate	Low	Very high	N/A	Very High	Moderate	Low	20	PN_4 is located west of Purga Creek and contains part of the Greenfleet plantings. The northern boundary contains a private road which is accessible from Morgans Road. The surrounding vegetation a mix of Swamp tea-tree and open woodland which could support a fire run and impact on the Plantings.	High [intolerable]	FT, PB, CR, EF	Medium [tolerable]	BSP, PZ, CE, PO	Low [acceptable]
Purga Nature Reserve PN_5	7.69	Very high	Very high	Moderate	N/A	Very high	N/A	Very High	Moderate	Low	21	PN_5 is located west of Purga Creek and contains Swamp Teatree. The northern and eastern boundaries adjoin the Greenfleet planting. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the Plantings	High [intolerable]	FT, CR, EF	Medium [tolerable]	BSP, PZ, CE	Low [acceptable]
Purga Nature Reserve PN_6	30.32	High	High	Moderate	Low	High	N/A	Very High	Moderate	Low	19	PN_6 is part of the Greenfleet plantations (planted 2008) which could support a fire run. Ephemeral and permanent waterholes of Purga Creek dominate the landform. Transmission lines run along the Northern border. The reserve may support a short lived fire run which may generate radiant heat and smoke impacts on the Plantings and Transmission Line.	High [intolerable]	FT, CR, EF	Medium [tolerable]	BSP, PZ, CE, PO, TL	Low [acceptable]
Purga Nature Reserve PN_7	77.31	High	High	Moderate	Low	High	N/A	Very High	Moderate	Low	19	PN_7 contains Greenfleet plantings (planted 2008) with Purga Creek traversing the northern section of the block which limits access. A powerline easement runs along the southern border. Wetlands adjoin part of the northern and eastern boundaries. The block could support a fire run and impact the Plantings, Tranmission Line and wetlands.	High [intolerable]	FT, CR, EF	Medium [tolerable]	BSP, PZ, CE, PO, TL	Low [acceptable]

Attachment 6: Kholo Enviroplan Reserve
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Bushfire Vulnerability Factor	Column
Ecological Asset Bushfire Sensitivity Risk	A
Ecological Health Risk	B
Fire Severity Risk	C
Bushfire Attack Level Risk	D
Access Risk	E
Housing Stock Risk	F
Fire Vulnerable and Smoke Sensitive Asset Risk	G
Landscape Vegetation Cover Risk	H
Fire Suppression Risk	I

Risk Summary

Sapling Pocket Nature Refuge lies north west of Kholo Enviroplan Reserve. A vacant house is contained within the reserve and a number of rural residential dwellings south of the reserve. These may be impacted by radiant heat and smoke impacts from a bushfire. The surrounding area is mostly cleared with small patches of retained vegetation. The reserve contains some fire sensitive vine forest.

Though it is unlikely that a fire will start within Kholo Enviroplan Reserve, the reserve is capable of supporting a fire run and susceptible to fires burning into the reserve from adjoining areas or adjacent Nature Refuge. Risks to rural residential dwellings can be lowered by mitigation actions implemented by property owners.

The main factors driving bushfire risk at Kholo Enviroplan Reserve are:
- **Ecological asset and Health risks** (Sapling Pocket Nature Reserve and the fire sensitive vine forest);
- **Access risk** (fire trails are the only access throughout most of the reserve and there are few public roads in the area); and
- **Housing Stock and Bushfire Attack Level risk** (distance to pre-2010 dwellings drives this risk).

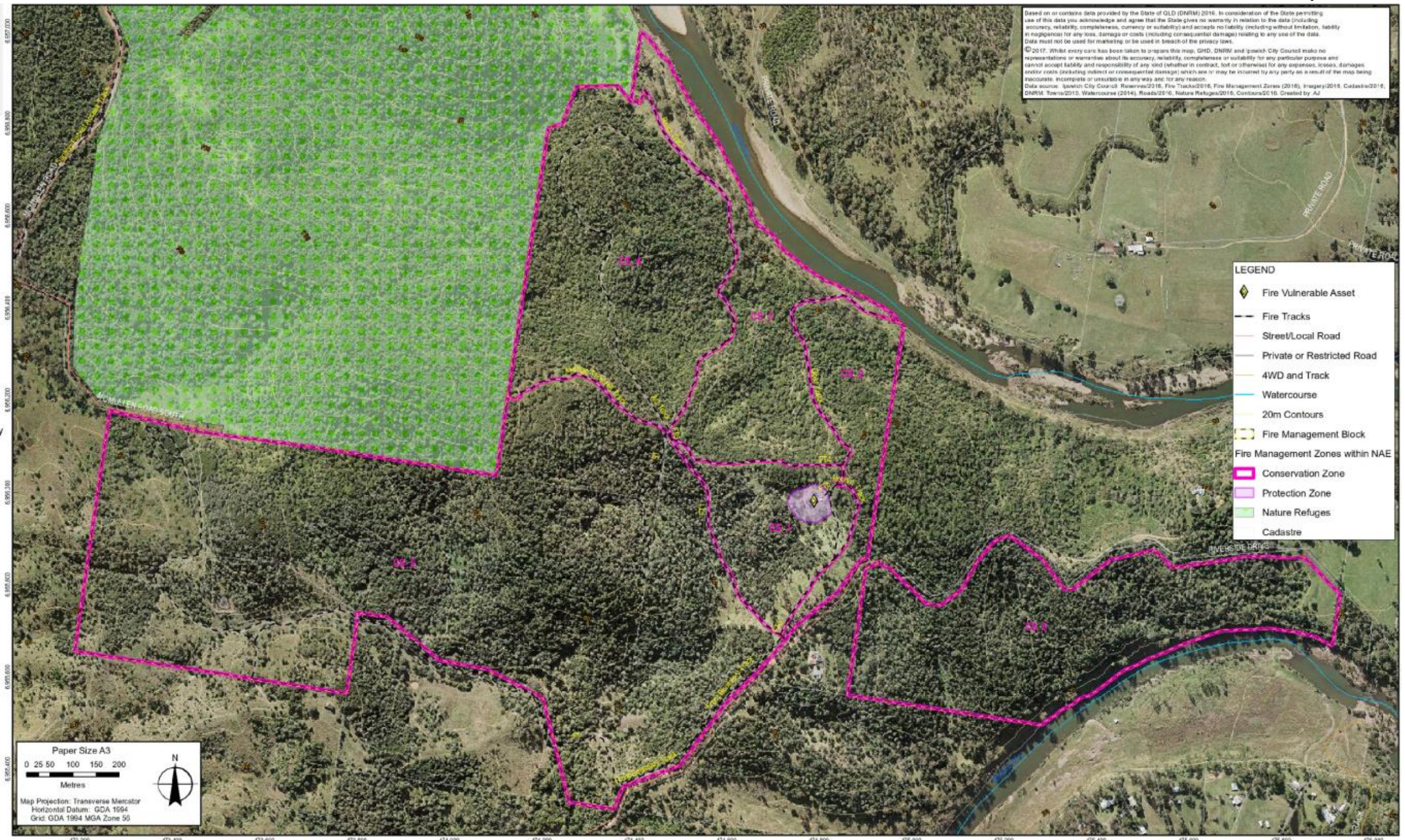
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	*Unmitigated risk*	ICC Mitigation Strategy	*Residual Risk after ICC actions*	Property owner and Fire Emergency Service Actions	*Residual Risk after shared responsibility actions*
Kholo Enviroplan Reserve CS_1	8.56	*Very high*	*High*	*Moderate*	*Very high*	*High*	*High*	*Low*	*Moderate*	*Moderate*	23	CS_1 is bounded by fire trails. A vacant house is contained within the block. A second rural residental dwelling is located south of the block. CS_1 contains fire sensitive vine forest. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the residence.	*High [intolerable]*	FT, PR, PB, VR, CR, EF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Kholo Enviroplan Reserve CS_2	7.77	*Very high*	*High*	*Moderate*	*Moderate*	*High*	*High*	*Low*	*Moderate*	*Moderate*	21	CS_2 is bounded by fire trails. A public road (Riverside Drive) runs along the south-east boundary. A rural residental dwelling is located south of the block. CS_2 contains fire sensitive vine forest and riparian vegetation. The reserve may support a short lived fire run which may generate smoke impacts on the residence.	*Medium [tolerable]*	FT, PR, PB, VR, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
Kholo Enviroplan Reserve CS_3	14.64	*Very high*	*High*	*Moderate*	*Moderate*	*High*	*High*	*Low*	*Moderate*	*Moderate*	21	CS_3 is bounded by fire trails. The Brisbane River runs along the north east boundary. A rural residental dwelling is located south of the block. CS_3 contains fire sensitive vine forest and riparian vegetation. The reserve may support a short lived fire run which may generate smoke impacts on the residence.	*Medium [tolerable]*	FT, PB, VR, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
Kholo Enviroplan Reserve CS_4	25.21	*Very high*	*High*	*High*	*Low*	*High*	*N/A*	*Low*	*High*	*Moderate*	20	CS_4 is bounded by fire trails. The Brisbane River runs north east of the block. CS_3 contains fire sensitive vine forest and the western boundary borders the Sapling Pocket Nature Reserve. The block may support a short lived fire run which may affect other blocks within the reserve.	*Medium [tolerable]*	FT, PB, VR, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
Kholo Enviroplan Reserve CS_5	78.97	*Very high*	*High*	*Low*	*Very high*	*High*	*High*	*Low*	*Moderate*	*Moderate*	22	CS_5 is bounded by fire trails and a public road on the north west and south east boundaries. Two residences are located south and south east of the block. CS_5 contains fire sensitive vine forest and part of the northern boundary borders the Sapling Pocket Nature Reserve. The reserve may support a short lived fire run which may generate smoke impacts on the residences.	*High [intolerable]*	FT, PR, PB, VR, CR, EF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
Kholo Enviroplan Reserve CS_6	24.89	*Very high*	*High*	*Low*	*Moderate*	*High*	*High*	*Low*	*Moderate*	*Moderate*	20	CS_6 is bounded by fire trails and a public road on the northern boundary. Rural-residential buildings are located around the block. CS_6 contains fire sensitive vine forest. The reserve may support a short lived fire run which may generate smoke impacts on the residences.	*Medium [tolerable]*	FT, PR, PB, VR, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*

Attachment 7: Stirling Road Reserve
Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

	Bushfire Vulnerability Factor	Column
	Ecological Asset Bushfire Sensitivity Risk	A
	Ecological Health Risk	B
	Fire Severity Risk	C
	Bushfire Attack Level Risk	D
	Access Risk	E
	Housing Stock Risk	F
	Fire Vulnerable and Smoke Sensitive Asset Risk	G
	Landscape Vegetation Cover Risk	H
	Fire Suppression Risk	I

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Risk Summary

Stirling Road Reserve (33 ha) contains some regenerating vine forest in the north of the reserve. This is a *Very High* ecological asset risk. Two rural residential dwellings sit to the east of the reserve in bushland rated as moderate fire severity risk and with limited access. The risk to these residences can only be reduced by actions taken by the property owners. Another rural residential block lies to the west in a relatively cleared area. Stirling Road runs to the south east of the block. It is the only public road access to the reserve.

The reserve is surrounded by rural-residential blocks, some of which are no longer actively cleared or managed to reduce fuel loads. The dwellings are vulnerable to bushfire impacts (radiant heat, ember attack, smoke impact). Though it is unlikely that a fire will start within Stirling Road Reserve, the reserve is capable of supporting a fire run and susceptible to fires burning into the reserve from adjoining areas.

The main factors driving bushfire risk at Stirling Road Reserve are:
- **Access and Fire Suppression Success risks** (single public road access to the reserve to the south east; rural residential blocks with limited access options);
- **Ecological Health risk** (all blocks are rated as *High*); and
- **Housing Stock risk** (all dwellings are pre-2010 buildings).

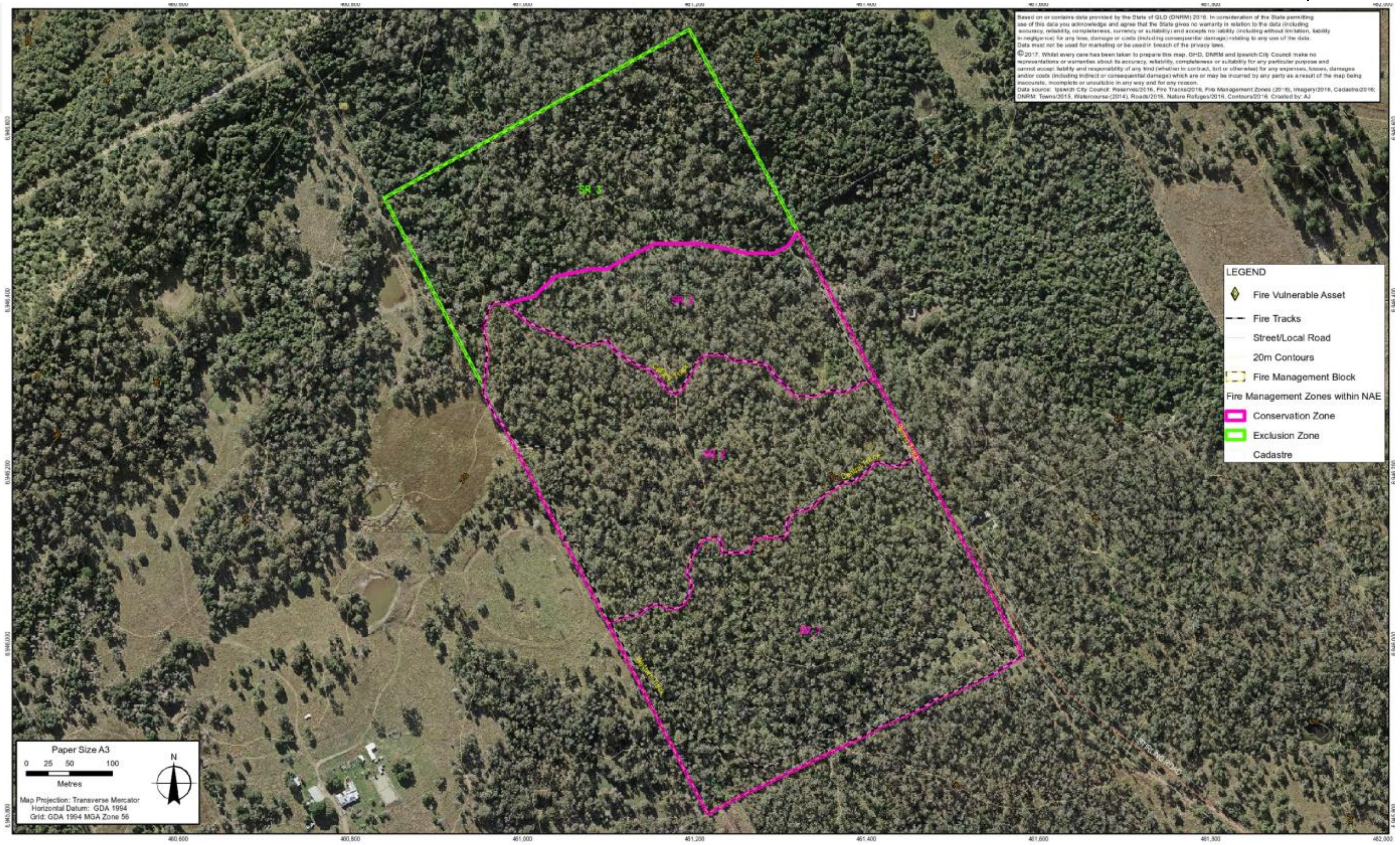
The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

CC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
Stirling Road Reserve SR_1	10.72	*Low*	*High*	*Moderate*	*High*	*Very High*	*High*	*Low*	*Moderate*	*High*	21	This block contains fire trails and a rural residential building sits to the east. The reserve may support a short lived fire run which may generate radiant heat and smoke impact on the adjoining residence.	*Medium [tolerable]*	PZ, FT, PR, PB, CR, VR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
Stirling Road Reserve SR_2	9.51	*Low*	*High*	*Moderate*	*Moderate*	*Very High*	*High*	*Low*	*Moderate*	*High*	20	This block contains fire trails and a rural residential building sits to the east. The reserve may support a short lived fire run which may generate smoke impact on the adjoining residence.	*Medium [tolerable]*	PZ, FT, PR, PB, CR, VR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
Stirling Road Reserve SR_3	13.21	*Very High*	*High*	*Moderate*	*Moderate*	*Very High*	*High*	*Low*	*Moderate*	*High*	23	Regenerating vine forest is present in the north east and north west corners. A rural residential building sits to the east. The reserve may support a short lived fire run which may generate smoke impact on the adjoining residence.	*Medium [tolerable]*	PZ, FT, PR, PB, CR, VR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*

Attachment 8: White Rock – Spring Mountain Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

	Bushfire Vulnerability Factor	Column
	Ecological Asset Bushfire Sensitivity Risk	A
	Ecological Health Risk	B
	Fire Severity Risk	C
	Bushfire Attack Level Risk	D
	Access Risk	E
	Housing Stock Risk	F
	Fire Vulnerable and Smoke Sensitive Asset Risk	G
	Landscape Vegetation Cover Risk	H
	Fire Suppression Risk	I

Risk Summary

A nature refuge lies south west of White Rock – Spring Mountain Reserve and transmission line runs south east through the reserve. Paperbark Flats Picnic Area is located in the north west corner near the Centenary Highway that runs north of the 2992 hectare reserve. The day use and mountain bike areas are in the northern section of the reserve. A number of *Very High* risk blocks (vulnerable to radiant heat, ember attack and smoke impact from bushfires) are adjacent to the new Springfield Lakes estate.

The reserve is mainly surrounded by unmanaged, *Very High* and *High* Potential Bushfire Intensity vegetation. Fires may start in the reserve or run into it from the surrounding area. The reserve is capable of supporting a large scale fire run.

The main factors driving bushfire risk at White Rock – Spring Mountain Reserve are:
- **Fire Severity and Surrounding Landscape Vegetation Cover risks** (most blocks are rated as *High* or *Very High* fire severity and the surrounding area is unmanaged forest);
- **Fire vulnerable and Smoke Sensitive Asset risk** (the Picnic and day-use areas, transmission line and highway all contribute to this risk); and
- **Fire Suppression Success risk** (steep topography).

The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

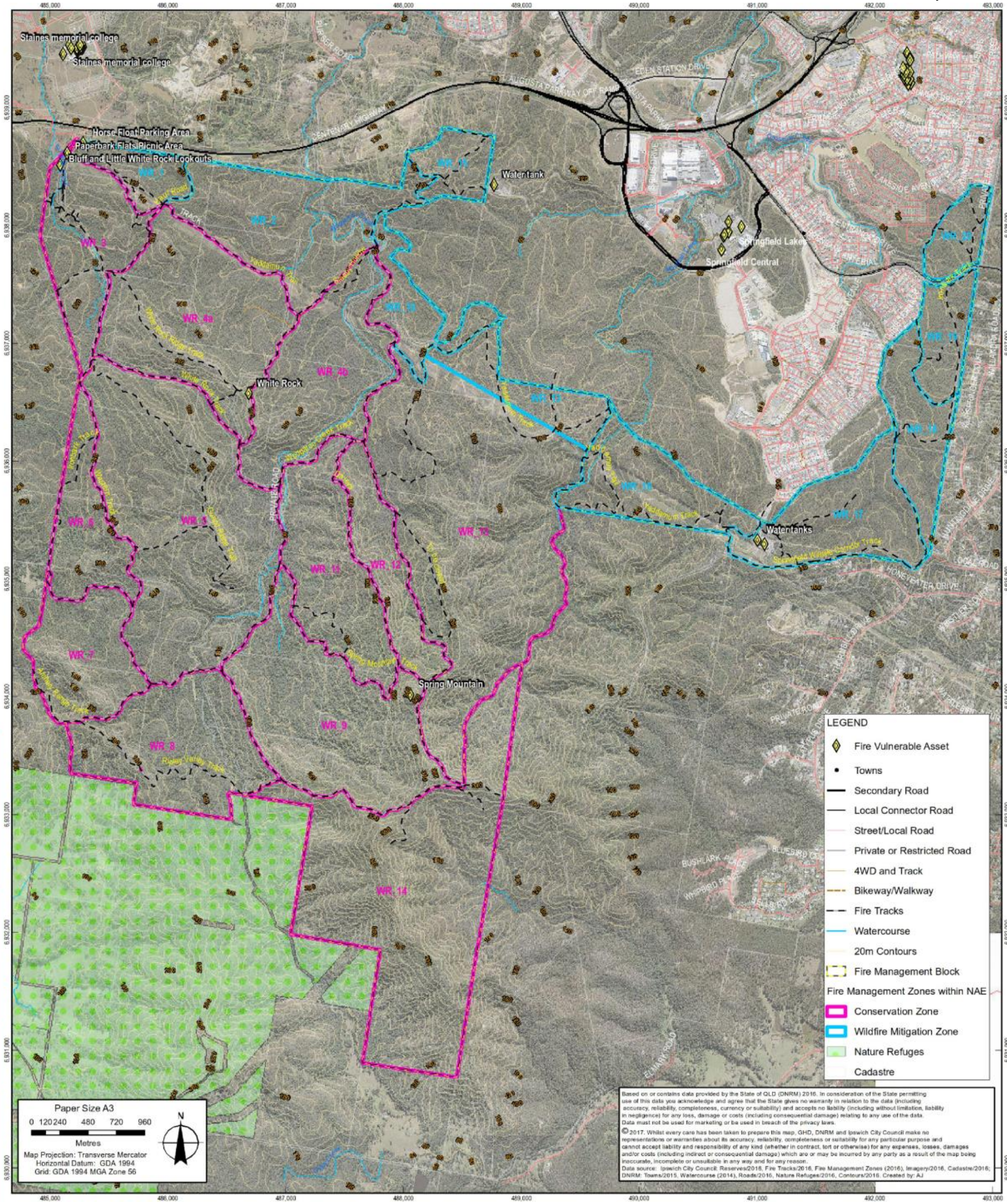
ICC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset

Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
WR_1	32.76	Low	Moderate	Moderate	Low	Low	N/A	Very High	High	Moderate	16	This block contains a picnic area. It is separated from Block 2 and 3 by fire trails. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact Centenary Highway and Transmission Line.	High [intolerable]	PZ, FT, PR, PB, CR, VR, EF	Medium [tolerable]	BSP, PZ, CE, TL	Low [acceptable]
WR_2	143.32	Low	High	Moderate	N/A	Low	N/A	Very High	Very High	Moderate	17	This block is utilised as a mountain bike area. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact Centenary Highway and Transmission Line.	High [intolerable]	FT, PR, PB, CR, VR, EF	Medium [tolerable]	BSP, PZ, CE, TL	Low [acceptable]
WR_3	95.51	Low	High	Moderate	N/A	Moderate	N/A	Very High	Very High	Moderate	18	This block a picnic area and is heavily used for day hiking. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact Centenary Highway and Transmission Line.	High [intolerable]	PZ, FT, PR, PB, CR, VR, EF	Medium [tolerable]	BSP, PZ, CE, TL	Low [acceptable]
WR_4a	183.96	Low	High	High	N/A	High	N/A	Very High	Very High	High	21	This block is used for day hiking. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the Transmission Line.	High [intolerable]	FT, PB, CR, EF	Medium [tolerable]	BSP, PZ, CE, TL	Low [acceptable]
WR_4b	143.81	Low	High	High	N/A	High	N/A	Very High	Very High	High	21	This block is used for day hiking. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the Transmission Line.	High [intolerable]	FT, PB, CR, EF	Medium [tolerable]	CE, TL	Low [acceptable]
WR_5	301.31	Low	High	High	N/A	N/A	N/A	Low	Very High	Very High	16	Fire trails bound the block with additional trails through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	Medium [tolerable]	FT, PB, CR, EF	Low [acceptable]	CE	Low [acceptable]
WR_6	69.59	Low	High	High	N/A	N/A	N/A	Low	Very High	Very High	16	A rural residental block lies west of WR_6. Fire trails almost bound the block. The reserve will support a fire run, including external fire runs, which may	Medium [tolerable]	FT, PB, CR, EF	Low [acceptable]	BSP, PZ, CE	Low [acceptable]



Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	*Unmitigated risk*	ICC Mitigation Strategy	*Residual Risk after ICC actions*	Property owner and Fire Emergency Service Actions	*Residual Risk after shared responsibility actions*
WR_7	85.97	*Low*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*Very High*	*Very High*	16	A rural residental block lies west of WR_7. The block is almost bounded by fire trails. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	BSP, PZ, CE	*Low [acceptable]*
WR_8	140.14	*Low*	*High*	*High*	*N/A*	*High*	*N/A*	*Low*	*Very High*	*Very High*	19	A rural residental block lies west of WR_8. The block is almost bounded by fire trails. A nature refuge adjoins the southern boundary of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	BSP, PZ, CE	*Low [acceptable]*
WR_9	193.35	*Low*	*High*	*Very High*	*N/A*	*N/A*	*N/A*	*Low*	*Very High*	*Very High*	17	Fire trails bound the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
WR_10	46.98	*Low*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Very High*	*Very High*	*Very High*	19	Fire trails bound the western boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the Transmission Line.	*High [intolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
WR_11	117.75	*Low*	*High*	*Very High*	*N/A*	*N/A*	*N/A*	*Low*	*Very High*	*Very High*	17	Fire trails bound the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
WR_12	65.46	*Low*	*High*	*Very High*	*N/A*	*N/A*	*N/A*	*Low*	*Very High*	*Very High*	17	Fire trails bound the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
WR_13	368.22	*Low*	*High*	*Very High*	*N/A*	*N/A*	*N/A*	*Very High*	*Very High*	*Very High*	20	The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the Transmission Line.	*High [intolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
WR_14	327.66	*Low*	*High*	*Very High*	*N/A*	*Very High*	*N/A*	*Very High*	*Very High*	*Very High*	24	A fire trail bounds the northern boundary and the nature refuge bounds the western boundary. A rural residential building lies south of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the residence and Transmission Line.	*High [intolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
WR_15	32.06	*Low*	*High*	*Very High*	*N/A*	*High*	*N/A*	*High*	*Very High*	*High*	21	This block contains fire trails. A water storage tank lies east of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact Centenary Highway and Transmission Line.	*High [intolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	BSP, PZ, CE, FO	*Low [acceptable]*
WR_16	81.04	*Low*	*High*	*High*	*Low*	*High*	*N/A*	*Very High*	*Very High*	*High*	22	This block contains fire trails. A residential area lies to the north east of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact residences and Transmission Line.	*High [intolerable]*	FT, PB, CR, EF	*Medium [tolerable]*	BSP, PZ, CE, TL	*Low [acceptable]*
WR_17	99.4	*Low*	*High*	*High*	*Very High*	*High*	*Low*	*Very High*	*High*	*High*	25	This block contains fire trails and water storage facilities. Residential areas lie north and south of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact residences, water storage facilities and Transmission Line.	*High [intolerable]*	FT, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE, TL, FO	*Medium [tolerable]*
WR_18	60.86	*Low*	*High*	*High*	*Very High*	*High*	*Low*	*Low*	*High*	*High*	22	This block contains fire trails. Residential areas bound the northwest and eastern boundaries. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact residences.	*High [intolerable]*	FT, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
WR_19	40.11	*Low*	*High*	*High*	*Very High*	*High*	*Low*	*Low*	*High*	*High*	22	This block contains fire trails. Residential areas bound the eastern and northwestern boundaries. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact residences.	*High [intolerable]*	FT, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
WR_20	28.15	*Low*	*High*	*High*	*Very High*	*High*	*Low*	*Low*	*High*	*High*	22	This block contains fire trails. It is separated from WR_19 by a arterial road. Residential areas bound the northwestern boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact residences.	*High [intolerable]*	FT, PR, PB, CR, VR	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*

Item 1 / Attachment 2.

Attachment 9: Flinders-Goolman Conservation Estate Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Bushfire Vulnerability Factor	Column
Ecological Asset Bushfire Sensitivity Risk	A
Ecological Health Risk	B
Fire Severity Risk	C
Bushfire Attack Level Risk	D
Access Risk	E
Housing Stock Risk	F
Fire Vulnerable and Smoke Sensitive Asset Risk	G
Landscape Vegetation Cover Risk	H
Fire Suppression Risk	I

Risk Summary

Flinders Goolman Conservation Estate (2200 ha) contains two Picnic Areas: Hardings Paddock in the north west corner and Flinders Plum in the central estate area, between Mount Blaine and Flinders Peak. There are numerous walking tracks through the estate and the day use areas are heavily used. A number of fire vulnerable assets lie west of, and a Transmission line borders the northern section, of the estate. Rural residential blocks bound the reserve and may be impacted by radiant heat, ember attack and smoke from bushfires. Both Mount Blaine and Flinders Peak contain fire intolerant vegetation (dry rainforest).

The reserve is mainly surrounded by unmanaged, *Very High* and *High* Potential Bushfire Intensity vegetation. Fires may start in the reserve or run into it from the surrounding area. The reserve is capable of supporting a large scale fire run.

The main factors driving bushfire risk at Flinders Goolman Conservation Estate are:
- **Fire Severity and Surrounding Landscape Vegetation Cover risks** (blocks are rated as *Very High* or *High* fire severity and the surrounding area is unmanaged forest);
- **Ecological Health risk** (all blocks are rated as *High*); and
- **Fire Suppression Success risk** (steep topography).

The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

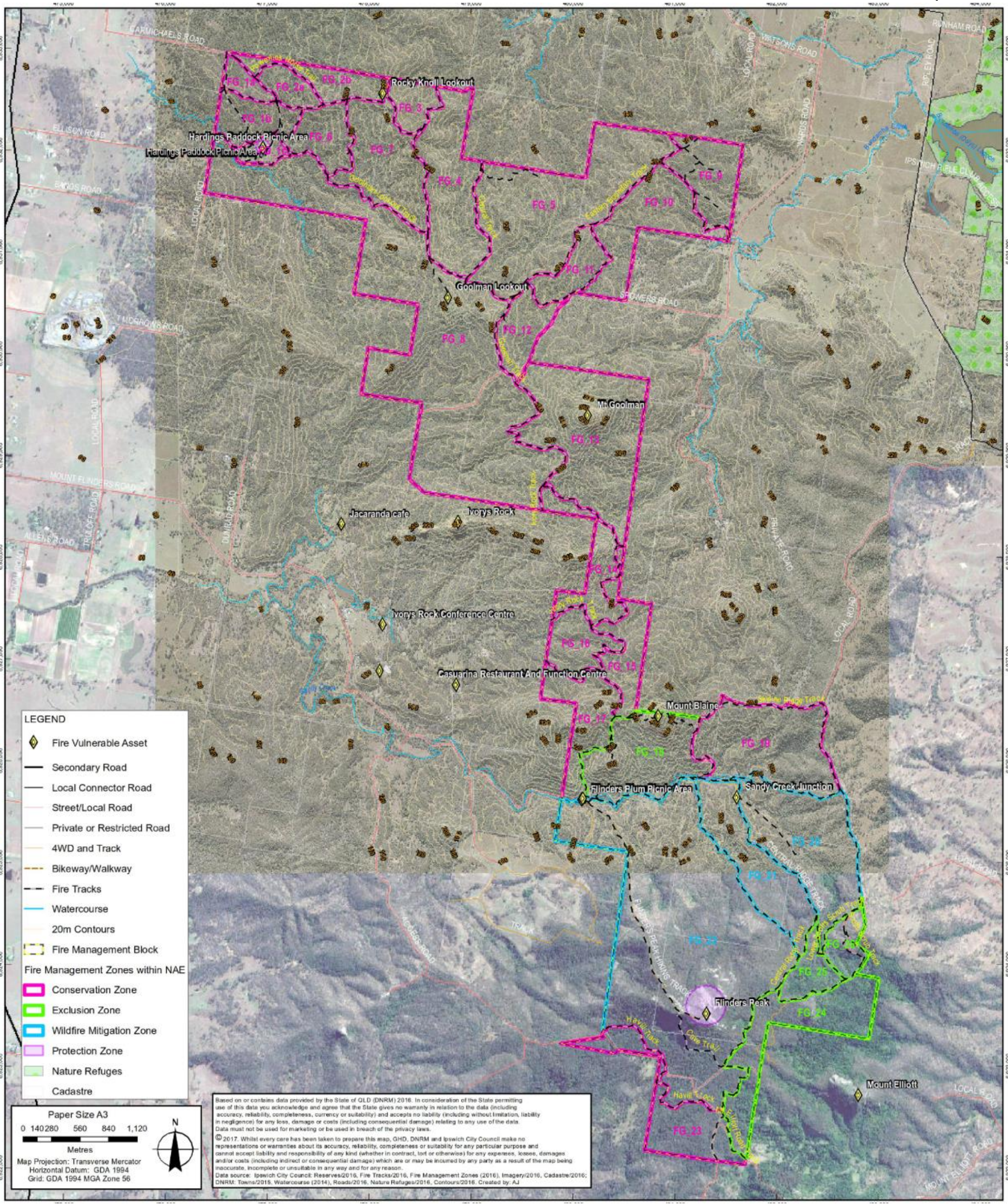
ICC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset

Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
FG_1a	12.23	Low	High	High	N/A	Moderate	N/A	Very high	High	High	19	FG_1a is bounded by firetrails. A public road runs north of the block. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	High [intolerable]	FT, PR, PB, CR	High [intolerable]	CE, TL	Medium [tolerable]
FG_1b	31.13	Low	High	High	Low	Moderate	High	High	High	High	21	FG_1b is bounded by firetrails. A picnic area lies in the adjacent FG_1c to the south. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area and nearby Transmission Line.	High [intolerable]	PZ, FT, PB, CR	Medium [tolerable]	CE, TL	Low [acceptable]
FG_1c	11.22	Low	High	Moderate	Very High	Moderate	High	Very high	High	High	24	FG_1c is bounded by firetrails. The block contains Hardings Paddock Picnic Area. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area.	High [intolerable]	PZ, FT, PB, CR	Medium [tolerable]	CE	Medium [tolerable]
FG_2a	17.18	Low	High	High	N/A	Moderate	N/A	Moderate	High	High	17	FG_2a is bounded by firetrails. A public road runs north of the block. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	High [intolerable]	FT, PR, PB, CR	High [intolerable]	CE, TL	Medium [tolerable]
FG_2b	29.13	Low	High	Very high	N/A	Moderate	N/A	Moderate	High	High	18	FG_2b is bounded by firetrails except the northern boundary. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	High [intolerable]	FT, PR, PB, CR	High [intolerable]	CE, TL	Medium [tolerable]



Item 1 / Attachment 2.

Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	*Unmitigated risk*	ICC Mitigation Strategy	*Residual Risk after ICC actions*	Property owner and Fire Emergency Service Actions	*Residual Risk after shared responsibility actions*
FG_3	19.27	*Low*	*High*	*Very high*	*N/A*	*High*	*N/A*	*Low*	*Very high*	*High*	19	FG_3 is bounded by firetrails except the northern boundary. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	*High [intolerable]*	FT, PR, PB, CR	*High [intolerable]*	CE, TL	*Medium [tolerable]*
FG_4	85.35	*Low*	*High*	*Very high*	*N/A*	*High*	*N/A*	*Low*	*Very high*	*High*	19	FG_4 is bounded by firetrails except the northern boundary. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	*High [intolerable]*	FT, PB, CR	*High [intolerable]*	CE, TL	*Medium [tolerable]*
FG_5	161.85	*Low*	*High*	*Very high*	*N/A*	*Very High*	*N/A*	*Low*	*Very high*	*High*	20	FG_5 is bounded by firetrails except the northern boundary. A transmission line runs through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	*High [intolerable]*	FT, PB, CR	*High [intolerable]*	CE, TL	*Medium [tolerable]*
FG_6	31.49	*Low*	*High*	*Very high*	*Low*	*High*	*N/A*	*Low*	*Very high*	*High*	20	FG_6 is bounded by firetrails. A picnic area lies in the adjacent FG_1c to the west. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area and nearby Transmission Line.	*High [intolerable]*	PZ, FT, PB, CR	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
FG_7	72.02	*Low*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	FG_7 is bounded by firetrails. A transmission line runs north of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the nearby Transmission Line.	*Medium [tolerable]*	FT, PB, CR	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
FG_8	368.52	*Moderate*	*High*	*Very high*	*Low*	*High*	*High*	*Low*	*Very high*	*Very high*	24	FG_8 is bounded on the northeastern boundaries by firetrails. Unmade road reserves run along the northwestern boundary and through the reserve east to west. A picnic area lies north of the block. Rural residential blocks lie to the west. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the nearby picnic area.	*Medium [tolerable]*	PZ, FT, PB, CR	*Low [acceptable]*	BSP, PZ, CE	*Low [acceptable]*
FG_9	44.41	*Low*	*High*	*High*	*Low*	*Moderate*	*N/A*	*Low*	*High*	*High*	17	FG_9 is bounded to the west by firetrails. A public road runs east of the block. Rural residential blocks lie to the south. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the nearby residences.	*Medium [tolerable]*	FT, PB, CR	*Medium [tolerable]*	BSP, PZ, CE	*Low [acceptable]*
FG_10	68.59	*Low*	*High*	*High*	*Low*	*High*	*N/A*	*Low*	*High*	*High*	18	FG_10 is bounded by firetrails to the north and west. A transmission line runs through the block. Rural residential blocks lie to the southeast. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the Transmission Line.	*High [intolerable]*	FT, PB, CR	*High [intolerable]*	BSP, PZ, CE, TL	*Medium [tolerable]*
FG_11	27.46	*Low*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	FG_11 is bounded by firetrails. A transmission line runs north of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the Transmission Line.	*Medium [tolerable]*	FT, PB, CR	*Medium [tolerable]*	CE, TL	*Low [acceptable]*
FG_12	31.21	*Low*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	FG_12 is bounded by firetrails along the northwestern boundaries. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR	*Low [acceptable]*	CE	*Low [acceptable]*
FG_13	139.67	*High*	*High*	*Very high*	*Low*	*High*	*N/A*	*Low*	*Very high*	*Very high*	23	FG_13 is bounded by a firetrail along the western boundary. It contains some fire intolerant areas. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the fire intolerant communities.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
FG_14	38.36	*Low*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*Very high*	17	FG_14 is bounded by firetrails except the western boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR	*Low [acceptable]*	CE	*Low [acceptable]*
FG_15	39.78	*High*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*High*	*Very high*	*Very high*	21	FG_15 is bounded by a firetrail along the western boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR	*Low [acceptable]*	CE	*Low [acceptable]*
FG_16	31.43	*Low*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Moderate*	*Very high*	*Very high*	17	FG_16 is bounded by firetrails except the western boundary. A number of facilities lie west of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve.	*Medium [tolerable]*	FT, PB, CR	*Low [acceptable]*	CE	*Low [acceptable]*
FG_17	47.73	*Very high*	*High*	*Very high*	*Very high*	*High*	*High*	*Very high*	*Very high*	*High*	31	FG_17 is bounded by firetrails except the western boundary. It contains some fire intolerant areas. The Flinders Plum Picnic Area is contained within the block. A number of facilities lie northwest of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area and fire intolerant communities.	*High [intolerable]*	PZ, FT, PB, CR, EF	*Medium [tolerable]*	CE	*Medium [tolerable]*
FG_18	79.35	*Very high*	*High*	*Very high*	*Very high*	*High*	*High*	*High*	*Very high*	*High*	30	FG_18 is bounded by firetrails. It contains some fire intolerant areas (dry rainforest) around the base of Mt Blaine. The Picnic Area lies west of the block.The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area and fire intolerant communities.	*High [intolerable]*	PZ, FT, PB, CR, EF	*Medium [tolerable]*	CE	*Medium [tolerable]*
FG_19	98.38	*Moderate*	*High*	*Very high*	*Moderate*	*Very High*	*High*	*Low*	*High*	*High*	24	FG_19 is bounded by firetrails. A rural residential block lies north of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the residence.	*Medium [tolerable]*	PZ, FT, PB, PR, CR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
FG_20	105.25	*High*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*High*	*High*	17	FG_20 is bounded by firetrails along the northwestern boundaries. It contains some fire intolerant areas (dry rainforest). The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the fire intolerant communities.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
FG_21	70.79	*Moderate*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	FG_21 is bounded by firetrails. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the fire intolerant communities to the south-east.	*Medium [tolerable]*	FT, PB, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
FG_22	388.94	*Moderate*	*High*	*Very high*	*High*	*High*	*High*	*High*	*Very high*	*Very high*	28	FG_22 is bounded by firetrails, with the exception of the western boundary. The Picnic Area lies immediatley north of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the picnic area.	*High [intolerable]*	PZ, FT, PB, PR, CR	*Medium [tolerable]*	CE	*Medium [tolerable]*
FG_23	56.82	*Moderate*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	17	FG_23 is bounded by firetrails and public roads, with the exception of the southern boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nearby fire intolerant communities.	*Medium [tolerable]*	FT, PB, PR, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
FG_24	76.72	*Very high*	*High*	*Very high*	*Very high*	*Very high*	*High*	*Low*	*Very high*	*High*	29	FG_24 is bounded by firetrails along the north western boundaries. It contains fire intolerant vegetation (dry rainforest). A rural residential building site on the southeastern boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the residence and fire intolerant communities.	*High [intolerable]*	FT, PB, PR, CR, EF	*High [intolerable]*	RA, BSP, PZ, CE	*Medium [tolerable]*
FG_25	22.24	*Very high*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*High*	*High*	18	FG_25 is bounded by firetrails. It contains fire intolerant vegetation (dry rainforest). The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the fire intolerant communities.	*Medium [tolerable]*	FT, PB, PR, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*
FG_26	19.98	*Very high*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*High*	*High*	18	FG_26 is bounded by firetrails. It contains fire intolerant vegetation (dry rainforest). The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the fire intolerant communities.	*Medium [tolerable]*	FT, PB, PR, CR, EF	*Low [acceptable]*	CE	*Low [acceptable]*

Item 1 / Attachment 2.

Attachment 10: Mount Grandchester Conservation Estate Fire Management Strategic Plan and Risk Dashboard

Ipswich Fire Management Strategic Plan 2017

Version Number: 1 | Created by: GHD | Version Date: APRIL 2017

	Bushfire Vulnerability Factor	Column
	Ecological Asset Bushfire Sensitivity Risk	A
	Ecological Health Risk	B
	Fire Severity Risk	C
	Bushfire Attack Level Risk	D
	Access Risk	E
	Housing Stock Risk	F
	Fire Vulnerable and Smoke Sensitive Asset Risk	G
	Landscape Vegetation Cover Risk	H
	Fire Suppression Risk	I

Background

This risk dashboard identifies and ranks factors that might be influencing bushfire risk within and surrounding Ipswich City Council's Natural Area Estate (NAE). This map based plan is complimented by a Fire Management Strategic Plan (2017) report which provides greater detail of the range of factors which may contribute to risk at ICC NAE, in addition to the site specific factors identified here.

Protection Zones automatically apply around all *Fire Vulnerable Assets* located on ICC lands. A minimum of ten metres radius for unoccupied assets and twenty metres for occupied assets, or to the existing mown extent for picnic/facility areas.

Approach

Each ICC NAE has been considered using nine bushfire risk factors (Listed A to I in the risk matrix opposite) to generate a relative priority score between reserves.

Risk Summary

Two Nature Refuge areas lie in the northern section of Mount Grandchester Conservation Estate, a Koala Offset area in the central section and Environmental Offset in the south western area. A number of blocks contain fire sensitive individuals (*Callitris baileyi* and *Allocasuarina littoralis*) and federally listed *Eucalyptus melliodora* open grassland community. There are a number of rural residential blocks surrounding the 973 hectare estate that may be vulnerable to ember attack and smoke impact from bushfires burning within the Estate. MG_11 and MG_12 are to become offset planting areas in the future.

Areas to the south west of the estate are unmanaged, *Very High* and *High* Potential Bushfire Intensity vegetation. Fires may start in the reserve or run into it from the surrounding area. The reserve is capable of supporting a large scale fire run.

The main factors driving bushfire risk at Mount Grandchester Conservation Estate are:
- **Fire Severity and Surrounding Landscape Vegetation Cover risks** (most blocks are rated as *High* or *Very High* fire severity and the surrounding area is unmanaged forest);
- **Ecological Health risk** (all blocks are rated as *High*); and
- **Fire Suppression Success risk** (due to steep topography).

The following risk table contain mitigation actions. The acronyms used are explained in the two tables below.

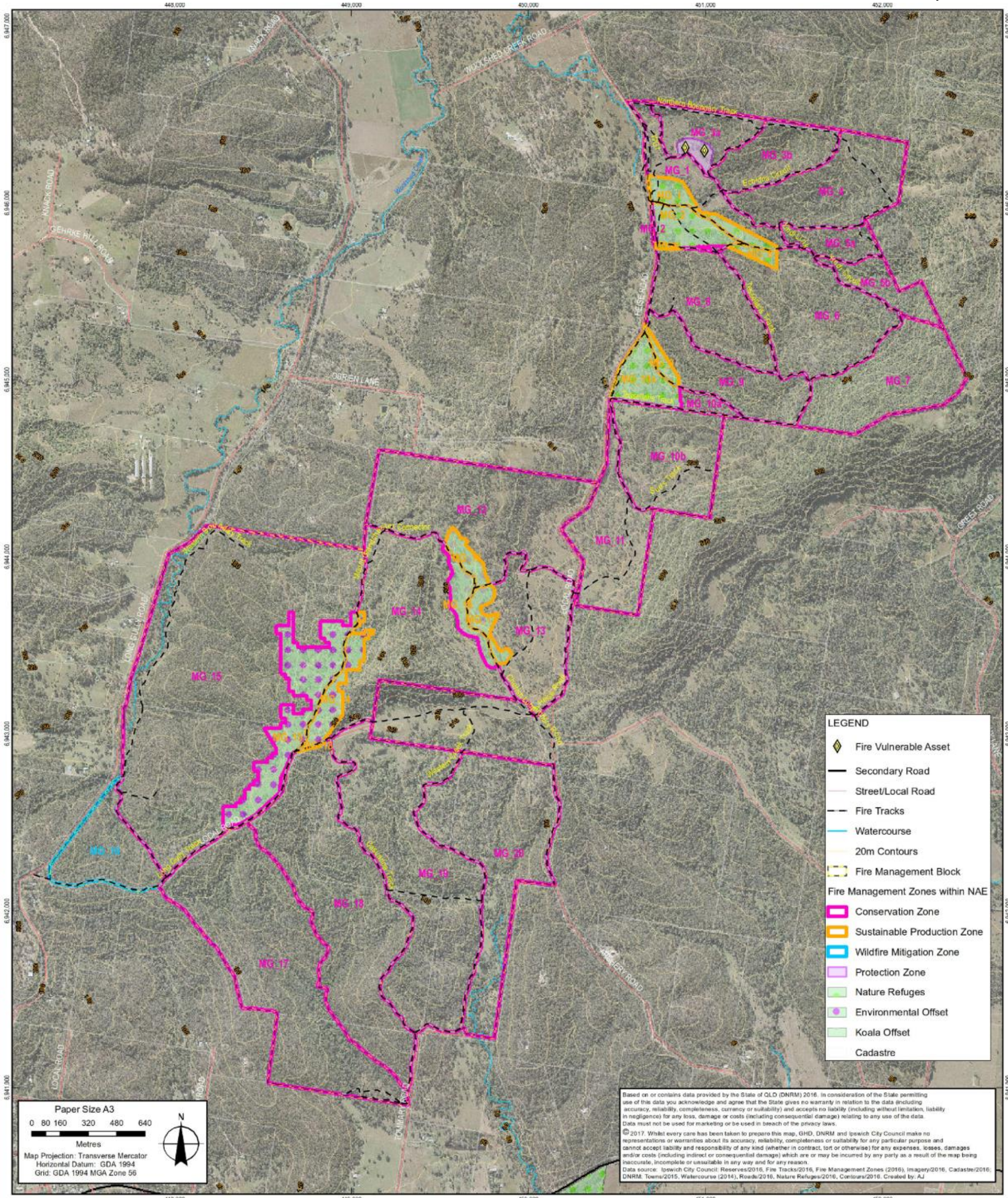
ICC MITIGATION

PZ	Maintain Protection Zone to required standard
FT	Maintain fire trails in accessible and stable condition, as per the NAE Standard (Service Tracks and Firebreaks)
PR	Maintain public roads in accessible and stable condition
PB	Maintain routine prescribed burning of blocks to maintain lower fuel levels, reduce fire intensity and rate of spread. The desired OFH should correspond to the block zoning class.
CR	Close reserve on total fire ban days and when fires are burning in the surrounding landscape
VR	Vegetation removal/ modification through activities such as slashing, manual removal, tree pruning (no fire)
EF	Exclude fire from vegetation communities which are fire-sensitive
CF	Exclude fire from the reserve to avoid coal fires starting

SHARED RESPONSIBILITY

RA	Residences adjoining the reserve may be vulnerable to bushfire impacts (direct flame, radiant heat and ember attack) due to the poor separation between residences and the adjoining hazard. Residents take action to reduce their vulnerability by actively modifying vegetation and /or maintaining structures to improve bushfire resistance
BSP	Prepare and implement QFES Bushfire Survival Plan
PZ	Prepare and maintain structures and protection zones around buildings
CE	QFES Community education
PO	Plantings Owner: Maintain internal slash break between plantings and reserve border, investigate possibility of thinning plantings around mature eucalypts.
TL	Transmission Line Owner: Maintain easement in accordance with industry standards
FO	Facilities owners to maintain protection zone around asset

Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
MG_1	13.9	Very high	High	Low	Moderate	Moderate	Low	Low	High	Moderate	19	MG_1 is bounded by firetrails and a public road to the west. A large shelter without walls and shed lie in the adjacent MG_3a block. Part of the block is a sustainable production zone/ nature refuge. The majority of the block is open grassland with minimal emergent trees. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the dwellings and nature refuge.	Medium [tolerable]	FT, PR, PB, CR	Medium [tolerable]	RA, BSP, PZ, CE, PO	Low [acceptable]
MG_2	8.84	Very high	High	Low	N/A	Moderate	N/A	Low	High	Moderate	16	MG_2 is bounded by firetrails and a public road to the west. The block is a sustainable production zone/ nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge and nearby unoccupied dwellings to the north.	High [intolerable]	FT, PR, PB, CR	Medium [tolerable]	RA, BSP, PZ, CE, PO	Low [acceptable]
MG_3a	14.28	Low	High	High	High	Moderate	High	Low	High	High	21	MG_3a is bounded by firetrails and contains a large shelter without walls and a shed. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the residences and nearby to the west nature refuge.	High [intolerable]	FT, PB, CR	Medium [tolerable]	RA, BSP, PZ, CE, PO	Low [acceptable]
MG_3b	18.14	Low	High	High	Low	High	High	Low	Very high	High	21	MG_3b is bounded by firetrails. A large shelter without walls and a shed lie west of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the unoccupied dwellings and nearby nature refuge.	High [intolerable]	FT, PB, CR	Medium [tolerable]	RA, BSP, PZ, CE, PO	Low [acceptable]



Item 1 / Attachment 2.

Bushfire Asset Zone	Hectares	(A) Ecological Asset Bushfire Sensitivity Risk	(B) Ecological Health Risk	(C) Fire Severity Risk	(D) Bushfire Attack Level Risk	(E) Access Risk	(F) Housing Stock Risk	(G) Fire Vulnerable and Smoke Sensitive Asset Risk	(H) Surrounding Landscape Vegetation Cover Risk	(I) Fire Suppression Success Risk	Prioritisation Score	Summary notes	Unmitigated risk	ICC Mitigation Strategy	Residual Risk after ICC actions	Property owner and Fire Emergency Service Actions	Residual Risk after shared responsibility actions
MG_4	32.83	*Moderate*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	MG_4 is bounded by firetrails. Nature refuge lies southwest of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge. Block contains mutiple individuals of fire sensitive *Callitris baileyi*	*Medium [tolerable]*	FT, PB, CR	*Medium [tolerable]*	BSP, PZ, CE, PO	*Low [acceptable]*
MG_5a	8.46	*Moderate*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	17	MG_5a is bounded by firetrails. Nature refuge lies west of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge. Block contains mutiple individuals of fire sensitive *Callitris baileyi*	*High [intolerable]*	FT, PB, CR	*Medium [tolerable]*	CE, PO	*Low [acceptable]*
MG_5b	10.4	*Low*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	15	MG_5b contains firetrails. Nature refuge lies west of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge. Block contains federally listed community, *Eucalyptus melliodora* open grassland	*Medium [tolerable]*	FT, PB, CR	*Medium [tolerable]*	CE, PO	*Low [acceptable]*
MG_6	44.33	*High*	*High*	*High*	*N/A*	*High*	*N/A*	*Low*	*Very high*	*High*	20	MG_6 is bounded by firetrails. Part of the block is a sustainable production zone/ nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge. Block contains federally listed community, *Eucalyptus melliodora* open grassland	*High [intolerable]*	FT, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_7	35.22	*Low*	*High*	*Very high*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	16	MG_7 north west boundary is a firetrail. The reserve will support a fire run which may enter adjoining blocks within the reserve. Block contains federally listed community, *Eucalyptus melliodora* open grassland	*Medium [tolerable]*	FT, PB, CR	*Low [acceptable]*	CE	*Low [acceptable]*
MG_8	29.93	*Moderate*	*High*	*High*	*N/A*	*Moderate*	*N/A*	*Low*	*Very high*	*High*	18	MG_8 is bounded by firetrails and an unmade road reserve to the west. Part of the block is a sustainable production zone/ nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_9	25.62	*High*	*High*	*High*	*N/A*	*Moderate*	*N/A*	*Low*	*Very high*	*High*	19	MG_9 is bounded by firetrails and an unmade road reserve to the west. Part of the block is a nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_10a	12.27	*Very high*	*High*	*High*	*N/A*	*Moderate*	*N/A*	*Low*	*Very high*	*High*	20	MG_10a is bounded by firetrails and an unmade road reserve to the west. Most of the block is a nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_10b	32.62	*Moderate*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*High*	*High*	15	MG_10b is partly bounded by firetrails. The northern boundary is part of a nature refuge. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nature refuge.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_11	28.64	*Low*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*High*	*High*	14	MG_11 contains firetrails and a unmade road reserve to the west. A nature refuge lies north of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the nature refuge.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Low [acceptable]*
MG_12	62.24	*High*	*High*	*High*	*Moderate*	*High*	*High*	*Low*	*High*	*High*	23	MG_12 southern boundary is a firetrail. A unmade road reserve makes up the eastern boundary. Rural residential buildings lie to the north and west of the block. Part of the block is a sustainable production zone. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the residences and production zone.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	RA, BSP, PZ, CE, PO	*Medium [tolerable]*
MG_13	34.52	*High*	*High*	*Moderate*	*N/A*	*High*	*N/A*	*Low*	*High*	*High*	18	MG_13 is bounded by firetrails. A unmade road reserve bounds the eastern boundary. Part of the block is a sustainable production zone. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the production zone.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	CE, PO	*Medium [tolerable]*
MG_14	69.17	*High*	*High*	*High*	*N/A*	*High*	*N/A*	*Low*	*High*	*High*	19	MG_14 is bounded by firetrails. A unmade road reserve runs south of the block. Rural residential buildings lie to the northwest of the block. Part of the block is a sustainable production zone. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the residences and production zone.	*High [intolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	RA, BSP, PZ, CE, PO	*Medium [tolerable]*
MG_15	180.17	*Low*	*High*	*High*	*Low*	*High*	*High*	*Low*	*High*	*High*	20	MG_15 is bounded by firetrails except along the northern boundary. A public road runs to the west and a Council track along south of the block. Rural residential buildings lie to the north and west of the block. Woolshed creek runs parralel to the western boundary. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the riparian zone and nearby residences.	*High [intolerable]*	FT, PR, PB, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
MG_16	20.54	*Low*	*High*	*High*	*Moderate*	*Moderate*	*High*	*Low*	*Very high*	*High*	21	MG_16 is bounded by firetrails to the northeast and south and a public road to the northwest and Council track to the south of the block. Residential buildings lie to the northwest and south of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the nearby residences.	*Medium [tolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
MG_17	82.65	*Low*	*High*	*Very high*	*Low*	*High*	*High*	*Low*	*Very high*	*High*	22	MG_17 is bounded partially by firetrails adjacent property fencing. Rural residential buildings lie to the south of the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Smoke may impact the nearby residences.	*Medium [tolerable]*	FT, PR, PB, CR	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
MG_18	78.14	*High*	*High*	*Very high*	*Low*	*High*	*N/A*	*Low*	*Very high*	*High*	22	MG_18 is bounded by firetrails except for the western boundary. A public road runs along the southeastern boundary. Rural residential buildings lie to the south of the block. There are two stands of *Allocasuarina littoralis* within the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the sensitive areas and nearby residences.	*High [intolerable]*	FT, PR, PB, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
MG_19	79.88	*High*	*High*	*High*	*N/A*	*N/A*	*N/A*	*Low*	*Very high*	*High*	17	MG_19 is bounded by firetrails. A public road runs along the northern and southern boundaries. Rural residential buildings lie to the south of the block. There are two stands of *Allocasuarina littoralis* within the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the sensitive areas and nearby residences.	*High [intolerable]*	FT, PR, PB, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*
MG_20	58.56	*Low*	*High*	*High*	*Low*	*High*	*N/A*	*Low*	*Very high*	*High*	19	MG_20 northeastern and western boundaries are firetrails. A public road runs to the east of the block. Rural residential buildings lie to the south and east of the block. A creek runs part way through the block. The reserve will support a fire run which may enter adjoining blocks within the reserve. Radiant heat and smoke may impact the riparian zone and nearby residences.	*Medium [tolerable]*	FT, PR, PB, CR, EF	*Medium [tolerable]*	RA, BSP, PZ, CE	*Low [acceptable]*

Appendix B – Fire History Overview

While concise and detailed records of fire history for the ICC NAE are only available for relatively recent fires (the last decade), the bushfire history for the last 100 years or so for the region provides evidence of the significant regional bushfire potential and risk. There is a strong correlation between drought years and high consequence bushfire events. Severe hydrological droughts, which can be characterised as extended periods (several years) of well below average rainfall (e.g. 1927-1936, 1951/4, 1964/6, 1969/70, 1979/83, 1990/96 and 2002/09, 2013/14), have occurred approximately every 10-20 years. Fire seasons coinciding with severe drought years have an elevated potential for higher intensity fires in south-east Queensland.

Historically, most significant fires in south-east Queensland are associated with droughts, or as a consequence of dry periods following flood events 1-2 years before. This fire history includes significant events as presented in Table 16.

Ipswich, with Caboolture and Logan City, recorded in excess of 2,500 vegetation fires over a five-year period, one of the highest in Queensland (Bryant 2008). Annually a number of small fires ignited by arson are reported, though most are contained to a small size.

When compared to the rest of Australia, Queensland has a very low number of house losses associated with bushfire. Based on historical analysis, the majority of house losses in Queensland have occurred within the last 15 years (Blanchi et al 2010). This extended interval between fire events may also contribute to complacency in property preparation.

