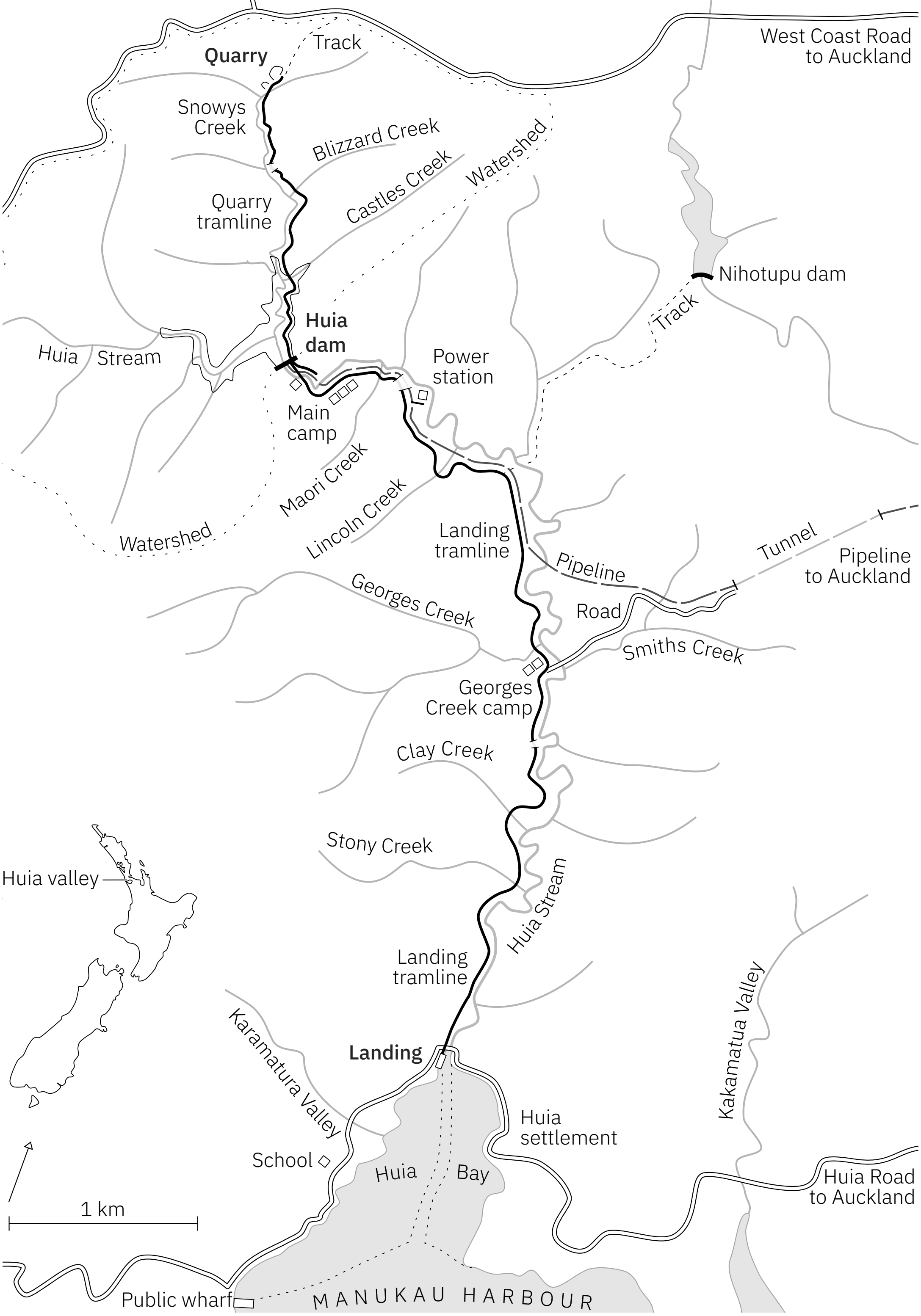
The Huia Tramline

Peter Hopcroft

Huia Valley 1929



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With its three feet six inch gauge, substantial ballasting, well-made cuttings and avoidance of erratic curves, the line is totally different from the usual run of tramlines found on large civil engineering tasks.

At least two years of heavy work will be expected from the line, and the opinion of the engineers is that if efficient service is to be obtained in the transport, of materials to the site up to schedule, then something better than a rickety line on which the wagons are more often off than on must be provided.

So long as the Huia line is free from slips and washouts, no delays are expected from this source.

The Huia Tramline

This second edition, to fix small errors: 18 June 2023
First published: May 2023

ISBN 978-0-473-67948-4 for PDF
ISBN 978-0-473-67947-7 for paperback

Published by Peter Hopcroft
13 Arnold St, Auckland 1021
Typeset with ConTEXt
Fonts XCharter and Plex Sans

huiatramline.nz

This book was inspired by other New Zealand local history writers. Many people gave their time freely to help me. I want it to continue.

Contents

For Zoya Kőszegi

my helpmate, playmate and soulmate

Introduction

I walked up the Huia valley and was surprised to see a huge grey wall blocking the way. The upper Huia dam. I asked myself, why was the dam built? How was it built? I realised that most of the path up to the dam and beyond was an old railway line. Why was there a railway? Why did it follow that particular path up the valley? What trains ran on it?

I looked for answers. This book is what I found out.

My thanks

To Harvey Stewart, for inspiration, information and a practical introduction to tramlines.

To the people who saw the tramline and told me about it: Gloria Rae, Ken Lawrence, Linda Pirimona, Merv Woon, Norm Laing, Phil Sharpe, Took Moore and Violet Moore.

To Andy Loader, Brian Trafford, Bruce Hayward, Bryan Bartley, David Braithwaite, David Hoyle, John Bethell, Keith Neidler and Sean Millar for help with technical things.

To Norm Laing, John Agnew and Watercare for sharing their photographs and maps. To Bill Prebble for the locomotive drawings.

To Auckland Council Archives, Auckland Libraries and Research West for photos, and for kindly helping me with my research.

To Caren Hopcroft, Jan Rivers, Jonathan Hopcroft, Michael Gee and Zoya Kőszegi for reviewing early versions of the book.

Arthur Mead

Arthur Mead was an Auckland City waterworks engineer and a manager for the Huia dam. He was described as, 'A quiet and deeply religious man, who had earned the respect of all who worked with him, as a man of great vision and as a remarkable intuitive engineer.'

In 1931, he published an article: 'The Huia water supply extension for the city of Auckland' in *Proceedings of the New Zealand Society of Civil Engineers*, 1931. Words from this article flow through the pages of this book.

Les Mills

Les was a manager for building the dam. He took over 200 photos of the work. They are the Clary Mills collection at Research West.

Huia dam

Huia Dam, in this book, is now called Upper Huia Dam, because there is now a Lower Huia Dam.

At a glance

Huia dam. 1947. Bottom left is the tramline and Huia Stream. Top right is a flooded tramline cutting, just up from Castles Bridge.

Introducing the tramline

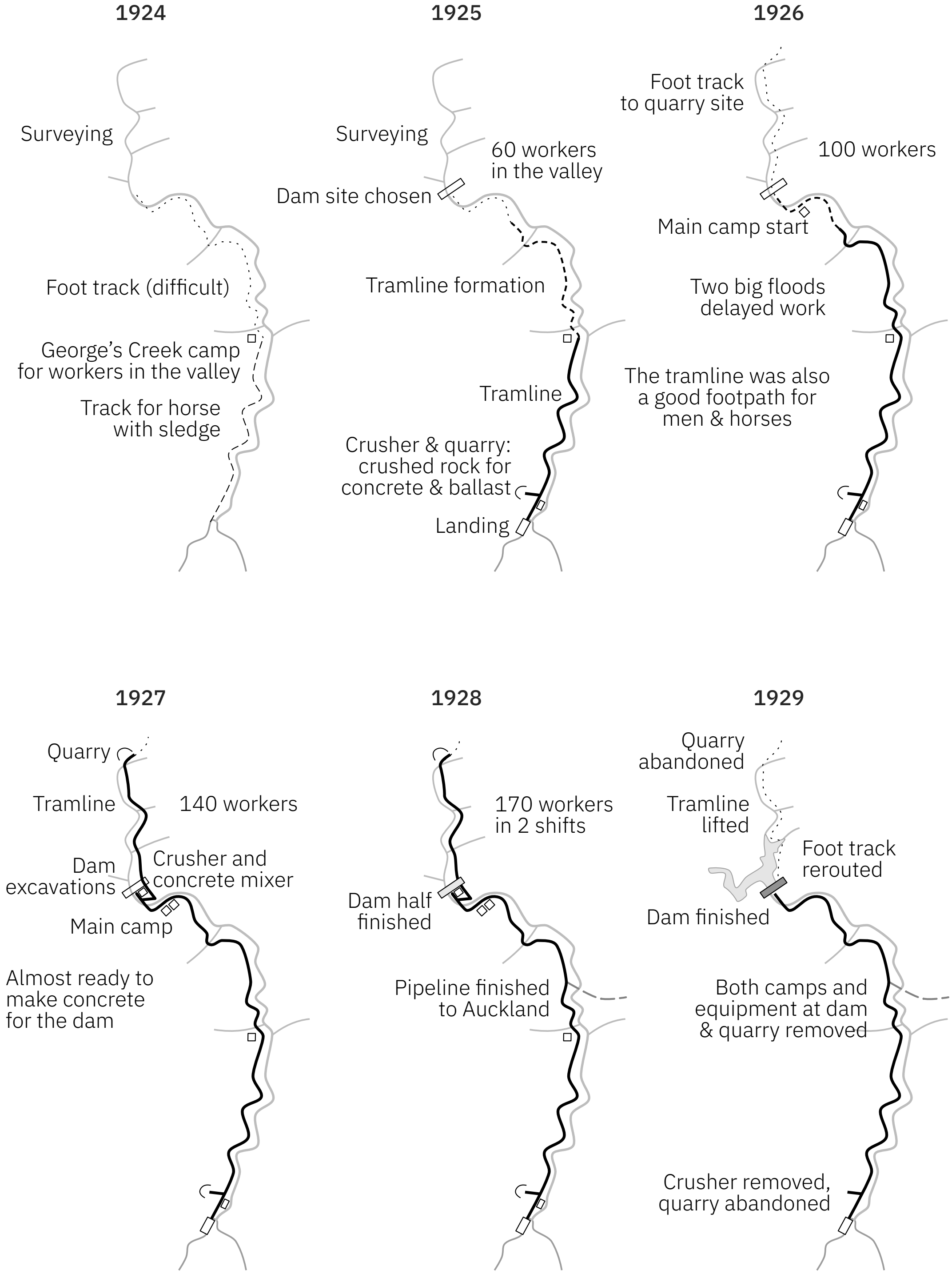
Huia is 25 kilometres south west of Auckland. The Huia tramline was a small private railway, built and operated by the Auckland city council. Its main job was to move supplies and people in the Huia valley for building the Huia water-supply dam, between 1925 and 1929. As well as the dam, the council built a pipeline to take the water to Auckland via a filter station at Titirangi.

