Taiepa Tiketike - supporting Parihaka's energy transition through a research partnership

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Kororia ki te atua, moungaarongo ki te whenua, whakaaro pai ki nga tangata katoa
Glory to God, peace on the land, goodwill to all people.

The followers of Tohu Kakahi and Te Whiti o Rongomai at Parihaka aspire to follow the legacy left by their tipuna, including adopting behaviours and innovative technologies which promote sustainable living on the land and peaceful coexistence with the environment. Supporting a transition towards sustainable energy at Parihaka is Taiepa Tiketike, a research partnership between Massey University and the Parihaka Papakāinga Trust, funded by the Ministry of Business, Innovation and Employment *Vision Mātauranga Capability Fund*

How?

- Through community engagement – becoming kanohi kitea (known faces), working with a local research assistant, working closely with a community organization (Parihaka Papakāinga Trust)
- Through education – Punanga Ngi workshops held at Parihaka papakāinga, providing coursework opportunities to community members, building community capability to carry the research forward
- Through research as outlined below:

Existing energy supply

Determine
- Energy content (J, kWh)
- Net Present Cost ($NZ) over 20 years
- Associated emissions (kg CO_2-e)

by
- Fuel type
- Energy need

Energy needs (current and future)

12 months data collection, 10 homes and 3 marae, completing Aug 2016. To also consider potential energy efficiency measures, population growth, and electric vehicle uptake. Monitoring includes:

- Time of use electricity in 6 circuits per building
- Monthly LPG; hot water volume, time of use ~20 days/building
- Firewood species, moisture content, bulk volume

Selecting useful renewable technologies for local generation of heat and electricity

Evaluate and optimise, including using HOMER software for electricity, f chart method for solar water heating. Estimate

- Net Present Cost ($NZ) over 20 years
- Associated emissions (kg CO_2-e)
- Proportion of energy needs (excluding transport) met by local renewable sources

The local renewable energy resources

Plantation Biomass

Previous trials [2],[3],[4] of short rotation coppicing of various Eucalyptus species produced the annual yields tabled below, with an energy content (higher heating value) of 19.6 – 20.5 MJ/kg

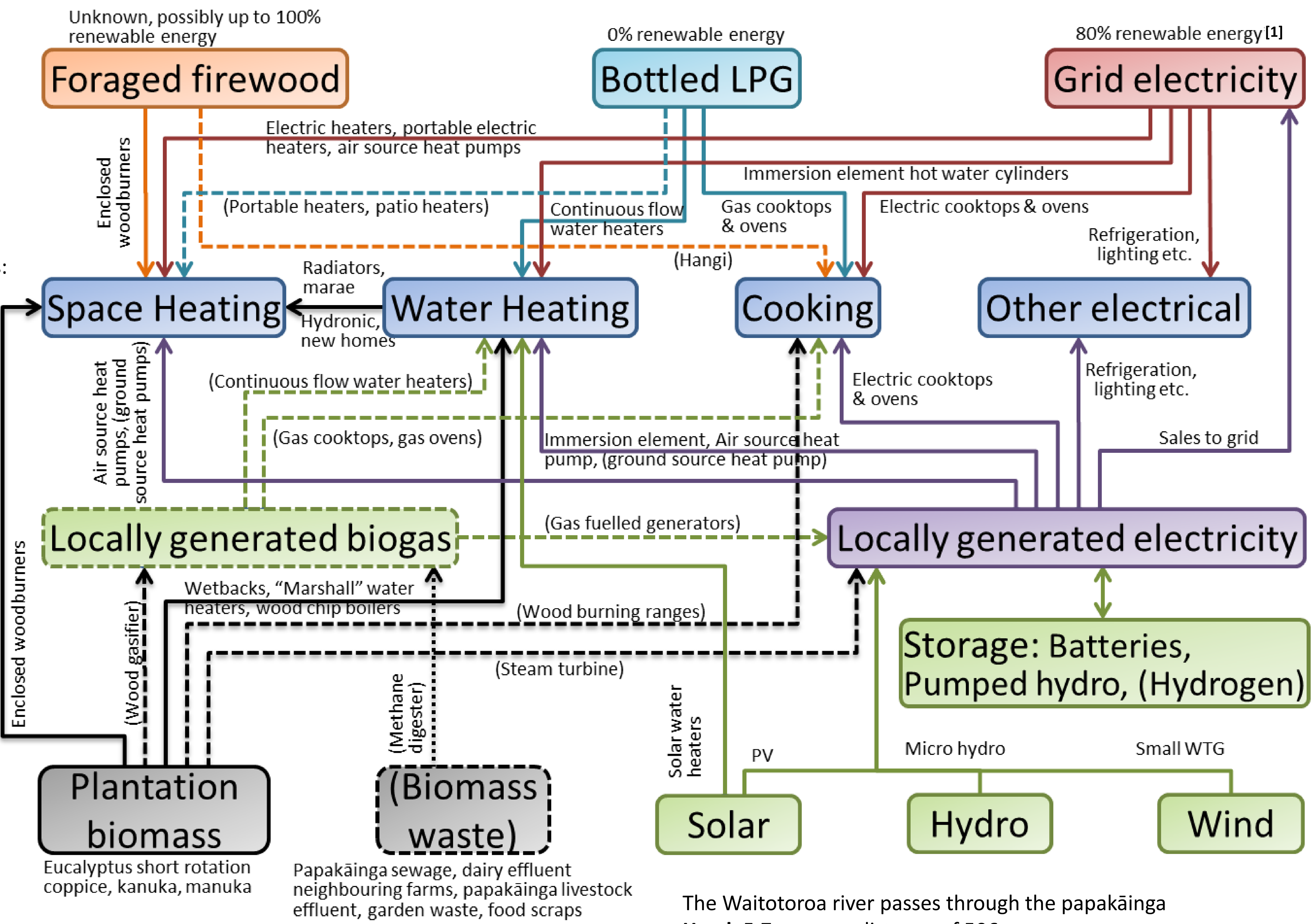
Best performing species	Stocking density (stems/ha)	Mean Annual Increment (tdm/ha/yr)
E vimnalis	5000	>24
E brookerana, E botryoides, E botryoides x saligna, E ovata, E elata, E obligua	2200	12 to 34

