Dan Johnson

THE TRANSITION FROM THE PLANNING ENVIRONMENT TO OPERATIONS

Introduction

- Why do we build models and how can they be used to support operations
- Case Studies:
  - QLD Drought: Water Quality Modelling
  - Christchurch Earthquake: Using models to aid the recovery
- The challenge and our role

Why do we build hydraulic models?

- Models are typically built to investigate/plan:
  - A new source;
  - Growth;
  - Capital renewals;
  - System deficiencies
- Projects largely planning focused on developer enquires or system deficiencies.

How can models support operations?

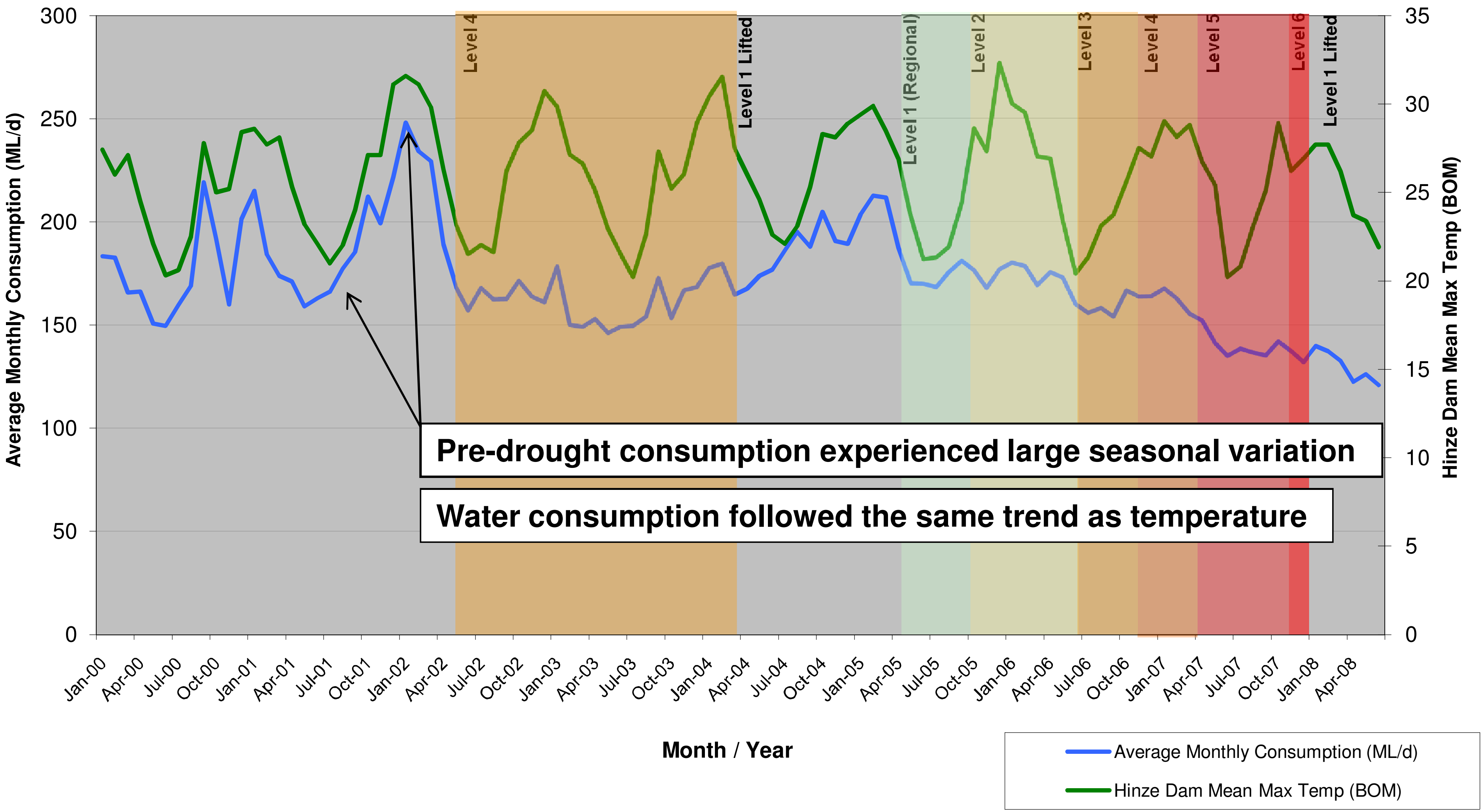
- Models can be used to:
  - Understand how the system operates under a range of demand conditions;
  - Determine and track the age of water;
  - Assess areas in the system that may be prone to sedimentation and design mains flushing programmes;
  - Investigate the effect of fire flow and compliance;
  - Design pressure management schemes;
  - Investigate and improve levels of service;
  - Optimise pump operation to reduce power usage.

Example 1: QLD Drought – Water Quality

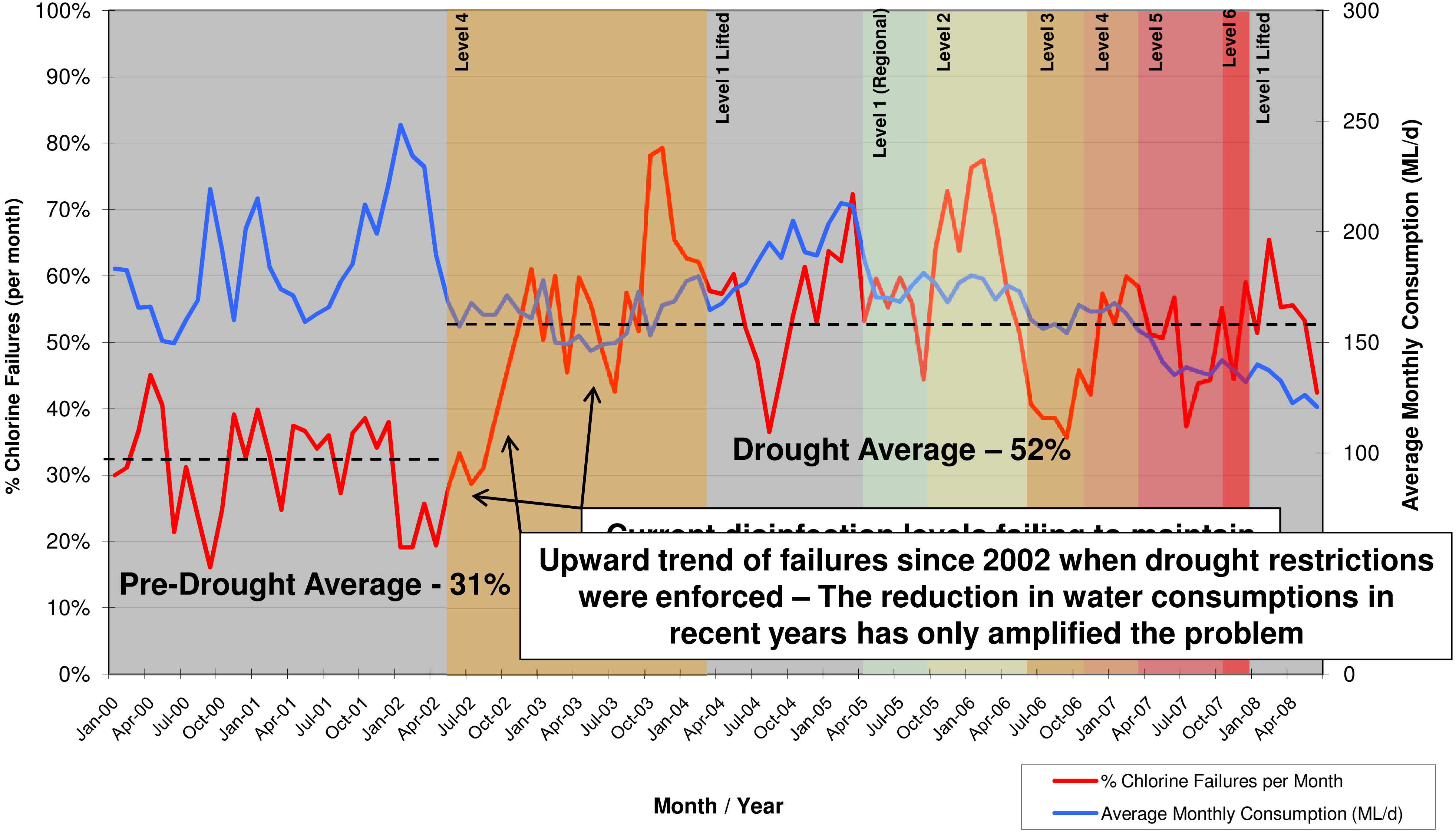
The problem:

- Demand reductions of 40-50% of normal operation;
- No mains flushing / cleaning for a number of years;
- Reservoir turnover times and a lack of cleaning;
- Pressure and leakage management: impacts on flow paths and age;
- Desalination Plant / New Trunk infrastructure: changed the operation and movement of water affecting WQ;
- Water mixing will modify the bulk transfer of water to the distribution and reticulation works.

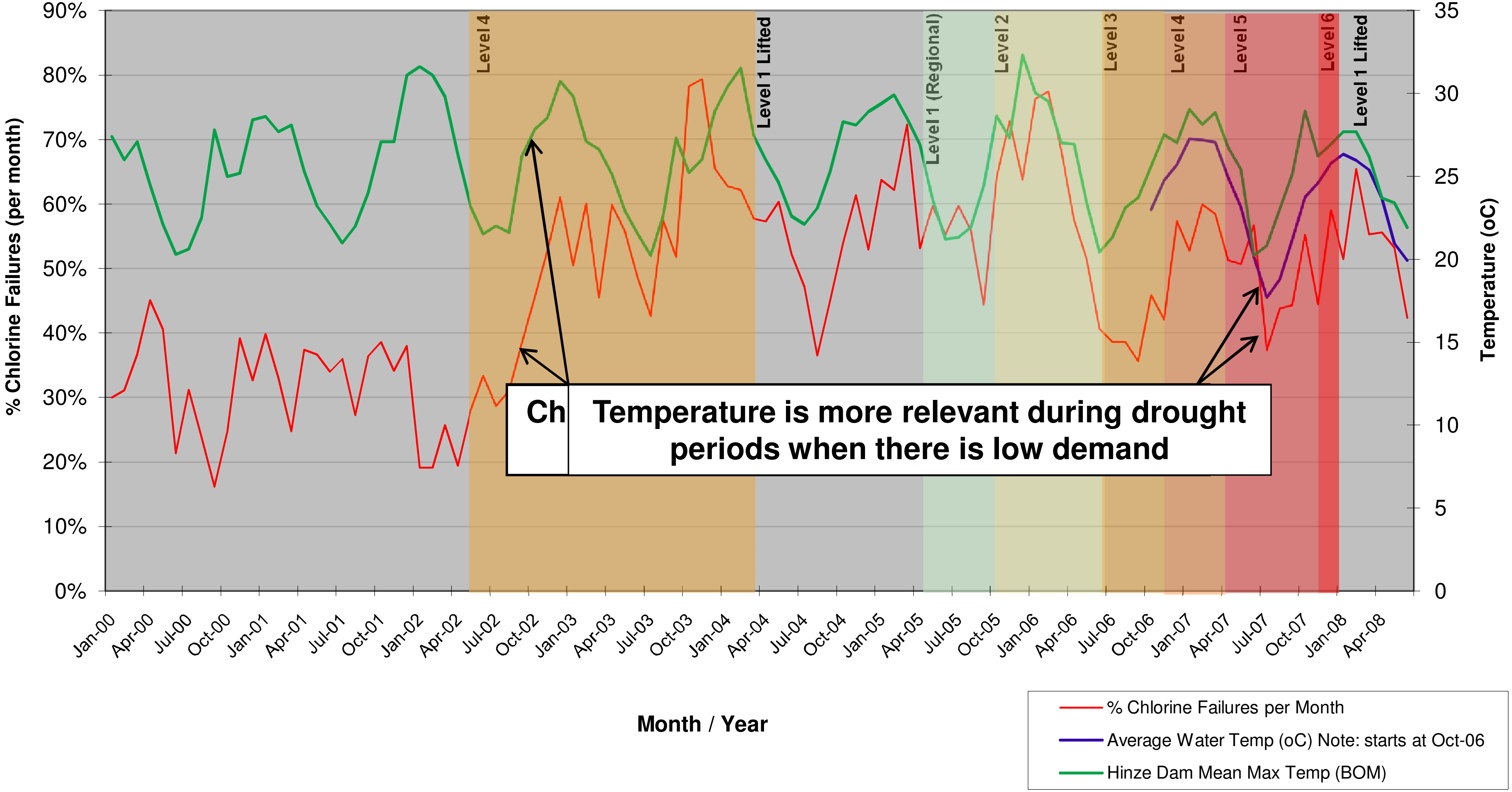
System Demand and Drought Restrictions



Chlorine Failures and Average Consumption



Chlorine Residual Failures and Temperature

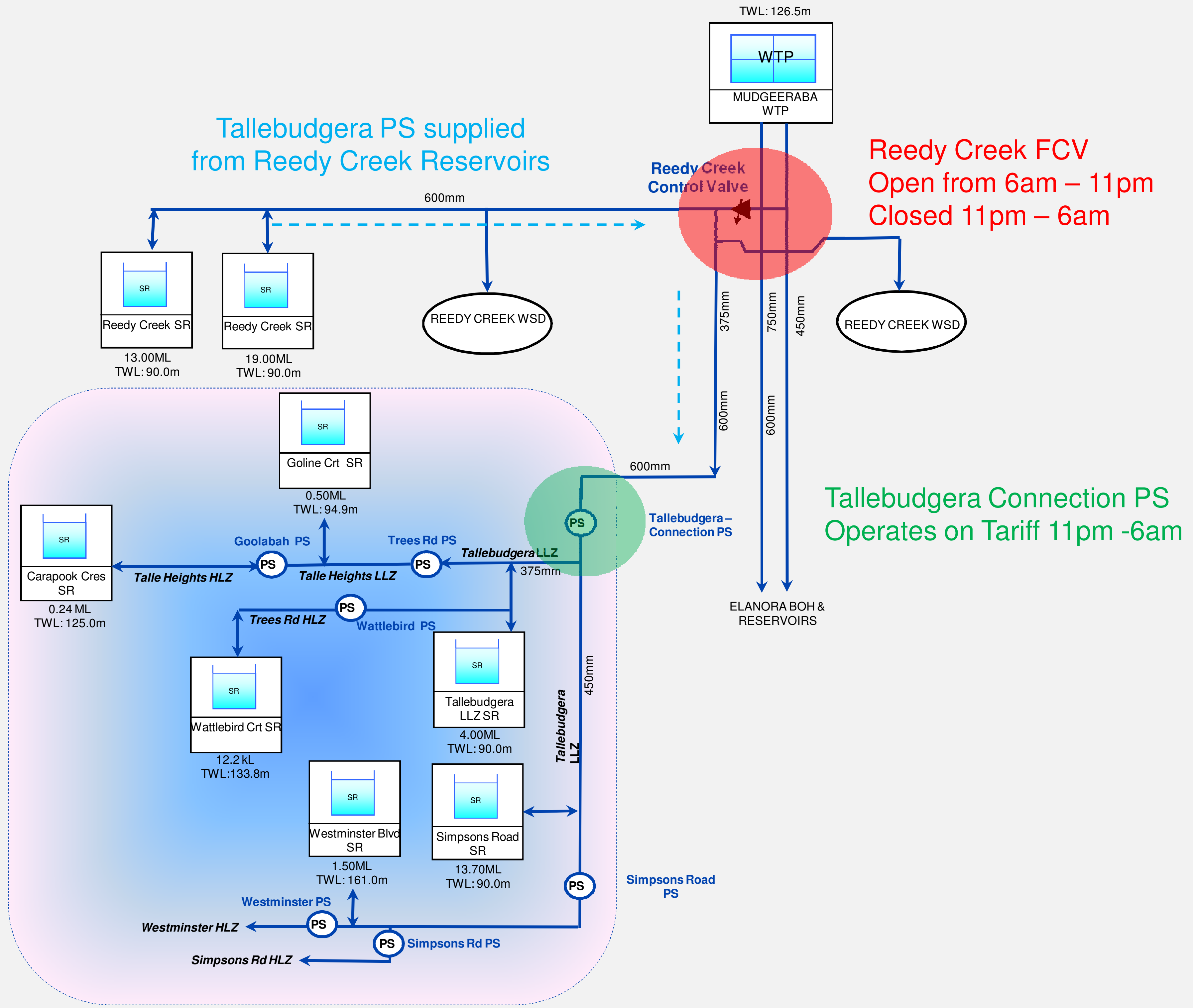


