eWater Source

Australia's National Hydrological Modelling Platform

Source MODELLING COMMUNITY

eWater Solutions

Guiding Principles for Modelling

Adaptive Complexity.

Matching models, data and outcomes (e.g. as study becomes more complex, use more complex models, evaluate uncertainty)

Flexibility – foster research and address uncertainty

No one right solution – multiple options (e.g. all models are approximations, additional uncertainty)

Openness and Community

Collaborative approach to development and access (e.g. free, open development platform)

Defensible

Good/Best Practice - Tools and Applications (Good Practice Guidelines)

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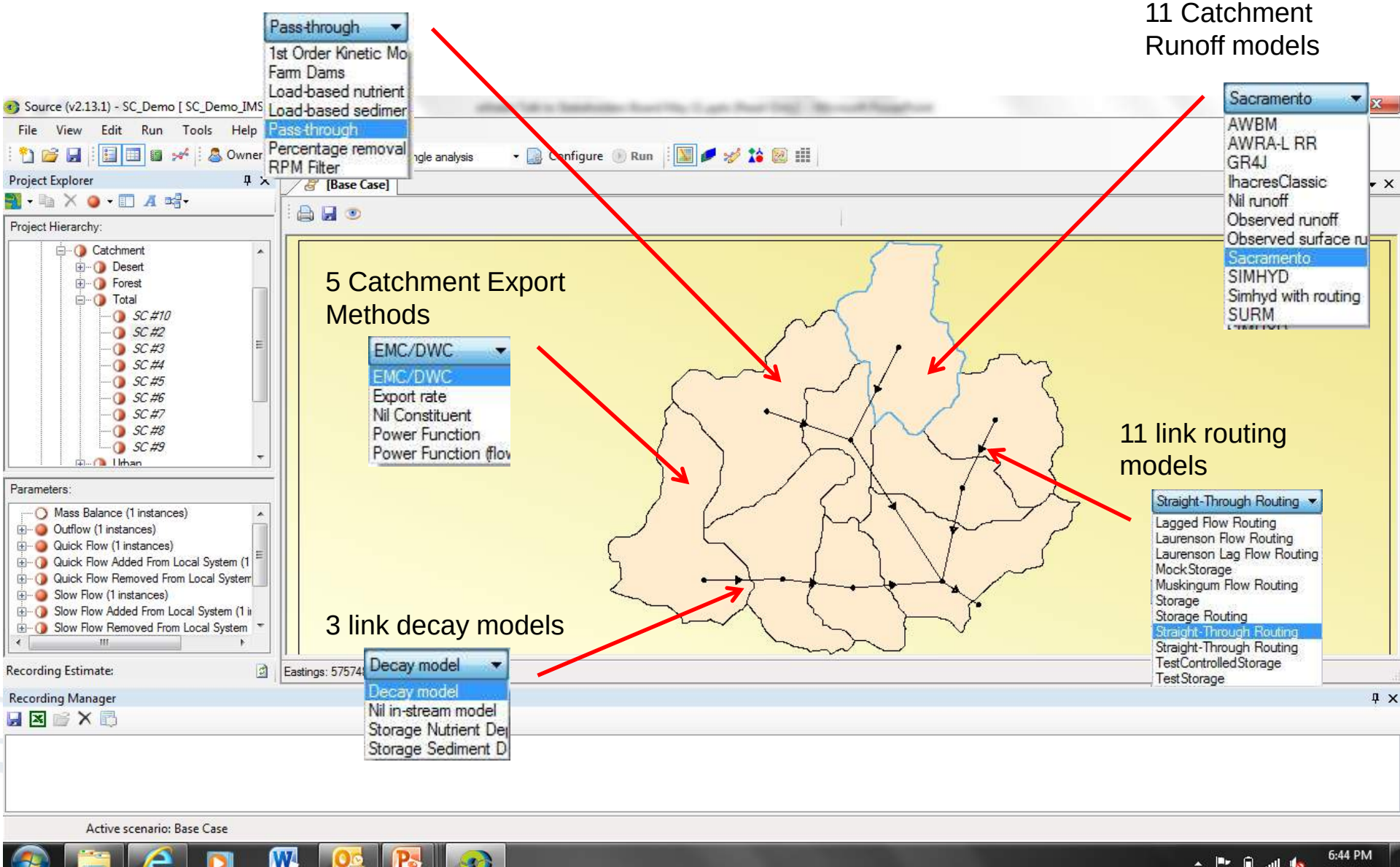
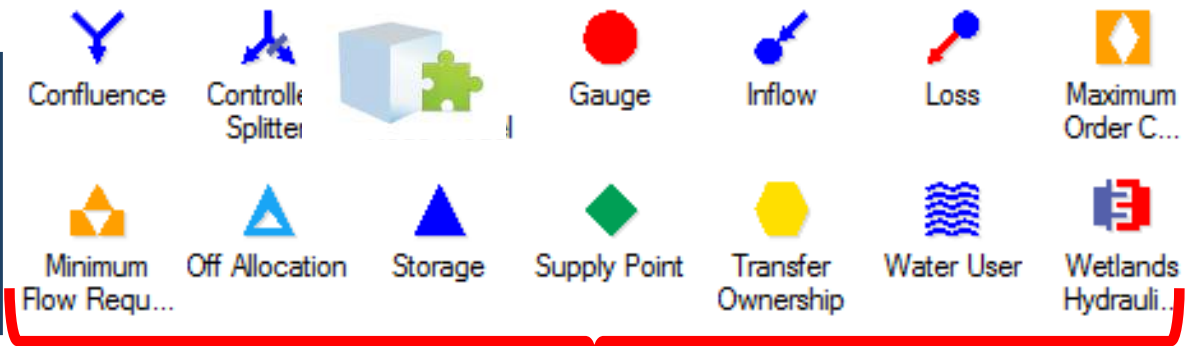
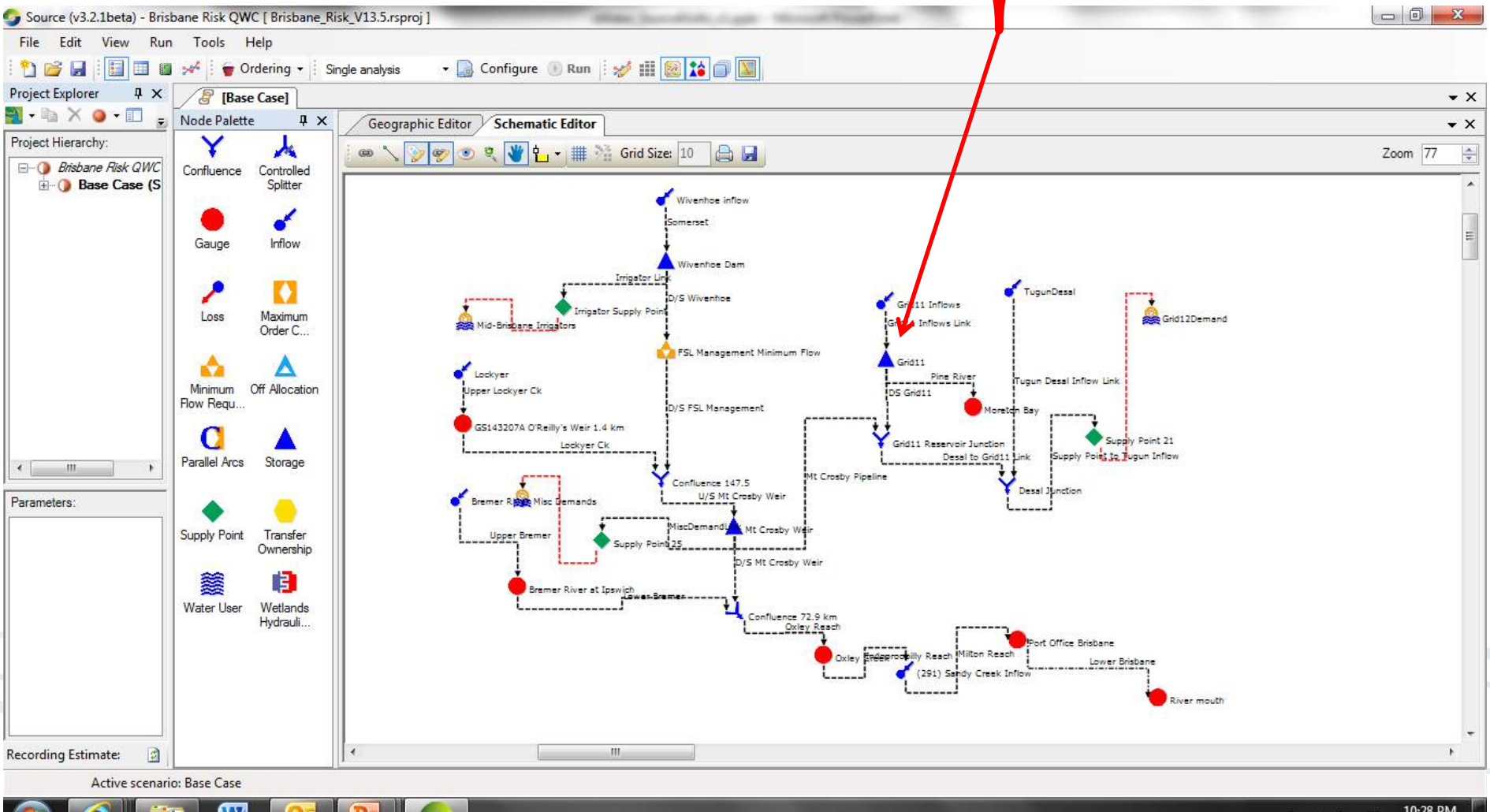
Multi-Function Hydrological Framework



Flexible Structure

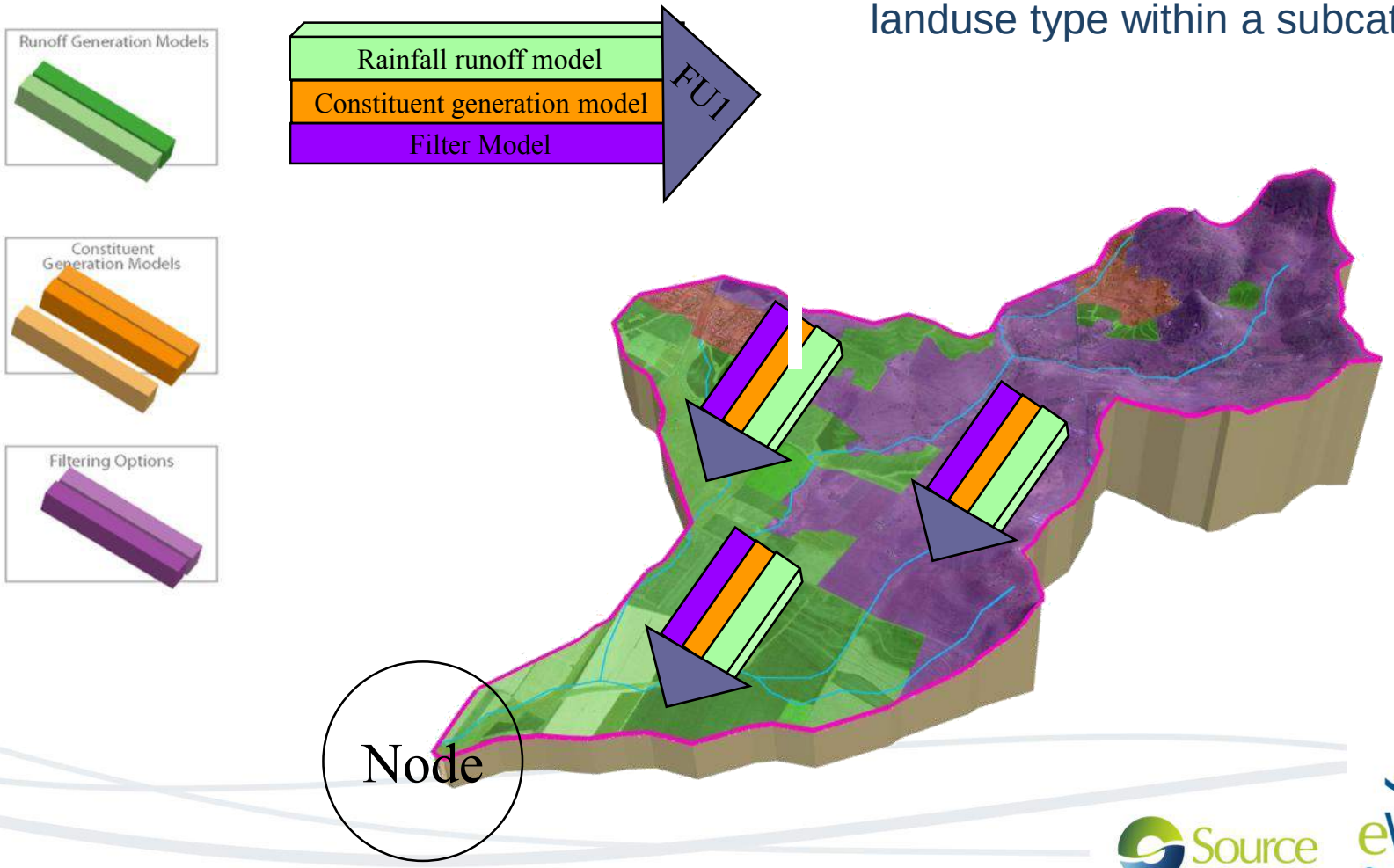
Nodes representing points of interest, physical and management characteristics





Water Quality Catchment Load Generation

- The combination of processes produces an output for a particular landuse type within a subcatchment



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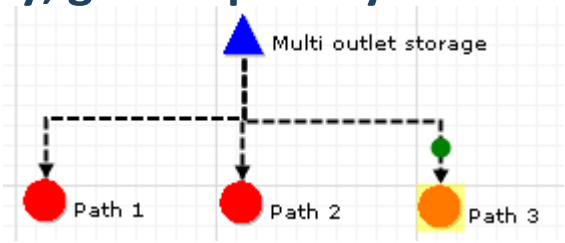
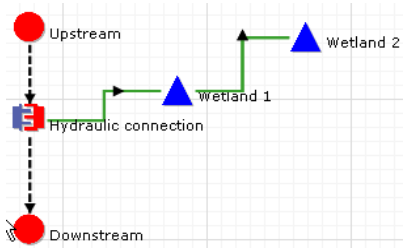
Reservoirs and Dams

- Storage volume/area/level relationship
- Multiple types of outlets (spillway, gated spillway and valve)
- Multiple outlet paths
- Seepage
- Net evaporation
- Hydropower
- Ownership: Shares of volume and outlet capacity, internal spilling and ceding
- Order water from upstream storages to maintain targets





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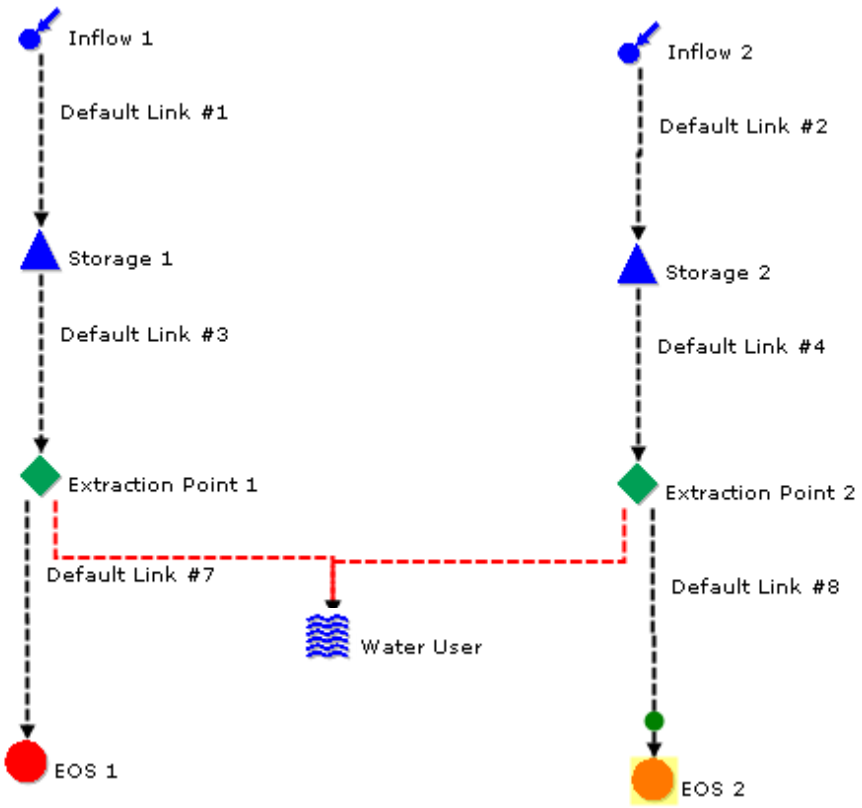
Demand Models

