There's something ***funky*** going on down there

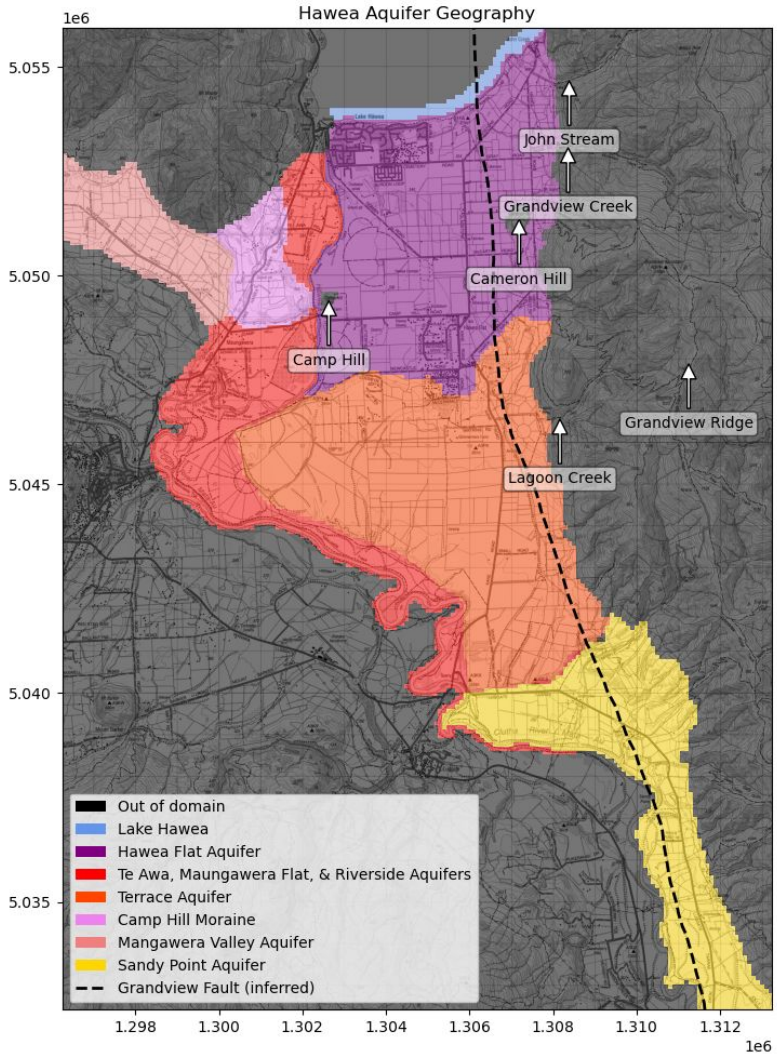
Deterministic groundwater modelling, glacial geomorphology, and hair-loss

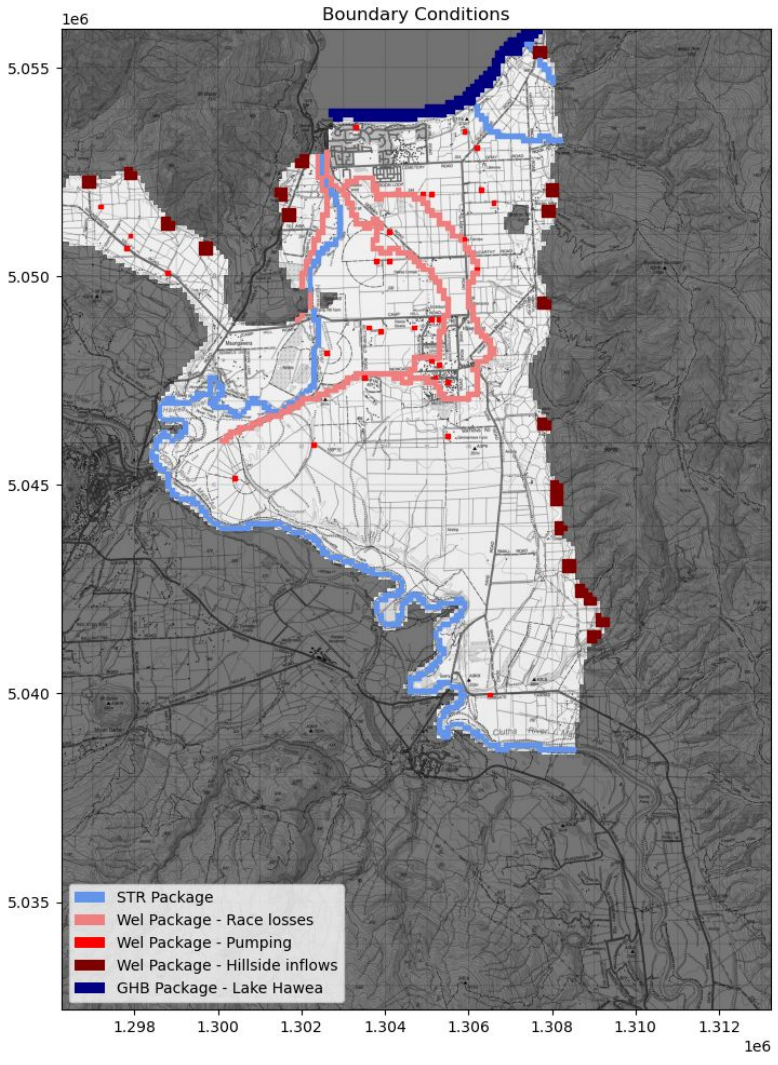
Matt Dumont and Jens Rekker

LINCOLN AGRITECH LTD

KSL Kōmanawa Solutions Ltd

Otago Regional Council





KSL
Kōmanawa Solutions Ltd

Previous data

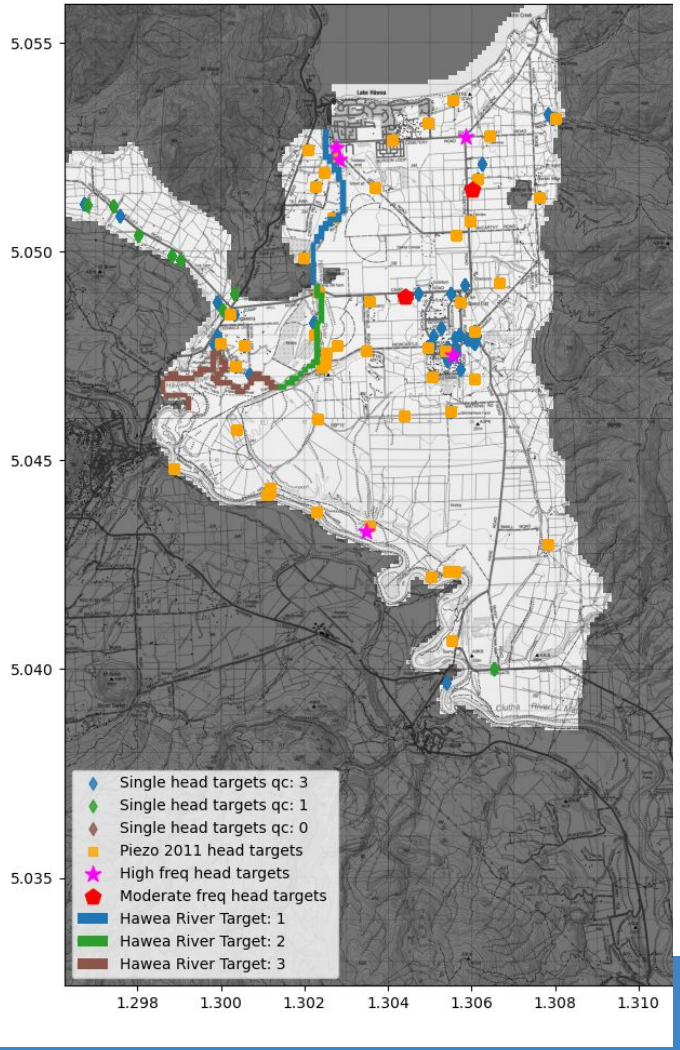
- 1 layer model (Scott Wilson 2012)
- Steady state
- Piezo survey
- Spot readings

New data:

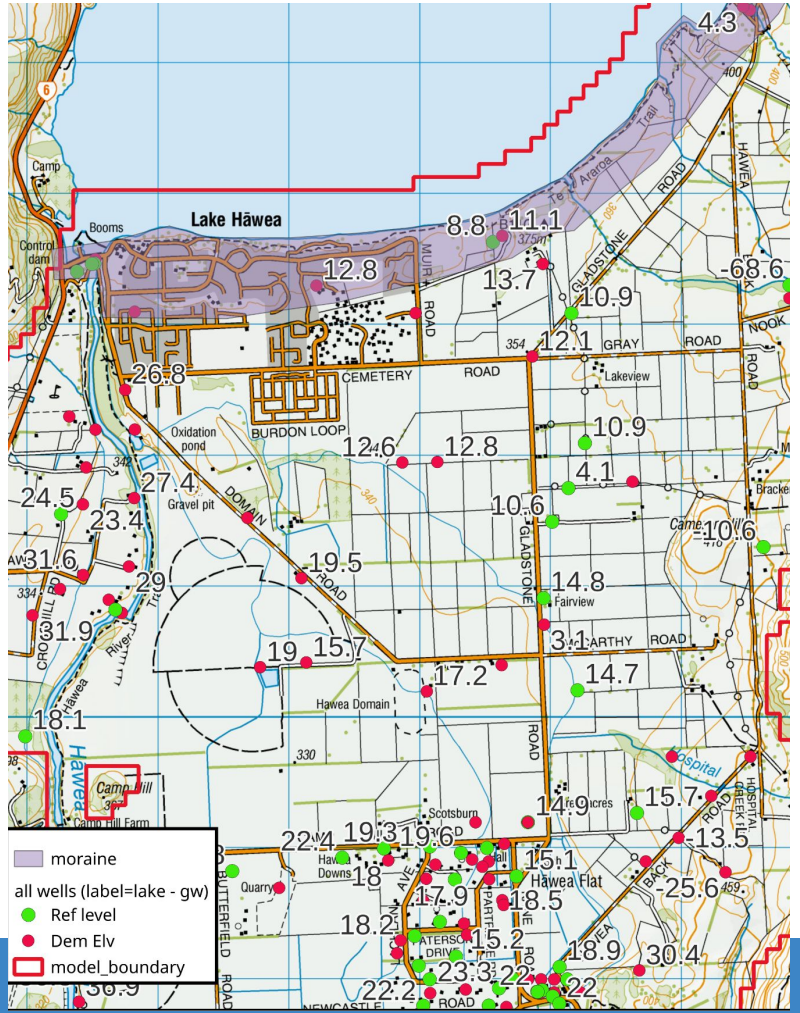
- 5 high frequency monitoring bores

Goal:

- Make Scott's model transient

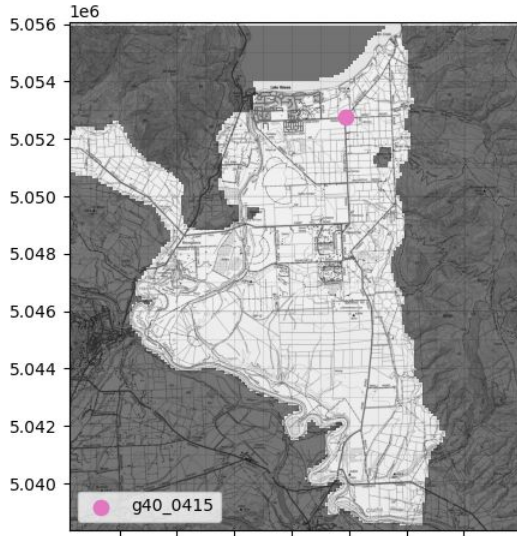


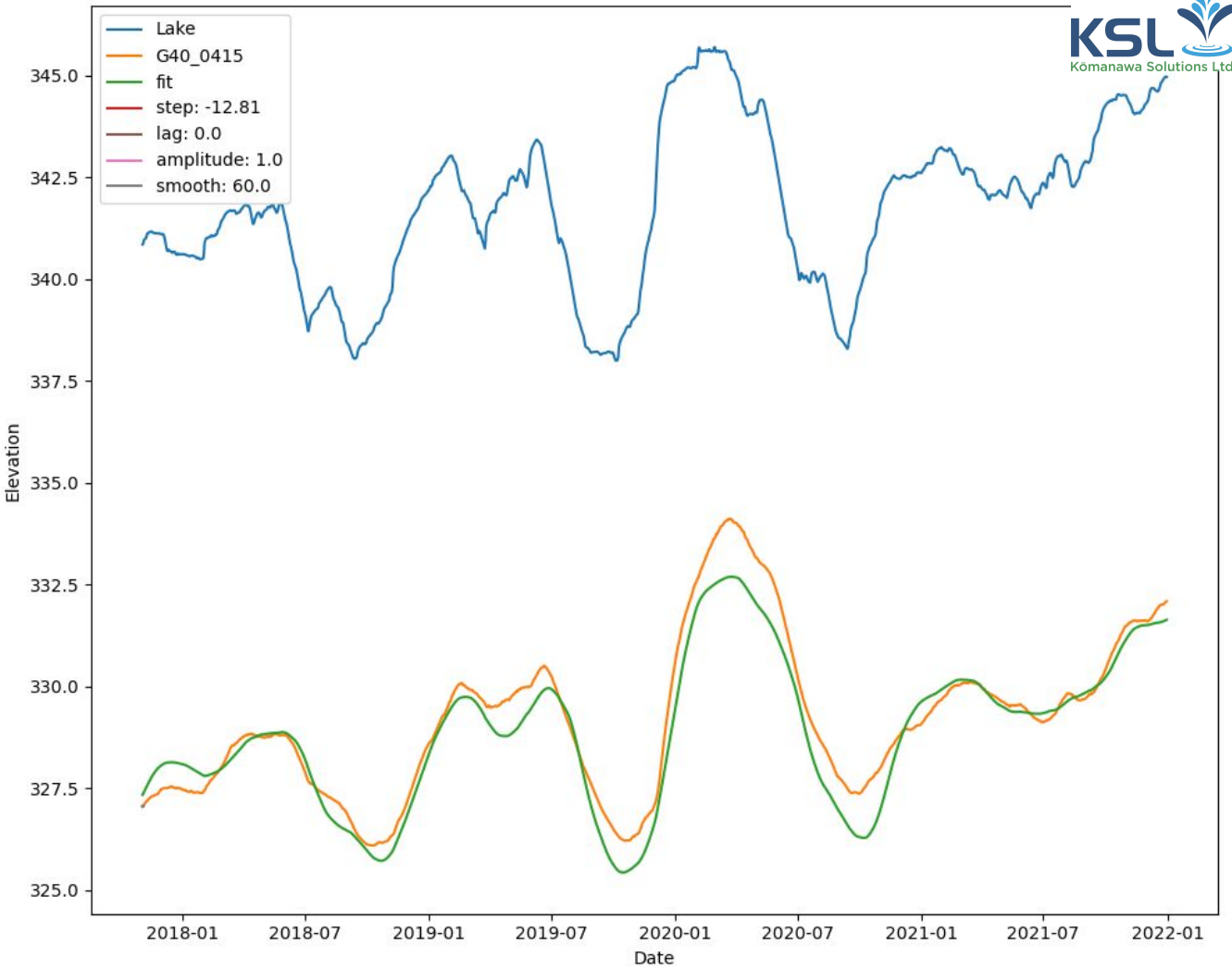
Large drop between the lake and the groundwater



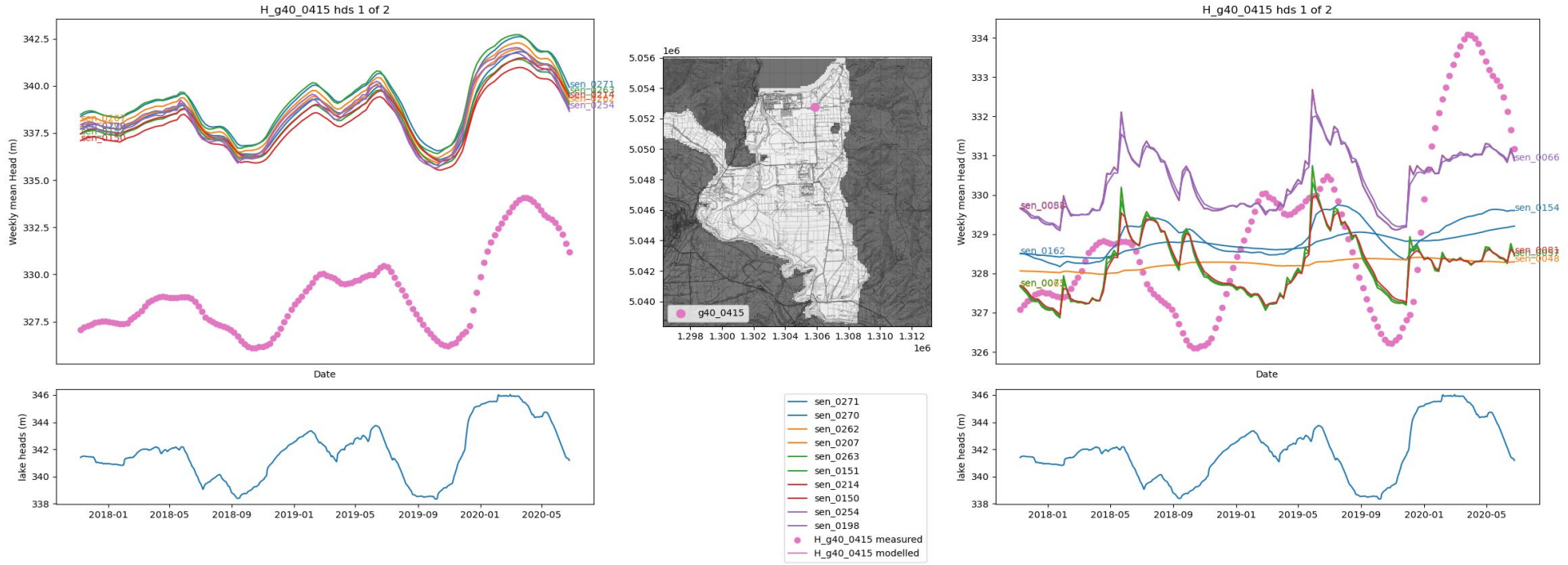
"My data is…
…problematic"

