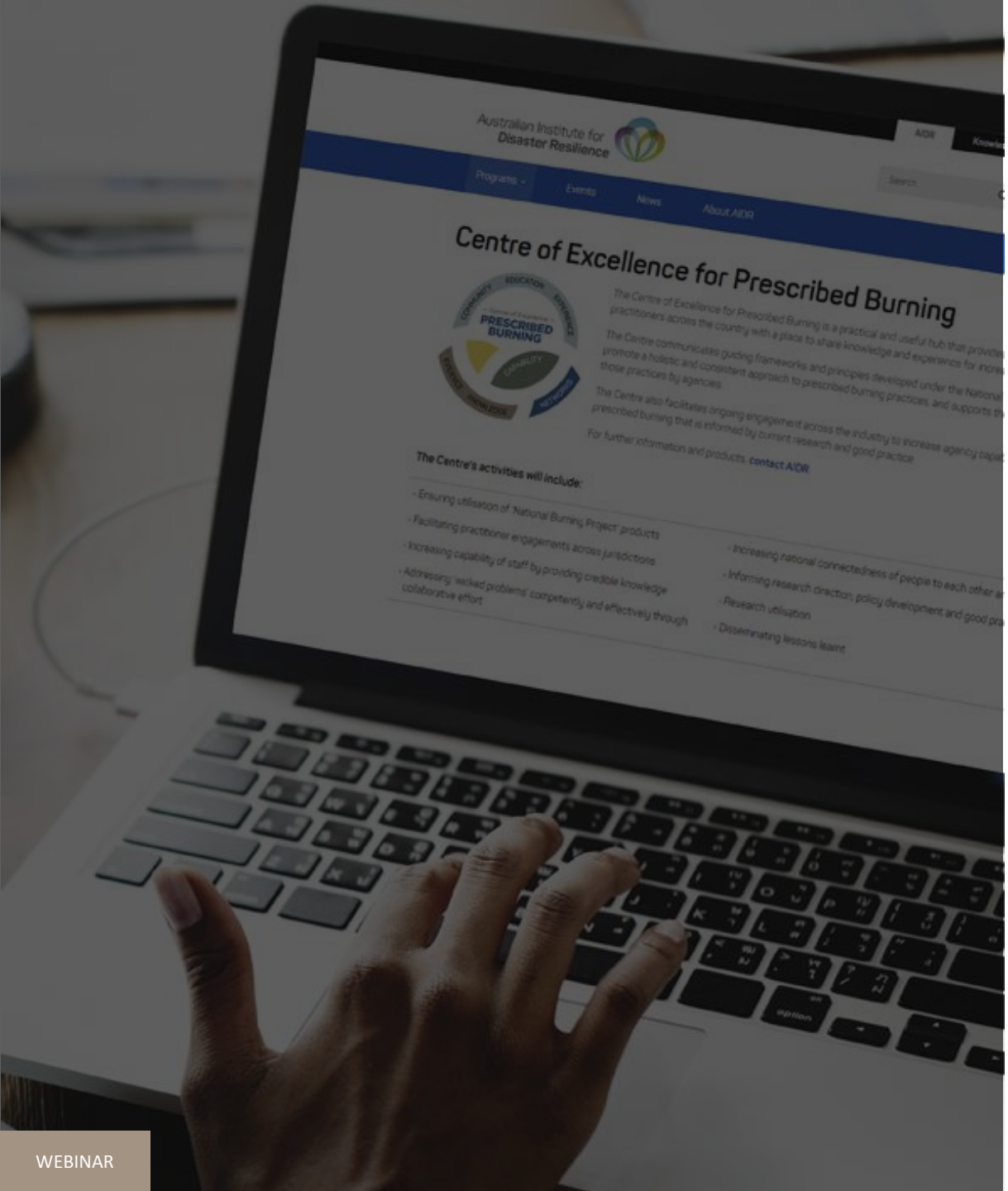

WEBINAR

Australian Institute for Disaster Resilience

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— Centre of Excellence —
PRESCRIBED BURNING

Prescribed burning objectives: cost-benefit analysis

PRESENTER

Geoff Park, Natural Decisions

DATE

May 2018

National Burning Project
Sub-project 2

- Analysis of tools and methodologies to balance competing objectives of burning programs and matching these to users

Geoff Park and Anna Roberts

16th May 2018

Project aims

- To determine the availability and suitability of tools and methodologies used by fire management agencies to set objectives, and to measure and evaluate the implementation of prescribed burning programs

- Develop case studies to inform the operationalisation of prescribed burn planning tools

Background

Two stages

1. Analysis of existing tools
   - Report available
2. To develop a separate Benefit: Cost Analysis tool which would use inputs from existing fire simulation and risk assessment tools and processes.

