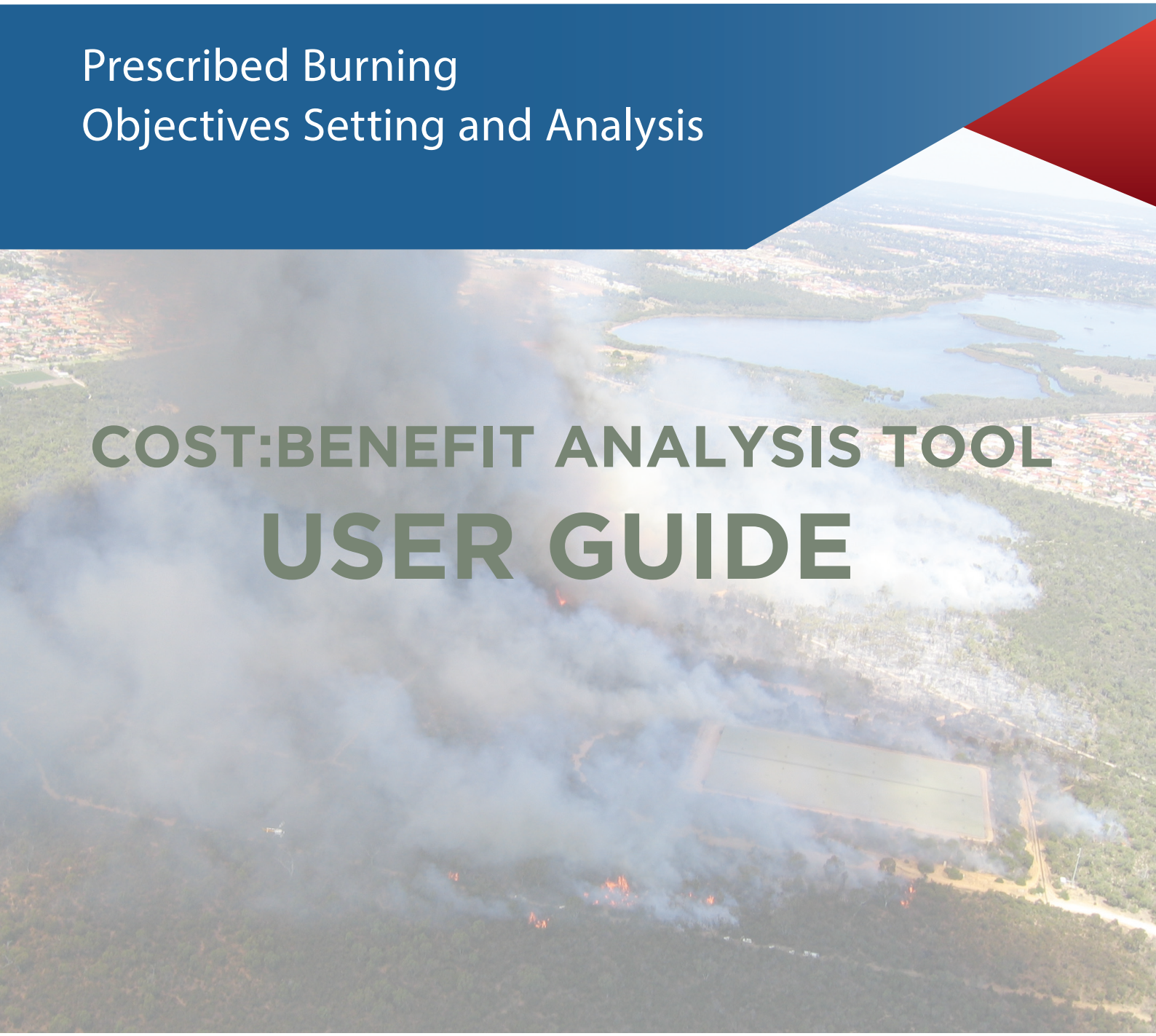
— Centre of Excellence —
PRESCRIBED BURNING

Prescribed Burning
Objectives Setting and Analysis



COST:BENEFIT ANALYSIS TOOL
USER GUIDE

A PRODUCT OF THE NATIONAL BURNING PROJECT

APRIL 2018

An Australian Government Initiative

afac

Australian Institute for Disaster Resilience

FFMG

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Source: Department of Environment, Water and Natural Resources, South Australia

