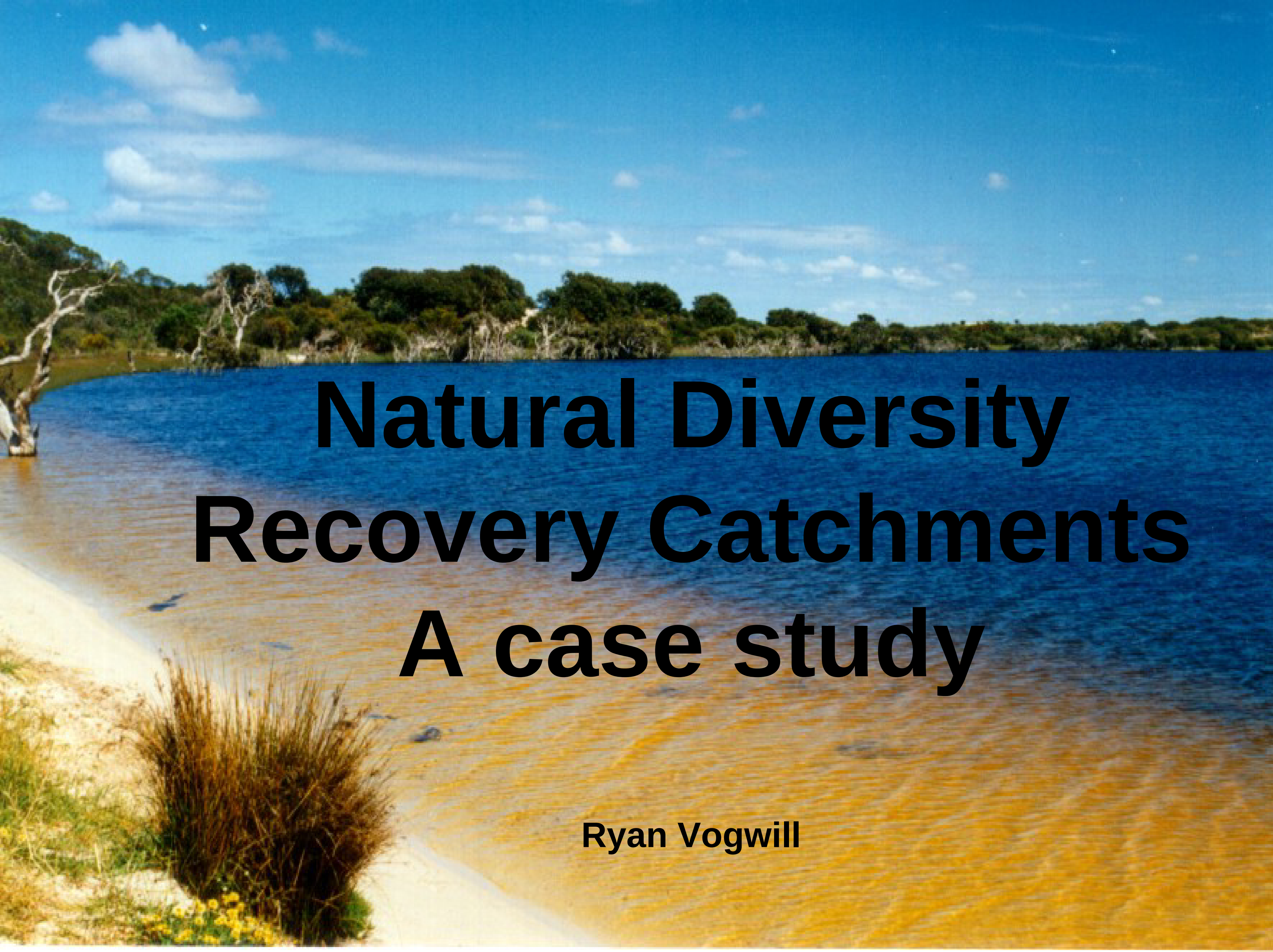


# Natural Diversity Recovery Catchments A case study

**Ryan Vogwill**

# Outline

- Part 1: planning tools
- Part 2: conceptual models, hypotheses, evaluation


Values
Goals
Biodiversity assets
Ecosystem processes
Feasibility of management
Priority actions
Implement, monitor
and evaluate

# Assessing biodiversity values

# What are biodiversity values?

1. The benefits for human well-being where this encompasses survival, reproduction and other key human needs.

# Why is natural biodiversity valuable?

- Productive use values
- Consumptive use values
- Aesthetics
- Health (physio-chem envt)
- Health (disease)
- Knowledge and educational values
- Recreation values
- Spiritual/philosophical/intrinsic values
- Opportunity values

| Stakeholder Values | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Knowledge and educational values** | 7 | 2 | 1 | 6 | 3 | 4 | 3 | 3 | 3 | 3 | 4 | 3 | 6 | 48 | 1 |
| **Health (phys/chem envt)** | 5 | 7 | 2 | 2 | 5 | 2 | 1 | 7 | 5 | 5 | 3 | 2 | 8 | 54 | 2 |
| **Recreation values** | 2 | 4 | 6 | 1 | 1 | 1 | 7 | 5 | 6 | 6 | 6 | 7 | 3 | 55 | 3 |
| **Spiritual/philosophical values** | 8 | 6 | 4 | 5 | 7 | 6 | 4 | 1 | 1 | 1 | 1 | 4 | 9 | 57 | 4 |
| **Aesthetics** | 1 | 5 | 3 | 7 | 2 | 7 | 6 | 9 | 4 | 7 | 5 | 8 | 5 | 69 | 5 |
| **Opportunity values** | 6 | 1 | 5 | 8 | 4 | 5 | 5 | 2 | 8 | 2 | 7 | 9 | 7 | 69 | 5 |
| **Health (organisms)** | 9 | 3 | 7 | 9 | 6 | 3 | 2 | 8 | 7 | 4 | 2 | 6 | 4 | 70 | 7 |
| **Productive use values** | 3 | 9 | 9 | 3 | 9 | 9 | 9 | 4 | 2 | 8 | 9 | 1 | 1 | 76 | 8 |
| **Consumptive use values** | 4 | 8 | 8 | 4 | 8 | 8 | 8 | 6 | 9 | 9 | 8 | 5 | 2 | 87 | 9 |