Water Age Is A Primarily Function of....

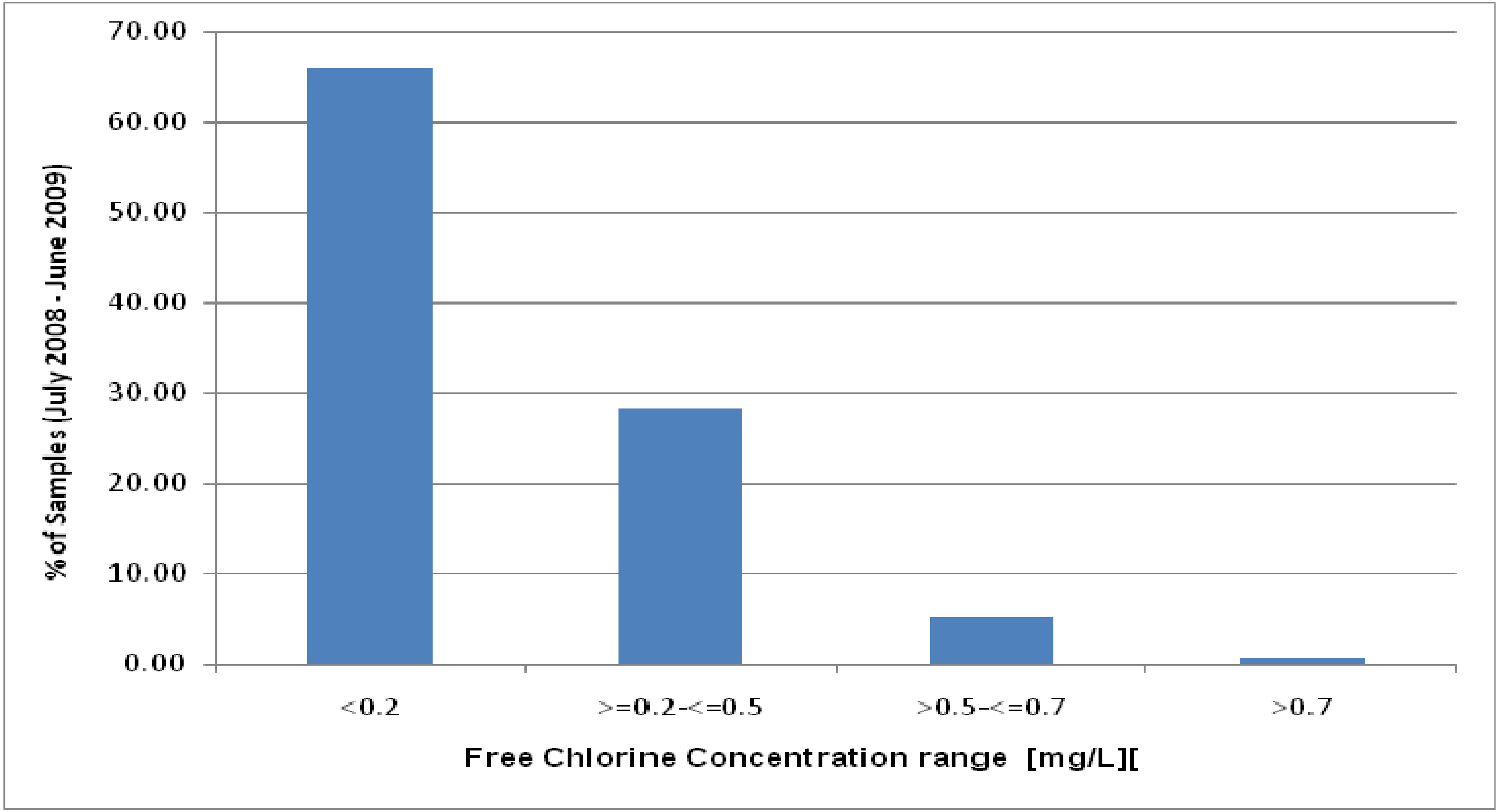
- Water Demand / Drought Restrictions – Decreased water use results in an increase in the amount of time water resident in the reticulation;
- Fire Flows – influence the size of the infrastructure, which in turn can lead to increased water age through low velocities;
- System Operation – Reservoir operation can significantly impact on water age through poor mixing and under utilisation;
- System Design – Pipelines are typically designed to meet planning demands of 20-years or more into the future – oversized for current demand.

