# AEES NEWSLETTER

**September 2013**

## Contents



## President's Report

Engineers Australia (EA) is preparing a new regulation to streamline the relations between EA and its technical societies. After some intensive discussions, this new regulation is at its final stages before being officially accepted. Whilst encouraging more collaboration between technical societies and relevant colleges such as the Civil College and the Structural College in supporting each others' activities, coordinating or jointly organizing some events, the new regulation has minimum impact on AEES and on our current operations. EA would also like technical societies to use the web page and online system that is currently under development, to maintain the membership database and to communicate with the technical society members. AEES has been doing very well in communicating with members; announcing and publicizing our annual conferences, and making announcements via EA newsletters (e.g., the AEES scholarship was announced in EA newsletters). However, in the future we should make use of EA communication channels to more widely publicize our activities such as AEES annual conferences.

We have received 70 abstracts for this year's annual conference in November at Hobart, Tasmania. Four keynote speakers were selected and invited to give presentations in the conference. They are Dr. Marlene Kanga, EA National President, who will open the conference and give a talk on systematic risk management processes to identify, assess and mitigate earthquake risks; Associate Professor Charles Clifton from the University of Auckland, who will talk about the performance of steel buildings in the Christchurch earthquake; Professor Kazuhiko Kasai from the Tokyo Institute of Technology, who will share with us his research experiences and observations on building performances from full-scale shake table tests and actual building monitoring during the 2011 Tohoku-Oki Earthquake; and Professor Paul Somerville, whose keynote presentation will focus on bridging the gap between seismology and engineering. In the last AGM held in Tweed Heads, we also decided to give financial assistance to assist students in attending our annual conferences and presenting their papers. Ten students who applied for assistance to attend the Hobart conference before the application deadline will receive registration fee waivers. It is going to be another exciting event and I am looking forward to meeting you there.

I have just submitted our annual report to EA reporting AEES activities in the period 1 July 2012 to 30 June 2013. Besides our normal activities such as the web page and the annual conference, I especially mentioned our bid in Lisbon during the World Conference on Earthquake Engineering (WCEE) for Australia to host the conference in 2016. Although our bid was not successful, those involved have learnt a lot and gained many exciting experiences. It was also the first time AEES has ever been so actively promoted at WCEE. Professor Carlos S. Oliveira, Chairman of the 15WCEE Organizing Committee sent a letter to me to thank AEES for our active participation in the conference.

I will attend the Engineering Practice Advisory Committee (EPAC) Meeting of the College, Technical Society and Special Interest Group Chairs on Thursday 24th and Friday 25th October 2013 in Canberra. In

accordance with the proposed EA regulations and our society's interests, I would like to discuss with Civil College and Structural College chairs during the meeting how to enhance our relations with these two EA colleges. I will report the meeting outcome to you in due course.

On average, about 10,000 people were killed annually by earthquakes in the last century. Although such statistics might not be completely accurate for a number of reasons, earthquake related deaths appear to be increasing this century. From 2001 to August 2013, earthquakes have already claimed more than 649,000 lives

http://earthquakeau.blogspot.com.au/2011/06/worlds-largest-earthquakes-2000-2011.html

http://wiki.answers.com/Q/How_many_people_die_from_earthquakes_a_year

The following list details the death toll in major earthquakes this century:

| Date | Place | M | Killed |
|---|---|---|---|
| 2001 Jan 26 | Gujarat, India | 7.6 | 20,085 |
| 2002 Mar 25 | Hindu Kush | 6.1 | 1,000 |
| 2003 May 21 | Northern Algeria | 6.8 | 2,266 |
| 2004 Dec 26 | Sumatra | 9.1 | 227,898 |
| 2005 Mar 28 | Nth Sumatra, Indonesia | 8.6 | 1,000 |
| 2005 Oct 8 | Pakistan | 7.6 | 86,000 |
| 2006 May 26 | Indonesia | 6.3 | 5,749 |
| 2008 May 12 | Eastern Sichuan, China | 7.9 | 69,195 |
| 2009 Sep 30 | Sth Sumatra, Indonesia | 7.5 | 1,117 |
| 2010 Jan 12 | Haiti | 7.0 | 222,570 |
| 2011 Mar 11 | Japan | 9.0 | 11,600 |
| 2012 Aug 11 | Iran | 6.4 | 306 |
| 2013 Apr 20 | China | 6.6 | 193 |

Such data indicates that despite that enormous investments of time and money placed on earthquake resistance related research and the design and construction of earthquake resistant infrastructure, earthquakes remain not only extremely unpredictable but also arguably the single most destructive natural disaster of our time. Together with EA and its relevant colleges, we hope to continue educating and influencing the general public, engineers, and politicians, to change their perceptions that Australia is free from earthquake threats. AEES looks forward to working more closely with the EA Colleges towards better protection for life and livelihood against possible earthquake loadings.

At the end of this year, I'll be stepping down from the position of President of the AEES; as such, this will be my last President's Report. It has been my honour to represent this society over the past three years, both nationally and internationally. My successor will be elected in the next AGM in Hobart, on Saturday 16th November 2013. I am confident that AEES will continue to thrive and I look forward to seeing its progress in the future.

Hong Hao

AEES President

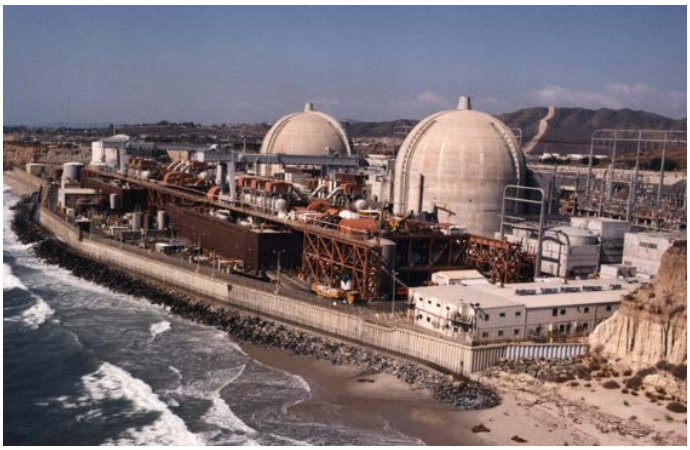
## San Onofre Nuclear site to close

[Extracts from the New York Times article by Matthew L. Wald, ] Published: June 7, 2013

The San Onofre nuclear power plant in Southern California pictured below, has been shut since January 2012. The owners now say that they will close it permanently because of uncertainty over when it could be reopened.

The two reactors at San Onofre closed when a small amount of radioactive steam escaped from new tubes damaged by vibration and friction. Coming months after the Fukushima Daiichi meltdown in Japan, the event prompted a wave of public opposition and set off a legal and regulatory battle that included Southern California Edison, the Nuclear Regulatory Commission and Mitsubishi Heavy Industries, which manufactured the parts that leaked.

"I think this is a step in the right direction, another move toward the renewable revolution that is under way in the state of California," said Mr. Freeman, adding that closing the reactors opens up the market to use the renewable power that will follow. For now, though, the replacement power source is natural gas.



The nuclear industry has had a difficult year as it tries to compete with cheaper, abundant natural gas. San Onofre's two reactors are the third and fourth reactors to be retired so far this year in the United States.

"It's no secret that power markets have been radically changed by the development of shale gas," said John Reed, an investment banker who specializes in nuclear reactors. "That changes the economics of any other power supply option, including nuclear."

Dominion shut its Wisconsin in May because of unfavorable economics, and Duke said in February that it would not restart Crustal Rapid 3 because mechanical problems were too expensive to fix. San Onofre 2 and 3 entered commercial operation in August 1983 and April 1984. A third reactor was mothballed in 1992.

Many nuclear plants around the country have won permission from the Nuclear Regulatory Commission to run 20 years beyond their initial 40-year licenses, but in a conference call with reporters, Mr. Craver of Edison International said that the prospects for license renewal were uncertain, following the three meltdowns at the Fukushima Daiichi plant in March 2011, and the demand by regulators for a re-evaluation of San Onofre's vulnerability to earthquake.

Edison had been seeking to restart one of the units at 70 percent power, a level it thought the steam generators could tolerate, but when plant opponents persuaded a panel of three administrative law judges at the Nuclear Regulatory Commission that this would require a public hearing, the company concluded that the proceedings could stretch to the end of next year or longer. Operation and maintenance expense at the plants, which employ 1,500 people are roughly equal whether it is running or not, he said, and if the plant could not reopen by December, retiring it would be cheaper.

The company has $2.7 billion saved up for decommissioning, which is about 90 percent of what is required, he said. Edison shares ownership with San Diego Gas & Electric, which owns 20 percent, and the city of Riverside, which owns 1.79 percent.

Edison has about $2.1 billion invested in the plant, the fuel and related assets.

## New Manual of Seismological Observatory Practice

The New Manual of Seismological Observatory Practice (NMSOP or "the Manual") was produced in 2002 under the overall guidance of Prof. Dr. Peter Bormann. NMSOP is a continuation and significant expansion of the materials and guidance provided by the earlier Willmore (1979) Manual of (analogue) Seismological Observatory Practice (MSOP), also introduces the new era of digital seismology. A slightly revised/corrected version has been available on the internet as NMSOP-1 since 2009. The latter can be downloaded for free or, if you require printed hard copies, they can be ordered at the GFZ library (30 EUR for two volumes of 1250 pages + shipment cost) via the new link http://nmsop.gfz-potsdam.de.

NEW Manual of Seismological Observatory Practice (second Edition NMSOP-2, 2012) Since March 2012 most of NMSOP-2 is on the Web, to be completed during 2012. With 4 new and 13 substantially amended topical Chapters, many new or significantly revised/amended Information Sheets, Data Sheets, Exercises, Tutorials, educational animations, programs and the largest ever published glossary of seismological and related earth scientific and engineering terms NMSOP-2 is the largest seismology e-book currently available. It is accessible via the website http://nmsop.gfz-potsdam.de, which provides also a link to NMSOP-1.

