Climate Change & Water Security Planning

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Queensland Water Modelling Network - February 2020

SOURCE STORE SUPPLY

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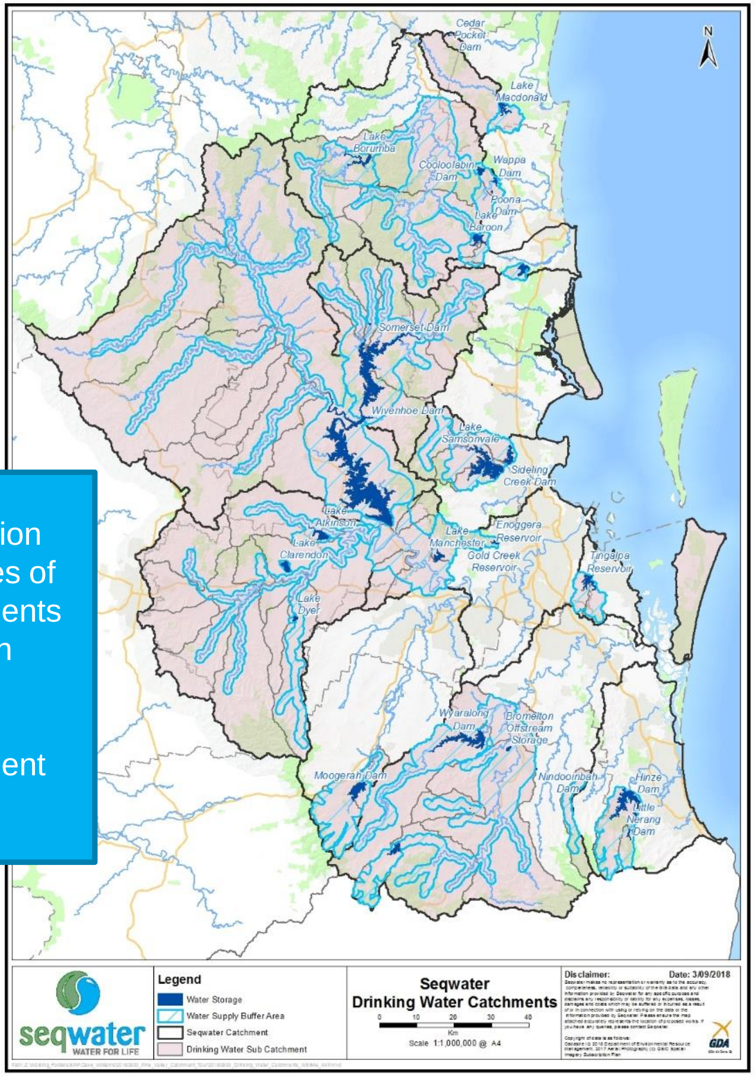
Contents & context

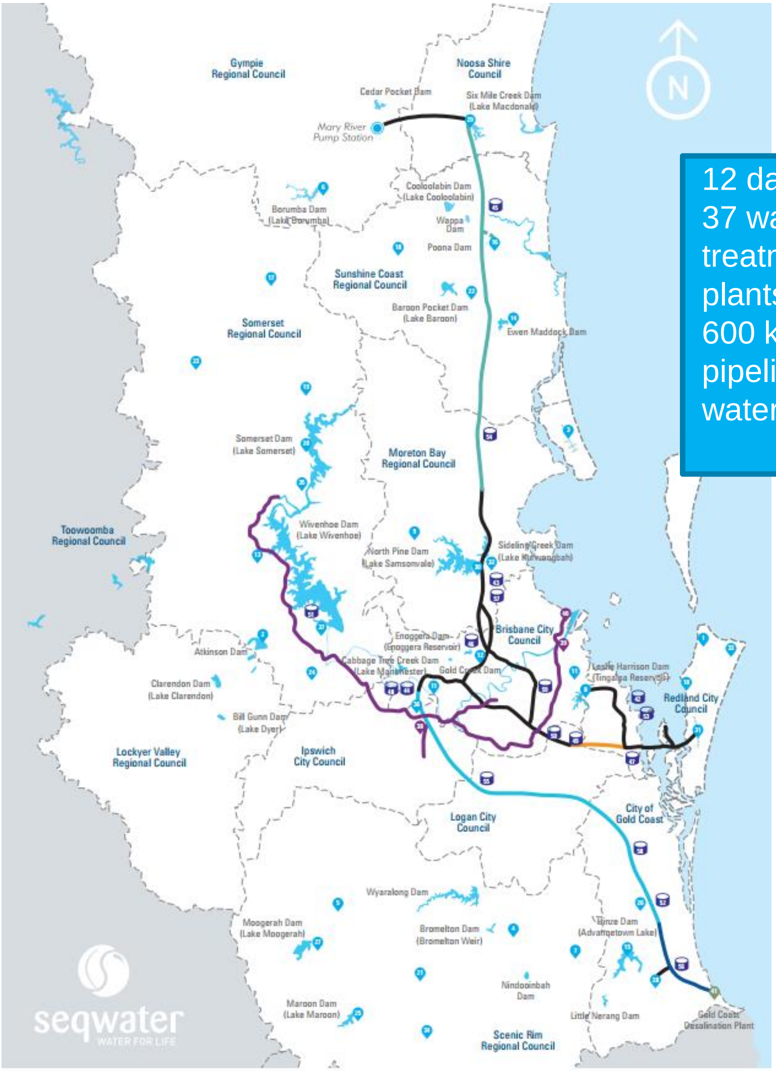
Policy question: How will climate change impact Seqwater and what should we do about it?

1. Overview of Seqwater's assets and services
2. A policy perspective on the modelling pipeline
3. Thoughts on what we need from water models to inform policy decisions
4. A very high level overview of (some of) our water modelling context
5. Case study - modelling water security planning and climate change

Seqwater drinking water catchments & water supply assets

1.2 million hectares of catchments
We own ~5% of source catchment land

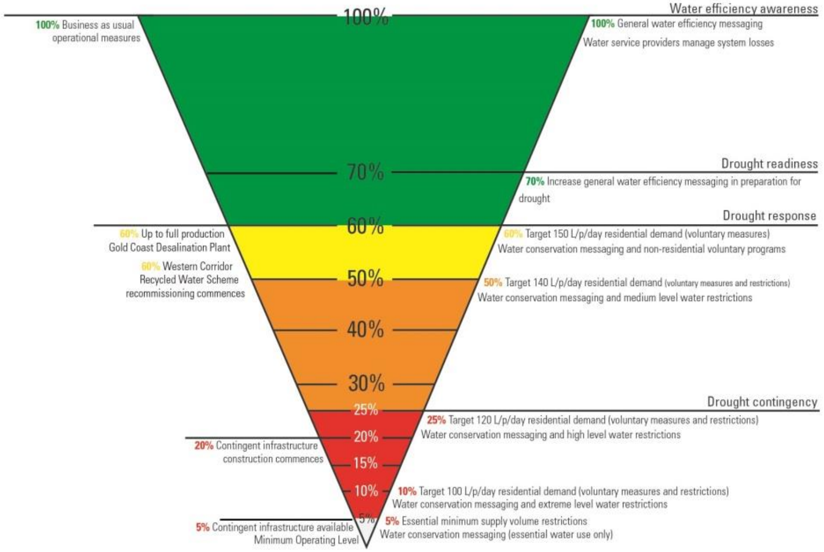




12 dams
37 water treatment plants
600 km pipeline - water grid

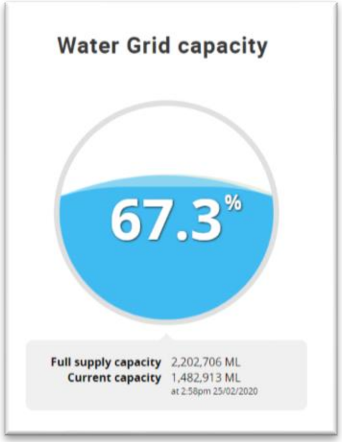
Drought response & resilience

South East Queensland adaptive drought response approach



Notes:

1. Percentages are based on the combined volume of the SEQ key bulk water storages
2. Demand management targets are SEQ regional averages.