Table 16 Previous significant bushfire events

Fire Season	Details	Previous wet period
1895	Large fires burnt through the district in September 1895 resulting in large scale stock losses and enveloping Ipswich in smoke.	1893
1918	Fires burnt for weeks north of Ipswich in October 1918, threatening the Pine Mountain school and closing the Ipswich to Pine Mountain Road	1916
1926	In October 1926 bushfires were reported to be burning along the Liverpool Ranges towards Grandchester from the south	1925
1936	The 1936 fires burnt around Greater Brisbane, occurring after an extended dry period that followed significant flooding in the previous two years (floods around Brisbane in 1934 and 1935). This fire burnt along the D'Aguilar Range from Mt Glorious area in a south-easterly path to The Gap. Fires were reported to have burnt on a five mile wide front over the Samford range and spreading through the Bunya district. Rich dairying country and grazing lands were reported 'fire ravaged' and large numbers of cattle killed.	1934 & 1935
1951/52	The 1952 fire season had the highest incidence of consecutive higher fire danger days, resulting in fire losses across the state. Major fires commenced in October 1951 across south-east Queensland including multiple fires burning for weeks around Ipswich. Bushfires around Grandchester and Long Gully, and along the Liverpool Range, burnt out thousands of hectares of grassland and forest The 1952 season was also preceded by major flooding across the region in 1951.	1951
1964-5	The 1964-65 fires, that burnt a total of 92,000 hectares in south east Queensland, occurred in a severe drought affected fire season which followed the 1963 floods.	1963
1968	The Brookfield fire to the east of Ipswich burnt more than 12,000 hectares in November 1968	1967
1976	Significant fires occurred in 1976, following the benchmark floods in 1974. Fires the following year resulted in the loss of 300 hectares of pine plantation at Petrie north of Brisbane.	1974
1991	In the drought affected 1991 season, large fires occurred throughout south-east Queensland. In the previous year parts of south-east Queensland experienced flooding.	1990
1994	In January 1994 a 4000 hectare fire burnt at Mount Glorious and around Mt Nebo. In late 1994 severe fires occurred across the region and included the Beerburrum fire that burnt through large areas, and resulted in significant injuries, loss of assets and 5,000 hectares of plantation. These 1994 fires occurred during a long El Niño, though major flooding of the upper reaches of the Brisbane River occurred in early 1992.	1992
2000	In August 2000 hundreds of fires were recorded across south-east Queensland resulting in property losses and injuries. The year before, heavy rain in February 1999 resulted in flooding in south-east Queensland.	1999
2004	In October 2004 significant fires occurred across south-east Queensland. Prior to this, in January to March 2004, heavy monsoon rainfall resulted in multiple flooding events in SE Queensland.	2004
2012	Fires occurred through south-east Queensland including south of Ipswich around Peak Crossing, where a fire burnt through White Rock -Spring Mountain Conservation Reserve at high intensity	2011

Appendix C – Climate and weather risk factors

Climate and weather are key fire risk factors (weather is the day-to-day state of the atmosphere, whilst climate is weather attributes of a locality averaged over a period of years – usually 30 or more). The climate dictates such things as how often the landscape will be in a fire prone condition – the timing and length of the bushfire season, and exposure to risk-elevating climatic events such as droughts in forested areas. The weather dictates the severity of fire conditions (wind speed and direction, relative humidity and temperature) on any given day, which has a strong influence on fuel combustibility and therefore on how fast fires can spread and how severely they will burn.

The ICC NAE incorporates a wide variety of landscapes, including undulating and moderately steep hills, riparian corridors and managed parkland. The key climate and weather characteristics of the ICC region are:

- A 'sub-tropical – warm humid summer' climate zone, with a warm-season that has moist climate, influenced by warm currents circulating through the Tasman Sea, providing rainfall and humidity whilst moderating extreme temperatures;
- Summers are generally very warm, wet and very humid, while winters are relatively dry and mild. Based on the Bureau of Meteorology data for Amberley AMO [17] the:
  - Mean maximum temperature (Figure 5) peaks in the summer months, with the highest maximum average temperature in January (31ºC). The maximum temperature is lowest in June and July (averaging 21ºC). The mean maximum temperature across the year is 26.8ºC.
  - Mean minimum temperature also peaks in January at approximately 20ºC, falling to a low of 5ºC in July. The mean minimum temperature across the year is 13ºC.
  - Difference between the minimum and maximum temperature for any given month is typically 14ºC; the largest variation occurs in August and September, where the differential averages 16ºC.
  - Mean annual rainfall (Figure 6) for Amberley AMO is 865.3 mm. The majority of this rain is distributed in the summer months, from November to March. There is a large reduction in average rainfall from March to April and an increase between September to October. July, August and September are the driest months, recording less than 40 mm of rainfall on average in each month.
- The bushfire season in south-east Queensland begins in late winter to spring, with the bushfire threat lessening with the summer rainfall period associated with tropical storms. Fire risk is elevated in those seasons that follow a previous wet summer, then a drier winter with westerly winds, and where spring and early summer rains are delayed;
- The most significant fires are likely to occur in late winter, spring and early summer, associated with very high fire danger days which peak in September (Figure 7) (note there is also a small April fire danger peak). From late winter through to early summer native vegetation is dry and grasslands may be cured. Higher fire danger typically occurs when a deep low frontal system establishes, resulting in strong dry westerly winds, low humidity and higher temperatures for south-east Queensland;
- Unlike southern Australia, these conditions mentioned above are generally short lived and are less likely to persist over consecutive days. As such, short-lived running fires on blow up days are more likely in south-east Queensland than the longer lasting 'campaign' fires.

[17] Amberley AMO is located approximately 5.3km WSW of Ipswich. Amberley AMO station opened in 1941 with rainfall and temperature statistics available from 1941-2016, and humidity statistics from 1952-2010.

It is noteworthy however, that the duration of the fire is less critical to bushfire consequence than the fire behaviour in the first twenty-four hours, when the greatest impacts are likely. In the Victorian 'Black Saturday' bushfires the vast majority of the 173 fatalities were as a result of fire activity during the first afternoon/evening of the fire events;

- In drought years bushfire risks are increased both in length and severity, as fires are more likely to start, spread more readily, and remain alight for extended periods than in an average or wet year; and
- The annual number of severe fire danger days (very high and greater) is forecast to increase in south-east Queensland (CSIRO 2007[18]) under climate change scenarios.

Risk Factor Summary: The most significant fires are likely to occur in late winter, spring and early summer, associated with very high fire danger days which peak in September. Unfavourable fire weather may be worsened where there are continuous fuels coupled with lower fuel moisture across the landscape (including within natural fire advantages such as creeklines).

ICC is unable to mitigate this risk factor.

[18] CSIRO / Australian Bureau of Meteorology (2007) *Climate change in Australia: technical report*, CSIRO, Australia

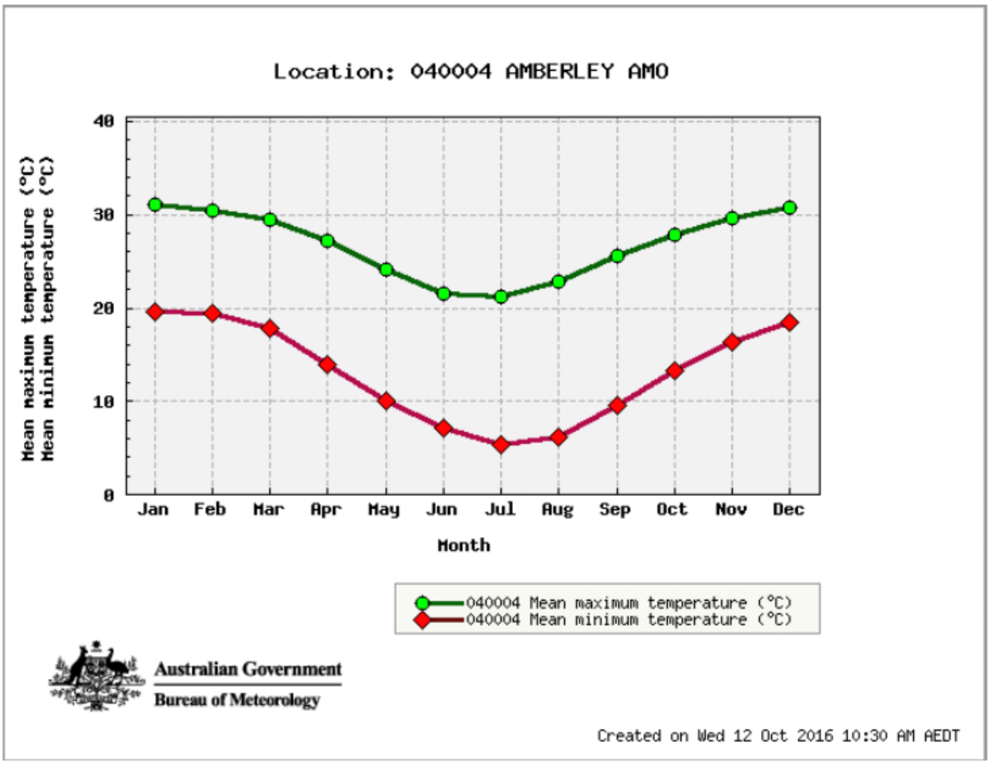


Figure 5 Amberley AMO mean maximum and minimum temperature

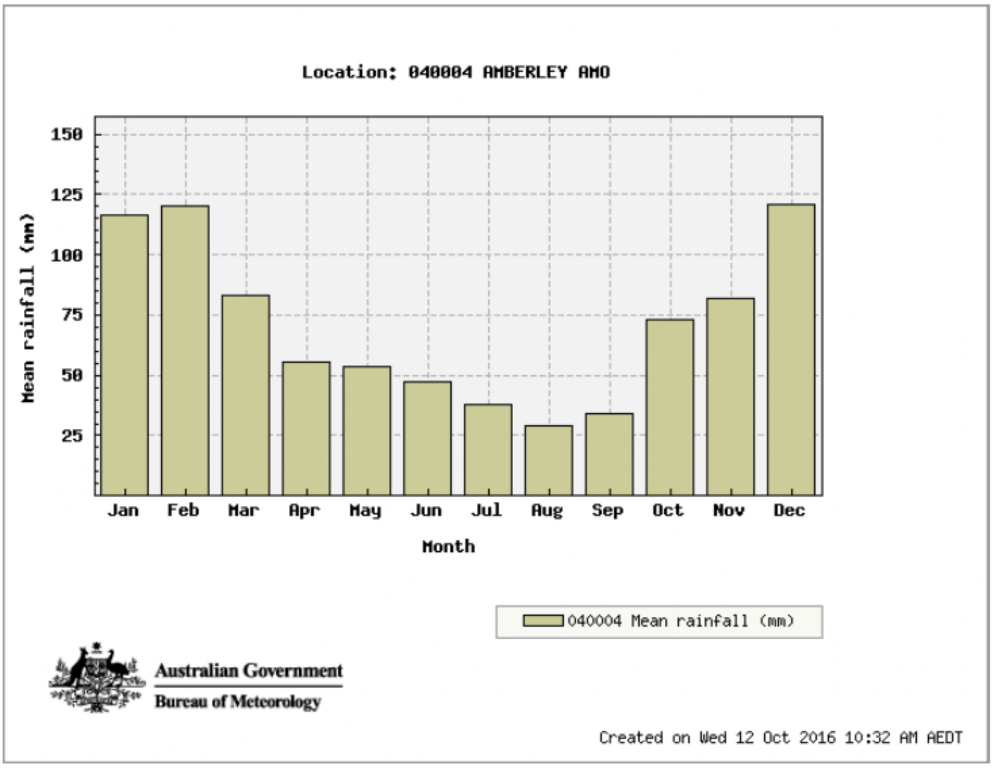
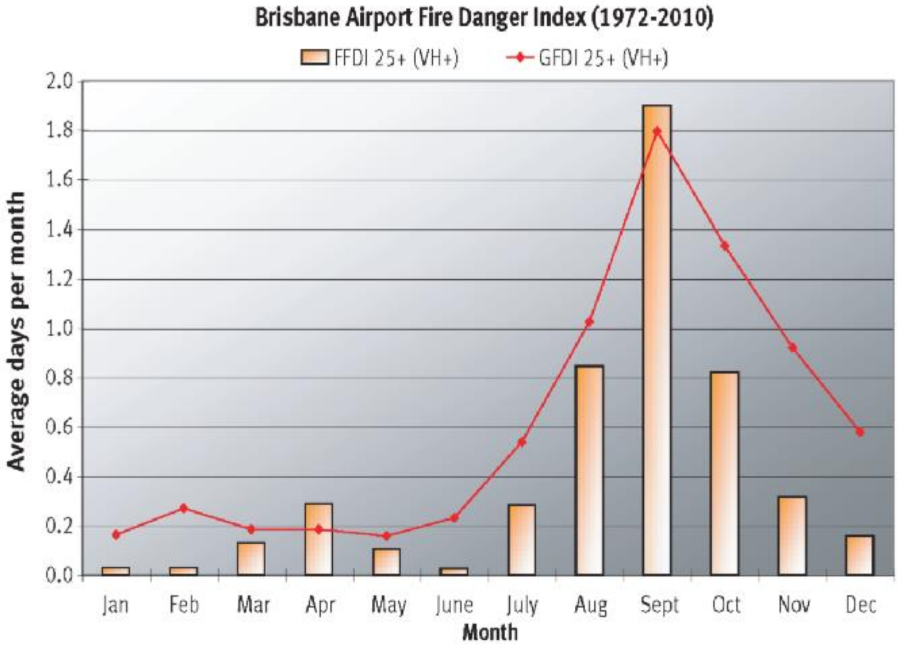
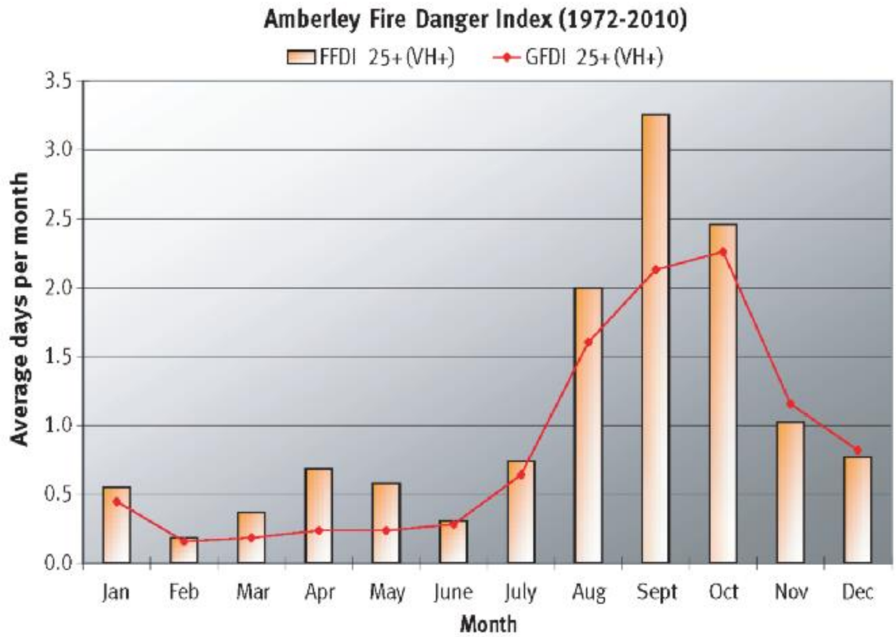


Figure 6 Amberley AMO mean rainfall





Source: DNPRSR (2013a)[19]

Figure 7 Very high fire danger index days for Brisbane Airport and Amberley

[19] DNPRSR (Department of National Parks, Recreation, Sport and Racing (2013a)), Planned burn guidelines: Southeast Queensland bioregion of Queensland, DNPRSR, Queensland Government Brisbane

Appendix D – Vegetation Groups and Maximum Potential Fuel Loads

Forests, woodlands and shrublands accumulate dead fine fuel during their growth, typically in the form of leaf and twig litter, shed bark and dead components of understorey vegetation. Fuel characteristics vary between vegetation types, and are influenced by other factors, including local climate conditions, aspect and soils.

Fuel accumulations can be ignited and will sustain combustion when their fuel moisture content falls below threshold values. For the dominant vegetation types in the ICC NAE (open forests/woodlands), fuel will typically ignite and carry fire with the assistance of wind at fuel moisture contents below about 20%. In eucalypt and *Corymbia* fuel types, combustion will not normally be sustained above a fuel moisture content of around 16% (Tolhurst and Cheney, 1999).

In the ICC NAE, conditions in which forest, woodland, planted and grassland fuels become combustible occur annually (in late winter and spring, and in prolonged seasons extending into early summer) and therefore the ICC NAE are exposed to some level of fire risk every year. Elevated risk seasons can occur when fuels across a high proportion of the area become dryer than normal (such as during drought), which typically happens one or more times per decade. Where fuels are at elevated or equilibrium levels they will burn hotter (at a higher intensity) and spread more quickly (with a higher rate of spread) than areas with lower fuels, thus creating a greater risk to surrounding communities.

Vegetation type and characteristics are used to quantify the level of hazard in both the Australian Building Standard (AS3959:2009) and the State Planning Policy (DSDIP 2016a). The vegetation hazard classes potentially found within the ICC NAE are summarised in Table 17 (Adapted from Leonard *et al* 2014). These hazard classes can be broadly cross-referenced to RE classes.

Table 17 Vegetation hazard classes within the ICC NAE

Vegetation hazard class	Potential fuel load (tonnes/ ha)	Description*
Melaleuca communities	33	*Melaleuca* communities are assumed to have the highest potential fuel load of any Vegetation Hazard Class. This category includes *Melaleuca* forest and woodland communities, as well as some swamps, wetlands and dry coastal heath communities. The vegetation has relatively high oil content and will often present a high bark fuel hazard due to presence of paperbark trees. Further, it commonly has a thick elevated fuel layer with a dense heath or shrubby understorey.
Open forests / woodlands – shrubby	30	Vegetation in this category will often feature a dense understory and full canopy. The canopy contributes high volumes of leaf and bark litter which can become suspended above the understory. This category includes shrubby eucalypt communities alongside shrubby open forests.
Tall open forest	28	Tall open forest is among the most hazardous fire vegetation classes. When mature, trees typically reach over 30 m and have projective foliage of 30-70%. This category includes tall open eucalypt forests with rainforest, ferny or grassy understories. Grassy types rely on regular burning to maintain open understorey and

		generally do not exist as long unburnt areas of very high fuel loads. More shrubby and rainforest understorey types are typically difficult to burn under mild weather conditions, and can develop extreme fuel loads (e.g. high quality blackbutt forests).
Heath communities	27	Vegetation in this category will often feature a low canopy of between 1 and 3 metres. The foliage tends to be dense, compact and volatile posing a very high elevated fuel hazard. This category includes both wet and dry coastal heath communities, montane communities and shrublands.
Cypress and *Casuarina* communities	20	Vegetation in this category will often feature multiple understories with the most hazardous fuel component usually being elevated fuels. Cypress will readily flare and sustain canopy fires in severe weather conditions. Surface fuels usually do not exceed a moderate level. This category includes cypress, *Casuarina* and bull oak communities.
Open forests / woodlands – grassy	19	Vegetation in this category will often feature an open canopy and sparse understory. The majority of the fuel is located on the surface and comprises leaf litter, grasses and coarse wooded debris. This category mainly features grass-dominated varieties of open eucalypt forests and woodlands.
Acacia communities	10	Vegetation in this category will often feature a dense canopy and are somewhat self-protecting from mild to moderate fire. The hazard is largely confined to the near surface and surface fuels. This category includes *Acacia* communities and woodlands alongside brigalow, blackwood and mulga communities.
Riparian and fringing communities	8	This category is wide-spread but localised to riparian communities, including western springs and fringing communities, foredune, saltpan and offshore island vegetation communities. It has a range of vegetation types from volatile high fuel load vegetation to self-protecting marginal rainforest or closed canopy communities.
Native grasslands, sedgelands and balds	5	This category incorporates native mitchell grasslands, spinifex grasslands, sedgelands and balds. It consists of generally native (or exotic) grass fuel with limited scattered other fuels, prone to lower intensity but very rapidly spreading fires.
Mixture of rural classes – mainly grasslands	5	This category incorporates unmanaged exotic and native grass fuels with scattered trees, sparse regrowth trees and shrubby vegetation.
Cropping and horticulture	5	This vegetation will generally produce low fuel areas but can include transient high fuel or volatile examples such as sugar cane, cereals and cotton.
Dry vine forest and vine thickets	5	Vegetation generally consists of closed communities with high biomass; however it is generally self-protecting and non-flammable unless there is weed incursion such as *Lantana*.
Hoop plantations	5	Generally on ex-rainforest sites where it develops wet (mesic) rainforest understorey, and is therefore non-flammable and self-protecting. However, young plantations and off site plantations, or *Lantana* infestations, can be flammable.
Mixture of urban classes	5	The fuel available in urban areas is present in a variety of readily combustible materials and sparse vegetation.

Rainforest	1	Non-flammable, however can carry mild surface fire in very dry conditions; self-protecting but can be subject to some incursion from severe fires adjacent.
Sparse ground cover	1	Including gibber plains, sand dunes, deserts, eroded or exposed soil.
Water bodies	0	Rivers, lakes, reservoirs or watercourses wider than 25 m were deemed to be permanent waterbodies.

*Vegetation group descriptions adapted from Leonard *et al* (2014); refer to this document for further information.

Appendix E – Vegetation Maps

Item 1 / Attachment 2.

Paper Size A3

0 25 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Highway
- Street/Local Road
- Private or Restricted Road
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Cadastre
- Conservation Park

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems

Denmark Hill Conservation Reserve

Figure 1

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Item 1 / Attachment 2.

Paper Size A3

0 25 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Street/Local Road
- Private or Restricted Road
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Cadastre

GHD

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems
Haig Street Quarry Bushland Reserve

Figure 2

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Paper Size A3

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Street/Local Road
- Private or Restricted Road
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Fire Sensitive Area
- Fire Intolerant Vegetation Community
- Cadastre

GHD

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems
Hillview Drive Reserve

Figure 3

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Paper Size A3

0 25 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Local Connector Road
- Street/Local Road
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Cadastre

GHD

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems
Ric Nattrass Environmental Park

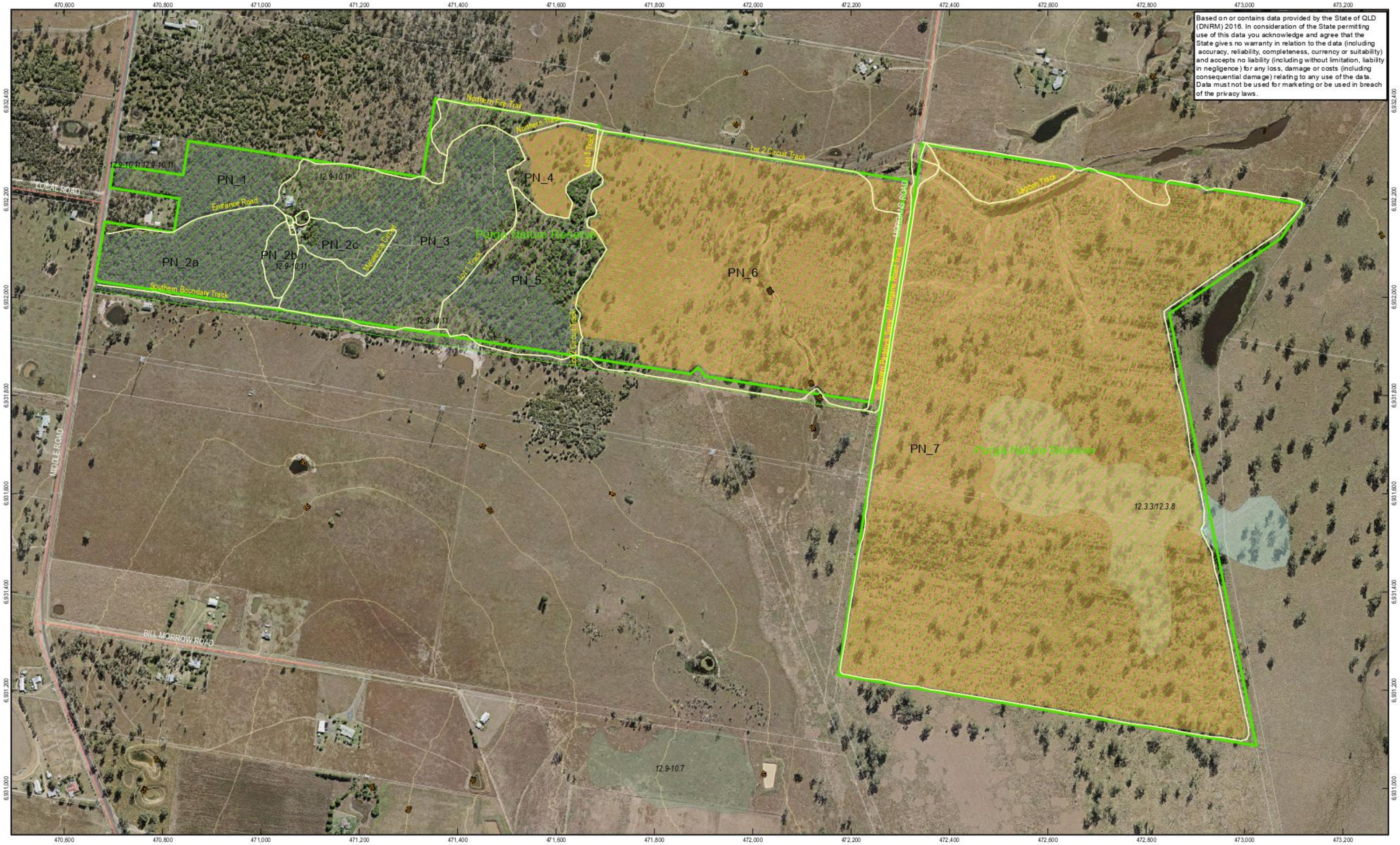
Figure 4

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Item 1 / Attachment 2.



Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

Street/Local Road
Fire Tracks
5m Contours
Natural Area Estate
Fire Management Block
Fire Sensitive Area
Greenfleet Planting site
Cadastre

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems

Purga Nature Reserve

Figure 5

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Item 1 / Attachment 2.

Paper Size A3

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Street/Local Road
- Private or Restricted Road
- 4WD and Track
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Fire Sensitive Area
- Fire Intolerant Vegetation Community
- Cadastre
- Nature Refuges

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems

Kholo Enviroplan Reserve

Figure 6

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Item 1 / Attachment 2.

Paper Size A3

0 25 50 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Street/Local Road
- Fire Tracks
- 5m Contours
- Natural Area Estate
- Fire Management Block
- Fire Sensitive Area
- Fire Intolerant Vegetation Community
- Cadastre

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems

Stirling Road Reserve

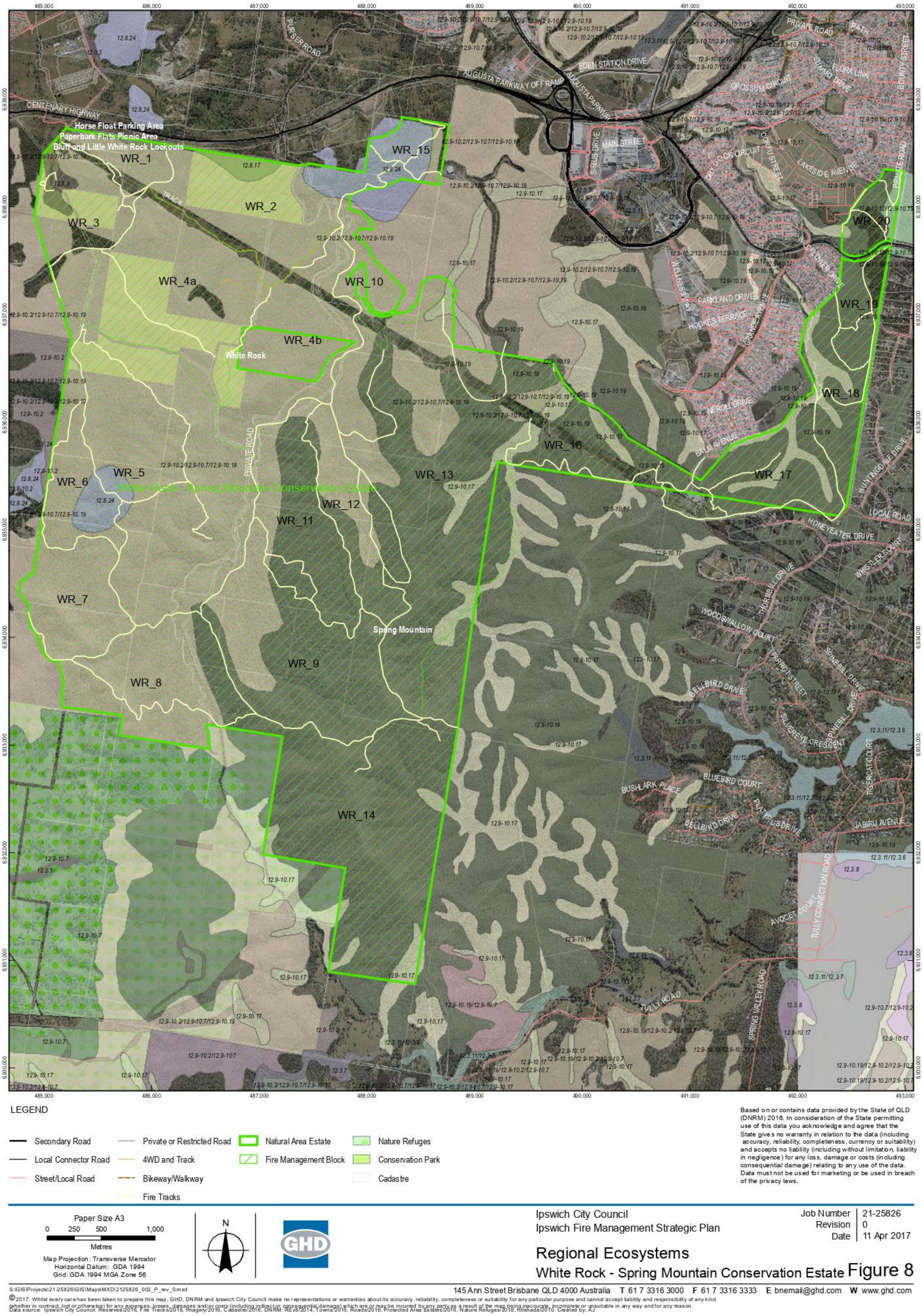
Figure 7

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

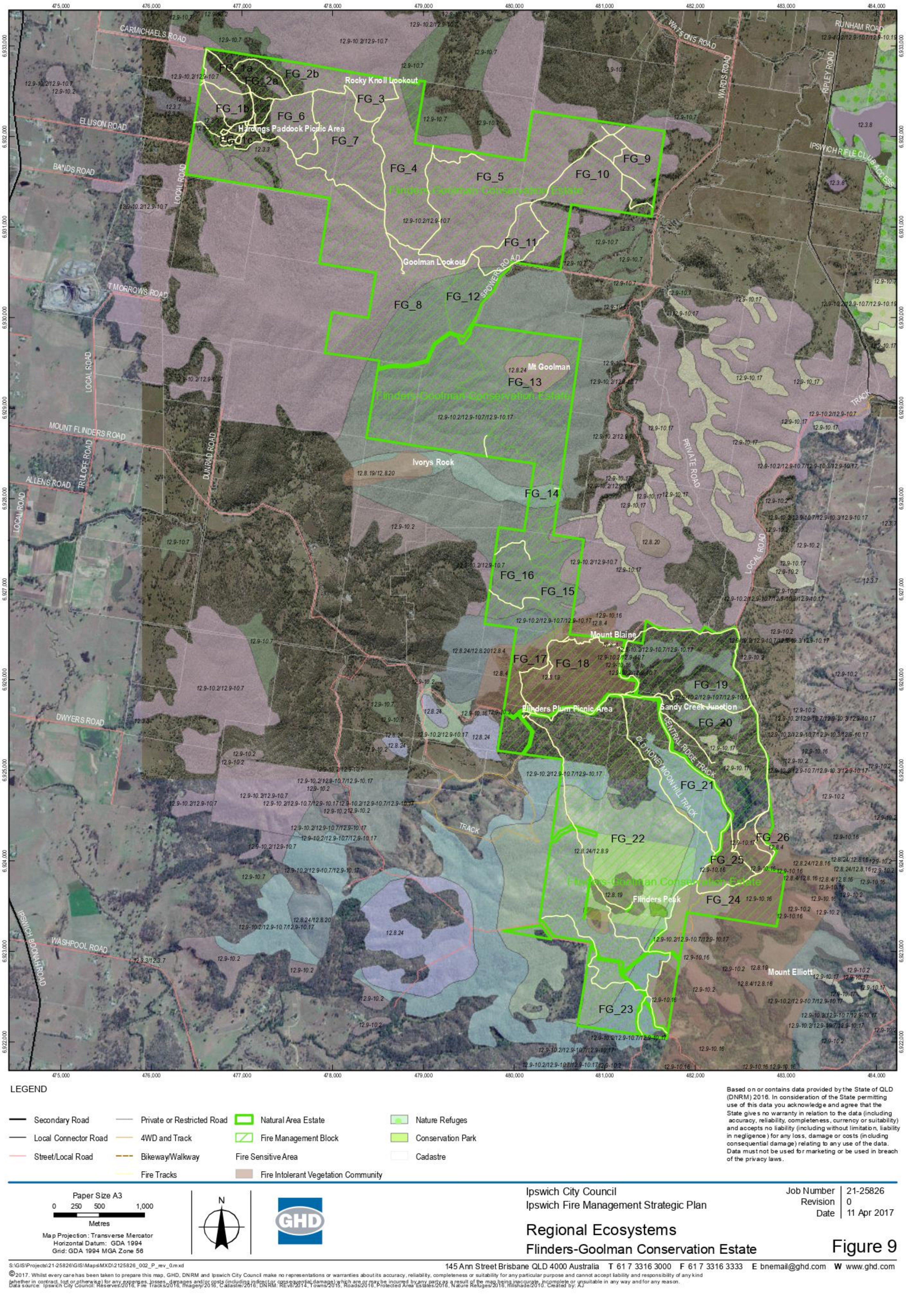
S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_L_rev_0.mxd

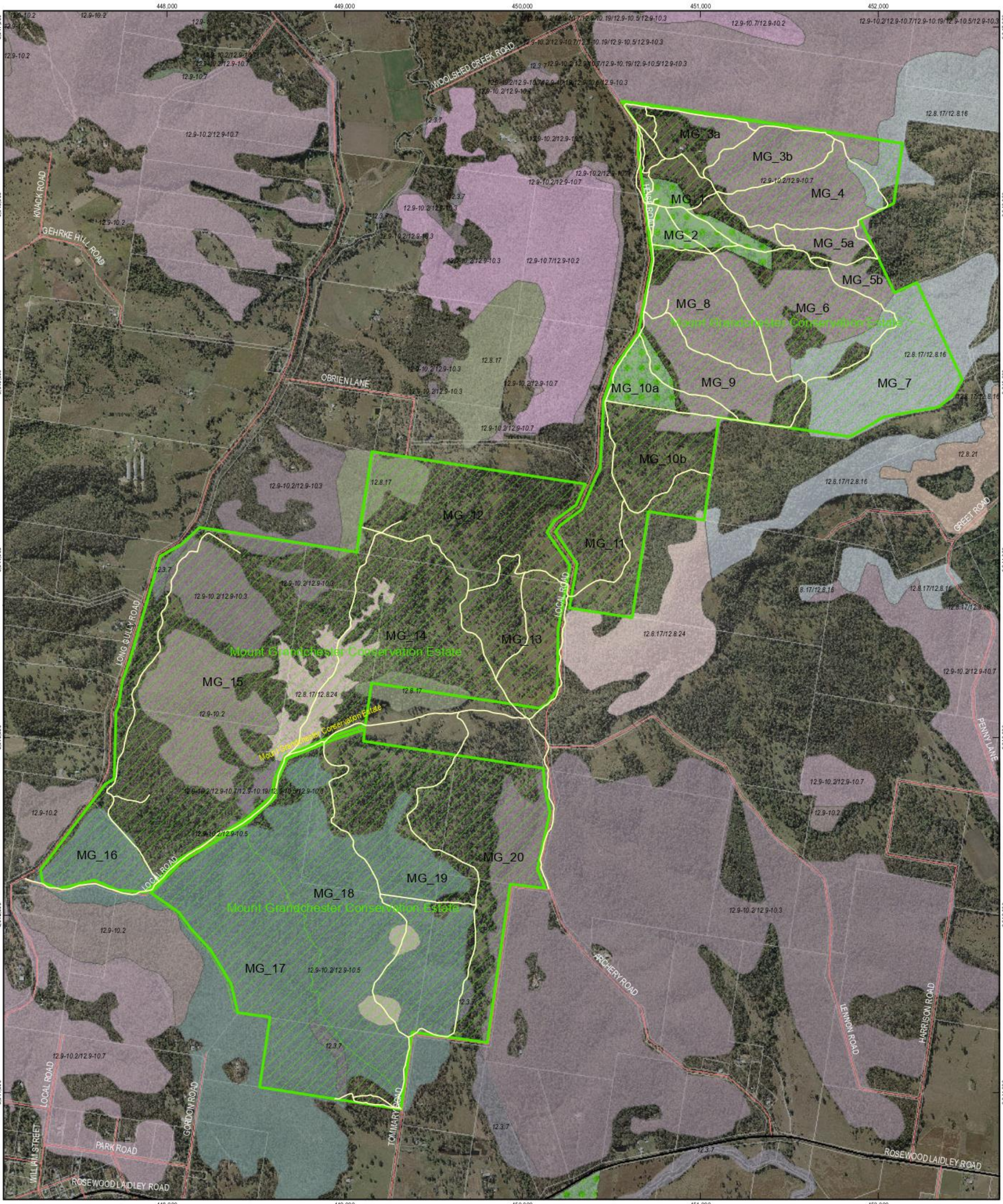
Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REV8/2016, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Contours/2016. Created by: AJ

Item 1 / Attachment 2.



Item 1 / Attachment 2.





LEGEND

- Secondary Road
- Street/Local Road
- Fire Tracks
- Natural Area Estate
- Fire Management Block
- Nature Refuges
- Cadastre

Fire Sensitive Area

- Fire Intolerant Vegetation

Based on or contains data provided by the State of QLD (DNRM) 2016. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

Paper Size A3
0 250 500
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Ipswich City Council
Ipswich Fire Management Strategic Plan

Job Number	21-25826
Revision	0
Date	11 Apr 2017

Regional Ecosystems
Mount Grandchester Conservation Estate

Figure 10

S:\GIS\Projects\21-25826\GIS\Maps\MXD\2125826_002_P_rev_0.mxd

145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: Ipswich City Council: Reserves/2016, Fire Tracks/2016, Imagery/2016, Cadastre/2016; DNRM: REv8/2014, Towns/2015, Roads/2016, Protected Area Estates/2016, Nature Refuges/2016, Hillshade/2010. Created by: AJ

Appendix F – Considerations for smoke management

In the operational planning for prescribed burning it is essential to analyse where, when, how, and why smoke concentrations which may represent a problem level occur, and identify strategies to reduce impacts on smoke sensitive values.

While there are less opportunities to apply mitigation actions in the uncontrolled environment of a bushfire, some of the considerations below, may also be applied in the management of a bushfire incident. Smoke hazard risk factors for consideration are:

- Values sensitive to smoke impact including:
  - – *At the source* – such as workplace health and safety considerations for fire fighters and adjacent residences including residents who have identified themselves as having a pre-existing illness, have children or are elderly. At the operational level this may require the rotation of lighting crews and advanced notice to potentially impacted residences in the lead up to the burn. Fire vulnerable assets located in areas directly adjoining the burning area require specific mitigation strategies in burn delivery;
  - – *As the smoke disperses* – it may impact on receptors such as transport and traffic routes (within the operations plan mitigation actions may include advice to motorists and stop/go controls). Under bushfire conditions significant volumes of smoke may disperse over long distances and general information about how residents can prepare themselves and put in place mitigation actions can be circulated; and
  - – *Where the smoke may settle* – including the location/extent, exposure timing, and sensitivity threshold dimensions. This is particularly difficult to predict as smoke can be transported and then settle some distance from the burning area. Also conditions which are ideal for prescribed burning (stable atmosphere and light winds) may not be conducive to smoke dispersal. Areas prone to smoke concentration and persistence such as fire vulnerable assets are identified in each map based risk plan and advance notification of prescribed burning operations is included in operations plans prepared.
- Weather patterns conducive to poor smoke dispersal and accumulation of smoke at surface level; and
- Burning times/scales/types that produce problem quantities of smoke at surface level.

Smoke management strategy elements to consider in the operational burn planning and delivery include:

- Weather patterns to avoid (poor smoke dispersal);
- Landscape locations requiring special/extra risk controls;
- Vulnerable values requiring burn timings and locations to be avoided, or to provide advance notification. This includes residents that have registered with ICC for personal advance notification (in addition to media and website advice) and direct liaison between ICC and managers of fire vulnerable assets that may be directly impacted by smoke hazards;
- Burn activity level limits under different conditions, or in different jurisdictions. It must be noted that low intensity prescribed burning produces considerably less smoke for a shorter period than bushfires due to the relatively lower levels of fuel combustion and smaller areas treated. Coordination with neighbouring jurisdictions regarding burning days or light up times, where possible, may provide a strategy to mitigate smoke impacts.

These actions are not possible to prescribe at a strategic planning level as weather, lighting pattern, fuel levels and proximity of the fire vulnerable asset to the burning block require a site specific prescription that may not be possible to finalise until the day of the burn. Consideration of smoke impacts and application of mitigation measures forms part of the established standard operating considerations for burn planning and delivery by those implementing the burn.

For more information on smoke hazard considerations see:

AFAC (2015) *Risk Management Framework – Smoke Hazard and Greenhouse Gas Emissions*. Report for National Burning – Sub-project 3. Australasian Fire and Emergency Services Authorities Council Limited, Melbourne.

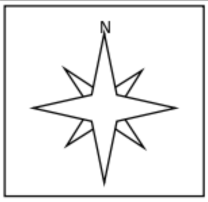
Appendix G - Fuel Hazard Sampling sheet and recommendations

Item 1 / Attachment 2.

Fire Management
Part A
Sample Sheet – Fuel Monitoring

		Season & Year	
Date:	/ /	Completed by:	
Reserve Name:			
Plot Number:		Fire Block Number:	
Location description:			
GPS Coordinates:			
Fire Management Zone:	☐ Wildfire Mitigation Zone ☐ Fire Exclusion Zone ☐ Conservation Zone	☐ Sustainable Production ☐ Protection Zone ☐ Reference Zone	

Site Characteristics

Evidence of fire? ☐ Last 12 months ☐ 1 to 3 years ☐ 3 years plus	**Type of fire**? ☐ Bushfire ☐ Planned burn ☐ Other ________ ☐ Don't know	Aspect (Measured as the compass direction from the highest point on the periphery of the plot sample through the centre point of plot)	
Slope (degrees)			

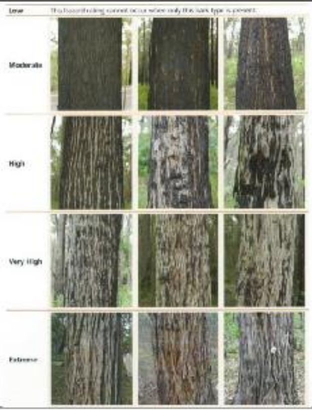
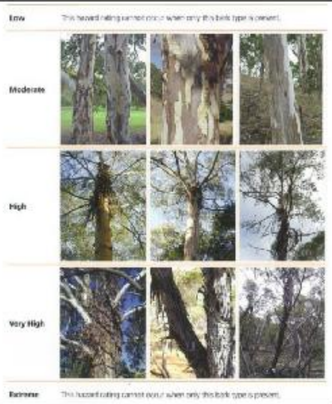
Vegetation Association (*circle letter*) (**current** from Brown and Root 2001 ICC)

Dry Mixed Eucalypt Forest	D	Rocky Heath	R
Long Leaved Spotted Gum	L	Broad-leaved Paperbark	B
White Mahogany Associations	W	Swamp Tea Tree	S
Forest Red Gum	F	Riparian Association	RA
Mixed Eucalypt Forest & Woodlands	M	Dry Eucalypt/Vine Forest	DV
Brush Box In Gullies	BB	Vine Forest	V
Yellow Box Forest	Y	Lantana/Vine Forest	LV
Remnant/Regrowth Forest	RR		

Item 1 / Attachment 2.

Bark Fuel Load Calculator (OFHG pp 10-21)	**(First determine if Stringy Bark, Ribbon Bark or Other)**

Use "Stringy Bark" if more than 10% of trees have fine fibrous bark.

	Stringy Bark	**Ribbon Bark**	**Other Bark Type**
Examples			
LOW	*Does not occur with this bark type (not present).*	*Does not occur with this bark type (not present).*	Trunk and branches entirely smooth.
MODERATE	Bark is tightly held	No long ribbons present.	Bark rubs off with firm pressure.
HIGH	Bark mostly tightly held, with a few pieces loosely attached	Long ribbons present on upper truck, lower trunk smooth.	Light hand pressure will break bark off.
VERY HIGH	Many pieces of bark loosely held. Deep fissures present.	Long ribbons hanging down to ground level or trunk flammable.	*Does not occur with this bark type.*
EXTREME	Bark weakly attached. Deep fissures present.	*Does not occur with this bark type.*	*Does not occur with this bark type.*

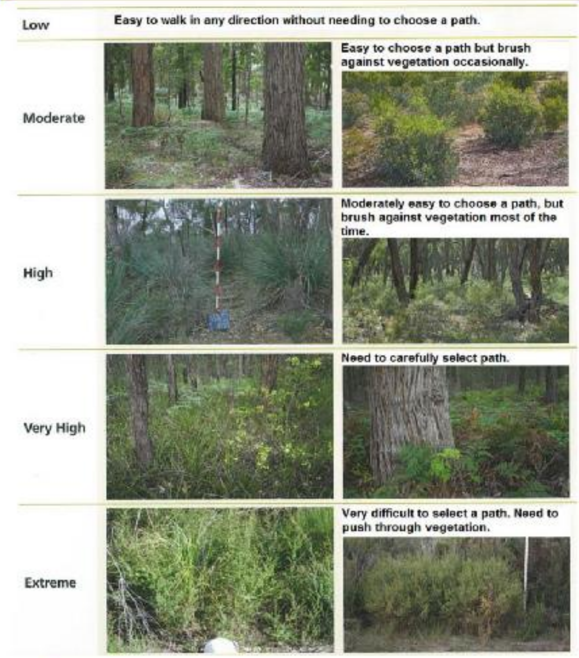
Bark Hazard (OFHG pp 10-21)

Stringybarks (p11-13)	NP	M	H	VH	E	*Select the Bark Hazard rating from left that will be used to determine Overall Fuel Hazard. (Only use the Stringybark hazard rating if more than 10% of the trees are Stringybark AND it has the highest rating. Otherwise use the bark with next highest rating.)*
Ribbonbarks (p15-17)	NP	M	H	VH		
Other barks (p18-21)	L	M	H			

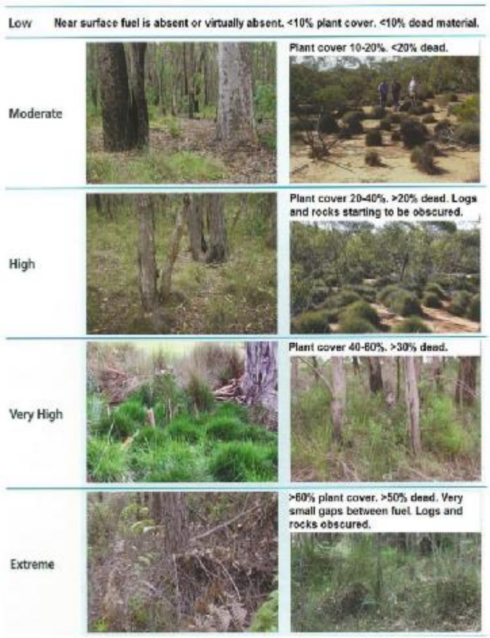
Bark hazard (*circle* >)	**L**	**M**	**H**	**VH**	**E**

Item 1 / Attachment 2.

Elevated Fuel Load Calculator
(OFHG pages 23-25)



Near Surface Fuel Load Calculator
(OFHG pages 27-29)



Elevated Fine Fuel Hazard (OFHG pages 23-25)					
Elevated % Cover:	%				
Elevated % Dead	%				
Elevated Fuel Av Height (m)	m				
Elevated fine fuel hazard (*circle* >)	L	M	H	VH	E
Near-surface Fuel (OFHG pages 27-29)					
Near-surface % Cover:	%				
Near-surface % Dead	%				
Near-surface Fuel Av Height (cm)	cm				
Near-surface fuel hazard (*circle* >)	L	M	H	VH	E

Surface Fine Fuel Calculator (OFHG pages 30-33)

Instructions

1. Randomly select a location and make a hole in the litter bed just wide enough for the end of the ruler to rest on the mineral soil.
2. Lightly press the disc down onto the surface fine fuel.
3. Read the ruler above the disk. Record litter bed height in millimetres.
4. Perform procedure 5 times and determine average litter bed height. Take more samples if results vary greatly.

Raw Data:

Surface Fine Fuel (OFHG pages 30-33) (take the average of *five* measurements)					
Surface litter % Cover:	%				
Average surface litter depth (mm)	mm				
Surface fuel hazard (*circle* >)	L	M	H	VH	E

Combined Surface and Near-surface hazard rating (OFHG page 34)					
Circle Surface Fine Fuel hazard from above in Column ❶ and Near-surface fuel from above in Column ❷ then circle the combined rating in the table ↘	Column ❷ Near-surface Fuel				
	L	M	H	VH	E
Column ❶:**Surface fuel hazard**					
L	*L*	*L*	*M*	*H*	*E*
M	*M*	*M*	*H*	*VH*	*E*
H	*H*	*VH*	*VH*	*VH*	*E*
VH	*VH*	*VH*	*E*	*E*	*E*
E	*E*	*E*	*E*	*E*	*E*
	❸ Combined Surface and Near-surface – as circled above				

Overall fuel hazard calculation (OFHG page 35 – see Table 8.1)

To determine the Overall Fuel Hazard rating:

1. Select the row that corresponds to the **Bark Hazard** ❶
2. Select the row that corresponds to the **Elevated Fine Fuel Hazard** ❷
3. Select the column that corresponds to the assessed level of **Combined Surface and Near-surface Fine Fuel Hazard** ❸
4. Identify where these two intersect and this will provide you with the corresponding Overall Fuel Hazard rating.

** ❸ is as worked out above*

Table 8.1 Determining the Overall Fuel Hazard rating

❶ Bark Hazard	❷ Elevated Fine Fuel Hazard	❸ Combined Surface and Near-surface Fine Fuel Hazard * L	M	H	VH	E
Low or Moderate	L	L	M	M	H	H
	M	L	M	M	H	H
	H	L	M	H	VH	VH
	VH	VH	VH	VH	VH	VH
	E	E	E	E	E	E
High	L	L	M	H	H	H
	M	L	M	H	H	H
	H	L	H	H	VH	VH
	VH	VH	VH	VH	VH	E
	E	E	E	E	E	E
Very High or Extreme	L	L	VH	VH	VH	E
	M	M	VH	VH	E	E
	H	M	VH	E	E	E
	VH	E	E	E	E	E
	E	E	E	E	E	E

Overall fuel hazard (OFH) (circle – this corresponds with table above)	L	M	H	VH	E

9.2 Indicative fuel loads (t/ha)

In the absence of local data obtained by sampling fuel loads destructively the following table of indicative fuel load data from Project Vesta and Victorian studies may be useful. These tonnes per hectare figures may be applied to the Forest Fire Danger Meter Mark V (McArthur 1973) for predicting forward rate of spread and flame height for forest fires.

Table 9.2 Indicative fuel loads (t/ha)

	Fuel hazard rating				
Fuel	Low	Moderate	High	Very High	Extreme
Bark	0	1	2	5	7
Elevated	0–1	1–2	2–3	3–5	5–8
Near-surface	1–2	2–3	3–4	4–6	6–8
Surface	2–4	4–10	8–14	12–20	16–20+

Photopoint	
Photo to be taken when the photographer is standing at the northern-most periphery of the plot facing due south.	
Camera make:	....
Model:	....
Time:	....
Image No.:	....
Cloud cover (%):	....

Office work	Does the OFH above correspond with the zoning?		Yes	No
	Does the Fire Management Block / Reserve require a mitigation action to be implemented?		Yes	No
	Does the risk table need updating?		Yes	No
Completed by:		Date:		

Part B
Vegetation Health and Plant Species Monitoring

Vegetation Health				
	Strong indicators for a prescribed burn - major signs of declining ecological health and/ or need for interval burning	**Medium indicators for a prescribed burn – some signs of declining ecological health and/ or upper end of burn interval**	**Low indicators for a prescribed burn – minimal signs of declining ecological health and/ or within the burn interval**	**Prescribed burn not required at this time. Ecological health is good and or is recovering from previous prescribed burn or wildfire**
Crown Dieback	☐ Severe/irreversibl e levels of dieback, with crown contracted, leaves sparse, dead branches and mostly epicormic growth.	☐ Established levels of dieback >25% or <25% of severe levels of dieback	☐ Emergent levels of dieback >10% but <25%	☐ Very low levels of dieback <10%,
Epicormic Shoots	☐ Mostly epicormic growth	☐ Crown contraction and moderate epicormic growth (~50% of crown)	☐ Little epicormic growth	☐ No to very little epicormic growth
Weeds	☐ Lantana and other weeds over 50%	☐ Lantana and other weeds up to 50%	☐ Mostly without lantana	☐ Minimal lantana
Grasses/Grass trees	☐ Grasses have completed collapsed and/or appear very sparse	☐ Grasses showing signs of drooping and are poorly formed and sparse	☐ Grasses and grass trees have mostly good growth form and are showing some signs of drooping	☐ Grasses and grass trees are have good growth form and showing no to little drooping
Shrubs	☐ Shrub layer has dead shrubs and crowns beginning to die	☐ Shrub layer is sparse, evidence that crowns are beginning to die	☐ Shrub layer appears mostly healthy, with some crown dieback	☐ Shrub layer appears healthy with new growth and/or flowers/seeds evident
Recruitment	☐ No evidence of shrub recruitment. The diversity of mid/ground layer species has declined since previous surveys	☐ Limited recruitment of new shrubs of any species	☐ Moderate recruitment of shrubs with a some diversity in species	☐ Good recruitment of a divers e range of shrub species
Overall fuel hazard	☐ Extreme	☐ Very High	☐ High	☐ Medium/Low
Age classes/Monocul ture	☐ Strong evidence of an abundance of bracken, dodder, one species or a flush of trees or weeds all at the same age >50%	☐ Moderate evidence of an abundance of bracken, dodder, one species or a flush of trees or weeds all at the same age 25-50%	☐ Minor evidence of an abundance of bracken, dodder, one species or a flush of trees or weeds all at the same age 10-25%	☐ No evidence of an abundance of bracken, dodder, one species or a flush of trees or weeds all at the same age <10%

Vegetation Health				
Total number of indicators				
Evidence for a prescribed burn based on vegetation health and/ or interval burning	☐ **Very High**	☐ **High**	☐ **Moderate**	☐ **Low**

GHD

133 Castlereagh Street
Sydney NSW 2000
T: +612 9239 7100   F: +612 9239 7199   E: sydmail@ghd.com

2125826-28446/https://projects.ghd.com/oc/Sydney/ipswichfiremanagemen/Delivery/Documents/2125826_ICCbushfireriskassessment.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Chantelle Dominiak	Dominic Adshead	DRAFT	Dominic Adshead	DRAFT	23/12/16
1	Chantelle Dominiak	Dominic Adshead	DRAFT REV1	Dominic Adshead	DRAFT REV1	
2	Chantelle Dominiak	Dominic Adshead	DAdshead	Dominic Adshead	DAdshead	28/03/17
3	Chantelle Dominiak	Dominic Adshead	DAdshead	Dominic Adshead	DAdshead	11/04/17

www.ghd.com

GHD

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Ipswich City Council

Review and Update of Fire Monitoring Program FINAL REPORT

November 2018

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Document Control

Document control						
Report title		Review and Update of Fire Monitoring Program				
Document ID			**Project number**		TR701	
File path		ICC - Review and Update of Fire Monitoring Program/Project Deliverables – Reports/Review and Update of Fire Monitoring Program				
Client		Ipswich City Council	**Client contact**		John Young	
Rev	**Date**	**Revision details/ status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	01/10/2018	Draft	Diana Virkki	Diana Virkki / Matti Virkki	Diana Virkki	Cuong Tran
1	22/10/2018	Issued to ICC for review	Matti Virkki	Matti Virkki	Diana Virkki	Cuong Tran
2	19/11/2018	Ten Rivers final amendments	Matti Virkki	Matti Virkki	Diana Virkki	Cuong Tran
3	23/11/2018	Final version	Matti Virkki	Matti Virkki	Diana Virkki	Cuong Tran
Current revision		3				

Table of Contents

1 Program Summary 10

2 Introduction 11

2.1 Objectives 11

2.2 Scope 12

2.3 Program Areas 12

2.4 Fire Monitoring Framework 13

2.5 Fire Management Zones 14

3 Review of Previous Monitoring Program 17

3.1 Introduction 17

3.2 Methodology 18

3.3 Results 20

3.4 Discussion 27

4 Analysis of Historical Data 28

4.1 Introduction 28

4.2 Methodology 29

4.3 Results 30

4.4 Discussion 34

5 Update of Fire Monitoring Program 37

5.1 Introduction 37

5.2 Methodology 38

5.3 Outcomes 39

5.4 Discussion 47

6 Decision Tool 49

6.1 Introduction 49

6.2 Methodology 50

6.3 Results 55

6.4 Discussion 65

7 Training 66

7.1 Introduction 66

7.2 Methodology 67

7.3 Results 68

7.4 Discussion 69

8 Discussion 70

9 Further Recommendations 72

10 References 73

10.1 Full reference list for Chapter 3 review 73

Appendix 1: Spring 2017 Survey Data 75

Appendix 2: Fire Monitoring Program – Operational Document 78

Appendix 3: Assessing Vegetation Condition Within Plot – Supplementary Guide 80

Appendix 4: Baseline Survey Data Sheet 85

Appendix 5: Fuel and Vegetation Monitoring Data Sheet 89

Appendix 6: Post Burn and Fire Assessment Data Sheet 96

Appendix 7: Digital Data Forms 99

Appendix 8: Digital Data Forms – Output Data 106

Appendix 9: Regional Ecosystem TFI Hazard Classes 109

Appendix 10: Updates to NAE FMU – Maps 111

Appendix 11: Update to Fire Monitoring Plots – Maps 115

Appendix 12: Decision Tool Model – Attribute Reference Table 126

Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers 129

Appendix 14: Decision Tool Model – Preliminary Run Results 136

Appendix 15: Decision Tool Model – Preliminary Run Maps 140

Appendix 16: Training Materials 161

Appendix 17: Training Run Survey Data 167

Appendix 18: Decision Tool Model – Fire Risk Assessment Plugin User Guide 172

Appendix 19: Decision Tool Model – Management Action Recommendations 180

List of Tables

Table 1. Management areas within ICC's Natural Area Estate 13

Table 2. Fire Management Zone description across the NAE. 15

Table 3. Key categories for review of the ICC fire monitoring program........ 20

Table 4 – Summary of review findings and recommendations........ 21

Table 5 - Review of historical data – Results........ 32

Table 6 – Recommendations for Fire Monitoring Program based on issues identified in review of historical data. 35

Table 7. Fire monitoring history of the ICC Natural Areas Estate reserves........ 38

Table 8. Updates to existing FMU's........ 45

Table 9. Review and rationalisation outcomes for the ICC fire monitoring plots. 47

Table 10 - Datasets used as attributes within the decision tool model........ 50

Table 11 - Top 20 sites for Risk Management Prioritisation........ 56

Table 12 - Top 20 sites for Conservation Management Prioritisation........ 57

Table 13 – FMP decision tool management action recommendations........ 60

Table 14 - Monitoring Plots Established in White Rock - Spring Mountain Conservation Estate 67

Table 15 - Summary data collected during the training run at White Rock - Spring Mountain Conservation Estate........ 69

Table 16 - Fuel and Vegetation Monitoring Digital Data Form Output Data........ 107

Table 17 - TFI to hazard class lookup table for Regional Ecosystem TFI........ 110

Table 18 - Index of Attribute Names and Descriptions........ 127

Table 19 - Decision Tool Model - Attribute Risk Rating and Scores Table........ 130

Table 20 - Fire History Risk Rating Calculations........ 130

Table 21 - Decision Tool Model - Management Action Triggers and Recommendations........ 131

Table 22 - Vegetation Condition Specific Management Actions........ 134

Table 23 - May 2018 Baseline Survey Data........ 168

Table 24 - May 2018 Fuel Monitoring Survey Data........ 170

List of Figures

Figure 1. Conceptual framework of the fire monitoring program. 14

Figure 2 - Fuel load monitoring data for White Rock - Spring Mountain Conservation Estate. 31

Figure 3 - Fuel load monitoring data for Denmark Hill Reserve 31

Figure 4: Examples of digital data forms for Fuel and Vegetation Monitoring 44

Figure 5. Conceptual framework of Fire Monitoring Program decision tool and parameters for each model. 52

Figure 6 - Field training day with NATs at White Rock - Spring Mountain Conservation Estate 68

Figure 7 - Baseline Survey Digital Data Form 100

Figure 8 - Fuel and Vegetation Monitoring Digital Data Form 101

Figure 9 - Fuel and Vegetation Monitoring Digital Data Form 102

Figure 10 - Fuel and Vegetation Monitoring Digital Data Form 103

Figure 11 - Post Burn and Fire Assessment Digital Data Form 104

Figure 12 - Post Burn and Fire Assessment Digital Data Form 105

Figure 13 - Updated Fire Management Units for Mount Grandchester Conservation Estate . 112

Figure 14 - Updated Fire Management Units for Purga Nature Reserve 113

Figure 15 - Updated Fire Management Units for White Rock - Spring Mountain Conservation Estate 114

Figure 16 - Denmark Hill Conservation Reserve – Fire Monitoring Plots 116

Figure 17 – Haig Street Quarry Conservation Reserve – Fire Monitoring Plots 117

Figure 18 - Hillview Drive Reserve - Fire Monitoring Plots 118

Figure 19 - Ric Nattrass Environmental Park - Fire Monitoring Plots 119

Figure 20 - Purga Nature Reserve - Fire Monitoring Plots 120

Figure 21 - Kholo Enviroplan Reserve - Fire Monitoring Plots 121

Figure 22 - Stirling Road Reserve - Fire Monitoring Plots 122

Figure 23 - White Rock - Spring Mountain Conservation Estate - Fire Monitoring Plots 123

Figure 24 - Flinders-Goolman Conservation Estate - Fire Monitoring Plots 124

Figure 25 - Mount Grandchester Conservation Estate - Fire Monitoring Plots 125

Figure 26 - FMU CS_1 Bushfire Risk Attribute Tab 137

Figure 27 - FMU FG_10 Ecological Risk Attribute Tab 138
Figure 28 - Decision Tool Model Attribute Table 139
Figure 29 - Denmark Hill Conservation Reserve - Risk Scores 141
Figure 30 - Denmark Hill Conservation Reserve - Conservation Scores 142
Figure 31 - Haig Street Quarry Conservation Reserve - Risk Scores 143
Figure 32 - Haig Street Quarry Conservation Reserve - Conservation Scores 144
Figure 33 - Hillview Drive Reserve - Risk Scores 145
Figure 34 - Hillview Drive Reserve - Conservation Scores 146
Figure 35 - Ric Nattrass Environmental Park - Risk Scores 147
Figure 36 - Ric Nattrass Environmental Park - Conservation Scores 148
Figure 37 - Purga Nature Reserve - Risk Scores 149
Figure 38 - Purga Nature Reserve - Conservation Scores 150
Figure 39 - Kholo Enviroplan Reserve - Risk Scores 151
Figure 40 - Kholo Enviroplan Reserve - Conservation Scores 152
Figure 41 - Stirling Road Reserve - Risk Scores 153
Figure 42 - Stirling Road Reserve - Conservation Scores 154
Figure 43 - White Rock - Spring Mountain Conservation Estate - Risk Scores 155
Figure 44 - White Rock - Spring Mountain Conservation Estate - Conservation Scores 156
Figure 45 - Flinders-Goolman Conservation Estate - Risk Scores 157
Figure 46 - Flinders-Goolman Conservation Estate - Conservation Scores 158
Figure 47 - Mount Grandchester Conservation Estate - Risk Scores 159
Figure 48 - Mount Grandchester Conservation Estate - Conservation Scores 160
Figure 49. Fuel layer classes as classified in OFHAG (Hines *et al*. 2006). 164

Acronyms

AFAC	Australasian Fire and Emergency Service Authorities Council
ANZECC	Australian and New Zealand Environment Conservation Council
BVG	Broad Vegetation Group
DBH	Diameter at Breast Height
EVNT	Endangered, Vulnerable, Near Threatened
EVR	Endangered, Vulnerable, Rare
FMP	Fire Monitoring Program
FMSP	Fire Management Strategic Plan
FMZ	Fire Management Zone
FMU	Fire Management Unit
GIS	Geographic Information Systems
ICC	Ipswich City Council
NAE	Natural Area Estates
NAT	Natural Areas Team
NT	Northern Territory
OFHAG	Overall Fuel Hazard Assessment Guide
QPWS	Queensland Parks and Wildlife Service
RE	Regional Ecosystem
SEQ	Southeast Queensland
SEQFBC	Southeast Queensland Fire and Biodiversity Consortium
TFI	Tolerable Fire Interval
WUI	Wildland-Urban Interface; defined as areas where homes are built near or among lands prone to wildland fire.