Stage 2 – Tool dev't and testing

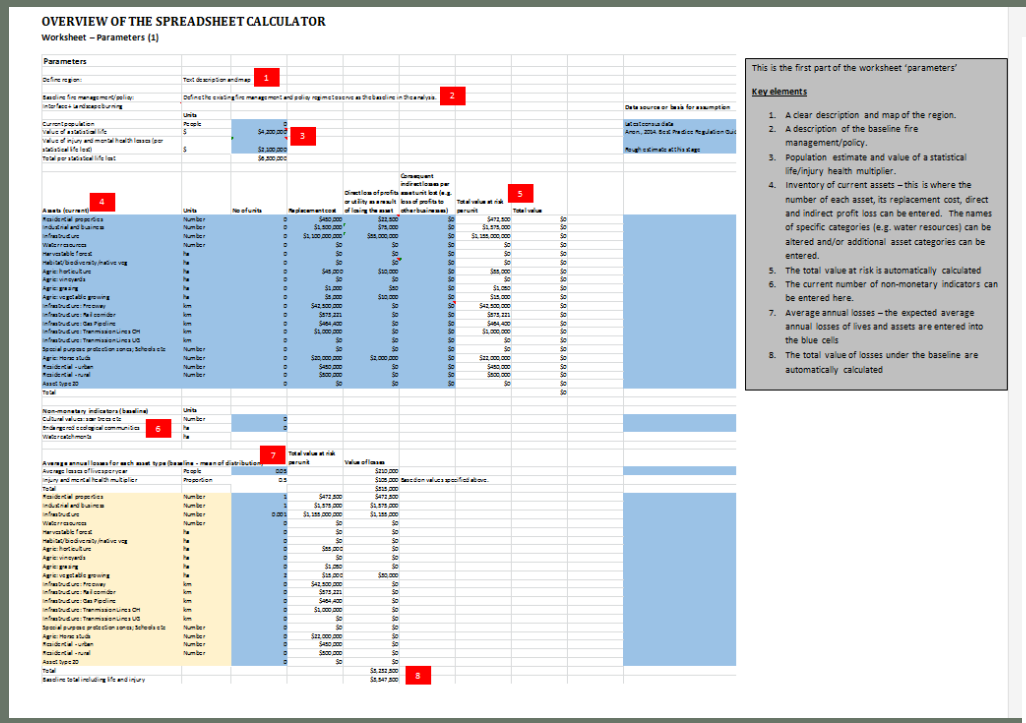
- Develop new tool(s)
  - General framework for non-experts to help understand elements of the problem and identify data needs
  - Detailed version to assess the full range of benefits and costs.

- Build on learnings from previous work
- Develop in partnership with fire agencies
  - Important for being useful in strategic decision-making relating to prescribed burning

Case study criteria

- Current and ongoing threat from bushfire
- Significant ecological, social and economic values
- Interest in different management policy options
- Level of institutional interest
  - Key personnel to assist the project team in the assessments
  - Timely provision of required data
  - Participation in expert workshops
- Potential transferability/application of findings to other environments and jurisdictions
- Potential costs to participants and to the project

Overview of the Tool & Guidance Template



OVERVIEW OF THE SPREADSHEET CALCULATOR

Worksheet – Parameters (1)

Parameters

Define region: Text description and map 1

Baseline fire management/policy: Define the existing fire management and policy regime to serve as the baseline in the analysis 2

Interface = Landscape burning

	Units			Data source or basis for assumption
Current population	People	0		
Value of a statistical life	$	$4,200,000	3	Lee Consulting Data
Value of injury and mental health losses (per statistical life lost)	$	$2,100,000		Arson, 2004: Bush Fire Prediction Regulation Guide
Total per statistical life lost		$6,300,000		Rough estimate at this stage

4 5

Assets (current)	Units	No of units	Replacement cost	Direct loss of profits/asset/unit lost (e.g. or utility as a result of losing the asset	Consequent indirect losses per asset/unit lost (e.g. loss of profits to other businesses)	Total value at risk per unit	Total value
Residential properties	Number	0	$480,000	$22,500	$0	$472,500	$0
Industrial and business	Number	0	$1,500,000	$75,000	$0	$1,575,000	$0
Infrastructure	Number	0	$1,100,000,000	$55,000,000	$0	$1,155,000,000	$0
Water resources	Number	0	$0	$0	$0	$0	$0
Harvestable Forest	Ha	0	$0	$0	$0	$0	$0
Habitat/Biodiversity/native veg	Ha	0	$0	$0	$0	$0	$0
Agric: Horticulture	Ha	0	$40,000	$10,000	$0	$50,000	$0
Agric: vineyards	Ha	0	$0	$0	$0	$0	$0
Agric: grazing	Ha	0	$1,000	$80	$0	$1,080	$0
Agric: vegetable growing	Ha	0	$8,000	$10,000	$0	$18,000	$0
Infrastructure: Freeway	km	0	$42,500,000	$0	$0	$42,500,000	$0
Infrastructure: Rail corridor	km	0	$873,221	$0	$0	$873,221	$0
Infrastructure: Gas Pipeline	km	0	$484,400	$0	$0	$484,400	$0
Infrastructure: Transmission Line OH	km	0	$1,000,000	$0	$0	$1,000,000	$0
Infrastructure: Transmission Line UG	km	0	$0	$0	$0	$0	$0
Special purpose protection zones; Schools etc	Number	0	$0	$0	$0	$0	$0
Agric: Horse studs	Number	0	$20,000,000	$2,000,000	$0	$22,000,000	$0
Residential - urban	Number	0	$400,000	$0	$0	$400,000	$0
Residential - rural	Number	0	$600,000	$0	$0	$600,000	$0
Asset type 20		0	$0	$0	$0	$0	$0
Total							$0