10m drop within 1km of the lake but almost no change in amplitude

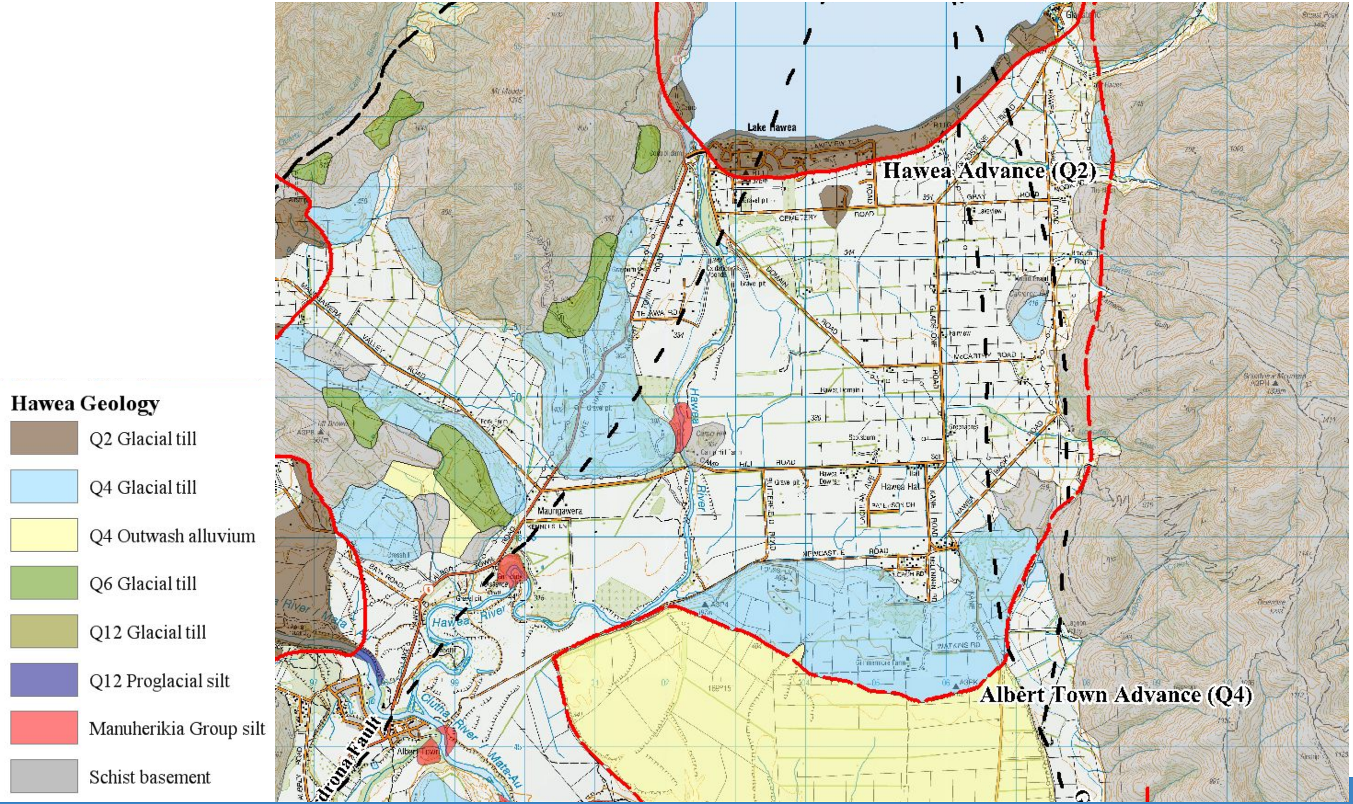


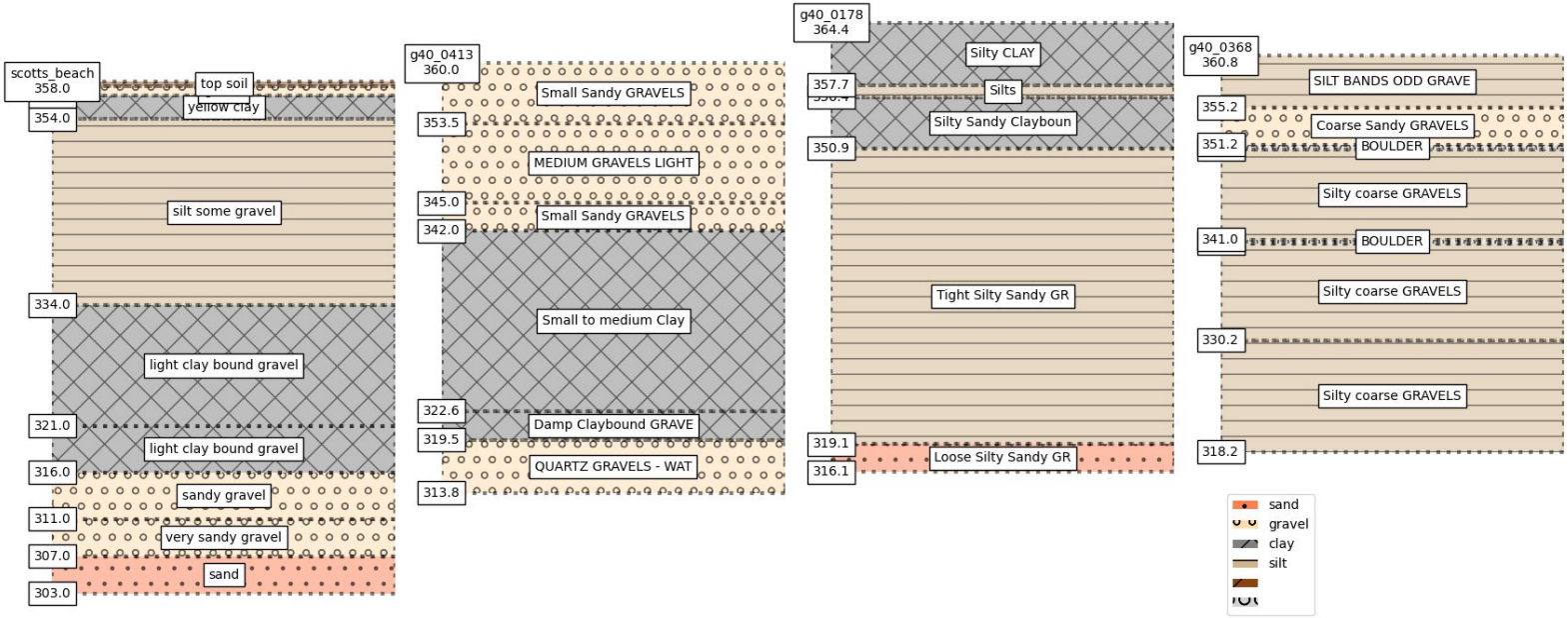


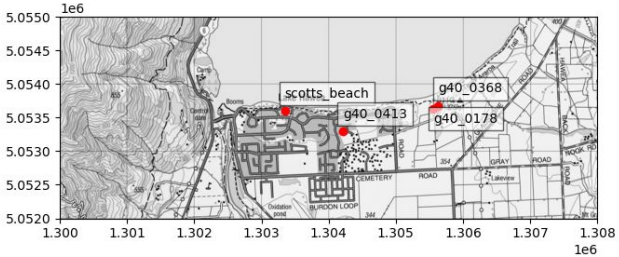
The 1 layer model couldn't match the data → hair loss