1 Program Summary

Ten Rivers was contracted by Ipswich City Council to:

- *Conduct a review and update of Council's existing fire monitoring program, processes, procedures and documentation to ensure alignment with the broader fire management strategy for the Natural Area Estate (NAE).*

In order to achieve this, the scope of the project as outlined by ICC was:

- Review, identify improvements, and update the following documentation/resources as required:
  - Fire Monitoring Program – Ipswich City Council – Maunsell/AECOM (May 2005)
  - Field Assessment Data Sheets including (but not limited to):
    - Establishing New Site Sheet (Form 1)
    - Fire Management – Fuel Load Monitoring Data Sheet (2017)
    - Fire Management – Vegetation Condition Monitoring Data Sheet (2017)
    - Post Burn Fire Behaviour Data Sheet (Form 4)
- Review existing monitoring assessment data captured since 2003 to present and recommend relevance and options for its future use in the updated Fire Monitoring Program
- Update monitoring plot locations through the establishment of new locations and deletion of old locations where necessary and provide Council the process used for any future plot inclusions or exclusions
- Undertake a field assessment run with relevant Council staff to familiarise them with updated procedures, process and locations
- Develop/provide a Data Analysis/Decision Tool for site prioritisation that includes geospatial capacity and incorporates both fuel hazard and vegetation condition where applicable across the NAE
- Input new monitoring assessment data captured using updated sheets and locations into the Data Analysis/Decision Tool for the consideration of prioritised site selection for the 2018/19 Fire Program.

The objectives of this project were to reduce bushfire risk to life, property and built assets and the biodiversity and ecological health of the NAE. After ICC's recent review of their broader Fire Management Program, and an updated strategic approach, the project aimed to update the Fire Monitoring Program to align with these updated objectives and strategic approach, as outlined within the Fire Management Strategic Plan (GHD, 2017).

This report details the methodology and processes used in this project, to complete the scope as outlined above.

2 Introduction

The management of fire risk and the ecological health of the Ipswich City Council's (ICC) Natural Area Estate (NAE) is a critical delivery element for the Council. Bushfire respects no boundaries or land tenures. Its impacts on people and the environment can be profound and long-lasting, and recovery can be slow. Due to the location of the Ipswich government area, Ipswich has a high bushfire risk caused by relatively dry weather conditions, a dominance of dry eucalypt forest and large patches of contiguous forest abutting residential blocks in a rapidly-developing region. With a projected doubling of the current Ipswich population of 200,000 by 2031 (South East Queensland (SEQ) Regional Plan), the risk of fires within the expanding wildland-urban interface (WUI) will also increase.

Monitoring and evaluation is a key component of any successful fire management program (AFAC 2016, AFAC 2017, ANZECC 1999). ICC has a strong commitment to bushfire management and awareness, through contributions to bushfire management, participation on emergency management committees, membership and contribution to the SEQ Fire & Biodiversity Consortium (SEQFBC), development of the recent ICC Fire Management Strategic Plan (GHD 2017), and the current project and process of reviewing and updating their fire monitoring program to stimulate bushfire monitoring in the region.

ICC initiated a Fire Monitoring Program developed by Maunsell in 2005, and since then program has seen the implementation of monitoring plots in seven estates within the NAE. In 2017, ICC conducted a review of their overarching fire management program, which led to an updated Fire Management Strategic Plan (FMSP) developed by GHD. The updated FMSP had the aim of providing a planning framework with which council could prioritise the management of NAE areas in relation to the risk profiles of each estate. Building off the profiles detailed in the FMSP, the update of the Fire Monitoring Program will provide a robust and efficient methodology of data collection and analysis. This will further justify the prioritisation of management actions across the NAE, ensuring risk profiles adequately represent the risk to life and property, including the risk to ecological values, as per the primary objectives of the FMP.

2.1 Objectives

ICC has two primary objectives across the NAE; that are therefore key goals of the fire monitoring program:

1) Risk reduction and the protection of life and property, and
2) Conservation of biodiversity and ecological values.

This project will therefore align to these two objectives while meeting ICC's requirements of this project, to develop:

a) A document outlining the fire monitoring program (and associated procedures) that aligns with Council's recently adopted strategy for fire management (GHD 2017);
b) Monitoring datasheets tailored to the type of management purpose;
c) Rationalisation of fire monitoring plots including the number of sites, location and assessment frequency are optimised and documented;

d) Assurance that the data collected is clear, accurate and evaluates monitoring and performance at both a project site and program level;
e) A data analysis/decision tool to select prioritised sites combining data repositories and geospatial representation;
f) Council staff are familiarised with the implementation of the updated fire monitoring procedures.

To achieve these objectives, we aimed to streamline ICC's fire monitoring program by developing a program that is targeted, aligns directly to strategic goals and land management objectives, and is optimised through efficient digital data collection forms that input into a geospatial decision-making tool.

2.2 Scope

The overarching scope of this project is to review and update the fire monitoring program of ICC's ten NAE Conservation Estates and Conservation Reserves. This report is therefore split into five results chapters to encapsulate this scope, as follows:

- Review of previous monitoring program: a desktop review of the Maunsell (2005) fire monitoring program;
- Analysis of historical data: collation, comparison and analysis of historically collected data by ICC and description of its applicability for use in further analyses;
- Update of monitoring program: a description of the updates recommended to the fire monitoring program, including the purpose, updated methods, update of monitoring data sheets and update of monitoring plots;
- Decision tool: a description of the development, inputs, analyses and outputs to the decision tool;
- Training: a description of the training and tools developed to deliver a training run for ICC's staff.

The focus is on a monitoring program that targets the two primary objectives of ICC's NAE: risk reduction and conservation. The new monitoring program and decision tool are designed to streamline and align the fire monitoring program to ICC's objectives and ensure the data collected is applicable and incorporated into an adaptive fire management framework.

2.3 Program Areas

ICC manages approximately 6,672 hectares of conservation land across ten reserves as part of its NAE (Table 1). This includes a range of urban, peri-urban to rural bushland areas of varying sizes and management requirements. The NAE is also exposed to residential and other infrastructure developments (current and planned), which places additional pressures on risk management of bushfires for Council. The NAE comprises of a variety of vegetation communities from semi-evergreen vine thickets to mixed eucalypt forests that house endangered flora and fauna, and lasting stands of endangered vegetation communities including the swamp tea-tree (*Melaleuca irbyana*) and Brigalow (*Acacia harpophylla*) (ICC 2015b). The diversity of vegetation communities poses interesting and varied fire management requirements; with fire dependent ecosystems and those threatened by too frequent, too high intensity or too infrequent fires.

Table 1. Management areas within ICC's Natural Area Estate.

Management Area	Location	Size (ha)
Denmark Hill Conservation Reserve	Urban	12
Haig Street Quarry Conversation Reserve	Urban	23
Hillview Drive Reserve	Urban	37
Ric Nattrass Environmental Park	Urban	14
Purga Nature Reserve	Peri-urban	138
Cameron's Scrub Conservation Estate (Kholo Enviroplan Reserve)	Peri-urban	160
Stirling Road Reserve	Peri-urban	33
White Rock – Spring Mountain Conservation Estate	Peri-urban	2,992
Flinders-Goolman Conservation Estate	Rural	2,200
Mt Grandchester Conservation Estate	Rural	973
	Total	**6,672***

2.4 Fire Monitoring Framework

The key to a successful monitoring program is to develop a clear monitoring framework that firstly includes a conceptual model (AFAC 2016, AFAC 2017, ANZECC 1999). This allows for clear identification of the objectives, where monitoring aligns, and how this is used to guide decisions in the future. Despite the essential role of monitoring and evaluation to improve and enhance land management programs, it is often regarded as an afterthought to management activities. Council recognises this and with this review of the bushfire monitoring program, the components of monitoring and evaluation has been integrated into an overarching management framework, to result in a more powerful resource to guide future land management across the NAE. The monitoring and evaluation then directs decision making, rather than completed *ad hoc* (AFAC 2016, AFAC 2017, ANZECC 1999).

ICC has two primary objectives across the NAE that are the focus of the fire monitoring program: risk reduction and conservation. The fire monitoring program must therefore be strongly aligned to these two opposing purposes. The fire monitoring program is therefore based on the conceptual framework shown in Figure 1. This framework forms the basis of the fire monitoring program and the decision tool; linking data collected on the ground to fire management zones that represent ICC's key priorities and drive management decisions.

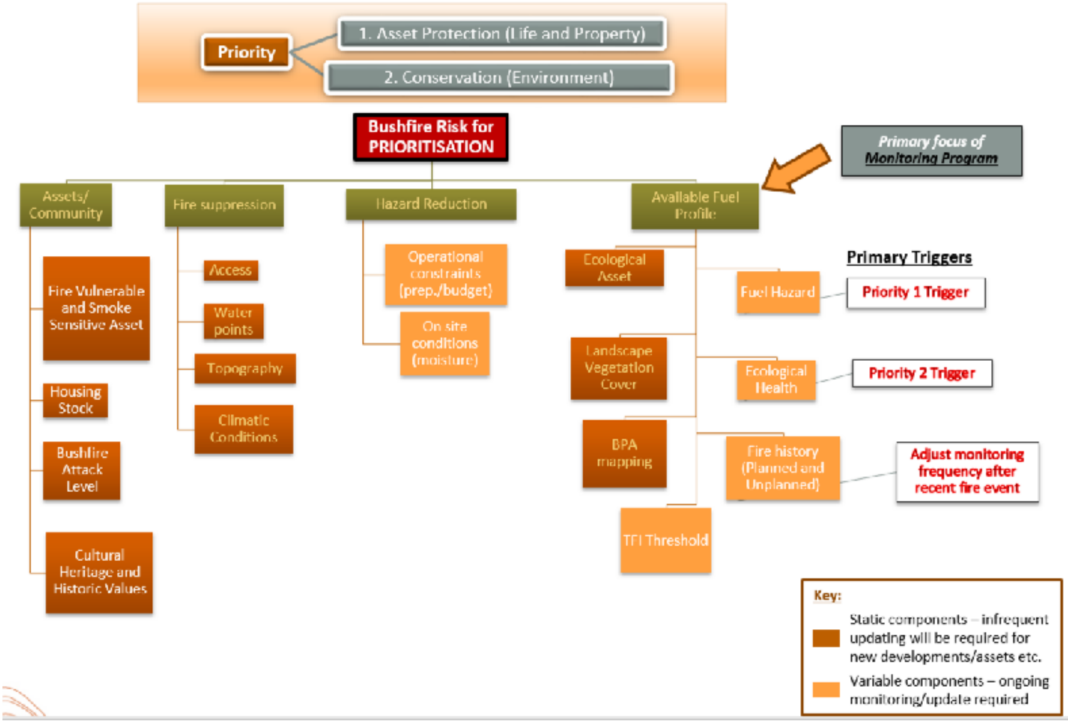


Figure 1. Conceptual framework of the fire monitoring program.

2.5 Fire Management Zones

The FMSP describes seven fire management zones (FMZ) across ICC's NAE (GHD 2017). For the purposes of this project, we have utilised these zones, as mapped in GHD (2017), and provided some minor recommendations on these (Table 2). Discussions with ICC have revealed that the FMZ across the NAE are currently in development and may be amended in the future. The zones and their objectives, however, are unlikely to change significantly. Additionally, the location and management options for each FMZ block is currently aligned to the NAE fire trail network, and therefore manageability and prescribed burning options are also unlikely to change. We therefore deemed the application of the FMSP FMZ's sufficient for the purposes of this project.

The fire management zones used in the FMSP are based on those identified by Queensland Parks and Wildlife Service (DNPRSR 2013b) (Table 2). For Protection and Wildfire Mitigation zones the overall fuel hazard (OFH) (based on Hines *et al.* 2010) or overall fuel load (tonnes per hectare based on DNPRSR 2012) is listed as a trigger for requirement of treatment, as informed by fuel monitoring. This project has reviewed the use of these triggers, which is further detailed and described in Chapters 3 and 6. This project recommends moving away from using a t/ha approach and focussing on structural fuel features that are detailed through the OFH guide (Hines *et al.* 2010) using a risk-based approach. The recommendations on the current FMZ's and objectives of these are briefly described in Table 2.

Table 2. Fire Management Zone description across the NAE.

Zone class	Description/ objectives (GHD 2017)	Recommendations	Areas of occurrence
Protection	To provide a high level of protection to life, property and infrastructure. Fuels should be maintained at relatively low levels by planned burning (as often as fuel levels allow) or other means (such as mechanical). Fuel reduction is scheduled when overall fuel hazard (OFH) exceeds low to moderate OFH (based on Hines *et al.* 2010) or 5 tonnes per hectare (based on DNPRSR 2012). Area treated target is 90%.	Focus on OFH only.	ICC fire vulnerable assets
Wildfire Mitigation	To increase the likelihood of controlling a wildfire in strategically important areas within a reserve. Planned burning is used to simplify the structure, and reduce the quantity of fuel to mitigate flame height, spread and intensity; to aid suppression effectiveness and improve wildfire controllability. Planned burns are completed generally at the lower end of a recommended fire frequency to maintain fuels at an OFH < HIGH or ≤ 8 tonnes per hectare. Area treated target is 60-80% of the block.	Focus on OFH only. Aim for an altered forest structure that is conducive to reduced risk (i.e. removal of shrub/elevated fuel). This can be achieved through mechanical mulching as well as frequent prescribed burning.	White Rock – Spring Mountain Conservation Estate, Mount Grandchester Conservation Estate, Haig Street Quarry Conservation Reserve, Flinders - Goolman Conservation Estate
Conservation	To maintain the natural role of fire as an ecological process.	Focus on vegetation condition. Conservation zones should include the frequent use of low intensity fires within vegetation communities that require such inputs to create a landscape mosaic.	Kholo Enviroplan Reserve, White Rock – Spring Mountain Conservation Estate, Mount Grandchester Conservation Estate, Haig Street Quarry Conservation Reserve,

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Zone class	Description/ objectives (GHD 2017)	Recommendations	Areas of occurrence
		Area treated target (where required) 50-75% of the block in a mosaic pattern.	Flinders Goolman Conservation Estate
Sustainable Production	To maintain sustainable production and use of forest products (such as timber, foliage, pasture, carbon, off set plantings).		Purga Nature Reserve, Mount Grandchester Conservation Estate
Rehabilitation	To combat a threatening process that cannot be addressed by the usual fire management practices.		Nil NAE
Reference	To monitor long-term effects of landscape change, such as fire regimes, wildfires or fire exclusion on nature conservation values.	Focus on vegetation condition. The reference sites should be treated as conservation areas. Current management for the Purga Nature Reserve reference sites include "fire exclusion", in areas where the endangered Swamp tea-tree occur, therefore this needs review based on the Tolerable Fire Interval of the species.	Purga Nature Reserve
Exclusion	To exclude fire totally (and actively). This may include areas such as former mining sites where there is the potential for coal tailings to be ignited or ecologically sensitive areas which are very susceptible to planned and unplanned fire impacts.		Denmark Hill Conservation Reserve, Flinders-Goolman Conservation Estate, Stirling Road Reserve

3 Review of Previous Monitoring Program

3.1 Introduction

ICC initiated a Fire monitoring program in 2005, which was developed by Maunsell (2005). The program recommended the establishment of permanent monitoring plots within three major conservation estates – White Rock - Spring Mountain Conservation Estate, Purga Nature Reserve, and Flinders-Goolman Conservation Estate. These monitoring plots were surveyed bi-annually, in the peak of the "dry season" and the peak of the "wet season", to determine average fuel loads and the season in which fuel load build-up was the most rapid. In 2010, and the years following, the program was expanded to integrate some of the smaller urban and peri-urban estates, with monitoring plots established across most of the sites comprising the NAE by the end of 2011. Over the next six years the program underwent several phases of fine tuning, eventually integrating Overall Fuel Hazard, as per the OFH Guide (Hines *et al*, 2010), and an assessment on vegetation condition which would allow the program to better align to conservation actions and values within the NAE.

Ten Rivers has been contracted by ICC to conduct a review of the previous Fire Monitoring Programs, in order to identify opportunities to streamline the program though the application of science-based, best-practice knowledge and research. The review encompasses several documents, plans and programs that made up the previous program including the Fire Monitoring Program (Maunsell, 2005), the Fire Management Strategic Plan (GHD, 2017) and the Natural Area Estate Fire Management Policy (ICC, 2015). The review also encompasses several best-practice guides and relevant scientific literature, to ensure the program update reaches the most suitable outcome for ICC.

3.1.1 Objectives

The objectives of this chapter were:

1) To complete a comprehensive review of the monitoring program, the Ipswich Fire Management Strategic Plan (2017), and the scientific literature and best-practice guidelines to identify the key criteria for efficient fire monitoring.

2) Determine gaps in the previous monitoring program and make recommendations for changes in the updated program.

3.1.2 Scope

The scope of this chapter is to review all documents that constituted or contributed to the previous ICC Fire Monitoring Program, primarily the Maunsell Fire Monitoring Program (2005). Aside from the Maunsell report, the other documents include:

- Ipswich Fire Management Strategic Plan (GHD, 2017)
- Ipswich Natural Area Estate Fire Management Policy (ICC, 2015)
- Ipswich Nature Conservation Strategy Background Report (ICC, 2015)

- Ipswich City Council Biodiversity Monitoring Project: Report (Queensland Herbarium, 2016).

The scope also includes a review of the relevant best practice, science-based literature that was used to update and streamline the program. A full reference list for this review can be found in Chapter 11.1

3.1.3 Program Areas

The previous fire monitoring program was developed to establish monitoring plots across three conservation estates within the NAE:

- White Rock - Spring Mountain Conservation Estate
- Purga Nature Reserve
- Flinders – Goolman Conservation Estate

The data collected at the initial monitoring points established during the development of the program was used to drive fire management and biodiversity conservation action within these three major estates.

The review of the program assessed the suitability of the program across these estates as well as the programs later use in four other estates that are part of the NAE:

- Denmark Hill Conservation Reserve
- Haig Street Quarry Conservation Reserve
- Hillview Drive Reserve
- Stirling Road Reserve.

3.2 Methodology

3.2.1 Assessment of key criteria

We first identified the key goals and directions of the fire monitoring program, and any issues or site-specific requirements. This was assisted by completing a detailed review of the recently adopted Ipswich Fire Management Strategic Plan (FMSP) (2017) to identify the key criteria for the fire monitoring program for review.

A desktop-based review of the recent literature and publications in fire management was undertaken to identify useful contributions to determine the best-practice approach for fire monitoring. Findings were summarised and assessed for inclusion into the fire monitoring program.

A list of key criteria for the fire monitoring program was developed from the above to utilise in the review.

3.2.2 Gap analysis

Using the key criteria (as above) as reference, an in-depth review of ICC's current fire monitoring program was conducted. This included an assessment of:

- Data collected
- Monitoring sites and replication of plots
- Usefulness of the monitoring data
- Previous outcomes of the program and if goals are being met
- Measurable risk reduction across the estates (i.e. based on wildfire history)
- Overall effectiveness of the program.

This review was based primarily on the Maunsell (2005) report that details the previous ICC fire monitoring program. Processes and procedures that require improvement were identified. Since the implementation of the Maunsell (2005) fire monitoring program, ICC have made amendments to the monitoring data sheets, information collected, and surveys completed (which now includes a vegetation condition assessment). These amendments were referenced in the review.

3.2.3 Limitations and Assumptions

- The review assumes all relevant documents relating to the previous Fire Monitoring Program were supplied by ICC, and that the program did not utilise methodology or procedures from other programs.

3.3 Results

3.3.1 List of key criteria

Review of the FMSP (GHD 2017) and external literature identified ten key categories used as the basis of the fire monitoring program review. Priority risk factors sourced from the FMSP were classed within these categories, along with a list of other key assessment criteria determined during the review (Table 3 and 4). These were then used to make recommendations for improvement on the fire monitoring program (Table 4). A full review bibliography can be found in Chapter 11.1

Table 3. Key categories for review of the ICC fire monitoring program.

Categories	Risk Factors from FMSP (GHD 2017)
Built asset	Bushfire Attack Level Risk D Housing Stock Risk F Fire Vulnerable and Smoke Sensitive Asset Risk G
Burn monitoring	N/A
Environmental	Ecological Health Risk B Ecological Asset Bushfire Sensitivity Risk A
Fire history	N/A
FMZ objectives	N/A
Framework	N/A
Fuel monitoring	N/A
Landscape risk	Fire Severity Risk C (BPA) Landscape Vegetation Cover Risk H Fire Suppression Risk I (topography)
Outcomes	N/A
Overall review	N/A

Table 4 – Summary of review findings and recommendations.

Category	Key assessment criteria	Recommendations
Built asset	Bushfire Attack Level Risk D Housing Stock Risk F Fire Vulnerable and Smoke Sensitive Asset Risk G	New FMZ design and the monitoring program should incorporate risk to built assets as per the FMSP (BAL risk, housing stock risk and sensitive assets). This should be embedded into the future decision tool to prioritise areas, with infrequent updating required. For all built assets - recommendations need to be aligned to council's City Plan.
Burn monitoring	Burn monitoring	During and post-burn monitoring should be completed consistently with data that aligns to the fuel risk analysis, incorporating factors such as fuel, weather, FMC, fire behaviour, smoke etc. if not already covered within operational burn planning. The data collected during a fire (prescribed or wildfire) on the days conditions or fire behaviour is vital to identify outcomes and success of the burn.
Environmental	Ecological Health Risk B	This information should be incorporated into the future decision tool with specific operations tasks linked to individual outcomes that relate to fire, i.e. weeds, if post-burn regeneration is a dense monoculture of Acacias, prescribed burning after one-year or mulching to reduce the density should be considered. These outcomes should be identified as triggers in the monitoring program. Post-fire weed management should be completed when post-fire monitoring identifies weed regeneration. This will achieve better environmental outcomes of the burn program.
	Ecological Asset Bushfire Sensitivity Risk A	To meet one of the two key priorities to the ICC of conservation/environmental assets, flora and fauna monitoring should be incorporated into the new program. This may include monitoring at infrequent intervals, where FMZ objectives specifically relate to conservation (conservation zones), where EVNT species are known to occur, or post-wildfire. Fire exclusion may not be the best objective for certain environmentally significant areas, however if it is, how this is operationally implemented is key, i.e. frequent burning in surrounding FMZ to reduce fire movement into the exclusion zone. Statistical analysis that highlights the error/uncertainty in the data is also important so that acceptable levels of change are not misinterpreted.
	Grazing Pressure	If grazing is permitted in reserves in the future, grazing pressure should be incorporated into the monitoring program. Grazing can reduce fuel loads but may also have environmental impacts through a reduction in native species, spreading of weeds or erosion.
Fire history	Maps of fire scar boundaries are collected, stored and analysed using increasingly sophisticated GIS tools and are one of the most fundamental	Fire information, including recent fire, fire history (where available, wildfires at a minimum) and fire regimes (ecological) should be collected and incorporated into the fire monitoring program, and embedded into the future decision tool to drive future prioritisation of bushfire mitigation. However, this should also be tied to on ground condition, as the REDD database fire management recommendations are imperfect and on ground

Category	Key assessment criteria	Recommendations
	ecological evaluation and planning tools.	monitoring should be able to drive fire regime decisions. The method for this should be explicitly described and incorporated into the regular program.
FMZ objectives	Strategic objectives include broad organisational level goals that are further detailed through performance measures that allow an organisation to monitor the success of burn programs.	Organisational goals that have clear performance measures should be incorporated into the monitoring program to allow overall program tracking.
	Objective That Council's natural area estate will be managed to protect life and property from wildfire while planning, manipulating and utilizing fire to maintain or enhance environmental values.	Incorporate all reserves in NAE to program, align monitoring with new FMZ with specific, measurable objectives, that incorporate risk-based trigger points, to allow tracking of trends and effectiveness of the program.
	Aim of FMS: • Maintain ecologically appropriate fire frequencies, distribution, seasonality and intensity	Align monitoring with new FMZ with specific objectives; those with conservation goals should highlight the Tolerable Fire Intervals and if these are being met. Detailed information regarding any fires on the estates should be included into the monitoring program. Further, this information should feed into the future decision tool.
	Aim of FMS: • Ensure cultural heritage and historic values within and around the estate are protected; and	Align monitoring with new FMZ with specific objectives that includes cultural heritage and historic values.
	Aim of FMS: • Minimise social impacts and hazards associated with smoke	The new Ipswich FMSP described social and smoke impacts, these should be identified and utilised within the future decision tool.
Framework	Well-developed partnerships between practitioners, scientists and policy makers	The SEQ FBC is a useful avenue for information and collaboration, this relationship should be maintained with frequent attendance at meetings.
	Within a land and fire management context, prescribed burn monitoring and evaluation ought to be part of a management system. Often monitoring and evaluation has been undertaken as	Develop a clear monitoring framework that firstly includes a conceptual model, clearly identifies the objectives, where monitoring fits in, and how this is used to guide decisions in the future. This will drive the future decision tool.

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Category	Key assessment criteria	Recommendations
	an afterthought to management activities. However, monitoring and evaluation is powerful if integrated into a management framework. In such a framework, monitoring and evaluation would ideally lead decision making, rather than being done as an afterthought to management activities.	
	The adaptive management cycle is a well-documented and understood approach to management and monitoring that involves planning, implementing actions, monitoring the outcomes of the actions, analysing and then reporting the results and adjusting planning and implementation in relation to the results in a continuous cycle.	Ensure data application is clearly identified in the monitoring program, and utilised and applied in the future decision tool, to drive land management practices through use of an adaptive management program.
	The monitoring is well documented (including objectives, methods, data analyses required, roles and responsibilities, approvals and reporting cycles). And the monitoring has a clear business case to ensure it has organisational and funding support	Clearly identified objectives, data analyses, roles and responsibilities, approvals and reporting cycles is required and will further assist with the development of a clear business case that ensures the program remains appropriately funded.
	Monitoring has appropriate leadership and sponsorship	A clear outline of the objectives for each FMZ including measurable outcomes, will allow for further justification and support for budgetary requirements. Clearer detail on program, responsibilities and budgetary requirements should be outlined within the new program.
	There is a commitment toward on-going funding, resourcing, data analysis and regular reporting.	A detailed assignment of roles within the monitoring program is required with a clear participation model that incorporates funding, resourcing, data analysis and regular reporting, for managers, implementers and stakeholders. Some level of stakeholder engagement should be employed as part of the monitoring program. The relevant stakeholders should be made aware of the monitoring program requirements and feedback into

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Category	Key assessment criteria	Recommendations
		the fire management program, where their input may be relevant and required (i.e. assistance from QFES for prescribed burning etc.)
Fuel monitoring	Maintenance of data quality and consistency of field methods.	Recording QA is useful to ensure the checking processing is completed consistently. This can be done by adding a column to data tables for QA check sign off
	Experiment or survey design is tailored to the problem at hand and tailored to test the objective or question(s);	Plot selection should target objectives of specific FMZ's and burn blocks
	Condition monitoring • Repeated monitoring at defined time intervals rather than in response to a management action. This monitoring provides a baseline against which changes in condition can be measured. It includes the state-wide fuel moisture monitoring network and the Victorian Forest Monitoring program.	Continued frequent monitoring is required however this will need to be rationalised and prioritised, given the addition of estates within the NAE, ongoing budgetary constraints etc. Use of the future decision tool will assist in this process.
	A sampling strategy which is robust, repeatable and independent of the individual doing the sampling	The monitoring methods require update to meet updated research and best practice, however it is acknowledged that visual fuel guides can be subjective. Clear guidelines on the data sheets, clear training information and an incorporation of various methods (i.e. QPWS guide for load estimates) is required to achieve the best outcome.
	The size and number of plots should reflect the level of reliability required of the results.	Ensure replication is suitable to the level of detail required and prioritisation of FMZs
	For surface, near-surface and elevated fuel layers the result of assessing the plot should reflect the average state of that fuel layer.	Ensure that the updated data sheets are clear in stating an average measurement is required for surface, near surface and elevated fuels.
	For bark hazard the result of assessing the plot should be based on the trees with the highest rating.	Ensure that the updated data sheets are clear and state that the highest rating should be used for overall bark hazard.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Category	Key assessment criteria	Recommendations
	Always record with the result the name and the version of the guide used.	An additional tab should be included that allows recording of the version used, so that the data sheets are able to be used in the future with later versions.
	Consider fuel arrangement - Consider how the arrangement of fuel at your site could moderate fire behaviour predicted from previous steps; especially if there is a large amount of available elevated fuel or high biomass grasses.	If the data sheets are being completed without reference to the OFH guide book, the importance of certain structural characteristics may be missed. Additionally, the OFHG has some shortfalls, where certain structural aspects are not prioritised, e.g. connectivity of elevated fuels. Ensure the data sheet have a clear outline of the identifying characteristics.
	Adaptive management framework (gather info before, during, after fire, present/interpret information, evaluate and improve management)	Ensure that the last aspects of adaptive management are incorporated into the program, i.e. present/interpret information, evaluate and improve management. Outlining clear objectives for the FMZ will allow for evaluation and improvement of the management program.
	For consistency: mark plots permanently (e.g. stakes), so that the exact plot can be revisited	Ensure any additional/new monitoring plots are permanently marked.
	Baseline information on each plot - objectives, location, history/land use, characteristics, vegetation type and fire history	Updated baseline data sheets should include further details that relate to FMZ, overall objectives and specific management objectives - these can be driven by site-based conditions i.e. weed issues.
	Photo point monitoring	Consistency in photo point monitoring should be incorporated, where photos accompany each fuel assessment. This should be included into the new data sheets so that they are not forgotten during monitoring. It is also recommended that four photos be taken at each site representing north, east, south and west so that all directions are covered, and more landscape variation is visible.
Landscape risk	Monitor landscape/fuel drying indicators to determine when suitable burning conditions are approaching.	Grass curing can vary significantly with landscape conditions. Landscape/fuel dryness indicators (i.e. KBDI) at a broad scale should also be imbedded into the decision tool to prioritise areas for burning or highlight risk of wildfire. This should be part of regular data collation.
	Access Risk E - Maintain fire trails in accessible and stable condition, as per	The survey track inspection program has clear linkages to fire monitoring. How these align should be investigated by ICC and streamlined where necessary. Recommend at a minimum to incorporate trail assessment notes into the fire monitoring program and ensure this is incorporated into the future decision tool.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Category	Key assessment criteria	Recommendations
	the NAE Standard (Service Tracks and Firebreaks)	
	Fire Severity Risk C (BPA) Landscape Vegetation Cover Risk H Fire Suppression Risk I (topography)	Incorporate BPA mapping, context and vegetation cover, and topography risk into monitoring program, and ensure this is incorporated into the future decision tool.
Outcomes	Repeated use of data	Ensure use of the data and analysis methods are clearly determined and identified in the update of the monitoring program, and that data is collected in a manner that enables efficient analysis.
	Results are reported and made available in a way that is accessible to planners and those implementing fires	Ensure use of the data, and the dissemination and communication of results are clearly outlined as part of the monitoring program.
Overall review	Data collected	Fuel load data collected based on the OFHG is not 100 % reliable as it is based on assumptions and broad ranges. Therefore, the hazard classes should also be utilised with a focus on a risk-based approach. Additionally, the monitoring program should be aligned to detailed and measurable objectives, with a clear outline of the application and analyses of the data, prior to determining which metrics to collect or enter online.
	Monitoring sites and replication of plots	Monitoring sites and replication should be aligned to FMZ's and their objectives.
	Usefulness of the monitoring data	Fuel load data collected based on the OFHG is not 100 % reliable as it is based on assumptions and broad ranges. Therefore, the hazard classes should also be utilised with a focus on a risk-based approach. Additionally, the monitoring program should be aligned to detailed and measurable objectives, with a clear outline of the application and analyses of the data, prior to determining which metrics to collect or enter online. Further, a detailed investigation into the raw data should be undertaken to determine if the data previously collected is worth analysing.
	Previous outcomes of the program and if goals are being met	Clear, measurable objectives need to be developed aligning to the FMZ's, which will assist with evaluation of the fire program and determining if objectives are met.

3.4 Discussion

An integral component of a successful monitoring program is to develop a clear monitoring framework (AFAC 2015), which will allow for clear identification of the objectives of the program, where monitoring aligns, and how this can be used to guide management activities. The key findings of this review indicated that in order for the FMP to better reflect ICC's aims for the program, it will require clear objectives that align to the FMZ and ICC's goals. The program will also require clear guidelines on data management, analysis and application, and a realignment of monitoring and data collection methodologies, including an evaluation of primary metrics used to drive objectives.

As per the previous FMP (Maunsell, 2005), the purpose of the program was for ICC to achieve its management responsibilities in "protecting life and property while maintaining and embellishing biodiversity." In order to align to the objectives of the FMZs, and the goals within ICC's FMSP and the NAE Fire Management Policy, the programs purpose should be refined and expanded to represent an objective based approach. As can be seen in Table 4, this will require the program to be streamlined to allow direct application of data into decision making, thus driving management outcomes. This will limit collecting data for the purely for the sake of monitoring, and instead ensure that all data collected for the program will serve a purpose.

The use of fuel loads as the primary indicative measure of bushfire risk within the previous FMP creates an issue of subjectivity and variability within the program data. This issue has been identified by other organisations conducting similar monitoring programs (Volkova *et al*. 2016) and has seen the industry move towards a more robust and indicative risk-based approach, where assessments are based on fuel structure. The Overall Fuel Hazard (OFH) assessment has become standard in Victoria and is currently used by other LGA's in Queensland and New South Wales. It is recommended this risk-based approach be adopted for all future monitoring to better align the monitoring data with management objectives.

To align the updated FMP to the FMSP (GHD, 2017) and its priorities, the addition of several variables into the monitoring program is required. The development of a decision tool model, which is included within the scope of the update to the FMP, will drive this process and ensure the integration of information and priorities based on the risk factors outlined in the FMSP. The decision tool will allow for integration of surrounding landscape risk and housing risk data with on-ground conditions (e.g. OFH, vegetation condition) to deliver a streamlined, adaptive monitoring program that provides robust management outcomes.

The overall scope in which a monitoring program is applied will determine how accurate and representative the monitoring data is in regard to the land areas being managed. Whilst the previous monitoring program recommended bi-annual monitoring to quantify fuel load changes between the wet and dry season, most industry standard methodology for fuel monitoring recommends yearly monitoring (AFAC 2016, SEQFBC 2002). In terms of cost efficiency for a program, the shift to annual as opposed to bi-annual monitoring will greatly increase the ability of the NAE teams to collect a broader range of data across more monitoring plots in each estate. This in turn will help create a more representative, robust set of data for each monitoring round, as a higher number of individual monitoring plots assessed each year will provide a better indication of smaller scale changes in risk between FMU's within each estate.

4 Analysis of Historical Data

4.1 Introduction

ICC have been collecting fire monitoring data within the current program for 14 years. A significant amount of resources and effort have gone into conducting and maintaining the fire monitoring program across the NAE.

The primary form of data collected as part of the fire monitoring program was fuel load (t/ha) estimations. The adoption of the Overall Fuel Hazard Assessment Guide (Hines *et al*, 2010) as a best practice tool by many organisations tasked with fire management saw ICC integrate additional survey techniques into their fire monitoring program in the last few years. From 2015, ICC initiated recording Overall Fuel Hazard (OFH) data as well as estimating the fuel load. Further to this, in 2016 ICC developed and implemented the use of a vegetation condition assessment tool with the aim of tracking and quantifying conservation values within the NAE.

One of the primary objectives of this project was for Ten Rivers to review the previous Fire Monitoring Program, and a key component of this is the review of the data collected as part of the program, and the analysis and outcomes of this data collection. This involves accessing and collating all available historical data that was collected under the previous Fire Monitoring Program, as well as reviewing any previous analysis conducted by ICC that utilised historical data from the program.

4.1.1 Objectives

The objectives of this chapter were:

1) To collate, compare and analyse historically collected data by ICC and describe its applicability for use in further analyses.
2) To determine the applicability of ICC's previously collected data for use in the decision tool.
3) To review previously used analysis techniques and outcomes of historical analysis to determine suitability for future use.

4.1.2 Scope

For the purposes of this analysis, all historical data that was available and provided by ICC for two NAE reserves of focus was collated, with consideration of fuel load, fuel hazard, and vegetation condition assessments. The most recent survey data available for all the NAE reserves was also part of this analysis.

Data collected as part of the FMSP (GHD, 2017) was also collated for review and analysis in order to ensure historical data aligned with objectives of the strategic plan and program.

Digital excel sheets used for previous analysis of historical data from all estates were also made available by ICC and reviewed.

4.1.3 Program Areas

The analysis of data for use in the decision tool incorporated all ten reserves within the NAE, to ensure that a sufficient baseline dataset was available to feed into the decision tool and use for manipulation and development of the model.

The focus of the historical data analysis was on two reserves within the NAE:

- Stirling Road Reserve (33 ha) – peri-urban, and
- Haig Street Quarry Conservation Reserve (23 ha) - urban.

These two sites were chosen due to their relatively small size, mixed history and objectives, as well as relatively consistent long-term data collection.

The north of Stirling Road Reserve comprises a regenerating vine forest that is a very high ecological risk asset, classed as an Exclusion FMZ. The remaining three blocks of Stirling Road are classed as Conservation zones.

Haig Street Quarry Conservation Reserve encompasses several vulnerable assets including a water tank, quarry pond, lookout and park infrastructure. The bushland areas within the reserve are classed as Wildfire Mitigation or Conservation zone.

4.2 Methodology

4.2.1 Data

All available digital and hardcopy data from Stirling Road Reserve and Haig Street Quarry Conservation Reserve was retrieved from ICC. These data sets were inspected and compiled. The hardcopy data was entered into an excel database for review and analysis.

Sites assessed and data available for analysis:

- Haig Street Quarry Conservation Reserve
  - Fuel loads: 2012 – 2017
  - Vegetation condition: 2017
- Stirling Road Reserve
  - Fuel loads: 2011 – 2017
  - Vegetation condition: 2017

Data collected for the FMSP (GHD, 2017) was accessed and collated into an excel database for review and to determine its suitability for use in the decision tool model.

4.2.2 Limitations and Assumptions

The following limitations should be considered when reading this chapter, as they may have impacted on the outcomes and usefulness of these analyses:

- It is assumed that all data made available was original survey data in its entirety and was collected according to the previous program
- The data available for a detailed analysis was not consistent, and some data sets were missing
- Long term historical data was collected by a number of different field technicians during the course of monitoring, thus monitoring techniques may vary season to season
- Some data sets contained gaps that could not be interpreted from final data, therefore some survey data was discarded from the analysis
- No process or procedure for application of management actions directed by outcomes of data collection could be identified.

4.3 Results

4.3.1 Historical data

The monitoring data that was previously compiled by ICC consisted of fuel load data collected in field, based off estimation tables contained within the Fire and Biodiversity Monitoring Manual (SEQFBC, 2002a). This data was collected in hard copy bi-annually from 2011 to 2017. From Spring 2014 to 2017, overall fuel hazard data was collected using methodology contained in the Overall Fuel Hazard Assessment Guide (Hines *et al.*, 2010). From Spring 2016, vegetation condition assessment data was collected using an assessment table adapted from the Queensland BioCondition Assessment Manual (Eyre *et al.*, 2015) and the FMSP (GHD, 2017).

As seen in Figure 2 (below), there are large variations within the fuel load data recordings in previous monitoring rounds that is not necessarily seasonal variation. The data from White Rock – Spring Mountain Conservation Estate serves as an indicative example of the variation that can stem from using fuel load as a primary metric for assessment of available fuels. This data also shows gaps in the monitoring rounds, which could indicate a divergence from the objectives of monitoring, i.e. if monitoring was not completed in those seasons, is the data being used for any meaningful analysis or management decisions?

Figure 3 (below) provides another representation of fuel load data collected in previous monitoring rounds, and again gives an indication of the variability of fuel load as an assessment metric. Further interpretation of the data indicates that seasonal variation in fuel loads is not necessarily severe enough to warrant bi-annual monitoring, and in some cases there is no clear indication that seasonal variation has a large effect on fuel loads at all. Figure 2 and Figure 3 were taken directly from ICC's Fire Plot Monitoring & Data Analysis document that was provided by ICC for review.

Figure 2 - Fuel load monitoring data for White Rock - Spring Mountain Conservation Estate

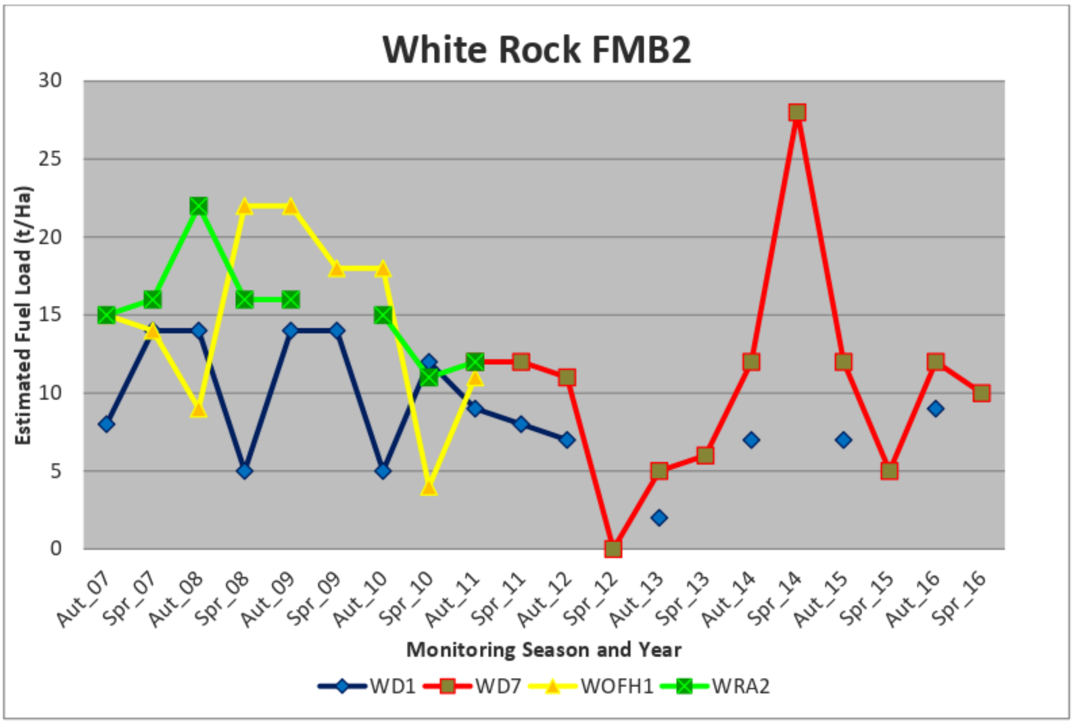
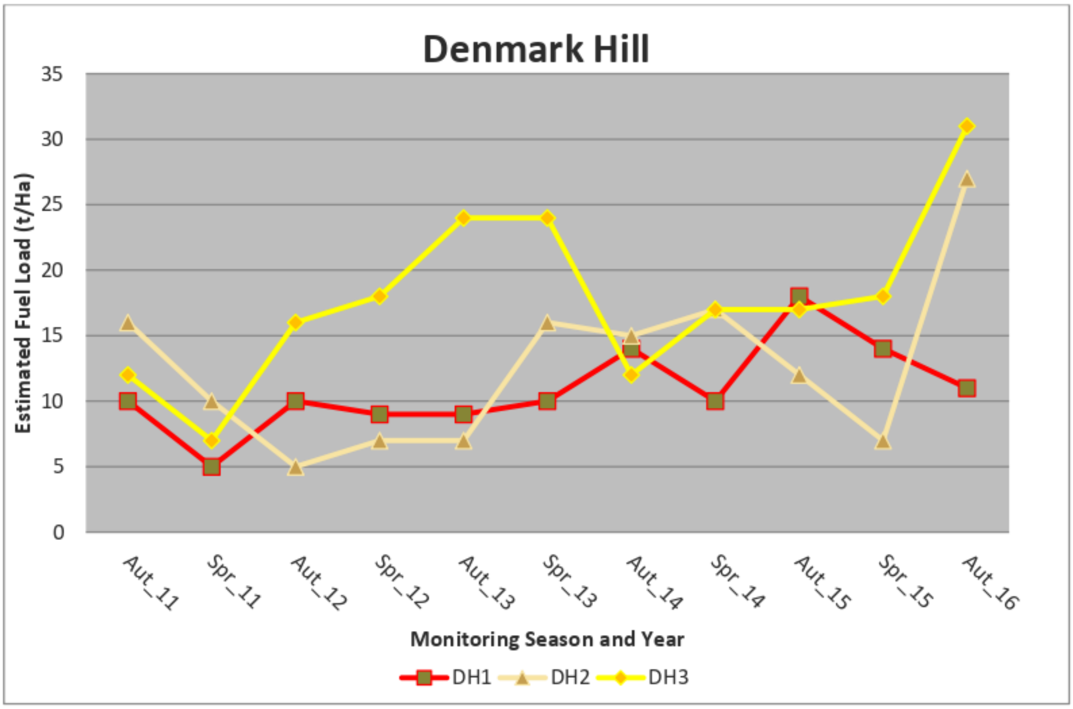


Figure 3 - Fuel load monitoring data for Denmark Hill Reserve



Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

A summary of the issues and inconsistencies found in the historical data is outlined in Table 5.

Table 5 - Review of historical data – Results

Action	Issue	Description	Consequences
Fuel Monitoring	Inconsistent fuel load calculations	Fuel loads, measured in t/ha Survey data shows a mix of fuel load taken from an average of the range, or from maximum of range.	Leads to large variation in the total fuel load data, including across multiple surveys of the same site.
	Justification for Fuel Hazard and Fuel Loads not recorded	Many surveys only show a hazard rating and no measurement data (% cover, height etc.), so unable to determine how a particular overall rating was reached.	Difficult to reliably look at changes across survey rounds on a particular site due to subjectivity of data.
	Inconsistent fuel hazard data	Where fuel hazard was recorded, methodology and/or instructions are inconsistent between monitoring rounds. Without access to photo's, accuracy of data cannot be verified for analysis.	There are large variations in data with no justification. This makes it difficult to draw conclusions from the data.
Baseline data	GPS data inaccurate	Some GPS location data seems to be inaccurate. Overall GPS data recording not sufficient.	Replication of data collection at the same monitoring points may be incorrect if permanent stakes are not relocated during field surveys.
Vegetation condition surveys	Inconsistent data collection	Total calculations for vegetation monitoring are inconsistent; objective of the table is not clear.	This leads to the calculation of overall health data being potentially inaccurate.
Overall data collection	Inconsistent data collection	Recording of data across different sites inconsistent; different methods and data sheets used across different sites and different monitoring periods.	This leads to overall results being inconsistent and adds difficulty in analysis and drawing conclusions.
Data management	Inconsistent data input	Inconsistent input of data. Data was not entered digitally in the past (prior to 2010)	Adds difficulty in analysis of data and application of results.

4.3.2 ICC previous analyses of data

Previous analysis of historical data conducted by ICC took the form of preliminary descriptive statistics, using the available fuel load data collected across three estates, Hillview Drive Reserve, Denmark Hill Conservation Reserve, and Haig Street Quarry Reserve. As many of the estates were not included in the fire monitoring program until 2010, the data used for analysis only dates to Autumn 2010, for a total of 14 monitoring rounds (2 seasons per year until 2016). The fuel load data for these estates was graphed in several ways to show seasonal changes and yearly changes for each season.

ICC entered fuel load (t/ha) and vegetation condition data into an Excel database and completed preliminary descriptive statistics from 2010. However, any further application of this data, including detailed analyses, use or application within the fire management program is not clearly demonstrated. Overall fuel hazard data was recorded on physical datasheets but not entered into any digital forms, and thus has also not been used for any further analysis or application by ICC.

Examples of the preliminary data analysis can be seen above in Figure 2 and Figure 3, which were taken directly from ICC's Fire Plot Monitoring & Data Analysis document.

4.3.3 NAE recent survey data

A review of the most recent available survey data was also conducted to gain an understanding of the progression of survey methodology and identify any issues or points for improvement in the current form of the Fire Monitoring Program. At the time of the most recent survey round, monitoring points had only been established in 8 of the 10 estates that make up the NAE, listed as follows:

- Denmark Hill Conservation Reserve
- Haig Street Quarry Conservation Reserve
- Hillview Drive Reserve
- Purga Nature Reserve
- Stirling Road Reserve
- White Rock – Spring Mountain Conservation Estate
- Flinders-Goolman Conservation Estate
- Mt Grandchester Conservation Estate

The survey data reviewed in this phase spanned across what was referred to as the Spring 17 season, between November and December 2017. A full copy of this data can be seen in Appendix 1: Spring 2017 Survey Data.

The most recent survey data reflected an improvement in survey methodologies within the monitoring program, with the data including overall fuel hazard calculations. The data collected additionally outlined the attributes that make up each strata within the OFH methodologies outlined in Hines *et al.* (2010), and the attributes and final score for an improved vegetation condition assessment. The vegetation condition survey methodology used in Spring 17 had also been updated since previous monitoring rounds.

The collected data did contain some gaps, and in some cases attributes were omitted or skipped, and there was not a clear direction on whether the primary objective of this monitoring round was to collect fuel hazard or fuel load data.

4.4 Discussion

A primary focus or objective for a monitoring program is key in ensuring that survey methodologies used and data collected is concise, robust, and ultimately useful. Through analysis of the historical data, and the most recent survey data provided by ICC, it is apparent that the components of the monitoring program have not been unified to a primary objective, and thus it is difficult to draw direction or infer recommendations for management of the NAE areas from the data collected. Key issues identified from this analysis of this data were:

- Inconsistent methodologies: over the years of monitoring, methodologies were updated and adapted;
- Changes in focus across subsequent survey rounds;
- Lack of data verification or quality assurance.

As shown in recent research (Volkova *et al.* 2016) and during the analysis of historical ICC data, due the subjectivity and inconsistency of fuel load (t/ha) assessments, data is not transferable to an overall fuel hazard. Where fuel hazard was not recorded, data is not useful for a meaningful analysis.
To ensure monitoring data is effectively utilised within a program, a detailed purpose and pre-determined analyses methods are required (AFAC 2016, AFAC 2017, ANZECC 1999). In lieu of this, pre-determined triggers using the data collected as criteria would assist in achieving the desired objectives. It is recommended that in updating the FMP, both of these strategies are used to align the program to ICC's goals and objectives for the NAE. The development of the decision tool model, by design, will cover both strategies in the following ways:

- Providing all monitoring data with a purpose (data that is not useful will be removed from assessment methodologies)
- Creating a framework for preliminary and further analysis
- Providing initial outputs based on the FMP objectives to drive management decisions
- Recommending management actions based on pre-determined rules used as triggers for management

This will ensure that the data collected in the field is used in the most appropriate, efficient, and meaningful way in order to drive management decisions for the program. These management decisions will in effect be the outcomes required to meet the objectives that have been outlined within the FMSP, and thus the objectives for the updated FMP.

The review of this historical data identified several areas for improvement within data collection methodologies, data-basing and storage, as well as issues regarding consistency and subjectivity. The following table contains the details of recommendations to improve the Fire Monitoring Program in the future to limit these issues.

Table 6 – Recommendations for Fire Monitoring Program based on issues identified in review of historical data.

Action	Issue	Consequence	Recommendations
Fuel Monitoring	Inconsistent fuel load calculations	Leads to large variation in the total fuel load data, including across multiple surveys of the same site.	Adopt overall fuel hazard as primary proponent of FMP, discontinue use of fuel load estimations
	Justification for Fuel Hazard and Fuel Loads not recorded	Difficult to reliably look at changes across survey rounds on a particular site due to subjectivity of data.	Ensure all background data is collected in OFH monitoring, i.e. heights, density and % cover for each strata of fuel. Incorporate variables into new data sheets and digital data collection forms.
	Inconsistent fuel hazard data	There are large variations in data with no justification. This makes it difficult to draw conclusions from the data.	In addition to the above, ensure all NAE personnel are trained in the use of the OFH guide, and frequent refreshers are undertaken. New data sheets and digital data collection forms should also incorporate background information and supplementary documentation to allow a thorough understanding and consistency in data collection.
Baseline data	GPS data inaccurate	Replication of data collection at the same monitoring points may be incorrect if permanent stakes are not relocated during field surveys.	Verify all GPS data recordings and ensure NAE team are trained in the use of GPS devices and are using the appropriate and consistent datum.
Vegetation condition surveys	Inconsistent data collection	This leads to the calculation of overall health data being potentially inaccurate.	Ensure all NAE personnel are trained in the vegetation condition methodologies, and frequent refreshers are undertaken. New data sheets and digital data collection forms should also incorporate background information and supplementary documentation to allow a thorough understanding and consistency in data collection.
Overall data collection	Inconsistent data collection	This leads to overall results being inconsistent and adds difficulty in analysis and drawing conclusions.	Ensure all NAE personnel are trained in all methodologies, and frequent refreshers are undertaken. New data sheets and digital data collection forms should also incorporate background information and supplementary documentation to allow a thorough understanding and consistency in data collection. Quality assurance measures should be undertaken frequently to ensure data

Action	Issue	Consequence	Recommendations
			is consistent and this requirement should be outlined in the FMP.
Data management	Inconsistent data input	Adds difficulty in analysis of data and application of results.	The use of digital data entry forms is recommended to limit handling and input directly into a decision tool. Quality assurance measures should be undertaken frequently to ensure data entry and management is consistent and this requirement should be outlined in the FMP.