Operational Pilot Study - Project Objectives

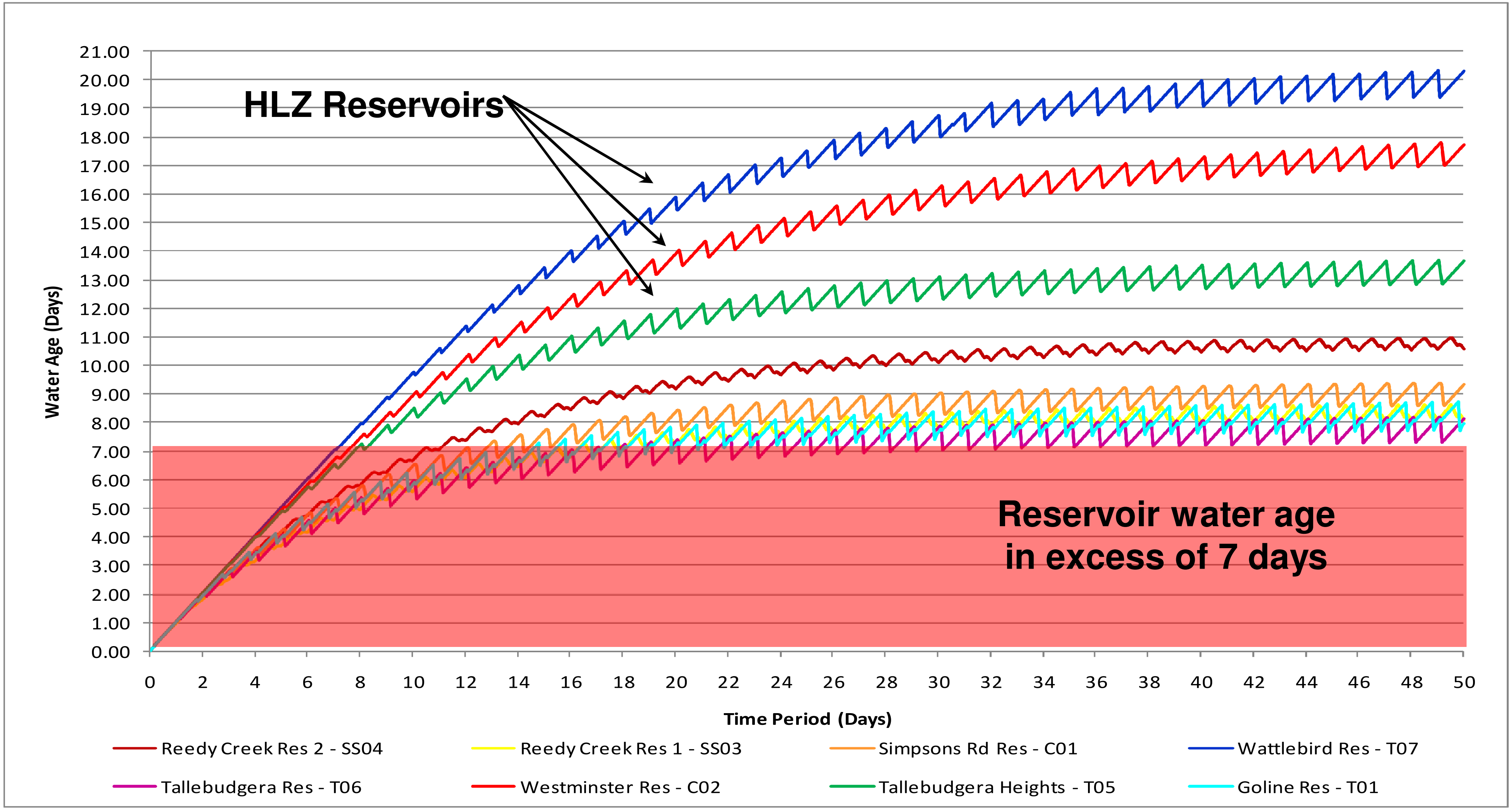
- Recommend operational changes that can be made to improve retention times in Currumbin Waters WSD reservoirs, using the model;
- Monitor chlorine residual in the WSD at selected points in the network prior to and following operational changes;
- Recommendations / lessons learnt to carry forward into the final phases of the strategy.


TWL: 126.5m
WTP
MUDGEERABA WTP
Tallebudgera PS supplied from Reedy Creek Reservoirs
Reedy Creek Control Valve
Reedy Creek FCV
Open from 6am – 11pm
Closed 11pm – 6am
600mm
SR
Reedy Creek SR
13.00ML
TWL: 90.0m
SR
Reedy Creek SR
19.00ML
TWL: 90.0m
REEDY CREEK WSD
REEDY CREEK WSD
375mm
750mm
450mm
600mm
600mm
600mm
SR
Goline Crt SR
0.50ML
TWL: 94.9m
Tallebudgera – Connection PS
Tallebudgera Connection PS
Operates on Tariff 11pm -6am
SR
Carapook Cres SR
0.24 ML
TWL: 125.0m
Goolabah PS
Trees Rd PS
Tallebudgera LLZ
375mm
Talle Heights HLZ
Talle Heights LLZ
ELANORA BOH & RESERVOIRS
Trees Rd HLZ
Wattlebird PS
SR
Wattlebird Crt SR
12.2 kL
TWL:133.8m
SR
Tallebudgera LLZ SR
4.00ML
TWL: 90.0m
450mm
Tallebudgera LLZ
SR
Westminster Blvd SR
1.50ML
TWL: 161.0m
SR
Simpsons Road SR
13.70ML
TWL: 90.0m
Simpsons Road PS
Westminster PS
Westminster HLZ
Simpsons Rd PS
Simpsons Rd HLZ