| Values (Personal ) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spiritual/philosophical values | 3 | 9 | 3 | 4 | 1 | 4 | 3 | 1 | 1 | 1 | 2 | 1 | 9 | 42 | 1 |
| Health (phys/chem envt) | 5 | 1 | 1 | 2 | 6 | 2 | 2 | 8 | 2 | 3 | 1 | 5 | 8 | 46 | 2 |
| Aesthetics | 9 | 6 | 2 | 1 | 4 | 5 | 1 | 7 | 3 | 8 | 3 | 4 | 5 | 58 | 3 |
| Health (disease) | 4 | 2 | 7 | 6 | 5 | 6 | 5 | 5 | 4 | 4 | 5 | 3 | 4 | 60 | 4 |
| Recreation | 8 | 3 | 6 | 3 | 7 | 1 | 4 | 4 | 5 | 6 | 4 | 8 | 3 | 62 | 5 |
| Knowledge and educational values | 2 | 8 | 8 | 5 | 2 | 3 | 6 | 6 | 7 | 2 | 6 | 2 | 6 | 63 | 6 |
| Opportunity | 1 | 7 | 9 | 7 | 3 | 7 | 7 | 2 | 6 | 9 | 7 | 9 | 7 | 81 | 7 |
| Productive use | 6 | 5 | 4 | 8 | 9 | 9 | 9 | 3 | 8 | 7 | 9 | 6 | 1 | 84 | 8 |
| Consumptive use | 7 | 4 | 5 | 9 | 8 | 8 | 8 | 9 | 9 | 5 | 8 | 7 | 2 | 89 | 9 |

# Values based approach:

- Improves the following components of planning, eg goal definition
- Ensures all stakeholders understand the range of views, implications for group dynamics. Particularly important in long-term projects with multiple stakeholders


Goal Setting and
threat analysis

# Goals

- Identify either the stated priority values, or the assets that need to be managed to deliver those values
- Spatially and temporally bound
- Measurable (outcome measure)

# Lake Warden goal

To recover the waterbird species richness and abundance, and living assemblages of the Lake Warden Wetland System, to a near natural state by the year 2030.

Note:

1. “A near natural state” is bench marked against early 1980s waterbird survey and data on lake hydrology
2. Goal to deliver values of knowledge/education, health, recreation and spiritual/philosophical values
3. The biodiversity assets need to be better specified

# Biophysical threat analysis

- Defines the key ecosystem processes that must be managed to achieve the goal
- Forms the basis for cause-effect models and quantitative analysis
- Issues:
  - poor classification systems
  - antagonistic-synergistic effects

| Threat category | Management issue | Prob. goal failure current management | Prob. goal failure, extra management | Assumptions underlying probability assessments |
|---|---|---|---|---|
| Altered biogeochemical processes | Altered hydrology, particularly salinity and acidity | 1 | 0.2 | Expected that 40-60 plant and invertebrate species, plus at least one bittern species, will become extinct in the catchment without management |
| | Nutrient cycles, including eutrophication | 0.2 | 0.01 | Provided: nutrient stripping on agricultural drainage and plantations are maintained and revegetation extended; eutrophication should be controlled. Note that we have poor understanding of increasing nutrients and its implications. |
| | Carbon cycle and climate change | ? | ? | Needs to be calculated with downscaled climatic data that are not currently available. Note also that if plantations become non-viable, replacement land use may degrade conservation values further. |
| Impacts of introduced plants and animals | Environmental weeds | 0.1 | 0.05 | Acacia linearis, (Moraea flaccida and Moraea miniata), Genista linifolia, Typha orientalis, Watsonia spp and bamboo are already present, salt water couch, kikuya being established. Note also poplars, etc. that people are experimenting with. |

# Altered Hydrology – 1996-2006

| | | | |
|---|---|---|---|
| Contribute to the development of improved drainage assessment, practice and policy. | No. NOIs processed | **4** | **10,374** |
| Revegetation (generally of cleared areas on private property) with main objective of hydrological control. Includes fencing. Not including commercially prospective species. | Land conservation plantings No. sites | **99** | **1,248,771** |
| | No. seedlings | **1,217,330** | |
| | Area planted | **875** | |
| | Km of fencing | **157** | |
| | No. of landholders involved | **75** | |
| Revegetation with commercially prospective species (generally of cleared areas on private property) with main objective of hydrological control. Includes fencing. | No. sites | **46** | **605,146** |
| | No. seedlings | **853,937** | |
| | Area planted | **1,918** | |
| | Km of fencing | **18** | |
| | No. of landholders involved | **44** | |
| Engineering works on Crown lands to protect public asset values. | List (separately) of investigations, reports | **11** | **3,115,271** |
| | No. of sites treated | **39** | |
| | Length of structure; or | **37** | |
| | Area treated | **1,300** | |
| Engineering works on private property to protect public asset values. | List (separately) of investigations, reports | **10** | **681,848** |
| | No. of sites treated | **40** | |
| | Length of structure; or | **42** | |
| | Area treated | **225,000** | |
| Monitoring and research/investigations (other than listed for particular project areas above). | List (separately) of investigations, reports | **22** | **3,536,490** |

