DEC TEC Course 4th November 2009 Decision Processes and Managing Ecologies, Using Examples from the Natural Diversity Recovery Catchments

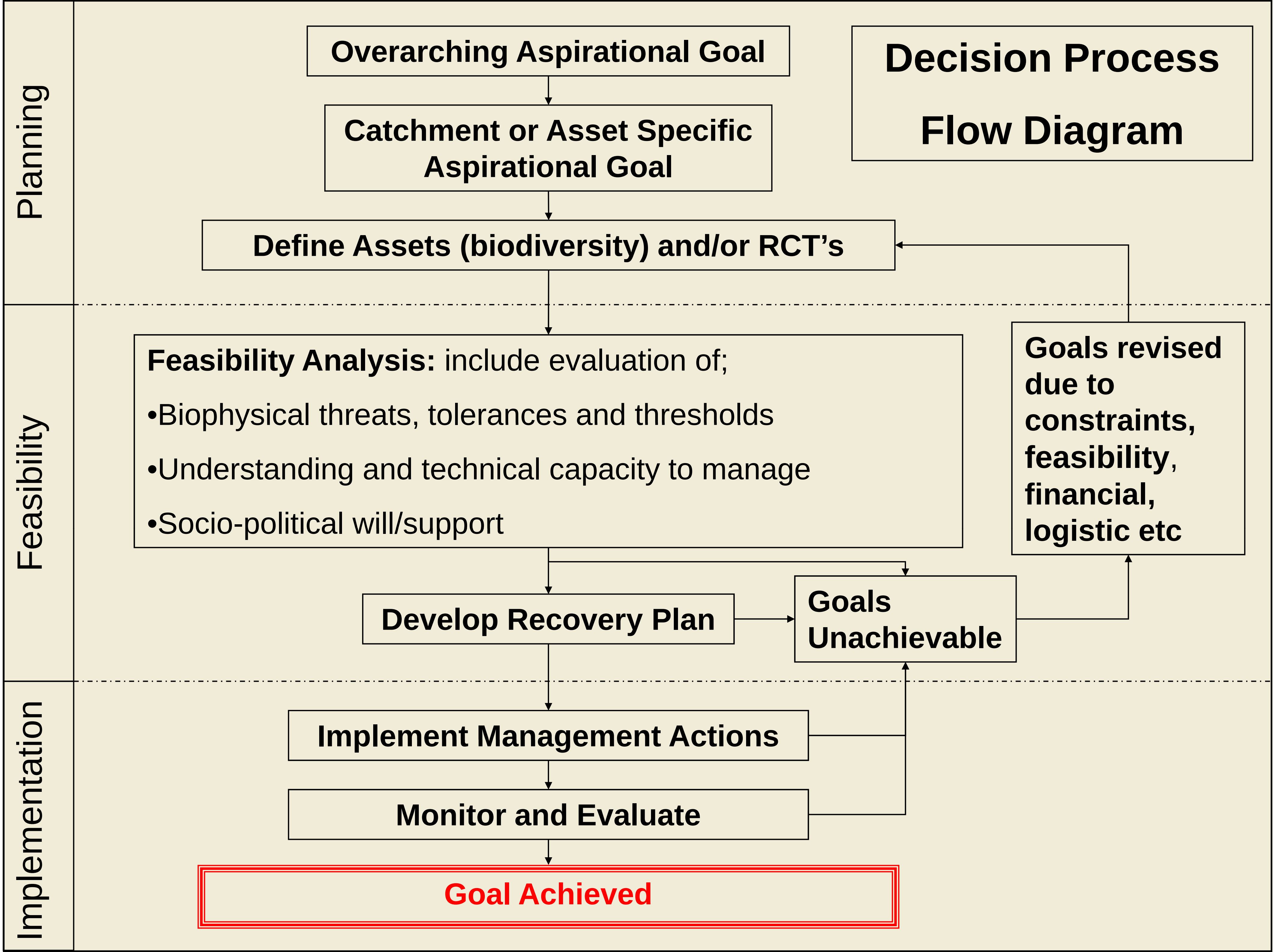
Dr Ryan Vogwill – Hydrologist/Hydrogeologist
Natural Resources Branch
Department of Environment and Conservation

