Water: Technology Commercialisation or Smart Services?

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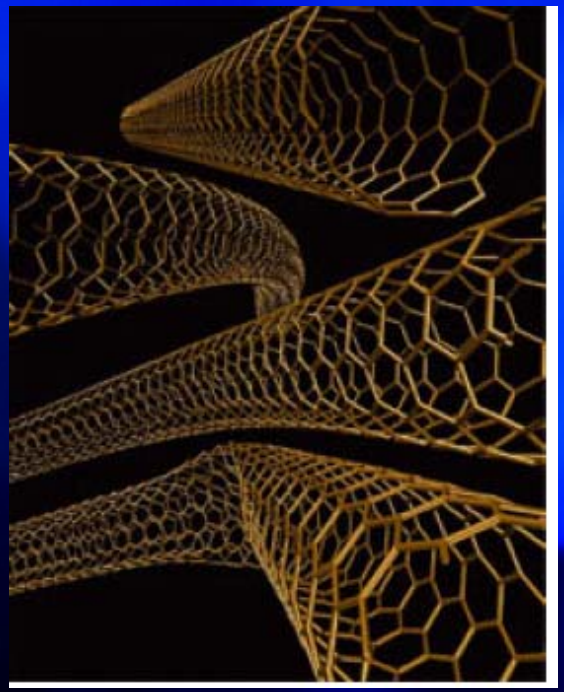
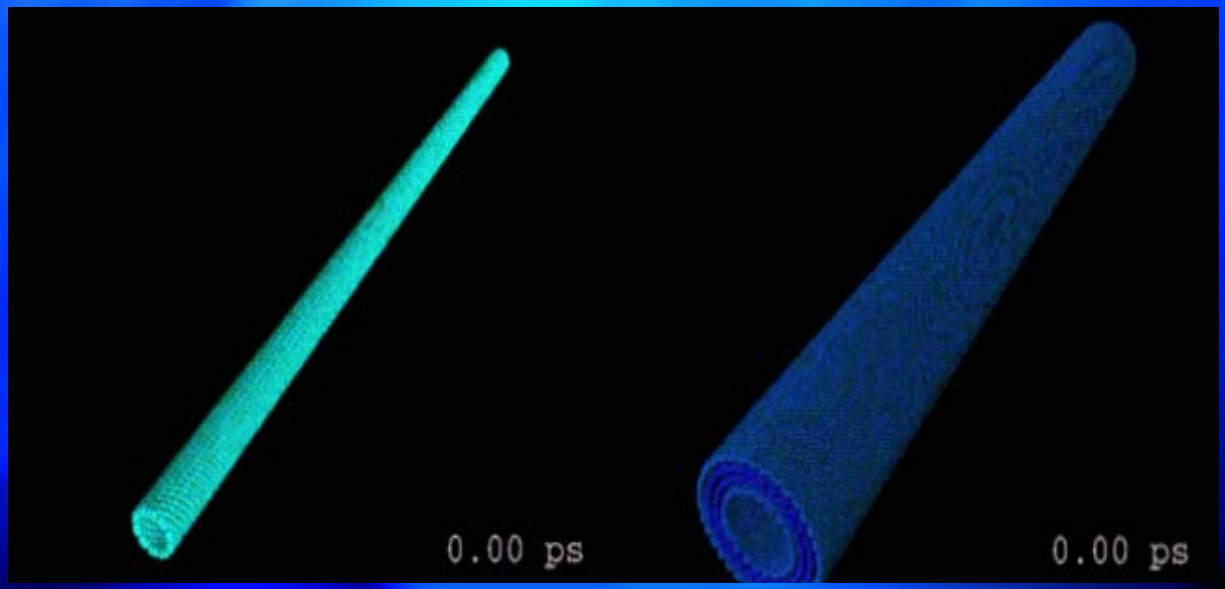
What can technology offer? – a taste

Key Technologies

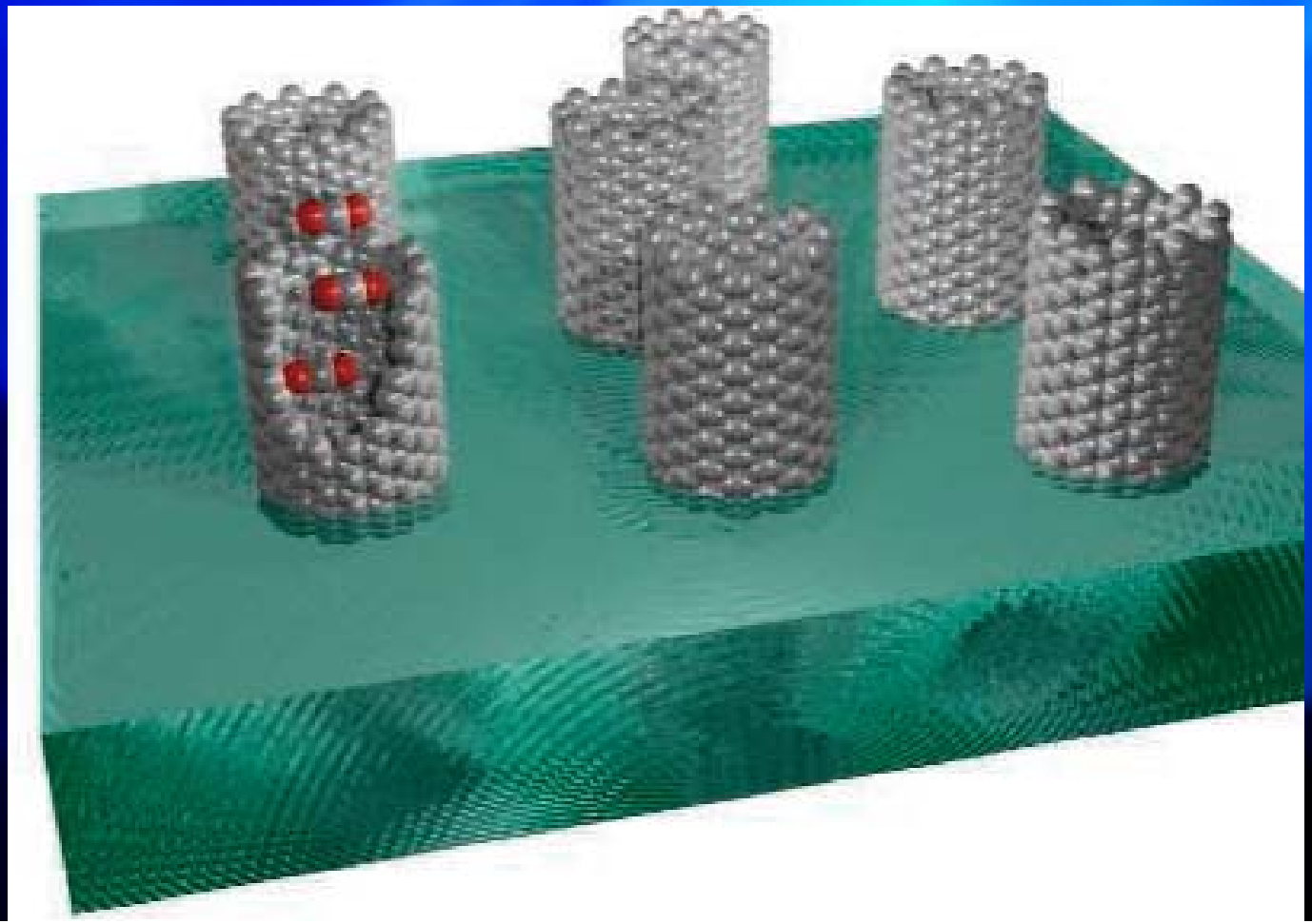
- Remotely sensed water meters
- Energy reduction technologies in water & wastewater treatment
- Membranes
- Nanostructured materials with specific properties

Nanotubes (Cientifica, 2003)





