

## A large pumped storage scheme for seasonal reliability of national power supply?

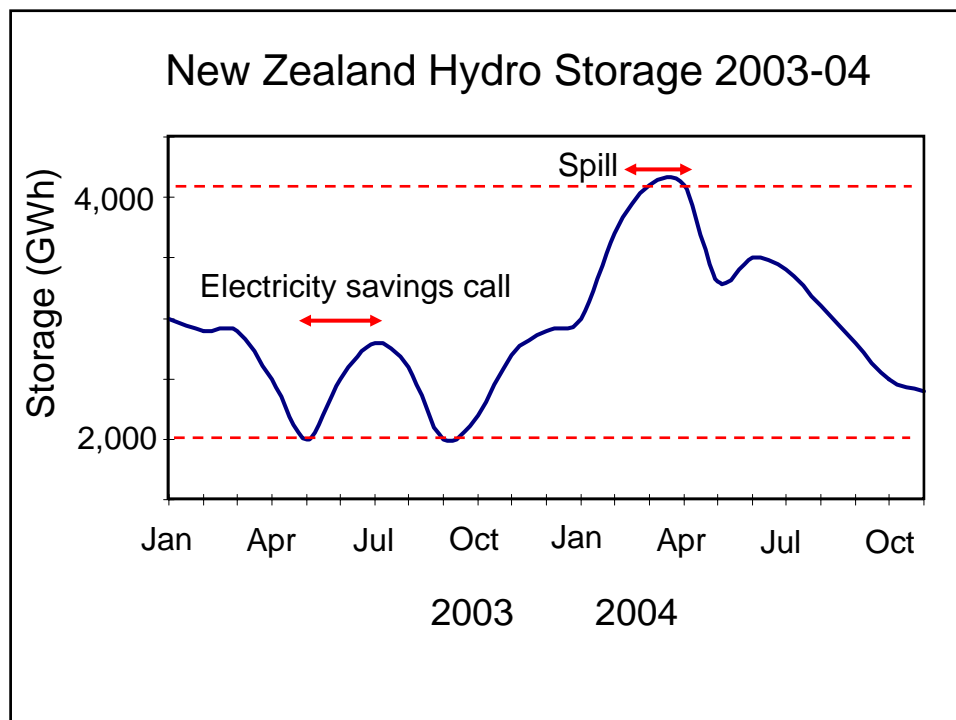
Earl Bardsley (University of Waikato)  
Bryan Leyland (LCL Ltd)  
Sarah Bear (URS Ltd)

## Acknowledgements

We thank Contact Energy Ltd and Meridian Energy Ltd for kind provision of generating and discharge data and financial support.

## The dry-year issue

- Most of NZ power will remain hydro
- Only 4,000 GWh storage capacity
- Insufficient storage to use wet years to offset low inflows later



## Stand-by coal-fired stations?

- Expensive to maintain
- No guarantee of new gas finds

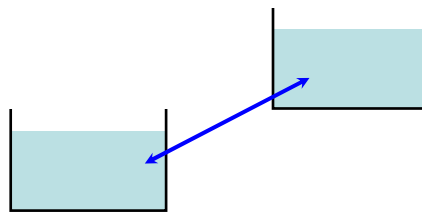
## Increase storage capacity?

- Capacity increase of about 10,000 GWh
- Not possible with existing lakes
- Pumped storage as an alternative?