References

[1] Electricity Authority (2016) Electricity in New Zealand 2016. *Retrieved from* https://www.ea.govt.nz/about-us/media-and-publications/electricity-nz/ June 2016
[2] Senelwa, Kingiri, & Sims, Ralph EH. (1999). Fuel characteristics of short rotation forest biomass. *Biomass and Bioenergy, 17*(2), 127-140.
[3] Sims, Ralph EH, Maiava, Tavale G, & Bullock, Bruce T. (2001). Short rotation coppice tree species selection for woody biomass production in New Zealand. *Biomass and Bioenergy, 20*(5), 329-335.
[4] Sims, Ralph EH, Senelwa, Kingiri, Maiava, Tavale, & Bullock, Bruce T. (1999). Eucalyptus species for biomass energy in New Zealand—Part II: Coppice performance. *Biomass and Bioenergy, 17*(4), 333-343.

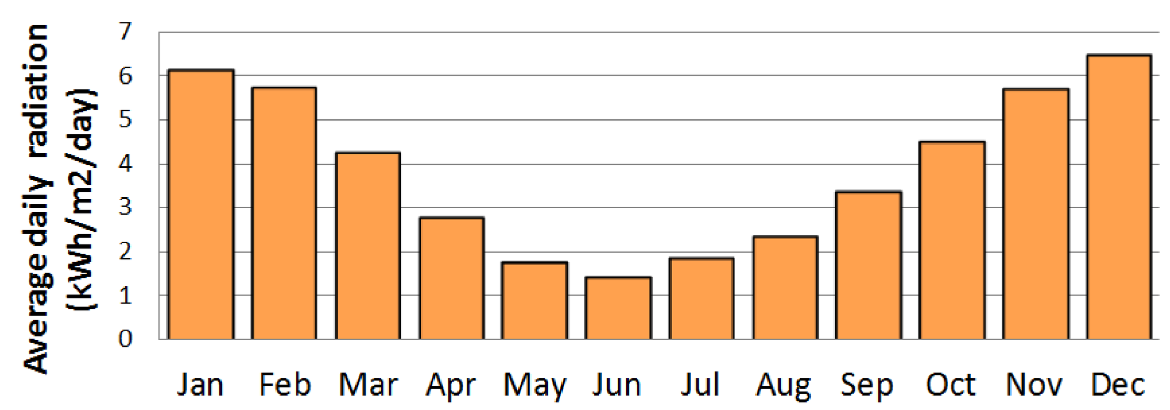
Research extent

Dashed lines, enclosed brackets aren't included in the research.