Non-monetary indicators (baseline)	Units		
Cultural values: sacred sites etc	Number	0	
Endangered ecological communities 6	Ha	0	
Water catchments	Ha		

7

Average annual losses for each asset type (baseline – mean of distribution)			Total value at risk per unit	Value of losses	
Average losses of lives per year	People	0.08		$510,000	
Injury and mental health multiplier	Proportion	0.5		$255,000	See Gov values specified above.
Total				$765,000	
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	$50,000	$0	
Agric: vineyards	Ha	0	$0	$0	
Agric: grazing	Ha	0	$1,080	$0	
Agric: vegetable growing	Ha	0	$18,000	$30,000	
Infrastructure: Freeway	km	0	$42,500,000	$0	
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Special purpose protection zones; Schools etc	Number	0	$0	$0	
Agric: Horse studs	Number	0	$22,000,000	$0	
Residential - urban	Number	0	$400,000	$0	
Residential - rural	Number	0	$600,000	$0	
Asset type 20		0	$0	$0	
Total				$1,157,500	
Baseline total including life and injury				$8,547,500	8

This is the first part of the worksheet 'parameters'

Key elements

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

APPENDIX 2: 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).
- *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

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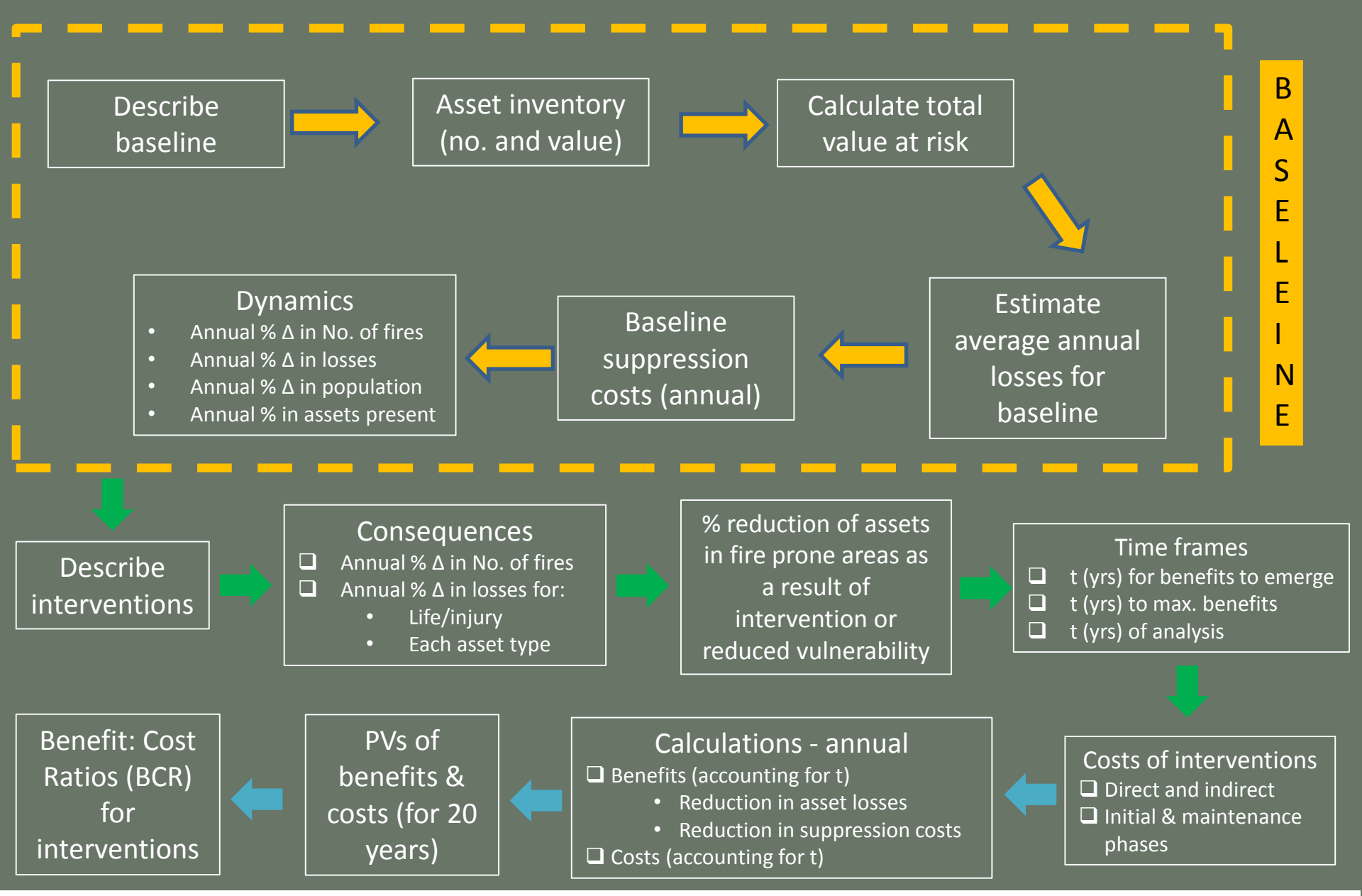
Information requirements (1)

