Bushfire Management Guidelines

City of Melville

February 2019

Executive Summary

These guidelines were prepared to accompany the Natural Areas Asset Management Plan and provide a reference document detailing guidelines for the management of fire within bushlands managed by the City of Melville. Fire is an ongoing management issue within the City as it not only threatens human lives and infrastructure but can have devastating effects on the ecosystem's functioning processes.

The impacts caused by fire on the natural environment influence both biotic and abiotic interactions, however it is important to note that some species of organism rely on the disturbance of fire to carry out life processes such as reproduction. The complexity that fire creates calls for direct management action and understanding of how fire interacts within its surrounding environment.

Best practice techniques discussed throughout this report within an urban environment include education of the surrounding community in fire preparation and involvement in natural areas through environmental community groups. This allows people to develop a sense of belonging and ownership and significantly decreases the occurrence of deliberately lit fires (arson) within an urban bushland context. Other management techniques include firebreaks (both internal and external), removal of flammable materials such as rubbish and weeds which increase fuel loads and prescribed burning. This report outlines the benefits of each method and the limitations with applying such a method within the City's bushland.

To mitigate the effects of bushfire within an urban context, it is recommended that these guidelines be reviewed regularly to ensure best practice techniques along with current literature are being used when assessing bushfire management.

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Acknowledgements

I would like to acknowledge the contribution of Kellie Motteram (Environmental Officer at City of Melville), Allan Johnstone (Lecturer in Sustainability at Murdoch University), and Blair Bloomfield (Environmental Maintenance Supervisor at City of Melville) in the preparation of these management guidelines.

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Acronyms and Abbreviations

City	- City of Melville
CoM	- City of Melville
DEC	- Department of Environment and Conservation
DER	- Department of Environment Regulation
DFES	- Department of Fire and Emergency Services
DPaW	- Department of Parks and Wildlife
FESA	- Fire and Emergency Services Association
KPI(s)	- Key Performance Indicator(s)
NAAMP (Waters, 2011)	- Natural Areas Asset Management Plan
'The Act'	- *Bush Fire Act* 2016
WA	- Western Australia

1. Introduction

Fire is a naturally occurring phenomenon within the bushlands of the south west of Western Australia. The native flora and fauna have adapted to cope with various fire intensities and regimes (Christensen and Abbott, 1989). Some organisms have developed adaptations that are dependent on fire to carry out certain life processes, such as reproduction (Gill, 1975). Since human settlement in Australia some 50,000 years ago, fire regimes have been altered and influenced, however over the past few hundred years with the colonisation of European settlement, many of these fire regimes have changed phases completely (Christensen and Abbott, 1989). Fire within urban settlement is highly discouraged due to the potential threats it has on human life and infrastructure (Keeley, *et al.,* 1999). With this comes the increase in fuel loads due to an excessively long period of time since last being burnt, which increases the intensity of fire dramatically when it does eventually occur (Christensen and Abbott, 1989). This can have devastating consequences on the natural environment, altering both the biotic and abiotic processes, causing a regime shift or alternate stable state (a stable state which has passed a threshold and can not return to its originating natural state without human intervention, such as a weedy environment) to arise (Keeley, *et al.,* 1999).

These guidelines will look into various management methods used to mitigate fire within an urban environment, and ways in which to respond on an environmental level when fire does occur. This document has been written on behalf of the City of Melville and aims to provide best practice techniques and meet statutory requirements for bushfire threat minimisation.

It is recommended throughout this report that all forms of management strategies undergo monitoring throughout the implementation and post implementation phase to ensure effective use of each strategy for the future. To maximise performance of monitoring, key performance indicators (KPIs) will be addressed in section 7 to maintain current best practice methods throughout the application and implementation process. Monitoring protocols will be assessed in section 6 of the report.

1.1. Management objectives

The City of Melville is responsible for the management of approximately 50 bushland reserves ranging from less then 0.5 to 49 hectares in area. Together they total 247 hectares. All of these reserves, with the exception of Ken Hurst Park are immediately surrounded by residential development.

Bushfire management is an essential component of the City's bushland management programme due to public safety requirements and a commitment to ensuring the long term conservation of remnant bushland and associated fauna in the municipality. The City is also subject to statutory requirements relating to bushfires, which it enforces through powers conferred upon it under Section 33 of the Bush Fires Act.

The management of fire within urban bushlands primarily focuses on the vicinity and potential impacts to human infrastructure and life. Limiting the potential for fire to occur within a bushland is the primary focus of fire management in an urban context.

The key objectives of this management report, as adopted from City of Melville (2008), are:

- To protect human life and property from harm by bushfire occurring on lands controlled by the City;
- To protect and conserve the environmental values of remnant bush land in the City from the harmful impacts of wildfires;
- To observe statutory obligations upon the council associated with bushfire management and control; and
- To increase community awareness of bushfire management issues in the City.

1.2. Methodology

A range of literature and 'on the ground application' has been used throughout this report to offer 'best practice' techniques in managing and mitigating the affects of fire. This report should be used in conjunction with other management documentation, including direct consultation with emergency services.

2. Governing Policy

The main policies guiding this report include:

Bush Fires Act 1954
Conservation and Land Management Act 1984
Emergency Management Act 2005
Environmental Protection Act 1986
Biodiversity and Conservation Act 2016Aboriginal Heritage Act 1972
Local Government Act 1995
Australian Standard ISO 31000:2018 Risk management – Principles and guidelines.
Local Law relating to Firebreaks

Under section 33 of the *Bush Fires Act* 1954 ('the Act') the City has a statutory requirement to prevent bushfires where possible.

Under the powers of the *Local Government Act* 1995, the City of Melville developed a set of guiding laws in conjunction with the *Bush Fires Act* 1954 section 62 (Extract from Government Gazette (No. 104) of Tuesday, 1 July, 1997. Local Law relating to Fire Breaks). The local law refers to the management of firebreaks as further outlined in section 4.2.

The period determined by the City of Melville for firebreaks is from the 15th November each year until the following 30th April each year.

Other related documents:

Bushfire Risk Management Planning Handbook (DFES 2015)
Bushfire Risk Management System User Guide (DFES 2015)
Bushfire Risk Management Planning Templates (DFES 2015)

https://dfes.wa.gov.au/safetyinformation/fire/bushfire/Pages/allpublications.aspx#7

3. Resource Optimisation

Fire management is the process of managing the effects of fire on human settlements and native bushland through the implementation of various strategies; whilst taking into consideration environmental, social and economic criteria (DEPI, 2013). It is therefore of great importance that correct implementation of management techniques are applied to ensure the impacts of fire are minimised. These strategies are listed in section 6 and further outlined throughout this report.

3.1. Risk/Reserve prioritisation

The Natural Areas Asset Management Plan (NAAMP) rates bushland reserves based on their ecological significance and potential threat impacts (Waters, 2011, pg. 16). These ratings have been used to identify risk level against fire risk factors in Table 1. This table has been developed as a general guideline in assessing the risks associated with each reserve. There is however the acceptance that certain bushlands may not fit to this matrix and therefore all bushlands should still be considered on a site-by-site basis. Figure 1 shows the bushfire risk areas within the City of Melville, as assessed by Department of Fire and Emergency Services (DFES) in 2014, based on proximity to public assets such as schools and government buildings.