Outline

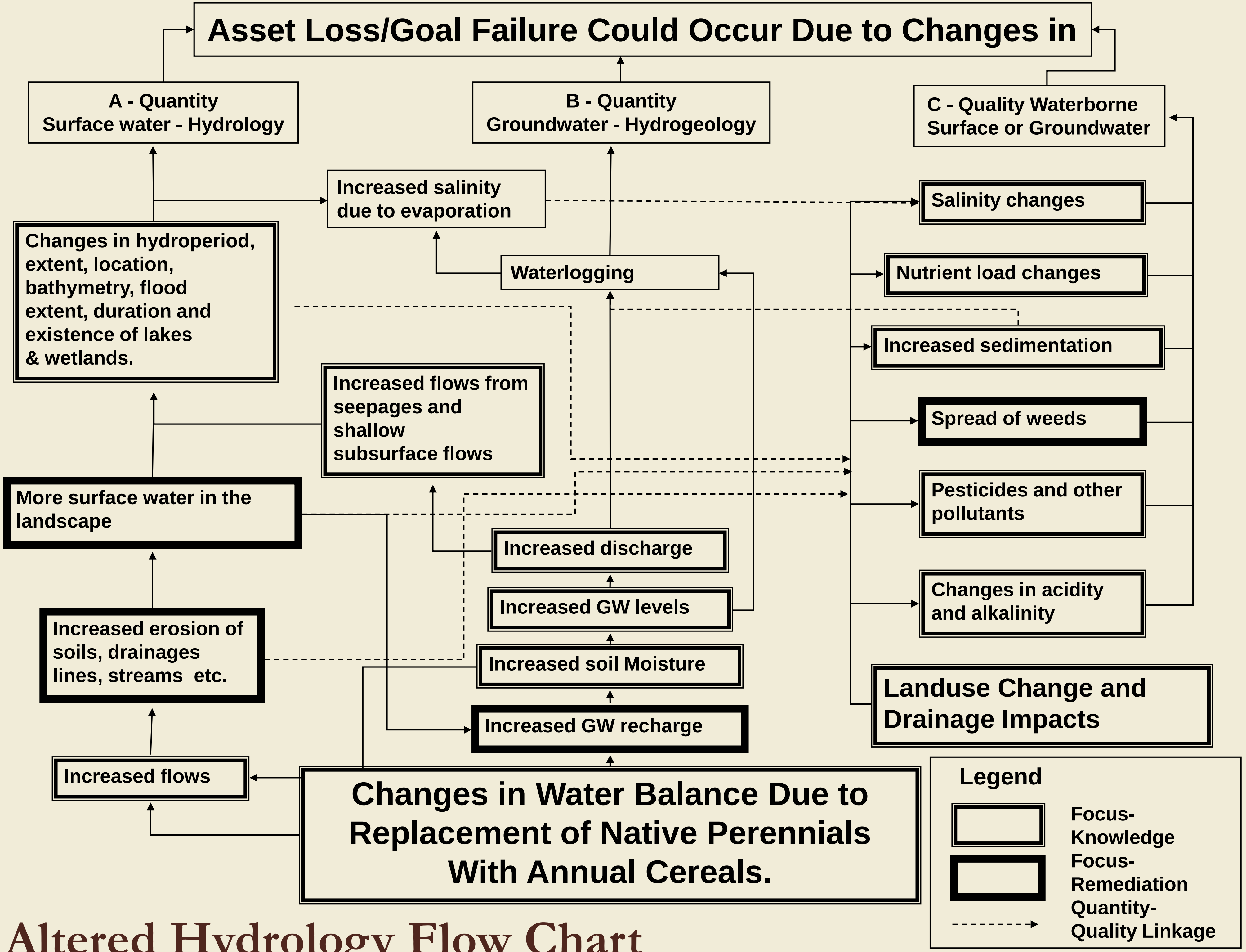
- Precursors to Management
- Decisions Processes
  - Flow diagrams
  - Some examples and tools from the NDRC's
    - Both simple and complex
- Summary

Precursor to Management

- Define Aspirational Goal
- Broadly Define Assets
  - Biodiversity
  - Resource and ecosystem service
  - Resource Condition Targets (RCT's)
- Broadly Define Threats,
  - Altered hydrology, landuse, climate change, lack of sociopolitical will, pest invasion etc



Decision Process
Flow Diagram
Planning
Feasibility
Implementation
Overarching Aspirational Goal
Catchment or Asset Specific Aspirational Goal
Define Assets (biodiversity) and/or RCT's
Feasibility Analysis: include evaluation of;
•Biophysical threats, tolerances and thresholds
•Understanding and technical capacity to manage
•Socio-political will/support
Goals revised due to constraints, feasibility, financial, logistic etc
Develop Recovery Plan
Goals Unachievable
Implement Management Actions
Monitor and Evaluate
Goal Achieved