5 Update of Fire Monitoring Program

5.1 Introduction

Success within any monitoring program is closely tied to the ability to work towards clear and achievable objectives. Within ICC's NAE, two primary objectives of fire management have been identified as the protection of life and property and the protection of biodiversity and ecological health. The results from chapters 3 and 4 highlight a need to update and streamline the Maunsell (2005) FMP with new and clearly defined methodologies that align to ICC's primary goals and ensure the data collected is usable within an adaptive management framework.

To align with the framework provided by the FMSP (GHD, 2017) and to work toward ICC's primary objectives, Ten Rivers have built upon the previous FMP, and the strategic approach of the FMSP. This has culminated in a robust, and efficient approach to fire monitoring, based on scientific knowledge and best-practice methodologies.

5.1.1 Objectives

The objectives of this chapter were to amend the ICC FMP in order to streamline and integrate data collection into the decision-making process of fire management for ICC based on best-practice methodologies.

5.1.2 Scope

The scope of this chapter was to update the ICC FMP based on outcomes of chapters 3 and 4, in terms of the following:

- Monitoring methodologies, including survey techniques and data compiling and analysis
- Data collection tools
- Monitoring plots.

This chapter outlines the process and methods undertaken within the *update* of the FMP. The operational document that encompasses the new FMP and detailed methodologies for implementation can be found in Appendix 2: Fire Monitoring Program – Operational Document.

5.1.3 Program Areas

The new fire monitoring program includes all ten reserves that make up the NAE. The previous FMP was originally based across only three conservation estates (Table 7). Four additional sites had since been incorporated, with some data collected from within these locations since establishment in 2010-2011 (Table 7). Two reserves, Ric Nattrass Environmental Park and Cameron's Scrub Conservation Estate have not been monitored in the past and therefore require establishment of new plots.

Table 7. Fire monitoring history of the ICC Natural Areas Estate reserves.

Natural Areas Estate	Monitoring History
White Rock – Spring Mountain Conservation Estate	Original site (Maunsell 2005)
Flinders-Goolman Conservation Estate	Original site (Maunsell 2005)
Purga Nature Reserve	Original site (Maunsell 2005)
Denmark Hill Conservation Reserve	Subsequently added (2010)
Haig Street Quarry Conversation Reserve	Subsequently added (2011)
Hillview Drive Reserve	Subsequently added (2011)
Stirling Road Reserve	Subsequently added (2011)
Mt Grandchester Conservation Estate	Subsequently added (2011)
Ric Nattrass Environmental Park	*New to add*
Cameron's Scrub Conservation Estate (Kholo Enviroplan Reserve)	*New to add*

5.2 Methodology

The update to the FMP was based on the outcomes discussed in the review chapters 3 and 4, where the Maunsell (2005) FMP was reviewed and historical FMP data was analysed. Refer to these chapters for details on the outcomes of the reviews and recommendations that have been drawn from here.

The operational document that encompasses the new FMP and detailed methodologies for implementation can be found in Appendix 2: Fire Monitoring Program – Operational Document. The following sections provide a description of the outcomes from the FMP update and changes proposed for the new FMP.

5.2.1 Limitations and Assumptions

The Maunsell (2005) document was the only previous report and detail of methodology available for the previous monitoring program. However, the ICC FMP had undergone numerous changes over the years, where alternate methods were updated and added (as described in Chapter 4). Written detail of these changes were unavailable for review however were deduced from the historical data and conversations with ICC. Therefore, this update of the FMP aims to streamline the methodologies and clarify directions as best as possible, based on the information available.

5.3 Outcomes

5.3.1 Updated Methodology

After the review of the previous FMP methodology and data collection tools, several areas of improvement were identified in order to streamline the program and better align data collection to the primary objectives of the program.

The following section provides details of the updates in methodology for all components of the FMP.

5.3.1.1 Baseline Survey

As with the previous monitoring program, the primary purpose of the Baseline Survey is to provide solid background on a monitoring plot, including plot characteristics and history etc., to provide a basis for subsequent survey rounds, monitoring, and analysis.

Previously, the Baseline Survey had been used to establish the location of a new monitoring plot and was only to be completed once per monitoring plot, and not repeated in subsequent monitoring rounds. This is to continue, as the majority of the information required for a baseline survey is non-variable and will not change from year to year.

As per recommendations made in Chapter 4, it is integral to data-basing and further modelling that GPS data is accurate and verified each monitoring round. This will ensure that the decision tool model used to drive management using monitoring data is providing spatially accurate results and recommendations. In areas where GPS signal is poor or unavailable, the importance of a meaningful, robust and accurate location description is key in ensuring a desktop operator can verify the GPS location using the location description provided by the Natural Area Teams (NATs) conducting monitoring.

5.3.1.2 Fire Management – Fuel and Vegetation Monitoring

The Fuel and Vegetation Monitoring Survey makes up the bulk of the FMP, and it is recommended surveys are conducted annually on all active monitoring plots within the NAE. The Fuel and Vegetation Monitoring Survey combines two objectives that were a focus of the previous program in order to ensure field surveys and data collection are streamlined to provide the most-cost effective outcome for the updated program.

The survey is composed of two primary sections, those being fuel hazard monitoring and vegetation condition monitoring. Building from the revisions made in the FMSP (GHD, 2017), the fuel hazard monitoring component utilises industry standard methodology found within the Overall Fuel Hazard Assessment Guide 4th Edition (Hines *et al.*, 2010), with the inclusion of some region-specific instructions for particular strata:

- Due to the presence of various paperbark species (*Melaleuca* spp.) within the ICC NAE, and their subsequent fine fuel risk, a provision has been added to assess paperbark species as ribbon barks, and to use this as the overall bark hazard if more than 30% of the trees present are paperbarks.

- Due to the abundance of smaller, shrubby species or species with contiguous fine fuels from the surface layer, a provision has been added to record any vegetation that is under 50 cm high as near surface fuels.

These instructions have been included to help clarify the classifications of different strata, the risks within those strata, and to ensure that the fuel hazard across the NAE is adequately reflected in the data recorded during the monitoring program.

As discussed in Chapter 4, fuel loads (t/ha) recording has now been omitted from the survey methodology due to the subjectivity of the data.

The Vegetation Condition Survey has been built using the previous Vegetation Health and Plant Species Monitoring (GHD, 2017) methodology, which combined assessment categories from the BioCondition Assessment Manual (Eyre *et al.*, 2015) and the SEQ Planned Burn Guidelines (QPWS, 2012). Some major changes were made to the previous survey methodologies, to further align the survey with the primary objectives of the program, and for the survey to provide a more precise and quantitative measure of the ecological health of a monitoring plot. Whilst some of the assessment categories have been altered, the assessment methodology remains relatively unchanged. A new formula has been developed to calculate the overall vegetation condition score after all assessment categories have been completed. This was based on a cumulative model and will assign an overall risk score to a monitoring plot based on the score range it falls into. A more detailed explanation of the assessment criteria and methodology can be found in Appendix 3: Assessing Vegetation Condition Within Plot – Supplementary Guide.

During this review, it was decided that in order to streamline annual surveys and ensure that the large number of monitoring plots could be completed within the necessary timeframe, the botanical checklist that was previously completed as part of the Fuel and Vegetation Monitoring Survey would be removed. While the data collected on the Botanical Checklist could be valuable for various uses, it was found that the data was not being used to fulfil any objectives within the program, and it would be more efficient to omit this part of the survey from the FMP.

5.3.1.3 Post-Burn Fire Assessment

The Post-Burn and Fire Assessment Survey is again primarily based off methodologies previously used within the FMP, with some minor changes to ensure the data collected remains relevant and can be easily used to update spatial data sets used in the decision tool model.

The primary changes to Post Burn and Fire Assessment methodology are the inclusion of a photo point for an active fire event, and the addition of instructions to map the fire scar boundary post fire event. The addition of photos of the fire event have been included to ensure that the data recorded during a Fire Assessment is verifiable, and in the event that the full survey cannot be completed while witnessing a fire, photo evidence of the event can be used to record relevant data at a later time.

Fire scar boundary mapping methodology has been included and standardised, as the fire history of a Fire Management Unit is an essential component of the decision tool model and will assist in driving management in relation to the objectives of the program. This updated methodology includes instruction on digitally mapping the fire scar boundary in the field, to allow for the data to be integrated into previous fire history mapping.

Further details of these changes can be seen on the data sheets attached in Appendices 4, 5 and 6.

5.3.2 Updated Data Sheets

The revised monitoring data sheets were closely aligned and built on the previous data sheets. Minor amendments were made on each data sheet type to streamline data collection and update the monitoring techniques. These amendments are summarised below.

5.3.2.1 Baseline Data Sheet

- Added GPS datum to ensure consistency in locational data
- Added photo point instruction and entry box to record image numbers and description
- Added Fire Management Zone entry box and primary objective description box
- Added section for evidence of urban impact in plot characteristics
- Added section for significant vegetation features
- Added "3-10 years" and "10 years+" to fire history selection criteria
- Removed compass diagram
- Moved rainfall data section into plot characteristics
- Vegetation type changed to standardised state-wide BVG mapping to align better with data to be used for decision tool model
- Altered wording in plot description regarding flora species present, limited each strata to 3 species, including weeds.
- Removed requirement for flora list to be completed, as this does not align with objectives and is better placed in another program
- Fuel load and Photo-point data sheet removed from baseline survey.

A full copy of the updated data sheet can be found in Appendix 4: Baseline Survey Data Sheet.

5.3.2.2 Fire Management – Fuel and Vegetation Monitoring Data Sheet

Part A: Fuel Monitoring

- Removal of "Camera Model" entry box
- Clarification of OFH instructions (within 15m radius of plot)
- Additional instruction/rule inserted for classification of paper barks in bark fuel hazard

- Bark fuel hazard reference table reorganised to reflect logical order of assessment
- Elevated fuel hazard reference table updated to include relevant attributes that make up each hazard class to assist in rationalising relevant hazard class
- Near surface fuel hazard reference table updated to include relevant attributes that make up each hazard class to assist in rationalising relevant hazard class
- Surface fuel hazard reference table updated to include relevant attributes that make up each hazard class to assist in rationalising relevant hazard class
- Rule added for elevated fuel hazard in regard to height of fuels – consider anything under 50cm as near surface fuel
- t/ha (fuel load) estimates removed to refocus priority on fuel hazard (relevant throughout data sheet)
- Instructions for combined and overall fuel hazard rating updated for clarification/ease of use
- Final data entry table added for operators to record hazard of each layer and overall fuel hazard

Part B: Assessing Vegetation Condition Within Plot

- Wording changes throughout vegetation condition table for clarity etc.
- Supplementary guide developed for use in conjunction with vegetation condition table, gives explanation of each attribute and how to assess etc.
- Attribute (4) – removed requirement for hollow bearing trees to be greater than 58 DBH, as this is a species-specific benchmark from BioCondition baseline data. Changed to “large” trees, with explanation of subjectivity in supplementary material
- Attribute (6) split into two separate attributes for species diversity, and recruitment of canopy species
- New attribute added as attribute (11) to assess a lack of native ground cover
- A new scoring system implemented for each attribute, to allow for a more robust final rating. Scores are combined in a cumulative model, with hazard classes based on score range.
- Hazard scale increased to 4 classes (Low, Moderate, High, Very High) to better align with the decision tool model and provide a more robust reflection of ecological health for each plot.
- Supporting resource for native grass clumping added, this was included from the Queensland Parks and Wildlife Service Planned Burn Guidelines (2015).

A full copy of the updated data sheet can be found in Appendix 5: Fuel and Vegetation Monitoring Data Sheet.

5.3.2.3 Post-Burn Fire Assessment Data Sheet

The updates and changes to the Post-Burn and Fire Assessment Data sheet are summarised below. The updates are to ensure that the data collected is relevant to the objectives of the FMP.

- Requirement for equipment list removed
- Time, date, season entry boxes added
- Completing officer entry box added
- Photos of fire event entry boxes added, with explanation of what is expected
- Photo GPS location and Aspect entry box added to ensure context of photos can be assessed
- Type of fire tick boxes added (Wildfire, planned burn etc.)
- Smoke behaviour entry box added
- Fuel moisture content entry box added, for a desktop assessment of climatic conditions during fire event
- Check boxes added for structure damage across different strata to assist in rationalisation of fire intensity and give better reflection of impact of fire
- Instructions added for mapping of fire scar boundary

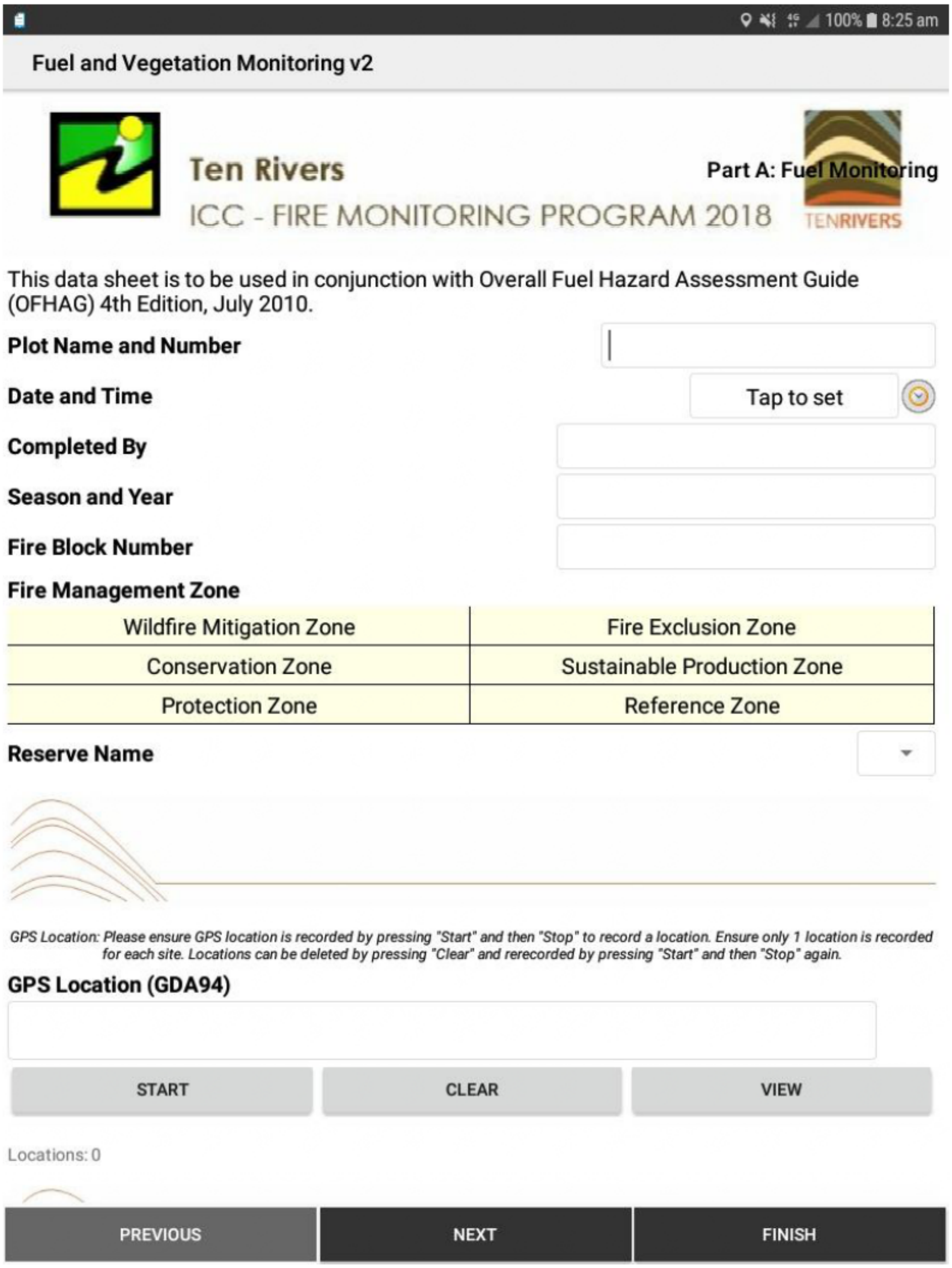
A full copy of the data sheet can be found in Appendix 6: Post Burn and Fire Assessment Data Sheet.

5.3.2.4 Digital forms

Each data sheet was also developed into a digital form using the Mobile Data Anywhere software package, as nominated by Spatial Officers from the ICC Works, Parks and Recreation Department. These digitals forms were developed to be used on a mobile device, for example a tablet or mobile phone, and include the ability to directly export recorded data into a digital database. This will assist in streamlining data collection, data handling and the input of data into the decision tool. Each digital form was based directly on the developed data sheets as described in the previous section. Further examples of these forms can be found in Appendix 7: Digital Data Forms.

Part of the development of the digital data forms was the ensure easy input of data into the decision tool model. The field names in the digital data forms output data directly correlate the field names within the model. An example of the output format for the digital data forms can be found in Appendix 8: Digital Data Forms – Output Data.

Figure 4: Examples of digital data forms for Fuel and Vegetation Monitoring



100% 8:25 am

Fuel and Vegetation Monitoring v2

Ten Rivers
ICC - FIRE MONITORING PROGRAM 2018

Part A: Fuel Monitoring

TENRIVERS

This data sheet is to be used in conjunction with Overall Fuel Hazard Assessment Guide (OFHAG) 4th Edition, July 2010.

Plot Name and Number

Date and Time Tap to set

Completed By

Season and Year

Fire Block Number

Fire Management Zone

Wildfire Mitigation Zone	Fire Exclusion Zone
Conservation Zone	Sustainable Production Zone
Protection Zone	Reference Zone

Reserve Name

GPS Location: Please ensure GPS location is recorded by pressing "Start" and then "Stop" to record a location. Ensure only 1 location is recorded for each site. Locations can be deleted by pressing "Clear" and rerecorded by pressing "Start" and then "Stop" again.

GPS Location (GDA94)

START CLEAR VIEW

Locations: 0

PREVIOUS NEXT FINISH

5.3.2.5 Supplementary survey material

Several supplementary documents were developed to assist in the transition from the previous monitoring program, and to provide instruction, context, and rationalisation for the monitoring and data recording methodology in the updated data sheets.

The supplementary documents should be carried as part of the survey kit as a reference sheet, and although they are not required to carry out monitoring, they may be useful to reference, especially in situations where new team members are conducting surveys. Each document is available in the following appendices:

Appendix 3: Assessing Vegetation Condition Within Plot – Supplementary Guide

Appendix 16: Training Materials

5.3.3 Updated Fire Management Units

During the review of the spatial data provided by ICC, some areas of concern were identified in the Fire Management Zone designations for FMU's within key reserves, namely Mount Grandchester Conservation Estate, Purga Nature Reserve, and White Rock – Spring Mountain Conservation Estate. To resolve the issue, it was recommended that some of the existing FMU's be reclassified and split into two separate FMU's in order to designate key areas Wildfire Mitigation or Protection Zones, to more adequately reflect the required management processes due to adjacent assets or housing stock.

The details of the new FMU implementation can be found in the table below. These changes are reflected in the updated spatial data sets, and the decision tool model. Maps of the updated FMU's can be found in Appendix 10: Updates to NAE FMU – Maps.

Table 8. Updates to existing FMU's

Old FMU	Old FMZ	New FMU's	New FMZ	Rationale
MG_3a	Conservation	MG_3a MG_1a	Conservation Protection	Block MG_3a contains a vulnerable asset, which was mapped as a Protection Zone in separate FMZ mapping. FMU's were updated to align to the FMZ mapping and better reflect management priorities
Multiple in Purga Nature Reserve	Reference	PN_1a Surrounding FMU's	Protection Reference	Purga Nature Reserve contains a caretaker dwelling, which was mapped as a Protection Zone in separate FMZ mapping. FMU's were updated to align to the FMZ mapping and better reflect management priorities
WR_13	Wildfire Mitigation	WR_13 WR_13a	Conservation	Due to neighbouring housing stock, WR_13 was designated a Wildfire Mitigation Zone. However, the FMU is quite large and the majority of the block is >100m away

Old FMU	Old FMZ	New FMU's	New FMZ	Rationale
			Wildfire Mitigation	from any dwellings. To better reflect the conservation values of the southern section of the FMU, it was split using the powerline easement as a containment line/break.

5.3.4 Updated Monitoring Plots

5.3.4.1 Review and rationalisation

The pre-existing fire monitoring plots were reviewed using a desktop analysis, including all active plots (68), suspended plots (2) and ICC's proposed plots (11) – totalling 81 monitoring plots.

Each monitoring plot and FMU was digitally assessed using the following criteria:

1) Fire Management Unit
   a. At least one representative plot per FMU
   b. As per GHD (2017) FMUs.
2) Vegetation type
   a. Dominant/representative type for that unit, particularly from a fire management perspective
   b. Using a combination of Brown and Root (2001) data and state-wide mapping of Broad Vegetation Groups and Regional Ecosystems (source: Q-Spatial).
3) Topography
   a. Representative of unit, i.e. not in creek line or ridge
4) Ease of access
   a. Efficiency for monitoring, 50-100m off track
5) Spatial representation.

The rationale behind ensuring each FMU has at least one representative plot (including representative in terms of vegetation, topography and spatially) is to ensure that each FMU has usable data collected in the monitoring program that is specific to that location, and is applicable to drive management actions for the FMU. This is the primary purpose of the FMP.

A total of 64 new plots are proposed, 30 are recommended to be removed, and 67 from ICC's original plots or proposed plots are recommended to be maintained (Table 9). The two suspended plots should not be continued.

For maps of the previous monitoring plots and their status, as well as the updated monitoring plots, refer to Appendix 11: Update to Fire Monitoring Plots – Maps.

Table 9. Review and rationalisation outcomes for the ICC fire monitoring plots.

Estate	Active (ICC)	ICC Proposed*	Suspended	Delete	New	New Active Total
Denmark Hill Conservation Reserve	3	2			2	*7*
Flinders-Goolman Conservation Estate	17	5		2	13	*33*
Haig Street Quarry Conservation Reserve	3	2			1	*6*
Hillview Drive Reserve	3	1		2	1	*3*
Kholo Enviroplan Reserve		1			5	*6*
Mount Grandchester Conservation Estate	8			5	20	*23*
Purga Nature Reserve	11			4	4	*11*
Ric Nattrass Environmental Park		4			1	*5*
Stirling Road Reserve	2	1			1	*4*
White Rock - Spring Mountain Conservation Estate	27	5	2	17	16	*33*
Grand Total	***74***	***21***	***2***	***30***	***64***	***131***

**ICC proposed plots were plots mapped and proposed for use in the previous FMP, but currently not in use.*

5.4 Discussion

The primary aim of the update to the FMP was to ensure a robust, implementable, and efficient program that was focused on two objectives; the protection of life, property and assets from fire risk, and the protection of the ecological health and biodiversity of the NAE through the effective management of fire within ICC's NAE. To achieve this, the update was to align the data sheets, survey methodologies, and survey tools with the two objectives of the FMP and ensure that all components of the program were focused on these objectives.

Updates to the data collection methodologies will ensure that the focus of FMP remains on the primary objectives, as outlined in the FMSP (GHD, 2017), and this project. The methodologies have been streamlined to ensure each round of monitoring provides relevant data for the management of the NAE, and that subsequent monitoring rounds will provide consistent data with methodologies that are implemented efficiently and are easily repeatable. The data collection methods are based on industry standard practices, and have been referenced from a selection of best practice guides and instructional material regarding effective land and fire management, including:

- SEQ Planned Burned Guidelines (QPWS, 2012)
- Overall Fuel Hazard Assessment Guide (Hines *et al*. 2010)
- Fire Monitoring Manual (SEQFBC, 2002)
- BioCondition Assessment Manual (Eyre *et al*., 2015)

The decision to focus the monitoring program using overall fuel hazard assessment as one of the primary metrics for data collection and management decisions will ensure that the program aligns with a risk-based approach to fire management. This aligns with current scientific research and best-practice methodologies that are becoming industry standard among fire and land management practitioners (AFAC, 2014).

Efficient data recording and storage methods will further ensure the update to the FMP achieves the objective of a best-practice approach to the management of the NAE. Moving towards future proofing the data collection procedures, whilst simultaneously streamlining the ability to input field collected data into the decision tool model, the development of digital data forms is integral to the update of the FMP. The predetermined database files (saved in Excel .dbf format) generated by the digital data forms also provide the ability to easily backup, transfer, and share the data collected during monitoring rounds.

Building on the objectives outlined for FMZ's in the FMSP (GHD, 2017), the update to the FMU's will ensure data collected is representative of each estate within the NAE, and their adjacent areas. The implementation of new FMU's in key areas will also ensure the management objectives will reflect the risk levels to both objectives of the updated FMP. This will result in more representative outcomes in relation to the each FMU and its associated FMZ designation.

Adequate data representing all FMU's within the NAE is the final component in ensuring the overarching objectives of the FMSP and the NAE Fire Management Policy are met. The previous FMP (Maunsell, 2005) limited the monitoring plots to three estates, and this was further expanded to eight of the ten estates by 2017, with a fair representation of each estate assessed via monitoring plots. In order to achieve the best outcomes according to the objectives of the FMP, it is essential that new monitoring plots be established across the NAE. The recommendations for at least one monitoring plot per FMU will provide the most representative data set of the entire NAE whilst maintaining a manageable and achievable program.

6 Decision Tool

6.1 Introduction

Geographic Information Systems (GIS) have become an invaluable tool for many industries, utilised by organisations and practitioners around the world to analyse and interpret geospatial data. The applications for GIS are vast, and many organisations have implemented the use of GIS models to provide predictive services, management recommendations, and other forms of prioritisation. A major component of this project is to develop a decision tool based on one such GIS model.

In order for the management of the NAE to best align with the primary objectives of the FMP, and to ensure that data collected as a result of the program is applied in the most suitable way, it was requested that a geospatial decision tool be developed that could utilise the data collected to generate priority based recommendations for the management of the NAE. The model would use collated fire monitoring data, as well as mapped vegetation types, fire history, and other historical data made available from the previous FMP and the FMSP (GHD, 2017).

6.1.1 Objectives

The objective of this chapter is to outline the development of a spatial decision tool, in the form of a geospatial model developed for the QGIS platform. QGIS is the platform used by ICC for Council's geospatial requirements.

6.1.2 Scope

The scope of this section covers:

- The development of a decision tool based on the QGIS framework that will incorporate data collected in the updated FMP, including fuel hazard and vegetation condition
- The integration of historical monitoring data into the decision tool to give an indication of prioritisation results based off previous monitoring rounds
- Integration of a data input procedure for newly collected data in subsequent monitoring rounds.

This chapter outlines the process and methods undertaken within the development of the decision tool and its baseline model. The operational document that encompasses the new decision tool and detailed methodologies for implementation can be found in the FMP operational document (Appendix 2: Fire Monitoring Program – Operational Document).

6.1.3 Program Areas

The decision tool will incorporate all ten reserves that make up ICC's NAE. As the updated monitoring program will incorporate monitoring plots in every FMU within each NAE estate, it is necessary that the decision tool contains the relevant historical data for these estates, as well as the capacity to incorporate all estates into the prioritisation process.

6.2 Methodology

The development of the decision tool model was a multi-step process, involving the selection and cleansing of appropriate data, the development of a conceptual framework, and finally the construction of the model itself. The process of development was conducted in unison with the review and analysis of historical data, as this was key in ensuring the most relevant and robust data could be used to build the framework that would later become the model proper.

6.2.1 Data

All data that was made available was analysed and assessed for its suitability within the model. In conjunction with the development of a conceptual framework for the model (Section 6.2.2), the appropriate data was collated in order to begin cleansing the data for use within the model.

Data was sourced from the previous FMP (Maunsell 2005), the FMSP (GHD, 2017), the Regional Ecosystem Description Database (REDD), ICC spatial data, the Department of Aboriginal and Torres Strait Islander (DATSIP) Cultural Heritage Register, and the Queensland Government QSpatial Catalogue.

The final iteration of the decision tool model includes the data listed in Table 10.

Table 10 - Datasets used as attributes within the decision tool model

Data	Model	Data Source	Description of data
Access Risk	Risk Management	FMSP	A rating of the difficulty of vehicle access to/from a FMU
Aspect	Risk Management	QSpatial	The geographical aspect (majority) of slopes present within an FMU
Bushfire Attack Level	Risk Management	FMSP	The Bushfire Attack Level for adjacent assets or housing stock as per AS3959:2009
TFI Threshold	Risk Management and Conservation	QLD RE Mapping, REDD	The tolerable fire interval threshold for the mapped regional ecosystem (majority or most representative) within an FMU
Ecological Asset Risk	Conservation	FMSP	Risk based on the presence of ecological assets that are fire vulnerable
Fuel Hazard	Risk Management	FMP	Overall Fuel Hazard assessments of fire monitoring plots based on Hines *et al.*, 2010
Fire Management Zone	Risk Management and Conservation	FMSP	Mapped Fire Management Zones from the FMSP, based on DNPRSR, 2013
Fire Vulnerability and Smoke Sensitive Assets	Risk Management	FMSP	Assets where residents or building users have a reduced capacity to respond to potential bushfire events

Data	Model	Data Source	Description of data
Vegetation Condition	Conservation	FMP	A measure of the ecological health of fire monitoring plot
Housing Stock Risk	Risk Management	FMSP	Risk to housing stock based on construction before or after AS3959:2009
Fire History	Risk Management and Conservation	ICC	History of fire events within the NAE
Slope	Risk Management	QSpatial	FMU's given slope classed based on majority slope above threshold
Cultural Heritage Assets	Risk Management and Conservation	DATSIP	Presence of cultural heritage assets within an FMU
Surrounding Landscape Vegetation Cover	Conservation	FMSP	The land cover and condition of land areas adjacent to assets

6.2.2 Conceptual Framework

The model framework is based on the FMP's conceptual framework. Since the updated FMP would align to two separate objectives, it was determined that the model would be developed as two models side by side, with each model to assess the most relevant attributes for each objective. The two different sides of the model were referred to as:

- Risk Management
- Biodiversity Conservation.

The risk management model was designed to align to the primary objective of the reduction of bushfire risk to life, property, and assets. Using historical data and information from the FMSP, the available data was analysed and suitable attributes for the risk management model were selected in order to provide an output of the overall level of risk for each FMU. Similarly, the conservation model was designed to align to the primary objective of the protection of biodiversity and ecological assets within the NAE. The attributes chosen for each model can be seen in Table 10.

After selecting the suitable attributes for each model, the conceptual framework flowchart was developed to help determine the relative weightings for each attribute i.e. how much they should contribute to an overall risk value, and also to help determine the interactions between different attributes, for example a compounding of risk where two attributes in a particular FMU have the potential for a risk greater than the sum of the two attributes individually (Figure 5). The conceptual framework flowchart also helped identify where attributes at particular values would lead to management action triggers.

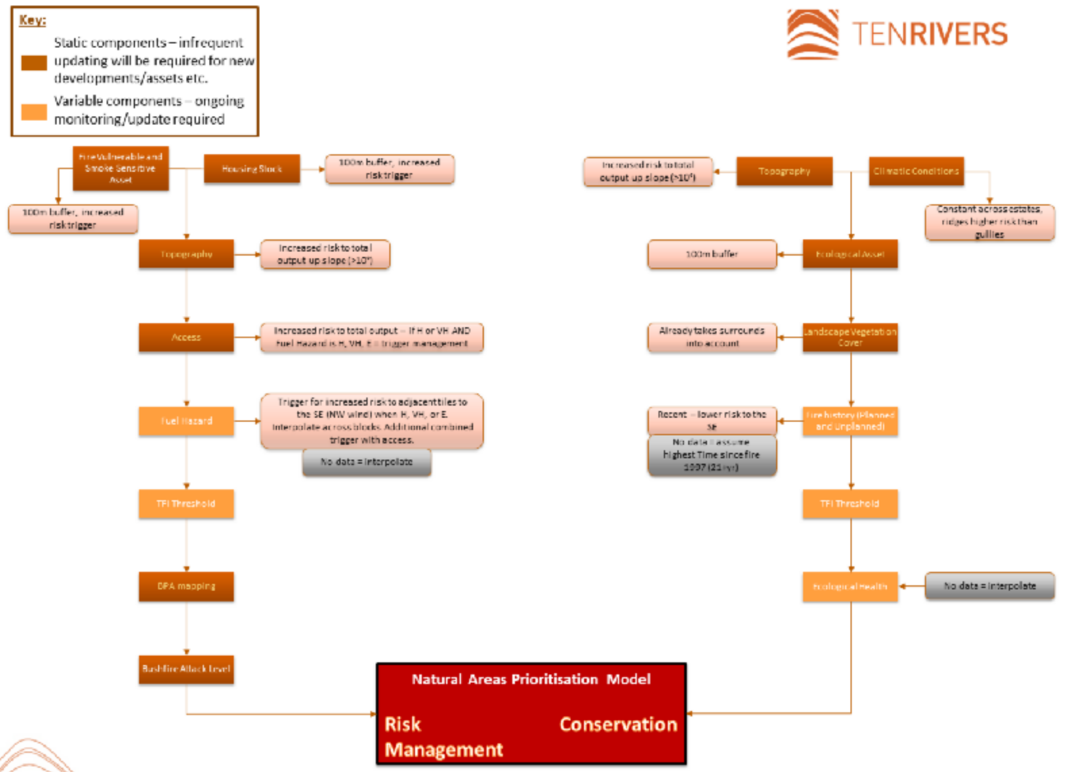


Figure 5. Conceptual framework of Fire Monitoring Program decision tool and parameters for each model.

6.2.3 Building the model

Utilising the QGIS software platform, relevant data was identified through analysis and the development of the conceptual framework, and then converted into a format suitable for entry into a geodatabase, where the attributes would represent each FMU as a geospatial layer. This master layer would become the basis for the model, where all static attributes for each FMU would be represented, and new data from subsequent monitoring rounds could be entered to provide updated risk scores each time new data is collected.

It was determined that the most suitable approach to construct the model was to use the master layer, referred to as the master FMU table, as an additive model, where each attribute was assigned relative values. These values could vary based on which model they were being used in and could also be altered based on interactions with other attributes present within an FMU. Further details of attribute interactions can be seen in section 6.2.3.3. The model would then use QGIS functionality to automatically calculate a total risk management or conservation score, which would be used as the primary metric to provide management action priority.

Once a preliminary iteration of the model was developed, and an initial result of the model outputs were assessed, it was determined that there was a requirement for further software development in order to streamline the use of the model and assist with data interpretation and manipulation in relation to management prioritisation within the NAE. This led to the development of a QGIS Plugin.

6.2.3.1 Vector Model Development

In order to design the initial iteration of the model to best reflect the desired outcomes and management of the NAE, a process of data cleansing, compiling, and weighting was followed. It was determined that converting all relevant data into vector layers to be used within QGIS would provide the best outcome, and whilst converting the data, each attribute's relative weighting against the total of the final outputs for each objective was determined. The following section details the rationale behind each attribute's use, and how the data was compiled into the model in order to contribute to a final output.

Data not listed in this section was scored in the model based purely on its relative weighting. Scoring scales for each attribute can be found in Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers.

- **Fuel Hazard** – Overall Fuel Hazard ratings were compiled from the physical data sheets provided by ICC from previous monitoring rounds. It was determined that the Spring 2017 monitoring round would be used for the design and test run of the model, as it was the most complete and broad dataset. The data was joined to the master FMU table and appended to each FMU. For any FMU with multiple monitoring plots, the highest OFH rating was used, to adequately reflect the risk. Any FMU that did not contain any OFH was defaulted to an OFH of High, as this value is, on average, the most common OFH rating within the vegetation types occurring within the NAE.
- **Cultural Heritage Assets** – The presence of cultural heritage assets was not used as a weighted attribute within the model and is solely used to provide a trigger for a management outcome. The point and polygon data sourced from DATSIP was joined to the master FMU table, and a 100m buffer zone was appended around each asset. The presence of an asset, or an assets buffer zone, within an FMU was used as the trigger to determine the need for a Cultural Heritage Management Plan before conducting land management activities.
- **Slope** – Topographic data was used to trigger interactions with other attributes within the master FMU table in order to adequately reflect the increased risk associated with particular topographical features. Each FMU within the NAE was given a slope class based on the majority slope occurring within the FMU. FMUs were classed either majority <10° or >10°. If the slope class was >10°, and the FMU contained runs of slope >100m in length, the OFH within the FMU was increased by one rating (e.g. a rating of Moderate would become High)
- **Aspect** – Like slope, aspect data for each FMU was used solely to trigger interactions with other attributes within the master FMU table. Each FMU was classed based on the majority aspect occurring within the FMU, under four aspect classes. These aspect classes were based on the relative increase in risk associated with prevailing severe fire weather patterns:
    - North west – Class 1 (Highest risk)
    - North east – Class 2
    - South west – Class 3
    - South east – Class 4 (Lowest risk)

  Any FMU that was designated as aspect class 1 would cause an increase to the OFH hazard for any adjacent FMU connected to the south east.

- **Ecological Health/Vegetation Condition** – Vegetation Condition scores were compiled from the previous monitoring round Spring 2017. Where no data was available for an FMU, the rating was defaulted to Moderate, based on the average Vegetation Condition ratings from previous monitoring, and field testing of the updated vegetation condition methodology.
- **TFI Threshold** – The tolerable fire interval for each FMU was used to increase the final output for both objectives within the model. Firstly, the most representative and/or greatest cover of Regional Ecosystem was determined for each FMU. Using the REDD, the TFI for each RE (and thus representative TFI for each FMU) was determined and appended to the master FMU table. Using the fire history for each FMU, the time since last fire was determined, and also appended to the master FMU table. Once the values were determined, a hazard class scale for each TFI range was developed (this can be seen in Appendix 9: Regional Ecosystem TFI Hazard Classes). The departure from TFI hazard was then determined, using the time since last fire to reference the TFI hazard class.

A reference list for attribute names can be found in Appendix 12: Decision Tool Model – Attribute Reference Table.

The scoring scale used for each attribute can be found in Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers.

6.2.3.2 QGIS Plugin Development

To meet the objectives of the decision tool model development, and to ensure that the model's use as a tool is concise, streamlined, and user friendly, the development of a specialised plugin within QGIS was initiated with the assistance of a specialist QGIS spatial analyst and programmer.

The development of the plugin was aimed at achieving specific goals in relation to the decision tool model, which were:

- Run the two sides of the model to provide two separate outputs based on the two primary objectives
- Provide a user interface to streamline the use of the model
- Provide a user interface to assist with the preparation and input of new data into the model
- Provide a user interface for final analysis of the data output from the model, and modification of data within the model, including interaction with other layers when any data is adjusted
- Generate and display outputs, including: prioritisation map; summary table and a location-based report detailing the final output of the model, as well as information based on conditional statements between layers within the model

6.2.3.3 Interactions

Due to the nature of the attributes within the model data, there were a number of attribute interactions leading to an increase in risk that would be higher than the risk value of the two attributes solely combined. These interactions involved:

- Neighbourhood effects:
    - Attributes present in an FMU above a particular hazard class would have an increased effect on attributes in neighbouring FMUs
- Cumulative effects:
    - The presence of two attributes above a particular hazard class within an FMU would have an increased effect on the final risk score of that FMU
- Management Actions
    - These are based on triggers involving interactions between attributes within a single FMU
    - Actions to remediate or reduce risk are automatically recommended in the model's final output

A full list of these interactions can be found in Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers.

6.2.4 Limitations and Assumptions

- The model is based off historical data and analysis conducted. It is assumed all data is an accurate representation of each FMU and its surrounds.
- Model outputs are only to the scale of each FMU, and thus only representative of the relative risk score of an entire FMU. Results do not give a representation of finer scale data, as this would require further ground-truthing.

6.3 Results

6.3.1 Model outputs

A preliminary run of the decision tool model was used to create prioritisation scores for both sides of the model (risk management and conservation), using data from the most recent monitoring round of the previous Fire Monitoring Program, Spring season 2017.

The results of this preliminary run have been organised into a series of tables for the purposes of this report, however for a reflective representation of how the data appears in the model, please refer to Appendix 14: Decision Tool Model – Preliminary Run Results.

The full data is available in the master FMU table shape file package delivered as part of the update. The operation of the model and plugin is dependent on a basic understanding of the QGIS software. A user guide document is available within the plugin user interface and can also be found in Appendix 18: Decision Tool Model – Fire Risk Assessment Plugin User Guide.

6.3.1.1 Prioritised FMUs

To fulfil the two primary objectives of the updated Fire Monitoring Program, there are two primary prioritisation outputs generated by the model:

- Risk to life, property, and built assets. Referred to as Risk Score
- Risk to biodiversity conservation values and ecological assets. Referred to as Conservation Score

The model will automatically display these outputs as a geospatial layer, with prioritised FMUs colour coded to reflect their relative risk rating according to their risk score. The ratings can be interpreted as follows:

- Red – Extreme risk
- Orange – Very High risk
- Yellow – High risk
- Green – Moderate risk
- Blue – Low risk

The prioritisation scores provide a detailed summation of the total risk profile of each FMU, with higher scores indicating increased risk. As the scores can be largely variable, and will vary between monitoring rounds, there are no set scores corresponding to each risk rating, and instead rating parameters are calculated based on the range of scores generated from each run of the model. This ensures the best interpretation can be made from visual inspection of the model outputs with each monitoring round.

The prioritisation scores are indicative of the level of risk for each objective within any given FMU, however, the final score does not necessarily indicate the need for immediate works. In order to further rationalise works, the model will also automatically generate management actions based on attribute interactions. Management action recommendations should be consulted before implementing any works. See section 6.3.1.2 for more information.

The following tables are a sample of the 20 highest prioritisation scores for Risk Management (Table 11) and Conservation Management (Table 12). Due to the automatic distribution of risk ratings from calculated risk scores, the top 20 sites for each objective all fall into the risk category of 'Extreme'. A spatial representation of this data for each estate can be found in Appendix 15: Decision Tool Model – Preliminary Run Maps.

Table 11 - Top 20 sites for Risk Management Prioritisation

Site Name	FMU	Fuel Hazard	Fire Management Zone	Total Risk Score
Purga Nature Reserve	PN_1a	Extreme	Protection Zone	39.00
Flinders-Goolman Conservation Estate	FG_1c	Very High	Protection Zone	38.00
Haig Street Quarry Conservation Reserve	HS_3	Extreme	Wildfire Mitigation Zone	38.00
Haig Street Quarry Conservation Reserve	HS_6	High	Protection Zone	34.00
White Rock - Spring Mountain Conservation Estate	WR_17	High	Wildfire Mitigation Zone	33.00

Site Name	FMU	Fuel Hazard	Fire Management Zone	Total Risk Score
Haig Street Quarry Conservation Reserve	HS_2	Extreme	Protection Zone	32.40
Flinders-Goolman Conservation Estate	FG_22	Very High	Protection Zone	32.00
White Rock - Spring Mountain Conservation Estate	WR_16	Very High	Wildfire Mitigation Zone	31.00
Ric Nattrass Environmental Park	RN_5	High	Wildfire Mitigation Zone	31.00
Haig Street Quarry Conservation Reserve	HS_1	High	Protection Zone	31.00
White Rock - Spring Mountain Conservation Estate	WR_18	Very High	Wildfire Mitigation Zone	30.00
Purga Nature Reserve	PN_2a	Extreme	Reference Zone	29.92
White Rock - Spring Mountain Conservation Estate	WR_20	Very High	Wildfire Mitigation Zone	28.00
Haig Street Quarry Conservation Reserve	HS_5	Very High	Protection Zone	28.00
Haig Street Quarry Conservation Reserve	HS_4	Extreme	Conservation Zone	27.52
Flinders-Goolman Conservation Estate	FG_17	Very High	Conservation Zone	27.20
Flinders-Goolman Conservation Estate	FG_18	Very High	Exclusion Zone	27.20
White Rock - Spring Mountain Conservation Estate	WR_19	High	Wildfire Mitigation Zone	27.00
Denmark Hill Conservation Reserve	DH_6	High	Protection Zone	27.00
Denmark Hill Conservation Reserve	DH_9	Extreme	Exclusion Zone	26.40

Table 12 - Top 20 sites for Conservation Management Prioritisation

Site Name	FMU	Vegetation Condition Score	Fire Management Zone	Conservation Score
Mount Grandchester Conservation Estate	MG_10 a	High	Conservation Zone	15.00
Mount Grandchester Conservation Estate	MG_1	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_6	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_9	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_18	High	Conservation Zone	14.00
Flinders-Goolman Conservation Estate	FG_13	High	Conservation Zone	14.00
Flinders-Goolman Conservation Estate	FG_15	High	Conservation Zone	14.00
Flinders-Goolman Conservation Estate	FG_17	High	Conservation Zone	14.00
Flinders-Goolman Conservation Estate	FG_18	High	Exclusion Zone	14.00

Site Name	FMU	Vegetation Condition Score	Fire Management Zone	Conservation Score
Flinders-Goolman Conservation Estate	FG_24	High	Exclusion Zone	14.00
Flinders-Goolman Conservation Estate	FG_25	High	Exclusion Zone	14.00
Kholo Enviroplan Reserve	CS_4	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_19	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_4	High	Conservation Zone	13.00
Mount Grandchester Conservation Estate	MG_8	High	Conservation Zone	13.00
Mount Grandchester Conservation Estate	MG_12	High	Conservation Zone	13.00
Flinders-Goolman Conservation Estate	FG_26	High	Exclusion Zone	13.00
White Rock - Spring Mountain Conservation Estate	WR_3	High	Conservation Zone	13.00
Mount Grandchester Conservation Estate	MG_19	High	Conservation Zone	14.00
Mount Grandchester Conservation Estate	MG_4	High	Conservation Zone	13.00

6.3.1.2 Management Actions

The use of the decision tool model for prioritisation of sites is also supplemented by the addition of management action recommendations as part of the model outputs. These recommendations are based off interactions between attributes within the model, referred to as triggers. The actions themselves are based off standard land management methodology in relation to Australian Standards (AS3959:2009) and best practice risk management.

If management actions are triggered within an FMU, the model will detail the recommendations in a generated report. Before a schedule of bushfire mitigation or biodiversity conservation works is prioritised and implemented, the management actions report should be consulted for an indication of the scope of works required for FMUs that have scored exceptionally high on the risk management or conservation components of the model. The attribute interactions within the decision tool model that trigger management actions, and the management action recommendations themselves can be found in Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers

Within the management action recommendations, there are particular interactions that require a further level of data in order to present the best possible outcomes. In these instances, the management action will recommend referencing the Vegetation Condition survey data for further information. After inspecting the data for the FMU in question, Table 22 should be used to determine the required action. The table lists a trigger score for each attribute within the Vegetation Condition survey. If the most recent survey for the FMU in question meets any of the trigger scores for an attribute, it is recommended the associated secondary management action be considered.

Management actions for the top 10 Risk Management scores can be found in the table below. A full list of management action recommendations from the preliminary run of the decision tool model can be found in Appendix 19: Decision Tool Model – Management Action Recommendations.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Table 13 – FMP decision tool management action recommendations

Site Name	FMU	Total Risk Score	Management Actions
Purga Nature Reserve	PN_1a	39.00	**Fuel hazard is high where access is difficult** Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc). If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas. **Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort **Fuel hazard is high adjacent to built assets** Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU. **Vegetation condition is low where ecological assets occur** Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health. Branched actions – requires further detail from Vegetation Condition survey (see Table 2) **Fuel hazard is high within Protection Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
Flinders-Goolman Conservation Estate	FG_1c	38.00	**Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort

Site Name	FMU	Total Risk Score	Management Actions
			Fuel hazard is high adjacent to built assets Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU. **Fuel hazard is high within Protection Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
Haig Street Quarry Conservation Reserve	HS_3	38.00	**Fuel hazard is high where access is difficult** Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc). If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas. **Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort **Fuel hazard is high where a wildfire occurred within 1-3 years** FMU requires increased monitoring to track fuel changes after wildfire. May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard. **Fuel hazard is high adjacent to built assets** Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU. **Fuel hazard is high within Wildfire Mitigation Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Site Name	FMU	Total Risk Score	Management Actions
Haig Street Quarry Conservation Reserve	HS_6	34.00	**Fuel hazard is high where a wildfire occurred within 1-3 years** FMU requires increased monitoring to track fuel changes after wildfire. May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard. **Fuel hazard is high within Protection Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
White Rock - Spring Mountain Conservation Estate	WR_17	33.00	**Occurrence of Cultural Heritage Assets** Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets **Fuel hazard is high where the time since prescribed burns is long** Assess fire history against TFI to determine the departure from the recommended fire frequency. If outside of TFI, nominate FMU as high priority for hazard reduction burn. Increased monitoring in FMU. May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.
Haig Street Quarry Conservation Reserve	HS_2	32.40	**Fuel hazard is high where access is difficult** Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc). If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas. **Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort **Fuel hazard is high where a wildfire occurred within 1-3 years** FMU requires increased monitoring to track fuel changes after wildfire. May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard. **Fuel hazard is high adjacent to built assets** Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Site Name	FMU	Total Risk Score	Management Actions
			Fuel hazard is high within Protection Zone Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
Flinders-Goolman Conservation Estate	FG_22	32.00	**Occurrence of Cultural Heritage Assets** Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets **Fuel hazard is high where access is difficult** Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc). If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas. **Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort **Fuel hazard is high adjacent to built assets** Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU. **Fuel hazard is high within Protection Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
White Rock - Spring Mountain Conservation Estate	WR_16	31.00	**Occurrence of Cultural Heritage Assets** Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets **Fuel hazard is high where access is difficult** Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc).

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Site Name	FMU	Total Risk Score	Management Actions
			If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas. **Fuel hazard is high adjacent to vulnerable built assets** Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort **Fuel hazard is high within Wildfire Mitigation Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
Ric Nattrass Environmental Park	RN_5	31.00	**Occurrence of Cultural Heritage Assets** Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets
Haig Street Quarry Conservation Reserve	HS_1	31.00	**Fuel hazard is high within Protection Zone** Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

6.4 Discussion

One of the main issues facing land managers tending to large estates, like that of ICC's NAE, is prioritising works to ensure that a best-practice outcome is reached whilst remaining within budget constraints. This issue is one of the primary reasons to develop a system to prioritise sites and use data to provide justification for implementing management works. The development of the decision tool model was requested to fulfil this objective, and to ensure that further management of the NAE under the FMSP (GHD, 2017) and updated FMP will be justified under the two primary objectives of the FMSP and the FMP.

The primary output of the model, the Risk Management and Conservation prioritisation scores, provide a yearly representative level of risk in relation to the two primary objectives of the program. Using these metrics as primary justification provides ICC with the ability to view each FMU, and each estate within the NAE, with a quantitative measure of overall risk and thus an indication of priority areas for management works.

To further justify the implementation of works, the decision tool model provides a secondary output, consisting of management action recommendations based on attribute interactions within each FMU. These management actions add a supplementary measure of rationalisation behind prioritising works within the NAE, and provide a baseline level of suggested works in order to reduce risks associated with each objective within a given FMU. The recommended works are based on land management procedures adopted from the SEQ Planned Burn Guidelines (QPWS, 2013), Managing Parks and Forests (QPWS, 2013), the Fire Monitoring Manual (SEQFBC, 2002), and best practice industry experience.

The incorporation of the decision tool model into the FMP will be a key step in ensuring the FMP will remain focused on the updated objectives, and that the FMP is aligned with the FSMP and the NAE Fire Management Policy. This will ensure that ICC can use the best information available to make justifiable decisions for managing the NAE in accordance with their objectives. The decision tool will also ensure that on an operational scale, allocation of budget will be further supported by the data collected through the FMP, and the program will retain a high level of relevance and efficiency until its next review.

7 Training

7.1 Introduction

A key part of developing a successful monitoring program that provides accurate and relevant data is ensuring the operators conducting the surveys are familiar with the material and are able to record accurate and consistent results.

In undertaking a complete review and update of ICC's Fire Monitoring Program, Ten Rivers was also contracted to provide in field training and support for councils NAT's, to ensure that teams on the ground were familiarised with new survey methodologies, the use of new data sheets, and that data collection was consistent across all operators conducting the assessments.

7.1.1 Objectives

The objectives of this chapter were to provide necessary components for a training run of the updated fire monitoring program and conduct a training presentation and field assessment day in which the Ten Rivers team could familiarise relevant council staff with the updated processes, procedures and survey materials.

7.1.2 Scope

The scope of this chapter includes the following:

- A training presentation tailored to the ICC NAT's, covering:
  - Updates to the data sheets
  - Realignment of the survey methodologies to match the objectives of the updated program
  - A summary of the supporting documents that form the basis of the program (OFHAG, Planned Burn Guidelines etc.)
  - Instruction on the rationalisation and establishment of new monitoring plots
- A field assessment run utilising the updated data sheets and survey tools, where several new monitoring plots will be established.

7.1.3 Program Areas

The program areas covered by the training section of the updated Fire Monitoring Program included one of the key reserves within the NAE, White Rock – Spring Mountain Conservation Estate. This estate was selected as the primary candidate for in field testing for the following reasons:

- The estate covers a variety of vegetation types across several FMU's, allowing the personnel involved in the test run the opportunity to make assessments in these different vegetation communities

- Historically, the vegetation communities across the estate have the capacity to support a large range of fuel hazards, allowing the test run to assess and capture a variety of fuel hazard data
- The estate contained several monitoring plots that the updated program proposed the removal or replacement of. This gave personnel involved in the test run the opportunity to apply the methodology for the establishment of a new monitoring plot.

7.2 Methodology

The development of a training run of the updated FMP created a good opportunity not only to familiarise council staff with the updated procedures, methods, and tools, but also to use the test run to identify any issues within the program and gain feedback prior to the full implementation of the program.

The primary aim of the training run was to ensure complete coverage of the materials and methodology of the updated FMP. To achieve this, training materials were formulated in order to concisely cover the relevant background information for the updated monitoring procedures and provide background and justification for the use of updated assessment methods. A presentation was developed that covered:

- What has changed from the previous monitoring program
- The realignment of monitoring objectives to the FMSP
- Additional materials required for monitoring
- The use of desktop assessments to supplement in field monitoring
- Updated procedures for establishing monitoring plots and subsequent monitoring.

A full copy of the training materials used for the presentation can be found in Appendix 16: Training Materials.

This presentation was delivered to the ICC NAT's on Thursday 17th May 2018, at the ICC depot in Yamanto, Ipswich. A two-hour presentation and interactive discussion were delivered.

The second phase of the training run involved the establishment and assessment of two new monitoring plots in White Rock – Spring Mountain Conservation Estate. Details of the two sites are listed in Table 13.

Table 14 - Monitoring Plots Established in White Rock - Spring Mountain Conservation Estate

Monitoring Plot Name	FMU	Broad Vegetation Group	Fire Management Zone
WR_3a	WR_3	10b/13c	Conservation Zone
WR_3b	WR_3	10b/9a	Conservation Zone

Prior to in field assessments, the two proposed monitoring plots were subject to a desktop assessment. Their location was assessed for suitability within the program, and they were determined to be representative of the differing vegetation communities within the FMU.

Relevant desktop data was entered onto the updated data sheets for a Baseline Survey and a Fuel and Vegetation Monitoring Survey for each monitoring plot to be surveyed.

After the presentation phase of the training session was complete, the NAT's commenced the field component of the training run, and the two new monitoring plots were established in White Rock – Spring Mountain Conservation Estate, using the updated methodology for a Baseline Survey. Both sites were then assessed using the updated methodology for a Fuel and Vegetation Monitoring Survey.

Figure 6 - Field training day with NATs at White Rock - Spring Mountain Conservation Estate

7.2.1 Limitations and Assumptions

The following limitations and assumptions apply to this section of the report:

- Whilst representative of the sites assessed, the data collected during the training run of the program is only a snapshot of potential data to be collected in a full monitoring round of the Fire Monitoring Program.
- Whilst care was taken to ensure the updated survey methods and procedures were followed, it is difficult to remove bias remaining from the previous methodologies.

7.3 Results

Data collected for the training run of the updated FMP was collated and entered into an excel database. Hard copies of the data were filed for reference.

A summarized table of the Baseline Survey and Fuel and Vegetation Monitoring Survey can be found below (Table 15). A full spreadsheet of complete data collected can be found in Appendix 17: Training Run Survey Data.

Table 15 - Summary data collected during the training run at White Rock - Spring Mountain Conservation Estate

	WR_3a	WR_3b
Estate	White Rock	White Rock
FMU	WR_3	WR_3
Fire Management Zone	Conservation	Conservation
GPS Location (GDA94)	485316 × 6937552	485438 × 6937843
Fire history	3-10 years	3-10 years
Last known fire	2014	2012
Type of fire	Wildfire	Wildfire
BVG	10b/13c	10b/9a
Bark Fuel Hazard	Moderate	Moderate
Elevated Fuel Hazard	Moderate	Very High
Near Surface Fuel Hazard	High	Very High
Surface Fuel Hazard	Moderate	High
Overall Fuel Hazard	Moderate	Very High
Vegetation Condition Hazard Rating	High	High

During the in-field training session, it was found that several clarifications were required on the wording within the vegetation condition data sheets. As an outcome of this, the new data sheets were reviewed again, and various tweaks were made to the wording to allow for a clearer understanding of the required assessment data.

7.4 Discussion

The training run for the updated FMP was a valuable opportunity to ensure the adoption of the new program methodology and procedures was a streamlined transition, and any issues or inconsistencies could be rectified before the implementation of the updated FMP across the entire NAE. The training day was successful and received positive feedback from the NAT's, supervisors and ICC project managers.

Input from the NAT's onto the data sheets was accumulated and input into an updated set of data sheets to provide more clarification and easier interpretation. It was highlighted during the training day that frequent refresher training days in the methodologies used in the FMP would be very useful and ensure that bias doesn't arise over time and that the data collected remains consistent. This is recommended to occur at least every two years, and when new team members join the NAT's.

8 Discussion

Bushfire risk to life and property, and to the ecological health of remnant vegetation and natural areas is a threat well known to Ipswich City Council and its Natural Area Estate teams. Due to the potential impacts of these risks, and ICC's obligations for the management of its NAE, these risks have become the focus and primary objectives of the FMSP (GHD, 2017) and the NAE Fire Management Policy (ICC, 2015a). In conducting this review and update to the FMP, Ten Rivers have restructured the program to ensure that FMP reflects these objectives and the industry standard best practice methodologies that will provide the best possible outcome for ICC.

An essential component of any monitoring program is clear and testable objectives (AFAC, 2016). Without clear objectives, multiple issues can arise, not limited to a lack of useful or meaningful analysis, a lack of operational relevance, and not enough clarity about which parameters to measure or monitor (AFAC, 2016). With these issues in mind, Ten Rivers implemented the use of best practice guides and literature to conduct the review and update of the FMP.

