# Modelling for the Basin Plan

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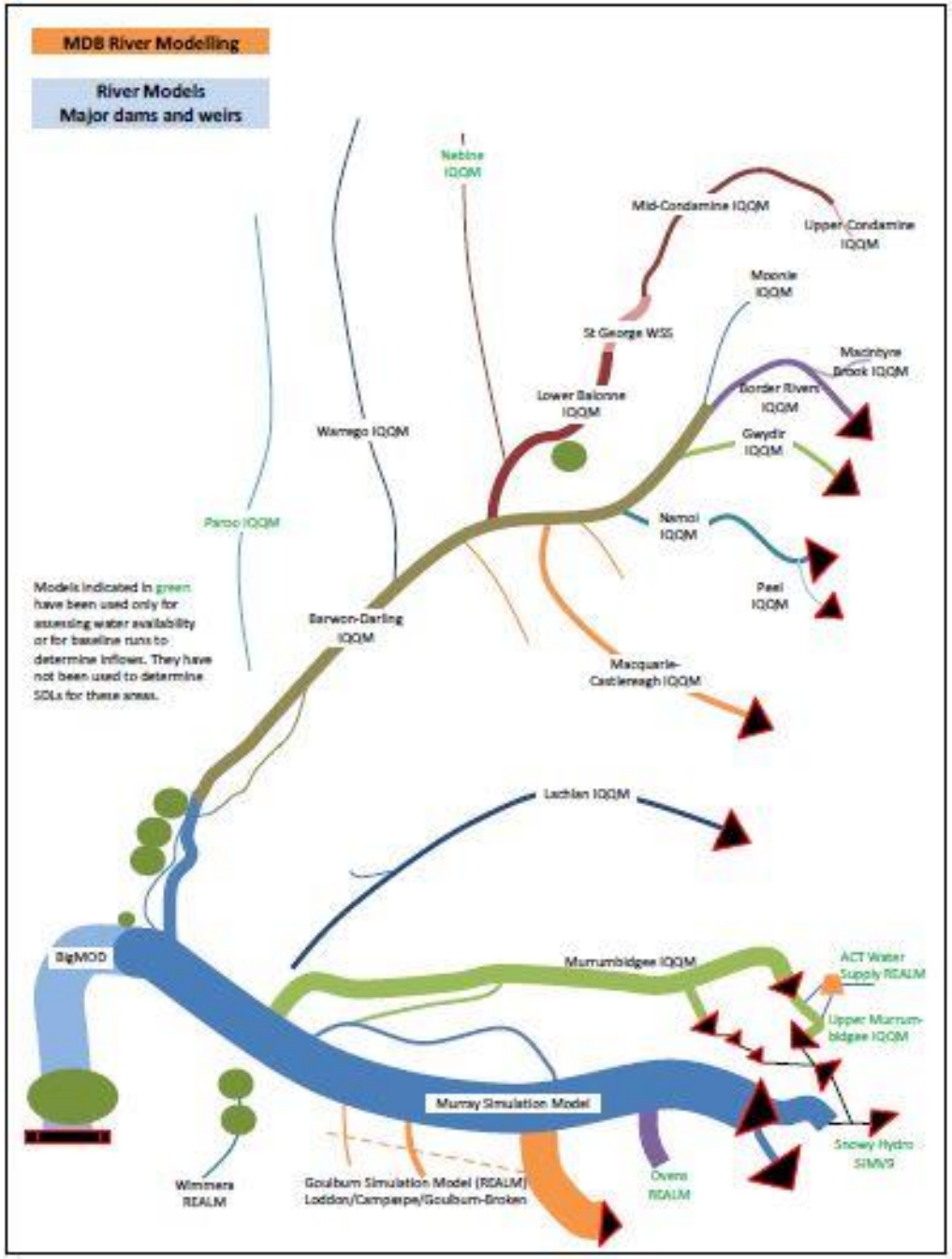