Altered Hydrology Flow Chart

Some Examples of Decision Processes from the NDRC's

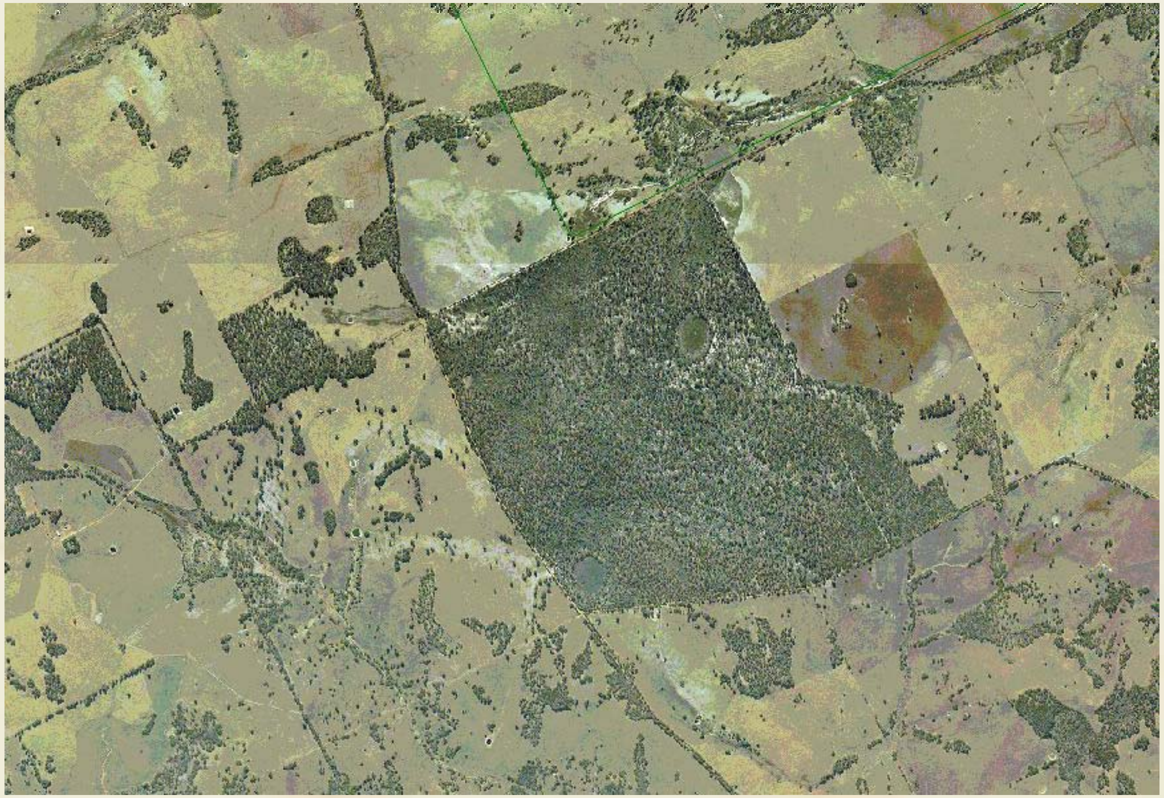
- Simple
  - Initial Intuition, Bayesian Belief Networks and Fault Trees
- Complex
  - Monte Carlo Simulation

Initial Intuition – BBN, Fault Trees

- Initially in situations without detailed understanding of physical processes and we have to rely on expert opinion and intuition
- Bayesian Belief Networks (BBN) and subjective risk assessment are good ways to rationalise between opinions and capture a measure of the uncertainty in this process
- Essentially experts are making a personal hypothesis on the available information regarding a particular goal, threat and asset
- BBN's, fault trees and interval arithmetic are excellent ways to capture, document and share this

Initial Intuition – BBN, Fault Trees

An example from Drummond NDRC ... thanks to Terry Walshe, Bob Huston and Mark Garkakalas