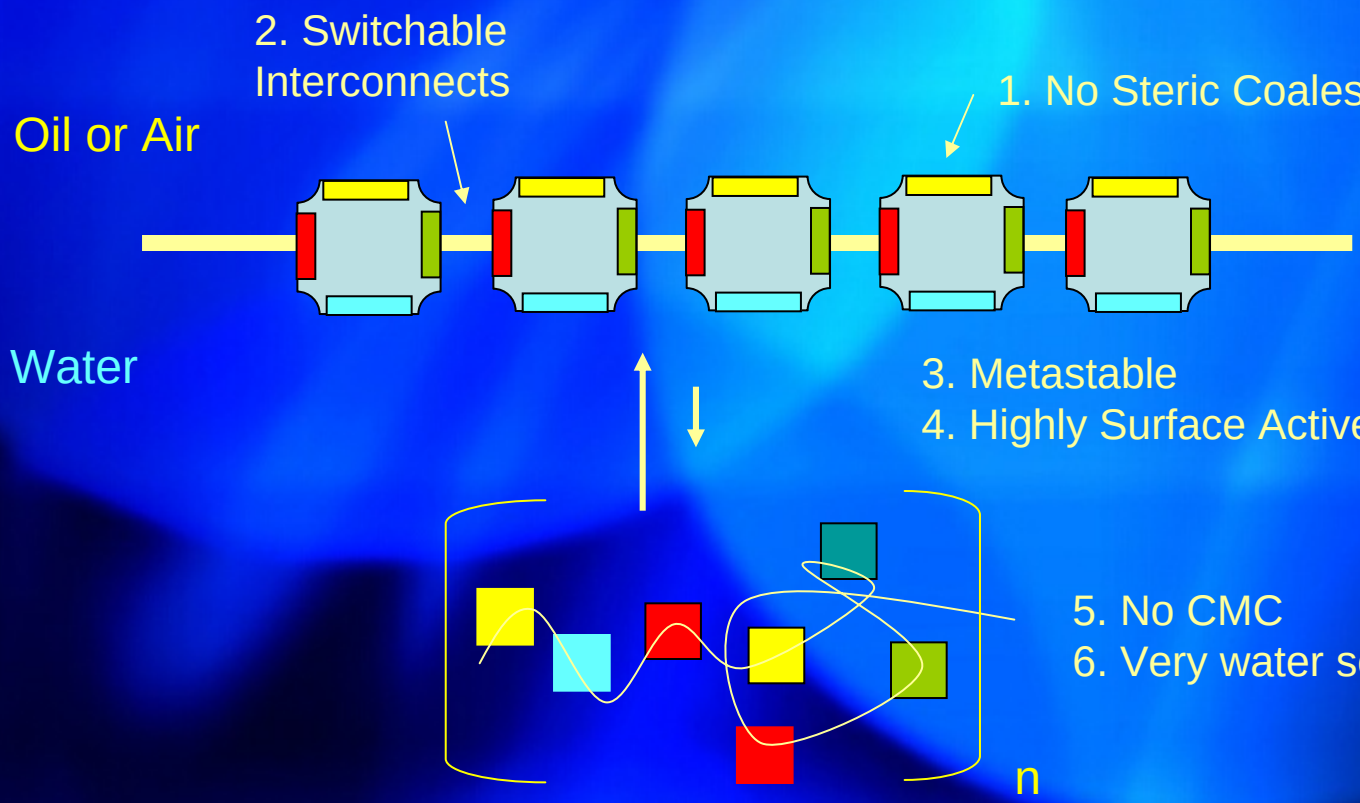
Nanoscale Modification of Membrane Properties to Enhance Water Flux (Holt et al., 2006)



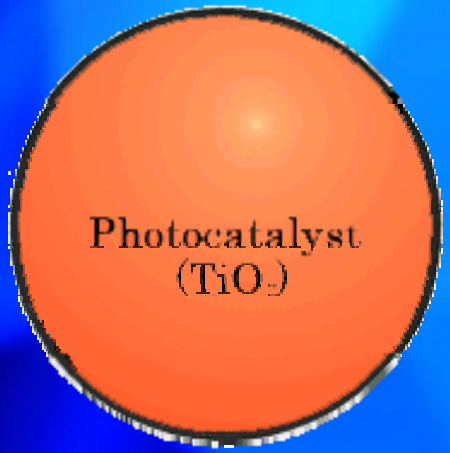
Foam Destabilisation in Handwash Detergents (after Middelberg, 2006)

- Laundry products that generate foam require significant rinsing.
- Individuals typically rinse to an end point where there is no visual foam. Sometimes this can require up to 8 rinse cycles with fresh water in each cycle.
- Many laundry products generate pH values in the range 9-10.
- Upon dilution with rinse water the pH drops to 8 or below. This pH drop can be used to trigger de-foaming by specific peptides which self-assemble in solution.
- Handwash detergents account for more than $3 billion/yr in sales from one US company (P&G).
- A key is competitive production of the peptides.

