

# Peaking Too Soon: A Case Study of Updating River Hydrology for a Latrobe River Tributary

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# Syllabus

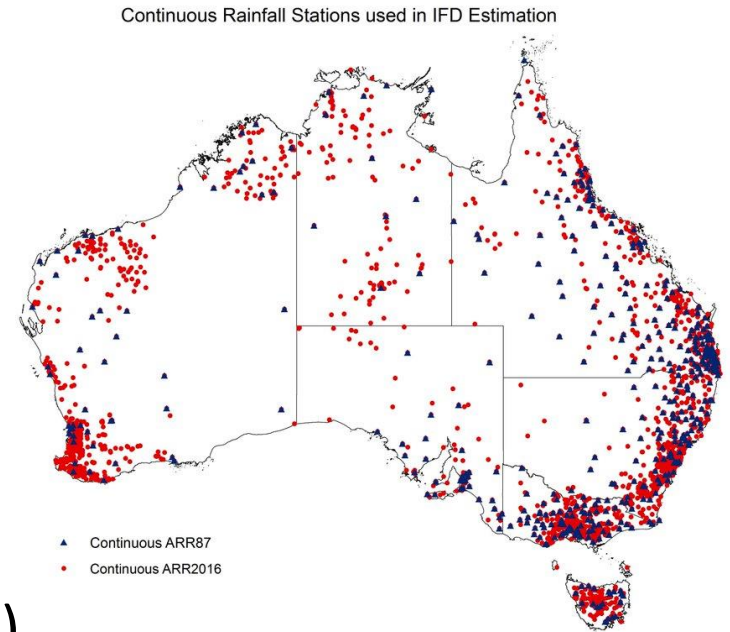
- Methodology Background
- Case Study Background
- Old Results
- New Results
- Comparison of Results
- Discussion



(Source: Travel Victoria, [travelvictoria.com.au](http://travelvictoria.com.au))

# Methodology Background/Motivation

- Australian Rainfall and Runoff (AR&R) first introduced in 1958 (AR&R58) and later refined in 1987 (AR&R87)
- Primary function to determine peak flow of catchment for different storm durations
- Insufficient for volumetrics and flow characteristics (rise, fall, hydrograph)
- Ultimately superseded by AR&R2016



Source: Geoscience Australia

# AR&R1987 to AR&R2016: A brief comparison

AR&R87	AR&R2016
Rational Method	Monte Carlo and Ensemble
Peak Flow	Peak Flow and Hydrograph
Low Amount of Data	High Amount of Data
Temporal Pattern Data Largely Infilled	Temporal Patterns Based on Observations
Peak Flow Retention Focus	Peak Flow, Hydrograph and Storm Volume Focus

# Methodological Challenges

- Older studies utilised limited information
- Catchment data information updates may not be quite sufficient
- Original information has been used for decades to inform decision making
  - \$\$\$ from lawsuits
  - Political Fallout
- Certain methods (RFFE) require strict catchment features for applicability