# Natural Diversity Recovery Catchments, Case Study – Part 2: Evaluation of outputs and outcomes.

# Hydrological threatening processes, cause-effect relationships and the level of understanding required to manage the impacts of altered hydrology

Dr Ryan Vogwill

Supervising Hydrologist
Natural Resources Branch
Department of Environment and Conservation

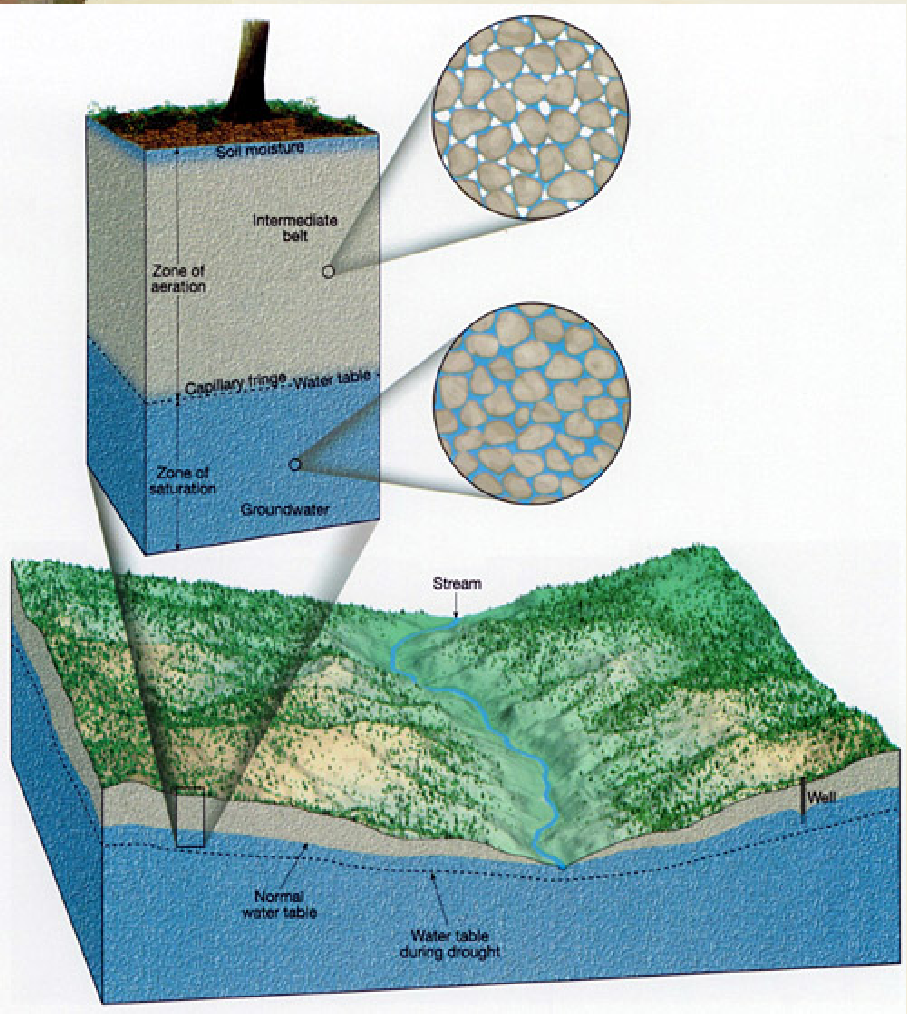
# Toolibin Lake – Physical Recovery Criteria

- Minimum depth to the water table beneath the lake and Toolibin Flats in spring, when the lake is dry, should be 1.5 metres
- The maximum salinity of lake water when the lake is full should be 1,000 mg/litre
- The maximum salinity of inflow to the lake………should be 1,000 mg/litre