Modelling pipeline

Policy / modelling interface

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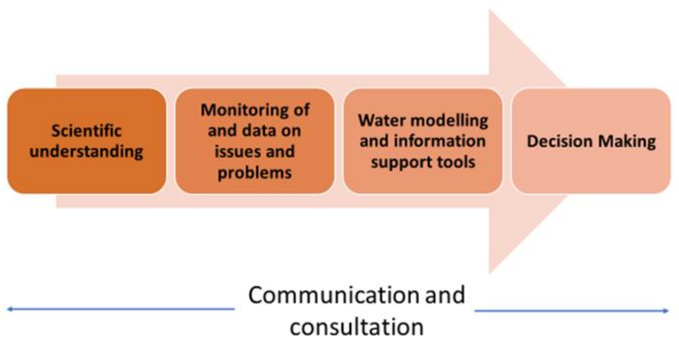
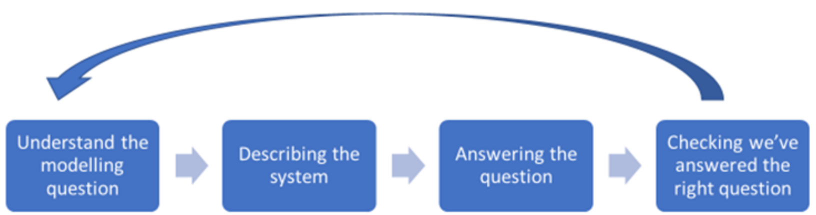
The modelling pipeline – concept vs reality?

What are the elements of the "Pipeline"



A pipeline of questions



Policy questions and modelling questions are formulated differently

Examples of policy questions we are considering relating to water supply and climate change:

- When will we need to augment our supply?
- Do we need to upgrade infrastructure to avoid service disruptions?
- Do we need to rethink our reliance on manufactured water vs dams vs decentralised systems?
- How do we balance the need to be prepared for plausible future conditions with the risk of over-investing and building unneeded infrastructure?
- How can we make sure climate change adaptation options don’t have unintended consequences?
- Do we have support from key stakeholders for the decisions we need to make?

When using modelling to inform policy we need…

Transparency around assumptions and limitations

Follow best practice

Use best available science

Use up to date reliable datasets (historic climate data & climate change projections)

Allow for comparison between different scenarios and options

Communication with different audiences

Modelling context

Bulk water supply & climate change

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Modelling context – Queensland water models

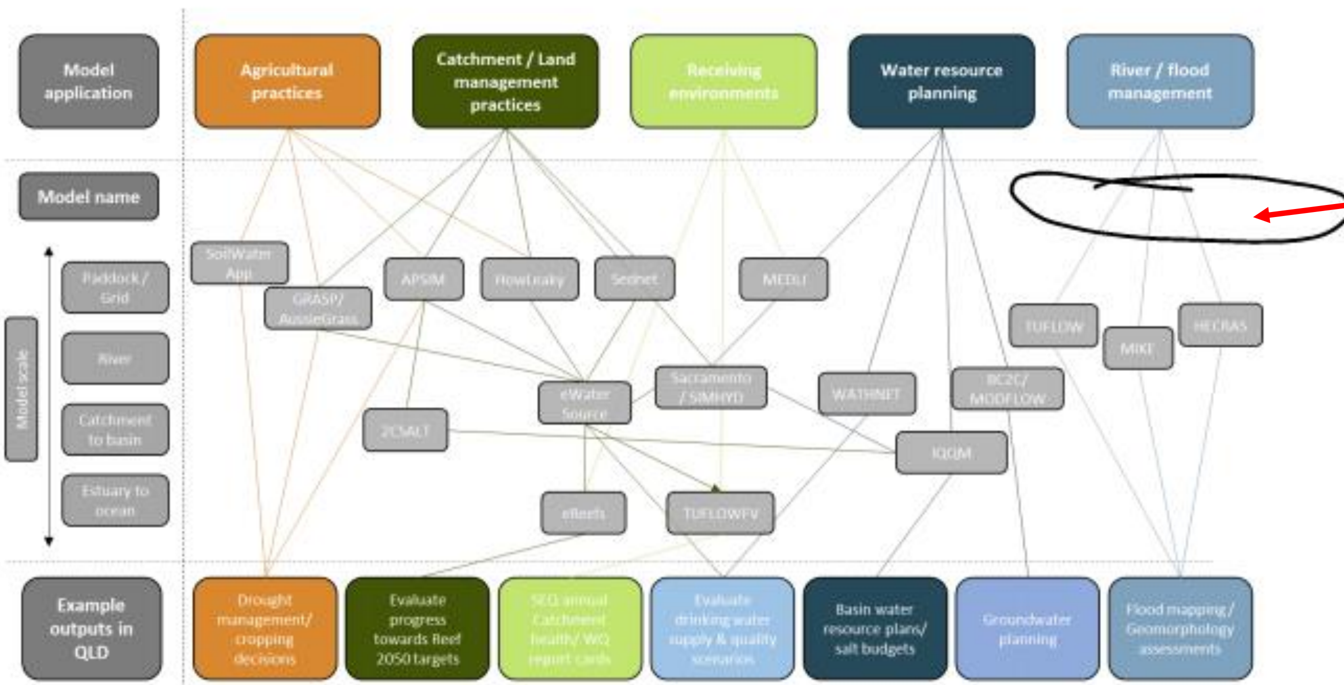
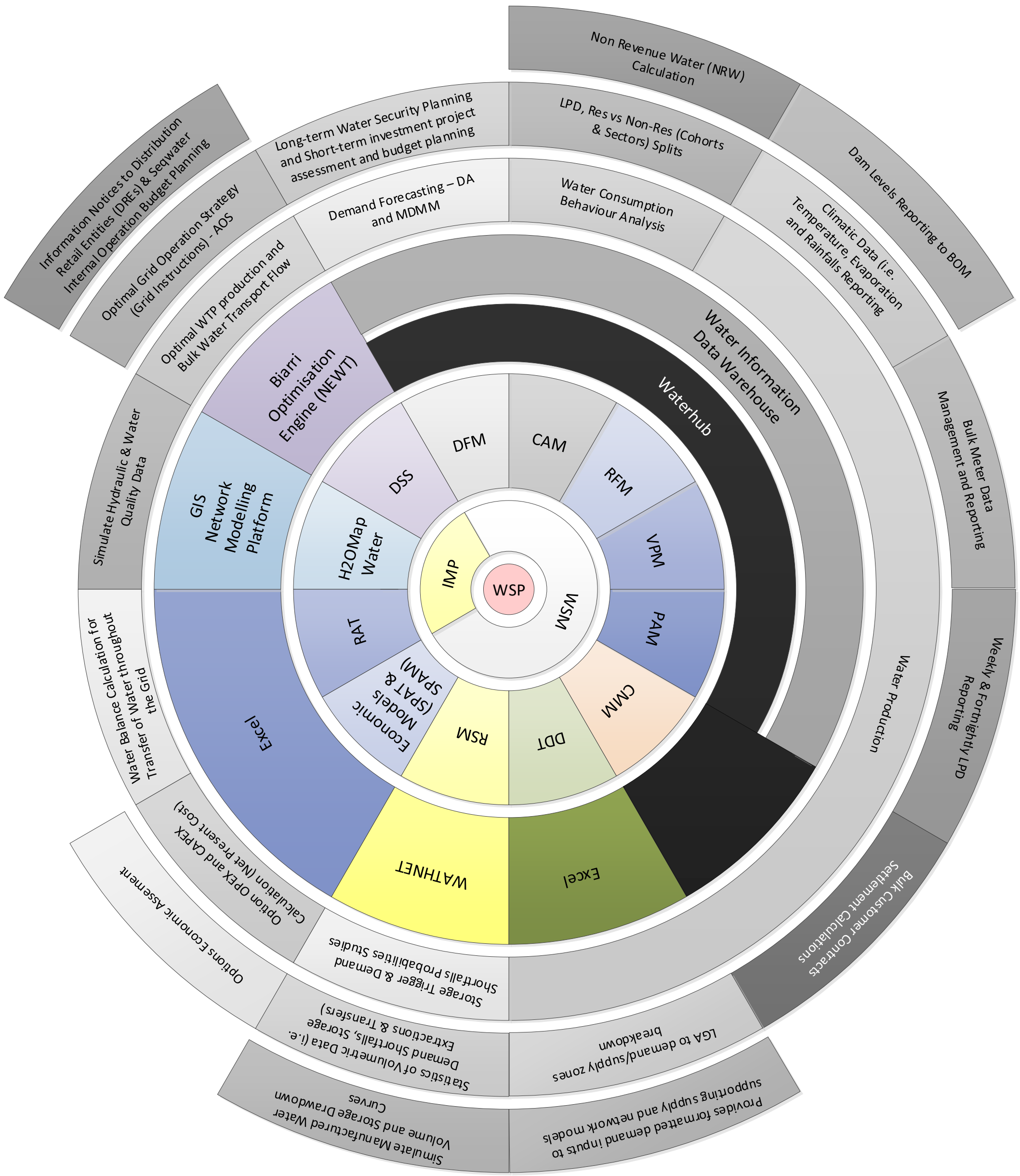
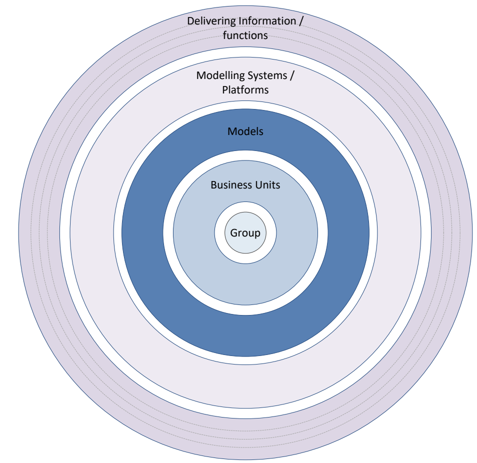


