

**Attachment 1: Project description and location**

- 1. Clutha Pumped Hydro Consortium Limited (**CPHC**) seeks resource consent to construct and operate a large pumped hydro scheme at Lake Onslow in Central Otago. The Clutha Pumped Hydro scheme (**CPH**) would pump water from the Mata-au/Clutha River (New Zealand’s largest river by flow) to a reservoir at a higher elevation (an enlarged Lake Onslow) then drop water back down the tunnel when electricity is required.
- 2. Water will be pumped up when demand and electricity prices are low (for instance, when high levels of hydro reservoir storage and windy and sunny conditions contribute to periods of high or excess electricity supply). Then, during periods of high electricity demand or low levels of alternative renewable generation, and periods of high electricity prices, water will be released from the upper reservoir back down the tunnel to the Mata-au/Clutha River. By doing this electricity will be generated to supply the national energy grid at times of constrained supply.
- 3. In effect, the enlarged Lake Onslow would serve as a battery by storing considerable energy potential for when it is needed most. To give some perspective on this point, the enlarged Lake Onslow would hold enough water to generate power at 1000MW for 6-months, producing 4500GWh of electricity. A lithium-ion battery big enough to store 4500GWh would be the equivalent of 300 million Tesla Powerwalls and cost over \$2 trillion.

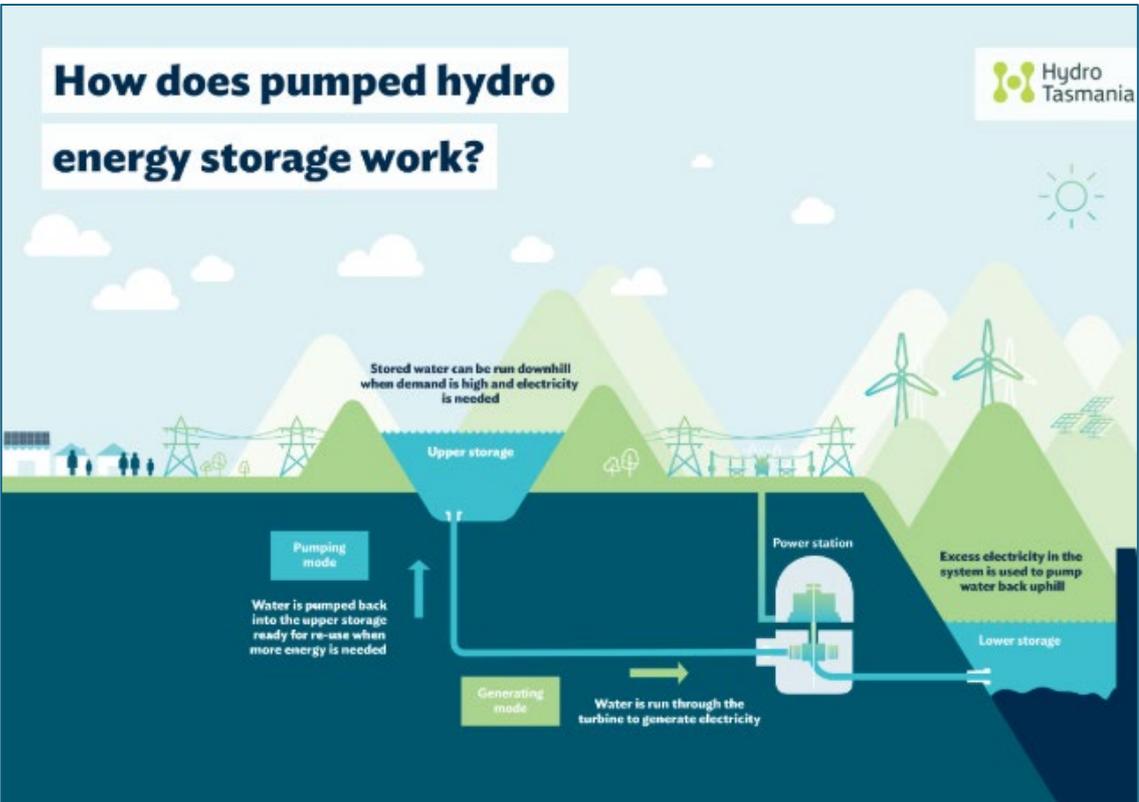


Figure 1 Illustration of the general concept of a pumped hydro scheme (Source: <https://www.hydro.com.au/clean-energy/our-major-projects/pumped-hydro>)

