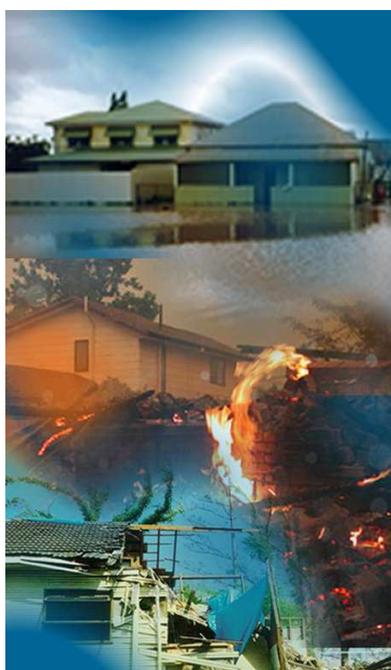


# Normalising the Insurance Council of Australia Natural Disaster Event List: 1967–2011



Report prepared for the Insurance Council of Australia

by

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## INTRODUCTION

This report builds upon the previous loss normalisation undertaken by Risk Frontiers for the Insurance Council of Australia (Crompton, 2006; Crompton and McAneney, 2008). Loss normalisation is used to estimate the losses sustained if past events were to impact present society; it is a process that must be carried out in order to have an ‘apples-versus-apples’ comparison of losses over time. Here we normalise all insured losses in the Insurance Council of Australia (ICA) Natural Disaster Event List between 1 July 1966 and 30 June 2011 to season 2011 values (where ‘season’ 2011 is defined as the 12-month period beginning 1 July 2011). While our normalisation approach quantifies the most important contributory factors, it is by design, an approach to be applied to a large number of events and so may ignore some unique features of particular events.

## LOSS NORMALISATION METHODOLOGY

The normalisation methodology applied to the insured losses in the ICA Natural Disaster Event List (hereafter ‘Disaster List’) is an updated version of that employed by Crompton and McAneney (2008). It converts losses recorded in season  $i$  ( $L_i$ ) to season 2011 values ( $L_{11}$ ) according to the following equation:

$$L_{11} = L_i \times N_{i,j} \times (D_{i,k} \times S_{i,total} / S_{i,new}) \times B_{tc} \quad (1)$$

where  $j$  is the Urban Centre/Locality (UCL) impacted by the event<sup>1</sup>;  $N_{i,j}$  is the dwelling number factor defined as the ratio of the number of dwellings in season 2011 in UCL  $j$  to the number in season  $i$ ;  $k$  is the State or Territory that contains the impacted UCL<sup>2</sup>;  $D_{i,k}$  is the dwelling value factor, defined by the ratio of the State/Territory average nominal value of new dwellings in season 2011 to that of season  $i$ ;  $S_{i,total} / S_{i,new}$  is the dwelling size adjustment, defined as the ratio of the factor increase in the average floor area of *total* residential dwellings to the factor increase in the average floor area of *new* residential dwellings between season  $i$  and 2011, and  $B_{tc}$  is the building code adjustment applied to tropical cyclone losses, which defaults to unity for all perils other than tropical cyclone.

<sup>1</sup> Multiple UCLs are used where applicable.

<sup>2</sup> Multiple States and/or Territories are used where applicable.



The UCL structure is one of the seven interrelated classification structures of the Australian Standard Geographical Classification that groups Census Collection Districts together to form areas defined according to population size (Australian Bureau of Statistics (ABS) – <http://www.abs.gov.au>). In broad terms, an Urban Centre is a population cluster of 1000 or more people while a Locality comprises a cluster of between 200 and 999 people. The number of dwellings in each UCL is reported in census years since 1966 (at 5-year intervals thereafter) in the Census of Population and Housing (ABS – <http://www.abs.gov.au>).

The dwelling value factor ( $D_{i,k}$ ) was calculated for the State or Territory containing the impacted UCL. State/Territory average nominal values of new dwellings are calculated by dividing the value of residential building work completed within a season by the number of completions within the same season with relevant values taken from Building Activity reports (ABS – <http://www.abs.gov.au>). The dwelling values exclude the price of land and increases are in part due to increasing average dwelling size as well as improvements in the quality of the housing stock.