OVERVIEW OF THE BCR CALCULATOR

Parameters					
Define region:	Text description and map	1			2
Baseline fire management/policy:	Define the existing fire management and policy regime to serve as the baseline in the analysis.				
Interface + Landscape burning					
	Units				
Current population	People	0			
Value of a statistical life	$	$4,200,000	3		
Value of injury and mental health losses (per statistical life lost)	$	$2,100,000			
Total per statistical life lost		$6,300,000			
4 **Assets (current)**	**Units**	**No of units**	**Replacement cost**	**Direct loss of profits or utility as a result of losing the asset**	**Consequent indirect losses per asset unit lost (e.g. loss of profits to other businesses)**
Residential properties	Number	0	$450,000	$22,500	$0
Industrial and business	Number	0	$1,500,000	$75,000	$0
Infrastructure	Number	0	$1,100,000,000	$55,000,000	$0
Water resources	Number	0	$0	$0	$0
Harvestable forest	ha	0	$0	$0	$0
Habitat/biodiversity/native veg	ha	0	$0	$0	$0
Agric: horticulture	ha	0	$45,000	$10,000	$0
Agric: vineyards	ha	0	$0	$0	$0
Agric: grazing	ha	0	$1,000	$50	$0
Agric: vegetable growing	ha	0	$5,000	$10,000	$0
Infrastructure: Freeway	km	0	$42,500,000	$0	$0
Infrastructure: Rail corridor	km	0	$573,221	$0	$0
Infrastructure: Gas Pipeline	km	0	$464,400	$0	$0
Infrastructure: Tranmission Lines OH	km	0	$1,000,000	$0	$0
Infrastructure: Tranmission Lines UG	km	0	$0	$0	$0
Special purpose protection zones; Schools etc	Number	0	$0	$0	$0
Agric: Horse studs	Number	0	$20,000,000	$2,000,000	$0
Residential - urban	Number	0	$450,000	$0	$0
Residential - rural	Number	0	$500,000	$0	$0
Asset type 20		0	$0	$0	$0
Total					
Non-monetary indicators (baseline)	**Units**				
Cultural values: scar trees etc	Number	0			
Endangered ecological communities 6	ha	0			
Water catchments	ha				
Average annual losses for each asset type (baseline - mean of distribution)		7	**Total value at risk per unit**	**Value of losses**	
Average losses of lives per year	People	0.05		$210,000	
Injury and mental health multiplier	Proportion	0.5		$105,000	Based on values spec
Total				$315,000	
Residential properties	Number	1	$472,500	$472,500	
Industrial and business	Number	1	$1,575,000	$1,575,000	
Infrastructure	Number	0.001	$1,155,000,000	$1,155,000	
Water resources	Number	0	$0	$0	
Harvestable forest	ha	0	$0	$0	
Habitat/biodiversity/native veg	ha	0	$0	$0	
Agric: horticulture	ha	0	$55,000	$0	
Agric: vineyards	ha	0	$0	$0	
Agric: grazing	ha	0	$1,050	$0	
Agric: vegetable growing	ha	2	$15,000	$30,000	
Infrastructure: Freeway	km	0	$42,500,000	$0	
Infrastructure: Rail corridor	km	0	$573,221	$0	
Infrastructure: Gas Pipeline	km	0	$464,400	$0	
Infrastructure: Tranmission Lines OH	km	0	$1,000,000	$0	
Infrastructure: Tranmission Lines UG	km	0	$0	$0	
Special purpose protection zones; Schools etc	Number	0	$0	$0	
Agric: Horse studs	Number	0	$22,000,000	$0	
Residential - urban	Number	0	$450,000	$0	
Residential - rural	Number	0	$500,000	$0	
Asset type 20		0	$0	$0	
Total				$3,232,500	8
Baseline total including life and injury				$3,547,500	

			Data source (A) or assumption
			Latest census data
			Anon., 2014. Best Practice Regulation Guid
			Rough estimate at this stage
Total value at risk per unit	5	ue	
$472,500		$0	
$1,575,000		$0	
$1,155,000,000		$0	
$0		$0	
$0		$0	
$0		$0	
$55,000		$0	
$0		$0	
$1,050		$0	
$15,000		$0	
$42,500,000		$0	
$573,221		$0	
$464,400		$0	
$1,000,000		$0	
$0		$0	
$0		$0	
$22,000,000		$0	
$450,000		$0	
$500,000		$0	
$0		$0	
		$0	

cified above.

This is the first part of the worksheet 'parameters'

Key elements

A. Data sources, assumptions and explanatory notes should be added here

1. A clear description and map of the region
2. A description of the baseline fire management/policy
3. Population estimate and value of a statistical life/injury health multiplier
4. Inventory of current assets – this is where the number of each asset, its replacement cost, direct and indirect profit loss can be entered. The names of specific categories (e.g. water resources) can be altered and/or additional asset categories can be entered
5. The total value at risk is automatically calculated
6. The current number of non-monetary indicators can be entered here
7. Average annual losses – the expected average annual losses of lives and assets are entered into the blue cells
8. The total value of losses under the baseline are automatically calculated

Worksheet – Parameters (2)