Different demand models

- **Time series**
- **Expression**
- **Irrigation**
- **Urban**
- **Environment**



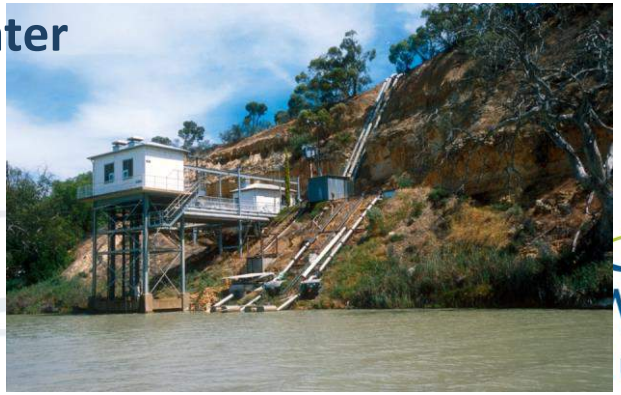
Water user storage (on-farm or urban)

Multiple extraction points including groundwater

Multiple licences with priority setting

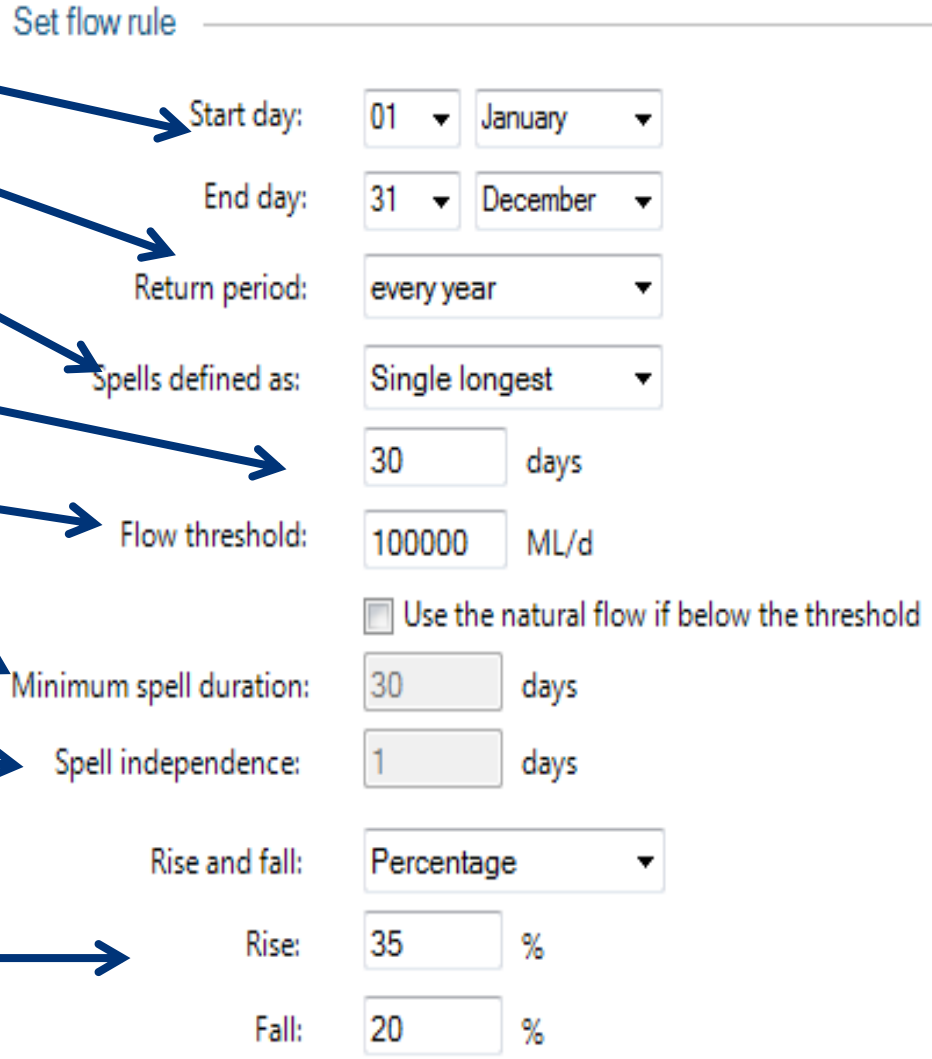
Recharge to groundwater model

Return flow to confluence



Ecosystem Services Flood/Fresh Rule

- What time of year is important?
- How often should it occur?
- Continuous flood, add up short floods or specify a number of floods
- How long should it last?
- Flow threshold? – natural drought?
- If multiple small spells, is there a minimum duration?
- If multiple spells should there be a gap between them?
- Are there maximum rates of rise and fall restrictions?
  Days
  Rate (ML/D)
  Percentage – daily percentage change



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GWSWIT - Reach scale model that estimates the flux between a river and the connected aquifer

Processes:

- Pumping from Unconfined Aquifer
- Pumping from Semi-Confined Aquifer
- Irrigation Recharge
- Floodplain Recharge
- Return Flows
- Quality (fixed conc)

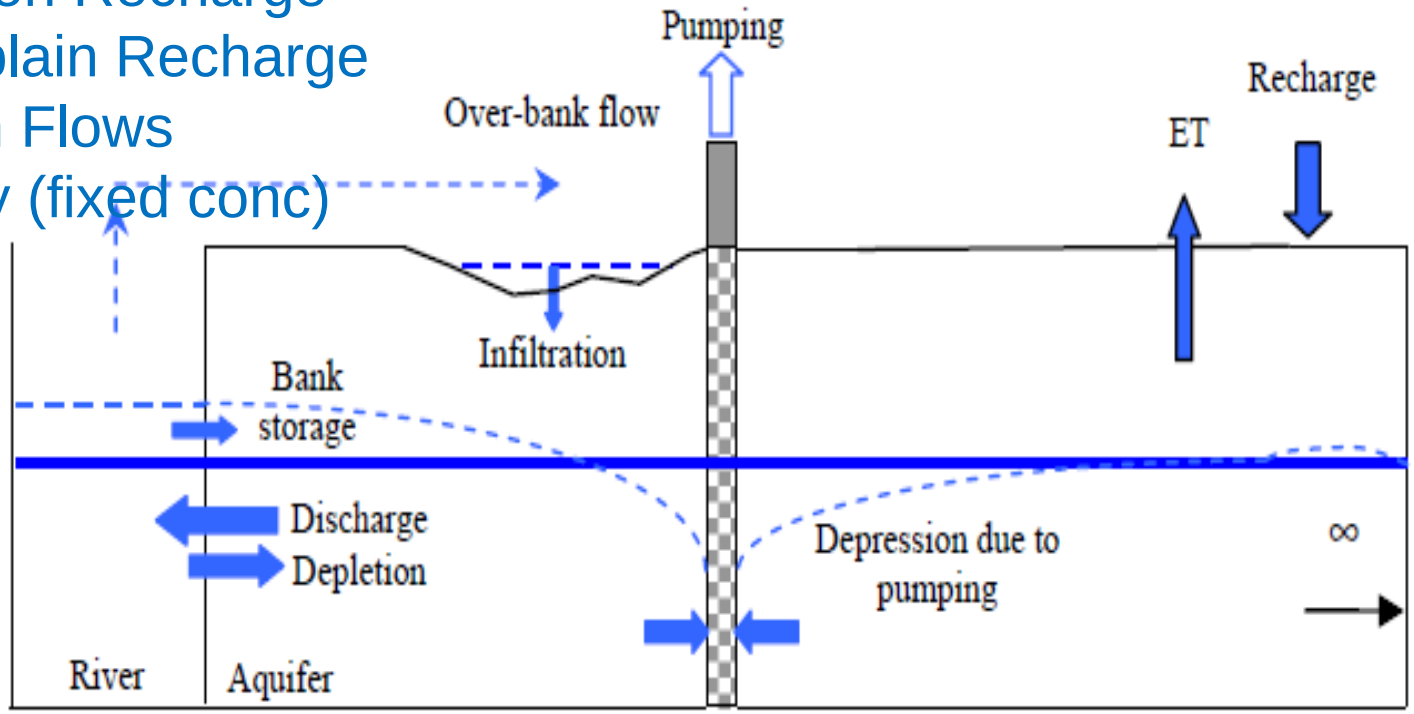
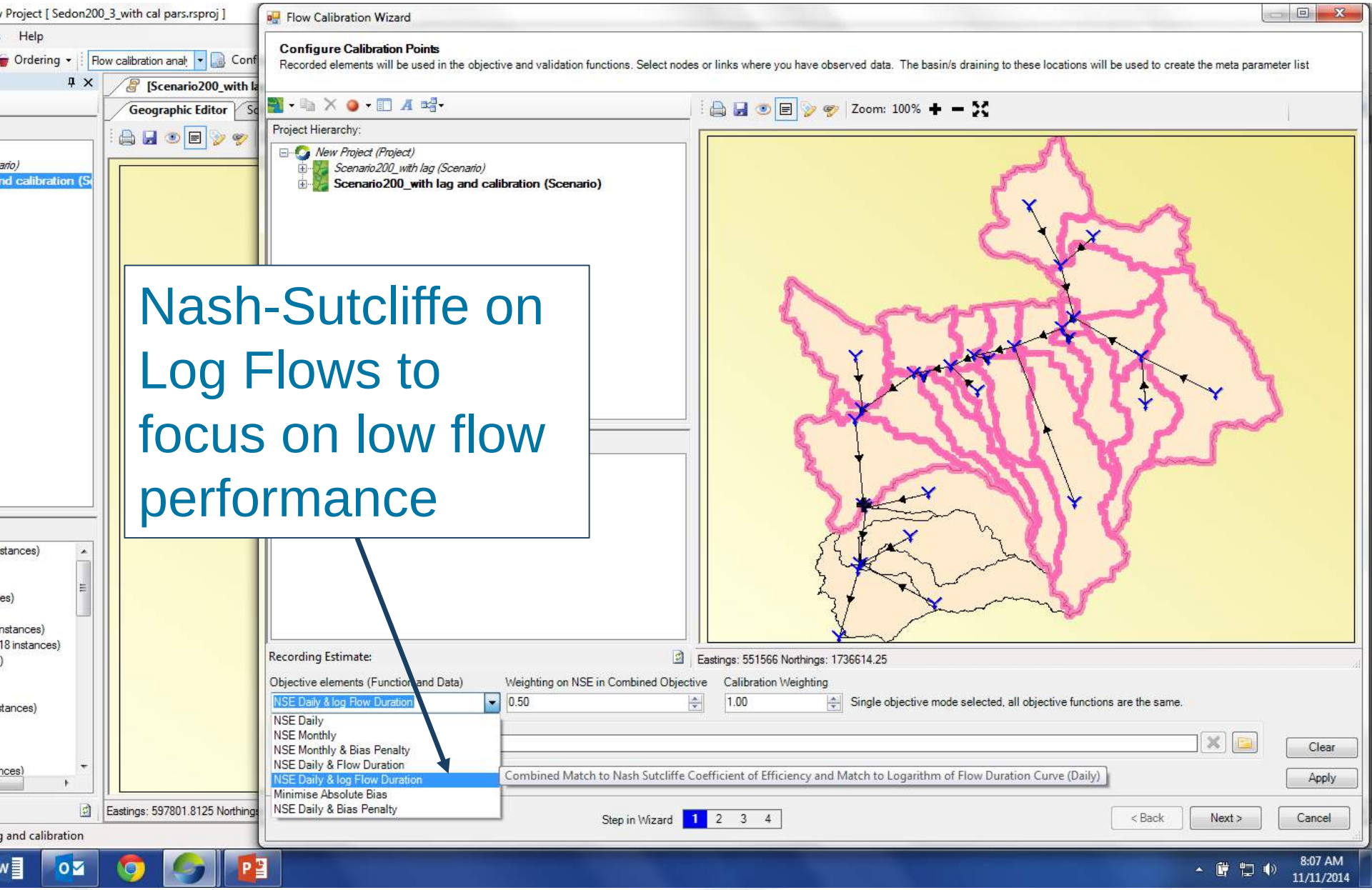
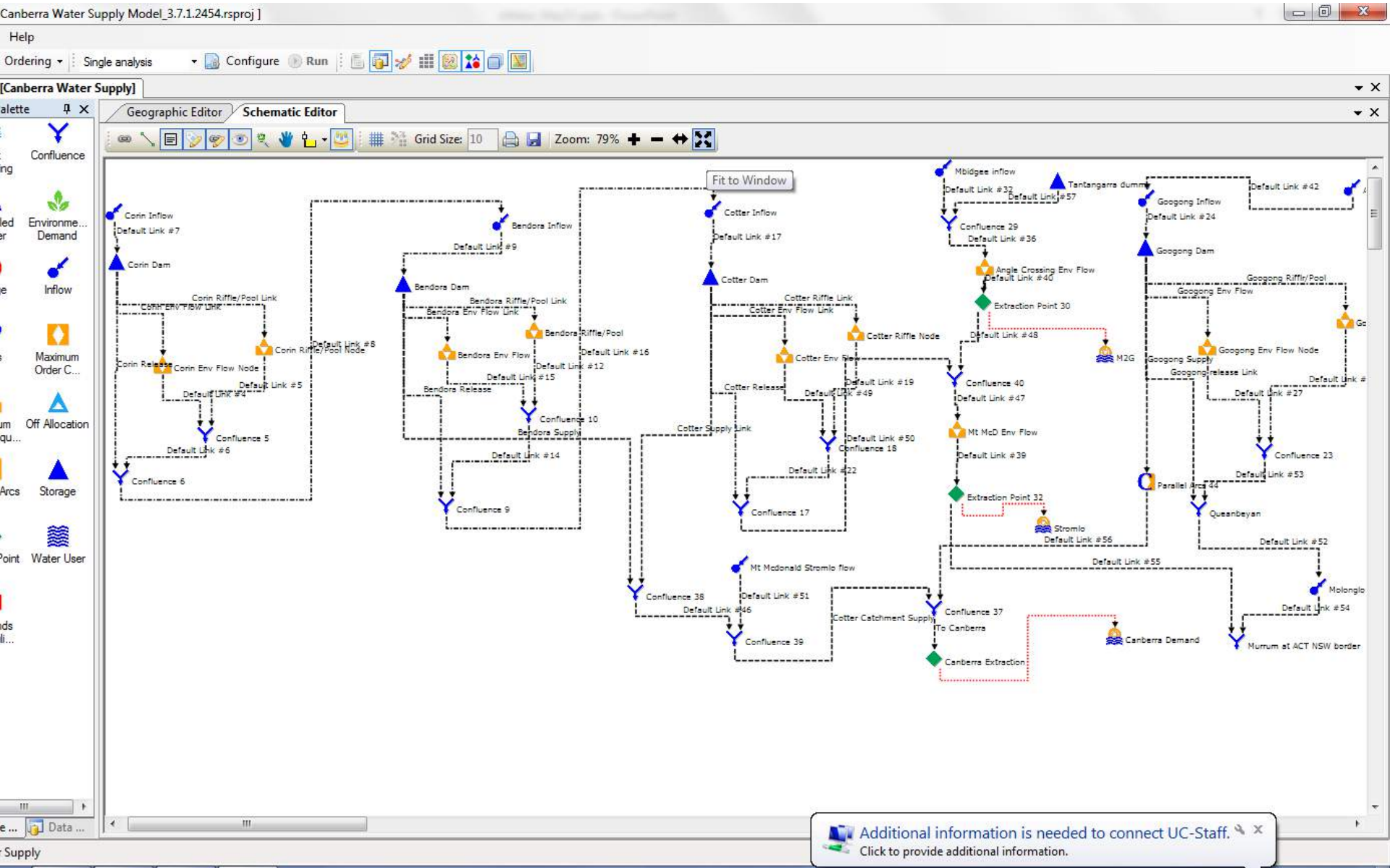