MDB River Modelling
River Models
Major dams and weirs
Nebine IQQM
Mid-Condamine IQQM
Upper Condamine IQQM
Moonie IQQM
St George WSS
Macintyre Brook IQQM
Lower Balonne IQQM
Border Rivers IQQM
Warrego IQQM
Gwydir IQQM
Namoi IQQM
Paroo IQQM
Peel IQQM
Models indicated in green have been used only for assessing water availability or for baseline runs to determine inflows. They have not been used to determine SDLs for these areas.
Barwon-Darling IQQM
Macquarie-Castlereagh IQQM
Lachlan IQQM
BigMOD
Murrumbidgee IQQM
ACT Water Supply REALM
Upper Murrum-bidgee IQQM
Murray Simulation Model
Snowy Hydro SIMVS
Wimmera REALM
Goulburn Simulation Model (REALM) Loddon/Campaspe/Goulburn-Broken
Ovens REALM

# History of Modelling

- The first computer models of rivers in the Basin were developed in the 1960's
- These models were developed to assess the benefits of dam construction
- Over time models have been developed to examine other matters:
  - 'Natural conditions' modelling
  - Salinity
  - Defining Cap conditions
  - Intervalley trade
  - Environmental flows
- This legacy affects the suitability of the models for Basin plan modelling:
  - The Victorian models and the MSM component of the MDBA's Murray system model MSM_Bigmod work on a monthly timestep when many environmental targets are expressed as daily flows,
  - The river systems have been managed separately and the models reflect this with the tributary models largely unaffected by downstream conditions

# Prior interaction between models

- Some interaction between systems has been handled by iteration namely:
  - Water availability in Barwon-Darling affected by Menindee Lakes storage which is modelled in MDBA Murray model,
  - Supplementary access in the Murrumbidgee affected by Lake Victoria storage which is modelled in MDBA Murray model
- These interactions have been handled by running the upstream and downstream models and generating a record of the downstream storage which could be read by the upstream model. The modelling was then repeated.
- The establishment of end-of-valley accounts between systems has been handled by extracting allocated water from the upstream model and transferring to the downstream model details of the allocations and the spill from upstream storages.
- The downstream model then calculated the volume of water in the end-of-valley account and called on it as required. Any water not called by the time that the upstream storages filled is spilled to the downstream system.
- The models therefore had limited capacity to make coordinated releases from multiple tributaries.

# Modelling framework

- As part of its Sustainable Yields study the CSIRO established a framework for running all 24 models in sequence. This system was able to handle the iteration between models where this was required.
- This framework required all States and Snowy Hydro to give the CSIRO the right to use their models. This was quite an achievement.
- For the Basin Plan modelling the MDBA adapted this system to process the model output with a standard system to produce standard statistics.
- The MDBA also ensured that model parameter files, data files, output and statistics were all stored on a database which enabled model runs to be reviewed and/or rerun  if required.
- The Sustainable Yields study had looked at climate change and had developed three new data sets, 2030 dry, 2030 median and 2030 wet. However these were not used for the Basin Plan.
- The Basin Plan model was run with the historical climate for 114 years from 1895 to 2009. The Baseline run was the diversion limits and operating rules in place at June 2009

# Environmentally sustainable level of development

- *A key objective of the Water Act 2007 is that the Basin Plan* must ensure the return to environmentally sustainable levels of take for water resources that are overallocated or overused.
- ***Environmentally sustainable level of take*** is defined as the level at which water can be taken from that water resource which, if exceeded, would compromise:

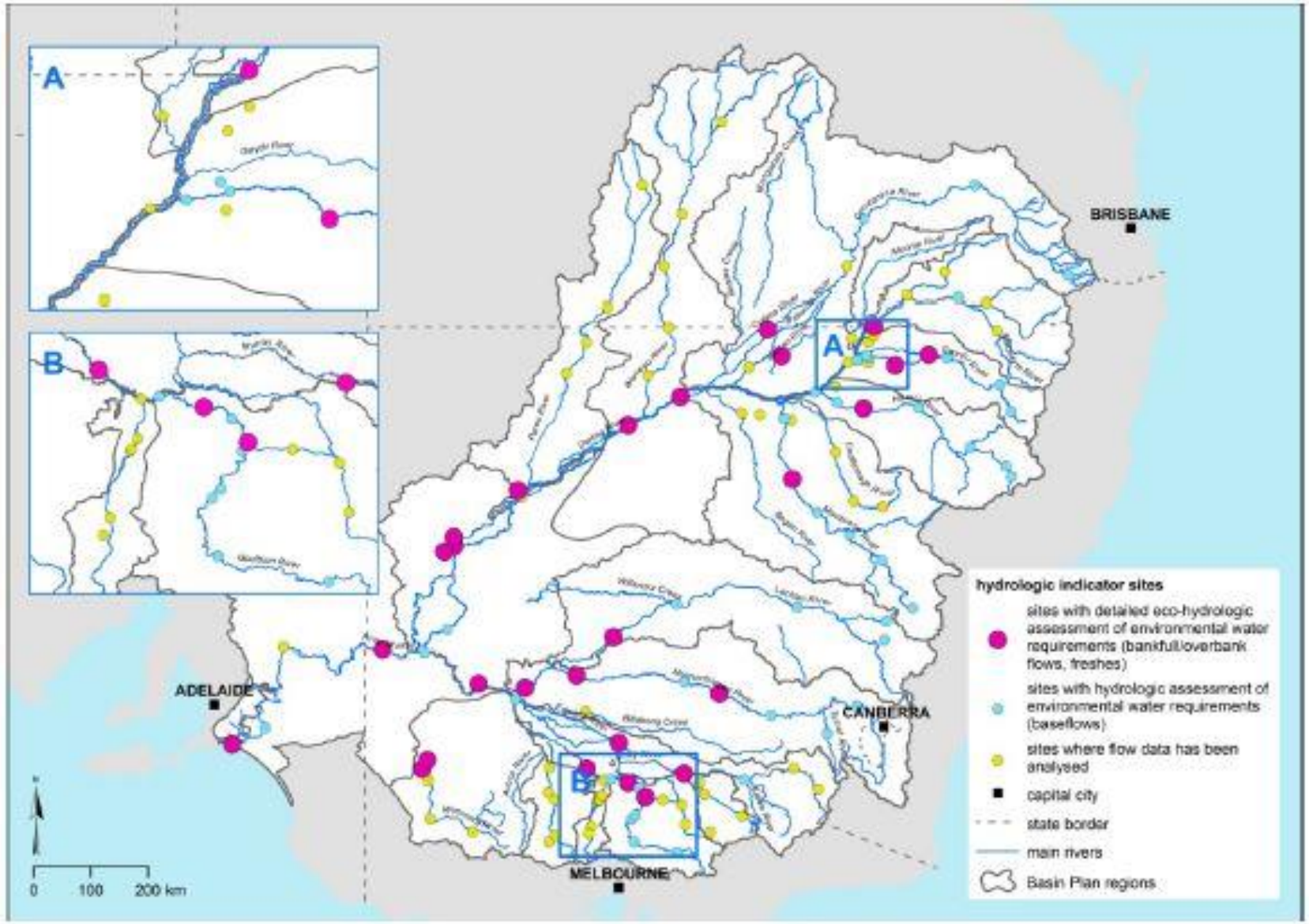
  (a) key environmental assets of the water resource; or

