Urban Water Security Research Alliance

Prototype modelling tool to aid development of integrated water management strategies

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Life Cycle Analysis and Integrated Modelling Project

In collaboration with eWater CRC

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Queensland Government

CSIRO

Griffith University

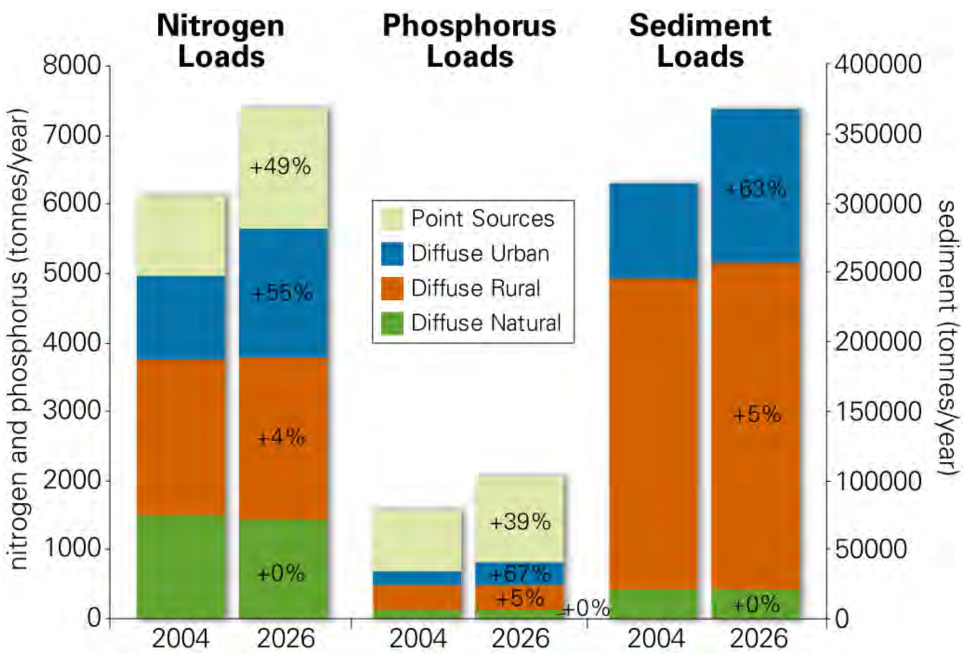
The University of Queensland Australia

Outline

- Why do we need a modelling tool to aid urban water management strategies?
- Prototype development
  - Modelling approach
  - Test application
  - Future direction

Why do we need another modelling tool?

- Integrated urban water management (IUWM) is emerging as the preferred approach for urban water management
- It requires co-ordinated planning and management of water supply, wastewater, stormwater and receiving water, to provide sustainable urban water systems
- To implement IUWM, understanding of system scale water quantity and quality impacts of different urban water management options is required



Graph sourced from: Paul Greenfield, Keynote speech, SEQ UWSRA, 17 Aug 09

Why do we need another modelling tool?

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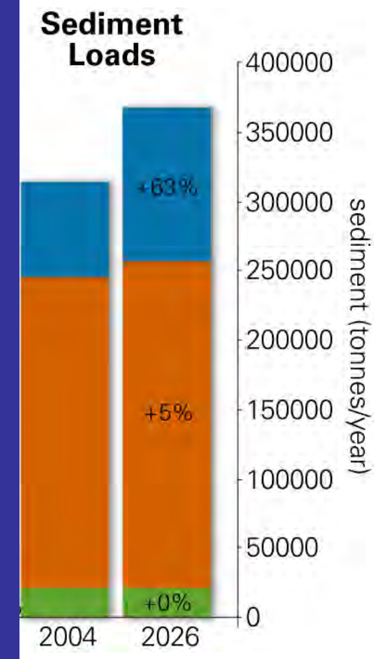
- **Current modelling tools are not adequate – why?**
  - Represent sub-systems, not the whole system
  - Often, there is no seamless modelling for water quantity and quality
  - Representation of some innovative sources at city/regional scale requires new methodologies: lumping and scaling-up
- **Hence the need for a new modelling tool**
- **A prototype version developed in collaboration with the eWater CRC**



