Fingerboards Mineral Sands Project Inquiry and Advisory Committee (IAC)

Presentation from Anthony Kiem

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Area of expertise

- Understanding the drivers and impacts of hydroclimatic variability and change in the Asia-Pacific region:
  - Understanding hydrological extremes and how these may change in the future
  - Extreme event (e.g. flood, drought, bushfire etc.) risk analysis
  - Hydrological (and water balance) modelling
  - Interaction between surface water and groundwater
  - Water resources management
  - Stochastic modelling
  - Seasonal/interannual forecasting
- Quantification of climate-related risk and development of more robust/resilient climate adaptation strategies

Scope

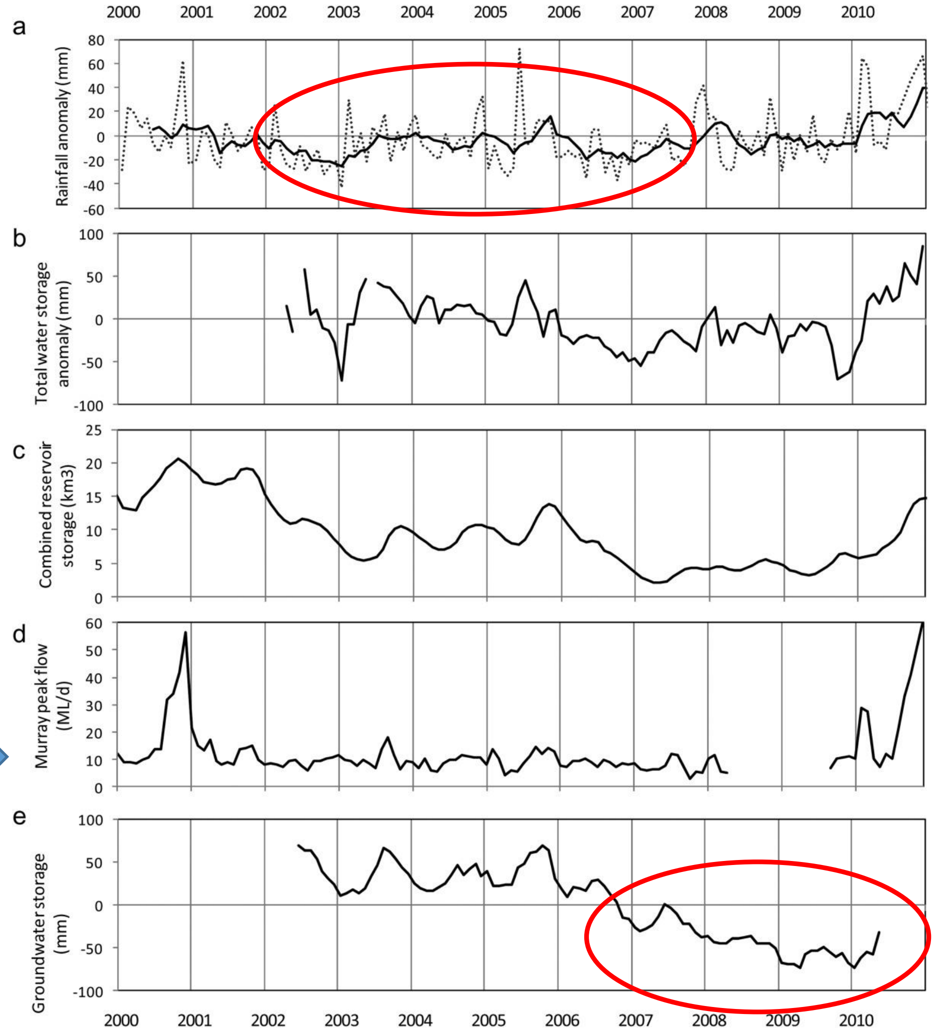
- Review the technical reports and related documents prepared for the Fingerboards Minerals Sands Project Environment Effects Statement (EES), the proposed Works Approval and the proposed planning scheme amendment that are relevant to your expertise, including the scoping requirements for the EES
- Prepare a statement of evidence, relevant to your expertise, on:
  - the adequacy of the materials and technical reports prepared by the Proponent, noting the IAC has required the Proponent to prepare additional information
  - the adequacy of the conclusions expressed in the EES and the other supporting documents
  - the adequacy of the proposed mitigation measures and whether additional mitigation measures should be considered
- Consider the Council's submission, including the SLR Technical Review and identify any areas of the review to which you disagree

