Selecting design events under climate change – the Australian approach

Impacts of climate change on extreme event hydrology
Australian Water School

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KNOW YOUR WEATHER.
KNOW YOUR RISK.

Selecting design events under climate change

- Before
  - During estimation of design rainfalls
    - Stationarity assessment of observed rainfalls

- After
  - When using design rainfalls
    - Climate change guidance in ARR2019

Before…

Stationarity assessment

(Dr Fiona Johnson)

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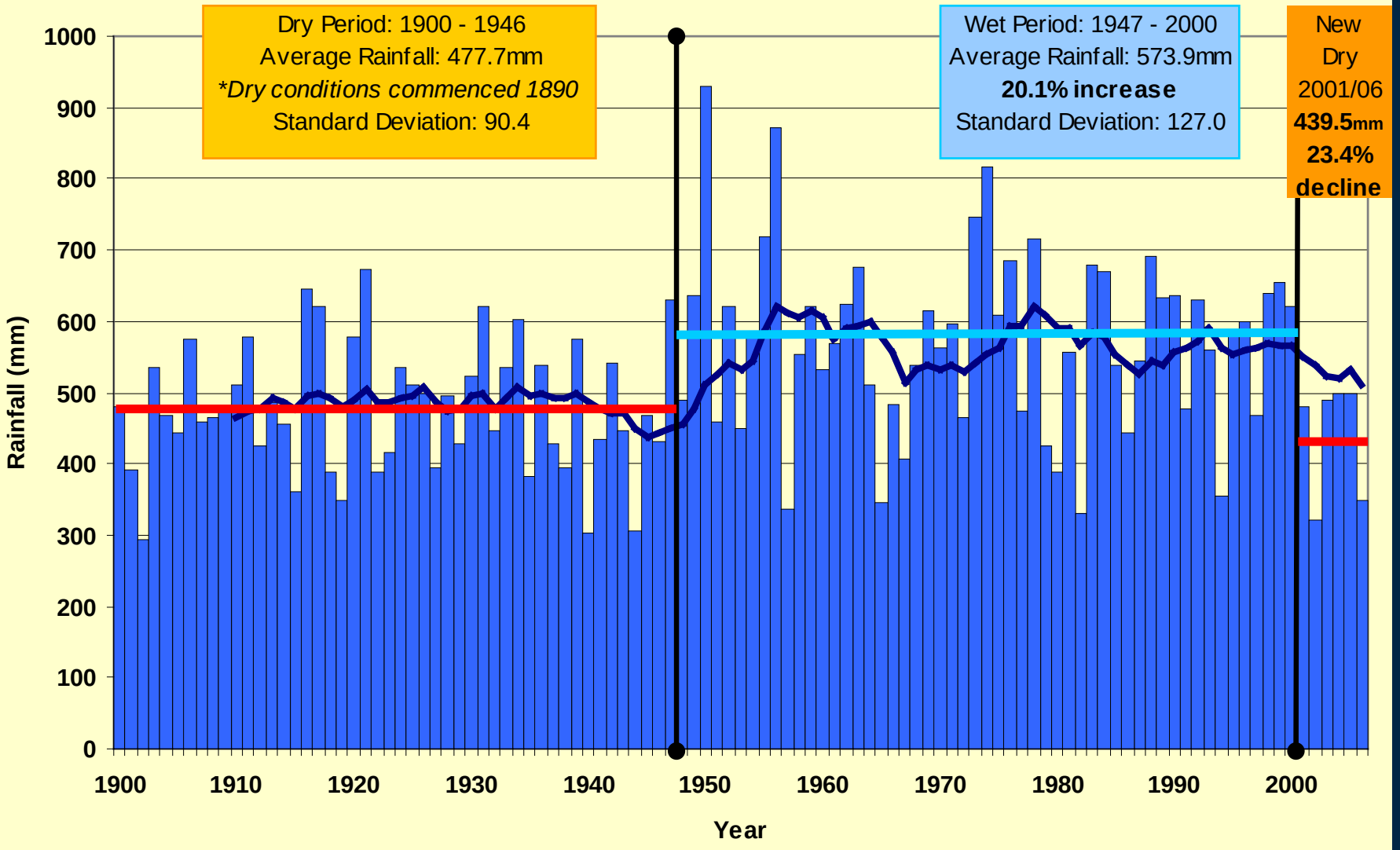
Stationarity Questions

Can we use all of the historical data in deriving the new design rainfalls?

or

Have the changes been so large that only the most recent data should be used?