The tramline had 3 sections:

- The landing tramline, from a landing (wharf) at Huia Bay on the Manukau harbour to the dam site, 6.6 kilometres up the valley. Barges brought cement and sand to the landing. A Price Cb locomotive hauled them up to the dam.
- The quarry tramline, from the dam to the quarry, 2.5 kilometres up the valley from the dam. A Gibbons and Harris locomotive took rock from the quarry down to the dam.
- At the dam, the quarry tramline was 12 metres above the landing tramline. A short piece of railway track connected them, called the switch line.

When the dam was finished, the quarry and switch lines were lifted. The landing tramline now carried people and supplies for the dam caretakers and the small work gang in the valley. In 1959, the tramline was lifted and converted to a road.

Huia dam construction timeline



In 1923, Auckland City Council must have been feeling smug. They had built 2 big concrete water supply dams in the Waitākere ranges. At last, water supply exceeded consumption and water restrictions seemed a thing of the past.

However, water consumption was increasing. Council waterworks engineers pressed the council to start the next dam, at Huia. There were many things to do, and each depended on a previous one being finished. First, surveyors needed to find a site for the dam and quarry, to prove the project was possible. Then, the crusher and quarry at Huia were needed to make the concrete for the landing. The landing was needed to bring in materials to make the tramline. The tramline was needed to carry men, equipment, supplies, the crushers and the concrete mixer to the dam site. The crushers and concrete mixer were needed to make concrete in bulk.

All that preliminary work took four and a half years. Then, actually building the dam took only one and a half years.

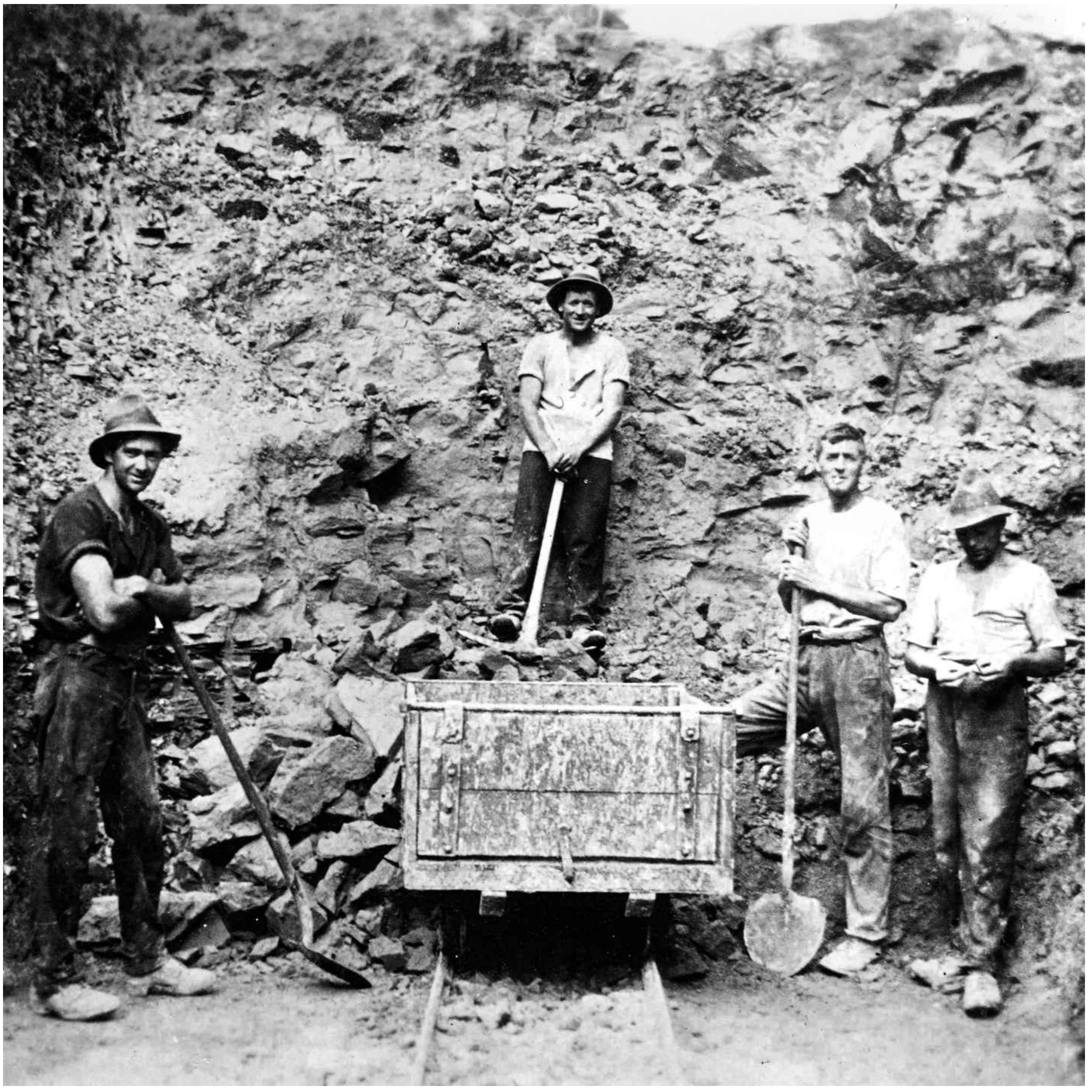
Before the tramline was finished, people and supplies in the valley moved slowly. The tramline route was formed far in advance of laying and finishing the railway track, to give workers and horses an easier walk. The city engineer pointed out in 1924: 'It is desirable that the tramway route should be formed as soon as possible, otherwise a good deal of work will require to be done on the present track to keep it open in the winter, which work could be profitably employed on the tramway route.'

During the 1920s, Auckland's water consumption increased faster than expected. In 1927, the council was forced to move workers from the Huia dam to enlarge the Waitākere dam, to store more water. Despite this, 'the exceptionally dry summer of 1927-28 … created somewhat of a panic, and the City Council instructed that the [Huia dam] works were to be operated by double shifts.' There had been an outcry from Aucklanders. They had spent all that money for 2 big dams in the Waitākere ranges and now there might be more water restrictions. In the event, only minor restrictions were needed. And working double shifts at the dam did not speed up construction very much.

Heavy rain often disrupted work. There were major storms in May and December 1926 and many smaller ones. An engineer wrote:

> Owing to the very heavy floods during Christmas, 1926, the best part of the summer which would have been of material assistance in advancing the heavy earth work in connection with the job, was occupied in restoring the extensive damage.

The tramline



Cement, sand and rock

The dam is made of concrete. The main job of the tramline was to carry cement, sand and rock to the dam site to make concrete. In this section, I calculate how much of each was required in a typical day. In other sections in this book, I use these figures to calculate what loads the trains on the tramline carried.

At Huia, a batch of concrete from the mixer used:

- 4 cubic feet of cement; three 124-pound (56-kilogram) bags
- 12 cubic feet of sand
- 24 cubic feet of crushed rock
- water; books on concreting suggest that for the above proportions, a batch would have about 4 cubic feet of water.

A batch gave 24 cubic feet of concrete. The volume was less than the total volume of the materials that went into it, because the small pieces and the water filled the gaps between the bigger pieces.

The proportions were 9 parts of crushed rock and sand to 1 part of cement. This is very weak by today's standards, which use more cement to make stronger concrete. But it was ideal for making the dam: it was cheaper, it didn't heat up or shrink when it set and it was strong enough for the job. The engineers did use stronger concrete, with more cement, in some places.

The workers made 180 batches in a typical day. I multiplied the figures above by 180 to calculate the volume of each material required each day. I used typical densities of loose materials that I found on the internet, to calculate the weight of each material that was required each day:

- Cement: 20 cubic metres; 540 bags of 56-kilograms is 30 tonnes.
- Sand: 61 cubic metres at 1.4 tonnes per cubic metre is 86 tonnes.
- Crushed rock: 122 cubic metres at 1.35 tonnes per cubic metre is 165 tonnes. This required 107 cubic metres of rocks from the quarry, because when rock is crushed it expands; there are now more gaps between the pieces.
- Water: 20 cubic metres at 1 tonne per cubic metre is 20 tonnes.

I was surprised to realise that most of the infrastructure in the valley was designed and operated just to bring these quantities of cement, sand and rock to the dam every day: the barge traffic across the Manukau harbour, the trains on the tramline, the rock crusher and concrete mixer at the dam, the number of workers at each place in the valley, and the size of the workers' camps.

Why a tramline?

The dam engineers built a tramline in the Huia valley to carry people and supplies for the Huia dam. The 2 big concrete dams that Auckland City built earlier in the Waitākere ranges also used tramlines. Why did they use tramlines? The short answer is, there was no other way back then to carry large quantities of materials. There is a longer answer …

Starting in the late 1800s, Auckland grew rapidly and new industries proliferated. Water consumption rose. But the people and the industries polluted the springs and wells in the city that supplied water. Auckland needed large volumes of water; it needed water supply dams. And the new industries enabled these dams to be built, by providing railways, rock crushers, concrete mixers, cranes, winches, electricity, motor launches, Portland cement, steel, telephones, salespeople to sell the machines, workers able to use the machines, repairers to keep the machines running, managers for large projects like the dam, and financiers to arrange large loans.

The tramlines at Huia and the 2 earlier big dams in the Waitākere ranges used technology developed for New Zealand's logging tramlines. Between about 1900 and 1950, there were about 500 logging tramlines, built to haul cut logs from the bush out to a sawmill. Their locomotives and wagons could cope with rough, temporary, railway track. They were ideal for the tramlines at the dams.

New Zealand's logging tramlines evolved rapidly between 1900 and 1930. This enabled the tramline at each of the big concrete dams to be better than the previous. For example:

- Building Waitākere dam, 1905 to 1910: Horses pulled the wagons. Then, many logging tramlines used horses.
- Enlarging the Waitākere dam, 1927: A rail tractor pulled the wagons. These were ordinary farm tractors with the wheels replaced by railway wheels. They were introduced on logging tramlines in 1923.
- Building Huia dam, 1925 to 1929: This tramline was steep. Suitable locomotives were available in 1926, when the council asked for tenders for a locomotive to haul sand and cement up to the Huia dam. The council accepted a Cb steam locomotive from A & G Price, which was designed for logging tramlines. The Huia workers did use a few horses and bullocks, mostly at the quarry and in the Nihotupu valley to haul pipes.