Narracan Creek in Flood 23/03/2011

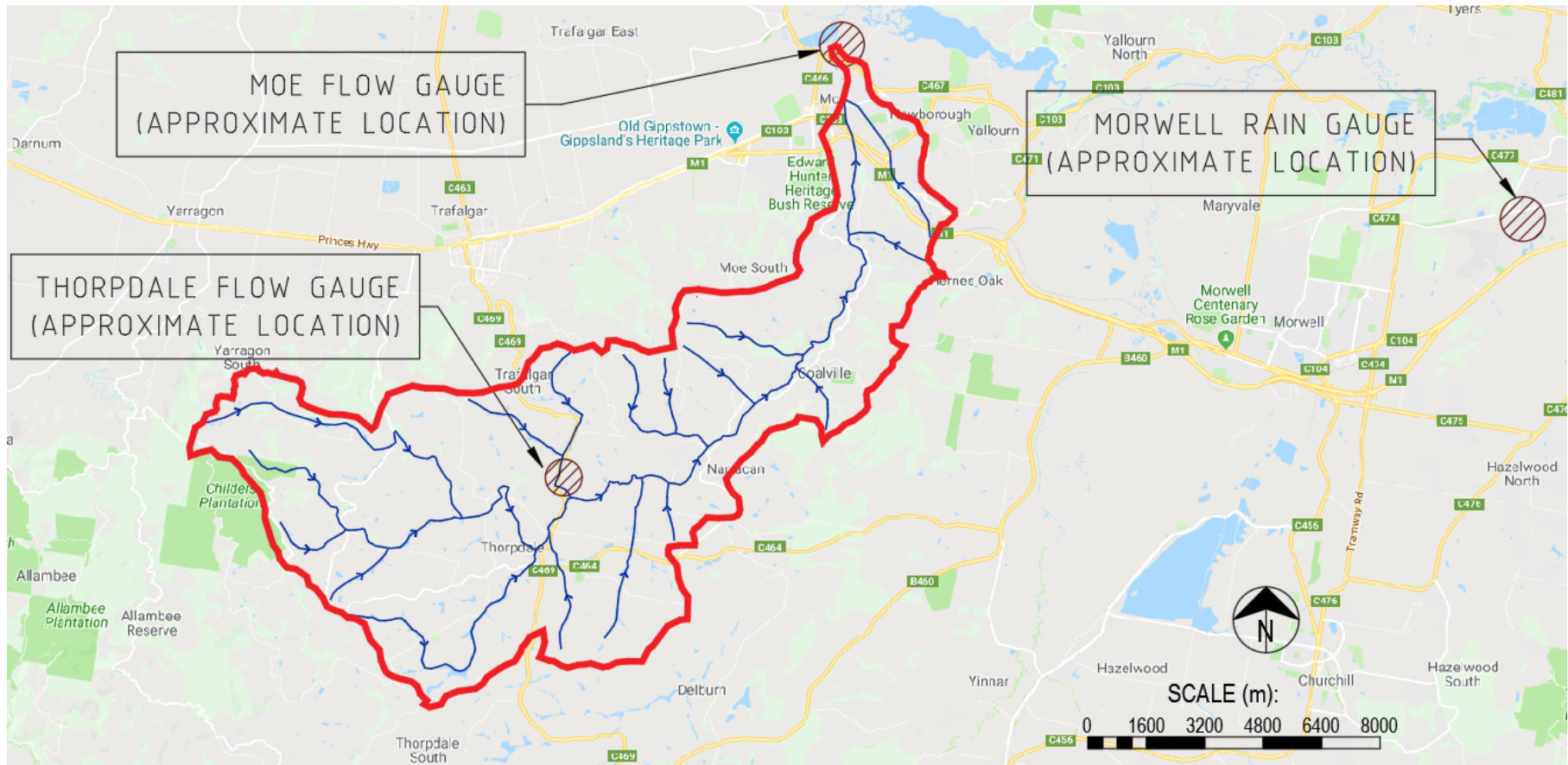
(Source: YouTube)



# Case Study Catchment Background

- Narracan Creek in SE Victoria
- Catchment Size = 130.2 km<sup>2</sup>
- Extensively cleared catchment
- Significant farm dams throughout
- One flow gauge at Moe and one flow gauge at Thorpdale
- One rainfall gauge/weather station present at Thorpdale
  - No sub-daily rainfall
- Closest sub-daily rainfall data gauge at Morwell

# Case Study Catchment Background



Narracan Creek catchment & gauge locations  
(Source: NearMap)

# Case Study Background

- Event based hydrology
  - Using RORB
- Existing catchment study commissioned by CMA
- Historic flows modelled as gaussian hydrograph with arbitrary rise and fall
- Peak flow reported to be  $170\text{m}^3/\text{s}$
- CMA requests that hydrology be updated to AR&R2016

