eWater Source

At the Workshop on Modern Tools and Techniques for Water Resources Assessment and Management

16-17 September 2014, Imperial Hotel, New Delhi

geoff.adams@ewater.com.au www.toolkit.ewater.com.au




The Source IWRM Platform

‘Catchment to Estuary’ water system modelling capability

Runoff and constituent generation

Transport through regulated and unregulated systems

Urban and rural systems, including newer urban infrastructure options, crop demand and production models

Ecological function (environmental watering demands, response models)

Link with other models and systems, optimisation, the cloud

Resource management, ownership, water markets

Groundwater interaction

Source MODELLING COMMUNITY eWater

Models are used in developing and monitoring water management policy

"We don't do policy change without modeling it first …"

eWater Ltd – our Current Owners

New South Wales Government
Department of
Environment, Climate Change and Water

Victoria
The Place To Be

Department of Sustainability and Environment

Government
of South Australia
Department of Water,
Land and Biodiversity
Conservation

Queensland
Government

Department of Environment and Resource Management

Australian Government
Department of the Environment

MURRAY–DARLING
BASIN AUTHORITY

Source
MODELLING COMMUNITY

eWater

Evolution of eWater

Hydrological Tools & Methods
13 Years, 14 Partners, $50M

River Ecology & Science
12 Years, 13 Partners, $50M

Frameworks to manage human and ecological use of water
6 years, 45 Partners, $160M

- 1992
- 1994 — COAG Reform Water Trading Introduced
- 1996 — Environmental Water Principles
- 2004 — National Water Initiative Creation of CEWH
- 2007 — 2007 Water Act Empowers MDBA Best Available Science Legally Testable
- 2012 — eWater Source National Hydrological Modeling Platform

eWater CRC - 34 Industry & 11 Research Partners

PUBLIC INDUSTRY

New South Wales Government
Department of Environment, Climate Change and Water

New South Wales Government
Department of Water and Energy

Victoria
The Place To Be

Department of Sustainability and Environment
Department of Primary Industries
Environmental Protection Agency (EPA)
Victorian Catchment Management Authorities

Queensland Government

Department of Environment and Resource Management Queensland Primary Industries and Fisheries – Department of Employment, Economic Development and Innovation

Murray–Darling Basin Authority

Department of the Environment, Climate Change, Energy and Water

Government of South Australia
Department of Water, Land and Biodiversity Conservation

Brisbane City

Sydney Catchment Authority

EPA South Australia

CORPORATE INDUSTRY

State Water

Lower Murray Water

Melbourne Water

SA Water

SunWater

SKM

BMT WBM

ACTEW Corporation

Southern Rural Water

Goulburn-Murray Water

RESEARCH

La Trobe University

Griffith University

Monash University

The University of Adelaide, Australia

The University of Newcastle, Australia

The University of Queensland

Australian Government Bureau of Meteorology

UC

SARDI South Australian Research and Development Institute

The University of Melbourne

CSIRO

Source Modelling Community

eWater

Source and Basin Planning

Stake-holders:

Environment, People

Urban

Irrigation

Industry

Understanding the System: Models

- Floods & Dry
- Surface Water
- Ground water
- Climate Change
- Water Quality
- Land Use and Agriculture

Assess Options:

- Industry $
- Environment, Services and
- Energy Supply
- Food Production
- Urban

Actions

Policy ↔ Implementation

Integrated Modelling System
for rural and urban water management

Ordering

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

- Delivery time
- The most efficient path
- Supply constraints
- Outlet constraints
- Different supply reservoirs

Based on two passes:

- Constraint pass (top to bottom pass)
- Ordering pass (bottom to top pass)

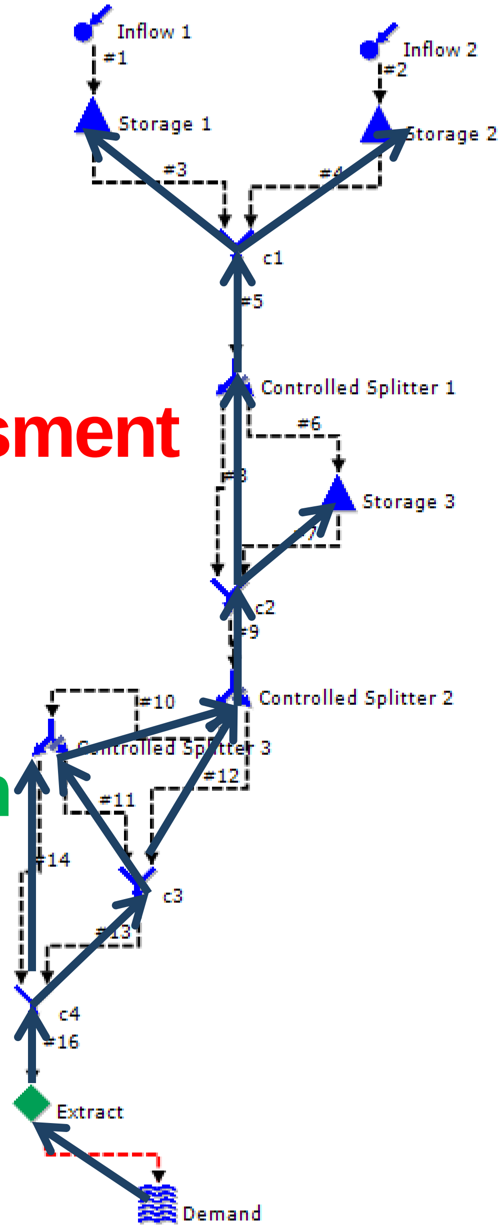
Defined rules or network linear programming (RELAXIV or PPRN).