Table 1: Risk prioritisation matrix

Risk Factors	**Close proximity to residents**	**Low occurrence of fire**	**High occurrence of fire**	**High public use**	**High abundance of flammable weeds**
NAAMP Rating 1	**H**	**M**	**H**	**H**	**H**
NAAMP Rating 2	**H**	**M**	**H**	**M**	**H**
NAAMP Rating 3	**H**	**L**	**M**	**M**	**M**
NAAMP Rating 4	**M**	**L**	**L**	**M**	**M**

City of Melville

Figure 1 Bushfire Risk Areas in the City of Melville (DFES 2017)

A list of all reserves where firebreak maintenance is carried out in the City has been compiled in Table 2. The priority rating for each bushland from the City's perspective is based on fire risk. Priority one firebreaks take priority, due to environmental importance, or proximity to human settlement.

Not all reserves within the City require firebreaks and therefore are not listed in this table. Additional information as to where these firebreaks are located can be found in the yearly firebreaks maintenance schedule or via request to the City of Melville Environmental Maintenance Supervisor.

Table 2: Bushland reserves firebreak maintenance priority

Priority	Reserves
1	Blackwall Reach Reserve Bateman Park Bullcreek Reserve Reg Bourke Richard Lewis Point Walter Reserve Robert Weir Peter Ellis Wireless Hill
2	Harry Stickland Trevor Gribble Bill Brown Peter Bosci Phillip Jane George Welby Ron Carroll
3	Bob Crawford Ken Ingram Connelly Reserve Hatfield Reserve Harold Field Reserve Beasley Park Douglas Freeman Park Dudley Hartree P J Hanley Bainton Park Elizabeth Manion Park Fred Johnson Park William Hall

4. Threat Prevention, Elimination, Containment and/or Management Techniques

There are various forms of management tools available when dealing with fire in an urban bushland environment. Current best practice measures available are: education/inclusion of residents; firebreaks; removal of flammable material; and prescribed burning.

The last of the four management methods is somewhat controversial in terms of implementation within an urban environment. It is becoming more difficult to get approval to carry it out, due to associated risks and community attitudes as addressed in section 4.4 (Prescribed burning).

4.1. Community education/Participation

Community education and participation programs as outlined by Waters (2011) is becoming, if not already, the most efficient form of fire management and fire mitigation. With correct procedures and protocols, the application of this strategy can significantly reduce the occurrence of deliberately lit fires (arson) (Dixon, *et al.,* 1995; Haswell and Brown, 2002). Arson can account for almost 50% of all urban bush land fires (Dixon, *et al.,* 1995).

The involvement of community also allows for residents to better prepare their gardens for fire minimisation and report fires within urban bushlands at an early stage. Such preparation undertaken by residents can be voluntary, such as minimising fuel loads on their property, or legislative requirements for maintenance of fire breaks on residential property as outlined in the guidelines of section 4.2 (Fire breaks) and sections 4.2.1 (Exemptions).

All information that is to be provided to residents should be done at least two months prior to the official start of fire season, i.e. the 30th of September. This would allow for the inclusion of firebreak maintenance notices and provide ample time for residents to prepare for bushfires, as well as raise any concerns with the City such as areas of high flammable risk, or apply in writing for an exemption in firebreak maintenance as outlined in section 4.2.1.

4.1.1. Promoting awareness for fire management

The other three management strategies previously mentioned in section 4 (Threat Prevention, Elimination, Containment and/or Management Techniques), and in further detail in section 4.2 (Fire breaks), 4.3 (Removal of flammable material), and 4.4 (Prescribed burning), should all be provided to residents surrounding urban bushlands. This is to ensure that they are aware of management precautions that are being implemented for their safety and protection of assets by the City, and allow them to understand the actions being taking on or around their property. It would also be of benefit to include information on post fire management. This should increase awareness of fragile areas and ensure disturbance is kept to a minimum within these areas during post-fire restoration.

The use of education days or training days can also be provided to residents as they not only provide information on how to prepare for fire within the vicinity of an urban bushland, but create a sense of belonging and ownership (Smith, 2011). Examples of training days and information sessions can be similar to community forums, where the general public is

invited to come along to an information night publicising what the City is doing in regards to fire management. This will allow for direct passing of information and could potentially be a very useful tool in increasing the communities' awareness of fire management. Other such events could include having an information bay/area at local events on behalf of the City, such as the Wireless Hill family fun day, or the Applecross Jacaranda festival or joining in with environmental 'Friends Of Groups' in their local bushland.

4.1.2. Encouragement of bushfire protection on private property

Basic bushfire protection on residential properties will greatly assist in reducing the risk to personal property by fire and also minimise the intensity and impact of fires if they were to occur. This can involve providing information on firebreak maintenance to residents within the surrounding areas of urban bushlands, along with information of fire safety management on their properties through such actions as pruning of vegetation, removal of overhanging dead plant matter, and mowing of lawns (see Appendix 1 for example letter).

A guiding document has been produced for FESA (now known as DFES) by Fontaine and Enright (2011) on ways to mitigate the effects of bushfire spreading to residential properties through the use of garden design and specific plant species. As well as a detailed list of fire-resistant species that can be planted and recommended distances from infrastructure, the report also contains a list of actions to help reduce the impact of embers, direct flame contact and radiant heat attack on buildings. Such recommendations include:

- Having paths adjacent to the building and driveway to maximise protection to the house
- Keeping firewood away from the building
- Ensuring fences that are combustible will not burn down and break the integrity of the building by breaking windows
- Keeping gutters free of leaves and other material that can burn
- Locating LP gas cylinders on the side of the house furthest away from the likely direction of bushfires and ensuring that they will vent away from the building if it is subject to flame contact or radiant heat.

4.1.3. Notification of procedures in the event of fire

Along with recommendations on how to prepare for a fire, notification should be given for actions to be carried out during a fire. All mail outs issued to residents should be submitted to, and have prior approval from, DFES prior to mail out and should take into account their recommendations.

4.1.4. Stakeholder Engagement with OBRM

The City of Melville is working closely with the Office of Bushfire Risk Management to implement fuel reduction measures within bushfire risk areas, as identified in Figure 1.

4.2. Fire breaks

Fire breaks are reduced fuel load zones which may be ploughed or slashed. The purpose of firebreaks is to allow access for fire fighting and maintenance vehicles, and therefore should be maintained in a state that allows for vehicles to move along unhindered.

As stated in section 33 (1a) of the *Bush Fires Act* 1954, the City has the power to determine the firebreak dimensions. The clearing guidelines for both internal and external firebreaks are:

- To be of no less than 3 metres wide;
- With a foliage free zone of 0.5 metres to 5 metres vertically.

Where there is failure to comply with this requirement under section 33 (3) of the *Bush Fires Act* 1954, the persons may be liable to prosecution and a penalty up to $5000.

Foliage below 0.5m does not need be completely removed, but instead can be classified as a 'Fuel Reduced Zone'. A bare earth strip has no ecological function, and retention of some level of ground cover is important to provide habitat and erosion control.