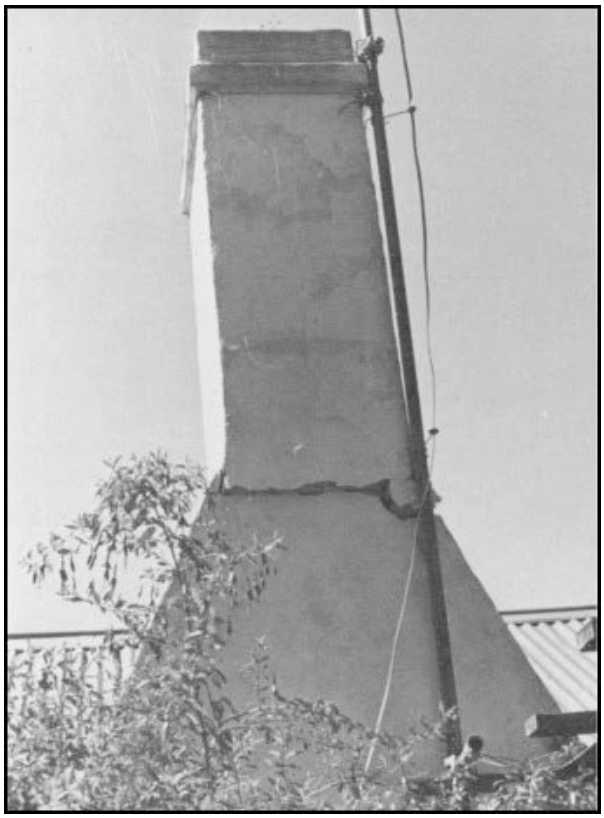
## 40 years ago – the 1973 Picton NSW earthquake

Sydney has been shaken by many earthquakes since the first in 1788 but more particularly by the three largest earthquakes in NSW, all of similar size. The most recent of them was the 1989 Newcastle earthquake, north of Sydney. The two earlier events were south of Sydney near Robertson and Bowral in 1961 and Picton in 1973.

The focus of the 1973 earthquake was under Lake Burragorang rather than Picton which explains why the damage was so light though spread over 40,000 km$^2$ (Denham, 1976. BMR Bulletin 164).

All three earthquakes occurred under the Sydney Basin and there is no known geological or other reason why a similar sized earthquake could not occur nearer or under Sydney.

A photo from Dayeh, 1976 (in Denham, 1976), is reproduced below, the complete bulletin can be found on line.



*Earthquake damaged chimney, farmhouse near Robertson NSW (photo from Dayeh, 1976).*

## The Man who Mapped the Shaking Earth

*By Russell Cuthbertson*

Since Will Twycross spoke at last year's AEES conference he has been on a remarkable whirlwind tour of the world (8 countries in 28 days) to showcase his documentary that celebrates the life of John Milne - "The Man who Mapped the Shaking Earth".

Milne's pivotal role in the origins of seismology and earthquake engineering has featured in every account of the history of the geophysical sciences since the late 19th century. 2013 marks one hundred years since his death.

After the debut screening at Tweed Heads, the documentary has been featured, and Will has spoken, at numerous international conferences.

First up was the Milne Symposium at the National Museum of Nature and Science, Tokyo, which was organised in conjunction with the Seismological Society of Japan and the Japanese Association for Earthquake Engineering. The summary of the exhibition was an elegant statement of how the Japanese still regard Milne. It read:

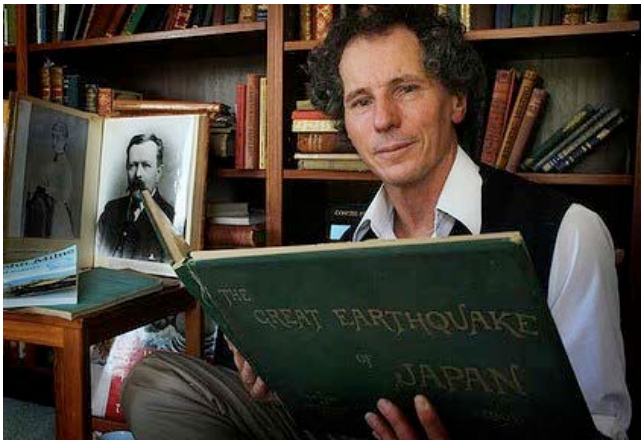
> ***A Man who loved Japan and was charmed by the field of Seismology***
>
> *The year 2013 marks the 100th anniversary of the death of John Milne, who established the science of seismology in Japan, as well as the 90th anniversary of the Great Kanto Earthquake, which struck in 1923. This exhibition displays documentation and panels related to the history of seismology in Japan, and an introduction to the results Milne achieved and other episodes of his life.*

Next up was the International Association for Seismology and Physics of the Earth's Interior, at Gothenburg, Sweden. This conference featured the delivery of a paper on the History of British Seismology, by Dr Roger Musson, who then joined with Will in introducing the Milne documentary.

Then it was on to the huge International Conference for the History of Science, Technology and Medicine, in Manchester.

The geological focus, fascinatingly, was around the role that art played in the 18th and 19th centuries in the evolving public perception of geology. Art and its use in interpreting his work was a subject very dear to John Milne's heart, and Will delivered a paper on "The Many Arts of the Father of Seismology".

The last scheduled conference on Will's list is the Seismological Society of Japan Conference in Yokohama in October.




*Will Twycross, great-nephew of John Milne also pictured*
*Photo: John Woudstra*

In addition to these international conferences Will also attended the Milne Anniversary Celebrations on the Isle of Wight, England in August at which he presented the 99th "Milne Cup" at the Newport Golf Course. Milne was the founding captain of the club in 1896. After presenting the cup, a red granite plaque with gold lettering was unveiled as a permanent memorial to Milne in the clubrooms.

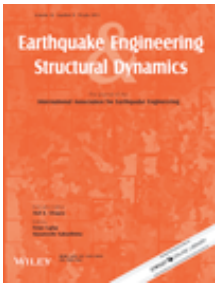
A beautiful Milne storyboard has been erected by the local council, and Will was honoured to join with Professor Teruyuki Kato, President of the Seismological Society of Japan in "opening" it.

On the afternoon of Milne's anniversary, the Milne-Twycross Room at Carisbrooke Castle was opened in front of a small invited gathering of guests, who included distinguished Japanese and British Seismologists.

Will was also invited to show the documentary to the students of the Department of Earth Sciences at Oxford University. This was a very appropriate bookend to his journey to the UK, as Oxford took over the collation of records and the publication of circulars from Milne's world-wide network after his death in 1913.

The publicity for the documentary continues with the intention of "Nature" to review it; the scheduled showing at the Seismological Society of Japan Conference in Yokohama in October; and its distribution to university departments and historical societies in Europe, North America and of course Japan.

## Earthquake Engineering & Structural Dynamics




Edited By: Anil K. Chopra, Peter Fajfar, Masayoshi Nakashima

*EARLY VIEW ARTICLES ARE NOW AVAILABLE ON WILEY ONLINE LIBRARY*

This is the journal of the International Association for Earthquake Engineering to which AEES is affiliated.

## Canada – an Analogy for Australia?

The internet is a fabulous tool. With a diligent search, or by luck, one can find some interesting articles such as the following one. Try replacing Canada with Australia every place you find it and ask if it makes sense. If so, what should we in Australia be doing?

http://www.iclr.org/images/Reducing_earthquake_risk.pdf

In this report sponsored by Lloyd's, the Institute for Catastrophic Loss Reduction identifies lessons for reducing the risk of earthquake damage in Canada based upon the recent tragic events in Haiti and Chile.

Some day a large earthquake will strike Vancouver, Montreal, Ottawa or another large urban centre in Canada. Such an event has the potential to cause loss of life, property damage and economic disruption unprecedented for Canada. The tragic and contrasting experiences earlier this year in Haiti and Chile show that appropriate investments in preparedness and resilience can help prevent future earthquakes from becoming disasters.

**Reducing the risk of earthquake damage in Canada: Lessons from Haiti and Chile**

By Paul Kovacs November 2010

Executive summary – Seven lessons for Canada

Important lessons can be learned from the tragic events this year in Haiti and Chile that can be applied to Canada to help reduce the probability that large earthquakes become catastrophes. Earthquakes can be powerful hazards. Hazards can become disasters if they strike a vulnerable community that is not prepared. Countries exposed to large earthquakes, like Canada, must invest in preparedness and resilience to reduce the risk that earthquakes will cause fatalities, property damage and economic disruption.

There are many lessons for homeowners, businesses and public officials in Canada from the tragic earthquakes in Haiti and Chile. In this report we highlight seven key lessons:

1. It is inevitable that a major earthquake will strike Canada

A number of communities in Canada have a high or moderate risk of experiencing a large earthquake, including Vancouver, Montreal, Ottawa, Victoria and Quebec City. It is essential that individuals, businesses and public officials understand the risks earthquakes pose.

2. We can help prevent earthquakes from becoming disasters

Three priorities for improving Canada's resilience to large earthquakes should include retrofitting or replacing vulnerable buildings, taking steps to reduce the threat of uncontrolled fire following an earthquake, and investment to strengthen the seismic resilience of public infrastructure. Sound investment in loss prevention can significantly reduce the need for recovery.

3. Building codes and retrofits protect lives and property

Most earthquake fatalities and extensive property damage are the result of buildings that collapse. Fortunately, modern building codes and a progressive engineering community have reduced the risk of loss for newer homes and buildings in Canada. However, investment should be made to retrofit or replace older and potentially vulnerable structures, including schools and hospitals.