Resource Assessment

Constraints

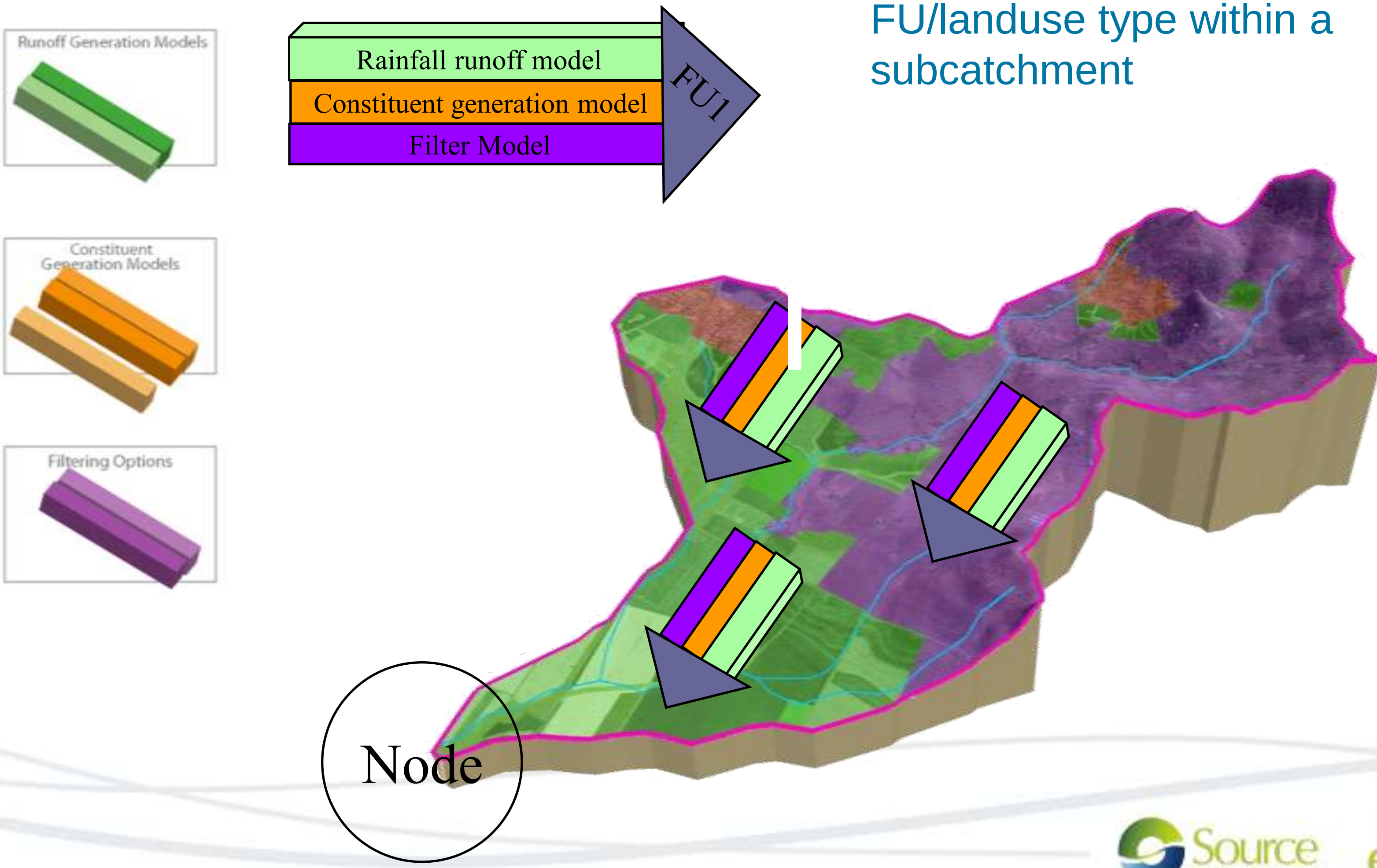
Order Up

Deliver Down



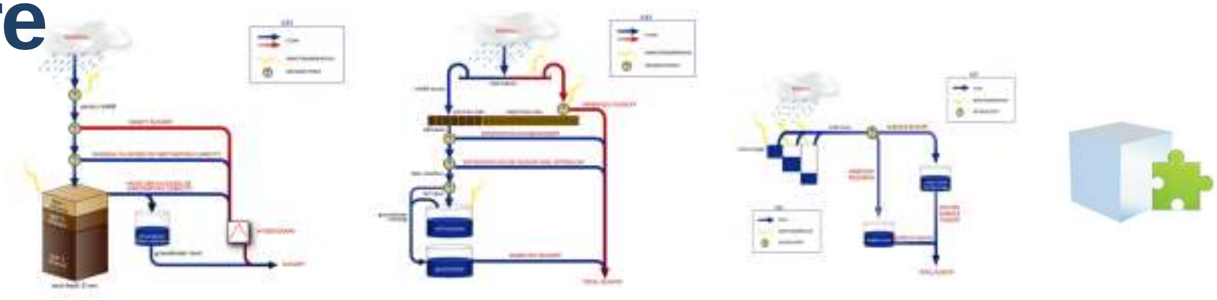
Hydrological framework

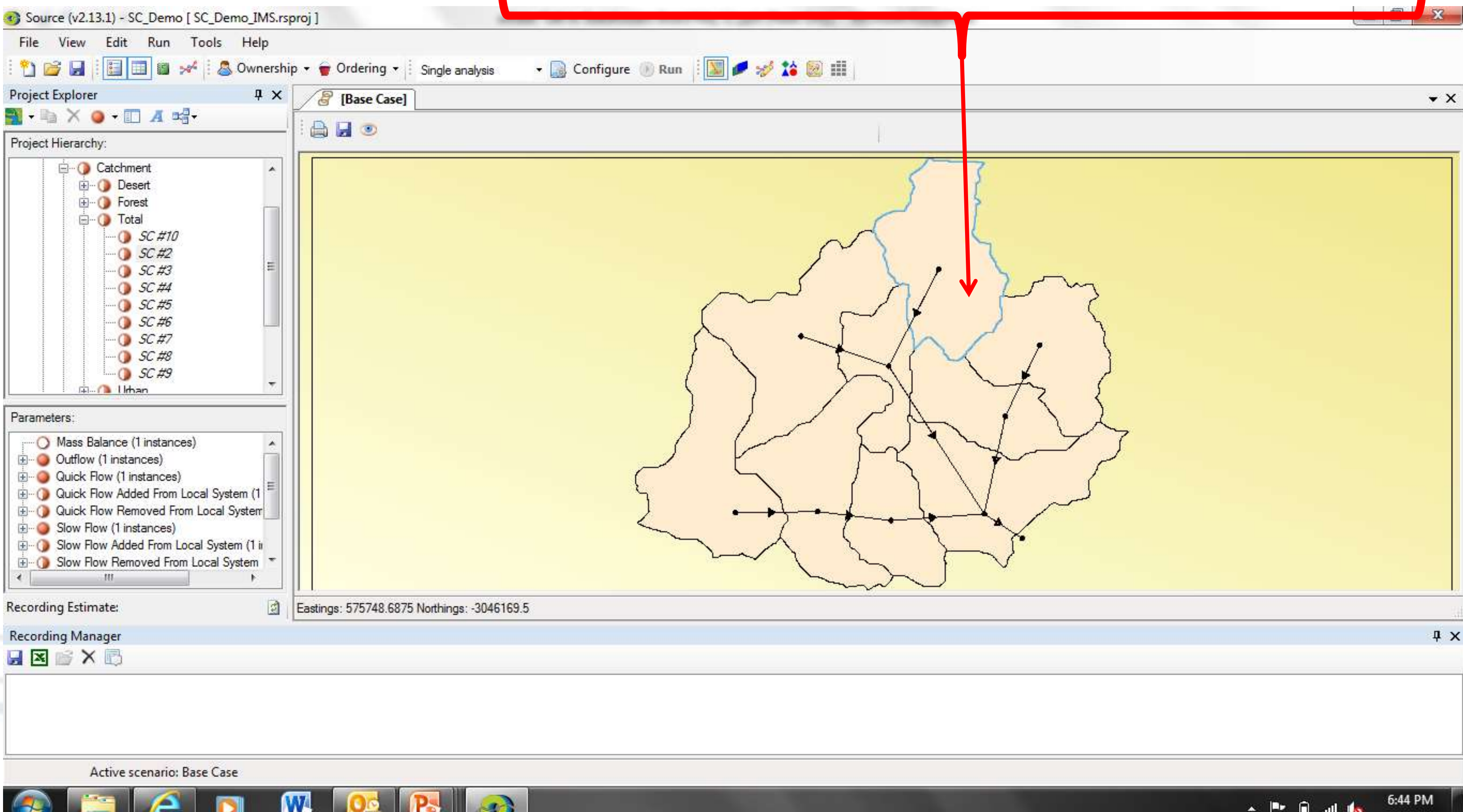
- The combination of processes produces an output for a particular FU/landuse type within a subcatchment



Flexible Structure

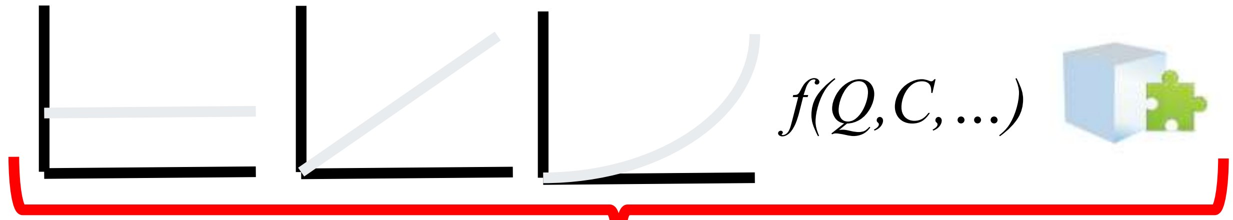
Alternate runoff conceptualisations
9 models + observed runoff
+ user defined plugins