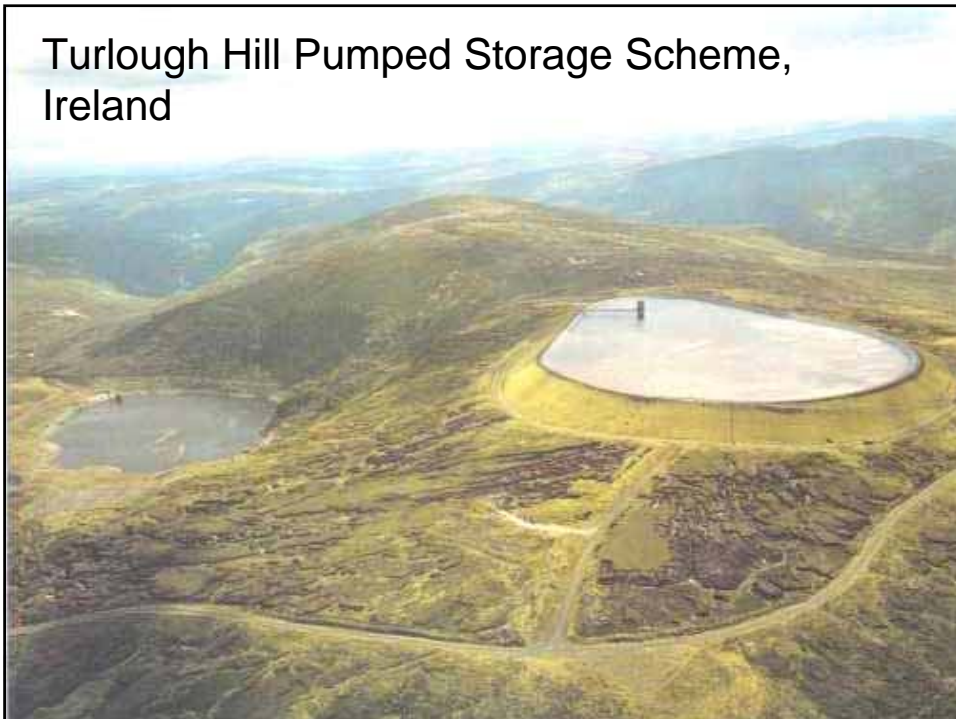
## Conventional pumped storage

(Small water volumes shifted between upper and lower reservoirs)

