Bushfire Interface Risk Modeling

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CSIRO - Manufacturing & Infrastructure Technology

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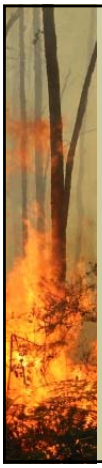

Background

- Bushfire impact on the urban interface over the past seven decades has taught us many lessons
- The general principles of how bushfires impact on the urban interface are now well established
- However we still lack the formal quantification of the most critical aspects of urban interface risk prediction
- The recent ACT bushfires stand as a reminder that previous urban impacts events do not represent the worst case scenarios for many aspects of the fire event.

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Purpose

- Predict the risk of destruction of any specific house at the bushfire interface
- The application of this model will:
  - Provide a risk estimate for any given building/environment/people scenario
  - Quantify the potential for mitigating risk for various features of building construction and town planning layout
  - Develop meaningful protocols for assessing building components and design

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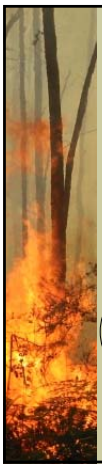
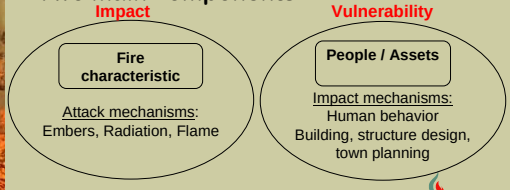


Base for the risk model

- The formal definition of Risk according to the Australian Standard is:

  'the chance of something happening that will have an impact upon objectives'

- Two main components



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Base for the risk model

- Spatial representation taking into account
  - The bushfire events
  - The individual element between the bushfire and the house that could contribute to or mitigate structural loss
  - The house design
  - Influence of human behavior
- Probability of ignition
  - Assess with physical model
  - Apply fundamental knowledge of bushfire attack mechanisms
  - Draw on extensive database of house ignition mechanisms
  - Draw on database of human behaviour influences

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Parameters for the risk model

- Bushfire event characteristics
  - Flame
  - Radiation
  - Ember attack
  - Environmental conditions
  - Synergistic affects of above
- Vulnerability
  - Combustibility
  - Configuration of combustible surfaces
  - Gaps in structure
  - Effects that led to gaps
  - Environmental conditions

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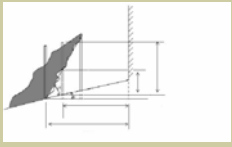
Bushfire event characteristic

Flames
- Characteristics
- Duration
- Area of impact



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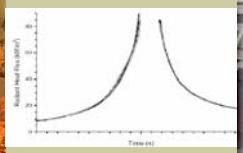
Bushfire event characteristic

Radiation
- intensity
- Duration
- Angle of attack



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Bushfire event characteristic

Embers

- Number
- Behaviour
- Quality
- Timing
- Orientation
- Windborne debris

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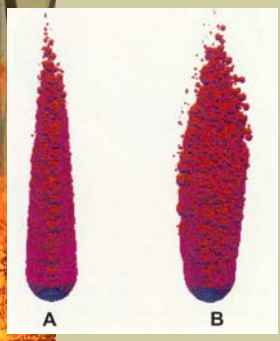