Firebreaks will not be established through known populations of declared rare flora.

For a list of bushlands containing firebreaks within the City, please refer to Table 2.

4.2.1. Exemptions

Should an owner or occupier of a residence/ property consider it impractical to install firebreaks or comply with other fire protection measures in accordance with Local Law developed from the *Bush Fires Act* 1954, the owner or occupier may apply in writing to the City no later than 31 October in each year for exemption or partial exemption from compliance with this Local Law.

If permission is not granted in writing, the owner or occupier must comply with the requirements of this Local Law, or be liable for prosecution under section 33 (3) of 'the Act'.

An exemption or partial exemption granted by the authorized Officer shall only remain in force until 31 March immediately following the date of grant of the exemption or partial exemption.

Exemptions may also be sought by City staff for environmental areas if establishment/maintenance of firebreaks is deemed to be environmentally destructive to the bushland values. Permission for exemptions to firebreaks must be sought from Ranger Services.

4.2.2. Removal of foliage overhanging residential properties

There is to be a minimum clearance of 2 meters between residential properties and any overhanging foliage from a bushland reserve (with an established formal firebreak). Foliage must be pruned back by the City to ensure a 2m clearance over a residential boundary or fence. This is in line with DFES building protection zone standards and is to be carried out prior to the 15th of November of every year.

4.2.3. External firebreaks

In the case where bushland immediately abuts residential properties, firebreaks must be maintained so that foliage from the bush land does not over hang residential property, as previously outlined. This is to be achieved through:

- The removal of all foliage within three meters of the property boundary between 0.5 and 5 metres above ground.

The exception to this is where grass trees (*Xanthorrhoea sp.*) are present within the foliage free zone. Grass trees should be completely trimmed, with all but a small clump of leaves remaining on the crown to minimize the threat that these may pose (refer to Figure 2).

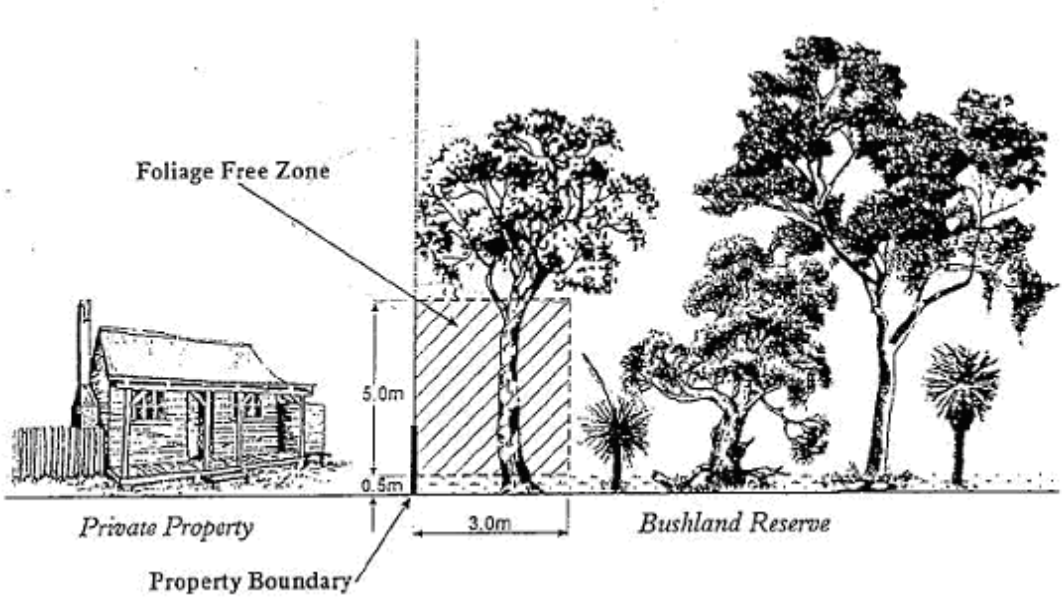


Figure 1: External perimeter firebreak specification for bushland reserves (CoM, 2008).


Figure 2: Trimmed grass tree

4.2.4. Internal firebreaks

In the case of a large bushland reserve, internal fire breaks may also be installed, or where otherwise suggested by DFES or forced upon via ministerial powers (as stated in sections 34 of the Act). Incorporation of firebreaks should be made in line with pre-existing or proposed path ways such as footpaths. The purpose of internal firebreaks is to allow access for fire fighting and maintenance vehicles, and therefore should be maintained in a state which allows for vehicles to move along unhindered.

Internal firebreaks will be selectively hand cleared according to Figure 3. With clearing guidelines of:

- No foliage between 0.5 metres and 5 meters above ground level, with a width of 3 metres;
- Foliage below 0.5 metres will not be removed.

The decision as to maintain / install internal firebreaks will be assessed on a site by site basis (unless otherwise stated) by the City's Environmental Department in conjunction with DFES, taking into account:

- Area of bushland
- Vegetation communities
- Vegetation conditions
- Presence of declared flora
- Topography
- Possible spread of disease

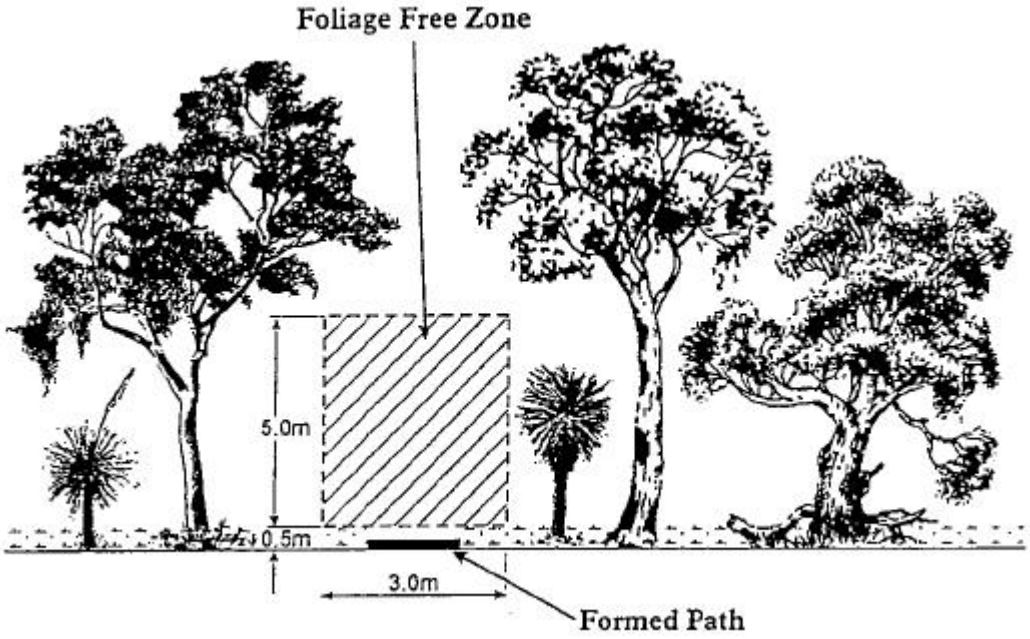


Figure 3: Internal firebreak specifications for bushland reserves (CoM, 2008).