Step 1: Define the geographic boundary

Step 2: Define the existing fire management and policy regime (base-line)

Step 3: Define the interventions to be assessed

- These require clear specification

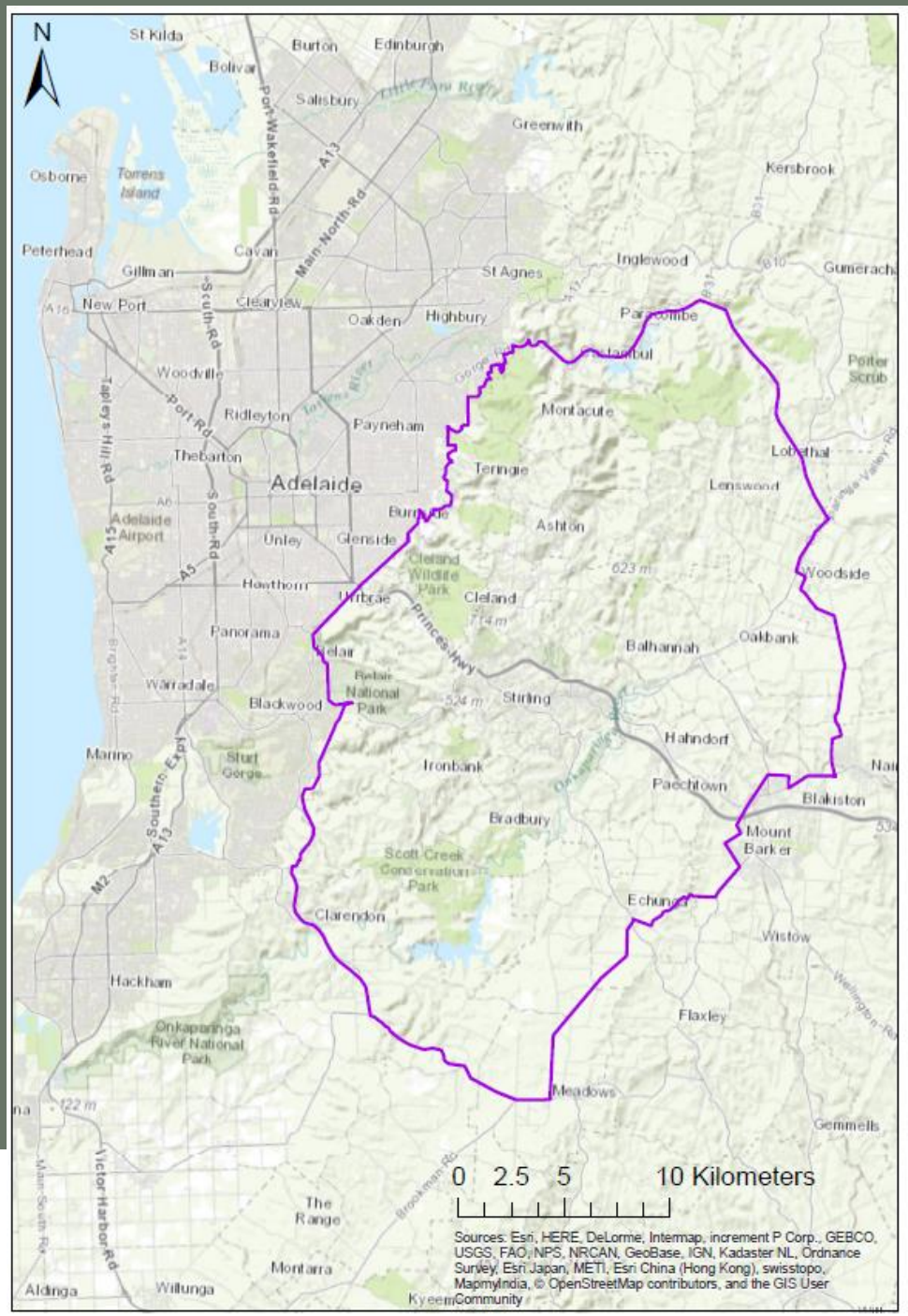


Natural Decisions

www.naturaldecisions.com.au

Adelaide Hills Case study (SA)