  (b) key ecosystem functions of the water resource; or

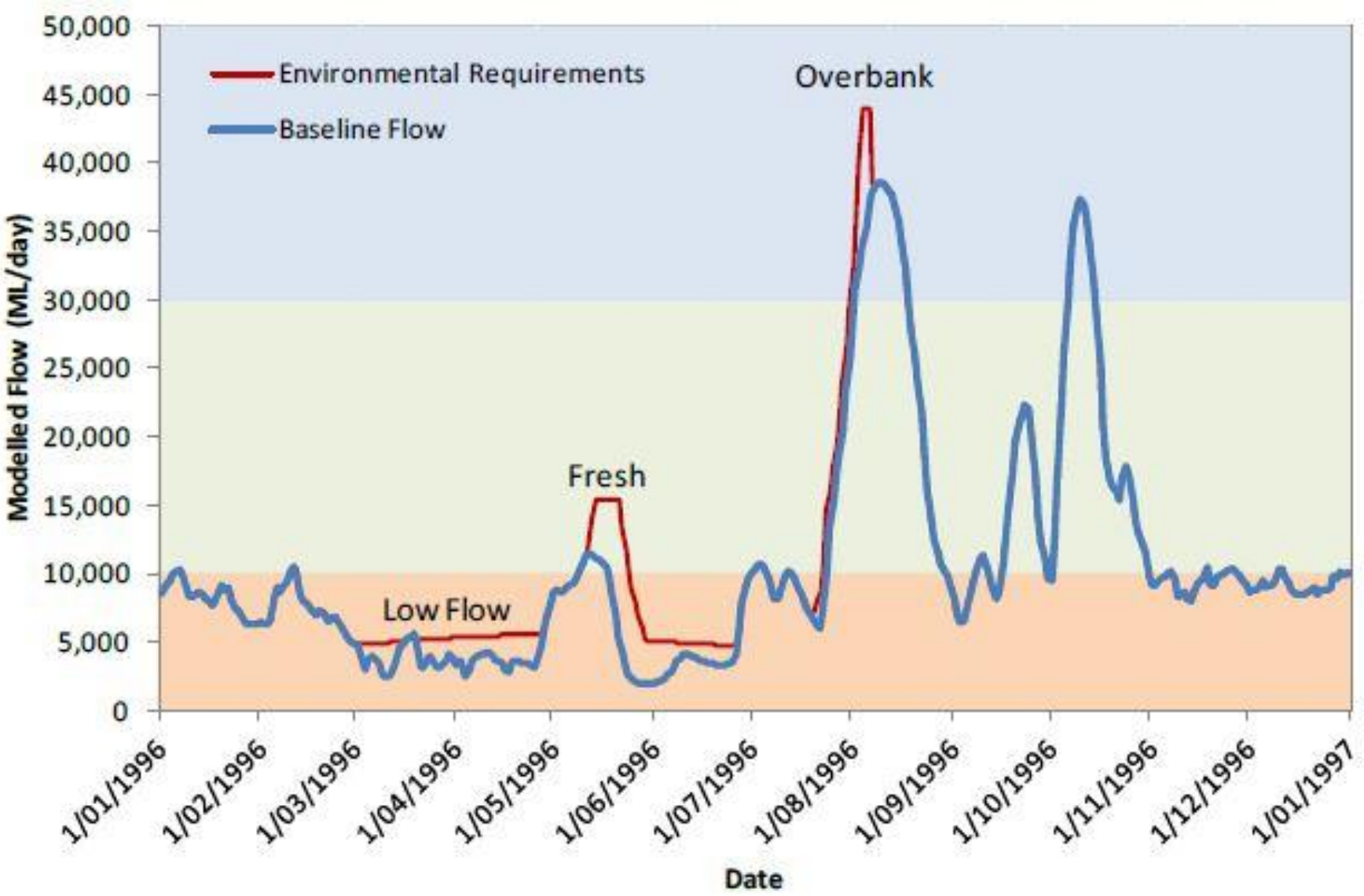
  (c) the productive base of the water resource; or

  (d) key environmental outcomes for the water resource.