4.3. Removal of flammable material

The removal of flammable material in bushland is extremely important for not only minimising the fuel load available during fire season, but creating greater mobility for emergency services in navigating through such reserves. Other benefits include increasing the visual appeal and public perception of reserves (Eagles, *et al.,* 2002).

Removal of flammable material can be done through techniques such as pruning of dead branches on plants, slashing dry/dead vegetation, removal of dead wood that does not offer any biological importance, removal of litter (especially from illegal dumping), and weed control.

Such removal should be carried out prior to fire season officially starting, along with the construction and maintenance of firebreaks. All fire preparation is to be carried out prior to the 1st of November.

4.3.1. Measurement and monitoring

Informed fuel management requires fuel monitoring and fire mapping. The Department of Parks and Wildlife of Western Australia (DPaW) has developed fuel measurement techniques which can be readily employed in the field. Fuel loads can be used to predict fire behaviour and intensity by taking into account soil and fuel moisture content, climatic conditions and ground slope.

Fire mapping provides important historical information for fuel management decisions and research purposes related to fire ecology and habitat maintenance. The City carries out a combination of visual fuel load assessments and mapping of fuel load each year.

4.3.2. Weed control

The ability to control and maintain weeds within an urban environment significantly decreases the impact that fire may have within the urban bushland and surrounding infrastructure (Ellis, *et al.,* 2004). The introduced non-native species Perennial Veldt Grass (*Ehrharta calycina*) is a high priority weed in the City of Melville, with an extremely high fire risk associated with it. It is therefore a key weed species that should be targeted to minimise the impacts of fire within urban bushlands (Antonio and Vitousek, 1992, pg. 65).

The management of Veldt Grass should be undertaken in accordance with the City of Melville Weed Control Guidelines (City of Melville, 2012a).

4.3.3 Litter control

Litter or rubbish is a major contributing factor to the fuelling of fire in urban bushlands, due to the possibility of having flammable materials amongst it (Waters, 2011, pg. 40). Almost 3000 hours per year are dedicated to removal of rubbish by City field staff (Waters, 2011, pg. 40). This is a high priority for the City to minimise the amount of litter within bushlands prior to bushfire season.

4.3.4. Clearing of dead plant matter

The Environmental Maintenance Team conducts periodic up-keep of reserves throughout the year, through the removal of dead branches offering no biological input that may pose a potential fire threat and the slashing and removal of dried grasses.

Dead plant matter is selectively removed, based on a visual assessment conducted by staff of the risk posed by dead plant material on a site by site basis.

4.4. Prescribed burning

Prescribed burning is the deliberate use of fire as a management tool to minimise fuel loads and in turn the potential impact of a large wildfire (Fernandes and Botelho, 2003). Fires are lit over small sections of bushland over a short time scale, to ensure that fuel loads do not accumulate to a significant amount with the potential to support a severe bushfire. This reduces the risk to ecological processes and human life/settlement if larger wildfires are prevented (Fernandes and Botelho, 2003).

The use of prescribed burning has the potential to be the most effective and economically viable tool when dealing with fire management practices (Hesseln, 2000). However the assessment of the validity and effectiveness of prescribed burning does not take into account areas surrounded by urbanisation. An urban environment places many constraints on prescribed burning, as the consequences can be life threatening and potentially catastrophic on urban infrastructure (Fernandes and Botelho, 2003).

There are various protocols surrounding the application of prescribed burning as a management tool. Prescribed burning should only be used if:

- Fuel loads accumulate to greater than eight (8) tonnes per hectare (DEC, 2012);
- The site has not previously been burnt for more then eight (8) years (Waters, 2011);
- No other method of fuel reduction is practical or economically feasible (Waters, 2011).
- an appropriate burn prescription has been developed
- there has been no air dispersion alert issued by the bureau of Meteorology or a fire ban period imposed by the FESA.
- Ministerial approval for the "taking" of declared flora has been obtained prior to any subscribed burns being undertaken in areas which are known to contain such plants.
- Authority to approve applications for the use of prescribed burns has been obtained from the Manager Health and Lifestyle Services.

No more than 30% of the bushland should be burnt during a prescribed burn and approvals must be acquired through Department of Environment Regulation (DER). Ministerial approval may also be required (DEC, 2012).

Prescribed burning is generally not recommended within an urban environment such as the City of Melville. This recommendation is consistent with other metropolitan areas and case studies documented in Waters (2011).

It is highly unlikely that the reserves within the City would meet the above criteria. Based on previous documentation of fire within the City's reserves, it is apparent that fire occurs on a relatively consistent time scale, in most reserves occurring once every three to four years (City of Melville, 2006: City of Melville, 2008) due to deliberately lit fires (arson) (Waters, 2011).

The Botanic Parks and Gardens Authority originally made the decision in 1962 to cease prescribed burning in Kings Park (Dixon *et al.,* (1995) however in 2015, they commenced a prescribed burning trial. The City will follow the progress of this research project to monitor the outcome of prescribed burning in an urban context.

4.5 Wildfire Suppression

Wildfire suppression in the City of Melville is the responsibility of the Fire and Emergency Services Authority (now DFES) which assumes control at a fire scene. The closest DFES stations are located in Murdoch, Fremantle and Canning Vale, enabling response times within 10-15 minutes of notification. In the unlikely event that DFES declare a bushfire an emergency situation the City will provide support as detailed by the City of Melville Emergency Management Plan.

The City of Melville Environmental Maintenance Teams, managed by the Environmental Maintenance Supervisor, have three vehicles with a 200 litre spray unit and 1000 litre water trailer, each with 80 metre long hoses. These vehicles and teams could be used in conjunction with DFES for mopping up operations after major bushfires. Appropriate fire training would be a prerequisite for officers undertaking this type of work.

Information of use to firefighters in attending a fire includes access points, water sources, high risk areas, topography and areas of particular value. This information should be readily available prior to arrival at the scene. The City of Melville Environmental Team and DFES regularly review fire response plans for the major reserves within Melville. In this way DFES is provided with all of the above relevant information and are made aware of the priorities for conservation within each of the reserves.

Where access points involve locked gates, DFES have been provided with keys to open them. Fire hydrants have been installed at strategic locations in bushland reserves as far as is practicable.

Environmental Services has more recently started to fence remnant bushland reserves. In each case DFES' input is sought as to their needs for access gates.

In all instances protection of life and property must take precedence over protection of vegetation. Ideally wildfires should be contained as soon as possible; however it is preferable to allow a fire to burn a larger area where it can be contained to a natural fire break or path rather than to create a new break or damage bushland trying to access the fire front through the bushland.

Wildfires should be contained as soon as possible; however it is preferable to allow a larger area to burn where the fire can be contained to a natural fire break or path rather than to create a new break or damage bushland trying to access the fire front through the bushland.

In the event of the Department of Fire and Emergency Services (DFES) declaring a bushfire emergency the Council will provide support as detailed in the City of Melville Emergency Management Plan.