- Mix of private & public land (approx. 3:1) with growing urban expansion and rural residential development.
- High bushfire risk area with recent significant bushfires (Pinery 2016, Sampson Flat 2015, Eden Valley 2014) either within or adjacent to study area.
- Size of study area ~ 60,000 ha
- Predominant land use/activities in area include: grazing, horticulture (grapes & fruit), forestry (softwood plantations), conservation, water supply, hobby farming.
- A significant proportion of bushland (high fuel hazard & high conservation value) occurs on private land.



Adelaide Hills Case Study Area

Adelaide Hills Case Study

Baseline …Current level of burning on public land but no burning on private land

Interventions:

1. Prescribed burning on 2.8% of private land. Public land as for base case.
2. Prescribed burning on 5.2% of private land. Public land as for base case.
3. Prescribed burning on 8.1% of private land. Public land as for base case.
4. Total area of prescribed burning as for base case, but 20% is shifted to private land
5. Total area of prescribed burning as for base case, but40% is shifted to private land
6. Total area of prescribed burning as for base case, but 70% is shifted from public to private land
7. Base-case prescribed burning plus additional weed spraying in other areas.

SA: Intervention 1

Baseline
x ha/yr of PB on public land

Asset inventory (no. and value)
44,920 people
13,233 houses etc.

Calculate total value at risk
$B 8.14

Estimate average annual losses for baseline
0.2 lives/yr
5 houses/yr etc.
$M 9.19/yr

Baseline suppression costs
$M 2.40/yr

Dynamics
- Annual % Δ in No. of fires (1%)
- Annual % Δ in losses (1%)
- Annual % Δ in population (1%)
- Annual % in assets present: Houses/business(1%), grazing & cropping (-1%), vineyards(1%)

BASELINE

Intervention 1
PB on 2.5% of private land

Consequences
- ❑ Annual % Δ in No. of fires (-5%)
- ❑ Annual % Δ in losses for:
  - Life/injury (-2%)
  - Each asset type (-3% of houses etc.)

% reduction of assets in fire prone areas as a result of intervention or reduced vulnerability
(set at nil for all asset types)

Time frames
- ❑ t (yrs) for benefits to emerge (2)
- ❑ t (yrs) to max. benefits (5)
- ❑ t (yrs) of analysis (20)

Costs of interventions
- ❑ Direct and indirect
- ❑ Initial & maintenance phases

$ 219,066/yr

Calculations - annual
- ❑ Benefits (accounting for t)
  - Reduction in asset losses $ 851K+
  - Reduction in suppression costs $ 58K+
- ❑ Costs (accounting for t) $ 219K