Interfacial Control



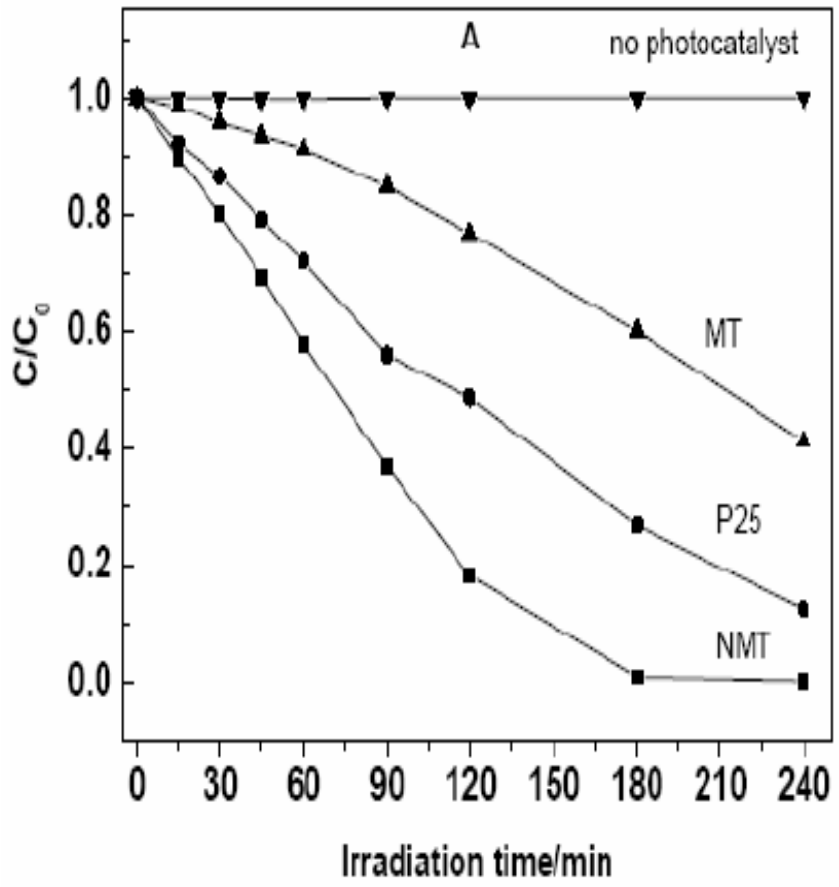
Photocatalysis on Nanocrystalline TiO_2

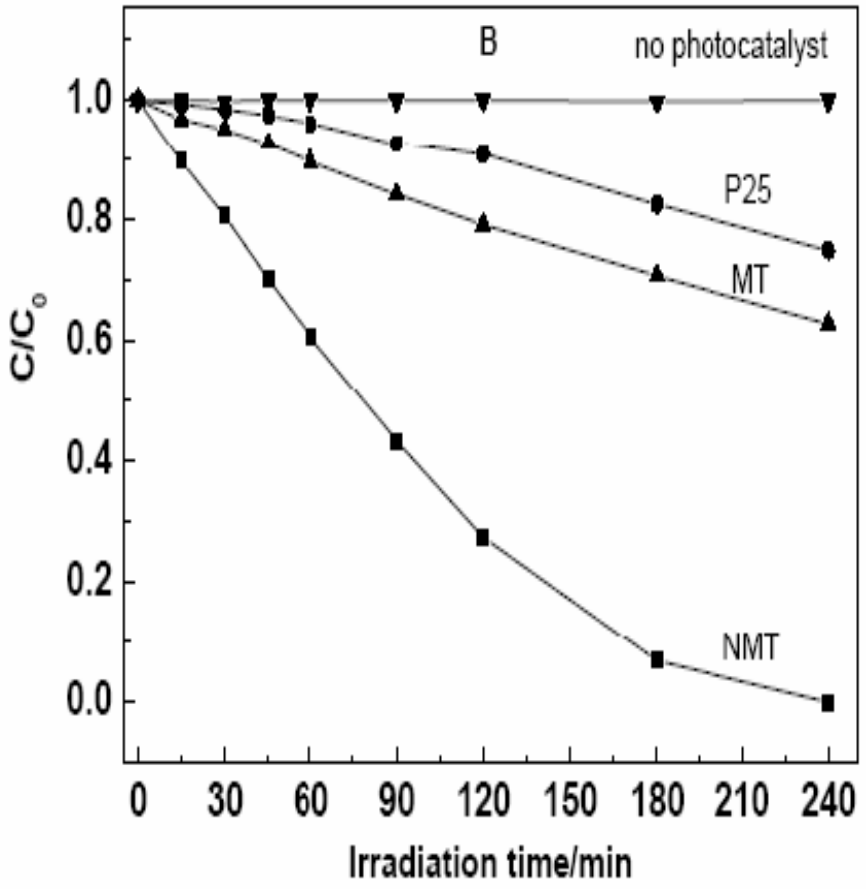


Rhodamine B degradation

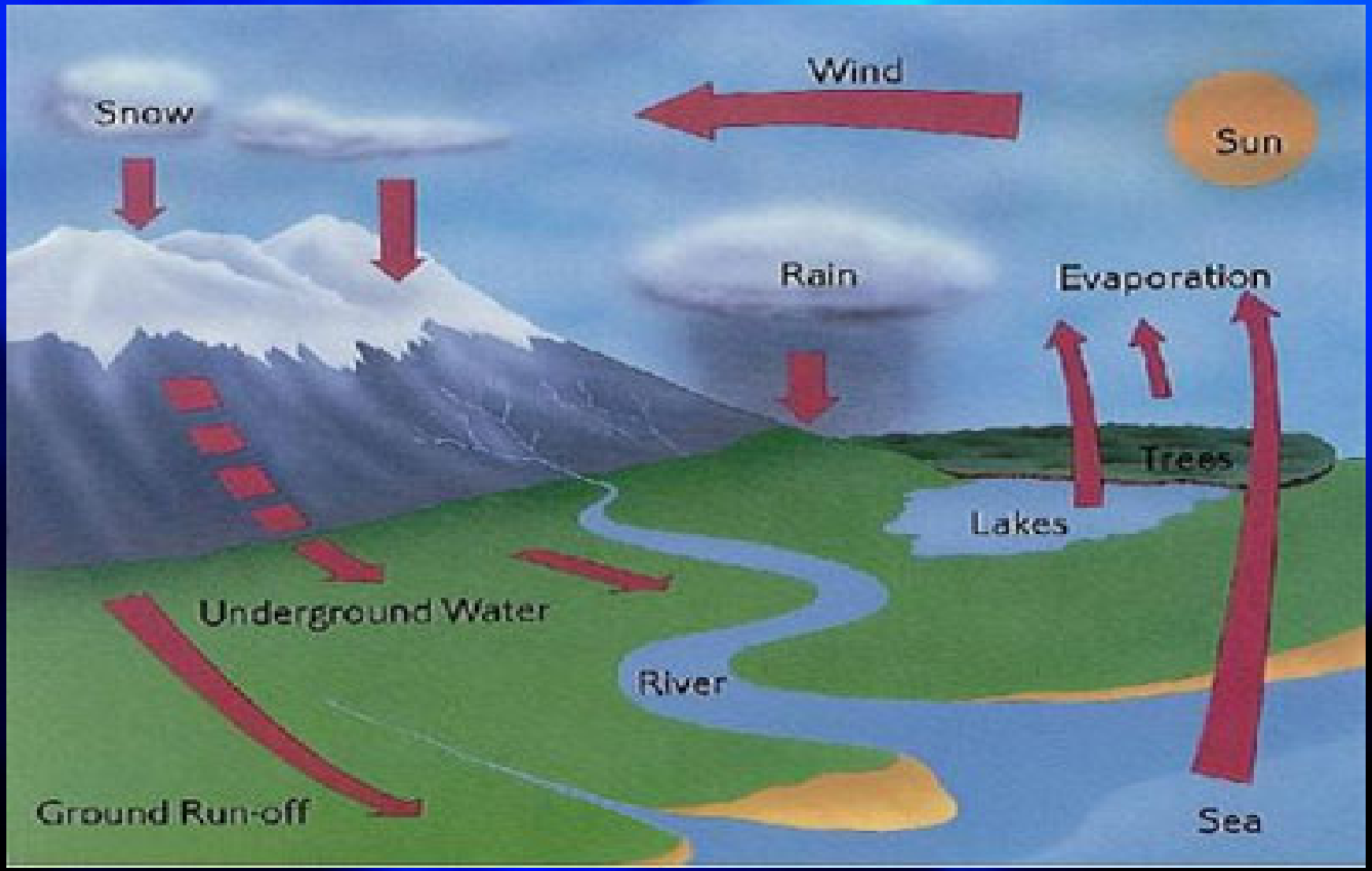
UV irradiation

Visible irradiation (>420nm)

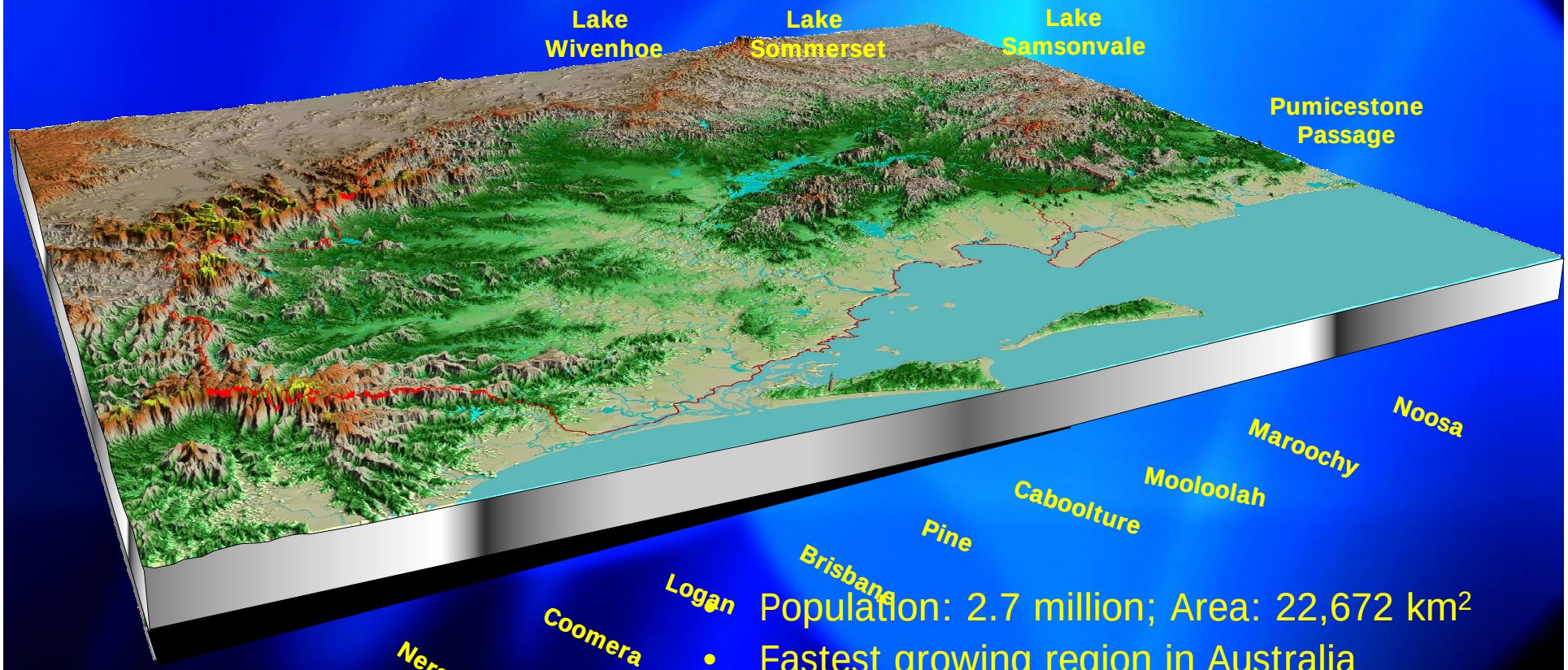




Water Cycle


Wind
Snow
Sun
Rain
Evaporation
Trees
Lakes
Underground Water
River
Ground Run-off
Sea

