Nitrogen and phosphorus transformations within Te Waihora affect the amounts of nutrients available to phytoplankton

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Key messages

- The nutrient concentrations in the lake don't simply reflect nutrient loads from tributaries, groundwater, rainwater and the sea. There is more P and less N in the lake.
- Microbes in the lake sediments remove nitrogen from the system by denitrification, but this only works in summer, not in winter when most of the nitrate load from the catchment occurs. Unfortunately, this means that much of the nitrate entering the lake is available to algae
- Large pools of phosphorus in the lake sediments can be recycled into the water column, mainly in summer
- Temperature and oxygen are key drivers of both denitrification and sediment phosphorus release

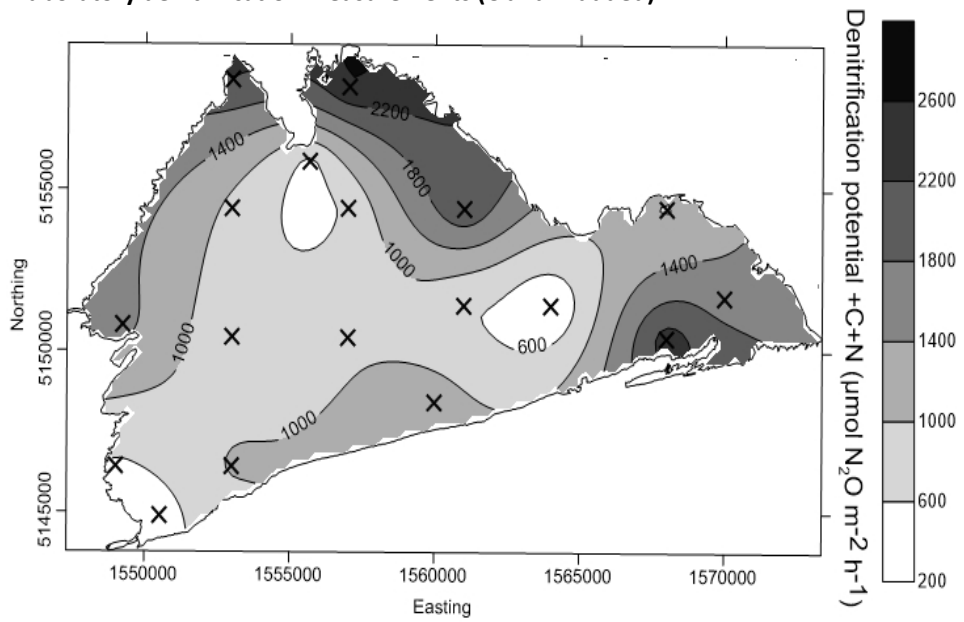
Context and objectives

- To understand where the algal blooms get their N and P from, we need to understand not only catchment sources of N and P, but also how these nutrients are cycled and recycled within the lake
- If nutrient remediation actions are to be undertaken, are they likely to have a positive effect in the short-term? In the long-term?
- An objective of this work is to refine the Te Waihora dynamic model so that it better reflects the processes at work in the lake and better predicts the outcomes of potential remediation actions