# 122 Hydrologic indicator sites



# Environmental requirements



| Region | | Location and Type of Demand Included | | | |
|---|---|---|---|---|---|
| | | Overbank | In-Channel/ Fresh | Baseflow | Downstream |
| Paroo | | Demand series cannot be included in these unregulated regions | | | |
| NORTHERN BASIN | Warrego | | | | |
| | Nebine | | | | |
| | Condamine-Balonne | | | | |
| | Moonie | | | | |
| SOUTHERN BASIN | Intersecting Streams | Not modelled as distinct region | | | |
| | Border Rivers | – | Mungindi[1] | | – |
| | Gwydir | – | • Mallowa Creek<br>• Yarraman Bridge[1] | Downstream Copeton Dam | – |
| | | | | Bronte[1]<br>(downstream demand series defined at Bourke) | |
| | Namoi | – | Bugilbone | • downstream Chaffey<br>• downstream Keepit | – |
| | Macquarie-Castlereagh | Macquarie Marshes | – | downstream Burrendong | – |
| | | | | Model node near Macquarie End-of-System<br>(downstream demand series defined at Bourke) | |
| | Barwon-Darling | Overbank/fresh events at Bourke<br>(demand series included in upstream models) | | – | – |
| Lachlan | | Overbank/fresh events to meet requirements for Lachlan Swamp, Booligal Wetlands, and Great Cumbung Swamp | | • downstream Wyangala Dam<br>• downstream Carcoar Dam | – |
| | Murrumbidgee | • Mid-Bidgee Wetlands<br>• Low-Bidgee floodplain | Balranald (including freshes, baseflow and downstream demand to Hattah/Chowilla/ Coorong, Lower Lakes and Murray Mouth (CLLMM)) | | |
| | Lower Darling | – | – | Burtundy | – |
| | Ovens | Not included in the IRSMF | | | |
| | Goulburn-Broken | Lower Goulburn Floodplain | Shepparton[1] | • downstream Eildon<br>• Trawool<br>• upstream Goulburn Weir<br>• Loch Gary<br>• McCoys Bridge<br>• Inflows Murray | McCoy's Bridge (downstream demand to Hattah/Chowilla/ CLLMM) |
| | Campaspe | – | – | • Coliban@Lyell Rd<br>• Downstream Eppalock<br>• Rochester<br>• Echuca | – |
| | Loddon | – | – | • downstream Cairn Curran<br>• downstream Tullaroop<br>• U/S Serpentine Weir<br>• D/S Serpentine Weir<br>• Appin South | – |
| | Murray | • Barmah-Millewa<br>• Gunbower-Koondrook-Pericoota<br>• Hattah Lakes<br>• Riverland-Chowilla | Coorong/Lower Lakes/Murray Mouth (flow at SA Border) | Flow at SA Border | – |
| Wimmera | | – | – | – | – |

[1] Demand not included in the SD 2009 scenario

# Flow targets at SA border for Chowilla

| | Target Flow (ML/d) | Minimum Duration (days) | Season | Low Uncertainty Target (% of years) | High Uncertainty Target (% of years) | Without Development (% of years) | 2009 Baseline (% of Years) | 2800 GL Water Recovery (% of years) |
|---|---|---|---|---|---|---|---|---|
| Fresh | 20,000 | 60 | Aug-Dec | 80 | 72 | 89 | 43 | 71 |
| | 40,000 | 30 | Jun-Dec | 70 | 50 | 80 | 37 | 59 |
| | 40,000 | 90 | Jun-Dec | 50 | 33 | 58 | 22 | 39 |
| Overbank | 60,000 | 60 | Jun-Dec | 33 | 25 | 41 | 12 | 26 |
| | 80,000 | 30 | Jun-May | 25 | 17 | 34 | 10 | 13 |
| | 100,000 | 21 | Jun-May | 17 | 13 | 19 | 6 | 8 |
| | 125,000 | 7 | Jun-May | 13 | 10 | 17 | 4 | 5 |

# Modelling supply of environmental water

- Limited time to develop comprehensive modelling of environmental releases.
- A simplified method for scheduling the callout of environmental flows was developed called the Environmental Event Selection Tool.
- Spreadsheet containing:
  - Without Development flows,
  - Baseline flows,
  - Estimates of environmental water available.
- The modeller manually selected the years to boost flows which generated daily environmental targets
- These targets were input to the models which attempted to meet them subject to delivery constraints and the available environmental allocations

# Determining water recovery targets

- Select target reduction.
- Determine how the reduction is shared across the Basin.
- Reduce entitlements for irrigation and add to environmental entitlements
- Scale down demand so that desired water recovery is achieved.
- Use tool to establish daily environmental targets
- Compare outcomes with targets
- Repeat.

# Issues

- Performance against target flows is binary.
- The environmental targets are to an extent arbitrary
- Difficult to assess the improvement in the environment.
- The logic of the environmental event selection tool can not be used by environmental managers.
  - Targets may not be achieved
  - Environmental managers are not bound to any operating rule
- Many channel capacity constraints have been tightened since the plan was developed.

# Final Comments

- All environmental indicators improve when you reduce diversions
- Even a reduction of 2100 GL/year will have significant environmental benefits
- It is possible to supply river operators with estimates of without development flows on a daily basis. Rules based on these estimates are showing promise
- The new daily model SOURCE is being rolled out across the Basin. This will have the capacity for control to pass between upstream and downstream models at each timestep which will enable workable environmental release rules to be tested and developed