Coles Bay Reserves Fire Management Plan: Rita and Doris Reserve, Harold Street Reserve

Jon Marsden-Smedley
June 2015

Contents

Figures, Tables and Maps

Cover photo: White kunzea (*Kunzea ambigua*) on granite outcrops in the Rita and Doris Reserve.

Summary of fire management objectives in the Coles Bay Reserves

The areas covered by this fire management plan are the Glamorgan Spring Bay Council managed Rita and Doris, and Harold Street Reserves within the township of Coles Bay. Note that the western third of the Rita and Doris Reserve is Crown Land and that a lease is currently being negotiated subject to a contribution towards the establishment of a fire break.

These reserves have not been burnt for at least 30 years and carry dense vegetation with high to very high fuel hazard levels in close proximity to houses and other assets.

The primary fire management goal in these reserves is reduction in wildfire risk through the application of planned burning. Some adverse ecological impacts to Oyster Bay pine forest may occur as the result of this burning but it is likely that the other rare species recorded in the reserves will be advantaged by the planned burning.

However, the fire management works and planned burning in this plan only form one aspect of reducing the level of fire risk in the Coles Bay township. In order to effectively reduce the level of fire risk, the reduction in the level of fuel hazard on adjacent private property is as, or more important than, fuel management in the council reserves and Parks and Wildlife Service managed land surrounding the Coles Bay township.

In most years, effective and safe planned burning can be conducted at Coles Bay between the months of June and August, with April to May, and September to October also being potentially suitable. In general, planned burning in April and May carries the possibility of heavy fuels being very dry following summer. During June to August, short day lengths results in fires typically only spreading during the mid-afternoon (although fires may continue to burn as very low intensity fires at other times of the day). Planned burning in September and October carries the risk of fires still continuing to smoulder in heavy fuels and the possibility of windy weather leading into summer reigniting the fires. This means that the optimal burning window in the Coles Bay reserves is between June and August.

In order to assist with the planned burning covered by this plan and to assist with the management of wildfires, it is recommended that the fire breaks surrounding the reserves be improved. In the Harold Street Reserve, the vegetation along Brooker Street should be cleared back to make a 6 to 8 m wide fire break. In the Rita and Doris Reserve, the construction of a 4 to 6 m wide and 125 m long fire break along the reserve's southwestern boundary along with cleaning up the reserve's northern and eastern boundary is required.

A total of five planned burning blocks have been mapped in the Rita and Doris and Harold Street Reserves. At the current time, these blocks are mostly carrying high to very high levels of fuel hazard. When planned burning is performed, the aim will be reduce the level of overall fuel hazard over at least 70% of each block to no more than moderate. The weather conditions and ignition strategy for conducting these planned burns along with the post-burn mop-up, patrol and monitoring required have been detailed in this plan.

The structure of the vegetation strongly indicates that there has been a marked reduction in the incidence of fire in the reserves over the past several decades. All of the rare species recorded in the reserves are likely to be advantaged by the planned burning. However, it is likely that the planned burning will result in reductions to the area and/or dominance of Oyster Bay pine forest in the reserves. It is strongly recommended that post-burning weed survey and control works be performed. As a result, with the exception of Oyster Bay pine forest, it is highly unlikely that the planned burning proposed in this plan will cause unacceptable ecological outcomes.

Introduction

The areas covered by this fire management plan are the Glamorgan Spring Bay Council managed Rita and Doris, and Harold Street Reserves within the township of Coles Bay. Note that the western third of the Rita and Doris Reserve is Crown Land which Council currently does not have a lease or license over.

These reserves have not been burnt for at least 30 years and carry dense vegetation with high to very high levels of fuel hazard in close proximity to houses and other assets. Therefore, the overall aims of this fire management plan are to perform fire management planning and works with the primary aim being to reduce the level of fire risk and a secondary aim being the management of the reserve's ecological values.

Fire is a fundamental aspect of the Australian environment.

As such, fire should not be regarded as unnatural or catastrophic, but rather as a recurring event that influences the nature of the Australian landscape and the adaptations of its flora and fauna. Many Australian plants require periodic fire to maintain ecological values and many Australian animals utilise a wide range of fire ages for food resources and shelter.

But, not all fires are desirable. Fires may occur under conditions that threaten human life and property, be too frequent or intense, cause temporary reductions to air quality and/or disruptions to the public. However, the application of fire offers enormous potential as a land management tool, with planned burning being one of a range of practices available to land managers for vegetation management.

Fire typically occurs in different vegetation types at different intervals, seasons and intensities. Australian plants and animals (ie Australia's biodiversity) are adapted to particular fire regimes (Gill 2008). If fire regimes occur outside the domain to which they are adapted (eg fires that are too frequent or too infrequent, too intense or not intense enough), reductions in biodiversity and possibly, local extinction may occur.

In contemporary landscapes, there are social and economic assets as well as environmental assets that need to be taken into account. These assets may be sensitive to fires, particularly high intensity fires.

In areas primarily burnt by wildfires, most of the area that gets burnt is burnt by fast moving, high to extreme intensity fires. This is due to most areas being burnt by fast moving fires. Fire management planning can be used to address this issue with planned burning being one of the tools that could be used.

The systems used and effectiveness of planned burning in Tasmania and South Australia have been reviewed in detail by Marsden-Smedley (2009[1], 2011[2]). This

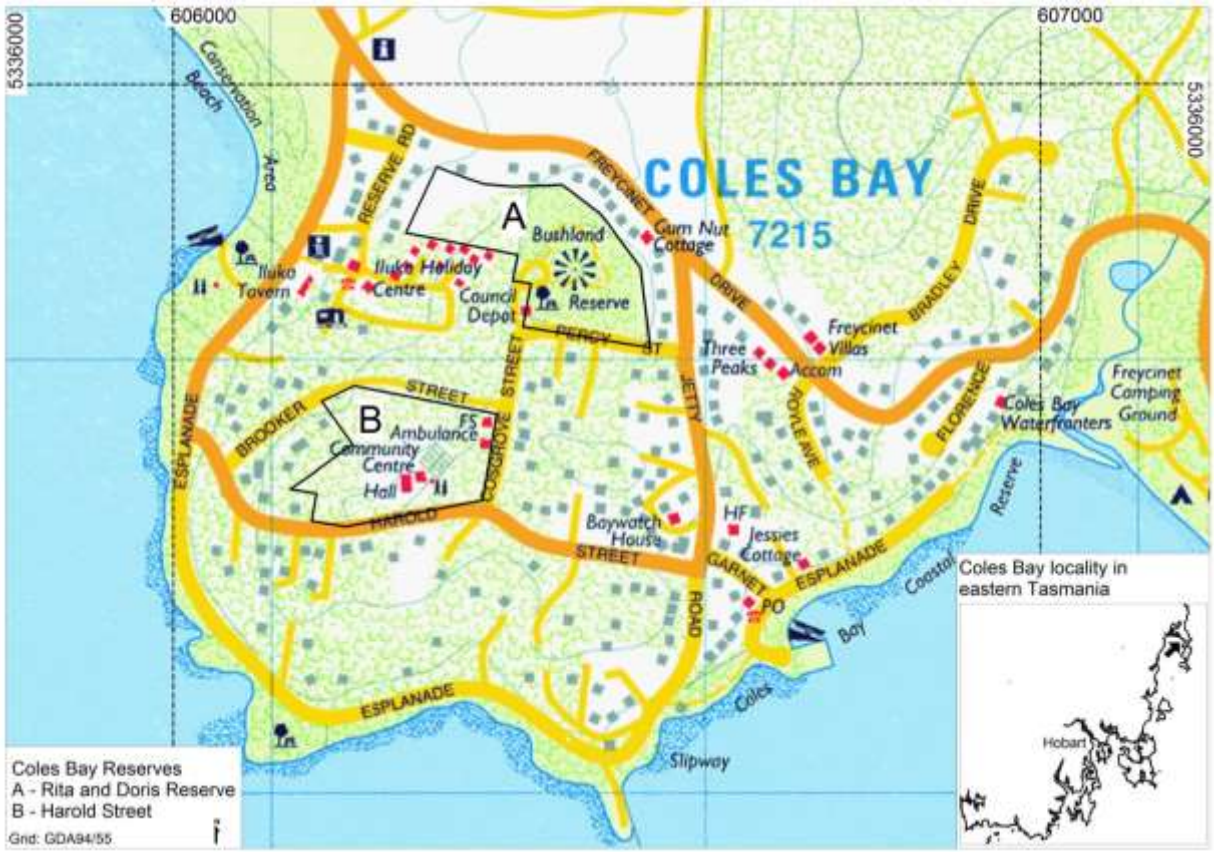
[1] Marsden-Smedley JB 2009. Planned burning in Tasmania: operational guidelines and review of current knowledge. Fire Management Section, Parks and Wildlife Service, Department of Primary Industries, Parks, Water and the Environment, Hobart, Tasmania. Available from: http://www.parks.tas.gov.au/index.aspx?base=15944

[2] Marsden-Smedley JB 2011. Prescribed burning in South Australia: review of operational prescriptions. Department of Environment and Natural Resources, Adelaide, South Australia. Available from: http://www.environment.sa.gov.au/firemanagement/Burns_and_Bushfires/Burning_prescriptions_for_South_Australia.

information has been simplified and updated in the Planned Burning Manual which was developed for the Red Hot Tips program (Marsden-Smedley and Sherriff 2014[3]).

Area covered and plan objectives

The Rita and Doris, and Harold Street Reserve are shown on Map 1.



Map 1. Location of the Rita and Doris, and Harold Street Reserves in Coles Bay.

These reserves comprise native vegetation dominated by dry eucalypt forest, Oyster Bay pine forest and tall heathland. The vegetation types present, including rare and threatened species and weeds have been reviewed in the council's vegetation plan (GSBC 2014[4]).

The primary fire management goal in these reserves is wildfire risk reduction. Hence, some adverse ecological impacts will be an acceptable outcome of the planned burning in these reserves. However, as far as is practical, these adverse ecological impacts will be minimised by careful design and implementation of the planned burning and with direct works to protect rare and/or threatened species, and Oyster Bay pines (Figure 1).

It also needs to be stated that the fire management works and planned burning in this plan should only form one aspect of reducing the level of fire risk in the Coles Bay township. In order to effectively reduce the level of fire risk, the reduction in the level of

[3] Marsden-Smedley JB and Sherriff LJ 2014. Planned burning manual - guidelines to enable safe and effective planned burning on private land. NRM North, Launceston Tasmania. Updated manual available from: http://www.macquariefranklin.com.au/red-hot-tips.html.

[4] GSBC 2014. Glamorgan Spring Bay Coles Bay Reserves: Native Flora and Fauna Management Plan 2014-2019.

fuel hazard on adjacent private property (eg see Figure 2) is as or more important than fuel management in the adjacent council reserves or on Parks and Wildlife Service managed land surrounding the Coles Bay township.

Information on private land vegetation management for wildfire mitigation can be obtained from the information sheet on building in bushfire prone areas put out by the Tasmania Fire Service[5].

Figure 1. Dense Oyster Bay pine regeneration in the Rita and Doris Reserve.

[5] TFS 2013. Building for bushfire: Planning and Building in Bushfire-Prone Areas for Owners and Builders. Available from: http://www.fire.tas.gov.au/userfiles/tym/file/131392_Building_for_Bushfires_web.pdf.

Figure 2. Fuel hazards on private land adjacent to the Rita and Doris Reserve.

Weather data

The nearest Bureau of Meteorology (BoM) Automatic Weather Station (AWS) is located at Friendly Beaches, about 13 km north of the Coles Bay township.

Data for temperature, dew point temperature, relative humidity and wind speed, recorded at 30 minute intervals by the Friendly Beaches AWS are available from the BoM website[6]. The average monthly data for rainfall (mm), daily maximum temperature and relative humidity at 15:00 hours recorded at the Friendly Beaches AWS are shown in Figure 3. Data for average monthly wind speed and direction are shown in Figure 4.

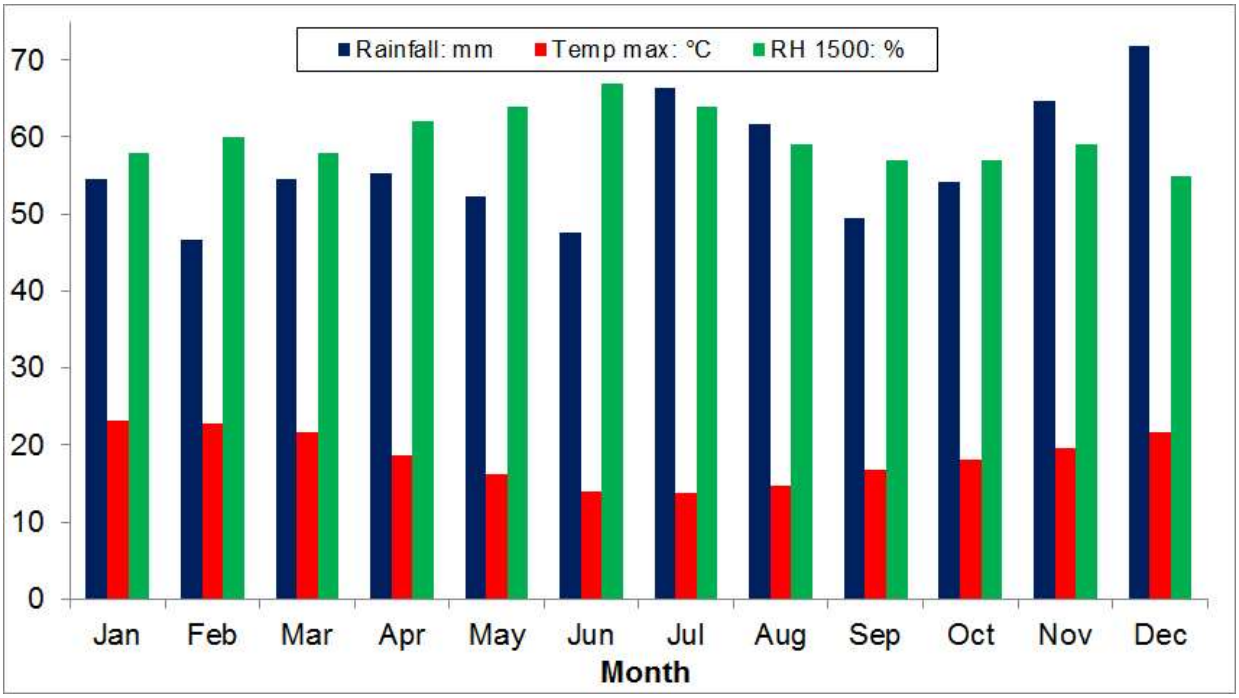


Figure 3. Average monthly rainfall, maximum temperature and 15:00 relative humidity recorded at the Bureau of Meteorology Friendly Beaches Automatic Weather Station.

In most years, effective and safe planned burning can be conducted at Coles Bay between the months of June and August (ie winter), with April to May, and September to October also being potentially suitable. This means that there is a broad window when planned burning can be conducted. Performing planned burning in winter also has the advantage that lower levels of resources are required to perform the burns.

In general, planned burning in April and May carries the possibility of heavy fuels not having wet up following summer and hence being dry enough to burn. During June to August, short day lengths results in fires typically only spreading during the mid-afternoon (although fires may continue to burn as very low intensity fires at other times of the day). Planned burning in September and October carries the risk of fires still continuing to smoulder in heavy fuels and the possibility of windy weather leading into summer reigniting the fires.

This means that the optimal burning window in the Coles Bay reserves is between June and August.

[6] BoM 2014. Friendly Beaches AWS data: http://reg.bom.gov.au/products/IDT60801/IDT60801.94987.shtml

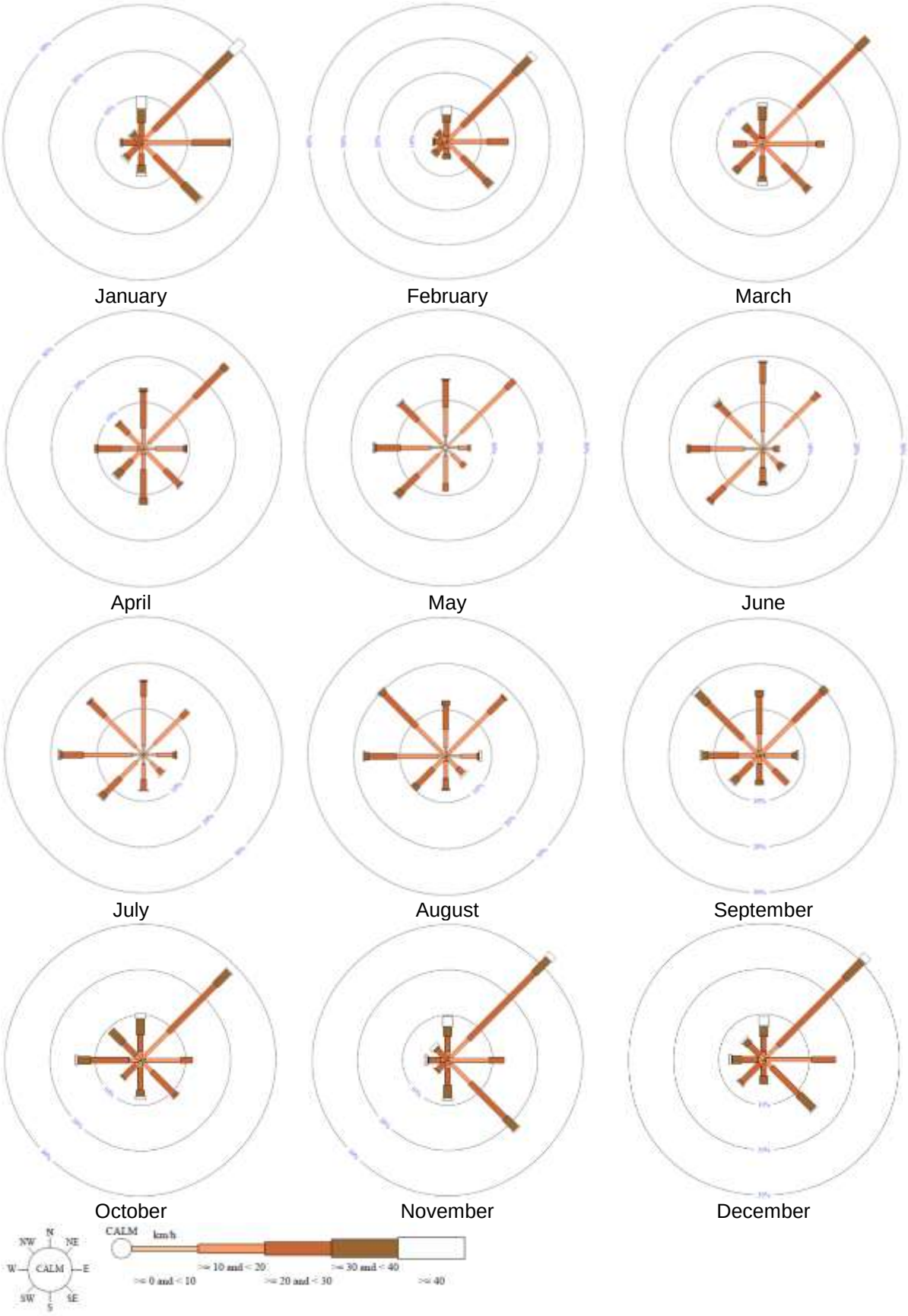


Figure 4. Average monthly wind speed at 15:00 hours recorded at the Bureau of Meteorology Friendly Beaches Automatic Weather Station.