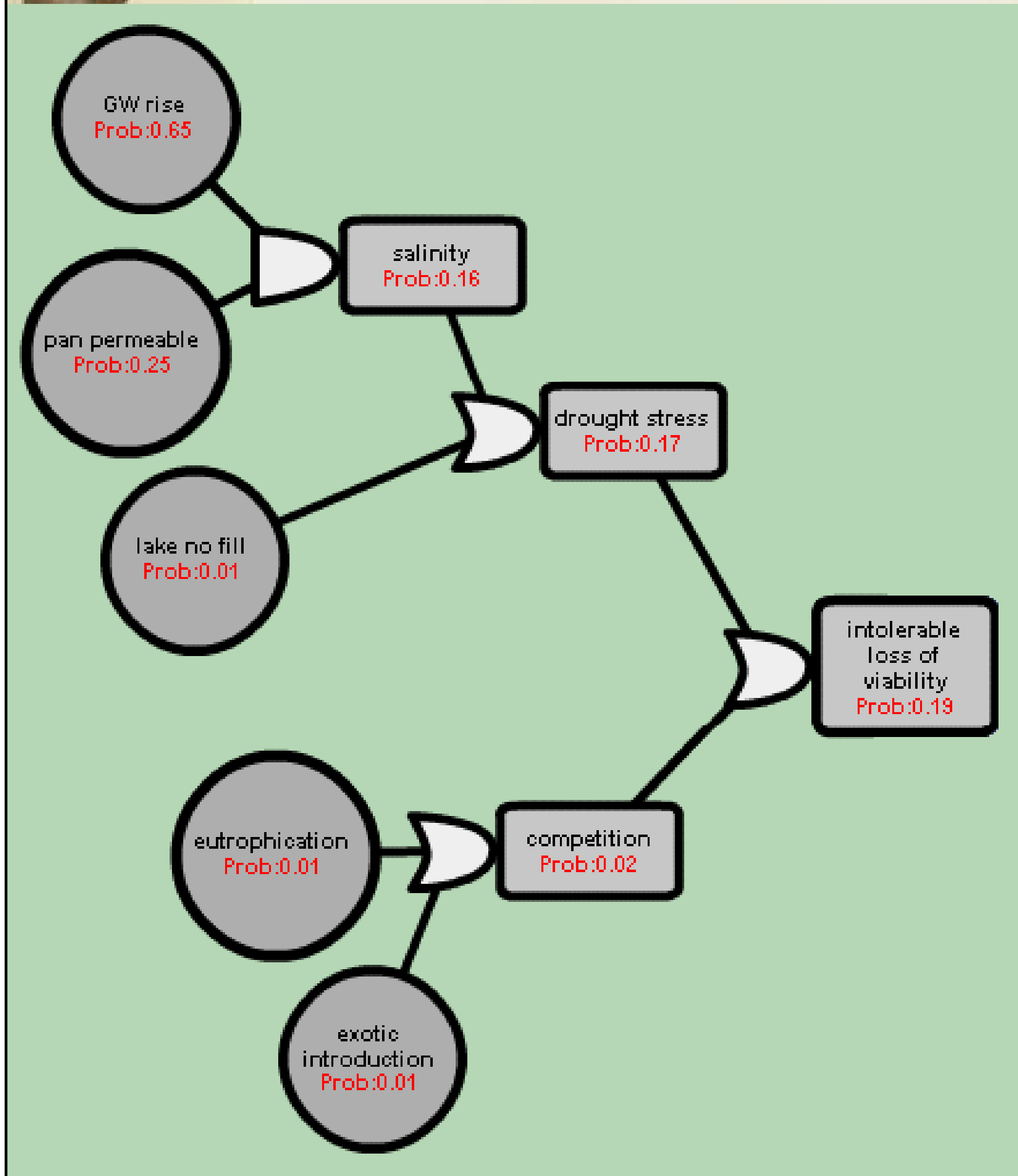


- Asset – Two fresh water claypans containing a TEC
- Threat – Altered hydrology
- Goal – Prevent 50% decline in population viability over 30 years in *Hydatella leptogyne and Eleocharis keigheryi*
- Knowledge – Distinct gaps exist