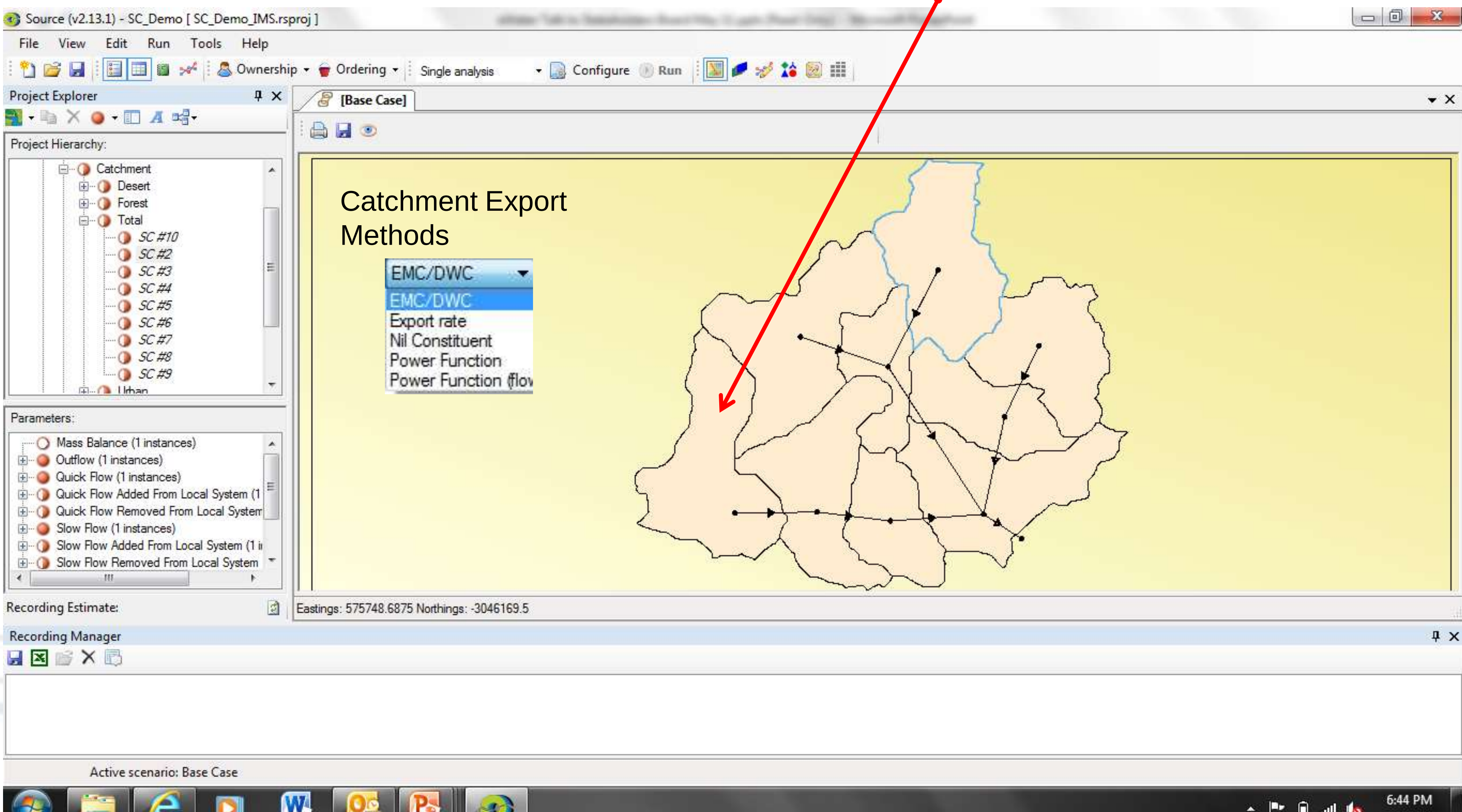




Constituent Generation

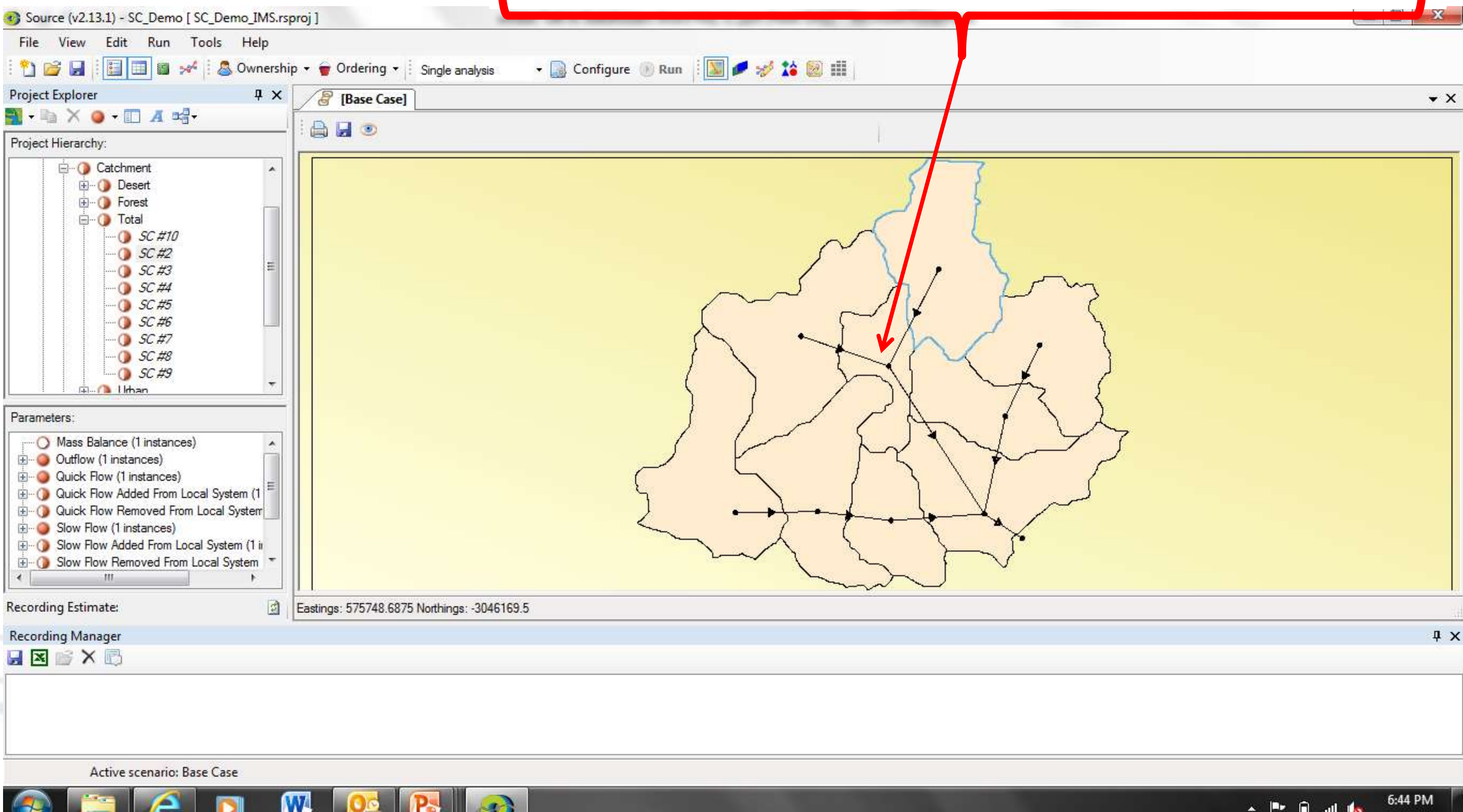
Catchment export methods to suit data availability





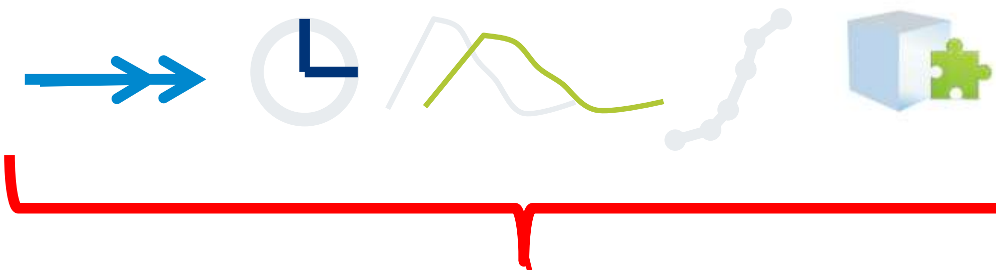
Node Types

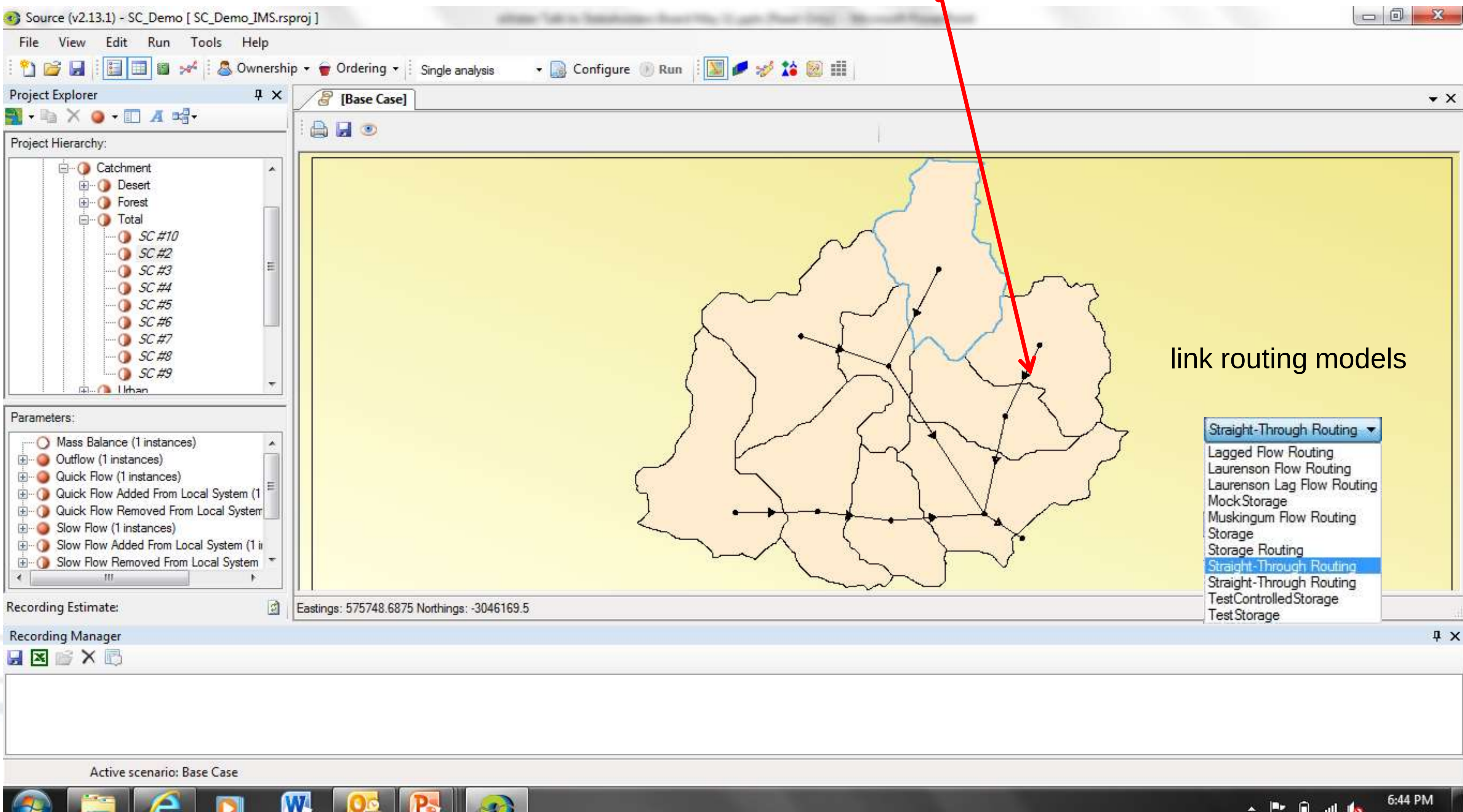
Nodes representing management functions, key structures, points of interest



Hydrological Routing

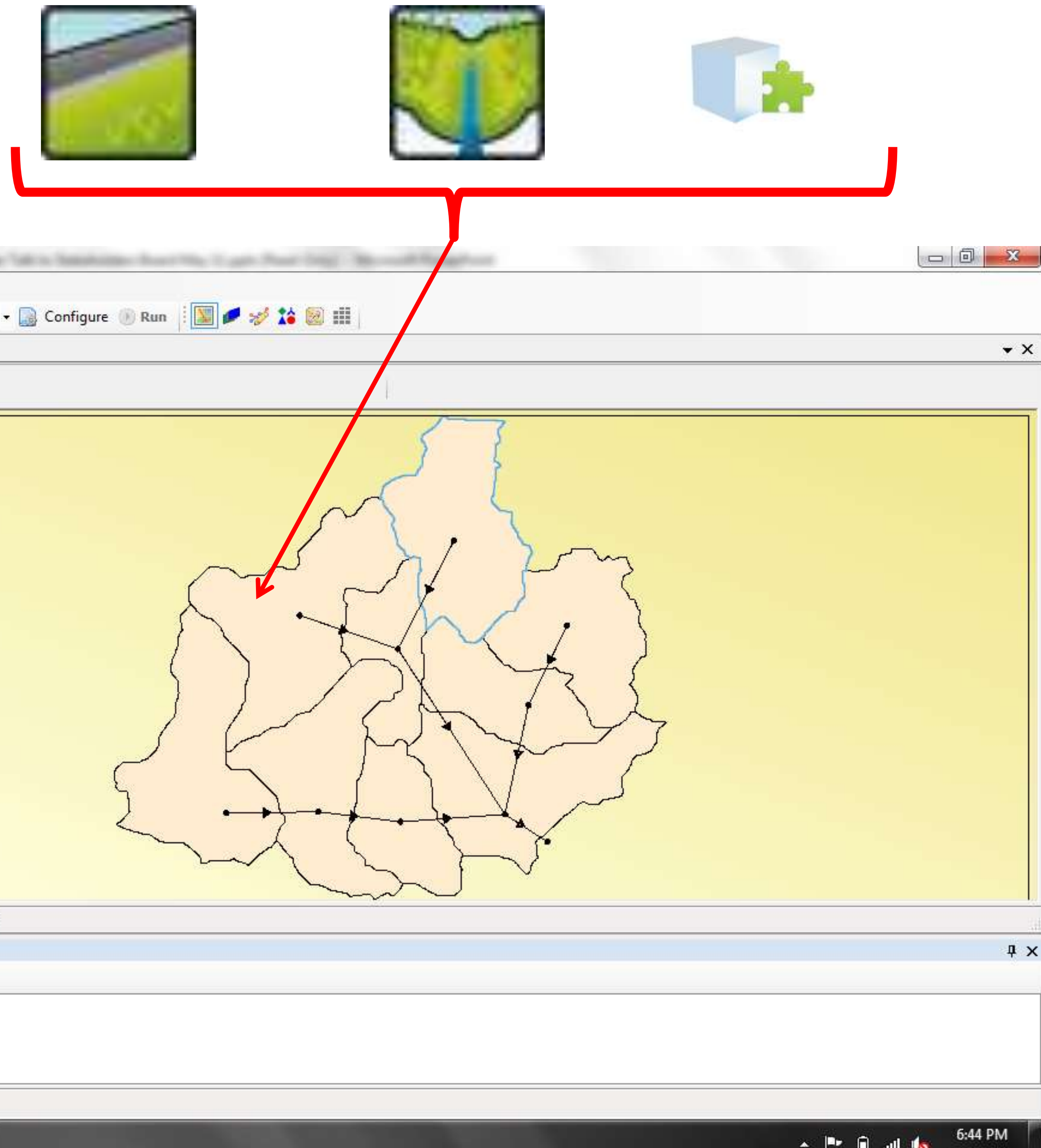
Alternate transport representations for flow, water quality constituents and ownership





