

Dr Gavin M. Mudd

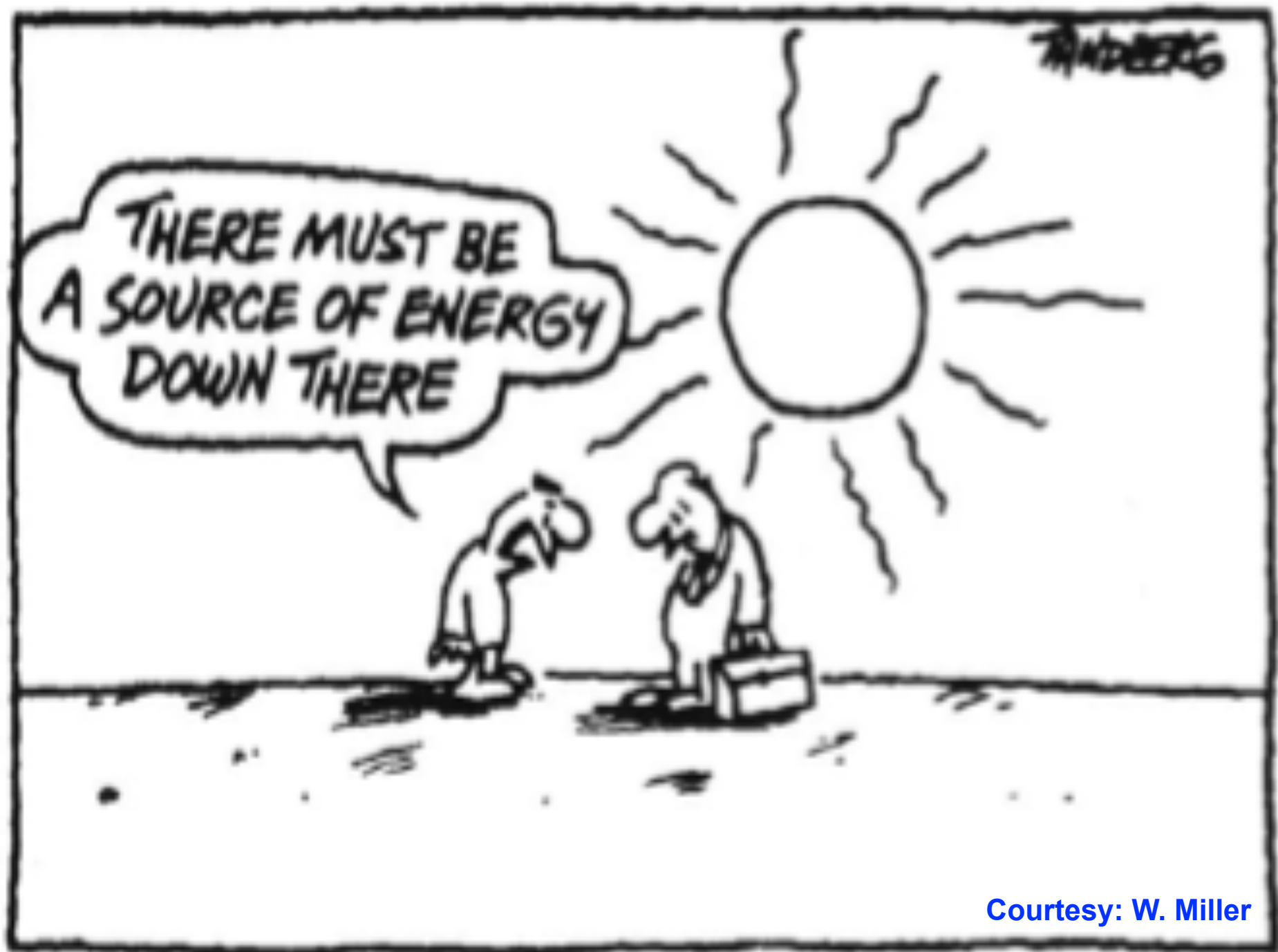
Environmental Engineering (Gavin.Mudd@monash.edu)

***Why is So Much Hot Air
Bubbling to the Surface:
CSG Impacts vs No Impacts?***

SEng Society Seminar, 9th May 2013

Ad Busters !!!!

- <http://www.youtube.com/watch?v=p8s4BB0en8Y&feature=endscreen&NR=1>



Courtesy: W. Miller

Presentation Overview

- Australia's Energy Resources ...
- What is Coal Seam Gas (brief !)
- Common Environmental Concerns
- Groundwater Risks and Impacts
- Need for Thorough Research & Evidence of **'NO HARM'**