Figure 1. *Models used in Queensland for water modelling and their connections.*

Hydrologic models for floodplain management

Seqwater water supply planning model landscape

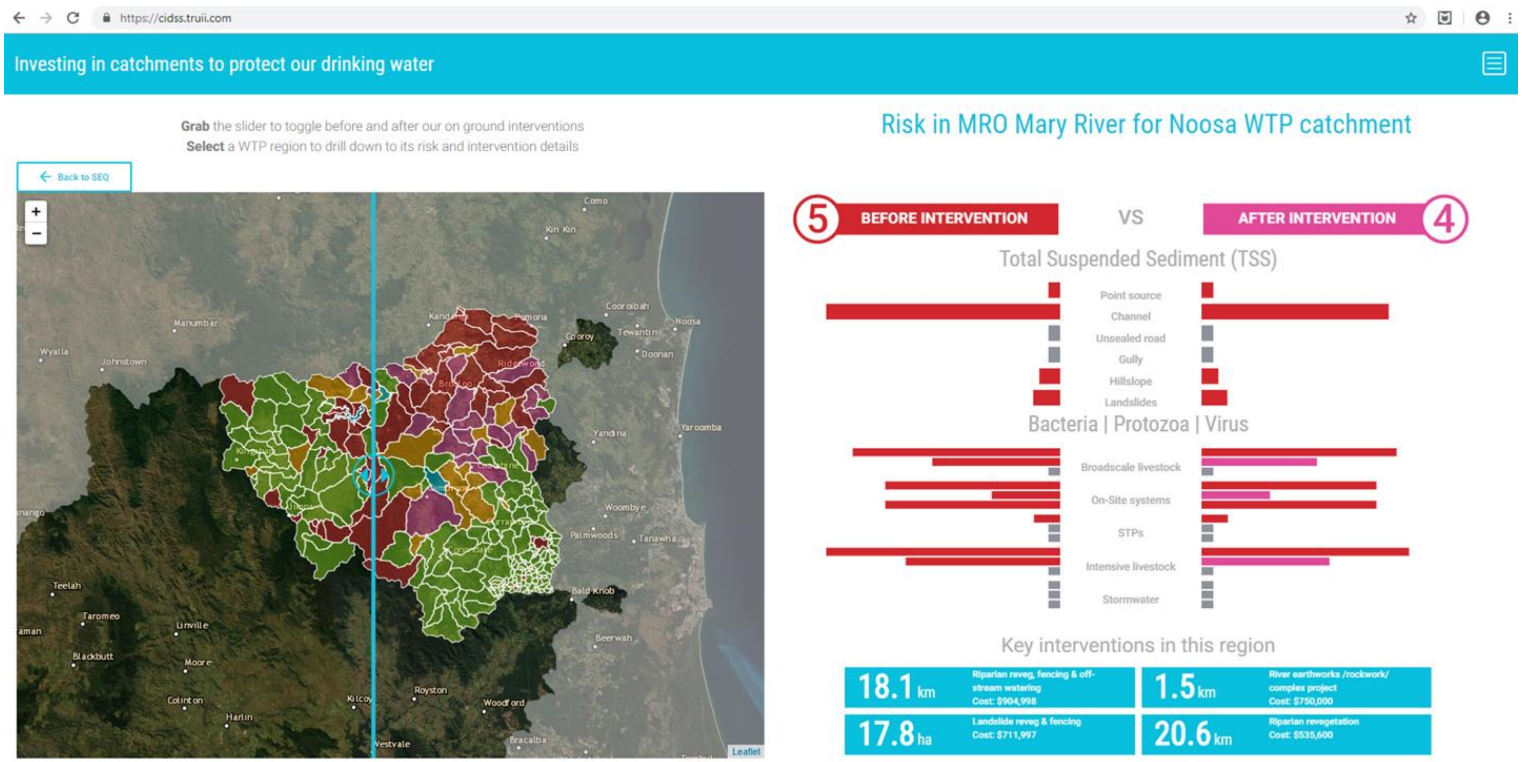




Acronym

CAM – Consumption Analysis Module
CMM – Contract Management Module
DDT – Demand Distribution Tool
DFM – Demand Forecasting Module
DSS – Decision Support System
H20Map – H2OMap Water
IMP – Integrated Master Planning team
PAM – Production Analysis Module
RAT – Rapid Assessment Tool
RFM – Reporting Facilitation Module
RSM – Regional Stochastic Model
SPAM – Stochastic Portfolio Assessment Model
SPAT – Strategic Portfolio Assessment Tool
VPM – Volumetric Point Measurement
WSM – Water Supply Modelling team
WSP – Water Supply Planning group