- Load-following for thermal stations
- Frequency control and voltage support

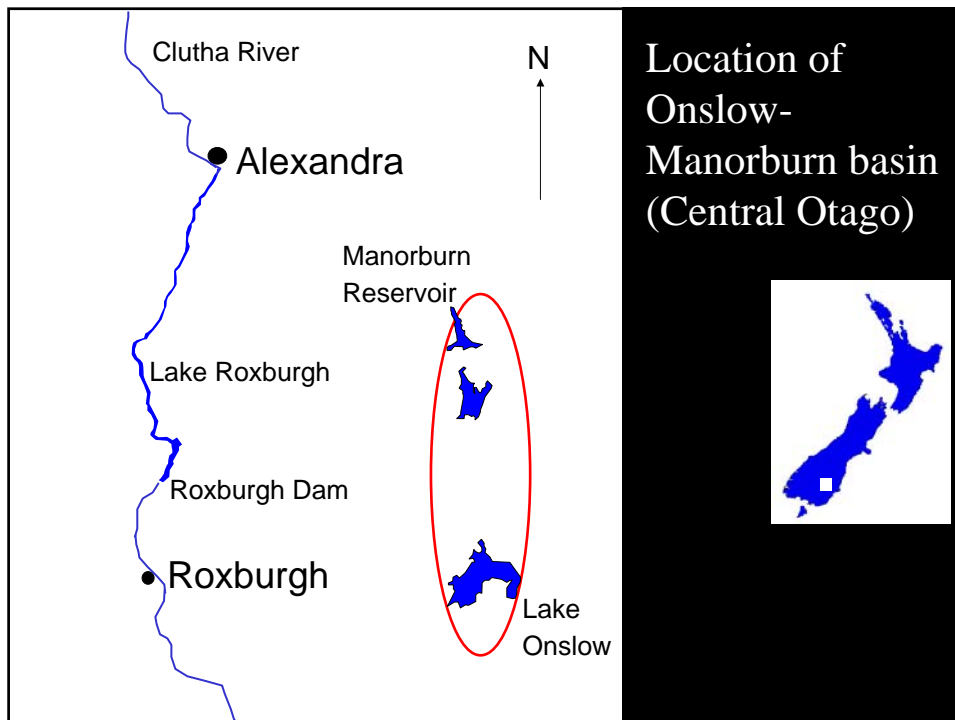


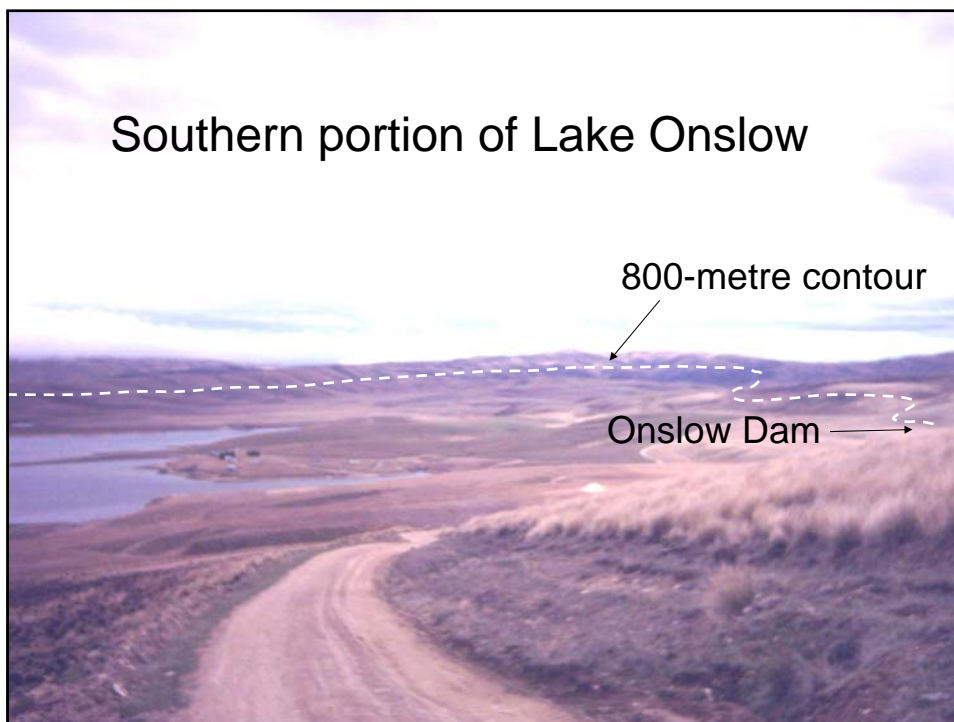
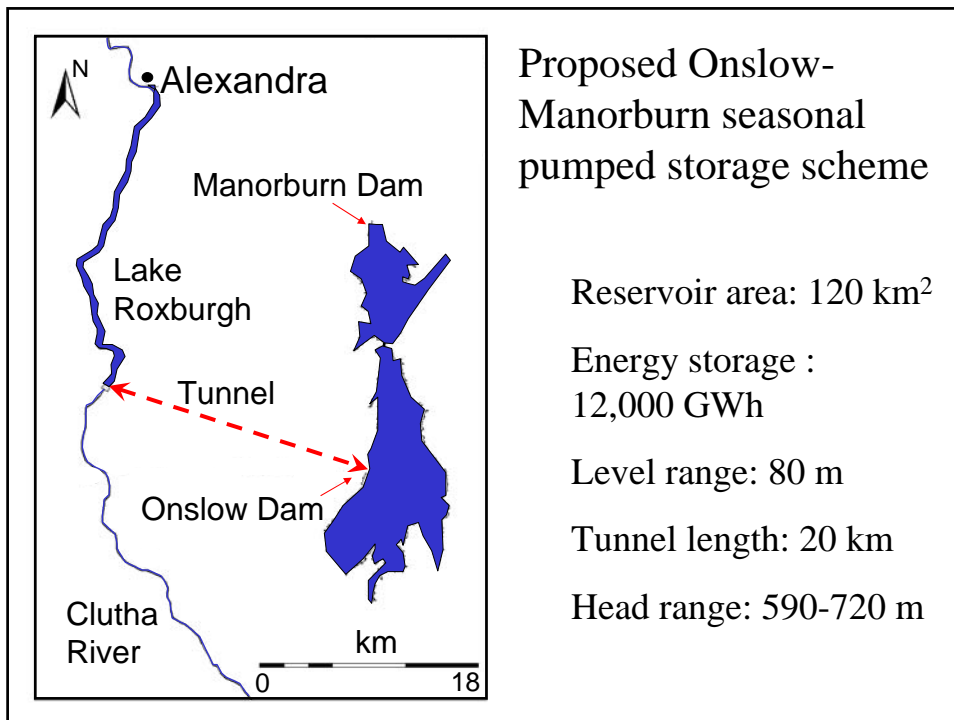
Turlough Hill Pumped Storage Scheme,  
Ireland

