



bushfire&natural  
**HAZARDS**CRC

# COST-EFFECTIVE MITIGATION STRATEGY DEVELOPMENT FOR FLOOD PRONE BUILDINGS

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An Australian Government Initiative



**Australian Government**  
**Geoscience Australia**

# PROJECT MANAGEMENT TEAM

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# PROBLEM STATEMENT

- Australia has experienced floods on a regular basis and some communities have been impacted repeatedly over a period of few years due to inappropriate urban development in flood plain areas.
- The flood events have resulted in significant logistics for emergency management and disruption to communities. They have also resulted in considerable costs to all levels of government to repair damage and enable community recovery.

# PROBLEM STATEMENT

Some recent floods in Australia

- 2005 Lismore flood
- 2010 Victorian flood
- 2010-11 Queensland flood
- 2011 Victorian flood
- 2013 Queensland/NSW flood



# RESEARCH OBJECTIVE

- To develop cost-effective strategies to mitigate damage to residential buildings from riverine floods.
- To provide the evidence base for decisions concerning the buildings having the greatest vulnerability in Australian communities by providing strategies for retrofit.

# BACKGROUND

- National Exposure Information System (NEXIS)
  - Building attributes
- Tools
  - Rapid Inventory Capture System (RICS)
  - Field Data Analysis Tool (FiDAT)
- Exposure and post-disaster surveys
  - Building attributes
  - Building damage and repair
- Vulnerability models
  - Brisbane-Ipswich (11: residential)
  - Sydney (8: residential, commercial, industrial)



# MITIGATION OPTIONS

- Structural/non-structural options
  - Dams, levees
  - Flood gates, retarding basins
  - Land use planning
  - Flood forecasting and warning
  - Flood awareness, community readiness
  - Evacuation arrangements

- Addressing the housing ← Project's focus

- Retirement <1%
- Elevating 5%
- Rebuild with revised ground floor use 12%
- Repair with more flood resistant material 19%
- Raising electrical outlets and hardware 8%
- Repair as previously\* \*60%

Responses from the postal survey after the 2011 Queensland flood

# ADDRESSING THE HOUSING

- Retirement



Inundation depth during 2011 floods: 5.0m

# ADDRESSING THE HOUSING

- Elevation



Inundation depth during 2011 floods: 3.2m

# ADDRESSING THE HOUSING

- Revised ground floor use



Inundation depth during 2011 floods: 3.0m

# ADDRESSING THE HOUSING

- Repair as previously



Inundation depth during 2011 floods: 2.4m

# TASKS

- Classification of residential building stock
- Literature survey of existing mitigation options
- Development of Australian specific mitigation options and costing, experimental testing of selected building materials
- Vulnerability assessment of current and retrofitted buildings
- Benefit verses cost analysis of retrofit and new construction options
- Identification of optimal retrofit strategies
- Stakeholder workshops

# TASKS (COMPLETED)

- Classification of residential building stock: review
  - HAZUS (USA): 11, structural system, storey class
  - Riskscape (New Zealand): structural system, wall and roof material, storeys, usage etc.
  - EDAC (Germany), 6, structural system, based on EMS-98, vulnerability classes
  - UPD (The Philippines): 15, structural system, storey class, wall material
  - UNISDR (Asia-Pacific): 27, structural system, 1, 2 or 3 storey, elevated/non-elevated, water susceptibility, usage
  - NSW Office for Environment and Heritage (NSW): 3, 1 or 2 storey, elevated/non-elevated
  - Geoscience Australia (QLD and NSW): 19, 1 or 2 storey, elevate/non-elevated, external and internal wall material, garage