PV (over 20 years)
benefits: $M 8.99
costs: $M 2.73

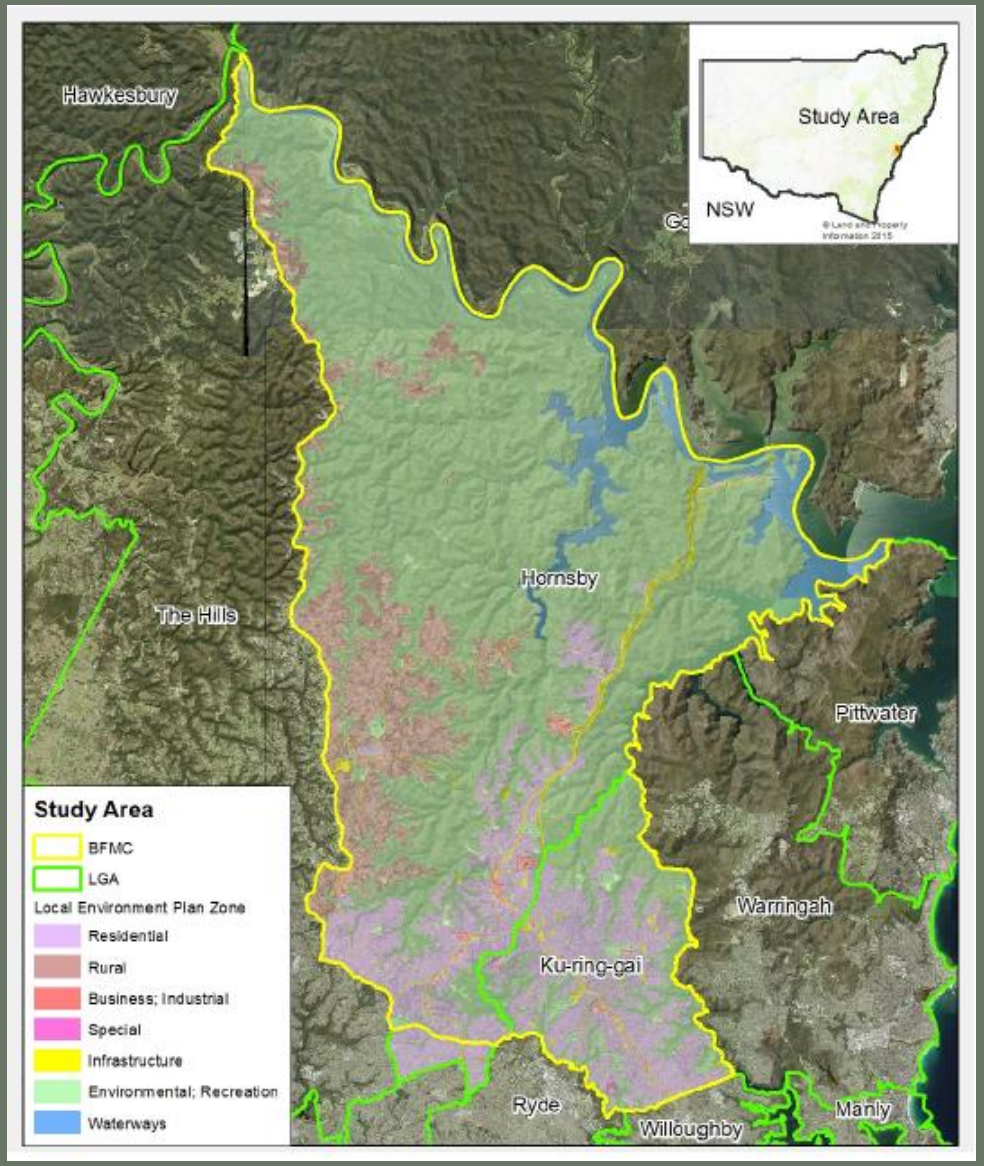
Benefit: Cost Ratios (BCR)
3.29

Overview of BCR Results – Adelaide Hills

Intervention	Δ in fire incidents % reduction	Δ Lives lost % reduction	Δ Houses lost % reduction	Δ Asset losses (reduction)	Δ Suppression cost (reduction)	Intervention cost	BCR
1. PB on 2.5 % of Private land	1.03%	0.67%	0.69%	$851,108	$57,616	$219,066	3.29
2. PB on 5 % of Private land	3%	2%	2%	$2,508,200	$169,792	$699,393	3.04
3. PB on 8 % of Private land	4%	3%	3%	$3,531,932	$239,093	$658,730	4.55
4. 20% of PB shifted to private land	0.07%	0.02%	0.02%	$33,706	$2,282	$18,035	1.58
5. 40% of shifted to private land	0.07%	0.02%	0.02%	$40,316	$2,729	$36,070	0.95
6. 70% of shifted to private land	0.08%	0.02%	0.03%	$43,401	$2,938	$27,052	1.36
7. Weed control	0.0072%	0.003%	0.0034%	$4,390	$297	$304,758	0.01

NSW Case study

- Hornsby- Kuringai Bushfire Risk Management Plan area
  - Typically uniform rainfall throughout the year (although higher rainfall can be experienced in the months of February to March)
  - Bush fire season generally runs from October to March when prevailing weather is strong northwest winds, low humidity and high temperatures.
  - Highest probability of bush fires occurs in December and January.
  - On average 40 bush fires per year … expected to experience major bush fires every 7-10 years.
  - Total area is 59,300 ha (54% NPWS, 9% Local Gov, 28% Private) – high levels of native vegetation close to urban interface
  - ~266,00 people
- Baseline: Current PB/hazard reduction
  - Current levels (past 5 years) of prescribed burning: interface (256 ha/yr) and landscape (556 ha/yr)
  - Other hazard reduction activities (manual HR, Comm. Ed., Ignition management)



Hornsby-Berowra Case Study Area

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NSW Case study

- Baseline … current level of interface and landscape burning
- Interventions
  1. Increase interface burning from 256 ha to 586 ha annually (maintain current level of landscape burning)
  2. Increase landscape burning from 556 ha to 1271 ha (maintain current level of interface)
  3. Increase interface burning to 586 ha and landscape burning to 1271 ha
  4. Retrofitting houses to meet new standards
  5. Increased mechanical treatments in APZs
  6. Do nothing – let fuel accumulate to max. level

NSW: Intervention 1

BASELINE

Baseline
256 ha/yr Interface + 556 ha/yr landscape burning

Asset inventory (no. and value)
266,144 people
94,315 houses etc.