The Waitotoroa river passes through the papakāinga
Head: 5.7m over a distance of 506m

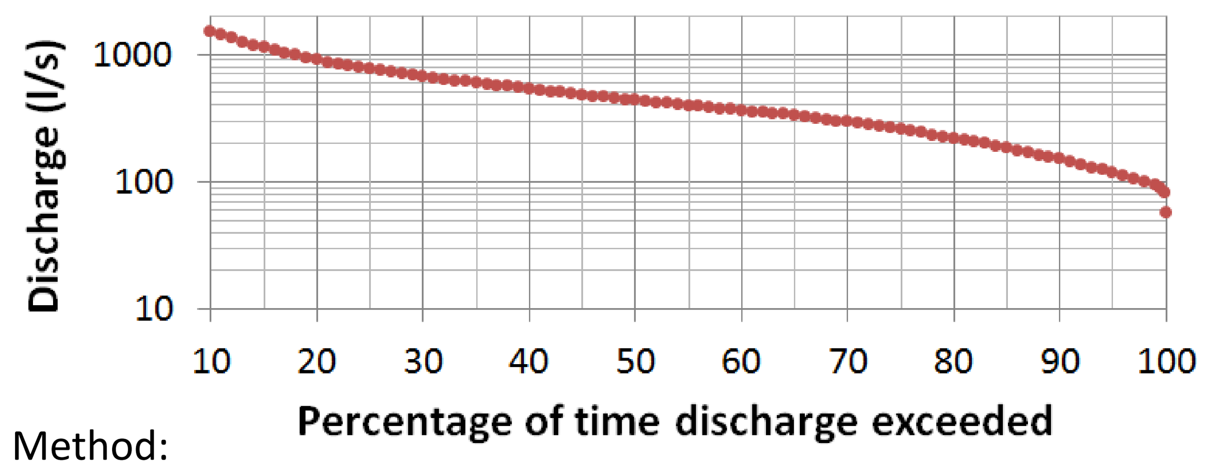
Solar radiation on a horizontal plane



Method:

- 12 months of 10 minute averages measured at Parihaka by pyranometer
- Scaled to a typical year based on 23 years of New Plymouth data collected by Metservice

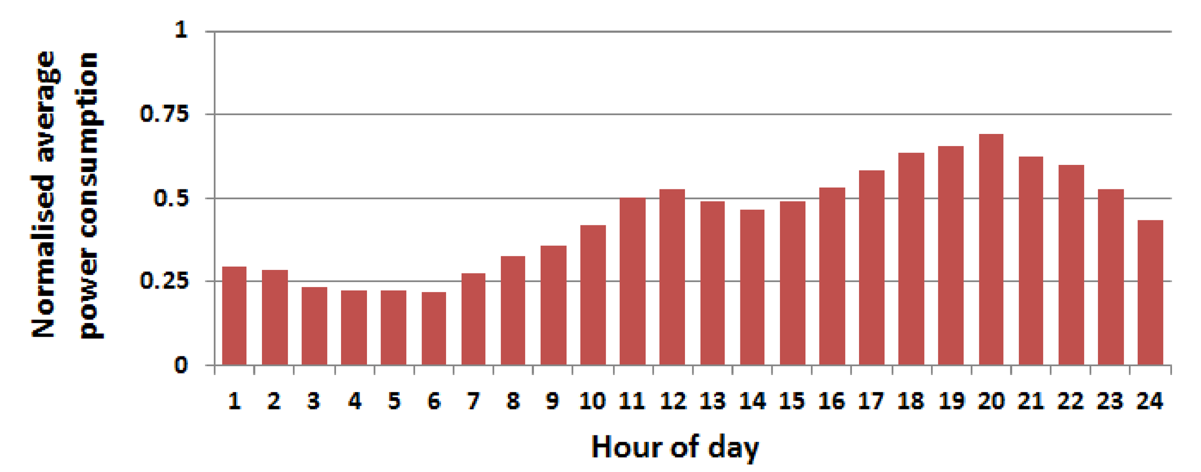
Flow Duration Curve of the Waitotoroa river