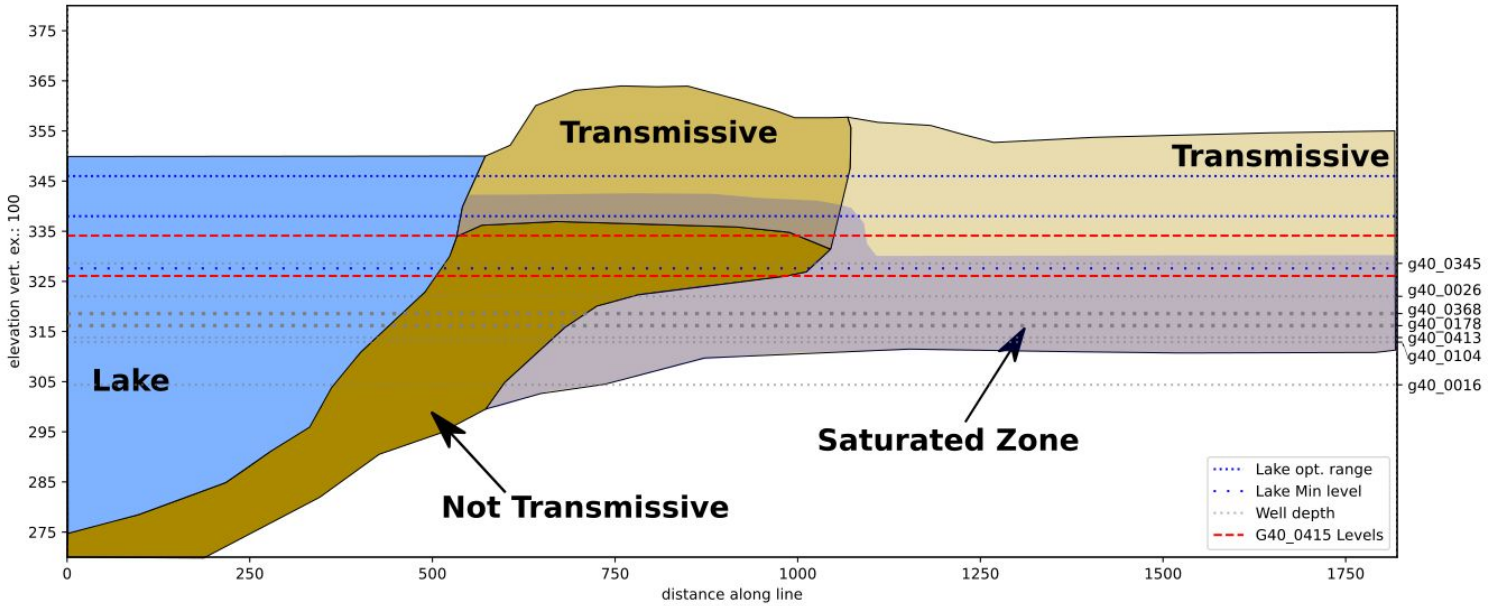


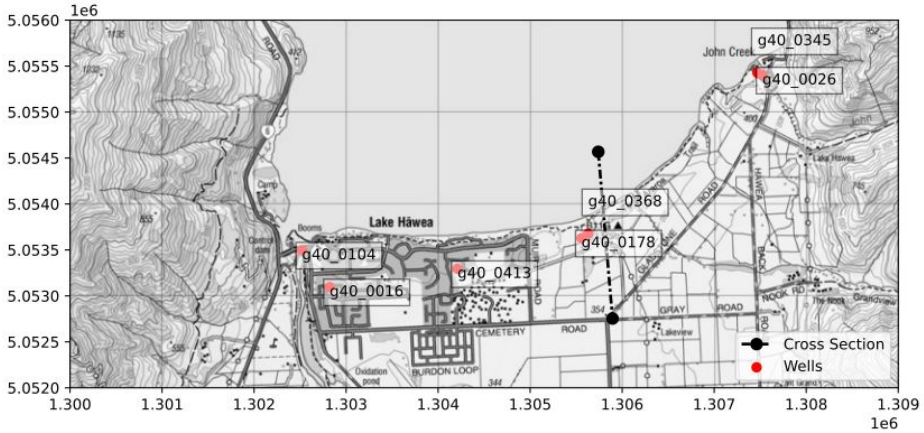
Back to glacial geomorphology

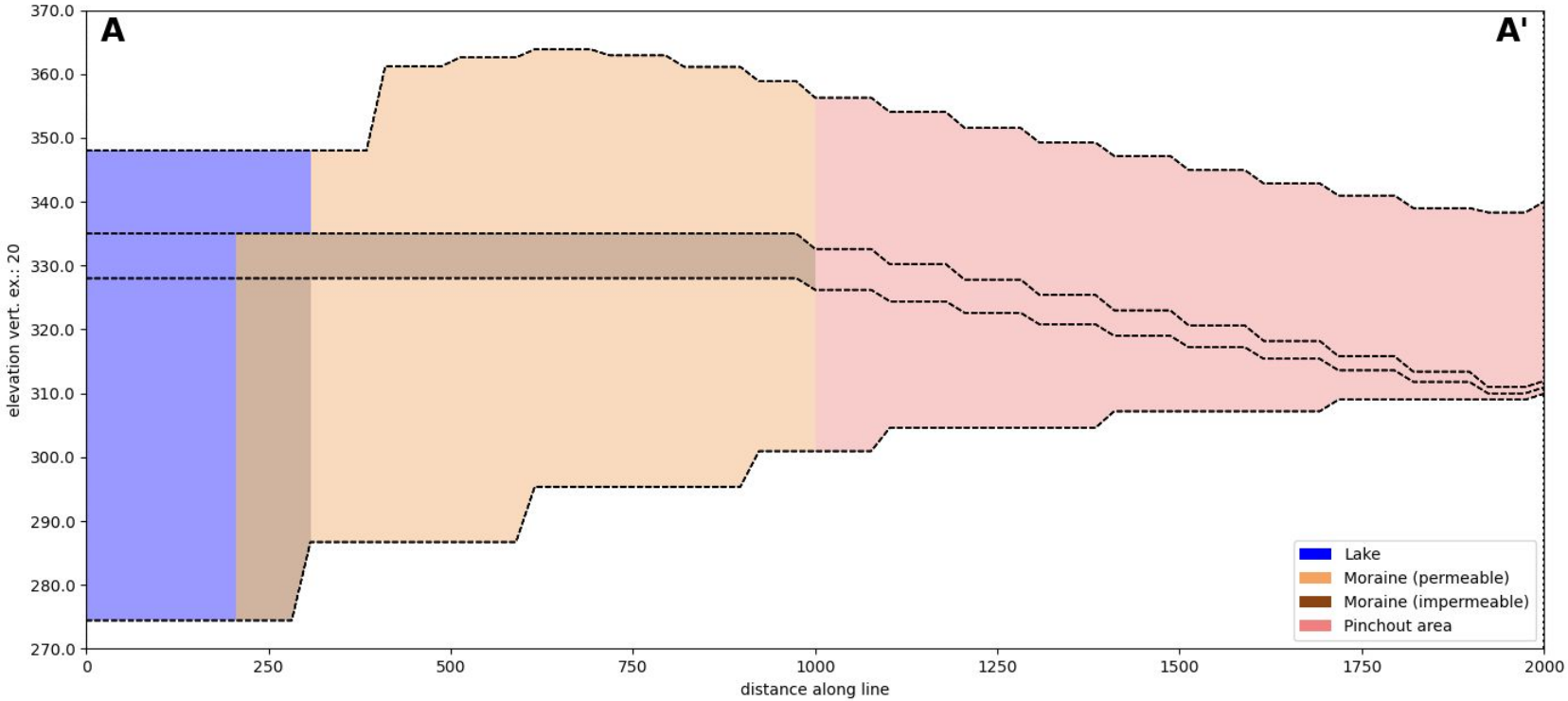


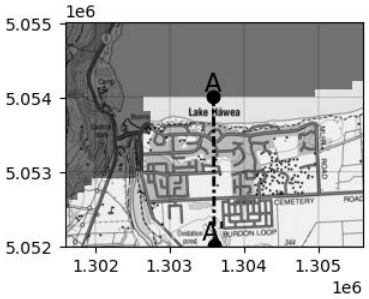

scotts_beach
358.0
top soil
yellow clay
354.0
silt some gravel
334.0
light clay bound gravel
321.0
light clay bound gravel
316.0
sandy gravel
311.0
very sandy gravel
307.0
sand
303.0
g40_0413
360.0
Small Sandy GRAVELS
353.5
MEDIUM GRAVELS LIGHT
345.0
Small Sandy GRAVELS
342.0
Small to medium Clay
322.6
Damp Claybound GRAVE
319.5
QUARTZ GRAVELS - WAT
313.8
g40_0178
364.4
Silty CLAY
357.7
Silts
Silty Sandy Clayboun
350.9
Tight Silty Sandy GR
319.1
Loose Silty Sandy GR
316.1
g40_0368
360.8
SILT BANDS ODD GRAVE
355.2
Coarse Sandy GRAVELS
351.2
BOULDER
Silty coarse GRAVELS
341.0
BOULDER
Silty coarse GRAVELS
330.2
Silty coarse GRAVELS
318.2
sand
gravel
clay
silt