Communication

Prior to performing planned burning in these reserves it is recommended that the Coles Bay community be informed of the works being planned and be provided with advice as to how they can reduce their own wildfire risk.

As a result, it is recommended that the Glamorgan Spring Bay Council send letters out to all neighbouring rate payers informing them of the planned burn as well as putting information in the local papers and through social media. This notification process could potentially be performed in conjunction with the Tasmania Fire Services' Bushfire Ready Neighbourhood program[7].

Wildfire risk in the Coles Bay Reserves

A critical issue that must be considered in any fire risk assessment is the location of fuel hazards relative to the location of assets. The Parks and Wildlife Service has conducted a state-wide assessment of wildfire risk using the Bushfire Risk Assessment Model (BRAM)[8]. This fire risk assessment indicated that the Rita and Doris, and Harold Street Reserves were of high risk. The BRAM also indicated that the bushland surrounding the Coles Bay township (mostly managed by the Parks and Wildlife Service) was of significant to high risk.

In this area, the greatest risk factors are associated with fuel hazards immediately adjacent to assets (eg houses, critical infrastructure such as council facilities and/or communication towers). A significant proportion of these fuel hazards are located on private land. This means that, if the reserves covered by this plan and vegetation on Parks and Wildlife Service (PWS) managed land adjacent to the Coles Bay township were fully fuel treated, then in the absence of fuel management also being performed on private land there will be the maintenance of substantial levels of residual risk.

This also means that, the fire management actions and planned burning associated with this plan should only form one aspect of reducing the level of wildfire risk to the Coles Bay township and that it is essential that an integrated program of reducing the level of fire risk on private land, fuel management in the council reserves and PWS managed land surrounding the township be performed. It is also recommended that the TFS commence a Bush Fire Ready program in the Coles Bay township to help facilitate these reductions in fire risk.

The aim of performing risk assessments is to provide a structured, and repeatable methodology for addressing risk related issues. This allows the relative risk levels of different actions to be assessed and, in doing so, allows for the minimising of the risk of adverse impacts whilst maximising the probability of achieving targeted outcomes. This means that the factors which have the greatest influence on fire risk can be quantified and balanced assessments made which maximise the opportunities to complete successful fire management, whilst minimising the risk of adverse outcomes.

[7] TFS 2015. www.bushfirereadyneighbourhoods.tas.gov.au.

[8] SFMC 2014a. East Coast Fire Management Area Fire Protection Plan. Executive Summary. State Fire Management Council, Hobart, Tasmania.
See also: SFMC 2014b. Bushfire in Tasmania: a new approach to reducing our Statewide relative risk. State Fire Management Council, Hobart, Tasmania.

The issues associated with fire risk assessment in a Tasmanian context have been reviewed by Marsden-Smedley and Whight (2011[9]).

The major advantage of standardised risk assessment systems is their ability to provide a consistent and repeatable framework within which the risk assessment can be performed. These systems also clarify the compromises and trade-offs (including the do-nothing option) that have to be made when performing operational land management. The major disadvantages of risk assessment systems is that they may, if they have not been designed properly, contain errors in the way they estimate risk, and may hide or make unclear the factors controlling risk level.

The risk assessment used in this fire management plan has been based on the Australian and New Zealand risk management standard (AS/NZS 2009[10]). This system defines risk as the likelihood that an event will occur multiplied by its consequence. For example, if an event is rated as being almost certain to occur but a moderate probability of causing adverse consequences, it will be rated as a significant risk. Alternatively, even if an event is rated as being practically impossible to occur but has a catastrophic consequence if it did occur, it would be rated as high risk. The risk assessment matrix used in this fire management strategy is in Table 1.

Table 1. Risk matrix used to guide this risk assessment.

		Likelihood					
Consequences		1 Practically impossible	2 Conceivable	3 Remotely possible	4 Unusual but possible	5 Quite possible	6 Almost certain
1	Moderate	Noticeable	Low	Low	Low	Moderate	Significant
2	Important	Low	Low	Moderate	Moderate	Significant	High
3	Serious	Low	Moderate	Significant	High	High	High
4	Very serious	Moderate	Significant	High	High	Extreme	Extreme
5	Disaster	Significant	High	High	Extreme	Extreme	Extreme
6	Catastrophic	High	High	Extreme	Extreme	Extreme	Extreme

Derived from Australian and New Zealand risk management standard AS/NZS 2009.

The major risk factors associated with wildfires in the area covered by this fire management strategy are reviewed in Table 2a. Due to the location of the reserves within the township of Coles Bay, the major wildfire risks are associated with wildfires spotting into the reserves from PWS managed land and/or a fire starting at houses adjacent to the reserves and threatening other properties in the town. Such a fire could be the result of arson, escaped fires from the Swanwick area, accidents and/or dry lightning. These risk factors could be managed by PWS planned burning the blocks immediately north and east of the Coles Bay township and by reducing the level of fuel hazard within the reserves and on private land in the township of Coles Bay.

The major risk factors associated with the planned burning covered by this fire management strategy are reviewed in Table 2b. These risks could be greatly reduced by performing the initial planned burns detailed in this plan in winter (due to the current high to very high levels of fuel hazard, see Table 4) and then programming subsequent planned burns prior to the level of fuel hazard reaching high.

[9] Marsden-Smedley JB and Whight S 2011. Planned burning in Tasmania II: fire risk assessment and the development of a standardised Burn Risk Assessment Tool (BRAT). TasForests 19:109-121.

[10] AS/NZS 2009. Australian and New Zealand Standard: AS/NZS ISO 31000, Risk management – Principles and guidelines. Standards Australia, Sydney, Australia and Standards New Zealand, Wellington, New Zealand.

In addition, in Table 2c, the risks associated with wildfires impacting on the Coles Bay township have been assessed assuming that both the PWS planned burning blocks adjacent to Coles Bay and the reserves covered by this plan have been planned burnt.

As can be seen in Table 2a, the risks associated with wildfires are primarily a consequence of the prevailing level of fire danger rather than the ignition type. Table 2c also indicates that if an integrated fire management program is implemented then there should be a marked reduction in the level of fire risk in the Coles Bay township.

Table 2. Fire risk factors reviewed in this fire management strategy.

Table 2a: Risks associated with wildfires	Likelihood	Consequence	Risk rating
Arson along the Coles Bay Road at low to high fire danger	4	2	Moderate
Arson along the Coles Bay Road at very high to catastrophic fire danger	4	5	Extreme
Escaped fires from Coles Bay township at low to moderate fire danger	4	2	High
Escaped fires from Coles Bay township at high fire danger	4	2	Very high
Escaped fires from Coles Bay township at very high to catastrophic fire danger	4	5	Extreme
Escaped fires from Swanwick at low to moderate fire danger	4	2	Moderate
Escaped fires from Swanwick at high fire danger	4	2	High
Escaped fires from Swanwick at very high to catastrophic fire danger	4	5	Extreme
Dry lightning in areas north of Coles Bay at low to high fire danger	5	1	Moderate
Dry lightning in areas north of Coles Bay at very high to catastrophic fire danger	5	2	Extreme
Table 2b: Risks associated with planned burning	**Likelihood**	**Consequence**	**Risk rating**
Fire escapes from PWS burns within 2 km of Coles Bay	4	1	Low
Fire escapes from planned burns in the reserves covered by this plan	4	2	Moderate
Table 2c: Risks associated with wildfires assuming that PWS managed blocks adjacent to Coles Bay and the reserves covered by this plan have been planned burnt	Likelihood	Consequence	Risk rating
Arson along the Coles Bay Road at low to high fire danger	4	2	Low
Arson along the Coles Bay Road at very high to catastrophic fire danger	4	4	High
Escaped fires from Coles Bay township at low to moderate fire danger	4	2	Low
Escaped fires from Coles Bay township at moderate fire danger	4	2	Low
Escaped fires from Coles Bay township at very high to catastrophic fire danger	4	5	Very high
Escaped fires from Swanwick at low to moderate fire danger	4	2	Low
Escaped fires from Swanwick at moderate fire danger	4	2	Low
Escaped fires from Swanwick at very high to catastrophic fire danger	4	5	High
Dry lightning in areas north of Coles Bay at low to high fire danger	5	2	Low
Dry lightning in areas north of Coles Bay at very high to catastrophic fire danger	5	4	High

Note: likelihood and consequence numbers from Table 1.

Smoke management

At the current time, the smoke management guidelines currently utilised in Tasmania are only binding on the forest industry and the PWS.

The Tasmanian smoke management system (FPA 2009[11], 2011[12]) has been developed by the Forest Practices Authority in conjunction with the Tasmanian Environmental Protection Agency (EPA) and covers planned burning for vegetation regeneration (including forest regeneration), hazard reduction and ecological management. The aim of the smoke management guidelines is to reduce the risk of

[11] FPA 2009. Forest Industry Standard for Prescribed Silvicultural Burning Practice: 2009. Forest Practices Authority, Hobart, Tasmania. See: http://www.fpa.tas.gov.au/__data/assets/pdf_file/0017/58112/Forest_Industry_Standard_for_prescribed_silvicultural_burning_practice_2009.pdf

[12] FPA 2011. Smoke management from planned burns. Forest Practices Authority, Hobart, Tasmania. See: http://www.fpa.tas.gov.au/__data/assets/pdf_file/0018/58113/Smoke_management_from_planned_burns_leaflet_2011.pdf.

smoke pollution to populated centres through improvements to the planning and conduct of planned burns.

The smoke management guidelines are based on the capacity of the atmosphere to absorb a certain amount of smoke before exceeding prescribed limits. This capacity varies with the atmospheric conditions, wind direction and plume dispersal. The guidelines require the number and amount of smoke produced by planned burns to be coordinated in order to minimise the risk of high concentrations of smoke within individual airsheds, using data and models developed by the Bureau of Meteorology.

The smoke management system classifies fuels as heavy, light or very light. Heavy fuel means wet forest residues, windrows and heaps, light fuel means dry forest residues, plantation residues or any comparable equivalent while very light fuel means unlogged dry forest fuel, stubble, grass or buttongrass.

As any of the planned fuel reduction work in the Coles Bay Council reserves will only be of a small scale the guidelines are not applicable nor binding on local government. Council will ensure that as a part of the communication undertaken prior to any fuel reduction work that local residents are informed that there will be increased smoke within the immediate township for a period and if they are sensitive to this in any way to take the necessary precautions such as staying inside.

Fire management works

In order to assist with the planned burning covered by this plan and with the management of wildfires, it is recommended that the fire breaks surrounding the reserves be improved.

In the Harold Street Reserve (Map 2), the vegetation along Brooker Street on the northern boundary of the reserve should be cleared back to make a 6 to 8 m wide break. This vegetation should be cleared from the northern side of Brooker Street. No rare and/or threatened species have been recorded from within this zone.

In the Rita and Doris Reserve, this will require the construction of a 4 to 6 m wide and about 125 m long fire break along the reserve's southwestern boundary between the back of 9 Reserve Road and the loop road at the top of the hill (Map 3). This section of the reserve's boundary currently carries extreme levels of fuel hazard in very close proximity to adjacent properties (Figure 6). It is also recommended that the fire break along the reserve's northern and eastern boundary between 5 Reserve Road and Percy Street be cleaned up on its northern, northeastern and eastern side (ie adjacent to the private properties, see Figure 7). There are no rare and/or threatened species recorded from within these areas.

Figure 5. Blue Gum (*Eucalyptus globulus*) in the Rita and Doris Reserve.

Figure 6. Extreme levels of fuel hazard on the southwest boundary of the Rita and Doris Reserve. Note Iluka rental cabin adjacent to reserve boundary in background.

Figure 7. Fire break on the eastern boundary of the Rita and Doris Reserve.

Planned burning in the Coles Bay Reserves

Planned burning forms for conducting the burning detailed in this plan are in Appendices 1 to 5 of this plan.

Background information on weather, fuel hazard and fire behaviour is in Appendix 6 of this plan while a review of Tasmanian legislation relevant to planned burning and wildfire control is in Appendix 7.

During all of the planned burns outlined in this plan, the Glamorgan Spring Bay Council will be responsible for the burns, with the TFS acting as an agent to the council.

Planned burning procedure

The overall aim of this fire management plan is to perform fire management planning and works in the Rita and Doris, and Harold Street Reserves in the Coles Bay township. This means that the primary aim will be to reduce the level of fire risk and the secondary aim will be to manage the reserve's ecological values.

When planned burns are conducted in the burning blocks in the reserves covered by this plan, the primary aims will be to perform the burning safely without having the fire's escape from the mapped burning blocks. During the planned burns, the safety zone will be located at the TFS shed at the junction of Cosgrove and Brooker Streets.

This means that in the weeks to months prior to a burn proceeding, the planned burn forms detailed in Appendices 1 to 5 of this plan will be reviewed to ensure that the forms are still current and that no changes are required.

It is recommended that in the month prior to the planned burn that signs be put up at the reserve's major entry points. In addition, as noted above, it is recommended that the Glamorgan Spring Bay Council send letters out to all neighbouring rate payers informing them of the planned burn as well as using other communication outlets such as local newsletters and social media.

In the week leading up to the burn, the weather will need to be monitored. The aim of this monitoring is to ensure that the conditions on the day of the burn and subsequent days are suitable, and that the forecast is stable and reliable. The suggested methodology for doing this monitoring is detailed in the Red Hot Tips *Weather and planned burning guide* available at the Macquarie Franklin website[13].

On the day of the burn, all personnel conducting the burn will need to be trained and accredited by the TFS and be wearing suitable clothing (see Section 3.7.1 in Marsden-Smedley and Sherriff 2014).

The recommended strategy for lighting the planned burn is summarised in Section 3.9 in Marsden-Smedley and Sherriff (2014).

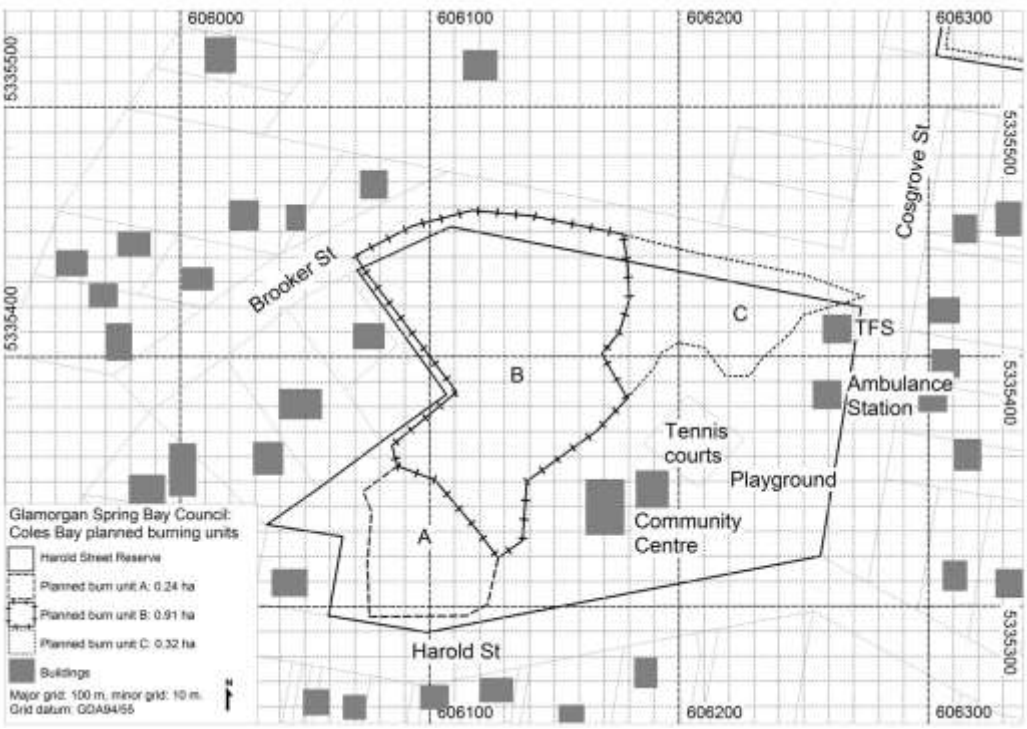
Following the planned burn, the block will need to be monitored and any burning material extinguished (see Section 4 in Marsden-Smedley and Sherriff 2014).