Energy Everywhere ... even in Oz



SEng Society Seminar: Coal Seam Gas & Groundwater
9 May 2013 /

Energy Everywhere ... even in Oz

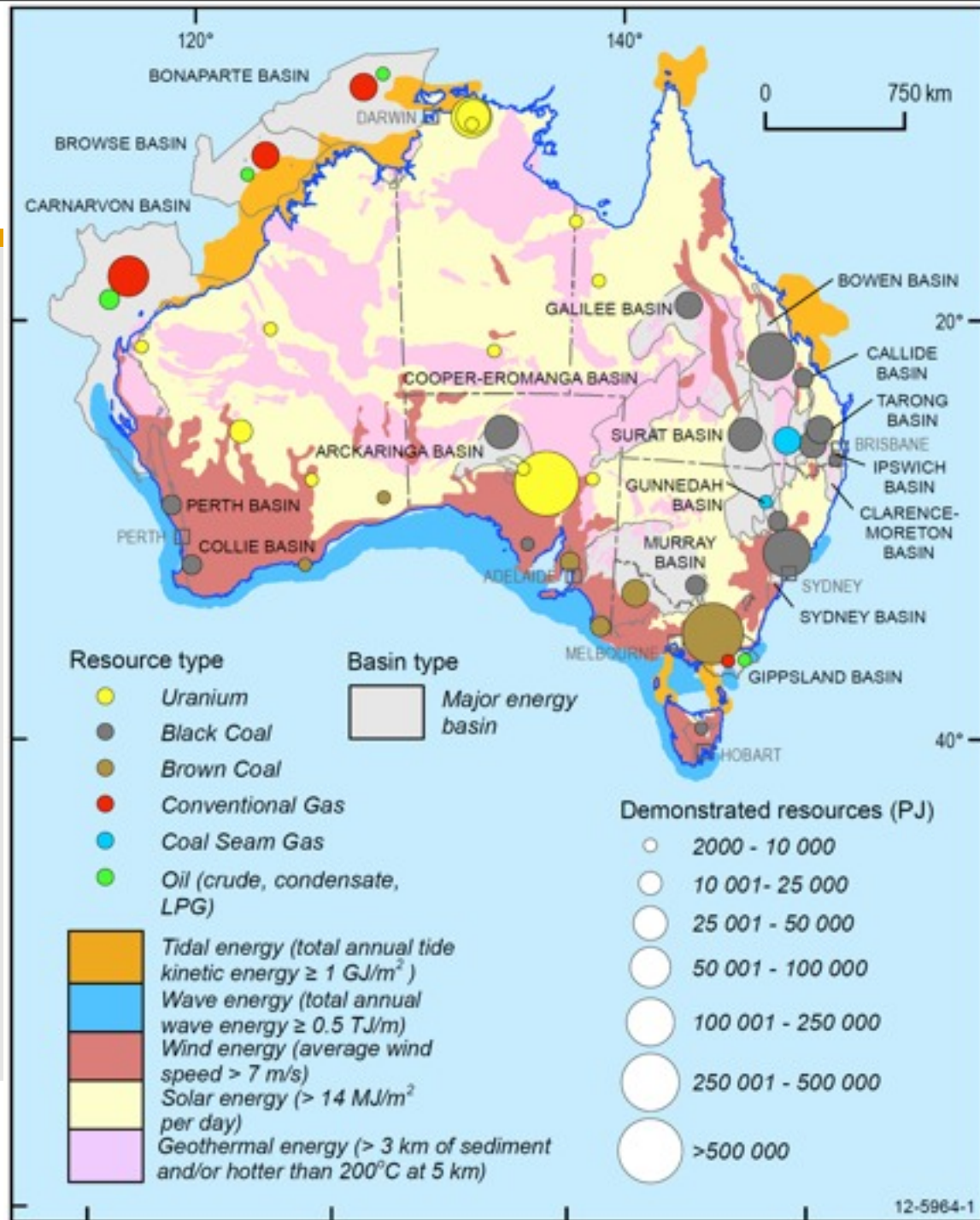
- **Australia has substantial and varied energy resources:**
 - *solar thermal & PV, wind, tidal, coal, conventional gas, coal seam gas, shale gas, uranium ...*
 - *But we are running out of conventional oil ...*

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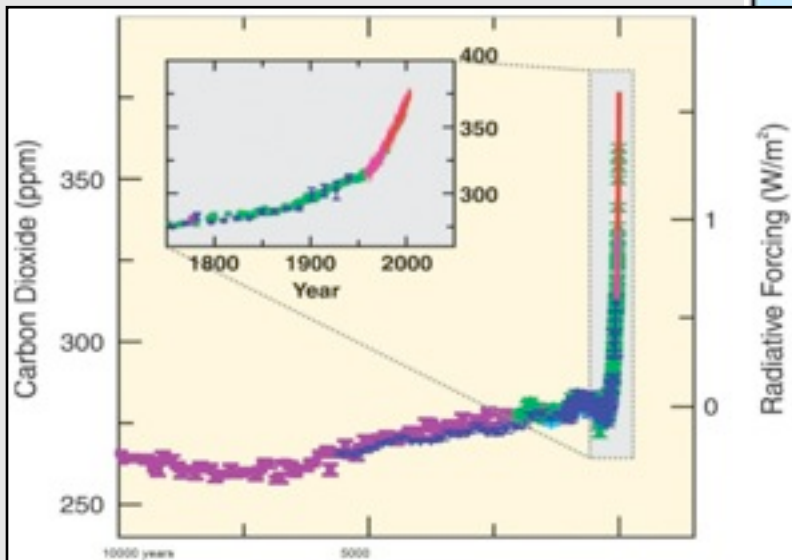
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 - *solar thermal & PV, wind, tidal, coal, conventional gas, coal seam gas, shale gas, uranium ...*
 - *But we are running out of conventional oil ...*
- ***Yet we continue to simply dig or drill ...***