The City of Melville will provide DFES with site specific information for each major bushland reserve under its control including:

i) access points
ii) water sources
iii) high risk areas
iv) topography, and
v) areas of special value

Fire hydrants will be maintained in strategic locations in all bushland reserves as far as is practicable.

Community Security Services have some capacity to suppress small fires in some situations.

4.6. Post fire management

Fire within an urban bushland context may not be ideal, as it places human settlement and lives at risk. However fire can be utilised if it does occur, as a management tool in targeting

weeds or revegetating an area. Through correct management and implementation along with timely responses, a previously burnt area can be an environmentally positive event.

As prescribed burning is not recommended (refer to section 4.4) within urban bushlands, every effort should be made to take advantage of fire within the City's bushlands once it has occurred to help revegetate the area or limit the re-emergence of invasive weed species.

4.6.1. Within 1 week

Following fire within an urban bushland, correct documentation should be compiled including a map of the burnt area and hectares burnt. Consultation with 'Friends of Groups' emergency services such as DFES and the Police should also be carried out, and information such as that listed below should be compiled for post fire monitoring.

- How the fire started (if able);
- Fire intensity;
- Fire response time;
- Accessibility through bushland;
- Review of assets and infrastructure lost;
- Potential for insurance claims to be made for damage;
- Emergency services recommendations/comments; and
- Any other relevant information.

Refer to Appendix 3 for an example of a post fire reporting template.

It is then recommended that the City's Environmental Maintenance Team be mobilised within a recently burnt area to provide temporary fencing if needed to ensure that access to the area is restricted. A review of the burnt site will be carried out to assess potential hazards (such as dead burnt trees) to public safety and to identify removal of rubbish. It is however noted that burnt hollows can be extremely valuable within an urban bushland context to many native animals, and should be taken into account when assessing the potential hazardous nature of a burnt tree.

It is further recommended that a review of the site be carried out in terms of assessing vehicle damage caused by emergency service vehicles, and consultation undertaken with such services to assess possible alternatives and future recommendations in either emergency response or bushland access reviewed through internal firebreak management. Once the site has been reviewed and assessed for possible safety issues, environmental restoration can then be carried out.

4.6.2. Environmental restoration

Such restoration practices will be assessing the area's proneness to erosion (top soil loss), introduction/re-establishment of weeds, and potential revegetation ability. If the area is determined as 'at risk of erosion', then correct management practices should be implemented, such as artificial matting, or revegetation in line with the City's Revegetation Guidelines (City of Melville, 2012b).

Weed management post fire is a vital component in post fire management, as many weeds are of South African origin, meaning they have adapted to fire like that of the Western Australian natives. Perennial Veldt Grass is one such weed that is stimulated by fire. Weeds will often germinate within one month of a fire and normally before local plant species can germinate thus adding to competition, and therefore weed control should be conducted within three to six months post fire (refer to City of Melville weed control guidelines for weed control techniques). If weeds are not controlled within a short time post fire, they have the potential to outcompete local natives and the area may become weed dominated. It is therefore highly recommended that best practice control methods be implemented before the weeds reach reproductive maturity.

As the recently burnt area is high in nutrients, and potentially low in competition (following weed management), the conditions become extremely favourable for revegetation of native tube stock or reseeding.

There are still a number of considerations to take into account such as time of year, as planting in mid winter with the seasonal rains would be the preferred and desired option. The timing of a fire can cause logistical difficulties as there may not be enough time to order tube stock for the coming tree planting season or even the following planting season, meaning that the earliest possible tube stock arrival for your designated area could be as long as 24 months. This time scale then misses the advantages that post fire revegetation offers, and becomes a general revegetation project. As it may not be possible to order tube stock for the coming tree planting season, it would be recommended that tube stock be re-allocated amongst incoming orders so that recently burnt areas take priority over previously designated projects.

As a general recommendation, in any burnt area greater than a quarter of an acre (1000m^2), direct seeding and/or planting of tube stock should be conducted to revegetate after a fire.

5. Considerations for Asset Management and Threat Limitation

5.1. Climate Change

Climate Change will likely affect fire regimes in Australia through changes to temperature, rainfall, humidity and wind – which all influence fire (NCCARF, 2013). It has been noted that climate change in the south west of Western Australia may create conditions that are more favourable towards supporting fire. With this shift towards increased fire intensity and frequency, it is important that fire management be altered as fire regimes alter. This involves for example, increasing the management of flammable material as vegetation dries out under Climate Change predictions.

5.2. Dieback

Dieback (*Phytophthora sp.*) is a soil born pathogen that attacks the roots of plants, causing them to rot by stopping the uptake of water and nutrients (CoM, 2013). The spread of

Phytophthora and in particular *Phytophthora cinnamomi* through the City is a high environmental threat (Waters, 2011).

Where possible all efforts should be made to minimise the movement of soils on vehicles and clothing when dealing with fire management actions. Hygiene procedures are implemented throughout the City, as listed in the Disease and Pathogen Guidelines (CoM, 2013). In the case of an emergency where fire service vehicles need to access an area which is susceptible to the spread of Dieback, emergency vehicles take priority in their efforts to put out a fire, and hygiene procedures may not need to be carried out if not timely or practical in an emergency situation.

5.3. Smoke water application on long unburnt sites

The use of smoke water to trigger an environmental response is to be assessed as a potential germination tool in the absence of fire over an extended period of time. As the use of prescribed burning is not recommended within the City (section 4.4), other potential forms of triggering germination need to be assessed, such as the application of smoke water. Where an area has gone through an extensive period of time without being burnt (>8 years) and is facing ecological detriment through the lack of regeneration, such alternative methods to the use of prescribed burning may be considered.

Heat and smoke from fire have been shown to act as environmental triggers to cue the germination of native species in Western Australia such as *Banksia sp.* (Rokich and Dixon, 2006). In recent years the understanding as to which was the dominating factor in germination has been under direct study, however studies are suggesting that certain species respond differently to both heat and smoke (Vigilante, et al., 1998). Some species respond better to heat, whilst others to smoke. The rate of smoke application can also affect species differently.

Various species respond to smoke germination, Appendix 4 lists a number of species, compiled from Vigilante, *et al.* (1998), that respond to smoke germination under laboratory conditions. In assessing the application of smoke water within the City, it would be recommended to keep in mind that studies previously conducted by Vigilante, *et al.* (1998) were undertaken within a laboratory environment. For use within the City, application would need to be conducted in the field, with multiple environmental factors and variables at play, and thus, vigilance would be recommended in the planning and management phases.

The application of smoke water on long unburnt areas can be an appropriate form of management in triggering germination without the direct application of fire, which can have negative effects on the environment (Moreira, *et al.,* 2010). Through the use of smoke water on the soil seed bank, it would be assumed that germination in key native species would be apparent within 3-4 months of application (Vigilante, et al., 1998). However, the elimination of competition would not have occurred through the usual process of fire, therefore making the likelihood of competition highly probable (Vigilante, et al., 1998). This would call for extensive management as to eliminate invasive weed species, and where extensive canopy cover is found, potential canopy thinning could be applied to allow for direct sunlight onto the understorey.