The five stages of this review, as outlined in Chapter 2, outlined a multi-faceted approach that would fulfil the objectives ICC set out for this project. These five stages were:

- Review of previous monitoring program: a desktop review of the Maunsell (2005) FMP;
- Analysis of historical data: collation, comparison and analysis of historically collected data by ICC and description of its applicability for use in further analyses;
- Update of monitoring program: a description of the updates recommended to the FMP, including the purpose, updated methods, update of monitoring data sheets and update of monitoring plots;
- Decision tool: a description of the development, inputs, analyses and outputs to the decision tool;
- Training: a description of the training and tools developed to deliver a training run for ICC's staff

The primary outcomes of the review of the previous FMP were the need for clear identification of the objectives of the program, and the requirement for data collection with a purpose. These outcomes closely aligned with ICC's objectives for the review and update of the FMP and helped further rationalise the need for a realignment and update of the program.

The analysis of historical data provided Ten Rivers with necessary background data with which to develop the requested decision tool, and the requisite understanding of previous methodologies used in order to develop updated tools to align the program to the FMSP and meet the objectives ICC had set out for the project. The analysis of the previous data also helped identify the gaps and shortfalls within the previous program that required focus within the update, including areas that would be highlighted within the training component of the project scope.

After the review of the previous program and the historical data provided by ICC, the update of the FMP was tailored to rectify the identified issues highlighted by the review and analysis, and bring the FMP in line with current best practice, science-based monitoring methods and procedures. Key outcomes were the update to the scope of data collected, the development of digital data forms, and the implementation of fire monitoring plots across every FMU within the

NAE. The major outcomes of the update all contributed to the most valuable component of the overall project, the decision tool model.

The development of the decision tool model was an integral part of the project and is key to the update of the FMP keeping in line with the two primary objectives and current best practice. The previous chapters of the program update all provided the necessary data, scope, and framework in order to construct a GIS model that would best represent the risks that are priority within ICC's NAE. Using the historical data and the FMSP, the decision tool model was constructed and designed as the major tool that will drive management decisions and prioritisation of sites within the NAE. The outputs it generates provide the major justification and rationalisation of not only the management of the NAE, but the full implementation of the FMP .

The final stage of this project was to develop and provide a short run training program for ICC's NAT's, with the added benefit of conducting a live training run of the monitoring tools and materials. The success of the training run was key in ensuring the implementation of the updated program was a smooth transition and that team members conducting monitoring had a consistent understanding of the methods and tools used.

As outlined in Chapter 2, the ICC's objectives for the review and update of the FMP were as follows:

a) A document outlining the FMP (and associated procedures) that aligns with Council's recently adopted strategy for fire management (GHD 2017);
b) Monitoring datasheets tailored to the type of management purpose;
c) Rationalisation of fire monitoring plots including the number of sites, location and assessment frequency are optimised and documented;
d) Assurance that the data collected is clear, accurate and evaluates monitoring and performance at both a project site and program level;
e) A data analysis/decision tool to select prioritised sites combining data repositories and geospatial representation;
f) Council staff are familiarised with the implementation of the updated fire monitoring procedures.

Through the five stages of this project, Ten Rivers have adequately fulfilled these objectives. Recommendations to ensure continued effectiveness of the update to the program can be found within the discussion sections of each chapter. In fulfilling these objectives, Ten Rivers has also aligned to FMP to the two primary objectives for fire management within the NAE, as outlined in the FMSP (GHD, 2017) and the NAE Fire Management Policy (ICC, 2015a), which are:

1) Risk reduction and the protection of life and property, and
2) Conservation of biodiversity and ecological values.

The following chapter contains additional recommendations outside the scope of the project, and a summary of operational recommendations based on initial outputs and findings from the most recent survey data and an initial run of the decision tool model.

9 Further Recommendations

In order to maintain the relevance and efficiency of the updated FMP, and to ensure the program continues to meet its objectives, some additional recommendations are suggested below:

- Background data should be subject to an annual review for Quality Assurance, e.g. housing stock risk, fire vulnerable and smoke sensitive assets. These data attributes are generally not subject to large or frequent changes, however when new built assets are constructed, or developments approved etc., they should be subject to desktop assessment to ensure the risk is adequately reflected within the decision tool model.
- The FMP should be subject to a 5-year review from the date of its current iteration. This would involve research into current best practice, technology, and assessment/modelling tools. 5-year reviews will ensure the program keeps up with best practice and evidence-based research.
- Team members involved in monitoring, data collection, and use of the decision tool should undergo training and knowledge refresher courses every 2 years. This will help keep data collected and methodologies used consistent across the life cycle of the FMP and will assist in eliminating subjectivity and bias that may arise from continued monitoring of the same estates.
- Some level of quality assurance should be maintained across all facets of the FMP. Verification of monitoring techniques, data collected, and its outcomes is essential in ensuring a consistent and efficient program. The use of digital data forms will assist in this as field collected data can be uploaded directly onto a shared network, and quality assurance checks can be conducted as necessary.
- The use of climatic data for the NAE should be considered in future. Climatic conditions were omitted from the decision tool and FMP, as finer scale data (from the Bureau of Meteorology for each Conservation Area) is not readily available nor easily recorded within the scope of the FMP. Future predictions under climate change scenarios, however, indicate that the frequency of high fire danger days may increase within the next decade. This may drive the need for climatic data to be included within the FMP.
- As mentioned in the update of the monitoring data sheets, the Botanical Checklist is to be removed from the FMP. The checklist itself, however, should be transferred to another program where it is more closely aligned to the aims and objectives it fulfils.

10 References

Leonard, J., Newnham, G., Opie, K., and Blanchi, R. (2014) A new methodology for state-wide mapping of bushfire prone areas in Queensland. CSIRO, Australia.

10.1 Full reference list for Chapter 3 review

DSE (2012) Code of practice for bushfire management on public land. Department of Sustainability and Environment, Finsbury Green, Melbourne. ISBN 978-1-74287-420-3 (online)

DNPRSR (2012) Planned burn guidelines: How to assess if your burn is ready to go. Department of National Parks, Recreation, Sport and Racing; Queensland Government Brisbane

DNPRSR (2013b) Fire management: Managing parks and forests. Queensland Parks and Wildlife Service, Department of National Parks, Recreation, Sport and Racing; Queensland Government Brisbane

ICC (2015a) Natural Areas Estate fire management policy. Document No. A4519418. Ipswich City Council.

ICC (2015b) Ipswich Nature Conservation Strategy 2015 – Background Report. Ipswich City Council.

GHD (2017) Ipswich fire management strategic plan. Report for Ipswich City Council.

AFAC (2015). Risk Management and Review Framework for Prescribed Burning Risks Associated With Fuel Hazards. Report for National Burning Project – Subproject 3. Australasian Fire and Emergency Service Authorities Council Limited. March 2015.

AFAC (2016). National guidelines for prescribed burning operations. Report for National Burning Project – Subproject 4. Australasian Fire and Emergency Service Authorities Council Limited (Melbourne: Victoria).

Australian and New Zealand Environment and Conservation Council (ANZECC) National Framework for the Management and Monitoring of Australia's Native Vegetation, December 1999. Published by the Department of Environment and Heritage, Commonwealth of Australia 2000.

AFAC (2016) A Risk Framework for Ecological Risks Associated with Prescribed Burning – National Burning Project: sub-project 3. Australasian Fire and Emergency Service Authorities Council Limited (Melbourne: Victoria)

SEQFBC (2002) Fire and biodiversity monitoring manual. Southeast Queensland Fire and Biodiversity Consortium, Gold Coast.

AFAC (2017). Objectives, Monitoring and Evaluation Framework for Prescribed Burning. Report for National Burning Project. Australasian Fire and Emergency Service Authorities Council Limited (Melbourne: Victoria).

Australasian Fire and Emergency Services Authorities Council (2016) National Position on Prescribed Burning (AFAC Publication No. 2036). East Melbourne, Vic: Australia. AFAC Ltd.

DELWP (2015) Monitoring, evaluation and reporting framework for bushfire management on public land. Department of Environment, Land, Water and Planning, Impact Digital, Melbourne. ISBN 978-1-74146-127-5 (pdf)

QPWS (2012) Planned Burn Guidelines – Southeast Queensland Bioregion of Queensland First edition. Queensland Parks and Wildlife Service (QPWS), Queensland Department of National Parks, Recreation, Sport and Racing (NPRSR), Brisbane.

Hines, F., Tolhurst, K.G., Wilson, A.A., McCarthy, G.J. (2010) Overall Fuel Hazard Assessment Guide 4th Ed; Victorian Government Department of Sustainability and Environment: Melbourne.

Volkova, L., Sullivan, A. L., Roxburgh, S. H., Weston, C. J. (2016) Visual assessments of fuel loads are poorly related to destructively sampled fuel loads in eucalypt forests. International Journal of Wildland Fire 25, 1193-1201.

Appendix 1: Spring 2017 Survey Data

TENRIVERS

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

SITE INFO												OVERALL FUEL HAZARD														VEGETATION CONDITION										
Reserve Name	Plot #	GPS Coords	Fire History (years)	Slope	Aspect	Season	Date	Time	Completed By	Image #	Cloud Cover (%)	Bark Hazard	Elevated Cover	Elevated Dead	Elevated Height	Elevated Hazard	Nearsurface Cover	Nearsurface Dead	Nearsurface Height	Nearsurface Hazard	Surface Cover	Surface Depth	Surface Hazard	Overall Hazard	Indicative Fuel Load	Crown Dieback	Plant Parasites	Epicormic Shoots	HBT's	Shrub crown dieback	Limited Diversity	Acacias	Monoculture	Grass clumping	Weeds	OVERALL CONDITION
Denmark Hill	DH1					Spring	23/11/17	14:30	SF, KM, A McG	51	30	VH	40	20	5	H	30	20	30	H	90	27	H	E	26	C	D	D	A	B	A	B	B	B	D	H
Denmark Hill	DH1		>3		90	Autumn	25/05/17	10:40	Sarah, Kaitly, Sisto	735	0	VH	40	20	4	H	30	20	30	H	85	22.8	H	E	23	D		C		C	C		C	D	D	M
Denmark Hill	DH2					Spring	24/11/17	14:15	SF, KM	52	90	VH	50	20	3	H	15	20	30	M	90	33	VH	E	31	C	D	D	A	B	A	B	A	D	C	H
Denmark Hill	DH2		>3		180	Autumn	25/05/17	13:10	Sarah, Kaitly, Sisto	736	25	H	40	20	2	H	15	20	30	M	90	28.6	VH	VH	24	D		C		B	C		B	D	C	M
Denmark Hill	DH3					Spring	28/11/17	11:30	SF, KM, A McG	1.23	95	VH	40	20	3	H	30	20	40	H	95	26.4	VH	E	32	A	D	D	B	B	A	C	B	D	C	M
Denmark Hill	DH3		>3		270	Autumn	25/05/17	8:00	Sarah, Kaitly, Sisto	734	0	VH	65	25	4	VH	30	20	50	H	90	29.2	VH	E	29	C		D		B	D		B	C	D	L
Flinders Goolman	FM5	479 960 x 6 931 307	>3	15	NW	Spring	3/11/17	11:20	Bronson Stallan	449	5	M	30	5	1.5	H	10	20	40	M	80	26	H	M	16	A	D	D	A	D	C	C	B	A	C	M
Flinders Goolman	FM6	481 590 x 6 925 302				Spring	28/11/17	12:15	Adam Milne	462	80	M	5	5	2	L	80	30	40	VH	80	20	M	H	12	C	D	D	A	D	A	D	B	B	B	M
Flinders Goolman	FM7	481 954 x 6 924 661				Spring	28/11/17	11:32	Michael	461	80	H	80	20	2	E	25	5	30	H	95	28	VH	E	32	C	D	D	D	C	A	A	A	D	D	L
Flinders Goolman	FM8	477 022 x 6 932 384	1-3			Spring	3/11/17	12:26	Michael	450	0	M	20	5	1.25	M	20	7	30	M	100	25	VH	H	21	C	D	D	A	D	C	C	C	D	D	L
Flinders Goolman	FM9	482 713 x 6 924 871				Spring	7/12/17	8:41	Michael	740	25	M	20	5	1	M	80	10	30	H	75	20	H	H	19	C	D	D	B	D	C	B	C	C	D	L
Flinders Goolman	FSRT1	481 902 x 6 926 452	>3			Spring	7/12/17	8:04	Michael	739	0	M	65	5	2	H	85	5	40	VH	80	17	H	VH	18	C	D	D	D	D	A	C	C	D	A	L
Flinders Goolman	FSRT2	482 430 x 6 825 922	>3			Spring	28/11/17	13:42	Michael	463	100	H	20	5	1.5	H	80	25	40	VH	85	31	H	VH	21	B	D	D	D	D	B	C	B	C	C	M
Hillview Drive	HD1					Spring	30/11/17	11:40	SF, KM, A McG	54	95	M	40	20	4	H	50	30	20	VH	85	27.2	H	VH	24	A	D	D	B	A	B	B	B	A	A	VH
Hillview Drive	HD1		>3		45	Autumn	24/05/17	8:30		729	100	M	50	25	4	VH	50	30	20	VH	85	26.5	H	VH	21	B		B		B	B		C	C	B	H
Hillview Drive	HD2					Spring	30/11/17	13:50	SF, KM, A McG	55	80	VH	25	20	4	M	50	30	30	VH	70	15.6	M	E	23	A	A	D	C	B	C	B	B	A	B	VH
Hillview Drive	HD2		>3		45	Autumn	24/05/17	14:00	Sarah, Kaitly, Sisto	733	0	H	25	20	5	M	50	30	50	VH	85	20.6	H	H	20	C		C		B	C		C	C	B	M
Hillview Drive	HD3					Spring	30/11/17	7:45	SF, KM, A McG	53		H	25	20	3	M	50	30	20	VH	70	10	M	H	20	A	D	B	B	C	A	B	B	A	A	VH
Hillview Drive	HD3		>3		90	Autumn	24/05/17	10:55	Sarah, Kaitly, Sisto	732	95	VH	25	20	5	M	50	30	30	VH	70	13.2	M	E	19	C		C		D	B		C	D	D	M
Haig Street Quarry	HS1					Spring	22/11/17	10:20	SF, KM, A McG	48	40	E	20	20	3	M	25	20	40	H	95	31.2	VH	E	33	C	D	D	A	B	B	B	B	D	D	M
Haig Street Quarry	HS1		>3		225	Autumn	23/05/17	12:05		727	0	E	40	20	3.5	H	15	20	30	M	90	25	VH	E	29	C		D		C	B		A	D	D	L
Haig Street Quarry	HS2					Spring	22/11/17	13:30	SF, KM, A McG	49	35	VH	65	25	3	VH	30	20	30	H	90	22.4	H	E	28	B	D	C	C	C	B	B	B	C	D	H
Haig Street Quarry	HS2		>3		270	Autumn	23/05/17	8:40		726	0	H	40	20	2.5	H	30	20	30	H	90	25.4	VH	VH	25	C		C		C	C		C	D	D	M
Haig Street Quarry	HS3					Spring	23/11/17	7:45	SF, KM, A McG	50	40	VH	50	30	4	VH	30	20	40	H	95	27.8	VH	E	34	C	A	A	C	B	B	C	A	A	D	VH
Haig Street Quarry	HS3		>3		225	Autumn	23/05/17	14:30		728	0	VH	65	25	6	VH	30	20	30	H	90	27.6	VH	E	29	D		C		B	C		B	C	D	M

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Purga	PNE	470 959 x 6 821 147	>3			Spring	7/11/17	10:55	Adam Milne	451	25	VH	10	80	1	M	70	20	30	M	60	14	M	VH	15	C	C	C	A	C	A	D	A	C	B	M
Purga	PSW	470 710 x 6 932 053	>3			Spring	7/11/17	11:45	Bronson Stallan	453	10	VH	35	20	1.5	H	80	25	40	H	80	20	H	E	21	C	D	C	D	C	C	D	B	C	B	M
Purga	PW1	470 915 x 6 932 084	>3			Spring	7/11/17	12:05	Michael	454	30	VH	20	5	1	M	75	10	30	M	30	16	M	VH	18	B	D	D	D	D	C	D	C	D	C	L
Purga	PW2	470 780 x 6 932 074	>3			Spring	7/11/17	11:15	Bronson Stallan	452	10	VH	10	80	1	M	90	30	30	H	60	9	M	VH	16	B	C	D	A	D	C	D	A	C	B	M
Stirling Road	SR1	461 122 x 6 946 436	>3	8	203	Spring	9/11/17	10:50	Bronson Stallan	456	30	M	25	30	1.5	M	50	10	50	h	70	12	M	M	12	C	D	D	A	D	B	B	A	C	B	H
Stirling Road	SR1	461 122 x 6 946 436				Autumn	23/05/17	13:01	Michael	377		M	40	10	2	M	80	5	40	H	70	18	H	H	16	C		D		A	A		C	D	C	M
Stirling Road	SR2	461 210 x 6 946 299	>3	6	245	Spring	8/11/17	14:30	Adam Milne	455		M	40	20	1.5	M	70	40	30	H	70	10	M	M	10	B	D	D	A	B	C	C	B	B	B	H
Stirling Road	SR2	461 210 x 6 946 299				Autumn	23/05/17	12:20	Michael	370		M	70	10	2	H	80	15	40	H	70	14	H	VH	18	B		D		A	A		B	C	B	H
Mt Grandchester	WC10	450 770 x 6 944 959	>3	16	200	Spring	1/11/17	10:30	Bronson Stallan	446	5	M	10	1	2	M	85	60	50	VH	70	18	M	H	14	B	D	D	A	D	B	A	B	A	D	M
Mt Grandchester	WC3	451 155 x 6 946 225	>3	11	184	Spring	1/11/17	8:40	Adam Milne	445	5	H	30	5	1.5	M	10	5	30	L	80	15	H	H	16	C	D	D	A	D	C	A	C	C	C	M
Mt Grandchester	WC8	451 030 x 6 945 616	>3			Spring	1/11/17	11:10	Michael	447	0	M	27.2	10	1.5	M	10	3	55	M	90	15	H	H	15	B	D	C	D	C	B	C	B	D	D	L
Mt Grandchester	WCM1	449 209 X 6 942 050	>3	2	305	Spring	1/11/17	12:20	Bronson Stallan	448	0	L	50	20	1.5	M	20	50	40	M	70	16	M	M	9	C	A	A	A	A	B	C	C	B	A	VH
White Rock	WD10					Spring	30/11/17		Nat 2		100	M					70	40	60	VH	95	15.6	VH			C	D	C	D	D	D	D	C	B	D	L
White Rock	WD11					Spring	28/11/17	13:22	Nat 2	547	95	M	40	10	1.5	M	50	20	30	H	80	15.3	M	M		D		D		D	D		C	D	D	L
White Rock	WD12					Spring	28/11/17	10:53		544	70	M	30	40	1	H	40	50	50	VH	100	23.2	VH	H		D		D		D	C			D	C	M
White Rock	WD13					Spring	28/11/17	14:03		548	90	M	40	20	1.5	M	40	20	50	H		14.4	M	M		D		C		D	D		D	D	D	L
White Rock	WD6	485 456 x 6 938 577				Spring	29/11/17	9:00	Nat 2		95	M	90	12	2.5	H	60	30	57.2	E		13.5	VH	VH												
White Rock	WD7					Spring	5/12/17		Nat 2			M	40	20	1.5	H	50	20	60	VH	90	14	VH	VH		C	D	D	C			B	C	C	A	M
White Rock	WD8					Spring	30/11/17		Nat 2			M	25	30	60	M	50	50	60	H	60	14.4	M	VH												
White Rock	WRB5A					Spring	5/12/17	8:15	Nat 3		95	M	40	20	1.75	H	75	30	35	H	50	15.4	M	H		C	D	D	A	C	B	A	D	A	D	M
White Rock	WRB5B					Spring	1/12/17		Nat 2			M	40	20	1.5	H	50	40		VH	30	13.2	M	VH		C		C		D	D		D	D	B	M
White Rock	WRLWRR					Spring	1/12/17		Nat 2		90	M	25	20	1.5	M	45	25	40	H	70	15.8	M	H		C		C		D	D		D	D	D	L
White Rock	WRWHR					Spring	4/12/17					M	50	20	1.5	H	50	25	60	VH	85	16.8	H	VH		D		D		D	D		D	D	D	L

Appendix 2: Fire Monitoring Program – Operational Document

Appendix 3: Assessing Vegetation Condition Within Plot – Supplementary Guide

Assessing Vegetation Condition Within Plot

Supplementary Guide

Overview

The following guide provides background information, definitions, and clarifications of each attribute assessed within the Vegetation Condition Table as part of TR-002 *Fuel and Vegetation Monitoring Data Sheet*. This guide is to be used in conjunction with TR-002 to ensure consistent methodology and accuracy of data collected between sites and subsequent monitoring periods.

Attributes

1. **Proportion of canopy trees with crown dieback, leaves sparse and dead branches, and or recently dead trees**
   This refers to the number of trees, as a percentage of the total number of trees present within the plot, that are showing indicators of crown dieback.
   For this attribute, "canopy trees" is defined as any tree (mature or sub-mature) that is clearly separate from the shrub layer in the mid-stratum (i.e. it's crown is well above the shrub layer). As such, regrowth of canopy species should not be considered, nor should any mature, shrubby trees. Trees forming a sub-canopy layer (i.e. above the mid-stratum but not part of the top canopy) should still be considered.
   The indicators of crown dieback that are present for an individual to be considered impacted include:
   - Areas of leaves that are clearly more sparse than is normal for the species
   - Areas of leaves that are dead and/or cured
   - Dead branches within the crown that do not have any leaves at all
   - Indication of branch attrition (i.e. branches that have recently fallen from the crown)

   Dead trees showing signs that the damage or event that affected them was recent should also be included. These signs include:
   - Dead and dried leaves still present on the tree
   - Strips of bark still present on the tree
   - Areas of the tree still showing sap (i.e. stag is not completely dry)

2. **Proportion of trees with plant pests or parasites (i.e. mistletoe, insect damage etc)**
   This refers to the number of trees, as a percentage of the total number of trees present within the plot, that are showing indicators of pests or parasites, and/or have plant parasites present on the tree. For this attribute, "trees' are defined as any tree species, mature or sub-mature, present in any layer within the plot.
   These indicators include:
   - Parasites known to be associated with declining health (this includes mistletoe but not other epiphytes such as staghorns and elkhorns)

- Visible signs of significant leaf damage (i.e. large amounts of insect damage, leaf galls etc)
- This does not include arboreal termitaria, or associated termite runs, unless they are observed to be causing significant structure damage

3. **Proportion of trees with epicormic or basal shoots**
   This refers to the number of trees, as a percentage of the total number of trees present within the plot, that have any epicormic or basal shoots present on the tree. For this attribute, "trees' are defined as any tree species, mature or sub-mature, present in any layer within the plot.
   Epicormic shoots do not have to be present on the main trunk of the tree being observed, and care should be taken to ensure that branches within the crown of large canopy trees are adequately assessed.

4. **Number of mature/large trees, with or without arboreal hollows (within 30m radius)**
   This refers primarily to the presence of larger mature trees within the plot's immediate area, and is assessed to a radius of 30 meters, instead of the 15 meters within the plots bounds, to give a better representation of the forest as a whole.
   Mature/large trees may differ in size between species and vegetation type, and thus is not defined by a single measurement. Instead, this attribute is assessed to give an indication of well established canopy trees that are recognized as healthy, older growth in relation to the general condition of the monitoring point.
   As a general guide, within most common canopy tree genera, for example *Eucalyptus* and *Corymbia*, large trees can be defined as approximately >30-50cm diameter at breast height (DBH).
   The presence of arboreal hollows should still be recorded even if the tree they are present in is dead.

5. **Proportion of shrub layer with dead or dying foliage and/or dead branches**
   This refers to the number of trees within the shrub layer, as a proportion of the total number of trees in the shrub layer, that are showing indicators of dead or dying foliage. For this attribute, the shrub layer is defined any tree, regardless of species, that has the majority of its foliage present within the mid-strata layer that is normally occupied by shrubby species (usually between 1-3m).
   In regard to dead branches present on shrubby species, this includes branches that have lost their foliage due to shading from other branches on the same tree. However, on regrowth of canopy or larger tree species, a small number of dead branches on the lower parts of the tree are normally observed due to the more rapid growth of trees at this stage, and thus should not be considered.

6. **Proportion of mid-stratum with limited species diversity (i.e. ≤2 species)**
   This refers to the proportion of the total mid-stratum area, as a percentage, that only has representation of a limited number of species. For example, if mid-stratum species cover 100m^2 of the total area of the plot, and an area of 40m^2 has representation of only two tree species (not including canopy trees), then 30-50% of the mid-stratum has limited diversity.
   For this attribute, the mid-stratum is defined as any trees present within the plot that do not form part of the canopy layer. This includes trees present in the shrub layer, up to trees that may form a sub-canopy below the top canopy, and everything in between.

Limited species diversity is defined as a lower than average representation of species for the vegetation type the plot is in. The number of species that constitutes limited diversity is variable between vegetation types, for example some vegetation types may only be described with two species in the under-story. Therefore, this attribute must be recorded as a representation of an abnormally low diversity of species in relation to the vegetation type.
For most of the common vegetation types the monitoring plots are present in, limited diversity would normally be representation of two or less species.

7. **Proportion of canopy species with limited signs of recruitment**
This refers to proportion of canopy species, as a percentage of the total number of canopy species present within the plot, that are not showing signs of recruitment within the plot area.
For this attribute, canopy species are defined as any mature tree species with representation in the top canopy or sub canopy layer.
"Limited signs of recruitment" is defined as a distinct lack of, or a very small number of regrowth stage individuals present in the lower strata of the plot area. For example, if there are 5 species present in the canopy layer of the plot, but only 4 of these species are present as regrowth in the lower layers, then 10-30% of the canopy species are showing limited signs of recruitment.

8. **Proportion of total area that is acacias**
This refers to the proportion of the entire plot, as a percentage of the total plot area, that has any acacia species present within it. For assistance in estimating percentage cover, see "*Visual Guide to Percentage Cover,*" page 6, *TR-002 Fuel and Vegetation Monitoring Data Sheet.*

9. **Proportion of total area with monoculture of the same aged vegetation (single species)**
This refers to the proportion of the entire plot, as a percentage of the total plot area, that is occupied by stands of monoculture community where all individuals are of the same age class. These areas must be well defined and must not have other species present within the stand, nor should the age within the monoculture species have large variations.
For example, if a plot has a stand of *Allocasuarina littoralis* that are all approximately 4-6 years old, and covers an $80m^2$ area within the plot, the proportion of the total area with monoculture of the same aged vegetation is 10-30% (a 15m radius plot has a total area of approximately $700m^2$).

10. **Proportion of native grasses clumped and with dead material accumulated**
This refers to the proportion of native grasses, as a percentage of the total cover of native grasses within the plot, that are experiencing some level of curing, clumping, or accumulation of dead material that is above the normal level for that species.
For assistance in assessing this, see "*Visual Guide to Native Grass Clumping,*" page 6, *TR-002 Fuel and Vegetation Monitoring Data Sheet.*
For most species of native grasses, it is within normal health for a small amount (roughly 10-20%) of cured material to be present on the underside of the grasses, and thus grasses representative of this should not be considered. Grasses with cured material on the top of the grass, at the ends of most of the blades, or clumped, dead material in the middle of the grass are indicative of poor health and should be considered.

11. **Proportion of total area lacking any native grasses or ground cover and/or showing erosion**
This refers to the proportion of the entire plot, as a percentage of the total plot area, that does not have any native species present in the surface layer. This includes areas within the plot that do not contain any ground cover, including
    - Areas of only leaf litter or exposed soil
    - Areas showing bare earth due to erosion or water movement
This also includes areas with only weedy ground cover eg *Lantana montividensis, Sphagneticola trilobata* etc.

12. **Proportion of total area with weeds**
This refers to the proportion of the entire plot, as a percentage of the total plot area, that has any weed species present. Weed species present in all layers should be considered.

Additional Definitions

Percentage cover vs percentage of individuals impacted
Percentage cover of layer: The table refers to proportion of layers impacted, which is defined as the proportion of a given layers total cover that is impacted by a certain attribute.
Example: "6. Proportion of mid-stratum with limited species diversity" – in sites where the mid-stratum only covers ¼ of the entire plot, if the mid-stratum is only made up of a single species, this should be classified as ">50%" as it is equivalent to 100% of that layer that has limited diversity.

Percentage cover of total area: The table refers to proportion of total area impacted, which is defined as the proportion of the entire plot that is impacted by a certain attribute.
Example: "12. Proportion of total area with weeds" – when the entire plot is covered in weeds (i.e. 100%), this should be classified as ">50%".

Percentage of individuals: The table refers to percentage of individuals impacted, which is defined as the percentage of the total number of individuals that are affected by a particular attribute
Example: "3. Proportion of area having trees with epicormic or basal shoots" – if there are 10 trees with 6 individuals that have epicormic shoots, this equates to 60%, and should be classified as ">50% of individuals impacted".

Appendix 4: Baseline Survey Data Sheet

Item 1 / Attachment 3.

Baseline Data Sheet

Date: ....../....../......

TENRIVERS

Instruction:

1. *Form to be prepared and approved by Conservation Management Officer prior to in-field monitoring then completed by Field Officer. Complete all possible desktop components prior to field visit.*
2. *One Baseline Data Sheet to be completed for each existing / proposed 15m radius plot.*
3. *Form to be reviewed for currency and completeness prior to each subsequent survey event.*
4. *Completed form to be submitted to GIS for data entry.*
5. *For further information, see Fire and Biodiversity Monitoring Manual prepared by Southeast Queensland Fire and Biodiversity Consortium.*

Reserve Name		**File Reference**	
Fire Block Number		**Last Amended**	
Fire Management Zone		**Date of Last Survey**	/ /
GPS Coordinates – MGA Zone 56 (GDA94)		**Plot Number**	

Location Description *(include name and distance from nearest track and describe entry point)*

....

....

Photo Point Description: *To be taken from the plot marker, taking four photos facing north, east, south, and west, in that order.*

Image No.	N:	E:						
	S:	W:	**Time**		**Date**	/ /	**Cloud Cover %**	

Plot Use and Characteristics

Primary objective of Fire Management Zone:

Previous Dominant Plot Use	**Current Secondary Plot Use**	**Comments**
Farming ❑ Grazing ❑ Mining ❑ Forestry ❑ Military (UXO) ❑	None ❑ Grazing ❑ Recreation ❑ Other (describe) ❑	Evidence of urban impact? **Yes/No** Why? .... Other comments: ....

Features Present		**Rainfall**
None ❑ Infrastructure ❑ Cultural resources ❑ Other (describe) ❑	Significant vegetation features (eg old growth trees):	Nearest gauge station: .... Average annual rainfall at gauge station (mm): ....

Plot Fire History		**Topographic**
Indicators of Fire: In the last 12 months ❑ 1 to 3 years ❑ 3 to 10 years ❑ Longer than 10 years ❑	Date of last known fire: ..../........./............... Type of Fire: ❑ Wildfire ❑ Planned burn ❑ Suspected arson	**Slope** *(degrees)* **Aspect** *(measured as the compass direction from the highest point on the periphery of the plot sample through the centre point of plot)* **Degrees** **Direction**

Form No: TR-001
Revision: 1.0

Date: May 2018

Page 1 of 3

Item 1 / Attachment 3.

Baseline Data Sheet

Date: ....../....../......

Broad Vegetation Type		Sub type		
10b	Dry to moist open forests to woodlands dominated by *Corymbia citriodora* (spotted gum)	13c	*Eucalyptus crebra*, and *E. fibrosa* on granitic and metamorphic ranges	❑
		13c/28e or 12a or 9a	*Eucalyptus crebra*, *E. fibrosa*, *Lophostemon suaveolens*, *L. confertus* and *Allocasuarina spp*. on rocky hill slopes ***OR*** *Corymbia trachyphloia* on inland hills with shallow soils ***OR*** *E. siderophloia*, *E. propinqua*, *E. acmenoides*, *E. microcorys*, *E. carnea*, *E. tindaliae*, *C. intermedia*, *L. confertus*	❑
		13d	*Eucalyptus moluccana* on a range of substrates	❑
		9g/13c/12a	*Eucalyptus tindaliae*, *E. acmenoides*; or *E. racemosa* or *E. seeana* or *E. tereticornis*, *C. intermedia* and *E. crebra*, *E. fibrosa* on granitic and metamorphic ranges, and *C. trachyphloia* on inland hills with shallow soils	❑
		9h	*Eucalyptus acmenoides*, *E. tereticornis*, *C. trachyphoia* or *C. intermedia*, and often *E. crebra* or *E. fibrosa*, frequently with a heathy shrub layer. On undulating hilly terrain.	❑
		8a	Wet tall open forest dominated by *Eucalyptus grandis*, *Lophostemon confertus*, containing a well developed understorey dominated by sclerophyll shrubs or ferns and palms.	❑
9g/10b	Moist to dry woodlands to open forest dominated by stringybarks or mahoganies such as *Eucalyptus tindaliae*, *E. acmenoides*; or *E. racemosa*, or *E. seeana*, or *E. tereticornis*, and *Corymbia intermedia*, with *C. citriodora*.			❑
9a	Moist eucalypt forests to woodlands dominated by a variety of species including *E. siderophloia*, *E. propinqua*, *E. acmenoides*, *E. microcorys*, *E. carnea*, *E. tindaliae*, *C. intermedia*, and *L. confertus*.			❑
11a	Moist to dry open forests to woodlands dominated by *Eucalyptus tereticornis* (blue gum), *E. melliodora*, *E. crebra* or *E. melanophloia*.			❑
13c	Woodlands of *Eucalyptus crebra, E. fibrosa* on granitic and metamorphic ranges.			❑
16a/16c	Open forest and woodlands dominated by *Eucalyptus tereticornis* fringing drainage lines or on floodplains. Associated species may include *Melaleuca spp*., *Corymbia tessellaris*, *Angophora spp*., *Casuarina cunninghamiana*. Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.			❑
18b	Woodlands dominated *Eucalyptus crebra* frequently with *Corymbia* spp. or *Callitris* spp. on flat to undulating plains.			❑
21b	Low open woodlands and tall shrublands of *Melaleuca spp.* Including *M. irbyana*.			❑
28e	Low open forest to woodlands dominated by *Lophostemon suaveolens* or *L. confertus* frequently with *Allocasuarina spp*. on rocky hill slopes.			❑
29b	Open shrublands to open heaths on elevated rocky substrates.			❑
29b/9h	Open shrublands to open heaths on elevated rocky substrates with *Eucalyptus acmenoides*, *E. tereticornis*, *C. trachyphoia* or *C. intermedia*, and often *E. crebra* or *E. fibrosa*, frequently with a heathy shrub layer. On undulating hilly terrain.			❑
2a	Complex evergreen notophyll vine forest frequently with *Araucaria cunninghamii* (hoop pine) from foothills to ranges.			❑
5a	Araucarian notophyll/microphyll and microphyll vine forests of southern coastal bioregions.			❑
7a	Semi-evergreen vine thickets on wide range of substrates.			❑
34c	Palustrine wetlands. Freshwater swamps on coastal floodplains dominated by sedges and grasses.			❑

Form No:
TR-001
Revision: 1.0

Date: May 2018

Page 2 of 3

Baseline Data Sheet

Date: ....../....../......

TENRIVERS

Plot Description

Identify up to 3 dominant canopy species within the plot

....

....

....

Identify up to 3 dominant mid-story species within the plot

....

....

....

Identify up to 3 dominant ground cover species within the plot

....

....

....

List up to 3 dominant weed species present within plot

....

....

....

....

....

Known significant species (eg EVNT, EVR etc) identified at site (specify if sighted or from record):

....

....

....

....

....

Soil Types	Percentage of Surface *(10% increments)*	Comments
❑ Exposed Rock		
❑ Sandy		
❑ Clayey		
❑ Loamy		
❑ Alluvial		
❑ Modified/imported		
❑ Erosion evident		
❑ Salinity evident		

Compiled by	Data Entry Completed by	Checked by
Name:	Name:	Name: ....
Signature:	Signature:	Signature: ....
Date: ....../....../............	Date: ....../....../............	Date: ....../....../............

Form No:
TR-001
Revision: 1.0

Date: May 2018

Page 3 of 3

Appendix 5: Fuel and Vegetation Monitoring Data Sheet

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

Date: ....../....../......

TENRIVERS

Part A: Fuel Monitoring

This data sheet is to be used in conjunction with Overall Fuel Hazard Assessment Guide (OFHAG) 4th Edition, July 2010.
If alternate edition used: .... # Edition

Assessment Details and Plot Information							
Season & Year		**Date**	/ /	**Time**		**Completed By**	
Reserve Name				**Fire Block Number**			
GPS				**Plot Number**			
Fire Management Zone	☐ Wildfire Mitigation Zone ☐ Fire Exclusion Zone ☐ Conservation Zone			☐ Sustainable Production ☐ Protection Zone ☐ Reference Zone			
Photo Point Description: *To be taken from the plot marker, taking four photos facing north, east, south, then west, in that order.*	....			**Image No.**	N:	E:	
					S:	W:	
				Cloud Cover (%)			

Overall Fuel Hazard Rating Calculation

Complete the following four steps to calculate the overall fuel hazard rating within 15m radius of monitoring point.

1.0 Bark Fine Fuel Calculation (*OFHAG pg10-21*)

Bark Type Identification & Hazard – determine if Stringy Bark, Ribbon Bark or Other and classify** *(circle)*			
Stringy Bark** *(pg11-13)*	**Ribbon Bark** *(p15-17)*	**Other Bark Type** *(p18-21)*	**Hazard Rating**
Does not occur with this bark type (not present).	*Does not occur with this bark type (not present).*	Trunk and branches entirely smooth.	**LOW**
Bark is tightly held	No long ribbons present.	Bark rubs off with firm pressure.	**MODERATE**
Bark mostly tightly held, with a few pieces loosely attached.	Long ribbons present on upper truck, lower trunk smooth.	Light hand pressure will break bark off.	**HIGH**
Many pieces of bark loosely held. Deep fissures present.	Long ribbons hanging down to ground level or trunk flammable.	*Does not occur with this bark type.*	**VERY HIGH**
Many pieces of bark loosely held. Deep fissures present.	Long ribbons hanging down to ground level or trunk flammable.	*Does not occur with this bark type.*	**EXTREME**

*(**Use "Stringy Bark" if more than 10% of trees have fine fibrous bark. Class Paper Bark as "Ribbon Bark", use this rating if more than 30% of trees present are Paper Bark.)*

Item 1 / Attachment 3.

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

TENRIVERS

Date: ……/……/……

2.0 Elevated Fuel Calculation (*OFHAG pg23-25*)

Elevated Fuel Key Attributes – Circle appropriate description for each attribute, then determine Hazard Rating *(circle)* based on the best representation, with Plant Cover (%) being the most important value					
Elevated Fuel Avg Height (cm):**	☐ 50-100 ☐ 100-150 ☐ 150-200		☐ 200-250 ☐ 250-300 ☐ >300		
Plant Cover (%)	<20%	20-30%	30-50%	50-80%	>70%
% Dead	<20%	<20%	<20%	20-30%	>30%
Vertical Continuity		Most of the fine fuel is at the top of the layer.	Most of the fine fuel is at the top of the layer.	Continuous fine fuel from the bottom to the top of the layer.	Continuous fine fuel from the bottom to the top of the layer.
Vegetation Density	Easy to walk in any direction without needing to choose a path between shrubs.	Easy to choose a path through but brush against vegetation occasionally.	Moderately easy to choose a path through, but brush against vegetation most of the time.	Need to carefully select path through.	Very difficult to select a path through. Need to push through vegetation.
Elevated Fine Fuel Hazard	**LOW**	**MODERATE**	**HIGH**	**VERY HIGH**	**EXTREME**

*(** Consider anything <50cm Near Surface Fuel)*

3.0 Combined Surface and Near-Surface Fuel Load Calculation *(OFHAG pg27-35)*

3.1 Near Surface Calculation *(OFHAG pg27-29)* – Circle appropriate description for each attribute, then determine Hazard Rating *(circle)* based on the best representation, with Plant Cover (%) being the most important value					
Near Surface Height (cm)	☐ 0-15 ☐ 15-30		☐ 30-50 ☐ 50-75		☐ 75-100 ☐ >100
Plant Cover (%)	10%	10-20%	20-40%	40-60%	>60%
% Dead	<10%	<20%	>20%	>30%	>50%
Horizontal Connectivity	Near-surface fuel is absent or virtually absent.	Gaps many times the size of fuel patches.	Gaps between fuel patches are greater than the size of fuel patches. Starting to obscure logs and rocks.	Fuel patches are equal to or larger than the gaps between the fuel patches.	Very small gaps between fuel patches. Logs and rocks obscured.
Near Surface Fine Fuel Hazard	**LOW**	**MODERATE**	**HIGH**	**VERY HIGH**	**EXTREME**

Item 1 / Attachment 3.

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

Date: ....../....../......

TENRIVERS

3.2 Surface Fine Fuel Calculation *(OFHAG pg30-33)* **– Calculate average litter depth, circle appropriate description for each attribute, then determine Hazard Rating** *(circle)* **based on the best representation, with Surface Litter Cover (%) being the most important value**

Instructions

1. Randomly select a location and make a hole in the litter bed just wide enough for the end of the ruler to rest on the mineral soil.
2. Lightly press the disc down onto the surface fine fuel.
3. Read the ruler above the disk. Record litter bed height in millimetres.
4. Perform procedure 5 times and determine average litter bed height. Take more samples if results vary greatly.

Raw Data:

1. mm	2. mm	3. mm	4. mm	5. mm	**Average Litter Depth:**

Horizontal Connectivity	Litter poorly interconnected. Large areas of bare soil or rock. More soil than litter. Soil surface readily visible through litter bed.	Litter well connected. Some areas of bare soil or rock. Soil surface occasionally visible through litter bed.	Litter well connected. Little bare soil.	Litter completely connected.	Litter completely connected.
Surface Litter Cover (%)	<60%	60-80%	80-90%	>90%	>95%
Litter Bed Depth	Very thin litter layer. <10mm	Thin litter layer. 10-25mm	Established litter with layers of leaves ranging from freshly fallen to decomposing. 20-30mm	Thick litter layer. 25-45mm	Very thick layer of litter. >35mm
Surface Fine Fuel Hazard	**LOW**	**MODERATE**	**HIGH**	**VERY HIGH**	**EXTREME**

3.3 Combined Surface and Near-Surface Hazard Rating *(OFHAG pg34)*

❶ Surface Fine Fuel Hazard Rating	❷ Near-Surface Fine Fuel Hazard Rating: Low	Moderate	High	Very High	Extreme
	❸ Combined Surface and Near-Surface Fine Fuel Hazard Rating				
Low	L	L	M	H	VH
Moderate	M	M	H	VH	E
High	H	VH	VH	VH	E
Very High	VH	VH	E	E	E
Extreme	E	E	E	E	E

Assessments of surface and near-surface fuels must be combined before an Overall Fuel Hazard rating can be determined. The near-surface fuel rating is used to adjust the surface fine fuel hazard rating, according to adjacent table. To determine the effect of near-surface fine fuel hazard:

1. Select the **surface fuel hazard rating** from column ❶
2. Select the **near-surface fuel hazard rating** from column ❷
3. Select the resulting **combined rating** value ❸ *(circle)*
4. Use this value to determine the Overall Fuel Hazard rating using the Table 4.0.

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

Date: ……/……/……

TENRIVERS

4.0 Overall Fuel Hazard Calculation *(OFHAG pg35)*

❶ Bark Hazard	❷ Elevated Fine Fuel Hazard	❸ Combined Surface and Near-Surface Fine Fuel Hazard Rating				
		L	**M**	**H**	**VH**	**E**
Low or Moderate	**L**	L	M	M	H	H
	M	L	M	M	H	H
	H	L	M	H	VH	VH
	VH	VH	VH	VH	VH	VH
	E	E	E	E	E	E
High	**L**	L	M	H	H	H
	M	L	M	H	H	H
	H	L	H	H	VH	VH
	VH	VH	VH	VH	VH	E
	E	E	E	E	E	E
Very High or Extreme	**L**	L	VH	VH	VH	E
	M	M	VH	VH	E	E
	H	M	VH	E	E	E
	VH	E	E	E	E	E
	E	E	E	E	E	E

To determine the Overall Fuel Hazard rating:

1. Select the row that corresponds to the **Bark Hazard** ❶

2. Select the row that corresponds to the **Elevated Fine Fuel Hazard** ❷

3. Select the column that corresponds to the assessed level of **Combined Surface and Near-surface Fine Fuel Hazard** ❸

4. Identify where these two intersect and this will provide you with the corresponding Overall Fuel Hazard rating *(circle)*.

Hazard Ratings *(Record your hazard ratings for each layer here, including Overall Fuel Hazard)*					
Bark Hazard	**Elevated Hazard**	**Near-Surface**		**Surface**		**OVERALL**
		Combined Surface and Near Surface Hazard				

Compiled by	**Data Entry Completed by**	**Checked by**
Name: ………………………………	Name: ………………………………	Name: ………………………………
Signature: ………………………………	Signature: ………………………………	Signature: ………………………………
Date: ……/……/………	Date: ……/……/………	Date: ……/……/………

Form No: TR-002
Revision: 1.0

Date: May 2018

Page 4 of 6

Item 1 / Attachment 3.

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

Date: ....../....../......

TENRIVERS

Part B: Assessing Vegetation Condition Within Plot

This data sheet is to to used in conjuction with the supplementary material Vegetation Condition Guide.

Attribute	(A) – 1 point Strong indicator of declining health	(B) – 2 points Moderate indicator of declining health	(C) – 3 points Low indicator of declining health	(D) – 4 points Indicator of good health
1. Proportion of trees with crown dieback, leaves sparse & dead branches, and/or recently dead trees	☐ >30% of individuals impacted	☐ 10 to 30% of individuals impacted	☐ 1 to10% of individuals impacted	☐ Nil individuals impacted
2. Proportion of trees with plant pests or parasites *(i.e. mistletoe, insect damage etc)*	☐ >50% of individuals impacted	☐ 30 to 50% of individuals impacted	☐ 10 to 30% of individuals impacted	☐ 0 to 10% individuals impacted
3. Proportion of trees with epicormic or basal shoots	☐ >50% of individuals impacted	☐ 30 to 50% of individuals impacted	☐ 10 to 30% of individuals impacted	☐ 0 to 10% individuals impacted
4. Number of mature / large trees, with or without arboreal hollows (within 30m radius)	☐ Nil specimens	☐ 1 specimen (with or without hollows)	☐ >1 specimen, nil hollows	☐ >1 specimen with hollows
5. Proportion of shrub layer with dead or dying foliage and/or dead branches	☐ >50% of individuals impacted	☐ 30-50% of individuals impacted	☐ 10-30% of individuals impacted	☐ <10% of individuals impacted
6. Proportion of mid-stratum with limited species diversity (ie ≤2 species)	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
7. Proportion of canopy species with limited signs of recruitment	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
8. Proportion of total area that is acacias	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
9. Proportion of total area with monoculture of the **same aged** vegetation (single species)	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
10. Proportion of native grasses clumped[a] and with dead material accumulated	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
11. Proportion of total area lacking any native grasses or ground cover and/or showing erosion	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
12. Proportion of total area with weeds	☐ >50%	☐ 30 to 50%	☐ 10 to 30%	☐ 0 to 10%
Total number of indicators[b]	(x 1)	(x 2)	(x 3)	(x 4)
Indicators multiplied by points value	+	+	+	
TOTAL cumulative value of all indicators	=			

[a] refer "Supporting resource" for "Visual Guide of Native Grass Clumping
[b] refer "Health Categories" on page 6 for description of calculating the overall vegetation condition

Form No: TR-002
Revision: 1.0

Date: May 2018

Page 5 of 6

Item 1 / Attachment 3.

Fire Management – *Fuel and Vegetation Monitoring Data Sheet*

Date: ....../....../......

TENRIVERS

Health Categories

The overall health score is a cumulative measure of the points values assigned to each category, and the total scores across all categories. To reach a total:

- First multiply the total number of indicators in each category by that categories points value (e.g. if there were 4 indicators in category **(C)**, multiply 4 by 3, giving 12 points total for category **(C)**).
- Then add the total scores of each category together to come to a total overall value.

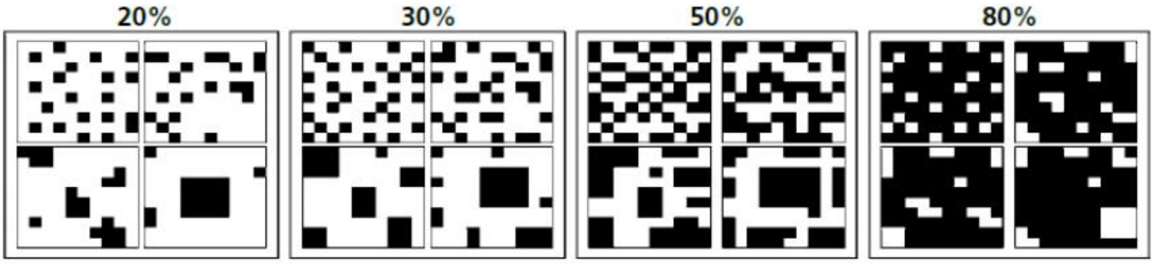
The overall vegetation condition score gives a measure of the general vegetation health of a plot, ranging from **Low** (in good health) to **Very High** (unhealthy).
To determine the vegetation condition rating, use the following table:

Points Value	41-48	33-40	26-32	12-25
Rating	LOW	MODERATE	HIGH	VERY HIGH
Relative Health	Healthy	Moderately Healthy	Moderately Unhealthy	Unhealthy

Supporting Resources:

Visual Guide for Percentage Cover:

Each quarter of any one square has the same percent cover.



Visual Guide to Native Grass Clumping:

A mixed grassy / shrubby understorey in decline due to absence of fire. Note drooping dead skirts on grass trees and sparse grass clumps.
Mark Burnham, QPWS, D'Aguilar National Park.

A sequence illustrating clumping grass decline in the absence of fire.
The bottom row indicates where fire has been absent too long.
Wayne Kington / David Kington, QPWS, Lamington National Park.

Form No:
TR-002
Revision: 1.0

Date: May 2018

Appendix 6: Post Burn and Fire Assessment Data Sheet

Item 1 / Attachment 3.

Post Burn and Fire Assessment Data Sheet

Date: ....../....../......

TENRIVERS

Instruction:

1. *Form to be completed by the Field Officer during in-field monitoring*
2. *One Fire Assessment Data Sheet to be completed for each sample plot*
3. *Part A of form to be completed when witnessing a fire regardless of whether plots have been established.*
4. *Part B of form to be completed at every survey event.*
5. *Part B of form to be completed within two weeks of notification of fire.*
6. *Completed form to be submitted to Conservation Management Officer for review, then to GIS for data entry.*
7. *For further information, see Fire and Biodiversity Monitoring Manual**

Season and Year		**Date**	/ /	**Time**		**Completed by**	

Reserve Name		**File Reference**	
Fire Block Number		**Last Amended**	
Plot Number		**Date of Last Survey**	
Fire Management Zone		**GPS Coordinates – MGA Zone 56 (GDA94)**	
Location Description *(include name and distance from nearest track and describe entry point)*			
Photos of fire event:	1. *Include a yard stick/measuring device visible in all photos* 2. *Photos must not be on fire edge* 3. *In the case of a controlled burn, take photos after fire has built its own intensity* 4. *Collect appropriate georeferenced data with photo (eg "Navcam" app)*		
Photo location description		**Image No.**	
		Time	
Photo GPS coordinates		**Photo Aspect (°)**	

Part A: Fire Behaviour

Type of fire:	❑ Wildfire	❑ Planned Burn	❑ Suspected arson
Flame height average (m):		Smoke behaviour:	
Fire movement:		Ignition source:	
Rate of spread (m/minute):			

Weather

Wind speed (km/hr):		Fuel moisture content (measured or desktop):	
Wind direction:		Cloud cover (%):	
Temperature (°C):		Relative humidity:	

Form No: TR-003
Revision: 1.0

Date: May 2018

Page 1 of 2

Item 1 / Attachment 3.

Post Burn and Fire Assessment Data Sheet

Date: ....../....../......

TENRIVERS

Part B: Post Fire Assessment						
Scorch height average (m):						
Crown scorch (%):						
Intensity (see table):	❑ Unburnt	❑ Low	❑ Moderate	❑ High	❑ Severe	❑ Extreme
Structure damage (tick all applicable):	❑ Bark	❑ Surface	❑ Grass layer	❑ Elevated layer	❑ Mid-storey	❑ Canopy

Grassland and open woodland	Heathland and shrubland	Forest and open woodland			Description
			U	Unburnt	
			L	Low	Patchy, does not remove all the litter and ground stratum, low scorch, little or no canopy scorch.
			M	Mod	Most or all ground stratum burnt, some scorch in the mid-stratum, little or no canopy scorch.
			H	High	Ground stratum burnt completely (or nearly so), at least some canopy scorch.
			S	Severe	All understorey burnt (or nearly so), extensive crown scorch.
			C	Canopy fire	Burnt through canopy (with or without burning mid-strata); ground stratum largely unburnt.
			E	Extreme	All understorey burnt (or nearly so), tree branches burnt.

Map Fire Boundary: *Use appropriate tools/systems to map fire scar boundaries*

1. *Walk perimeter of burn scar area along immediate scar edge and log complete boundary with GPS*
2. *Note percentage of area burnt and mosaic pattern within burn scar areas*
3. *In areas where percentage burnt or patchiness varies, map scar areas seperately*

File reference and map type	

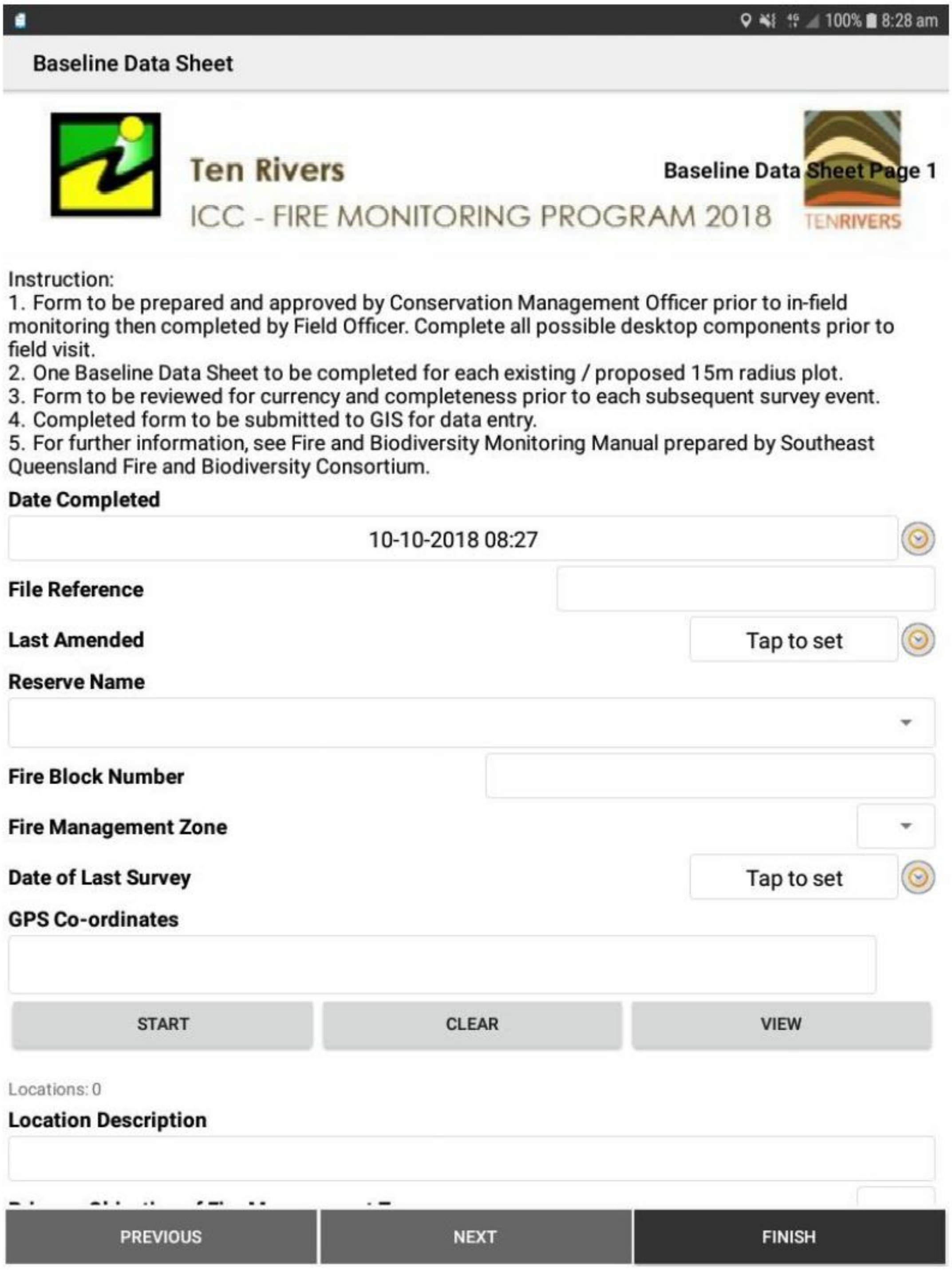
Compiled by	Data Entry Completed by	Checked by
Name:	Name:	Name: ....
Signature:	Signature:	Signature: ....
Date: ....../....../...........	Date: ....../....../...........	Date: ....../....../...........

Form No: TR-003
Revision: 1.0

Date: May 2018

Page 2 of 2

Appendix 7: Digital Data Forms



8:28 am

Baseline Data Sheet

Ten Rivers Baseline Data Sheet Page 1
ICC - FIRE MONITORING PROGRAM 2018

Instruction:
1. Form to be prepared and approved by Conservation Management Officer prior to in-field monitoring then completed by Field Officer. Complete all possible desktop components prior to field visit.
2. One Baseline Data Sheet to be completed for each existing / proposed 15m radius plot.
3. Form to be reviewed for currency and completeness prior to each subsequent survey event.
4. Completed form to be submitted to GIS for data entry.
5. For further information, see Fire and Biodiversity Monitoring Manual prepared by Southeast Queensland Fire and Biodiversity Consortium.