Could road trucks have been used at Huia?

Rail was the best way to carry goods within New Zealand until it was challenged by road in the 1920s.

In 1920, the Auckland city council had used trucks to carry sand and cement for the Nihotupu auxiliary dam. This was a small concrete dam in the Waitākere ranges, close to Auckland. Ray Allen, who worked on the dam, wrote: 'Sand and cement were brought up from Waikumete by anyone who had a truck available … The [road] had big, jagged lumps which quickly tore their tyres to shreds.' The road became impassible in winter and work halted.

The council could not have used trucks at the Huia dam to carry sand, cement or rocks. The trucks of the day were not reliable and could only carry a few tonnes. Trucks only started replacing tramlines for logging in the late 1930s.

The Huia dam made some use of motor vehicles:

- In 1923, Arthur Mead got a Douglas Motor bike for inspections in the valley. He chose a light bike so he could lift it out of ruts in the tracks.
- The Huia pipeline workers used a light truck and a medium truck. There was a steep road from the landing tramline near Georges Creek up to the pipeline. The average gradient was 1 in 8. It was too steep for bullocks or a tramline. But a truck could cope, apparently. A Ford owners book of the time claimed that a Ford model T could climb 1 in 5 gradients in low gear, 'so hills should hold no fears for Model T Ford owners.'
- The 1928 stocktake of equipment in the Huia valley showed 2 farm tractors, a Peterborough and a MacCormick-Deering. These tractors looked much like today's farm tractors.

After the Huia dam, the Auckland council built 2 water supply dams in the Waitākere ranges and 5 in the Hunua ranges, south east of Auckland. The first was the lower Nihotupu dam in 1948. All were earth dams, which are significantly cheaper than concrete dams. By the 1940s, New Zealand had powerful and reliable trucks and road-making machinery, such as bulldozers, graders and carryalls. These enabled Auckland to build the earth dams.

Finally

In 2002, modern filters, pumps and control systems enabled Auckland to collect water from the Waikato River. No dam required.

Tramway licence

Auckland city owned most of the land in the Huia valley. But just up from the landing, the tramline ran beside the public road and across 2 private properties. Because of this, the tramline came under the 1908 Tramways Act. The dam engineers seemed surprised when they were told they had to apply to Waitematā County Council for a tramway licence. They seemed affronted when the county turned down their first application because it did not comply with the requirements. When the licence was granted, the county's requirements were:

- Two conspicuous warning notices to be erected at crossing at Huia [road] bridge.
- Crossing to be metalled and maintained flush with railhead.
- Efficient brakes to be installed on all rolling stock.
- Speed limit at crossing to be four miles per hour.
- Engine must travel in front of [the railway wagons] at all times.
- No rolling stock to be stationary on crossing.
- LA Laing's property befronting excavation to be supported by an efficient breast wall.
- Entrance twelve feet wide on a 1 in 12 grade to be made from bridge to LA Laing's house.
- In all places where excavation will reduce width or undermine Huia Road, the said road shall be cut out of hill side to give a road fourteen feet in width with 1 to 1 batter both above and below road level and a substantial post and rail fence shall be erected on outer edge of road above excavation for tramway.

Surveying the tramline

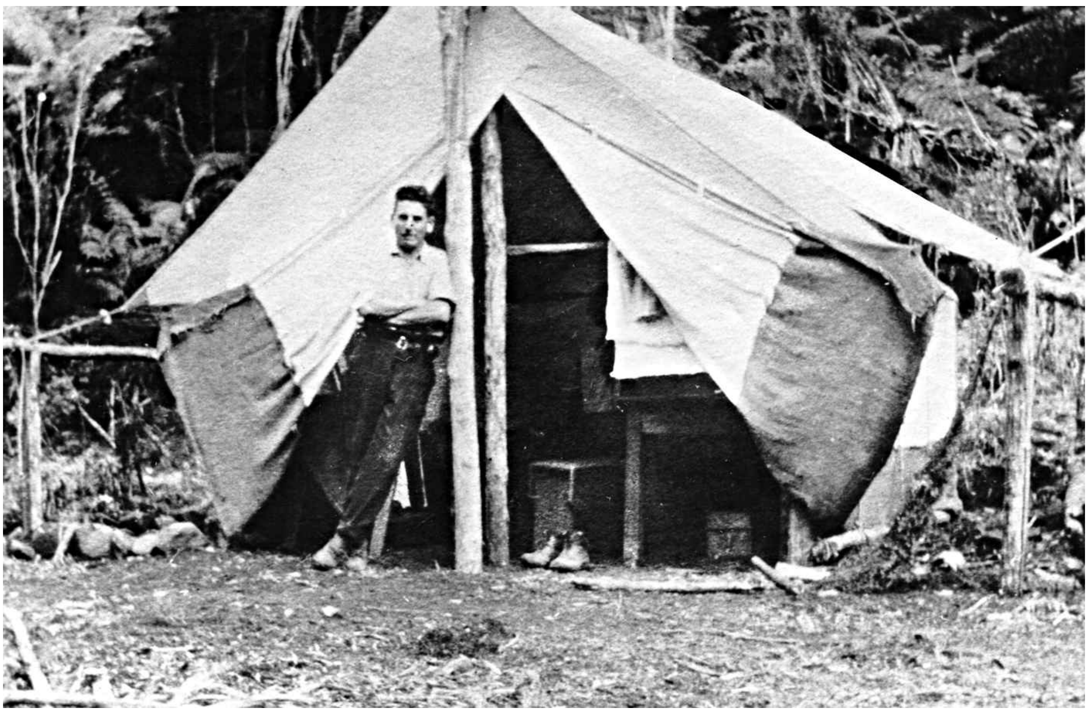
Joe Clarke led the team that surveyed the tramline route up the valley. They first did a preliminary survey to find the shape of the valley, then an accurate survey.

They lived in tents at Georges Creek, halfway up the valley to the dam. Clarke described the work:

> I did my work in a tent. I didn't have a table, it was 4 bits of ti-tree stuck in the ground and a drawing board put on top. I used a kerosene lamp at night. That was my drafting office. After a while they built a hut for me … I had been surveying to establish the tram track ... through fairly heavy bush and steep country and it was quite a job, a very interesting job.

For accurate work, Clarke measured angles between points in the valley with an instrument called a theodolite. And he measured distances between the points with a long steel wire unrolled from a hand-held drum, called a chain. From these measurements, he could calculate the positions and heights of the points and draw a map. But it was hard making accurate measurements in the bush. The chain gang had to slash straight paths for the chain and the uneven ground limited the length of the paths.

↓ Joe Clarke at his drawing office at Georges Creek. 1926. Joe joined the council 14 years before as an office boy and educated himself to be an engineer.



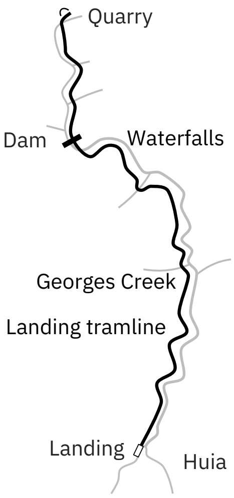
For the less-accurate preliminary survey, Clarke used a small theodolite called a stadia, which let him measure distances without using a chain. An assistant had a wooden staff, about 4 metres long, with markings along its length. The assistant held it vertical. Clarke used the stadia to measure the horizontal and vertical angles to the staff, and the angle between the markings on the staff. From these angles he could calculate the distance to the staff: the further away the staff was, the smaller the angle between the markings. The gang did not have to slash straight paths through the bush for a chain, but often they would have had to slash the bush so that Clarke could see the staff.

They took a series of measurements up and down the valley. Back in his tent in the evening, Clarke calculated the positions and heights of the points in the valley, and planned the work for the next day.

The surveying was accurate. There is a pipeline tunnel between the Huia and Nihotupu valleys. It is 1.2 kilometres long and the exit is just 34 centimetres below the entrance. The tunnel was driven from both ends at the same time, so the surveyors had to survey over the hill between the tunnel ends. When I walked up the tramline, it seemed to be just a meandering path through the bush. I was surprised to find it had been planned so exactly.

Arthur Mead surveying at the Huia dam site. He has had to extend a tripod leg back to steady it.

Designing the tramline



When the preliminary survey was finished, Joe Clarke could plot a trial tramline route. He then made an accurate survey, and plotted the final tramline route. There were many factors to consider …

The shape of the Huia valley

The upper and lower stretches of the Huia valley both have gentle gradients. They are separated by a high rock cliff, down which the stream cascades in a series of waterfalls. The Huia dam was built in the upper stretch of the valley, at a wide basin where several creeks met. It is higher than Auckland and the water flows to Auckland by gravity. No pumps are required. In the 1960s, the lower Huia dam was built in the lower stretch of the valley, where it was wide. By then there were suitable electric pumps to pump the water up to Auckland. A wide valley with a gentle gradient is a good place for a dam, because it can store a lot of water. But these gentle gradients meant that other parts of the tramline were steep.

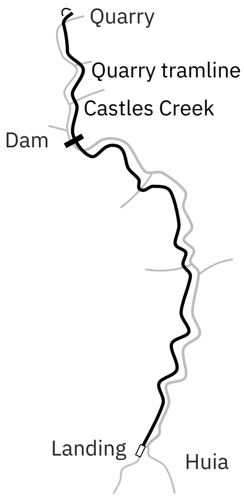
The landing tramline

The landing tramline ran up the west bank of the valley from the landing to the dam, because there were fewer large valleys to cross on that side. Georges Creek's valley is narrow and winding. The only possible place for the tramline to cross it was near where it flows into Huia Stream. This is only 41 metres above sea level. Georges Creek divided the landing tramline into two halves:

- The lower half was easier. The gradient could change to suit the shape of the valley sides, an average of about 1 in 85. The valley was wide and the curves could be gentle. Most were 90 to 180 metres radius.
- The upper half was more difficult. It was steep, with a gradient of about 1 in 33. Many curves are 60 metres radius. Between the high rock cliff and the dam, the valley is narrow and winding. This required the sharpest curves on the landing tramline, one of 40 and two of 46 metres radius.

On New Zealand's public railways, the steepest gradients are also about 1 in 33. The sharpest curves are about 100 metres radius. A curve near Britomart station is 95 metres radius. The track is strengthened, the train takes the curve slowly, and you can hear the bogie wheels grinding against the rails.