1e6
5.0550
5.0545
5.0540
5.0535
5.0530
5.0525
5.0520
scotts_beach
g40_0413
g40_0368
g40_0178
1.300
1.301
1.302
1.303
1.304
1.305
1.306
1.307
1.308
1e6

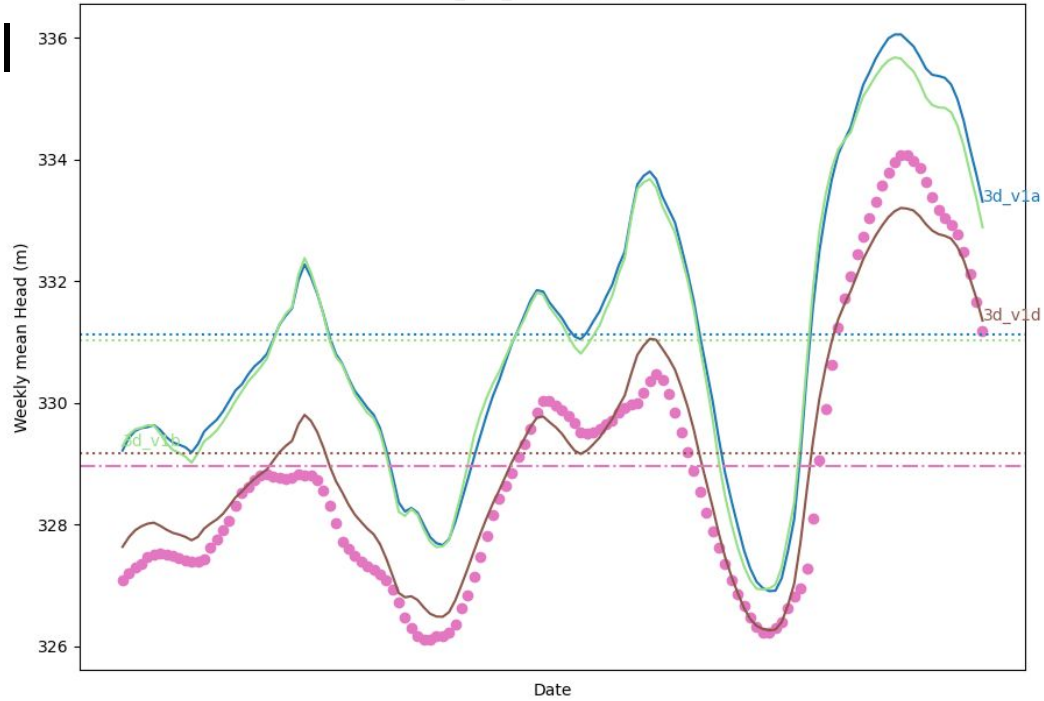

Transmissive
Transmissive
Lake
Saturated Zone
Not Transmissive
elevation vert. ex.: 100
distance along line
g40_0345
g40_0026
g40_0368
g40_0178
g40_0413
g40_0104
g40_0016
Lake opt. range
Lake Min level
Well depth
G40_0415 Levels

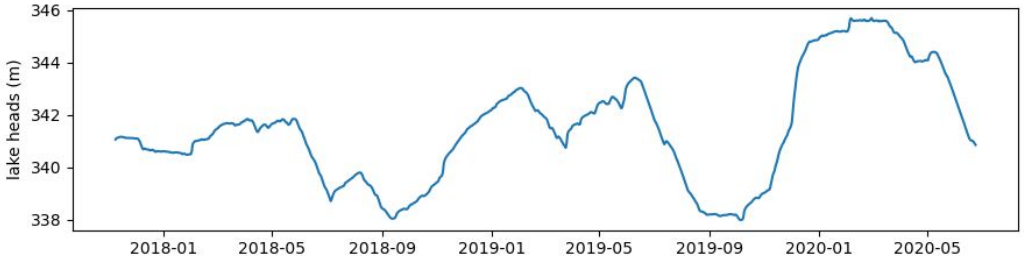

1e6
g40_0345
g40_0026
g40_0368
g40_0178
g40_0104
g40_0413
g40_0016
Lake Hāwea
Cross Section
Wells
1e6

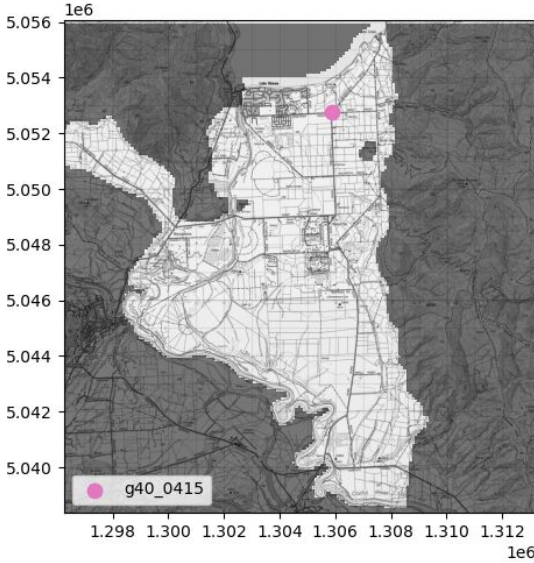

A
A'
elevation vert. ex.: 20
distance along line
Lake
Moraine (permeable)
Moraine (impermeable)
Pinchout area

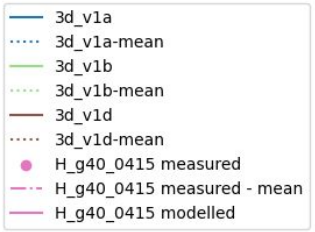

1e6
A
A'
Lake Hāwea
CEMETERY
BURDON LOOP
1e6

The model fits !

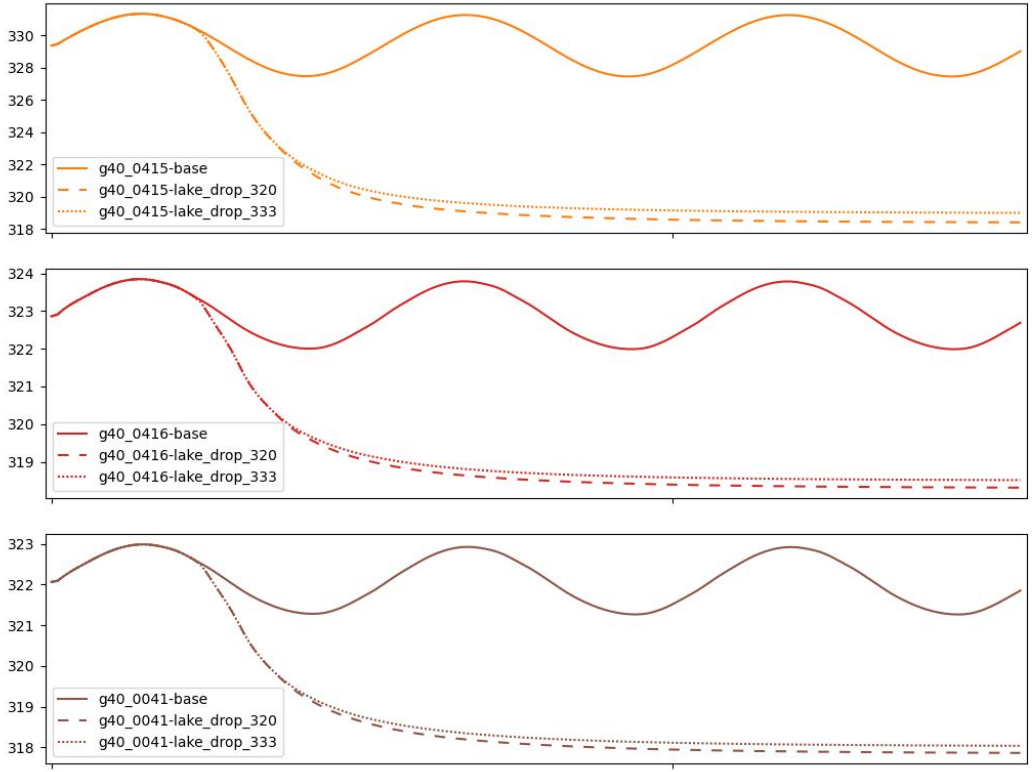






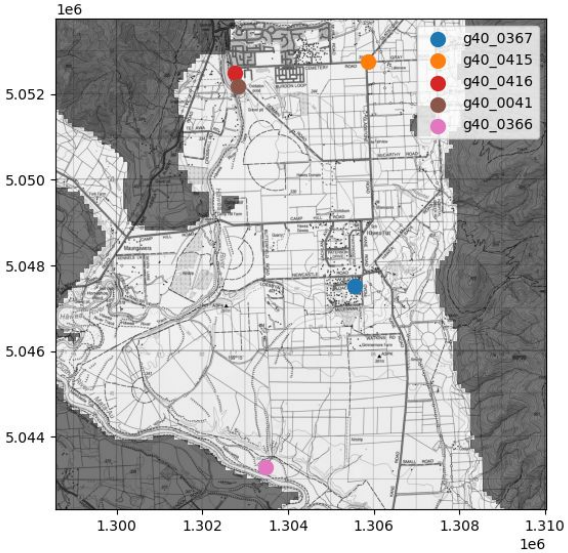


Key prediction: Lake can become disconnected from the groundwater leading to low groundwater levels