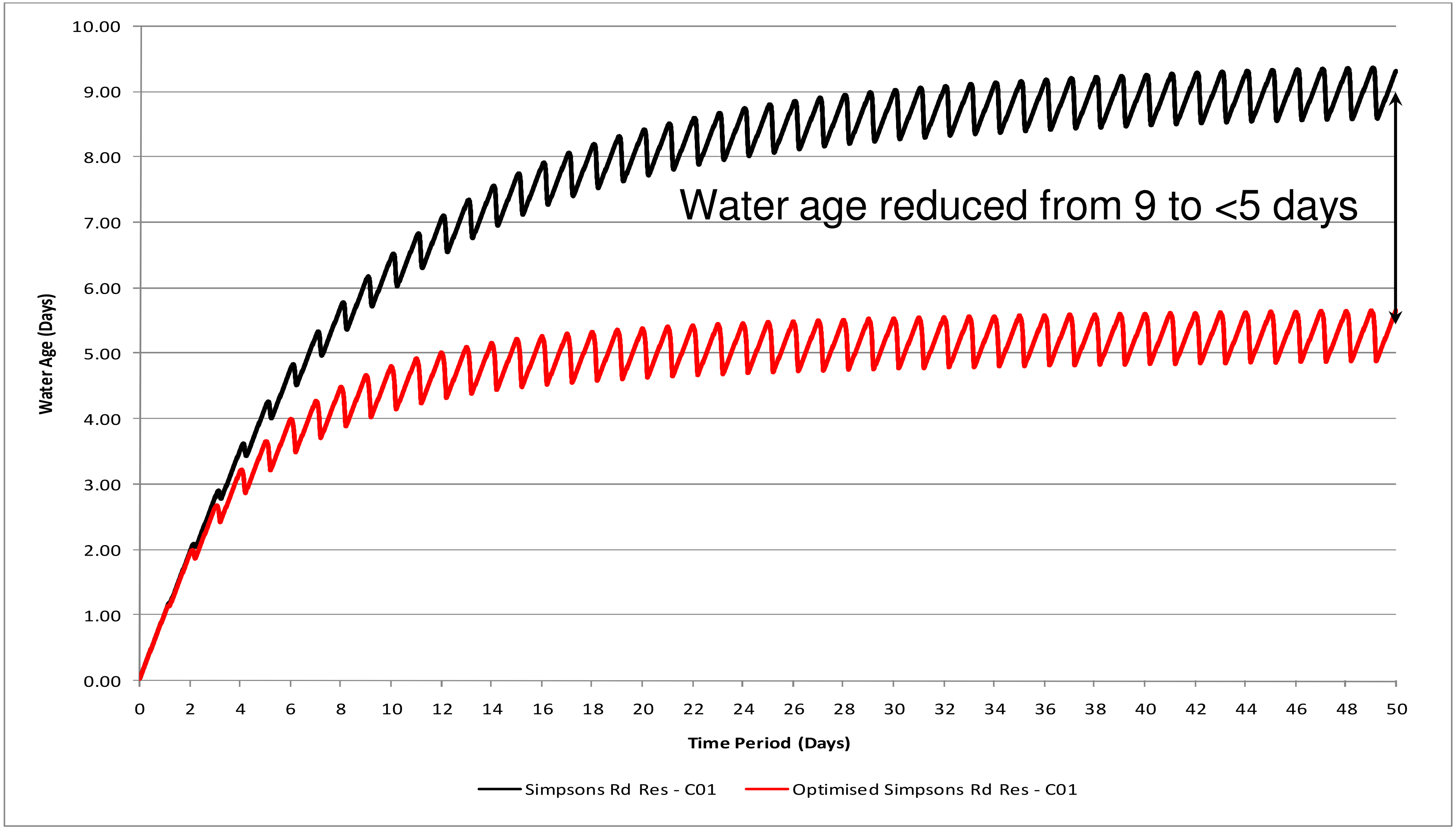
Chlorine LIMS Concentration Range



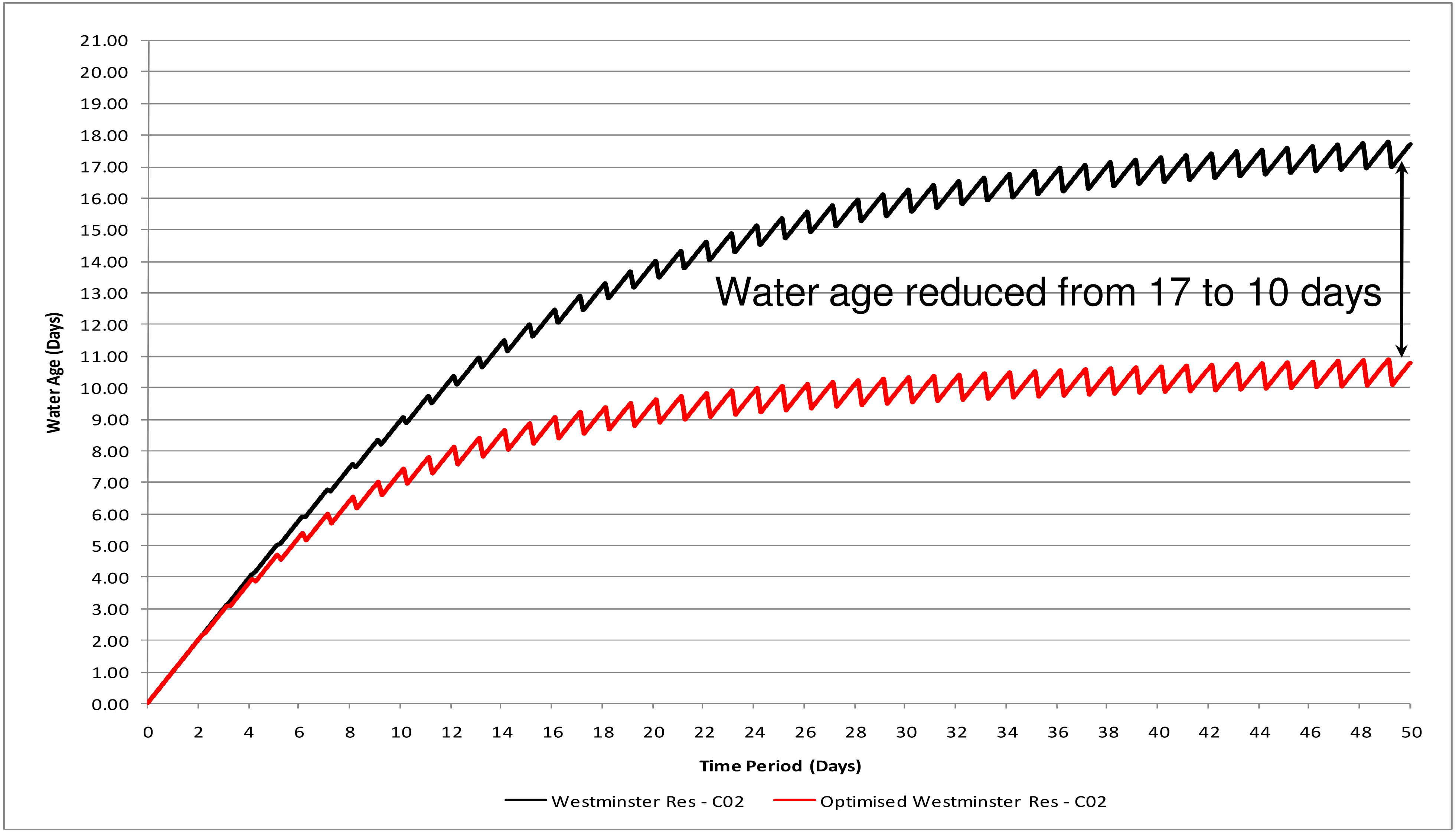
Reservoir Water Age