[13] MF 2014. Red Hot Tips weather and planned burning guide: http://www.macquariefranklin.com.au/red-hot-tips.html

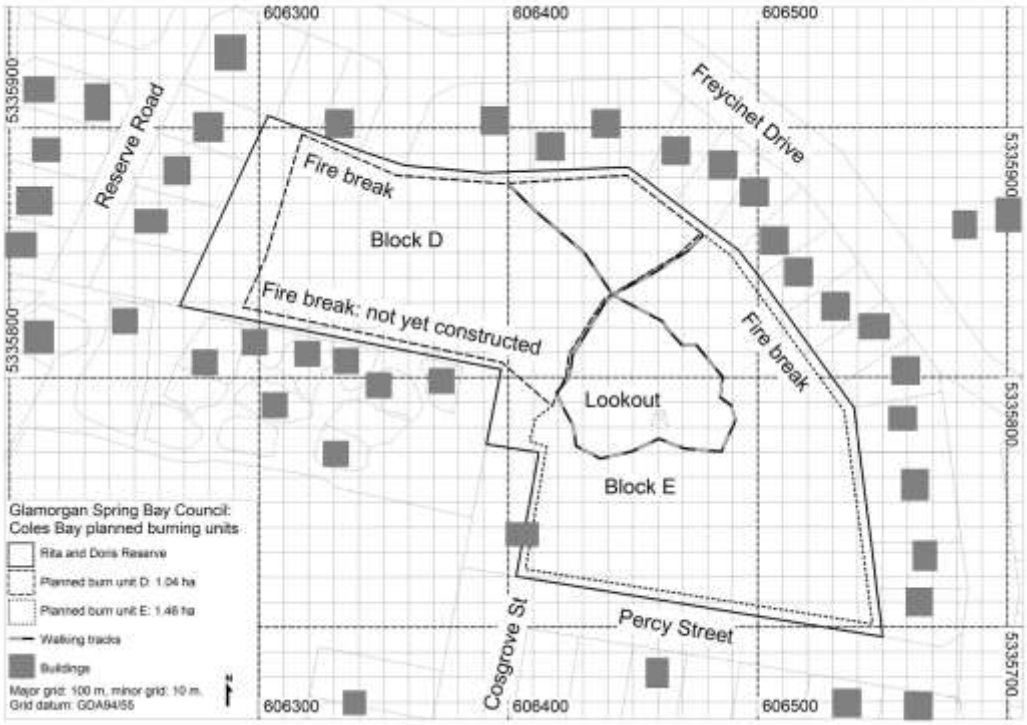
Planned burning blocks

A total of five planned burning blocks have been mapped in the Rita and Doris and Harold Street Reserves (Maps 2 and 3) with detailed maps of the blocks being in the Planned Burning Forms in Appendices 1 to 5.

The sizes and perimeters of the proposed burning blocks are shown in Table 3.



Map 2. Harold Street Reserve planned burning blocks.



Map 3. Rita and Doris Reserve planned burning blocks.

Table 3. Sizes and perimeters of the Rita and Doris, and Harold Street Reserves.

	Harold Street Reserve	
	Area	Perimeter
Block	ha	m
A	0.24	190
B	0.91	440
C	0.32	295
whole reserve	2.55	723

	Rita and Doris Reserve	
	Area	Perimeter
Block	ha	m
D	1.04	465
E	1.46	490
whole reserve	2.97	840

Fuel hazard rating

The level of fuel hazard in the reserves has been assessed using the Victorian Fuel Hazard Guide (Hines et al. 2010[14]). Additional information on the assessment of fuel hazard is in Appendix 6. The current (October 2014) levels of fuel hazard rating and fuel load in the reserves are shown in Table 4.

Table 4. Fuel hazard ratings and fuel loads in the Rita and Doris, and Harold Street Reserves.

		Fuel hazard rating					Fuel load
Reserve		Surface	Near-surface	Elevated	Bark	Overall	t/ha
Harold Street Reserve	A	M	M to H	M to H	M	M	13.0
	B	M	H	H	M	H	14.0
	C	M to H	M to H	H	M	H	15.5
	whole reserve	M to H	M to H	H	M	H	15.5
Rita and Doris Reserve	D	H to VH	H to VH	M to H	M to H	H to VH	21.0
	E	H to VH	H to VH	H	H	H to VH	22.0
	whole reserve	H to VH	H to VH	M to H	M to H	VH	21.0

When planned burning is performed, the aim will be reduce the level of overall fuel hazard over at least 70% of each block to no more than moderate. In order to keep the level of fuel hazard in the reserves at these levels, it is anticipated that the application of planned burning will be required at about eight to ten year intervals. However, by staggering the burning of the different blocks it should be possible to increase the time interval between burns in individual blocks to between about ten and 15 years.

Weather conditions for planned burning

The guidelines for planned burning in this fire management plan have been based on the guidelines for planned burning in Marsden-Smedley (2009) with the addition of fuel hazard rating. The advantage of incorporating fuel hazard rating explicitly into the planned burning guidelines is that it insures that when burns are conducted with high, very high or extreme levels of fuel hazard, that the level of the other factors are reduced (eg lower wind speed, higher relative humidity and/or lower temperature). Conversely, when burns are conducted with low or moderate levels of fuel hazard, the level of the other factors may be increased (eg higher wind speed, lower relative humidity and/or higher temperature). The guidelines for conducting planned burning in the Coles Bay reserves in Table 5. have been structured around four sections:

- seasonal conditions;
- conditions leading up to the day of the burn;
- conditions during the day of the burn, and;
- the conditions following the burn.

[14] Hines F, Tolhurst KG, Wilson AAG and McCarthy GJ 2010. Overall fuel-hazard guide. 4th edition, Report 82, Fire Management Branch, Department of Sustainability and Environment, Melbourne, Victoria.

Table 5. Planned burning guidelines.

Seasonal conditions				
Optimal season: June to August				
Shoulder season: April to May, or September to October				
Conditions in the two days preceding the day of the burn				
Relative humidity	%			<70
Temperature	º C			>10
Precipitation	mm			<0.2 mm per day
Cloud cover	%			<25
C-Haines Index	dimensionless			≤8
Forest Fire Danger Index	dimensionless			≤20
Conditions during the planned burn				
		Overall fuel hazard rating		
	Units	L or M	H	VH or E
Wind speed at 10 m	km/h	15 to 30	10 to 20	5 to 10
Relative humidity	%	40 to 60	45 to 70	50 to 80
Temperature	ºC	15 to 25	10 to 20	10 to 20
C-HainesIndex	dimensionless	≤5	≤5	≤5
Forest Fire Danger Index	dimensionless	5 to 10	0 to 10	≤5
Conditions following the day of the burn				
No strong winds forecast within 48 hours or before ≥1 mm of rain is forecast				

Performing planned burning in the Coles Bay Reserves

The prevailing conditions when planned burns are conducted will need to drive the lighting strategy, the time of day that burns are lit, the fire control boundaries utilised and whether smoke management will be an issue.

Prior to lighting each of the burns, the block needs to be comprehensively checked to ensure that no members of the public are within the area planned to be burnt.

During all of the planned burns performed in these reserves, the safety zone will be located at the TFS fire shed at the corner of Cosgrove and Brooker Streets.

In general, the downwind boundaries of the block being burnt will need to be reinforced by burning before the rest of the block is burnt. The ignition strategy utilised (eg head, flank or back fire ignition, spot versus line ignition) will need to be determined on the day according to the characteristics of the block being burnt and prevailing weather conditions.

Post-burn mop-up and patrol

Prior to fire crews leaving the fireground, all burning material adjacent to the block's boundaries should be inspected and if necessary, extinguished. The block should also be inspected by at least two people at ~21:00. The block should be inspected again at ~09:00 and ~15:00 on following day. The block should then be checked at ~15:00 on each of the next two days and then again on the next windy day (>30 km/hr) unless >10 mm of rain has fallen.

All burning logs, stumps and duff within 30 m of the block's boundaries should be extinguished. In the smaller blocks (ie Harold Street Reserve blocks A and C) this means that the entire block will be checked for burning material.

Post-burn monitoring

It is strongly recommended that the accumulation of fuel hazard following burns be monitored and that subsequent burns be scheduled once the block's overall fuel hazard ratings reach an average of high.

Biodiversity

Species and community diversity

The structure the vegetation in both of the Rita and Doris, and Harold Street Reserves strongly suggests that there has been a marked reduction in the incidence of fire over the past several decades. This reduction in fire frequency can be seen in the spreading structure of the large old trees (some of which are in poor health) and the dense regrowth of younger tree and heath species (eg see Figures 1, 5, 6, 8, 9, 11 and 12).

This means that it is highly probable that the use of planned burning in these reserves will result in increases in the species and structural diversity.

Rare and threatened species

Three rare plant species listed under the Tasmanian *Threatened Species Protection Act 1995* (see Appendix 7) have been recorded in the Rita and Doris, and Harold Street Reserves (GSBC 2013):

- *Brachyloma depressum* Spreading heath;
- *Spyridium vexilliferum* var. *vexilliferum* Helicopter bush, and;
- *Zieria littoralis* Dwarf zieria.

The characteristics of these species have been summarised in Department of Primary Industries, Parks, Water and the Environment (DPIPWE) threatened species note sheets[15].

The characteristics of two of these species, Spreading heath and Helicopter bush, strongly suggest that the planned burning proposed in this plan is likely to result in positive outcomes. Although the fire dynamics of Spreading heath are poorly known, the species is reported to mainly occur in heathland on granite which is at marked odds with its occurrence as a low understorey heath in closed dry forest in the reserves. As regards Helicopter bush (Figure 10), it's DPIPWE threatened species note sheet indicates that it requires frequent fire (ie <5 to 6 years between fires) and is advantaged by disturbance. The third rare species recorded from the reserves, Dwarf zieria, has been observed to vegetatively resprout following fire and so should be relatively resistant to burning.

Rare and threatened community types

Approximately a quarter of the area of the reserves is dominated by Oyster Bay pine forest (TasVeg type NCR). Although this species regenerates well following fire, its requirement for seed regeneration and the time taken to set seed means that it is sensitive to short inter-fire intervals (<15 years between fires). This means that, due to the primary management aim in the reserves being risk mitigation (and hence the requirement for relatively short inter-fire intervals), it is probable that after two or three planned burns, that there will be a reduction in the cover and dominance of Oyster Bay pine in the reserves. However, the impacts on Oyster Bay pines can be, at least partly,

[15] Threatened species note sheets available from the DPIPWE website:
Brachyloma depressum http://dpipwe.tas.gov.au/Documents/Brachyloma-depressum.pdf
Spyridium vexilliferum http://dpipwe.tas.gov.au/Documents/Spyridium-vexilliferum-var-vexilliferum-notesheet.pdf
Zieria littoralis http://dpipwe.tas.gov.au/Documents/Zieria-littoralis.pdf

off-set by breaking the reserves into smaller burning blocks and as far as is practical, minimising fire intensity in the vicinity of mature Oyster Bay pines and performing planned burning at ten to 15 year intervals. The impacts to Oyster Bay pines could also be reduced by minimising the intensity of planned burns in the vicinity of mature pines by wetting down the pines, raking litter away from the tree's trunks and/or doing the initial light-up of the planned burns immediate adjacent to the pines and allowing the fires to burn away from the pines.

However, it is also probable that the reduction in cover and dominance by Oyster Bay pine in the reserves will be offset by an increase in species and structural diversity (particularly of small species such as orchids, herbs and forbs) due to the planned burning opening up the reserve's mostly dense vegetation resulting from the previous long inter-fire intervals.

Post-fire weed management

The weeds recorded in the reserves have been detailed in GSBC (2013). Several of these weeds species have the potential to increase their cover and abundance following fire. However, the more open conditions post-burning will allow for quick and effective surveying and control.

As a result, it is recommended that the Council schedule weed survey and control works following the burns. The Council should also consider co-ordinating this work with local volunteer groups who could perform the majority of the work.

Figure 8. Heathland on rock plates in the Rita and Doris Reserve, looking down towards Muirs Beach.

Figure 9. Dense Bull oak regrowth in the Harold Street Reserve.

Figure 10. Helicopter bush (*Spyridium vexilliferum* var. *vexilliferum*) on the boundary of Block A in the Harold Street Reserve.

Figure 11. Black peppermint dry forest in the Rita and Doris Reserve.

Figure 12. Black peppermint, Bull oak and Oyster Bay pine open dry forest on the top of the hill in the Rita and Doris Reserve.
Note open structure of vegetation and low to moderate levels of fuel hazard.

References

AS/NZS 2009. Australian and New Zealand Standard: AS/NZS ISO 31000, Risk management – Principles and guidelines. Standards Australia, Sydney, Australia and Standards New Zealand, Wellington, New Zealand.

BoM 2014. Friendly Beaches Automatic Weather Station Weather data. http://reg.bom.gov.au/products/IDT60801/IDT60801.94987.shtml.

DPIPWE 2014. Threatened species note sheets:
Brachyloma depressum http://dpipwe.tas.gov.au/Documents/Brachyloma-depressum.pdf.
Spyridium vexilliferum http://dpipwe.tas.gov.au/Documents/Spyridium-vexilliferum-var-vexilliferum-notesheet.pdf.
Zieria littoralis http://dpipwe.tas.gov.au/Documents/Zieria-littoralis.pdf.

GSBC 2014. Glamorgan Spring Bay Coles Bay Reserves: Native Flora and Fauna Management Plan 2014-2019.

FPA 2009. Forest Industry Standard for Prescribed Silvicultural Burning Practice: 2009. Forest Practices Authority, Hobart, Tasmania. http://www.fpa.tas.gov.au/__data/assets/pdf_file/0017/58112/Forest_Industry_Standard_for_prescribed_silvicultural_burning_practice_2009.pdf.

FPA 2011. Smoke management from planned burns. Forest Practices Authority, Hobart, Tasmania. http://www.fpa.tas.gov.au/__data/assets/pdf_file/0018/58113/Smoke_management_from_planned_burns_leaflet_2011.pdf.

Hines F, Tolhurst KG, Wilson AAG and McCarthy GJ 2010. Overall fuel-hazard guide. 4th edition, Report 82, Department of Sustainability and Environment, Melbourne, Victoria.

Marsden-Smedley JB 2009. Planned burning in Tasmania: operational guidelines and review of current knowledge. Parks and Wildlife Service, Department of Primary Industries, Parks, Water and the Environment, Hobart, Tasmania. http://www.parks.tas.gov.au/index.aspx?base=15944.

Marsden-Smedley JB 2011. Prescribed burning in South Australia: review of operational prescriptions. Department of Environment and Natural Resources, Adelaide, South Australia. http://www.environment.sa.gov.au/firemanagement/Burns_and_Bushfires/Burning_prescriptions_for_South_Australia.

Marsden-Smedley JB and Sherriff LJ 2014. Planned burning manual - guidelines to enable safe and effective planned burning on private land. NRM North, Launceston Tasmania. http://www.macquariefranklin.com.au/red-hot-tips.html.

Marsden-Smedley JB and Whight S 2011. Planned burning in Tasmania II: fire risk assessment and the development of a standardised Burn Risk Assessment Tool (BRAT). TasForests 19:109-121.

MF 2014. Red Hot Tips weather and planned burning guide: http://www.macquariefranklin.com.au/red-hot-tips.html.

SFMC 2014a. East Coast Fire Management Area Fire Protection Plan. Executive Summary. State Fire Management Council, Hobart, Tasmania.

SFMC 2014b. Bushfire in Tasmania: a new approach to reducing our Statewide relative risk. State Fire Management Council, Hobart, Tasmania.

TFS 2013. Building for bushfire: Planning and Building in Bushfire-Prone Areas for Owners and Builders. http://www.fire.tas.gov.au/userfiles/tym/file/131392_Building_for_Bushfires_web.pdf.

TFS 2015. www.bushfirereadyneighbourhoods.tas.gov.au.

Appendix 1: Planned burn form: Harold Street Reserve Block A

PLANNED BURNING FORM

PERMIT NUMBER: .

BURN NAME: HAROLD STREET BLOCK A

A PERMIT HOLDERS / PERSON IN CHARGE OF BURN

Name:	**Nick Johnston**
Street address:	**Coles Bay Volunteer TFS**
Suburb/Town/Location:	**Coles Bay, 7215**
Contact Details:	**0418 108 774, stay@edgeofthebay.com.au**

B LOCATION OF PLANNED BURN

Same location as permit holder?	**No**
Burn location:	**Glamorgan Spring Bay Council** **Harold St Reserve block A**, **Coles Bay**

C DESCRIPTION OF AREA

Vegetation type/s:		**Dry forest and scrub**		
Years Since Last Burn:		**>30 years**		
Size of Area to be Burnt (Ha):		**0.24 ha**		
Fuel Hazard Rating:	Surface:	**M**	Near-Surface:	**M to H**
	Elevated:	**M to H**	Bark:	**M**
Quantity of fine fuels:	~**13 t/ha**	Overall Fuel Hazard Rating:		**M**
Topography:	Aspect	**Near flat**		
	Slope:	**Less than 5° slope**		
Boundaries/Control Lines:		**Roads, tracks**		
Safety zone location:		**TFS shed on Cosgrove Street**		

What needs to be done to ensure Control Lines are secure:

Immediately prior to ignition, put in ~40 m long wet line linking Harold Street with the northeast flank

What is the most vulnerable edge:

Wet line and western flank: narrow 4wd track with overhanging dry forest

D WEATHER

Temperature:	**<20°**	Relative Humidity:	**>40%**
Wind Speed:	**≤20 kmh**	Wind direction:	**any**
Outlook:	**no winds >30 kmh forecast for 48 hrs**		
C-Haines Index:	**≤6 for the 2 days prior and following burn**		
Season of burn:	**Winter if possible, must be between April and Oct**		
Nearest Fire Weather Station:	**Friendly Beaches AWS**		
Fire Danger Rating on day:	**≤5**		

Next Three Days	Day 1	Day 2	Day 3
Fire Danger Rating	**≤5**	**≤5**	**≤10**

E PERSONNEL AND RESOURCES

Number of personnel at burn:	**Winter: min of 5; Autumn and Spring: min of 8**
Name of person in charge:	**Nick Johnston 0418 108 774**
Firefighting equipment on site:	**Winter: 1 light tanker and 1 heavy tanker** **Autumn and Spring: 2 light tankers and 1 heavy tanker**
Backup firefighting equipment:	**PWS Freycinet, TFS Bicheno and Cranbrook**

Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK A

F LIGHTING TECHNIQUE

Number of people lighting fire: **1 or 2**
Time taken to light fire: **1 to 2 hours**
Time of day to light fire: **After 15:00 EDST**
Burn duration: **2 hours, plus time taken to burn out heavy fuels**
Sequence of lighting:
Prior to light-up, inspect block and ensure no members of the public are present. Light off wet line, then along downwind boundary of block, working into the wind and allow fire to burn into block.