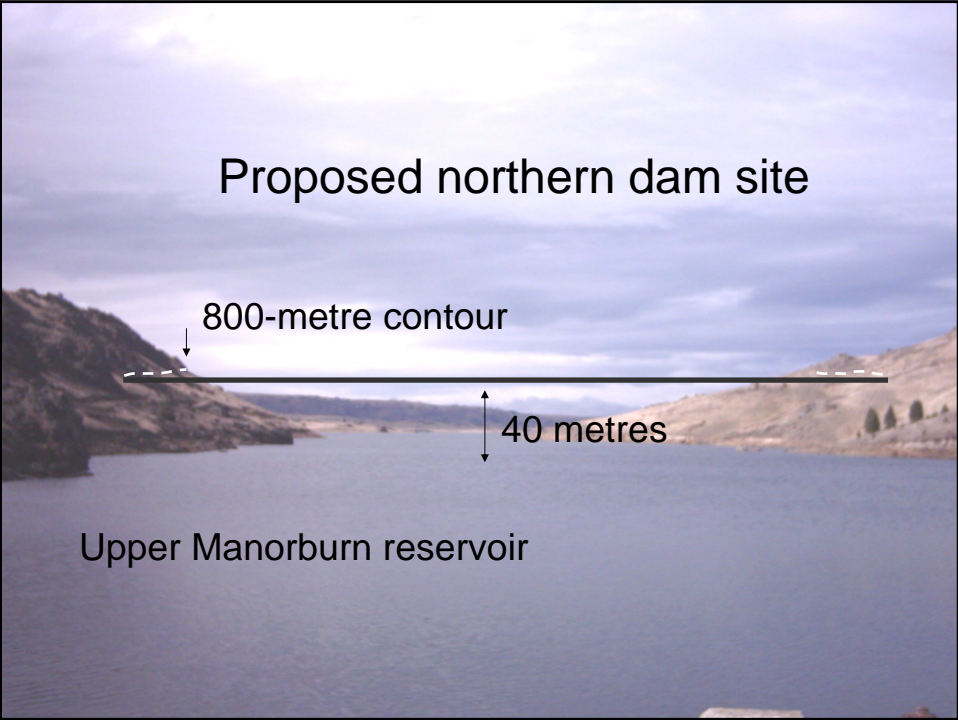


The Saurdal seasonal pumped storage scheme (Norway) : A model for New Zealand?

Energy storage	7,760 GWh
Reservoir level range	125 metres
Upper Reservoir area	82 km <sup>2</sup>
Tunnel length	10.5 km



