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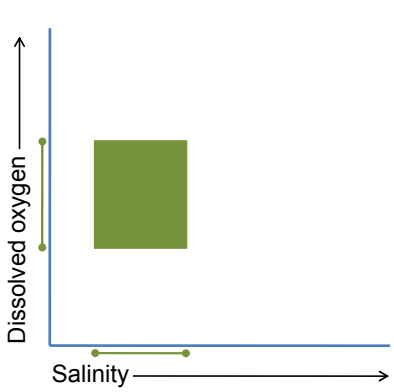
The response of water quality and phytoplankton to barrage releases in the Northern Coorong

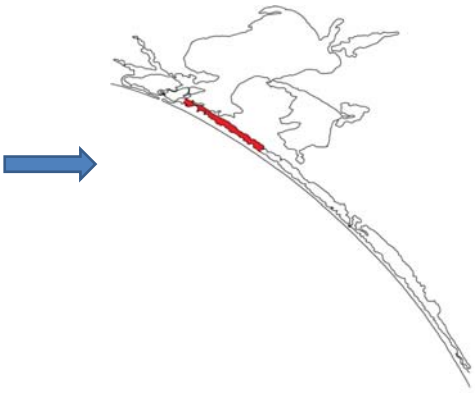
Kane Aldridge and Justin Brookes

Government of South Australia
Department of Environment and Natural Resources

Water quality → habitat availability

- Along with geomorphology, water quality determines habitat availability in aquatic systems
  - Physiological response

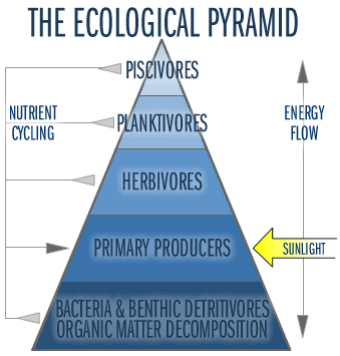




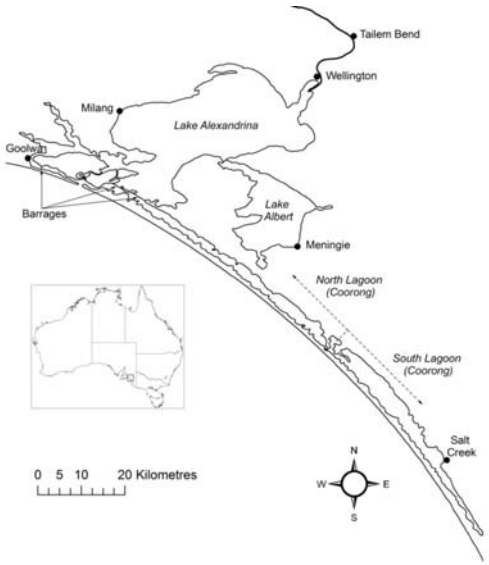
Nutrients and phytoplankton

- Nutrients
  - Metabolised by organisms to give energy and build tissue
  - P, N and Si often determine the total biomass
  - Form helps shapes the ecosystem structure
  - Flow dependant
    - High flows – mobilisation from catchment
    - Low flows - internal cycling

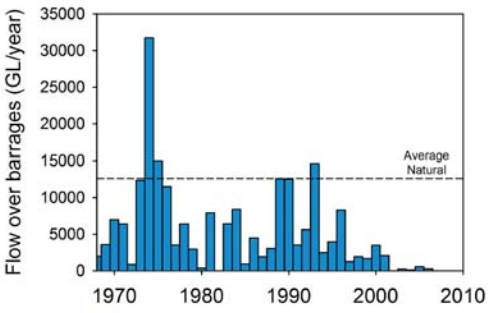
- Phytoplankton
  - Major energy source of aquatic ecosystems
  - Flow dependant
  - Influences ecosystem structure
    - Algal blooms – 'short-circuit' of foodweb
    - Important interactions with macrophytes - driven by nutrients, turbidity and salinity