South East Queensland Catchment



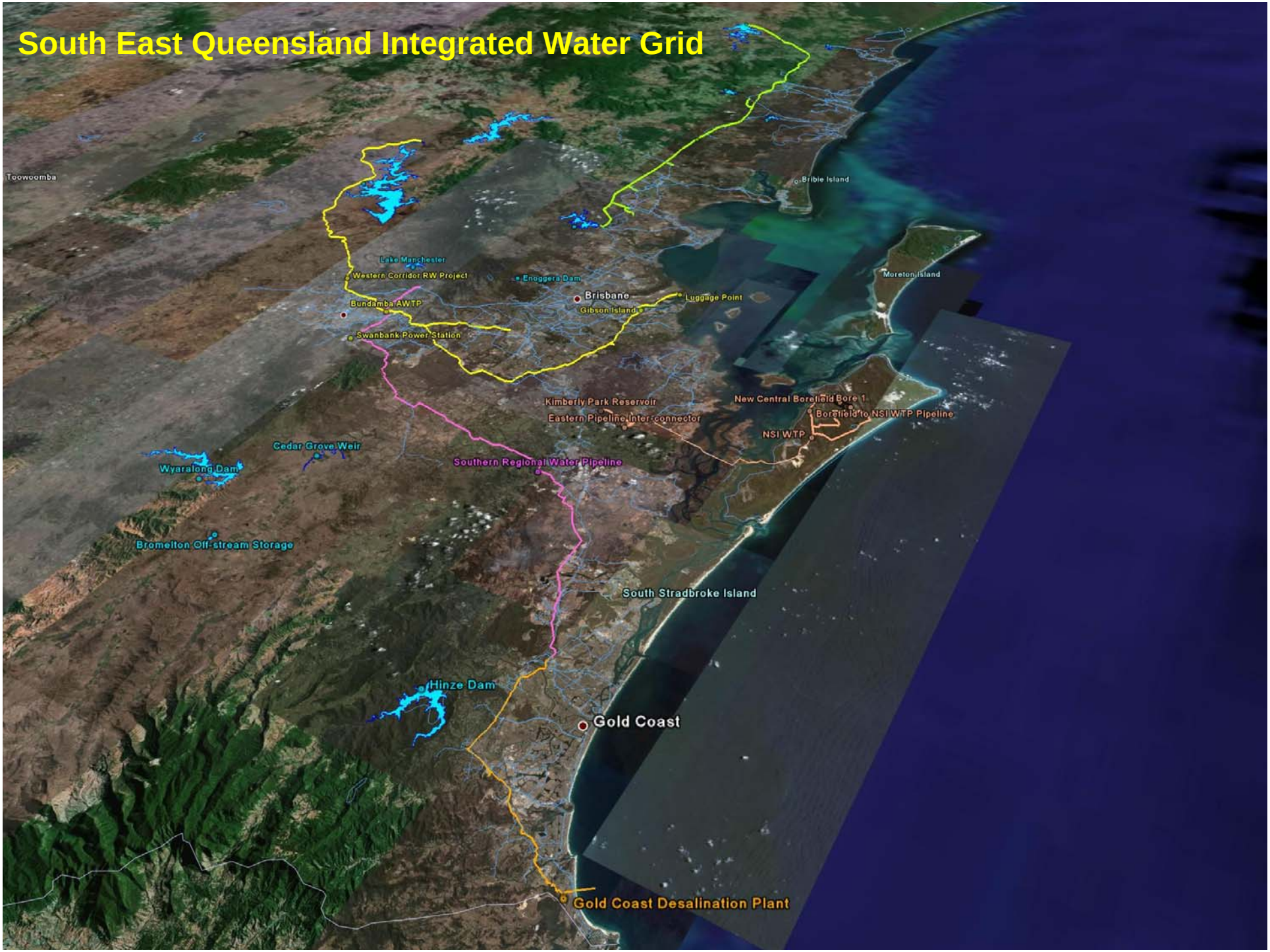
Population: 2.7 million; Area: 22,672 km^2

- Fastest growing region in Australia
- Since European settlement:
  - catchment significantly altered
  - dams and weirs regulate river flows
  - land clearing resulted in more flows, erosion and delivery of both nutrients and sediment
  - decline in aquatic species diversity

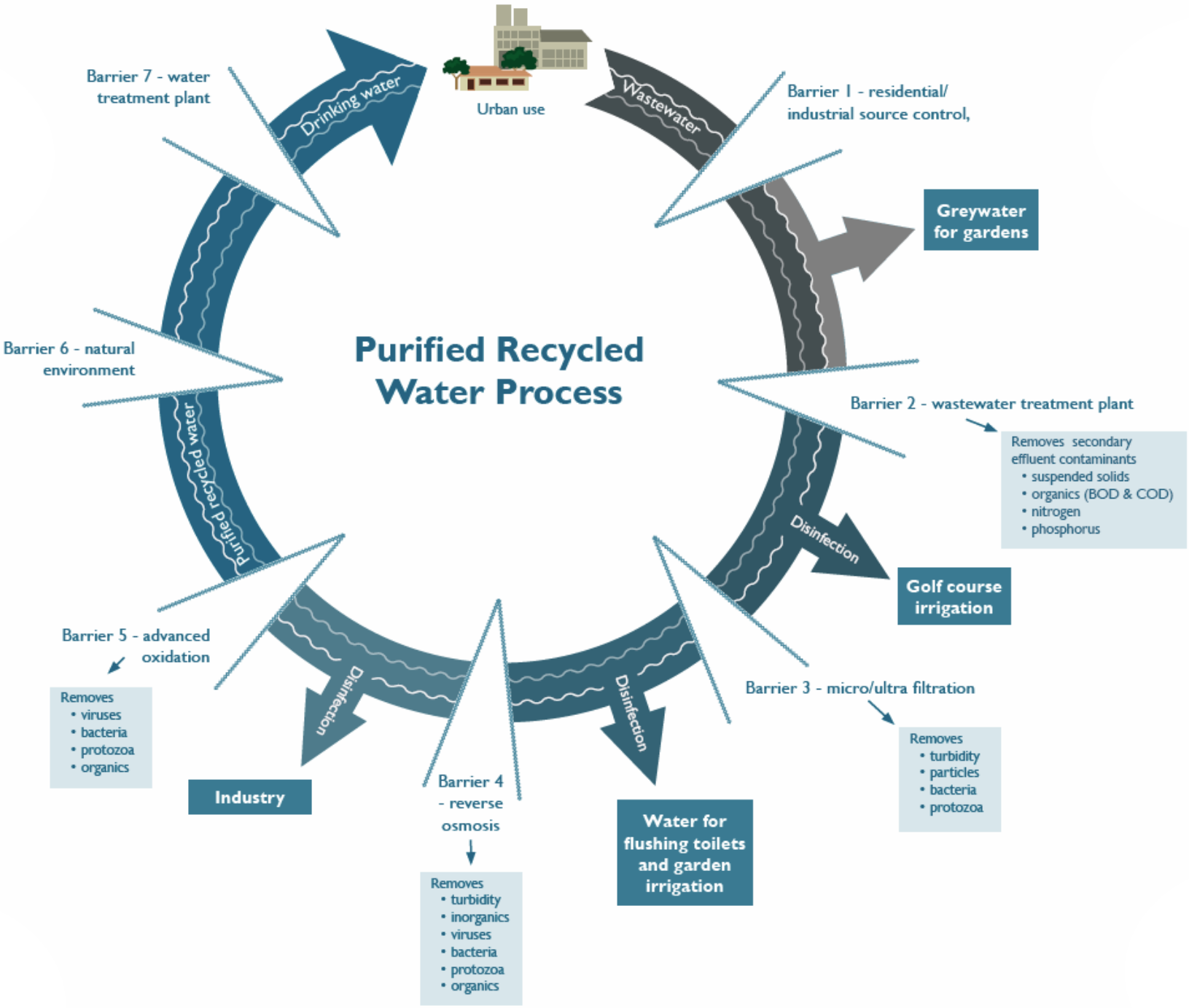
Future Water Management

- Traditionally we manage four inter-related systems in a relatively independent fashion
  - Supply
  - Disposal
  - Stormwater management
  - Aquatic ecosystem health