G PATROL / MOP UP / EXTINGUISH

Number of personnel available to patrol and extinguish perimeter and hot spots within 100 metres of perimeter over the next three days:
At least 2 people to check block at ~21:00 on day of burn and then again at ~09:00 and ~15:00 on following day, check at ~15:00 on next 2 days and then on the next windy day (>30 km/hr) unless >10 mm of rain has fallen, extinguish all burning logs in block.
What firefighting equipment will be available for this purpose: **Coles Bay TFS**

H RISKS

Identify any assets which may be at risk as a result of the planned burn:
Adjacent houses, ambulance station, community centre, TFS shed

I ESCAPES

If the fire escapes or the fire activity is excessive:
Call for assistance from Bicheno and Cranbrook TFS

J PERMIT HOLDER'S OBLIGATIONS

This plan forms the primary conditions of your fire permit, it is not valid until approved by the Fire Permit Officer and has the permit number written in the top right hand corner of the front page. This plan must be retained by you and you must be able to produce this plan and your fire permit upon the request of an authorised officer at any time during the duration of the fire. Failure to retain this plan will be deemed to be a breach of the conditions of permit. A copy of the plan must be provided for the permit officer.
Upon the declaration of a Total Fire Ban your permit is revoked. If your fire is alight you must take immediate steps to stop it spreading and extinguish it.
If you need help dial 000 and ask for the Fire Service

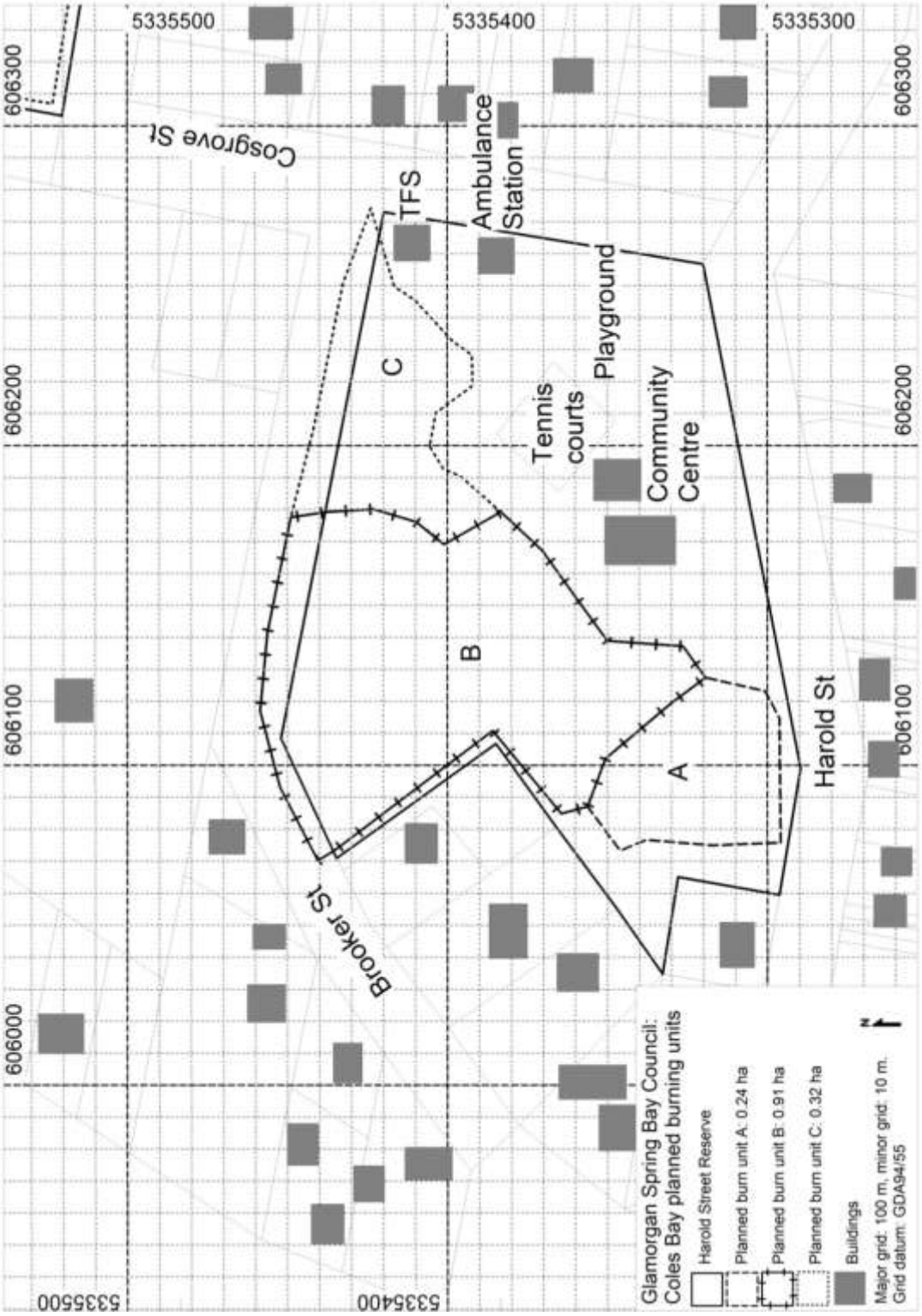
K ADDITIONAL FIRE WEATHER INFORMATION

Listed below are the Fire Weather Forecast Station for which the Bureau of Meteorology issues detailed fire weather forecasts and fire weather outlooks. The information for the fire weather station nearest the planned burn area is available from a number of sources.
Weather by Fax (Bureau of Meteorology) and which can be accessed by Fax Machine
Fire Weather Forecast for next day/or on the day of the planned burn Phone: 1902 935 803
Fire Weather Outlook for the next three days Phone: 1902 935 804
Bureau of Meteorology Ph: (03)62212000 and ask for the Fire Danger Rating for a specific station.

Person in charge of burn approval: _____ **Signature:** _____
Date: _____
Council approval: _____ **Signature:** _____
Date: _____
District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK A

L MAPS OF PLANNED BURN AREA

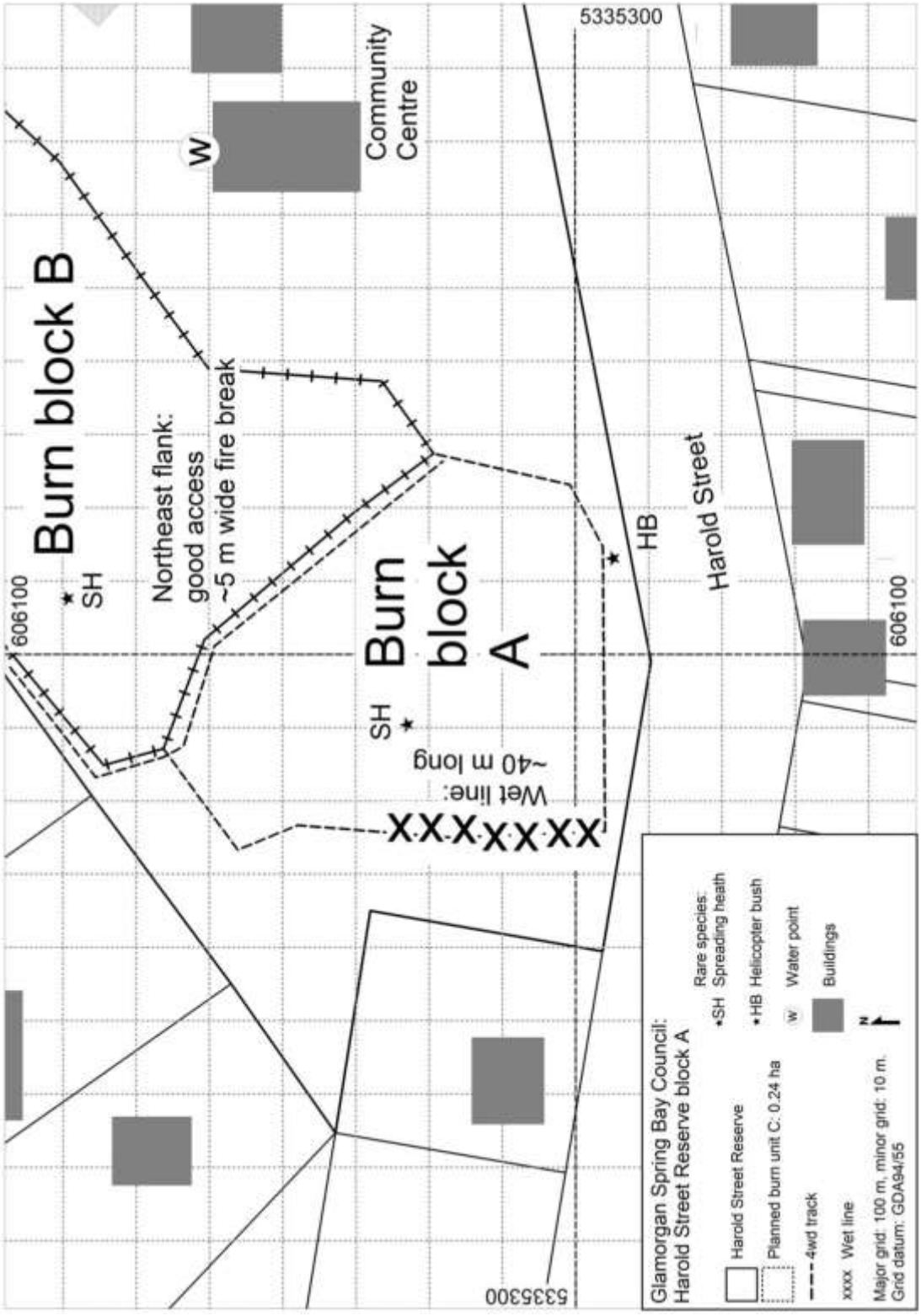


Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK A



Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

Appendix 2: Planned burn form: Harold Street Reserve Block B

PLANNED BURNING FORM

PERMIT NUMBER: .

BURN NAME: HAROLD STREET BLOCK B

A PERMIT HOLDERS / PERSON IN CHARGE OF BURN

Name:	**Nick Johnston**
Street address:	**Coles Bay Volunteer TFS**
Suburb/Town/Location:	**Coles Bay, 7215**
Contact Details:	**0418 108 774, stay@edgeofthebay.com.au**

B LOCATION OF PLANNED BURN

Same location as permit holder?	**No**
Burn location:	**Glamorgan Spring Bay Council** **Harold St Reserve block B**, **Coles Bay**

C DESCRIPTION OF AREA

Vegetation type/s:		**Dry forest and scrub**		
Years Since Last Burn:		**>30 years**		
Size of Area to be Burnt (Ha):		**0.91 ha**		
Fuel Hazard Rating:	Surface:	**M**	Near-Surface:	**H**
	Elevated:	**H**	Bark:	**M**
Quantity of fine fuels:	~**14 t/ha**	Overall Fuel Hazard Rating:		**H**
Topography:	Aspect	**Near flat**		
	Slope:	**Less than 5° slope**		
Boundaries/Control Lines:		**Roads, tracks**		
Safety zone location:		**TFS shed on Cosgrove Street**		

What needs to be done to ensure Control Lines are secure:

Immediately prior to ignition, on the fire's northeast flank put in ~20 m long wet line linking the end of the 4wd track with the tennis courts

What is the most vulnerable edge:

Wet line and western flank: narrow 4wd track with overhanging dry forest

D WEATHER

Temperature:	**<20°**	Relative Humidity:	**>40%**
Wind Speed:	**≤20 kmh**	Wind direction:	**any**
Outlook:	**no winds >30 kmh forecast for 48 hrs**		
C-Haines Index:	**≤6 for the 2 days prior and following burn**		
Season of burn:	**Winter if possible, must be between April and Oct**		
Nearest Fire Weather Station:	**Friendly Beaches AWS**		
Fire Danger Rating on day:	**≤5**		

Next Three Days	Day 1	Day 2	Day 3
Fire Danger Rating	**≤5**	**≤5**	**≤10**

E PERSONNEL AND RESOURCES

Number of personnel at burn:	**Winter: min of 5; Autumn and Spring: min of 8**
Name of person in charge:	**Nick Johnston 0418 108 774**
Firefighting equipment on site:	**Winter: 1 light tanker and 1 heavy tanker** **Autumn and Spring: 2 light tankers and 1 heavy tanker**
Backup firefighting equipment:	**PWS Freycinet, TFS Bicheno and Cranbrook**

Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK B

F LIGHTING TECHNIQUE

Number of people lighting fire: **1 or 2**
Time taken to light fire: **1 to 2 hours**
Time of day to light fire: **After 15:00 EDST**
Burn duration: **2 hours, plus time taken to burn out heavy fuels**
Sequence of lighting:
Prior to light-up, inspect block and ensure no members of the public are present. Light off wet line, then along downwind boundary of block, working into the wind and allow fire to burn into block.

G PATROL / MOP UP / EXTINGUISH

Number of personnel available to patrol and extinguish perimeter and hot spots within 100 metres of perimeter over the next three days:
At least 2 people to check block at ~21:00 on day of burn and then again at ~09:00 and ~15:00 on following day, check at ~15:00 on next 2 days and then on the next windy day (>30 km/hr) unless >10 mm of rain has fallen, extinguish all burning logs in block
What firefighting equipment will be available for this purpose: **Coles Bay TFS**

H RISKS

Identify any assets which may be at risk as a result of the planned burn:
Adjacent houses, ambulance station, community centre, TFS shed

I ESCAPES

If the fire escapes or the fire activity is excessive:
Call for assistance from Bicheno and Cranbrook TFS

J PERMIT HOLDER'S OBLIGATIONS

This plan forms the primary conditions of your fire permit, it is not valid until approved by the Fire Permit Officer and has the permit number written in the top right hand corner of the front page. This plan must be retained by you and you must be able to produce this plan and your fire permit upon the request of an authorised officer at any time during the duration of the fire. Failure to retain this plan will be deemed to be a breach of the conditions of permit. A copy of the plan must be provided for the permit officer.
Upon the declaration of a Total Fire Ban your permit is revoked. If your fire is alight you must take immediate steps to stop it spreading and extinguish it.
If you need help dial 000 and ask for the Fire Service

K ADDITIONAL FIRE WEATHER INFORMATION

Listed below are the Fire Weather Forecast Station for which the Bureau of Meteorology issues detailed fire weather forecasts and fire weather outlooks. The information for the fire weather station nearest the planned burn area is available from a number of sources.

Weather by Fax (Bureau of Meteorology) and which can be accessed by Fax Machine

Fire Weather Forecast for next day/or on the day of the planned burn	Phone: 1902 935 803
Fire Weather Outlook for the next three days	Phone: 1902 935 804

Bureau of Meteorology Ph: (03)62212000 and ask for the Fire Danger Rating for a specific station.