*...and so the saga began...*



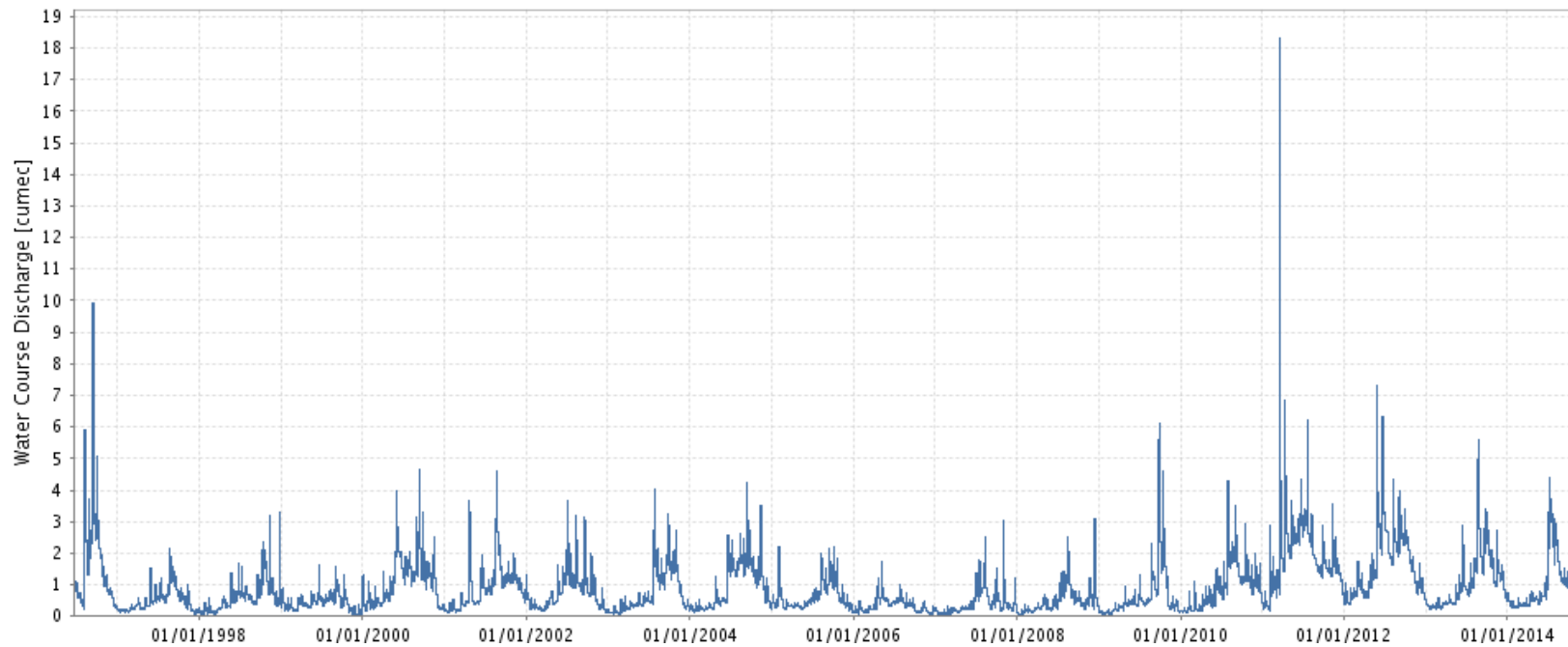
# Site Overview



Narracan Catchment Landuse Composite Aerial Image

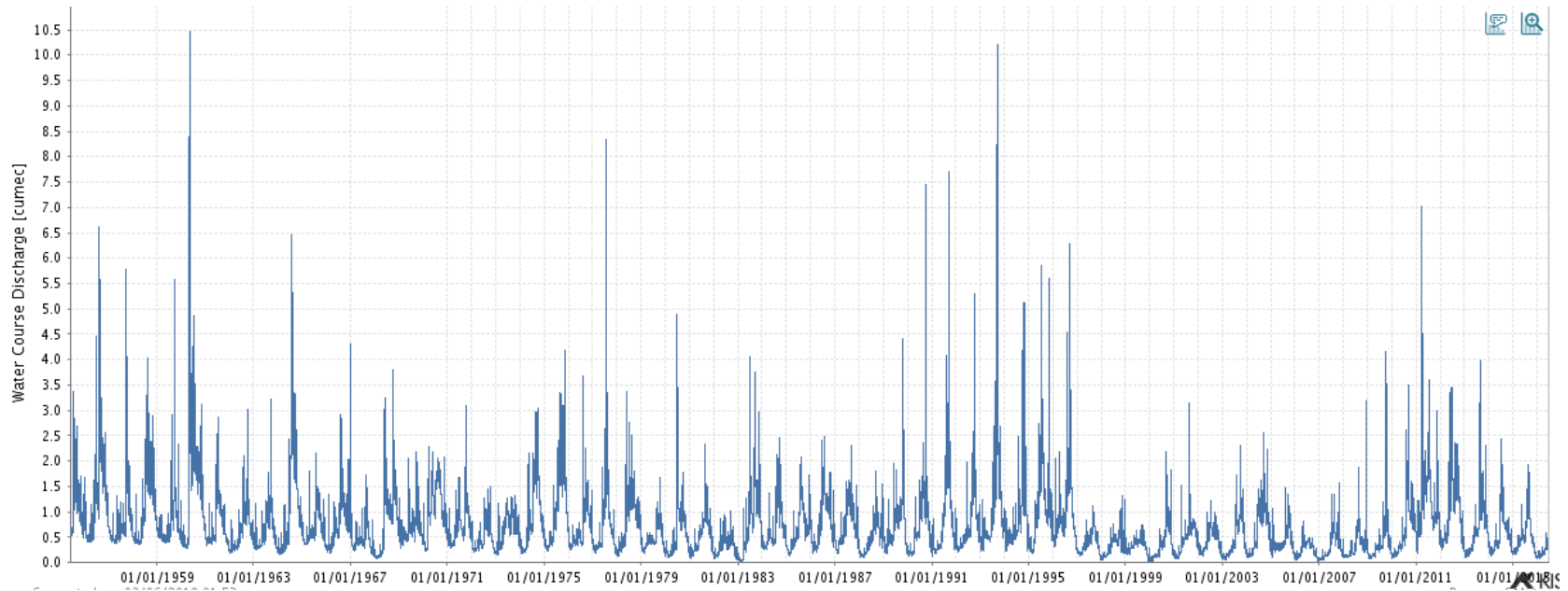