Figure 1. Conceptualisation of the Floodplain Model


Project [Sedon200_3_with cal pars.rsproj]
Help
Ordering
Flow calibration anal
[Scenario200_with la
Geographic Editor
Flow Calibration Wizard
Configure Calibration Points
Recorded elements will be used in the objective and validation functions. Select nodes or links where you have observed data. The basin/s draining to these locations will be used to create the meta parameter list
Project Hierarchy:
New Project (Project)
Scenario200_with lag (Scenario)
Scenario200_with lag and calibration (Scenario)
Zoom: 100%
Nash-Sutcliffe on Log Flows to focus on low flow performance
Recording Estimate:
Eastings: 551566 Northings: 1736614.25
Objective elements (Function and Data)
Weighting on NSE in Combined Objective
Calibration Weighting
NSE Daily & log Flow Duration
0.50
1.00
Single objective mode selected, all objective functions are the same.
NSE Daily
NSE Monthly
NSE Monthly & Bias Penalty
NSE Daily & Flow Duration
NSE Daily & log Flow Duration
Minimise Absolute Bias
NSE Daily & Bias Penalty
Combined Match to Nash Sutcliffe Coefficient of Efficiency and Match to Logarithm of Flow Duration Curve (Daily)
Clear
Apply
Step in Wizard
1
2
3
4
< Back
Next >
Cancel
Eastings: 597801.8125 Northings
8:07 AM
11/11/2014

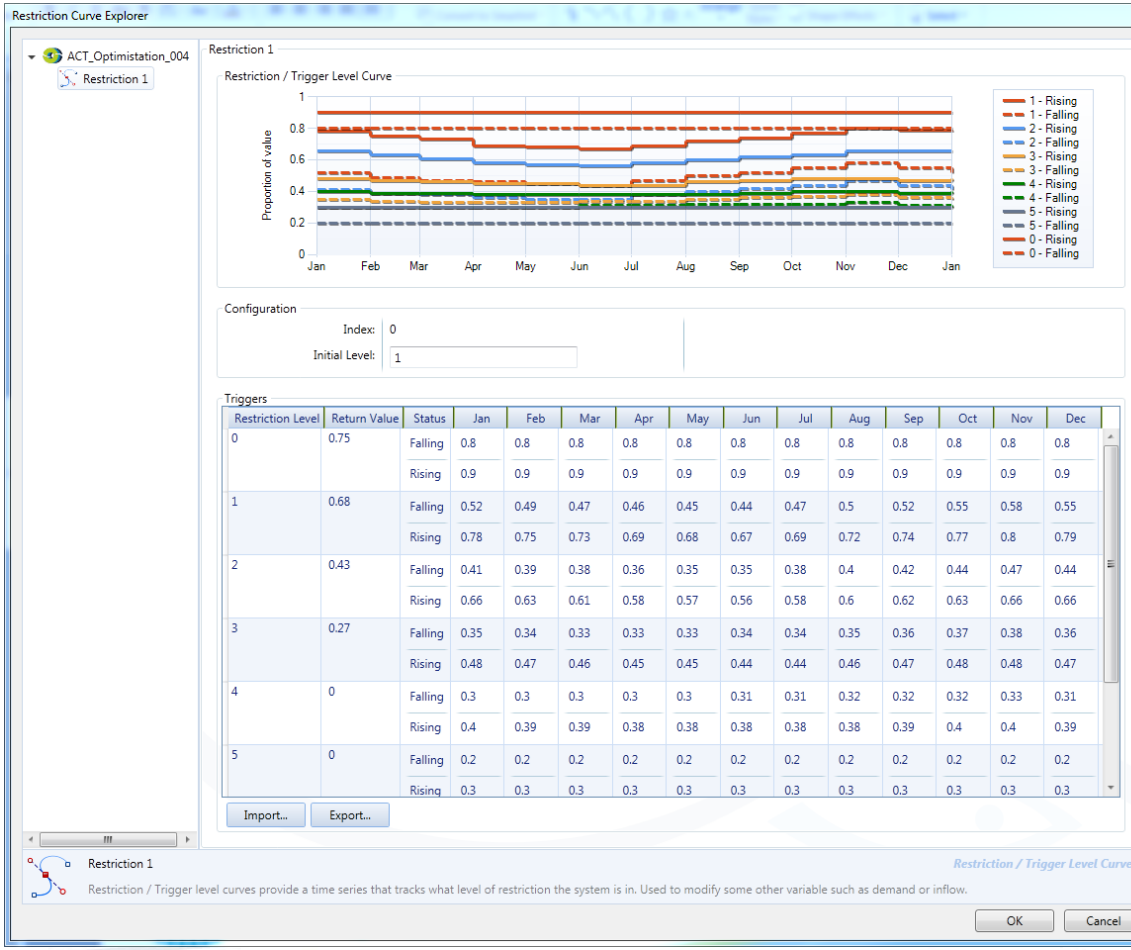
Canberra Water Supply



Demand Restriction Curves

Modification of demand to reflect behaviour based on system state such as Climate-Based Demand Restrictions.

Can be used to define desalinization trigger levels



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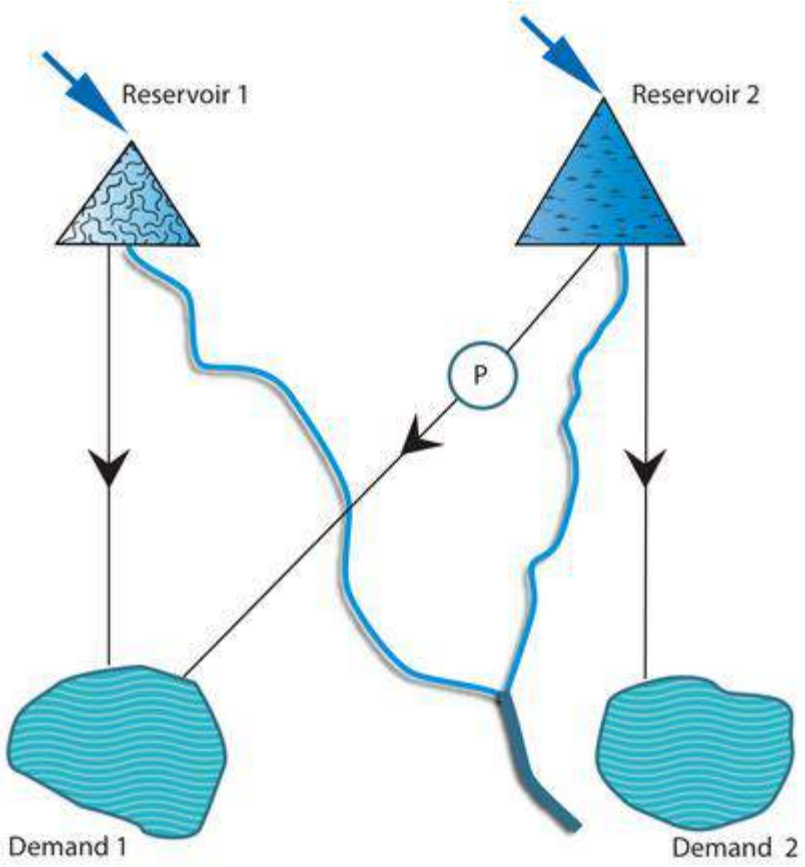
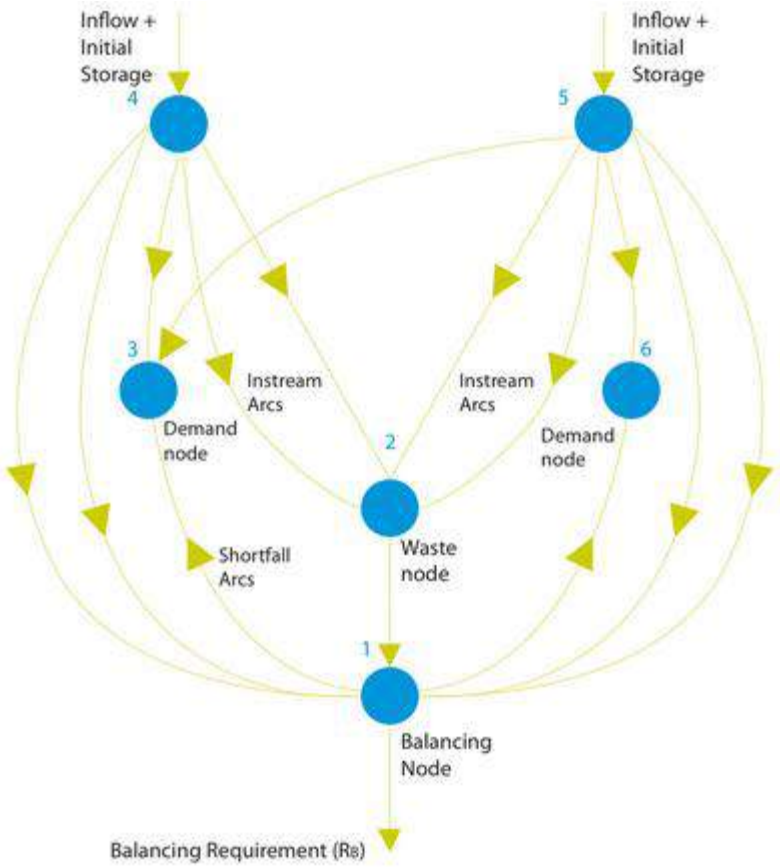
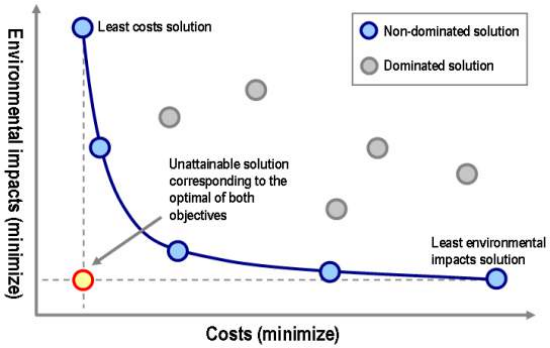
NETLP – Optimisation of Complex Demands and Sources.



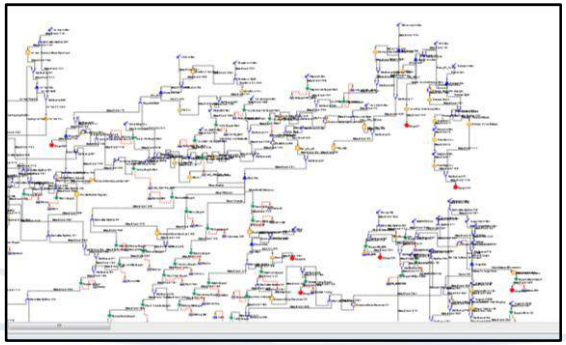


Multiple Operational Configurations – Inputs to Optimisation

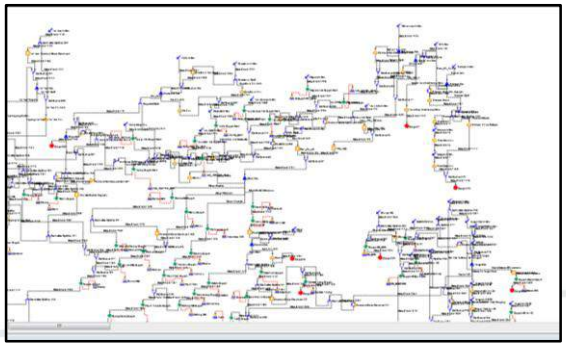
Strategy to provide 95% reliability of supply over forecast period



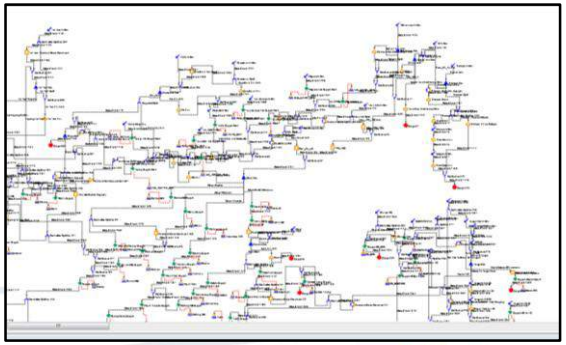
High Demand Wet Weather Operations - 30% Probability



High Demand Normal Operations – 20% Probability



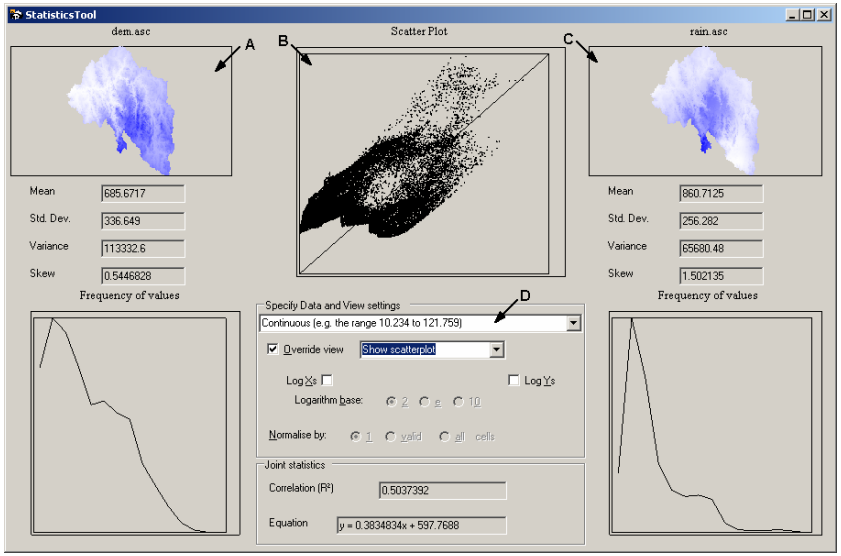
High Demand Maintenance of Tanks – 50% Probability

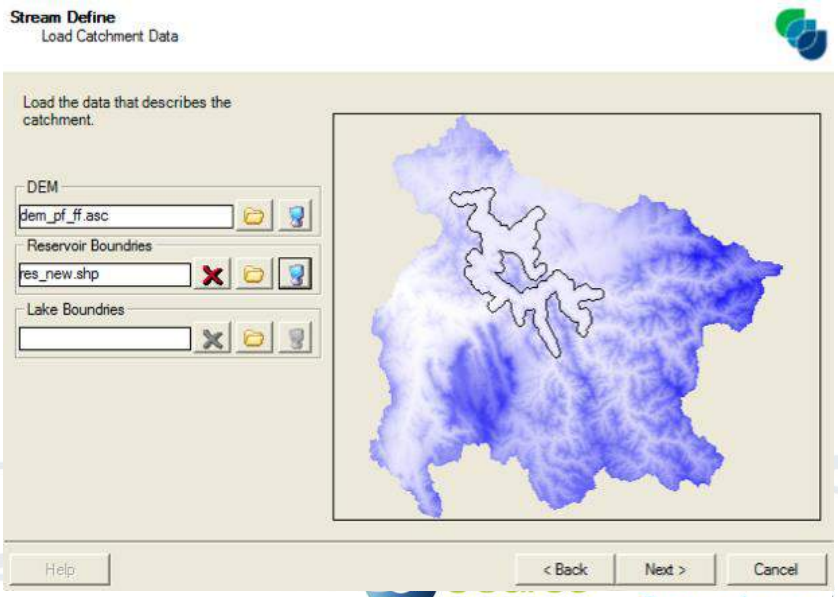


Melbourne Water

Built upon TIME – a general purpose modelling system

- A software framework for developing eco-hydrological models based upon the Microsoft .NET framework.
- Designed to support the creation, testing and end-user delivery of environmental simulation models.
- Supports the management, manipulation and presentation of a variety of data types, as well as support for testing, integrating and calibrating simulation models.
- Underpins a range of spatial and temporal modelling systems including the toolkit models (www.toolkit.net.au)





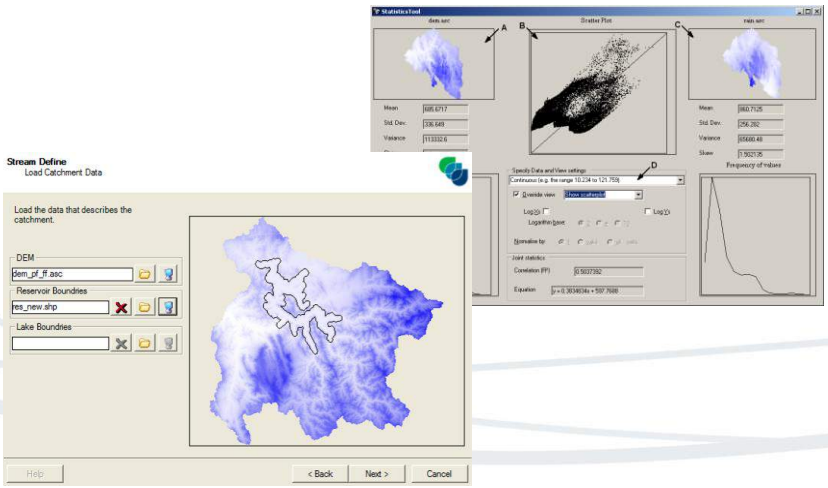
MODELLING COMMUNITY Solutions

Adaptable Architecture - Plugins

Plugins are compiled .NET libraries which extend Source to perform custom behaviour