Suppression costs			
Baseline (current) suppression costs	$	$5,000,000	
Baseline (current) suppression costs	Proportion of asset losses	1.40944327	Simplifying assumption: suppression costs are a constant propo
Dynamics			
Annual proportional change in number of fires (e.g. due to climate change or population growth)	Proportion	0	Assumption is that losses increase in proportion
Annual proportional change in losses per asset hit by fire (e.g. due to climate change (affecting fire intensity) or increasing real values of assets (factoring out inflation))	Proportion	0	
Annual proportional change in population (used to adjust numbers of injuries and lives lost)	Proportion	0	
Annual proportional change in assets present in region		Assets are assumed to grow at this rate throughout the time period for the analysis.	
Residential properties	Number	0	
Industrial and business	Number	0	
Infrastructure	Number	0	
Water resources	Number	0	
Harvestable forest	ha	0	
Habitat/biodiversity/native veg	ha	0	
Agric: horticulture	ha	0	
Agric: vineyards	ha	0	
Agric: grazing	ha	0	
Agric: vegetable growing	ha	0	
Infrastructure: Freeway	km	0	
Infrastructure: Rail corridor	km	0	
Infrastructure: Gas Pipeline	km	0	
Infrastructure: Tranmission Lines OH	km	0	
Infrastructure: Tranmission Lines UG	km	0	
Special purpose protection zones; Schools etc	Number	0	
Agric: Horse studs	Number	0	
Residential - urban	Number	0	
Residential - rural	Number	0	
Asset type 20		0	
Asset type 21		0	
Asset type 22		0	
Asset type 23		0	
Asset type 24		0	
Asset type 25		0	
Discount rate (real)		0.05	

9

10

11

12

13

14

ortion of the value of asset losses.

. Could be positive or negative.

This is the second part of the worksheet 'parameters'

Key elements

9. Suppression costs – this is an estimate of the annual costs of suppression under the baseline regime
10. The number of expected fires may change over time due to factors such as climate change or population growth – enter the annual % increase from the baseline
11. The % of asset losses may be affected by factors such as increased fire intensity (eg due to climate change) or an increase above baseline inflation in asset values.
12. You can account for population growth (or decline) by entering a % annual change here.
13. The number of assets (e.g. residential properties) may increase (or decrease over time) – enter the % annual change here.
14. Discount rate – this can be varied according to preference – it is set by default at 5%

Worksheet – benefits and costs assumption (1)

Benefits of interventions		15	Intervention 1 Interface burning only	Intervention 2 Landscape burning only	Intervention 3 Do nothing
Proportional reduction in number of fire incidents once the intervention has fully kicked in (relative to baseline), allowing for the estimated number of extra fires that are generated by the new intervention (e.g. escapes from prescribed burning)	Proportion	16	0.00	0.02	0.05
Proportional reduction in consequences (losses) per fire once the intervention has fully kicked in, due to reduced spread and reduced intensity.	Proportion	17			
Life/injury			0.0100	0.0191	0.0240
Residential properties			0.0300	0.0308	0.0415
Industrial and business			0	0.46	0.002
Infrastructure			0.001	0.0100	0.0300
Water resources			0	0	0
Harvestable forest			0	0.0003	0.0040
Habitat/biodiversity/native veg			0	0.0076	0.0062
Agric: horticulture			0	0.0397	0.0550
Agric: vineyards			0	0.0397	0.0550
Agric: grazing			0	0.0397	0.0550
Agric: vegetable growing			0	0.0397	0.0550
Infrastructure: Freeway			0	0	0
Infrastructure: Rail corridor			0	0	0
Infrastructure: Gas Pipeline			0	0	0
Infrastructure: Tranmission Lines OH			0	0	0
Infrastructure: Tranmission Lines UG			0	0	0
Special purpose protection zones; Schools etc			0	0	0
Agric: Horse studs			0	0	0
Residential - urban			0	0.6	0.09
Residential - rural			0	0.15	0.06
Asset type 20			0	0	0
Asset type 21			0	0	0
Asset type 22			0	0	0
Asset type 23			0	0	0
Asset type 24			0	0	0
Asset type 25			0	0	0
Proportional reduction in numbers of assets expected to be in fire-prone areas due to the intervention, or reduced vulnerability of the assets	Proportion	18			
Life/injury			0	0	0
Residential properties			0	0	0
Industrial and business			0	0	0
Infrastructure			0	0	0
Water resources			0	0	0
Harvestable forest			0	0	0
Habitat/biodiversity/native veg			0	0	0
Agric: horticulture			0	0	0
Agric: vineyards			0	0	0
Agric: grazing			0	0	0
Agric: vegetable growing			0	0	0
Infrastructure: Freeway			0	0	0
Infrastructure: Rail corridor			0	0	0
Infrastructure: Gas Pipeline			0	0	0
Infrastructure: Tranmission Lines OH			0	0	0
Infrastructure: Tranmission Lines UG			0	0	0
Special purpose protection zones; Schools etc			0	0	0
Agric: Horse studs			0	0	0
Residential - urban			0	0	0
Residential - rural			0	0	0
Asset type 20			0	0	0
Asset type 21			0	0	0
Asset type 22			0	0	0
Asset type 23			0	0	0
Asset type 24			0	0	0
Asset type 25			0	0	0
Time at which benefits start to emerge	years	This may be at the er	2	5	5
Time at which benefits reach their maximum	years	Benefits reach maxir	5	1	1
Time frame for the analysis	years	Up to 20 is allowed.	20	20	20