# TASKS (COMPLETED)

- Classification of residential building stock: adopted

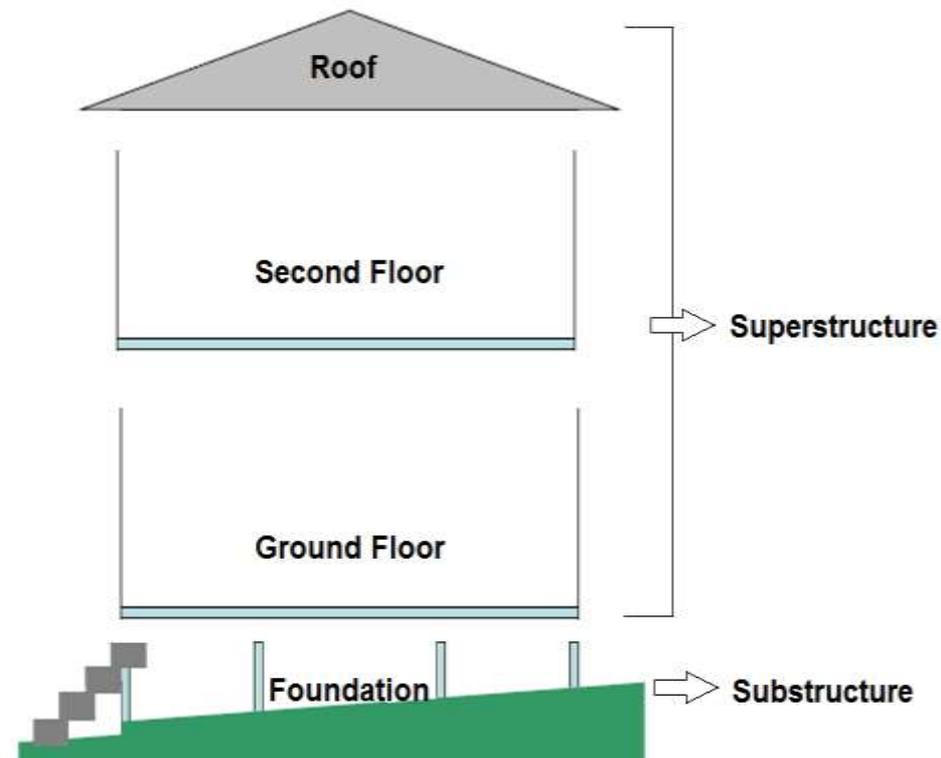
## **Floor level attributes:**

- Construction Period
- Fit-out Quality
- Storey Height
- Bottom Floor System
- Internal Wall Material
- External Wall Material

## **60 possible combination of floor system**

## **Roof attributes:**

- Pitch
- Material





# PARALLEL ACTIVITIES

- Engagement with other projects within the cluster
- Engagement with other projects outside the cluster
- Formalising experimental work
- Engagement with Bundaberg Regional Council
- Engagement with builder in Bundaberg to assess cost of house raising
- Calibration/validation of vulnerability models

# PROJECT TIMELINES

	Start	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-16	Jun-16	Sep-16	Dec-16	Mar-17	Jun-17
<b>Project Management - Work Plan, Communication, Collaborations</b>															
<b>Classification of building stock into vulnerability classes</b>															
Review of literature, NEXIS and international practices															
Report on building classification															
<b>Literature survey of existing mitigation options</b>															
Review of literature, national and international practices															
Publication on proposed research at AFAC and BNHCRC Conference															
Report on review of existing mitigation strategies															
<b>Development of Australian specific mitigation options and costing modules</b>															
Identification of Australian specific mitigation options															
Developing costing modules of different mitigation strategies															
Publication on retrofit options and costing modules															
Report on retrofit options and developing of costing modules															
<b>Development of strategies for new construction, quantity surveying and experimental plan</b>															
Strategies for new construction															
Quantity surveying															
Experimental plan for testing of materials to flood resilience															
Report on strategies for new constructions and quantity surveying															

# OUTCOMES

- Mitigation strategies enabling asset owners to invest.
- Evidence-base to inform decision making to reduce flood risk.
- Vulnerability assessment of existing and retrofitted building types.
- Alignment with parallel BNHCRC projects for earthquake and severe wind.
- Contribution to several research themes of the CRC.
- Alignment to the strategies outlined in National Strategy for Disaster Resilience.

# CONCLUDING REMARKS

- The project is on track and progressing smoothly.
- The deliverables have been completed on time.
  - Project Management Plan
  - Quarterly reports
  - Annual report
  - Building schema report
- There is a room for improvement in stakeholders engagement.

# THANK YOU



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# PROJECT TIMELINES

Activities	Start	Jun-14	Dec-14	Jun-15	Dec-15	Jun-16	Dec-16	Jun-17	Dec-17	Jun-18	Dec-18	Jun-19	Dec-19	Jun-20	Dec-20
<b>Project Management - Work Plan, Communication, Collaborations</b>															
<b>Classification of building stock into vulnerability classes</b>															
Review of Literature, NEXIS and International Practices															
Report on building classification															
<b>Literature survey of existing mitigation options</b>															
Review of Literature, National and International Practices															
Building material susceptibility to damage on wetting and drying															
Report on review of existing mitigation strategies															
<b>Development of Australian specific mitigation options, costing and experiments</b>															
Identification of Australian specific mitigation options															
Costing of different mitigation strategies															
Publication on retrofit options and costing modules															
Report on retrofit options and developing of costing modules															
Experimental testing of materials to flood resilience															
Report on strategies for new constructions and costings															
<b>Stakeholder workshop - flood vulnerability and mitigations strategies</b>															
<b>Vulnerability assessment of current and retrofitted buildings</b>															
Vulnerability for a range of inundation depths of existing buildings															
Vulnerability assessment of retrofitted buildings															
Report on vulnerability models															
Publication on flood vulnerability models for key building types															
<b>Benefit verses cost analysis of retrofit and new construction</b>															
Cost benefit analysis for diff. retrofit strategies, design level, severity range and catchment type															
Report on cost benefit analysis															
<b>Stakeholder workshop - build consensus on communication strategies</b>															
Publication on benefit versus cost analysis and optimal cost effective mitigation strategies															
Final Report															