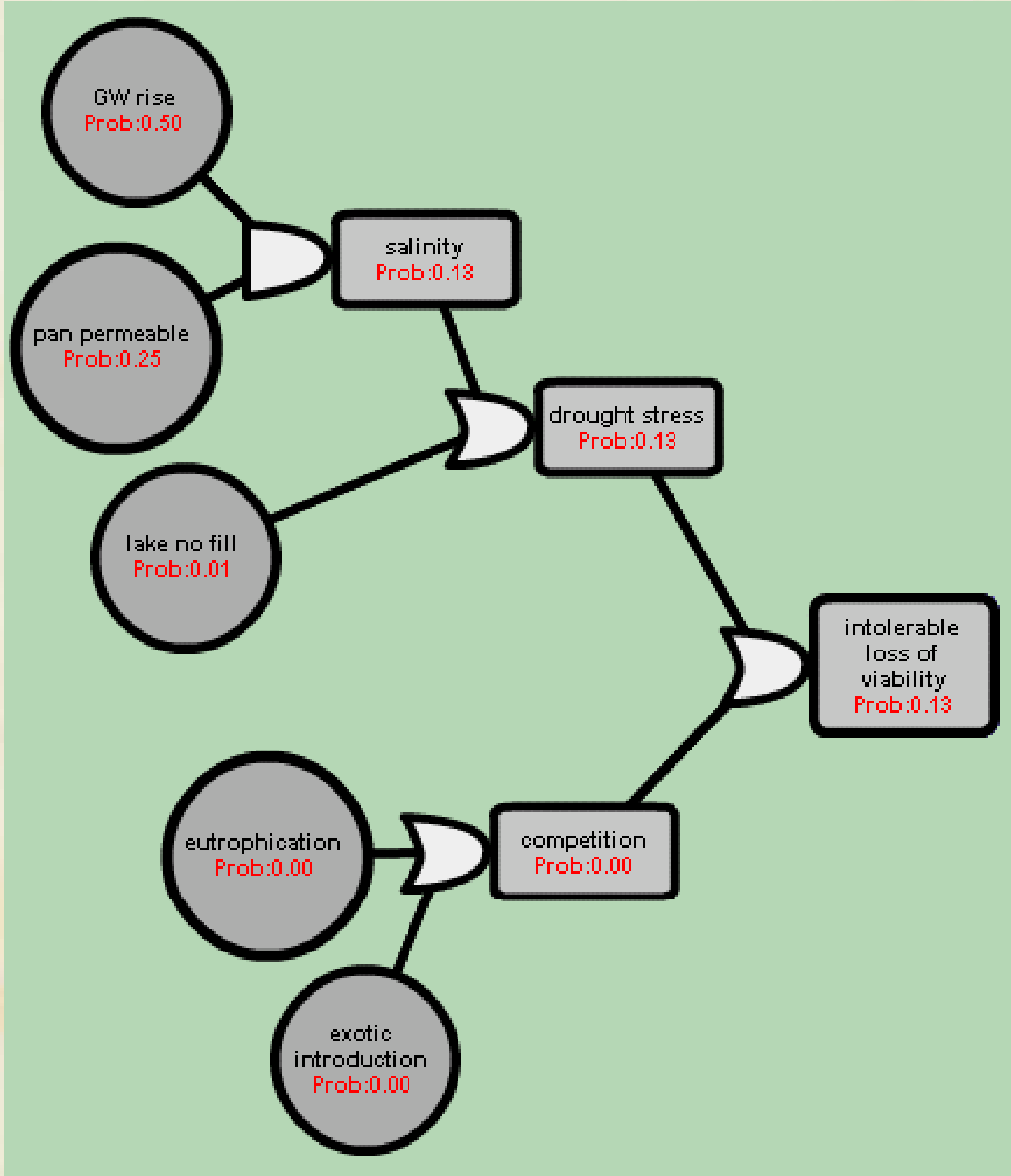
Initial Intuition – BBN, Fault Trees

	Lower bound	Best estimate	Upper bound
Southwest wetland			
groundwater rise	0.50	0.65	0.80
pan permeability	0.10	0.25	0.60
lake fails to fill	0.00	0.01	0.03
eutrophication	0.00	0.01	0.02
exotic introduction	0.00	0.01	0.02
50% reduction in viability	**0.05**	**0.19**	**0.52**
Northeast wetland			
groundwater rise	0.30	0.50	0.65
pan permeability	0.10	0.25	0.60
lake fails to fill	0.00	0.01	0.03
eutrophication	0.00	0.00	0.00
exotic introduction	0.00	0.00	0.01
50% reduction in viability	**0.03**	**0.13**	**0.41**