19

Intervention 4	Intervention 5		Data source or basis for assumption
Retrofitting houses to meet new standards	Increased mechanical treatments in APZs		
0.06	0.00		
0.0007	0.0007		
0.0008	0.0008		
0.34	0.0010		
0.0008	0.0008		
0	0		
0.0004	0.0004		
0.0007	0.0007		
0.0008	0.0008		
0.0008	0.0008		
0.0008	0.0008		
0.0008	0.0008		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0.52	0		
0.08	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
0	0		
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0	0		
0	0		
0	0		
0	0		
0	0		
5	2		
1	5		
20	20		

This is the first part of the worksheet 'benefits and costs assumptions' – this part relates to the benefits associated with the selected scenarios.

Key elements

15. Describe the different intervention scenarios – these should be documented as precisely as possible here or elsewhere
16. For each intervention you need to estimate the % reduction in number of fire incidents
17. For each intervention estimate the proportional reduction in consequences (losses)
18. The number of assets expected to be in fire prone areas may change as a result of the intervention or due to reduced vulnerability (e.g. retrofitting)
19. There are three time factors to consider:
    - The time in years when the benefits start to emerge
    - The time when they reach a maximum
    - The overall time frame for the analysis – a max. of 20 years is allowed

Worksheet – benefits and costs assumption (2)

Costs of interventions					
Time frame for initial phase of intervention costs	years	Up to 20 is allowed.	2	3	20
Direct costs of intervention, initial phase					
Aircraft	$/year		1000000	0	0
Machinery	$/year		100000	100000	0
Personnel	$/year		200000	250000	100000
Meals/accommodation	$/year		25000	25000	50000
Other	$/year		0	0	0
Total	$/year		1325000	375000	150000
Direct costs of intervention, maintenance phase					
Aircraft	$/year		50000	0	0
Machinery	$/year		10000	10000	0
Personnel	$/year		150000	187500	75000
Meals/accommodation	$/year		18750	18750	37500
Other	$/year		0	0	0
Total	$/year		228750	216250	112500
Indirect costs of intervention, initial phase					
Administration/management	$/year		50000	60000	30000
Public and private costs of additional regulation	$/year		0	0	0
Other	$/year		0	0	0
Total	$/year		50000	60000	30000
Indirect costs of intervention, maintenance phase					
Administration/management	$/year		25000	30000	15000
Public and private costs of additional regulation	$/year		0	0	0
Other	$/year		0	0	0
Total	$/year		25000	30000	15000
Non-monetary indicator 1	Number		0	0	0
Non-monetary indicator 2	ha		0	0	0
		Baseline	**Intervention 1**	**Intervention 2**	**Intervention 3**
BCR (calculated on the next sheets)			**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
Non-monetary indicator 1	Number	0	0	0	0
Non-monetary indicator 2	ha	0	0	0	0

20

21

22

23

24

25

26

5	5
0	0
50000	0
50000	50000
0	10000
0	0
100000	60000
0	0
5000	0
37500	37500
0	7500
0	0
42500	45000
20000	10000
80000	0
0	0
100000	10000
10000	5000
40000	0
0	0
50000	5000
0	0
0	0
Intervention 4	**Intervention 5**
#DIV/0!	**#DIV/0!**
0	0
0	0

This is the second part of the worksheet 'benefits and costs assumptions' – this part relates to the costs associated with the selected scenarios.

Key elements

The intervention costs include both the direct costs and indirect costs, over two phases, an initial implementation phase followed by a maintenance phase.

20. Specify how long (in years) the initial phase will take – the length of the maintenance phase is automatically calculated as Tine frame for analysis minus the initial phase
21. Annual direct costs during the initial phase
22. Annual indirect costs during the initial phase
23. Annual direct costs during the maintenance phase
24. Annual indirect costs during the maintenance phase
25. Non-monetary indicators
26. BCR results are automatically calculated together with the estimated non-monetary benefits

The spreadsheet includes a series of additional worksheets that show the calculations for the baseline and intervention scenarios. These calculations are automated and it is therefore not possible to enter data, only to view the results of data entered in the 'parameters' and 'benefits and cost assumptions' worksheets.