*(Source: NearMap)*

# Gauge Data Observations



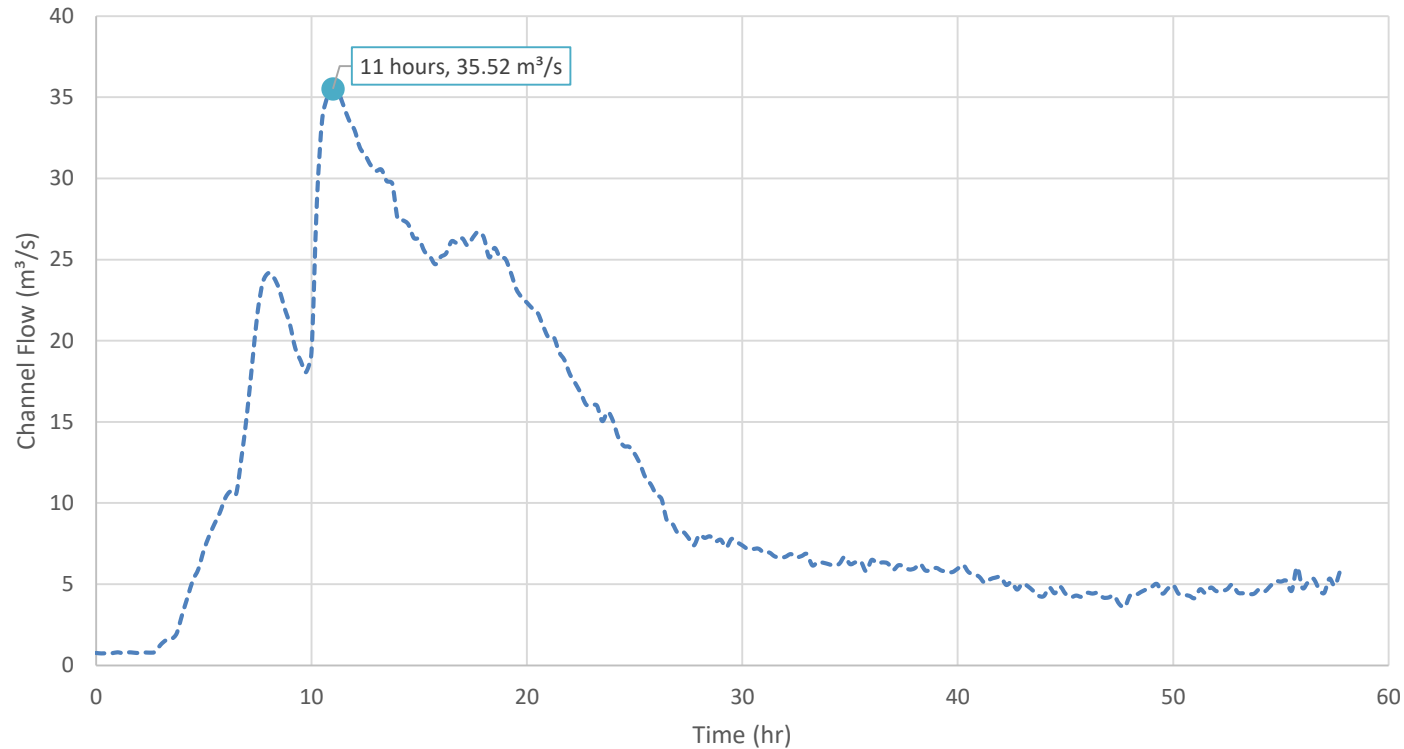
Flow hydrograph for Narracan Creek at Moe flow gauge from 1996 to 2015