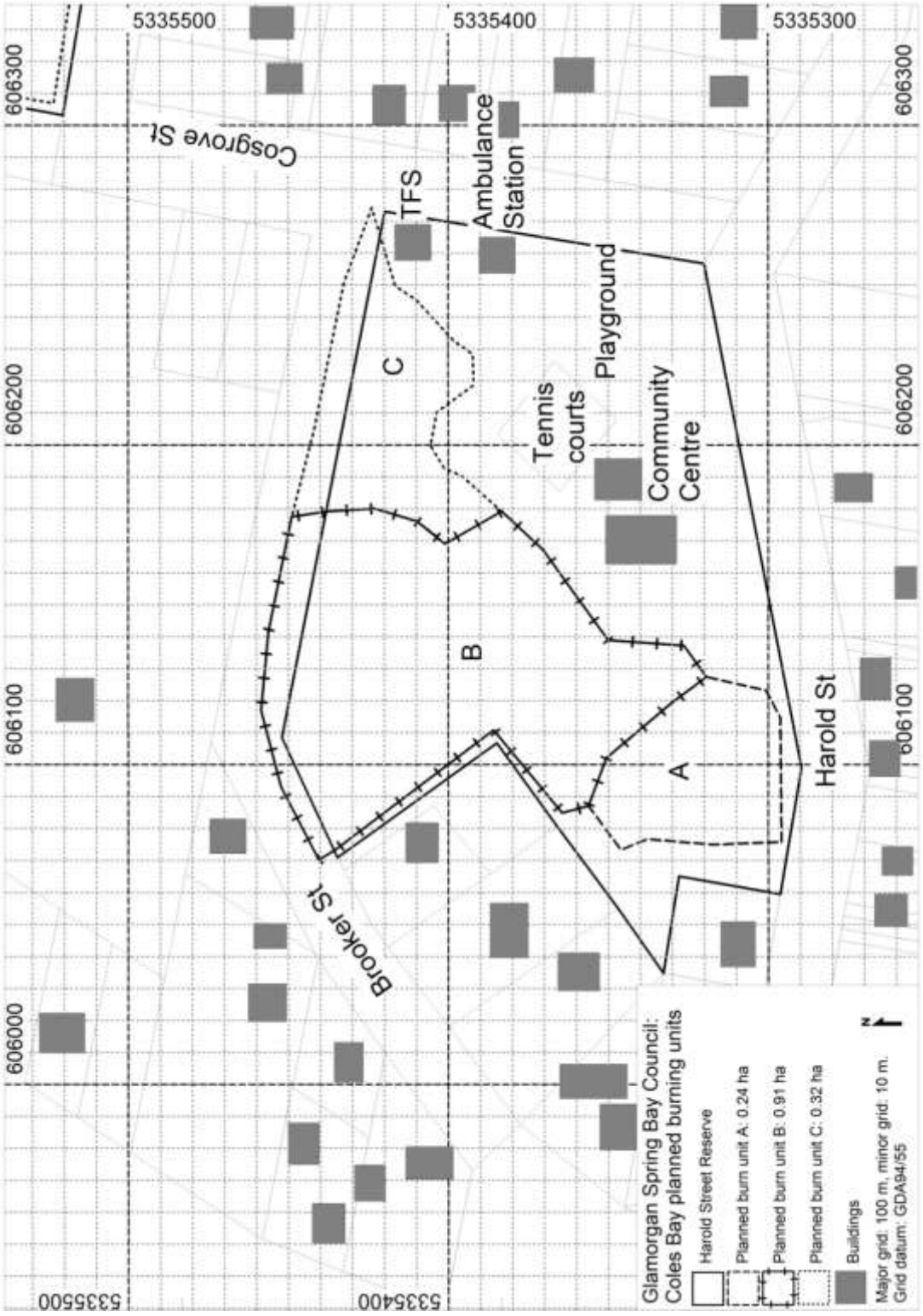
Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK B

L MAPS OF PLANNED BURN AREA

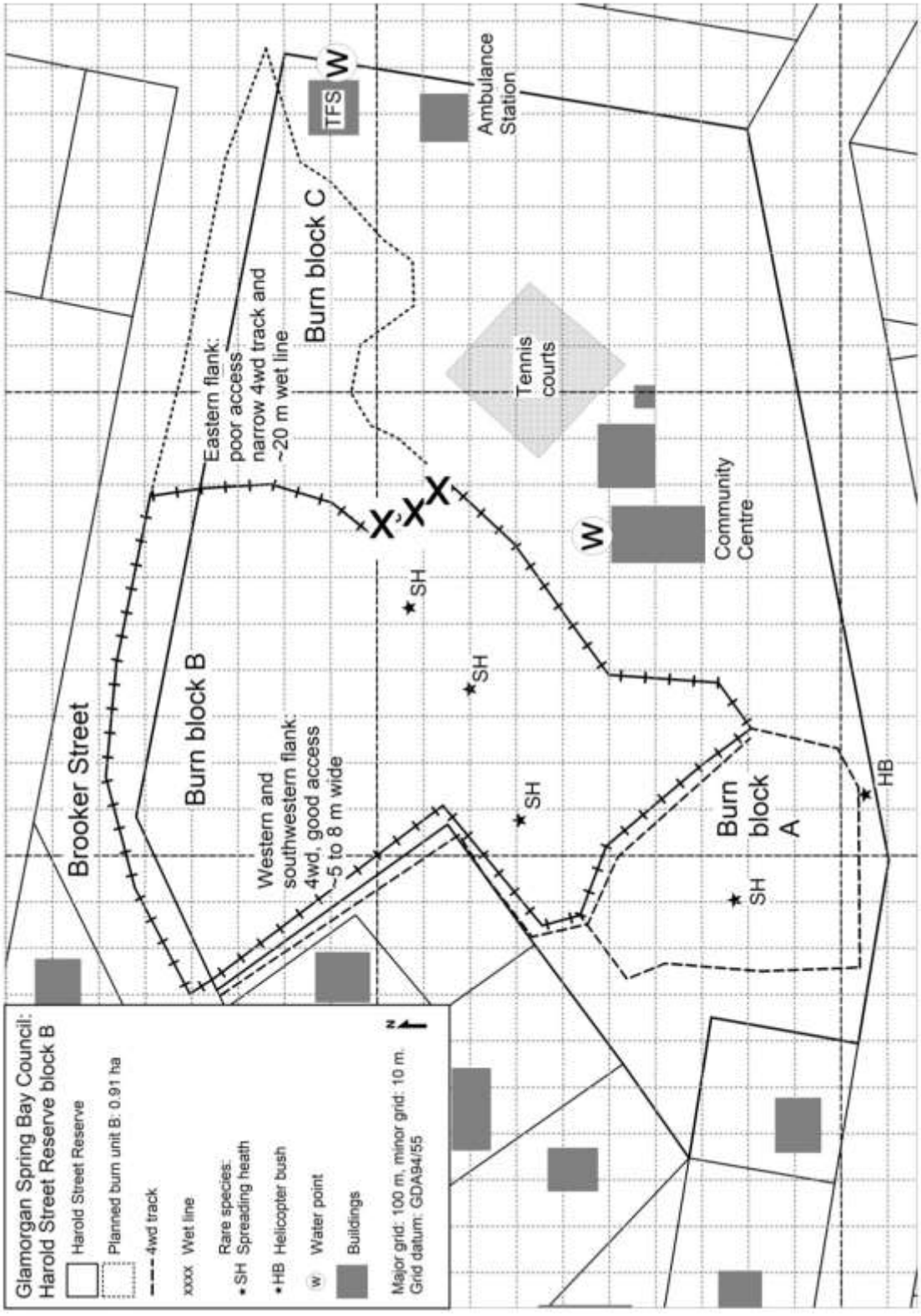


Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK B



Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

Appendix 3: Planned burn form: Harold Street Reserve Block C

PLANNED BURNING FORM

PERMIT NUMBER: .

BURN NAME: HAROLD STREET BLOCK C

A PERMIT HOLDERS / PERSON IN CHARGE OF BURN

Name:	**Nick Johnston**
Street address:	**Coles Bay Volunteer TFS**
Suburb/Town/Location:	**Coles Bay, 7215**
Contact Details:	**0418 108 774, stay@edgeofthebay.com.au**

B LOCATION OF PLANNED BURN

Same location as permit holder?	**No**
Burn location:	**Glamorgan Spring Bay Council** **Harold St Reserve block C**, **Coles Bay**

C DESCRIPTION OF AREA

Vegetation type/s:		**Dry forest and scrub**		
Years Since Last Burn:		**>30 years**		
Size of Area to be Burnt (Ha):		**0.32 ha**		
Fuel Hazard Rating:	Surface:	**M to H**	Near-Surface:	**M to H**
	Elevated:	**H**	Bark:	**M**
Quantity of fine fuels:	~**15.5 t/ha**	Overall Fuel Hazard Rating:		**H**
Topography:	Aspect	**Near flat**		
	Slope:	**Less than 5° slope**		
Boundaries/Control Lines:		**Roads, tracks**		
Safety zone location:		**TFS shed on Cosgrove Street**		

What needs to be done to ensure Control Lines are secure:

Immediately prior to ignition, on the fire's southwest flank put in ~20 m long wet line linking the end of the 4wd track with the tennis courts

What is the most vulnerable edge:

Wet line and western flank: narrow 4wd track with overhanging dry forest

D WEATHER

Temperature:	**<20°**	Relative Humidity:	**>40%**
Wind Speed:	**≤20 kmh**	Wind direction:	**any**
Outlook:	**no winds >30 kmh forecast for 48 hrs**		
C-Haines Index:	**≤6 for the 2 days prior and following burn**		
Season of burn:	**Winter if possible, must be between April and Oct**		
Nearest Fire Weather Station:	**Friendly Beaches AWS**		
Fire Danger Rating on day:	**≤5**		

Next Three Days	Day 1	Day 2	Day 3
Fire Danger Rating	**≤5**	**≤5**	**≤10**

E PERSONNEL AND RESOURCES

Number of personnel at burn:	**Winter: min of 5; Autumn and Spring: min of 8**
Name of person in charge:	**Nick Johnston 0418 108 774**
Firefighting equipment on site:	**Winter: 1 light tanker and 1 heavy tanker** **Autumn and Spring: 2 light tankers and 1 heavy tanker**
Backup firefighting equipment:	**PWS Freycinet, TFS Bicheno and Cranbrook**

Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK C

F LIGHTING TECHNIQUE

Number of people lighting fire: **1 or 2**
Time taken to light fire: **1 to 2 hours**
Time of day to light fire: **After 15:00 EDST**
Burn duration: **2 hours, plus time taken to burn out heavy fuels**
Sequence of lighting:
Prior to light-up, inspect block and ensure no members of the public are present. Light off wet line, then along downwind boundary of block, working into the wind and allow fire to burn into block.

G PATROL / MOP UP / EXTINGUISH

Number of personnel available to patrol and extinguish perimeter and hot spots within 100 metres of perimeter over the next three days:
At least 2 people to check block at ~21:00 on day of burn and then again at ~09:00 and ~15:00 on following day, check at ~15:00 on next 2 days and then on the next windy day (>30 km/hr) unless >10 mm of rain has fallen, extinguish all burning logs in block
What firefighting equipment will be available for this purpose: **Coles Bay TFS**

H RISKS

Identify any assets which may be at risk as a result of the planned burn:
Adjacent houses, ambulance station, community centre, TFS shed

I ESCAPES

If the fire escapes or the fire activity is excessive:
Call for assistance from Bicheno and Cranbrook TFS

J PERMIT HOLDER'S OBLIGATIONS

This plan forms the primary conditions of your fire permit, it is not valid until approved by the Fire Permit Officer and has the permit number written in the top right hand corner of the front page. This plan must be retained by you and you must be able to produce this plan and your fire permit upon the request of an authorised officer at any time during the duration of the fire. Failure to retain this plan will be deemed to be a breach of the conditions of permit. A copy of the plan must be provided for the permit officer.
Upon the declaration of a Total Fire Ban your permit is revoked. If your fire is alight you must take immediate steps to stop it spreading and extinguish it.
If you need help dial 000 and ask for the Fire Service

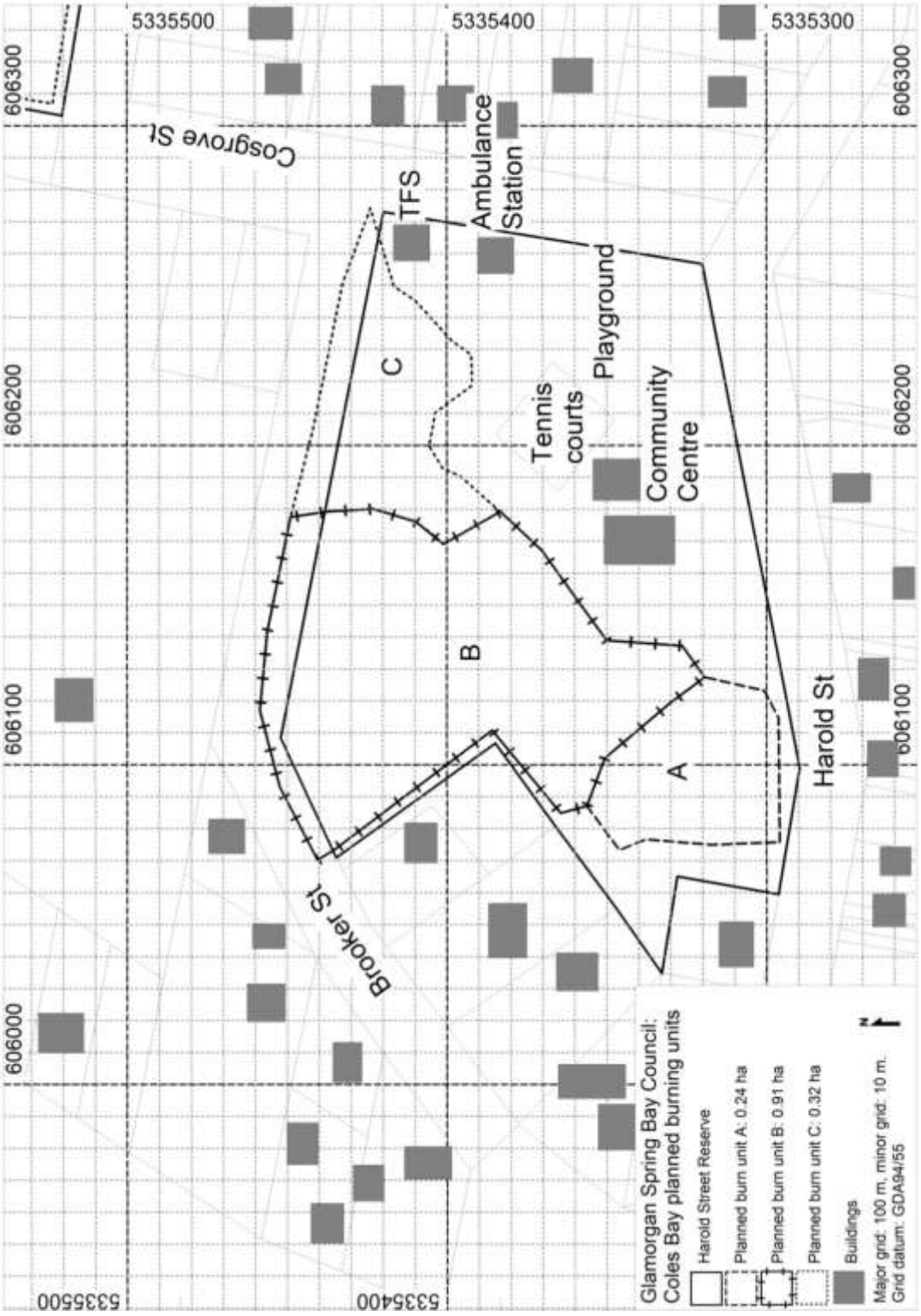
K ADDITIONAL FIRE WEATHER INFORMATION

Listed below are the Fire Weather Forecast Station for which the Bureau of Meteorology issues detailed fire weather forecasts and fire weather outlooks. The information for the fire weather station nearest the planned burn area is available from a number of sources.
Weather by Fax (Bureau of Meteorology) and which can be accessed by Fax Machine
Fire Weather Forecast for next day/or on the day of the planned burn Phone: 1902 935 803
Fire Weather Outlook for the next three days Phone: 1902 935 804
Bureau of Meteorology Ph: (03)62212000 and ask for the Fire Danger Rating for a specific station.

Person in charge of burn approval: _____ **Signature:** _____
Date: _____
Council approval: _____ **Signature:** _____
Date: _____
District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK C

L MAPS OF PLANNED BURN AREA

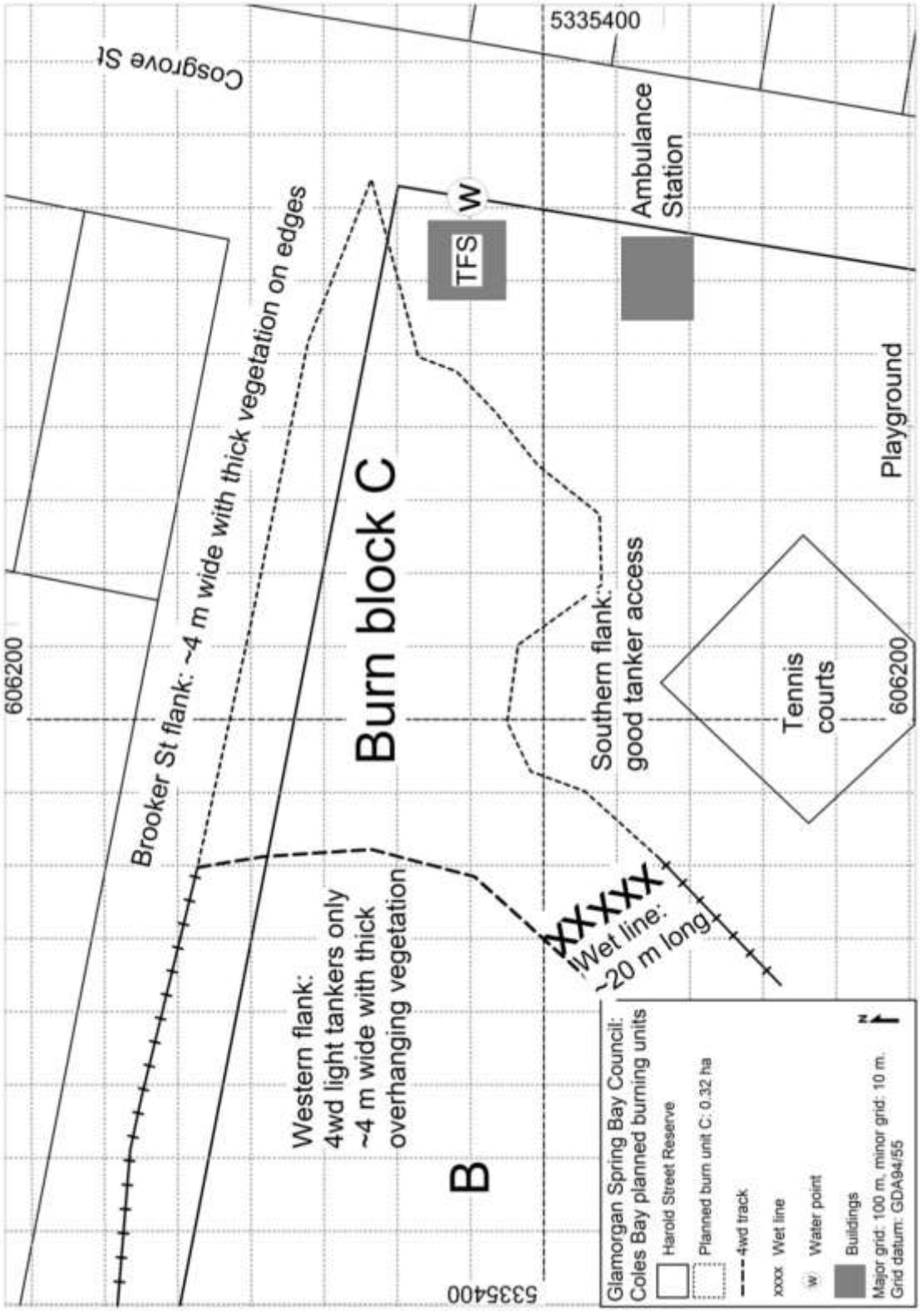


Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: HAROLD STREET BLOCK C



Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

Planned burn form - Harold St Reserve Block C: page 4 of 4

Appendix 4: Planned burn form: Rita and Doris Reserve Block D

PLANNED BURNING FORM

PERMIT NUMBER: .