Energy ... Oz Style

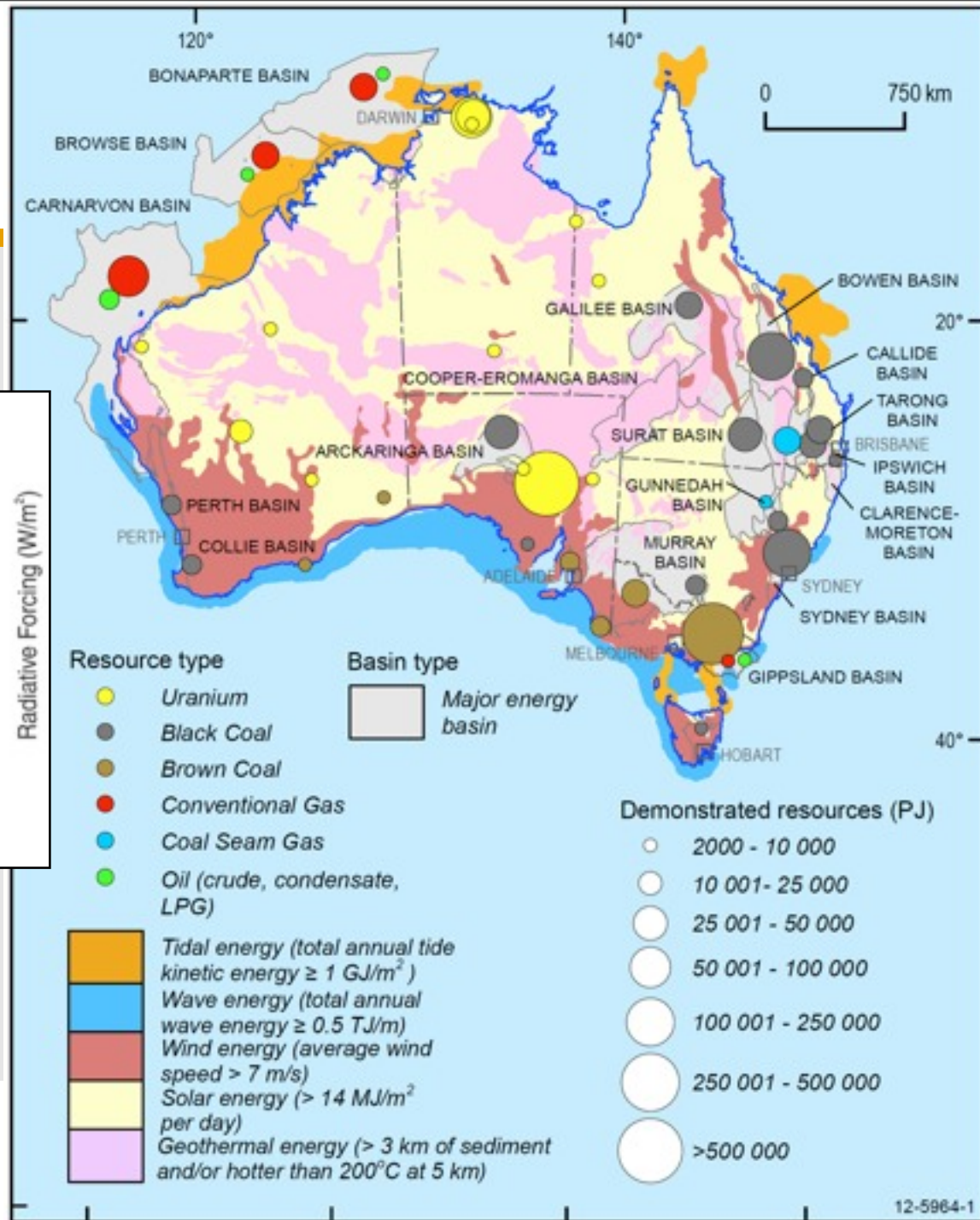
Energy in Australia 2012
BREE for RET



Energy ... Oz Style



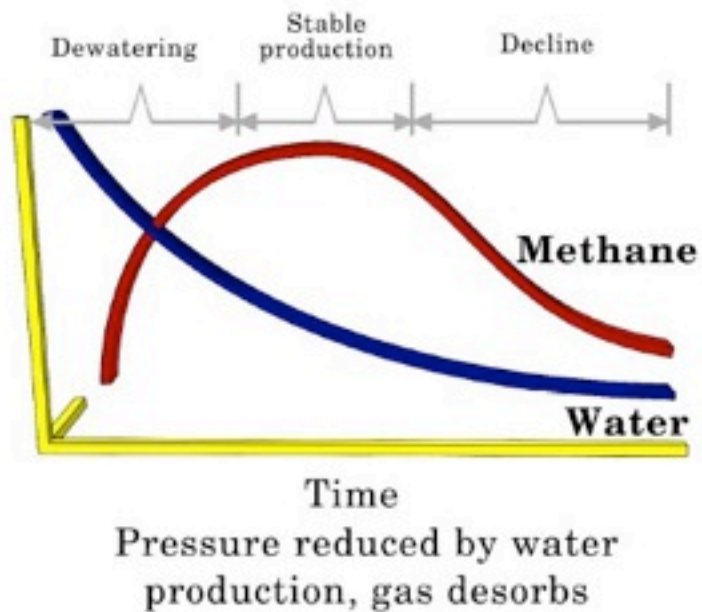
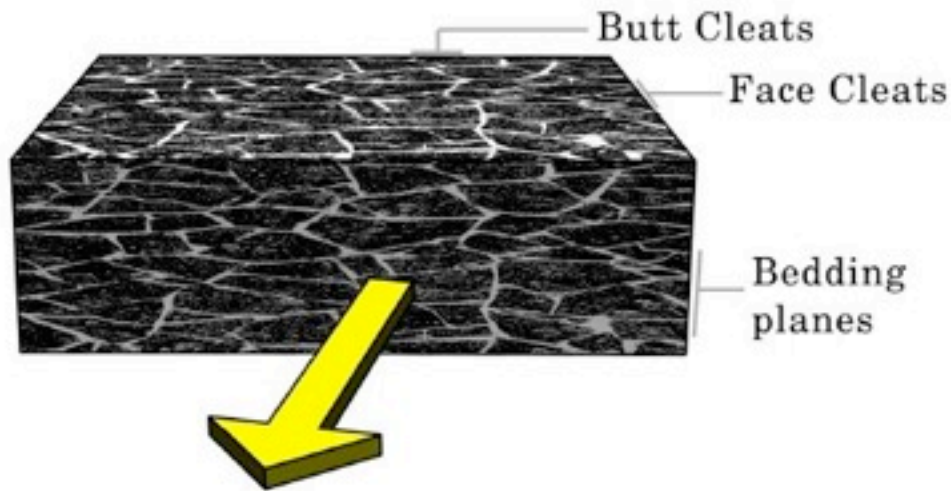
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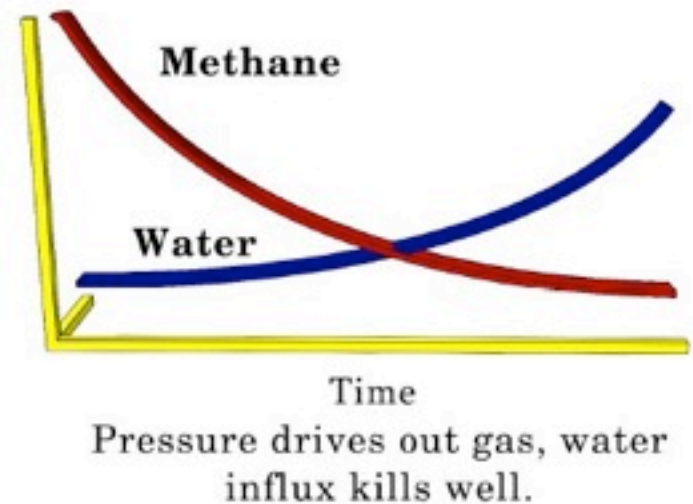
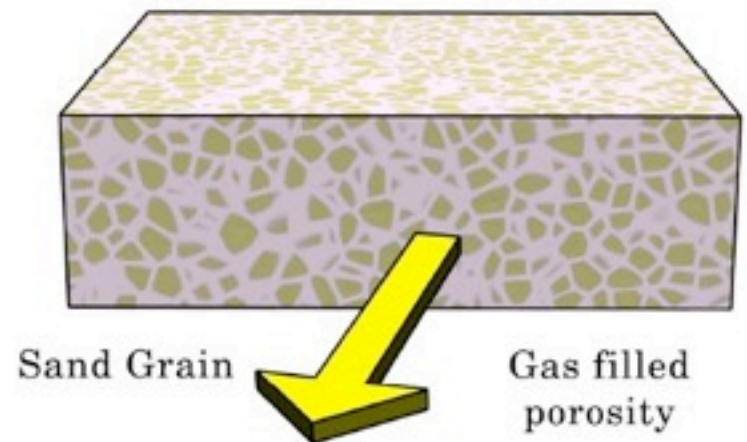
What is Coal Seam Gas ?