Catchment decision support system

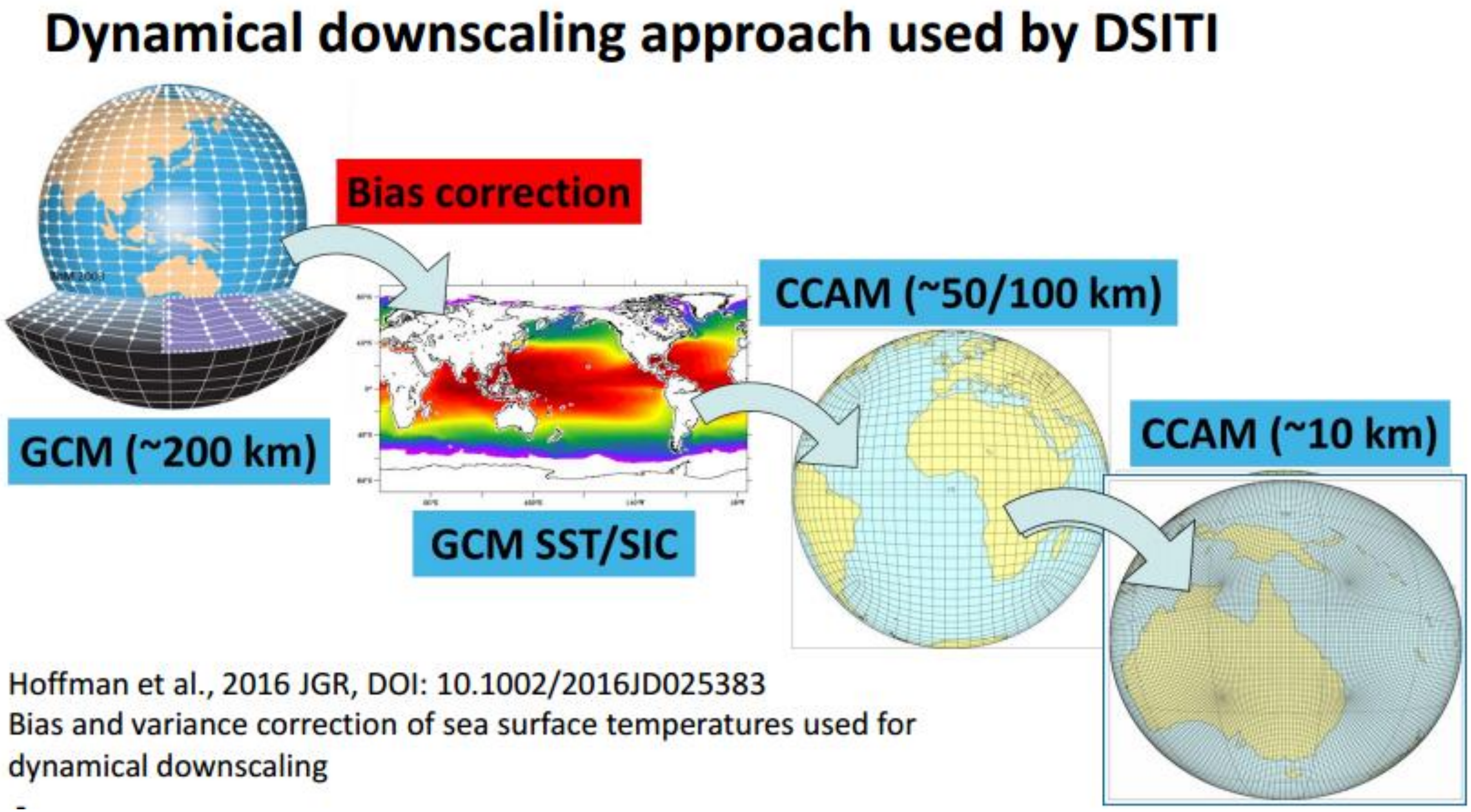


Truii

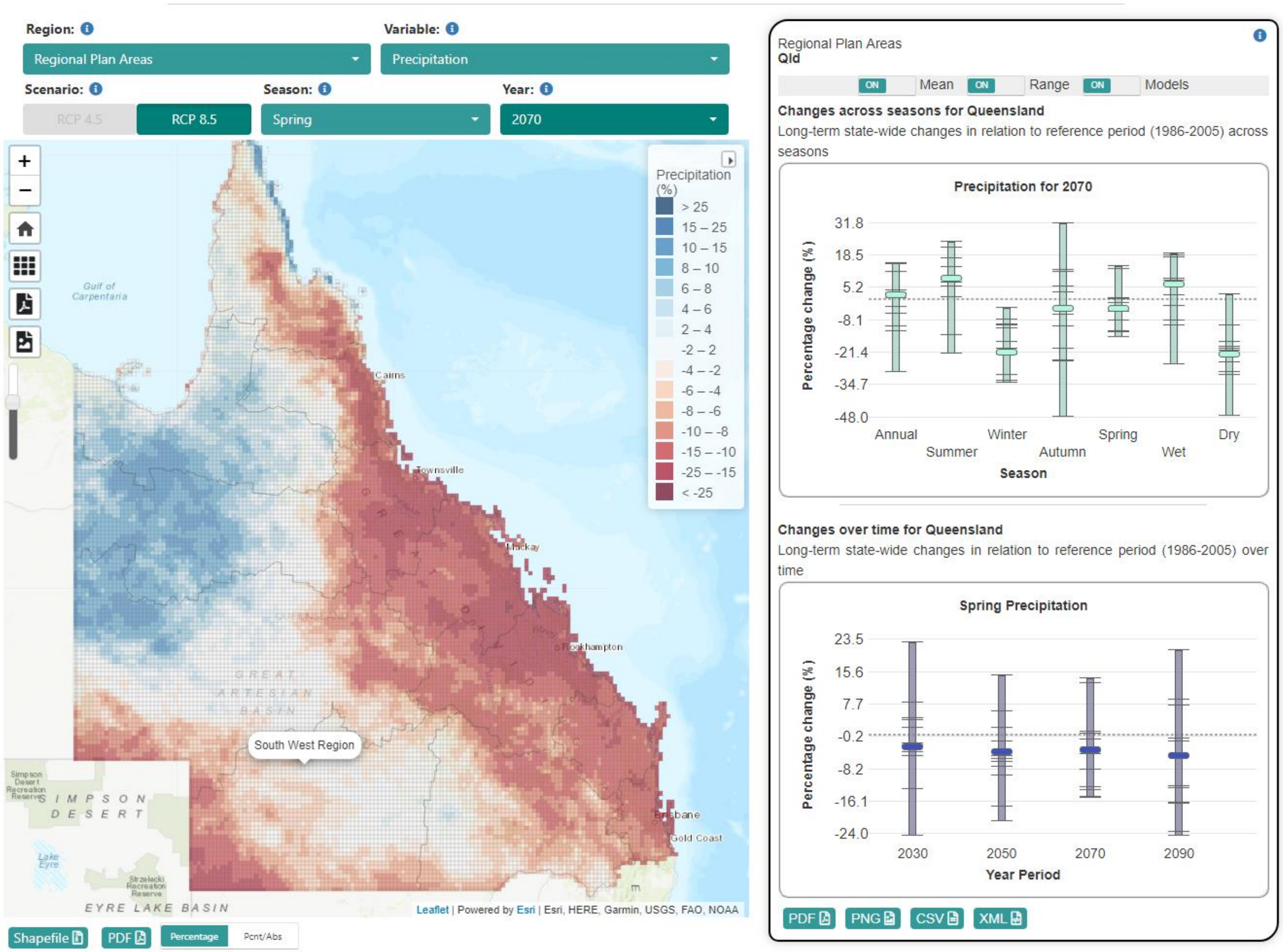
Find the truth in your data

Climate change projection modelling

- High resolution downscaled climate change projections data for Queensland available from DES (previously DSITI)



Queensland future climate dashboard – downscaled model projections



Source: https://app.longpaddock.qld.gov.au/dashboard/#responseTab1

Climate adjusted data sets

Climate change policy decisions

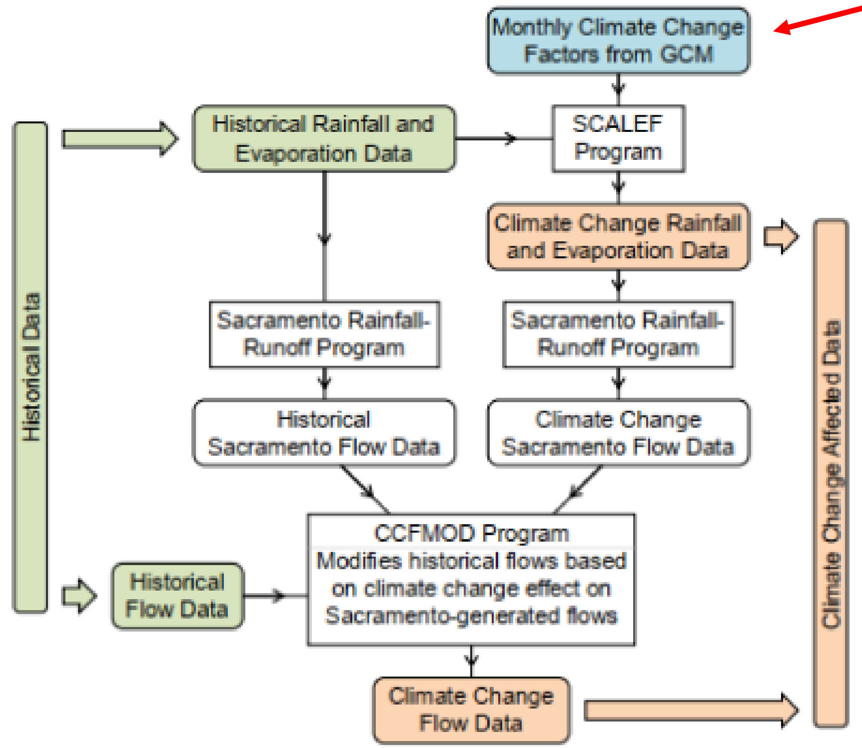


Figure 2.2 Schematic for generation of daily climate change data

Diagram source: Climate Change Data Generation for the SEQRSM. DSITI. (Draft July 2014)