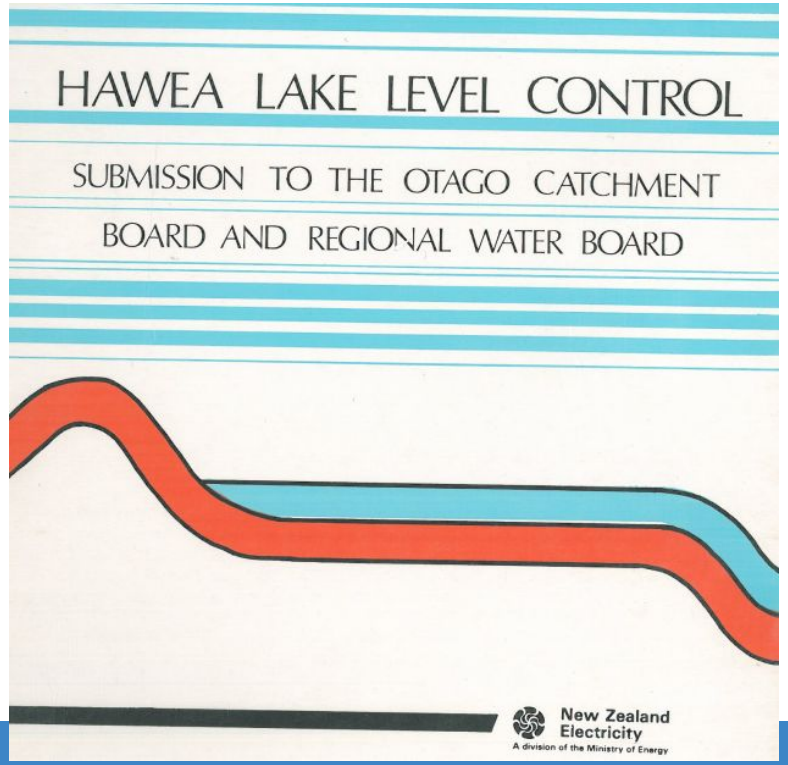


What level? →

327.6 - 338 m msl



The end? → Nope, new (old) data appears!



Ministry of Works and Development

Appendix III contd.

Inquiries to

Date 30 May 1984

Our ref

Your ref

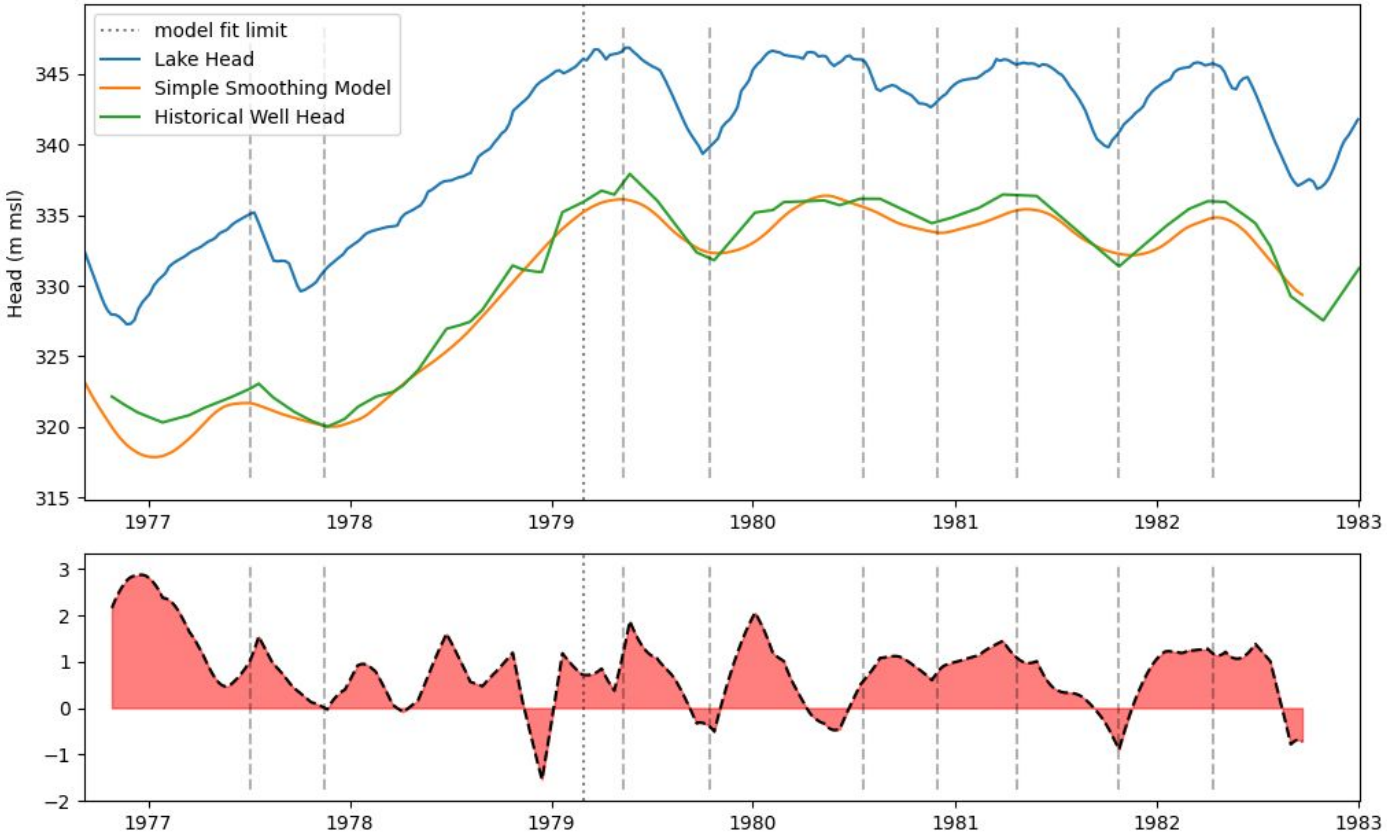
Deputy Secretary
New Zealand Electricity
Division of Ministry of Energy
Private Bag
WELLINGTON

Attention : S Astwood

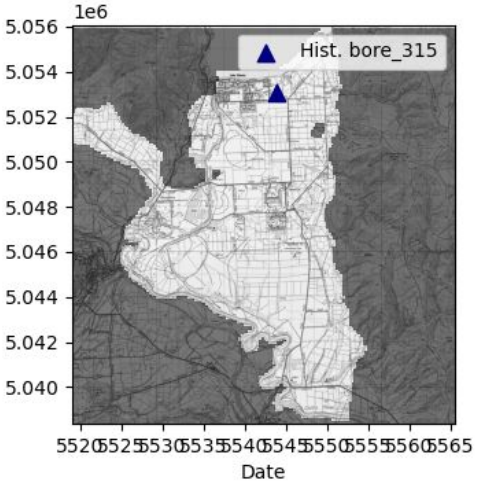
GROUNDWATER LEVELS ON HAWEA FLATS

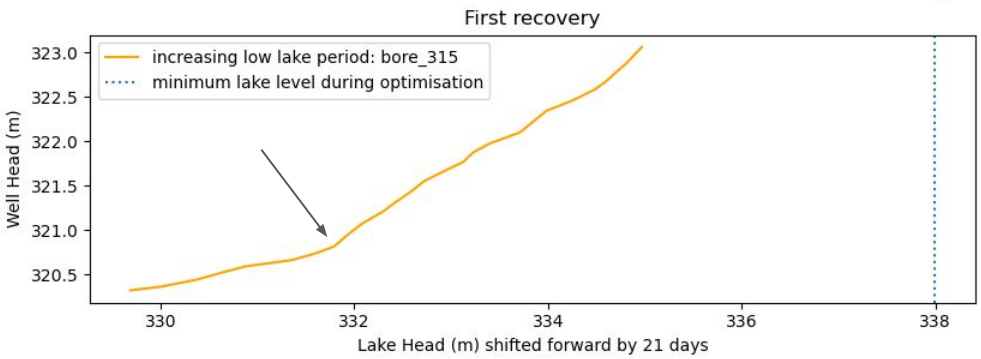
This data was unknown to KSL, LAL, & ORC. It seems to have been lost when the Ministry of Works and Development was dissolved