GUIDANCE FOR THE SPREADSHEET CALCULATOR

This document provides guidance for a spreadsheet calculator designed to assess benefits and costs of fire risk mitigation strategies (such as planned or prescribed burning) relative to a defined baseline program. The assessment is over a 20-year time frame, because the tool is designed for longer-term strategic decision making rather than shorter term more tactical or reactive decision making. The tool currently is partially populated with NSW data as an example for illustration (which can be replaced) and has the following sheets:

- *Cover* – lists the version and date of the model;
- *Parameters* – these are the input parameters required by the model for the baseline fire management. We allow for the fact that the baseline may change over time. Values are to be entered in the blue cells;
- *Benefit & cost assumptions* – the idea of the tool is to calculate the benefits and costs of alternative interventions (can also be termed as scenarios) compared to the baseline. After defining the alternative interventions, each intervention is represented by a column in this sheet, and values are provided in the green cells;
- *BCRs* – this stands for Benefit: Cost Ratios. The BCRs of each intervention are summarised on this sheet. They are also shown at the bottom of the *Benefit and cost assumptions* sheet; and
- *Intervention calculations* – this shows the calculations over 20 years for each intervention (1 sheet per intervention).

This document provides guidance for using and interpreting the spreadsheet calculator and is arranged in order of the sheets in the accompanying spreadsheet tool.

Blue cells (found in the *Parameters* sheet and also a few in the *Benefit & cost assumptions* sheet) are cells that you can modify. These are either values used to calculate outcomes in the baseline scenario, or labels for asset types or cost types. Once entered, the values or labels are copied/used in other parts of the spreadsheet.

The green cells (found in *Benefit & cost assumption* sheet) also require populating – these are specific impacts associated with interventions.

COVER SHEET

The version and date of the model is listed. An overview of instructions will be added to the final version.

PARAMETERS SHEET

Definition of the case study area

Definition of the geographic extent of case study area is required (row 3). Clarity about this helps to avoid confusion when entering numerical values for the analysis. An accompanying map (PDF and/or. kml file) showing the boundary of the case study region helps all team members have a clear understanding of the study area. The area within the boundary is where management interventions are planned to occur, for both baseline and alternative interventions. The following information would be valuable to display on a map or maps:

- Major land use types (e.g. conservation areas, public land, urban areas, agricultural land, rural living areas, significant infrastructure assets etc.);
- Bushfire management zones (e.g. Asset Protection Zones, Strategic Fire Advantage Zones, Land Management Zones etc.); and
- Bushfire Management Treatment areas (e.g. prescribed burn history etc.).

In addition it would be useful to have a brief description of the case study area.

At this stage, we recommend that this information be recorded in separate files. If we convert the tool to be web based, it would include room for this information.

Baseline fire management regime/policy

The baseline fire management regime needs to be clearly defined (write it in row 5). ***It is extremely important to be clear about what the baseline management scenario is,*** including any changes expected in the baseline over the coming 20 years. All of the intervention scenarios are measured relative to the baseline. The project team and fire simulation modellers need to work closely together and both understand the baseline and interventions being assessed, so that the information collected is appropriate for the analysis. This is true both for cases where the information is generated by fire simulation modelling and where it is obtained from other research or from expert judgements.

As part of the baseline definition, define the starting fuel load. The fuel load may evolve over time depending on the management scenario.

Thinking about the baseline

The baseline needs to be a management regime which participants identify with (a realistic, and hopefully, recognisable regime). It is the scenario against which alternative scenarios will be assessed. Whilst in theory the baseline does not have to represent current fire prevention and management regimes, it commonly makes sense for this to be the case, in which case the baseline can also be called the 'business-as-usual' or 'current practice' scenario.

Whatever the baseline is, it needs to be defined specifically enough to be able to provide a range of information about it, including:

- The numbers and values of assets of various types;
- Average annual losses for each type of asset under the baseline regime, that is the baseline level of expected losses under this regime;
- Any consequent losses – other losses that flow on from asset losses (e.g. loss of electricity poles might cause losses of stock or sales to businesses in the region) that would be expected under the baseline regime; and
- Suppression costs – this is the average expenditure on fire suppression under the baseline regime. It is important to differentiate this from the costs associated with implementing the baseline (e.g. current levels of prescribed burning).

Specifying the baseline needs to include factors such as:

- Area and frequency of burns in asset protection zones and the resources needed to achieve this;

- Area and frequency of burns in landscape burns and associated usual resources;
- Amount of other hazard reduction strategies such fuel removal, fire trails, etc.;
- Community education measures;
- Other management such as prosecution, permits , manning towers, closure of recreation areas, monitoring, and whether houses are required to be built to new standards; and
- Suppression strategies – resources (number and type) for fire suppression, including in bad fire years.

An example baseline defined for a case study area in NSW was *'The current mix of asset protection zone interventions and landscape prescribed burning regimes'.* This implicitly encompasses all of the factors listed above. However, it would probably be advisable to spell out the various factors in a bit more detail, so that participants have clarity about what the baseline includes when parameter values are being generated.