- For a sustainable future, we need to manage these in a linked, integrated manner

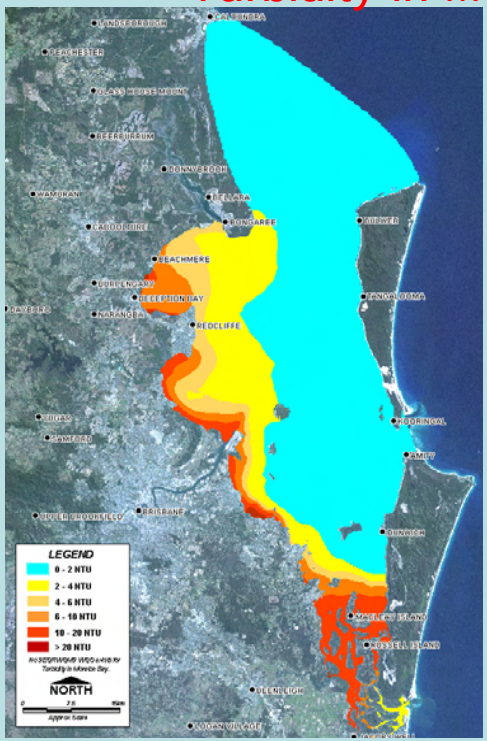

South East Queensland Integrated Water Grid
Toowoomba
Bribie Island
Lake Manchester
Western Corridor RW Project
Enoggera Dam
Brisbane
Luggage Point
Moreton Island
Bundamba AWTP
Gibson Island
Swanbank Power Station
Kimberly Park Reservoir
New Central Borefield Bore 1
Eastern Pipeline Inter-connector
Borefield to NSI WTP Pipeline
NSI WTP
Cedar Grove Weir
Wyaralong Dam
Southern Regional Water Pipeline
Bromelton Off-stream Storage
South Stradbroke Island
Hinze Dam
Gold Coast
Gold Coast Desalination Plant


South East Queensland Integrated Water Grid
Western Corridor Recycled Water Scheme
Ipswich
Swanbank Power Station
Bundamba AWTP
Lake Manchester
Enoggera Dam
North Pine Dam
Brisbane
Gibson Island
Luggage Point

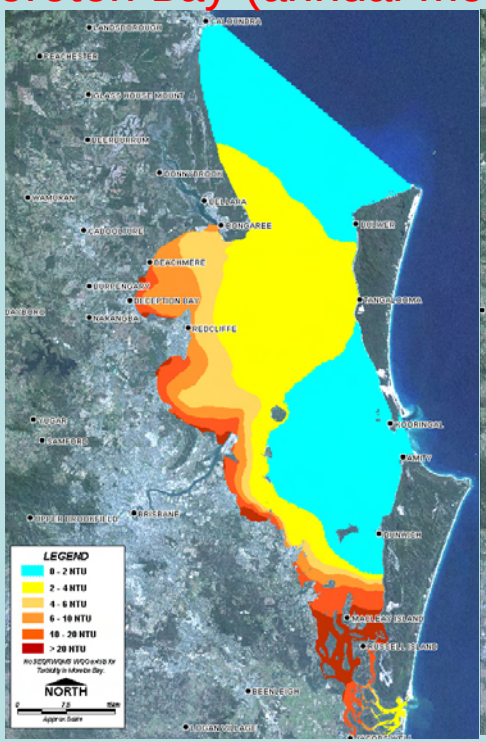

Purified Recycled Water Process
Urban use
Wastewater
Drinking water
Barrier 1 - residential/ industrial source control,
Greywater for gardens
Barrier 2 - wastewater treatment plant
Removes secondary effluent contaminants
• suspended solids
• organics (BOD & COD)
• nitrogen
• phosphorus
Disinfection
Golf course irrigation
Barrier 3 - micro/ultra filtration
Removes
• turbidity
• particles
• bacteria
• protozoa
Disinfection
Water for flushing toilets and garden irrigation
Barrier 4 - reverse osmosis
Removes
• turbidity
• inorganics
• viruses
• bacteria
• protozoa
• organics
Disinfection
Industry
Barrier 5 - advanced oxidation
Removes
• viruses
• bacteria
• protozoa
• organics
Purified recycled water
Barrier 6 - natural environment
Barrier 7 - water treatment plant

Challenges for Moreton Bay

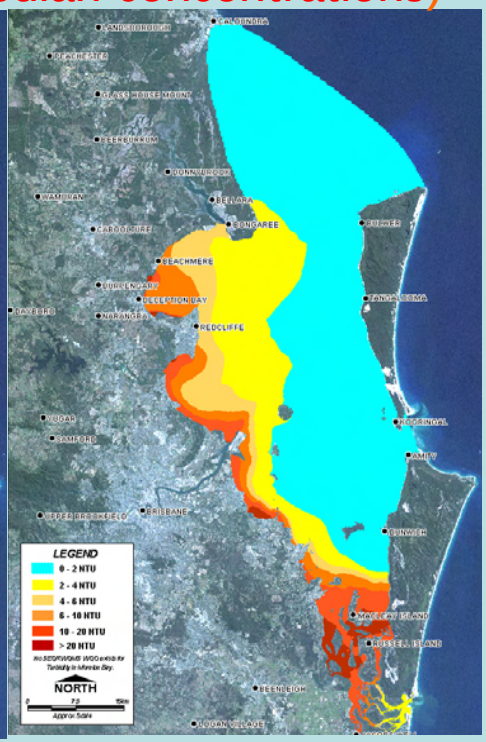
Turbidity in Moreton Bay (annual median concentrations)



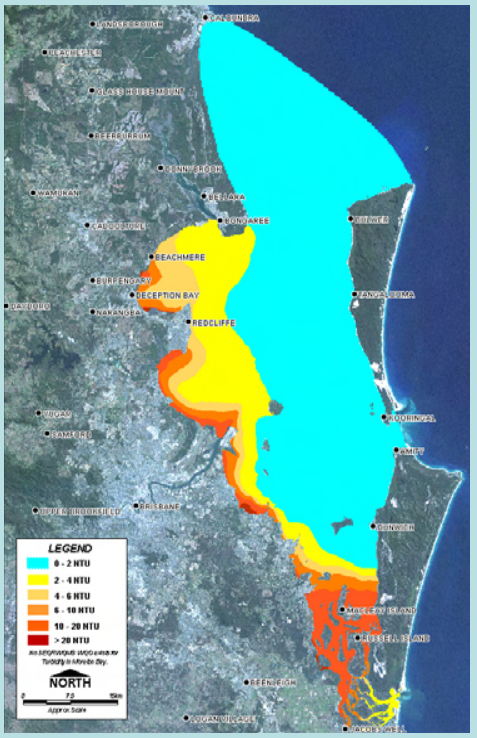
Current: 2004 with committed upgrades



2026 Business As Usual: 2026 with committed upgrades



Intermediate Investments for Load Reduction: 50% reuse, 100% WSUD in greenfield, 50% retrofit, 20% reduction in rural diffuse loads



Maximum Investments for Load Reduction: 100% reuse, 100% WSUD in greenfield, 100% retrofit, 50% reduction in rural diffuse loads

- 0-2 NTU
- 2-4 NTU
- 4-6 NTU
- 6-10 NTU
- 10-20 NTU
- >20 NTU

Annual Ecosystem Health Report Card

River Estuary Report Card 2002

Noosa River — *A-
- Extensive seagrass meadows
- Low nutrient and sediment loads
- Very low sewage nitrogen signal
- 2001 grade: A-

Maroochy River — *C
- Remnant seagrass meadows
- Poor biological nutrient processing
- Sewage nitrogen signal in middle reaches
- 2001 grade: C

Mooloolah River — *B
- Extensive mangrove communities in mid/upper reaches
- No seagrass meadows
- Channel and river bank modifications in lower reaches
- 2001 grade: B-

Pumicestone Passage — *A-
- Extensive seagrass, mangrove and saltmarsh areas
- Generally good water quality
- No sewage nitrogen signal
- 2001 grade: B

Caboolture River — C
- High level of biological nutrient processing
- Elevated phytoplankton & total nitrogen
- High sewage nitrogen signal
- 2001 grade: C