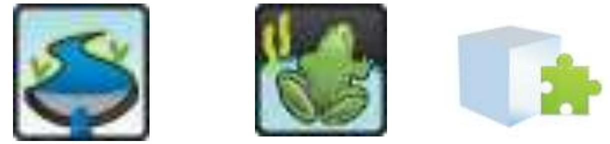
Constituent Filters

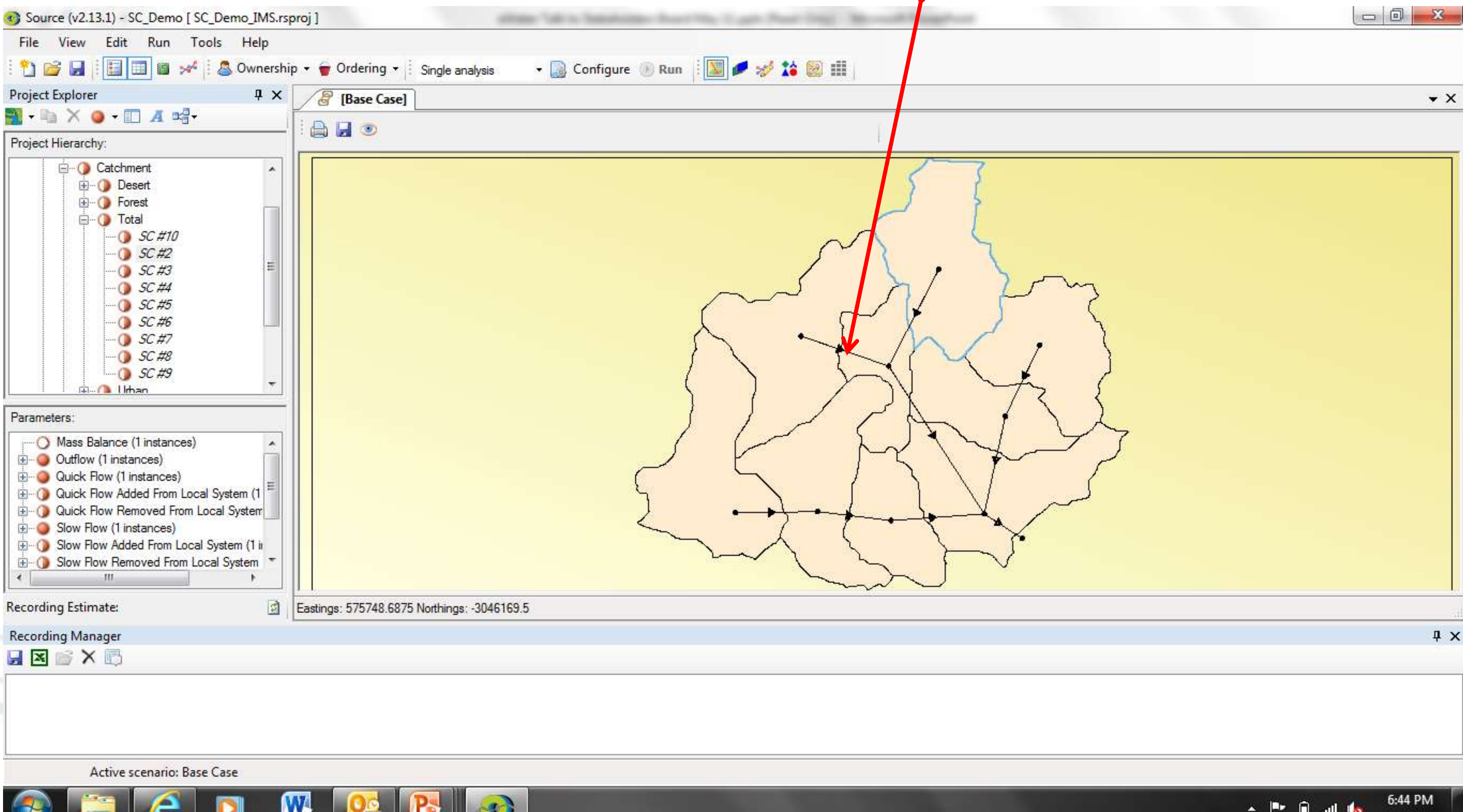
Export filters to represent land management actions (7 filter models)



Instream Decay

Decay of constituents instream or within reservoirs 3 models



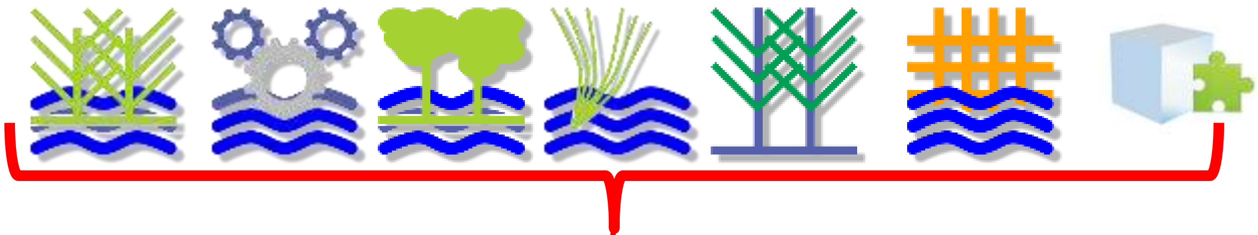


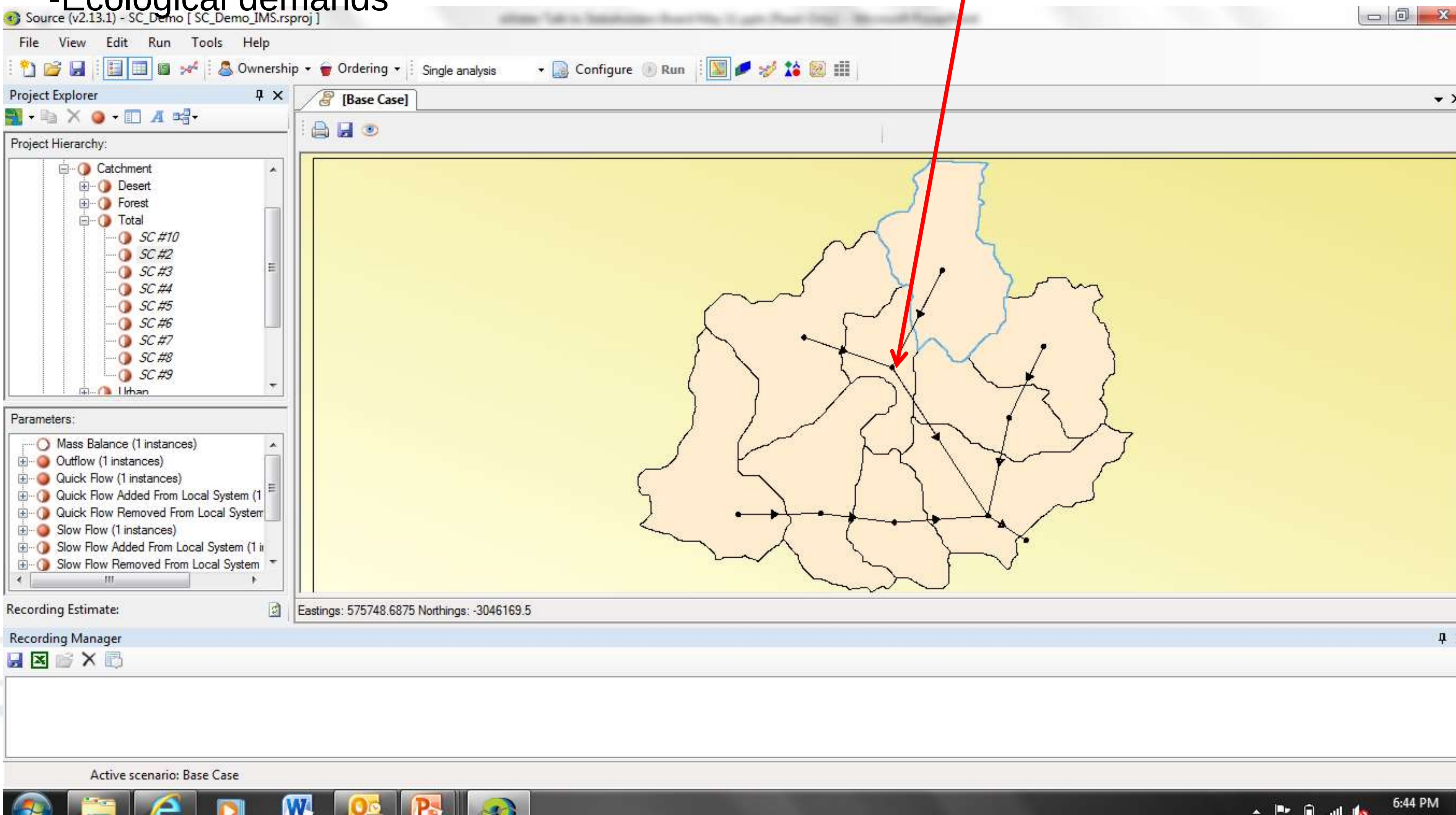
Demand Models

-Represent demand as a time series, a recurring pattern or with a model.