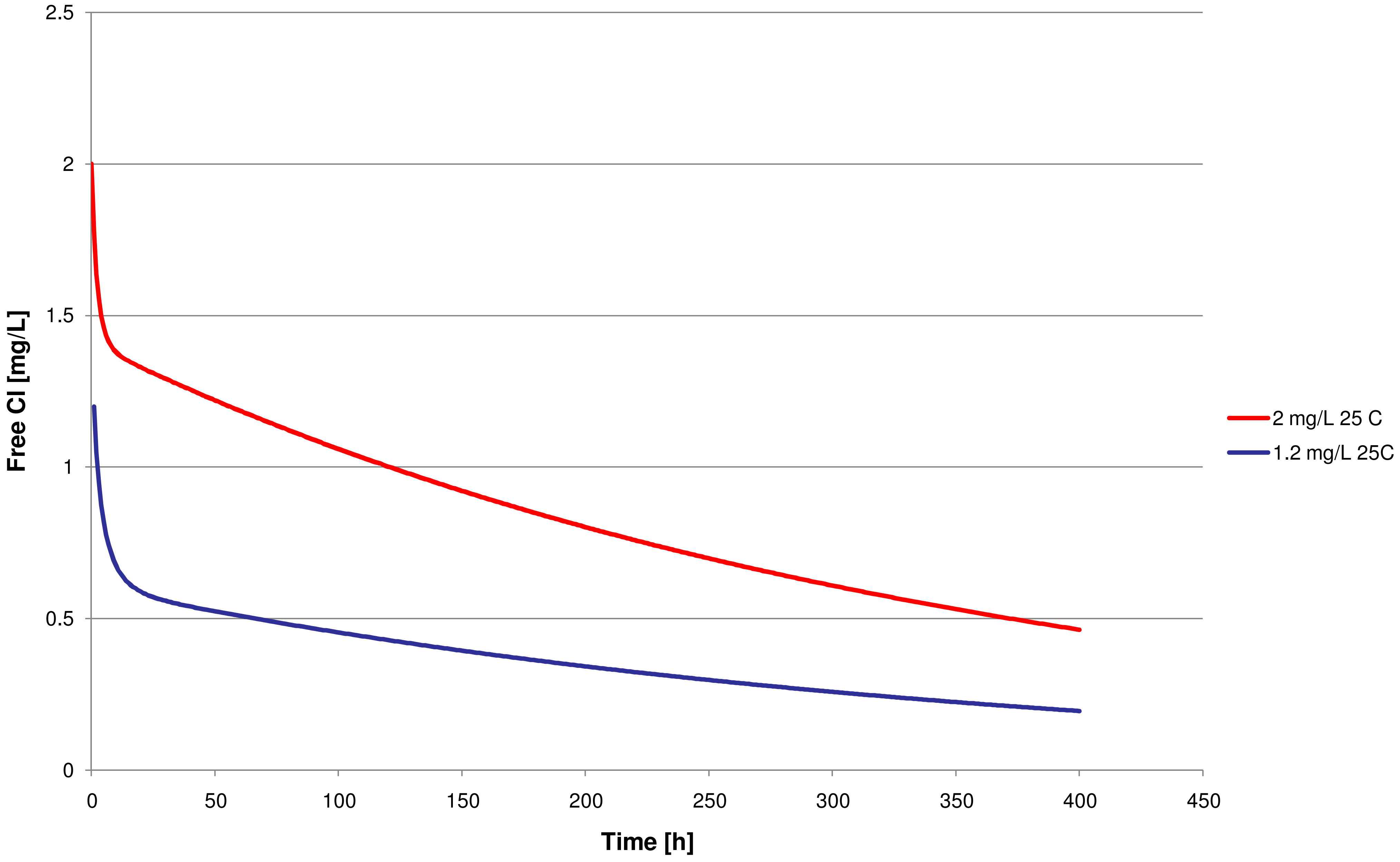
Results at Simpons Rd Reservoir (40-60% Level)



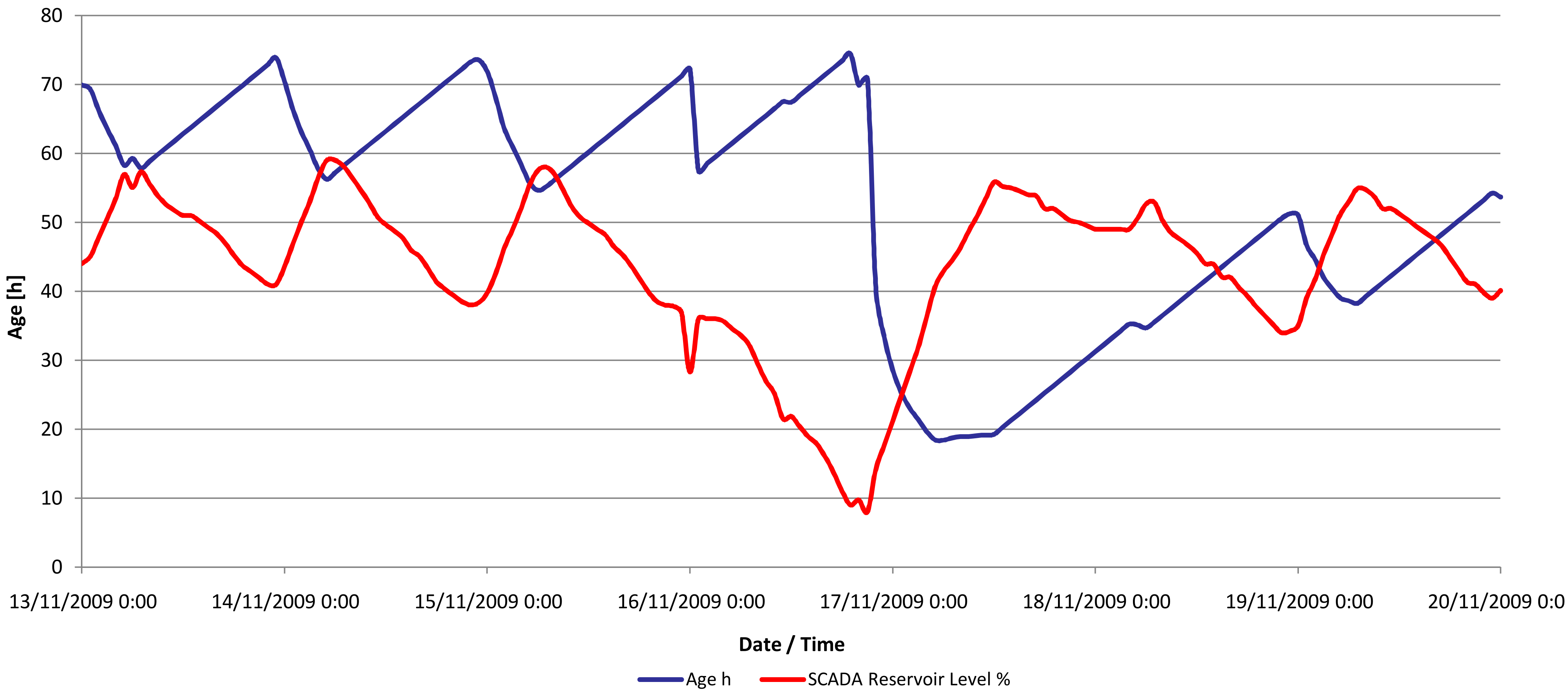
Results at Westminster Bld Reservoir (60-70%)