Plugins allow third-parties to create modules which can be used to perform custom tasks

Can be based on TIME Libraries



Examples of ways plugins can be used to customise Source:

- New Nodes
- Custom User Interfaces
- Constituent Generation Models
- Constituent Filter Models
- Additional parameterisers
- Results Transformations
- Data Importing / Exporting

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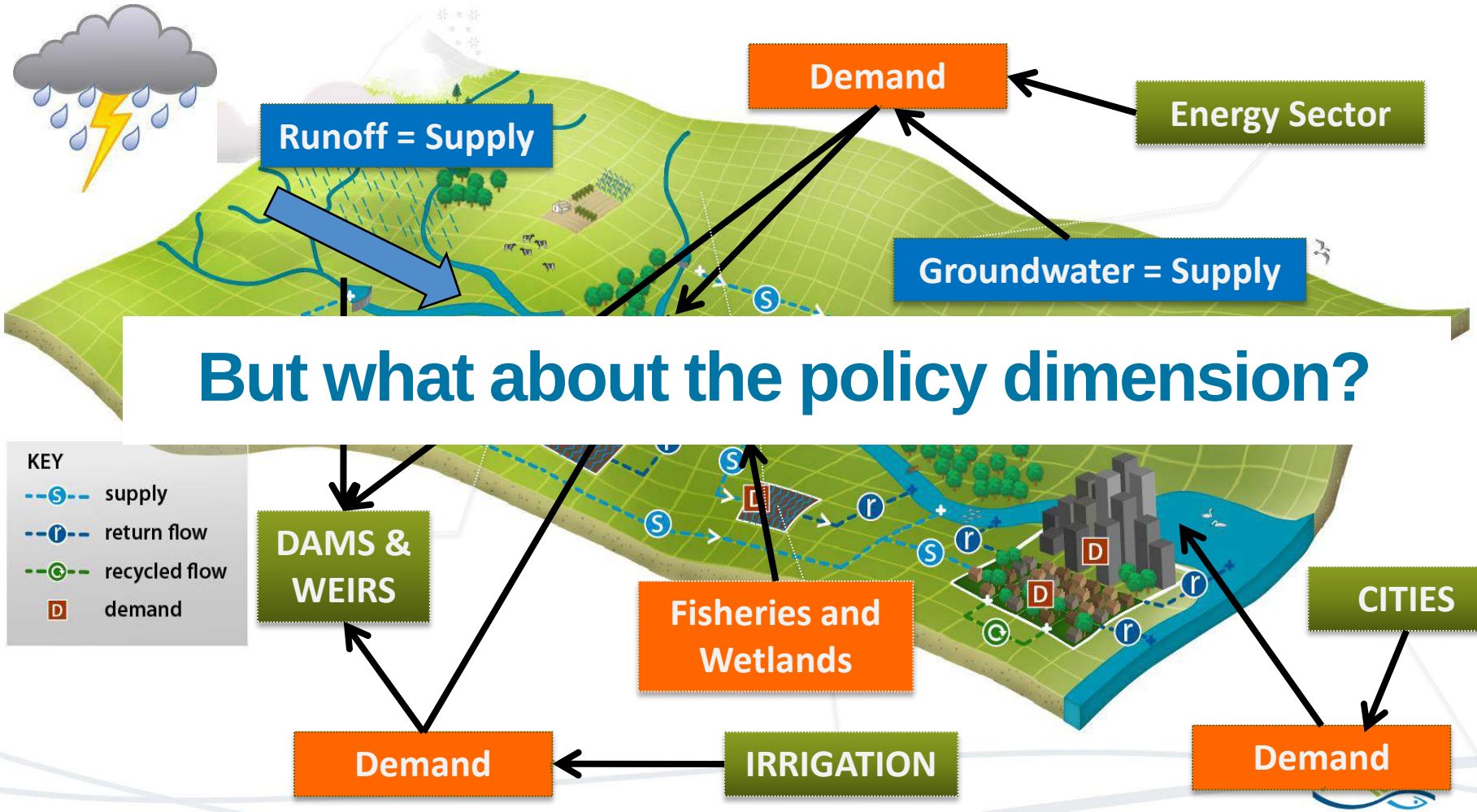
Incorporation of Water Management

The "4th" Dimension

eWater Source – IWRM supply and demand of water quantity and quality - local to basin scale



Source MODELLING COMMUNITY

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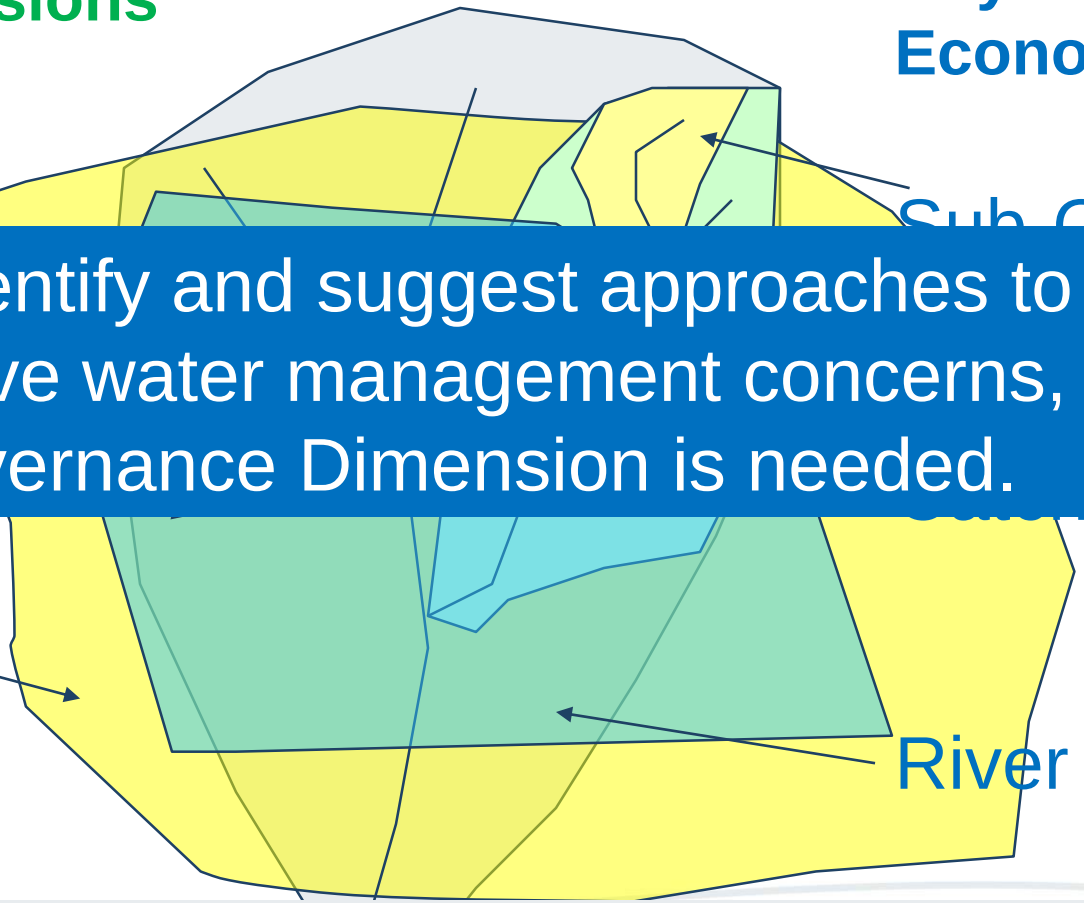
Transboundary IWRM

Political, Legal & Agency Divisions

Physical, Chemical, Economic & Social



Mun

Prov

State

Sub-Catchment

ment

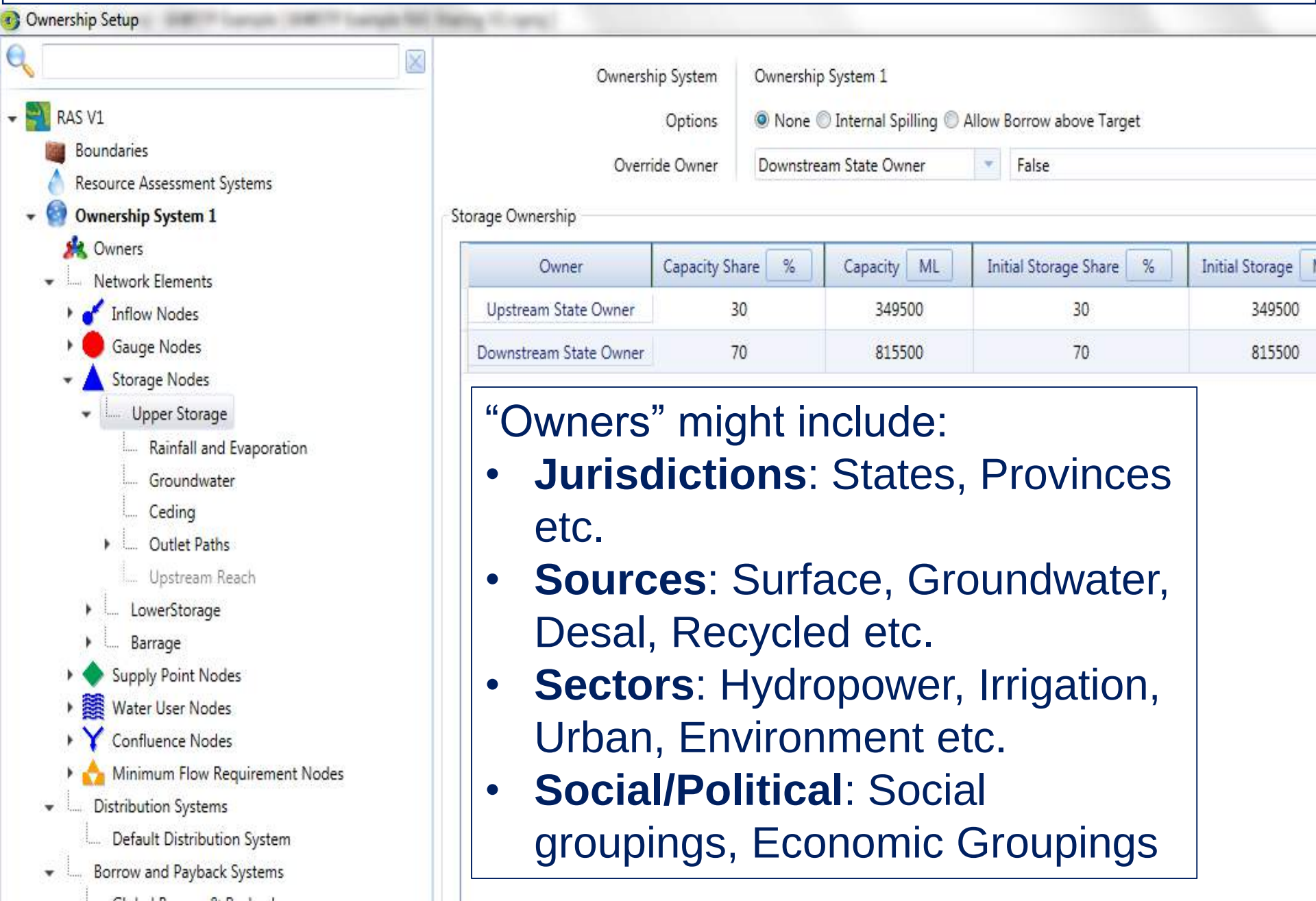
River Basin

To identify and suggest approaches to resolve water management concerns, Governance Dimension is needed.

Sources: Surface, Groundwater, Desal, Recycled etc…

Sectors: Hydropower, Irrigation, Urban, Environmental, etc…

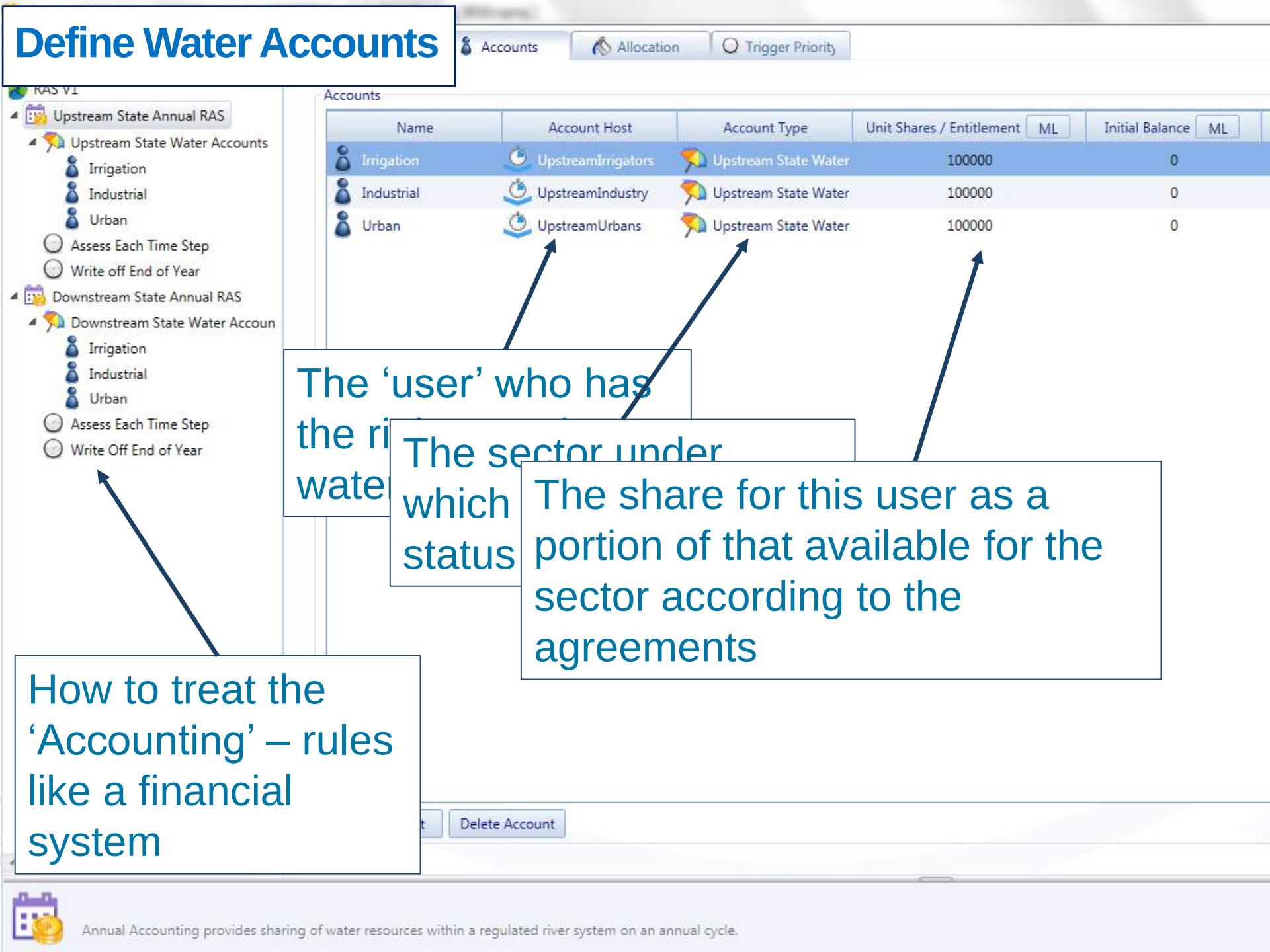
Define Sectors as additional Governance layer



"Owners" might include:

- **Jurisdictions**: States, Provinces etc.
- **Sources**: Surface, Groundwater, Desal, Recycled etc.
- **Sectors**: Hydropower, Irrigation, Urban, Environment etc.
- **Social/Political**: Social groupings, Economic Groupings