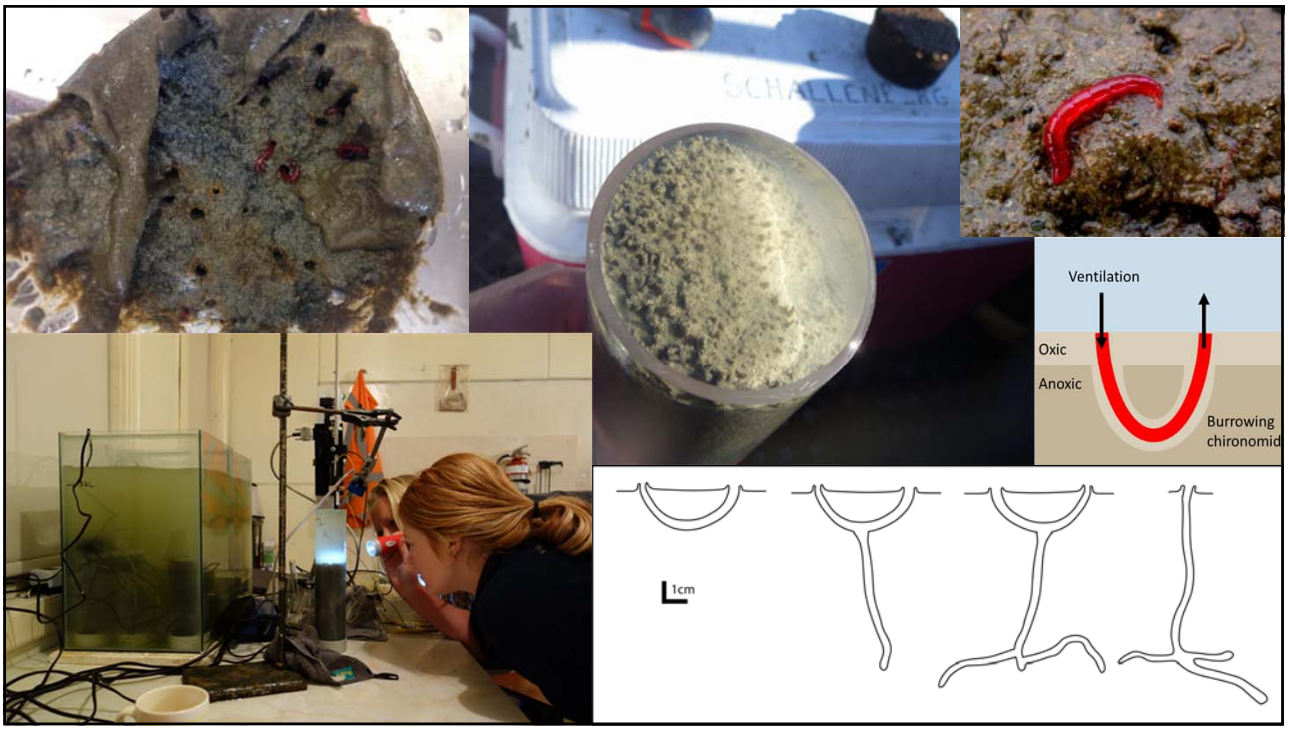
Methods

1. Analysis of long-term ECAN water quality data
2. Putting new water quality monitoring instruments in the lake
3. Experiments to understand the drivers of denitrification in the lake
4. Measurements to understand the pool of sediment P in the lake, where it is located and whether it is released into the water column
5. Combine the above information within the Te Waihora dynamic model (update the model)

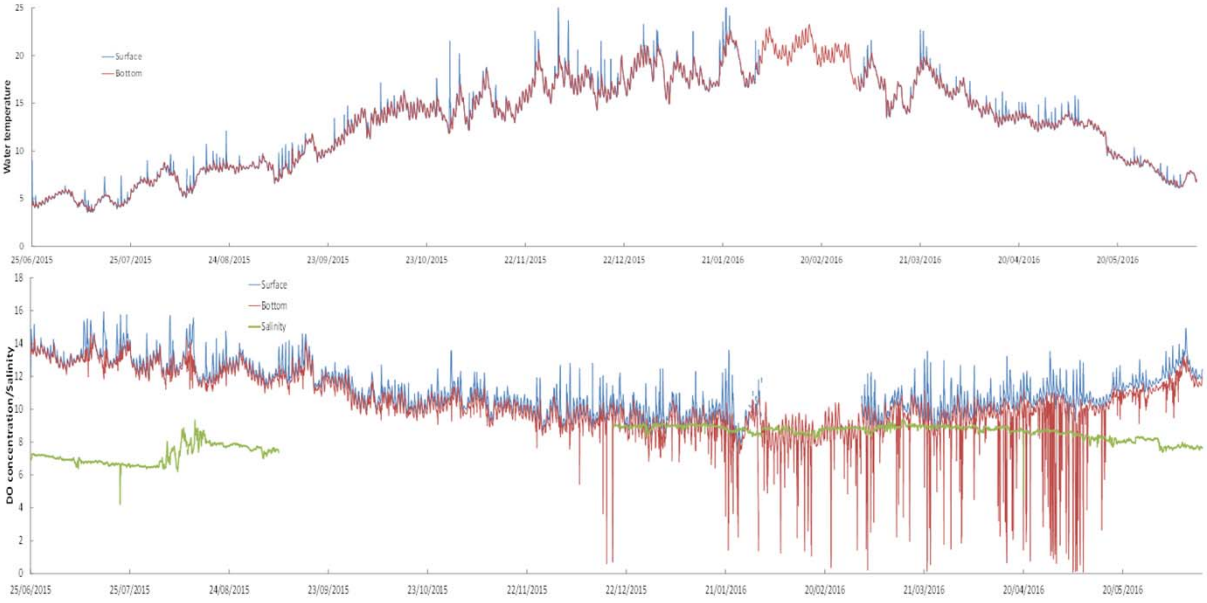
Laboratory denitrification measurements (C and N added)



Schallenberg & Crawshaw (2017)

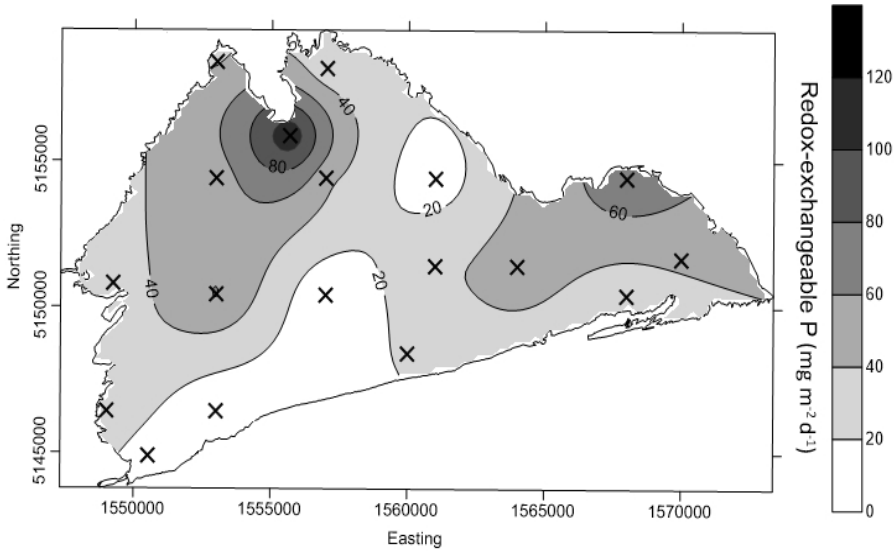


ECAN mid-lake monitoring site



Schallenberg & Crawshaw (2017)

Phosphorus pool in the sediments



Schallenberg & Crawshaw (2017)

Implications:

- Our findings help explain why the lake has excess nitrate in winter (high inflows - no denitrification) and excess phosphate in summer (internal P load)
- Our work shows that internal nutrient processing plays an important role in determining N and P availability to phytoplankton and that it mediates the effects of current and historical nutrient inputs to the lake
- All four lake interventions of interest to the Selwyn Waihora Zone Committee (water level management, phosphorus legacy management, restoration of macrophytes and wetland development) are also likely to affect in-lake nutrient processes in ways which will reduce nutrient (re)cycling and availability to phytoplankton.

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