Cl decay in Mudgeeraba water 25℃ (bulk model)



Reservoir Water Age during Cl measurement



Operational Lessons Learnt

- Ensure the highest residual is entering the network, prevent cascading zones where water goes through reservoirs before getting to the outlying zones;
- Night v Day Reservoir Operation:
- Reservoir Volume = Operating + Emergency
- Chlorine residual can be predicted in a reservoir if the tank volumes and inflow rates are know - useful tool to assess the level of mixing in a reservoir.

Cl2 Strategy Improvement Options For Network

Investigation and improvement options to focus on:

- Prioritise WSDs to improve residual chlorine and implement an action plan;
- Change reservoir/pump operating windows;
- Reservoir cleaning/mixing/inlet & outlet configuration;
- System flushing: Uni-Directional Flushing (UDF);
- Increased dosing at the WTPs;
- Rechlorination within the network;
- WTP improved treatment.

Example 2: Using the models to aid the EQ recovery

- The largest and most complex model in New Zealand
- Approx 85,000 pipes
- 23 pumping stations (with multiple wells drawing from 5 aquifers at different depth and some artesian wells)
- Controls depends on duty controller ! Each have different ways to maintain supply !!

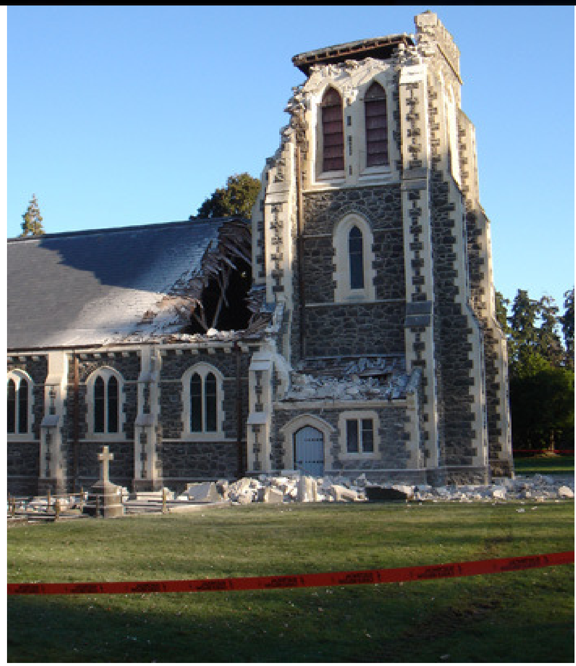
Operational & Planning Needs – Proposed Uses

- Need to reduce water loss by better control of the system and better quantification of unaccounted for water.
- Improve turnover in reservoirs to improve water quality
- Ensure that the system is able to respond to rapid development.
- Prepare for possible resource constraints and tighter abstraction rules.
- Be able to respond promptly and effectively to supply deficiency issues.
- Prepare better Emergency operating procedures.
- Rationalisation and re-zoning to enable better system management

Use To Date

- Used mostly to model future Planning Scenarios – plan for expected major growth – mostly north and south west of the city.
- BUT - despite awareness training to try to generate interest - not much day to day involvement of operations team.

Then... at 4:30am on Saturday 4th September 2010



A few obvious problems

Earthquake Recovery

- Urgent repairs carried out;
- System now working – mostly;
- Increased background leakage – higher nightlines;
- A number of bores out of action – may take some time to recover (re-construct);

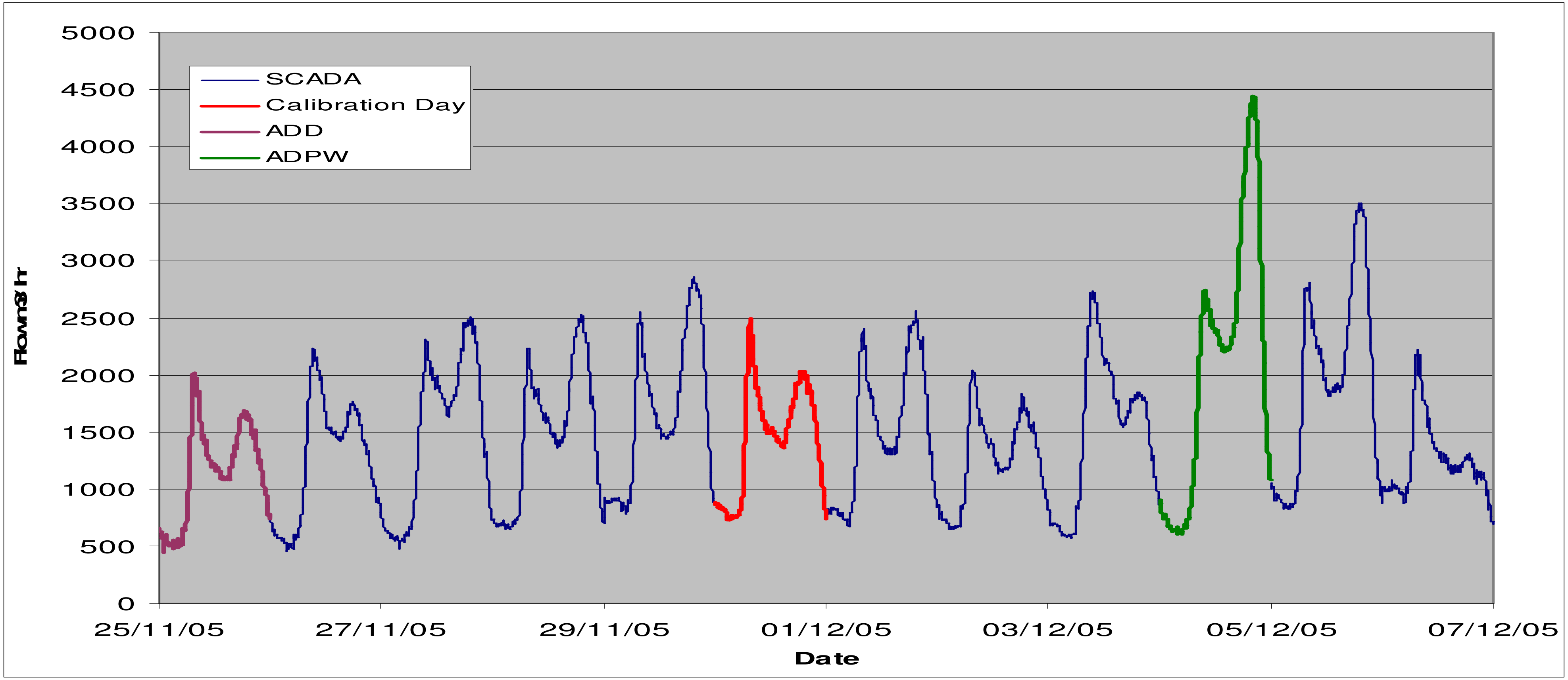
Operators Urgent Request – How can the models help