-Cultural flows

-Ecological demands





Options for Customising Source

1. Functions

Powerful math and logic language built into Source (MS Excel-style formulae)

2. Custom Functions

User defined extensions to the Function Manager

3. Plugins!

Open ended system for changing the algorithms, user interface or operation of Source

…

Options for Customising Source cont.

4. External Scripting

Batch runs, calibration, uncertainty analysis, links to other systems – models, FEWS

5. Optimisation

Multi-objective optimisation, trade-off analysis

6. Run-time Configuration Changes

Scenario analysis

Functions

Ability to calculate mathematical expressions within Source using system variables

Has similar syntax to Excel

Large set of common used functions (trigonomic, statistical, logical)

Piecewise Linear, Patterns and Time of Evaluation

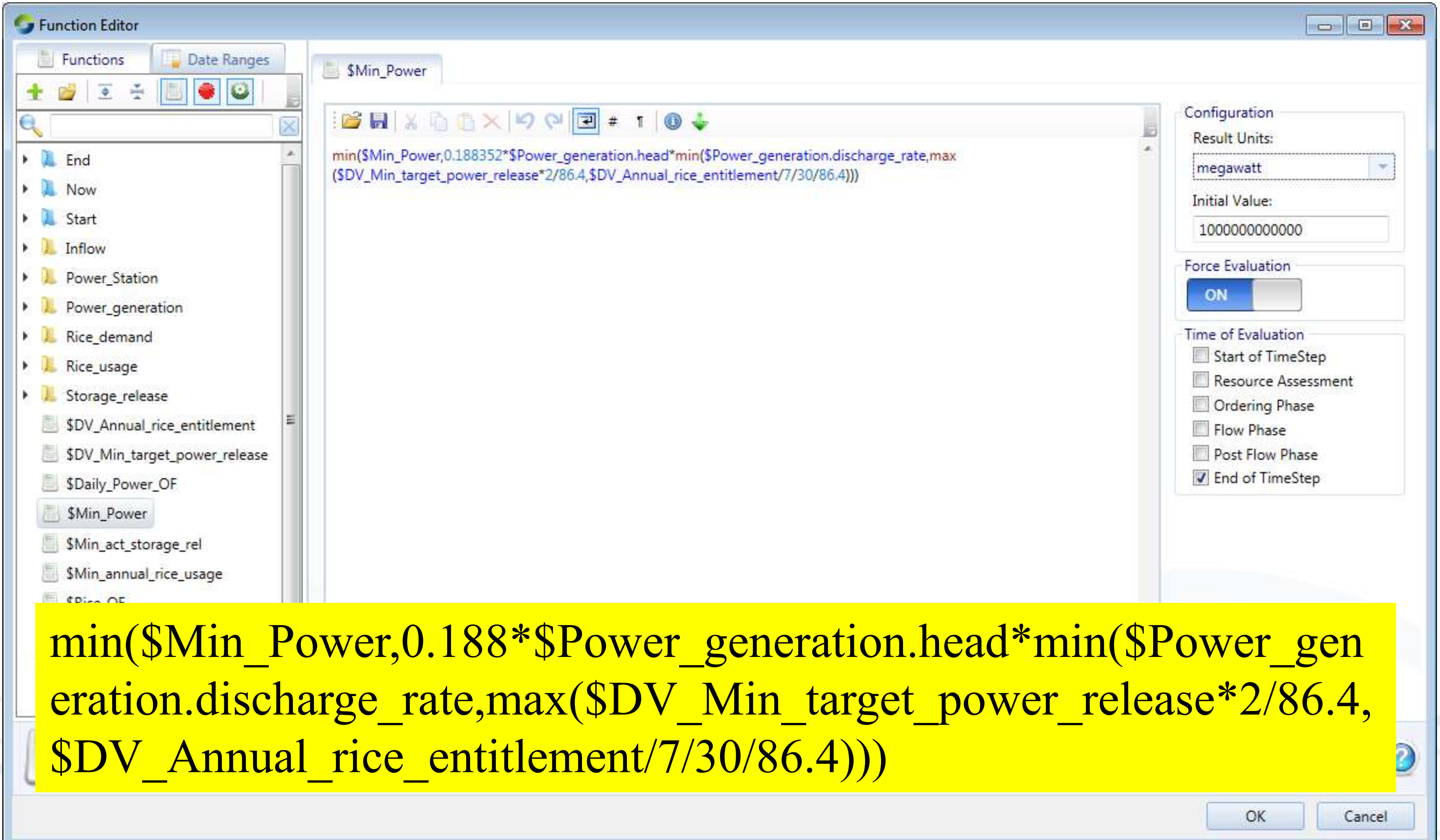
Custom Functions

Extend the language of the expression editor

Reuse common logic

Written in C# and loaded as a plugin

Functions

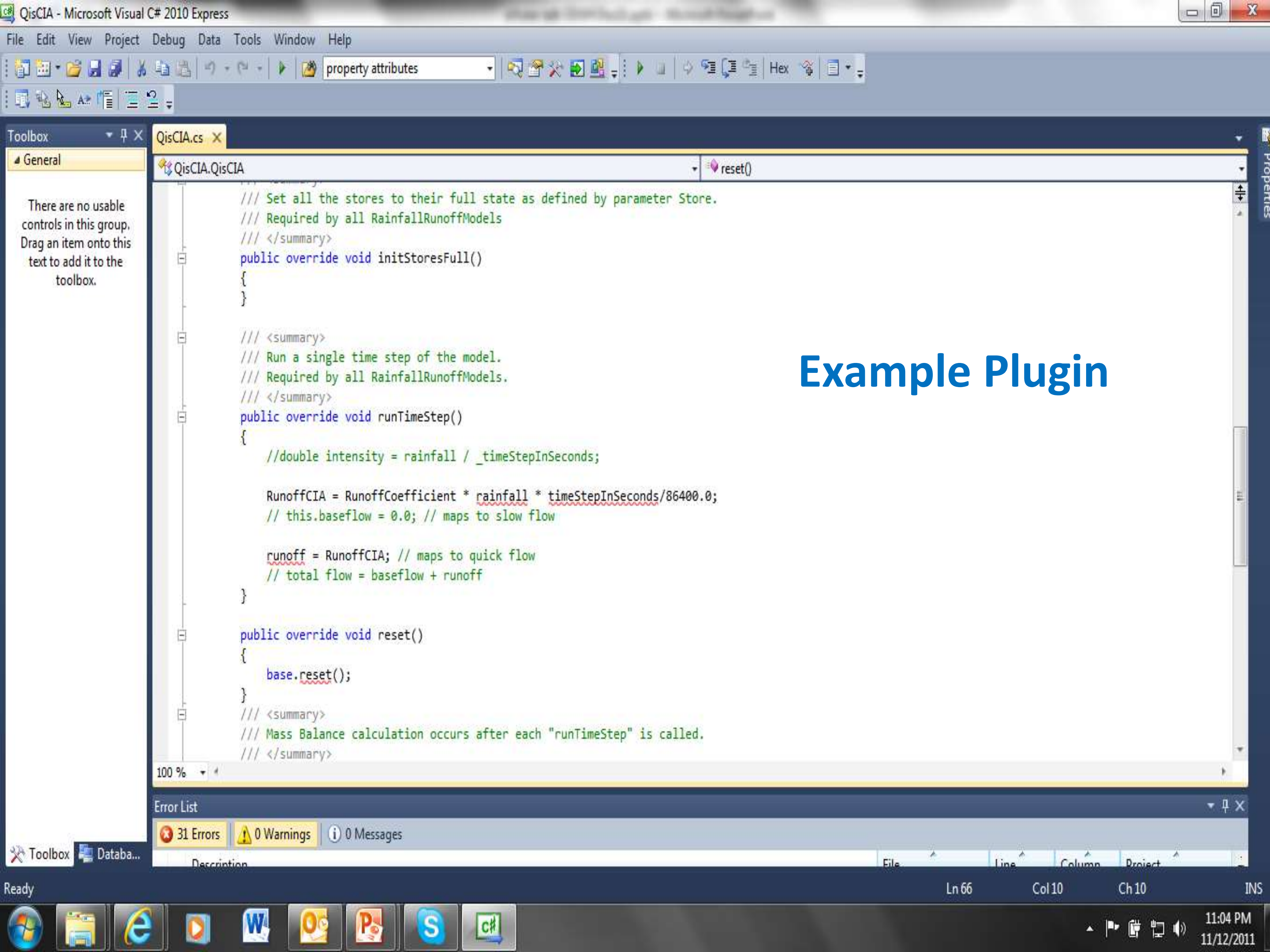


min($Min_Power,0.188*$Power_generation.head*min($Power_generation.discharge_rate,max($DV_Min_target_power_release*2/86.4,$DV_Annual_rice_entitlement/7/30/86.4)))

