

# Bringing power to the back country

A Genkit Micro Hydro case study at "The Glazebrook Station and Hunting Lodge"



To bring power to remote Glazebrook Station from the main national grid would have cost more than \$900,000 over approximately 16km. Excavation would have been required almost the entire distance. Genkit was able to solve the problem for around one third of the cost, using a remote micro hydro power system.

## ➔ AT A GLANCE

### Challenge:

Powering a luxury back country lodge with an efficient and environmentally friendly power source.

### Solution:

Genkit's micro hydro system with diesel generator backup.

### Outcome:

Cost-effective power system capable of running 3 upmarket homes. Certified to NZ and Australian standards.



IMG1: Glazebrook Lodge

Glazebrook Station is buried deep in the heart of NZ's high country in the Waihopai Valley, seemingly far away from any modern conveniences. With a brand new luxury deer hunting and safari lodge servicing high paying customers, electricity is more than an extravagance for Glazebrook's owners, but a necessity.

### The Glazebrook Challenge

Owned by US based company, Westervelt, Glazebrook offers an isolated and unspoiled experience in an authentic high country station, complete with plentiful modern conveniences. An efficient and environmentally friendly form of power was required to run the lodge that would be more cost-effective than operating diesel generators full-time or running power lines to the site.

### Genkit's Solution

At the forefront of alternative power in New Zealand, Genkit's Nick Tones has made Glazebrook Station self-sufficient. Using the elements in the environment, Genkit created a micro hydro system producing around 3.25 kilowatts of power (equating to 2400 units per month on your power bill); enough to run three upmarket houses. The system keeps a bank of batteries charged, which via inverters, change the power into usable electricity for the lodge. A backup diesel generator takes over at peak times, but is rarely used.

### The Weir:

The system begins with a man-made weir (dam) upstream, providing water



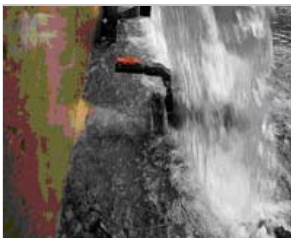
**IMG2:** The weir across the river to retain water and regulate flow



**IMG3:** The fish ladder; a resource consent requirement



**IMG4:** Filtered water intake



**IMG5:** Start of the pipeline



**IMG6:** Water input to powerhouse



**IMG7:** Water return to river

that travels 2.1km downhill through a pipeline, into a 1 metre deep trench to the turbine and battery bank.

Exact weir location is critical to ensure appropriate water volumes may be taken without affecting river flow. Sufficient levels must also be left downstream for fish to migrate upstream and through the weir. Placed at the junction of two streams, which feed into the Glazebrook River and in turn into the Waihopai, the lowest recorded water flow here is 38 litres per second. "We're only drawing off 3.7 litres per second for the turbine" says Nick. "That's less than 10% of the lowest recorded flow".

A fish ladder of small stones going up the river bed provides safe passage and a resting place for migratory fish while they ascend, in line with the Department of Conservation (DoC) requirements. Positioning the weir further up either of the streams would have increased overall power output from increased elevation, but high percentage take-off would have also hindered fish migration.

Pressure on the weir construction is reduced by embedding it as low as possible into the river bed so no more than 200mm of water is held back. The weir is pinned into rocks on each side, providing a stable anchor. The three 18 tonne precast sections making up the construction are secured to the river bed using 20 tonnes of reinforced concrete brought to the site. "We had to tow a cement truck up here, through several treacherous river crossings and over slippery, rough ground" says Nick.

The water is filtered as it flows over the weir to catch any debris. The stainless steel filter lid is pitched at an angle and perforated with 2mm holes. This protects the turbine impeller 2.1km further down the hill in the powerhouse, and also ensures migratory fish don't enter the pipeline.

Every weir is site specific and Genkit improved upon the original consulting engineers' natural stonewall design. Although aesthetically pleasing, this early design required around 2 metres of water to be held back with the filtered intake on the inside, raising serious concerns about weir strength and robustness. In the aftermath of storms and water level rises, the filter would have also been impossible to clean, as the river bed has risen to the top of the wall over time (as shown in IMG2 above). In the final Genkit design, as all the debris in a storm flows over the wall with little or no pressure, the water intake filter is very easy to clean with a brush.

***The Pipeline:***

This carries the water from the weir to the powerhouse below. The pipeline, 110mm in diameter, is constructed from 100 metre lengths of varied pressure-rated pipe. Buried at 1 metre deep (and at 2 metres passing under



**IMG8:** The powerhouse; battery and generation room



**IMG9:** Hydro turbine mounted on base plate



**IMG10:** Constant volt charger (left) and turbine controller (right)



**IMG11:** The battery room for energy storage



**IMG12:** Inverter electrics

three streams), the pipeline also flows through a steel pipe to cross a stream above flood level, before ending up at the power station connected to the turbine. Once run through the turbine, the exhausted water falls into a fibreglass pit and returns to the river.

***The Powerhouse:***

Situated below the lodge, the powerhouse is constructed from poly-panel, commonly used for walk-in chillers. Three individual compartments allow the turbine, battery bank and inverter/electrics to be housed separately. As battery cells emit highly explosive fumes at high voltage, they must never be exposed to any electrical equipment that may cause spark or to heat produced by power generation.

***The Power Production Room:***

Water from the weir flows through the turbine located in the power production room of the powerhouse. With a 4 kilowatt 3-phase inductive motor, the turbine produces a nominal 3.25 kilowatts of power used to charge the battery bank. The base plate that the turbine is mounted upon has a filtered air vent, allowing the exhausted water to return to the stream unhindered without vacuum. The air vent also draws air inwards, removing all condensation from the room and keeping the charging and control equipment dehumidified.