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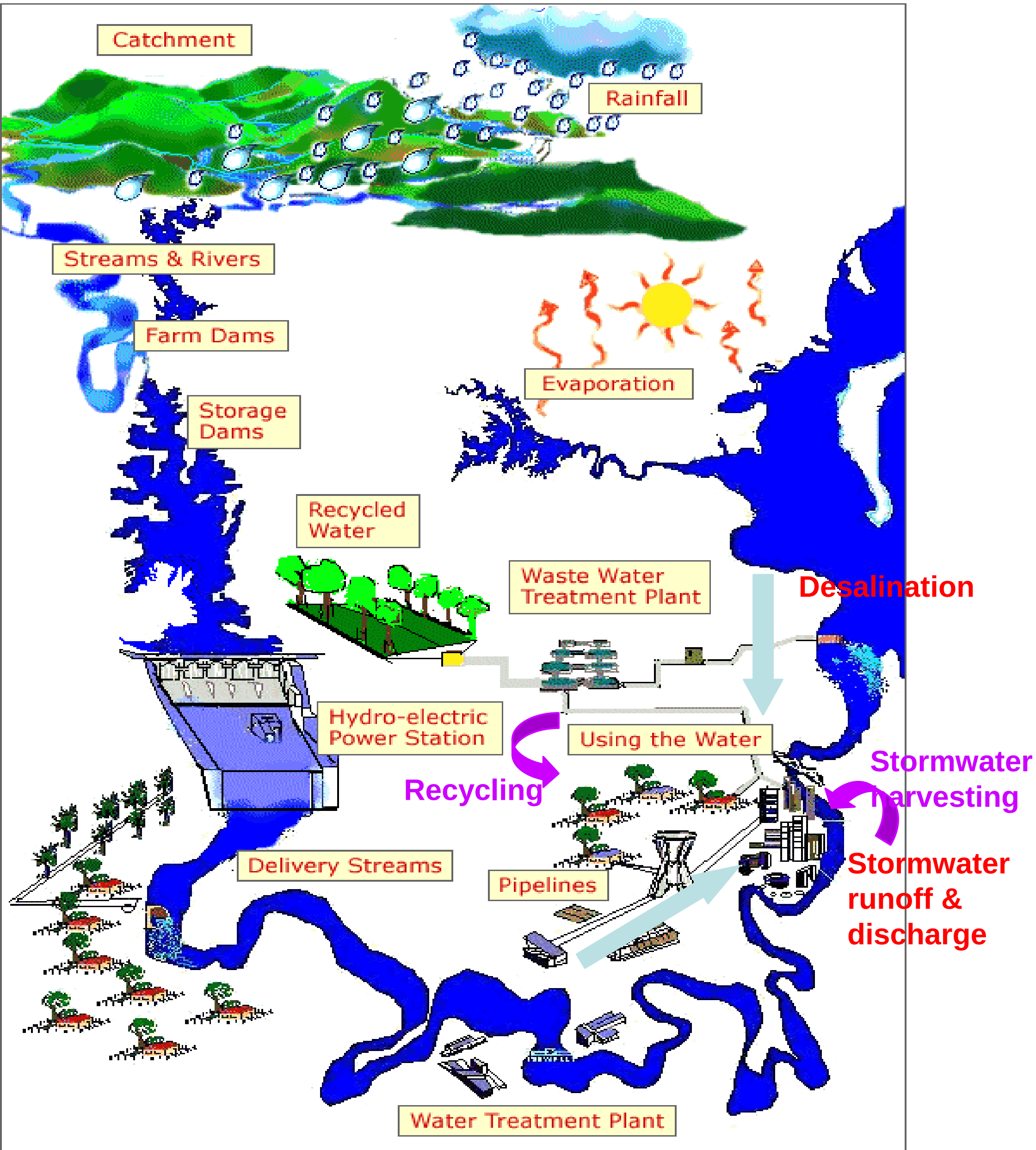
Purpose of the Prototype