4. Canada's public infrastructure is vulnerable to damage

Earthquakes in Haiti, Chile and elsewhere resulted in severe destruction of essential systems, including transportation and water systems. Public infrastructure in Canada appears highly vulnerable following decades of underinvestment, and may be severely challenged by a large earthquake. Even in the absence of a large earthquake, significant investments are required to retrofit these ageing systems to a better level of performance.

5. Effective preparedness will reduce the risk of losses

The local and provincial emergency response systems in Canada have a good record of successfully responding to natural hazards. However, Canada's system of emergency preparedness has never been tested by an event as large as a major earthquake. Moreover, there are some concerns about the preparedness of the Government of Canada to provide federal services, and support, if requested, the provincial and local response.

6. Canadians must understand recovery tools like insurance

The best time to plan for recovery from a major earthquake is before the event strikes. Tools like insurance and public relief are essential mechanisms to fund the recovery process. Individuals, businesses, governments and other stakeholders should take the time to understand the specific role that insurance and the other tools may play to support recovery following an earthquake.

7. Science and research provide the foundation for action

Countries vulnerable to major earthquakes, like Canada, must invest in research to enhance their knowledge of the hazard, the potential impacts, and seismic safety. Investment in science and research will provide the knowledge to support effective actions by decision makers.

## Earthquake-prone Buildings NZ

The Government's policy to deal with earthquake-prone buildings must balance public safety, costs, heritage issues and the wider interests of communities, says Labour's Building and Construction spokesperson Raymond Huo.

"The costs associated with strengthening buildings concerns that a one-size-fits-all approach would see businesses and communities ignored, and the importance of protecting heritage stock were all issues raised during the review of the earthquake-prone buildings policy.

"Due consideration needs to be given to each of these concerns, as well as those expressed by affected parties about the difficulty of obtaining insurance for older buildings, buildings just above the earthquake-prone threshold, and those that are earthquake-prone.

"A recent survey by the Wellington City Council indicated that around half of the earthquake-prone building owners had difficulty getting insurance, and many faced premium increases of more than 50 per cent.

"We don't want to see businesses go belly-up, nor do we want to see community character and heritage interests overlooked.

"Submitters at the stage of the review were also eager to communicate that a lack of insurance impacts on a building owners ability to obtain a loan in order to pay for the strengthening work to be done. This process can be a costly chicken/egg situation.

"Concerns from submitters such as the New Zealand Heritage Trust Board, note that while many heritage buildings are privately owned, these places are often of value to society as a whole - yet private owners are shouldering these costs singlehandedly. Ensuring that disability access is not affected by upgrades is also important.

"While Labour welcomes the Government's intention to introduce legislation to amend the Building Act 2004, further details are still required. Any legislation the Government proceeds with needs to be developed as an integrated package, rather than in a piecemeal manner like the Building Amendment Bills (No 3) and (No 4), introduced by the Minister Maurice Williamson."

## New Australian Pool of Ocean-bottom seismographs

Twenty broadband instruments will be purchased in 2013 for short-term and long-term deployment around the Australian coast for Earth imaging, offshore exploration and *natural hazard assessment*.

Extracted from an article by Alex Goncharov, Geoscience Australia in TAG June 2013 page 23.

## Letters

Dear Colleague:

The III Latin-American Congress of Seismology and the II Latin-American and Caribbean Symposium of Geophysics will take place in Bogota, Colombia, from the 23rd through the 25th of July 2014.

In parallel, we will also host the First Regional Assembly of the Latin-American and Caribbean Seismological Commission – LACSC, which is a subcommission of the International Association of Seismology and Physics of the Earth's Interior – IASPEI. Additionally, several workshops organized by IRIS, ISC and GEM will take place.

For more information and deadlines, please visit the web page: www.geoslac.org

Please, feel free to resend this information to all members of the Earth Sciences Community.

Sincerely, Local Organizing Committee

## Conferences

**15-17 November 2013 - The 2013 AEES Annual Conference will be held in Hobart, Tasmania. www.aees.org.au**

**20 - 23 November 2013** the 19th NZGS Symposium "Hanging by a Thread – Lifelines, Infrastructure and Natural Disasters". Queenstown, New Zealand.

http://www.nzgs13.co.nz/

**9 – 11 July 2014 ASEC 2014 - Structural Engineering in Australasia – World Standard**

Sky City Auckland Saturday 12 July in Christchurch for a field trip post-2010 **Abstract Submissions** close 7 July 2013earthquakes. Selection criteria here.

**23-25 July 2014** IASPEI Regional Assembly of the Latin American and Caribbean Seismological Commission Bogotá, Colombia,

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**The 2011/12 AEES Committee**

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See Website: www.aees.org.au for more information.

## A tale of two seisms

Ernabella 23/03/2012 (Mw5.4) and Mulga Park 09/06/2013 (Mw 5.6)

*Dan Clark & Andrew McPherson (Geoscience Australia, dan.clark@ga.gov.au)*

On 23 March 2012, at 09:25 GMT, a $M_W$ 5.4 earthquake occurred in the eastern Musgrave Ranges of north-central South Australia, near the community of Ernabella (Pukatja) (Figure 1). Several small communities in this remote part of central Australia reported the tremor, but there were no reports of injury or significant damage. This was the largest earthquake recorded on mainland Australia in the past 15 years and resulted in the formation of a 1.6 km-long surface deformation zone that included reverse fault scarps with a maximum vertical displacement of more than 0.5 m (average ~0.1 m), extensive ground cracking, and numerous rock falls (Clark *et al.* 2013).

Fifteen months later, on 09 June 2013, at 14:22 GMT, a $M_W$ 5.6 earthquake occurred ~15-20 km northwest of the 2012 surface rupture, and was named the Mulga Park earthquake. Despite being only slightly larger in magnitude to the 2012 event, this event was felt much more widely. It was strongly felt in Fregon (85 km S), Amata (88km W), Mimili (130 km SE) and Indulkana (170 km ESE). Pukatja community members, some 30 km south of the epicentre, described similar ground shaking intensities to the 2012 Ernabella event (~MMI VI). Data from the event recorded on the EarthScope USArray (144deg separation) were reviewed and lacked obvious depth phases, suggesting a very shallow hypocentre (<5 km, Mark Leonard pers. comm.). No significant damage or injury was reported.

Ground cracking suspected to be related to the earthquake was observed on a local community track by Peter Ruwoldt, Deputy Principal at Ernabella School. Subsequent examination by GA officers confirmed this interpretation and found that in contrast to the 2012 event, ground cracking and minor dune settlement were the only surface expressions relating to the 2013 Mulga Park earthquake. The cracks formed in a region of sand plain and dunes on the northwest side of the Musgrave Ranges (Figures 1 and 2). They were sub-vertical in orientation and irregular in strike (Figure 2). Sinuous trends and intersections were commonly observed (e.g. Figure 2a). Where a hardpan was locally exposed the cracks were covered by pop-up lids, forming mole tracks. Evidence of cracking was much reduced or lost where soft sand covered the ground surface. Consequently, the features were best expressed in dam walls and along tracks. No vertical displacements were evident, nor were patterns indicative of a significant lateral displacement. While the length of the cracks varied from location to location, the scale of the mole tracks and pop-ups remained relatively constant. Crack density and interconnection was found to be the best proxy-indicator of ground shaking intensity during the earthquake.

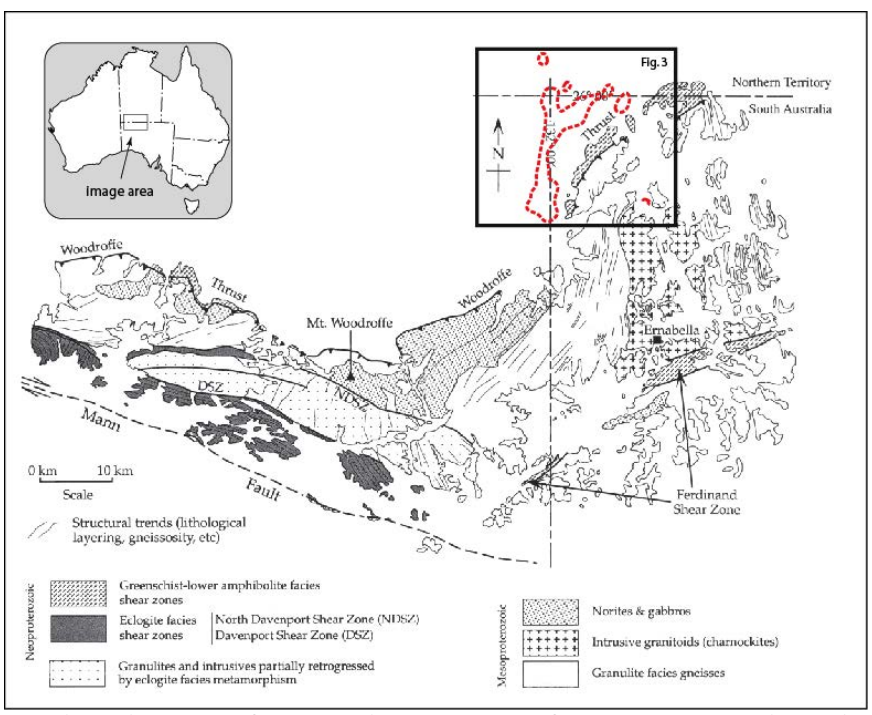


*Figure 1 – Geological setting of the 2012 and 2013 earthquakes, within the Musgrave Ranges (modified after Camacho & McDougall 2000). Red line in the SE corner of the inset box is the 2012 surface rupture. Crosshairs at the northwest extent of the red dashed polygon in the inset box marks the likely epicentre of the 2013 event.*