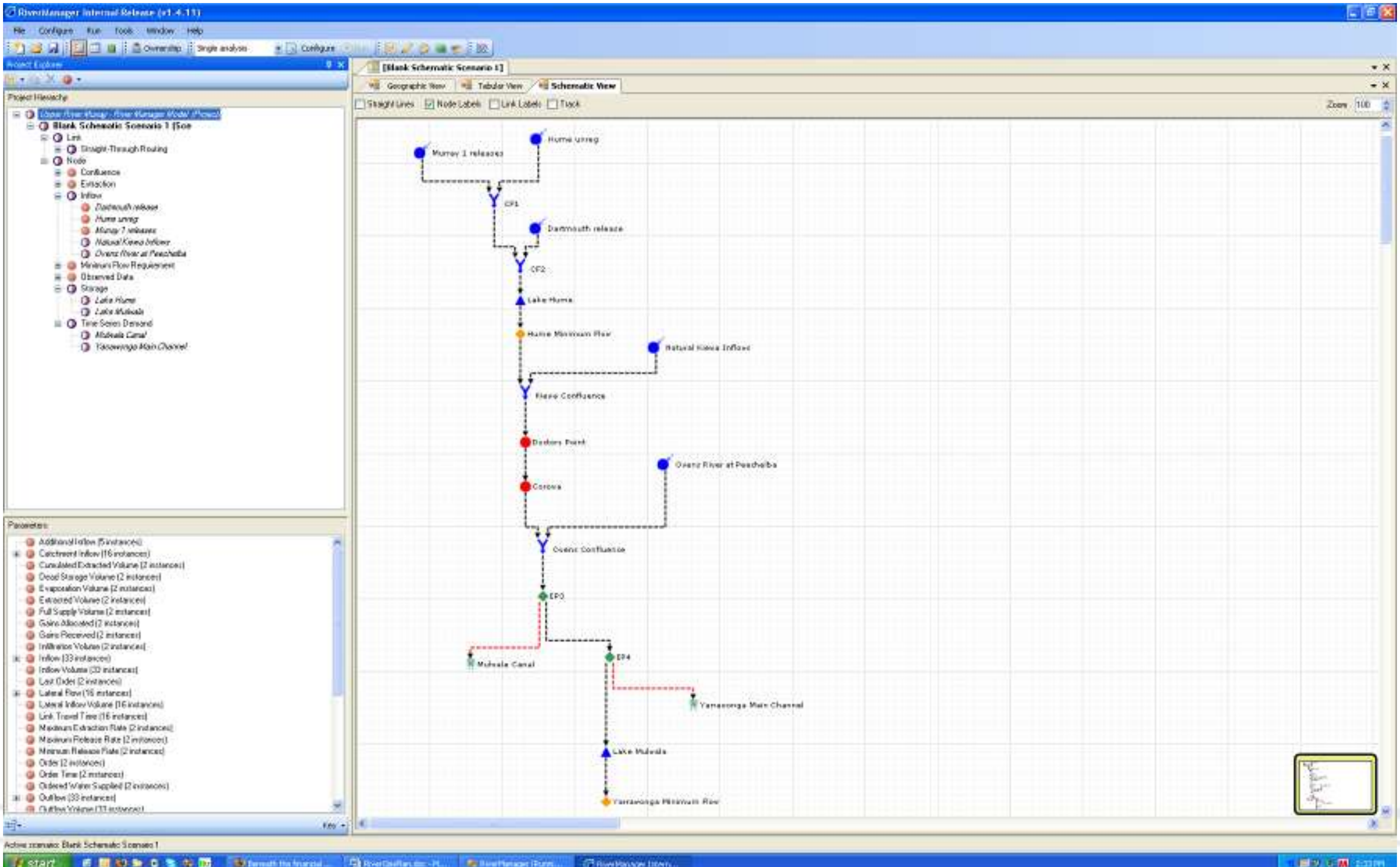
Plugins

- Replacement component models (demand, runoff, routing, etc)
- Provide a tailored user interface
- Automate repetitive tasks, such as data pre processing, output report generation
- Written in a .NET language such as C# or Visual Basic
- Basic development tool set free of charge from Microsoft

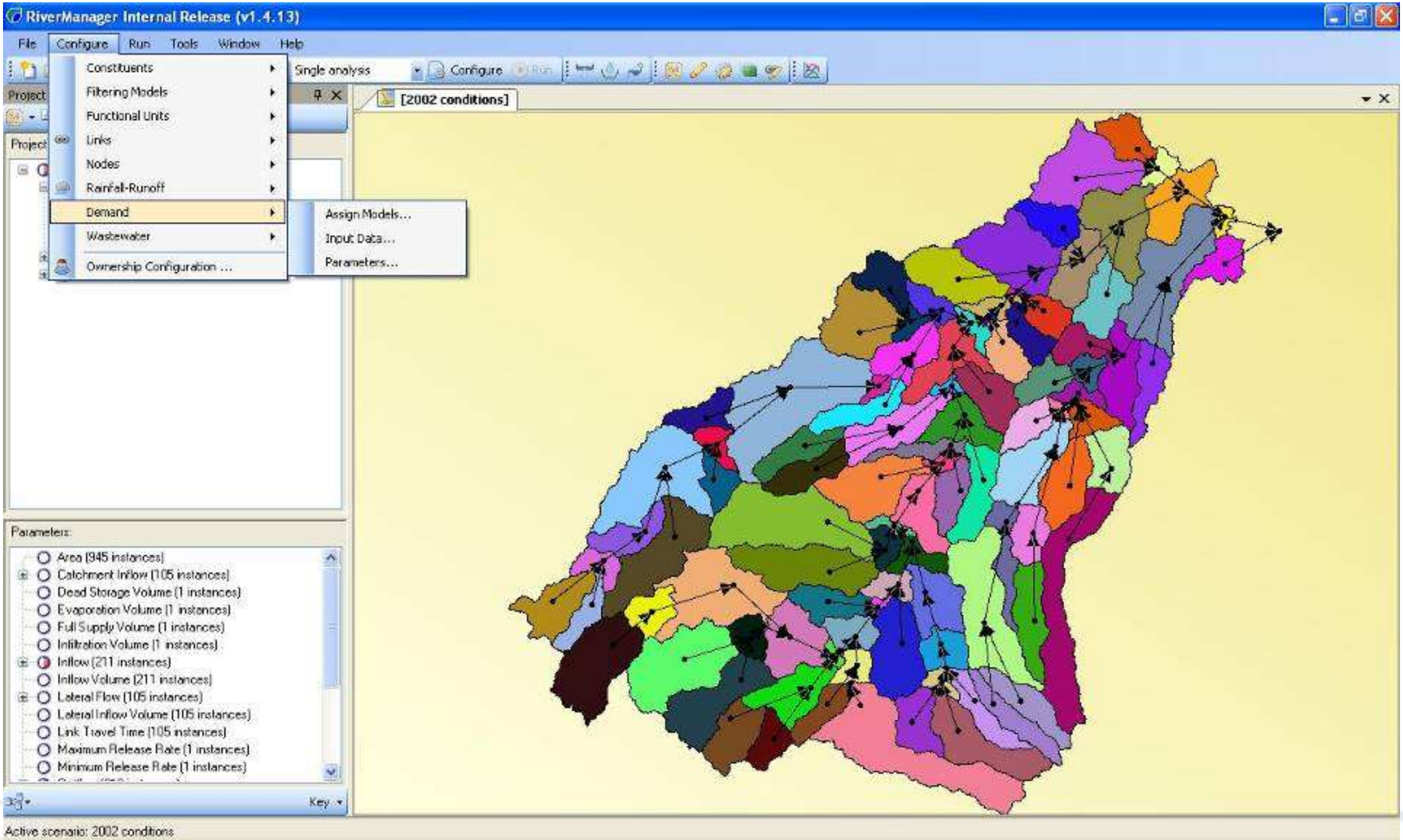
Example Plugin



Planner view



Catchment View



Managing water supply to competing demands

‘Water from dam may be used for Mulshi project’

TIMES NEWS NETWORK

Mumbai: Water from the Mulshi dam, which is used for power generation and irrigation purposes, could be diverted to the new hill city project being planned in Pune's Mulshi taluka. This, however, would depend on permission from the private power company that currently uses the water for its purposes, said the government.

This and several other concessions have been granted to the project by the state urban development. In a notification, it has allowed multiple concessions to the new township based on the reasoning that "in order to promote tourism and orderly development of the land, the modification (to declare the area as a township) is necessary and should be sanctioned subject to conditions".

Pic used for representation only

The project would have to comply with a set of stringent recommendations made by the Madhav Gadgil committee report on ecological sustainability of the Western Ghats. The state-level expert appraisal committee (SEAC) of the Union ministry of environment and forests (MoEF) has said it will apply the Gadgil panel's guidelines to the project mooted by Maharashtra Valley View Private Limited.

"The government has only approved the project in keeping with the guidelines it has put in place for hill station projects. However, until the Gadgil committee's recommendations are applied, it is difficult to say for sure if such projects would be environmentally feasible despite all clearances from the state," said G K Deshpande, acting chairman of the SEAC.

The Western Ghats Ecology Expert Panel report Part II of the Gadgil committee had in August last year said the entire Western Ghats must be considered ecologically sensitive, especially to ensure the sustainability of rivers.

Times of India, Mumbai. 13/6/12

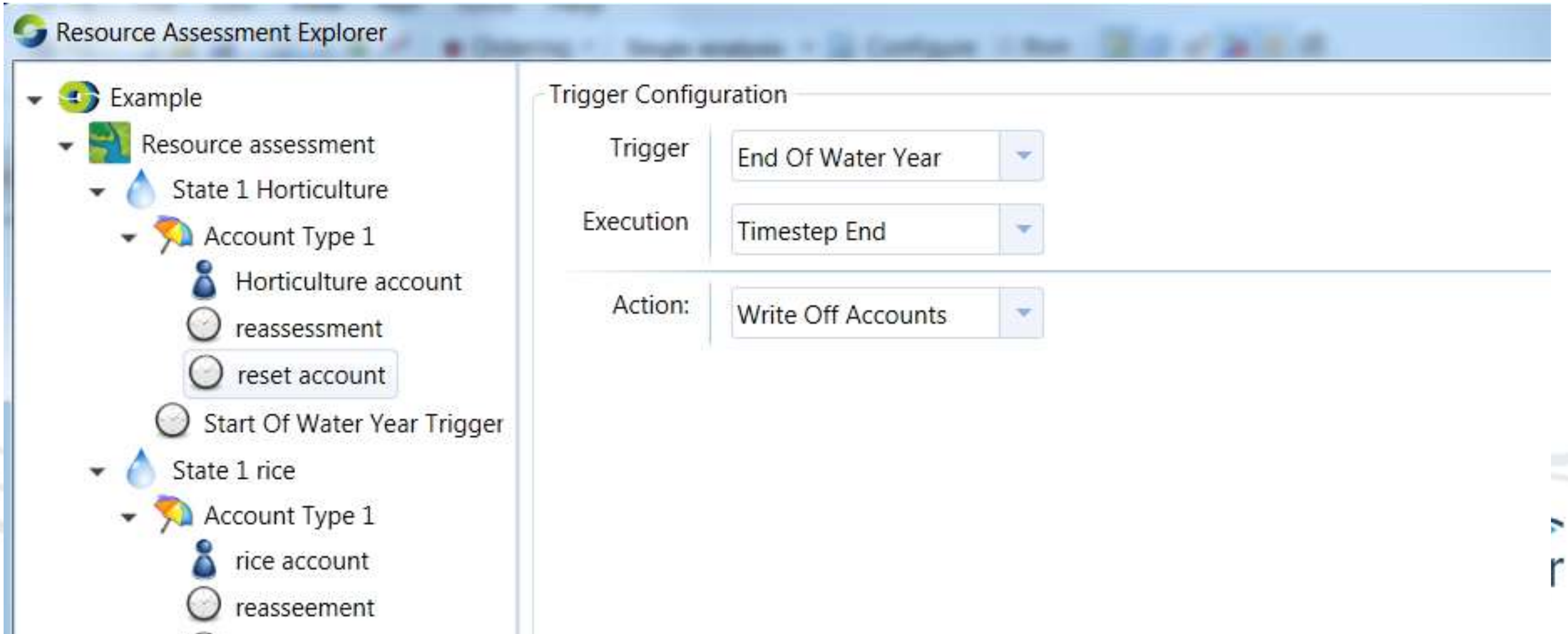
We can model water access rules in different ways