- Coal can often contain significant amounts of methane – also called ‘natural gas’ – hence the name ‘coal seam gas’ (CSG)
- CSG is a major problem for coal mining – especially underground (CSG is the principal cause of coal mine accidents, & historically simply vented to the air)
- You can extract CSG before coal mining, or even separately through bores & pipes

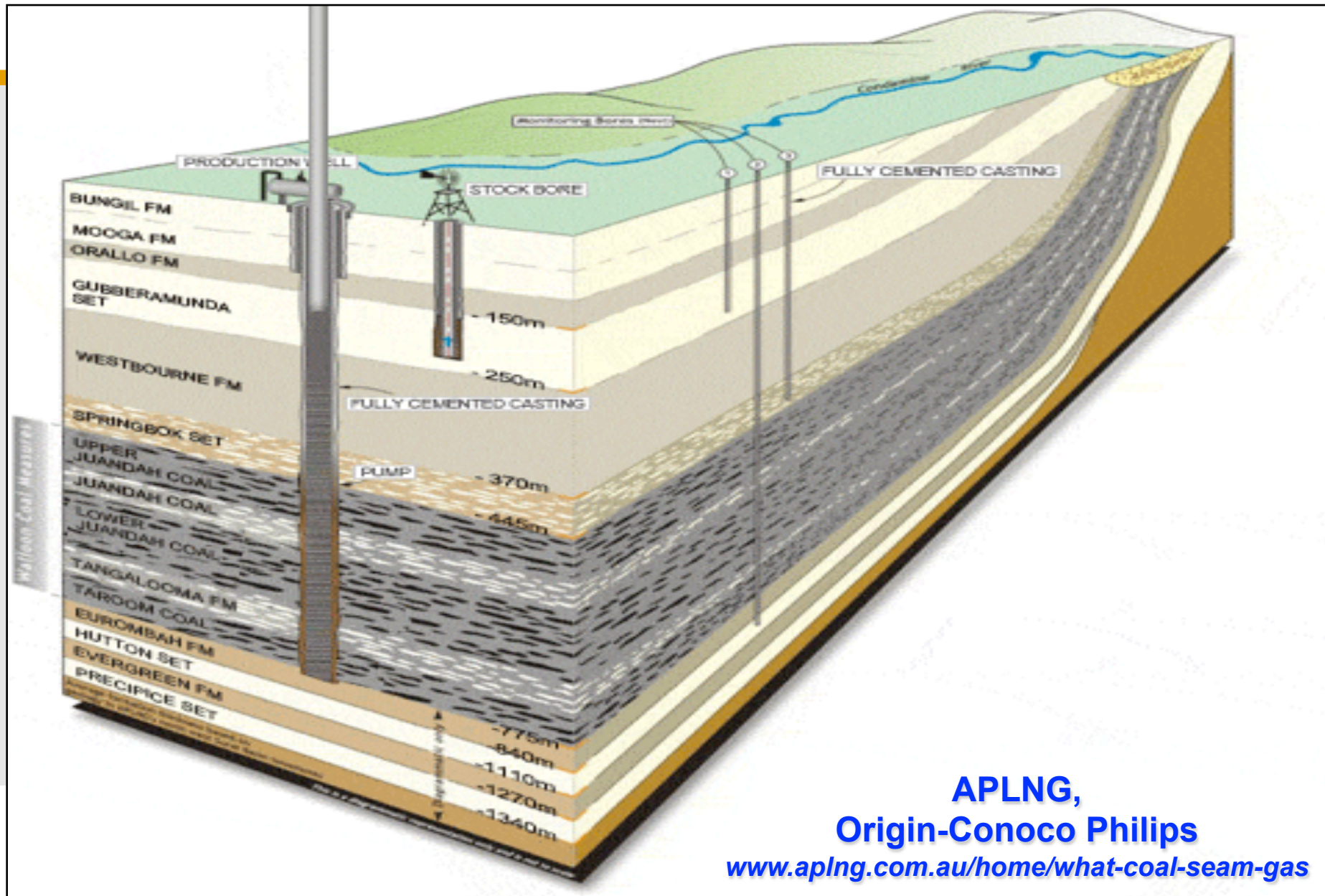
Coal Seam



Conventional



CSG vs Geology vs Groundwater ...