The dwelling size adjustment was calculated at the national level. Available average floor area of new residential dwellings data for various seasons between 1984 and 2006 was obtained from Building Activity reports (ABS – <http://www.abs.gov.au>) and an average growth rate was calculated. This growth rate was used to determine the average floor area of new residential dwellings in each of the seasons from 1966 to 2011. The average floor area of total residential dwellings in season  $i$  ( $A_{i, total}$ ) was then calculated as follows:

$$A_{i, total} = [(A_{i, new} \times (C_i - C_{i-1} + F_i) + A_{i-1, total} \times (C_{i-1} - F_i)] / C_i \quad (2)$$

where  $A_{i, new}$  is the average floor area of new residential dwellings in season  $i$ ;  $C_i$  is the number of dwellings in Australia in season  $i$ ;  $F_i$  is the number of demolitions in season  $i$  and  $A_{i-1, total}$  is the average floor area of total residential dwellings in season  $i-1$ . An average demolition rate was estimated from differences between the number of residential dwellings completed and the change in the number of dwellings in a given season. For the purpose of Equation (2) a value of approximately  $20m^2$  less than  $A_{1966, new}$  was assumed



for  $A_{1966, \text{total}} \cdot S_{i, \text{total}} (S_{i, \text{new}})$  (as used in Equation (1)) is then the ratio of  $A_{2011, \text{total}} (A_{2011, \text{new}})$  to  $A_{i, \text{total}} (A_{i, \text{new}})$ .

The additional factor ( $B_{tc}$ ) applied to tropical cyclone losses in Equation (1) adjusts for the influence of building code changes in tropical cyclone-prone areas that have markedly reduced the vulnerability of construction from around the early 1980s. We adopt 1975 for Darwin, 1976 for Townsville and 1981 elsewhere as threshold years for the building code regulation of the wind standard and to discriminate between new and improved construction. Failure to allow for the wind standard being regulated would be to assume that the ratio of pre- to post-19XX buildings is the same in season 2011 as what it was when the event occurred.

The tropical cyclone building code adjustment ( $B_{tc}$ ) is unique to each tropical cyclone event loss and incorporates the proportion of the loss attributable to wind damaged buildings and contents (as opposed to flooding or storm surge, wind damage to cars, etc); the proportion of pre- and post-19XX dwellings in the impacted UCL both in the season the event occurred and in season 2011; and pre- and post-19XX residential building loss ratios (ratios of insured losses to insured value) that are a function of peak gust speed. This loss ratio also includes damage due to wind-driven rain following wind damage to the envelope of the dwelling. The adjustment assumes the post-19XX buildings were built in line with the wind standard, i.e. no more or less vulnerable than the wind standard prescribes.

## METHODOLOGICAL REFINEMENTS

We have refined the Crompton and McAneney (2008) loss normalisation methodology by including the dwelling size adjustment in Equation 1 and we have made other less obvious refinements in the development of the other normalisation factors. Some of these refinements were made possible due to the increased availability of data and others, including the dwelling size adjustment, are enhancements to the original methodology. The most important refinements are discussed below.

### Dwelling Number Factor



In their calculation of the dwelling number factor Crompton and McAneney (2008) used the number of ‘occupied’ dwellings and did not have data for the 1971, 1976 and 1991 census years. They estimated occupied dwelling numbers using an exponential or linear curve fit to the remaining census data between census years 1966 and 2001. In our updated approach we use the total number of dwellings (i.e. including ‘unoccupied’ dwellings) and all census data from 1966<sup>3</sup>. We use linear interpolation to determine the number of dwellings for seasons between census years and estimate the 2006-2011 season dwelling numbers by extrapolating from the 2001 and 2006 census data.

Crompton and McAneney (2008) used a single UCL for each event in the calculation of the dwelling number factor whereas our current approach is to use multiple UCLs when necessary with up to eight UCLs used to represent each event. The main source of additional information accessed to determine the affected locations was Risk Frontiers’ PerilAUS natural disaster database; other information sources include Bureau of Meteorology significant weather summaries and State Emergency Service event reports.