# Gauge Data Observations



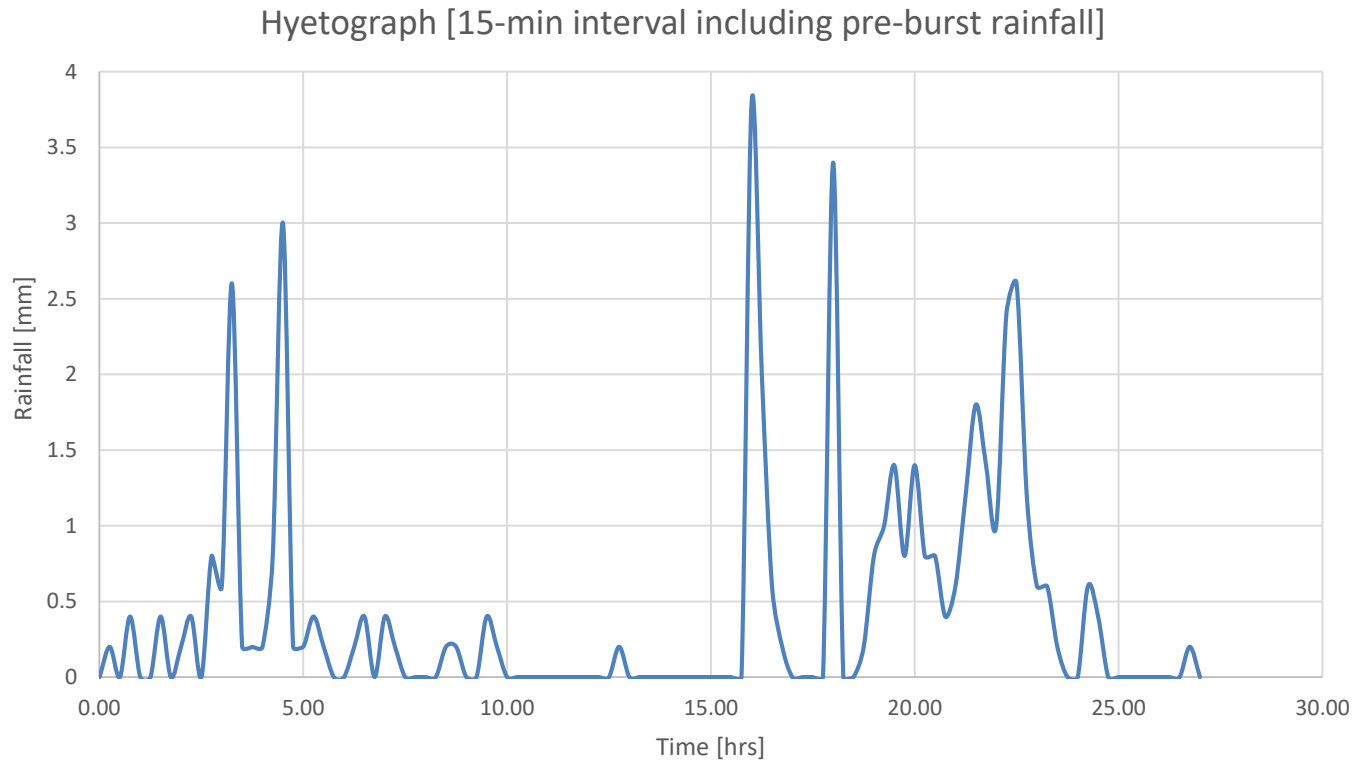
Flow hydrograph for Narracan Creek at Thorpdale flow gauge from 1955 to 2016

# Gauge Data Observations



Flow hydrograph for Narracan Creek at Moe flow gauge for 23<sup>rd</sup> March, 2011 storm event

# Gauge Data Observations



Hyetograph for Morwell rain gauge for 23<sup>rd</sup> March, 2011 storm event

# Original Catchment: AR&R1987

- Model calibrated to 1975 anecdotal storm event
  - Assumed bank heights, and assumed flows for calibration
- Calculated 1 in 100-year peak flow of  $170 \text{ m}^3/\text{s}$ , duration 36 hours – with a gaussian flow distribution