CSG Exploration or 'Appraisal' Well



Gladstone EIS,
Santos, 2009

CSG Production Well



Gladstone EIS, Santos, 2009

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Common Environmental Concerns

- Major environmental issues with CSG include:
 - compatibility of land use (eg. farming v CSG)
 - surface water impacts (toxics, erosion, floods, ...)
 - groundwater impacts – quantity & quality
 - toxic pollutants released – accidents or ongoing operations
- The extent of scientific research documenting these risks is **MINIMAL** ...

CSG & Water Issues

- Water **WATER** **WATER**

Aerial view of a CSG Water Pond



Saturday, 11 May 13

Groundwater Concerns v CSG

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 2. **Poor quality of CSG formation waters**
 3. **Potential for explosive buildup of methane gas**
 4. **Dependence of rural communities & industries on groundwater**

Camden CSG, Outer SW Sydney ...

AGL, 2006-07 Annual Environmental Performance Report, pp 4-14

4.6 GROUNDWATER POLLUTION

A previous technical assessment of the groundwater regime found that as the entire casing of each well is cemented from top to bottom, connection between the Illawarra coal measures and overlying aquifers is not possible. The potential for cross contamination between aquifers during the production life of a well is therefore extremely unlikely.

Given the limited volumes of groundwater generated during well construction and the nature of the containment within the coal measures as well as overlying formations, surface aquifer depletion or subsidence are not considered to be significant issues.

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Previous technical assessment of the groundwater regime has noted that the potential for contamination or depletion of shallow sandstone aquifers of the area, or cross-contamination between aquifers during the production life of a well, is extremely unlikely given the use and construction of gas production wells. As the entire casing of each well is cemented from top to bottom, connection between the Illawarra coal measures and overlying Hawkesbury Sandstone aquifers is not possible and the potential for cross contamination between aquifers during the production life of a well is therefore extremely unlikely. Given the limited volumes of groundwater generated during well construction and operation, the nature of the containment within the coal measures as well as overlying formations, shallow sandstone aquifer depletion has not been considered an issue.

To further assess the groundwater situation within the project area AGL has developed a groundwater investigation and monitoring program in conjunction with Parsons Brinckerhoff (PB), a specialist environmental and engineering consultancy.

AGL, 2010-11 Annual Environmental Performance Report, pp 34

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ie. “NO DATA = NO PROBLEM”

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Case Study: Condamine Alluvium, Qld

Courtesy: A. Brown

Duke Uni. – GW, Shale Gas & CH₄

- Osborn et al., 2011, Proc. Nat. Acad. Sci.

Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing

Stephen G. Osborn^a, Avner Vengosh^b, Nathaniel R. Warner^b, and Robert B. Jackson^{a,b,c,1}

^aCenter on Global Change, Nicholas School of the Environment, ^bDivision of Earth and Ocean Sciences, Nicholas School of the Environment, and ^cBiology Department, Duke University, Durham, NC 27708

Edited* by William H. Schlesinger, Cary Institute of Ecosystem Studies, Millbrook, NY, and approved April 14, 2011 (received for review January 13, 2011)