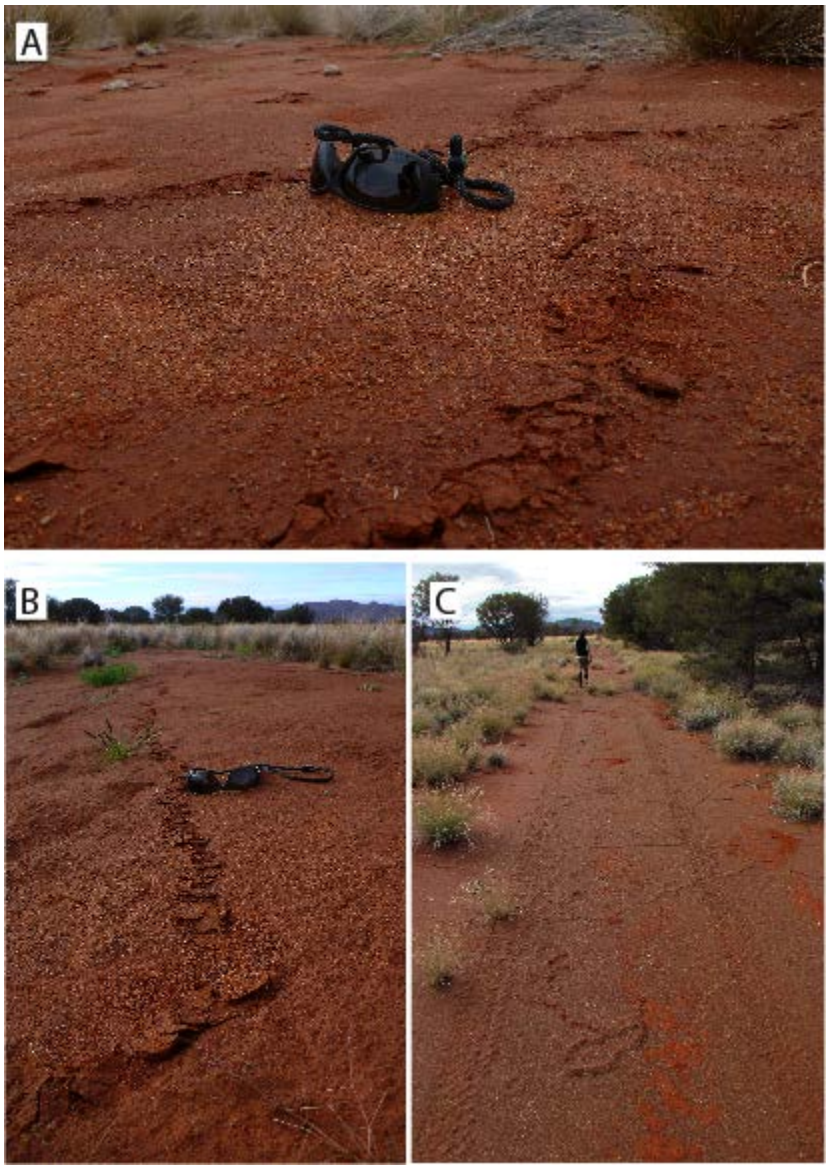


*Figure 2 – images of ground cracking relating to the 2013 earthquake. A)& B) mole tracks/pop-ups developed in desert hardpan, C) area of moderately dense cracking (density 4 on Figure 3). The Musgrave Ranges can be seen in the background in parts B & C.*

Over a three day period the distribution and spatial density of ground cracking was mapped along a number of tracks and along foot traverses (Figure 3). Cracking density ranged from rare, isolated, short (~1m) cracks with poorly developed mole tracks or pop-ups (Density 2, Figure 3), to networks of interconnected cracks tens of metres long with prominent pop-ups (Density 6, Figure 3). Open cracking was observed locally on several dune crests, indicating settlement. No discrete surface breaks directly relating to faulting were observed. Furthermore, in marked contrast to the 2012 event, no rock falls were observed on nearby ranges.

A contour separating Density 3 (low to moderate density cracking) and above defines a narrow arcuate band of cracking approximately 18 km in length (red dashed line, Figure 3). This band parallels the mapped position of the southeast boundary of the Woodroffe Thrust (cf. Camacho & McDougall 2000). At this location the 30 degree southeast-dipping 'Woodroffe Thrust' is a several-kilometre wide zone of highly deformed and metamorphosed rocks rather than a single fault (Camacho *et al.* 1995, Camacho & McDougall 2000, Lin *et al.* 2005). The northwest boundary of the thrust zone is concealed beneath the sand plane, and might conceivably coincide with the arcuate zone of high density cracking.

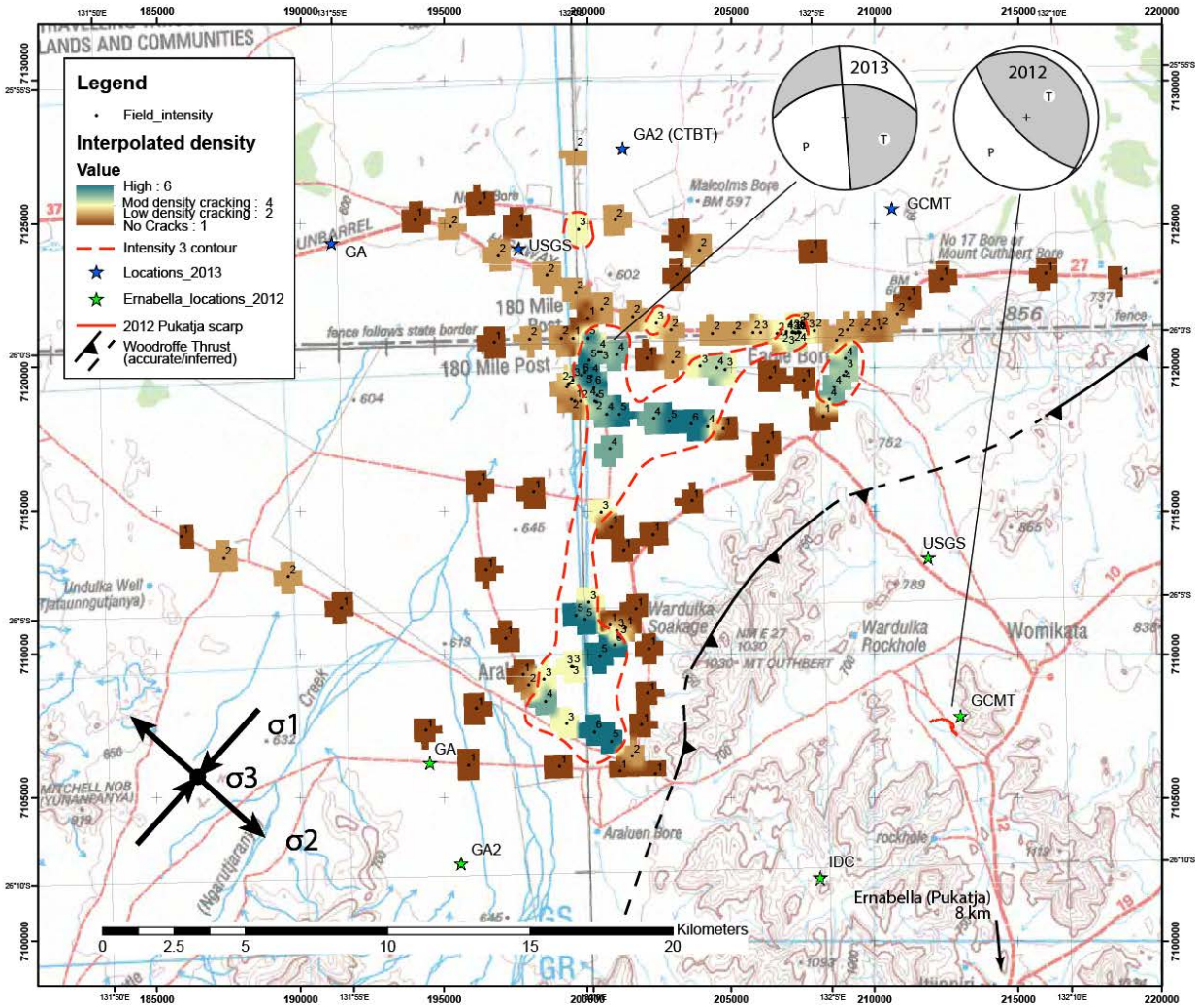


*Figure 3 – field cracking density data and interpolated density surface (neighbourhood statistics) showing a band of high density cracking paralleling the Woodroffe Thrust some several kilometres to the west of the range front. Calculated epicentres for the 2012 and 2013 events are marked (green and blue stars, respectively), as is the 2012 Pukatja surface rupture trace. Focal mechanisms for the 2012 event (Clark et al. 2013), and the 2013 event (based on fitting a moment tensor to surface wave spectra from 25 stations, 81% double couple, 19% CLVD: constructed by M De Kool ) are shown.*

A lobe of high density cracking extends to the north from the centre of the main arc of moderate to high density cracking. Some of the most consistently high-density cracking observed occurred within this lobe (Figure 2A & B). Together with the west limb of the arc, this lobe defines a northerly trend which is consistent with failure along the northerly trending nodal plane of the focal mechanism derived for the event (Figure 3).

While the P-axes of the focal mechanisms constructed for the 2012 and 2013 events are similar, indicating northeast-directed compressive stress, the mechanisms themselves, and surface effects, are quite different. The 2012 rupture resulted in the formation of a 1.6 km long reverse fault scarp (Clark *et al.* 2013) (Figure 3). Excavation into the shallow subsurface revealed failure along a northwest striking, southwest dipping reverse fault, consistent with the focal mechanism derived from the event. The rupture followed, in part, the boundary between a metamorphosed granite and the surrounding highly deformed and metamorphosed country rocks. Ground cracking was largely localised to the close proximity of the surface rupture, which is likely to have terminated in a down-dip direction several kilometres above the plane of the Woodroffe Thrust. Rock falls were mapped up to 15 km from the surface rupture. In contrast, The 2013 Mulga Park event, 0.2 magnitude units larger, resulted in the formation of an ~18 km long zone of surface cracking which in part parallels the Woodroffe Thrust, and no discernible surface rupture. Furthermore, no rock falls were observed relating to the event. The areal extent of the surface effects of the 2013 event are similar to that of the 1986 $M_W$5.7 Marryat Creek earthquake (80 km east), which is associated with a 13 km long reverse fault scarp with a maximum offset of 0.6 m (Machette *et al.* 1993).