Smoke water can be quite expensive in terms of manual labour required for application along with the initial cost of the product. This should be taken into account when assessing the validity of such a management tool.

It is important to assess such alternatives to maintaining ecological functions through disturbance within small remnant bushlands to that of fire. If in future an area was deemed to be at risk of losing primary ecological functions or rare species due to the lack of regeneration and germination of seeds, it would be recommended that the City seek advice as to best ways to manage and restore prime ecological functions. The application of smoke water is somewhat restrictive, especially for 'in the field' application, away from a set laboratory environment. It is also noted that some weeds trigger a response to smoke water and should also be assessed prior to application (Vigilante, et al., 1998).

5.4. Management of damage

5.4.1. Physical damage caused 'during fire' and 'post fire' by vehicles

The majority of physical damage to bushlands is usually not caused by the fire itself but by activities occurring during or after the event through vehicle access (City of Melville, 2006). Due diligence should be taken when operating vehicles or work operations within bushlands 'during fire' or 'post fire', as the areas are extremely susceptible to erosion and the introduction/spread of weeds and plant disease (CoM, 2006). It has also been noted that the use of fire emergency vehicles within urban bushlands during fire can cause large amounts of damage, therefore appropriate management of internal firebreaks/access routes should be maintained. As well as the maintenance and encouragement of pre-established access routes within urban bushlands, communication should be made to emergency services that where practical, they should minimise destruction of native vegetation.

There is however recognition that where emergency services deem the fire to be threatening life or human settlement, they should take all measures necessary to carry out their duties. Forward planning can certainly minimise the affects that 'during fire' and 'post fire' vehicle access within bushlands has on the fragile environment.

5.4.2. Use of foam as a fire suppressant

The use of foam and other water additives are often used in the suppression of fires. There is however concern over the impacts foam has on ecological function through the chemicals it is made up from. Foam contains nutrients in the form of phosphates and nitrates (Davies, n.d.). The addition of such nutrients can be advantageous for weed species, as well as leading to the disruption of the nutrient cycle through soil and water (Davies, n.d.).

There is an apparent lack of research and understanding of the effects that foam has on environmental communities. It is recommended that foam or other additives are not used in areas of open water bodies or close to areas of open water bodies such as wetlands (Davies, n.d.).

6. Monitoring

Monitoring of bushlands is conducted on a five weekly basis by Environmental Maintenance teams throughout the City. The monitoring involves a visual assessment of all flammable materials as outlined in section 4.3 (Removal of flammable material) of this report, and where needed, corrective action implemented. Environmental Maintenance teams complete a number of tasks within each bushland which are recorded on a management checklist document (refer Appendix 2). As well as general maintenance, all environmental department team members are on high alert during the fire season to report any high risk areas within bushlands to the Maintenance teams and the Environmental Maintenance Supervisor.

The general public are often reporting areas of visual fire risk, which are taken into account and included on the general maintenance of the bushland and any high risk areas mitigated according to sections 4.3 (Removal of Flammable Material) of this report.

As outlined previously, reserves are prioritised within the City, monitoring and firebreak maintenance conducted where needed according to the prioritisation list (refer Table 2).

Prior to fire season commencing, the City's Environmental Maintenance Supervisor meets with DFES to discuss the up and coming fire season and the City's involvement leading up to the commencement of fire season in regards to mitigating the affects of fire within urban bushlands. DFES have fire management plans for the larger reserves within the City, which are also discussed during this meeting. DFES's main priority within these meetings is access to bushlands and firebreak maintenance - as these are maintained throughout the year, they are generally satisfactory. Where able, mention should be made during this meeting in regards to management damage as outlined in section 5.4 (Management damage).

The monitoring of fire itself within the City's urban bushlands has improved over previous years and is adequate for referring to, and noting fire events within bushlands. Refer to section 4.5.1 (Within 1 week) for post fire management and monitoring protocols with specific attention to maintaining contact and relations with emergency services. Appendix 3 outlines a previously used fire monitoring template which can be used for the evaluation of future fires within the City's bushlands.

7. Key Performance Indicators

7.1. Fire prevention

- Make current bushfire management strategies available to residents of the City of Melville on website.
- Bushfire awareness information provided to the community prior to November each year

7.2. Ignition and fuel reduction

- Clearing of illegally dumped rubbish within 1 week of notification;
- Clearing of firebreaks to be completed within 1 month of maintenance notification;

- Percent of firebreaks for which firebreak maintenance is completed.

7.3. Wildfire suppression

- Notification of any changes to fire maps to FESA within 1 month prior to fire season.

7.4. Assisted regeneration – as outlined in section 4.5 (Post fire management)

- Spraying of weeds (weed control) to be conducted within 3 to 6 months post fire;
- Planting of native seed stock within 24 months of fire (budget dependent and timing dependent with regards to nursery ordering – potentially reallocate plant stock if it misses ordering date).

8. Conclusion

Fire within the City's bushlands is a significant threat to human lives, infrastructure, and environmental processes. It is therefore of high priority that correct management and implementation of the guidelines and recommendations throughout this report be implemented for use as on the ground applications in minimising the affects of fire.

As outlined, the inclusion of community through education and partnerships is the most efficient form of fire mitigation, as almost half of bushland fires are caused through arson. If the community can be educated and included, people can develop a sense of belonging and ownership and feel the need to preserve and protect their local bushland.
Community involvement along with decreasing of flammable materials can greatly minimise the chances and impacts of fire impacting on the native vegetation.

The management models used within the City to mitigate the effects of fire were outlined in section four, where particular attention was focussed on their implementations and practicalities of use. It is vital that where each method is implemented, correct review and monitoring is taken into account and documented for further use. This involves recording such details as how it was used, time it was used, strengths, weaknesses, improvements, recommendations, and general comments. The benefits of monitoring such management models allow for future improvements and effectively lead to the safety of people's lives and homes around these bushlands.

As the majority of bushlands within the City are located adjacent to urban areas, fire is a constant threat to both environmental processes and human lives/infrastructure. It is therefore a high priority management issue on an annual basis when reviewing bushland maintenance. It is recommended that these guidelines be reviewed on a biannual basis to ensure best practice management is being implemented, especially with the potential risks associated with fire if not managed correctly.

References

Antonio, C. M. D., Vitousek, P. M., (1992). Biological invasions by exotic grasses/ fire cycle, and global change. *Annual review of Ecology and Systematics*, 23, page: 63-87

Christensen, P., Abbott, I., (1989). Impact of fire in the eucalypt forest ecosystem of southern Western Australia: a critical review. *Australian Forestry.* 52 (2), page: 103-121.

City of Melville, (2006). *Bushfire Management Strategy*. Environmental Services.

City of Melville, (2008). *Bushfire Management Strategy*. Environmental Services.

City of Melville, (2012a). *Environmental Weed Management*. Environmental Services.

City of Melville, (2012b). *Revegetation Management.* Environmental Services

City of Melville, (2013). *Guidelines to the management of disease and pathogens*. Environmental services.

Davies, S., (N.D., – date accessed 2013). *Guidelines for fire management planning for urban bushland*. Urban Bushland Council of Western Australia.