New South Wales Annual Rainfall

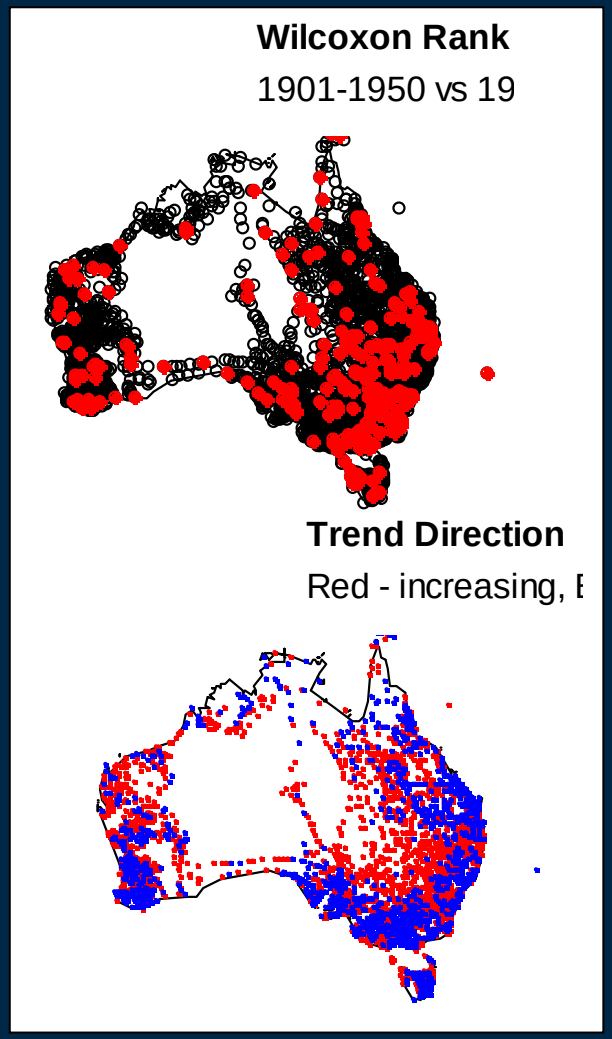


Assessment of stationarity

- Analyses undertaken to assess if there is significant evidence of non-stationarity in Australia's rainfall record
- Based on annual maximum series of both daily read and continuous rainfall data
  - 17,247 daily read stations
  - 58 long term continuous rainfall stations
- Undertaken on both point & region basis

- Assessed trends in daily and sub-daily annual maximum rainfall time series
- Assessed changes to fitted extreme value distributions
- Assessed average regional trends in threshold exceedances

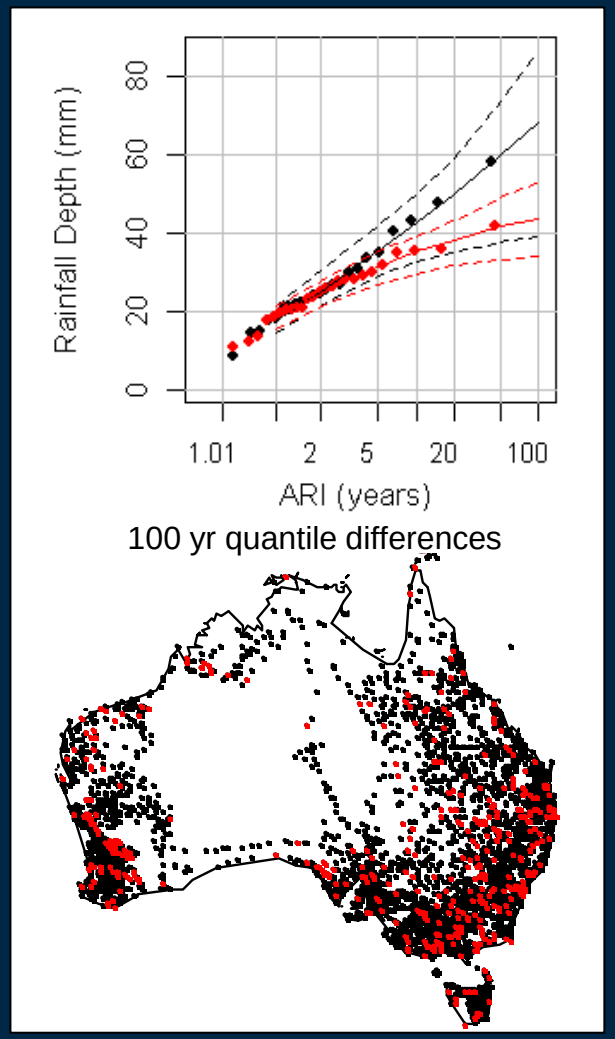
Trends in annual maximum time series



	Daily (1901-2000)	1 hour (1956-2008)	6 minute (1956-2008)
Total stations	4191	58	58
Positive trends	2733 (9% sig.)	39 (49% sig.)	47 (47% sig.)
Negative trends	1458 (5% sig.)	19 (21% sig.)	11 (9% sig.)