The focal mechanism for the Mulga Park earthquake indicates strike slip failure (Figure 3), with the sub-vertical northerly trending nodal plane favoured as the failure plane. Epicentres calculated for the event by various organisations are widely scattered (blue stars, Figure 3), but are ubiquitously to the north of the zone of cracking. We speculate that the rupture initiated near the NT/SA border and progressed to the south along a steeply dipping, northerly oriented structure (underlying the northerly high-density lobe). It is not clear whether the rupture partly propagated onto a structure associated with the northwest margin of the Woodroffe Thrust, or if the arc of high density cracking that parallels the Thrust is the result of reflection of energy directed at the thrust interface. At this location, the thrust interface represents a boundary between Greenschist to Amphibolite facies felsic granitoids and gneisses of the Mulga Park Domain, and highly deformed Granulite facies rocks of the Woodroffe Thrust zone (Camacho *et al.* 1995). This reflection scenario makes intuitive sense, as a reasonable rupture dimension for this earthquake is 6 km (length) x 4 km (width) (e.g. Leonard 2010), and the Woodroffe Thrust is poorly oriented for reactivation in the current stress field in the epicentral region.

**Acknowledgements**

The authors are extremely grateful to the people of the Anangu Pitjantjatjara Yankunytjatjara community of central Australia who, at short notice, kindly granted permission to access and work on their land. Peter Ruwoldt is warmly thanked for again discovering and reporting the surface deformation that formed the starting point for our field investigation.

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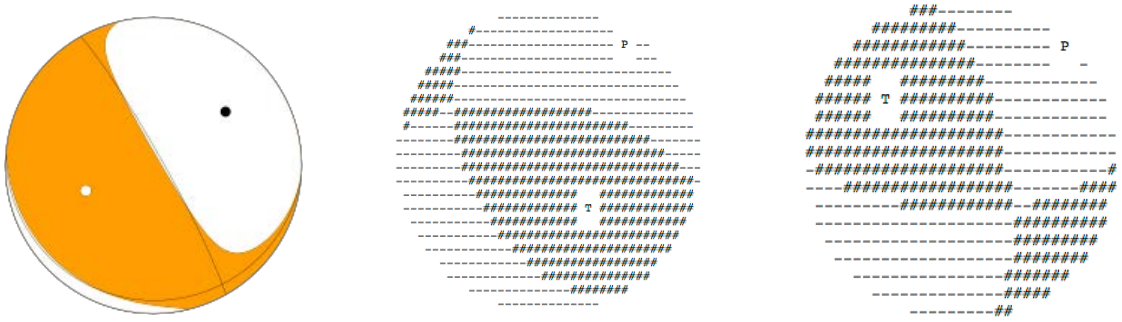
**Notes by Hon. Editor**

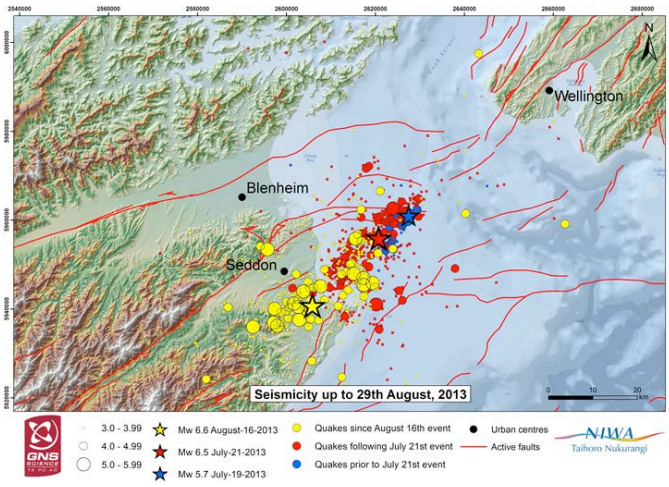
In the location parameters published on-line by GA, their RMS residual time (uncertainty in origin time) was 5.19 seconds, which is quite high indicating significant uncertainty in their computed shallow focal depth. An alternative explanation for the lack of observed faulting and aftershocks is that the focal depth was at least 10km deep, supported by an observation by the Hon. Editor of a pP phase on an Antarctic station.

Three quite different focal mechanisms have been derived by different groups in the US, using the same data, L to R: USGSMT, USGS SLU, and GCMT. The only parameter in common is the direction of the principal stress, approximately NE/SW like the GA focal mechanism above that is itself different again to these three. It must have been a complex earthquake.



## New Zealand in the Spotlight Again

A magnitude 6.5 earthquake occurred on 16 August 2013 south of Blenheim on the South Island of New Zealand, as the result of strike-slip faulting on or near the plate boundary between the Pacific and Australian plates. At this latitude, the Pacific plate moves towards the WSW with respect to Australia at a rate of approximately 40 mm/yr. The focal mechanism is consistent with plate motion oriented displacements. This region suffered a number of moderate sized earthquakes in recent weeks, including a M 6.5 earthquake approximately 40 km to the east in Cook Straight, on July 21, 2013. The July 21 event was preceded by several M 5.3-5.8 events and was followed by a dozen or more aftershocks between M 4.5-5.0, aligned NE-SW, and some deeper subduction-related activity, mostly offshore of the north coast of New Zealand's South Island.




In contrast to the earlier events, the August 16 earthquake is on land, near the eastern end of the complex Marlborough Fault System. The epicentre is located approximately 10 km southeast of the Awatere Fault in the vicinity of Lake Grassmere. The Marlborough Fault system is characterized by a series of NE striking right-lateral strike slip faults that subdivide the northern South Island into a series of crustal blocks that are being transported to the northeast. There is no mapped surface fault that can be linked to the August 16 event, but the NE trending fault plane is parallel to the Awatere and Clarence faults of the Marlborough system.

The earthquake bounced two huge container cranes off their rail tracks at CentrePort, and one of them was out of action until Wednesday. Concrete piles beneath the wharf at the southern end of the terminal were damaged in the earthquake on 16 August, and engineers' checks are likely to take about another month. In the meantime, the heavy-duty container-lifting crane was being kept off the southern end as a precaution.

Wharf workers told The Dominion Post that about 50 of the massive container terminal piles had been damaged in the quake, but Mr Larsen said: "We need to find out the exact situation and we'll find that out when the engineers come back with their final report." He confirmed "a few piles" had been damaged. There had been no disruption to any container ship services.

Wellingtonians need to think twice before fleeing after a major earthquake, and accept that they may not make it home to their loved ones immediately. That was the message from a meeting of the region's leaders in Upper Hutt yesterday about the magnitude 6.5 and 6.6 earthquakes that shook the central North Island on July 21 and August 16. Many agreed Civil Defence staff needed to better educate the public on how to react after a big quake. Wellington Civil Defence Controller Bruce Pepperell said streaming out on to the streets, as many people did on August 16, was not the best course of action. Fortunately for those who did on July 21, all the facades and windows that were going to tumble into the streets had already done so. The situation was not helped by 25 fire alarms being triggered in the Wellington CBD that day, which spooked a lot of people, he said. Upper Hutt Mayor Wayne Guppy said the mad dash to pick up children from school and head home after the August quake was not helpful either, because it jammed up the roading network.

GNS scientist Ken Gledhill told the mayors he believed the August earthquake was brought forward by the quake a month earlier. This was uncommon of earthquakes registering magnitude 6 or more, he said, which historically had been single events followed by a series of aftershocks. The mostly likely future scenario was that aftershocks from the Cook Strait earthquakes would continue for a few weeks before settling down, Dr Gledhill said. He pointed out that the shaking experienced during the Canterbury quake of 2011 was 10 times worse than the Cook Strait quakes.

More than 4000 claims have poured into the Earthquake Commission following the central New Zealand earthquakes back in July, and damage assessment will begin today. EQC says it will spread 20 assessment teams across the lower North Island and upper South Island to check out home, land and contents damage.

It's expected to take between three and six months for all claims to be assessed, with around 75-per cent concerning properties in the lower North Island. EQC's approach will be different to that used in Christchurch with assessors using a one-visit approach, looking at house, land and contents damage in one fell swoop.

Customers have three months from the date of the damage occurring to submit a claim for damage and those who've suffered damage from subsequent aftershocks are being reminded to submit a new claim each time.

## Christchurch

by Angela Saurine, National Travel Reporter, Herald Sun June 23, 2013 12:00am.

TWO years after it was struck by a devastating earthquake, Australian tourists are finally returning to Christchurch in large numbers. International visitor numbers were up 12%, Christchurch and Canterbury Tourism CEO Tim Hunter said the city was experiencing strong forward bookings for winter. Bookings for stays in the city during the ski season were up dramatically.

"The confidence in staying in the city is returning," Hunter said. "We had really good weather over summer which meant if you ran an outdoor business there were lots of operating days. *The earthquake activity has stopped* - we get occasional very minor shudders but that's about it." Accommodation is back to nearly two-thirds of pre-earthquake levels, with several more hotels set to open in coming months.

A new "cardboard cathedral" designed by Japanese architect Shigeru Ban is due to be finished soon and will act as a venue for concerts, exhibitions and community events. New bars and restaurants have popped up in former warehouses, buses, car washes and shipping containers.

"One of the most popular things has been the Cashel Mall, which is built from colourful shipping containers," Hunter said. "That has been a huge hit. It has 50 shops and cafes and there's constantly entertainment in terms of music and performing arts. "It really is such a contrast to the devastation that's around it. "Visitors get a sense that there's a bit of vitality despite the rebuild that's going on."