Pine Rivers — D+
- Some biological processing of nutrient
- Small increase in phytoplankton biomass
- Moderate sewage nitrogen signal
- 2001 grade: D+

Brisbane River — D-
- High nutrient and sediment loads
- Biological processing of nutrients during winter
- Highest sewage nitrogen signal in the region
- 2001 grade: D-

Bremer River — F
- Highest nutrient and sediment loads in region
- Elevated phytoplankton & low dissolved oxygen
- High sewage nitrogen signal
- 2001 grade: F

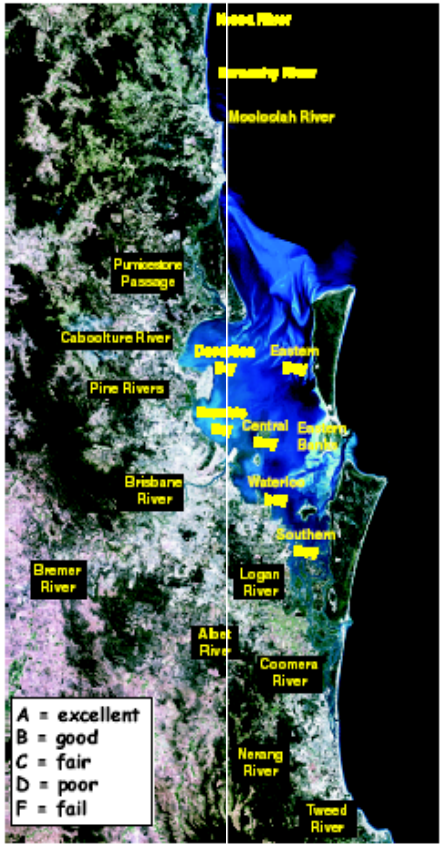
Logan River — D-
- High nutrient and sediment loads
- Biological processing of nutrients during winter
- High sewage nitrogen signal
- 2001 grade: D

Albert River — 2001 grade: D — #D

Coomera River — 2001grade: B — *B

Nerang River — 2001grade: B — #B

Ecosystem health MONITORING PROGRAM



* Grades based on limited data set (e.g. 9 months data in northern region)
# Insufficient ecosystem health data, results based on water quality only

Moreton Bay Report Card 2002

Overall Rating — B
- The health of Moreton Bay improved
- No flood event
- Reduced sewage nitrogen plume
- 2001 grade: C

Deception Bay — C-
- Evidence of seagrass in southern bay
- *Lyngbya* blooms present in northern bay
- Poor water quality in southern bay
- 2001 grade: D (southern) D- (northern)

Bramble Bay — D
- Highest nutrient and phytoplankton concentrations in Moreton Bay
- No seagrass recovery
- Sewage nitrogen plume decreased
- 2001 grade: F

Central Bay — A-
- Relatively good water quality
- Corals present but have low coverage
- No sewage nitrogen signal
- 2001 grade: B

Eastern Banks — B
- *Lyngbya* bloom present but less extensive than 2000-01
- Dense coral at Myora Springs
- 2001 grade: C

Eastern Bay — A-
- Extensive seagrass beds
- Diverse & dense corals north of Peel Island
- Localised *Lyngbya* bloom south of Peel Island
- 2001 grade: A-

Waterloo Bay — B-
- No sewage nitrogen signal
- Corals present but have low coverage
- Extensive but shallow seagrass meadows
- 2001 grade: B-

Southern Bay — B-
- High phytoplankton biomass
- *Lyngbya* bloom near Victoria Point
- No sewage signal from Logan River
- 2001 grade: C-

South Broadwater — #A-

Annual Ecosystem Health Report Card

Catchments of SEQ

Ecosystem health
MONITORING PROGRAM

Freshwater report Card 2002

Noosa — **A-**
- Most rivers in very good condition
- Some major tributaries in fair condition due to increased sedimentation
- Excellent riparian vegetation in National Park
- 2001 grade: A-

Maroochy - Mooloolah — **C+**
- Most rivers in fair condition
- Excessive algal production in small streams cleared of vegetation
- Water weeds dominant in some sub-catchments
- 2001 grade: C+

Stanley - Kilcoy — **B-**
- Upland streams in excellent condition, lowland rivers in fair condition
- Major dams affect fish communities
- Sedimentation causes habitat loss in some systems
- 2001 grade: B-

Caboolture - Pumicestone — **C**
- Most streams in fair condition
- Excess sediment in some small coastal sub-catchments due to clearing
- Good riparian vegetation on upland streams, fair on lowland reaches
- 2001 grade: C

Upper Brisbane — **D+**
- Lowland streams in fair to poor condition
- Some smaller upland streams in good condition
- Loss of riparian vegetation has led to excessive algal growth
- 2001 grade: D

Pine — **C**
- Most streams in fair to good condition
- Fish communities in some streams dominated by introduced species
- High algal productivity in some streams
- 2001 grade: C

Mid Brisbane — **C**
- River in fair to poor condition
- Some changes to fish community
- Altered flow regime reduces opportunity for fish recruitment
- 2001 grade: C

Lower Brisbane (tributaries) — **D**
- Most creeks in fair to poor condition
- Fish communities dominated by introduced species
- Creeks often choked with introduced weeds
- 2001 grade: D-

Lockyer — **F**
- Major streams in very poor condition, some upland streams good
- Stream flow reduced by water extraction, particularly during dry years
- Channels lack suitable riparian vegetation and often choked with weeds
- 2001 grade: F

Logan - Albert — **D+**
- Rivers in fair to poor condition
- Some upland streams in very good condition
- Introduced fish species prevalent, especially carp
- 2001 grade: D

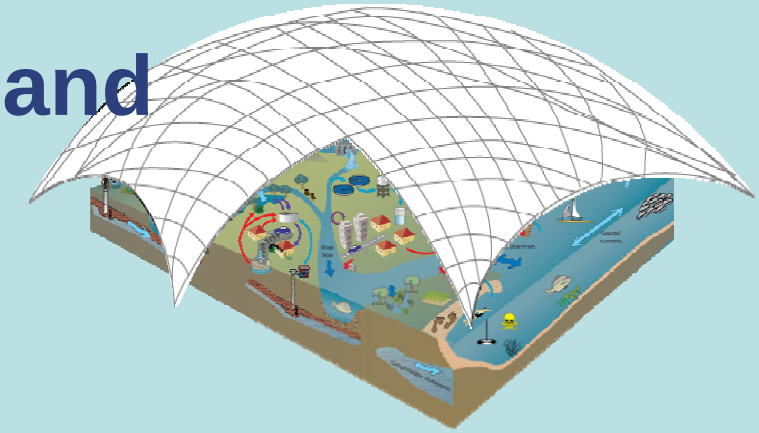
Bremer — **F**
- Major streams in very poor condition
- Stream flow reduced by water extraction, particularly during dry years
- Channel erosion in some areas
- 2001 grade: F

Gold Coast — **B-**
- River and stream condition varies from very good to poor
- Waterweeds choke channels in some sub-catchments
- Very high algal growth in small streams cleared of vegetation
- 2001 grade: B-