Initial Intuition – BBN, Fault Trees



SW wetland – best estimate



NE wetland – best estimate

Complex – Monte Carlo Simulation

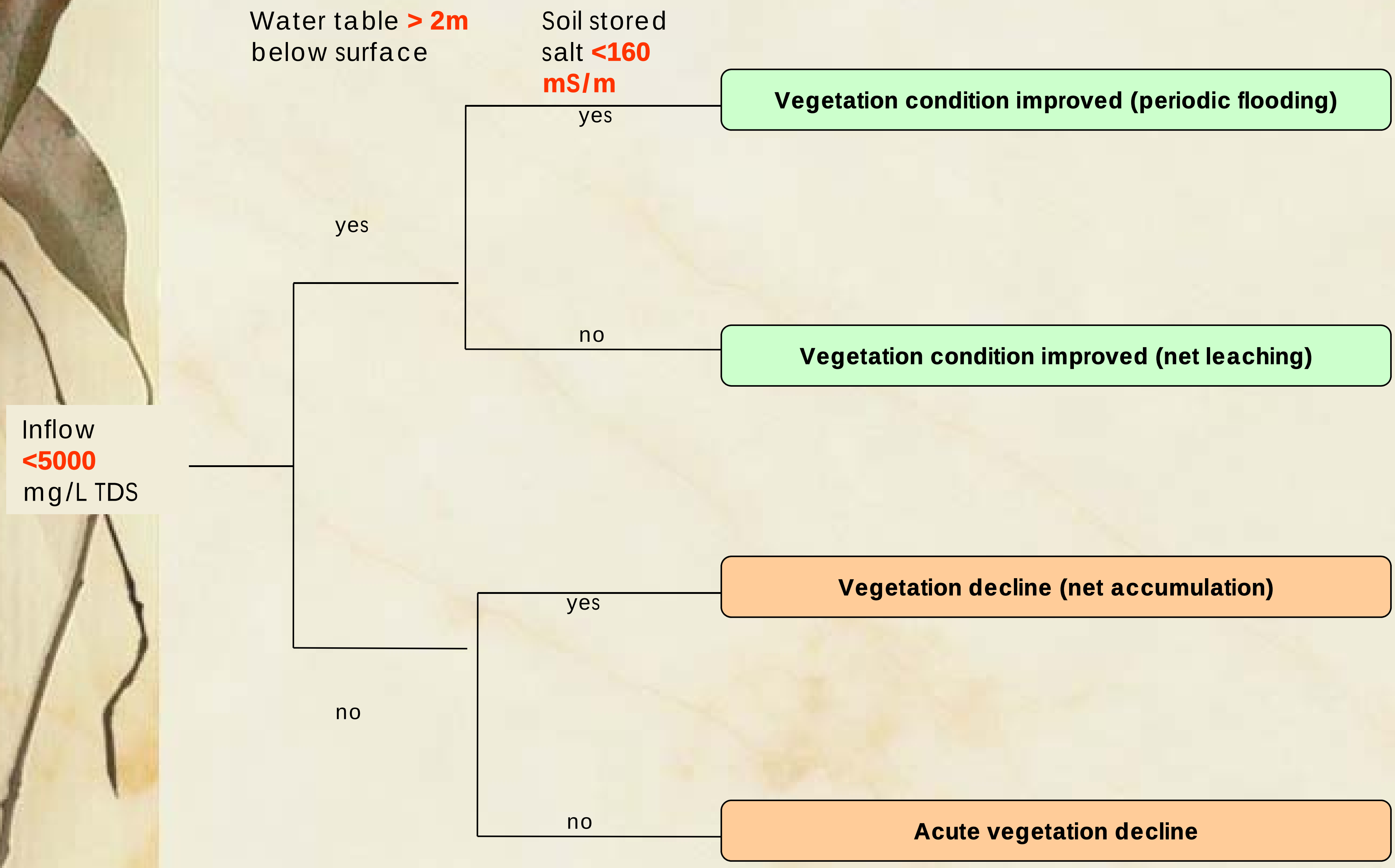
- **What do we mean by "simulation?"**
- When we use the word ***simulation***, we refer to any method meant to imitate a real-life system, especially when we have insufficient data to model all physical processes
- Without the aid of Monte Carlo simulation, a model will only reveal a single outcome, generally the most likely or average scenario, but not necessarily. A robust risk analysis uses a model combined with a simulation to automatically analyze the effect of varying inputs on outputs of the modeled system.