The quarry tramline

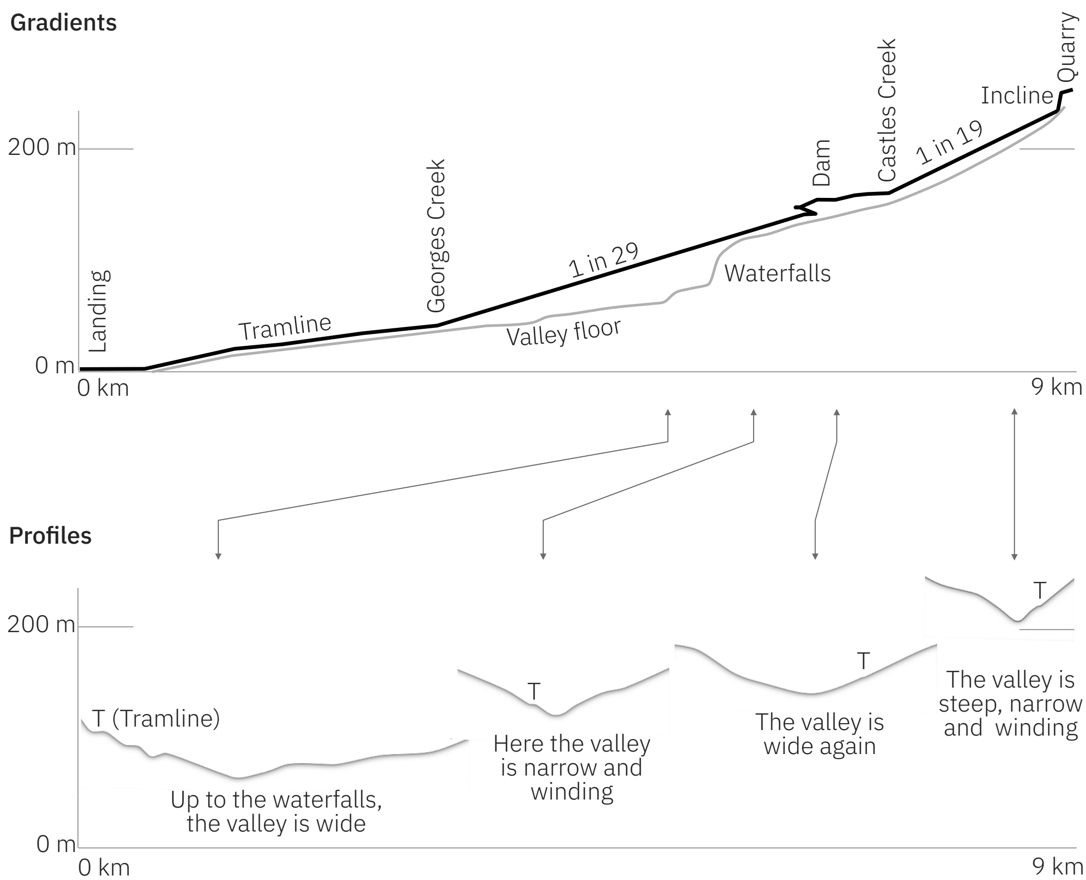


The quarry tramline ran up the east side of the stream from the dam to the quarry, because there were fewer large valleys to cross on that side. The only possible place for the tramline to cross Castles Creek was near where it flows into Snowys Creek, 160 metres above sea level. This is only a few metres above the tramline at the dam. Castles Creek divided the quarry tramline into two parts:

- The lower part, with a gentle gradient.
- The upper part, with a very steep gradient of about 1 in 19.

A 1 in 19 gradient is about the steepest that would allow the train to come down without skidding out of control when the track was wet and dirty. This, and the shape of the valley at the quarry, left the top of the quarry tramline 20 metres below the quarry. The engineers had to build an incline, a short length of very steep track, to reach the quarry. Wagons were winched up and down.

Many curves on the quarry tramline and the switch line at the dam were only 24 metres radius.



Curve compensation

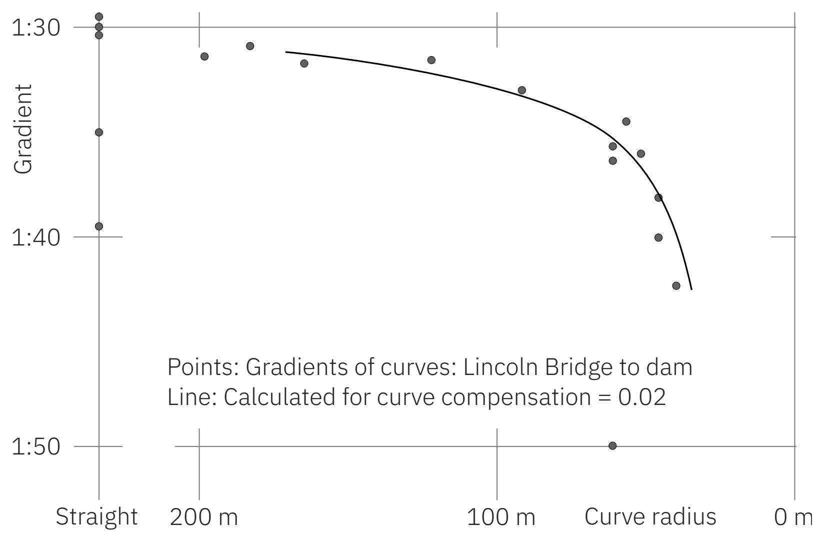
When a train rounds a curve, there is extra friction as the rail forces the wheels around the curve. If a sharp curve has a steep gradient, it is usual to reduce the gradient to compensate for this extra friction. The sharper the curve, the more the reduction. This is called curve compensation. To achieve the same average gradient on the line, the gradient of the straight sections of track, between the curves, must be increased.

For the landing tramline: 'The upper two miles were run at an even grade of 1 in 33, and partly compensated for curvature by increasing the grade on [straight track] to 1 in 29 and flattening curves according to radius.'

For the quarry tramline: 'Owing to the gorge-like valley, in which its route lay, much sharper curves had to be adopted for this line. These were mostly of 80 feet radius, and the ruling grade on the greater portion was 1 in 20, increased to 1 in 18 on the tangents and flattened on the curves.'

Friction on a curve is complicated. Railway engineers use approximations to design curve compensation. The amount of curve compensation can be expressed as a number: a common value given for 3-foot 6-inch track is 0.03. This graph below shows some actual landing tramline curves and their gradients on a steeper part of the tramline. The curve for a curve compensation of 0.02 fits the points fairly well. This is consistent with the tramline curves being partly compensated.

Curve compensation. The smaller the curve radius, the more its gradient is reduced.



Transition curves

Straight and curved sections of track are often separated by a short length of track that gradually changes from being straight to being curved. This is called a transition curve. It eases the train into the curve. Without it, there would be a jolt as the curve suddenly started accelerating the train sideways.

Arthur Mead wrote: 'A short transition was given to curves sharper than 400 feet, and helped greatly in giving sweet running.'

Superelevation

Curves on railways usually have the outer rail raised slightly, so the train leans inwards and travels smoothly round the curve. This is called superelevation. The amount of superelevation depends on the train's speed on the curve. Usually, the superelevation is calculated for the fastest speed anticipated.

The drawings for the Lincoln Bridge show that the landing tramline superelevation was designed for 19 kilometres per hour. The dam engineer's 1926 specification for the locomotive specified the superelevation for 24 kilometres per hour, and Arthur Mead wrote that that the train came down at 24 kilometres per hour. The train was much slower going up.

After 1930 the petrol-powered locomotives, called jiggers, travelled faster, over 30 kilometres per hour, and the transition curves and superelevation would not have been so well maintained. Gloria Rae travelled on the tramline in the 1950s. She described going around a curve as 'that little sideways shift, just as though the jigger was about to flip me out, and then change its mind. This happened many times. One was never ready.'

Siding gradients

On the quarry tramline, places where wagons would be moved by hand or horse had gradients of about 1 in 40. These were beside the crusher hopper, the passing loop at the bottom of the quarry incline and the track from the top of the incline to the quarry faces. A loaded wagon is harder to push than an empty wagon because it has more friction. Ideally, the gradient would have been chosen so the force needed to pull a loaded wagon down was about the same as the force needed to pull an empty wagon up.

Track gauge

Most railways in New Zealand have a track gauge (the distance between the rails) of 3 feet 6 inches. Some private railways had a smaller gauge. These are easier to build and can have sharper curves. But the smaller locomotives are less powerful and the smaller wagons hold less. The tramlines at the 2 earlier big concrete dams in the Waitākere ranges had gauges of 2-feet, 2 feet 6 inches or 3 feet 6 inches. The Huia tramline's gauge was 3 feet 6 inches.

Rails

New Zealand's public railways used rails that weighed 25 to 50 kilograms per metre. Most tramlines, including the Huia tramline, used rails that weighed 15 kilograms per metre. They were cheaper, easier to bend into curves and strong enough for the modest loads that were carried. On the Huia tramline, the maximum load was 5 tonnes per axle.

Turntables

A steam locomotive's boiler is a steel tank, filled with water. It is heated by hot air from a fire in a steel firebox at the driver's end. The hot water in the boiler surrounds and cools the firebox. As the water in the boiler boils away to make steam, the water level in the boiler falls. If the level falls below the top of the firebox, the top of the firebox can overheat and melt, and the boiler can explode. To reduce this risk, steam locomotives that operate on track that mostly slopes one way, as at Huia, have their boilers facing uphill. This mostly keeps the water at the firebox deeper than the water at the other end of the boiler.

There was no turntable at Huia to turn the steam locomotives end to end. None was necessary. Small steam locomotives can move forwards and backwards equally well. And a steam locomotive driver can see forwards and backwards equally well.

Plotting the tramline route

Joe Clarke would have had to consider all the above factors when he plotted the final tramline route. All were interrelated. 'Introducing [curve] compensation sometimes taxes the ingenuity of the locating engineer.' He also would have tried to take into account the cost of the earthmoving required. At that time, council engineers could only make estimates, based on experience. Clarke himself started introducing better job costing to the city council in the 1930s.

Building the tramline

There were 2 stages: first earthmoving, then laying the rails.

Earthmoving

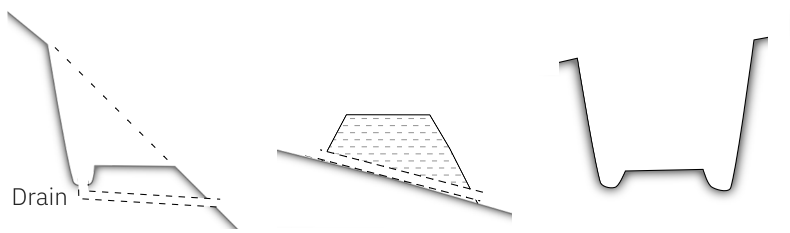
The earthmoving was to make a solid base (the formation) for the tramline. The workers used pick and shovel, and occasionally used explosives to break up rock. They threw the spoil into the valley, or carted it away in wheelbarrows or in small railway wagons, pushed by hand on temporary rails. They dug out many tree stumps. New Zealand workers were skilled at making tramlines through the bush.