Evidence – Period of record used for analysis

- Water balance was conducted based on 1901-2017
- This misrepresents the current climate baseline
  - Which means the future climate change assessments also have issues as the climate change factors are applied to the 1901-2017 data
- DELWP 2016 suggests post-1975 data should be used
- DELWP 2020 suggests post-1997 data should be used
- This would result in less rain and surface water and increased reliance on external water supply (i.e. groundwater)
- Suggest that modelling should be redone using the post-1975 or post-1997 data to re-evaluate the water balance and quantify how much (and how often) external water is required

Evidence – Non-stationarity of rainfall-runoff relationships

- Shifts in precipitation and temperature regimes influence plant phenology through altered soil water relations
- This further alters vegetation responses and the hydrological cycle
- Protracted droughts (like the Millennium Drought) reduce connectivity between surface and subsurface water which can further alter hydrological processes.



Propagation of the meteorological drought through the hydrological cycle in the MDB. (From van Dijk et al. 2013)

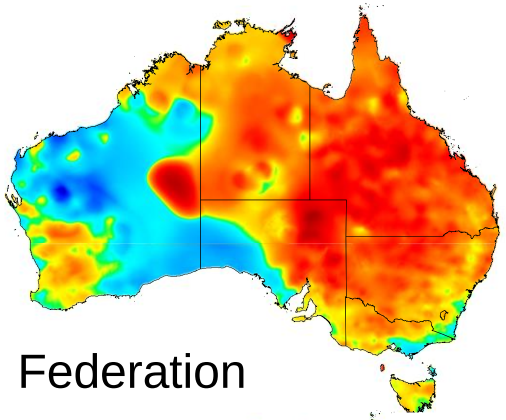
Evidence – Non-stationarity of rainfall-runoff relationships (cont.)

- The modelling conducted assumes that the future catchment dynamics will remain as they were in the past (i.e. during the periods used to calibrate the hydrological models).
- This assumption is problematic because catchment characteristics and dynamics are unlikely to remain the same in the future due to (a) climate-change-induced changes to rainfall, evaporation, and temperature and (b) changes in land use, vegetation, and soil.
- **This is why it is important that data used for hydrological model calibration is from a period that is representative of the current climate situation (i.e. post-1997)**

Evidence – Impacts of climate variability and change

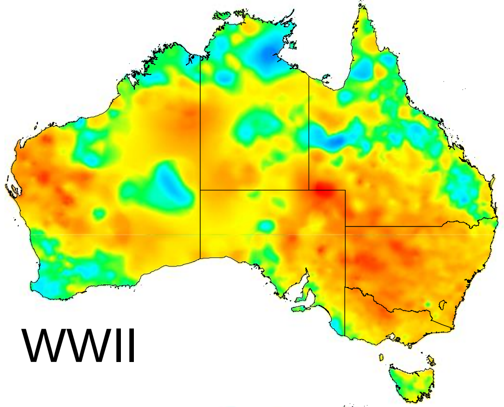
- Droughts different to and worse than the Millennium Drought are possible
  - My opinion is that the EES Scoping Requirements of "accounting for climate risks and the potential effects of climate change" are not met because the impacts of droughts worse than the Millennium Drought have not been properly assessed
    - A back-to-back Millennium Droughts scenario has been assessed but this just extends the duration of the drought
    - Duration is just one aspect of drought that needs to be considered. Other drought aspects that need consideration are the timing, magnitude of rain deficit, and spatial extent (important when relying on surface water or groundwater allocations that might come from outside the catchment of interest).
  - This is why stochastic climate modelling should be used – to assess impacts of droughts that have different duration, timing, magnitude, and spatial extent than those seen in the historical record.