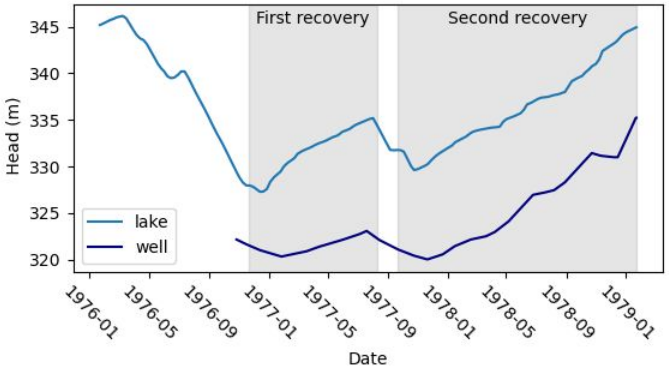
Lake Head and Simple Smoothing Model for Bore 315
fit from record after 1979-03-01

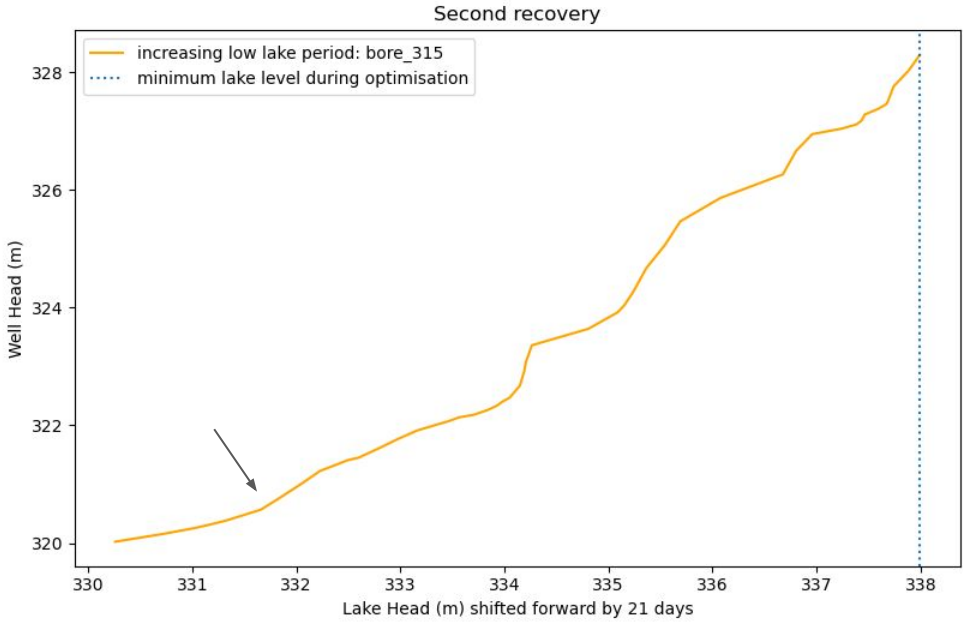


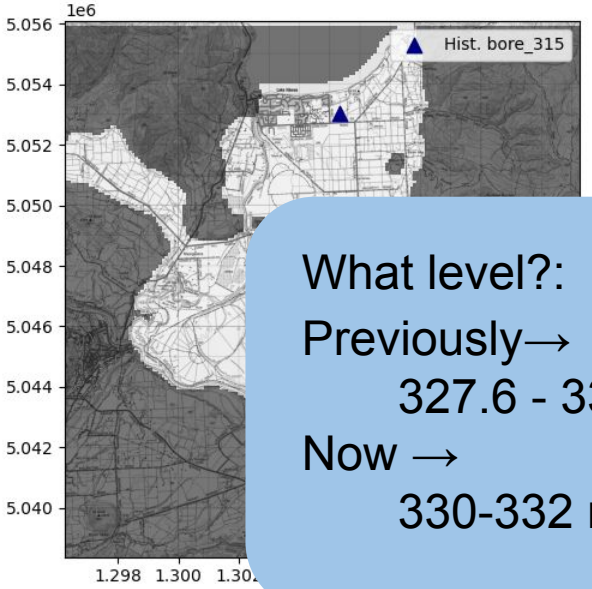
step: -10.58
lag: 26.2
amplitude: 1.14
smooth: 203.22











What level?:

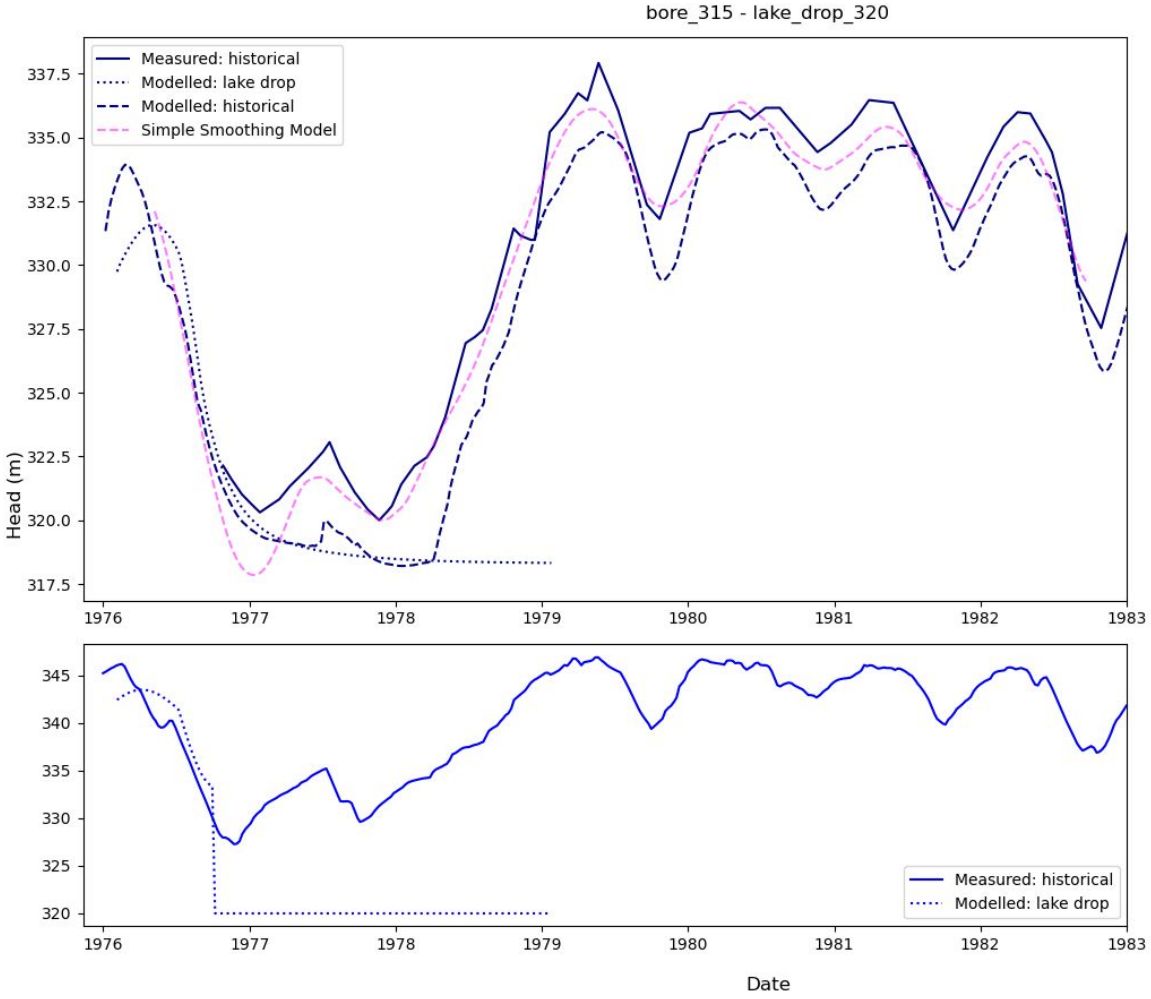
Previously→

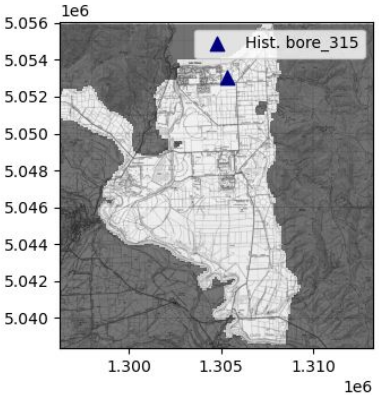
327.6 - 338 m msl

Now →

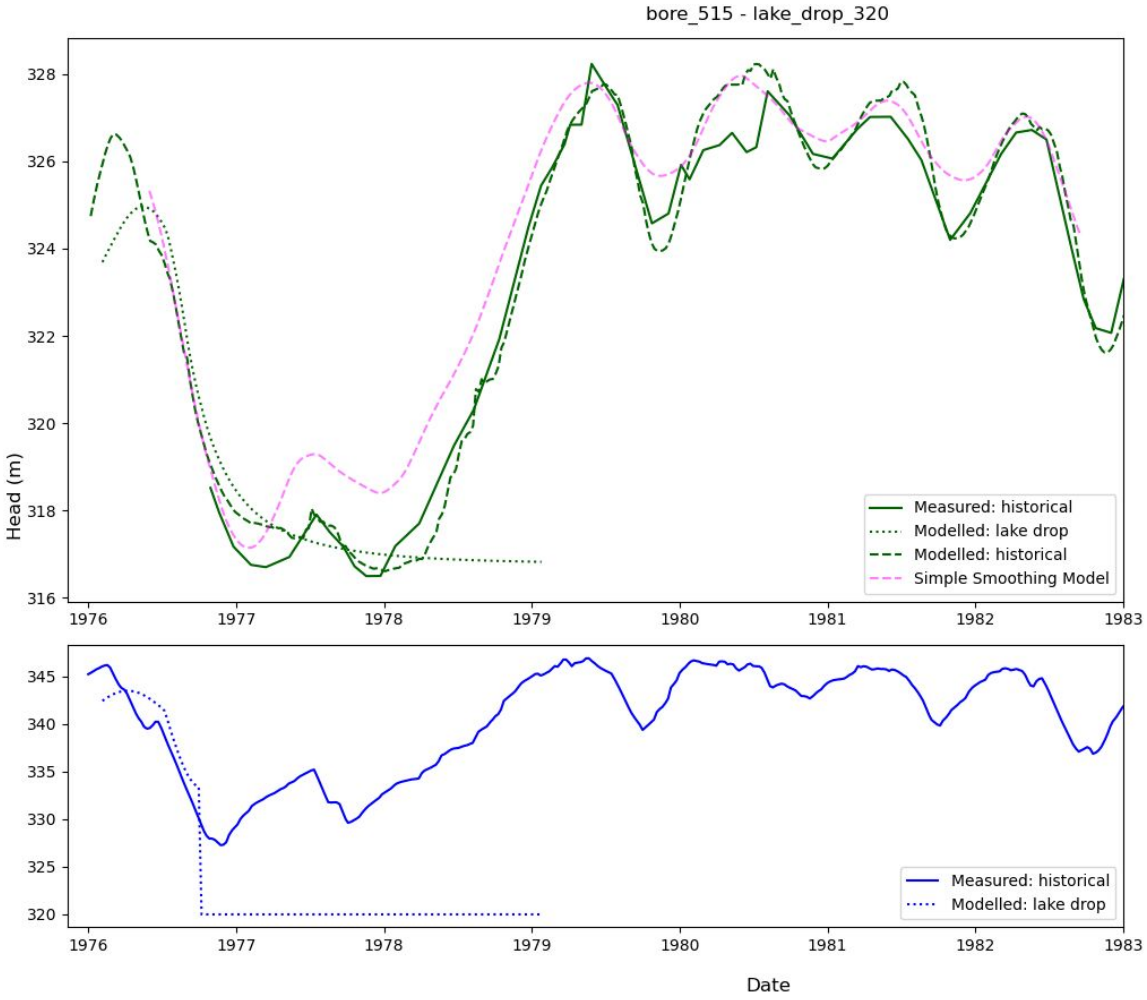
330-332 m msl

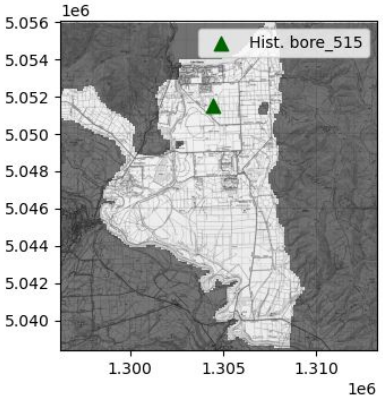
How does the model do?



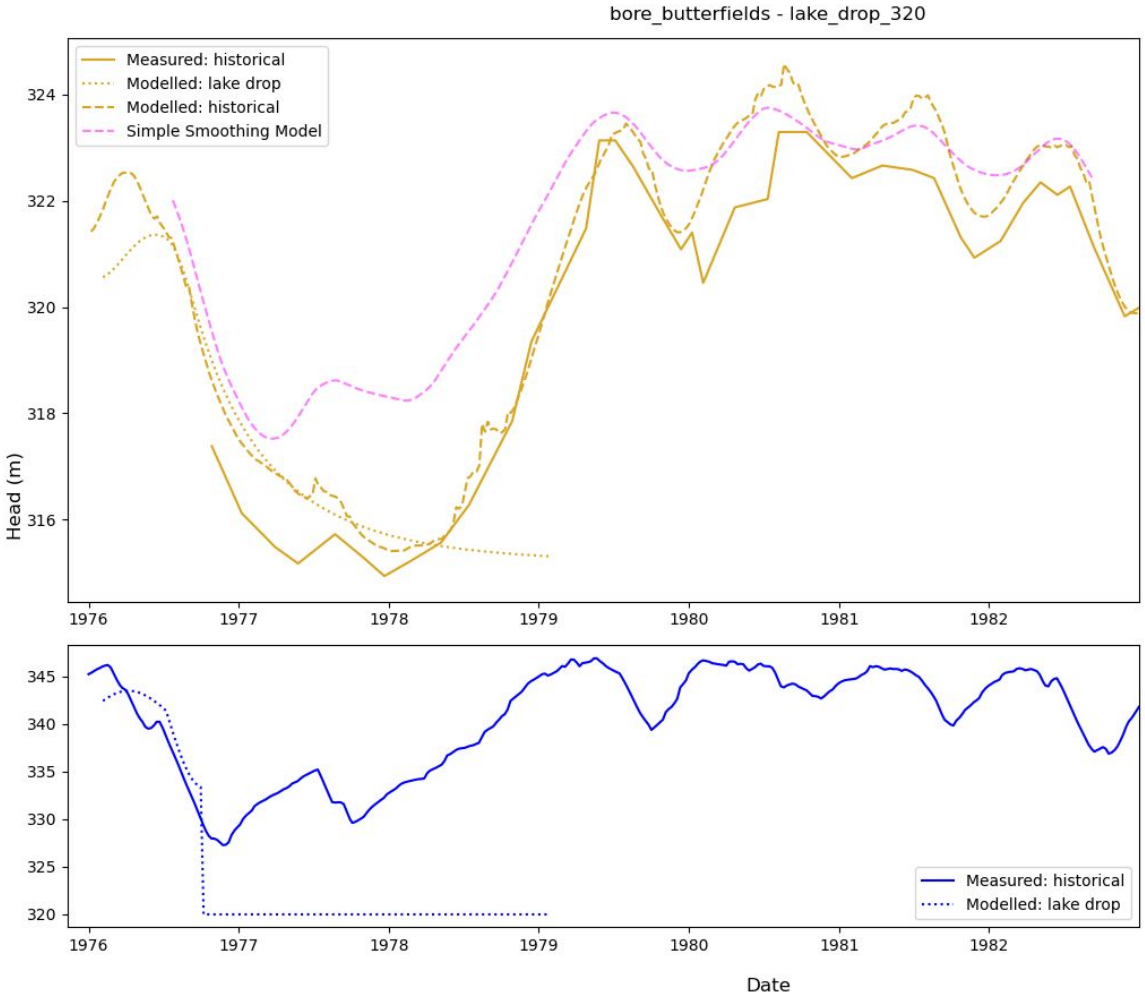


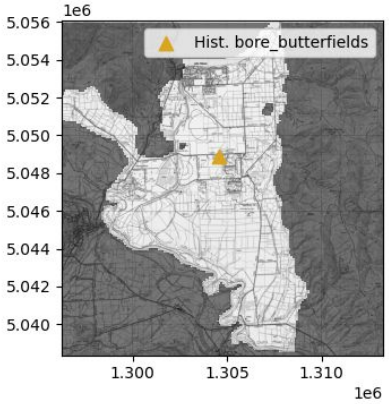
How does the model do?





How does the model do?





Conclusions

- There’s a freaking underground waterfall happening in Otago!
- Important for Lake Hawea management.
- There is still some value in deterministic modelling.
- We really need to consider uncertainties in our structure as well as our parameterisation.
- Data stewardship is an essential part of resource management, and it must be able to survive generational turnover in practitioners and even organisations.
    - Scientific programming can help here → provides links between data and information.

My personal soapbox

- Lets move to modelling being more than just some modflow files.
- Include data and code.
- Open access (hopefully).
- Stewardship.
- “git philosophy”.
- As an industry we need to upskill!