Rainfall run-off model

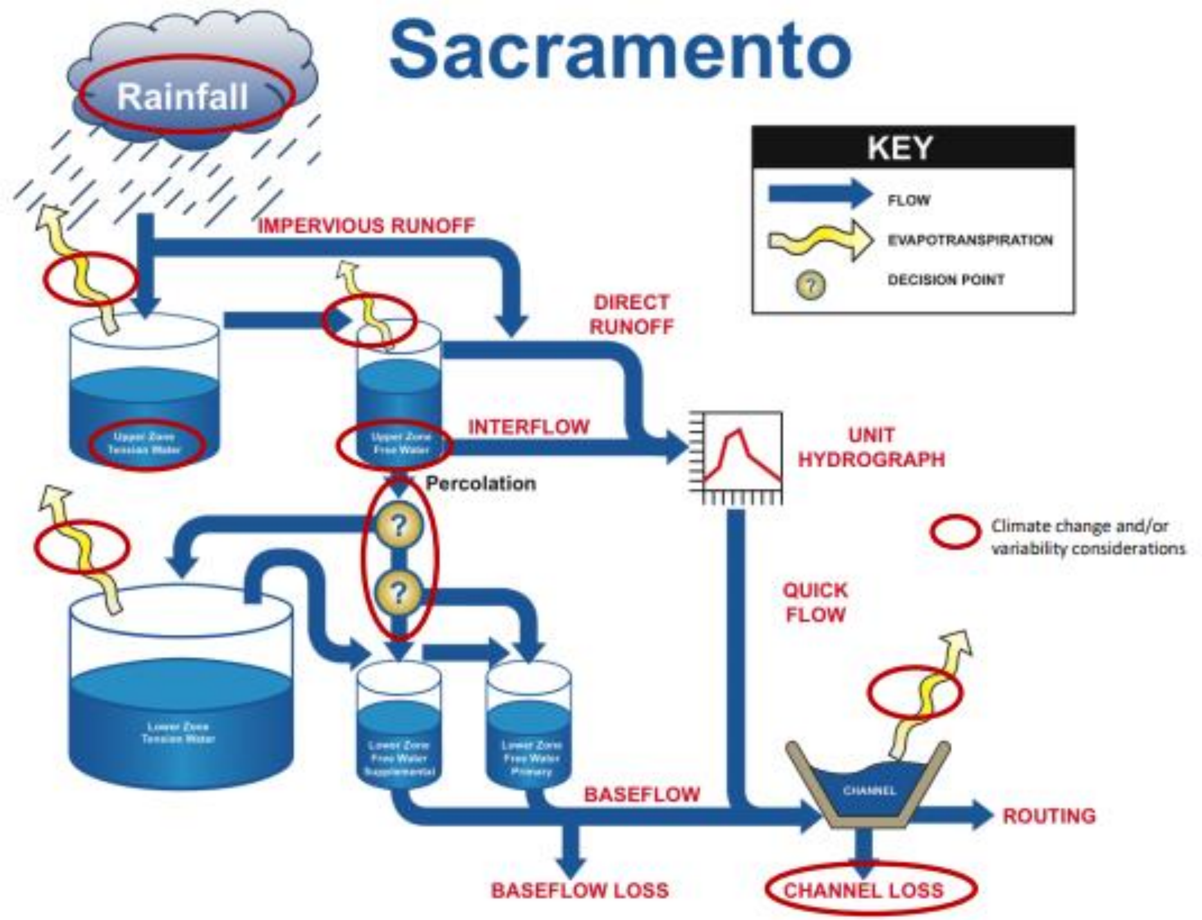


Figure 25 *Conceptual model for Sacramento Rainfall Runoff model (eWater 2019)*

https://science.des.qld.gov.au/__data/assets/pdf_file/0034/98863/critical-review-climate-change-water-modelling-qld.pdf

Case study – water security program V3

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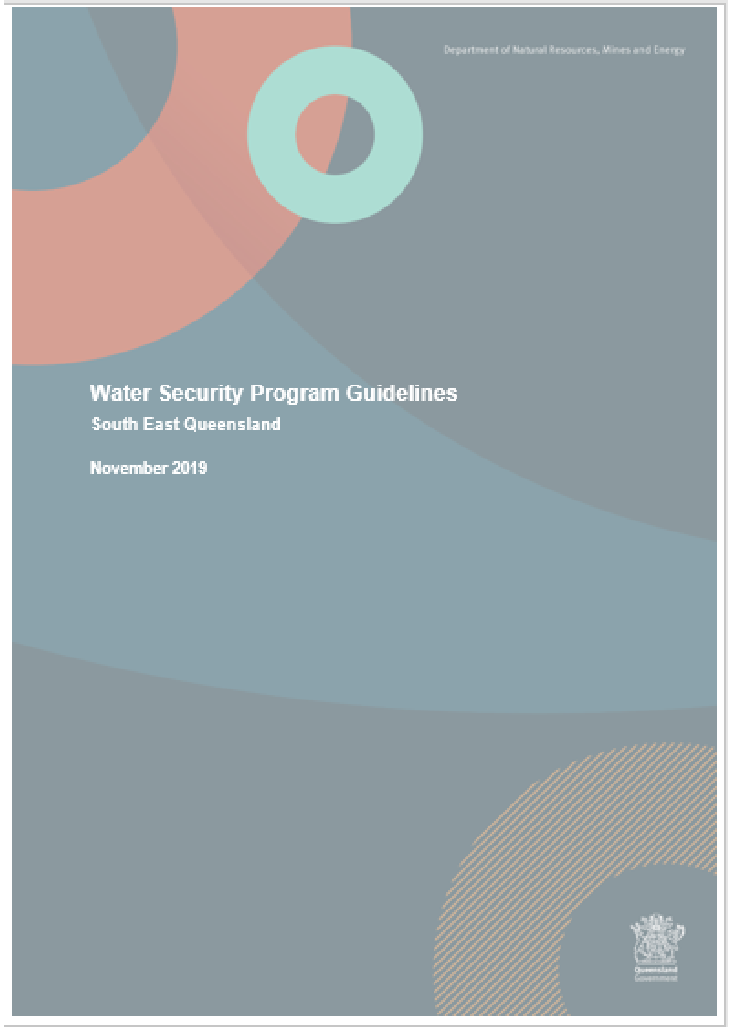
DNRME Water Security Program (WSP) Guidelines

2019 DNRME water security program guidelines for SEQ require that WSPV3 include:

- **<u>Analysis of climate change</u>** in SEQ and the possible ramification for future droughts.
- **<u>Inclusion of climate change in scenario analysis</u>** to inform bulk water supply assessments underpinning future water infrastructure planning.



Steps to model climate change impacts for WSP V3

Decide climate change parameters - RCPs, projection source, model selection

Commission climate-adjusted datasets

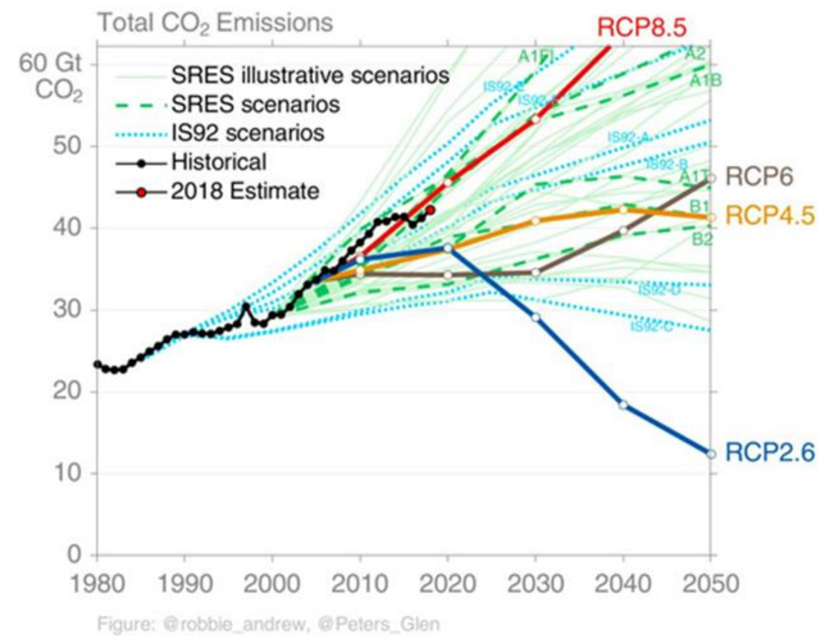
Apply adjusted datasets to water supply (RSM) modelling

- Climate change adjusted base case
- Sensitivity tests for 3 climate change scenarios

Climate change models

Climate models –
GCMs, downscaled models

- What is the nature of changes in climate variables that we will experience?
  - Rainfall changes?
  - Temperature?
  - Evaporation / evapotranspiration?
  - Extreme events (floods, drought frequency and magnitude)?
- What is the magnitude of these changes?
- When and where will changes occur?
- How certain are we of these changes?
- What are the range of plausible scenarios?



Conceptualise range of anticipated impacts

<u>Very high confidence</u>:
- Average temperatures will increase in all seasons
- More hot days and warm spells
- Mean sea level rise and increased extreme sea level events

<u>High confidence</u>:
- Potential evapotranspiration projected to increase in all seasons
- Increased intensity of extreme rainfall events
- Harsher fire weather

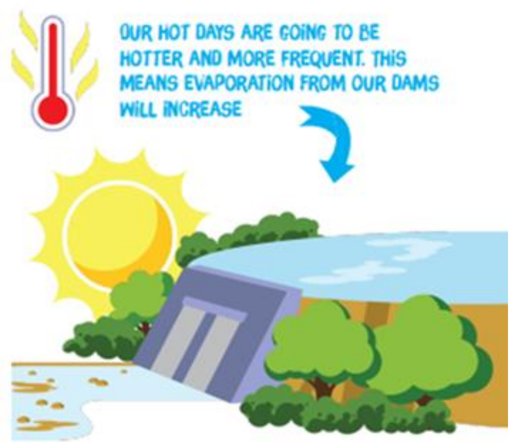
<u>Possible but unclear:</u>
Rainfall changes - could be masked by natural variability over the next 20 years.