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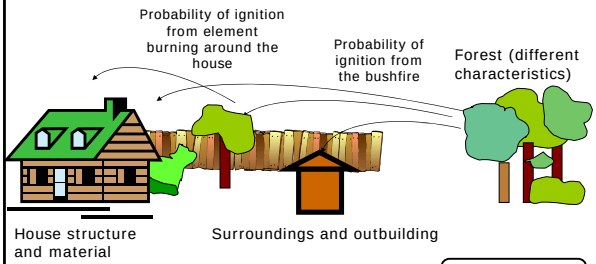
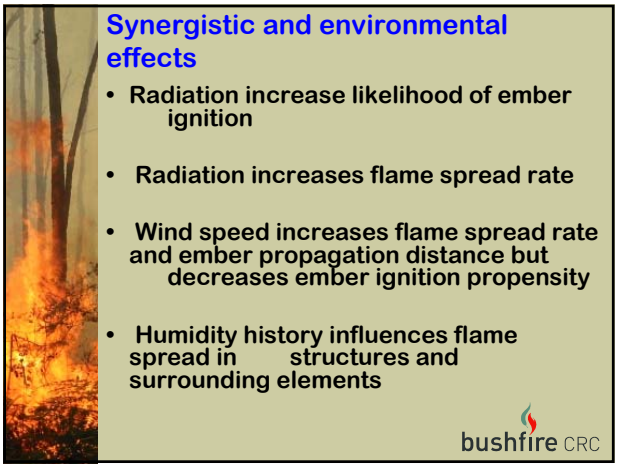
Spatial representation of bushfire attack on house




Synergistic and environmental effects
• Radiation increase likelihood of ember ignition
• Radiation increases flame spread rate
• Wind speed increases flame spread rate and ember propagation distance but decreases ember ignition propensity
• Humidity history influences flame spread in structures and surrounding elements
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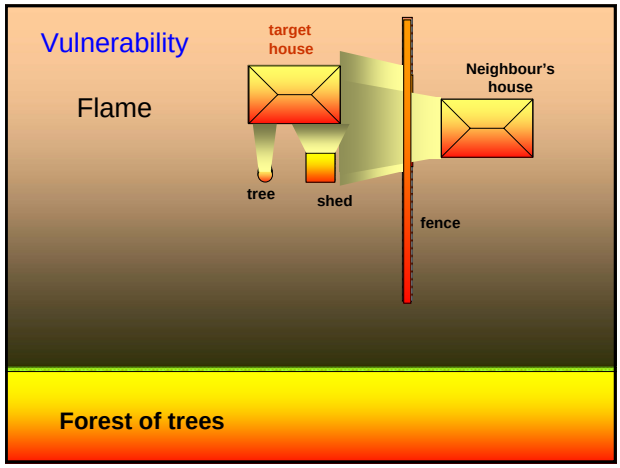
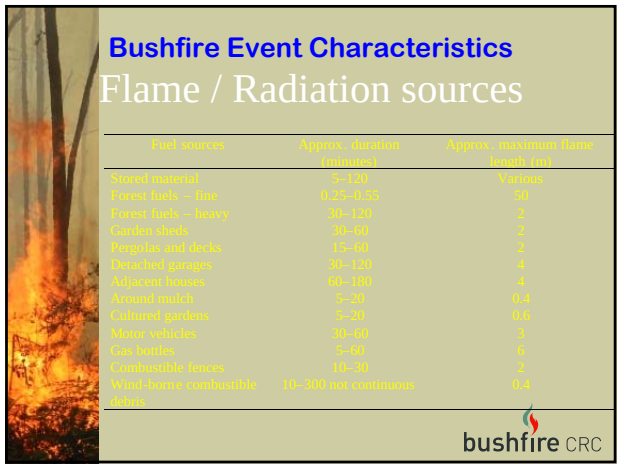

Vulnerability
Flame
target house
Neighbour's house
tree
shed
fence
Forest of trees