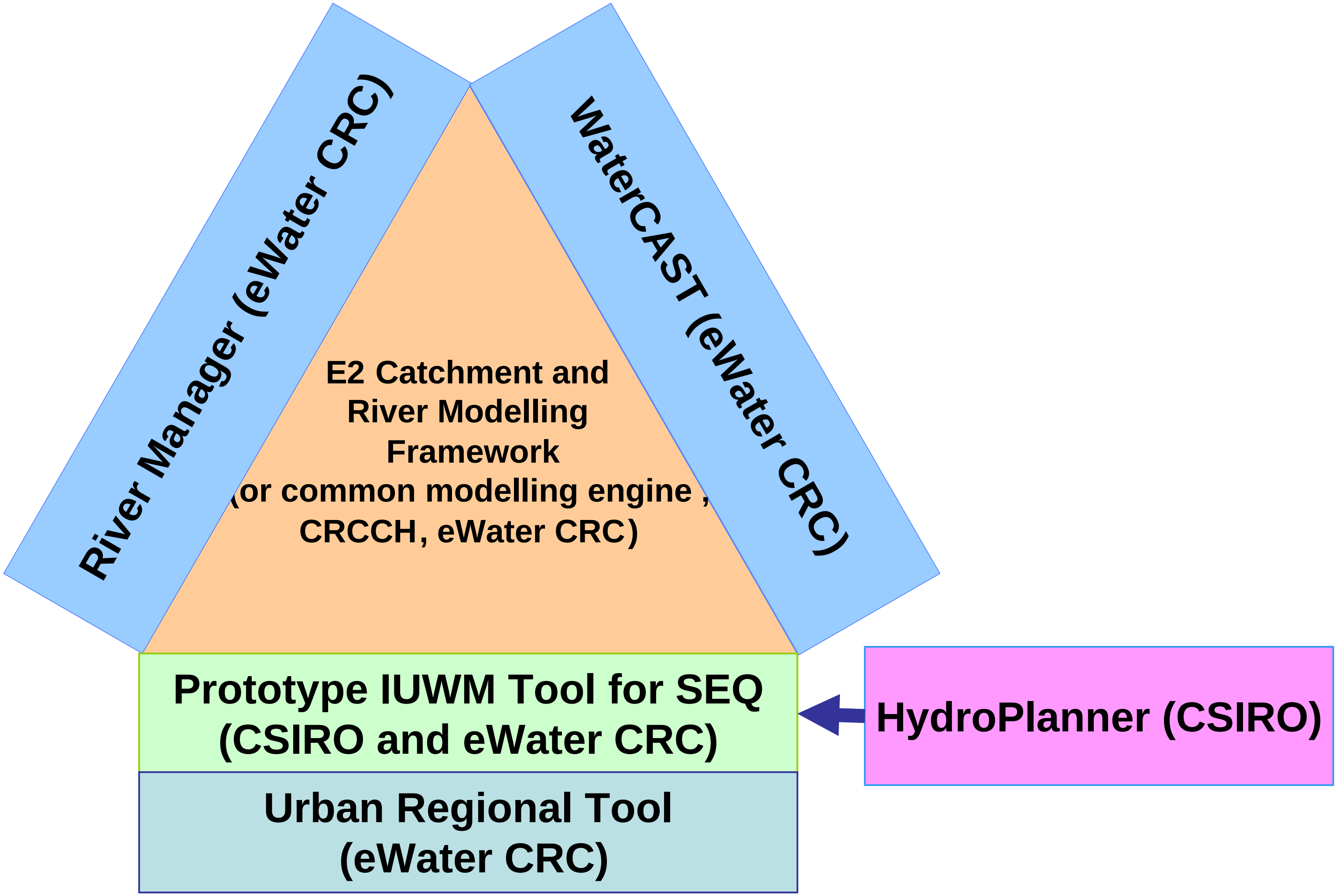


- To demonstrate capacity to predict the potential implications of:
  - centralised options
  - decentralised options

  on:
  - supply system dynamics (reliability, demand shortfall, system yield, vulnerability and resilience)
  - water quality in receiving water bodies