Most workers lived at Georges Creek camp:

> We lived under canvas in ti-tree framed tents. The Auckland City Council provided the cook, Tom McQuillan, a cook house and utensils. Food was cooked in wood-stoked camp ovens. The food bill was tallied up each week and apportioned among the men. It varied a bit, but we lived very well on about 17/6d a week. I was getting £1.1.4d a day then. Each morning we cut our own lunches, and at nights we enjoyed suppers of bread toasted over a huge open fireplace.

For some of the route, the formation was at ground level. All the workers had to do was to shovel away the loose topsoil. But for most of the route the formation was above or below ground level. There were 3 common profiles for the formation:

The 3 common profiles for the formation. Arthur Mead wrote: 'The formation was 9 feet wide, with ½ to 1 batters [25 degrees to the vertical] on cuttings.'



A side cut, where the track ran along the side of the valley. Most of the tramline was like this. The workers just shovelled the spoil down into the valley.

An embankment, where the track was above ground level. The workers would have packed the spoil into place in layers, so that it didn't compress too much when trains went over it.

A cutting, where the track was below ground level. The workers carted the spoil away in wheelbarrows or in small railway wagons pushed by hand on temporary rails.

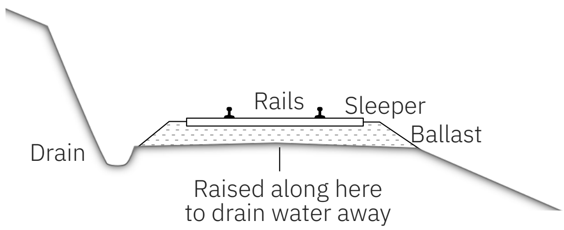
Workers digging one of the big cuttings just up the valley from Georges Creek. They would have used wheelbarrows here because they wouldn’t have had to move the spoil far.

It is important to drain rain water away from railway track. Otherwise the ground can get wet and move, and the sleepers can rot. Along a side cut, an open drain at the bottom of the cut took water to pipes under the formation. Pipes drained any water that would accumulate on the uphill side of an embankment. Most pipes were iron, 23 centimetres in diameter. Cuttings had a ditch on both sides to take the water out of the cutting.

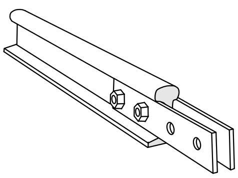
The tramline crosses 8 large creeks on bridges. It crosses more than 80 small creeks on embankments, with pipes to channel the water through, 23 to 97 centimetres in diameter. Even fairly large creeks have embankments. For example, Stoney Creek has an embankment 30 metres long, an average height of 3 metres, and 2 pipes for the creek, each 97 centimetres in diameter.

Laying the rails

Cross section of railway track.

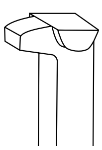


1. Sleepers: The winning quotation was for 6,000 sleepers, 1.9 metres long, 18 by 13 centimetres in section, of heart kauri or totara. They were split from trees cut in the nearby bush and adzed to the final size. Sleepers were spaced about 75 centimetres apart. In some places, the workers laid a continuous line of ponga logs on the formation before placing the sleepers. The logs were about 2 metres long and parallel to the sleepers. I assume these were to help drain wet areas.



Fishplates on a rail.

2. Rails: The workers bent rails for curves, placed them on the sleepers and bolted them together end-to-end with fishplates. Rails come with 2 fishplate bolt holes at each end. If the workers had to cut the rail, they had to drill 2 holes in the cut end of the rail. All work was done by hand. They used a rail gauge to set them to 3 feet 6 inches apart. And finally they hammered 4 dog spikes into each sleeper to attach the rails to the sleepers. A dog spike is a big nail with an offset head to bear down on the rail's base. Its head looks just like a dog's head.



A dog spike head.

3. Trains could now use the track. Trains brought crushed rock and emptied it over the sleepers. The rock is called ballast.

> The workers used crowbars or jacks to raise the track about 15 centimetres, and started packing ballast under the sleepers. They looked along the rails to check they were straight. They placed lengths of wood, called profile rods, across the rails and looked along them to check the track wasn't twisted. A profile rod is about 2 metres long and the workers use might have used 3, spaced about 15 metres apart. Finally, the workers packed the ballast under the sleepers with beater picks. A beater pick is like a normal pick with a hammer head on one point.

Ballast spreads the load of a train onto the ground, it keeps the rails from moving, and it drains water from the sleepers. The tramline had about half a cubic metre of ballast per metre of rail. Assuming the ballast was spread 2 metres wide, the depth was about 20 centimetres. New Zealand public railway track ballast is typically 3 metres wide and 30 centimetres deep.

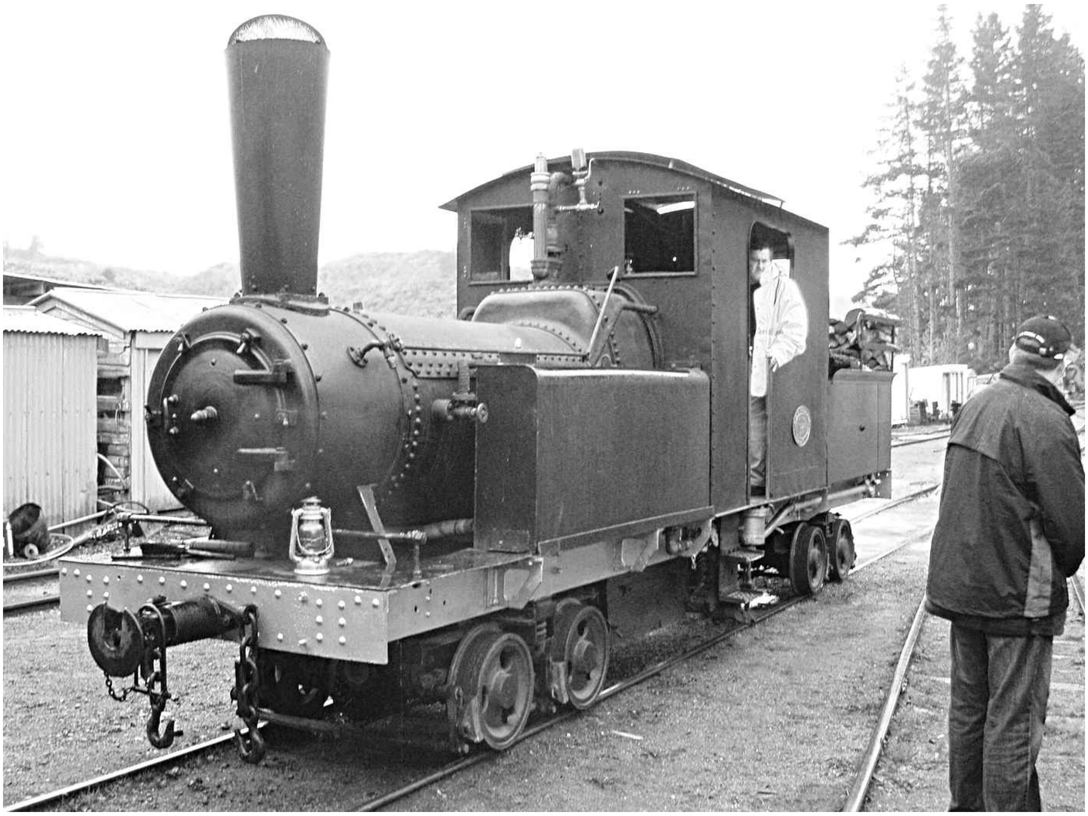
The weight of the first trains compacted the formation and the ballast: 'There were some derailments in the first few weeks on the quarry line, until it settled into position, but on the whole, accidents were very few.' Once the ballast had settled, the sharp edges of the crushed rock helped lock it together.

Railways need continuous maintenance: the track sinks and moves, ballast washes away, slips cover the track, sleepers split and rot, spikes come loose. 'The tramlines were maintained in good order throughout their use by surfacemen, about one man per mile.'

The Huia tramline cost a lot to build, about a fifth of the total cost of the dam. The tramline was well made for a tramline, but it was not made as well as the public railways. The formation was narrower, the cutting sides were steeper, it would not have been drained as well, and it had less ballast. It was not meant to be permanent and it did its job well. A newspaper wrote:

> With its three feet six inch gauge, substantial ballasting, well-made cuttings and avoidance of erratic curves, the line is totally different from the usual run of tramlines found on large civil engineering tasks.

Locomotives and wagons



Tramline locomotives

New Zealand has had 2 main railway systems:

- The public railways, built by the government to carry passengers and freight between stations. They are permanent, well built and well maintained. Gradients and curves are gentle.
- Tramlines, which were usually private, short, temporary and built cheaply. The track was often poor, with steep gradients and sharp curves. Most carried logs out from the bush to a sawmill.

The Huia tramline had steep gradients and sharp curves. It used locomotives and wagons designed for logging tramlines.

In the 1800s, public railways and tramlines used similar, small steam locomotives. Over the years, most public-railway locomotives became big and powerful, to haul heavy loads at high speed. They required a long rigid chassis and many wheels to support a big boiler. Their steam engine pistons were mounted low down, to drive the locomotive wheels directly.

Tramline locomotives evolved differently:

- They were smaller. They could be less powerful because the poor track limited the top speed.
- Steam engines (like all piston engines) don't produce as much power at slow speeds. There were two ways to overcome this. The first was to use a small, fast-turning (and therefore powerful) steam engine driving the wheels through reduction gears. The second was to use small-diameter wheels so the engine could turn faster for a given locomotive speed.
- If the locomotive had 8 or more wheels, the chassis would be split into 2 or more parts (called bogies) that turned and pivoted independently. Bogies coped well with the poor track.
- To help stay on the poor track, the wheels were wide, with deep flanges.
- They carried less fuel and water, because trips were shorter. They were designed to burn wood, readily available at logging tramlines, rather than coal.
- To avoid damage from debris, or if the locomotive fell off the track, the steam engine was placed higher in the locomotive.

But there was a problem. A bogie locomotive needed a complicated system of shafts and gears to drive all the axles. These often failed.

The Huia tramline had 3 steam tramline locomotives:

- The Price Cb locomotive had 2 bogies, with 8 small-diameter wheels. The small 2-cylinder steam engine was in the cab behind the driver. It drove all wheels through a 2-speed forward and reverse gearbox and a complicated system of shafts and gears.
- The Gibbons and Harris locomotive had 4 small-diameter wheels. Two small steam engines tucked up under the boiler drove all the wheels through reduction gears.
- The Bagnall locomotive had 4 small-diameter wheels, with the axles close together.