Impacts of climate variability and change (cont.)



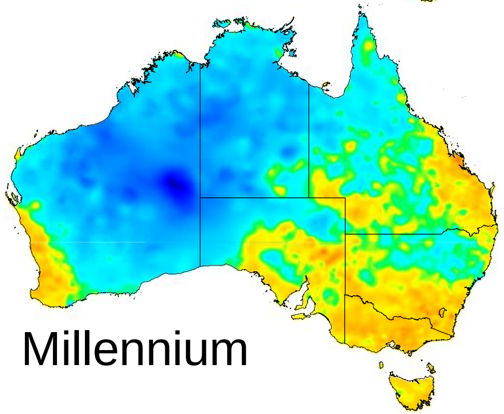
Federation

- Northeast Australia
- Spring/summer decline
- Driven mostly by ENSO



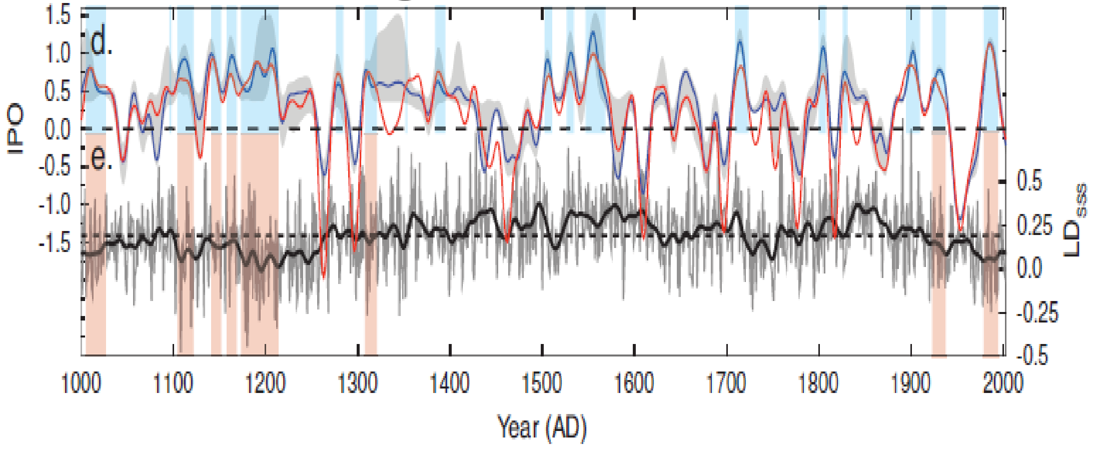
WWII

- Widespread - northwest-southeast gradient
- Decline across all seasons
- Driven most by Indian but ENSO + SAM play a role



Millennium

- Southeast & southwest Australia
- Autumn decline
- Driven mostly by SAM + ENSO



Vance et al (Geophys. Research Lett., Jan 2015)

All droughts are different

Need to assess impacts of droughts that have different duration, timing, magnitude, and spatial extent than those seen in the historical record….

Do this using stochastic climate modelling

Evidence – Climate change scenarios

- Existing work uses the median climate change projections (2.3% decrease in rain by 2040)
- This does not consider the range of what is plausible and so is not precautionary
- All climate model scenarios (including the highest and lowest) are equally plausible
- A common approach to deal with this uncertainty is to consider an upper and lower bound from the range of projected climate scenarios and conduct hydrological modelling for that upper/lower bound to determine whether the risks associated with those scenarios are acceptable or able to be managed.
- Considering just one climate scenario does not meet the EES Scoping Requirements of "accounting for climate risks and the potential effects of climate change”

New work raises further questions about water availability during and after drought

REPORT

Watersheds may not recover from drought

Tim J. Peterson[1,2,*], M. Saft[2,†], M. C. Peel[2,†], A. John[2]