- A **Monte Carlo simulation**, is one which randomly generates values for uncertain variables over and over and can be used for optimizing calibration or an objective

Complex – Lake Toolibin

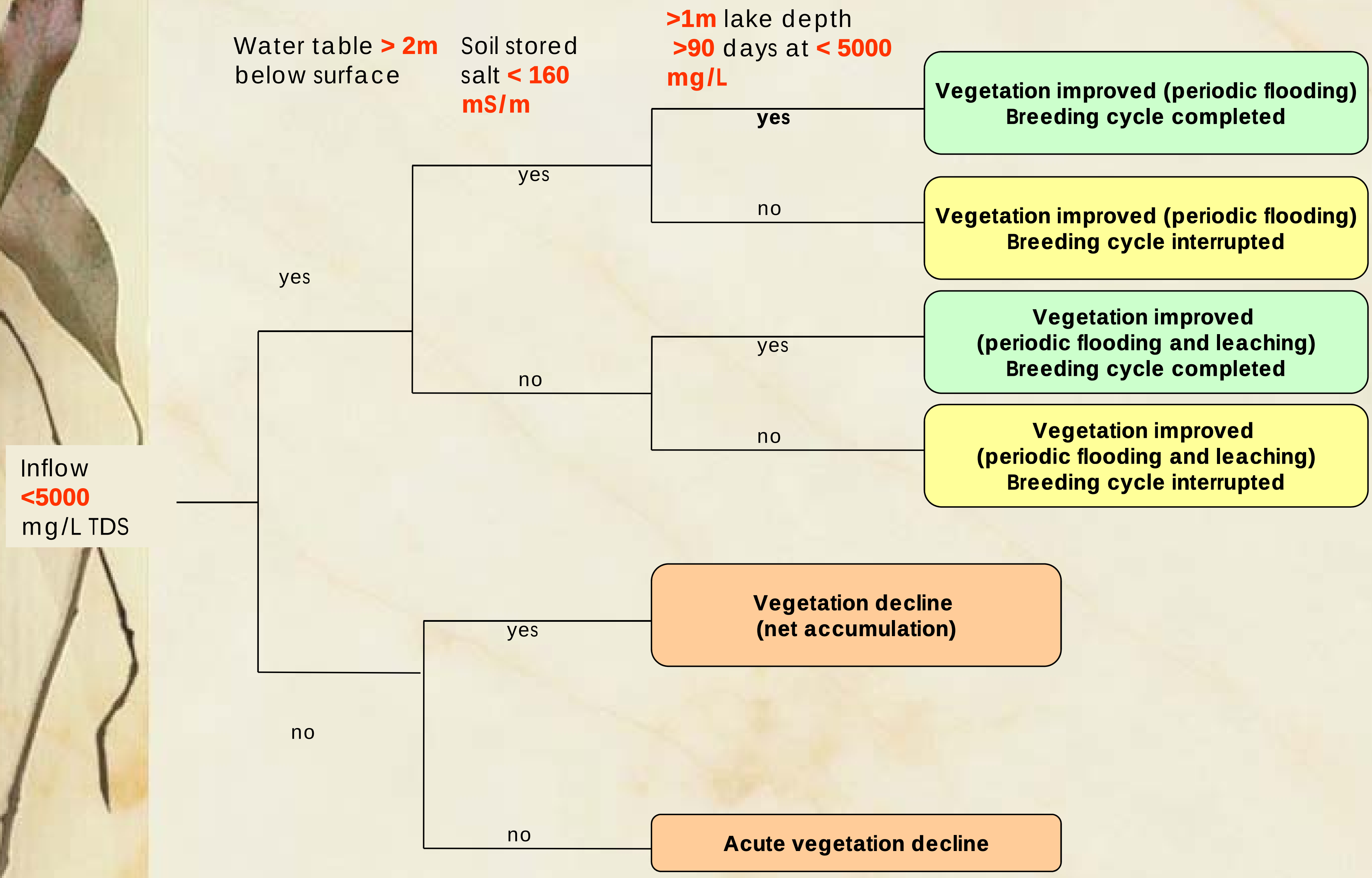
- Asset – Lake Toolibin Vegetation Community and Water Bird's
- Threat – Altered hydrology
- Goal 1 – Prevent further decline and where possible recovery exist declines in lake floor vegetation
- Goal 2 - Provide suitable water bird breeding habitat
- Goals are linked and at times contradictory
- Knowledge levels are high, excellent understanding of the water balance