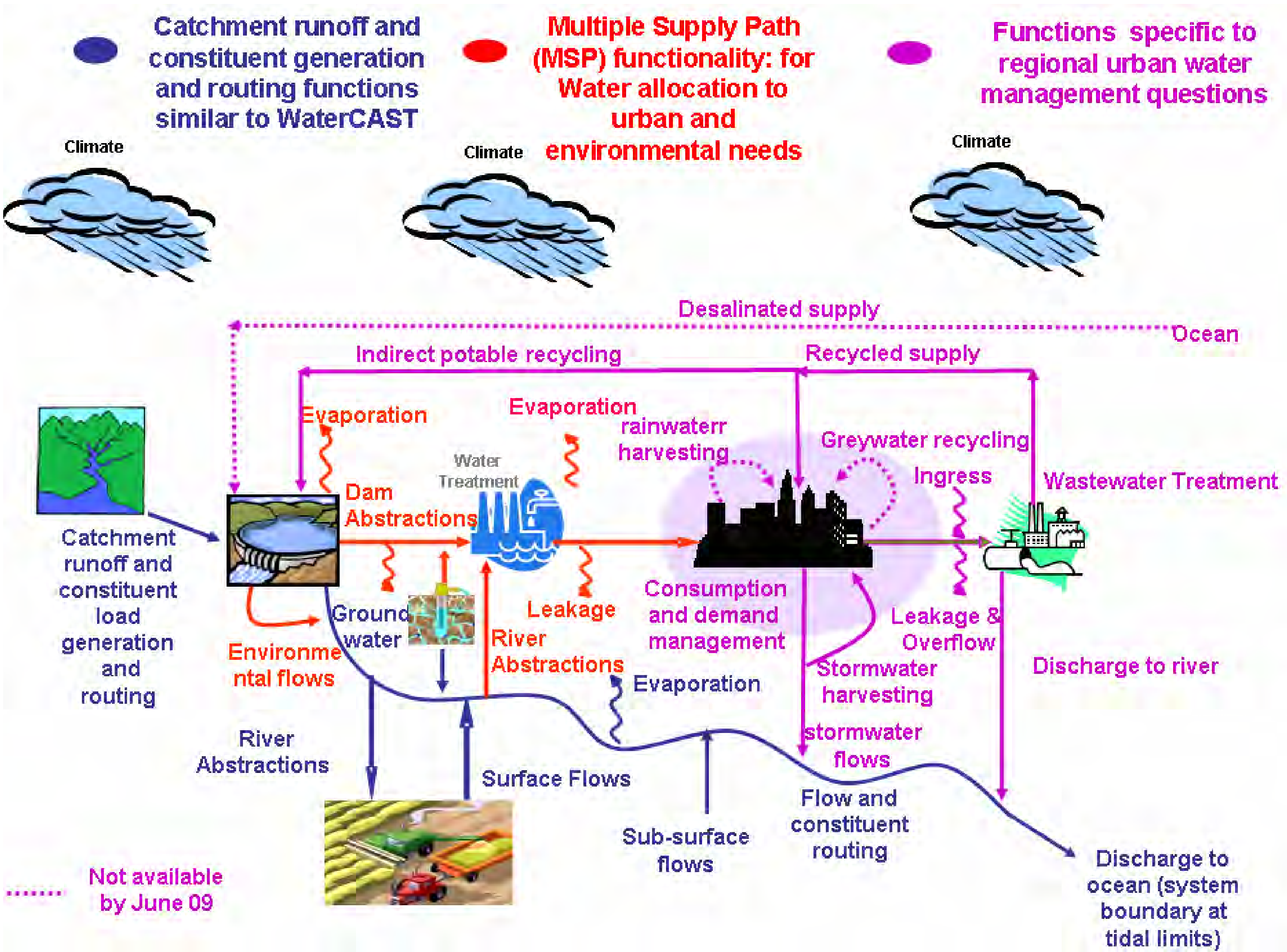
By considering changes in climate, land uses and urban development