4. The Clutha Pumped Hydro scheme would comprise the following main elements:
  - A. An upper reservoir to store the water that will be used to create energy when needed. That reservoir is a larger Lake Onslow.
  - B. To increase the size and storage capacity of Lake Onslow, a new dam will be constructed on the Te Awa Makarara/Teviot River.
  - C. A structure or structures from the Mata-au/Clutha River to harvest and return water to the river.
  - D. A buffer reservoir beside the Mata-Au/Clutha River to store the harvested water for pumping.
  - E. Intakes/outlets within Lake Onslow to transfer water between Lake Onslow and the lower buffer reservoir.
  - F. Intake/outlet structures within the lower buffer reservoir to connect water between the lower buffer reservoir and the powerhouse.
  - G. Underground tunnels (waterways) to transfer water between the lower buffer reservoir and the powerhouse, and the powerhouse to Lake Onslow.
  - H. An underground powerhouse which connects the upper and lower water sources and:
    - i. generates electricity with water coming down from Lake Onslow as it passes into the lower buffer reservoir and then the Mata-Au/Clutha River; and
    - ii. pumps water up to Lake Onslow.
  - I. Supporting infrastructure for the construction and/or operational phases including roading, concrete plant, plant and construction equipment, accommodation, transmission lines (not including connection to the grid which will be dealt with separately but including relocation of existing infrastructure, as needed) and water supply.
5. Geographically, the CPH Scheme would have a presence in three adjoining areas:
  - A. Lake Onslow and its surrounds;
  - B. The Teviot Valley;
  - C. The Mata-au/Clutha River Valley.

6. Key characteristics of the enlarged Lake Onslow are:

<b>Characteristic</b>	<b>5TWh storage</b>
Full supply level	max lake level 769mRL
Minimum lake level	695mRL
Operating range	74m
Maximum reservoir area	71Mm <sup>2</sup> /7100ha
Maximum reservoir volume	3676Mm <sup>3</sup>

7. Key characteristics of the dam required to create the enlarged Lake are:

<b>Characteristic</b>	<b>5TWh storage</b>
Dam crest height (m)	770mRL
Dam footprint (m <sup>2</sup> )	175,000
Dam length (m)	2600

8. CPHC considered several Full Supply Level options. Having evaluated the costs and benefits of those options, it is proposing a lake design at the 769mRL contour. **Attachment A** to this Project Description document includes three plans that show:

- A. Where the proposed Lake would sit relative to surrounding topography and the existing Lake (refer *Map 2A: 770mRL Lake Level*).
- B. The pattern of land ownership around the CPH proposal (refer *Map 2B: Project Area (Showing Tunnel Options & Landowners)*). In addition to showing affected and adjacent landowners, this plan shows the tunnel options for which approval is sought. Two alternative starting points at the Lake are shown. Two connection points with the Mata-Au/Clutha via the penstocks, powerhouse and lower buffer reservoir are also shown – one at Craig Hill, and the other at Craig Flat. Other options were considered but are no longer pursued.
- C. A similar plan to that described immediately above showing affected and adjacent land ownership but with closer focus on the enlarged Lake (refer *Map 2C: Landowners – Comparison to 770mRL Lake Level*).

9. The approximate location of the dam is also shown on the plans. Figure 2 below provides an approximate long section of the dam, noting too there may be a need for barriers for seiche waves (although they would not be a major component of the dam structure required).

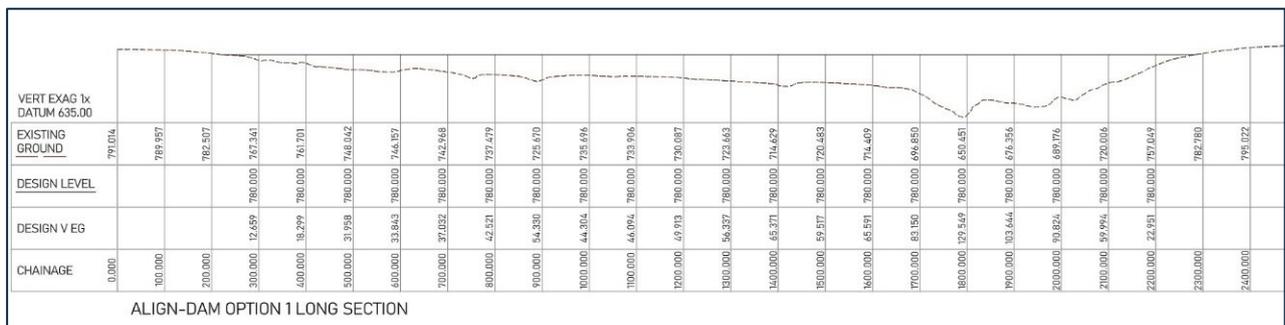


Figure 2 Approximate long section of the proposed dam

10. The exact footprint and shape of features such as the dam, tunnel, powerhouse and lower buffer reservoir will not be known until after detailed design. Unsurprisingly for a project of this magnitude, detailed design will cost millions and cannot sensibly be undertaken unless and until all necessary approvals are obtained. However, all material benefits and impacts of the CPH proposal can be adequately and appropriately evaluated in the absence of detailed design having been done. This is an orthodox approach for large-scale projects – a category within which the CPH project fits.

**ATTACHMENTS:**

- **MAP 2A: 770mRL Lake Level**
- **MAP 2B: Project Area (Showing Tunnel Options & Landowners)**
- **MAP 2C: Landowners Comparison to 770mRL Lake Level**