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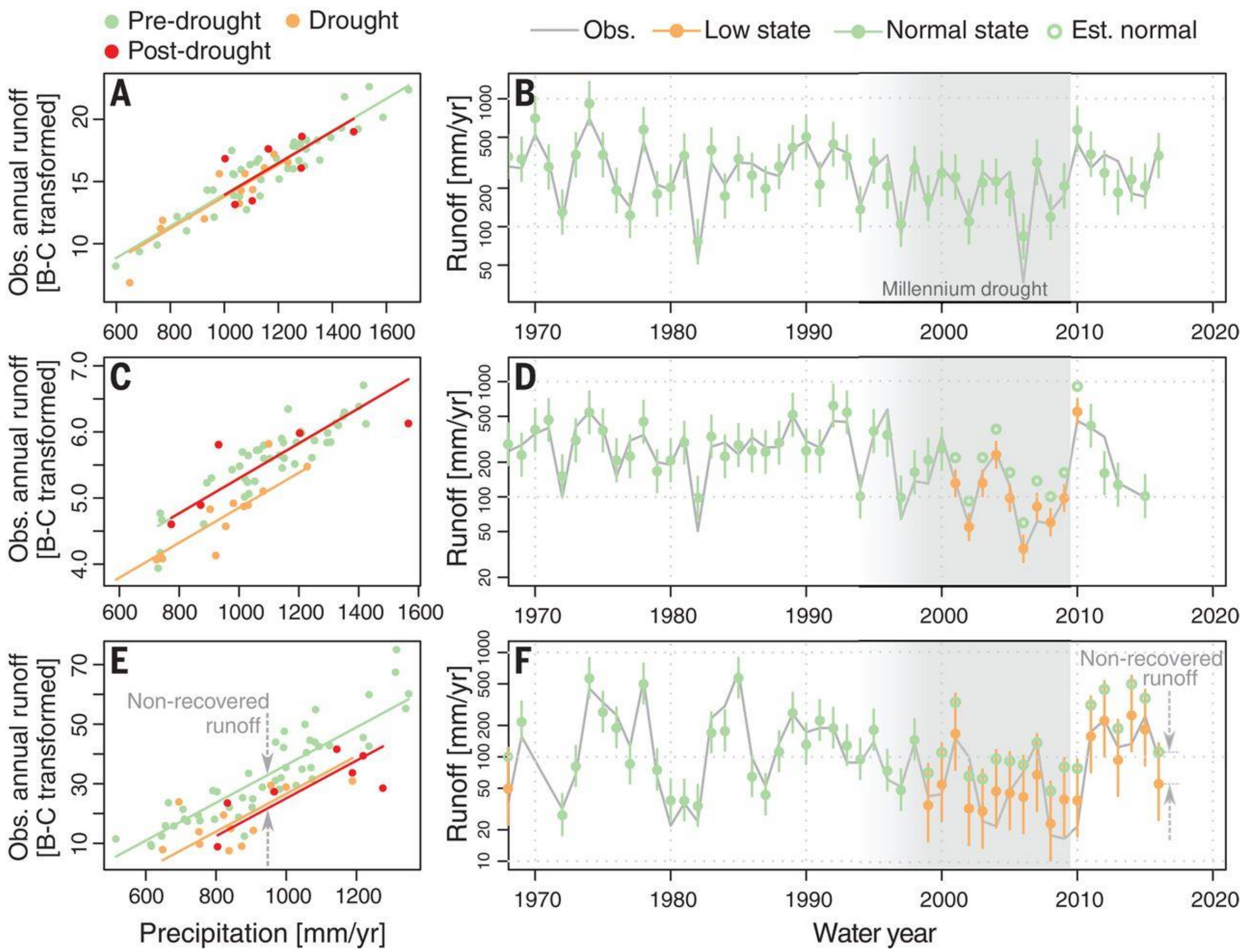
Is precipitation all that a watershed needs to recover from drought?

Conventional wisdom says yes, but this is not necessarily true. Peterson *et al.* (2021) studied streamflow and precipitation in 161 watersheds in southeastern Australia across the Millennium Drought.

They found that runoff in approximately one-third of the watersheds had not returned to pre-drought levels even after 7 years despite the resumption of more normal precipitation.

Fig. 1 Three examples of how watersheds may respond and recover (or otherwise) from a drought.



Tim J. Peterson et al. Science 2021;372:745-749

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