Define Water Accounts



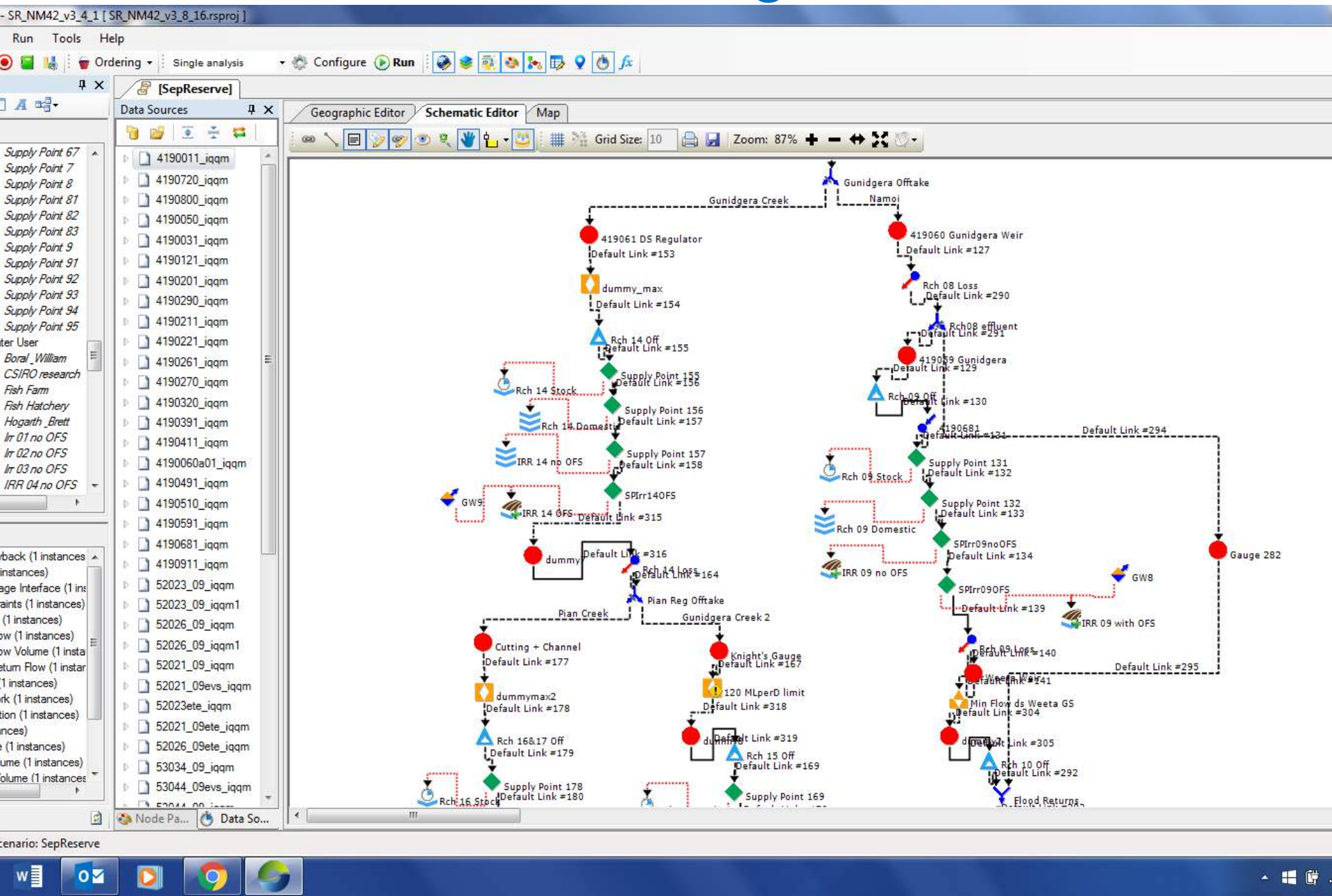
The ‘user’ who has the ri… wate…

The sector under which … status

The share for this user as a portion of that available for the sector according to the agreements

How to treat the ‘Accounting’ – rules like a financial system

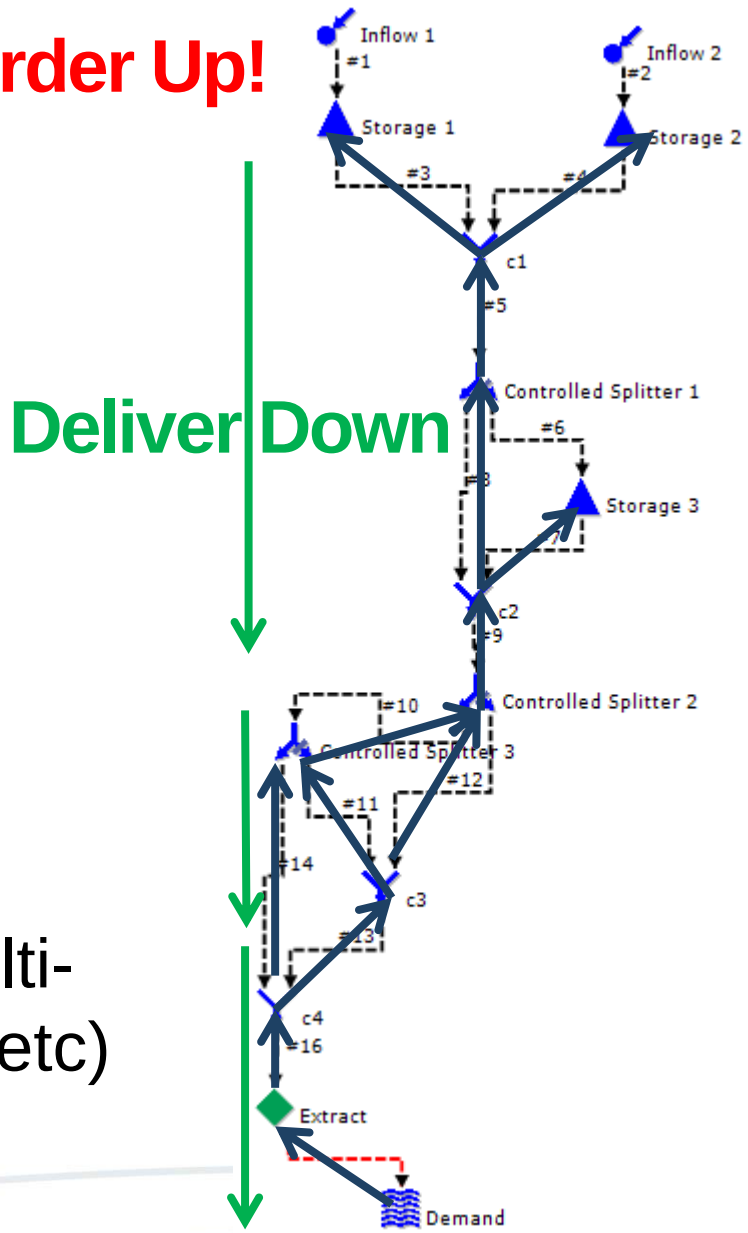
Models focussed on management



Ordering

How much water to release from storage to meet downstream requirements. Taking into consideration:

- Delivery time
- The most efficient path
- Channel Supply constraints
- Reservoir Outlet constraints
- Different sources of supply (multi-reservoir, urban water sources etc)



Source MODELLING COMMUNITY

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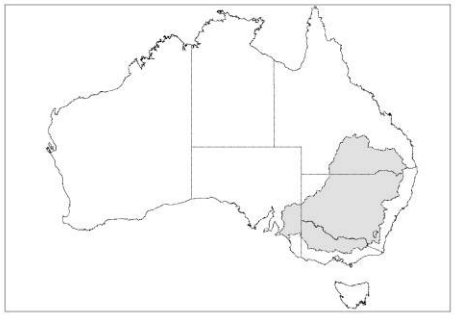
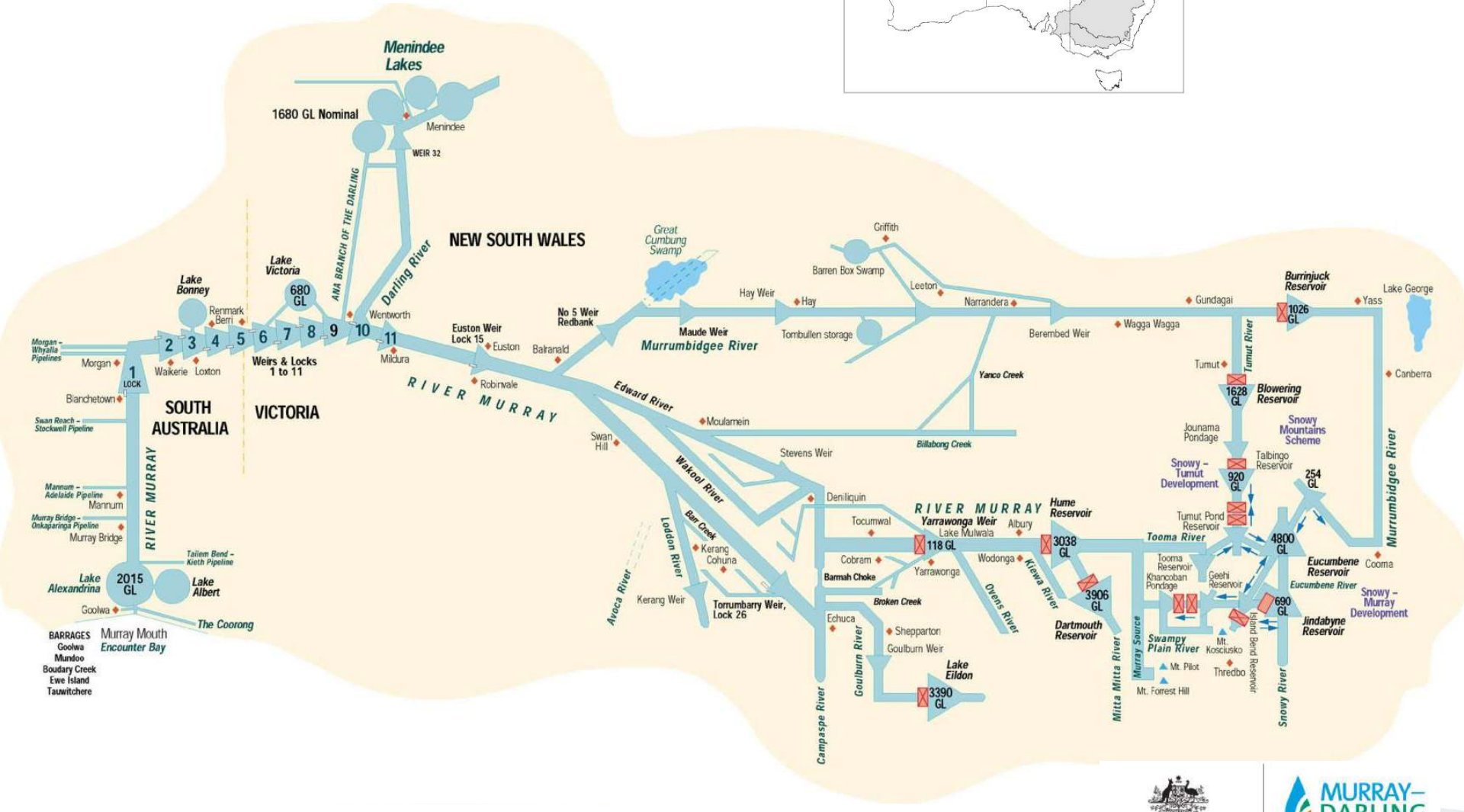
DARWIN
Katherine River
Lake Argyle
Ord River
Flinders River
Gilbert River
Cape York
The Great Barrier Reef
Wet Tropics
Burdekin
Herbert River
Mackay/Whitsundays
Pioneer River
GREAT BARRIER REEF (GBR) CATCHMENTS
Fitzroy
Mary Burnett
SE Queensland
Lake Eyre
Paroo
Macintyre Brook
BRISBANE
Nth Gnangara
Avon River Basin
Gingin
Condamine-Balonne
Nerang
Barwon-Darling
Namoi
Warrego
Moonie
Gwydir
PERTH
45+ Models in SW Western Australia
Lower Darling
MURRAY-DARLING BASIN
Macquarie-Castlereagh
NSW Murray
SYDNEY
ADELAIDE
RIVER MURRAY
CANBERRA
SA Murray
Murrumbidgee
VIC Murray
VIC Murray
Goulburn-Loddon-Campaspe
Goulburn-Broken
MELBOURNE
Pipers Brook
HOBART
Southern-connected Murray–Darling Basin
GBR Catchment Loads Monitoring Program
Other Source applications

Murray-Darling - Southern Interconnected Basin





Australian Government

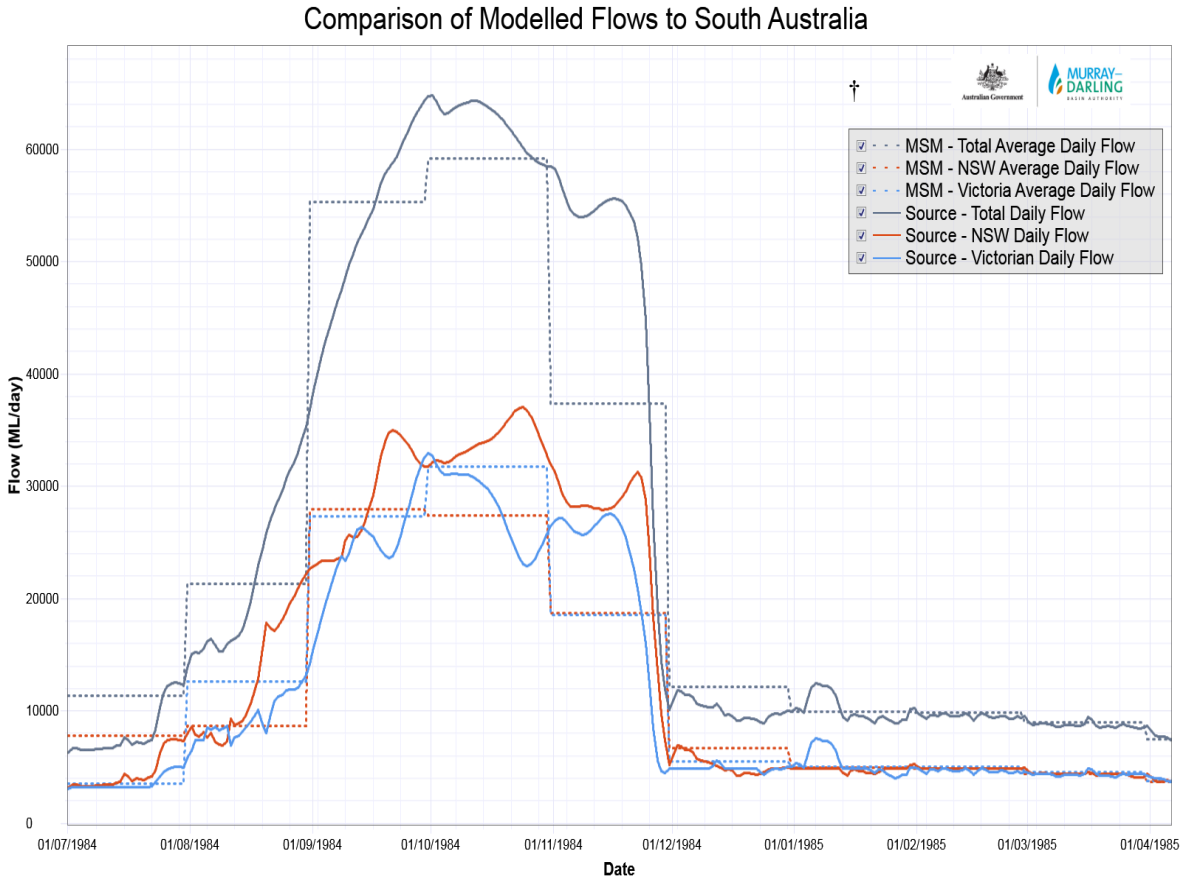
MURRAY–DARLING BASIN AUTHORITY

Modelling Modes

- Long Term Planning (100+ yrs)
- Short Term Planning (1-5 yrs)
- Flow forecasts (6 mths)
- Operational Management (weeks)
- Water Accounting (1989 - now) – representing changes in water management rules and policy over time.