Relationship with other products



Source: Joel Rahman, eWater CRC

Key Functionalities of the prototype



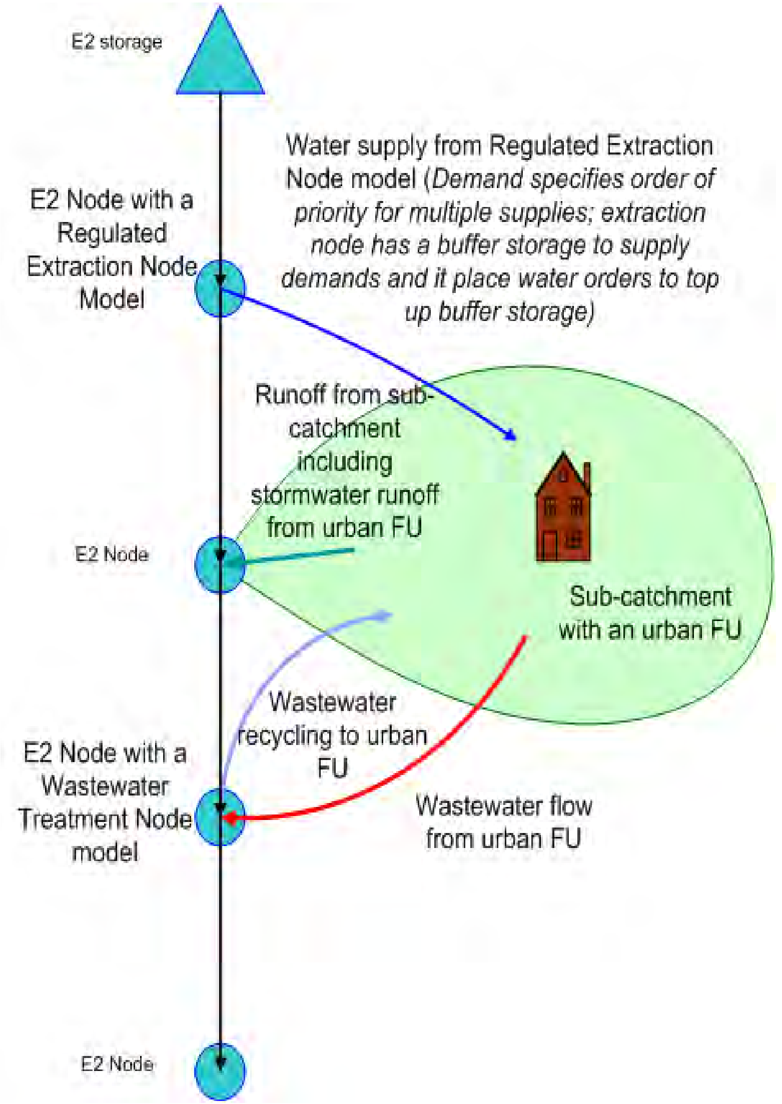
Key functionalities of the prototype

Temporal scale	• daily
Spatial scale	• whole-of-urban water system • Follow hydrological boundaries, rather than urban boundaries
Climate	• Simulate the effect of historical and future climates – Climate variability: ability to run stochastic replicates – Climate change: ability to run multiple projections
Supply system performance	• User can specify Level of Service criteria in terms of frequency, duration and severity of system demand shortfall •Computes system yield, reliability, vulnerability (severity of the failure) and resilience (how quickly system recovers from a failure state)
Urban water demand	• Demands as Functional Unit (FU) model • Demand time series specified as input data