Some Examples of WSUD

The South East Queensland Integrated Water Cycle

Conceptual Diagram



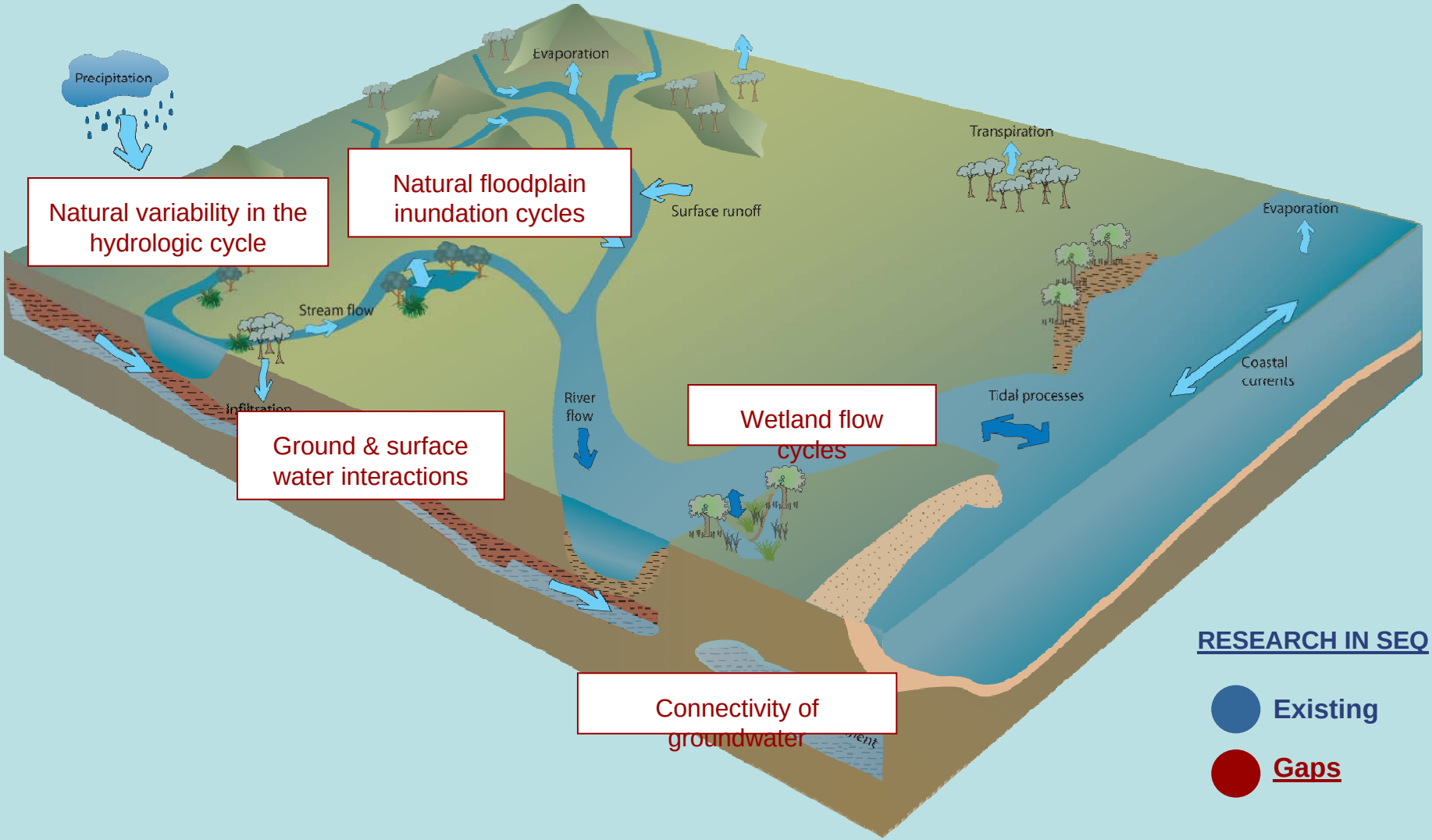
CONCEPTUAL LAYERS

- Natural hydrologic cycle
- Environmental values
- Environmental values: servicing the values
- Environmental values: pressures
- Institutional arrangements

SCIENCE RESEARCH

- Decentralised Urban Water Cycle
- Centralised Urban Water Cycle
- Rural Water Cycle
- Total Water Cycle

Natural hydrologic cycle



Natural variability in the hydrologic cycle

Natural floodplain inundation cycles

Ground & surface water interactions

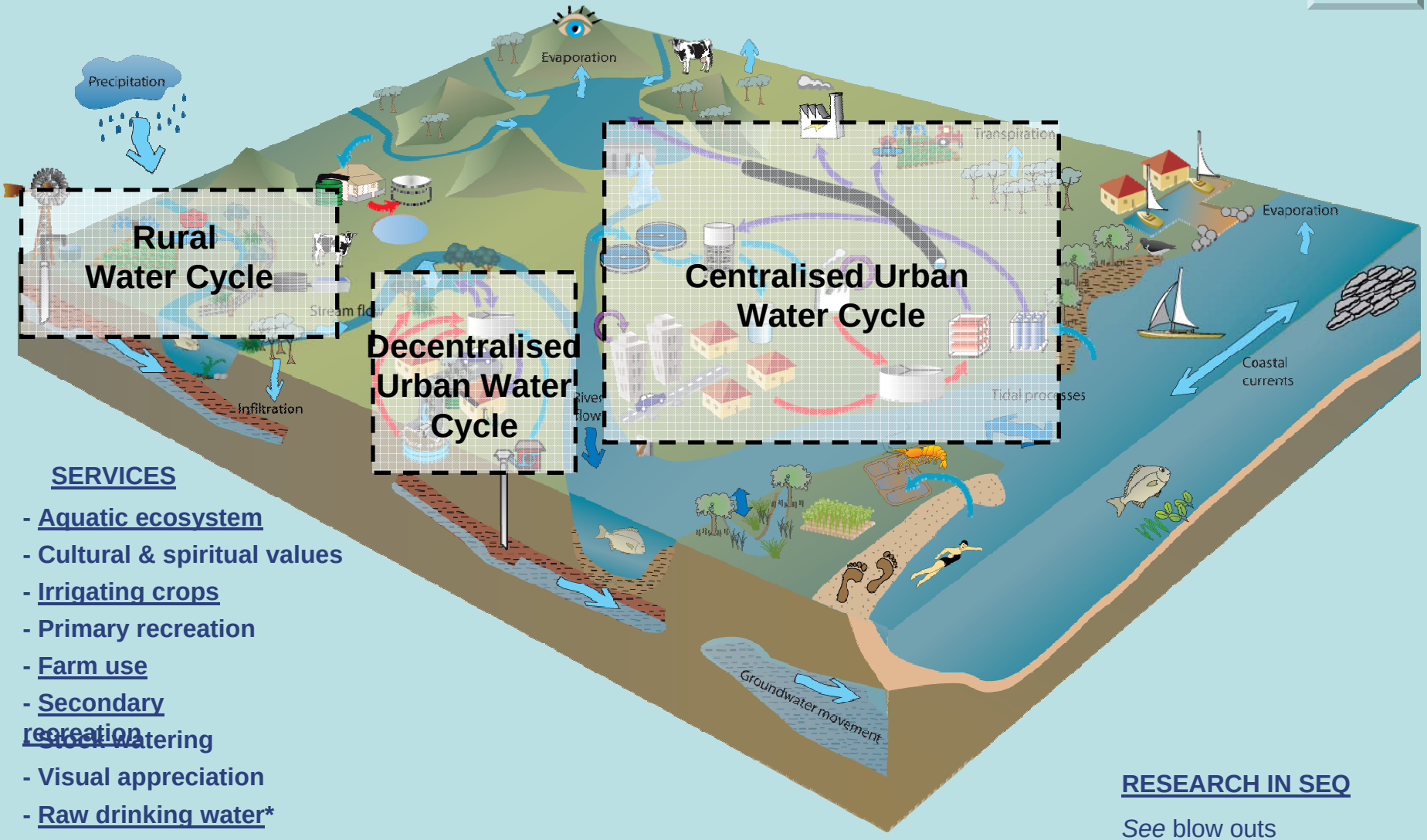
Wetland flow cycles

Connectivity of groundwater

RESEARCH IN SEQ

- Existing
- Gaps

Environmental values: servicing the values



SERVICES

- Aquatic ecosystem
- Cultural & spiritual values
- Irrigating crops
- Primary recreation
- Farm use
- Secondary recreation
- Stock watering
- Visual appreciation
- Raw drinking water*
- Human consumption
- Industrial use
- Aquaculture