Tramline locomotives were designed for function, not comfort. Leslie Williams, a Huia dam worker, described his job on a 2-foot gauge locomotive in the Nihotupu valley in 1926:

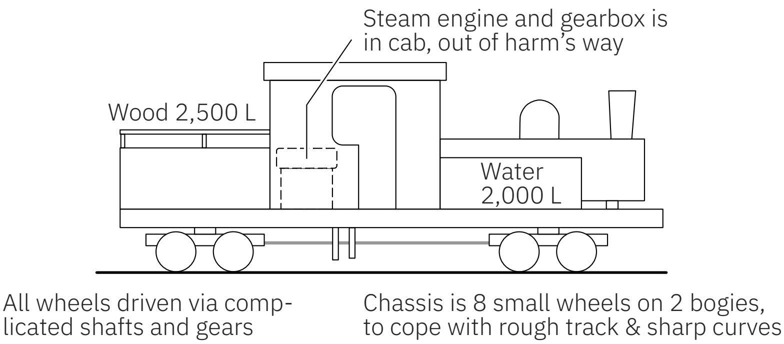
> I had to have a large tin of sand on one side of the loco. On the hills, I had to feed sand on to the rails with one hand, to stop the wheels from slipping, and hold to the side of the loco with the other hand. Often my feet slipped on the wet sleepers of the tram line. In trying to save myself from falling I got my arm burnt on the hot cylinder of the engine. I was wet all the time.

Prices made both types of locomotive in the 1920s in their factory at Thames.

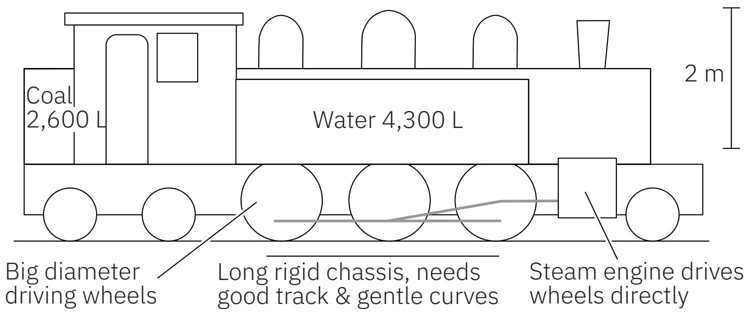
The Cb was slower & smaller. It weighed 16 tonnes, the Wf 43. The Cb held half the volume of water and the same amount of fuel, though it was designed to burn wood, which is less efficient than coal.

Both the Wf and the Cb could pull about the same load at low speeds.

Cb A medium-size tramline locomotive



Wf A medium-size public-railway locomotive



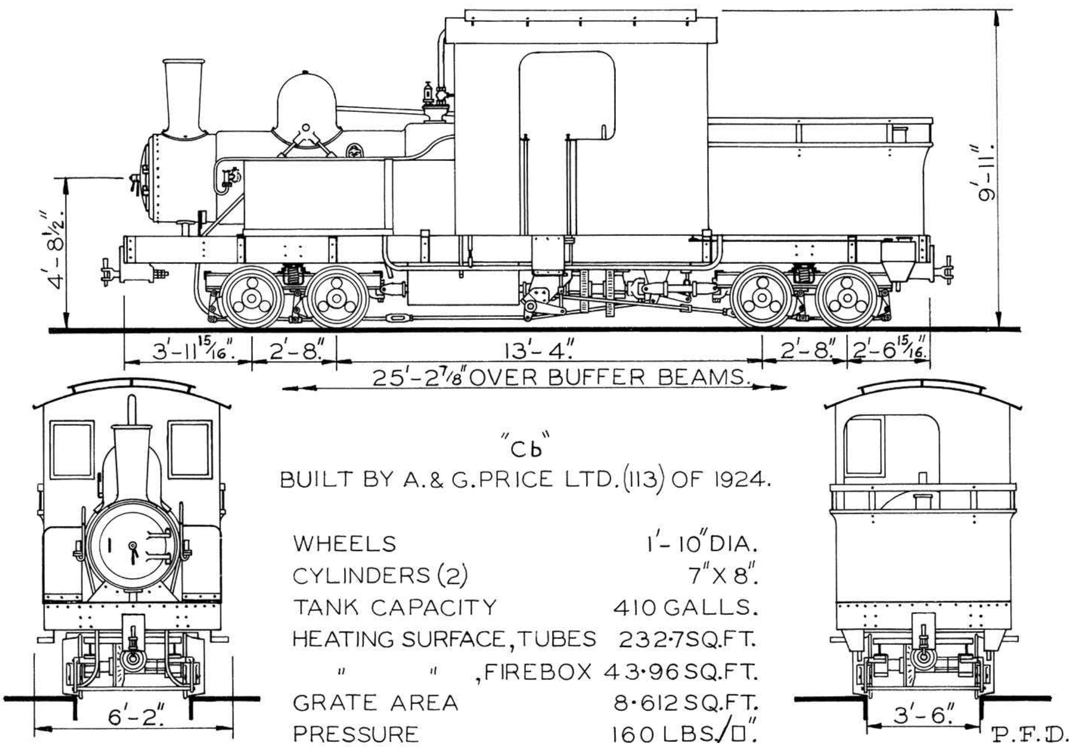
Price locomotive

The Price locomotive was bought to haul sand and cement from the landing up to the dam. It was the most powerful locomotive on the Huia tramline.

In early 1927, the dam engineers called for 'Tenders for a steam, oil [petrol or diesel] or storage battery locomotive for water supply extension works.' Of the 11 tenders, 2 were for oil locomotives and 9 for steam. Most were English. Some were too slow and some were expensive. There were tenders for 2 new kinds of locomotive, a battery locomotive and a rail tractor. Both were too slow. The rail tractor was the cheapest, even cheaper than a small second-hand steam locomotive. In the late 1920s, rail tractors were replacing small steam locomotives on New Zealand's logging tramlines.

The Price locomotive was the logical choice for Huia. It was powerful enough, not too expensive, made in Thames (70 kilometres south east of Auckland) and spare parts were available. It was a proven design, the 7th of 9 C-class tramline locomotives that Prices built. The engineers knew it would cope well with the Huia tramline track.

↓ A typical Price Cb locomotive. The Huia Price was number 117.



Peter Dyer, NZ Railway & Locomotive Society

The locomotive was made and delivered during 1927:

- in May the construction was 'well forward'
- the locomotive was tested at Thames, unbolted and shipped to Huia
- it arrived at the landing on 30 August, was assembled, and made its first run on 2 September.

The new locomotive had several problems that were repaired under 'the maintenance clause in the contract', a 3 month guarantee. The steel bars that supported the fire in the boiler soon bent badly, because Prices had designed them for burning wood, not coal. A gudgeon pin wore. A slot on the crankshaft wore. The inner springs frequently broke. I gather that these were typical problems for such locomotives. The dam engineers blamed Prices and Prices blamed the locomotive driver.

The Price locomotive proved to be a good choice. It was fast enough and reliable. It was out of action several times, including once for a week after it fell off the rails while backing through the turnout at the Huia crusher. It was repaired on site and the Bagnall locomotive would have replaced it.

The regular train trips up the valley reminded the workers of the outside world:

> The small 16-tons locomotive has been in constant use throughout the work, and its shrill whistle rises above the noise of the workshops to attract attention to a link with civilisation.

People who visited the dam were used to how public railway locomotives looked and behaved. They thought the locomotives they saw at Huia were strange. Reporters described the Price locomotive as 'a rather prehistoric looking locomotive, panting and puffing impatiently,' and 'a fussy little engine, whose funnel belched smuts and live cinders in prodigal fashion.' Gwyn Williams, daughter of the locomotive driver, called it:

> A rather shaky-looking species of engine, which has been given endearing nick-names by the work men. It has overturned a few times, but always manages to do its work to the satisfaction of the driver, and his friend, the fireman.

The locomotive has been restored at the Bush Tramway Club at Pukimiro. When I saw it there, I thought it looked light and elegant. I expect steam locomotives to make a powerful 'chuff chuff chuff' sound. The Price made a higher-pitched sound and did not seem as powerful as it was.

Gibbons and Harris locomotive

The Gibbons and Harris locomotive's main job at Huia was hauling rocks from the quarry to the dam.

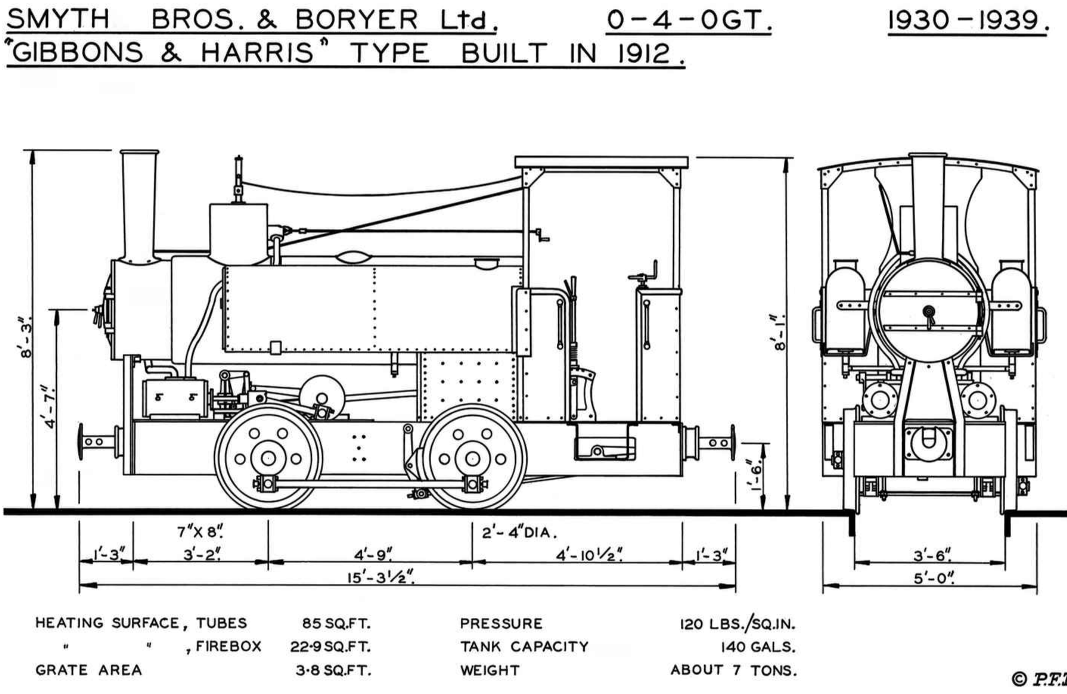
Murdoch & McLennan, sawmillers, ordered this locomotive in 1911, to haul logs out of the Hunua Ranges, south east of Auckland. The locomotive was built in Auckland and Whangarei and was the 5th and last Gibbons and Harris tramline locomotive. It had 2 small steam engines driving the wheels through gears.