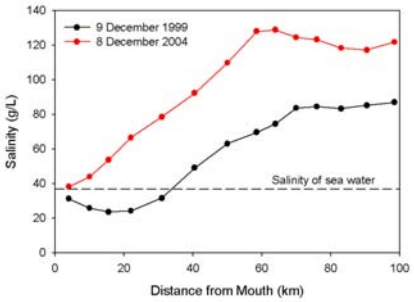


Coorong, Lower Lakes & Murray Mouth



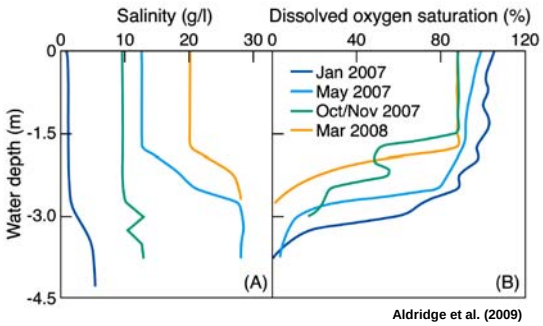
Increasing salinity





Brookes et al. (2009)

Drought conditions



Aldridge et al. (2009)

Parameter	Pre-barrage release
NH_4-N (mg/L)	≈0.05
NO_x-N (mg/L)	≈0.005
FRP (mg/L)	≈0.03
FRSi (mg/L)	≈0.03
Chlorophyll *a*	5.8 ± 2.8
Cyanobacteria (cells/mL)	0
Chlorophyta (cells/mL)	0
Bacillariophyta (cells/mL)	513-872
Cryptophyta (cells/mL)	0
Streptophyta (cells/mL)	0
Dinoflagellata (cells/mL)	154-487
Euglenozoa (cells/mL)	0

Seuront and Leterme (2010)

Inflows!

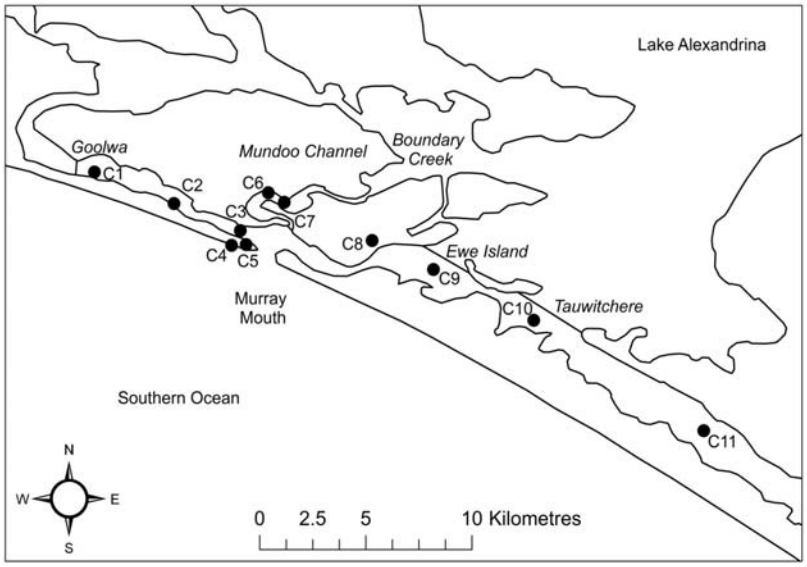
Measurements

- 1st November 2010 – 25 May 2011

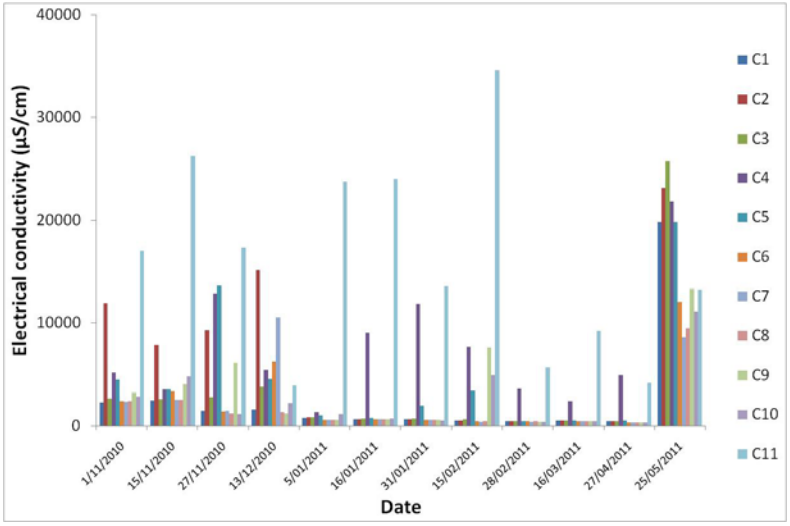
- 12 occasions
  - Water temperature, specific electrical conductivity, dissolved oxygen, pH, turbidity and chlorophyll *a at* 0.25 m depth intervals