DEC (Department of Environment and Conservation), (2012). *Fire Management Principles*. Government of Western AustralianI. *http://www.dec.wa.gov.au/management-and-protection/fire/fire-management/fire-management-principles.html*

DEPI (Department of Environment and Primary Industries), (2013). *Fire Management*. The State of Victoria, Australia. http://www.dse.vic.gov.au/fire-and-other-emergencies/fire-management

Dixon, I., Keys, K., Paynter, R., Keighery, B., Dixon, K. and Hopper, S. (1995) *Kings Park Bush land Management Plan 1995-2005*, Perth: Kings Park and Botanic Garden.

Eagles, P. F. J., McCool, S. F., Haynes, C. D., (2002). *Sustainable Tourism in Protected Areas. Guidelines for Planning and Management.* IUCN Gland, Switzerland and Cambridge, UK.

Ellis, S., Kanowski, P., Whelan, R. J., (2004). *National Inquiry on Bushfire Mitigation and Management*. Council of Australian Governments. Commonwealth of Australia.

Fernandes, P. M., Botelho, H. S., (2003). A review of prescribed burning effectiveness in fire hazard reduction. *International Journal of Wild Fire*. 12. page: 117-128

Fontaine, J. B., Enright, N. J., (2011). *Plant guide within the building protection zone for the Swan Coastal Plain of Western Australia*. Fire and Emergency Services Authority of Western Australia.

Gill, M. A., (1975). Fire and the Australian flora: a review. *Australian Forestry.* 38(1), page: 4-25.

Haswell, D. and Brown, N. (2002). 'Approaches to community safety and bushfires in south western Australia', *Fire In Ecosystems of South-western Australia: Impacts and Management*, Perth.

Hesseln, H., (2000). The economics of prescribed burning: A research review. *Forrest Science*. 46 (3): page: 322-334.

Keeley, J. E., Fotheringham, C. J., Morais, M., (1999). Re-examining fire suppression impacts on bushland fire regimes. *Science*. 284(5421), page: 1829-1832.

Moreira, B., Tormo, J., Estrelles, E., Pausas, J. G., (2010). Disentangling the role of heat and smoke as germination cues in Mediterranean Basin flora. *Annals of Botany.* 105(4), page: 627-635.

NCCARF (National Climate Change Adaptation Research Facility), (2013). *Climate Change, Fire and Terrestrial Biodiversity*. Adaptive research network, terrestrial Biodiversity. James Cook University Australia.

Rokich, D. P., Dixon, K. W., (2006). Recent advances in restoration ecology, with a focus on the Banksia woodland and the smoke germination tool. *Australian Journal of Botany.* 55(3), page: 375-389.

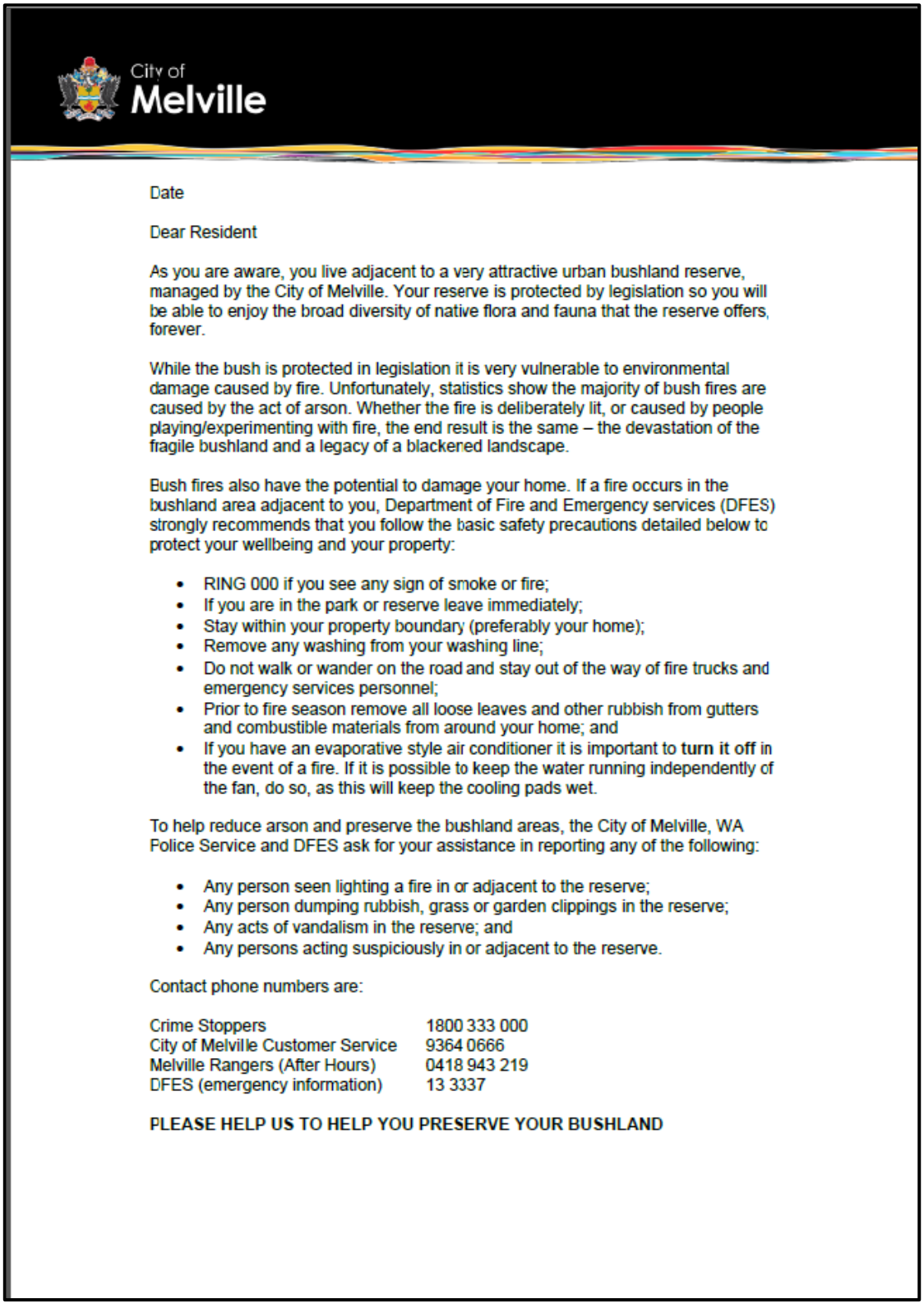
Smith, K. M., (2011). *The Relationship Between Residential Satisfaction, Sense of Community, Sense of Belonging and Sense of Place in a Western Australian Urban Planned Community*. Edith Cowan University, Faculty of Computing, Health and Science.

Vigilante, T., Dixon, K., Sieler, I., Roche, S., Tieu, A., (1998). *Smoke germination of Australian plants*. Rural Industries Research and Development Corporation.

Waters, A. (2011). *City of Melville – Strategic Natural Areas Asset Management Plan 2011*, Report by Woodgis Environmental Assessment and Management for the City of Melville, Western Australia.