BURN NAME: RITA AND DORIS BLOCK D

A PERMIT HOLDERS / PERSON IN CHARGE OF BURN

Name:	**Nick Johnston**
Street address:	**Coles Bay Volunteer TFS**
Suburb/Town/Location:	**Coles Bay, 7215**
Contact Details:	**0418 108 774, stay@edgeofthebay.com.au**

B LOCATION OF PLANNED BURN

Same location as permit holder?	**No**
Burn location:	**Glamorgan Spring Bay Council** **Rita and Doris Reserve block D**, **Coles Bay**

C DESCRIPTION OF AREA

Vegetation type/s:		**Dry forest and scrub**		
Years Since Last Burn:		**>30 years**		
Size of Area to be Burnt (Ha):		**1.04 ha**		
Fuel Hazard Rating:	Surface:	**H to VH**	Near-Surface:	**H to VH**
	Elevated:	**M to H**	Bark:	**M to H**
Quantity of fine fuels:	~**21.0 t/ha**	Overall Fuel Hazard Rating:		**H to VH**
Topography:	Aspect	**Near flat**		
	Slope:	**Less than 5° slope**		
Boundaries/Control Lines:		**Roads, tracks**		
Safety zone location:		**TFS shed on Cosgrove Street**		

What needs to be done to ensure Control Lines are secure:

The fire needs to be carefully lit along the walking track between blocks D and E

What is the most vulnerable edge:

Walking tracks between blocks D and E, southwest flank which is close to units in the Iluka Holiday Centre

D WEATHER

Temperature:	**<20°**	Relative Humidity:	**>40%**
Wind Speed:	**≤20 kmh**	Wind direction:	**West to north**
Outlook:	**no winds >30 kmh forecast for 48 hrs**		
C-Haines Index:	**≤6 for the 2 days prior and following burn**		
Season of burn:	**Winter if possible, must be between April and Oct**		
Nearest Fire Weather Station:	**Friendly Beaches AWS**		
Fire Danger Rating on day:	**≤5**		

Next Three Days	Day 1	Day 2	Day 3
Fire Danger Rating	**≤5**	**≤5**	**≤10**

E PERSONNEL AND RESOURCES

Number of personnel at burn:	**Winter: min of 5; Autumn and Spring: min of 8**
Name of person in charge:	**Nick Johnston 0418 108 774**
Firefighting equipment on site:	**Winter: 1 light tanker and 1 heavy tanker** **Autumn and Spring: 2 light tankers and 1 heavy tanker**
Backup firefighting equipment:	**PWS Freycinet, TFS Bicheno and Cranbrook**

Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK D

F LIGHTING TECHNIQUE

Number of people lighting fire: **2 or 3**
Time taken to light fire: **2 to 3 hours**
Time of day to light fire: **After 15:00 EDST**
Burn duration: **2 hours, plus time taken to burn out heavy fuels**
Sequence of lighting:
Prior to light-up, inspect block and ensure no members of the public are present. Carefully light along walking tracks between blocks D and E then along downwind boundary of block, working into the wind and allow fire to burn into block

G PATROL / MOP UP / EXTINGUISH

Number of personnel available to patrol and extinguish perimeter and hot spots within 100 metres of perimeter over the next three days:
At least 2 people to check block at ~21:00 on day of burn and then again at ~09:00 and ~15:00 on following day, check at ~15:00 on next 2 days and then on the next windy day (>30 km/hr) unless >10 mm of rain has fallen, extinguish all burning logs in block
What firefighting equipment will be available for this purpose: **Coles Bay TFS**

H RISKS

Identify any assets which may be at risk as a result of the planned burn:
Adjacent houses and units

I ESCAPES

If the fire escapes or the fire activity is excessive:
Call for assistance from Bicheno and Cranbrook TFS

J PERMIT HOLDER'S OBLIGATIONS

This plan forms the primary conditions of your fire permit, it is not valid until approved by the Fire Permit Officer and has the permit number written in the top right hand corner of the front page. This plan must be retained by you and you must be able to produce this plan and your fire permit upon the request of an authorised officer at any time during the duration of the fire. Failure to retain this plan will be deemed to be a breach of the conditions of permit. A copy of the plan must be provided for the permit officer.
Upon the declaration of a Total Fire Ban your permit is revoked. If your fire is alight you must take immediate steps to stop it spreading and extinguish it.
If you need help dial 000 and ask for the Fire Service

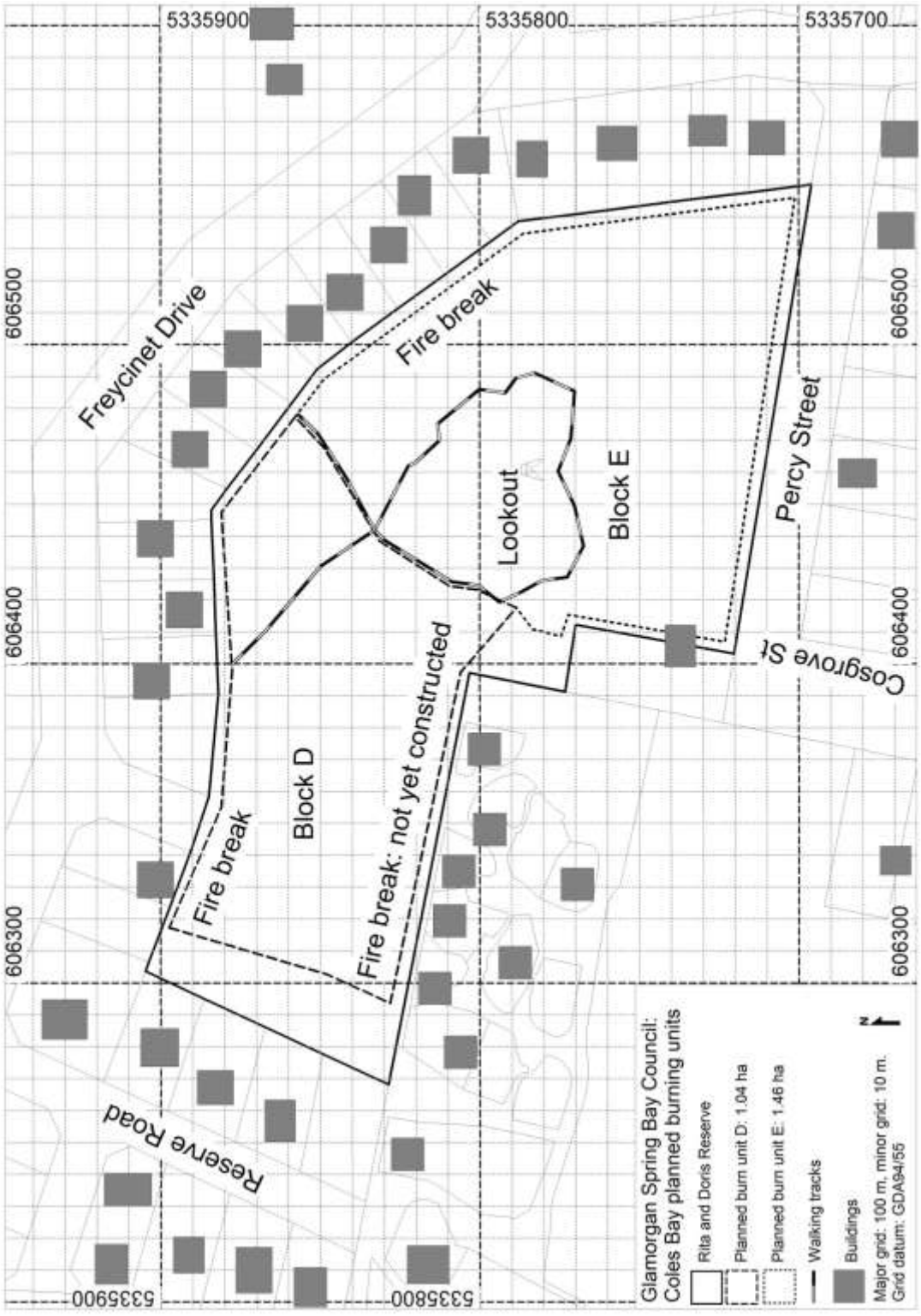
K ADDITIONAL FIRE WEATHER INFORMATION

Listed below are the Fire Weather Forecast Station for which the Bureau of Meteorology issues detailed fire weather forecasts and fire weather outlooks. The information for the fire weather station nearest the planned burn area is available from a number of sources.
Weather by Fax (Bureau of Meteorology) and which can be accessed by Fax Machine
Fire Weather Forecast for next day/or on the day of the planned burn Phone: 1902 935 803
Fire Weather Outlook for the next three days Phone: 1902 935 804
Bureau of Meteorology Ph: (03)62212000 and ask for the Fire Danger Rating for a specific station.

Person in charge of burn approval: _____ **Signature:** _____
Date: _____
Council approval: _____ **Signature:** _____
Date: _____
District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK D

L MAPS OF PLANNED BURN AREA

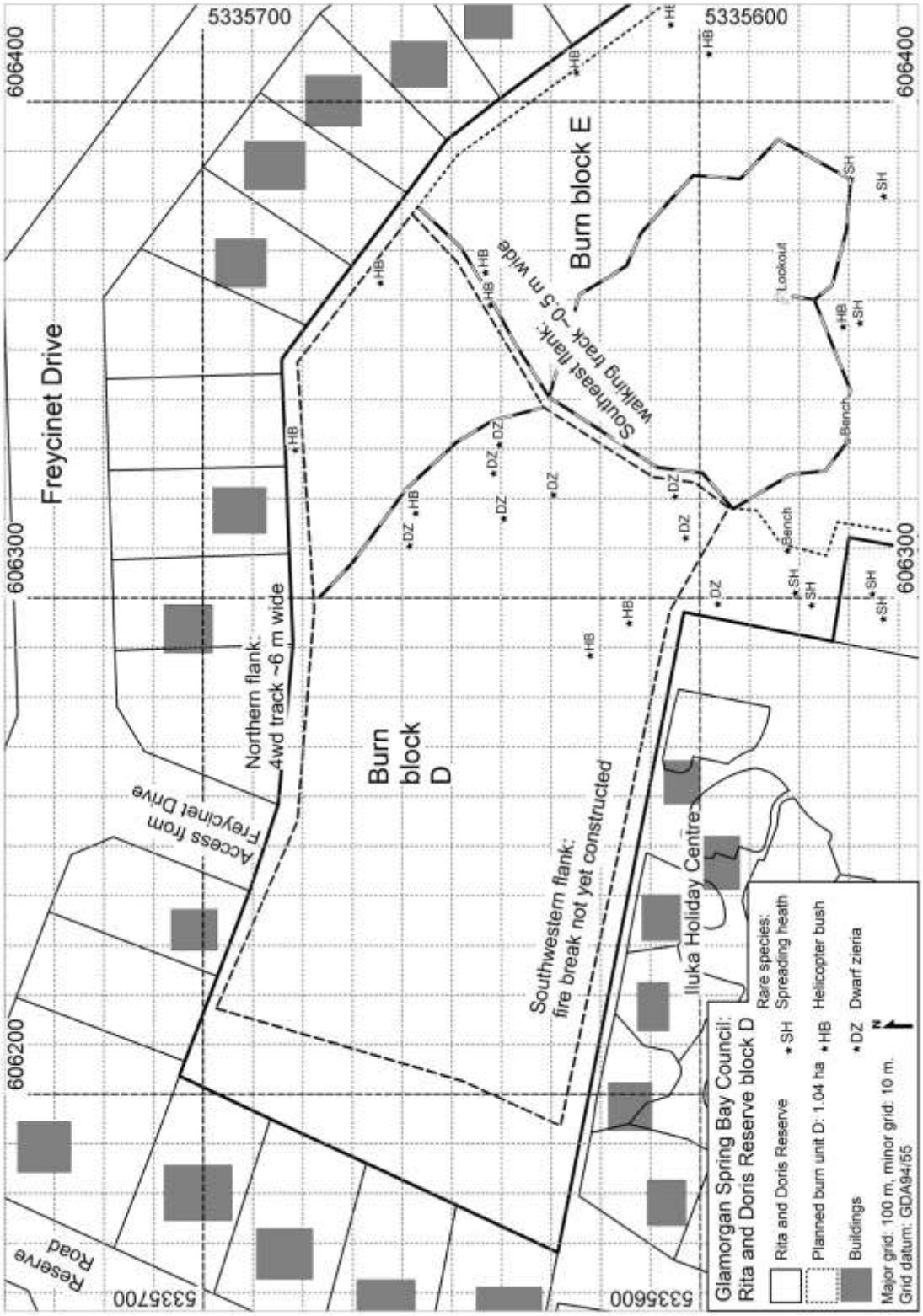


Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK D



Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

Appendix 5: Planned burn form: Rita and Doris Reserve Block E

PLANNED BURNING FORM

PERMIT NUMBER: .

BURN NAME: RITA AND DORIS BLOCK E

A PERMIT HOLDERS / PERSON IN CHARGE OF BURN

Name:	**Nick Johnston**
Street address:	**Coles Bay Volunteer TFS**
Suburb/Town/Location:	**Coles Bay, 7215**
Contact Details:	**0418 108 774, stay@edgeofthebay.com.au**

B LOCATION OF PLANNED BURN

Same location as permit holder?	**No**
Burn location:	**Glamorgan Spring Bay Council** **Rita and Doris Reserve block E**, **Coles Bay**

C DESCRIPTION OF AREA

Vegetation type/s:		**Dry forest and scrub**		
Years Since Last Burn:		**>30 years**		
Size of Area to be Burnt (Ha):		**1.46 ha**		
Fuel Hazard Rating:	Surface:	**H to VH**	Near-Surface:	**H to VH**
	Elevated:	**H**	Bark:	**H**
Quantity of fine fuels:	~**22.0 t/ha**	Overall Fuel Hazard Rating:		**H to VH**
Topography:	Aspect	**Near flat**		
	Slope:	**Less than 5° slope**		
Boundaries/Control Lines:		**Roads, tracks**		
Safety zone location:		**TFS shed on Cosgrove Street**		

What needs to be done to ensure Control Lines are secure:

The fire needs to be carefully lit along the walking track between blocks D and E

What is the most vulnerable edge:

Walking track between blocks D and E

D WEATHER

Temperature:	**<20°**	Relative Humidity:	**>40%**
Wind Speed:	**≤20 kmh**	Wind direction:	**West to north**
Outlook:	**no winds >30 kmh forecast for 48 hrs**		
C-Haines Index:	**≤6 for the 2 days prior and following burn**		
Season of burn:	**Winter if possible, must be between April and Oct**		
Nearest Fire Weather Station:	**Friendly Beaches AWS**		
Fire Danger Rating on day:	**≤5**		

Next Three Days	Day 1	Day 2	Day 3
Fire Danger Rating	**≤5**	**≤5**	**≤10**

E PERSONNEL AND RESOURCES

Number of personnel at burn:	**Winter: min of 5; Autumn and Spring: min of 8**
Name of person in charge:	**Nick Johnston 0418 108 774**
Firefighting equipment on site:	**Winter: 1 light tanker and 1 heavy tanker** **Autumn and Spring: 2 light tankers and 1 heavy tanker**
Backup firefighting equipment:	**PWS Freycinet, TFS Bicheno and Cranbrook**

Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK E

F LIGHTING TECHNIQUE

Number of people lighting fire: **2 or 3**
Time taken to light fire: **2 to 3 hours**
Time of day to light fire: **After 15:00 EDST**
Burn duration: **2 hours, plus time taken to burn out heavy fuels**
Sequence of lighting:
Prior to light-up, inspect block and ensure no members of the public are present. Light along downwind boundary of block, working into the wind and allow fire to burn into block, then carefully light off walking track between blocks D and E

G PATROL / MOP UP / EXTINGUISH

Number of personnel available to patrol and extinguish perimeter and hot spots within 100 metres of perimeter over the next three days:
At least 2 people to check block at ~21:00 on day of burn and then again at ~09:00 and ~15:00 on following day, check at ~15:00 on next 2 days and then on the next windy day (>30 km/hr) unless >10 mm of rain has fallen, extinguish all burning logs in block
What firefighting equipment will be available for this purpose: **Coles Bay TFS**

H RISKS

Identify any assets which may be at risk as a result of the planned burn:
Adjacent houses, ambulance station, community centre, TFS shed

I ESCAPES

If the fire escapes or the fire activity is excessive:
Call for assistance from Bicheno and Cranbrook TFS

J PERMIT HOLDER'S OBLIGATIONS

This plan forms the primary conditions of your fire permit, it is not valid until approved by the Fire Permit Officer and has the permit number written in the top right hand corner of the front page. This plan must be retained by you and you must be able to produce this plan and your fire permit upon the request of an authorised officer at any time during the duration of the fire. Failure to retain this plan will be deemed to be a breach of the conditions of permit. A copy of the plan must be provided for the permit officer.
Upon the declaration of a Total Fire Ban your permit is revoked. If your fire is alight you must take immediate steps to stop it spreading and extinguish it.
If you need help dial 000 and ask for the Fire Service

K ADDITIONAL FIRE WEATHER INFORMATION

Listed below are the Fire Weather Forecast Station for which the Bureau of Meteorology issues detailed fire weather forecasts and fire weather outlooks. The information for the fire weather station nearest the planned burn area is available from a number of sources.

Weather by Fax (Bureau of Meteorology) and which can be accessed by Fax Machine

Fire Weather Forecast for next day/or on the day of the planned burn	Phone: 1902 935 803
Fire Weather Outlook for the next three days	Phone: 1902 935 804

Bureau of Meteorology Ph: (03)62212000 and ask for the Fire Danger Rating for a specific station.