- How can the peak demand be met this summer given supply constraints?
- Assess the impact of the earthquake on the Christchurch Central Zone in meeting peak summer demand;
- Review Ferrymead system to investigate supply issues between Mt Pleasant and McCormack's Bay; and
- Consider Ferrymead as an option to meet peak demand within the Central zone.

Scenarios To be Assessed

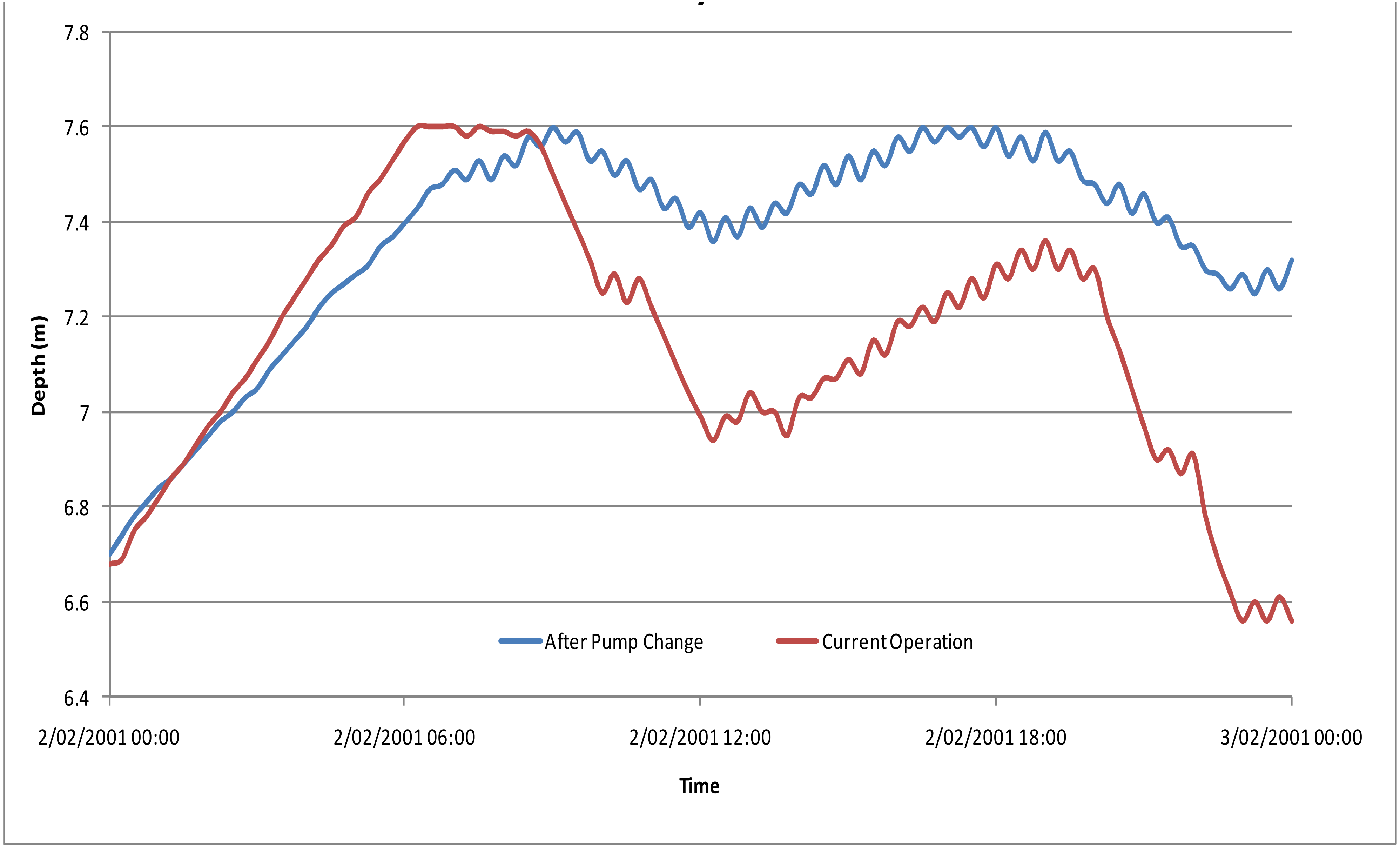
- Update the model to peak day (January 2009) demand;
- Increase leakage (NRW) by 10% to 19 ML/d to allow for additional losses in the network;
- Update the Central Zone model to isolate wells that are unlikely to be available this summer;
- Assess the impact on the system and major reservoirs i.e. Huntsbury, Worsley;
- Investigate options to improve the inflow to McCormack's Bay reservoir;
- Open the Central and Ferrymead Zonal boundary, to supply water into the Central zone.

Christchurch NW Zone – Net inflow



- Note the changing demand pattern throughout the field test – heavily influenced by climate.

With a number of pumps inoperable - Key res levels fall over 24hrs



Operational Solutions

- Operational changes e.g. valve settings tested in the model and actions agreed;
- Open the Central and Ferrymead zone boundary to allow full connectivity between the two systems;
- A figure of 145 ML/d will provide a buffer to allow the affects of restrictions to occur before reservoir levels become critical.
- It is recommended that CCC implements ‘City wide water restrictions’ this summer to reduce peak demand and relieve stress on the system.

Why wait for mother nature?

Earthquake

Drought

Flood

System Failure

The Challenge

- Move hydraulic models from the typical planning environment into the operations room?
- How do we introduce hydraulic models in to our daily routine to support day-to-day operational decisions?
- Planning and O&M staff to work closer on network issues – allowing better transfer of knowledge and joined up thinking.

Our Role As Engineers

- Educate staff on the uses of a hydraulic model – it is not a black box or a threat to their jobs;
- Work closer with operational staff on a day to day basis;
- Talk through the issues, constraints and long term problems in the network and use the model to review and implement an action plan in the field;
- Demonstrate that a model can help support decision making in the field – install confidence.

Thank you for listening - Questions

Thank you for listening
– Any questions