# Lake Rotoehu: project update

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# Lake Rotoehu: water level



# Bathymetry

### Irwin (68 (74?))



#### UoW (2010)



# Bathymetry

- Reprocessed UoW (2010) survey to regular grid (at right).
- Calculated hypsography and compared with provided BoP hypsography (black vs red, below)





# Monitoring sites and catchment land use



Land use



Additional site
Te Pohue
Rakaumakere
Swamp
Buoy
Lake input
Maero
Soda Springs
Outlet

Water	Forest (native)	Scrub	Urban	Dairy
Wetland	Forest (exotic)	Lifestyle & parks	Drystock	Other

# **Collation and quality control of BoP monitoring data**

Lots of soda springs and Swamp samples have been swapped in BoPs db (or at time of sampling)



Open circles are data that have been removed for quality control

# Only continuously gauged inflow is Waitangi

Data are only useful when lake level < ~294.7 masl (blue)



## Very little discharge-concentration relationship





# **Summary of measured loads**



- Geothermal P load looks to be higher than previous estimates (Soda Springs = mostly geothermal, Rakaumakere = some geothermal)
- High overall loads from the coldwater southern streams
- Swamp conc/loads too high to be mostly Rotoma water. Geothermal? GW from agriculture?

# Meteorology: Airport data adjusted using NIWA's VCS.



# Mean annual rainfall is high ~2.19 m

## Water budgets: catchment balance

Water budget components





# Water budgets: assumed interception and yield by land use

Landuse	Interception (m)	Water yield (m3/s)
Dairy	0.96	0.105
Drystock	0.96	0.223
Forest (exotic)	1.16	0.199
Forest (native)	1.25	0.163
Geothermal	0	0.3
Lifestyle & parks	0.96	0.013
Other	1	0.002
Rotoma	0	0.381
Scrub	1	0.003
Urban	0.8	0.014
Water	1.42	0.066
Wetland	1.42	0.005
Total	0.91	1.474

# Water budgets: stream measurements w/ water balance



8 Monitoring sites 5787000 Northing (NZTM) 5784000 81000 78000 22 Additional site 0 Te Pohue Rakaumakere 🛑 Swamp 😑 Buoy Soda Springs Lake input Outlet Maero

# Water budgets: comparison



Where does all the extra southern water go? To the lake by GW drainage, or does it drain away from catchment. Assessment of stream subcatchments by GIS experts/ hydrologists would be helpful.



# Large flat area in southern catchment

# Does this area drain to lake via GW, or out of catchment??

## Lake Water quality





Lake Rotoehu: simulated versus observed temperature at 0.5 and 9 m

### Initial hydrodynamic model

# OK, but calibration needs to be improved

## **Evidence for internal loading**



# Plots of dissolved nutrients vs consecutive days of anoxia

DRP and NH4 appear to increase dramatically and quite linearly during stratified periods. More data needed!





#### Bottom DO in Rotoehu, 2011 to present

- Days of anoxia highly variable among years
- Buoy data very instructive model is needed to fill some gaps in buoy record
- Quite a lot of anoxia in 2019-20, yet a very good summer for the lake.
  - Low surface flows during sumer?
  - Low geothermal loading...?



Do Si concentrations in Rotoehu (range ~ 8 to 22 ppm) indicate large changes in geothermal load which could be a driver of changes in TLI??

# **NEXT STEPS**

- Complete the update of 1D lake models (incl. new catchment water balance and model water balance approaches).
- Calibrate model in detail using buoy record to 'fill the gaps' of buoy record and look back in time/water level.
- Use empirical methods and biogeochemical simulations to estimate internal loads, and compare to external loads (which will be compiled when setting up model inflows.