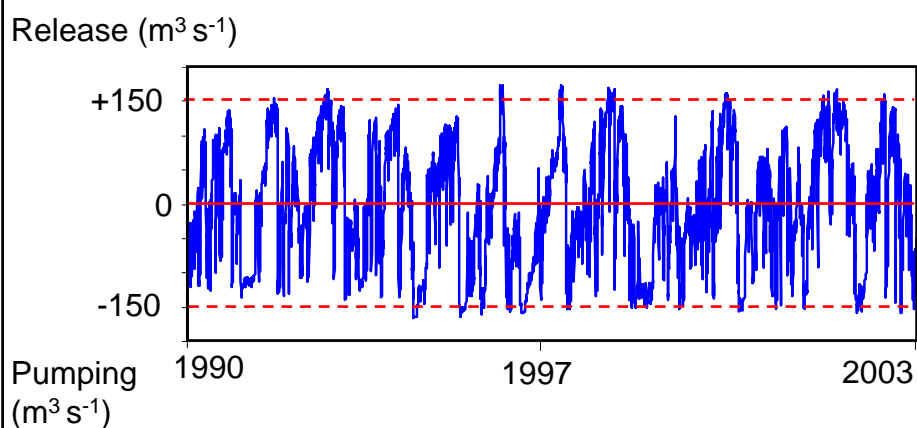




## Simulation

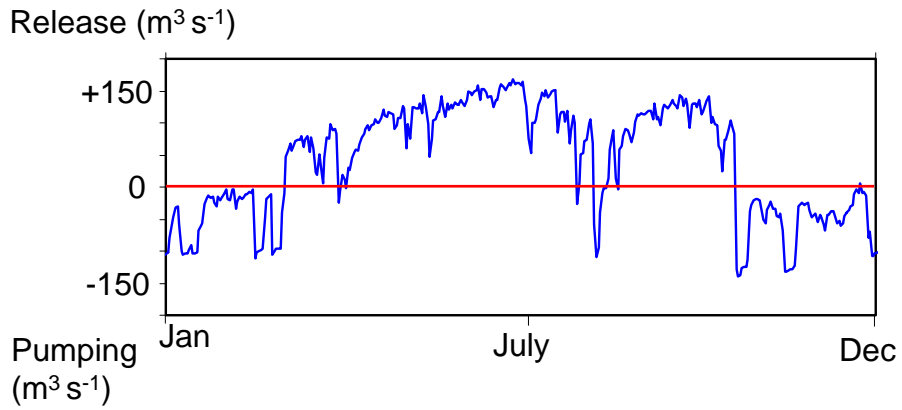
- As if scheme was in operation 1990-2003
- Seek to smooth Clutha + Waitaki power yield through dry periods
- Move existing hydro lakes toward mid-range levels (spill reduction)

### Pumped storage daily water uptake or release to Clutha River (1990-2003)

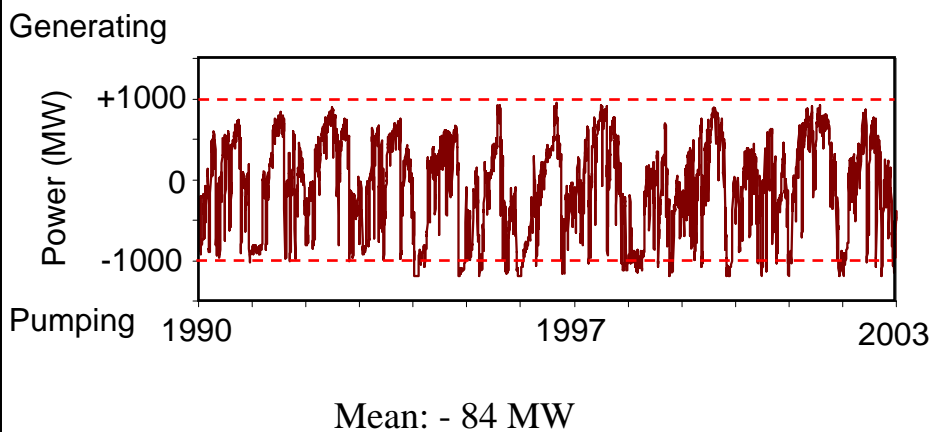




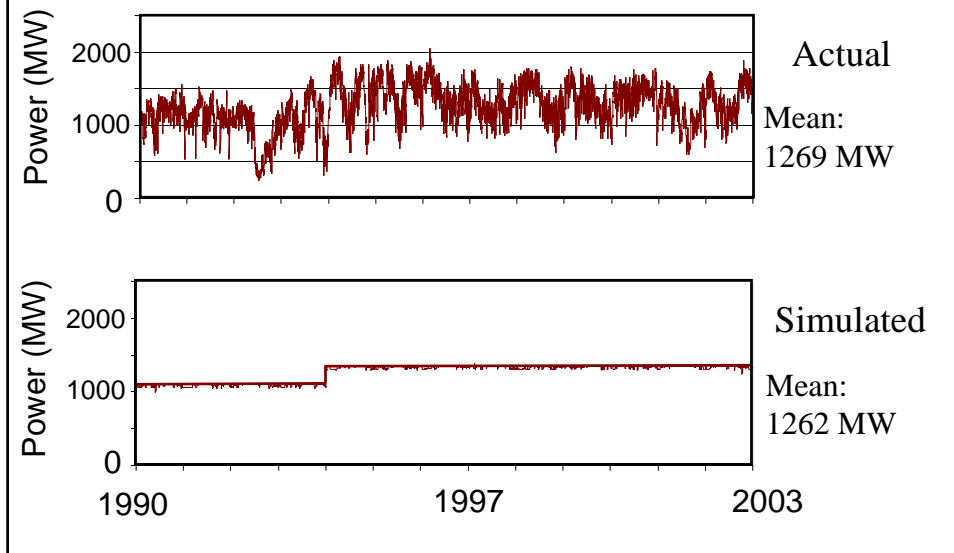
### Pumped storage daily water uptake or release to Clutha River (1992 dry year)