Source: CSIRO 2015 – Climate Change in Australia Projections Cluster Report – East Coast

Water supply models

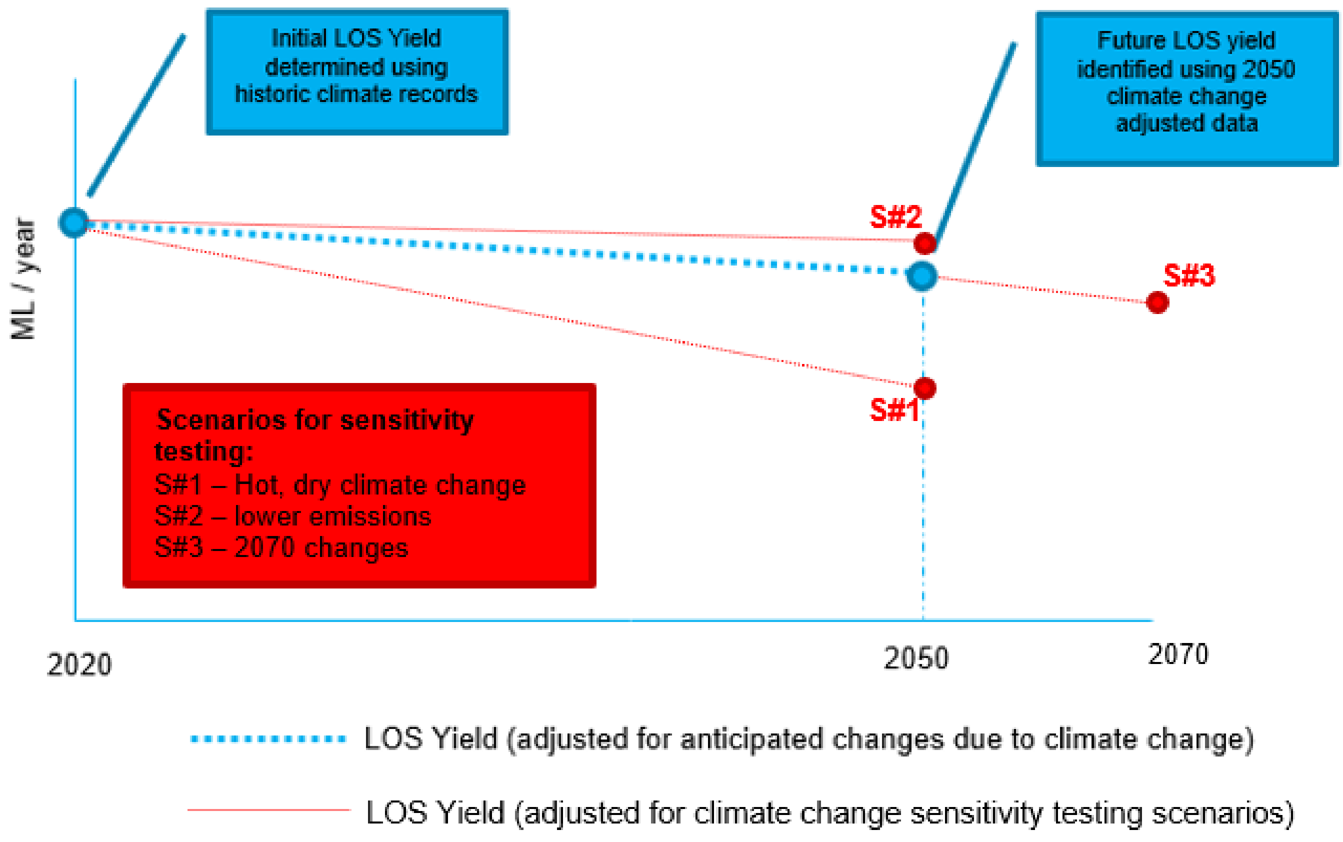
Water supply, flooding and catchment models

- How will changes in climate impact on bulk water supply?
  - Will the inflows into our system change?
  - Are our assets vulnerable to extreme events?
  - Will demand increase?



Recommended water security base case and scenarios

Rethink LOS yield to incorporate climate changes over time in base case for water security program.



Anticipated outcomes

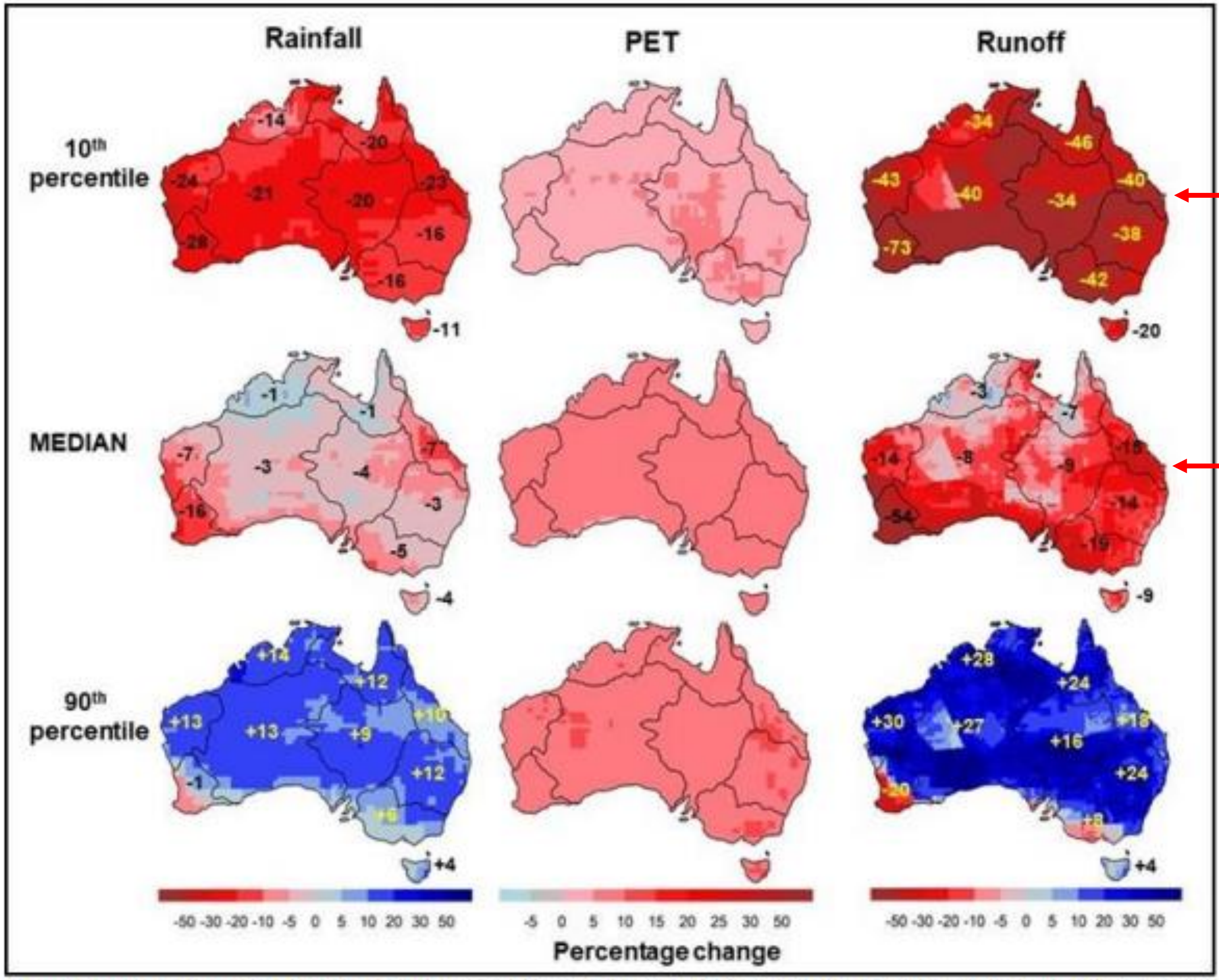


Figure 11 *Range of projected changes in future rainfall, PET and runoff for Australia for 2046–2075 relative to 1976–2005 under RCP8.5 (modelling following Chiew et al., 2017).*

Hot, dry scenario

Base case

Recommendations & conclusions

Conclusions

Climate change is a challenge for water modelling and policy

Iterative approaches to framing policy questions and modelling questions is needed

Clear and effective communication of modelling is needed to support good policy decisions

Final thoughts

- Recognise that water management is a multi-disciplinary sector.
- Recognise the benefits of cross-discipline communication – cut down on jargon / acronyms and try to speak a common language
- Take opportunities (like this forum) to learn from each other