# Outline

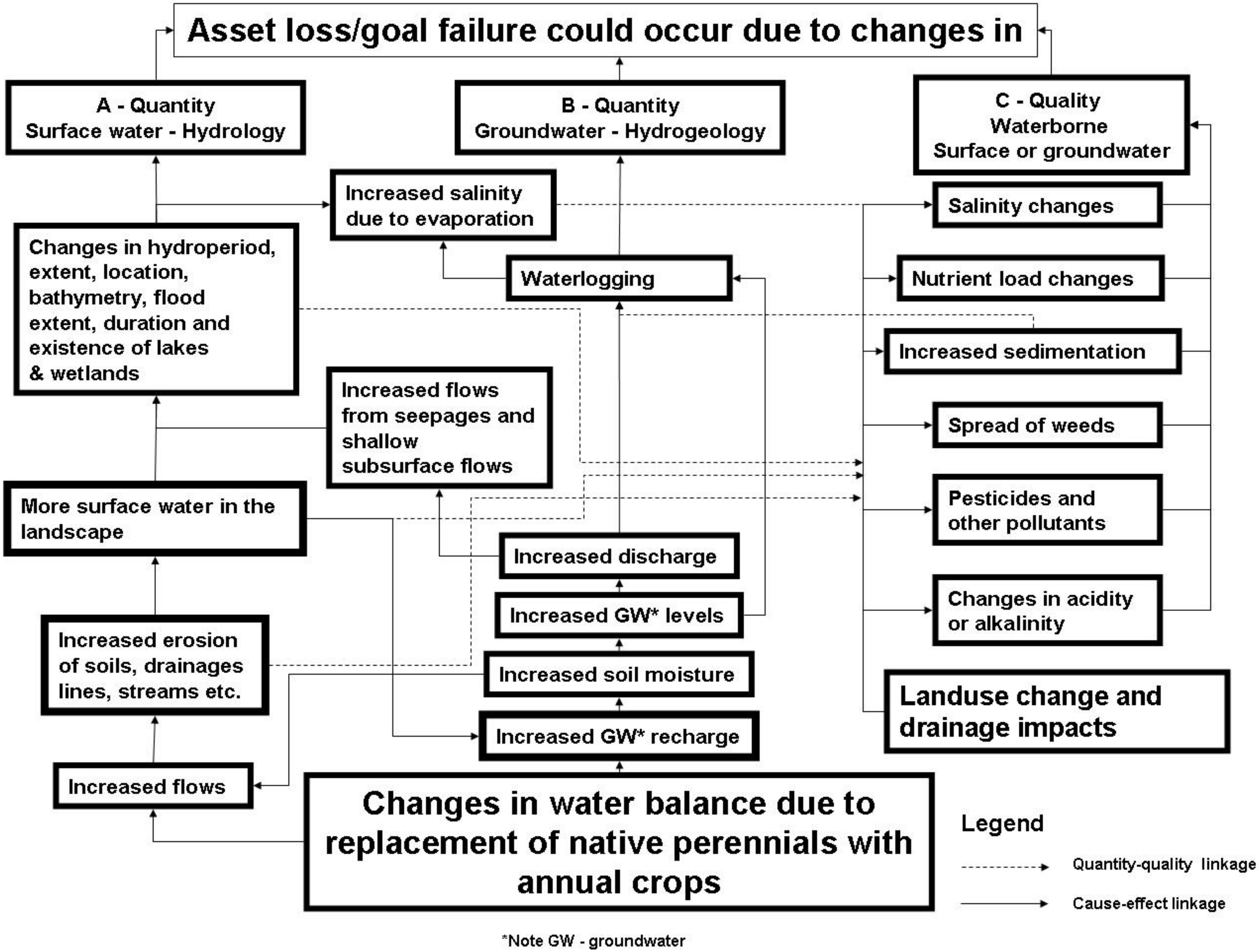
- The three domains of water
- Cause effect relationships in altered hydrology impacts
- Toolibin Lake hydrological benefit of intervention
- Biological response to hydrology changes
- Summary

# 3 Domains of Water Flow: Surface – Unsaturated – Saturated




- Hydrogeologists focus on the saturated zone.
- Hydrologists focus on surface water.
- Soil physicists focus on the unsaturated zone.
  - Everyone thinks their area is the most important.
- But without an understanding of all domains (and their interactions) you may not be making the correct interpretations of threatening hydrological processes at both asset and landscape scales.
- Particularly if you want to assess impacts from and to vegetation