- 6 occasions
  - Nitrogen – NH_4, NO_X, TKN (→ TON)
  - Phosphorus – FRP, TP
  - Reactive silica
  - Phytoplankton – identification and counts

Sampling sites

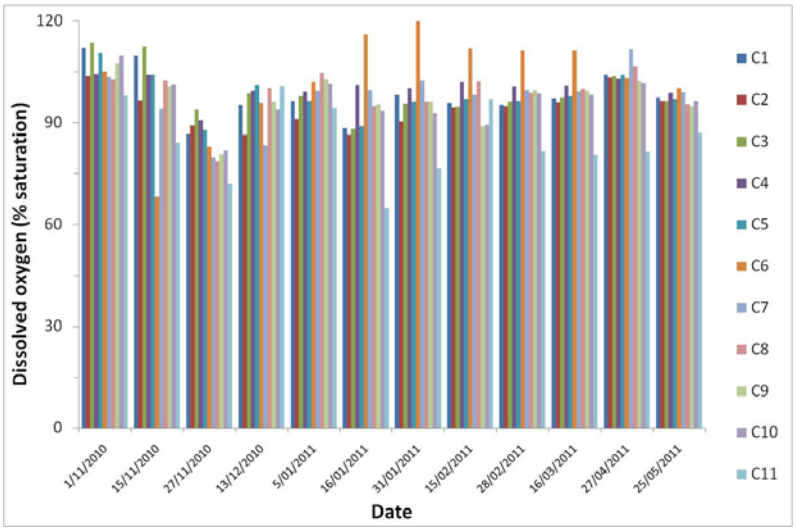


Electrical conductivity



- Large, rapid ↓ - 54159 to 2945 µS/cm at C2
- Influence beyond Mark Point (often <5000 µS/cm)
- Highly variable at C4, C5 and C11
- Spike in May 2011 due to onshore winds

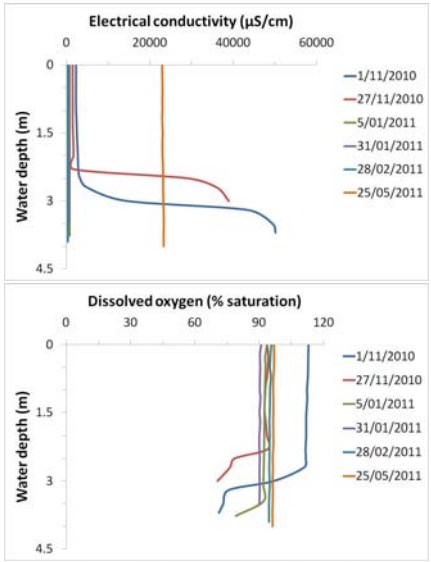
Dissolved oxygen



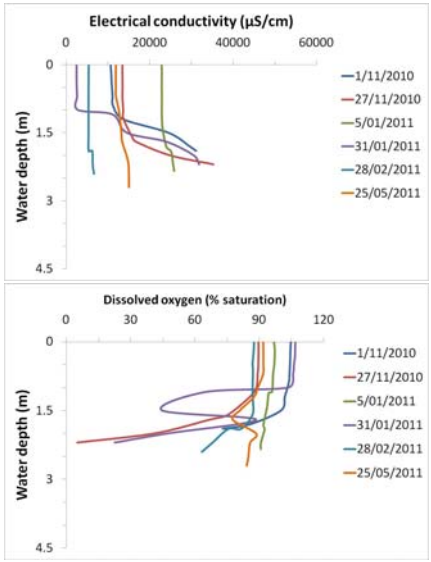
- Initial ↓ – DOC release
- Subsequent ↑ (stratification breakdown)
- Lower at Mark Point (stratification)