Processes Modelled

- Water Sharing between States
- Water Resource Assessment
- Allocating Water to Users
- Irrigation Demands and Forecasting
- Environmental Rules & Demands
- Ordering water from storages
- Operation & Management Rules
- Flow and Salinity Routing
- Water Accounting



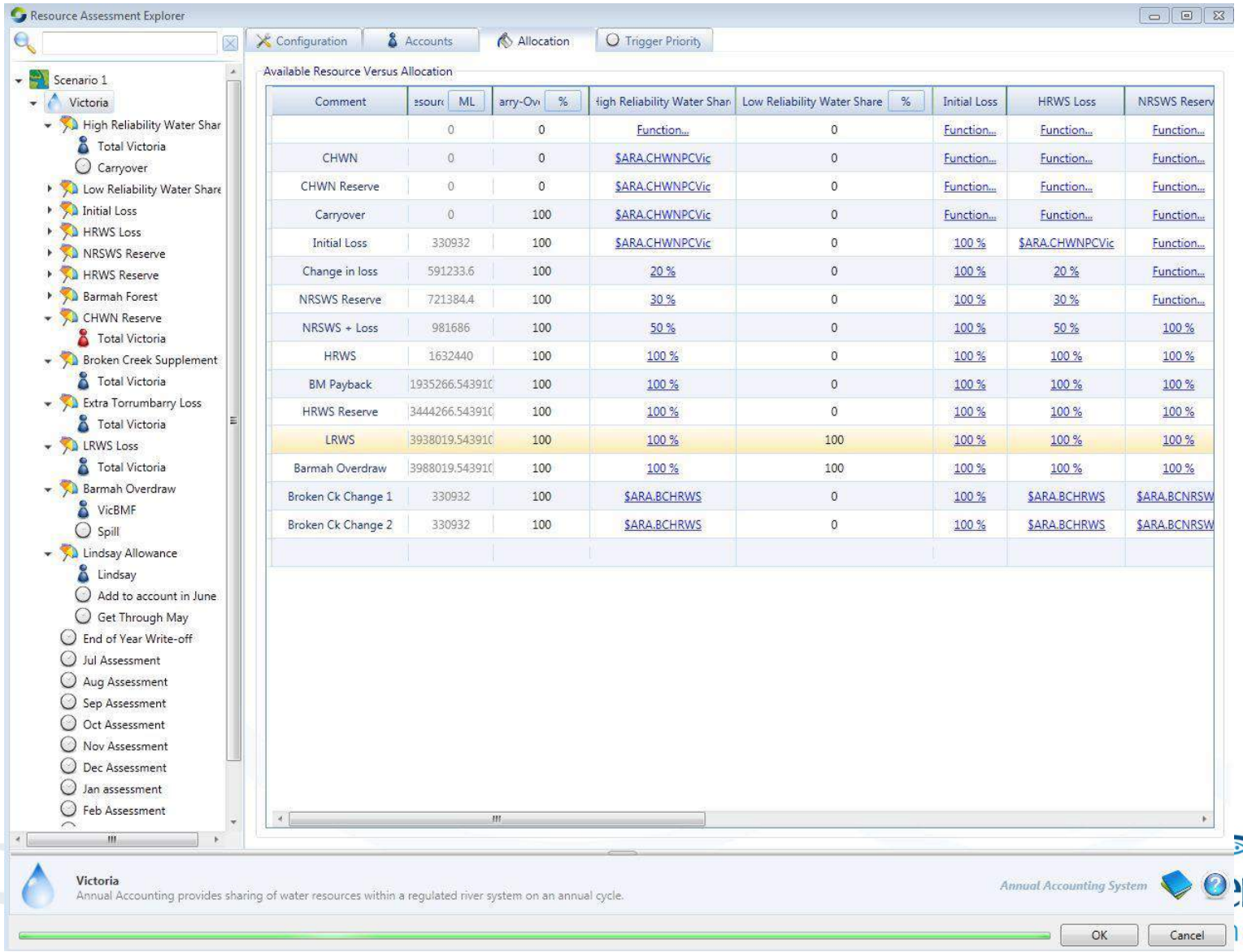
- Represented the Murray and Lower Darling River System in Source, including integration of water policy
- Currently understanding the transition from modelling the system at a monthly to daily timestep
- Adoption of Source model is dependent upon agreement by the Basin States as it represents the legal agreements

† Work in Progress

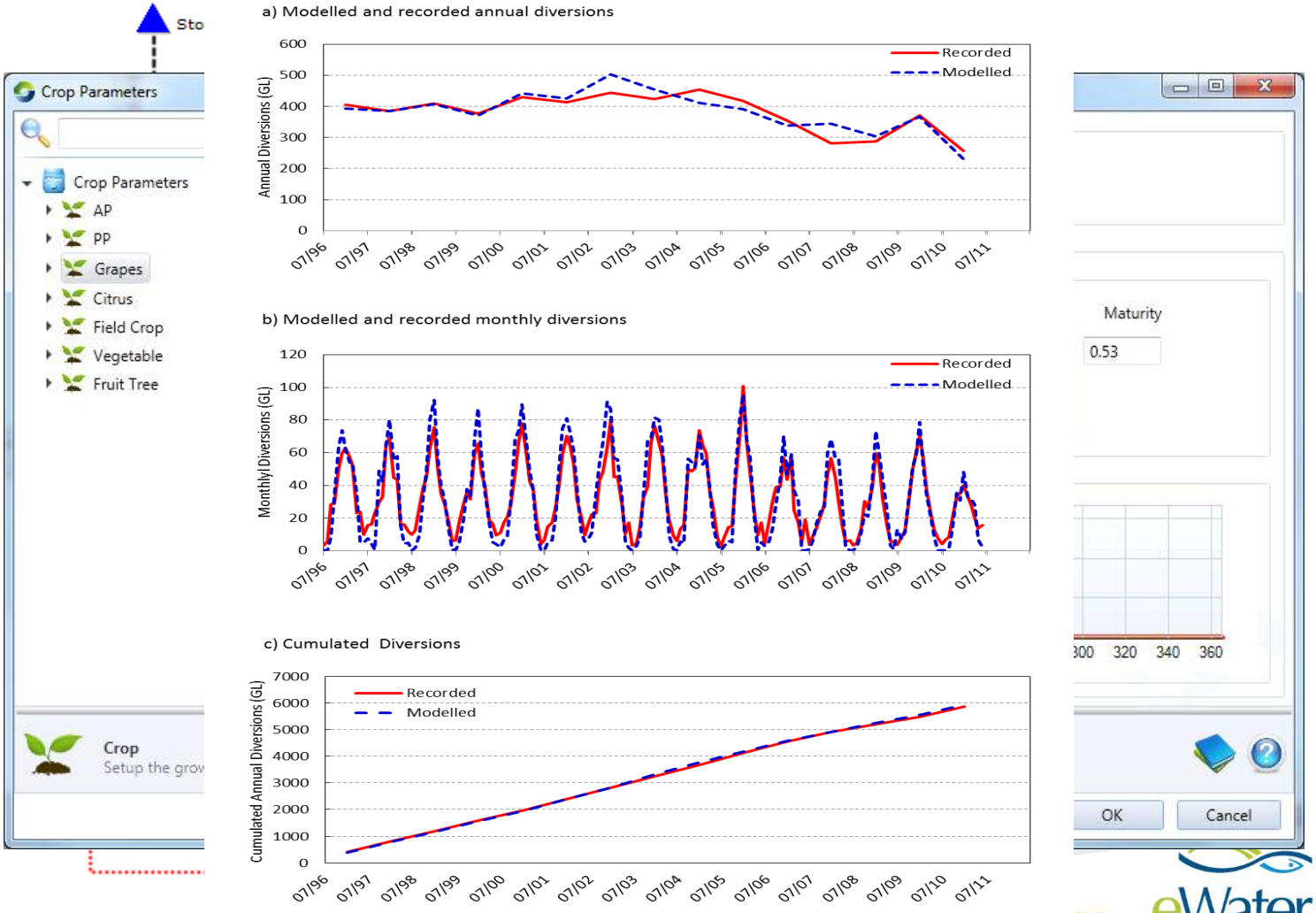
AVERAGE ANNUAL SYSTEM DIVERSIONS*	Source (GL/Year)	MSM (GL/Year)
NSW Murray Diversions	1,736	1,733
NSW Lower Darling Diversions	52	56
VIC Diversions	1,724	1,662
SA Diversions	656	670
Kiewa Diversions	11	11
Ovens Diversion	25	25
Total Diversions	4,206	4,158

* Work in Progress - example of comparison of models

Water Allocation



Irrigation Demands



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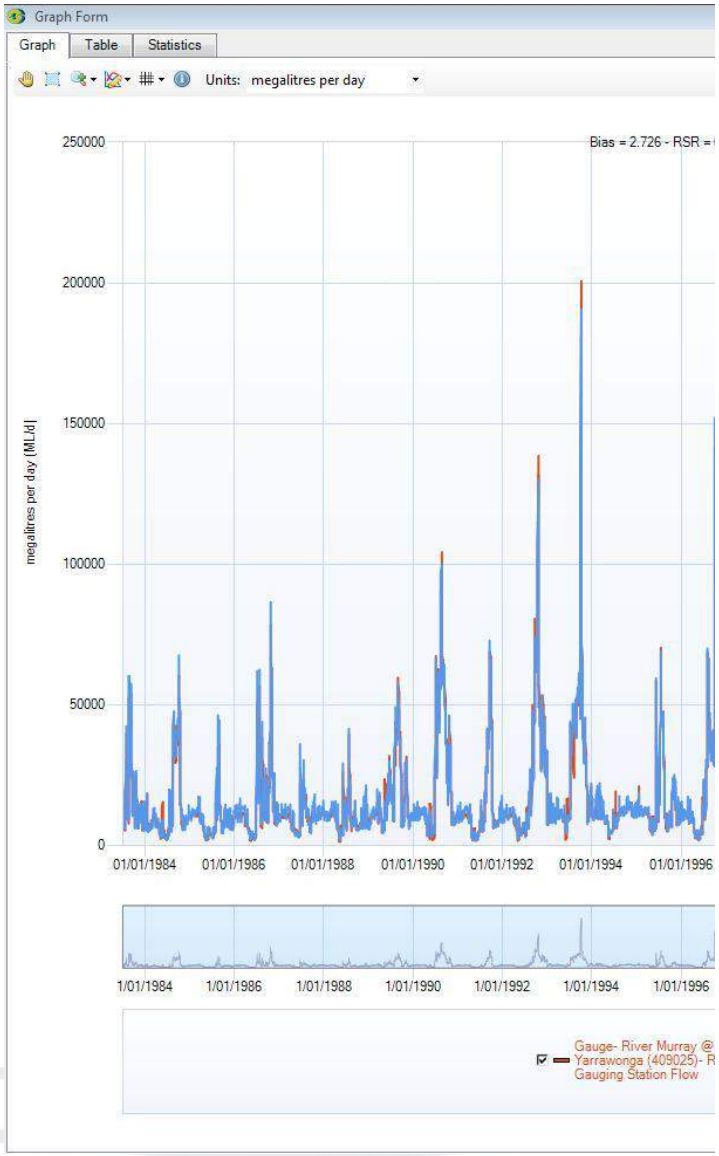
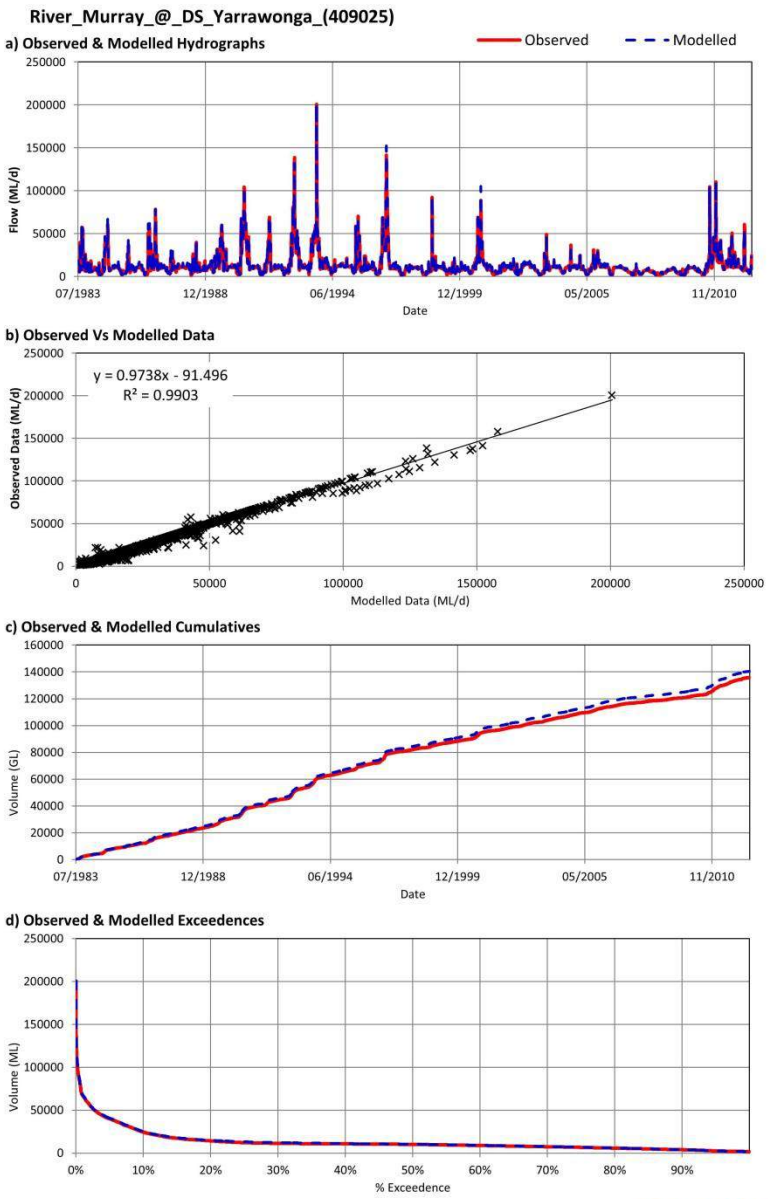
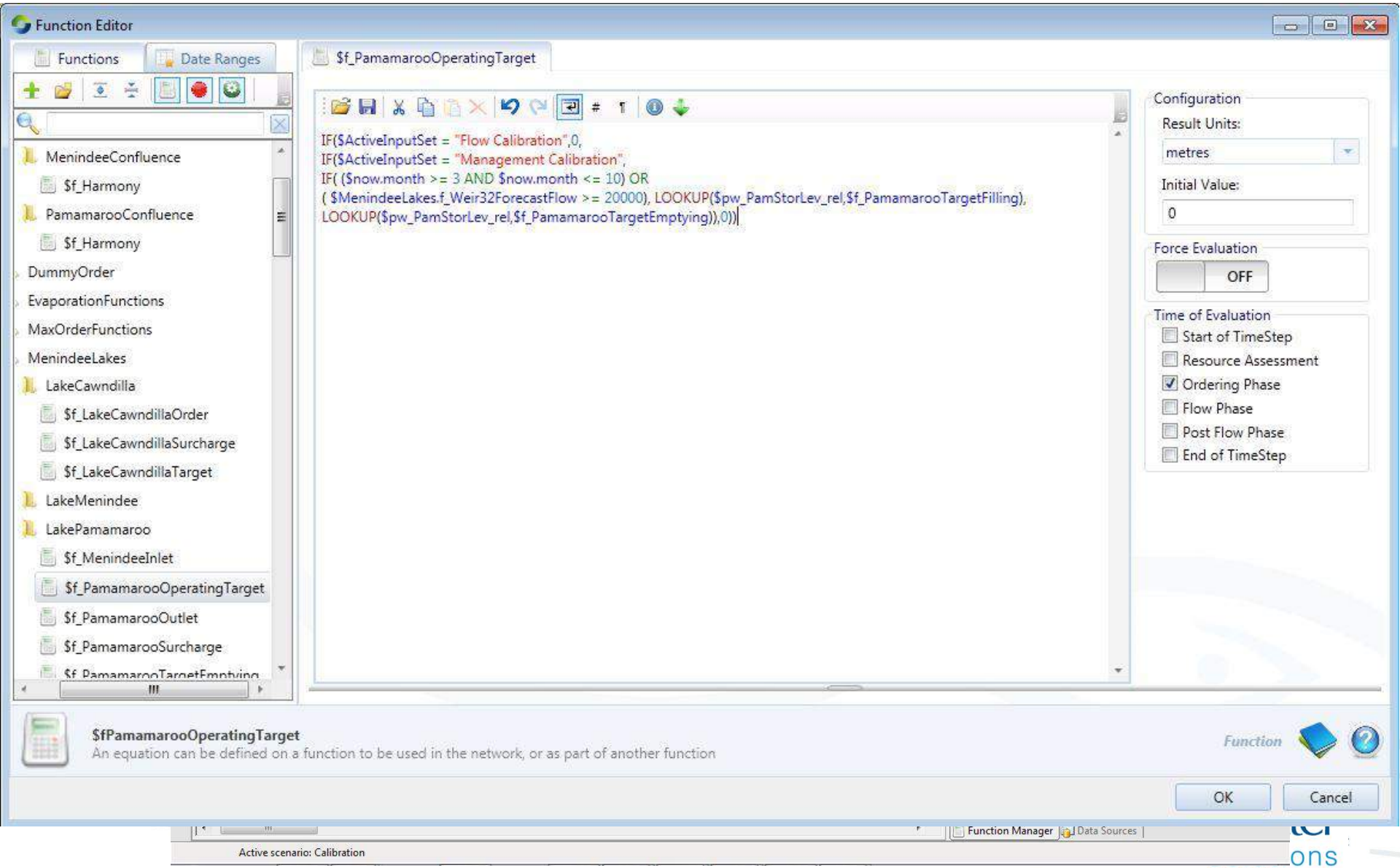
Flow Calibration