A work in progress....thanks to Terry Walshe, Peter Lacey and Stuart Jones

Toolibin.... Vegetation



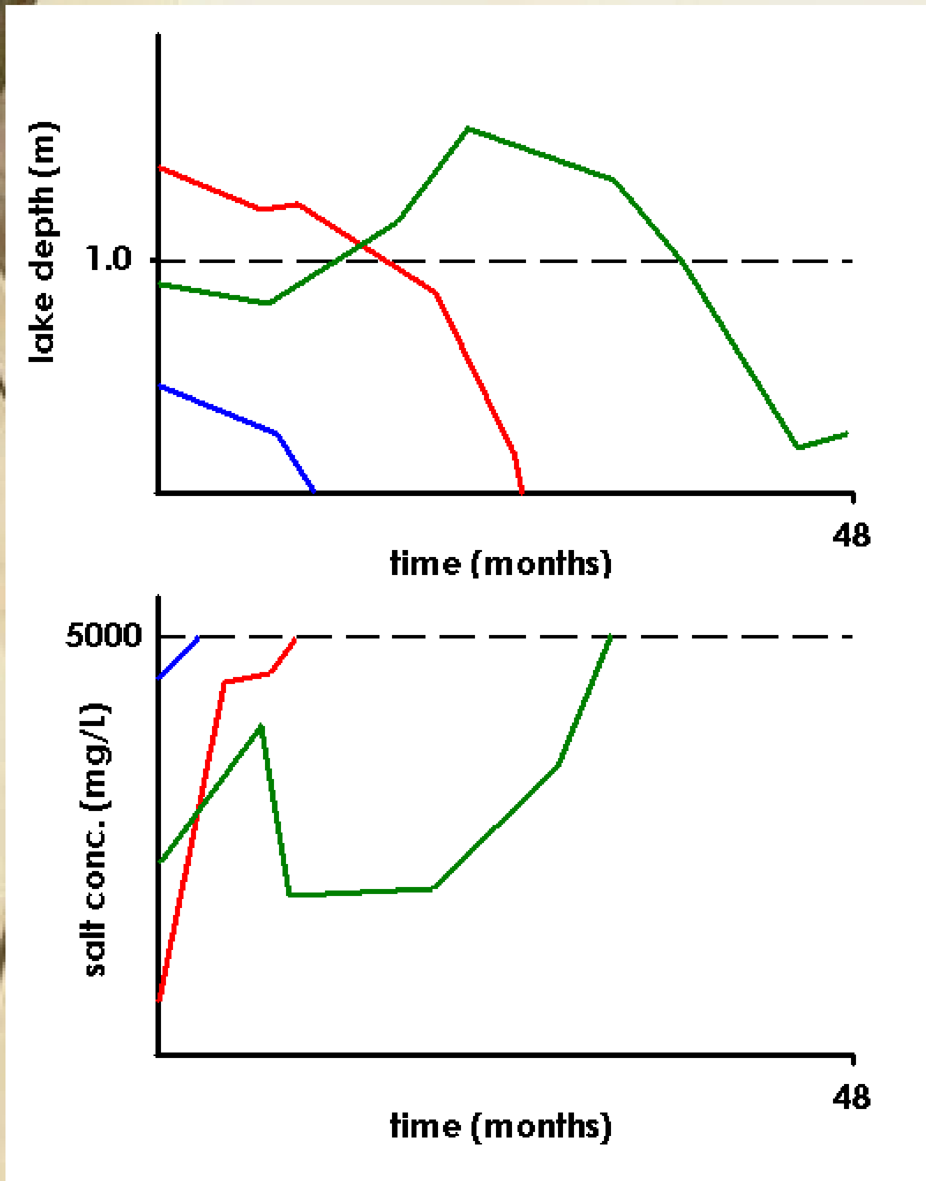
Toolibin.... Water Birds

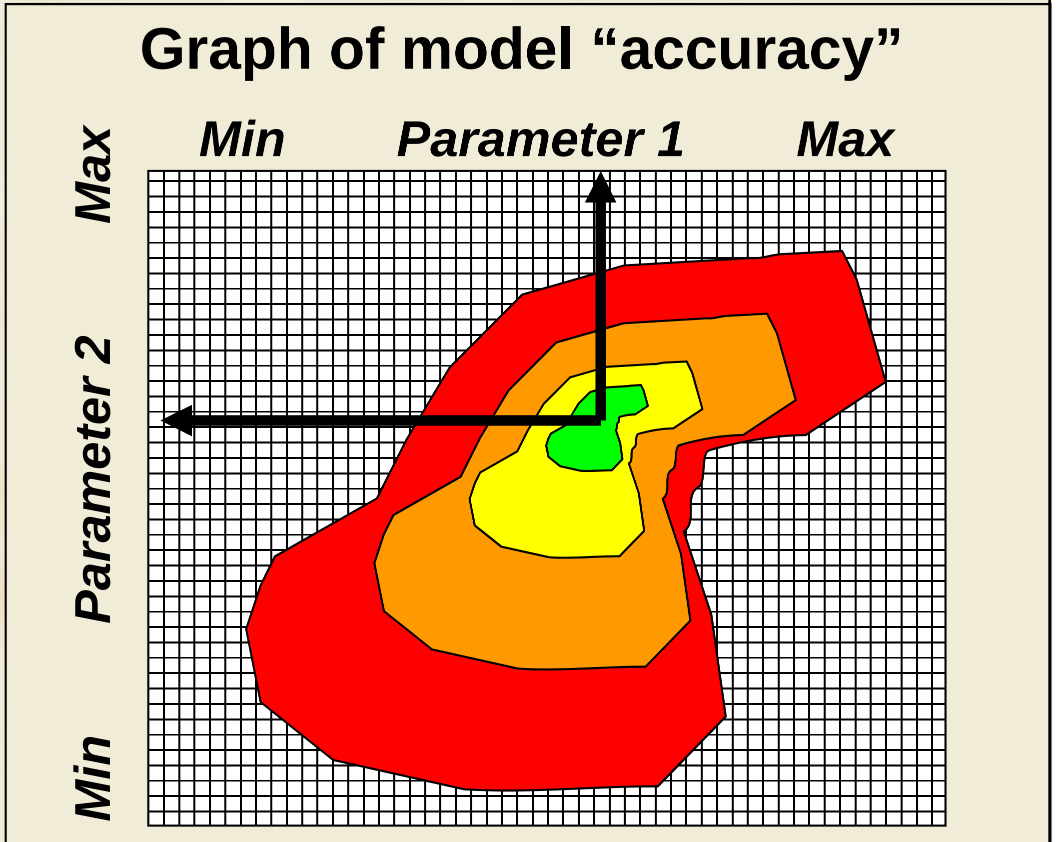


*** Assumes manual outlet is effective in eliminating risks of vegetation decline associated with evaporation-mediated salinity (and inundation)**

Complex – Lake Toolibin

- Water balance well understood
- Resource Condition Targets well defined, excellent infrastructure
- Conflicting goals and model parameter uncertainty
- Define water balance model sensitivity and range of outputs with a Monte Carlo Simulation, typically an automated process
- Results can be used to improve calibration or optimize a management objective





Summary

- Decision process flow diagrams
- Altered hydrology is not just salinity
- Initial intuition
  - Test hypothesis (monitoring)
  - Confirm or revise hypothesis (iterative)
- Gather data and build models
  - Test hypothesis (numerical calibration)
  - Confirm or revise hypothesis (iterative)
- Sensitivity and/or Monte Carlo analysis
- Use for scenario analysis and management
- Goal failure is undesirable but spending and decisions need to be robust and defendable.