Human life factors

We come to the first of the numerical values required. In rows 8-11 of the *Parameters* sheet, provide the current population, the value of a statistical life and value of injury and mental health losses.

The current population can be estimated based on census data or other knowledge.

The value of a statistical life is the amount that an individual or a government is willing to spend to avoid the loss of a life. It is not the value of preventing a particular person dying at a particular time. Rather it is probabilistic and non-specific, but that is appropriate for long-term planning to protect lives in general. To specify a value, we recommend following the guidance of (Anon. 2014).

We provide the facility to enter a value for injury and/or mental health losses. In the current model, these are specified as a value per statistical life lost. In other words, they are assumed to be proportional to the number of lives lost. Options for providing this number include: past research, expert opinion, assuming it is zero or assume it is a simple proportion of the value of a statistical life.

For these values, and all other values, we recommend that you record the source and/or basis for the estimate. We provide a space in column J for you to do so. Alternatively, you can enter comments within the spreadsheet behind the relevant cells.

Assets (current)

There is a default set of names for asset types in the spreadsheet. These can be altered if desired, in the blue cells A14 to A38 of the *Parameters* sheet. The units of measure for each of the asset types also need to be defined (column B). For example, depending on the type of asset, the units could be numbers, hectares or kilometres.

The current number of units of each asset type in the case study area needs to be defined (column C).

For each asset type, there are three different types of costs that can occur if the asset is lost. The three types of costs are additive.

- Replacement cost (column D). This is the cost of replacing the asset if lost (for example, for residential properties it would be the house replacement cost, not the land plus house value);

- Direct loss of profit or utility as a result of losing the asset (column E). This represents additional losses of profit or utility for the owner of the asset, beyond the replacement cost for the asset. There is often limited information about this. For some assets there will be no additional losses of profit or utility. If you think there are likely to be such losses then it could be estimated as a proportion of the replacement cost of the asset. Alternatively it could be set at zero with the understanding that the overall results will be conservative (under-estimate the benefits); and
- Consequent indirect or flow-on losses as a result of losing the asset (column F). This represents losses of profit or utility for people other than the owner of the asset. An example loss of infrastructure (e.g. a phone line or mobile phone tower) that results in a loss in profit to businesses. Another is blockage of a major road due to fire, preventing customers from reaching a business. The figures required here are long-term average annual levels of consequent losses. These losses are even harder to estimate than direct losses.

Non-monetary indicators

There may be indicators of loss that are not expressed in monetary terms, but which nevertheless can be predicted and measured. An example might be hectares of habitat loss for a particular critically endangered species. The tool includes the facility to capture and report on these indicators and the difference that is made by the various strategies. Each indicator should be named (column A) and the unit's specified (column B) along with the number for the baseline (column C).

Average annual losses for each asset type (baseline)

For each asset the average annual losses under the baseline need to be estimated. Where fire simulation modelling is used, this could be the mean loss of the distribution. Alternatively it could be losses based on the historical data from fires in relevant areas. Ideally, loss estimates would consider the range of possible fire severities, and the frequencies of fires for each level of severity. Remember that results need to be expressed per year. For example, if there is on average one catastrophic fire every five years, the annual loss due to catastrophic fires will be 20% of the expected loss from one fire. If there are 20 moderate sized fires per year, the annual losses for moderate should be calculated as the expected loss from one moderate fire times 20.

Annual losses are specified in column C in terms of the specified units for each asset type (column B). These units are copied down from the previous table. The total value lost is calculated (column E) and summed for all asset types for which monetary values have been estimated.

Suppression costs

Provide an estimate of the average annual suppression costs for the baseline burning regime***. It is important to note that this is the cost associated with putting out fires that occur with the baseline regime in place, not the cost of implementing measures associated with the baseline regime (e.g. current levels of prescribed burning).*** This represents the total cost for the whole area. These costs include all costs related to suppression, including costs of equipment, salaries of fire fighters, food and accommodation, and other required support (e.g. administration).

Suppression costs vary from year to year depending on the severity of the fire season. The figure included here should be the average across a run of seasons, including relatively good and relatively severe seasons.

Preferably, this value would be estimated from historical information on actual suppression costs over a number of years.