### **Dwelling Value Factor**

The most obvious refinement in Equation (1) is the dwelling size adjustment which was not included in the Crompton and McAneney (2008) normalisation methodology. Both our current approach and Crompton and McAneney (2008) used the average nominal value of new dwellings to represent the change in replacement value over time. However, part of the increase in new dwelling values is due to the increase in the average floor area of new dwellings. The dwelling size adjustment is required as the size of new dwellings increases faster than the size of total dwellings and it is the increase in the size of total dwellings that needs to be included in our normalisation.

Our updated way of calculating the dwelling value factor for each State and Territory is to use our derived average nominal value of new dwellings for seasons 1974-2010 (1973-2010 for Tasmania). We extrapolate to season 2011 using the average growth rate over the seasons 2005-2010 and to season 1966 using the average growth rate over the seasons 1974-1984 (1973-1983 for Tasmania). Crompton and McAneney (2008) determined new

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<sup>3</sup> The 2011 census data is yet to be released.



dwelling values for each State and Territory by fitting an exponential curve to 5 of the derived data points.

### **Building Code Adjustment**

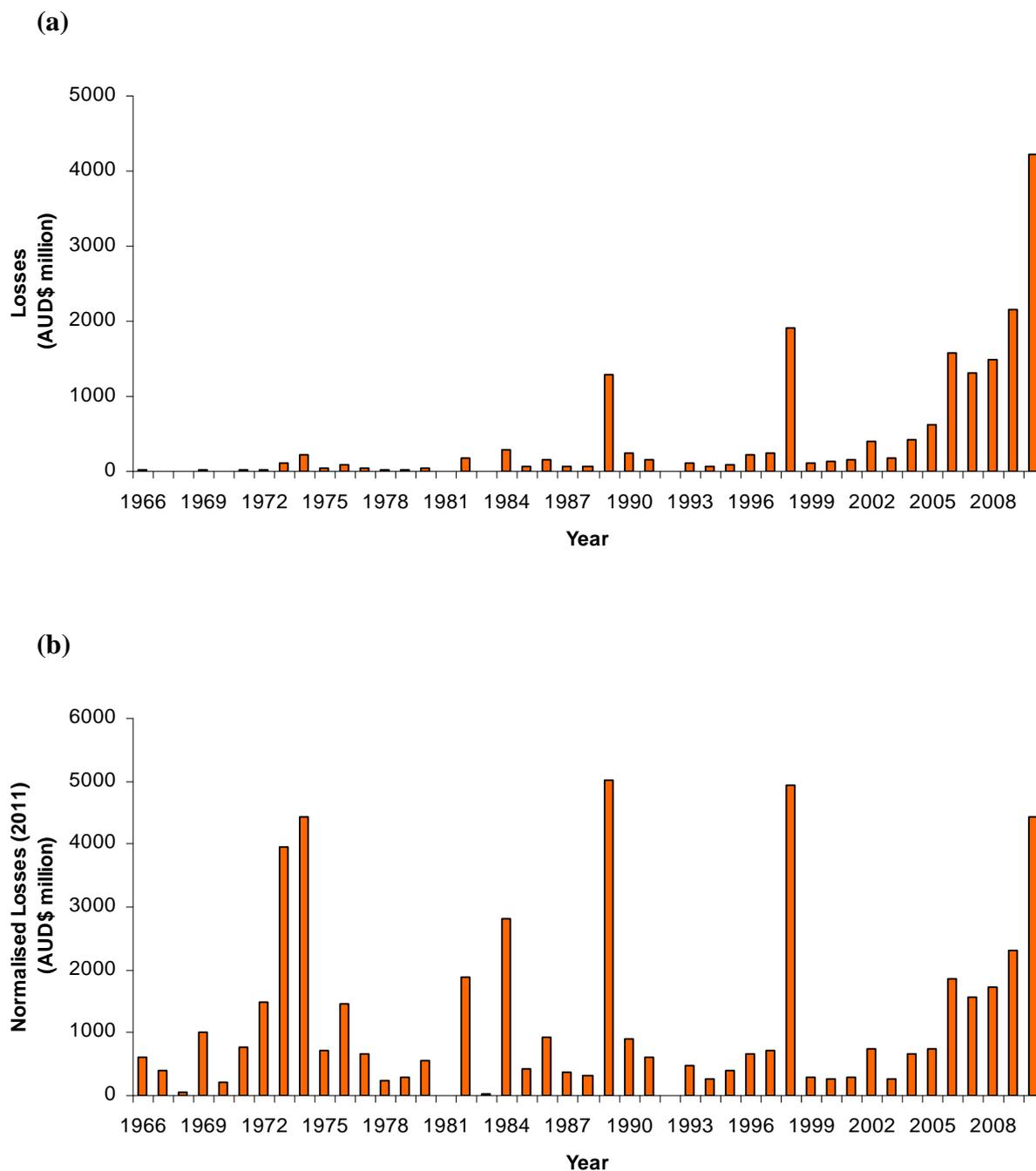
Refinements to the building code adjustment include the use of multiple UCLs in line with the updated dwelling number factor approach. We also make an allowance for demolitions (consistent with the approach used in the dwelling size adjustment) when calculating the proportion of pre- and post-19XX dwellings in the impacted UCL.