Significance defined at 5% level

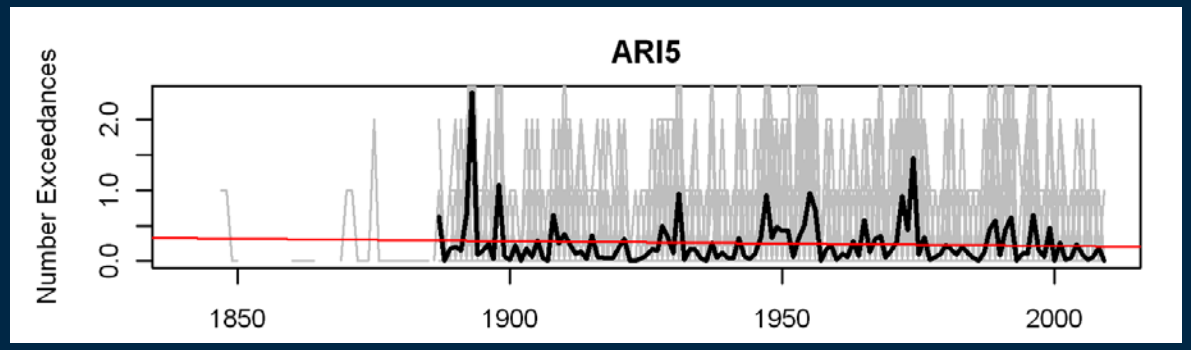
Changes in extreme value distribution



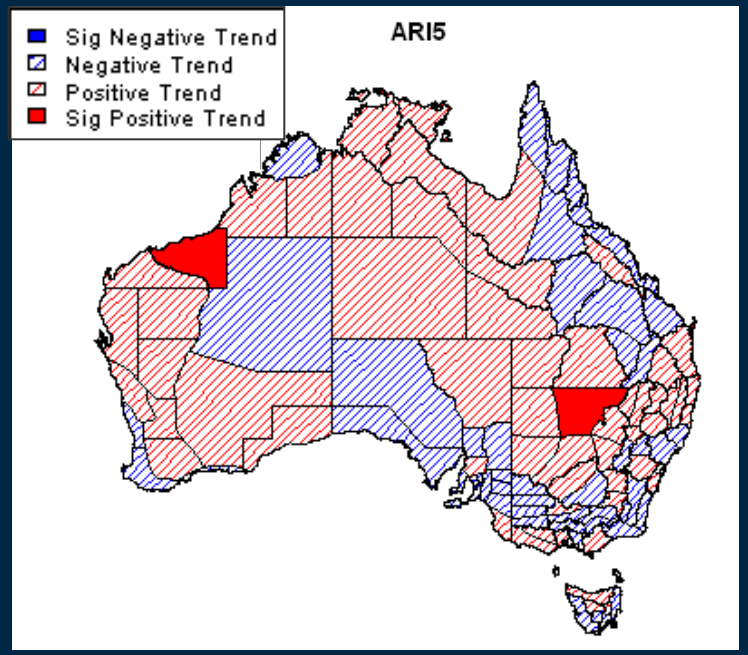
	Daily (1901-2000)	1 hour (1956-2008)	6 minute (1956-2008)
5 yr ARI	10.3%	1.7%	15.5%
20 yr ARI	10.9%	6.9%	17.2%
100 yr ARI	10.1%	1.7%	10.3%

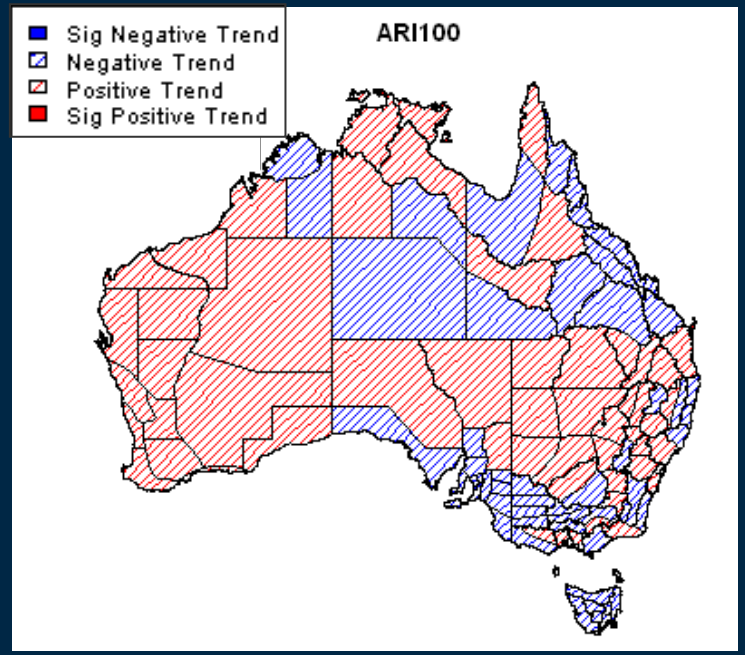
Significance defined at 5% level

Regional average threshold exceedance trends



Annual exceedance time series





Conclusions

- No significant evidence of non-stationarity in the Australian historic rainfall record could be found
- Although some individual stations show significant changes over time, there were no clear patterns to the changes spatially
- There is more evidence of change at shorter durations (particularly sub-hourly) but this may be a reflection of the shorter periods of record and greater impact of inter-decadal variability
- Therefore, the full historical record could be used in deriving design rainfall estimates

Note: These conclusions are specific to the analyses undertaken for the durations and probabilities of relevance to design rainfalls. They should NOT be taken out of context or misinterpreted to say that climate change is not occurring.

After….

Climate Change Advice in ARR2019

(Dr Bryson Bates et al)