# Altered Hydrology – Impact Conceptual Model

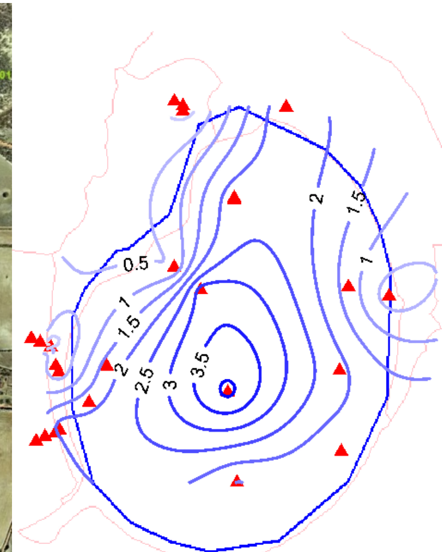




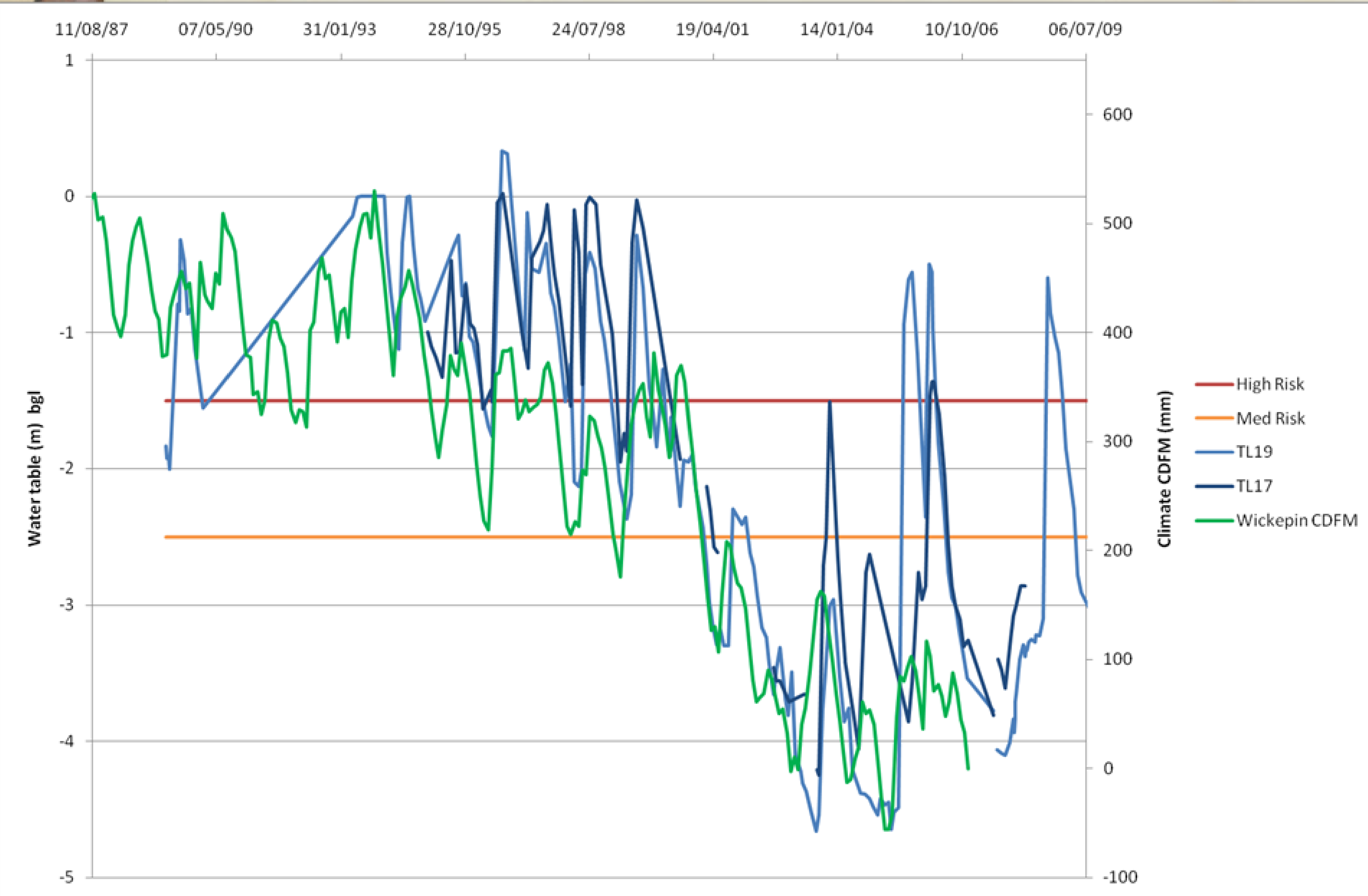

# Ecophysiology – Toolibin Lake

## *Hydrological Interventions*

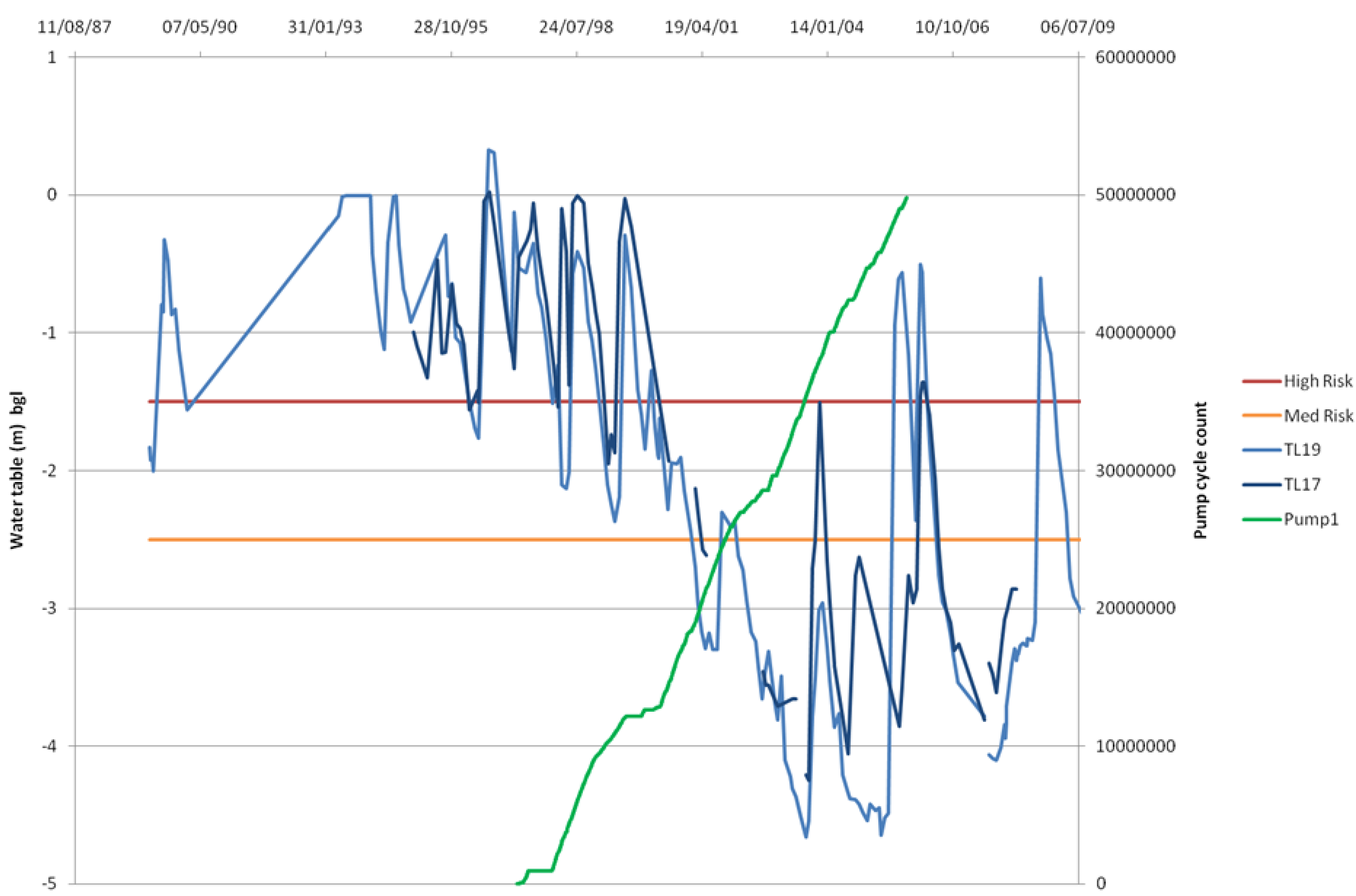
Lake Toolibin Drawdown in m May1996 - May 2005