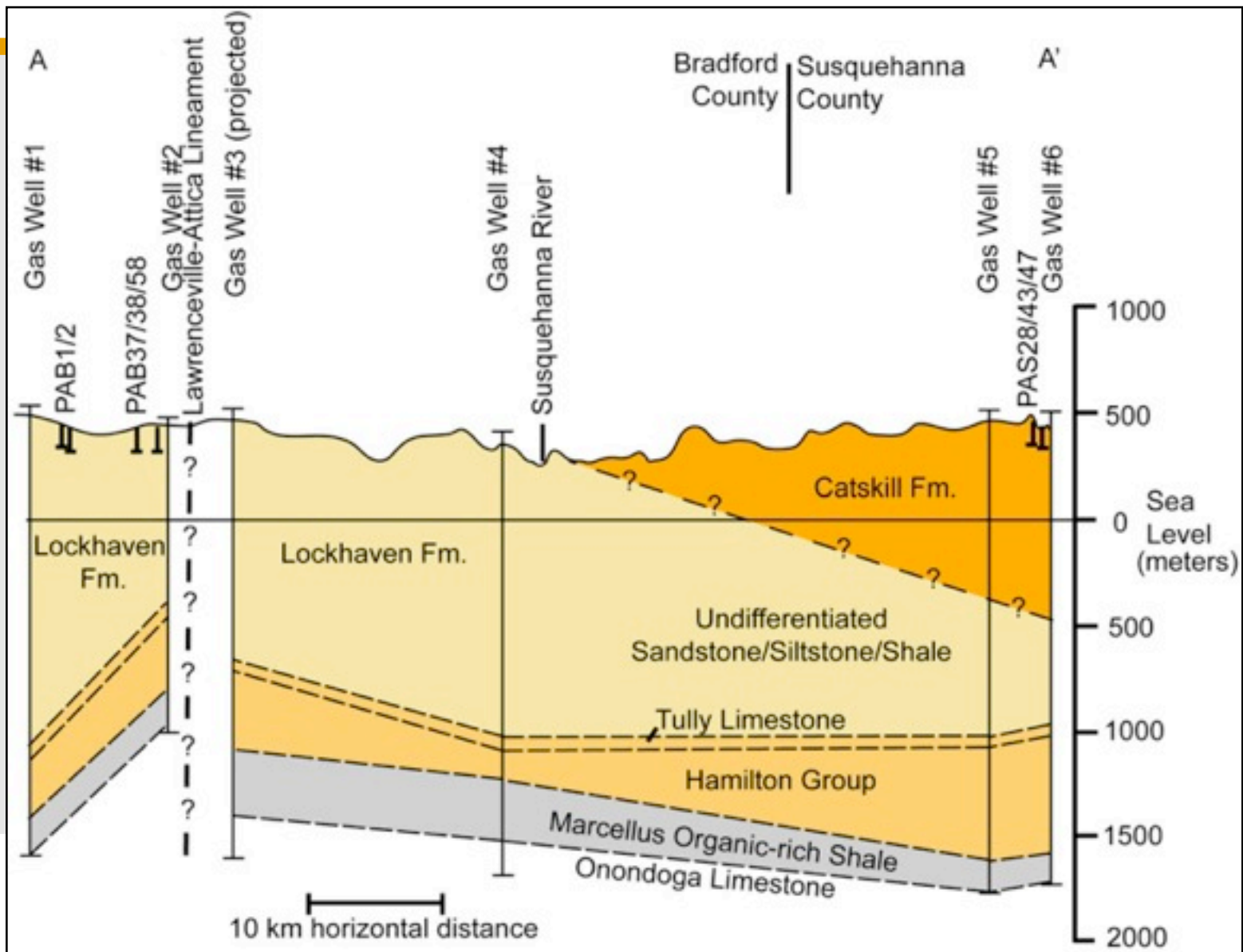
Directional drilling and hydraulic-fracturing technologies are dramatically increasing natural-gas extraction. In aquifers overlying the Marcellus and Utica shale formations of northeastern Pennsylvania and upstate New York, we document systematic evidence for methane contamination of drinking water associated with shale-gas extraction. In active gas-extraction areas (one or more gas wells within 1 km), average and maximum methane concentrations in drinking-water wells increased with proximity to the nearest gas well and were 19.2 and 64 mg CH₄ L⁻¹ ($n = 26$), a potential explosion hazard; in contrast, dissolved methane samples in neighboring nonextraction sites (no gas wells within 1 km) within similar geologic formations and hydrogeologic regimes averaged only 1.1 mg L⁻¹ ($P < 0.05$; $n = 34$). Average $\delta^{13}\text{C}\text{-CH}_4$ values of dissolved methane in shallow groundwater were significantly less negative for active than for nonactive sites ($-37 \pm 7\text{‰}$ and $-54 \pm 11\text{‰}$, respectively; $P < 0.0001$). These $\delta^{13}\text{C}\text{-CH}_4$ data, coupled with the ratios of methane to higher-chain hydrocarbons and $\delta^2\text{H}\text{-CH}_4$ values