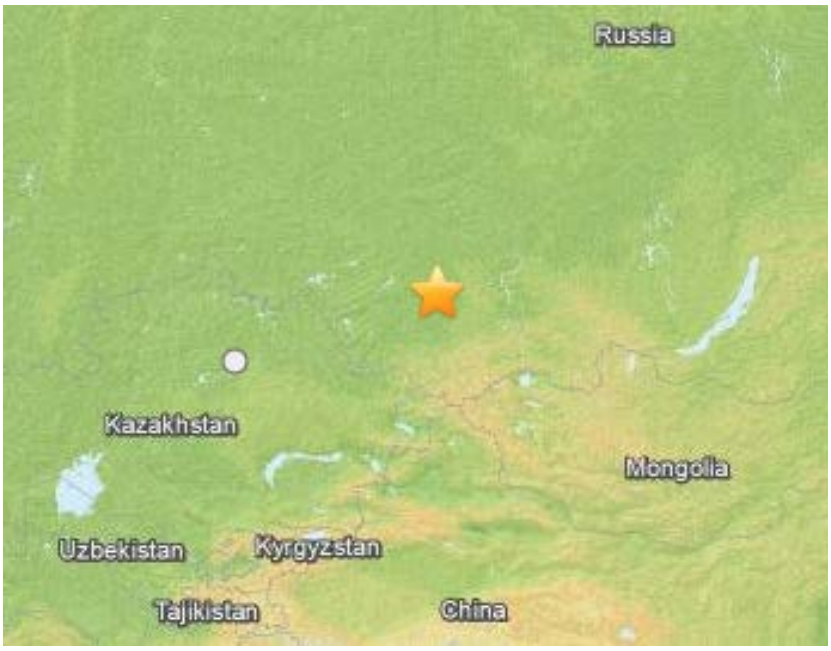
An exhibition called *The Quake City* has also become a major drawcard for visitors since it opened in February. Several charities also have come up with innovative ideas to help lift the mood. Gap Filler organises events such as mini golf, exhibitions and performances on vacant land created by the earthquake, while volunteers from Greening the Rubble have been creating parks and gardens in areas damaged by the quakes. "There's still a very big infrastructure repair job going on in the city so there's a lot of road works where they're decking out water mains and sewer pipes because of the amount of underground damage," Hunter said. "It's going to take three years to complete that job."

About 100 buildings damaged in the quake are yet to be demolished.

## Damaging Russian earthquake, or was it triggered?

**2013-06-18 at 23:02:09 UTC**

Earthquake Damages 500 Homes in Kemerovo Region ***(from The Moscow Times 2013 | Issue 5150)***
Location 54.242°N 86.149°E depth 10km, magnitude M 5.3
Nearby Cities
3km (2mi) W of Starobachaty, Russia
5km (3mi) SSE of Bachatskiy, Russia
14km (9mi) ESE of Gur'yevsk, Russia
21km (13mi) SSW of Belovo, Russia




More than 500 homes have been damaged in the village of Bachatsky as a result of an earthquake that struck the Kemerovo on Wednesday. It was the strongest earthquake to have struck the region in over 100 years and was felt 300 kilometers away in Novosibirsk.

The U.S. Geological Service said it registered a magnitude of 5.3 on the Richter scale. It occurred at 3 a.m. Moscow time, RIA-Novosti reported Wednesday.

A local official confirmed preliminary reports that about 500 homes had sustained damage ranging from cracks in the walls to collapsed walls, ceilings and chimneys.

Power was cut off this morning, but has now been restored, while the water supply and communications links were not affected.

However, an official in Bachatsky village said the locals are afraid to enter their homes after the earthquake for fear of collapsing walls and are staying outside.

Viktor Seleznyev, director of the Geophysical Service at the Siberian chapter Russian Academy of Science's, said the earthquake was provoked by human industrial activity. The Kemerovo region has one of the largest coal basins in the country where coal is produced in open-pit mines. Explosives are frequently used to delve deeper into the ground, which could have triggered local tectonic processes, he said.

The nearby Bachatsky open-pit coal mine is gigantic: 11 kilometers long, more than two kilometers wide, with a depth of 350 meters. According to Seleznyev, the earthquake took place in the immediate vicinity of the mine, only 800 meters away from the mine's administration building.

Regional Governor Aman Tuleyev has ordered all work at underground mines in the Kemerovo Region, part of Russia's Kuzbass coal-producing heartland, to be suspended.

Read more: http://www.themoscowtimes.com/news/article/earthquake-damages-500-homes-in-kemerovo-region/481940.html#ixzz2WizAvW2H

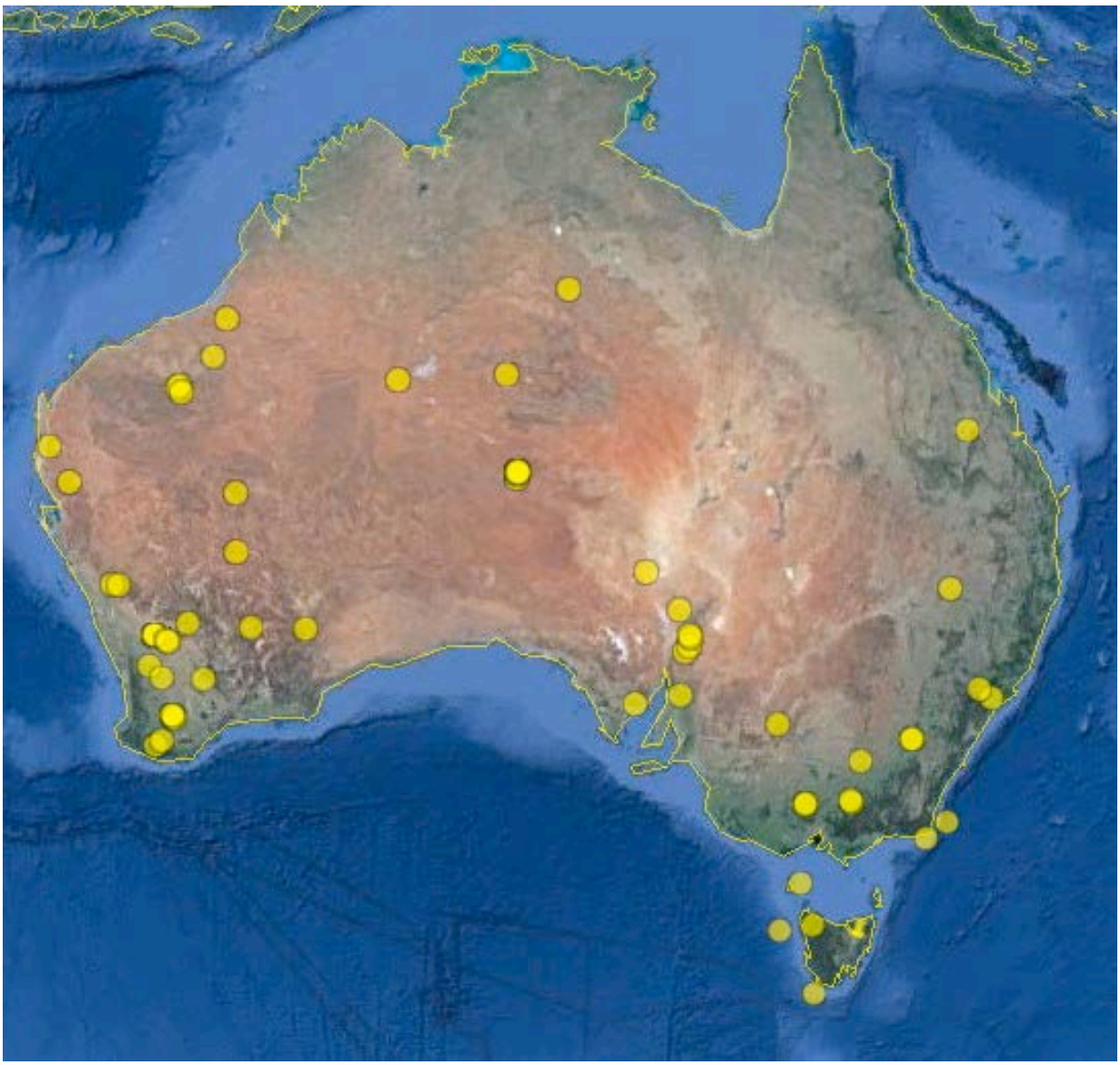
## Australian Earthquakes 01 Jun to 31 Aug 2013

This past quarter was energetic, earthquake-wise, in Australia, the largest event magnitude ML 5.7 near Ernabella South Australia on 09 June (see article page 8). The aftershock sequence at Tennant Creek continues with a magnitude 4.2 event there on 18 July.