# Toolibin Lake response of Intervention

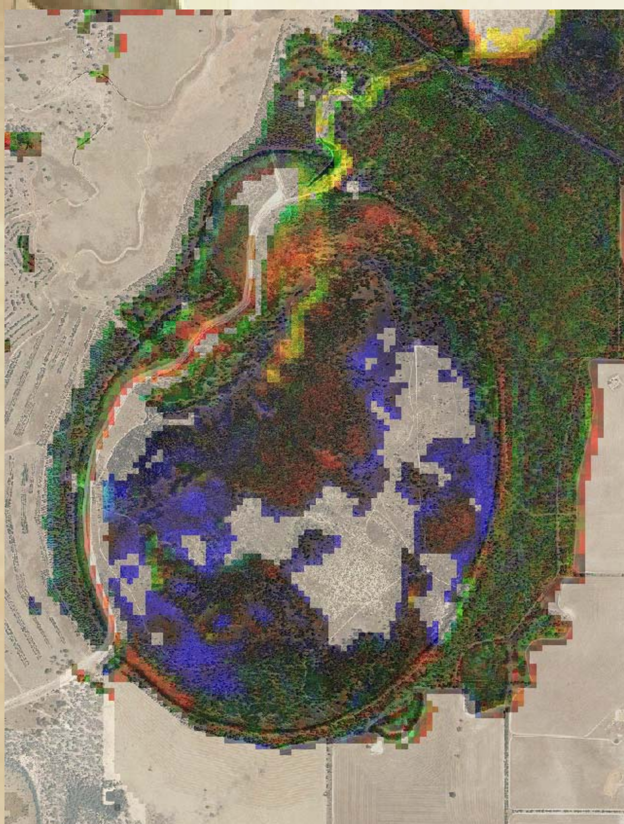


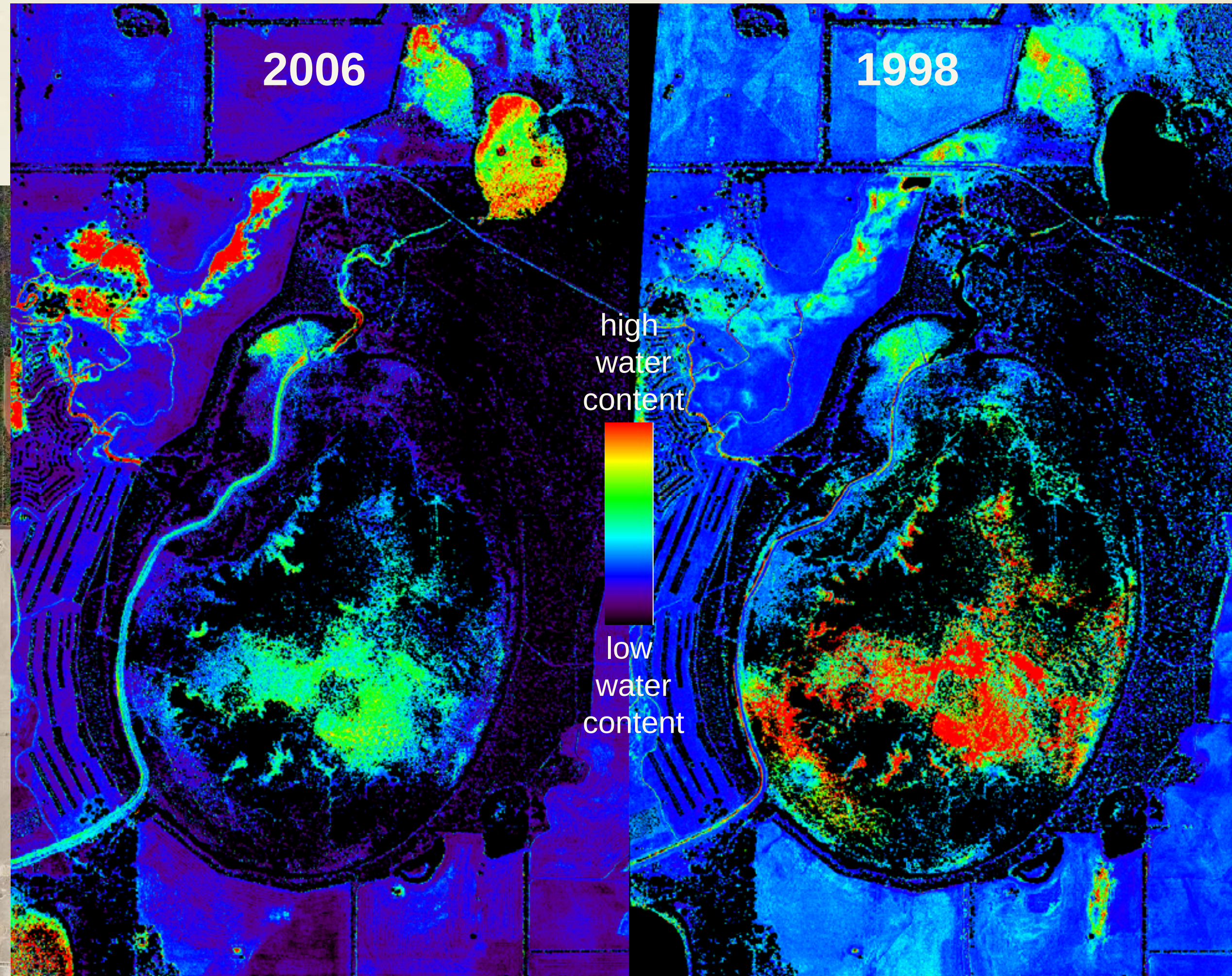
# Toolibin Lake response of Intervention