APPENDICES

Appendix 1



City of Melville

Date

Dear Resident

As you are aware, you live adjacent to a very attractive urban bushland reserve, managed by the City of Melville. Your reserve is protected by legislation so you will be able to enjoy the broad diversity of native flora and fauna that the reserve offers, forever.

While the bush is protected in legislation it is very vulnerable to environmental damage caused by fire. Unfortunately, statistics show the majority of bush fires are caused by the act of arson. Whether the fire is deliberately lit, or caused by people playing/experimenting with fire, the end result is the same – the devastation of the fragile bushland and a legacy of a blackered landscape.

Bush fires also have the potential to damage your home. If a fire occurs in the bushland area adjacent to you, Department of Fire and Emergency services (DFES) strongly recommends that you follow the basic safety precautions detailed below to protect your wellbeing and your property:

- RING 000 if you see any sign of smoke or fire;
- If you are in the park or reserve leave immediately;
- Stay within your property boundary (preferably your home);
- Remove any washing from your washing line;
- Do not walk or wander on the road and stay out of the way of fire trucks and emergency services personnel;
- Prior to fire season remove all loose leaves and other rubbish from gutters and combustible materials from around your home; and
- If you have an evaporative style air conditioner it is important to **turn it off** in the event of a fire. If it is possible to keep the water running independently of the fan, do so, as this will keep the cooling pads wet.

To help reduce arson and preserve the bushland areas, the City of Melville, WA Police Service and DFES ask for your assistance in reporting any of the following:

- Any person seen lighting a fire in or adjacent to the reserve;
- Any person dumping rubbish, grass or garden clippings in the reserve;
- Any acts of vandalism in the reserve; and
- Any persons acting suspiciously in or adjacent to the reserve.

Contact phone numbers are:

Crime Stoppers	1800 333 000
City of Melville Customer Service	9364 0666
Melville Rangers (After Hours)	0418 943 219
DFES (emergency information)	13 3337

PLEASE HELP US TO HELP YOU PRESERVE YOUR BUSHLAND

Appendix 2

Reserve: **Date:**

Team Members: **Take 5 #:**

EXTERNALS	Yes	No	N/A	Notes
Grass Mowed				
Weed Control Required				
↳Species				
Mulch Cover Adequate				
Fences, Bollards, Etc Condition Acceptable				
Dead Timber Removed (10 metre zone into bush)				
Overhanging Trees & Shrubs?				
Litter Removed (Total Number of Bags Collected)				
Signs & Shelters Condition Acceptable				
Signs & Shelters Graffiti Free				
Other				
PUBLIC ACCESS AREAS/TRACKS/PATHS	Yes	No		Notes
Paths Clear				
Weed Control Required Adjacent To Access Ways				
↳Species				
Overhanging Trees & Shrubs Pruned ?				
Rubbish/Litter/Dog Faeces Removed				
Hazardous Infrastructure Present (Lifting Paths, Cracking, etc)				
Other				
BUSHLAND	Yes	No		Notes
Weed Control Required				
↳Species				
Dead/Hazardous Timber				
Dumpings Present				
Dumpings Removed				
Rubbish/Litter/Dog Faeces Removed				
Dry Fuel Load Present				
Dry Fuel Load Removed				
Firebreaks Clear				
Signs of Erosion				
Erosion Removed/Repaired				
Signs of Vandalism				
Vandalism Removed/Repaired				
New Signs or Symptoms of Dieback				
Treatment Recommended				
Evidence of Recent Fire				
Other				

ITEMS REQUIRING FURTHER ACTION	RESPONSIBLE PERSON

Appendix 3

City of Melville Post Bushfire Reporting Template

Fire information

Date:
Area burnt:
Size of area burnt:
Wind Direction:
Time to extinguish:
Follow up visits? FESA:
Fire intensity:

Summary of asset Damage
Short description and $$

Summary of Ecological Damage
Short description and $$

Fire Map
Intramaps map of area burnt

Asset Inventory

Asset Description	Damage	Photo	Replacement Cost

Total cost of assets lost or damaged due to fire

Ecological Damage
Damage to vegetation
Damage to wildlife
Significance of site

Ecological Implications
Weather conditions post fire
Erosion potential
Weed reinvasion

Post Bushfire Management

Damage/Impact	Management Action	Photograph	Cost

Preventative Measures taken by City of Melville

Fire History information

Appendix 4

Plant Genera that are Responsive to Smoke			
Acacia *	*Conostylis*	*Laxmannia*	*Stackhousia*
Acanthocarpus	*Crassula*	*Lechenaultia*	*Stipa* *
Acrotriche	*Cryptandra*	*Leptomeria*	*Stirlingia*
Actinostrobus	*Cyathochaeta* *	*Leptospermum*	*Stylidium*
Actinotus	*Dampiera* *	*Leucopogon*	*Tersonia*
Adenanthos *	*Desmocladus* *	*Levenhookia* *	*Tetraria*
Agonis	*Dianella Diplolaena*	*Lobelia*	*Tetrarrhena*
Agrostocrinum	*Drosera*	*Lomandra*	*Tetratheca*
Allocasuarina *	*Epacris*	*Loxocarya*	*Thysanotus*
Alyxia	*Eriostemon*	*Lysinema*	*Trachymene* *
Amphipogon	*Eucalyptus* *	*Macropidia*	*Trichocline*
Andersonia	*Exocarpus*	*Melaleuca* *	*Tripterococcus*
Anigozanthos	*Gahnia*	*Mitrasacme*	*Trymalium* *
Arthropodium	*Geleznowia*	*Myriocephalus*	*Velleia*
Astartea	*Georgiella*	*Neurachne*	*Verticordia*
Astroloma	*Gompholobium* *	*Opercularia* *	*Waitzia* *
Baeckea	*Gonocarpus*	*Orthrosanthus*	*Xanthorrhoea* *
Banksia *	*Grevillea*	*Patersonia*	*Xanthosia*
Billardiera	*Gyrostemon*	*Persoonia*	
Blancoa	*Haemodorum*	*Petrophile*	
Boronia	*Hakea*	*Phyllanthus* *	
Bossiaea *	*Hemigenia* *	*Pimelea*	
Brunonia	*Hemiphora*	*Pityrodia*	
Burchardia	*Hibbertia*	*Platysace*	
Bursaria	*Hovea* *	*Pomaderris*	
Caesia	*Hyalosperma* *	*Poranthera* *	
Callitris	*Hybanthus*	*Ptilotus*	
Calytrix	*Hydrocotyle* *	*Ricinocarpus*	
Chamaescilla	*Hypocalymma*	*Rulingia*	
Chieranthera	*Isopogon*	*Scaevola*	
Clematis	*Isotoma* *	*Siegfriedia*	
Codonocarpus	*Johnsonia*	*Sollya*	
Comesperma	*Kennedia* *	*Sowerbaea* *	
Conospermum	*Lachnostachys*	*Sphenotoma*	
Conostephium *	*Lasiopetalum*	*Spyridium*	
*Australian genera which are responsive to smoke and germinate under nursery or field conditions (Vigilante, *et al.*, 1998. pg. 12)			