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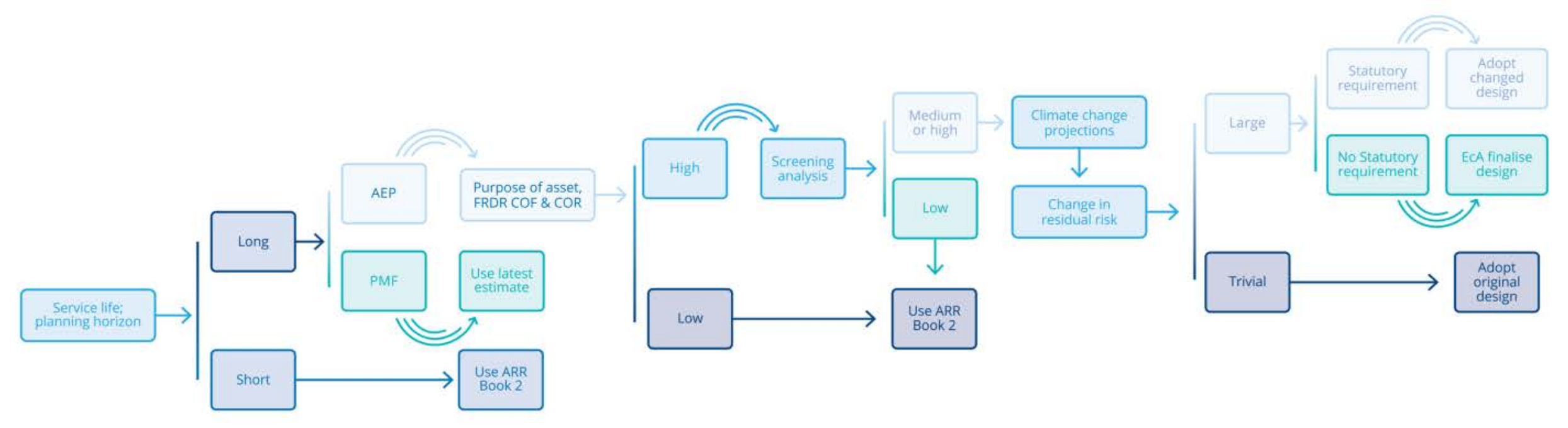
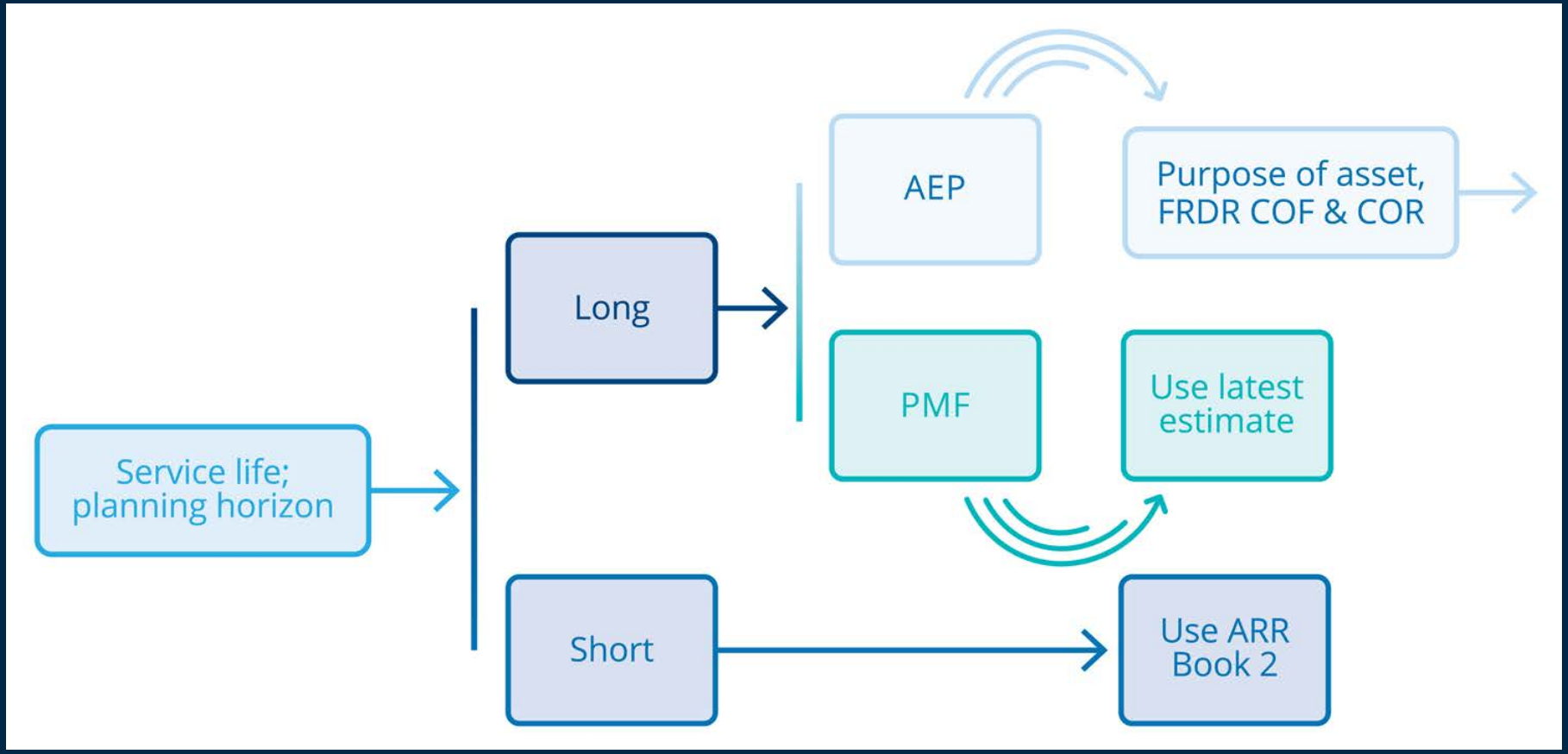
Climate Change Advice in ARR2019