The controller alters 3-phase input to a nominal 200/240 volt single phase. It also monitors the speed of the turbine by dump loading excessive energy into the resistive load element mounted above the controller. Should the turbine overspeed due to controller failure, or underspeed because of blockage at the weir, the manager is alerted and the turbine automatically shuts down. The slow hydraulic closure method prevents extreme shock waves transmitting back up the pipeline which may cause it to burst.

The controller output feeds into a constant volt charger fitted with two potentiometers, designed to produce a low ripple charge effect. One potentiometer sets the float charge of the connected battery bank. The second fine-tunes the output from the turbine into maximum charging parameters without overloading the turbine and causing it to labour.

***The Battery Room:***

The battery bank is made up of 48 1000amp/hour *Genergiser* battery cells, with sufficient capacity to power the lodge under moderate load for approximately 36 hours. *Genergiser* batteries are manufactured to German standards especially for Genkit. A vent fan pressurises the battery room automatically when the batteries begin to gas under charge.

***Inverter/Electrics Room:***

The inverter/electrics room houses 12 kilowatts of output made up of 4



**IMG13:** Controller within lodge



**IMG14:** The lodge living area



**IMG15:** The lodge kitchen



**IMG16:** The lodge laundry



**IMG17:** One of the lodge bedrooms

inverters. “These invert battery power into normal power as we know it” says Nick. Also installed in this room are the master outward-bound power distribution board and controller.

#### **Backup Diesel Generator:**

If for any reason the system fails, there is a backup diesel generator. A three cylinder, 27 kilowatt, single phase air-cooled generator was chosen, due to the extremely cold conditions experienced in the area during winter. Air-cooled generators are normally commissioned in extra cold environments.

For cooling purposes, the generator requires about 800 litres of air per second, so an extractor fan was installed to ventilate at about 2100 litres per second. This provides more than adequate air flow for the generator when the

inverter/chargers in the adjoining room are running. The ventilator also provides extra cooling for the excessive heat being dumped out by the turbine controller.

The generator will automatically start up and support the system when:

- Battery power is low due to consumption exceeding the turbine’s input
- The weir is blocked, causing the turbine to shut down
- The consumer has drawn a peak load beyond the inverter’s maximum output potential.

#### **Benefits and Outcome**

The entire system is certified to New Zealand and Australian standards. Westervelt’s Marketing Manager, Robby Johnson says the hydro system is necessary for efficient power to run the lodge. “We’re saving money by not having to run diesel generators full-time and certainly saving on the expense of running power lines to the lodge. The system will become more cost effective over time”. Johnson says Westervelt would recommend other back country businesses to use renewable power.

The Glazebrook power project took about four months to complete, with five to six weeks of concentrated work. The entire installation cost around \$300,000. About \$40,000 of that was to lay the pipes, with the remainder for the electrics, turbine and resource consents.

#### **Additional Information**

##### **Further references:**

<http://www.glazebrookstation.com>

<http://www.westerveltlodges.com>

[http://www.genkit.net/stories/storyReader\\$55](http://www.genkit.net/stories/storyReader$55)

<http://www.seanz.org.nz/microhydro.php> (All about micro hydro)

<http://www.kiwisafaris.co.nz/locations-north.html> (Site of similar installation)



**IMG18:** Walk-in chiller



**IMG19:** The lodge verandah

### ***Load parameters and limits:***

The Glazebrook system has been designed to supply power for the following appliances and equipment:

- Internal lights (75 x 10-15 watt low energy lights and 10 x 40 watt reading lamps)
- External spot lamps (10 x 100 watt)
- Sewage system
- Water pump (1100 watt for 3 hours per day)
- 2 x washing machines and 2 x clothes dryers
- 2 x fridges, 1 x fridge freezer and 1 x walk-in chiller
- 1 x dishwasher
- 2 x microwaves
- 1 x oven (6 kilowatt thermostatically controlled)
- 1 x double hot plate and 2 x range hoods
- Various appliances (Deep fryer, food processor, juice fountain, 2 x kettles, 2 x toasters, 1 x clothes iron, 2 x vacuum cleaners, 4 x electric blankets, hair dryers)
- 2 x televisions, VCR, DVD, Hi-Fi, CD, tape deck and Sky decoder
- Telephone system, cordless phones and facsimile
- Alarm system
- Computer and printer
- Phone and camera chargers
- Various electric hand tools

### ***Project credits:***

Genkit credits the following organisations and individuals who contributed to the successful outcome of the Glazebrook project:

- Alan Simpson ("Bart"), Land and Marine Electrical Contractors
- Brian Horton, Power Engineering Solutions
- Grant and Owen Bensemman, Excavators, Bensemman Contracting Ltd
- Jan Clayton-Green, Department of Conservation – <http://www.doc.govt.nz>, <http://www.infonews.co.nz>
- Kevin McKinstry, Manager, Westervelt Hunting Lodges – <http://www.westervelt.com>
- Murray Clarke, Project Manager, MCL Building – email [mclbuilding@globe.net.nz](mailto:mclbuilding@globe.net.nz)
- Philip Maw, Solicitor, Wynn Williams & Co. – [www.wynnwilliams.co.nz](http://www.wynnwilliams.co.nz)
- Russell Burmaby, Electrical Inspector
- The Marlborough District Council – [www.marlborough.govt.nz](http://www.marlborough.govt.nz)
- Tony Robinson, Hydrologist, Water and Atmosphere Information Ltd – [www.wai.co.nz](http://www.wai.co.nz)