*Earthquakes in the Australian region, magnitude 2.5 or greater, located by Geoscience Australia, SRC and PIRSA (the latter solutions show no seconds in time).*

| UTC Date | UTC Time | Latitude °S | Longitude °E | Depth (km) | ML | Approximate location |
|---|---|---|---|---|---|---|
| 2013-06-01 | 05:58:56 | -23.65 | 148.85 | 3 | 3.2 | Near Blackwater, Qld. |
| 2013-06-03 | 20:25:26 | -34.29 | 116.98 | 0 | 2.9 | SW of Kojonup, WA. |
| 2013-06-03 | 20:09:14 | -34.44 | 116.65 | 10 | 2.7 | SW of Kojonup, WA. |
| 2013-06-03 | 19:44 | -29.0 | 149.0 | - | 3.5 | Mungindi, NSW. |
| 2013-06-03 | 18:03:48 | -31.26 | 138.66 | 10 | 2.5 | S of Blinman, SA. |
| 2013-06-03 | 13:29:28 | -30.63 | 117.43 | 2 | 2.7 | N of Koorda, WA. |
| 2013-06-03 | 13:27:21 | -30.65 | 117.42 | 0 | 2.7 | N of Koorda, WA. |
| 2013-06-05 | 13:17:52 | -20.26 | 121.55 | 0 | 3.6 | Great Sandy Desert, WA. |
| 2013-06-06 | 09:44:21 | -30.70 | 121.47 | 0 | 2.8 | Near Kalgoorlie, WA. |
| 2013-06-08 | 19:48:32 | -35.24 | 146.22 | 0 | 2.5 | SW of Narrandera, NSW. |
| 2013-06-09 | 16:32:13 | -34.15 | 142.51 | 10 | 2.5 | E of Mildura, NSW. |
| 2013-06-09 | 15:54:33 | -25.97 | 132.04 | 0 | 3.3 | Near Mulga Park, NT. |
| 2013-06-09 | 14:34:41 | -25.91 | 132.05 | 0 | 3.3 | Near Mulga Park, NT. |
| 2013-06-09 | 14:22:15 | -26.11 | 131.99 | 0 | **5.7** | Near Ernabella, SA. |
| 2013-06-09 | 14:21:56 | -25.88 | 132.03 | 0 | 3 | Near Mulga Park, NT. |
| 2013-06-09 | 05:38:43 | -25.92 | 131.97 | 0 | 3.6 | Near Mulga Park, NT. |
| 2013-06-09 | 03:03:52 | -36.86 | 144.11 | 2 | 2.6 | Bradford Hills, Vic |
| 2013-06-09 | 02:36 | -36.9 | 144.1 | 2 | 2.9 | Bradford Hills, Vic |
| 2013-06-12 | 13:30:39 | -22.75 | 127.74 | 0 | 3.6 | Lake Mackay, WA. |
| 2013-06-13 | 15:30:20 | -30.63 | 117.44 | 5 | 2.8 | N of Koorda, WA. |
| 2013-06-14 | 11:21:27 | -31.63 | 138.67 | 16 | 2.9 | NE of Hawker, SA. |
| 2013-06-16 | 10:47:03 | -30.66 | 117.40 | 7 | 2.6 | N of Koorda, WA. |
| 2013-06-17 | 09:49:32 | -28.76 | 115.96 | 0 | 2.5 | Near Morawa, WA. |
| 2013-06-20 | 03:54:33 | -29.19 | 136.88 | 10 | 3.4 | Near Lake Eyre, SA. |
| 2013-06-22 | 11:57 | -36.8 | 146.2 | 12 | 3.4 | Tatong, Vic |
| 2013-06-23 | 12:48:05 | -25.09 | 114.77 | 0 | 3.2 | E of Carnarvon, WA. |
| 2013-06-24 | 05:52:43 | -36.65 | 146.06 | 0 | 2.7 | Near Benalla, Vic |
| 2013-06-25 | 20:48:24 | -28.81 | 116.23 | 0 | 2.5 | NE of Morawa, WA. |
| 2013-06-29 | 15:11:03 | -32.31 | 119.22 | 10 | 2.5 | NE of Hyden, WA. |
| 2013-07-02 | 11:10:26 | -30.43 | 138.22 | 10 | 2.6 | NW of Leigh Creek, SA. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2013-07-04 | 14:53:05 | -37.13 | 150.63 | 0 | 2.5 | E of Eden, NSW. |
| 2013-07-05 | 03:19:21 | -33.44 | 117.62 | 2 | 2.6 | SW of Dumbleyung, WA. |
| 2013-07-05 | 01:53:33 | -33.46 | 117.59 | 5 | 2.9 | SW of Dumbleyung, WA. |
| 2013-07-09 | 16:09:47 | -31.67 | 117.00 | 2 | 2.5 | Meckering, WA. |
| 2013-07-10 | 02:57:26 | -41.28 | 145.33 | 11 | 2.6 | Near Lyons River, Tas. |
| 2013-07-11 | 00:18:45 | -31.83 | 138.52 | 2 | 2.6 | Near Hawker, SA. |
| 2013-07-13 | 10:19:02 | -25.89 | 132.00 | 0 | 3.2 | Near Mulga Park, NT. |
| 2013-07-14 | 03:39:53 | -22.58 | 119.64 | 0 | 2.9 | Pilbara, WA. |
| 2013-07-15 | 04:20 | -39.8 | 144.3 | 12 | 4.0 | E King Is, Bass Strait Tas. |
| 2013-07-16 | 04:55 | -41.3 | 144.6 | - | 2.6 | W of Kenneth Bay, Tas. |
| 2013-07-18 | 11:39:11 | -19.82 | 133.89 | 10 | 4.2 | Tennant Creek, NT. |
| 2013-07-19 | 18:42:08 | -32.12 | 117.45 | 5 | 2.6 | Near Quairading, WA. |
| 2013-07-20 | 15:24:40 | -33.54 | 117.70 | 5 | 2.5 | S of Dumbleyung, WA. |
| 2013-07-21 | 08:48:53 | -32.35 | 150.86 | 0 | 3 | Near Muswellbrook, NSW |
| 2013-07-21 | 07:52:33 | -33.31 | 138.44 | 5 | 2.7 | Near Gladstone, SA. |
| 2013-07-22 | 07:07:42 | -22.40 | 119.50 | 0 | 2.5 | Pilbara, WA. |
| 2013-07-22 | 05:09:24 | -21.49 | 120.95 | 10 | 2.9 | NE of Nullagine, WA. |
| 2013-07-23 | 09:34:42 | -30.86 | 117.91 | 9 | 2.8 | Near Bencubbin, WA. |
| 2013-07-29 | 11:32 | -31.35 | 138.63 | - | 3.1 | Near Wilpena, SA. |
| 2013-07-29 | 05:21:51 | -22.68 | 131.67 | 0 | 3.2 | SW of Yuendumu, NT. |
| 2013-08-01 | 04:16:52 | -30.91 | 117.96 | 0 | 2.9 | Near Bencubbin, WA. |
| 2013-08-02 | 17:46:07 | -26.15 | 121.41 | 10 | 3 | Near Lorna Glen, WA. |
| 2013-08-03 | 13:42 | -43.9 | 145.9 | - | 3.1 | S Port davey, Tas. |
| 2013-08-08 | 23:23:33 | -32.62 | 151.48 | 2 | 3.4 | NW of Maitland, NSW. |
| 2013-08-10 | 04:03 | -38.1 | 145.4 | 16 | 2.5 | Cardinia Vic |
| 2013-08-13 | 07:04:57 | -22.34 | 119.59 | 10 | 2.8 | Pilbara, WA. |
| 2013-08-14 | 11:39 | -33.58 | 136.71 | - | 3.5 | NE of Cleve, SA. |
| 2013-08-15 | 05:29:33 | -30.36 | 118.91 | 10 | 2.6 | Near Bonnie Rock, WA. |
| 2013-08-17 | 21:44:40 | -28.12 | 121.21 | 10 | 3 | SE of Leinster, WA. |
| 2013-08-19 | 12:14:58 | -23.77 | 114.12 | 10 | 2.9 | NE of Carnarvon, WA. |
| 2013-08-21 | 11:02:57 | -33.45 | 117.66 | 0 | 2.9 | SW of Dumbleyung, WA. |
| 2013-08-24 | 20:27:48 | -34.31 | 148.33 | 3 | 2.5 | Near Young, NSW. |
| 2013-08-24 | 06:39:35 | -30.87 | 123.66 | 0 | 2.7 | NE of Zanthus, WA. |
| 2013-08-28 | 09:15:19 | -34.33 | 148.28 | 0 | 2.6 | Young, NSW. |
| 2013-08-30 | 23:04 | -37.8 | 149.8 | - | 2.9 | S of Mallacoota, Vic |



*Plotted epicentres as listed in table above from Geoscience Australia.*

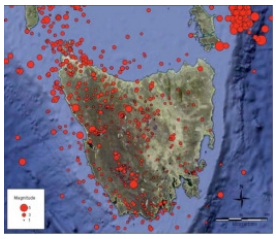
# AEES 2013

## Australian Earthquake Engineering Society Conference

## 15-17 November, 2013

The Old Woolstore Hotel

Hobart, Tasmania

# WELCOME

AEES President, Professor Hong Hao, and the AEES Committee look forward to welcoming you to Hobart, Tasmania, Australia to attend the 2013 Australian Earthquake Engineering Society Conference. The conference will be held at the Old Woolstore Hotel over three half days commencing at 1pm on the Friday (registration will open at 12nn) and concluding at 1.15pm on the Sunday.

There will be conference dinners on both Friday evening (at Peppermint Bay) and Saturday evening (at the Museum of Old & New Art - MONA).

There will also be a Partners' High Tea at Wrest Point and a tour to the Callington Mill via Richmond Bridge. A day trip has also been organised for those who are able to stay an extra day, to the Gordon Dam via the Mount Field National Park.

A meeting of Australian Seismologists is scheduled for Friday prior to the conference at the Old Woolstore Hotel and the AEES AGM will also be held during the conference.

Our keynote speakers this year are:

**A/Prof Charles Clifton**, Assoc Professor of Civil Engineering, The University of Auckland

**Prof Kazuhiko Kasai**, Division of Structural Engineering, Tokyo Institute of Technology

**Prof Paul Somerville,** Deputy Director, Risk Frontiers, Macquarie University, NSW

We will have a blend of keynote speakers, oral presentations and poster presentations.

Each poster presenter will be given the opportunity for a short oral presentation within the main program and will be asked to attend their poster during breaks. All abstracts will be published in the conference proceedings and full papers will be provided to each participant on CD/USB.

There will be an **Australian Seismologists meeting** held at the conference venue) on Friday 15 November, from 8.30-11.30am before the full conference commences for those interested in attending. There is no cost however please indicate your intention to attend on the conference registration form. For further information please contact David Love at david.love@sa.gov.au.