Key functionalities of the prototype

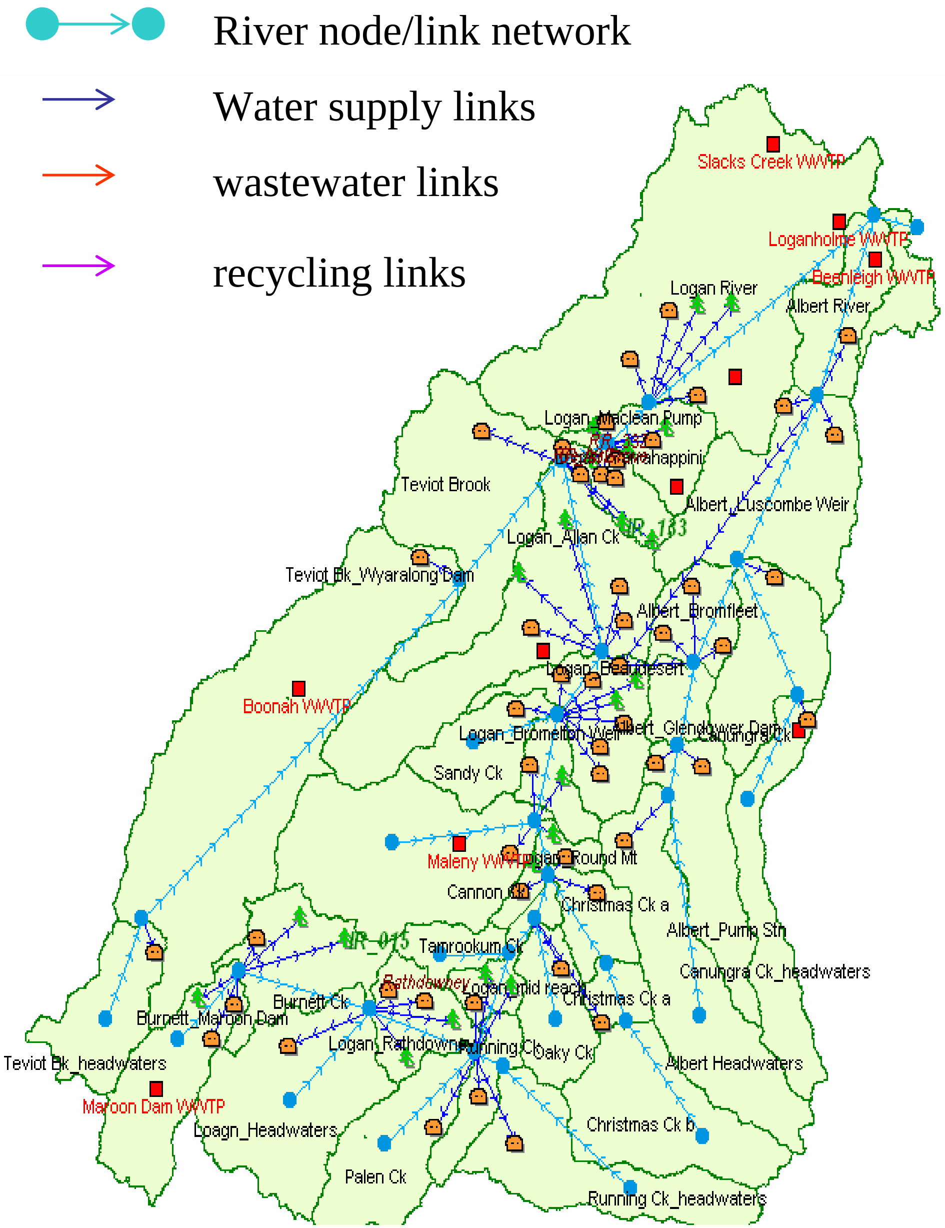
Runoff and constituent generation and transportation	• FUs generate runoff and constituents as per WaterCAST • Runoff time series can be specified as input data for urban FUs • Routing of flow through river network as per WaterCAST
Urban water supply (bulk water allocation)	• Functionality needed was *Multiple Supply Path (MSP)* • But MSP was not available in 08/09; hence developed quasi MSP method
Wastewater	• Urban FUs generate wastewater • Transportation of wastewater via pipes • Treatment provided at Wastewater Node Model, which allows recycling and dispose of unused effluent to receiving waters
Centralised supplies	• Large scale stormwater harvesting using ponds and lakes • wastewater recycling, new dams

Key software features developed



- urban demand as a FU model
- New node models for:
  - Regulated extraction node model to supply urban demands
  - WTP node model to represents WTPs
  - Flood harvesting node model for unsupplemented demands
- Splitter functionality to represent off-stream storages
- System performance indicators (system yield, demand shortfalls, reliability, vulnerability and resilience)
- User interface improvements