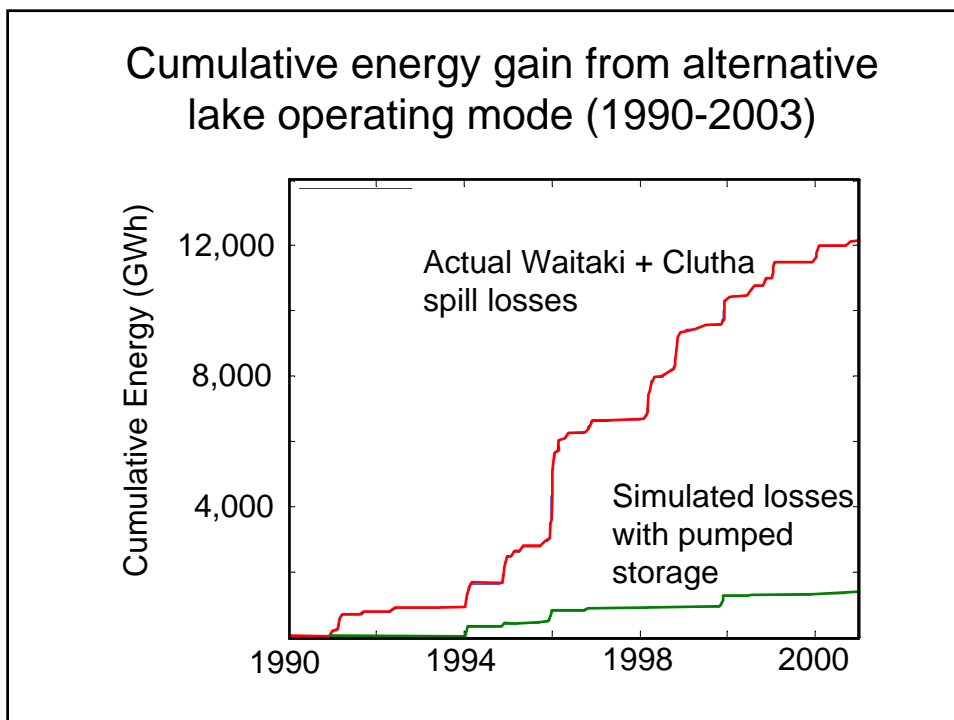
### Pumped storage daily power generated or used for pumping (1990-2003)