Langlands, the contractor building the upper Nihotupu dam, bought the locomotive in 1917, to haul rocks from the quarry to the dam. The city council acquired the locomotive when they took over work on the Nihotupu dam. They took it to Huia in about 1926 to help construct the tramline up the valley. It hauled city councillors to view the dam's progress. A reporter described a visit in 1926:

> At Huia, a quaint little locomotive that has already done good service on the tramway from the Manukau to the Nihotupu dam, was waiting, and seated on a nameless truck arrangement, the city fathers … commenced their journey into the bush at the rate of eight miles an hour.

The workers called the locomotive Hector. They sometimes called it the Segar locomotive, after one of the makers.

↓ Gibbons and Harris locomotive used at the dam, number 5.



Peter Dyer, NZ Railway & Locomotive Society

The speed of dam construction was limited by the supply of rocks from the quarry, and the dam engineers bought a Bagnall locomotive to haul rocks when the Gibbons and Harris was being repaired.

After the dam was finished, the locomotive 'was approaching the condition of being worn out, and was laid up frequently for repairs, but as regards steaming and tractive power, behaved well.' When the council offered it for sale, they pointed out its poor condition:

> The weight of 8 tons is without water or coal; the working weight would be about 9 tons. The locomotive is in running order, but requires overhauling and probable repairs to the driving gear to put it in perfect condition. I suggest that, if you are disposed to entertain the proposal, you obtain an engineer's report.

Despite this, Smyth Brothers & Boryer bought the locomotive, and used it for 10 years to haul logs. A tribute to the ingenuity of the logging tramline engineers. In 2022, Watercare owned it and stored it at the Lower Nihotupu dam.

↓ The locomotive at the Nihotupu dam quarry with wagons loaded with rocks. About 1922.

↑ Auckland councillors visit. About 1926. The track is not ballasted yet. Arthur Mead stands at the back, between 2 hats.

↓ The payday exodus, every second Friday. The train has bought these people down to Huia road bridge. They will catch a launch to Onehunga and spend the weekend in Auckland.

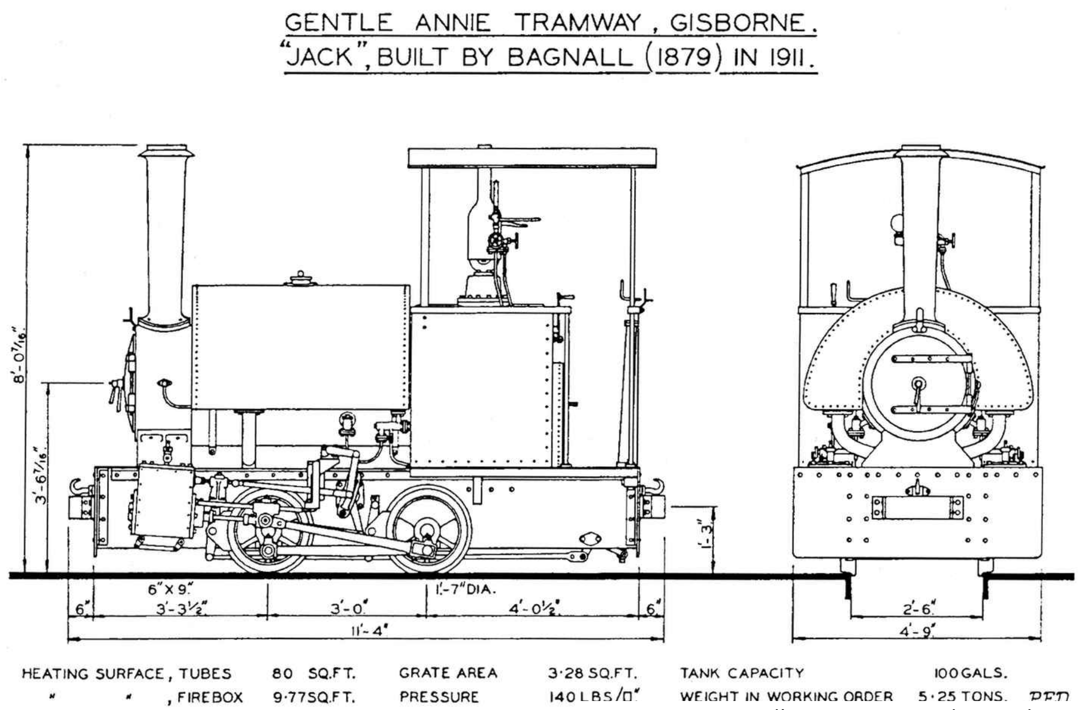
Bagnall locomotive

The Gibbons and Harris locomotive that hauled rocks from the quarry often broke down, because it was second-hand and well-used. The dam engineers looked for a standby locomotive. They asked the government's Public Works Department if they could buy or hire 1 of the 12 small locomotives helping build a second railway line between Auckland City and Westfield. The department was reluctant, until the engineers reminded the department that Auckland City had generously provided waterfront land for the new railway. In the early 1900s, New Zealand had imported 10 small Bagnall locomotives from Britain, mostly for logging tramlines and shunting. They were not all the same.

The Bagnall locomotive was at the dam before September 1928. It was used for shunting and when the other locomotives had broken down. I have only seen 2 photos of the locomotive at Huia. In both the locomotive is near the cement shed at the dam and is in shadow. When it was offered for sale after the dam was finished, the description was,

> Shipping weight 9 tons, boiler pressure 140 pounds, can haul 4 tons up a 1 in 19 gradient and 12 tons up a 1 in 30 gradient.

↓ Bagnall locomotive Jack. The Huia Bagnall looked much like this, but the cab was longer. It was works number 1902.

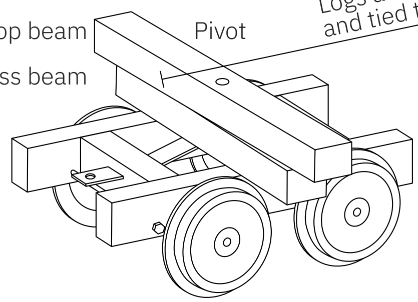


Peter Dyer, NZ Railway & Locomotive Society

Tramline wagons

Most Huia tramline wagons were built using log bogies. These were developed to carry logs on logging tramlines.

A typical log bogie.



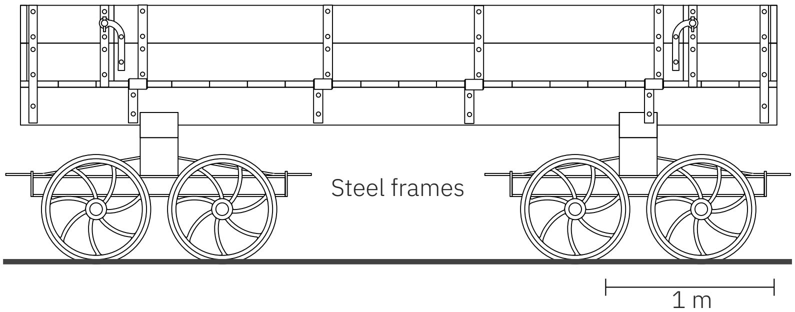
At Huia, some wagons were just a log bogie, without the 2 top beams, and with a wooden platform to carry loads. Some wagons like this had raised wooden sides and ends, to carry rocks or sand. Each train from the quarry had one of these wagons, called a 2-yard wagon (capacity 2 cubic yards, or 1.5 cubic metres, when filled to level with the top).

Bigger tramline wagons had a log bogie at each end. The bogies swivelled and tilted independently, which helped the wagon stay on the track. To carry pipes, the workers just tied a few pipes between a pair of log bogies. The pipes kept the bogies in place and there was no need for a chassis. The workers found the log bogies ideal for the job and built more wagons on this principle. To carry equipment, they attached some timber beams between a pair of log bogies and tied the load to the beams. To carry cement, sand or rocks, they built 16 wagons with wooden sides and ends on 2 bogies. They called them 5-yard wagons (capacity 5 cubic yards or 4 cubic metres). One side hinged down for loading or unloading.

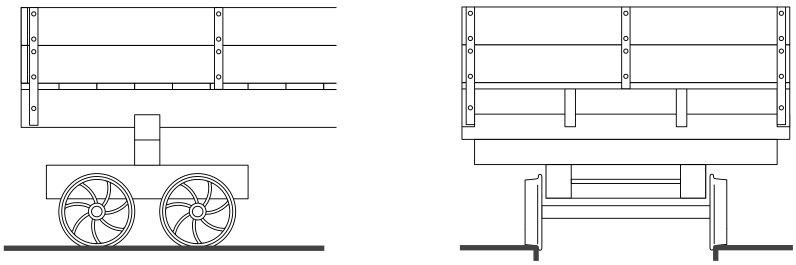
To build the wagons, the dam engineers bought at least 20 log bogies from The Kauri Timber Company (24-inch diameter wheels, steel frames) and 32 wheel sets from Cory-Wright & Salmon (each set was 1 axle, 2 inside roller bearings and 2 wheels; maximum load 2 tons per axle, wheel diameter 16 inches, diameter over flanges 18 inches, wheel width 3 inches).

Typical Huia 5-yard wagons. There were small differences between wagons.

24-inch diameter wheels



16-inch diameter wheels



The 1928 stocktake listed sixteen 5-yard wagons:

- Nine, each with 2 Kauri Timber Company bogies with 24-inch diameter wheels. There were 2 spare bogies.
- Four with roller bearings and 16-inch diameter wheels.
- Three with grease bearings and 16-inch diameter wheels.

The stocktake listed these smaller wagons, all with 16-inch wheels:

- Three 2-yard wagons, used on the quarry tramline.
- Two side tip, 2-yard, with roller bearings. These were made to order by the Great Northern Foundry. Construction was '3/16 plate, pin and link couplings, together with screw brake on four wheels and brake platform.'
- Four wood flat top.
- Three wood side tip wagons. Photos show these being used to build the tramline, carrying ballast.