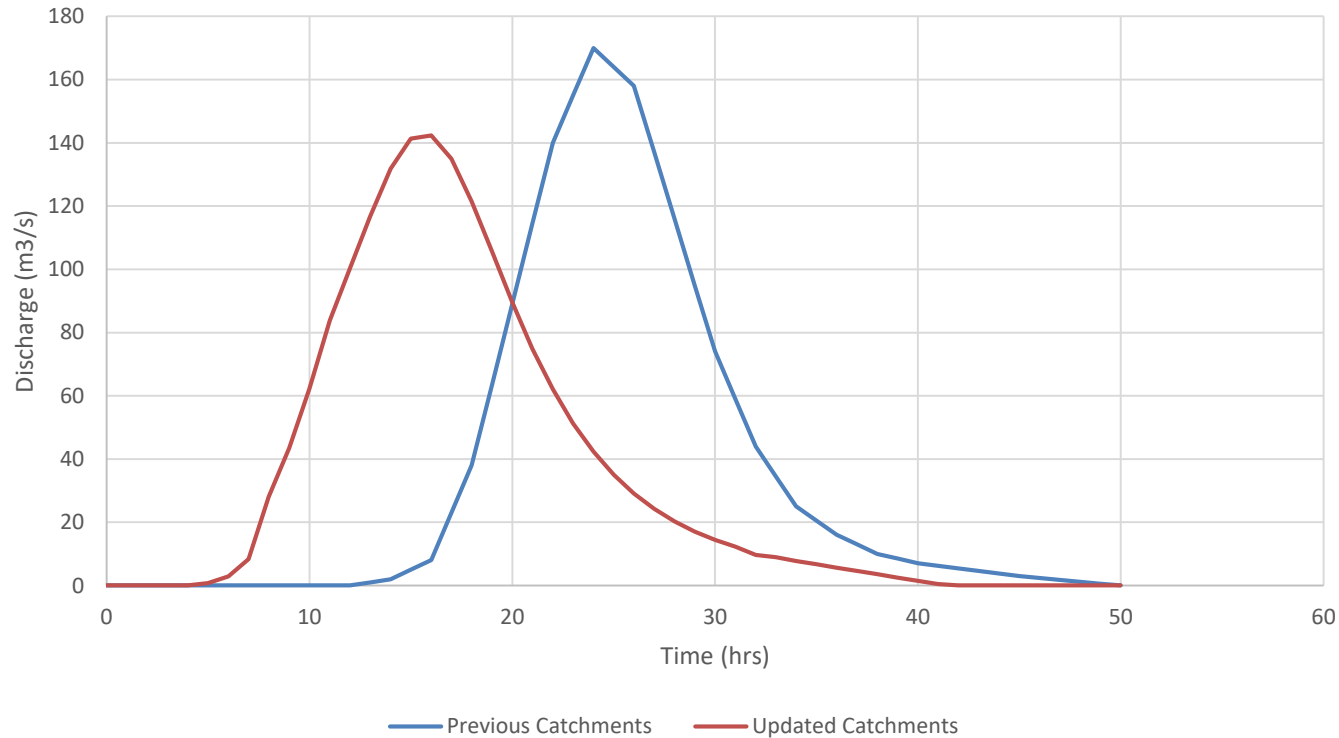
# Updated Catchment: AR&R1987

- Calculated 1 in 100-year peak flow of  $143 \text{ m}^3/\text{s}$ , duration 12 hours – with a gaussian flow distribution



# Original Catchment vs. Updated Catchment: AR&R1987 (cont'd)

Narracan Creek 100-YR ARI Design Event Hydrograph



# Methodology & Results: AR&R2016 Update

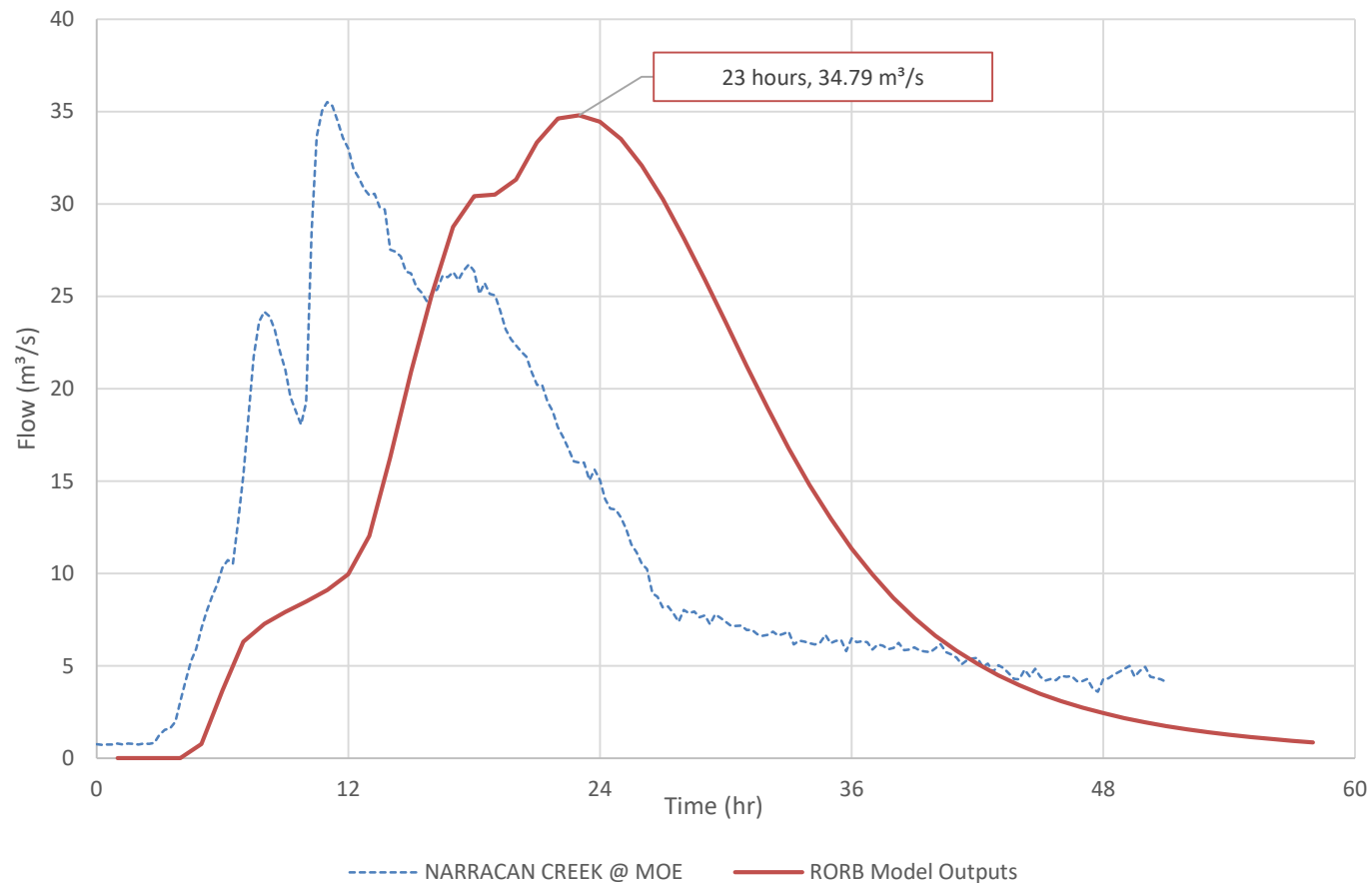
- RORB for event based hydrology
- Three phases:
  - Calibration – Morwell Rain Gauge, Moe Flow Gauge, Thorpdale Daily Rain Gauge (kinda) and Documentary Evidence
  - Monte Carlo
  - Ensemble
- RFFE used to evaluate results against regional estimates