As well as local knowledge key findings from published papers might be useful to prompt thinking about suppression costs. We aren't suggesting the findings will apply to a particular situation, more to prompt some of the things which need to be thought about:

- Suppression costs were found to be most strongly related (58% variation explained) to fire size and private land in the north-western United States. Sixteen non-managerial factors were considered, covering fire size and shape, private properties, public land attributes, forest and fuel conditions, and geographic settings (Liang *et al.* 2008);
- Variables having the largest costs in other United States study were fire intensity, area burned and total housing value within 20 miles of ignition (Gebert, Calkin, and Yoder 2007);
- Another United States study (Mangan, 1999 page 32 cited in (Anon. 1999) estimated that average spending in aviation resources including equipment, food, showers, and toilets was 56.6% of total costs, with personnel being 31.7%;
- In Spain, fire prevention strategies costed around 33% and fire suppression 67% of the total fire management budget (Velez, 1999 page 171, cited in Anon. 1999);
- Fire managers increase suppression spending in areas where there is increased newspaper coverage and political pressure in response to increase risk of adverse wildfire outcomes (Dononvan, Prestemon, and Gebert 2011);
- Suppression costs are driven by the amount and type of firefighting resources used and the duration of the incident. The deployment of these resources is in turn influenced by a multitude of factors including incident management strategies and tactics, proximity to human communities and private property, weather and landscape conditions driving fire behaviour, and sociopolitical issues (Thompson and Anderson 2015); and
- More houses equate to increases in suppression costs. In California the expected increase in the log daily cost with each unit increase in the log count of homes within 6 miles (9.7km) of an active fire is 0.07 (P=0.005) (Gude *et al.* 2013).

Dynamics

Because the benefits and costs of fire management interventions are being considered over a 20-year time frame, in some case study areas considerable changes (e.g. population growth) could occur. These can be included where relevant.

Dynamics can be included in the following areas:

- Annual proportion in the number of fires that occur, for example, due to climate change or population growth;
- Annual proportional change in losses per asset hit by fire, for example, due to climate change which affects fire intensity or increasing real value of assets (factoring out inflation);
- Annual proportional change in population, which is used to adjust the numbers of lives lost and injury impacts; and
- Annual proportion change of assets in the case study region. Separate numbers can be entered for each type of asset.

These can be left as zero if no particular changes are expected or can be estimated.

Discount rate (real)

We recommend the use of 5% as a suitable real discount rate, but another rate can be used if desired.

BENEFIT AND COST ASSUMPTIONS SHEET

This sheet deals with the benefits and costs of the interventions being considered.

Benefits of the interventions

Just as was done for the baseline, each intervention being considered needs to be clearly defined and specified. Each intervention will differ from the baseline scenario, and the aim of the analysis is to determine whether the additional benefits (relative to the baseline) outweigh the additional costs.

Defining the interventions

Each intervention (also called scenarios) needs to be defined and a summary title put in row 2. It should be sufficiently well specified in an accompanying document that the assumptions are clear enough to enable the reader to follow the logic about the assumptions about benefits and costs.

Each intervention needs to be described clearly enough to enable the benefits to be estimated. The three types of benefits to be estimated are the:

- Proportional reduction in number of fire incidents once the intervention has fully kicked in (relative to baseline), allowing for the estimated number of extra fires that are generated by the new intervention (e.g. escapes from prescribed burning);
- Proportional reduction in consequences (losses) per fire once the intervention has fully kicked in due to reduced spread and reduced intensity; and
- Proportional reduction in number of fire incidents once the intervention has fully kicked in (relative to baseline), allowing for the estimated number of extra fires that are generated by the new intervention (e.g. escapes from prescribed burning).

Example interventions (each of which would need more specific information to be included) could be:

- Increased prescribed burning at a landscape scale. The area of increase and location would need to be specified so that the additional benefits and costs can be estimated;
- New houses in specified vulnerable locations could be built to an improved standard to reduce fire damage;
- Increased interface burns in asset-protection zones. The amount and location of these would need to be defined specifically to enable the additional benefits and costs to be estimated; and
- Increase mechanical interventions to reduce/remove fuel. The locations would need to be specified as well as whether the intervention is in addition to or at least partly replaces the current (baseline) management regime.

Note that it is possible to define an intervention scenario that involves less intense management and higher losses than the baseline. In this case, the reduction in losses (in the benefits section) would be negative, signifying that losses increase, and the additional costs would also be negative, signifying that costs are less than the baseline.

Guidance on adding new interventions is provided at the bottom of the Benefits and costs assumptions sheet and reproduced below.

To add in a new intervention, follow these steps:

1. Add in a green column of numbers for the intervention, in rows 3-93 above;
2. Enter appropriate numbers in the new green cells;
3. Create a new sheet for this intervention by copying one of the existing intervention sheets;
4. On that new sheet, in the benefits section, for each asset type, do a search and replace for $D (or whichever green column has the original green numbers for the sheet you copied) to $E or whichever green column contains the new parameters);
5. In the row of BCRs (just above here), link to the BCR result in the new sheet; and
6. Add the new intervention into the BCRs sheet.

Estimating the benefits of interventions

There are three main concepts in considering the benefits of the intervention:

- The proportional reduction in number of fire incidents once the intervention has fully kicked in (row 3). This needs to allow for the estimated number of extra fires that are generated by the new intervention (e.g. escapes from prescribed burning);
- The proportional reduction in consequences per fire once the intervention has fully kicked in, due to reduced spread and reduced intensity (row 6 onwards for each relevant asset type); and
- The proportional reduction in numbers of assets expected to be in fire-prone areas due to the intervention, or reduced vulnerability of the assets (row 35 on). Note that this is only likely to be relevant for interventions involving changed planning standards or building regulations.