Bushfire Event Characteristics
Flame / Radiation sources
Fuel sources
Approx. duration (minutes)
Approx. maximum flame height (m)
Stored material
5–120
Various
Forest fuels – fine
0.25–0.55
50
Forest fuels – heavy
30–120
2
Garden sheds
30–60
2
Pergolas and decks
15–60
2
Detached garages
30–120
4
Adjacent houses
60–180
4
Around mulch
5–20
0.4
Cultured gardens
5–20
0.6
Motor vehicles
30–60
3
Gas bottles
5–60
6
Combustible fences
10–30
2
Wind-borne combustible debris
10–300 not continuous
0.4
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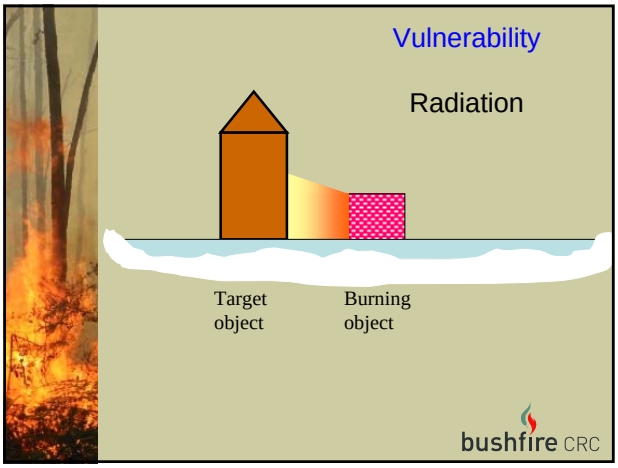
Vulnerability
Radiation
Target object
Burning object
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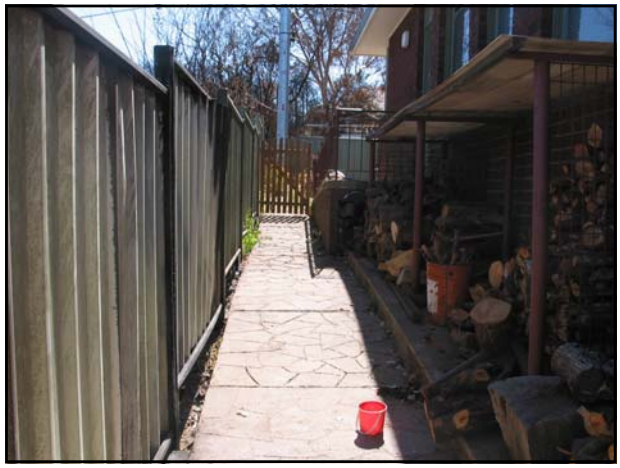

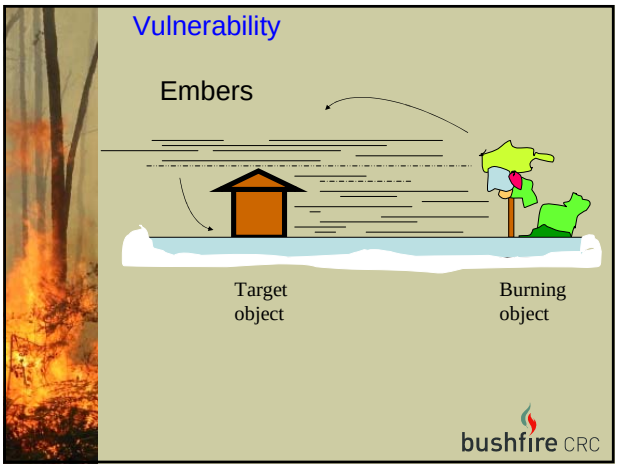
Vulnerability
Embers
Target object
Burning object
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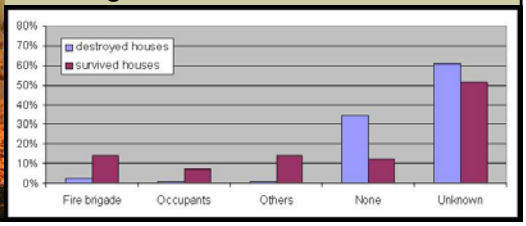
Human behavior

- Timing
- Capability
- Knowledge
- Critical decision making



Risk based model development principles

- Start from the houses perspective
- Utilise the full range of ignition modes and their synergistic effects
- Define parameters and structure of risk model based on existing knowledge

.....and later phases

- Integrate risk model into larger model
- Enhance risk model through targeted data gathering

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Risk based model development summary

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And in later phases

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