Crompton and McAneney (2008) adopted 1981 as a threshold year throughout tropical cyclone-prone areas of Australia for the building code regulation of the wind standard whereas our updated approach varies the threshold year in Darwin and Townsville. We have also updated our estimated proportion of the insured loss attributable to wind damaged buildings and contents.

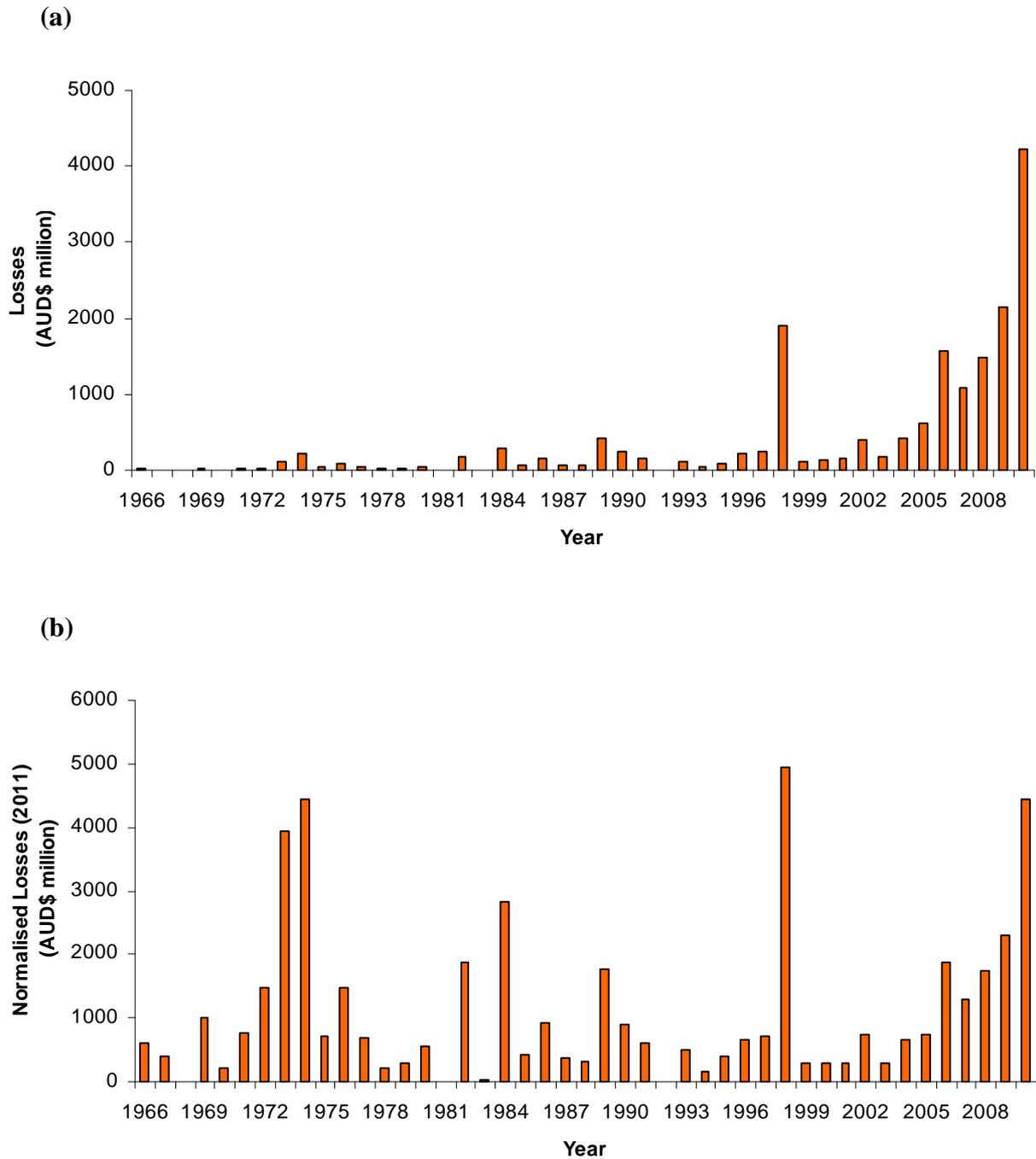
While our normalisation methodology (Equation (1)) quantifies the most important contributory factors, it is by design, an approach that can be applied to a large number of events. It is important to recognise that our methodology has limitations and does not encompass all of the factors unique to each event. Taking Tropical Cyclone Tracy as an example, since Tracy made landfall in 1974 the extent of government owned housing in Darwin has fallen and this affects insurance penetration as the government owned homes and flats were not insured through private insurance (Mason and Haynes, 2010). On the other hand the proportion of pre-1975 dwellings in Darwin in season 2011 will be less than estimated due to the occurrence of Tracy.