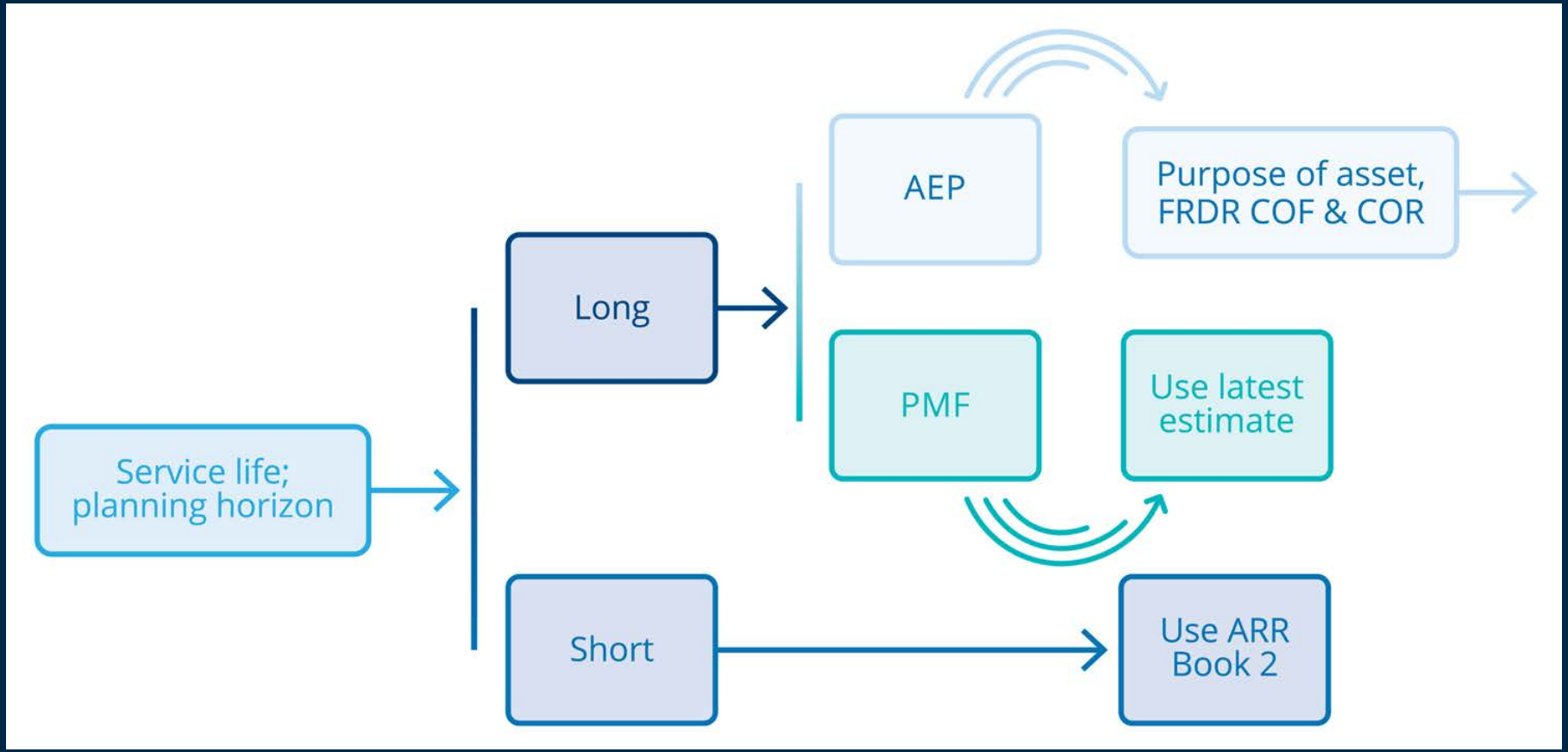
- ARR2019 Book 1; Chapter 6 – Climate Change Considerations
- Six step process
- Decision tree approach
- Enables practitioner to reach appropriate course of action