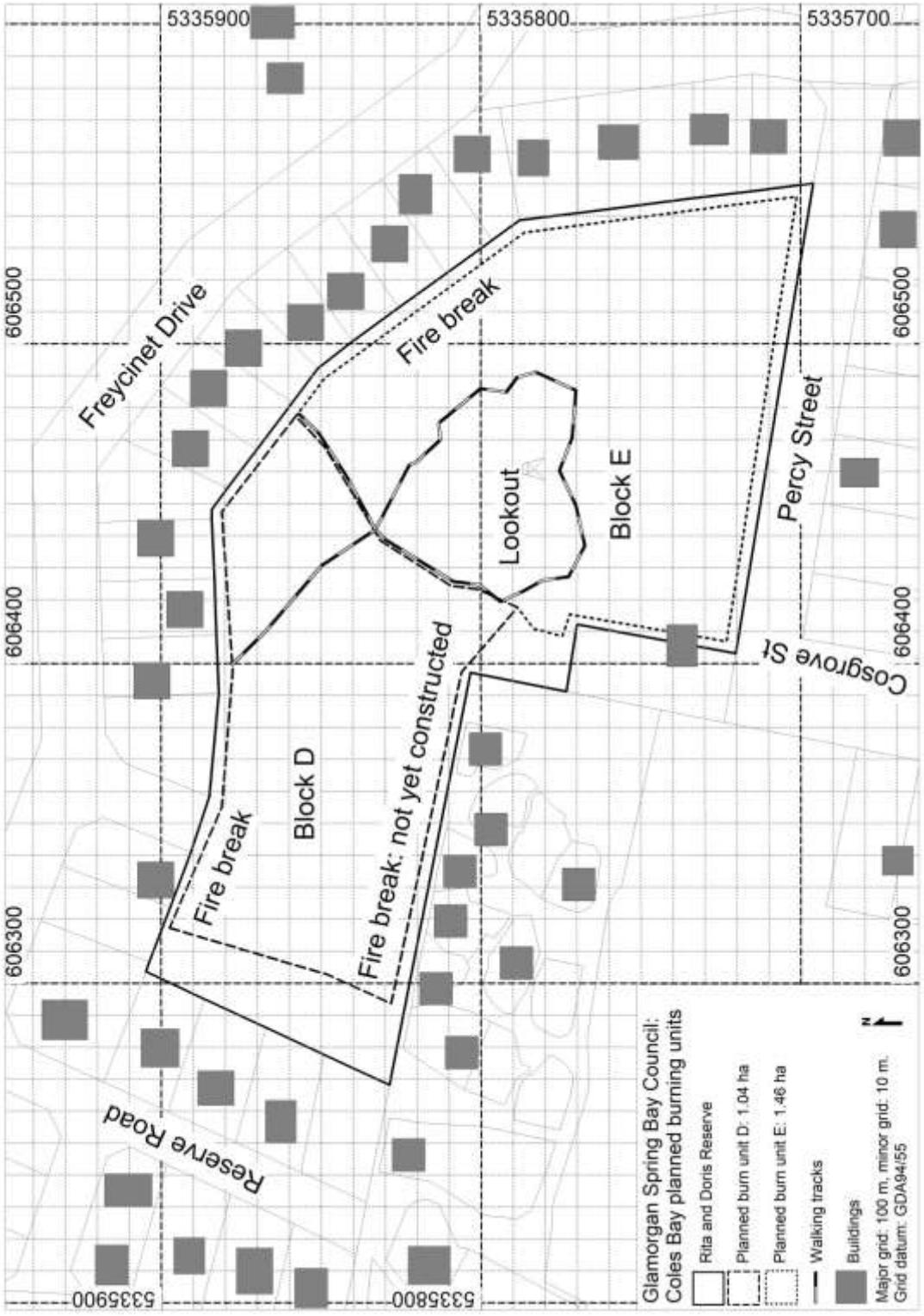
Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK E

L MAPS OF PLANNED BURN AREA

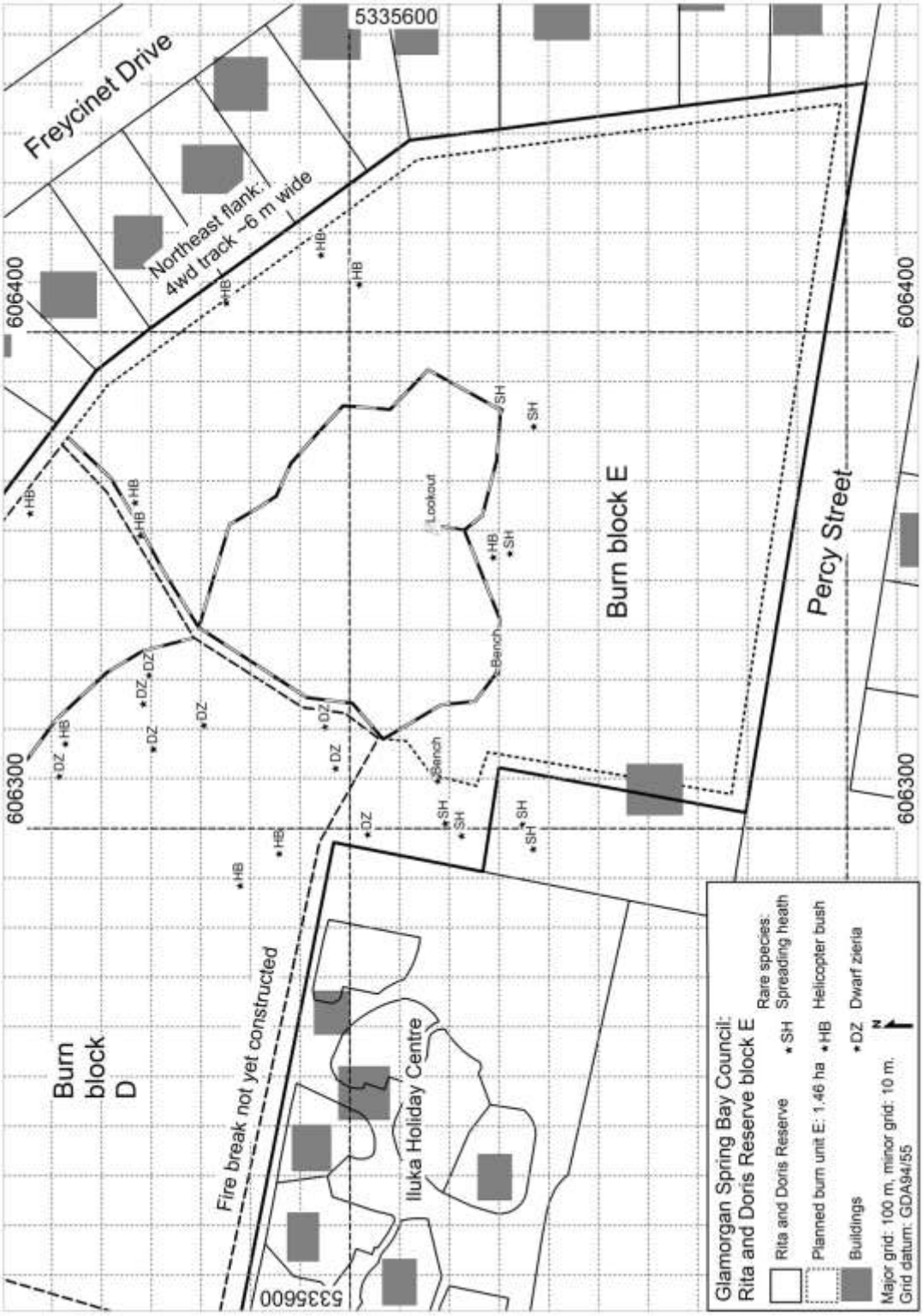


Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

PLANNED BURNING FORM: RITA AND DORIS BLOCK E



Person in charge of burn approval: _____ **Signature:** _____
Date: _____

Council approval: _____ **Signature:** _____
Date: _____

District Officer Approval: _____ **Signature:** _____
Date: _____

Appendix 6: Influences on fire behaviour

Influences on fire behaviour

The main factors influencing fire spread rate are wind speed, slope, fuel characteristics and fuel moisture while the main influences on fire intensity are the rate of fire spread, fuel height and fuel load.

The rate of fire spread is normally estimated from its quasi-steady state. The quasi-steady state is the fire's average spread rate once minor variation resulting from short term changes in wind speed (eg gusts), fuel characteristics and/or slope have been accounted for. The normal method of estimating a fire's intensity is to use flame height.

The relative importance of wind speed, fuel characteristics and fuel moisture on fire behaviour varies at different wind speeds. At low to moderate wind speeds (ie <25 km/h) wind speed and fuel characteristics have similar levels of influence on fire behaviour in moorlands (Marsden-Smedley and Catchpole 1995b) and dry eucalypt forests (Cheney et al. 2012). At higher wind speeds (ie >25 km/h), wind speed becomes the dominant influence on fire behaviour.

When assessing fire behaviour, it is important to consider both the conditions prevailing at the ground surface (eg wind speed, fuels being burnt, humidity and site slope) and the degree of atmospheric instability (see Mills and McCaw 2009). Under highly unstable atmospheric conditions, fires have a higher probability of forming large convection columns which acts to increase the fire's ventilation rate with resultant increases in wind speed and decreases in humidity. This means that if fires occur under highly unstable atmospheric conditions then it is much more likely that they will burn with enhanced levels of fire behaviour.

Wind speed

Overall, wind speed is the most important factor influencing the rate of fire spread (Sullivan 2009). Of these factors, wind speed is the most important, accounting for about half of the observed variation in fire spread rate. Wind acts to push flames down closer to unburnt fuel and increases the air supply to the fire. The degree of atmospheric instability also has a major influence on a fire's potential to achieve high rates of spread and intensity.

Site slope

The issue of the influence of slope on fire spread rate was modelled by McArthur (1967) who predicted that the rate of fire spread would double for every 10º of slope uphill and halve for every 10º of slope downhill. McArthur (1967) also states that during high intensity eucalypt fires burning in undulating country, the effect of spotting across lee slopes onto the next uphill slope will overcome the effects fires burning slowly down lee slopes before burning rapidly up the next upslope and hence, during these fires the effect of slope can be ignored.

Fuel hazard rating and fuel load

The most important fuel factor influencing fire behaviour is the percentage of dead fuel followed by fuel structure which is in turn, more important than fuel load (see Marsden-

Smedley and Catchpole 1995a, 1995b, DEH 2012; Hines et al. 2010; Cheney et al. 2012, Gould et al. 2007a, 2007b). This is because by itself, the fuel load only has very minor influences on fire spread rate, although it does have significant influences on fire intensity. In order to address this issue, fuel hazard assessment systems have been developed which incorporate the different influences of different fuel factors into easily utilised ratings.

When fuel hazards are assessed, the level of fuel hazard is based on a combination of the surface , near-surface, elevated and bark fuels (Figure A1). Each of these stratums are assessed on a five point scale between low and extreme (Hines et al. 2010).

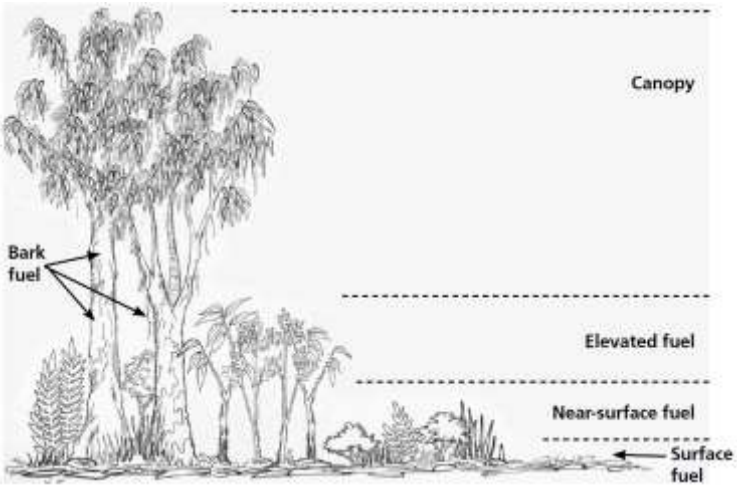


Figure A1. Fuel hazard stratums. Copied Figure 3.1 in from Hines et al. (2010).

The surface fuel stratum is comprised of: dead grass; leaves; bark; and twigs; predominantly in a horizontal orientation and in contact or close to contact with the soil surface. Surface fuels often contain the majority of the fuel load and often have elevated fuel moistures and relatively low aeration. This results in these fuels having minor influences on rates of spread, but major influences on fire intensity.

The near-surface fuel stratum consists of live and dead fuels above the surface fuel stratum, and comprises both vertical and horizontal material. In some sites, the surface and near-surface fuel stratums integrate. Near-surface fuels are typically about 10 to 30 centimetres deep, but may be as high as one metre in some situations. Due to their proximity to the surface fuels, near-surface fuels will normally be burnt in a fire. Near-surface fuels consist of fine fuel including: suspended bark; leaf litter; low shrubs; bracken; tussock grasses; and sedges and rushes.

The elevated fuel stratum consists of shrubs, immature overstorey species and tall bracken. The fuels in this stratum are primarily vertical in their orientation and are typically about one to two metres tall, but may be 8 to 10 metres tall in wet eucalypt forests. This stratum has a major influence on flame height and the development of crown fires (Gould et al. 2007a; Cheney et al. 2012).

The main bark types affecting fire behaviour are: smooth or gum barks; platy bark; and stringybark. Gum bark (also known as candle bark) consists of long, coiled bark strips which may burn for extended periods and be lofted in the fire's convection column, resulting in the potential to for long distance spotting (ie greater than two kilometres). Platy bark (ie the bark tends to form small "plates") from peppermints, ironbarks and pines is characterised by layers of dead bark which can flake off and cause short to

medium range spotting (ie up to about two kilometres). Stringybarks form fibrous wads which can be removed by fire and can result in extensive short to medium range spotting.

Fuel moisture

For fire management purposes, the term fuel moisture is the fuel moisture content of dead fuel which has a diameter of less than six millimetres. Fuel moisture is calculated as the percentage weight of water in the fuel to its oven dry weight.

The most important factors influencing the fuel moisture are relative humidity, dew point temperature, amount of solar radiation (which is in turn influenced by the cloud cover, season, slope and aspect) and recent rainfall. By itself, temperature only has very minor influences on fuel moisture and hence, fire behaviour. However, temperature does influence fire crew fatigue and their ability to manage fires.

The relative humidity is the actual vapour pressure in the atmosphere as a percentage of the maximum vapour pressure that the atmosphere can hold at that temperature. The relative humidity is highly temperature dependent, with air at 30° C being able to hold about six times as much water vapour as air at 0° C. The dew point temperature is the temperature at which the vapour pressure of the moisture present in the atmosphere equals the maximum vapour pressure that the atmosphere can hold at that temperature (ie 100% RH). The dry bulb temperature is the actual air temperature. Precipitation includes all moisture particles large enough to be deposited on the ground surface. It influences fuel moisture and hence fire dynamics through both short and long term effects. Short term influences mostly occur to moisture content of fine dead fuel through the precipitation amount and time (typically hours) since the precipitation stopped. Long term influences mostly occur to heavier fuels through the precipitation amount, intensity and duration along with the time (typically days) since the precipitation stopped.

Fuel moistures vary between a minimum of about two percent up to a maximum of about 200%. When fuel moistures are below the fibre saturation point of about 30 to 35%, water can occur either within fibres and/or as vapour in intercellular spaces. At fuel moistures above the fibre saturation point water can occur as liquid in intercellular spaces and/or as liquid on the fuel's surface.

In dry eucalypt forests, fires will normally fail to sustain (ie keep burning) when the fuel moisture exceeds about 30%, and typically only burn at low intensity when the fuel moisture exceeds about 20 to 25%. However, these forests have the potential to burn with high rates of spread, high intensity and with a high risk of spot fires when the fuel moisture is less than about 10% (Tolhurst and Cheney 1999).

Under the conditions suitable for planned burning (eg low wind speeds, mild temperatures, low cloud covers and no precipitation) the diurnal range in fuel moistures typically results in fires burning poorly overnight, picking up in their level of fire behaviour late morning, burning well in the early to mid-afternoon and then dying down in the mid to late evening.

This means that if fires are lit early in the day (when fuel moistures are relatively high) it will be necessary to intensely light the fire (eg use a close ignition spacing, burn with the wind and/or up slopes) resulting in the possibility of excessive levels of fire behaviour once fuel moistures reach their minimum values mid-afternoon. A similar

situation may occur if the wind speed rises above the level expected. As a result, it is recommended that planned burns be lit once fuel moistures have reached their minimum values for the day and are rising. This issue will be discussed in more detail below in the section on fire ignition strategies.

Changes in fuel moisture also occur within vegetation types as a result of changes in aspect and/or slope. For example, gullies or south facing slopes may be shaded and/or have denser vegetation resulting in their having higher dead fuel moistures than flat areas, ridges and north facing slopes. These areas with higher fuel moistures therefore have the potential to act as boundaries if their moisture contents are sufficiently high to make them non-flammable. It may also be possible to perform two stage burns, where the drier ridges and north facing slopes are burnt at moister times of the year and then gullies or south facing slopes are burnt when conditions are drier, using the recently burnt ridges and north facing slopes as boundaries. This system has the advantage that the most flammable parts of the vegetation are burnt under the lowest risk conditions.

The single leaf test can be used as a simple way of determining fuel moistures in the field. This test involves selecting a single piece of fuel and seeing at what angle it will sustain burning. If it sustains burning when pointing straight up, the fuels will probably be too dry for planned burning. If it only sustains burning when pointing straight down, then the fuels are probably too wet to get an adequate burn (Figure A2). The single leaf test can also be used to estimate the moisture of different locations, such as gullies versus ridges, or different parts of the fuel layer, such as fuels that are exposed on the top versus those which are shaded on the lower part of the layer.