Test application to Logan Basin

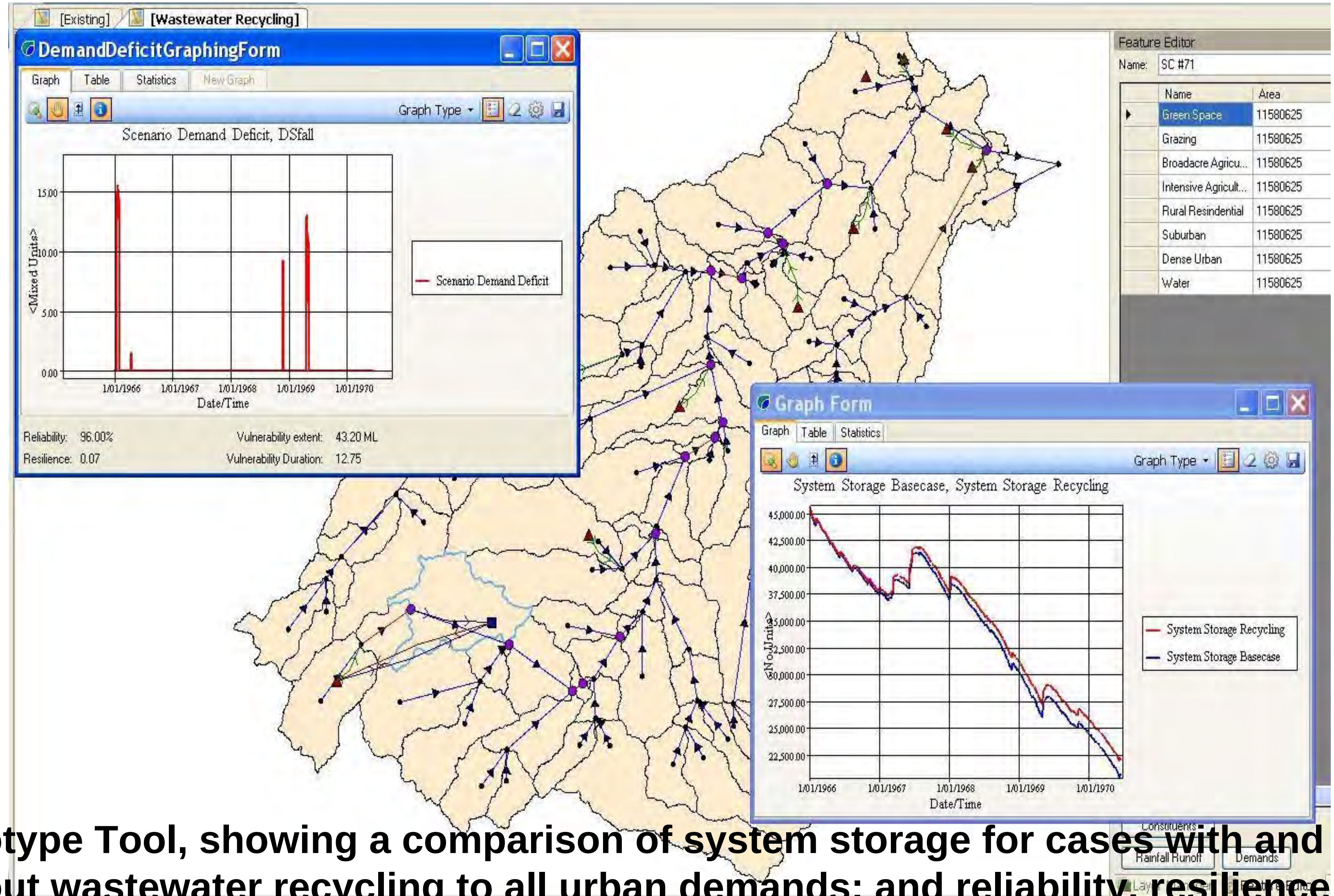


- Purpose of application: proof-of-concept
- Modelling question:
  - what will be the impact of proposed urban development and climate change over next 50 years on:
    - receiving water quality?
    - Supply system performance?
  - Without/with following water management options:
    - Recycling for urban and irrigation uses
    - stormwater harvesting for urban and irrigation uses

Key Assumptions: test application

- All data sourced from Logan IQQM model
- Excluded flow-constrained and unsupplemented demands
- Excluded external supplies, i.e. Logan as a closed catchment
- Supplementary irrigation demands as input time series
- Sub-catchments: as per WaterCAST, but recalibrated to represent IQQM inflows

Some outputs of the test application



Prototype Tool, showing a comparison of system storage for cases with and without wastewater recycling to all urban demands; and reliability, resilience and vulnerability of the supply system for a case with recycling

Take home messages and future direction

- **A prototype version of a total water cycle modelling tool developed**
  - for demonstrating the assessment of potential water quantity and quality impacts of different urban water management options at regional catchment scale
- **A review of the prototype is planned, before undertaking full development in alignment with eWater CRC’s Urban Regional Tool**

Urban Water Security Research Alliance

THANK YOU

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