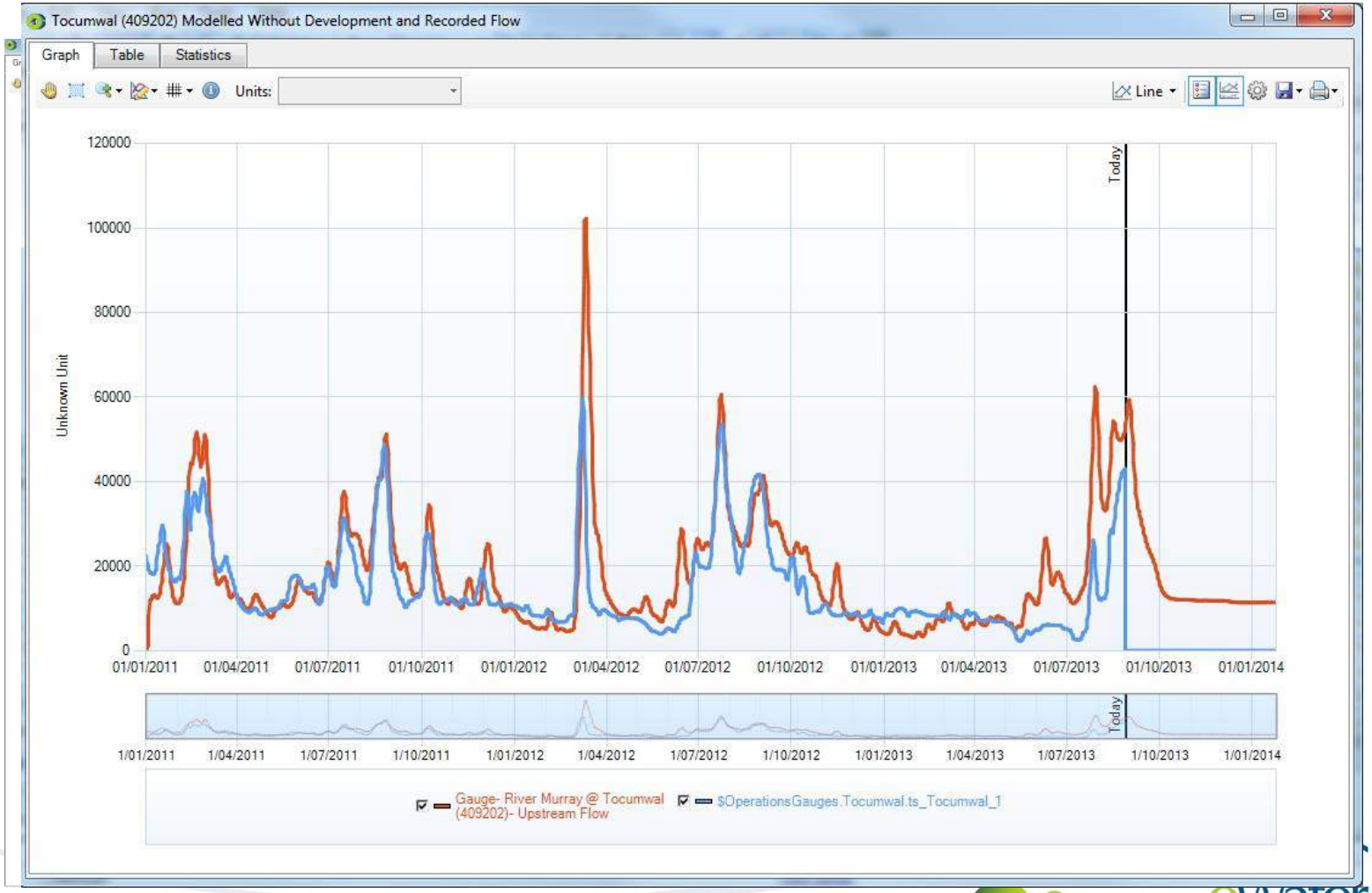




Management Calibration



River Operations



Source MODELLING COMMUNITY

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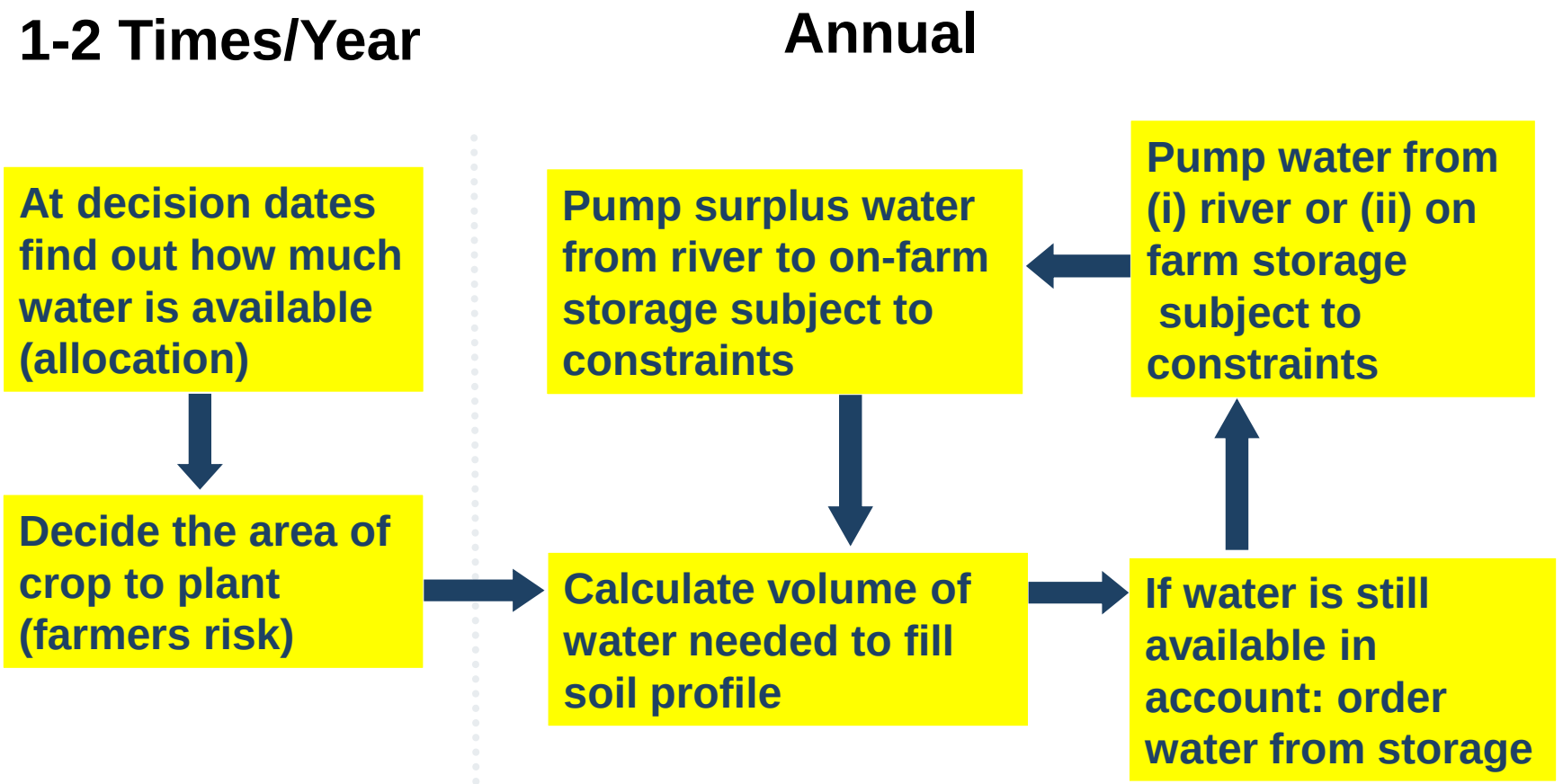
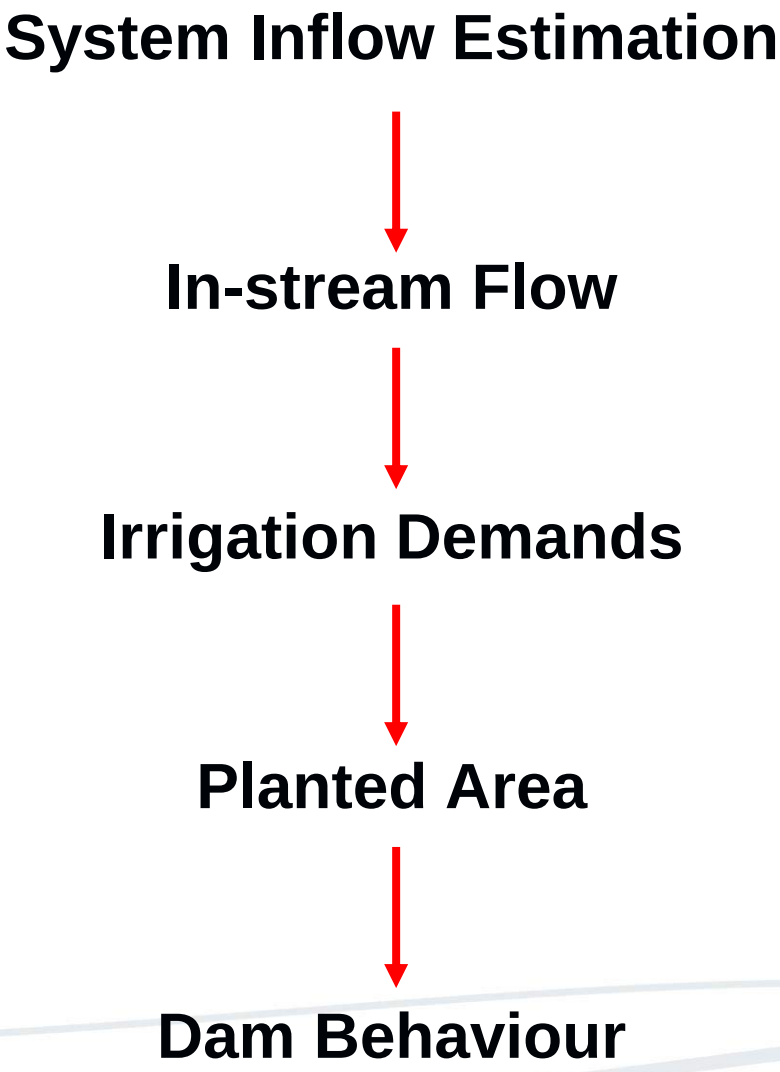
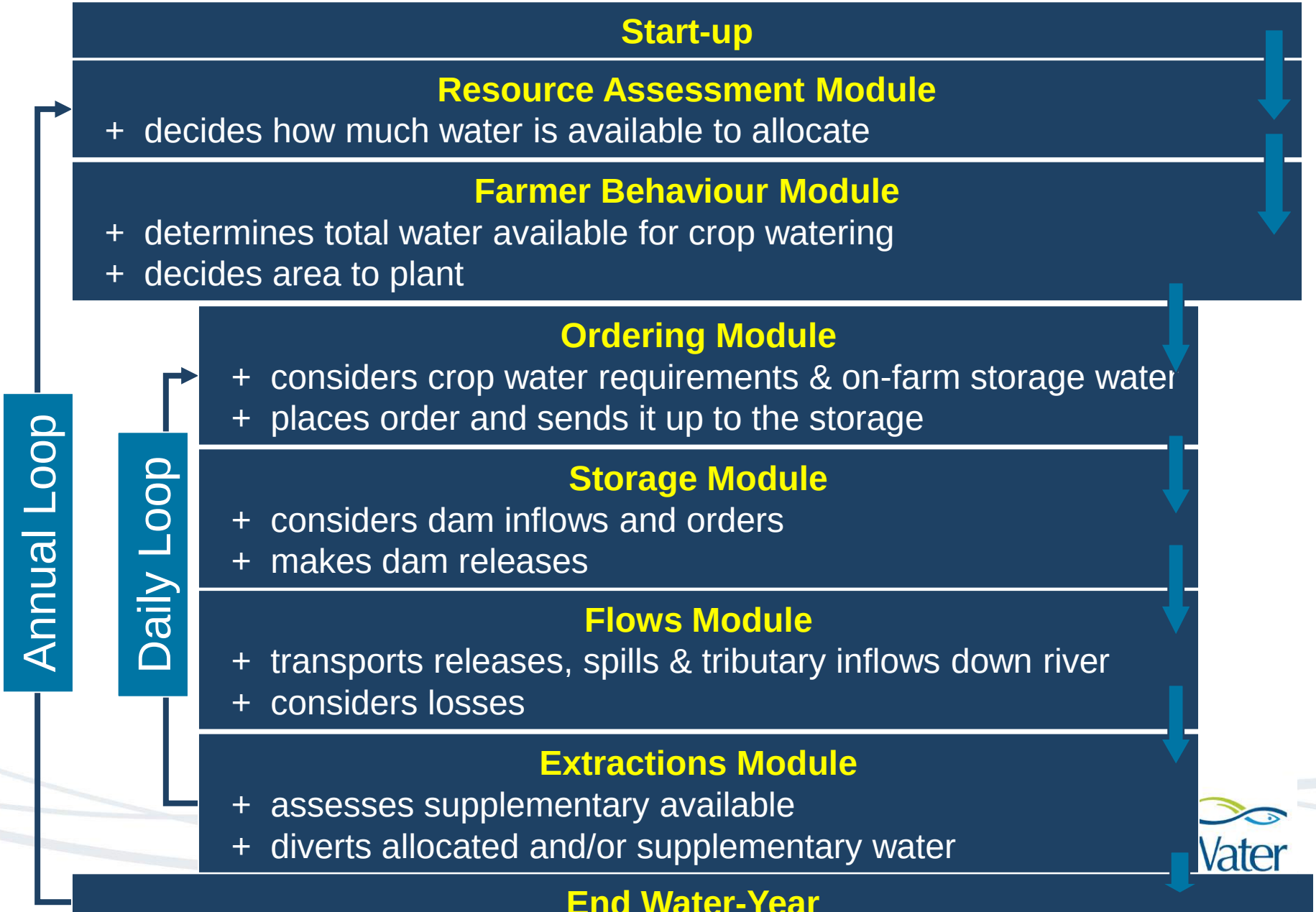
Operation of irrigation nodes