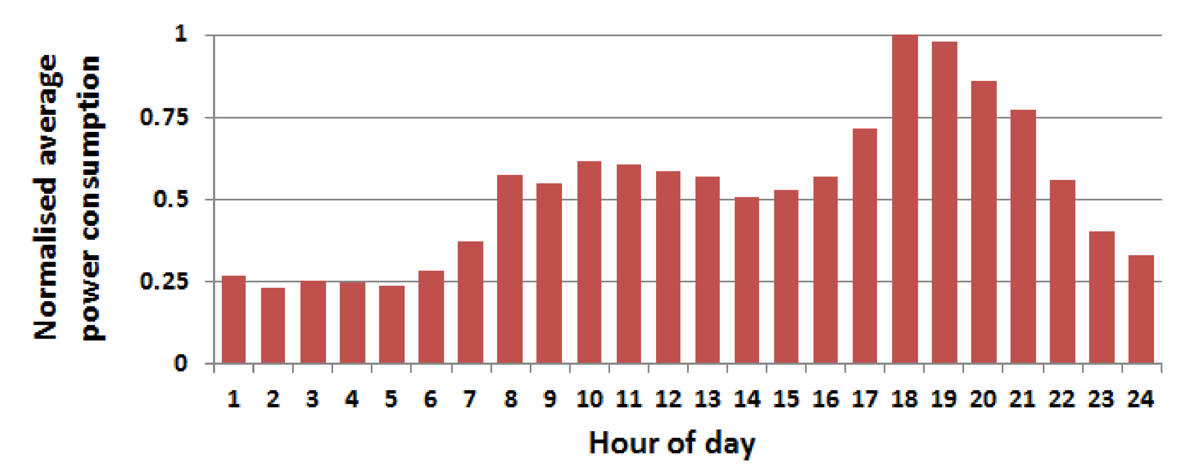
Method:

- 12 months of weekly stage (level) recordings
- 11 flow gaugings – find relationship between discharge & stage
- Correlate discharge values (< 1000 l/s) with concurrent discharge values of Kapoaiaia river nearby
- Use 15 years of Kapoaiaia 15 minute averages to predict FDC
- Head measured using dumpy level

Parihaka daily electricity load profile - summer



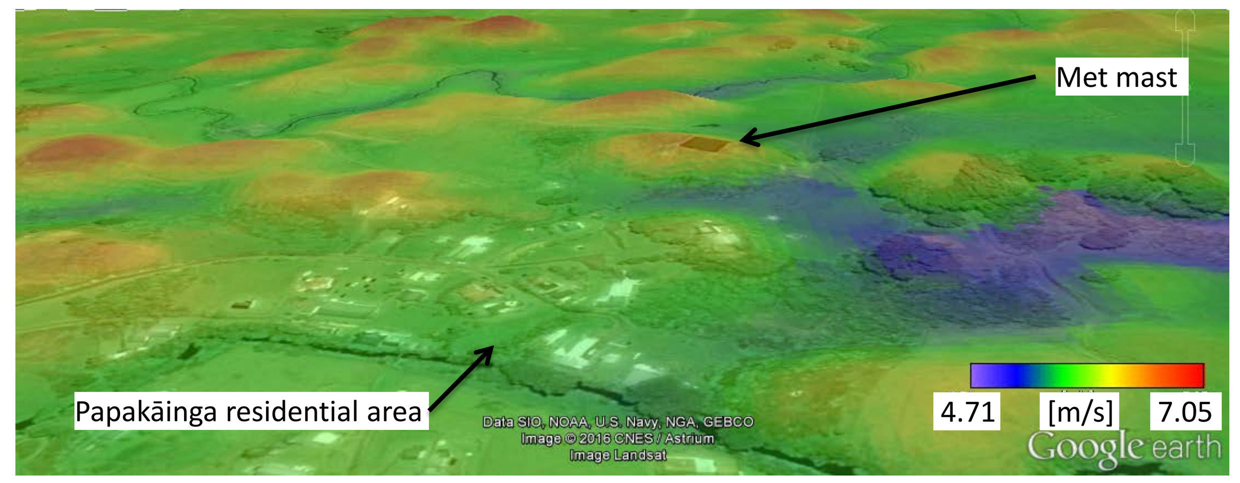
Parihaka daily electricity load profile - winter



Method:

- Aggregate of 10 sample residences (out of ~17 total)
- Incoming feed to buildings measured with current sensors
- Hourly means over one month periods displayed
- Transformer monitoring underway to capture all loads

Predicted mean wind speeds at 30 m a.g.l



Method:

- 12 months of 10 minute wind speed and direction averages measured at Parihaka (15m and 10m a.g.l).
- Long term wind climate predicted using Measure-Correlate-Predict methods with 10 years data collected near Cape Egmont by Taranaki Regional Council.
- Spatial extrapolation modelled using WAsP software.

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