Narracan Creek in Flood 23/03/2011

(Source: YouTube)

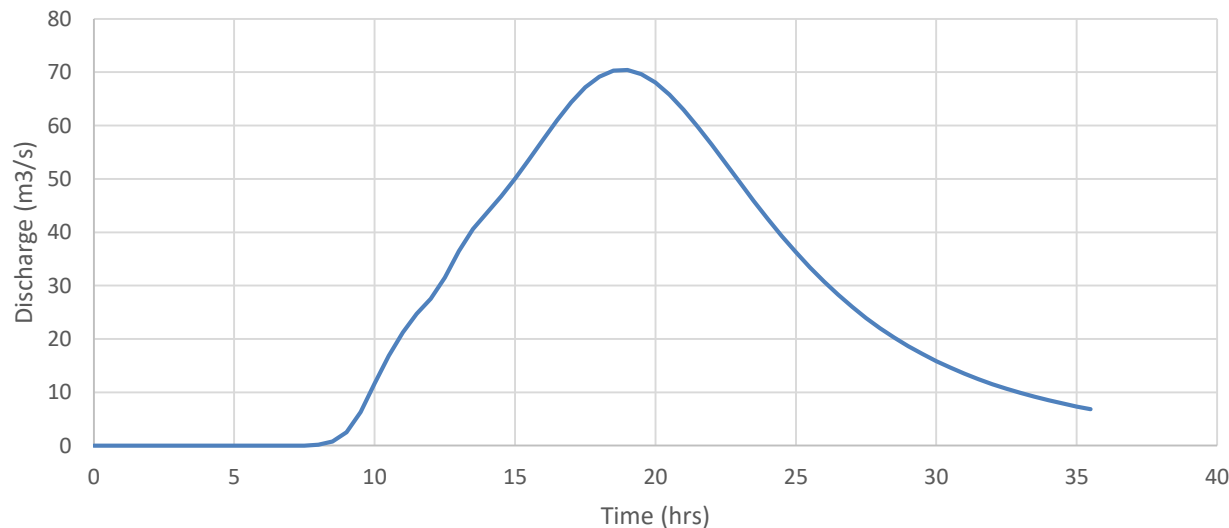
# Methodology & Results: AR&R2016



Narracan Creek Flood Gauge (23/03/2011) against RORB Output

# Methodology & Results: AR&R2016 (cont'd)

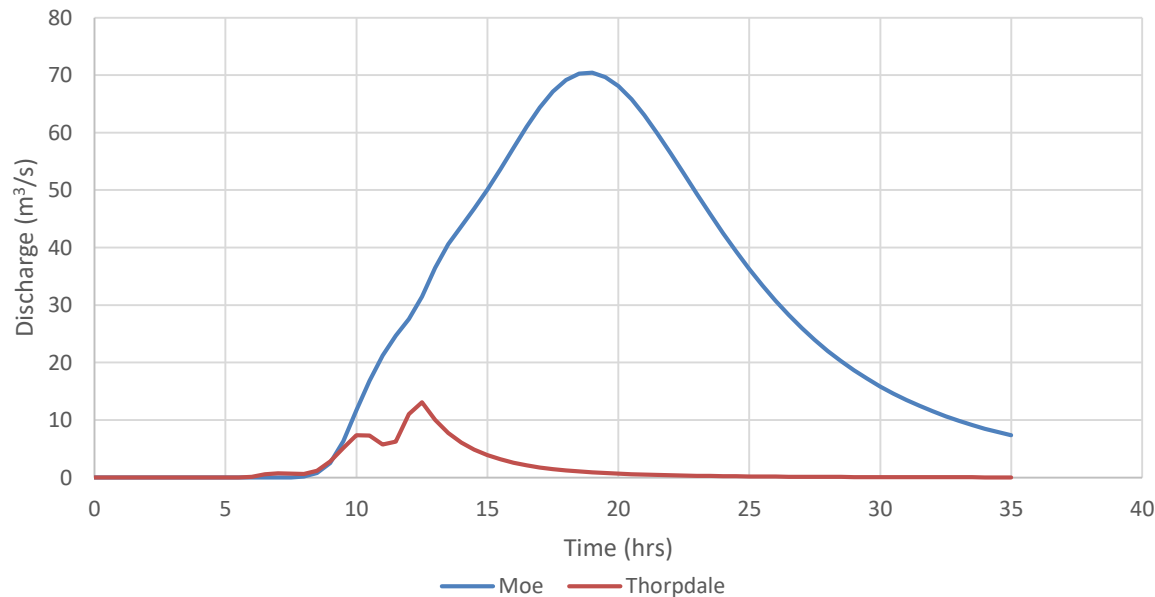
- Peak 1% AEP flow from Monte Carlo method:
  - $69.7 \text{ m}^3/\text{s}$ , storm duration = 12 hours
- This was then applied to the ensemble method to produce a hydrograph.
  - Surprisingly, the hydrograph comes out as a gaussian distribution.