Breakdown of stratification and increased DO

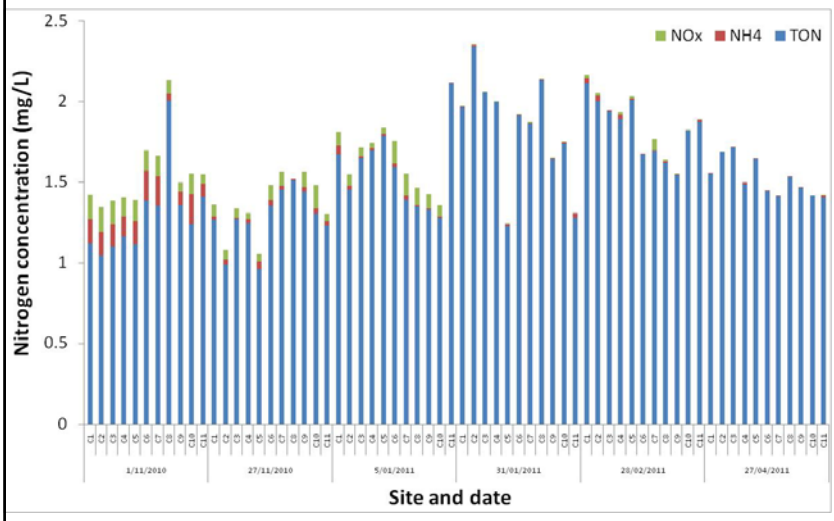
C2



C11

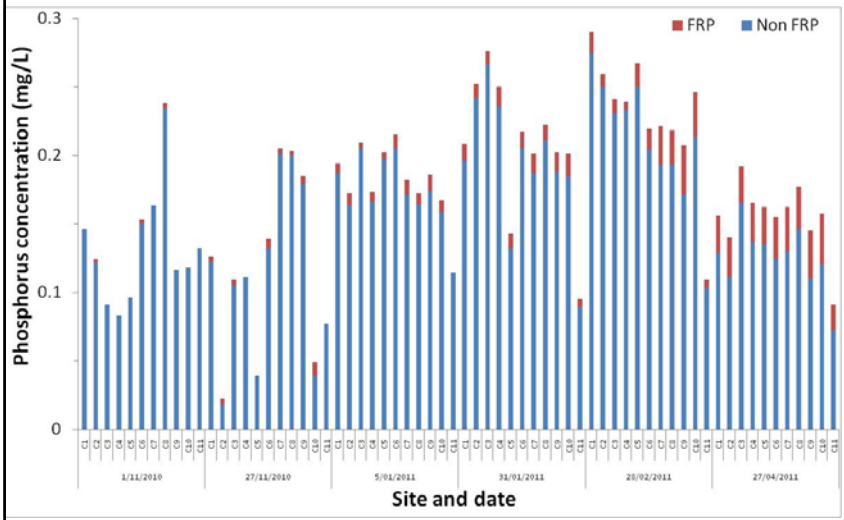


Nitrogen



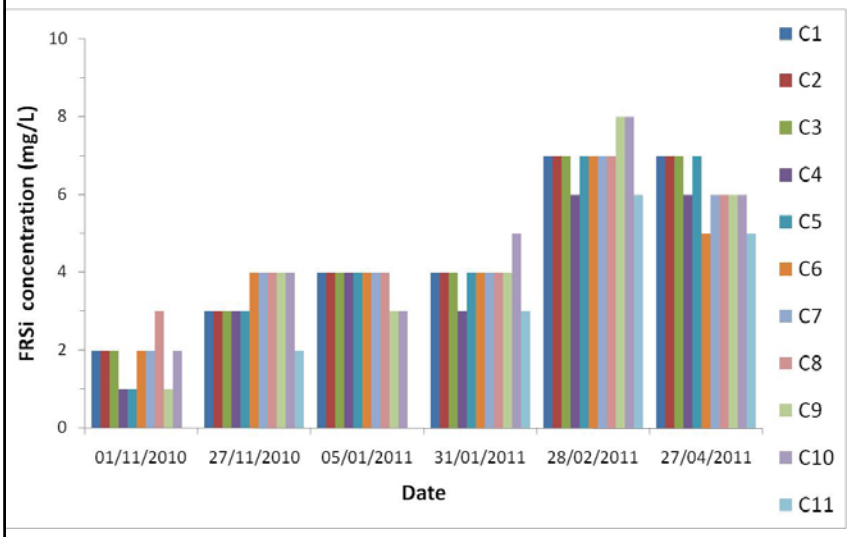
- ↑ TON – primary and secondary/microbial biomass
- ↓ NO_x and NH_4 - incorporation into biomass or tightly coupled nitrification-denitrification (↑ DO)