Extra background info

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Summary of changes

Variable		South East Queensland Regional Plan Area 2050 RCP 8.5 model average Compared with 1986-2005 reference period
Rainfall	Annual precipitation	-0.94%
	Spring precipitation	-11.51%
Consecutive dry days	Spring consecutive dry days (maximum number of days with <1mm precipitation)	Increase by 2.12 days
Temperatures	Annual mean temperature	+1.76ºC
	Annual maximum temperature	+1.96ºC
	Summer maximum temperature	+2.11ºC
	Spring maximum temperature	+2.16ºC
	Annual heatwave frequency (number of days)	29.16% increase
	Number of hot days (over 35ºC)	Increase by 11.77 days per year
Evaporation	Annual evaporation	+15.03%
	Spring evaporation	+16.28%

Key decision – Include future climate in LOS yield assessments

- In version 2 we considered climate change as a single dataset compared with unchanged LOS Yield
- “if climate change happens” and “no climate change”

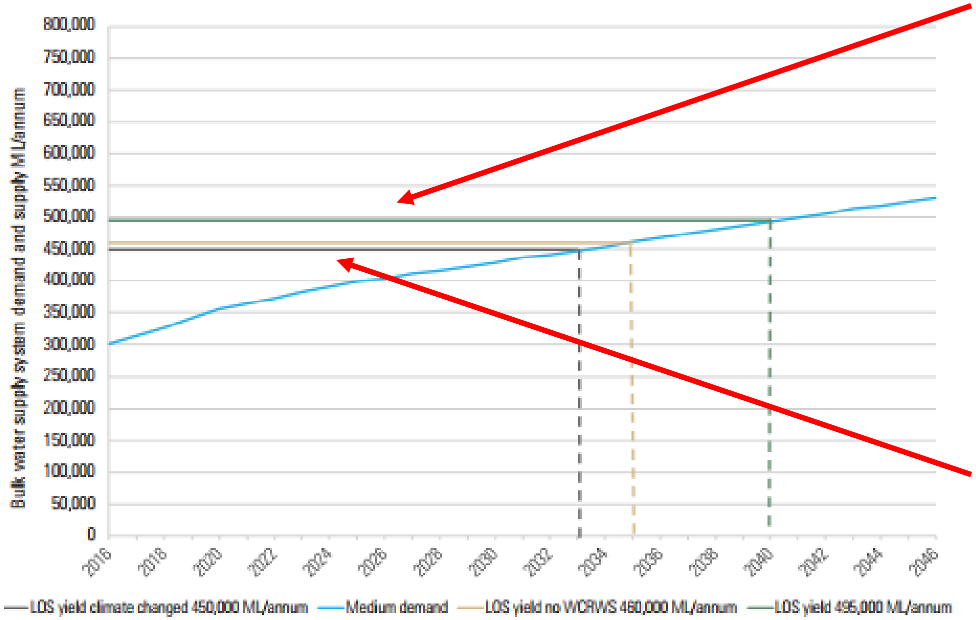


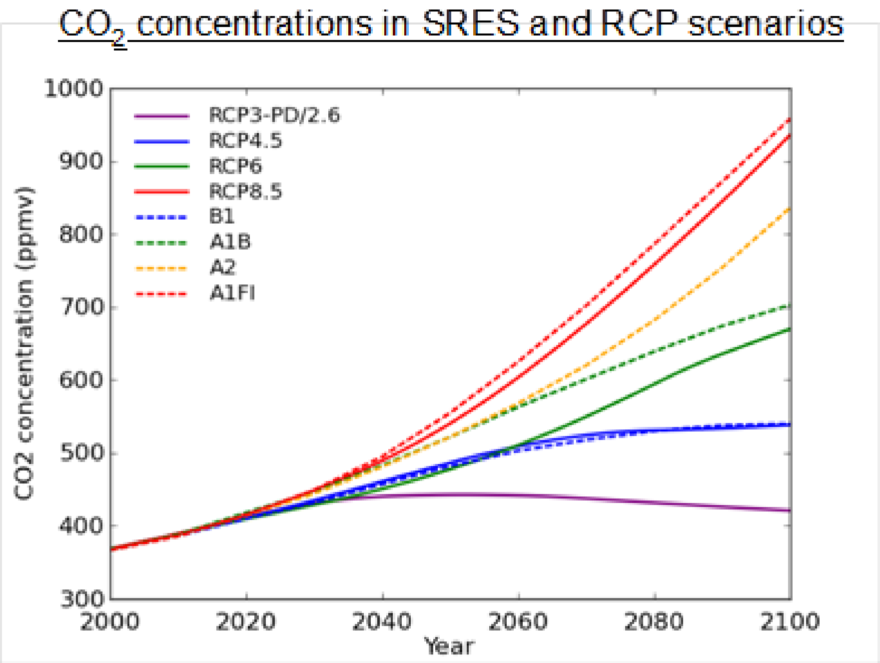
Figure 4-6 Impact of climate change and no WCRWS on LOS yield

No climate change – historic climate continuing into the future

Climate changed LOS yield - based on 2030 CC projections

Version 2 - Water Supply Planning SEQRSM Climate Data

- Relies on data from 4th IPCC report (2007)
  - Uses SRES (Special Report on Emission Scenarios) A1B (2030) and A1FI (2070)
  - Results of 11 global circulation models used to select 10th, median and 90th percentile rainfall as at 2030 and 2070
  - Recognizes that decision making processes have to account for various uncertainties
- Not updated with data from 5th IPCC report (2014) and updated scenario tools (Representative Concentration Pathways) or downscaled data for Queensland



Source: https://www.climatechangeinaustralia.gov.au/static/ccia/2.1.6/climate_futures/images/RCP_vs_SRES.png

Deciding on "base case" for future climate

Parameter	Recommendation for base case	Justification
Emissions pathway	RCP 8.5	Emissions trajectory. Consistent with application by others in water industry. Data availability for SEQ.
Timeframe	2050	2051 planning horizon for WSPV3.
Data source	Queensland Future Climate data. Queensland Government, Department of Environment and Science.	Best available downscaled data source for SEQ. High resolution data at 10km grids. Updated with 5th Assessment IPCC CMIP5 models.
Model (GCM) selection	Model average (50th percentile) based on inflows into the water grid storages.	Represents appropriate balance for considering feasible future conditions in base case.

Scenarios for WSPV3

Scenario for sensitivity testing	Change from base case parameters (all other parameters remain unchanged)
Scenario #1 **Hot, dry scenario**	Model selection = 10^{th} percentile rainfall & 90^{th} percentile evaporation and temperature.
Scenario #2 **Lower emissions scenario**	Emission scenario = RCP 4.5
Scenario #3 **Longer term changes**	Timeframe = 2070

Detail re scenarios for WSPV3

Scenario for sensitivity testing	Change from base case parameters (all other parameters remain unchanged)	Justification
Scenario #1 **Hot, dry scenario**	Model selection = 10^{th} percentile rainfall & 90^{th} percentile evaporation and temperature.	Sensitivity testing for declining rainfall is essential for WSPV3. Rainfall is the major driver of inflows and water security. However, future rainfall projections are unclear for SEQ, with some climate models indicating increased rainfall, while some indicate declines. This scenario will reflect a more intense climate change situation where inflows are low due to low rainfall and high evaporation / temperature.
Scenario #2 **Lower emissions scenario**	Emission scenario = RCP 4.5	Is generally consistent with achievement of the Paris Agreement therefore should be considered as a feasible (best case) future scenario.
Scenario #3 **Longer term changes**	Timeframe = 2070	Aligns with longer range water security program outlook and the ability to consider longer term impacts.