Calculate total value at risk
$B 59.037

Estimate average annual losses for baseline
0.064 lives/yr
1.6 houses/yr etc.
$M 1.76/yr

Baseline suppression costs
$M 5.95/yr

Dynamics
- Annual % Δ in No. of fires (0%)
- Annual % Δ in losses (0%)
- Annual % Δ in population (1.2%)
- Annual % in assets present (0%)

Intervention 1
↑Interface burning to 586 ha/yr

Consequences
- ❑ Annual % Δ in No. of fires (-3.1%)
- ❑ Annual % Δ in losses for:
  - Life/injury (-60 %)
  - Each asset type (-60% of houses etc.)

% reduction of assets in fire prone areas as a result of intervention or reduced vulnerability
(set at nil for all asset types)

Time frames
- ❑ t (yrs) for benefits to emerge (1)
- ❑ t (yrs) to max. benefits (3)
- ❑ t (yrs) of analysis (20)

Costs of interventions
- ❑ Direct and indirect
- ❑ Initial & maintenance phases

$ 299,970/yr

Calculations - annual
- ❑ Benefits (accounting for t)
  - Reduction in asset losses $997K+
  - Reduction in suppression costs $M 3.37
- ❑ Costs (accounting for t) $300K

PV (over 20 years)
benefits: $M 47.75
costs: $M 3.74

Benefit: Cost Ratios (BCR)
12.77

Overview of BCR Results – Hornsby

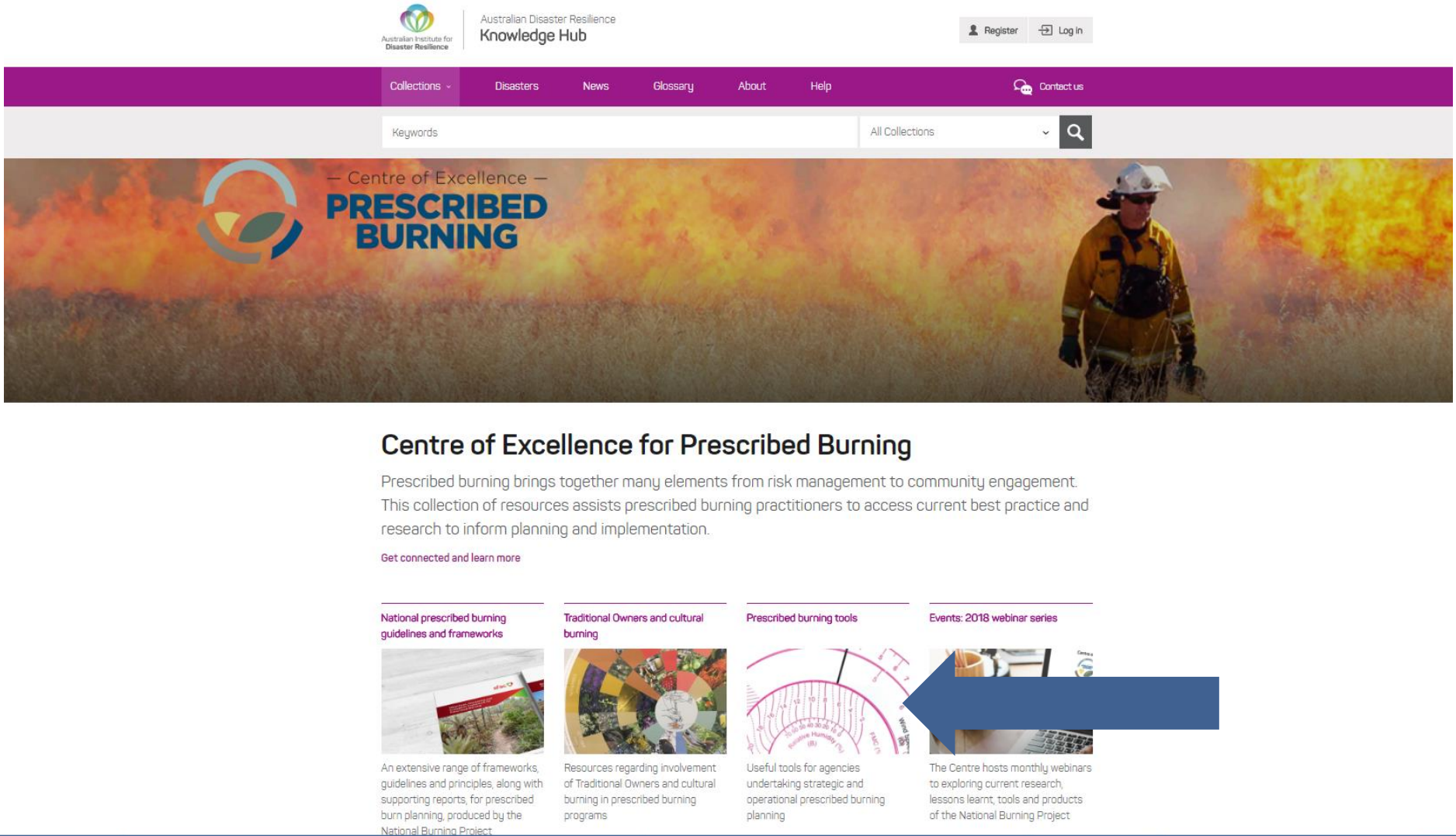
Intervention	Δ in fire incidents % reduction	Δ Lives lost % reduction	Δ Houses lost % reduction	Δ Asset losses (reduction)	Δ Suppression cost (reduction)	Intervention cost/yr	BCR
1. Increase Interface burning	3.1%	60%	60%	$997,913	***$3,370,406***	$299,970	12.77
2. Increase landscape burning	9%	50%	50%	$943,668	***$3,187,196***	$726,440	4.98
3. Increase interface + landscape burning	10.5%	73%	73%	$1,227,369	***$4,145,483***	$1,026,410	4.59
4. Retrofitting	0%	66%	66%	$768,265	***$2,594,781***	$105,434,000	0.08
5. Increase mechanical APZ	0%	4%	4%	$53,649	***$181,197***	$146,000	2.52
6. Max. Fuel	+51.2%	+595%	+595%	+$15,104,339	***+$51,014,205***	-$1,026,410	0.02