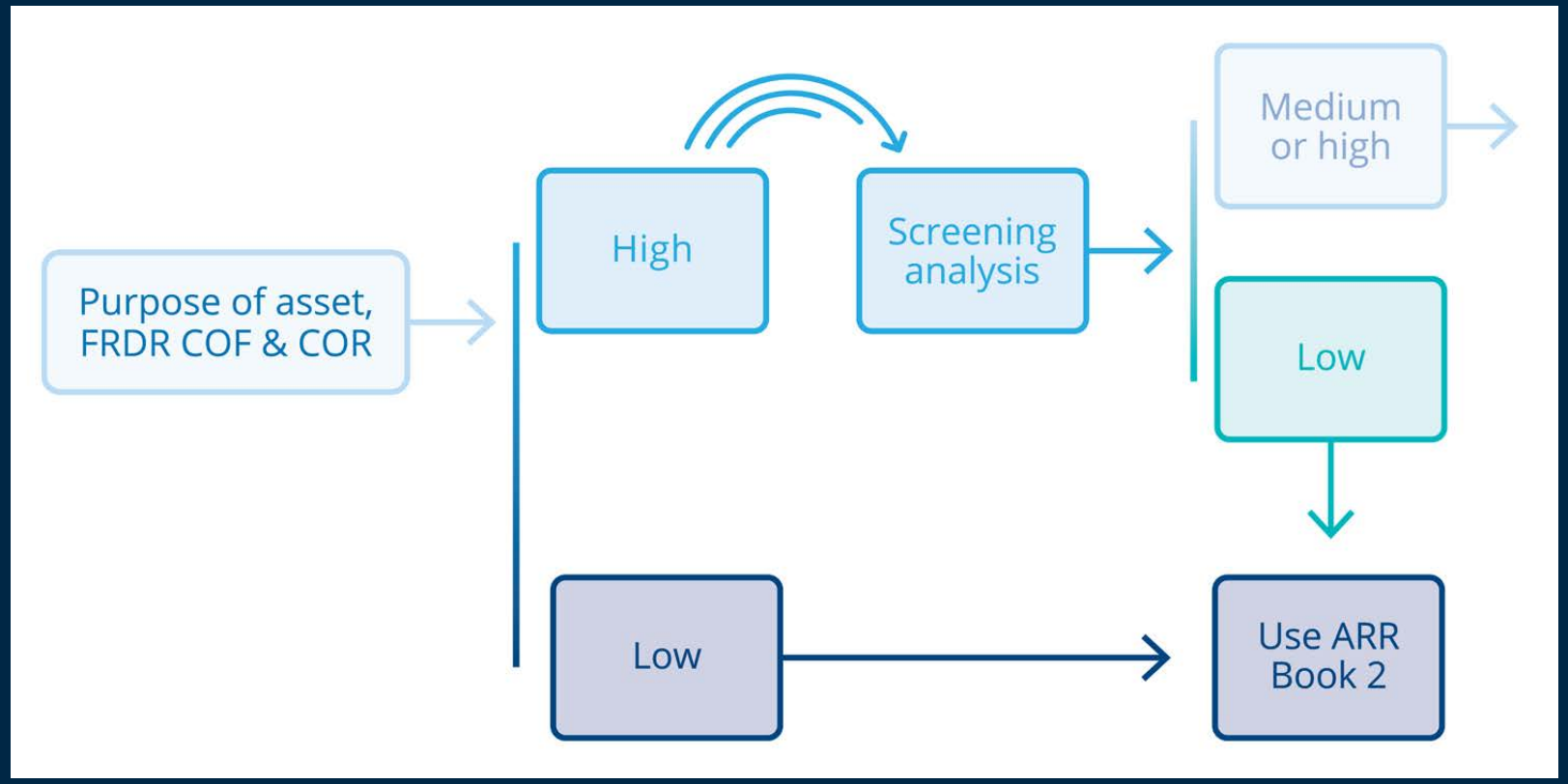
Step 1 - Set the Effective Service Life or Planning Horizon



Step 2 – Set the Flood Design Standard



Step 3 – Consider the Purpose and Nature of the Asset or Activity and Consequences of its Failure