Phosphorus



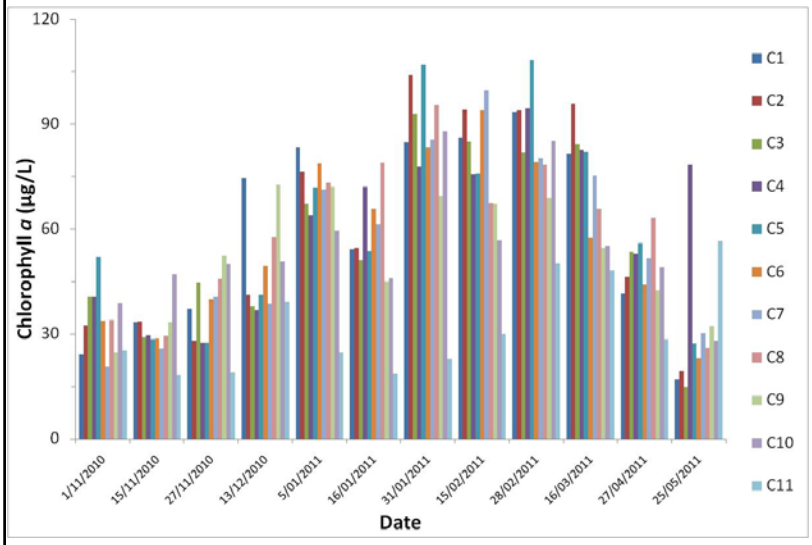
- ↑ FRP - mobilisation from basin

Silica



• ↑ FRSi, mobilisation from basin

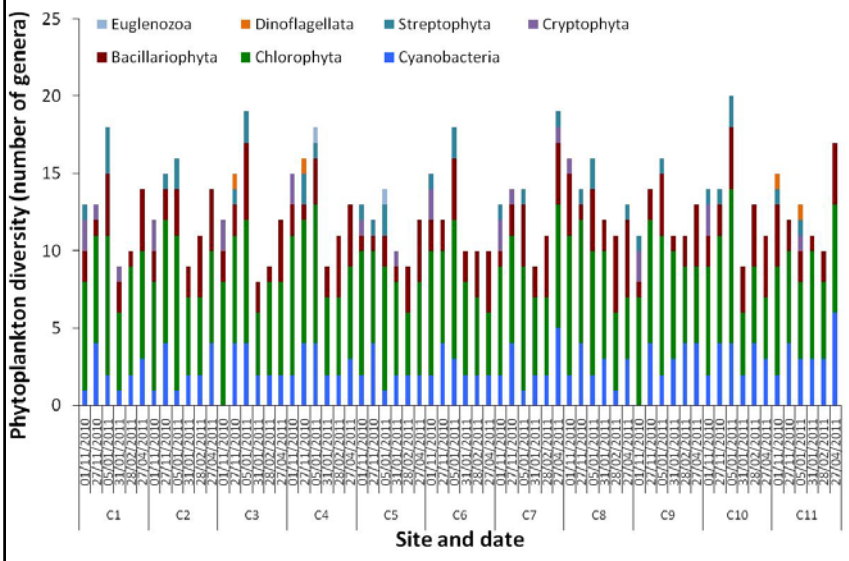
Chlorophyll



• ↑ phytoplankton biomass (≈5µg/L during drought)

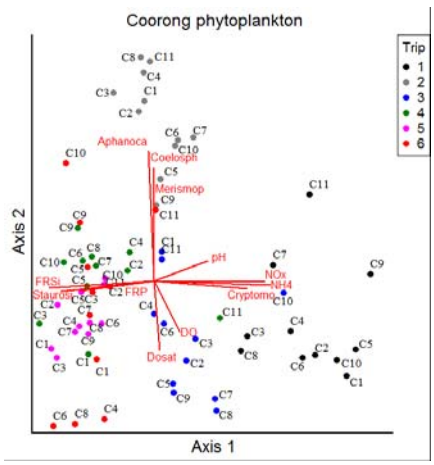
•↓ towards end but high TON - incorporation into zooplankton/microbial biomass