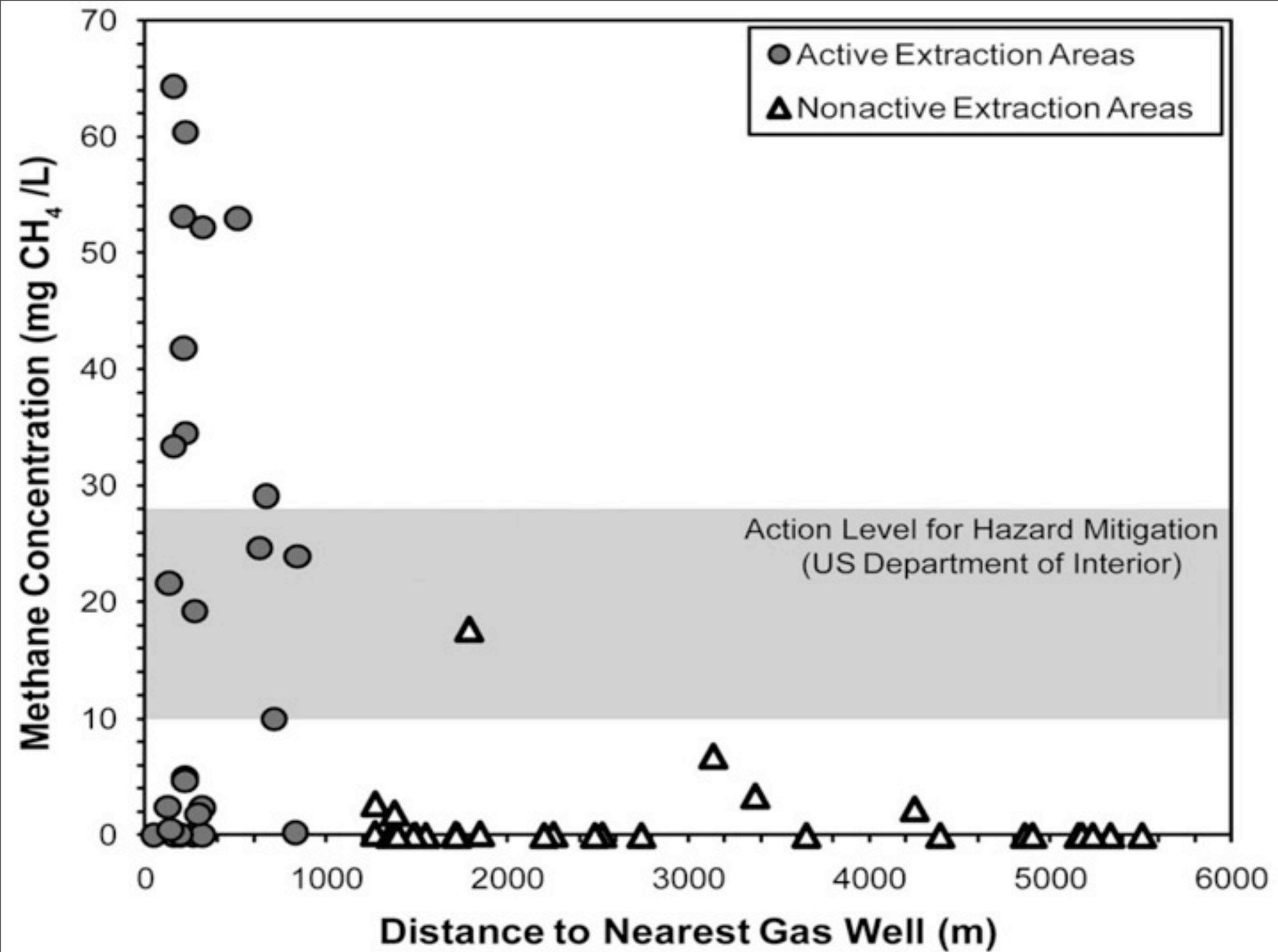


Duke Uni. – GW, Shale Gas & CH₄

- Osborn et al., 2011, Proc. Nat. Acad. Sci.
- Study of CH₄ in groundwaters of shale gas extraction and background (non-gas) areas
 - for shale gas areas, showed that CH₄ concentrations in groundwater are significantly higher than background norms
 - isotope fingerprinting clearly showed shale CH₄ as the source

Duke Uni. – GW, Shale Gas & CH₄

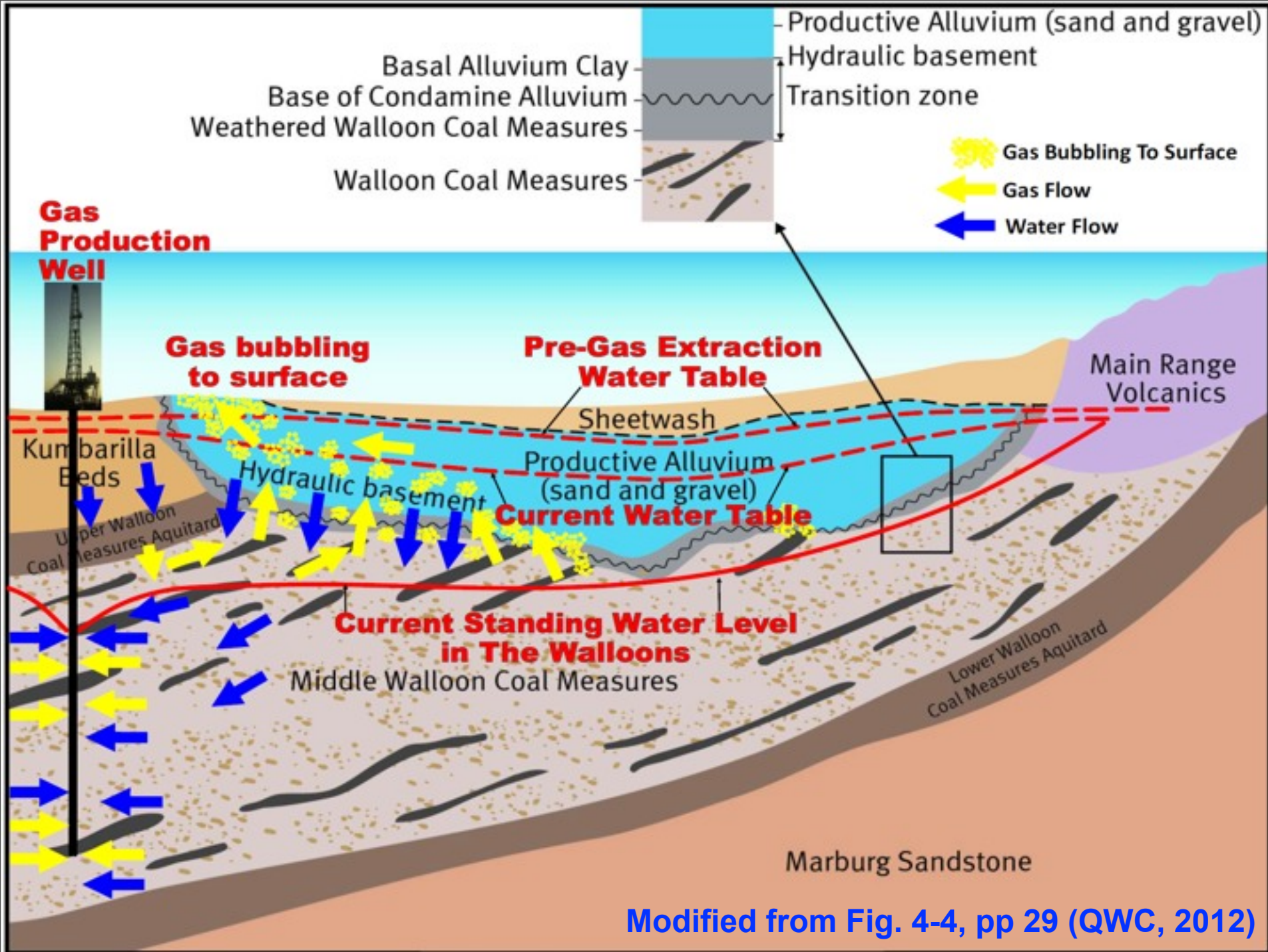




‘Bubbly’ Condamine Style ...

- In mid-2012, several kilometres of the Condamine River near Dalby-Chinchilla were found to be bubbling away ...
- Bubbles quickly proven to be strong CH₄ ...
- Within 1 hour of the video going on YouTube, CSG & QG ‘denied’ it could be related to CSG impacts ... then they announced an ‘investigation’ (Sir HA style!)