Date Completed
10-10-2018 08:27

File Reference

Last Amended Tap to set

Reserve Name

Fire Block Number

Fire Management Zone

Date of Last Survey Tap to set

GPS Co-ordinates

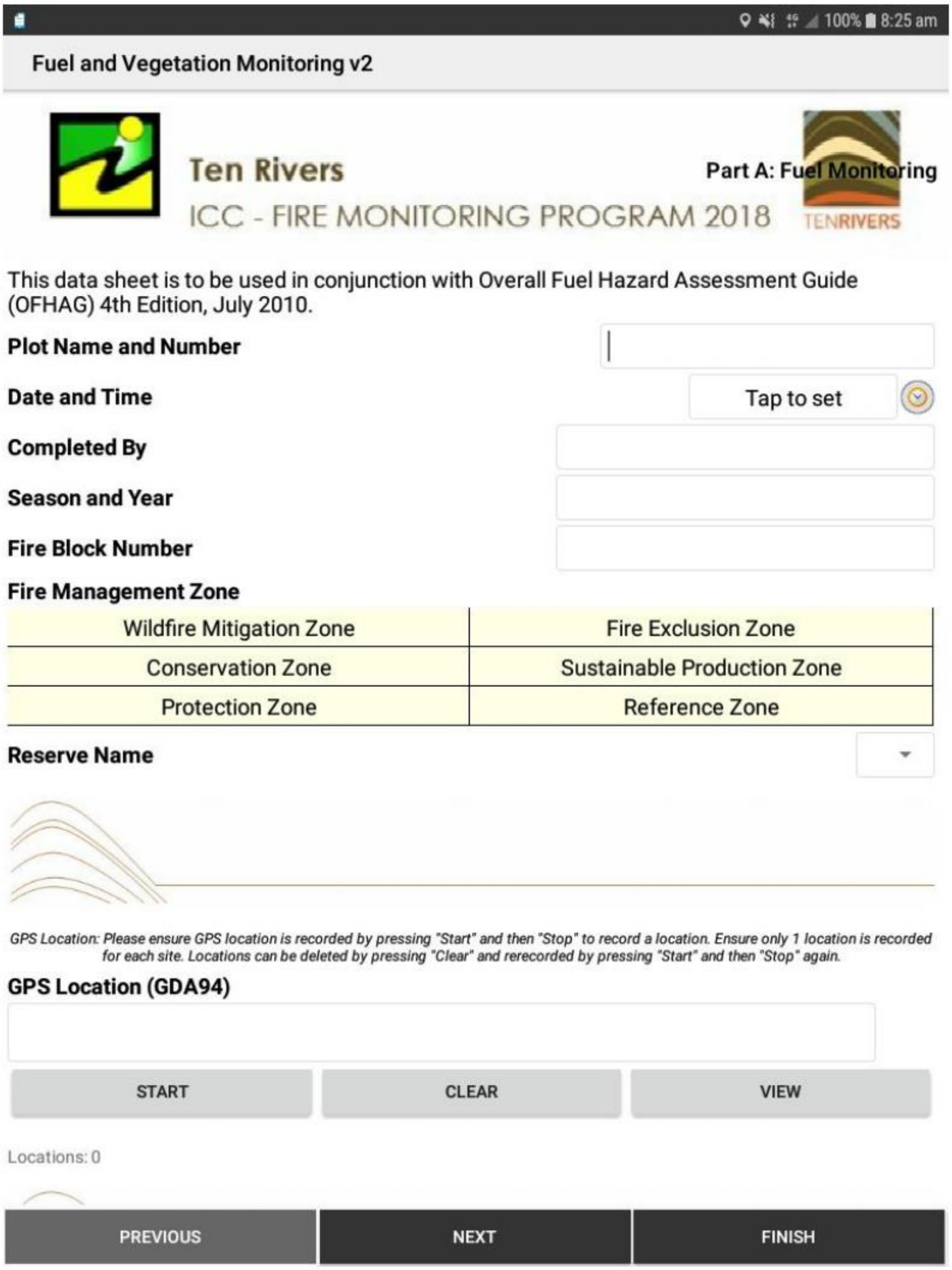
START | CLEAR | VIEW

Locations: 0

Location Description

PREVIOUS | NEXT | FINISH

Figure 7 - Baseline Survey Digital Data Form



100% 8:25 am

Fuel and Vegetation Monitoring v2

Ten Rivers
ICC - FIRE MONITORING PROGRAM 2018

Part A: Fuel Monitoring

TENRIVERS

This data sheet is to be used in conjunction with Overall Fuel Hazard Assessment Guide (OFHAG) 4th Edition, July 2010.

Plot Name and Number

Date and Time Tap to set

Completed By

Season and Year

Fire Block Number

Fire Management Zone

Wildfire Mitigation Zone	Fire Exclusion Zone
Conservation Zone	Sustainable Production Zone
Protection Zone	Reference Zone

Reserve Name

GPS Location: Please ensure GPS location is recorded by pressing "Start" and then "Stop" to record a location. Ensure only 1 location is recorded for each site. Locations can be deleted by pressing "Clear" and rerecorded by pressing "Start" and then "Stop" again.

GPS Location (GDA94)

START CLEAR VIEW

Locations: 0

PREVIOUS NEXT FINISH

Figure 8 - Fuel and Vegetation Monitoring Digital Data Form

Item 1 / Attachment 3.

100% 8:26 am

Fuel and Vegetation Monitoring v2

3.2 Surface Fine Fuel Calculation *(OFHAG pg30-33)* **– Calculate average litter depth, determine appropriate description for each attribute, then determine Hazard Rating based on the best representation, with Surface Litter Cover (%) being the most important value**

Instructions

1. *Randomly select a location and make a hole in the litter bed just wide enough for the end of the ruler to rest on the mineral soil.*
2. *Lightly press the disc down onto the surface fine fuel.*
3. *Read the ruler above the disk. Record litter bed height in millimetres.*
4. *Perform procedure 5 times and determine average litter bed height. Take more samples if results vary greatly.*

Horizontal Connectivity	Litter poorly interconnected. Large areas of bare soil or rock. More soil than litter. Soil surface readily visible through litter bed.	Litter well connected. Some areas of bare soil or rock. Soil surface occasionally visible through litter bed.	Litter well connected. Little bare soil.	Litter completely connected.	Litter completely connected.
Surface Litter Cover (%)	<60%	60-80%	80-90%	>90%	>95%
Litter Bed Depth	*Very thin litter layer.* *<10mm*	*Thin litter layer.* *10-25mm*	*Established litter with layers of leaves ranging from freshly fallen to decomposing. 20-30mm*	Thick litter layer. 25-45mm	*Very thick layer of litter.* *>35mm*
Surface Fine Fuel Hazard	**LOW**	**MODERATE**	**HIGH**	**VERY HIGH**	**EXTREME**

The above table is for reference only, please enter measurements below

Litter Depth 1 (mm)

Litter Depth 2 (mm)

Litter Depth 3 (mm)

Litter Depth 4 (mm)

Litter Depth 5 (mm)

Litter Depth Average 0.00

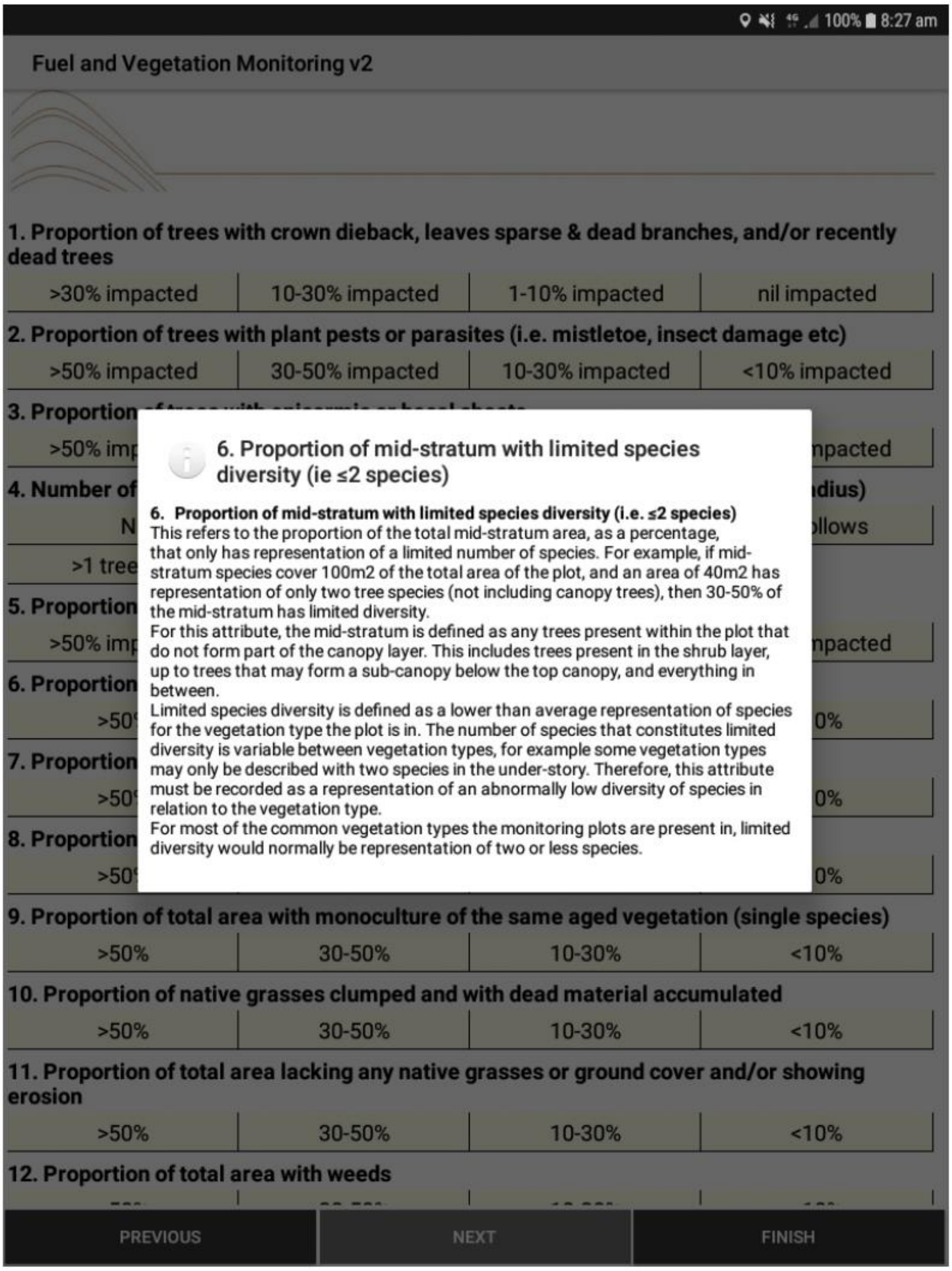
Surface Fuel Percentage Cover

<60%	60-80%	80-90%	>90%	>95%

Surface Fuel Hazard

PREVIOUS | NEXT | FINISH

Figure 9 - Fuel and Vegetation Monitoring Digital Data Form



100% 8:27 am

Fuel and Vegetation Monitoring v2

1. Proportion of trees with crown dieback, leaves sparse & dead branches, and/or recently dead trees

>30% impacted	10-30% impacted	1-10% impacted	nil impacted

2. Proportion of trees with plant pests or parasites (i.e. mistletoe, insect damage etc)

>50% impacted	30-50% impacted	10-30% impacted	<10% impacted

3. Proportion ... >50% imp ... npacted

4. Number of ... dius) ... N ... llows ... >1 tree

5. Proportion ... >50% imp ... npacted

6. Proportion ... >50 ... 0%

7. Proportion ... >50 ... 0%

8. Proportion ... >50 ... 0%

6. Proportion of mid-stratum with limited species diversity (ie ≤2 species)

6. Proportion of mid-stratum with limited species diversity (i.e. ≤2 species)
This refers to the proportion of the total mid-stratum area, as a percentage, that only has representation of a limited number of species. For example, if mid-stratum species cover 100m2 of the total area of the plot, and an area of 40m2 has representation of only two tree species (not including canopy trees), then 30-50% of the mid-stratum has limited diversity.
For this attribute, the mid-stratum is defined as any trees present within the plot that do not form part of the canopy layer. This includes trees present in the shrub layer, up to trees that may form a sub-canopy below the top canopy, and everything in between.
Limited species diversity is defined as a lower than average representation of species for the vegetation type the plot is in. The number of species that constitutes limited diversity is variable between vegetation types, for example some vegetation types may only be described with two species in the under-story. Therefore, this attribute must be recorded as a representation of an abnormally low diversity of species in relation to the vegetation type.
For most of the common vegetation types the monitoring plots are present in, limited diversity would normally be representation of two or less species.

9. Proportion of total area with monoculture of the same aged vegetation (single species)

>50%	30-50%	10-30%	<10%

10. Proportion of native grasses clumped and with dead material accumulated

>50%	30-50%	10-30%	<10%

11. Proportion of total area lacking any native grasses or ground cover and/or showing erosion

>50%	30-50%	10-30%	<10%

12. Proportion of total area with weeds

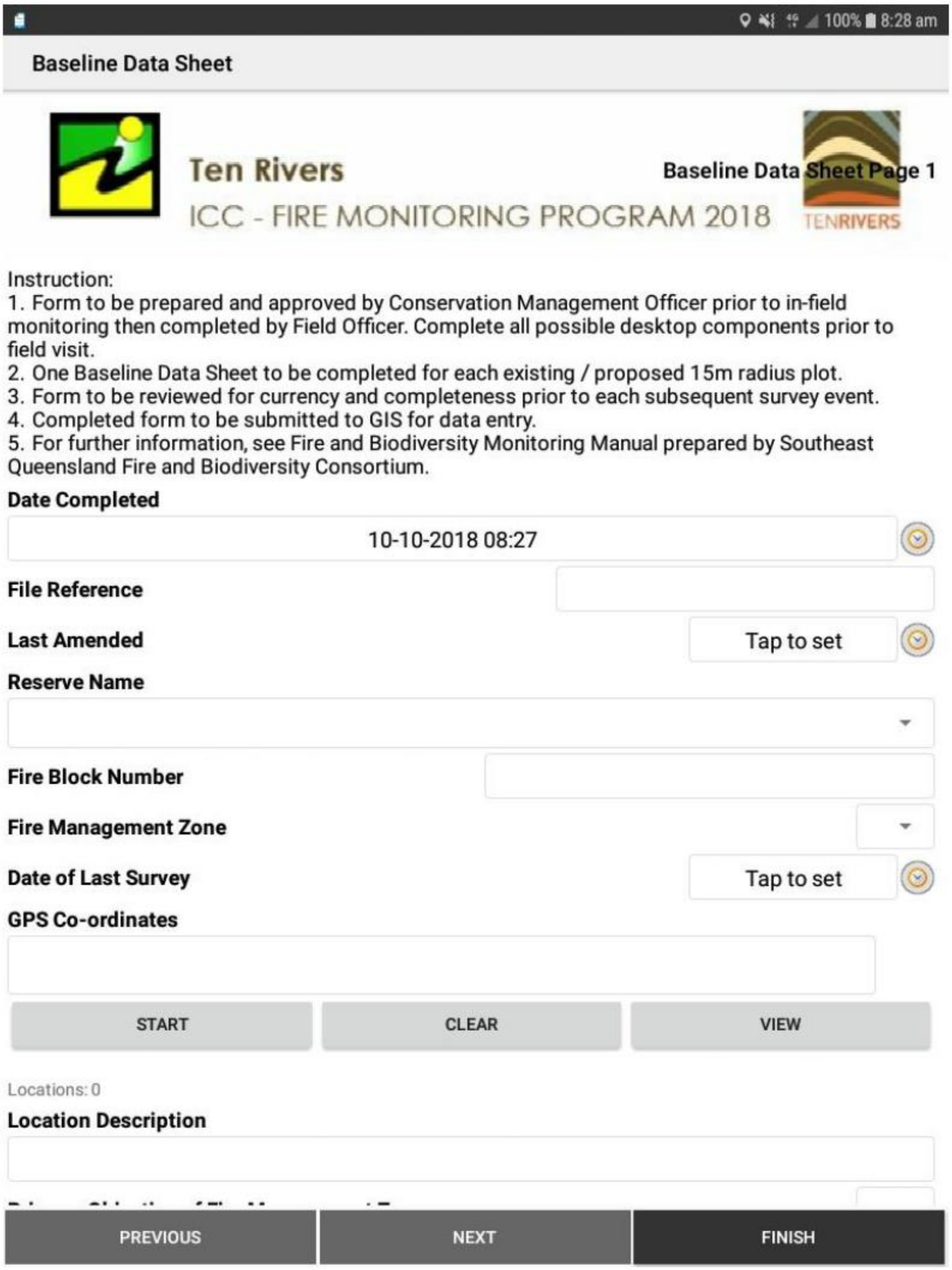
PREVIOUS | NEXT | FINISH

Figure 10 - Fuel and Vegetation Monitoring Digital Data Form

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS



Baseline Data Sheet

Ten Rivers

ICC - FIRE MONITORING PROGRAM 2018

Baseline Data Sheet Page 1

Instruction:
1. Form to be prepared and approved by Conservation Management Officer prior to in-field monitoring then completed by Field Officer. Complete all possible desktop components prior to field visit.
2. One Baseline Data Sheet to be completed for each existing / proposed 15m radius plot.
3. Form to be reviewed for currency and completeness prior to each subsequent survey event.
4. Completed form to be submitted to GIS for data entry.
5. For further information, see Fire and Biodiversity Monitoring Manual prepared by Southeast Queensland Fire and Biodiversity Consortium.

Date Completed

10-10-2018 08:27

File Reference

Last Amended Tap to set

Reserve Name

Fire Block Number

Fire Management Zone

Date of Last Survey Tap to set

GPS Co-ordinates

START CLEAR VIEW

Locations: 0

Location Description

PREVIOUS NEXT FINISH

Figure 11 - Post Burn and Fire Assessment Digital Data Form

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

8:30 am 100%

Post Burn Fire Assessment Data Sheet

Cloud Cover (%)

Temperature (°C)

Relative Humidity

Part B: Post Fire Assessment

Scorch Height Average (m)

Crown Scorch (%)

Intensity (see table)

Unburnt	Low	Moderate	High	Severe	Extreme

Grassland and open woodland	Heathland and shrubland	Forest and open woodland			Description
			U	Unburnt	
			L	Low	Patchy, does not remove all the litter and ground stratum, low scorch, little or no canopy scorch.
			M	Mod	Most or all ground stratum burnt, some scorch in the mid-stratum, little or no canopy scorch.
			H	High	Ground stratum burnt completely (or nearly so), at least some canopy scorch.
			S	Severe	All understorey burnt (or nearly so), extensive crown scorch.
			C	Canopy fire	Burnt through canopy (with or without burning mid-strata); ground stratum largely unburnt.
			E	Extreme	All understorey burnt (or nearly so), tree branches burnt.

Using this table, determine the intensity of the fire and record above.

PREVIOUS | NEXT | FINISH

Figure 12 - Post Burn and Fire Assessment Digital Data Form

Appendix 8: Digital Data Forms – Output Data

Table 16 - Fuel and Vegetation Monitoring Digital Data Form Output Data

GUID	Date	Created	Saved	UnitID	PlotNameandNumber
1295DFA8-12F3-4E41-8A2C-045EB65A4A24	4/07/2018	2018-07-04 08:04:19 +0000	2018-07-04 08:27:15 +0000	MATTI_VIRKKI	wr_16 burn scar west
50AE511A-53AF-4C6F-8EF0-B99EB8CC696E	4/07/2018	2018-07-04 15:38:34 +0000	2018-07-04 15:53:59 +0000	MATTI_VIRKKI	mg_4
6CCAA70C-832C-416E-B603-E071ACA59032	4/07/2018	2018-07-04 09:34:41 +0000	2018-07-04 09:45:23 +0000	MATTI_VIRKKI	wr_16 burn scar east

DateandTime	CompletedBy	SeasonandYear	FireBlockNumber	FireManagement Zone	ReserveName
4/07/2018 8:04	A Dalton	winter	WR_16	Wildfire Mitigation Zone	White Rock - Spring Mountain Conservation Estate
4/07/2018 15:39	A Dalton	winter 2018	MG_4	Conservation Zone	Mt Grandchester Conservation Estate
4/07/2018 9:35	M Virkki	winter 2018	WR_16	Conservation Zone	White Rock - Spring Mountain Conservation Estate

GPSLocationGDA94	StringyBark Hazard	RibbonBark Hazard	OtherBark Hazard	OverallBark Hazard	ElevatedFuel AverageHeight
0490770 x 6935593	Not Present	Not Present	Low	Low	100-150 cm
451799 x 6946286	Not Present	Not Present	Low	Low	100-150 cm
489757 x 6935639	Not Present	Not Present	Moderate	Moderate	150-200 cm

ElevatedFuel PercentageCover	ElevatedFuel PercentageDead	ElevatedFuelHazard	NearSurfaceFuel AverageHeight	NearSurfaceFuel PercentageCover
20-30%	>30%	High	0-15 cm	<10%
30-50%	20-30%	Moderate	15-30 cm	<10%
20-30%	>30%	Moderate	30-50 cm	10-20%

NearSurfaceFuel PercentageDead	NearSurface FuelHazard	LitterDepth1	LitterDepth2	LitterDepth3	LitterDepth4	LitterDepth5
>50%	Low	7	5	9	5	6
>50%	Low	4	6	9	8	7
>50%	Moderate	10	12	9	15	6

LitterDepthAverage	SurfaceFuelPercentageCover	SurfaceFuelHazard	CombinedSurfaceandNear SurfaceHazardRating	FHR
6.4	<60%	Low	Low	1
6.8	<60%	Low	Low	1
10.4	<60%	Low	Moderate	2

1CrownDieback	2PlantParasites	3EpicormicShoots	4MatureTrees	5ShrubDieback	6LimitedDiversity
2	4	3	3	1	2
3	4	4	4	1	3
2	4	2	4	1	3

8Acacias	9MonocultureVeg	10GrassClumping	11GroundCover	12Weeds	VegetationCondition ScoreTotal	HER
1	4	4	1	4	33	2
4	4	4	1	4	39	2
2	2	4	1	4	32	4

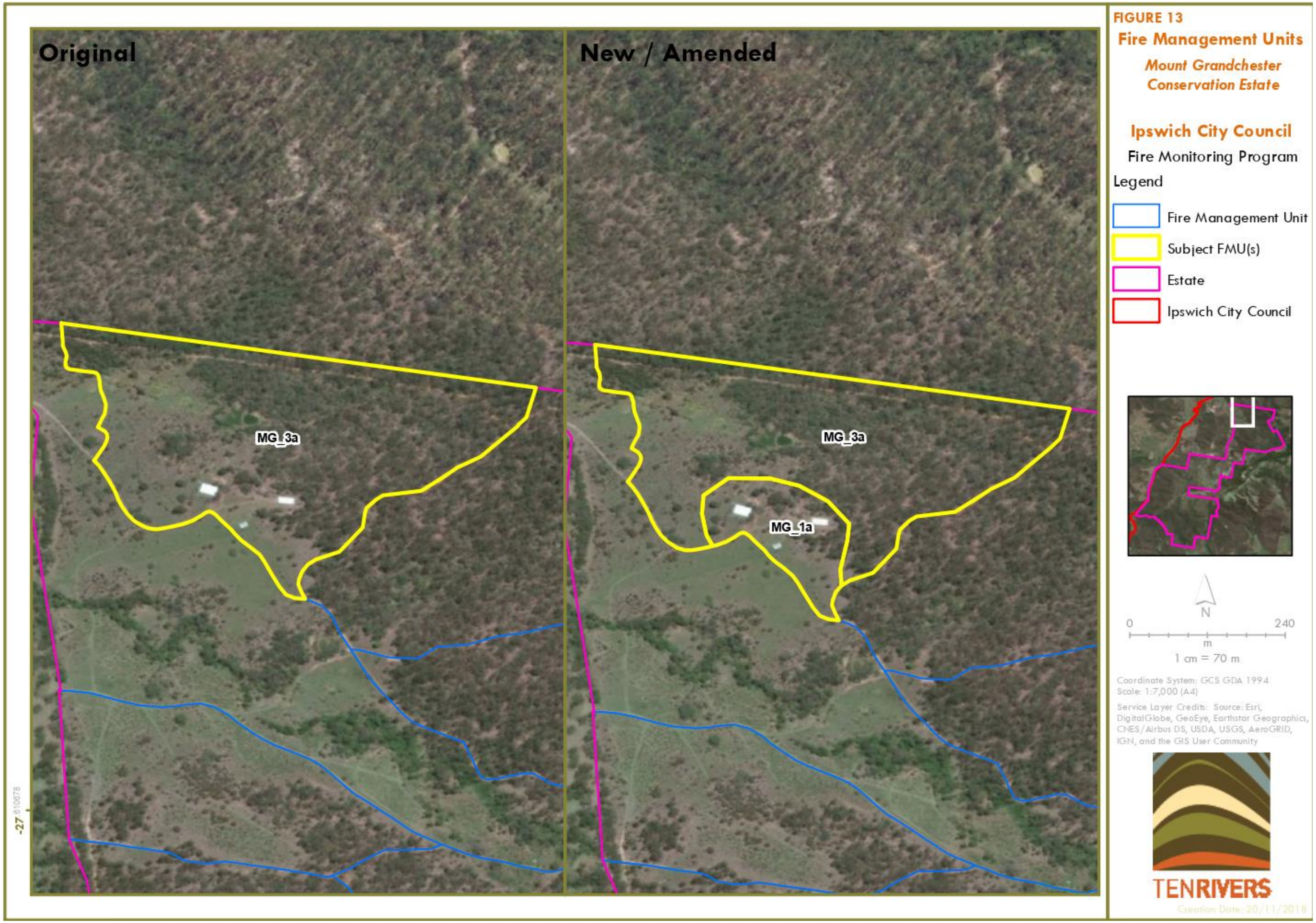
Appendix 9: Regional Ecosystem TFI Hazard Classes

Table 17 - TFI to hazard class lookup table for Regional Ecosystem TFI

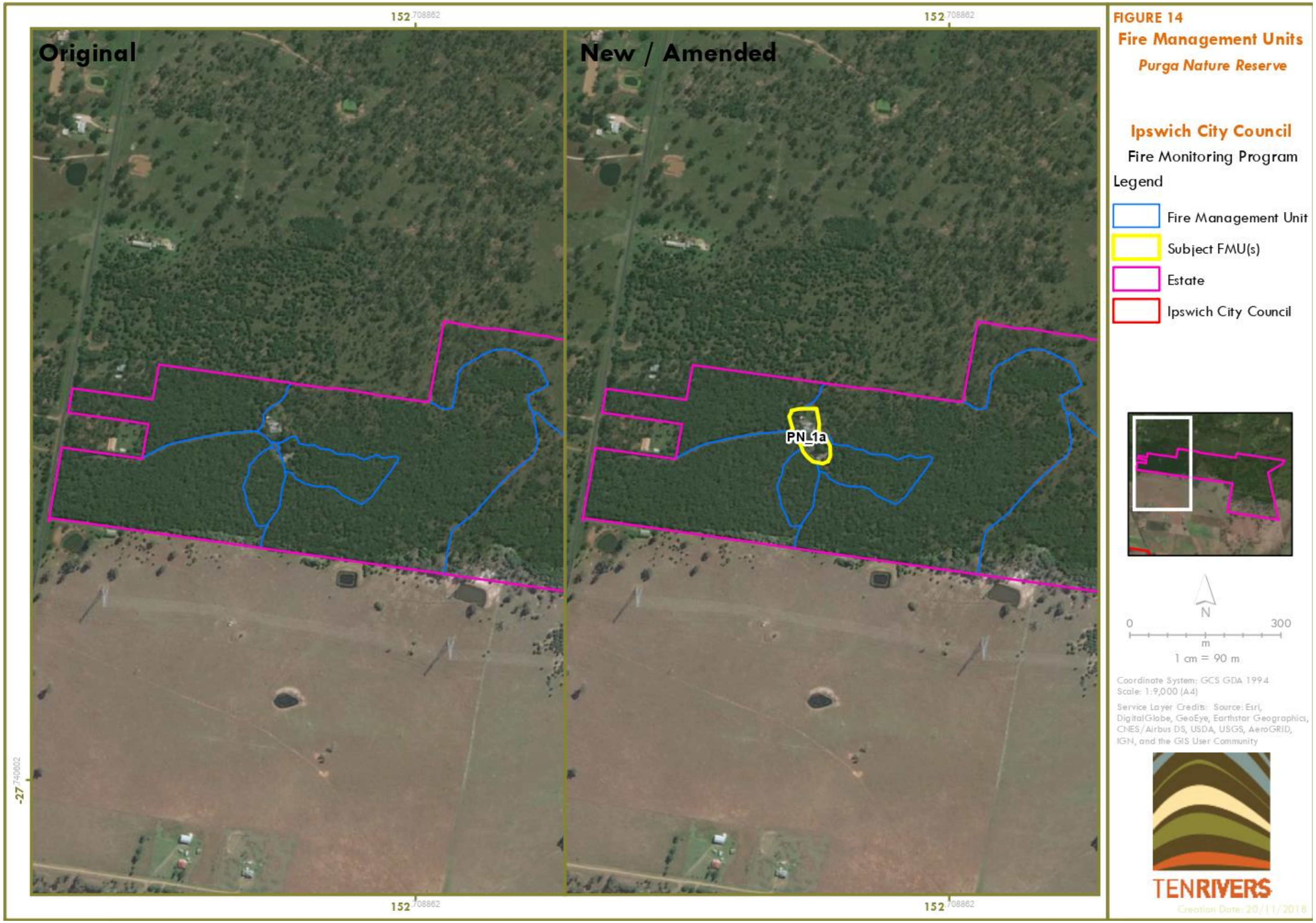
TFI (years)	Low	Moderate	High	Very High
4-25	<4	5-8	9-12	13+
3-25	<3	4-8	9-12	13+
3-20	<3	4-6	7-9	10+
20-20	<15	16-20	21-24	25+
3-6	<3	4	5	6+
20-50	<20	21-35	36-49	50+

Appendix 10: Updates to NAE FMU – Maps

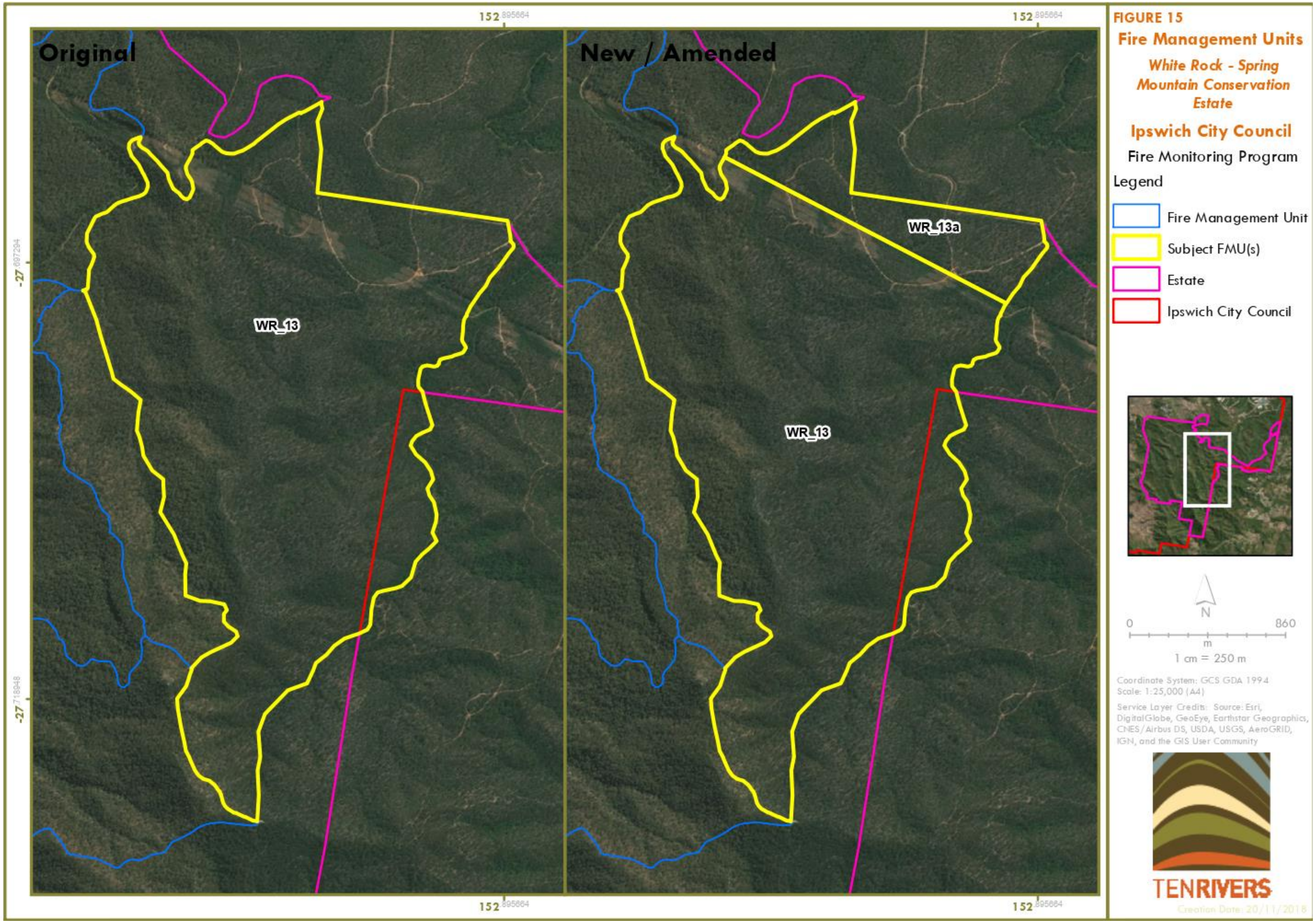
Item 1 / Attachment 3.



Item 1 / Attachment 3.



Item 1 / Attachment 3.



Appendix 11: Update to Fire Monitoring Plots – Maps

Item 1 / Attachment 3.

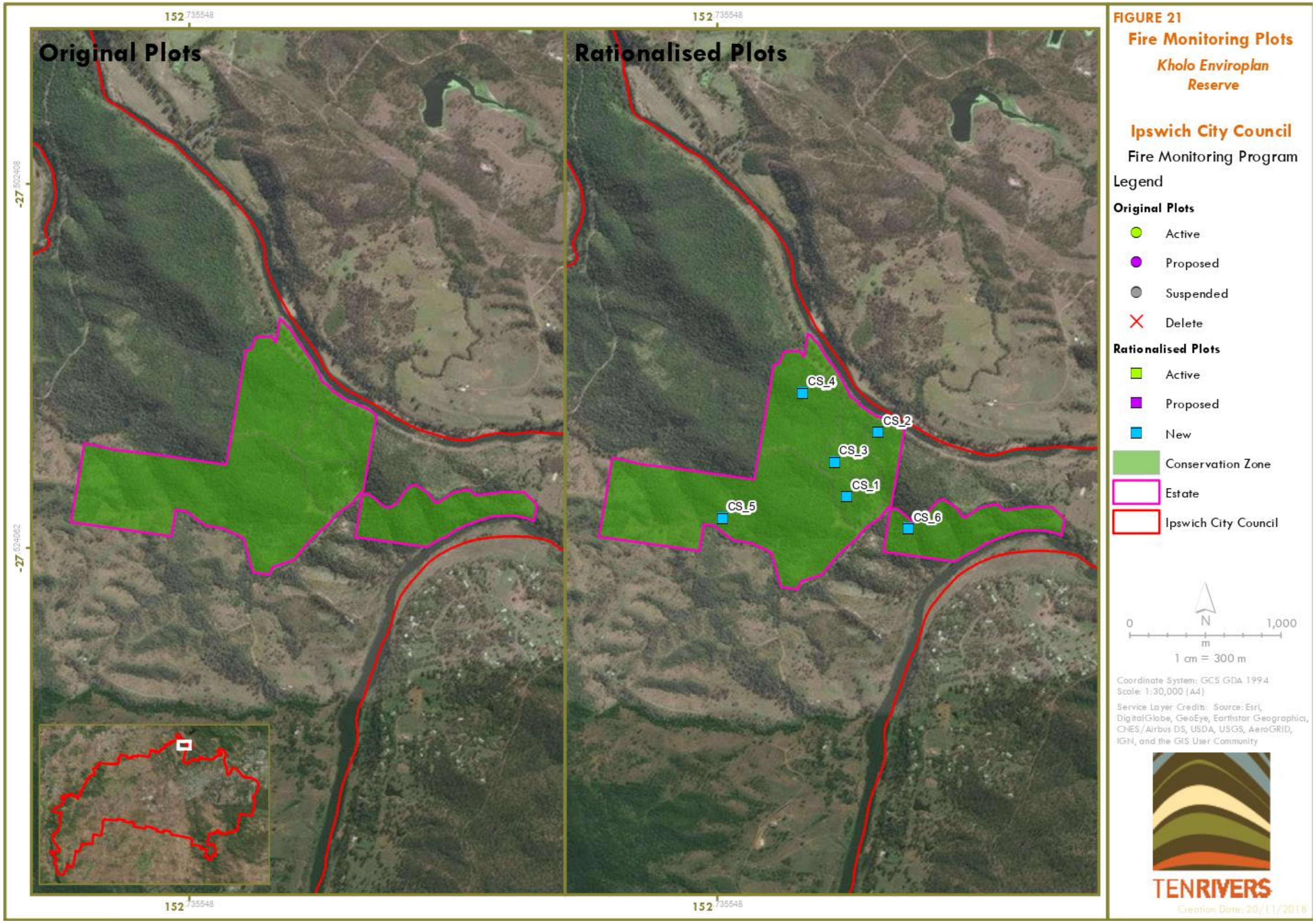
Item 1 / Attachment 3.

Item 1 / Attachment 3.

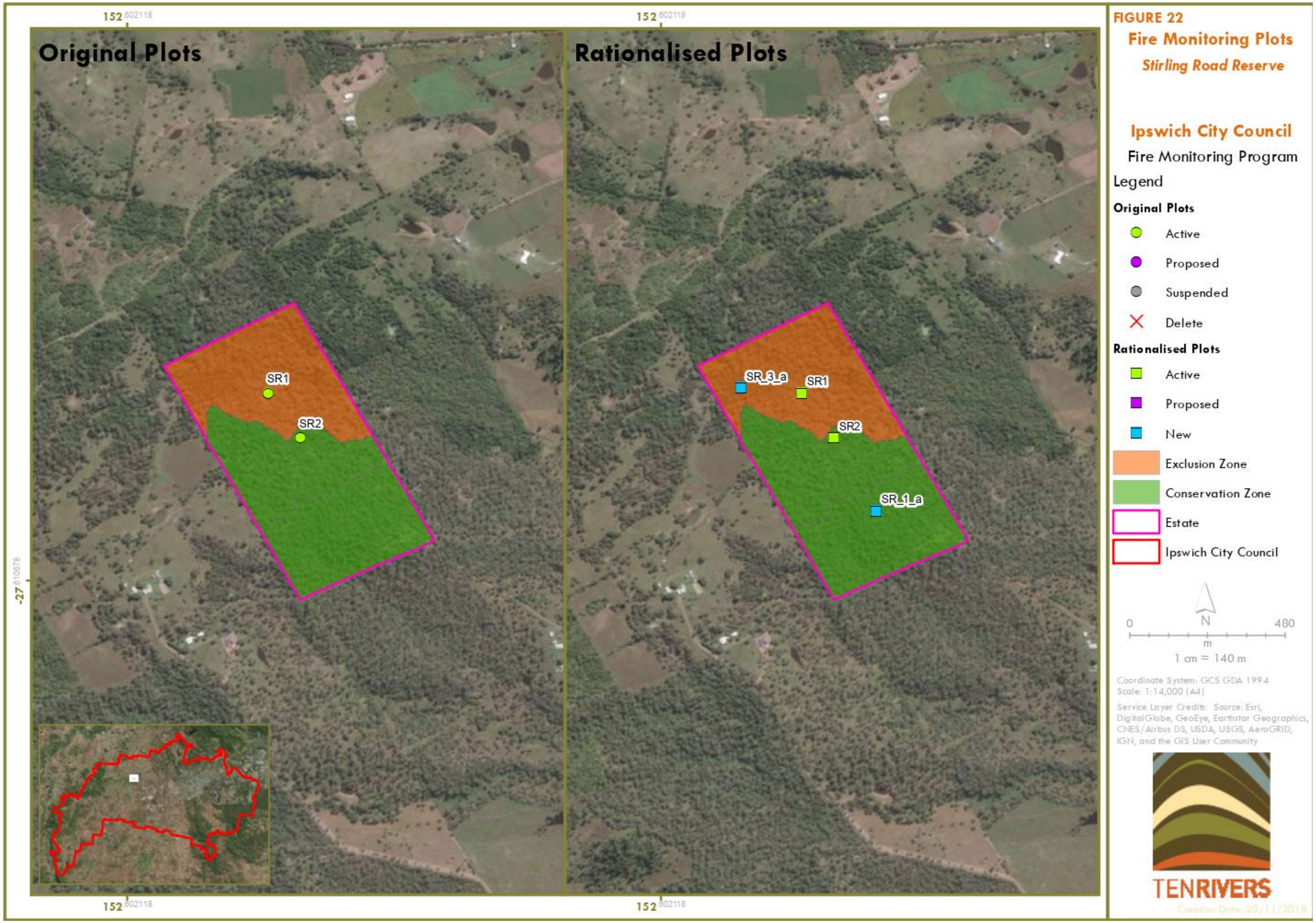
Item 1 / Attachment 3.

Item 1 / Attachment 3.

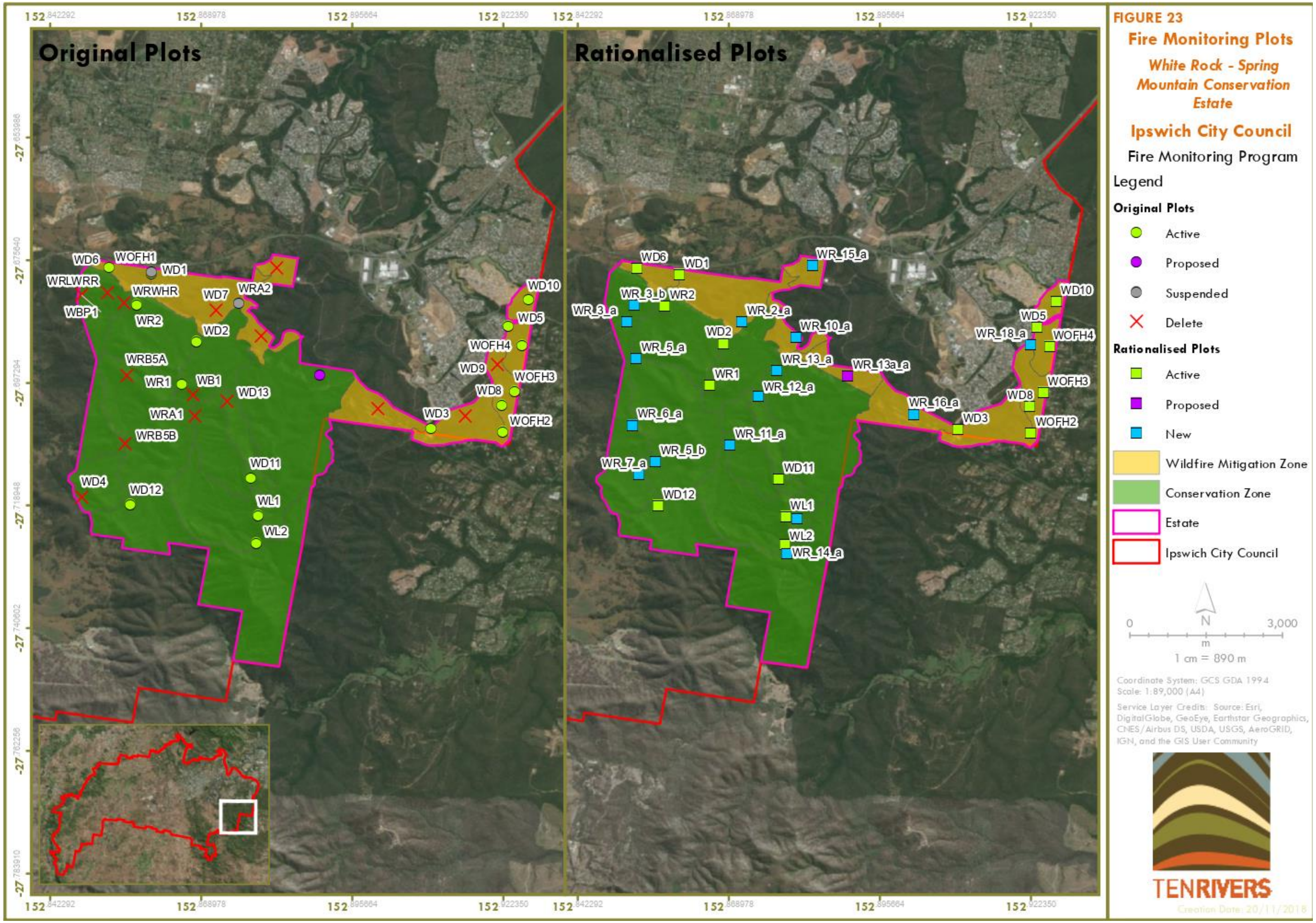
Item 1 / Attachment 3.



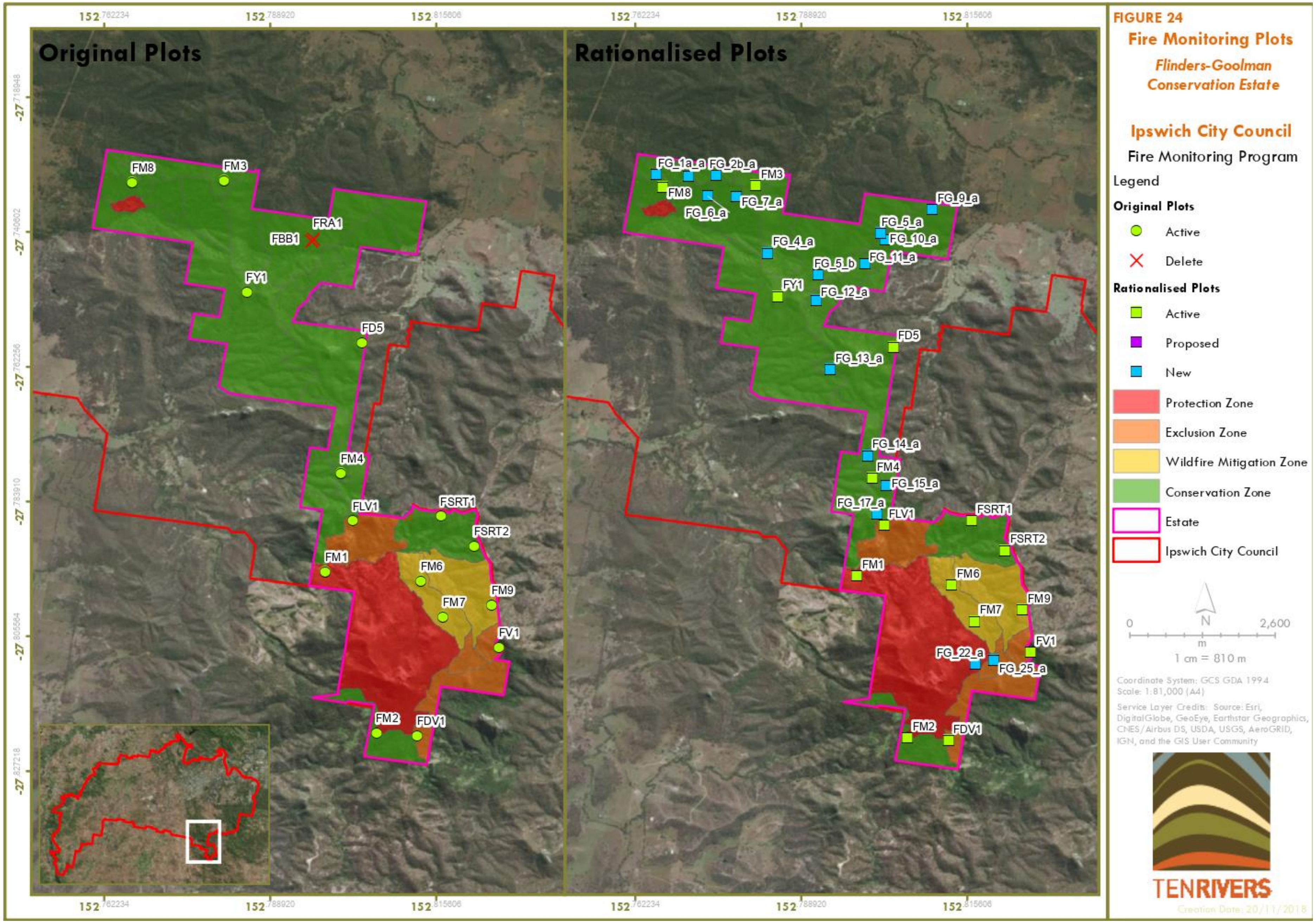
Item 1 / Attachment 3.



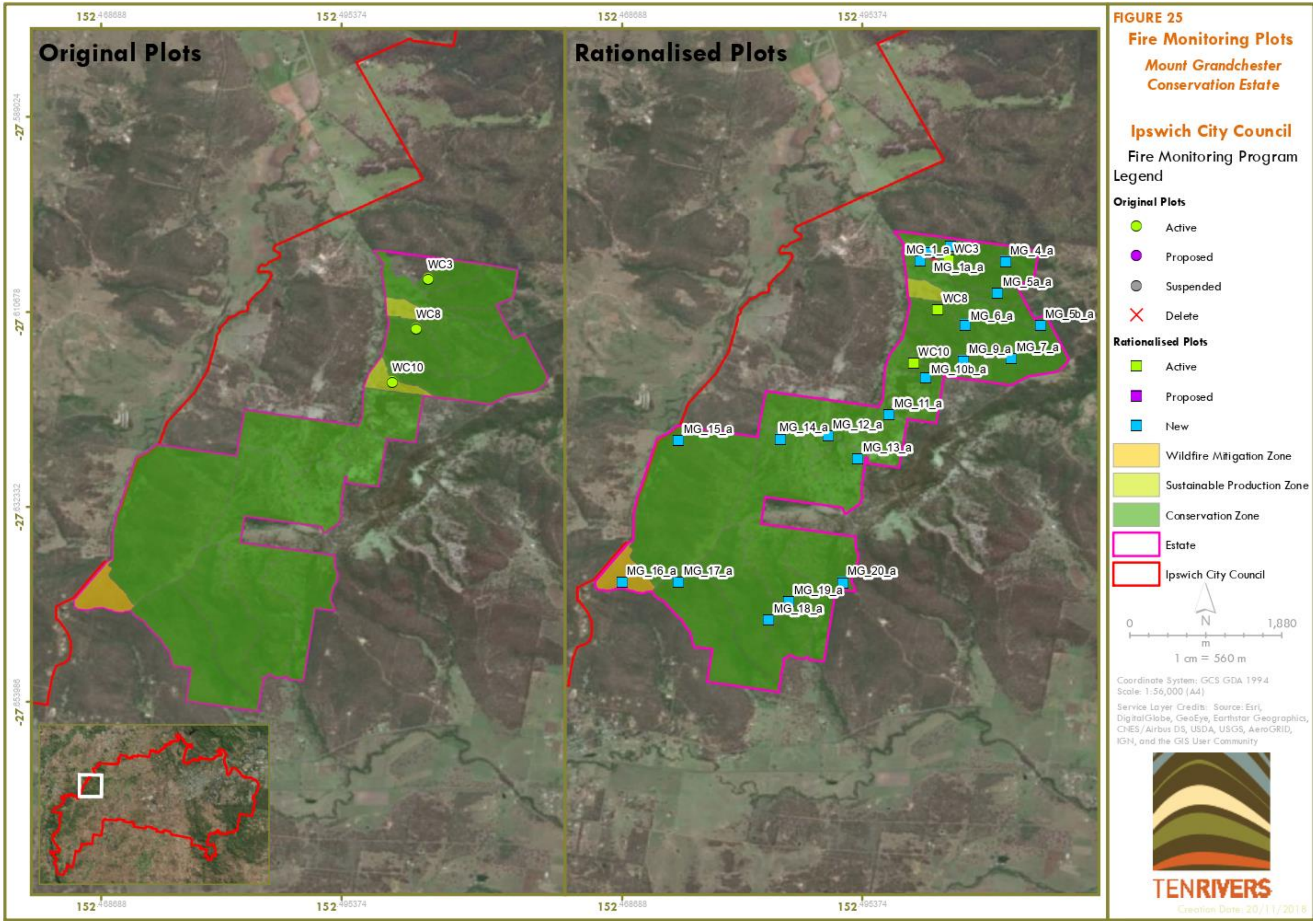
Item 1 / Attachment 3.



Item 1 / Attachment 3.



Item 1 / Attachment 3.



Appendix 12: Decision Tool Model – Attribute Reference Table

Table 18 - Index of Attribute Names and Descriptions

Attribute	Description	Attribute	Description
AR	Access Risk rating	**HSR**	Housing Stock Risk rating
AR_VALUE	Access Risk score	**HSR_VALUE**	Housing Stock Risk score
Area_Ha	Area of the FMU in hectares	**Man_Action**	Management actions recommended (Yes/No?)
Area_m	Area of the FMU in m^2	**MAX_TFImin**	The minimum time since fire of the TFI range of the FMU (years)
ASP_BOOST	Aspect boost, a multiplier based on risk from aspect class	**MRF_PLAN_V**	Fire History - Most Recent Fire – Planned – Score
ASPCT_CLS	Aspect Class rating	**MRF_PLAN_Y**	Fire History - Most Recent Fire – Panned – Years
ASPCT_VAL	Aspect Class score	**MRF_UNPL_V**	Fire History - Most Recent Fire – Unplanned - Score
BAL	Bushfire Attack Level rating	**MRF_UNPL_Y**	Fire History - Most Recent Fire – Years
BAL_VALUE	Bushfire Attack Level score	**NEW_FMB_ID**	New Fire Management Block ID (FMU)
Block	Name of the FMU	**NoBurnFMB**	Recommended to avoid burning FMU due to vegetation communities
Boosted_FH	Fuel Hazard score after boost from model interactions	**OLD_FMB_ID**	Old Fire Management Block ID (FMU)
CFMZ_Facto	Final output scoring factor for FMZ designations (Conservation Model)	**P_SCORE**	Prioritisation score (unused in final model)
CONS_SCORE	The final output for the Conservation Model (prioritisation score)	**Perimeter_**	Perimeter of FMU
DeptTFImin	The departure from the minimum TFI (Years)	**PO_CH**	Presence of cultural heritage assets
DTM_VALUE	Departure from TFI minimum score	**RISK_SCORE**	The final output for the Risk Model (prioritisation score)
EA_BFSR	Ecological Asset Risk rating	**SE_FHBoost**	South East connecting FMU fuel hazard boost
EA_VALUE	Ecological Asset Risk score	**SE_High_FH**	FMUs that are SE of high fuel hazard
FHs17_VALU	Fuel Hazard Spring 2017 score	**SE_Pl_Bst**	Boost to Fuel Hazard from SE FMUs affected by Planned Burn History
Fire_Decis	Comments on use of fire within FMU (from previous FMP)	**SE_Pl_Low**	Planned Burn History affecting FMUs to the south east
Fire_Sensi		**Site_Name**	Name of the estate
FMZ_Factor	Final output scoring factor for FMZ designations (Risk Model)	**SL_VALUE**	Surrounding Landscape Vegetation Cover score
FMZ_type	Fire Management Zone designation	**SL_VCR**	Surrounding Landscape Vegetation Cover rating
FSR	Fire Severity Risk rating	**SLOPE_CL**	Slope class (<10° or >10°)

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Attribute	Description	Attribute	Description
FSR_VALUE	Fire Severity Risk score	**Slope_Pe_1**	Percentage of FMU with <10° slope
FSSR	Fire Suppression Success Risk Rating	**Slope_Perc**	Percentage of FMU with >10° slope
FSSR_VALUE	Fire Suppression Success Risk score	**Slope_Pere**	Unused in current iteration of model
FV_SSA	Fire Vulnerable and Smoke Sensitive Assets rating	**SLP_BOOST**	Boost factor for fuel hazard from slope class
FV_VALUE	Fire Vulnerable and Smoke Sensitive Assets score	**SLP_VALUE**	Hazard class for slope
HER	Ecological Health (Vegetation Condition) Rating	**TFI_range**	TFI range of representative RE within FMU
HER_VALUE	Ecological Health (Vegetation Condition) Score	**UID**	Unit ID

TENRIVERS

Appendix 13: Decision Tool Model – Attribute Scores, Interactions and Management Triggers

Table 19 - Decision Tool Model - Attribute Risk Rating and Scores Table

Attribute	Model	Risk Rating and Associated Scores					
		N/A	Low	Mod-erate	High	Very High	Extreme
Access Risk	Risk	N/A	1	2	3	4	N/A
Bushfire Attack Level	Risk	0	1	2	4	8	N/A
Departure from TFI	Conservation	N/A	1	2	3	4	N/A
Ecological Asset Risk	Conservation	N/A	1	2	3	4	N/A
Fuel Hazard	Risk	N/A	1	2	4	8	12
Fire Vulnerability and Smoke Sensitive Assets	Risk	0	1	2	4	6	N/A
Vegetation Condition	Conservation	N/A	1	2	4	8	N/A
Fire History - Planned	Risk	N/A	1	2	3	4	N/A
Fire History - Unplanned	Risk	N/A	1	2	3	4	N/A
Fire History - Unplanned	Conservation	N/A	1	2	3	4	N/A
Housing Stock Risk	Risk	0	1	2	4	6	N/A
Surrounding Landscape Vegetation Cover	Conservation	N/A	0	1	2	3	N/A

Table 20 - Fire History Risk Rating Calculations

Attribute	Model	Time Since Last Fire (Years)			
		Low	Moderate	High	Very High
Fire History - Planned	Risk	<1	1-3	3-10	10+
Fire History - Unplanned	Risk	10+	3-10	<1	1-3
Fire History - Unplanned	Conservation	10+	3-10	<1	1-3

Table 21 - Decision Tool Model - Management Action Triggers and Recommendations

Model	Trigger	Attributes	Description	Management Actions
Risk	If *Fire Vulnerable and Smoke Sensitive* Asset risk and/or *Housing Stock* risk are **HIGH** and *Fuel Hazard* is **VERY HIGH** or **EXTREME**	FV_SSA HSR OFH (input data) FHs17_VALU (current test data)	Fuel hazard is high adjacent to vulnerable built assets	Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU. Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including: • Slashing of surface fuels • Use of a forest mulcher to reduce elevated fuels • Manual removal of weeds (e.g. lantana thickets) if necessary Only implement prescribed burn as last resort
Risk	If any *Cultural Heritage Assets* are present within the FMU	PO_CH	Occurrence of Cultural Heritage Assets	Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets
Risk	If *Access Risk* is **HIGH** or **VERY HIGH** and *Fuel Hazard is* **VERY HIGH** or **EXTREME**	OFH (input data) FHs17_VALU (current test data) AR	Fuel hazard is high where access is difficult	Inspection of access trails, fire trails and breaks required. Review capacity for trail remediation (grading, track widening etc). If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.
Risk	If *BAL rating* is **HIGH** or **VERY HIGH** and *Fuel Hazard* rating is **VERY HIGH**, or **EXTREME**	BAL OFH (input data) FHs17_VALU (current test data)	Fuel hazard is high adjacent to built assets	Fuel reduction required before next fire season to mitigate risk to life and property. Implement mechanical reduction in buffer zone around assets. Nominate FMU as high priority for hazard reduction burn. Increase monitoring in FMU.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Model	Trigger	Attributes	Description	Management Actions
Risk	If *Fire History – Planned* is **VERY HIGH (4)** and *Fuel Hazard* is **HIGH, VERY HIGH**, or **EXTREME**	MRF_PLAN_V OFH (input data)	Fuel hazard is high where the time since prescribed burns is long	Assess fire history against TFI to determine the departure from the recommended fire frequency. If outside of TFI, nominate FMU as high priority for hazard reduction burn. Increased monitoring in FMU. May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.
Risk	If *Fire History – Unplanned* is **VERY HIGH (4)** and *Fuel Hazard* is **HIGH, VERY HIGH**, or **EXTREME**	MRF_UNPL_V OFH (input data)	Fuel hazard is high where a wildfire occurred within 1-3 years	FMU requires increased monitoring to track fuel changes after wildfire. May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.
Risk	If *FMZ* is **PZ** or **APZ** and *Fuel Hazard* is **HIGH, VERY HIGH**, or **EXTREME**	FMZ OFH (input data) FHs17_VALU (current test data)	Fuel hazard is high within Protection Zone	Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.
Risk	If *FMZ* is **WMZ** and *Fuel Hazard* is **VERY HIGH** or **EXTREME**	FMZ OFH (input data) FHs17_VALU (current test data)	Fuel hazard is high within Wildfire Mitigation Zone	Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan. Site visit required to assess risk to assets, life and property. High priority for fuel reduction works. If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Model	Trigger	Attributes	Description	Management Actions
Conservation	If *Ecological Asset Risk* is **HIGH** or **VERY HIGH** and *Vegetation Condition* risk is **HIGH** or **VERY HIGH**	EA_BFSR HER	Vegetation condition is low where ecological assets occur	Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health. Branched actions – requires further detail from Vegetation Condition survey (see Table 23)
Conservation	If *TFI Departure Hazard* is **HIGH** or **VERY HIGH** (**3** or **4**) and *Vegetation Condition* is **VERY HIGH**	DTM_VALUE HER	Vegetation condition is low where a departure from the TFI occurs	Nominate FMU as high priority for ecological burn. Increase vegetation condition monitoring in FMU to track ecological health Survey of EVR or EVNT vegetation is highly recommended
Conservation	If *Fire History – Unplanned* is **VERY HIGH** and *Vegetation Condition* is **VERY HIGH**	MRF_UNPL_V HER	Vegetation condition is low where a wildfire occurred within 1-3 years	Increased monitoring required in FMU to ensure regrowth of fire obligate species (acacia, casuarina etc) do not overtake or displace other vegetation in the area. Consideration for ecological burn in next fire season.
Conservation	If *Vegetation Condition* is **VERY HIGH** and *FMZ* is **Exclusion Zone, Protection Zone, Sustainable Production Zone** or **Wildfire Mitigation Zone**	HER FMZ	Vegetation condition is low within Exclusion Zone, Protection Zone, Sustainable Production Zone or Wildfire Mitigation Zone	Requirement for increased monitoring in FMU. Ensure that ecological assets and adjacent Conservation or Reference Zones are not adversely affected by poor ecological health of this FMU. If there is risk of adverse effects, consult Vegetation Condition Assessment Report for indication of drivers of poor health and options for management.
Conservation	If *Vegetation Condition* is **VERY HIGH** and *FMZ* is **Conservation Zone** or **Reference Zone**	HER FMZ	Vegetation condition is low within Conservation Zone or Reference Zone	Requirement for increased monitoring in FMU Branched actions – requires further detail from Vegetation Condition survey (see Table 23)

Table 22 - Vegetation Condition Specific Management Actions

Trigger Score	Attributes	Description	Management Action
1	1CrownDieback	>30% of trees with crown dieback, leaves sparse & dead branches, and/or recently dead trees	Further surveys required to determine source of dieback. Recommend detailed ecological survey
1	2PlantParasites	>50% of trees with plant pests or parasites *(i.e. mistletoe, insect damage etc)*	Control of pests or plant parasites may be required in this FMU. Recommend implementing control actions if overall health of affected trees is in decline.
1	3EpicormicShoots	>50% of trees with epicormic or basal shoots	If planned burns are proposed in this FMU, assess to ensure planned management burns do not impact on epicormic growth
1	4MatureTrees	Nil mature / large trees, with or without arboreal hollows (within 30m radius)	In areas of high environmental value or with known species of interest (such as Greater Glider), consider the use of artificial habitat features such as nest boxes.
1, 2	5ShrubDieback	>30% of shrub layer with dead or dying foliage and/or dead branches	Further surveys required to determine source of dieback. Recommend detailed ecological survey
1	6LimitedDiversity	>50% of mid-stratum with limited species diversity (i.e. ≤2 species)	Possible bush regeneration works required. May need to be conducted in conjunction with mechanical/manual weed removal and/or weed spraying
1	7LimitedRecruitment	>50% of canopy species with limited signs of recruitment	Possible bush regeneration works required. May need to be conducted in conjunction with mechanical/manual weed removal and/or weed spraying
1	8Acacias	>50% of total area that is acacias	Consider fuel reduction works such as mechanical mulching or low intensity burning under moist conditions.
1	9MonocultureVeg	>50% of total area with monoculture of the **same aged** vegetation (single species)	Consider fuel reduction works such as mechanical mulching or low intensity burning under moist conditions.
1, 2	10GrassClumping	>30% of native grasses clumped and with dead material accumulated	Consider increasing burn frequency to reinstate grassy forest systems.