Option 1 – do nothing

Option 2 – use functions to constrain supply

Option 3. Apply allocation system

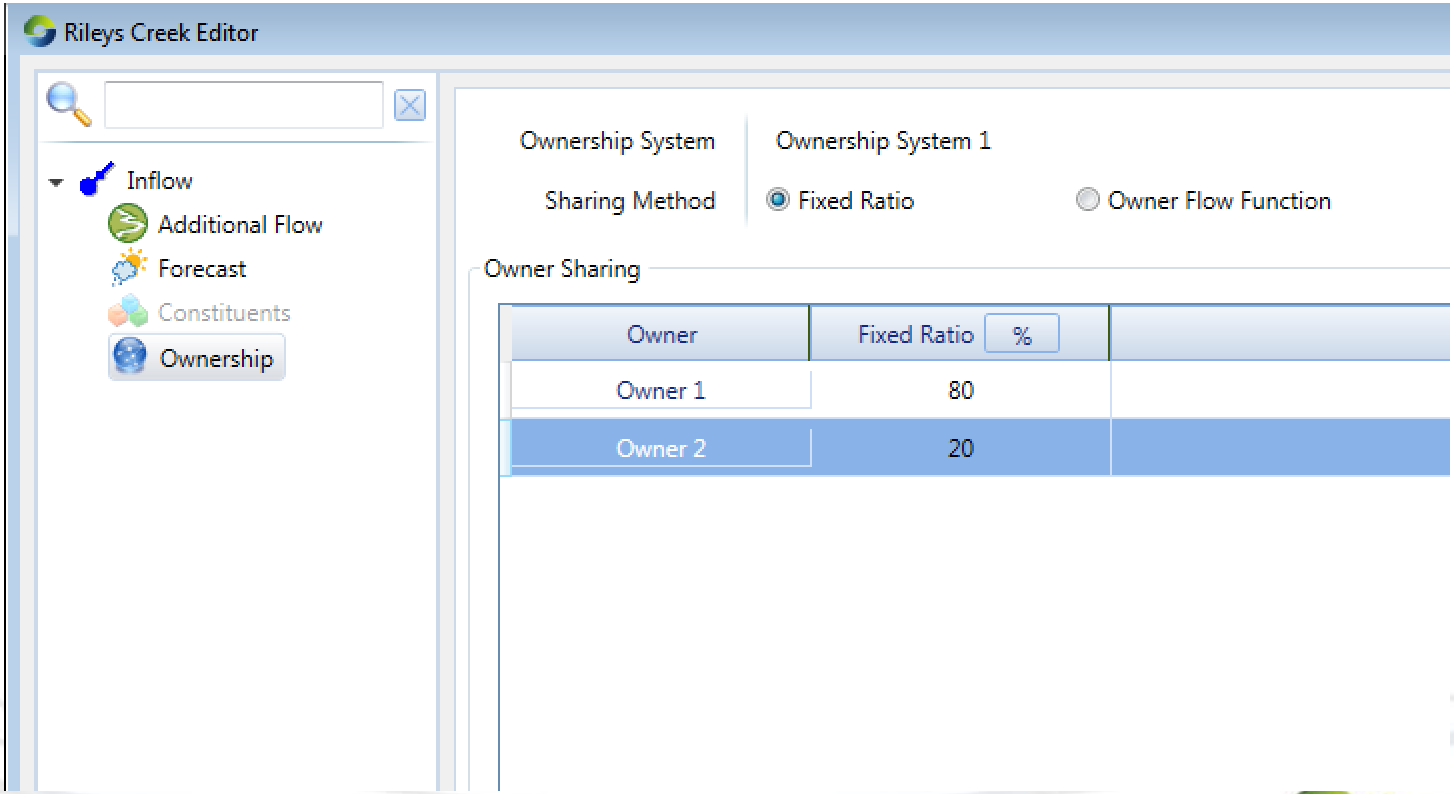
Use the ‘resource assessment’ functionality to allocate available resources to different users e.g. on a seasonal basis



Ways for modelling different water access rules

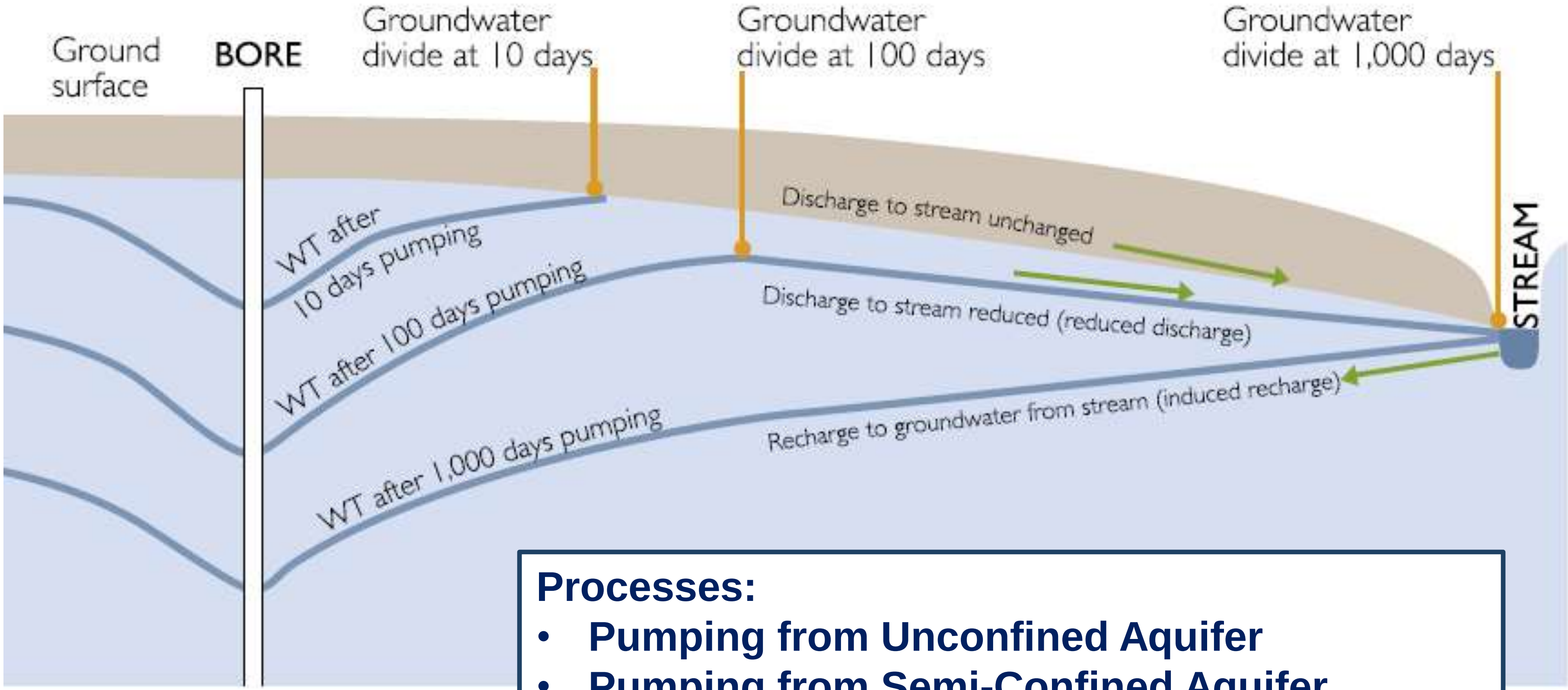
Option 4. Ownership.

Use the ‘ownership’ functionality to ‘lock in’ a users access to a particular quantity or share of water



Groundwater/Surface Water Interaction

Impacts of groundwater pumping on rivers



Processes:

- **Pumping from Unconfined Aquifer**
- **Pumping from Semi-Confined Aquifer**
- **Irrigation Recharge**
- **Diffuse Recharge**

From: Evans R. (2007). The impact of groundwater use on Australia's rivers ~ Exploring the technical, management and policy challenges. Land and Water Australia, Canberra.