RESEARCH IN SEQ

See blow outs

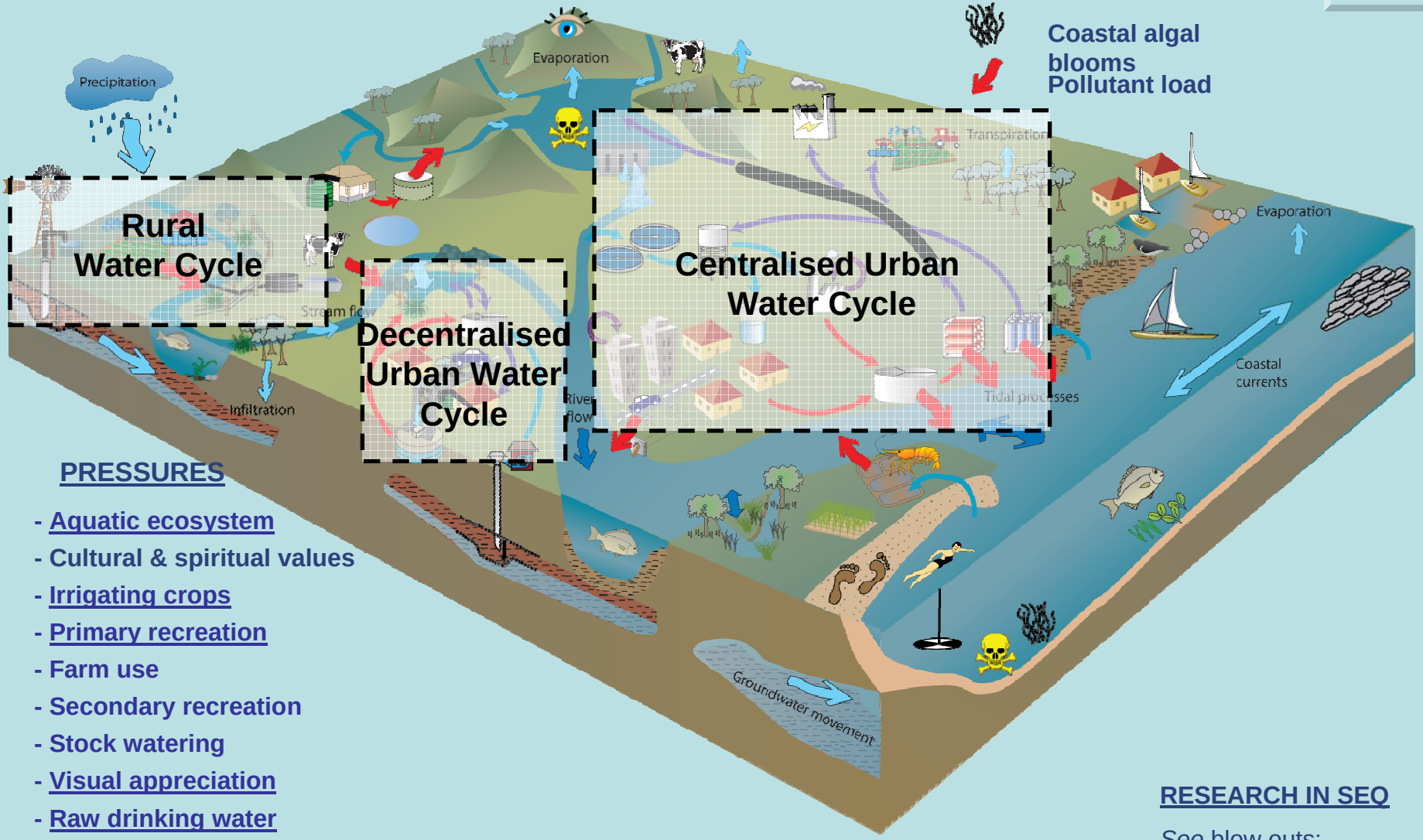
Environmental values: pressures

Water clarity

Toxins

Coastal algal blooms

Pollutant load



PRESSURES

- Aquatic ecosystem
- Cultural & spiritual values
- Irrigating crops
- Primary recreation
- Farm use
- Secondary recreation
- Stock watering
- Visual appreciation
- Raw drinking water
- Human consumption
- Industrial use
- Aquaculture

RESEARCH IN SEQ

See blow outs:

Centralised Urban Water Cycle

Trade waste characterisation *(Urban Water Alliance)*

Reuse optimisation *(UQ Chair in Recycled Water)*

Recycled water to agriculture *(Urban Water Alliance)*

Demand management

Water use efficiency in industry

Desalinatio n

Evaporative loss from storages *(Urban Water Alliance)*

Reservoir impacts & treatment *(Urban Water Alliance, UQ, GU, CSIRO)*

Leakage *(Urban Water Alliance)*

Water treatment plant *(CRCWQ&T)*

Reject stream – AWTP & desalination

Dense urban recycling *(Urban Water Alliance)*

STP treatment efficacy *(Urban Water Alliance, AWMC)*

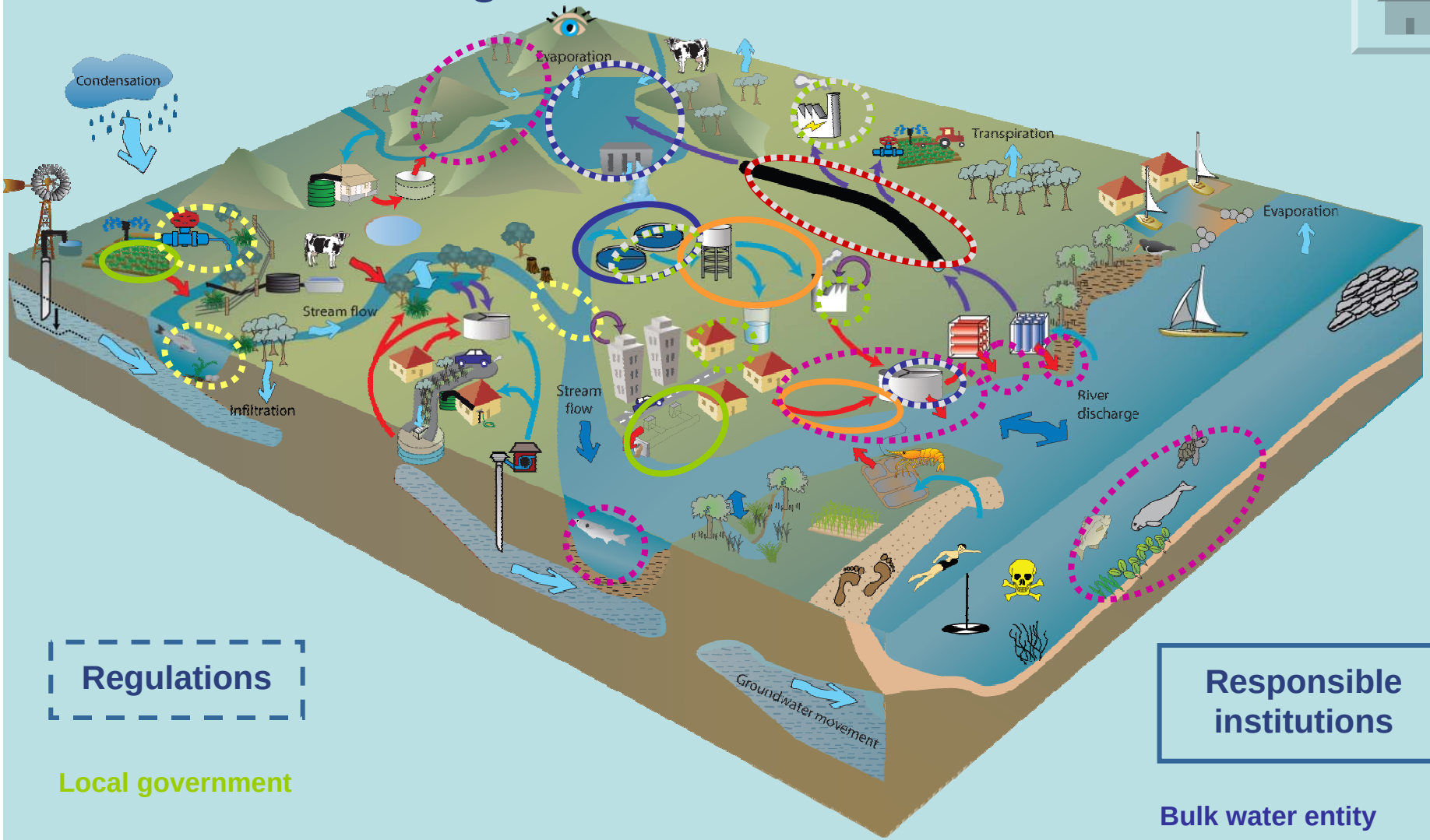
- Traditional water supply
- Advanced Wastewater Treatment and Western Corridor Recycling Scheme
- Lockyer
- Desalination
- Recycling within commercial buildings & industry

RESEARCH IN SEQ

Existing

Gaps

Institutional Arrangements



Regulations

Local government

Environmental regulation (EPA)

Water quality regulation (NRW)

Public health regulation

Responsible institutions

Bulk water entity

Bulk transport

Distribution

Local government