## **RESULTS**

Figure 1 presents the annual aggregate insured losses and the annual aggregate normalised insured losses for all events in the Disaster List. Figure 2 presents the same data for weather-related events only. The losses have been normalised and aggregated by season (years beginning 1 July) to take account of the southern hemisphere seasonality of the meteorological hazards.



**Figure 1.** (a) Annual aggregate insured losses (AUD\$ million) for all events in the Disaster List for years beginning 1 July; (b) as in (a) but with losses normalised to season 2011 values.



**Figure 2.** (a) Annual aggregate insured losses (AUD\$ million) for weather-related events in the Disaster List for years beginning 1 July; (b) as in (a) but with losses normalised to season 2011 values.



The top 10 normalised insured losses are given in Table 1. The highest ranked normalised insured loss is the 1999 Sydney hailstorm and the average annual normalised insured loss over the 45-year period is AUD\$1174 million.

In their normalisation of the Disaster List ending at the 2005 season Crompton and McAneney (2008) noted the low loss activity in the most recent 5 seasons. Since that time there has been heightened loss activity with the most recent 5 seasons to 2010 averaging double the 45-year average. The annual insured loss over the most recent 10 seasons (2001 – 2010) averaged AUD\$1462 million, a cost that is within 25% of the average annual loss over the full 45-year period of the Disaster List.

**Table 1.** Ten highest ranked normalised insured losses (AUD\$ million).

Rank	Event	Year	Location	State	Loss (AUD\$ million)	Normalised loss (2011) (AUD\$ million)
1	Hailstorm	1999	Sydney	NSW	1700	4296
2	Tropical Cyclone Tracy	1974	Darwin	NT	200	4090
3	Earthquake	1989	Newcastle	NSW	862	3240
4	Flood <sup>a</sup>	1974	Brisbane	QLD	68	2645
5	Flood	2010/11	Multiple	QLD	2400	2529
6	Hailstorm	1985	Brisbane	QLD	180	2063
7	Ash Wednesday Bushfires <sup>b</sup>	1983	Multiple	VIC/SA	176	1796
8	Severe Storm	2007	Multiple	NSW	1480	1742
9	Tropical Cyclone Madge	1973	Multiple	QLD/NT/WA	30	1492
10	Tropical Cyclone Yasi	2011	Multiple	QLD	1300	1352

<sup>a</sup>The 1974 Brisbane flood resulted from the degeneration of Tropical Cyclone Wanda.

<sup>b</sup>The two separate loss entries in the Disaster List for this event have been combined into a single loss.

## ACKNOWLEDGEMENTS

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