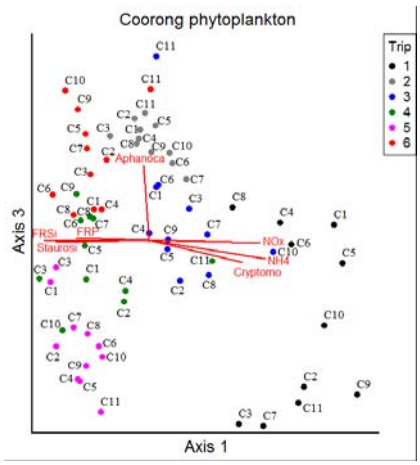
Phytoplankton diversity



- Initially ↑ i blue-greens (Lower Lakes)
- •Diatoms ↑ through the study (↑ FRS - food sourc for Goolwa Cockles (Seuront and Leterme 2010)

Changes to water quality ⟶ phytoplankton community



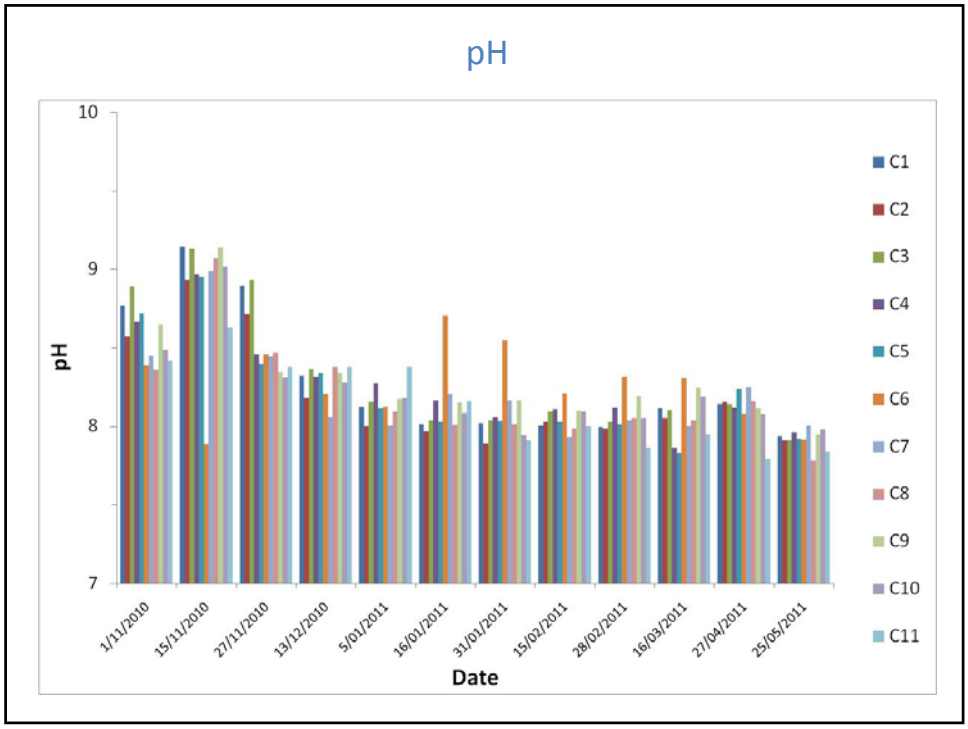


Conclusions

- Rapid changes to habitat availability
  - Reduced salinity levels
    - Short-term negative impacts on habitat for marine and sensitive estuarine organisms
    - Immediate benefits for freshwater organisms and diadromous fish
    - Impacts must be considered at a regional and long-term scale
  - Increased DO in the hypolimnion would increase habitat availability
- Significant changes in 'food' availability
  - Increased nutrient imports
  - Increased abundance, diversity and of the phytoplankton community
  - Likely to result in continued elevated primary productivity
  - Increased resources may cascade through the food-web, assuming that this primary productivity occurs in forms that are available to higher organisms

Recommendations

- Ecological monitoring
  - – Observe longer term response
  - – Consider greater spatial scale – Southern Coorong?
  - – A framework to capture unforseen events
  - – Long-term - build a 'matrix' on the hydro-ecological
- Research
  - – Rates of mixing of freshwater and saline water
  - – Interactions between trophic levels
  - –Where do the nutrients go in the food-web?
    - – Monitoring data can be assessed against clear targets
- Management
  - – Where possible, more gradual initial releases following extreme droughts
  - – Consideration of barrage release mechanisms and SE drainage to enhance mixing


pH
10
9
8
7
pH
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
1/11/2010
15/11/2010
27/11/2010
13/12/2010
5/01/2011
16/01/2011
31/01/2011
15/02/2011
28/02/2011
16/03/2011
27/04/2011
25/05/2011
Date