# KEYNOTE SPEAKERS

## Charles Clifton

Charles is an Associate Professor of Civil Engineering at the University of Auckland, where he has specialised in structural steel and composite engineering since joining in 2008. This followed a productive period since 1983 as Senior Structural Engineer at the Heavy Engineering Research Association, where he conducted research in structural steel, composite construction, fire engineering and durability. He also made considerable contributions to the introduction of new and revised standards, developed widely used design guides and was actively involved in professional development. A long and productive collaboration with the University of Auckland saw many innovations researched, developed and adopted by the profession, and also saw the award of his PhD in 2005. Charles is a Fellow of IPENZ and of the National Society for Earthquake Engineering. He is currently active in a range of research projects involving the development of low-damage seismic solutions, performance of composite steel floors in severe fires, and floor and frame solutions using light-gauge steel members and components. He has been involved with the assessment of buildings in the severe 2010/ 11 Christchurch earthquake series and in plans for rebuilding the city.

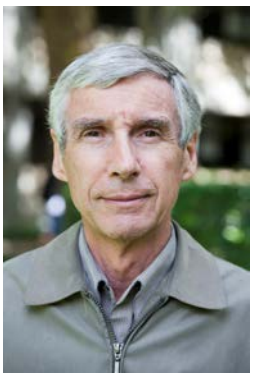
## Kazuhiko Kasai

Prof. Kazuhiko Kasai received Ph.D. degree from University of California, Berkeley in 1985. He was a faculty member at Illinois Institute of Technology and later at Lehigh University in US, and became a professor in 1997 at Tokyo Institute of Technology. Prof. Kasai is an internationally recognized researcher and educator in the areas of steel structure, response control, and earthquake engineering.

Prof. Kasai has been the chairman of Response Control Committee and Passive Control Effects Sub-Committee, Japan Society of Seismic Isolation (JSSI), Steel Passive Control Sub-Committee, Architectural Institute of Japan (AIJ), and various other structural engineering and response control committees in Japan. He also served as the chief editor for "JSSI Manual for Design and Construction of Passively Controlled Building", monthly academic journals of AIJ, and others.

Prof. Kasai was the Japan-side leader of the NEES and E-Defense US-Japan steel building research projects including full-scale experiments of conventional structure and value-added (passive-controlled or innovative) structures. He is also the Japan-side leader of the China-Japan joint research on seismic evaluation and mitigation for super-tall buildings, sponsored by the National Natural Science Foundation of China (NSFC) and Japan Science and Technology Agency (JST).

## Paul Somerville

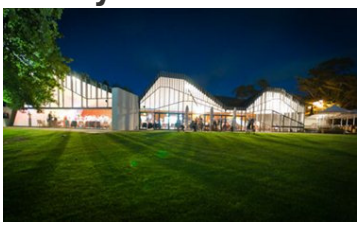
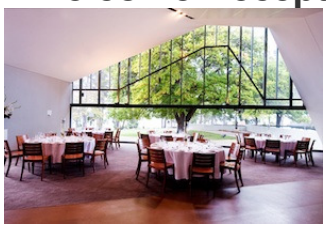


Professor Paul Somerville was born in Armidale, NSW, Australia and received his B.Sc. degree in Geophysics from the University of New England. He received his M.Sc. and Ph.D. degrees in Geophysics at the University of British Columbia in Vancouver, Canada. He spent two years as a Visiting Research Fellow at the Earthquake Research Institute, University of Tokyo, and has been involved with Japanese colleagues in engineering seismology research for his whole career.

Paul is Principal Seismologist at URS Corporation, where he does research and development on earthquake source and strong ground motion prediction models, and applies these in the design and analysis of major buildings, bridges, dams and power generation facilities in various countries including Australia, New Zealand, Japan and United States. He is also Senior Seismologist at Risk Frontiers, Macquarie University, where he builds catastrophe loss models for earthquakes and tsunamis for the insurance industry in the Asia-Pacific region.

# SOCIAL EVENTS

## Friday 15 November – Welcome Reception

A great way for AEES members and non-members alike to meet up and get to know each other at this casual dinner at the beautiful Peppermint Bay, a worldclass venue located in the rural village of Woodbridge, a short bus ride from Hobart via the picturesque Channel Highway. Peppermint Bay is set on four acres of waterfront headland and has commanding 270° water and mountain views. Partners/children are most welcome. A bus will depart the conference venue and return you to your accommodation after dinner.

## Saturday 16 November – Conference Dinner



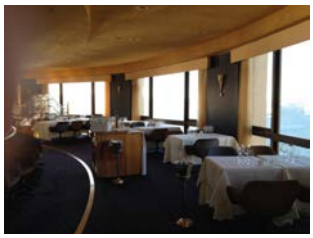


Join us for the official conference dinner at the spectacular MONA. Guests will travel by ferry (not like any ferry you've ever experienced, rather the amazing MR1 - an experience in itself!) from Hobart wharf to MONA where you'll find the design of the building as surprising as the works it houses. Book on the early ferry if you'd like some time to view the Museum or come on the later ferry if you're just coming for the Michelin star rated feast. Either way, don't miss this experience! Partners and children very welcome.

# PARTNERS

## Friday 15 November – High Tea @ the Point

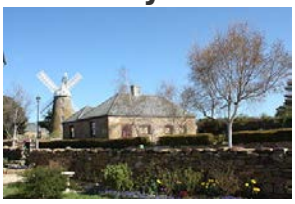





One for the partners! Watch the world go by with the best views in town from the Point Revolving Restaurant at Wrest Point. Indulge in the decadent treats and 5 star service. Partners will be driven to/fro the conference venue and Wrest Point. Numbers are limited so please book early!

# OPTIONAL TOURS

## Saturday 16 November – Callington Mill Tour/Richmond Bridge

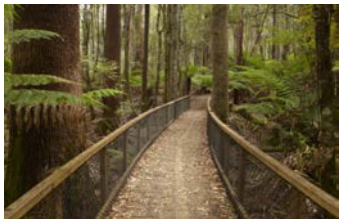



Callington Mill, built in 1837, is located in the beautiful town of Oatlands, an hours bus ride from Hobart. It is the only working example of its type in the southern hemisphere and the third oldest windmill in Australia. The restoration of the Mill to its former glory was completed in 2010. The tour is focused on the Callington Mill complex, including climbing the mill tower. The complex is comprised of the Mill Tower, the Mill Owner's House, the Miller's Cottage, the Granary and the Stables.

The Richmond Bridge is the oldest bridge still in use in Australia. It is a heritage listed arch bridge located on the "convict trail" in Richmond. Constructed of sandstone, hauled to the construction site by convicts using hand carts, it consists of four main arches which spring from sloping fins with angular leading edges aligned with the flow of to the lake.

## Monday 18 November – Day trip to Gordon Dam / Mt Field National Park



Be picked up from your hotel at 8.30am and start the day with a drive through the Derwent Valley to Mt Field National Park. After a short walk through rainforest dotted with huge manferns & some of the tallest trees in the world, see the impressive Russell Falls.

Back on the bus and after a drive through Tasmania's magnificent south-west wilderness you will reach Strathgordon, between Lakes Gordon and Pedder. Together these lakes form The Gordon River Power Development Hydro Electric Scheme which occupies a vast area of over 500sq kms. Lake Gordon was created from the Gordon River by constructing a 140m high dam across the river above its intersection with the Serpentine River. Water from the lakes is used in the underground Hydroelectric Gordon Power Station, located near the Gordon Dam.

The Dam itself is several metres higher than the Sydney Harbour Bridge (134m), and holds back thirty times the amount of water in the Harbour itself.

Near Strathgordon you'll enjoy a picnic lunch at Ted's Beach on the banks of Lake Pedder. A chance to sit and take in the breathtaking scenery of this Lake that once stirred the emotions of an entire country.

Then you have the choice of walking down to the top of the Dam wall, about 200 stairs, and of course back up again, which will reward you with some of the most awe-inspiring views. If you're not keen on the walk, just stay at the top lookout and enjoy the scenery from there.

After the visit to the Dam, it is time to board the coach and make your way back to Hobart. We will arrive back late afternoon, around 5.30pm, and you will be dropped off at your hotel.

# TRAVEL

**By Air**

Flights are available from all mainland States and Hobart is a little over an hour's flight from Melbourne, the nearest mainland capital city. The Airporter Shuttle service meets all flights and drops off at accommodation in central Hobart and inner city suburbs. For more information visit www.tasredline.com.au.

**By Ferry (from Melbourne)**

The Spirit of Tasmania passenger ships will transport you and your car on an overnight journey from Port Melbourne to Devonport (Devonport is approx 252km - 3.5 hour drive from Hobart

# ACCOMMODATION

Self contained apartment style accommodation (4 star) is available at the conference venue, the **Old Woolstore Apartment Hotel.**

We have negotiated special conference rates at the Old Woolstore so please quote the AEES conference when you make your booking. We recommend you **book before 18 October** to guarantee availability. Our block of rooms may be released to the general public after this date.

Rates are from $189 per night and include a full buffet breakfast, internet access and 1 espresso coffee. To book please contact the hotel directly on 1800 814 676 or email reservations at reservations@oldwoolstore.com.au

If you're looking for a bit more luxury we would recommend the nearby Grand Mercure Hobart Central Apartments at 34 Murray Street (rooms from $239 not including bfast), or The Henry Jones Art Hotel at 25 Hunter Street (rates start at $365). There is also the Zero Davey Boutique Apartment Hotel which is nearby (rates start $185 per night). If you want to be in the heart of Salamanca Wharf, the Salamanca Wharf Hotel. at 17a Castray Esplanade, is brand new and smack in the wharf area (rates start at $225). If you're looking for budget accommodation try the Mercure Hadley's Hobart Hotel (from $179 per night per room for share accom) or check out www.wotif.com