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Trigger Score	Attributes	Description	Management Action
1	11GroundCover	>50% of total area lacking any native grasses or ground cover and/or showing erosion	Consider increasing burn frequency to reinstate grassy forest systems. If ground cover issues are severe, consider bush regeneration works in FMU.
1, 2	12Weeds	>30% of total area with weeds	Implementation of weed management works required. Apply recommended management strategies for target species i.e. weed spraying, slashing, mechanical works etc.

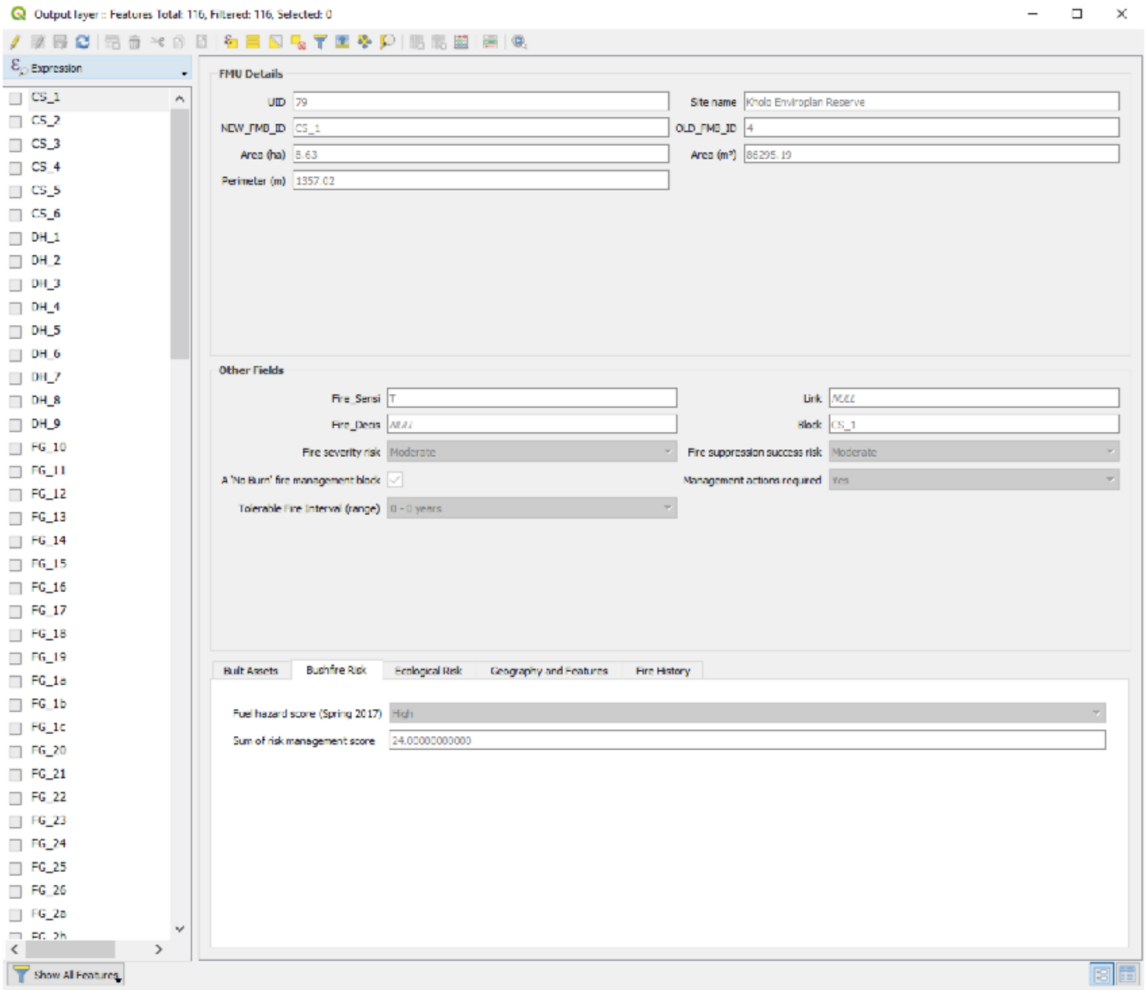
Appendix 14: Decision Tool Model – Preliminary Run Results

Ten Rivers

ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Figure 26 - FMU CS_1 Bushfire Risk Attribute Tab



Item 1 / Attachment 3.

Figure 27 - FMU FG_10 Ecological Risk Attribute Tab

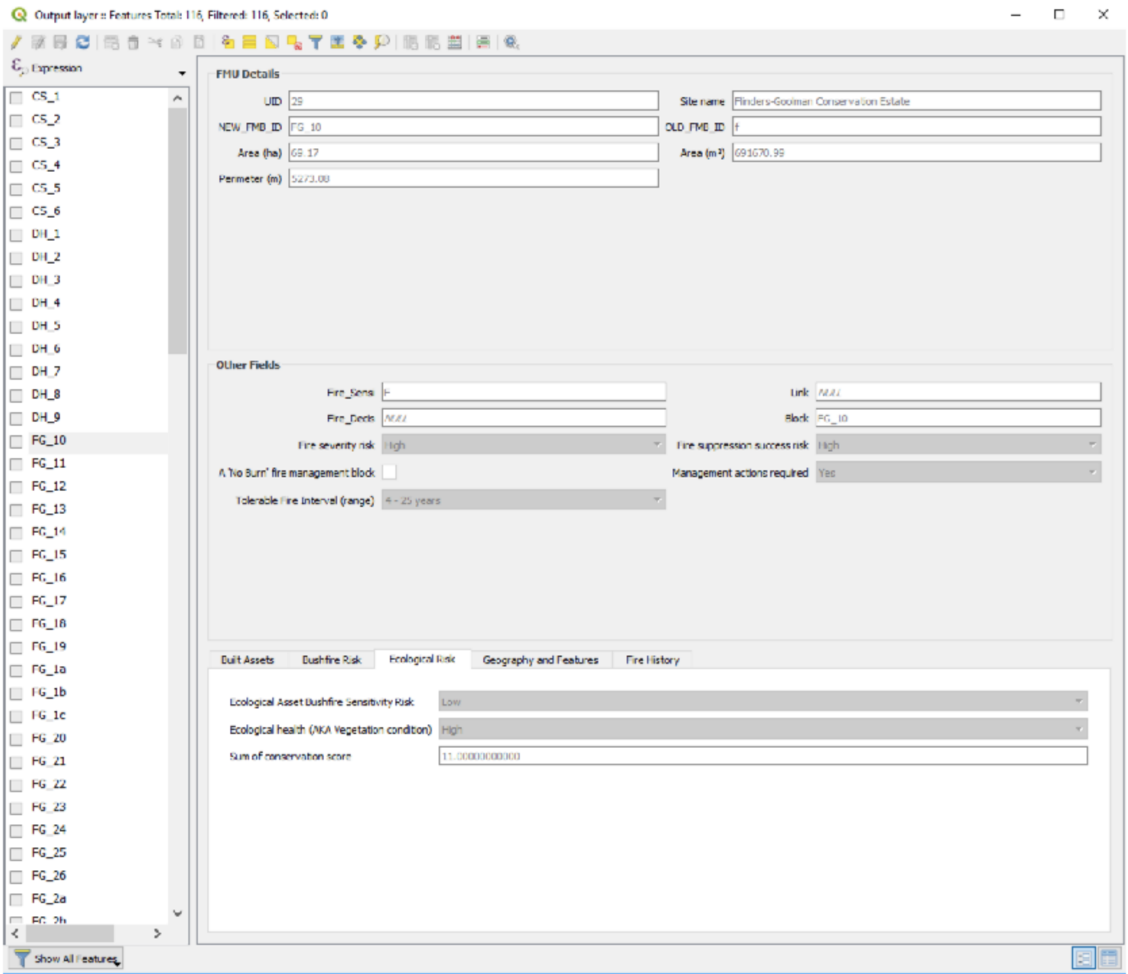


Figure 28 - Decision Tool Model Attribute Table

Output layer :: Features Total: 116, Filtered: 116, Selected: 0

	UID	Site name	NEW_FMB_ID	OLD_FMB_ID	Fire_Sensi	Area (ha)	Area (m²)	Perimeter (m)	Link	Fire_Decis	Block	al Asset
1	105	Mount Grandchester Conservation Estate	MG_10b	10	F	32.90	328963.47	2312.14			MG_10b	Moderat
2	108	Mount Grandchester Conservation Estate	MG_20	7	F	59.05	590493.32	4536.79			MG_20	Low
3	107	Mount Grandchester Conservation Estate	MG_19	6	T	80.56	805566.23	5306.20			MG_19	High
4	110	Purga Nature Reserve	PN_4	l	T	3.99	39928.89	1256.99		Fire exclusion	PN_4	High
5	109	Mount Grandchester Conservation Estate	MG_13	h	F	34.82	348156.87	2626.12			MG_13	High
6	112	White Rock - Spring M...	WR_4b	4	F	145.02	1450242.05	6187.77			WR_4b	Low
7	111	Purga Nature Reserve	PN_5		T	7.75	77542.71	1556.85			PN_5	Very Hig
8	81	Khalo Enviroplan Reserve	CS_3	2	T	14.77	147555.79	3001.90			CS_3	Very Hig
9	80	Khalo Enviroplan Reserve	CS_2	1	T	7.84	78400.03	1881.84			CS_2	Very Hig
10	83	Khalo Enviroplan Reserve	CS_5	5	T	79.65	796452.98	4587.05			CS_5	Very Hic
11	82	Khalo Enviroplan Reserve	CS_4	3	T	25.43	254252.16	2221.60			CS_4	Very Hic
12	85	Haig Street Quarry Conservation Reserve	HS_5	k,l,n	F	2.95	29499.49	707.47			HS_5	Low
13	84	Khalo Enviroplan Reserve	CS_6	6	T	25.11	251064.36	2764.00			CS_6	Very Hig
14	87	Haig Street Quarry Conservation Reserve	HS_4	k	F	3.18	31843.71	1096.49			HS_4	Low
15	86	Haig Street Quarry Conservation Reserve	HS_6	k,l,n	F	4.37	43688.80	1094.47			HS_6	Low
16	89	Haig Street Quarry Conservation Reserve	HS_3	m	F	2.07	20726.99	1028.64			HS_3	Low
17	88	Haig Street Quarry Conservation Reserve	HS_1	l	F	4.89	48937.04	937.34			HS_1	Low
18	91	Denmark Hill Conservation Reserve	DH_7	2	T	1.44	14354.58	753.80			DH_7	Low
19	90	Haig Street Quarry Conservation Reserve	HS_2	j	F	6.03	60319.96	1375.70			HS_2	Low
20	93	Denmark Hill Conservation Reserve	DH_9	9	T	1.51	15090.49	636.97			DH_9	Low
21	92	Denmark Hill Conservation Reserve	DH_4	4	T	1.81	18131.87	752.24			DH_4	Low
22	95	Denmark Hill Conservation Reserve	DH_8	1	T	0.94	9395.15	772.79			DH_8	Low

Show All Features

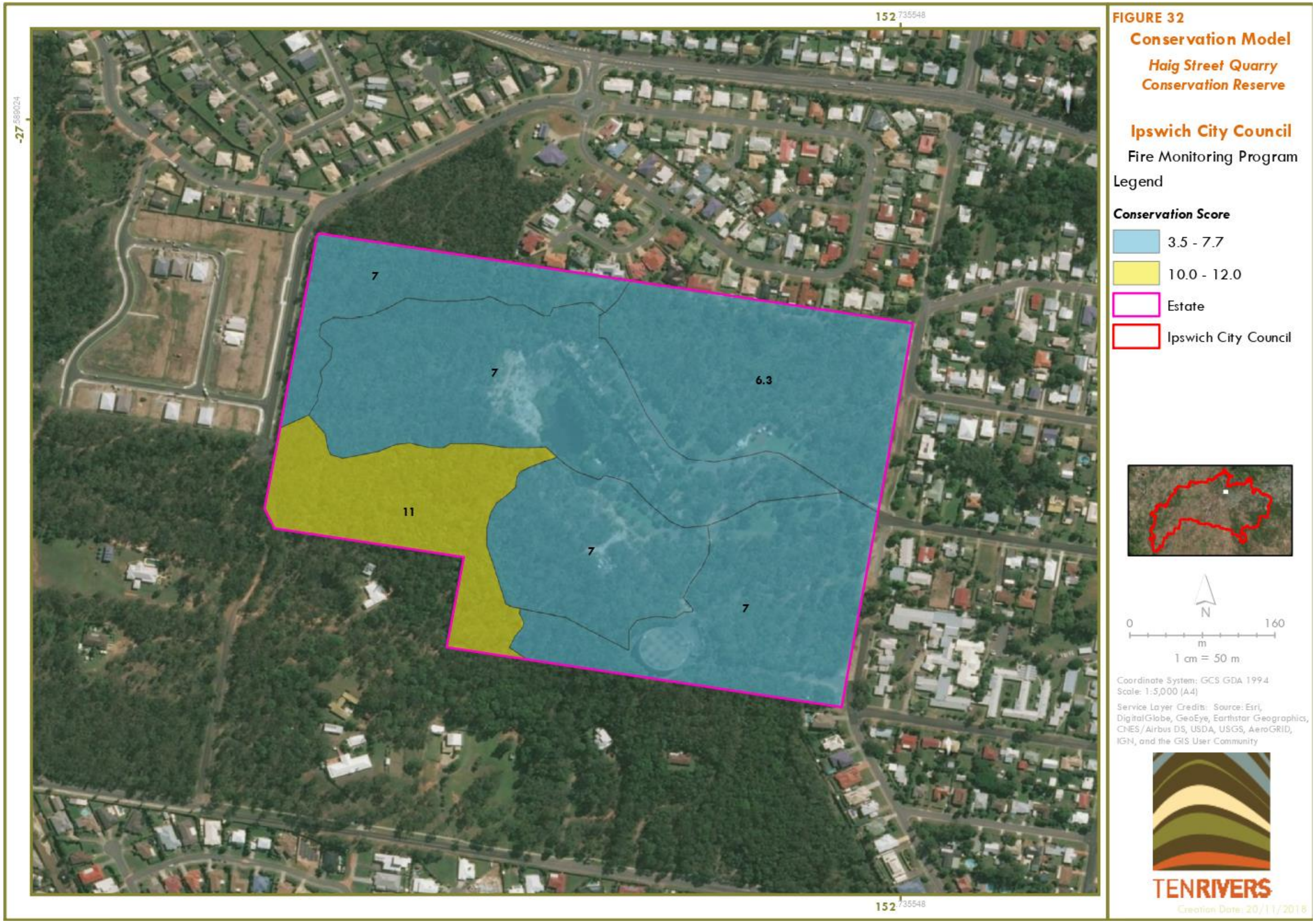
Appendix 15: Decision Tool Model – Preliminary Run Maps

Item 1 / Attachment 3.

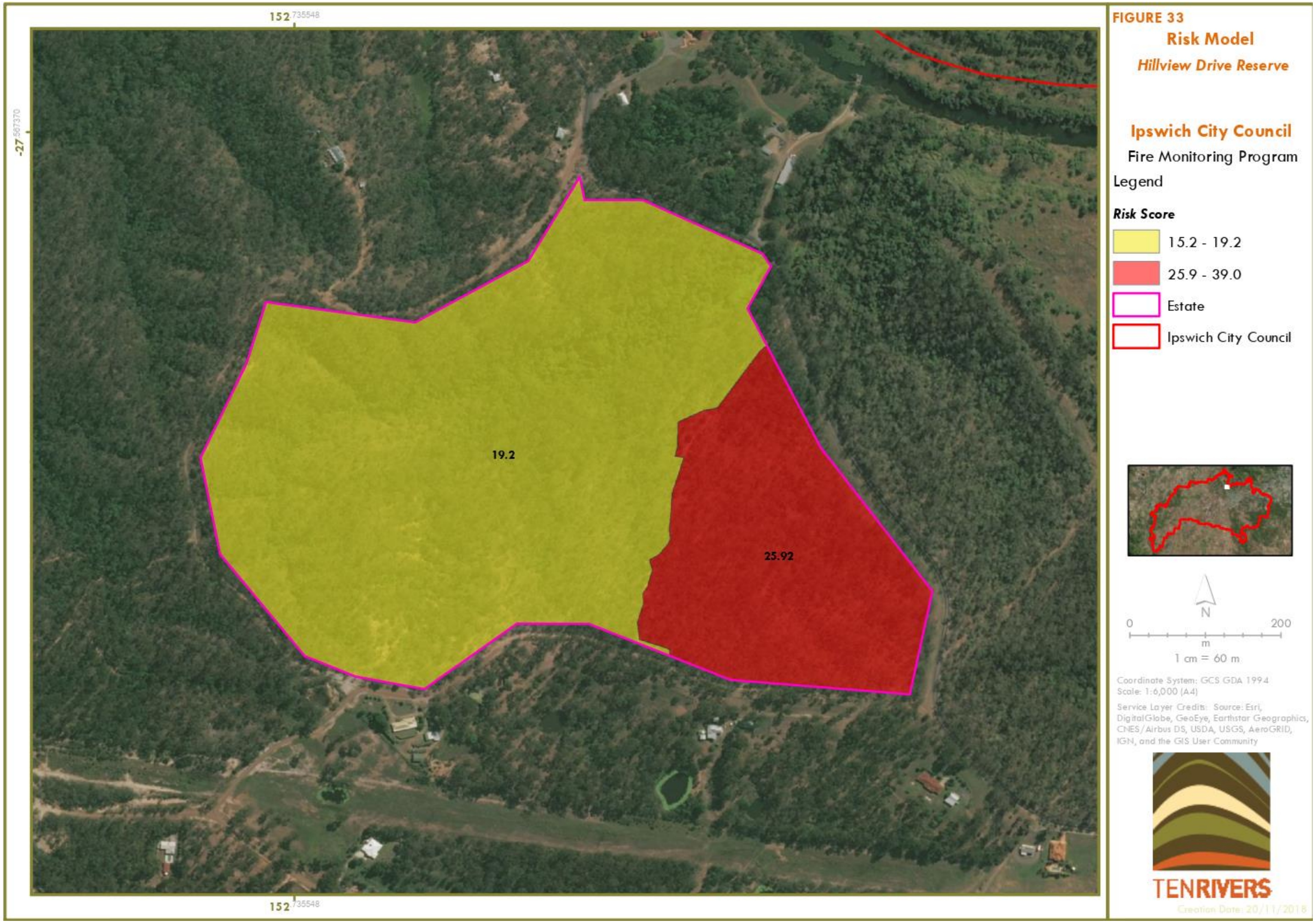
Item 1 / Attachment 3.

Item 1 / Attachment 3.

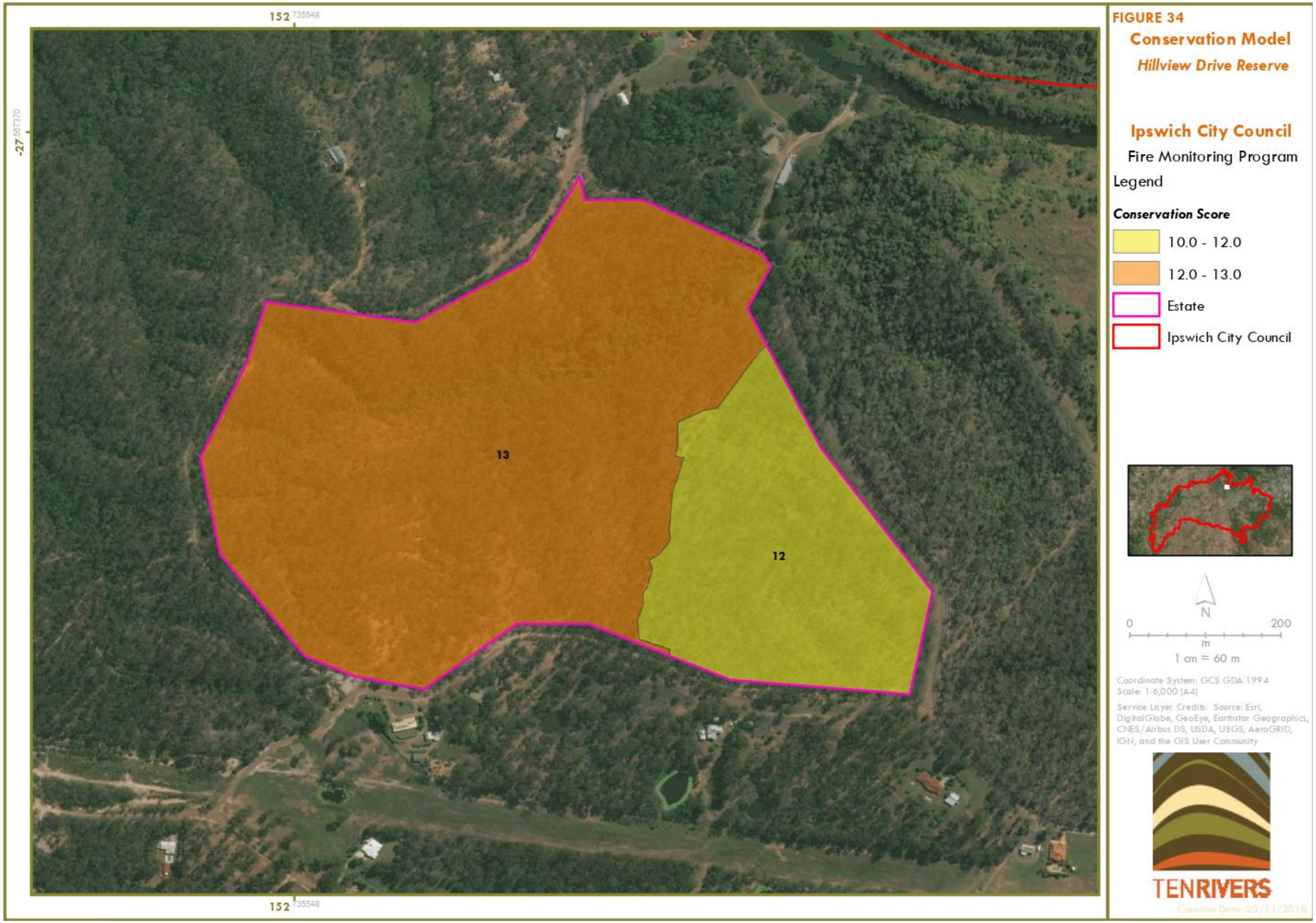
Item 1 / Attachment 3.



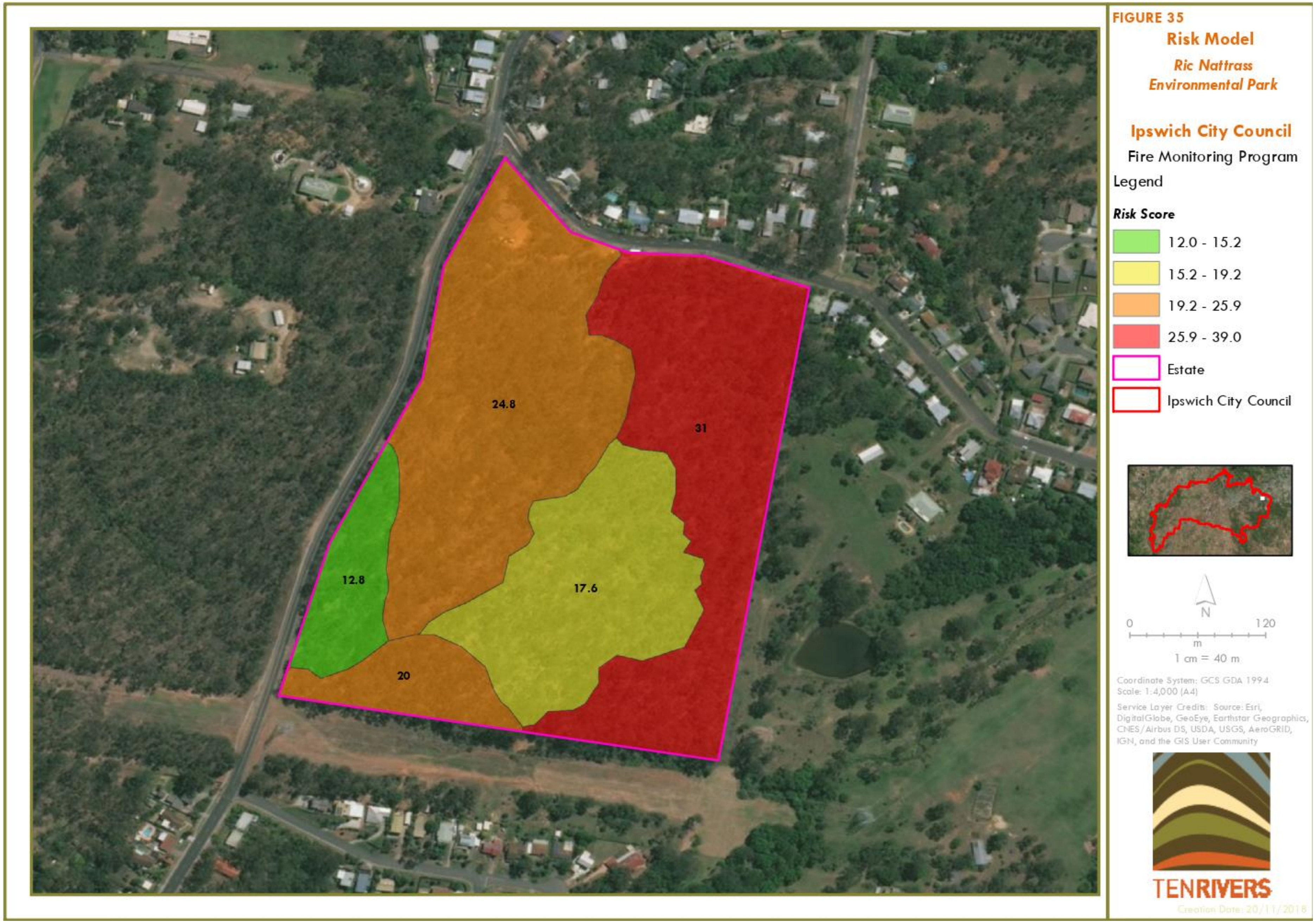
Item 1 / Attachment 3.



Item 1 / Attachment 3.



Item 1 / Attachment 3.



Item 1 / Attachment 3.

FIGURE 36

Conservation Model

Ric Nattrass Environmental Park

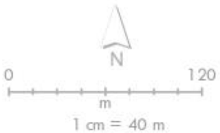
Ipswich City Council

Fire Monitoring Program

Legend

Conservation Score

- 3.5 - 7.7
- 7.7 - 10.0
- Estate
- Ipswich City Council



Coordinate System: GCS GDA 1994
Scale: 1:4,000 (A4)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

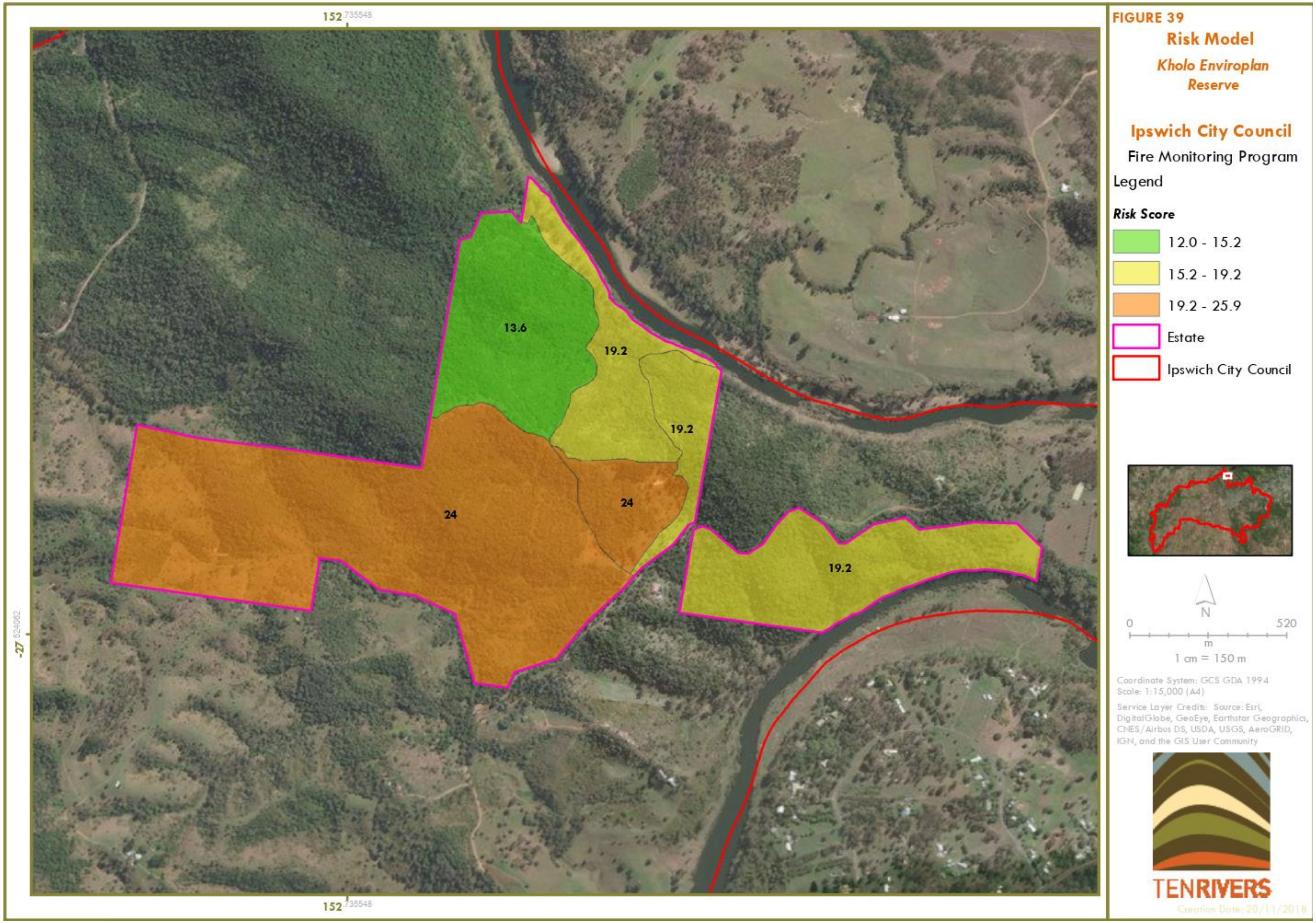
TENRIVERS

Creation Date: 20/11/2018

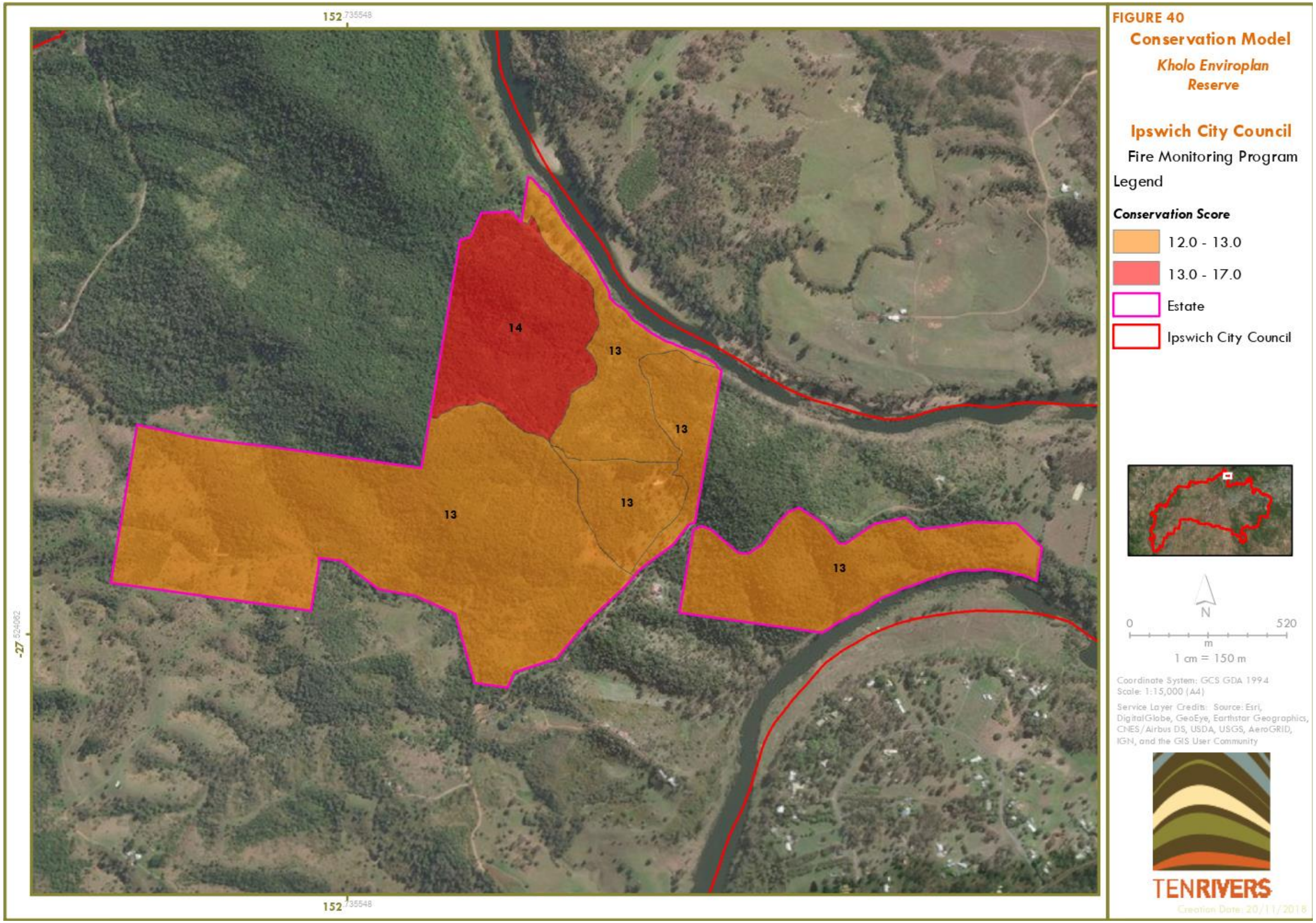
Item 1 / Attachment 3.

Item 1 / Attachment 3.

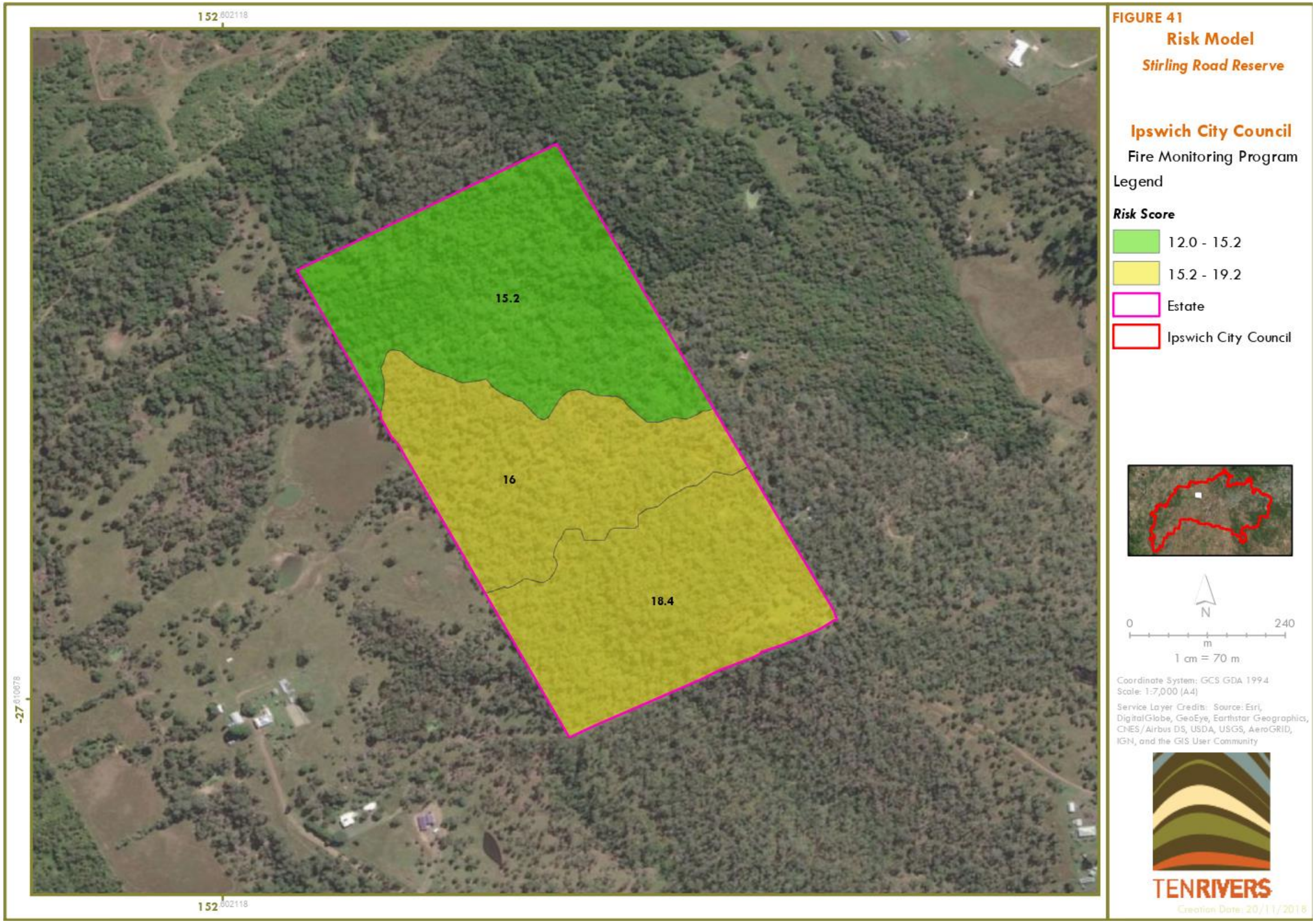
Item 1 / Attachment 3.



Item 1 / Attachment 3.

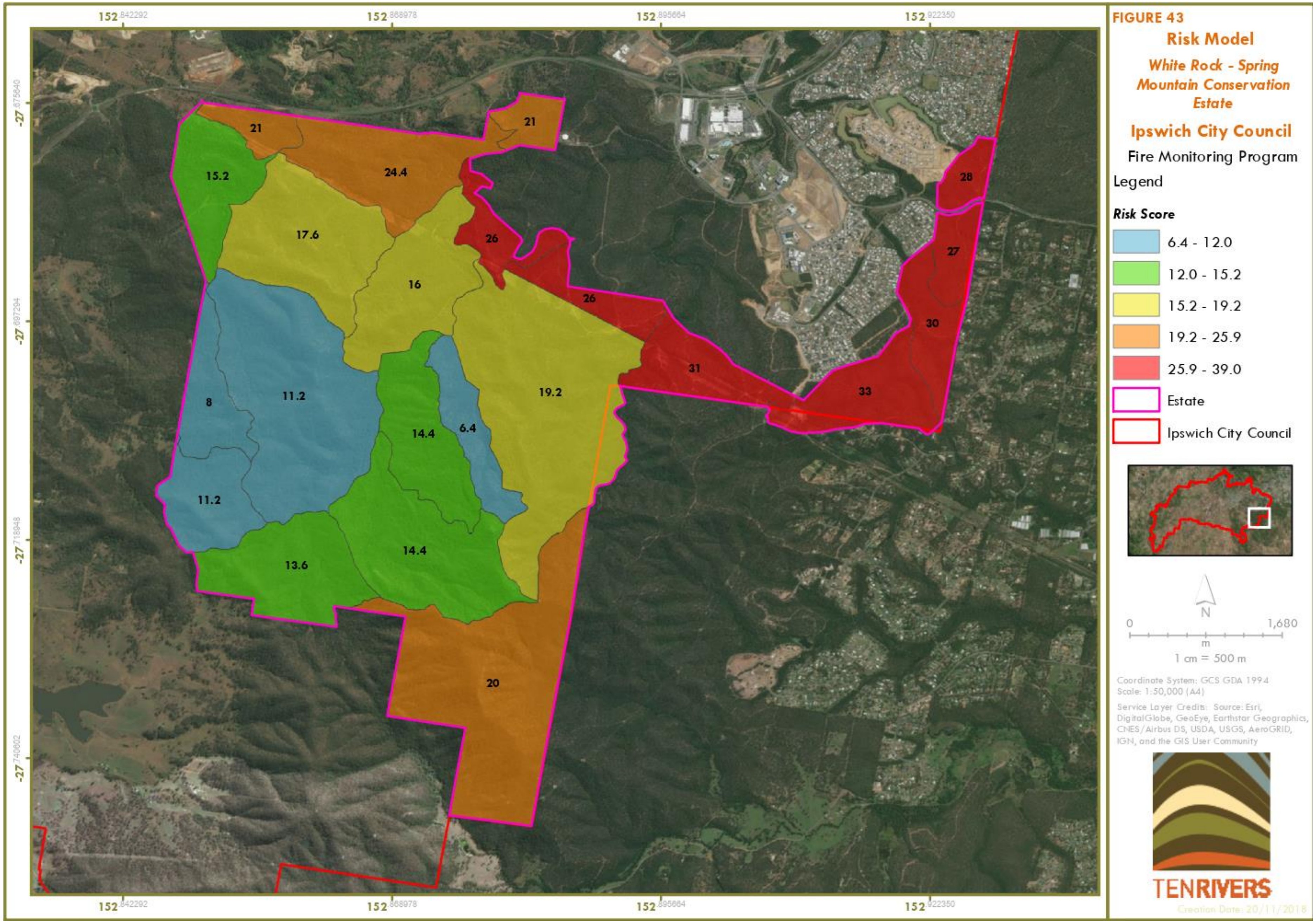


Item 1 / Attachment 3.

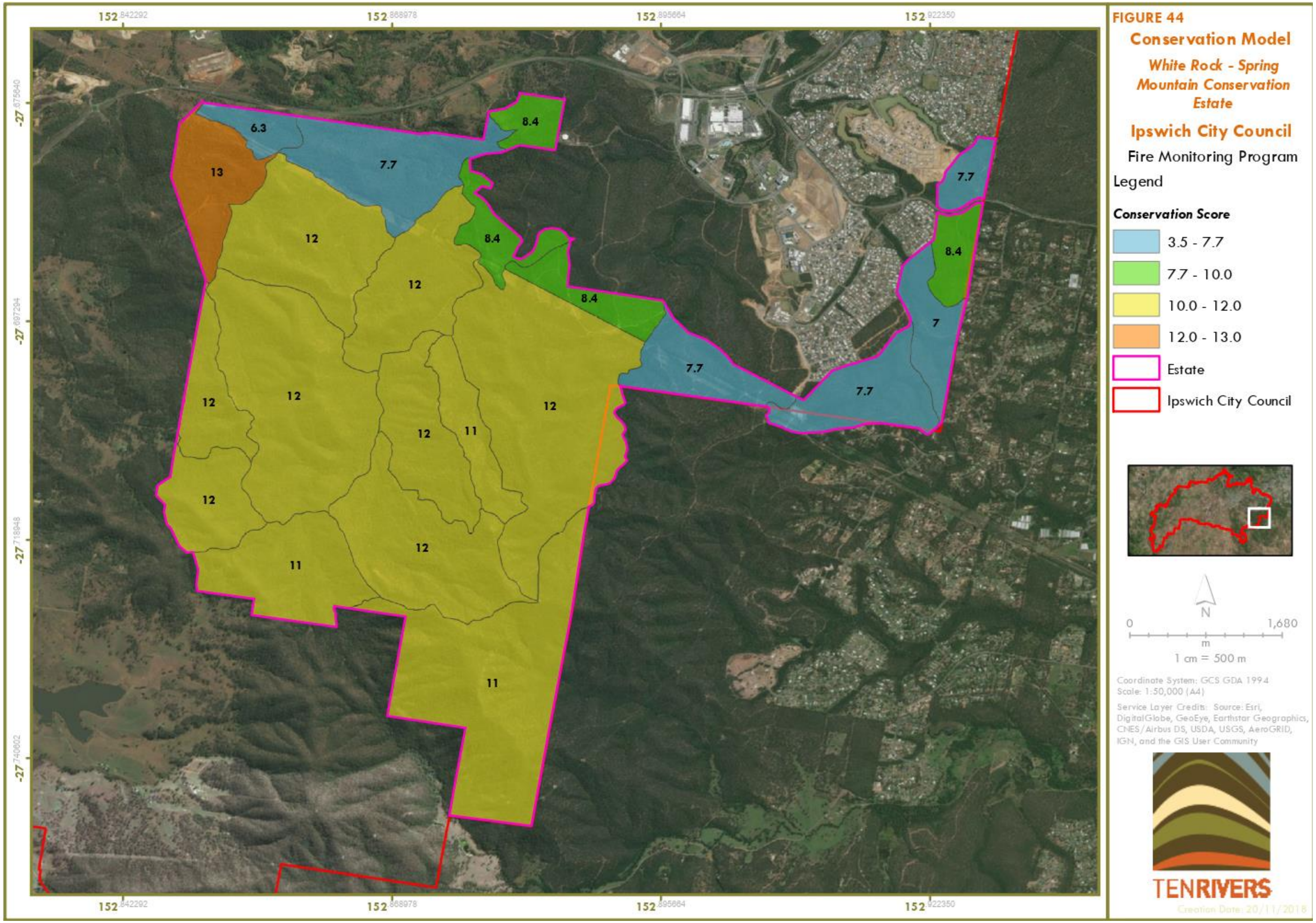


Item 1 / Attachment 3.

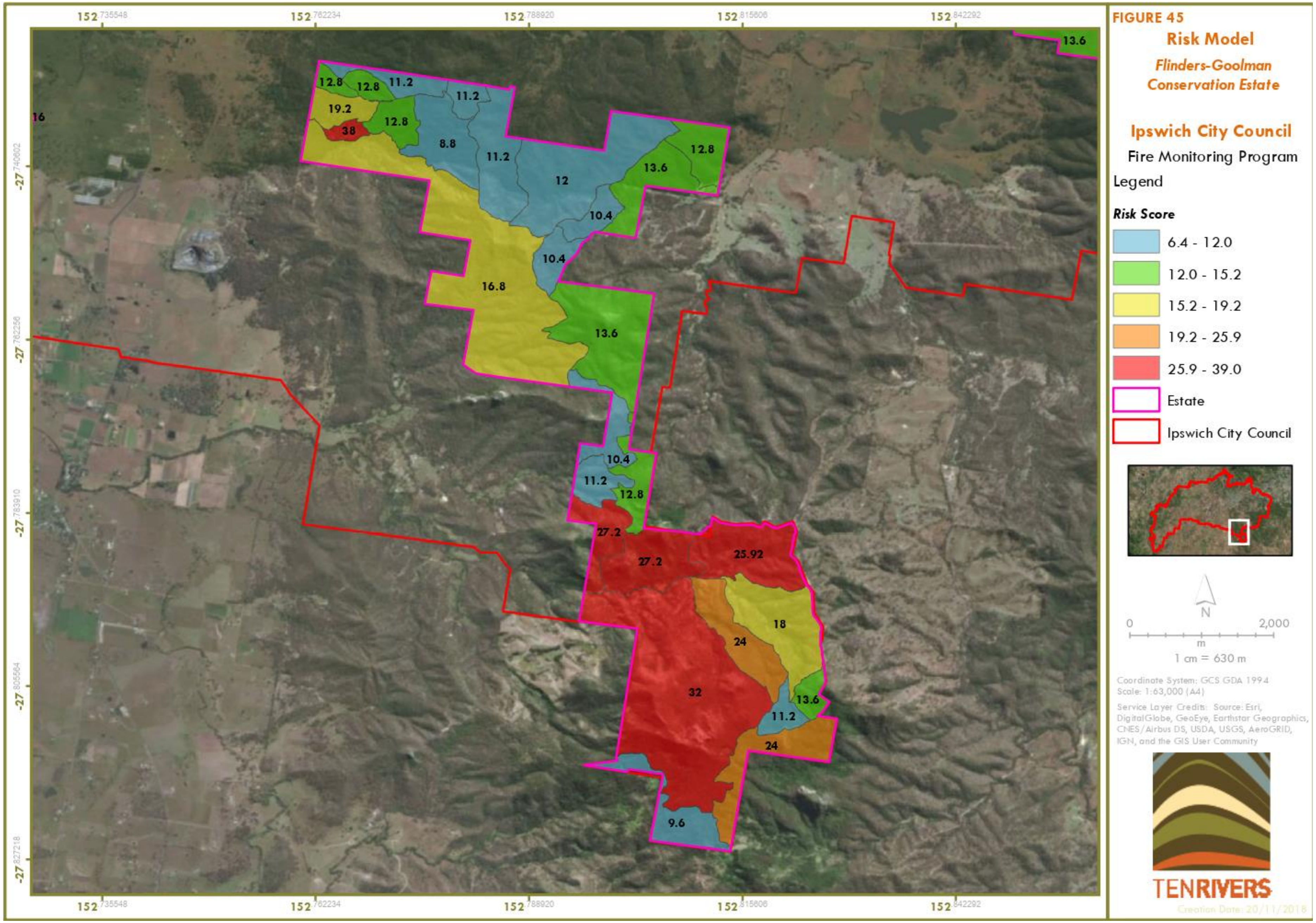
Item 1 / Attachment 3.



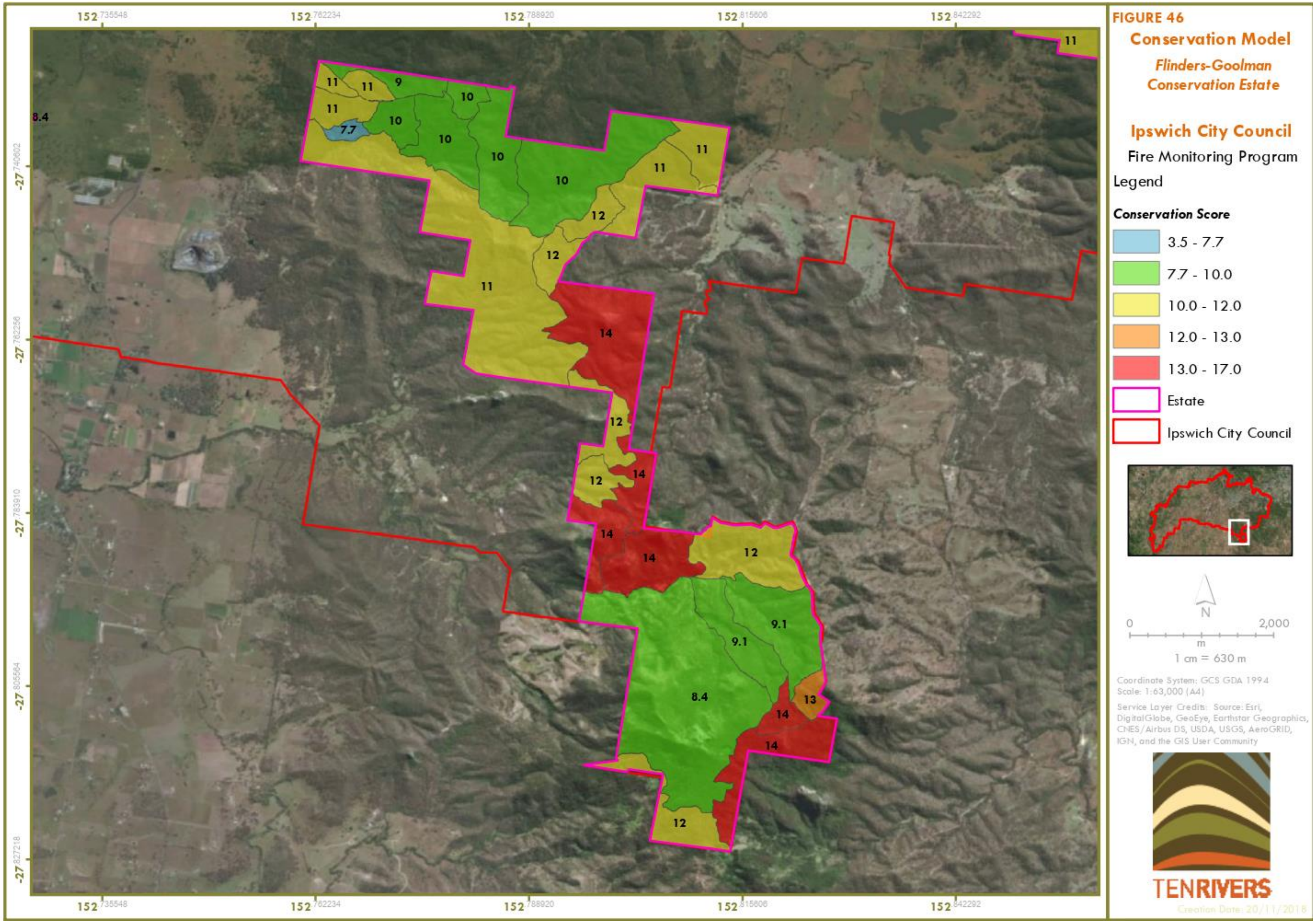
Item 1 / Attachment 3.