Some reflections

- Thinking clearly about the baseline was a major challenge
- Was difficult to get information on costs
  - Difference between intervention costs and suppression costs
- Fire behaviour modelling is great but there is a temptation to assume the outputs will fit neatly into the model … need dialogue between modeller and analyst
- Decrease in costs (suppression) is actually a benefit!

Key Learnings (1)

- Different mind sets associated with the disciplinary expertise of project participants
- Time and effort required to develop a shared understanding
- Information limitations, data gaps and integration with fire modelling
- Flexibility of the BCT to receive data inputs
- Believability of the results



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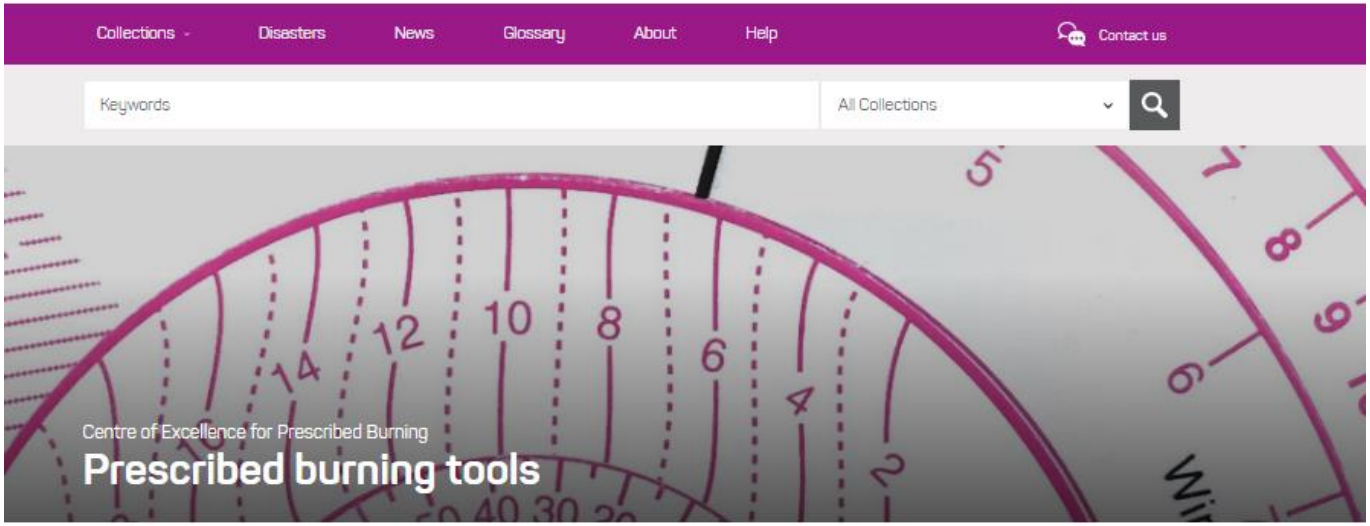

Documents

PDF

3.2 MB

Objectives Setting and Analysis User Guide

This user guide is provided for agencies who are using the Objectives Analysis spreadsheet tool.

Download

XLSX

0.2 MB

Objectives Setting and Analysis cost-benefit tool

This tool is designed for longer-term strategic decision making rather than shorter-term decision making; the latter is often more tactical or reactive. The tool is partially populated with NSW data for illustrative purposes only; users should replace this and complete the spreadsheet with data specific to the region in question.

Download

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LAURENCE McCOY – NSW RURAL FIRE SERVICE

MIKE WOUTERS – DEPARTMENT OF ENVIRONMENT AND WATER - SA