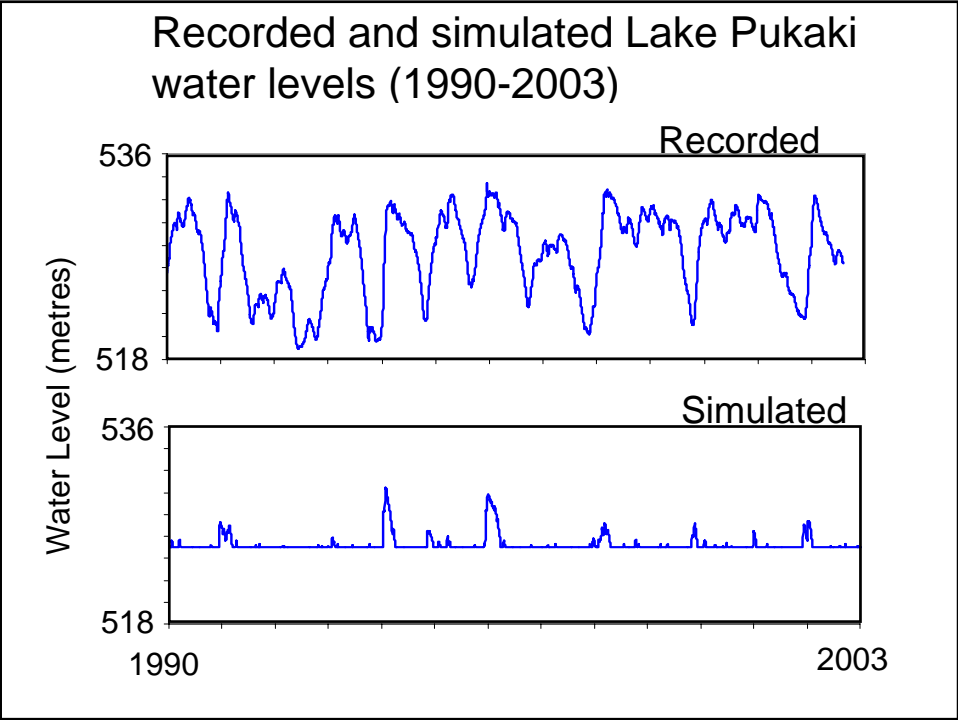
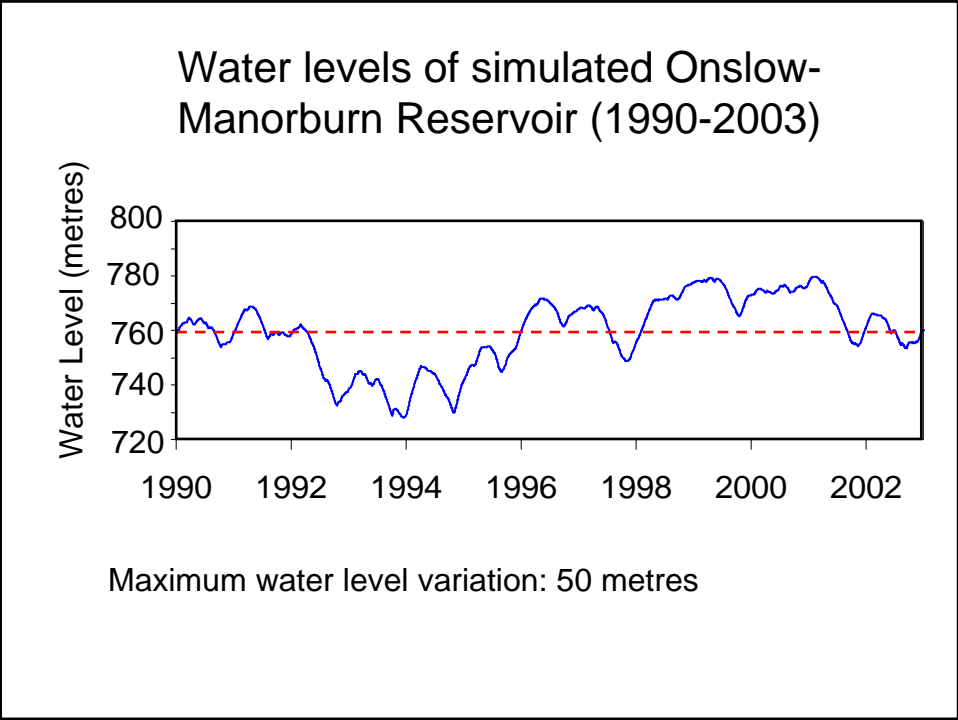