Note: Reduced suppression costs will be a benefit associated with interventions. A simplifying assumption is that the suppression costs will be a constant proportion of the asset losses; that is if the intervention is predicted to reduce asset losses, the suppression costs will be decreased in proportion.

Timeframes

There are three concepts here based on a concept of an initial period of intervention implementation (or roll out phase), followed by a maintenance phase:

- Time at which the benefits start to emerge (row 61). For some interventions this might correspond to the end of the initial phase of implementing the intervention (see row 66) and for other interventions there may be a delayed effect. The benefits of the intervention will be calculated after this time;
- Time at which benefits reach their maximum level. Depending upon the intervention this may well occur some years after the initial phase of the project; and

- Time frame for the analysis – up to 20 years. Less can be specified if required.

Costs of the interventions

These are the costs, additional to the baseline, that are required to implement the intervention.

The time frame for the initial phase of the intervention costs is listed in row 66. It is assumed that a different (probably higher) level of costs is borne in this period, relative to the maintenance phase. For interventions which don't have an initial start-up phase, the time frame for the initial phase would be set at zero.

There are four components to considering annual costs, direct and indirect costs and initial and maintenance phases of the costs.

Direct costs: For the direct costs there are some suggested headings in the blue cells (aircraft, machinery, personnel, meals/accommodation and other; these can be modified to reflect the scenario better as required) to help think about cost items involved. These are summed to give a total annual cost for the initial phase. These same cost headings are used to estimate the maintenance phase direct costs.

Indirect costs: Headings of administration/management and public and private costs of additional regulation are suggested as headings to help think about indirect costs in each of the initial and maintenance phases.

Non-monetary indicators under each scenario

If non- monetary indicators have been specified, the indicator levels for each scenario need to be provided. There are absolute levels of the indicators, not changes relative to the baseline.

The benefit: cost ratios for each scenario and non-monetary indicators are summarised at the end of this sheet (rows 96-98).

BCR SHEET

This sheet repeats the calculated benefit: cost ratios and non-monetary indicators.

BASELINE CALCULATION SHEET

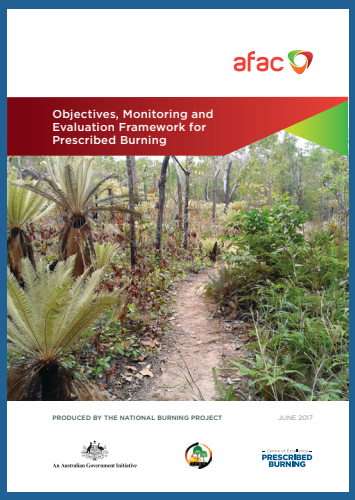
This sheet shows the asset values and losses for the baseline scenario, over time. The values and losses are all shown in real terms, meaning that inflation has been factored out of them.

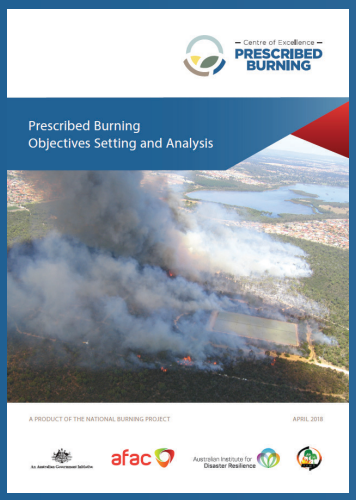
INTERVENTION CALCULATION SHEETS

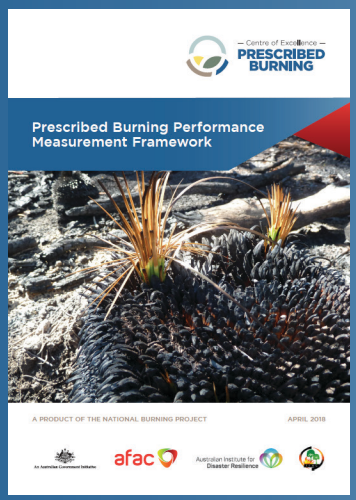
These sheets show the benefits and costs for each scenario over time, broken down into asset types and cost types. The benefits and costs are all shown in real terms, meaning that inflation has been factored out of them. If the numbers are going up over time, it means they are increasing at more than the rate of inflation.

At the bottom of each sheet, the benefits and costs of the intervention are summarised as total present values, based on standard discounting methods.

Source: Tasmanian Parks and Wildlife Service







Objective Setting and Analysis

Analysis of Tools and Methodologies to Balance Competing Objectives of Burning Programs

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