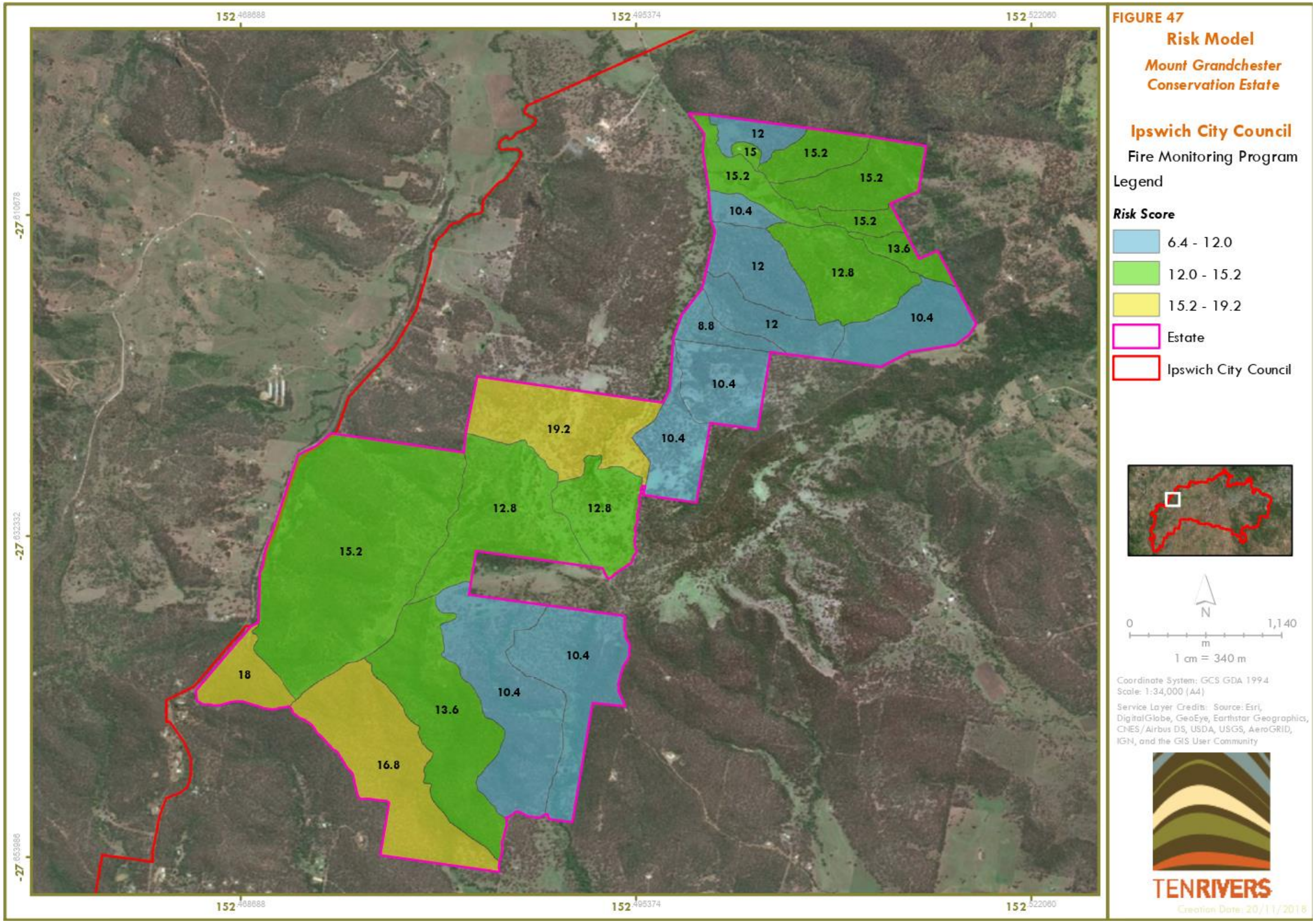
Item 1 / Attachment 3.



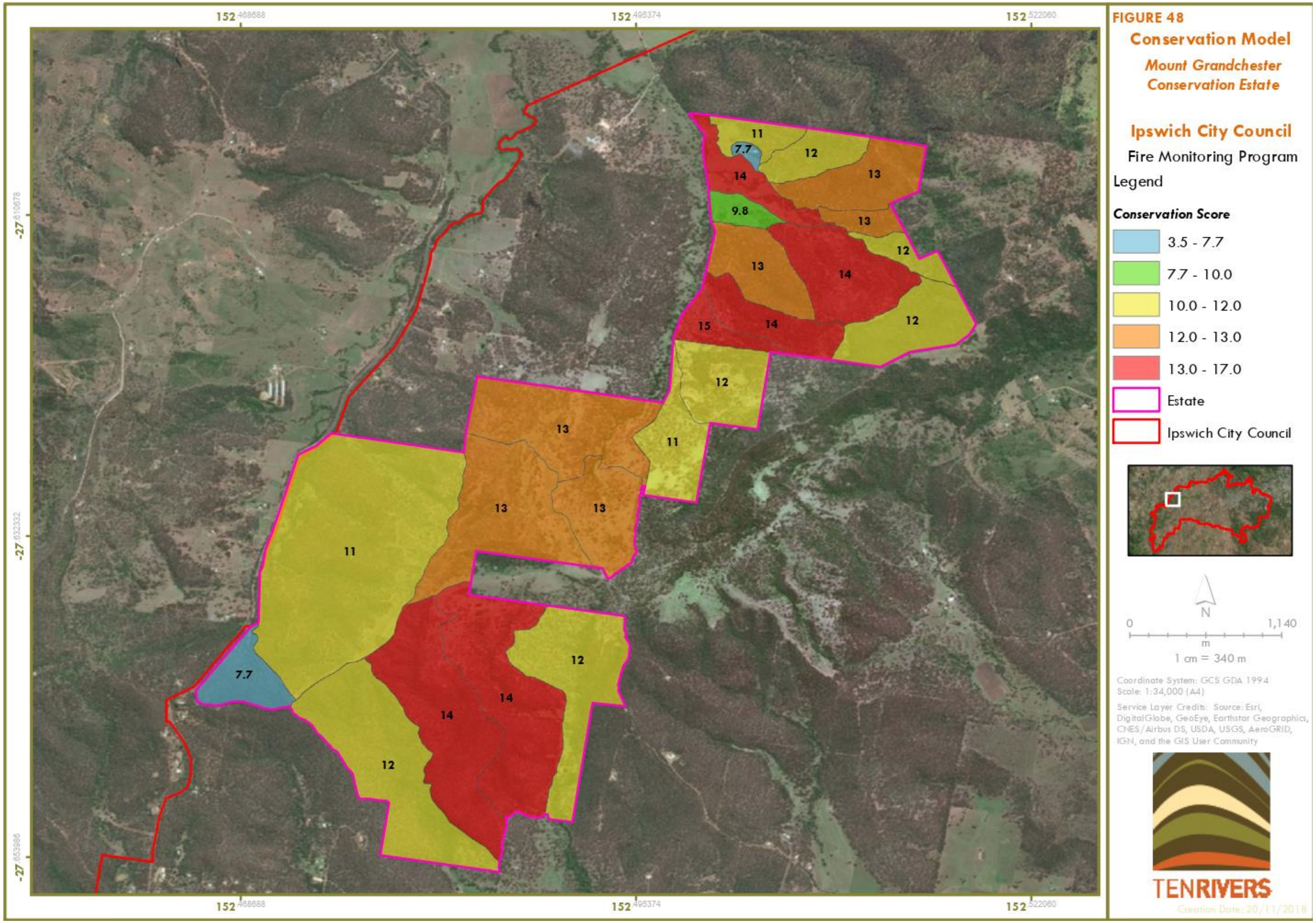
Item 1 / Attachment 3.



Item 1 / Attachment 3.



Item 1 / Attachment 3.



Appendix 16: Training Materials

Fire Monitoring Program 2018 – Review and Update

Training Materials

Overview

Ten Rivers were contracted by ICC to review and update the Fire Monitoring Program to align with the recent Fire Management Strategic Plan (FMSP) (GHD 2017). Fire management is a key land management activity within the Natural Areas Estate (NAE) of Ipswich and monitoring the risk and environmental responses to this is vital. The monitoring program has been designed to meet the two primary objectives across the NAE: risk management and conservation management. These two priorities align to the allocated Fire Management Zones (FMZ):

- Protection zone,
- Wildfire mitigation zone,
- Conservation zone,
- Fire exclusion zone,
- Reference zone, and
- Sustainable production zone.

Ten Rivers have developed a Decision Tool to drive fire management actions that prioritises areas for management based on the data that **you collect**. The monitoring data will be fed into the Decision Tool, therefore accurate and complete data is key for the entire fire management program.

What has changed from previous monitoring program?

- Focusing and streamlining the monitoring data to align to the two key objectives
- Fuel - focus on Hazard ratings as opposed to t/ha
- Refinement of vegetation condition assessment
- Removal of flora checklist to streamline data collection in alignment to the objectives

What tools are we using to achieve these objectives?

- New data sheets
- Overall Fuel Hazard Assessment Guide (OFHAG) (Hines *et al.* 2006)
- SEQ Fire and Biodiversity Consortium Monitoring Manual (FBC 2002)

How do these integrate into what you do in the field?

- Use of OFHAG as overarching instruction
- Refresher on use of data sheets for in field monitoring
- Fire and Biodiversity Monitoring Manual as further reading and background info

Methodology

Overview

Annual monitoring in Spring to drive management actions during burn season.

Three steps of data collection:

1. Baseline – site establishment form, to be completed once at initiation of a monitoring point
2. Part A – Fuel hazard – annually within all Fire Management Units (FMU)
3. Part B – Vegetation condition – annually within all FMU
4. Fire Assessment – during and/or post fire (planned or unplanned)

Two field technicians should complete the assessment together. This helps eliminate subjectivity and removes bias from continued surveying.

1. Site Establishment and Desktop assessment

Current plot locations will be rationalised, where plots are going to be added, removed or kept based primarily on a desktop assessment. Plot selection will be based on the following criteria:

- Fire Management Unit – at least one representative plot per FMU
- Vegetation type – dominant/representative type for that unit
- Topography – representative of unit, i.e. not in creek line or ridge
- Ease of access – efficiency for monitoring, 50-100m off track
- Spatial representation

Each new, and existing, plot will require a baseline data sheet to be completed to set up the site. This includes background information to be done as a desktop assessment, and additional verification and data to be collected in field, including:

- Topography
- Vegetation type
- Record dominant species present
- Significant species
- Geology.

Equipment required for site establishment:

- Star picket and driver, plus tag for star picket
- Permanent marker
- "Baseline Data Sheet" with completed desktop component
- Pen/pencil
- Compass and clinometer for topographic information
- Camera
- GPS capable device for location verification.

2. Part A of Monitoring Data Sheet – Fuel hazard

The new methodology will focus wholly on the OFHAG and classifying Fuel Hazard, as opposed to fuel load (t/ha). This is bringing the focus onto a risk-based approach to align with current best-practice and the FMSP.
The OFHAG classifies the risk of each fuel layer, i.e. surface, near-surface, elevated and bark fine fuels (<6 mm) (see Figure 1). It emphasises the importance of fuel structure and connectivity as opposed to focusing on the load/amount.

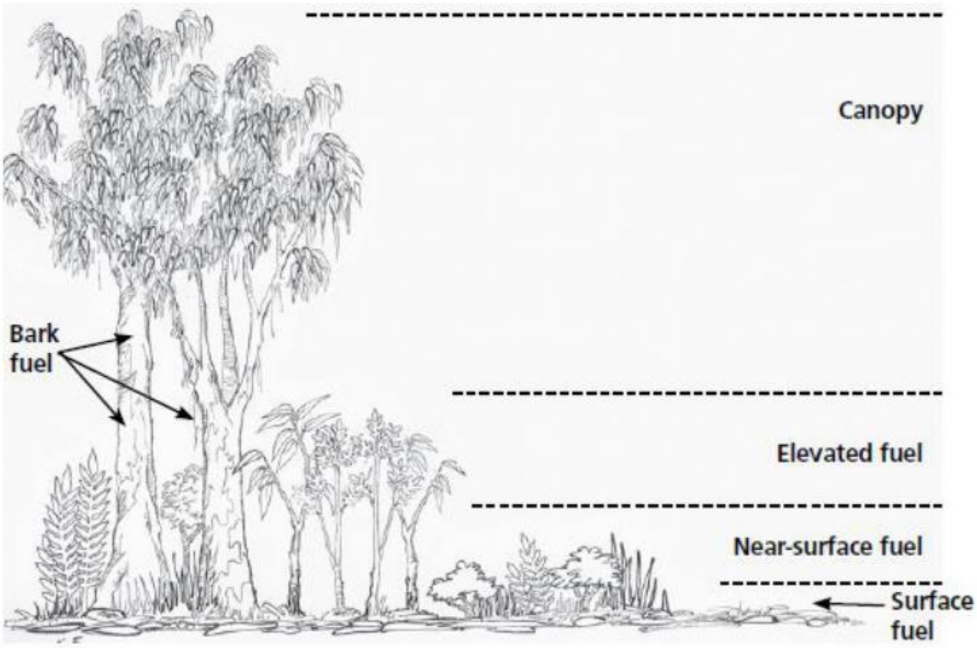


Figure 49. Fuel layer classes as classified in OFHAG (Hines *et al.* 2006).

Refer to OFHAG for further information.

We have included region specific details into the data sheet to provide additional information for fuel hazard assessment as outlined below.

- **Bark Hazard: classification of paper barks**

The classification of *Melaleuca* spp. (Paper barks) bark fuel in SEQ should be rated within the Ribbon Bark classification of the OFHAG.

Bark fuel on many mature *Melaleuca* species is similar in behaviour and hazard to ribbon bark species found in Victoria. Due to this, it is pertinent to assess and record paper barks as ribbon barks, especially in regards to hazard, as this is not sufficiently accounted for in the OFHAG 4th Ed.

- **Distinction between fuel layers – Near Surface and Elevated**

Vegetation <50cm in height should be classified as near surface fuel.

When assessing near surface and elevated fuels, any shrubby or sub-mature species where the majority of the fuel sits below 50 cm and the fuel is contiguous from the surface layer, this should be considered near surface fuels. This is due to the hazard rating of elevated fuels being weighted more heavily in an overall fuel hazard calculation based on the assumption of connectivity to the canopy. High amounts of elevated fuel lead to canopy and high strata structure damage, and more intense fires; and over-estimating this layer will artificially inflate the Overall Fuel Hazard Rating. See example in OFHAG 4th edition, pg 7, "bracken fern…".

Equipment required for Part A: Fuel Monitoring:

- "Fuel and Vegetation Monitoring Data Sheet" and pen
- "Assessing Vegetation Condition Within Plot" supplementary guide
- Litter depth disc and ruler
- Copy of Overall Fuel Hazard Assessment Guide – 4th Edition
- Camera.

**Note the importance here for accurate and consistent data collection.

Part B of Monitoring Data Sheet – Vegetation Condition

Built on the previous vegetation condition assessment table developed by ICC and based on the Qld Herbarium BioCondition assessment manual, Ten Rivers developed an updated vegetation condition calculator to quantify conservation objectives. The data sheet assesses health based on twelve attributes that are rated as low, moderate, high and very high risk.

Explanatory notes to assist use of data sheet:

- **Percentage cover vs percentage of individuals impacted**

Percentage cover of layer: The table refers to proportion of layers impacted, which is defined as the proportion of a given layers total cover that is impacted by a certain attribute. Example: "6. Proportion of mid-stratum with limited species diversity" – in sites where the mid-stratum only covers ¼ of the entire plot, if the mid-stratum is only made up of a single species, this should be classified as ">50%" as it is equivalent to 100% of that layer that has limited diversity.

Percentage cover of total area: The table refers to proportion of total area impacted, which is defined as the proportion of the entire plot that is impacted by a certain attribute. Example: "12. Proportion of total area with weeds" – when the entire plot is covered in weeds (i.e. 100%), this should be classified as ">50%".

Percentage of individuals: The table refers to percentage of individuals impacted, which is defined as the percentage of the total number of individuals that are affected by a particular attribute

Example: "3. Proportion of area having trees with epicormic or basal shoots" – if there are 10 trees with 6 individuals that have epicormic shoots, this equates to 60%, and should be classified as ">50% of individuals impacted".

- **"Mature/large" trees**

These are defined as well-established and significant canopy trees, for example, for eucalypts, this is usually >30-50 cm DBH. Note there is variation between species, and large non-eucalypts should usually be classified as >20 cm DBH.

- **Health Categories and cumulative model**

The attributes recorded in the vegetation condition table are assigned scores based on their rating as follows:

(A) – 1 point Strong indicator of declining health	(B) – 2 points Moderate indicator of declining health	(C) – 3 points Low indicator of declining health	(D) – 4 points Indicator of good health

The overall health score is a cumulative measure of the points values assigned to each category, and the total scores across all categories. To reach a total:

- First multiply the total number of indicators in each category by that categories points value (e.g. if there were 4 indicators in category (C), multiply 4 by 3, giving 12 points total for category (C)).
- Then add the total scores of each category together to come to a total overall value.

The overall vegetation condition score gives a measure of the general vegetation health of a plot, ranging from Low (in good health) to Very High (unhealthy).
To determine the vegetation condition rating, use the following table:

Points Value	41-48	33-40	26-32	12-25
Rating	LOW	MODERATE	HIGH	VERY HIGH
Relative Health	Healthy	Moderately Healthy	Moderately Unhealthy	Unhealthy

3. Fire Assessment – during and/or post fire (planned or unplanned)

This data sheet should be completed during and/or after any planned or unplanned burns within the NAE. The data incorporates a measure of weather conditions, fire intensity and detailed mapping of the burn extent. Climatic conditions may be recorded during or post-hoc from the BOM website if climatic recorders are unavailable.

Equipment required for Fire Assessments:

- Fire Assessment Data Sheet and pen
- Yard stick/measuring device for photo points
- GPS
- Camera.

Appendix 17: Training Run Survey Data

Table 23 - May 2018 Baseline Survey Data

Plot Number	Reserve Name	Fire Block Number	FMZ	GPS (GDA94)	Location Description	File Reference	Last Amended	Date of Last Survey	Image Numbers	Time
WR_3a	White Rock Spring Mountain Conservation Estate	WR_3	Conservation Zone	485316 x 6937552	Approx. 50m off track heading directly south up hill				0860-0863	14:14:00
WR_3b	White Rock Spring Mountain Conservation Estate	WR_3	Conservation Zone	485438 x 6937843	Approx. 50m off track, heading East north east off track				0856-0859	14:23:00

Plot Number	Cloud Cover %	Primary Objective	Previous Dominant Use	Current Secondary Use	Comments	Features Present	Rainfall	Nearest Gauge Station	Fire History	Date of Last Known Fire	Type of Fire	Slope (°)
WR_3a	10	Conservation	Grazing, Mining, Forestry, Military	Recreation		Infrastructure		Amberley	3-10 years	2014	Wildfire	9
WR_3b	10	Conservation	Grazing, Mining, Forestry, Military	Recreation		Infrastructure		Amberley	3-10 years	2012	Wildfire	12

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

Plot Number	Aspect (°, direction)	Broad Vegetation Group	Dominant Species				Significant Species	Sighted or Record	Soil Type	% Cover (*a/b/c etc.*)
			Canopy	Mid-storey	Ground Cover	Weeds				
WR_3a	10°N	10b/13c	*C. Citriodora, E. crebra, C. tesselaris*	*A. disparrima, A. excelsa*	*Lomandra spp., E. stricta, Dianella spp.*	*L. montevidensis, L. camara, P. lutea*	nil		Loamy/ exposed rock	90/10
WR_3b	210°SW	10b/13c/9a	*L. confertus, E. crebra, C. citriodora*	*A. disparrima, A. excelsa*	*E. stricta, Lomandra spp.*		nil		Loamy/ exposed rock/ erosion	90/10/10

Table 24 - May 2018 Fuel Monitoring Survey Data

Plot Number	Season and Year	Date	Time	Completed By	Reserve Name	Fire Block Number	GPS (GDA94)	Fire Management Zone	Photo Point Description	Image #	Cloud Cover %
WR_3a	Autumn	17/05/2018	11:00	D Virkki	White Rock Spring Mountain Conservation Estate	WR_3	485316 x 6937552	Conservation Zone	From plot marker, N, E, S and W	0860-0863	10%
WR_3b	Autumn	17/05/2018	12:12	S Faithful	White Rock Spring Mountain Conservation Estate	WR_3	485438 x 6937843	Conservation Zone	From plot marker, N, E, S and W	0856-0859	10%

	Bark Fine Fuels		Elevated Fine Fuels						Near Surface Fine Fuels				
Plot Number	Bark Type	Bark Fuel Hazard	Average Height (cm)	Plant Cover (%)	% Dead	Vertical Continuity	Vegetation Density	Elevated Fuel Hazard	Average Height (cm)	Plant Cover (%)	% Dead	Horizontal Connectivity	Near Surface Fuel Hazard
WR_3a	Other	Moderate	100-150	20-30	<20	High	Moderate	Moderate	15-30	20-40	>20	High	High
WR_3b	Other	Moderate	200-250	50-80	<20	High	Very High	Very High	30-50	40-60	>30	Very High	Very High

Ten Rivers
ICC - UPDATE OF FIRE MONITORING PROGRAM

TENRIVERS

	Surface Fine Fuels					
Plot Number	Average Depth (mm)	Horizontal Connectivity	Surface Litter Cover (%)	Surface Fuel Hazard	Combined Rating	Overall Fuel Hazard Rating
WR_3a	16	Moderate	60-80	Moderate	High	Moderate
WR_3b	22	High	80-90	High	Very High	Very High

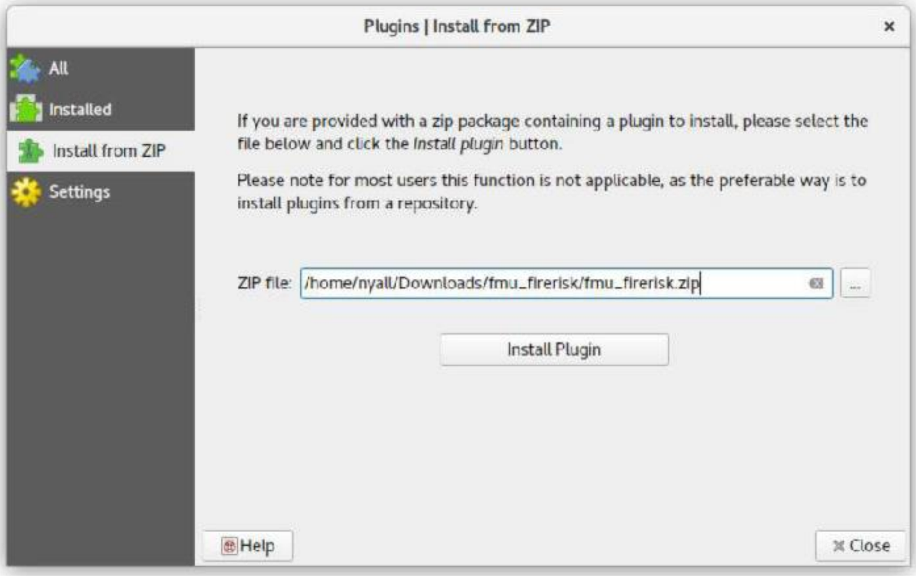
Appendix 18: Decision Tool Model – Fire Risk Assessment Plugin User Guide

QGIS Fire Risk Assessment - User Guide

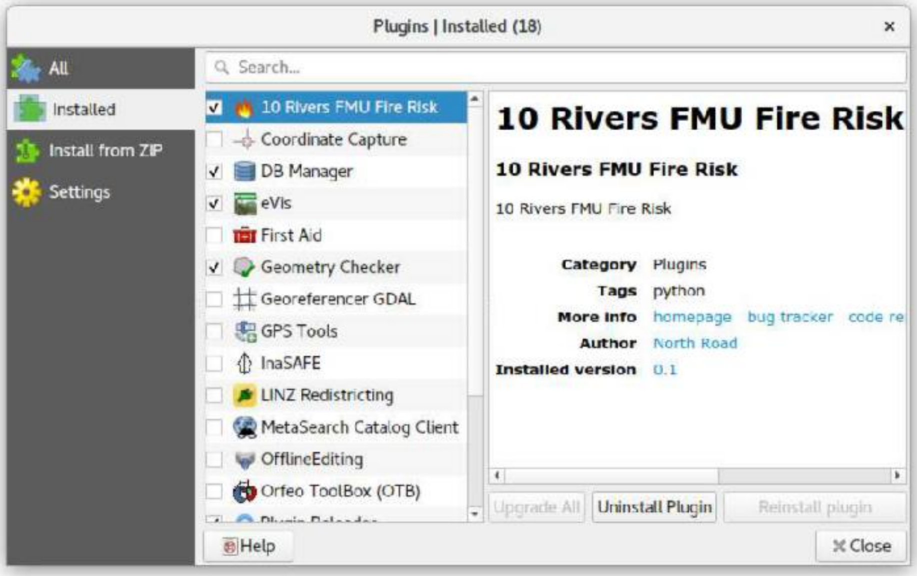
Plugin Installation

The Fire Risk Assessment plugin is distributed as an archived ZIP file containing all files and scripts required for the plugin operation. The plugin is compatible with all versions of QGIS from 3.2 and above. QGIS must first be installed and operational on the target workstation.

In order to install the plugin from the provided ZIP file, the Plugins -> Manage and Install Plugins option should be selected from within QGIS. In the Plugin Manager dialog, select the "Install from ZIP" option. Click the "..." button and select the provided ZIP file. Finally, click the "Install Plugin" button to install the plugin onto the workstation.



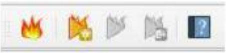
After the plugin has been installed it must be activated from the "Installed" section of the Plugin Manager. Click the checkbox next to the "10 Rivers FMU Fire Risk" plugin entry to activate the plugin.



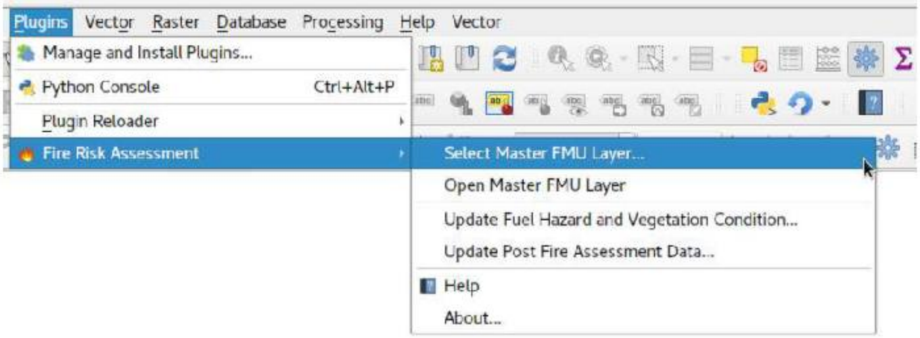
The same procedure should be followed when upgrading the plugin as when installing it for the first time.

Plugin Components

When installed, the Fire Risk Assessment plugin adds a new toolbar to the QGIS interface, containing shortcuts to the core plugin functionality.



The plugin also adds a Fire Risk Assessment submenu under the Plugins menu. This submenu contains lesser used configuration options and other tools associated with the plugin.



Plugin Configuration

Before the plugin can be used to conduct assessments, the path to the current FMU master layer must be setup. This is done by selecting the "Select Master FMU Layer" option from the Plugins - Fire Risk Assessment menu. This will trigger a file selector allowing the user to select the location of the layer from their workstation or a network path. This path is stored on the workstation and will be remembered for subsequent usage of the plugin.

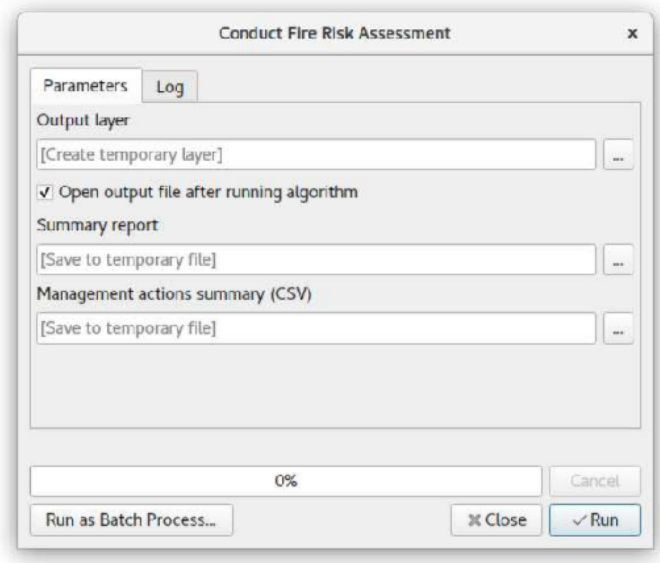
At any stage a new master FMU layer can be set by triggering the same option from the Fire Risk Assessment menu.

The Fire Risk Assessment menu also offers an "Open Master FMU Layer" action which is a shortcut to opening the current master FMU layer within QGIS. This option can be used when permanent edits must be made to the master FMU layer.

Conducting Assessments

Fire risk assessments are conducted by clicking the "Conduct Fire Risk Assessment" button on the plugin toolbar. Clicking this button triggers an assessment using the current values and observations recorded in the master FMU layer.

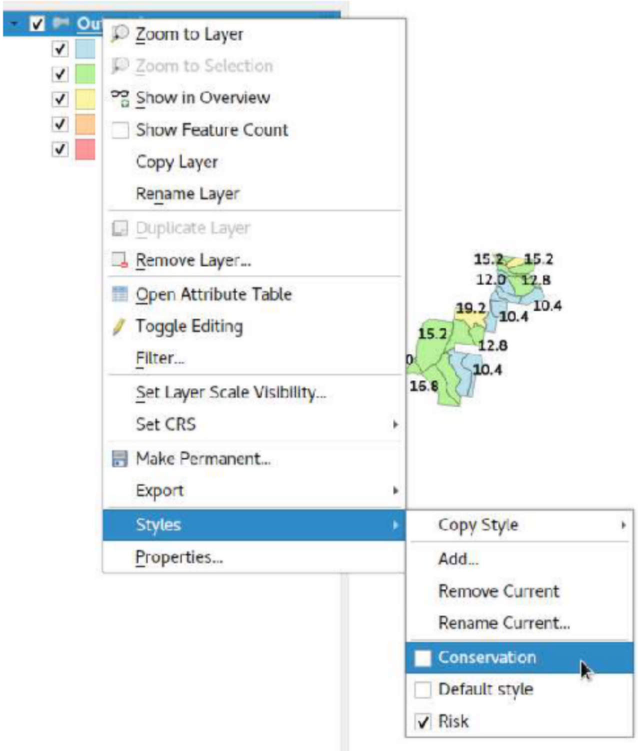
After clicking the button, a dialog will open showing available options for the assessment:



The available options include:

- **Output layer**: Allows the user to specify a file path to save the generated assessment to. The default value is to save the assessment to a temporary location, which is discarded after closing the current QGIS project.
- **Summary report**: Allows the user to specify a file path for the generated HTML report containing management actions for each FMU.
- **Management actions summary (CSV)**: An optional path for creation of a CSV file containing a summary list of management actions required for each FMU.

Clicking the Run button will perform the fire risk assessment, and load the results into the current QGIS session. By default the output is styled using the calculated Risk score. To switch to the calculated Conservation score, right click the layer within the layer tree, and select Styles - Conservation.

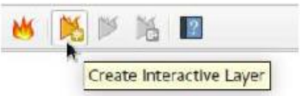


The layer can be then be interrogated using the standard QGIS map analysis tools, including the Identify tool, interactive layer styles, and the Statistical Summary panel.

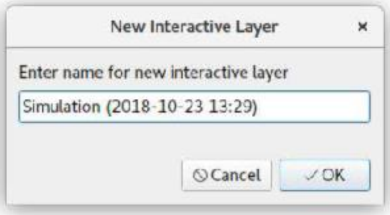
Interactive Layers

The plugin also allows for creation of "Interactive" FMU layers, which allow users to freely modify the properties and attributes recorded for each FMU and determine the consequent effect they have on the calculated risk ratings.

To create a new interactive layer, click on the "Create Interactive Layer" action on the plugin toolbar:



A prompt will be displayed, asking for a new for the new interactive layer. The name defaults to the current date and time, but can be freely modified:

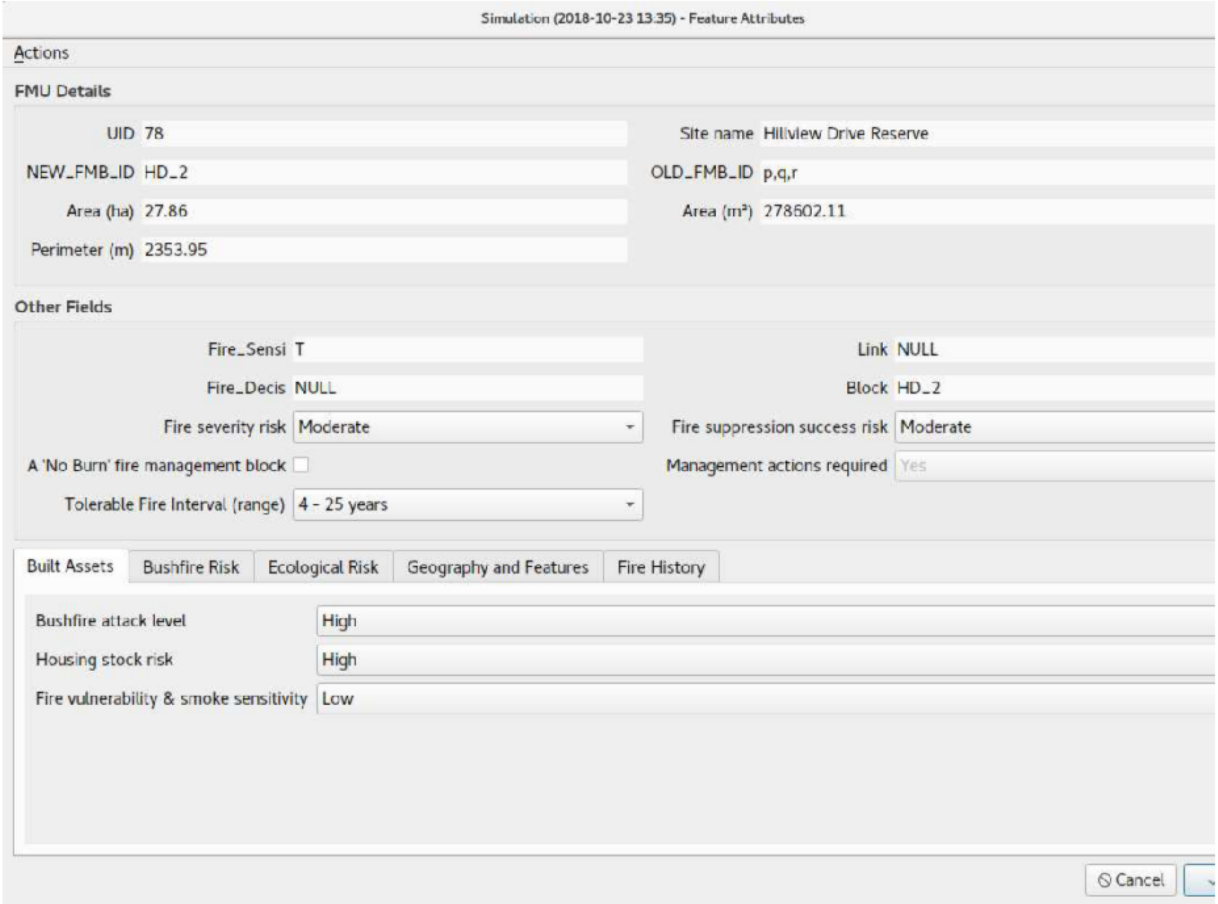


After clicking OK the new layer will be added to the current QGIS project. Interactive layers are a temporary copy of the master FMU layer, and accordingly can be freely edited in any way without affecting the master FMU table.

Edits can be made using all the standard QGIS editing functionality. In particular, the layers have been setup to take full advantage of QGIS' editing form capabilities. To utilise these, use the Identify tool and click on an FMU polygon. In the "Identify Results" panel which opens, click the "Edit Feature Form" button in the toolbar:

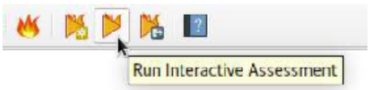
A dialog will open showing all the properties of the FMU. Some of these properties are read only (such as physical, constant attributes of the FMU), whilst others allow modification. The editable settings can be tweaked to control how the FMU is treated during simulated model runs, e.g. allowing users to run a simulation with a different Bushfire Attack Level score:

Item 1 / Attachment 3.

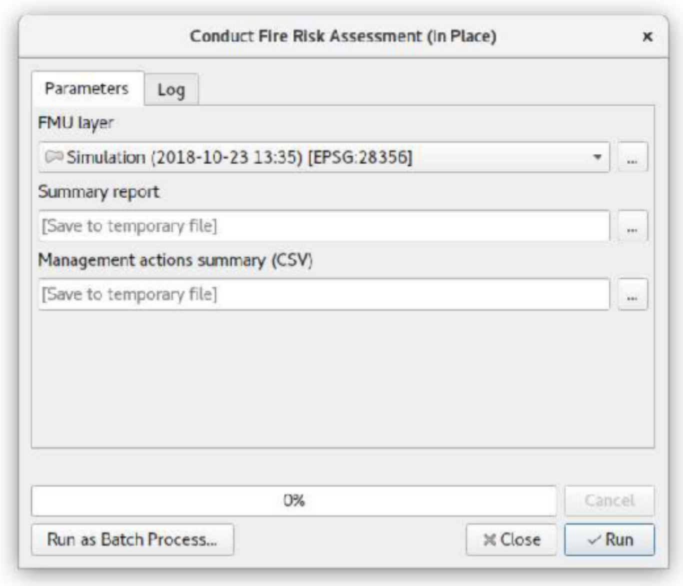


Running Simulations on Interactive Layers

Whenever an interactive layer is selected within the current QGIS project, the "Run Interactive Assessment" action on the plugin toolbar will be enabled:



Clicking this button will open a dialog with options for the assessment:



The available options include:

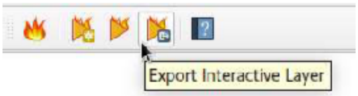
- **FMU layer**: Shows the interactive FMU layer on which the assessment will be run.
- **Summary report**: Allows the user to specify a file path for the generated HTML report containing management actions for each FMU.
- **Management actions summary (CSV)**: An optional path for creation of a CSV file containing a summary list of management actions required for each FMU.

Clicking the "Run" button in this dialog will run the model on the simulated layer. When running an interactive assessment, the results are immediately applied to the layer and shown within QGIS. Multiple simulation runs are possible on a single layer, allowing users to tweak the FMU properties as desired and re-run the model to immediately visualise the results.

Exporting Interactive Layers

Finally, interactive layers can be exported for long term storage. By default interactive layers are temporary layers and are discarded whenever the current QGIS project is closed. By exporting the interactive layers to a permanent location the parameters used for simluations can be kept as a long-lasting record of the analysis conducted.

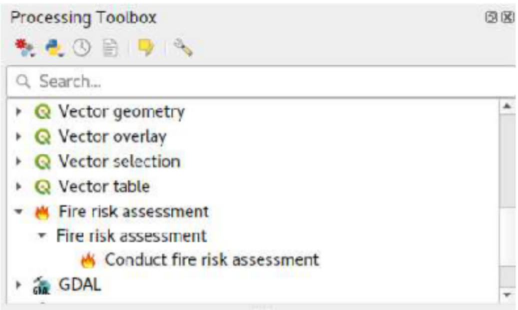
To export an interactive layer, just select the layer within the QGIS project and click the "Export Interactive Layer" action on the plugin toolbar:



The layer can then be saved to any standard disk-based format, including Shapefiles or KML files.

Fire Risk Assessment Toolbox Algorithm

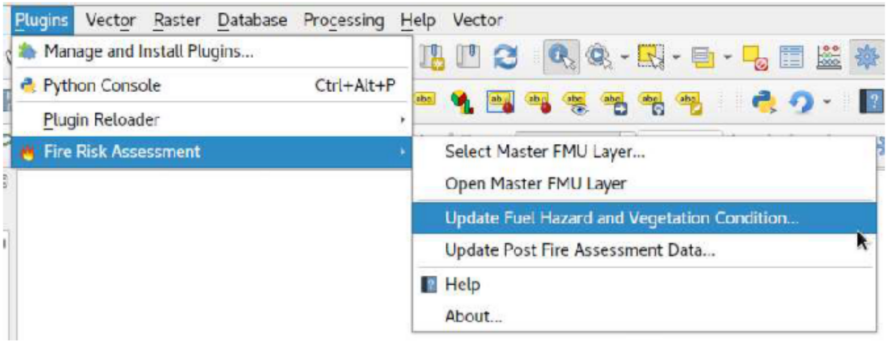
The fire risk assessment model is also available for use through QGIS' Processing Toolbox. This allows the assessment to be run as part of a larger scripted workflow, e.g. one created via QGIS' Graphical Modeler. The assessment tool is available under "Fire Risk Assessment" - "Conducty fire risk assessment":



Updating the FMU Layer

The plugin includes automated tools for updating the master FMU layer's properties based on field surveys and ground condition observations. These tools are designed to be used alongside the data collection tools created by 10 Rivers staff to accompany the plugin.

To run the data update tools, select either "Update Fuel Hazard and Vegetation Condition" or "Update Post Fire Assessment Data" from the Plugins, Fire Risk Assessment menu:



The plugin will then prompt for the location of the corresponding CSV file exported from the field capture tool. After selecting this file, it will be validated and then the parameters stored within the master FMU layer will be automatically updated as a result.

Plugin Support

This plugin was developed by North Road. Please contact us for plugin support and assistance.

Appendix 19: Decision Tool Model – Management Action Recommendations

FMU Fire Risk

- Denmark Hill Conservation Reserve (DH_1)
- Denmark Hill Conservation Reserve (DH_2)
- Denmark Hill Conservation Reserve (DH_3)
- Denmark Hill Conservation Reserve (DH_4)
- Denmark Hill Conservation Reserve (DH_5)
- Denmark Hill Conservation Reserve (DH_6)
- Denmark Hill Conservation Reserve (DH_7)
- Denmark Hill Conservation Reserve (DH_8)
- Denmark Hill Conservation Reserve (DH_9)
- Flinders-Goolman Conservation Estate (FG_10)
- Flinders-Goolman Conservation Estate (FG_11)
- Flinders-Goolman Conservation Estate (FG_12)
- Flinders-Goolman Conservation Estate (FG_13)
- Flinders-Goolman Conservation Estate (FG_14)
- Flinders-Goolman Conservation Estate (FG_15)
- Flinders-Goolman Conservation Estate (FG_16)
- Flinders-Goolman Conservation Estate (FG_17)
- Flinders-Goolman Conservation Estate (FG_18)
- Flinders-Goolman Conservation Estate (FG_19)
- Flinders-Goolman Conservation Estate (FG_1a)
- Flinders-Goolman Conservation Estate (FG_1b)
- Flinders-Goolman Conservation Estate (FG_1c)
- Flinders-Goolman Conservation Estate (FG_20)
- Flinders-Goolman Conservation Estate (FG_21)
- Flinders-Goolman Conservation Estate (FG_22)
- Flinders-Goolman Conservation Estate (FG_23)
- Flinders-Goolman Conservation Estate (FG_24)
- Flinders-Goolman Conservation Estate (FG_25)
- Flinders-Goolman Conservation Estate (FG_26)
- Flinders-Goolman Conservation Estate (FG_2a)
- Flinders-Goolman Conservation Estate (FG_2b)
- Flinders-Goolman Conservation Estate (FG_3)
- Flinders-Goolman Conservation Estate (FG_4)
- Flinders-Goolman Conservation Estate (FG_5)
- Flinders-Goolman Conservation Estate (FG_6)
- Flinders-Goolman Conservation Estate (FG_7)
- Flinders-Goolman Conservation Estate (FG_8)
- Flinders-Goolman Conservation Estate (FG_9)
- Haig Street Quarry Conservation Reserve (HS_1)
- Haig Street Quarry Conservation Reserve (HS_2)
- Haig Street Quarry Conservation Reserve (HS_3)
- Haig Street Quarry Conservation Reserve (HS_4)
- Haig Street Quarry Conservation Reserve (HS_5)
- Haig Street Quarry Conservation Reserve (HS_6)
- Hillview Drive Reserve (HD_1)
- Hillview Drive Reserve (HD_2)
- Kholo Enviroplan Reserve (CS_1)
- Kholo Enviroplan Reserve (CS_2)
- Kholo Enviroplan Reserve (CS_3)
- Kholo Enviroplan Reserve (CS_4)

- Kholo Enviroplan Reserve (CS_5)
- Kholo Enviroplan Reserve (CS_6)
- Mount Grandchester Conservation Estate (MG_1)
- Mount Grandchester Conservation Estate (MG_10a)
- Mount Grandchester Conservation Estate (MG_10b)
- Mount Grandchester Conservation Estate (MG_11)
- Mount Grandchester Conservation Estate (MG_12)
- Mount Grandchester Conservation Estate (MG_13)
- Mount Grandchester Conservation Estate (MG_14)
- Mount Grandchester Conservation Estate (MG_15)
- Mount Grandchester Conservation Estate (MG_16)
- Mount Grandchester Conservation Estate (MG_17)
- Mount Grandchester Conservation Estate (MG_18)
- Mount Grandchester Conservation Estate (MG_19)
- Mount Grandchester Conservation Estate (MG_1a)
- Mount Grandchester Conservation Estate (MG_2)
- Mount Grandchester Conservation Estate (MG_20)
- Mount Grandchester Conservation Estate (MG_3a)
- Mount Grandchester Conservation Estate (MG_3b)
- Mount Grandchester Conservation Estate (MG_4)
- Mount Grandchester Conservation Estate (MG_5a)
- Mount Grandchester Conservation Estate (MG_5b)
- Mount Grandchester Conservation Estate (MG_6)
- Mount Grandchester Conservation Estate (MG_7)
- Mount Grandchester Conservation Estate (MG_8)
- Mount Grandchester Conservation Estate (MG_9)
- Purga Nature Reserve (PN_1)
- Purga Nature Reserve (PN_1a)
- Purga Nature Reserve (PN_2a)
- Purga Nature Reserve (PN_2b)
- Purga Nature Reserve (PN_2c)
- Purga Nature Reserve (PN_3)
- Purga Nature Reserve (PN_4)
- Purga Nature Reserve (PN_5)
- Purga Nature Reserve (PN_6)
- Purga Nature Reserve (PN_7)
- Ric Nattrass Environmental Park (RN_1)
- Ric Nattrass Environmental Park (RN_2)
- Ric Nattrass Environmental Park (RN_3)
- Ric Nattrass Environmental Park (RN_4)
- Ric Nattrass Environmental Park (RN_5)
- Stirling Road Reserve (SR_1)
- Stirling Road Reserve (SR_2)
- Stirling Road Reserve (SR_3)
- White Rock - Spring Mountain Conservation Estate (WR_1)
- White Rock - Spring Mountain Conservation Estate (WR_10)
- White Rock - Spring Mountain Conservation Estate (WR_11)
- White Rock - Spring Mountain Conservation Estate (WR_12)
- White Rock - Spring Mountain Conservation Estate (WR_13)
- White Rock - Spring Mountain Conservation Estate (WR_13a)
- White Rock - Spring Mountain Conservation Estate (WR_14)
- White Rock - Spring Mountain Conservation Estate (WR_15)
- White Rock - Spring Mountain Conservation Estate (WR_16)
- White Rock - Spring Mountain Conservation Estate (WR_17)

- White Rock - Spring Mountain Conservation Estate (WR_18)
- White Rock - Spring Mountain Conservation Estate (WR_19)
- White Rock - Spring Mountain Conservation Estate (WR_2)
- White Rock - Spring Mountain Conservation Estate (WR_20)
- White Rock - Spring Mountain Conservation Estate (WR_3)
- White Rock - Spring Mountain Conservation Estate (WR_4a)
- White Rock - Spring Mountain Conservation Estate (WR_4b)
- White Rock - Spring Mountain Conservation Estate (WR_5)
- White Rock - Spring Mountain Conservation Estate (WR_6)
- White Rock - Spring Mountain Conservation Estate (WR_7)
- White Rock - Spring Mountain Conservation Estate (WR_8)
- White Rock - Spring Mountain Conservation Estate (WR_9)

Denmark Hill Conservation Reserve (DH_1)

Risk Score: 24.00
Conservation Score: 7.00

Denmark Hill Conservation Reserve (DH_2)

Risk Score: 22.40
Conservation Score: 5.00

Denmark Hill Conservation Reserve (DH_3)

Risk Score: 20.80
Conservation Score: 7.00

Denmark Hill Conservation Reserve (DH_4)

Risk Score: 22.72
Conservation Score: 5.00

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:

  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary

- Only implement prescribed burn as last resort

Denmark Hill Conservation Reserve (DH_5)

Risk Score: 24.00

Conservation Score: 3.50

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Denmark Hill Conservation Reserve (DH_6)

Risk Score: 27.00
Conservation Score: 4.20

Management actions required:

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Denmark Hill Conservation Reserve (DH_7)

Risk Score: 23.52
Conservation Score: 6.00

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Denmark Hill Conservation Reserve (DH_8)

Risk Score: 24.00
Conservation Score: 7.00

Denmark Hill Conservation Reserve (DH_9)

Risk Score: 26.40
Conservation Score: 6.00

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:

  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary

- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Flinders-Goolman Conservation Estate (FG_10)

Risk Score: 13.60
Conservation Score: 11.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Flinders-Goolman Conservation Estate (FG_11)

Risk Score: 10.40
Conservation Score: 12.00

Flinders-Goolman Conservation Estate (FG_12)

Risk Score: 10.40
Conservation Score: 12.00

Flinders-Goolman Conservation Estate (FG_13)

Risk Score: 13.60
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_14)

Risk Score: 10.40
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Flinders-Goolman Conservation Estate (FG_15)

Risk Score: 12.80
Conservation Score: 14.00

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_16)

Risk Score: 11.20
Conservation Score: 12.00

Flinders-Goolman Conservation Estate (FG_17)

Risk Score: 27.20
Conservation Score: 14.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_18)

Risk Score: 27.20
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_19)

Risk Score: 25.92
Conservation Score: 12.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Flinders-Goolman Conservation Estate (FG_1a)

Risk Score: 12.80
Conservation Score: 11.00

Flinders-Goolman Conservation Estate (FG_1b)

Risk Score: 19.20
Conservation Score: 11.00

Flinders-Goolman Conservation Estate (FG_1c)

Risk Score: 38.00
Conservation Score: 7.70

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.

- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Flinders-Goolman Conservation Estate (FG_20)

Risk Score: 18.00
Conservation Score: 9.10

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Flinders-Goolman Conservation Estate (FG_21)

Risk Score: 24.00
Conservation Score: 9.10

Management actions required:

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Flinders-Goolman Conservation Estate (FG_22)

Risk Score: 32.00
Conservation Score: 8.40

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.

- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Flinders-Goolman Conservation Estate (FG_23)

Risk Score: 9.60
Conservation Score: 12.00

Flinders-Goolman Conservation Estate (FG_24)

Risk Score: 24.00
Conservation Score: 14.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_25)

Risk Score: 11.20
Conservation Score: 14.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_26)

Risk Score: 13.60
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Flinders-Goolman Conservation Estate (FG_2a)

Risk Score: 12.80
Conservation Score: 11.00

Flinders-Goolman Conservation Estate (FG_2b)

Risk Score: 11.20
Conservation Score: 9.00

Flinders-Goolman Conservation Estate (FG_3)

Risk Score: 11.20
Conservation Score: 10.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Flinders-Goolman Conservation Estate (FG_4)

Risk Score: 11.20
Conservation Score: 10.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Flinders-Goolman Conservation Estate (FG_5)

Risk Score: 12.00
Conservation Score: 10.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Flinders-Goolman Conservation Estate (FG_6)

Risk Score: 12.80
Conservation Score: 10.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Flinders-Goolman Conservation Estate (FG_7)

Risk Score: 8.80
Conservation Score: 10.00

Flinders-Goolman Conservation Estate (FG_8)

Risk Score: 16.80

Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Flinders-Goolman Conservation Estate (FG_9)

Risk Score: 12.80
Conservation Score: 11.00

Haig Street Quarry Conservation Reserve (HS_1)

Risk Score: 31.00
Conservation Score: 6.30

Management actions required:

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Haig Street Quarry Conservation Reserve (HS_2)

Risk Score: 32.40
Conservation Score: 7.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Haig Street Quarry Conservation Reserve (HS_3)

Risk Score: 38.00
Conservation Score: 7.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Haig Street Quarry Conservation Reserve (HS_4)

Risk Score: 27.52
Conservation Score: 11.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to

reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Haig Street Quarry Conservation Reserve (HS_5)

Risk Score: 28.00
Conservation Score: 7.00

Management actions required:

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Haig Street Quarry Conservation Reserve (HS_6)

Risk Score: 34.00
Conservation Score: 7.00

Management actions required:

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Hillview Drive Reserve (HD_1)

Risk Score: 25.92
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Hillview Drive Reserve (HD_2)

Risk Score: 19.20
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_1)

Risk Score: 24.00
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.

Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_2)

Risk Score: 19.20
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_3)

Risk Score: 19.20
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_4)

Risk Score: 13.60
Conservation Score: 14.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_5)

Risk Score: 24.00
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Kholo Enviroplan Reserve (CS_6)

Risk Score: 19.20
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to

reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_1)

Risk Score: 15.20
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_10a)

Risk Score: 8.80
Conservation Score: 15.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_10b)

Risk Score: 10.40
Conservation Score: 12.00

Mount Grandchester Conservation Estate (MG_11)

Risk Score: 10.40
Conservation Score: 11.00

Mount Grandchester Conservation Estate (MG_12)

Risk Score: 19.20
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_13)

Risk Score: 12.80
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_14)

Risk Score: 12.80
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_15)

Risk Score: 15.20
Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_16)

Risk Score: 18.00
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_17)

Risk Score: 16.80
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_18)

Risk Score: 13.60
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_19)

Risk Score: 10.40
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_1a)

Risk Score: 15.00
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Mount Grandchester Conservation Estate (MG_2)

Risk Score: 10.40
Conservation Score: 9.80

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_20)

Risk Score: 10.40
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_3a)

Risk Score: 12.00
Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_3b)

Risk Score: 15.20
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Mount Grandchester Conservation Estate (MG_4)

Risk Score: 15.20
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_5a)

Risk Score: 15.20
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_5b)

Risk Score: 13.60
Conservation Score: 12.00

Mount Grandchester Conservation Estate (MG_6)

Risk Score: 12.80
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Mount Grandchester Conservation Estate (MG_7)

Risk Score: 10.40
Conservation Score: 12.00

Mount Grandchester Conservation Estate (MG_8)

Risk Score: 12.00
Conservation Score: 13.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Mount Grandchester Conservation Estate (MG_9)

Risk Score: 12.00
Conservation Score: 14.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_1)

Risk Score: 24.80
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_1a)

Risk Score: 39.00
Conservation Score: 9.10

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Fuel hazard is high within Protection Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

Purga Nature Reserve (PN_2a)

Risk Score: 29.92
Conservation Score: 11.00

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Purga Nature Reserve (PN_2b)

Risk Score: 21.60
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_2c)

Risk Score: 21.60
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_3)

Risk Score: 26.40
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_4)

Risk Score: 15.20
Conservation Score: 8.40

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_5)

Risk Score: 16.00
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_6)

Risk Score: 16.00
Conservation Score: 8.40

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Purga Nature Reserve (PN_7)

Risk Score: 16.00
Conservation Score: 8.40

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

Ric Nattrass Environmental Park (RN_1)

Risk Score: 24.80
Conservation Score: 10.00

Ric Nattrass Environmental Park (RN_2)

Risk Score: 12.80
Conservation Score: 10.00

Ric Nattrass Environmental Park (RN_3)

Risk Score: 20.00
Conservation Score: 10.00

Ric Nattrass Environmental Park (RN_4)

Risk Score: 17.60
Conservation Score: 10.00

Ric Nattrass Environmental Park (RN_5)

Risk Score: 31.00
Conservation Score: 7.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Stirling Road Reserve (SR_1)

Risk Score: 18.40
Conservation Score: 10.00

Stirling Road Reserve (SR_2)

Risk Score: 16.00
Conservation Score: 10.00

Stirling Road Reserve (SR_3)

Risk Score: 15.20
Conservation Score: 13.00

Management actions required:

Vegetation condition is low where ecological assets occur

- Increased monitoring, survey of ecological assets required to determine management actions in the event of declining ecological health.
- Branched actions – requires further detail from VegCond survey (see Table 2)

White Rock - Spring Mountain Conservation Estate (WR_1)

Risk Score: 21.00
Conservation Score: 6.30

Management actions required:

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_10)

Risk Score: 26.00
Conservation Score: 8.40

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_11)

Risk Score: 14.40

Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_12)

Risk Score: 6.40
Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_13)

Risk Score: 19.20
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:

  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary

- Only implement prescribed burn as last resort

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.

- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

White Rock - Spring Mountain Conservation Estate (WR_13a)

Risk Score: 26.00
Conservation Score: 8.40

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_14)

Risk Score: 20.00
Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

White Rock - Spring Mountain Conservation Estate (WR_15)

Risk Score: 21.00
Conservation Score: 8.40

Management actions required:

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_16)

Risk Score: 31.00
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce

hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_17)

Risk Score: 33.00
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

White Rock - Spring Mountain Conservation Estate (WR_18)

Risk Score: 30.00
Conservation Score: 7.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
    - Slashing of surface fuels
    - Use of a forest mulcher to reduce elevated fuels
    - Manual removal of weeds (eg lantana thickets) if necessary

- Only implement prescribed burn as last resort

Fuel hazard is high adjacent to built assets

- Fuel reduction required before next fire season to mitigate risk to life and property.
- Implement mechanical reduction in buffer zone around assets.
- Nominate FMU as high priority for hazard reduction burn.
- Increase monitoring in FMU.

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_19)

Risk Score: 27.00
Conservation Score: 8.40

Management actions required:

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

White Rock - Spring Mountain Conservation Estate (WR_2)

Risk Score: 24.40
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:

- Slashing of surface fuels
- Use of a forest mulcher to reduce elevated fuels
- Manual removal of weeds (eg lantana thickets) if necessary

- Only implement prescribed burn as last resort

Fuel hazard is high within Wildfire Mitigation Zone

- Fuel Hazard exceeds target Fuel Hazard recommendation in Fire Management Strategic Plan.
- Site visit required to assess risk to assets, life and property.
- High priority for fuel reduction works.
- If prescribed burn not achievable, requires mechanical hazard reduction works as soon as practicable to reduce hazard to target levels.

White Rock - Spring Mountain Conservation Estate (WR_20)

Risk Score: 28.00
Conservation Score: 7.70

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where the time since prescribed burns is long

- Assess fire history against TFI to determine the departure from the recommended fire frequency.
- If outside of TFI, nominate FMU as high priority for hazard reduction burn.
- Increased monitoring in FMU.
- May require ground truthing of fuel hazards etc. to determine necessity of planned burn in this FMU in the next fire season.

White Rock - Spring Mountain Conservation Estate (WR_3)

Risk Score: 15.20
Conservation Score: 13.00

Management actions required:

Fuel hazard is high where a wildfire occurred within 1-3 years

- FMU requires increased monitoring to track fuel changes after wildfire.
- May require mechanical control of regrowth and/or low intensity prescribed burn to mitigate elevated fuel hazard.

White Rock - Spring Mountain Conservation Estate (WR_4a)

Risk Score: 17.60
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

Fuel hazard is high adjacent to vulnerable built assets

- Inspection of buffer adjacent assets (100 m) to assess immediate bushfire risk within FMU.
- Consider mechanical reduction of fuels within 100 m of housing stock and/or fire vulnerable and smoke sensitive assets adjacent or within FMU. Including:
  - Slashing of surface fuels
  - Use of a forest mulcher to reduce elevated fuels
  - Manual removal of weeds (eg lantana thickets) if necessary
- Only implement prescribed burn as last resort

White Rock - Spring Mountain Conservation Estate (WR_4b)

Risk Score: 16.00
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_5)

Risk Score: 11.20
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_6)

Risk Score: 8.00
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_7)

Risk Score: 11.20
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

White Rock - Spring Mountain Conservation Estate (WR_8)

Risk Score: 13.60
Conservation Score: 11.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets

Fuel hazard is high where access is difficult

- Inspection of access trails, fire trails and breaks required.
- Review capacity for trail remediation (grading, track widening etc).
- If trail remediation not possible, implement fuel reduction (mechanical or prescribed burning) where possible to reduce hazard in difficult to access areas.

White Rock - Spring Mountain Conservation Estate (WR_9)

Risk Score: 14.40
Conservation Score: 12.00

Management actions required:

Occurrence of Cultural Heritage Assets

- Before implementation of any works within this FMU, review Cultural Heritage Management Plan or similar, and develop site specific action plan for management of Cultural Heritage assets