Previous assessment findings

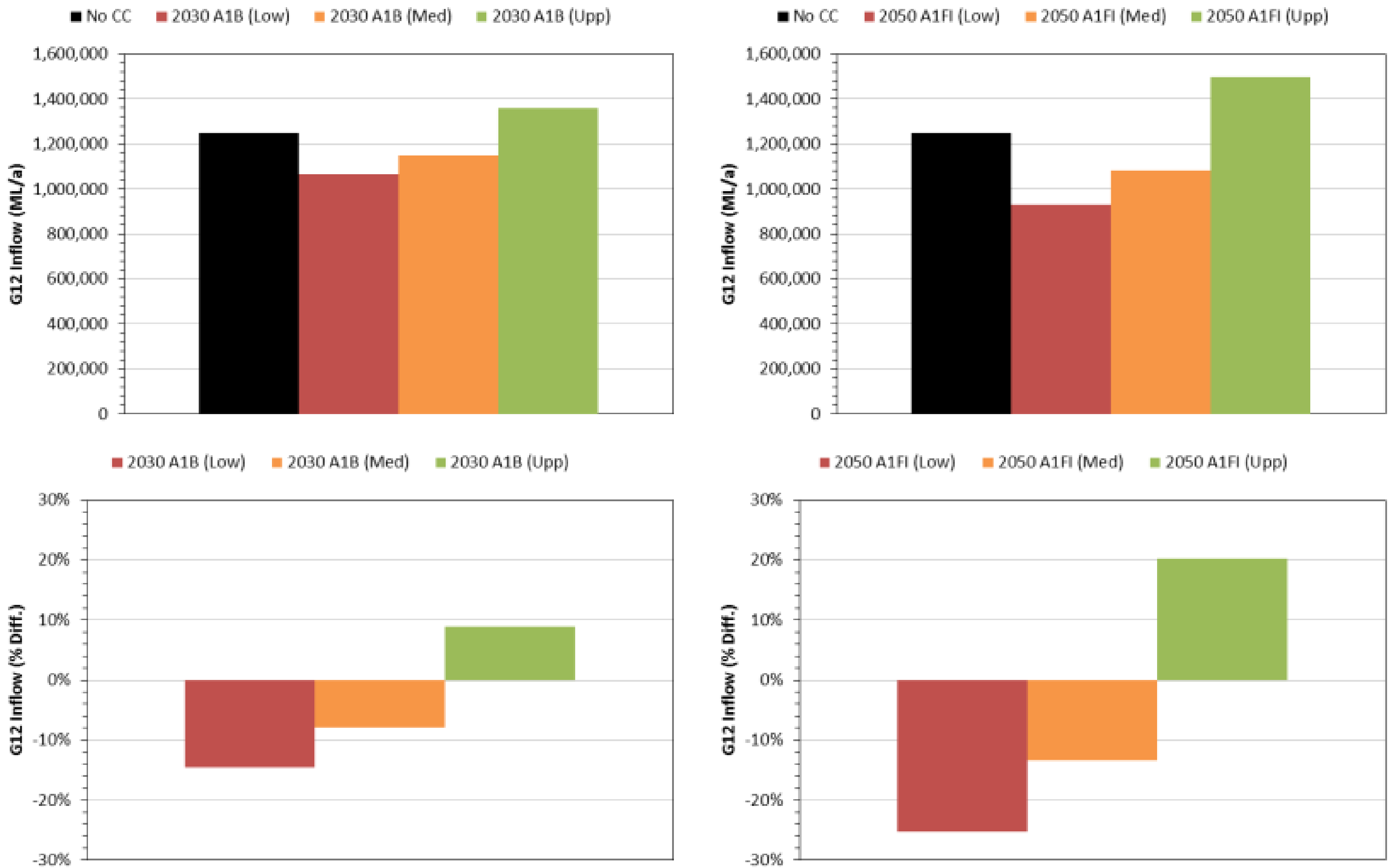


Figure B.6 Climate change impact on average of annual historical G12 inflows

Diagram source: Climate Change Data Generation for the SEQRSM. DSITI. (Draft July 2014)

LOS Objectives for SEQ

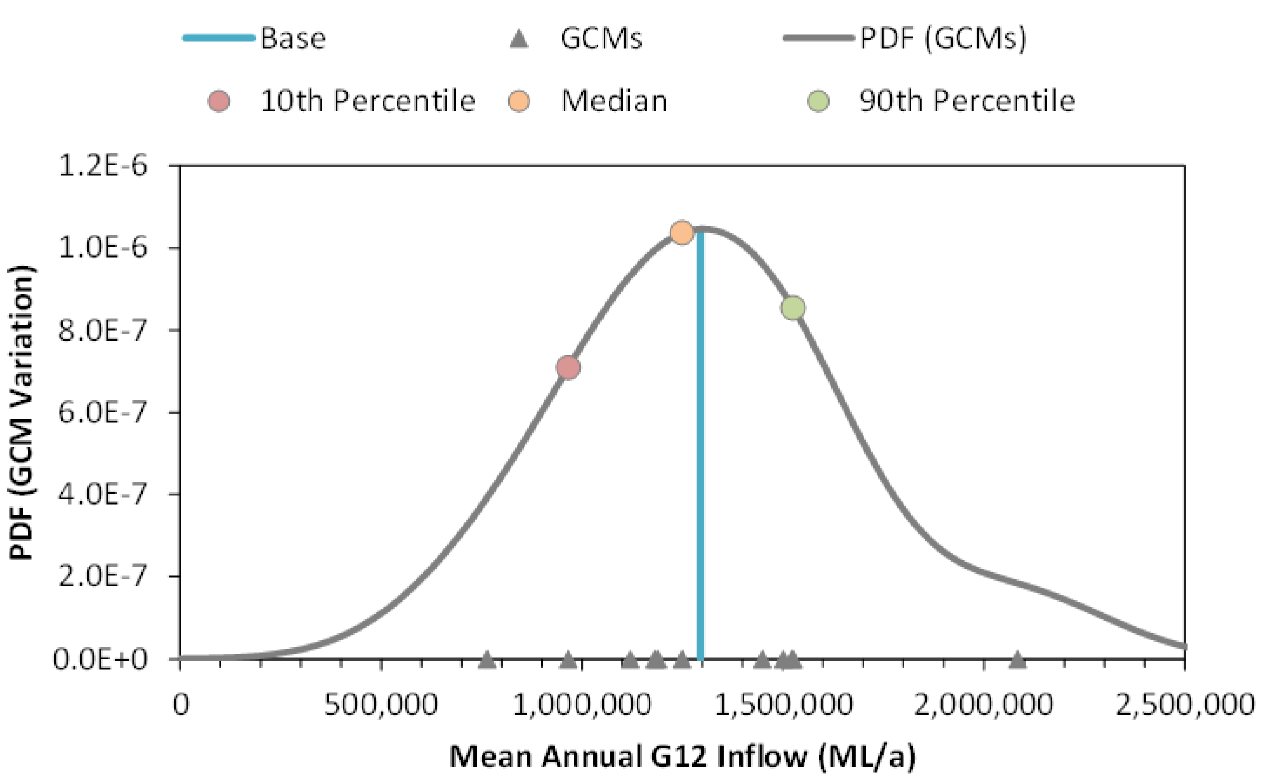
Desired level of service objectives for SEQ

- The desired LOS objectives are set in the Water Regulation 2016 (s. 79-81).
- These objectives for SEQ require that the bulk water supply network be able to supply enough water:
- to meet the projected regional average urban demand estimated by Seqwater, so that medium level water restrictions on residential water use will (on average) not occur more than once every 10 years, be more severe than 140 litres per person per day, or last more than 1 year
- to provide an essential minimum supply volume of 100 litres per person per day in an extreme drought event (i.e. a 1 in a 10,000 year event), so that key storages (i.e. Baroon Pocket, Wivenhoe and Hinze dams) will not reach their minimum operating level more than once in every 10,000 years on average.

Review of LOS objectives

- The 2019 review of the LOS objectives (PDF, 999KB) found that the current objectives are satisfactory in helping to ensure water security for SEQ. The review recommended:
- updating the Water Security Program Guidelines for South East Queensland (PDF, 712KB)
- investigating further work prior to the next LOS review in 2024
- updating legislation to change the duration of medium level restrictions objective.

10th 50th, 90th percentile inflows



Guiding principles – using models for policy

Follow best practice.

Use best available science.

Transparency - understand & communicate limitations and assumptions.

Allow for comparison between different scenarios and options.

Use up to date reliable datasets (historic climate data & climate change projections).

We need some consistency in how we use climate change data and projections across our business.

Source: NCAARF / Coast Adapt

Special considerations for climate change

- Polarising & increased scrutiny on decisions
- Many future possibilities
- Risks of acting too little and acting too much
- Well-funded climate change denial

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THE CLIMATE DENIAL MACHINE: HOW THE FOSSIL FUEL INDUSTRY BLOCKS CLIMATE ACTION.

It takes a lot to defy common sense on a global scale, all to benefit one industry. But for decades, fossil fuel interests have done just that, running a sophisticated and sprawling network of well-funded think tanks and front groups with one goal: Stop any real climate action, no matter the cost to billions.

To be exact, **a 2019 Influence Map report** found that "the five largest publicly-traded oil and gas majors (ExxonMobil, Royal Dutch Shell, Chevron, BP, and Total) have invested over $1Bn of shareholder funds in the three years following the Paris Agreement on misleading climate-related branding and lobbying."

Source: https://www.climaterealityproject.org/blog/climate-denial-machine-how-fossil-fuel-industry-blocks-climate-action