1% AEP Flow Hydrograph using AR&R2016

# Methodology & Results: AR&R2016 (cont'd)

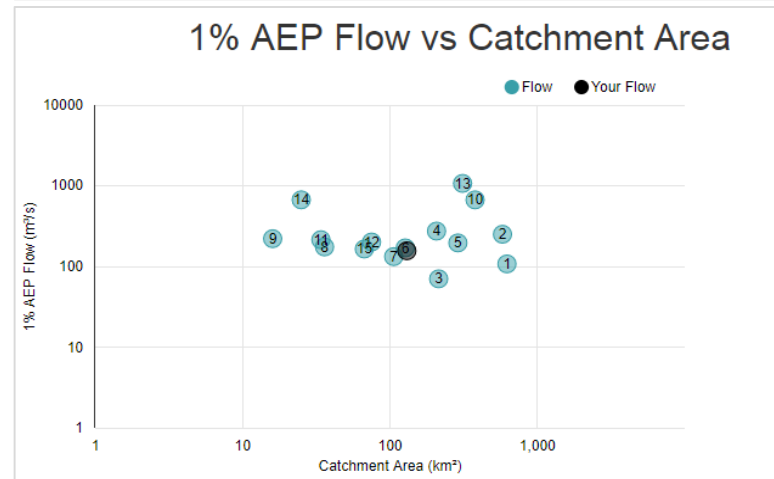
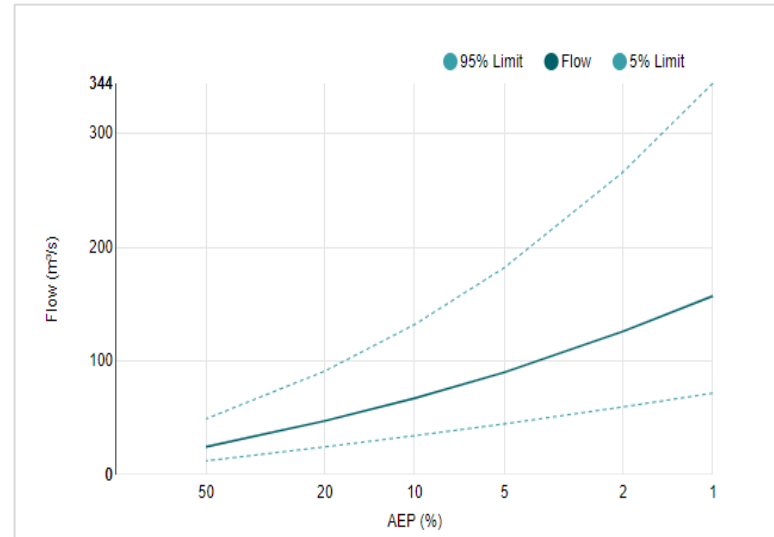
- Peak 1% AEP flow from Monte Carlo method at Thorpdale:
  - 13.1 m<sup>3</sup>/s, storm duration = 12 hours



Narracan Creek Peak Design Hydrographs at Moe & Thorpdale

# Methodology & Results: Regional Flood Frequency Estimate

- Parameters:
  - Catchment area = 130.2 km<sup>2</sup>
  - Distance to nearest gauged catchment = 7 km
- Peak 1% AEP flow from RFFE:
  - 157 m<sup>3</sup>/s



RFFE Outputs from RFFE Website

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# Comparison of Results and Discussion

- AR&R1987 and Regional Flood Frequency Estimate within 10% of each other
- AR&R2016 less than half the value of the other two methods
  - Corroborated by flow gauges in catchment; and
  - Daily Rainfall Gauge at Thorpdale

	AR&R1987 (previous catchment)	AR&R1987 (updated catchment)	RFFE	AR&R2016
Peak Flow	170 m <sup>3</sup> /s	143 m <sup>3</sup> /s	157 m <sup>3</sup> /s	69.7 m <sup>3</sup> /s

# Conclusion

- AR&R2016 is a massive step forward from AR&R1987
- Further investigation requires additional data:
  - Radar Rainfall for Areal Reduction Factors and catchment specific storm hyetographs for calibration
  - Significant increases to complexity of catchment modelling
- RFFE corroborated AR&R87 results, but inappropriate for manipulated catchments
- A significant amount of uncertainty remains for regional catchments despite the great advances in AR&R2016

We need more data and more data availability!!

# Thank you for your time

Special thanks to Tony Ladson.



## March 2011 Flood Event Observation

(Source: YouTube)