### Simulation result: Clutha + Waitaki power yield maintained (1990 – 2003)

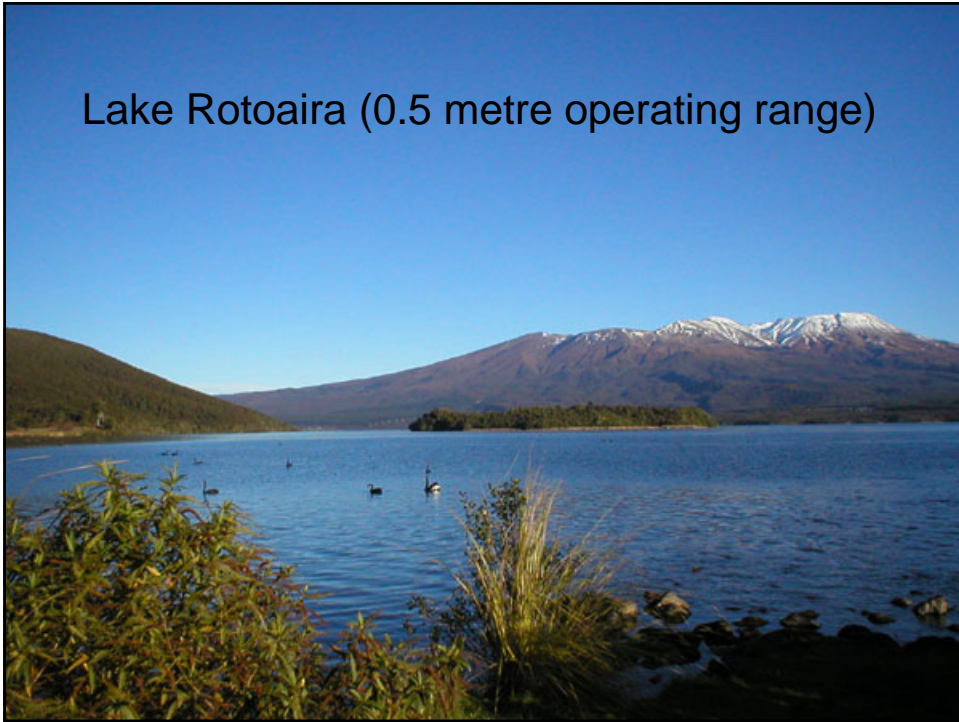


### Cumulative energy gain from alternative lake operating mode (1990-2003)

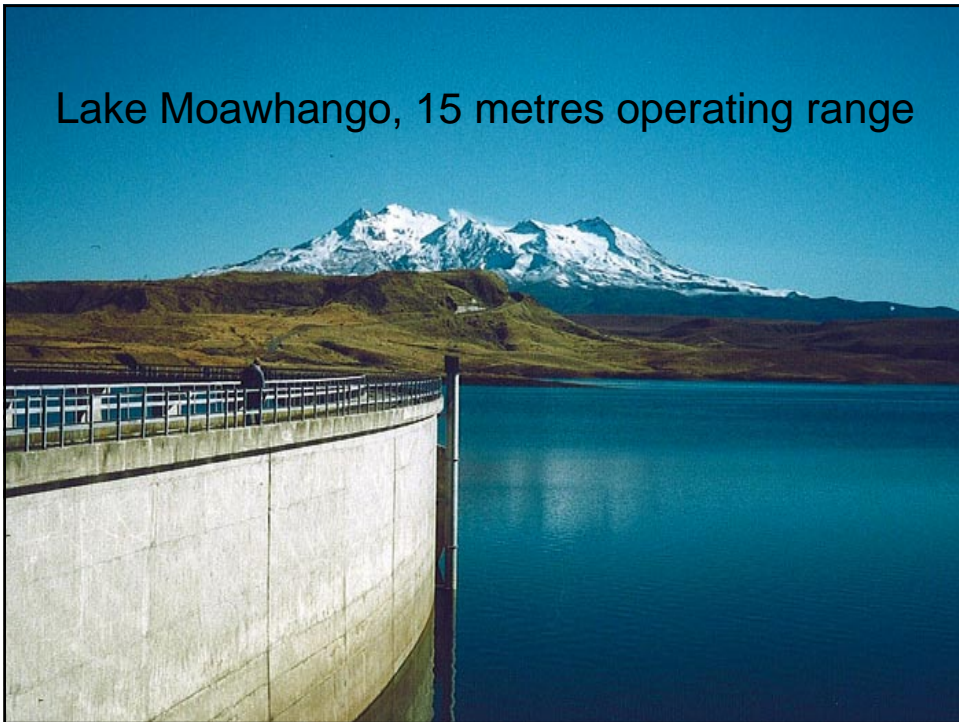




Lake Rotoaira (0.5 metre operating range)



Lake Moawhango, 15 metres operating range



### Related Benefits of the Onslow-Manorburn Scheme:

- Spinning reserve and frequency-keeping
- Supporting wind energy and small hydro
- Some reduction in Lower Clutha flood peaks
- Water supply for Dunedin city

### Onslow-Manorburn pumped storage: Conclusions

- Energy-neutral
- Could buffer hydro power output through future climatic variations
- Reduced hydro lake seasonal fluctuations
- But would it fit into the market?