# Toolibin Lake response of Intervention

**Vegmachine**
**Vegetation Change 2000-2009**

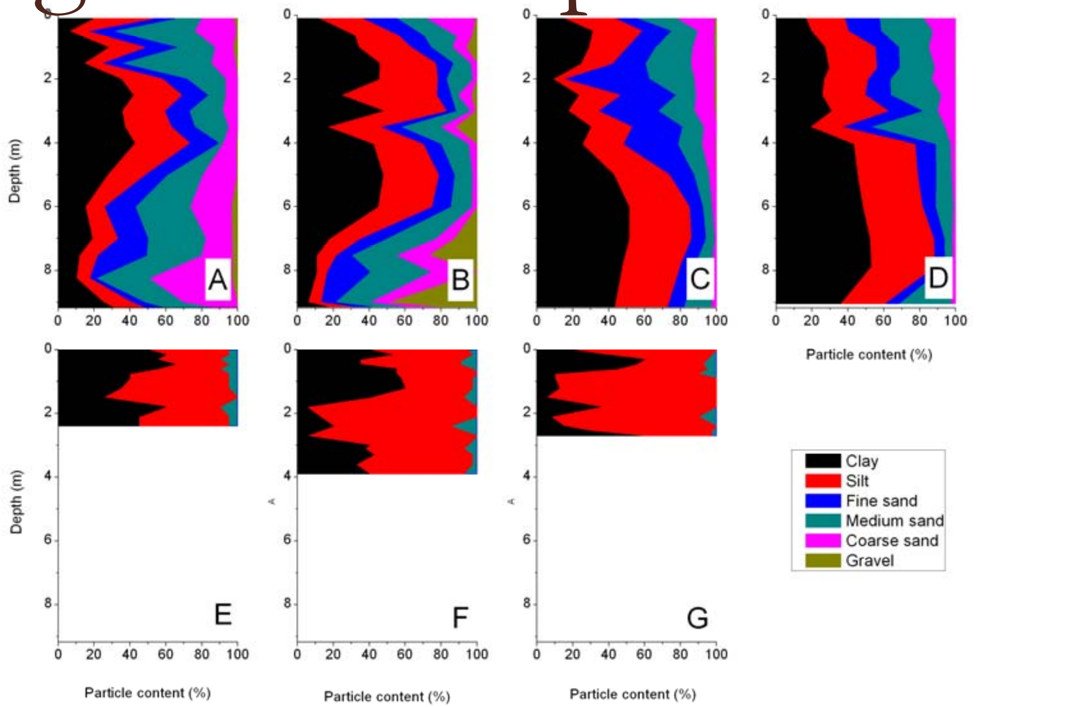




# Variation in vegetation response

Drivers for variability

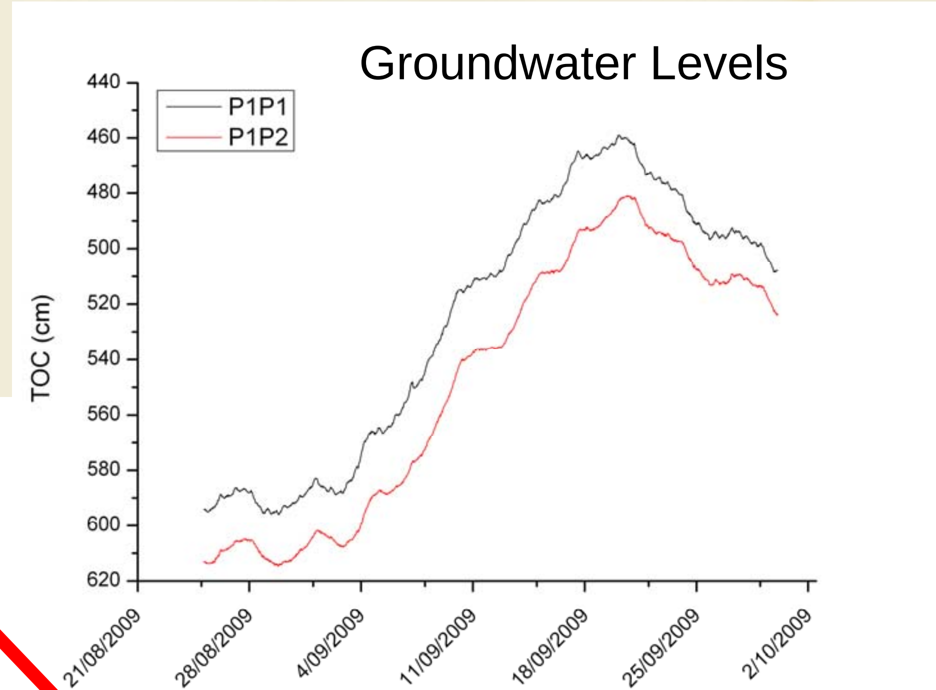
- Unsaturated zone/Soils – Ability to flush salts out of the rooting zone.
- Hydrogeology – Drawdown from pumping.
- Hydrology – Proximity to inflow area and centre of lake (concentrations of salt).
- Ecophysiology of vegetation species and how that interacts with **ALL** of the above.