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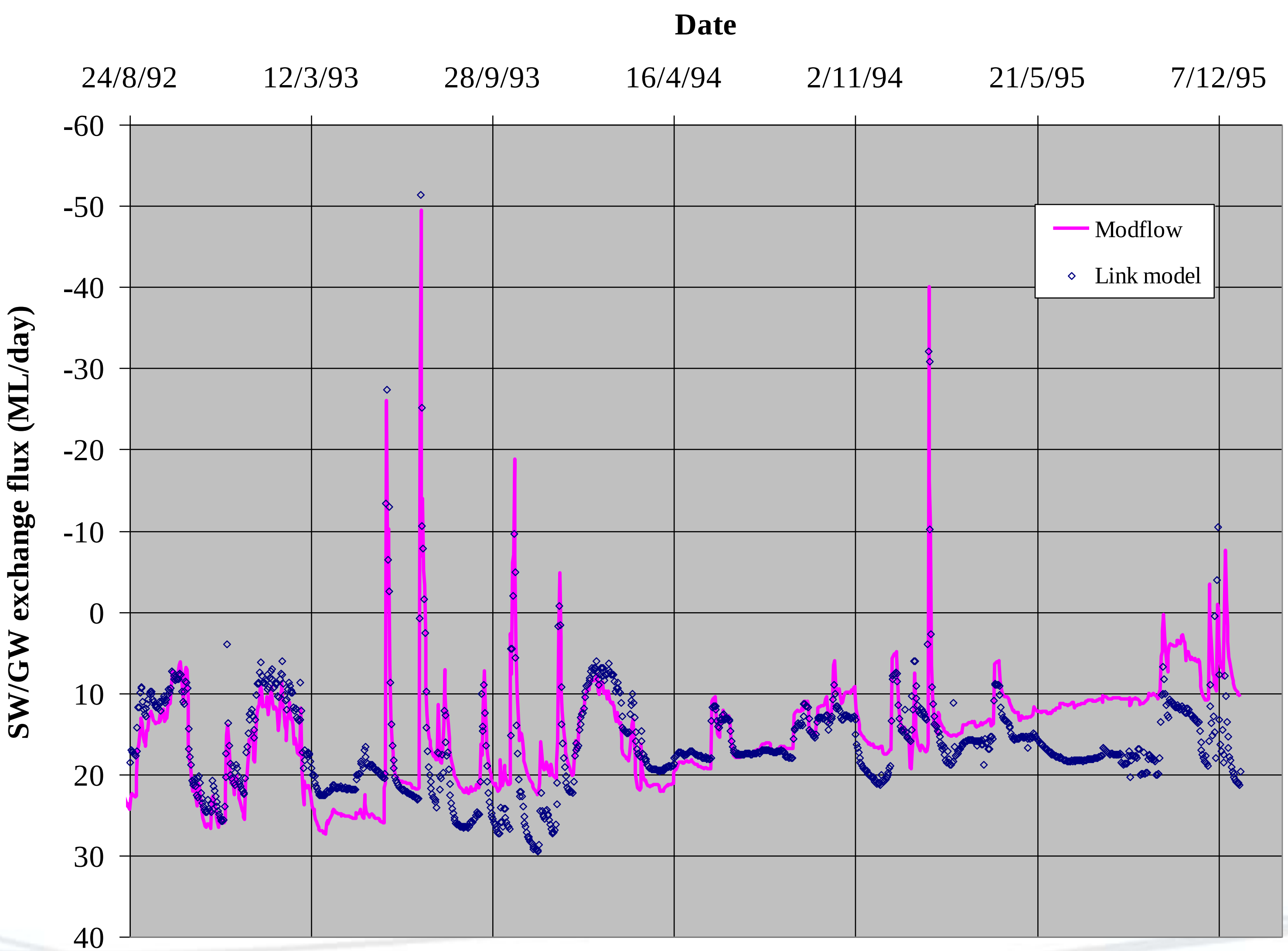
Groundwater Link Model versus MODFLOW



+ve = Gaining, -ve = Losing

The Source IWRM Platform

- The freely available 'Public Release' is a fully featured IWRM platform
- 330 downloads from 42 countries
- Pricing for the full featured release, which also covers water markets, resource assessment etc. is targeted at commercial use
- Under the Government to Government Agreement we can customise Source to the Indian context
- The Australian Central and State governments are committed to Source. Source is being used for statutory WRM in Australia.

Australian Government
Department of Foreign Affairs and Trade
Australian Aid
CSIRO
eWater
Source MODELLING COMMUNITY
eWater

The Source IWRM Platform

- Quality software engineering
- Extensive unit tests
- Hundreds of regression tests to ensure stability
- User models are added to the regression test suite for assurance
- Readily customisable for specific users – e.g.
    - Glacier, snowmelt
    - Resource assessment
    - Small catchment dams
    - GIS

Australian Government
Department of Foreign Affairs and Trade
Australian Aid
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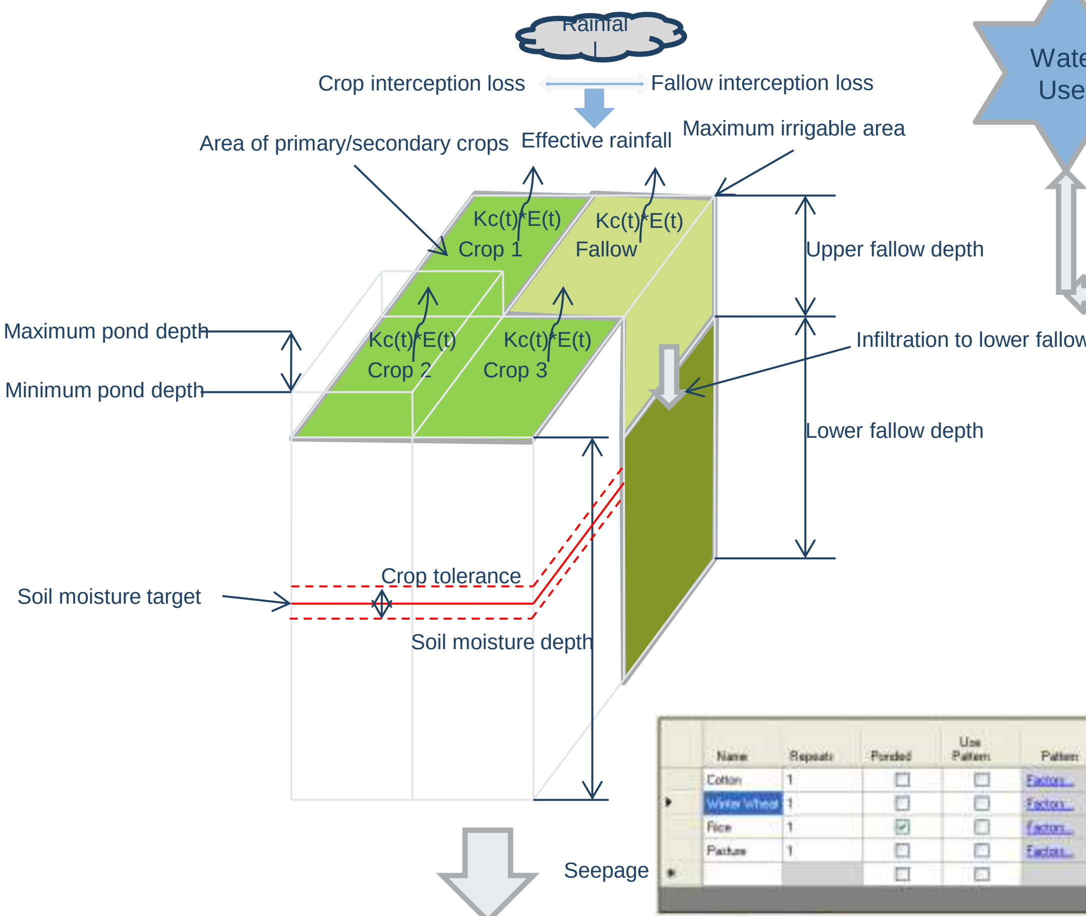
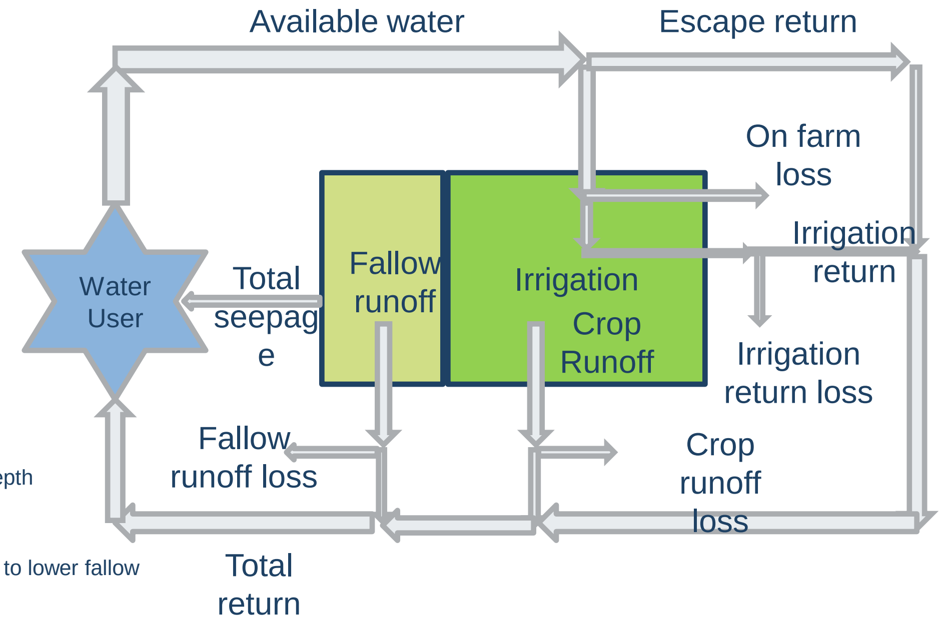
Thank You!

Irrigation Demand





FAO Crop Factors

					Crop Coefficient					Number of growing days				
Name	Repeats	Ponded	Use Pattern	Pattern	Initial	Development	Mid-Season	Late-Season	Maturity	Initial	Development	Mid-Season	Late-Season	Losses
Cotton	1	☐	☐	Factors...	0.4	0.4	1.2	1.2	0.6	30	50	60	55	Losses...
Winter Wheat	1	☐	☐	Factors...	0.3	0.3	1.15	1.15	0.3	160	75	60	30	Losses...
Rice	1	☑	☐	Factors...	1.1	1.1	1.1	1.1	0.95	35	40	10	35	Losses...
Pasture	1	☐	☐	Factors...	0.85	0.85	0.95	0.95	0.85	140	60	120	46	Losses...
		☐	☐											

Import... Export...

1000 Gl = 1 km^3

Storages	**Active Capacity**
Murray	7498.67 Gl
Campaspe	304.65 Gl
Loddon	220.08 Gl
Bullarook Ck	5.442 Gl
Murrumbidgee	2632.895 Gl
Menindee Lakes	1555.051 Gl
Goulburn	3558.512 GL
Ovens	32.379 GL
Broken	39.653 GL
Snowy	5020.124 Gl
Total	20867.46 Gl
	20.9 km^3

MDB average long-term annual inflow and water use

Surface water GL

Inflows		
Inflows to the Basin	31,599 GL/year	31.6 km^3/year
Transfer into the Basin	954 GL/year	1.0 km^3/year
Total	32,553 GL/year	32.6 km^3/year
Water Use		
Watercourse diversions	10,903 GL/year	10.9 km^3/year
Interceptions	2,720 GL/year	2.7 km^3/year
Water used by the environment & losses	13,788 GL/year	13.8 km^3/year
Outflows from the Basin	5,142 GL/year	5.1 km^3/year
Total	32,553 GL/year	32.6 km^3/year