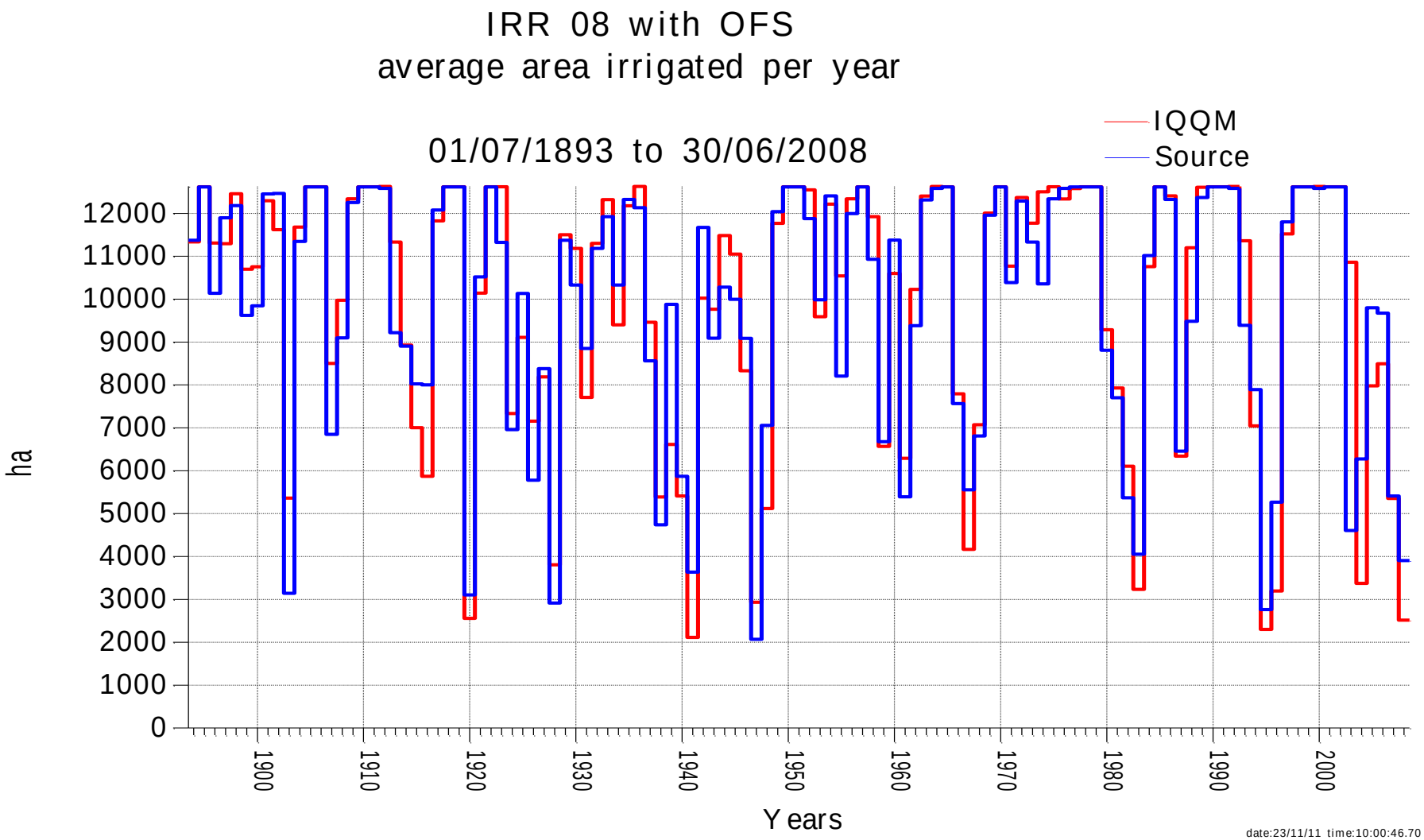
Calibration Procedure



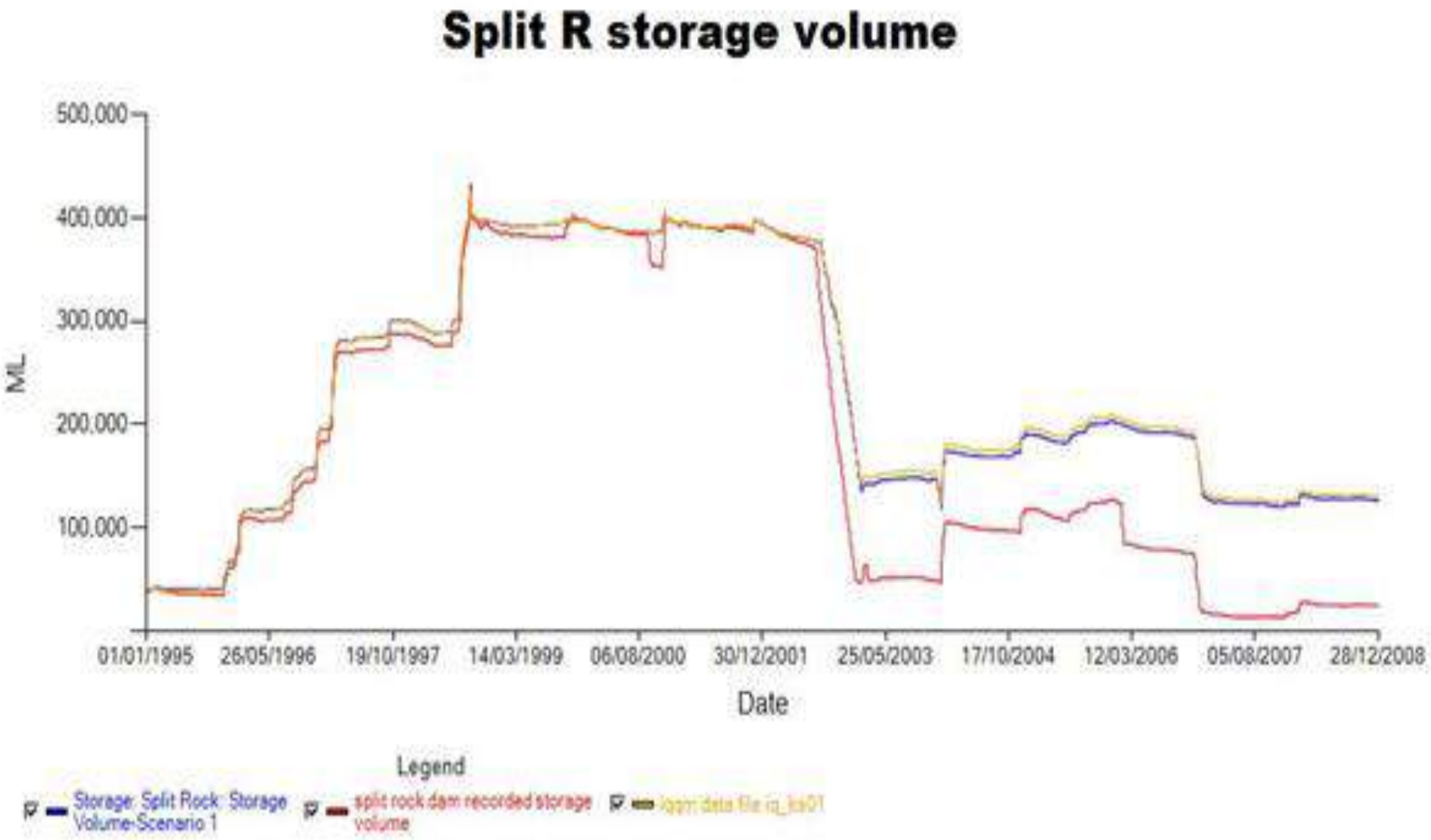
Simulation overview



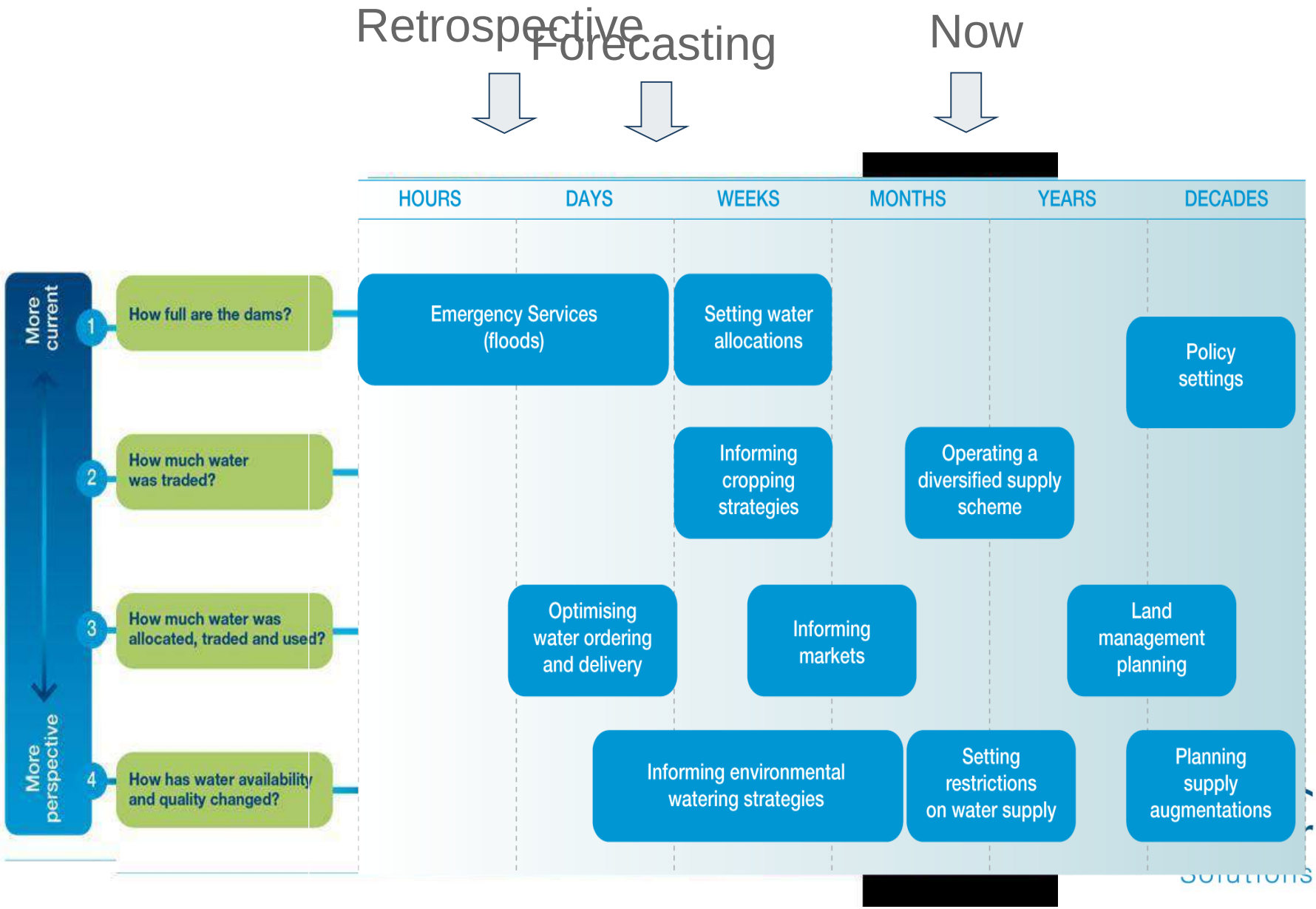
Namoi – Area irrigated



Upper Namoi - results



Use of models to inform decision making
Water accounting and forecasting



eWater Source combines IWRM water balance with governance

- Tracking of water through the system based on entitlements
- Resource assessment methods to allocate water between different competing uses within a jurisdiction
- Value of water is intrinsically embedded through incorporation of agreements
- Ability to create a water budget both by source and as a 'water accounting' tool to support transparency and continuous improvement of policy/agreements

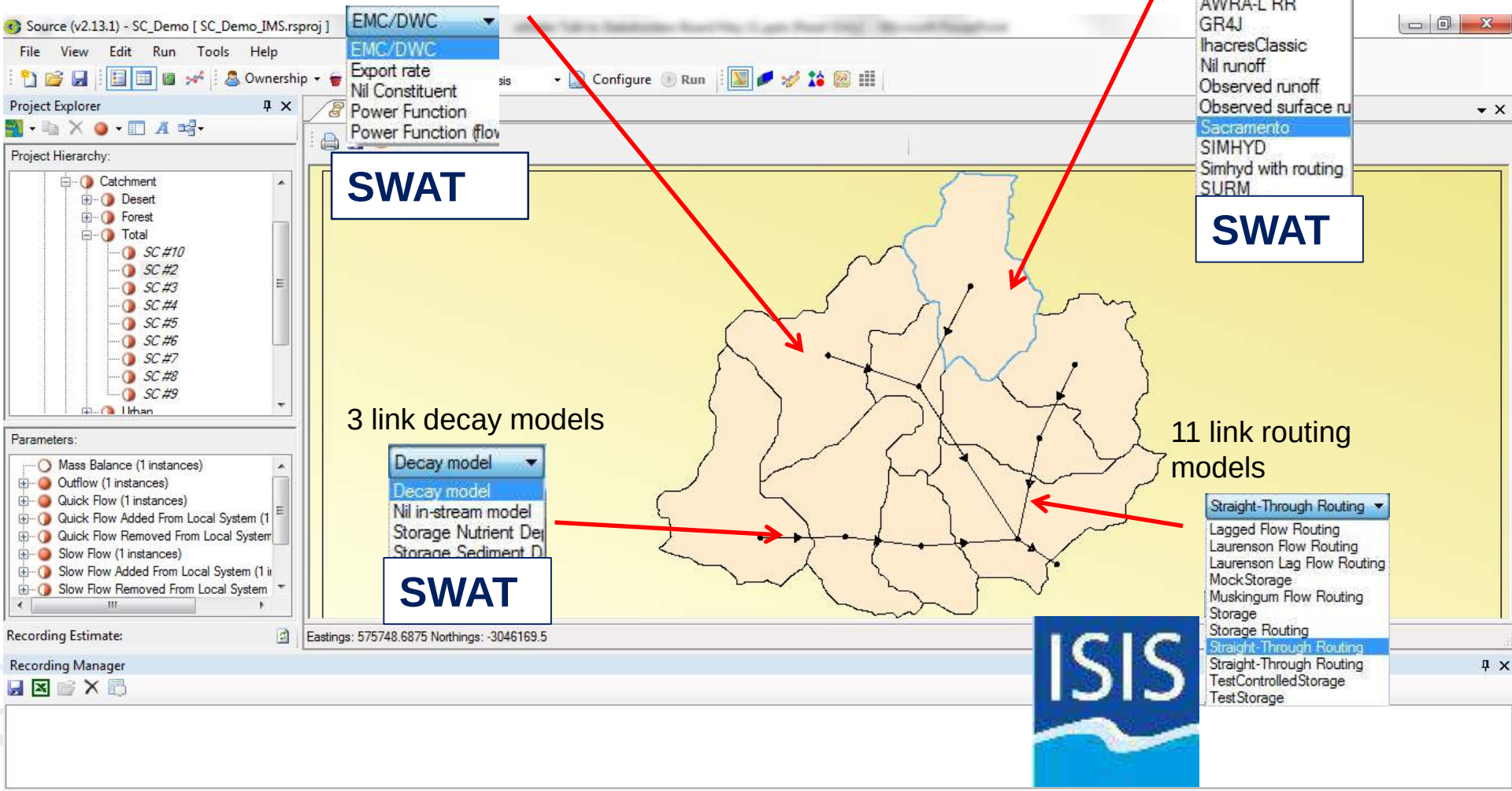
Source MODELLING COMMUNITY

eWater Solutions

Source as Integration Framework – One Interface

11 Catchment Runoff models

5 Catchment Export Methods

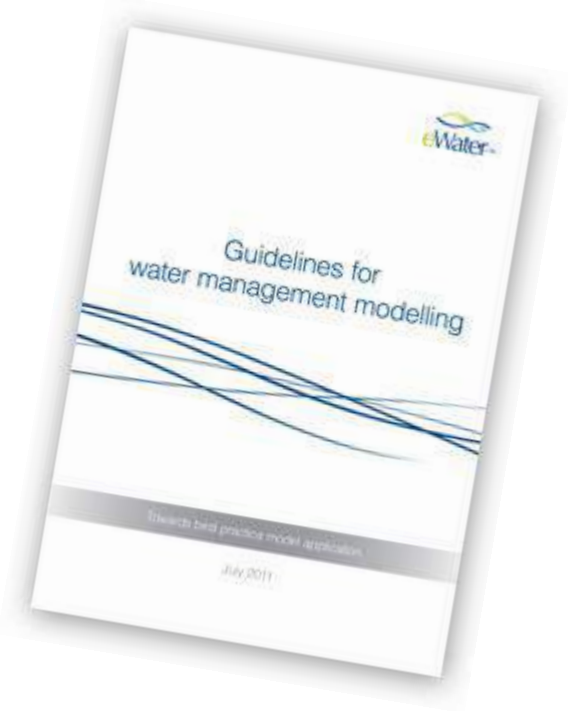


Best Practice Guidelines

High level guide released in September 2011

More specific guidelines at various stages of development

- Runoff generation (published)
- GW-SW Interactions (published)
- Water sharing rules (published)
- Uncertainty analysis (in review)
- Storages and wetlands (draft)
- Environmental demands (draft)
- River operations (draft)
- River Losses (draft)



http://ewater.com.au/publications/guidelines-for-water-management-modelling/

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Source Released as Two Versions

- **Source (Public Version)** is free upon registering with the eWater Toolkit. Source (Public Version) is a fully featured IWRM hydrological water balance tool including water quality and flow forecasting.
- The unrestricted release of **Source** has the additional capability of enabling advanced Governance to be added to the IWRM platform including Ownership, Resource Allocations, Operational Mode and Water Markets/Trading. **Source** is Australia's National Hydrological Modelling Platform.

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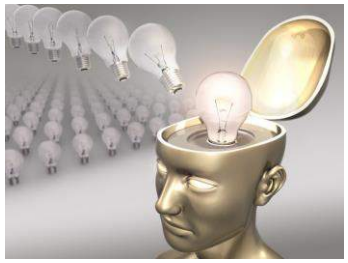
eWater's commitment: Support the needs of our modelling community

1 Provide Technology Transfer of information and tools to meet you needs



2 Work to remove or minimise obstacles

3 Support with community, capacity building, training and mentoring

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Thank You!

http://ewater.org.au/

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