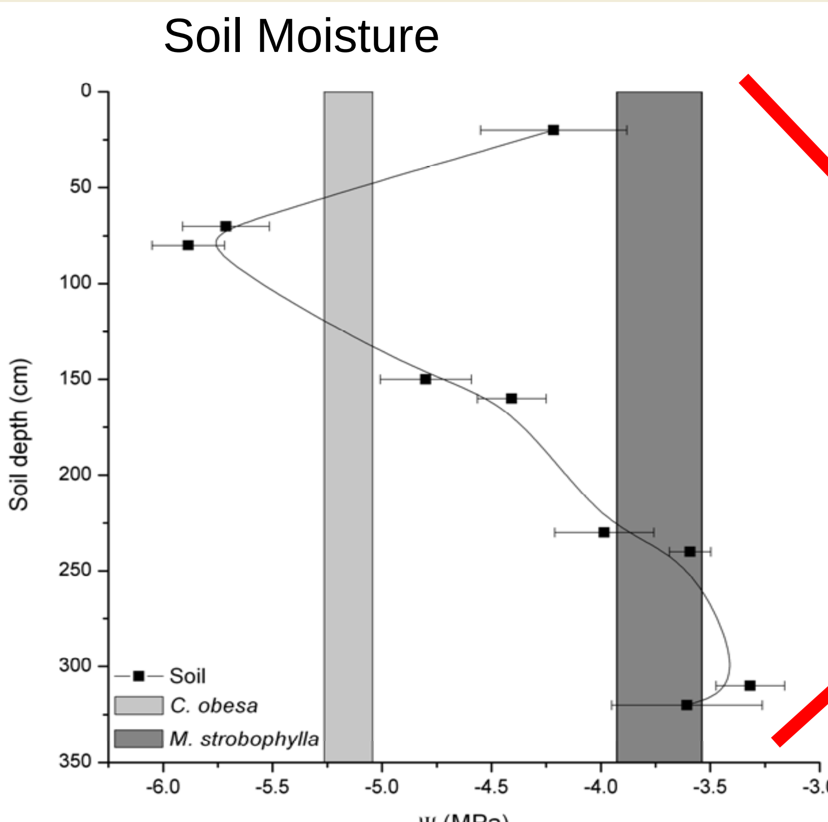


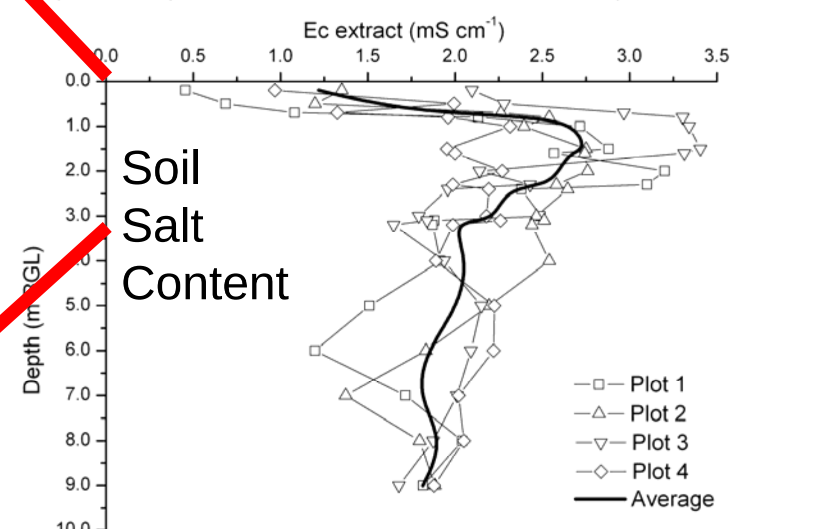

# Ecophysiology – Toolibin Lake

## *Casuarina obesa* and *Melaleuca strobophylla*

- *Casuarina's* - shallow rooted and adapted to less water (can apply a greater suction) root zone has experienced some flushing.
- *Melaleuca's* - deeper rooted and adapted to more water (less suction) root zone has not experienced flushing.
- Need to understand soil, chemistry, moisture, hydraulics in high resolution.



# Summary

- Cause effect diagrams are an excellent way to present and capture conceptual models of threatening process.
- Land clearing has created impacts, returning perennials to the landscape will mitigate these impacts however there is hysteresis in the hydrological response to planting trees or managing hydrology. *"The way back is not the same as the way there"*
  - ➢ Sometimes engineering solutions are required to allow plants to survive long enough to get established and/or control the water balance.
- Hydrology is expensive and difficult, we need more data at both a regional and local level covering all three hydrological domains.
  - ➢ This needs to be put in the context of the impacts on biota.
- We need a better understanding of the water use and tolerances of both prospective commercial species and key wetland species (CRC FFI Biorisk) to optimise revegetation and hydrological impact mitigation.