<https://www.youtube.com/watch?v=jKjTFXeTV8o>



But Wait ... MORE !!!

- Enter my old friend **RADON**
- Ground-breaking research by SCU folks has shown significantly elevated CH₄ and **RADON** in the Qld CSG fields near Tara ...

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Article

Enrichment of radon and carbon dioxide in the open atmosphere of an Australian coal seam gas field

Douglas R. Tait, Isaac Santos, Damien Troy Maher, Tyler Jarrod Cyronak, and Rachael Jane Davis

Environ. Sci. Technol., **Just Accepted Manuscript** • DOI: 10.1021/es304538g • Publication Date (Web): 27 Feb 2013

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<http://www.abc.net.au/news/2013-03-07/research-claims-elevated-coal-seam-gas-field-levels/4559596>



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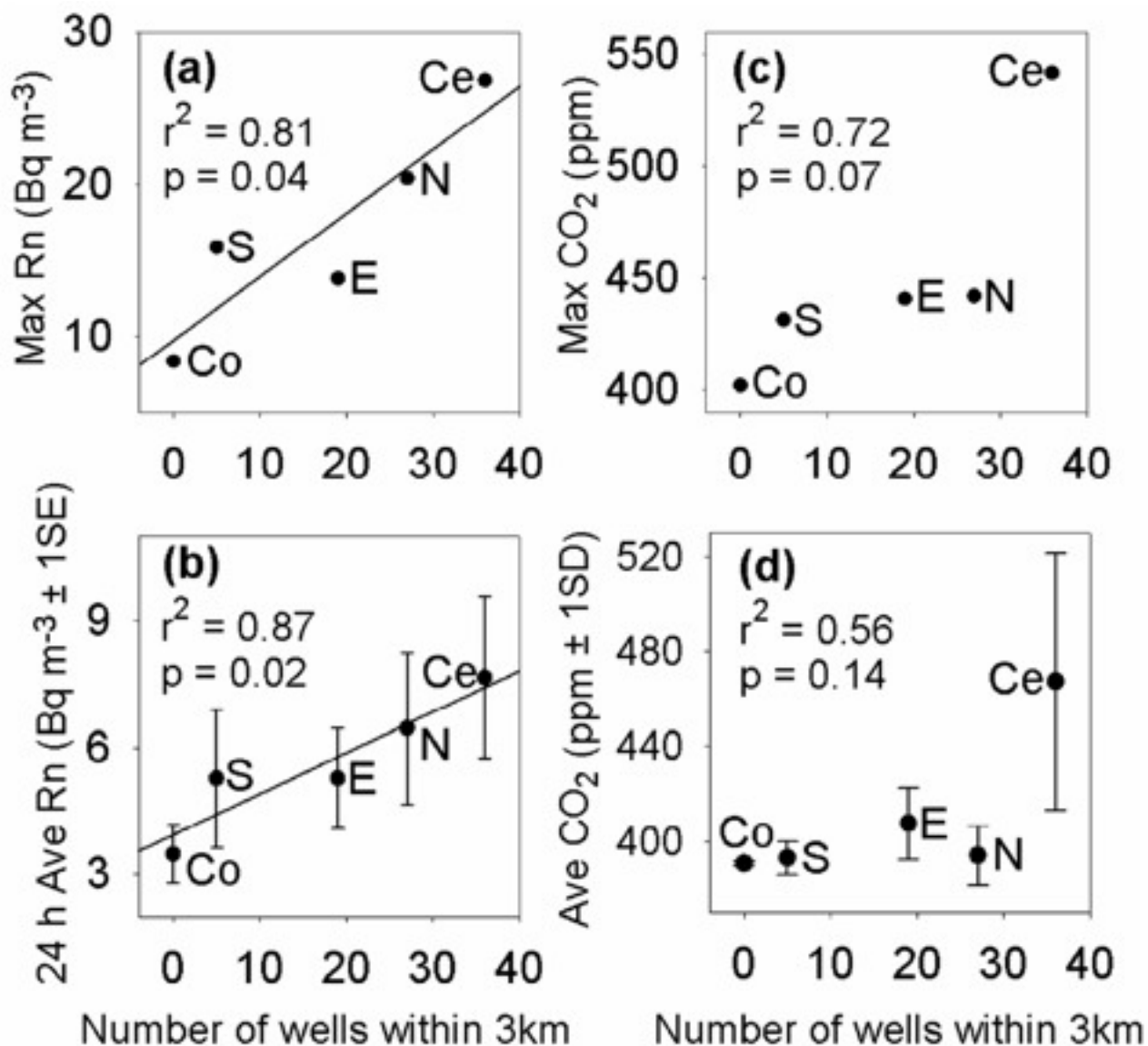
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Methane & Radon v CSG

Tait et al (2013)



Need for MUCH Better Monitoring ...

- CSG industry in Australia is rapidly expanding – fracking expected to increase (albeit still minority of wells)
- Yet we still do not understand the full extent of groundwater risks – in space & time
- Both industry & government have been too lax in simply believing minimal impacts
- Need much greater monitoring & transparency
- Track record is poor on both fronts ...

Summary & Choices ...

- CSG is a technically viable way to produce gas, often very profitable **BUT**
- CSG has major issues around water
 - Often poor quality water extracted with CSG
 - Can be major impacts on groundwater resources – still major uncertainty with spatial & temporal extent
- **Industry/government claim no impacts**
- **Many communities assert severe impacts ...**
- Whether CSG should muscle out renewable energy is yet to be seen

Acknowledgements

- John Polglase (some photo's!)
- Andrew Brown (GW graphs!)
- Many community groups in NSW and Qld working on CSG issues
- Any questions, please contact me:
Gavin.Mudd@monash.edu
(Office 03 9905 1352 / Mobile 0419 117 494)