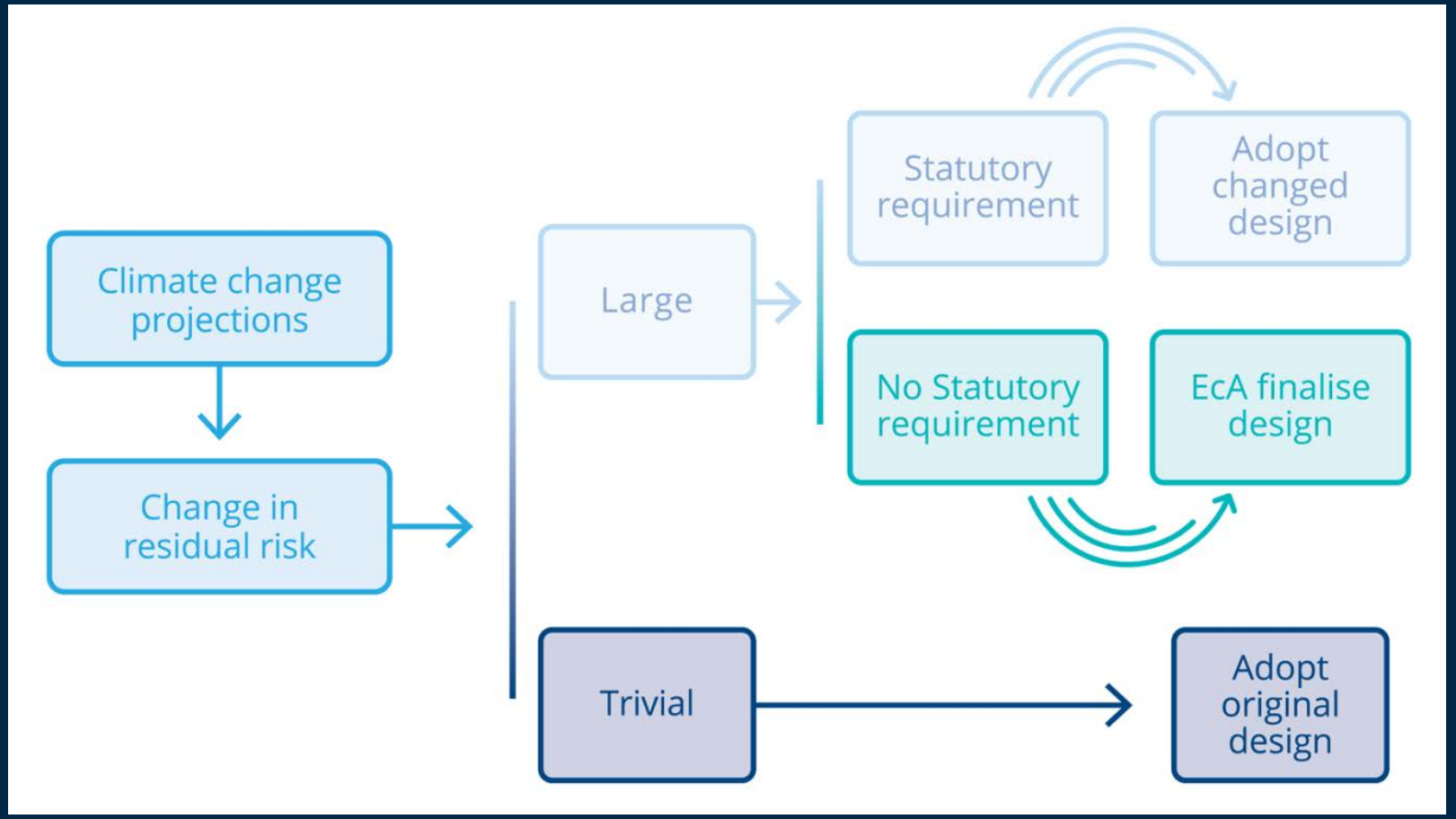


Step 4 – Carry out a Climate Change Risk Screening Analysis

AEP (%)	AEP (1 in x)
5	20
2	50
1	100
0.5	200
0.2	500

- If design AEP corresponds to i^{th} row, consider:
  - $(i+1)^{th}$
  - $(i+2)^{th}$

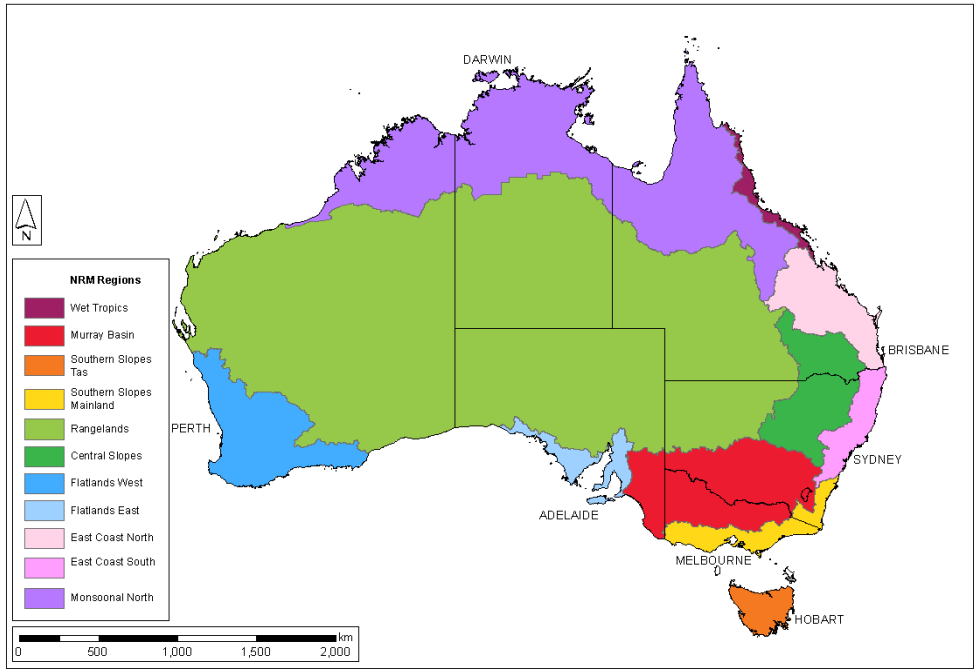
Step 5 – Consider Climate Change Projections and their Consequences



Climate futures tool

		Annual Surface Temperature (°C)			
		Slightly Warmer < +0.5	Warmer +0.5 to +1.5	Hotter +1.5 to +3.0	Much Hotter > +3.0
Annual Rainfall (%)	Much Wetter > +15.0				
	Wetter +5.0 to +15.0		2 of 30 GCMs +	9 of 30 GCMs 1 of 6 DS +	2 of 30 GCMs +
	Little Change −5.0 to +5.0			12 of 30 GCMs 4 of 6 DS +	3 of 30 GCMs +
	Drier −15.0 to −5.0			2 of 30 GCMs +	
	Much Drier < −15.0				