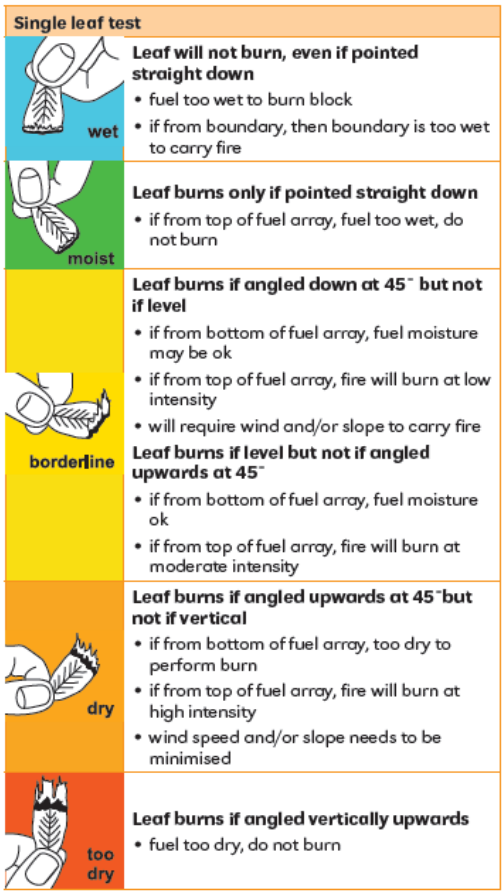


Figure A2. Single leaf test for determining fuel moisture.

Atmospheric stability

For more than 50 years atmospheric stability has been recognised as a major factor influencing fire behaviour (eg Byram 1959; McArthur 1967; Luke and McArthur 1979; Hines 1988; Bally 1995; Tolhurst and Chatto 1999; Mills and McCaw 2010). Fires burning under unstable atmospheric conditions have increased probabilities that large scale fire convection columns will develop, which have the potential to result in enhanced surface wind speeds, the drawing down of low humidity air from aloft down to the ground surface and the possibility of downdrafts causing abrupt changes in wind speed and fire behaviour.

Methods for quantifying the degree of atmospheric stability for fire management purposes were introduced to Australia by Bally (1995) who used the Haines Index (Haines 1988) to show that a large proportion of the area burned in Tasmania occurred on days when the Haines Index was 5 or 6. However, subsequent research has indicated that the Haines Index provides poor discrimination of the degree of atmospheric stability across the southern mainland of Australia. This led Mills and McCaw (2010) to extend the range of the Haines Index and develop the Continuous Haines Index (C-Haines). The C-Haines is very similar in concept to the Haines Index, except that it uses a linear extension of the bounds of the original Haines Index so that it ranges between a minimum of 0 and a maximum of about 13.

The main advantage of incorporating measures of atmospheric stability when predicting fire behaviour is that it overcomes a major shortcoming in all of the fire behaviour prediction models currently utilised in Australia. That is, these models only incorporate the influences of weather, fuel and topography at the ground surface and do not incorporate the effects of stability on fire behaviour. This means that it is not possible at the current time to make a quantitative prediction of the increase in fire rate of spread and intensity expected when the atmosphere is unstable (and conversely, the decrease in the level of fire behaviour expected when the atmosphere is stable). However, when the atmosphere is highly stable, the level of fire behaviour is likely to be less than that predicted by fire behaviour models (ie, lower rates of fire spread, intensity and spotting). Conversely, when the atmosphere is unstable the level of fire behaviour is likely to be greater than that predicted by fire behaviour models (ie, higher rates of fire spread, intensity and especially, a larger number of spotfires and greater spotfire distances).

Direction of fire travel

The direction which a fire travels is dominated by two main factors: the direction the wind is blowing in and terrain. Terrain mainly influences fire path through the direction in which the slope is pointing (ie the aspect). These two factors, wind and slope, act to reduce the distance between flames and unburnt fuel and to carry burning embers forward to ignite unburnt fuel. For example, fires burning with the wind have their flames pushed down closer to the ground surface (rather than standing upright) while fires burning up slopes have their flames closer to unburnt fuel on their upslope side.

Parts of a fire

Fires are normally divided into three zones: head fires, flank fires and back fires. The head fire is the most intense part of the fire and burns in the same direction as the

wind and/or up the slope. The flank fire is the section of the fire which is burning at 90° to the wind direction and/or across the slope. The back fire is the least intense part of the fire and burns back into the wind and/or down the slope.

If fires occur in areas with uniform vegetation and topography and under conditions of uniform wind direction then the relationships between head versus flank and back fire spread rate and intensity will be dominated by the wind speed with fires becoming longer and narrower as the wind speed increases. However, such uniform conditions very rarely occur in the field with the normal situation being for fuel type, slope, aspect, wind speed and wind direction to all vary, often over small distances and time periods. This variation acts to increase the spread rate of flank and back fires. This means that when wind speeds are low (eg below about 10 km/hr) and/or there is a high degree of variation in wind direction (eg as often occurs when fires are burning under turbulent conditions) the fire may frequently switch between being a head, flank or back fire, resulting in decreases in head fire spread rate and increases in flank and back fire spread rate. Conversely, where fires are burning under high wind speed conditions (eg above about 40 km/hr) and/or when there is little variation in wind direction, then fires may burn as long narrow fires with relatively low rates of flank and back fire spread. As a result, flank fires normally average about 40% and about 60% respectively of the head fire rate of spread and flame height while back fires normally average about 10% and about 50% respectively of the head fire rate of spread and intensity.

Scorch

The main factors influencing scorch height are fire intensity (ie flame height and Byram's Intensity), temperature and wind speed.

Scorch is mainly a concern in dry eucalypt forest fuel hazard management burning, due to its potential to increase litter fall and/or result in overstorey tree damage or death. This is particularly an issue where the planned burn targets bark removal in dry eucalypt forest and hence, requires fires to be burnt at moderate intensities and/or with dry fuels. The probability of canopy scorch during dry eucalypt forest burns can be minimised by ensuring burns are conducted at four to six year intervals (and hence with low to moderate surface and near surface fuel loads and fuel-hazards). Where trees less than about 10 to 15 metres tall occur within planned burning blocks it is normally not possible to prevent scorching (and frequently torching) due to the entire canopy being within the flaming zone. This situation is particularly an issue during burns in heathlands, buttongrass moorlands and dry eucalypt woodlands.

Scorch normally averages about six to eight times the flame height in spring, and 10 to 14 times the flame height in autumn due to the typically drier fuels in autumn (DSE 2008).

Effects of fireline length

Following ignition at a point, fires go through an acceleration phase with the vegetation type and wind speed influencing the length of fireline required for fires to reach their quasi-steady state (Cheney and Gould 1995). This length varies from between 50 and 100 metres for buttongrass moorland fires burning with wind speeds of up to about 30 km/h (Marsden-Smedley and Catchpole 1995b), about 100 metres for grasslands and

up to about 300 to 450 metres for forest fires burning with high wind speeds (Gould et al. 2007b).

When fires are burning under constant conditions (ie when there is no variation in wind direction, wind speed, fuel conditions and topographic features) the head, flank and back fires will steadily increase according to the length to breadth ratio for that wind speed and vegetation type (see above). This means that with increasing time since ignition, there is a steady increase in the fireline length and as a result an increase in the rate of fire spread until the quasi-steady state is reached. However, environmental conditions are rarely if ever constant, particularly wind direction, resulting in firelines switching between head, flank and back fires. This increase in flank fire spread results in an increase in fireline length and a marked reduction in the time taken for fires to reach their quasi-steady state (Cheney and Gould 1995).

This means that fires burning with a fireline lengths of less than 50 m will tend to have lower rates of spread, intensity and spotting than would normally be expected under the prevailing conditions. Hence, when planned burns are conducted, if the length of active fireline can be minimised then the level of fire behaviour will also be kept to a minimum.

Fire danger rating

The primary aim of the fire danger rating is to provide a description of fire suppression difficulty and was developed in Australia by Luke (1953) with further development by Douglas (1957) and Luke and McArthur (1978; see also Cheney 1988).

In Tasmania, three systems are used for estimating fire danger:

- Forest Fire Danger Rating (FFDR, McArthur 1973);
- Scrub Fire Danger Rating (SFDR, Marsden-Smedley 2002), and;
- Moorland Fire Danger Rating (MFDR, Marsden-Smedley et al. 1999).

The fire danger rating integrates the influences of fuel, site factors and weather on fire behaviour, into a dimensionless index of fire behaviour and control (ie suppression) difficulty. The fire danger rating system has recently been updated by the Australasian Fire Authorities Council and consists of a numerical value and a rating class. The numerical values vary between 0 (fires will not sustain) up to in excess of 100. The rating classes vary between:

- low	0 to 5	fire control relatively easy;
- moderate	6 to 11	direct attack on fires possible if well resourced;
- high	12 to 24	fire control operations difficult and frequently fail;
- very high	25 to 49	fire control operations very difficult and normally unsuccessful;
- severe	50 to 74	fire control unlikely to be feasible or safe;
- extreme	75 to 99	fire control not feasible or safe, and;
- catastrophic	100+	very high level threats to life and property.

References

Bally J 1995. The Haines Index as a predictor of fire activity in Tasmania. Proceedings of Bushfire ’95, Australian Bushfire Conference, 27-30 September 1995, Hobart, Tasmania.

Byram GM 1959. Combustion of forest fuels. Chapter 3 in Davis KP (ed). Forest Fire Control and Use. McGraw-Hill, New York.

Cheney NP 1988. Models used for fire danger rating in Australia. In: Conference on bushfire modelling and fire danger rating systems. Cheney NP and Gill AM (eds). 11-12 July 1988, CSIRO, Canberra, ACT. CSIRO Division of Forestry, Canberra, ACT.

Cheney NP and Gould JS 1995. Fire growth in grassland fuels. International Journal of Wildland Fire 5: 237-247.

Cheney NP, Gould JS, McCaw WL and Anderson WR 2012. Predicting fire behaviour in dry eucalypt forest in southern Australia. Forest Ecology and Management 280: 120-131

DEH 2012. Overall fuel hazard guide for South Australia. Department for Environment and Heritage, Adelaide, South Australia.

Douglas DR 1957. Forest Fire Weather Studies in South Australia. Bulletin 9, South Australia Woods and Forests Department.

DSE 2008. Fire management manual 10.1: prescribed burning. Fire Management Branch, Department of Sustainability and Environment, Melbourne, Victoria.

Gould JS, McCaw WL, Cheney NP, Ellis PF and Mathews S 2007b. Field guide: fuel assessment and fire behaviour prediction in dry eucalypt forest. Ensis-CSIRO, Canberra, ACT and Department of Environment and Conservation, Perth, WA.

Gould JS, McCaw WL, Cheney NP, Ellis PF, Knight IK and Sullivan AL 2007a. Project Vesta - fire in dry eucalypt forest: fuel structure, fuel dynamics and fire behaviour. Ensis-CSIRO, Canberra, ACT and the Department of Environment and Conservation, Perth, WA.

Haines DA 1988. A lower atmospheric severity index for wildland fires. National Weather Digest 13: 23-27.

Hines F, Tolhurst KG, Wilson AAG and McCarthy GJ 2010. Overall fuel-hazard guide. 4th edition, Report 82, Fire Management Branch, Department of Sustainability and Environment, Melbourne, Victoria.

Luke RH 1953. Fire Control Manual. Bushfire Committee of New South Wales.

Luke RH and McArthur AG 1978. Bushfires in Australia. Australian Government Publishing Service, Canberra, Australia.

Marsden-Smedley JB 2002. Scrub Fire Danger Rating System: version 1.1. Fire Management Section, Parks and Wildlife Service, Department of Primary Industries, Water and Environment, Hobart, Tasmania.

Marsden-Smedley JB and Catchpole WR 1995a. Fire modelling in Tasmanian buttongrass moorlands I. Fuel characteristics. International Journal of Wildland Fire 5: 203-214.

Marsden-Smedley JB and Catchpole WR 1995b. Fire modelling in Tasmanian buttongrass moorlands II. Fire behaviour. International Journal of Wildland Fire 5: 215-228.

Marsden-Smedley JB, Rudman T, Catchpole WR and Pyrke A 1999. Buttongrass moorland fire behaviour prediction and management. TasForests 11: 87-107.

McArthur AG 1962. Control burning in eucalypt forest. Forestry and Timber Bureau Leaflet 80, Commonwealth of Australia, Canberra, ACT

McArthur AG 1966. Weather and grassland fire behaviour. Forestry and Timber Bureau Leaflet 100, Commonwealth of Australia, Canberra, ACT.

McArthur AG 1967. Fire behaviour in eucalypt forest. Leaflet 107, Forestry and Timber Bureau, Department of National Development, Commonwealth of Australia, Canberra, Australian Capital Territory.

McArthur AG 1973. Forest fire danger meter, mark 5. Forest Research Institute, Forestry and Timber Bureau, Canberra, Australia.

Mills GA and McCaw L 2009. Atmospheric Stability Environments and Fire Weather in Australia – extending the Haines Index. Report prepared for the Centre for Australian Weather and Climate Research, Melbourne, Victoria, Department of Environment and Conservation, Manjimup, Western Australia and the Bushfire Cooperative Research Centre, Melbourne, Victoria.

Sullivan AL 2009. Wildland surface fire spread modelling, 1990–2007. 2: Empirical and quasi-empirical models. International Journal of Wildland Fire 18: 369-386.

Tolhurst KG and Chatto K 1999. Development, behaviour and threat of a plume-driven bushfire in west-central Victoria. Research Report No 48. Department of Natural resources and Environment.

Tolhurst KG and Cheney NP 1999. Synopsis of the knowledge used in prescribed burning in Victoria. Fire Management Branch, Department of Natural Resources and Environment, Melbourne, Victoria.

Appendix 7: Legislation relevant to this fire management plan

The major Tasmanian legislation relevant to fire management on private land is the Fire Service Act 1979. The other main legislation relevant to fire management on private land are the Local Government Act 1993 and the Threatened Species Protection Act 1995.

Information on Tasmanian acts of parliament is available from the Tasmanian government legislation website[16].

Fire Service Act 1979

This Act states that Tasmanian land owners and managers have a common law responsibility to take all reasonable steps to minimise the risk of fires originating on their property causing injury and/or damage to adjacent properties. The main priorities for fire management under this Act are to:

1. protect human life;
2. minimise the risk of fires spreading to adjacent properties;
3. minimise the area burnt by wildfires.

The sections of the Act relevant to this strategy are summarised below.

Section 49 of the Act states that officers authorised by the State Fire Commission (including those in the Tasmania Fire Service) are permitted to enter and inspect land for fire hazards, and if the officer deems it appropriate, require the level of fire hazard to be reduced.

Section 56 of the Act states that authorised officers may require the construction of firebreaks aiming to reduce the spread of fires.

Section 61 of the Act states that the State Fire Commission may declare a fire permit period for part or all of Tasmania.

Section 62 of the Act states that during the fire permit period authorised officers may take all necessary steps to reduce the danger of fire, and requisition resources for the purposes of fire-fighting operations.

Section 63 states that during the fire permit period, a person may not light or cause to be lit, a fire for the purposes of clearing vegetation without taking all reasonable precautions to prevent that fire from spreading to adjoining land.

Section 64 of the Act states that during the fire permit period the occupier of the land shall, immediately after becoming aware of a fire take diligent steps to extinguish a fire and/or to prevent it from spreading, and report the fire to the Tasmania Fire Service or the police.

Section 66 of the Act states that during the fire permit period fires may not be lit without a permit for the purposes of clearing vegetation and that an authorised officer can specify the permit conditions under which fires may be lit. Section 66 also states that, provided permit conditions are complied with, a permit holder is not liable for any loss should the fire escape onto neighboring properties.

Section 67 of the Act states that an authorised officer may revoke, suspend or vary the conditions under which a fire permit has been issued.

[16] TheLaw website: http://www.thelaw.tas.gov.au/index.w3p

Section 69 of the Act states that camp fires may be lit for the purposes of cooking, warmth and/or the burning of carcasses. Section 69 also states that fires may not be lit in or on peat or humus, in marram grass or within 3 metres of any stump, log or standing tree, and that the fire will not be left unattended unless it has been completely extinguished. In addition, during the fire permit period, fires lit under this section of the Act will have all flammable material within 3 metres of the fire removed.

Section 70 of the Act states that the State Fire Commission may declare a day of total fire ban over any part of Tasmania. During a day of total fire ban the Act states that the State Fire Commission may specify fires that are not subject to the total fire ban and prohibit or restrict the use of specified machines or apparatus in the open. Section 70 states that during days of total fire ban fire permits will not be issued, or if they have been issued, then the permits are revoked. Section 70 also states that an occupier of land on which a fire occurs on a day of total fire ban will immediately after becoming aware of a fire take diligent steps to extinguish the fire, to prevent it from spreading and report the fire to the Tasmania Fire Service or the police.

Section 71 of the Act states that during a day of total fire ban it is an offence to light, cause to be lit, maintain or use, a fire in the open air on any land for any purpose, unless that fire has been excluded from the ban. Section 71 also prohibits the use any machine or apparatus prohibited under the declaration of a total fire ban.

Section 72 of the Act authorises officers of the Tasmania Fire Service to take actions considered necessary or expedient to extinguish a fire or prevent it from spreading.

Section 73 of the Act authorises on a day of total fire ban any person who finds a fire burning within one and a half kilometres of their land to take any reasonable actions to extinguish the fire or preventing it from spreading. Section 73 also requires any person intending to enter land for the purposes of extinguishing a fire to notify the Tasmania Fire Service that they intend to enter land for the purpose of extinguishing the fire (provided it is reasonably practicable for that notice to be given), and they must comply with any directions given by authorised officers of the Tasmania Fire Service.

Local Government Act 1993

This Act covers the issuing of fire abatement notices. Section 200 of the Act authorises local councils to issue fire abatement notices. Section 201 of the Act authorises the council to, if required, perform the fire risk abatement and if necessary recover the costs of performing the abatement from the land's owner or occupier.

Threatened Species Protection Act 1995

The main parts of the Act relevant to this fire management strategy are Sections 3 and 51, and Schedules 1 and 3. Section 3 defines "take" to include kill, injure, catch, damage, destroy and collect, meaning that a permit from the Department of Primary Industries, Parks, Water and Environment will be required where a planned burn covers land containing listed threatened species. Section 51 states that a person must not knowingly, without a permit, take or disturb any listed threatened species. Schedule 1 aims to promote Tasmania's sustainable development of natural and physical resources and protection of native species. Schedule 3 contains a list of the Tasmanian rare and threatened species covered by the Act.