A sample Australian Climate Futures table



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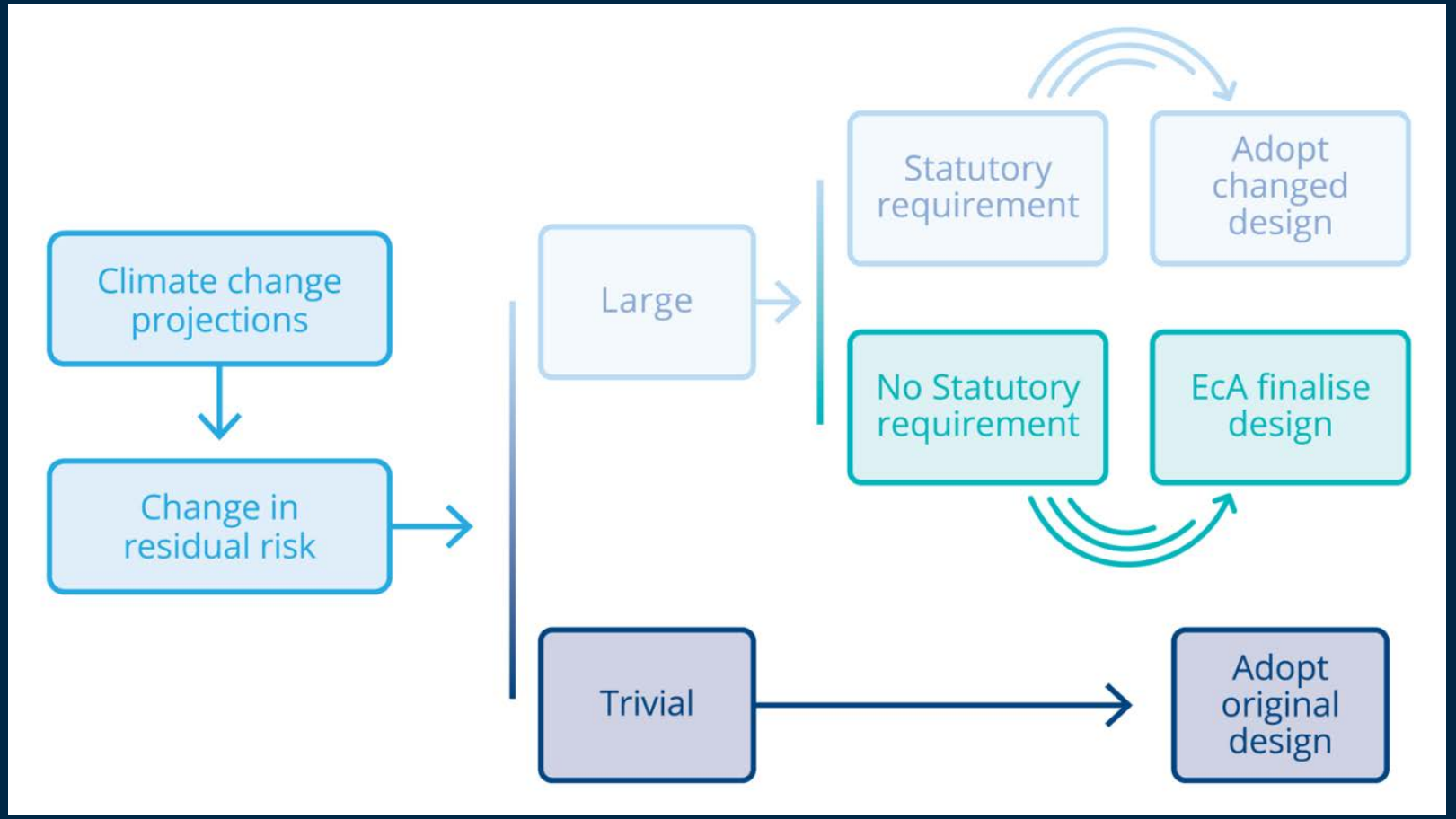
Step 6 – Consider Statutory Requirements

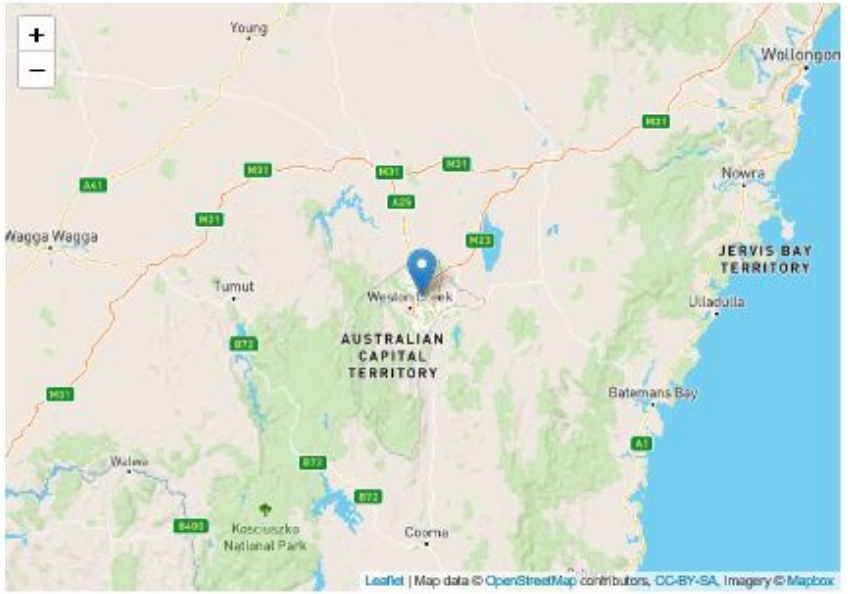


ARR Data Hub - Interim Climate Change Factors

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	149.101
Latitude	-35.298
Selected Regions (clear)	
BOM IFDs	show
Interim Climate Change Factors	show
Probability Neutral Burst Initial Loss	show



Data

BOM IFDs

Click here to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	02 March 2021 11:18PM

Interim Climate Change Factors

	RCP 4.5	RCP6	RCP 8.5
2030	0.816 (4.1%)	0.726 (3.6%)	0.934 (4.7%)
2040	1.046 (5.2%)	1.015 (5.1%)	1.305 (6.6%)
2050	1.260 (6.3%)	1.277 (6.4%)	1.737 (8.8%)
2060	1.450 (7.3%)	1.520 (7.7%)	2.214 (11.4%)
2070	1.609 (8.2%)	1.753 (8.9%)	2.722 (14.2%)
2080	1.728 (8.8%)	1.985 (10.2%)	3.246 (17.2%)
2090	1.798 (9.2%)	2.226 (11.5%)	3.772 (20.2%)

Layer Info

Time Accessed	02 March 2021 11:18PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

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Thank you

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