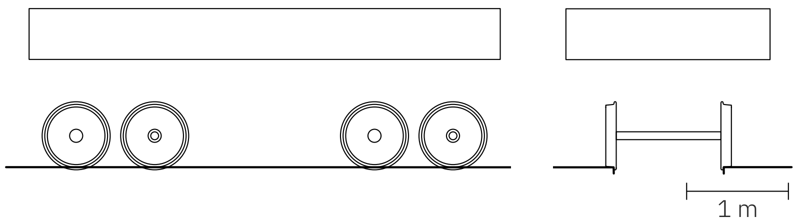
All log bogies seem to have had hand-operated brakes. The Kauri Timber Company bogies had screw brakes with cast brake blocks. The other bogies had 'bush brakes', which I assume means a handle with a ratchet that pulled a lever that pulled the brake blocks against the wheels. The are several photos of the bogies, but only one shows any sign of a brake. Perhaps the brake blocks are between the 2 wheels at the top, and in shadow.

To keep stationary wagons from rolling down a slope, they pushed a stick, called a sprag, through a spoked wagon wheel, to jam against the wagon underframe. Or they wedged a stone under a wheel.

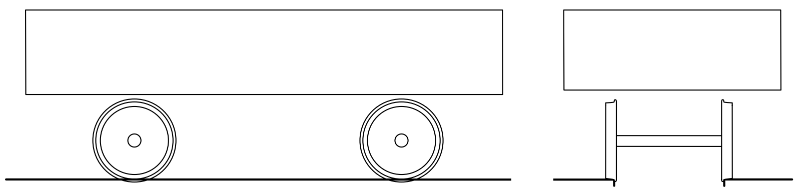
Why didn't the engineers buy ordinary railway wagons?

The Huia tramline's 5-yard wagons carried loads of 7 to 8 tonnes. The L wagon was a comparable wooden-bodied wagon used on New Zealand's public railways. It too could carry up to 8 tonnes.

5-yard wagon, Huia tramline



L wagon, public railways



The Huia engineers made their own wagons, rather than buying comparable public railways wagons.

- The Huia wagons were cheaper.
- Their bogies better suited the Huia tramline's rough track and sharp curves.
- They were lighter, to reduce the weight of a train going uphill. An L wagon was solidly built, and weighed over 4 tonnes empty. A Huia wagon had thinner timbers and smaller steel straps. I estimate they weighed 2.2 tonnes empty. They required a fair amount of repair work, but they only had to last a few years.

However, the log bogie's top and cross beams raised the floor of a Huia wagon higher than an L wagon's. This would have made it difficult to load or unload the wagons by hand from the ground.

The landing tramline

Carrying cement and sand

Loads

The landing tramline train usually carried cement and sand from the landing to the dam. On a typical day, it carried 20 cubic metres (30 tonnes) of cement, and 61 cubic metres (86 tonnes) of sand; see page 13. Each train had four 5-yard (4 cubic metre capacity) wagons. The train made 4 round trips a day, so each trip carried:

- Cement: 5 cubic metres (7.5 tonnes), loaded into one 4-cubic-metre wagon.
- Sand: 15 cubic metres (21.5 tonnes), loaded into three 4-cubic-metre wagons.

The total load was therefore 29 tonnes. Mead wrote that the 'ordinary load was about 32 tons of cement and sand, plus weight of trucks', which is a bit more than what I calculated. The loads were heaped above the wagon sides. The sand had to be covered to stop it blowing off, and the cement bags had to be covered to keep them dry. The wagons had canvas covers, 3 by 6 metres.

The landing train used 2 sets of 4 wagons. One set was at the dam being unloaded. The other set was moving up or down the valley, or being loaded at the landing. At the landing, the locomotive moved the empty wagons into place to be loaded. At the dam, the locomotive simply exchanged the full and empty wagons. The train made almost 1,000 round trips altogether.

Speeds and distances

The landing tramline was 6.6 kilometres long. The train made four round trips a day. Assuming a 9-hour day, that's 2 hours and 15 minutes for a round trip. On the steep half of the tramline the train went up at 8 kilometres per hour. It coasted down at 24 kilometres per hour:

> Running down empty, the driver disengaged gears, closed the throttle and controlled on the steam brake at about 15 miles per hour. He became very expert at re-engaging gear for the level stretches while travelling.

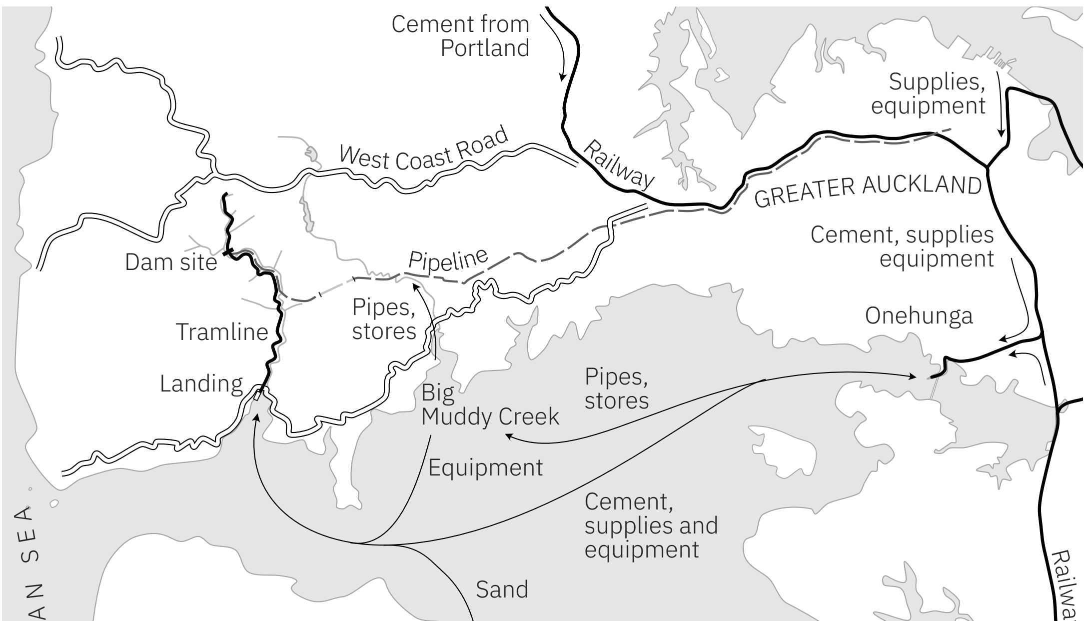
Assuming the train went up the less-steep half of the line at 16 kilometres per hour, the total travel time is a bit under an hour. If it took 15 minutes to exchange the wagons at the dam then there was about an hour to move the wagons at the landing as they were being loaded.

Manukau harbour

All supplies, equipment and people for the dam, except for water and rock for concrete, were brought in by barge and launch.

The dam engineers used local boat operators. In the 1920s, several boat operators ran regular services once or twice a week on the Manukau harbour. They carried people and supplies between Onehunga wharf and the isolated settlements around the harbour. These services were important for those settlers. Gwyn Williams wrote:

> The Council launch runs twice a week throughout the year, carrying supplies of food, cement, gelignite and all general supplies to the Council Camp, situated four miles up the valley. The days on which the launch comes in are gala days in Huia. The settlers come from all parts of the valley to collect their bread, which they usually carry home in pillow-cases or flour bags. The “loco” puffs importantly down the line and up again to the Camp loaded with supplies. The [Huia store keeper] comes round the beach from his store in an antiquated Ford lorry, and collects the mail and supplies for his store. … Afterwards, nearly everybody gathers in the store, and reads his mail, the only thing that some of them have to look forward to.



Cement

The dam engineers mostly used C White to carry goods and people by launch, and to bring bags of cement by barge. The dam required up to three 60 tonne barge-loads a week. The cement was railed from the manufacturer in Portland, Northland, to Onehunga wharf in railway L or La wagons. It was timed to arrive at Onehunga before 8 am, to barge to Huia at the next high tide. The launch usually left the full barge at the landing to unload and took away the empty one. Cement came in jute bags, 18 to the tonne.

Sand

The dam engineers mostly used H Bray to bring sand by barge from a sandbank at Graham's Beach, 13 kilometres south east of the landing. The dam required up to 86 tons of sand a day, one barge-load. Most days, near high tide, a launch bought a full barge and took the empty one away. To load a barge, there would have been a boat kept at Graham's Beach, with a grab on a power derrick. It would lift sand from the sea floor and dump it into the waiting barge. Sand for concrete should not have too much salt, but once the sea water had drained from the sand the salt content would be low enough.

The regular sand and cement traffic for the dam would have been significant work for the barge operators.

Launches

A typical large commercial launch on the Manukau harbour was 13 metres long by 3 metres wide, with a petrol engine giving a speed of 20 kilometres per hour. It carried 60 people or more. C White, who carried goods and people for the dam, had two launches like this, Awhitu and Callie.

Launch travel must have been grand, though miserable in wet or rough conditions. A sand bar across the mouth of Manukau Harbour shelters the harbour from the Tasman Sea waves, but there can be a swell at the western end of the harbour.

Barges

There were two common types of barge on the Manukau harbour. A hopper barge had a large, open hold to carry loose material, like sand and cement bags. A pontoon barge had a flat top to carry supplies. A typical 1920s Auckland barge was about 6 metres wide. The ones for Huia would have been about 15 metres long.

The launch Outlaw near Whatipu, 9 kilometres west of Huia. 1931.

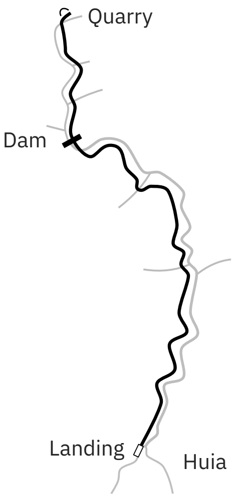
Workers unload sand from a hopper barge at Big Muddy Creek, for building the upper Nihotupu dam. About 1920. The shed with vertical boards stored bags of cement. The tramline to the Nihotupu dam runs off to the right.

Big Muddy Creek

Big Muddy Creek is 5 kilometres east of Huia. In the late 1910s, for building the upper Nihotupu dam, a wharf, storage shed and engine shed were built there, with a 2-foot gauge tramline up to the dam. In 1925, the sheds stored crushers, concrete mixers and other equipment that had been used to build the dam.

The Huia dam engineers barged this equipment to Huia, to help build the Huia dam. They also landed pipes, people, equipment and supplies to build the pipeline from the Huia dam across the Nihotupu valley to Titirangi.

The landing



The engineers built a landing at the mouth of Huia Stream, to receive launches and barges, and to transfer the supplies to tramline wagons to be taken up the valley.

They built a concrete wall parallel to the shore, filled behind it with dirt, and topped it with crushed rock. The bottom of the wall was in papa rock. Papa is soft and slippery when wet. It must have been difficult to dig the trench for the wall through the mud. The workers could only do the work when the tide was out. Water would cover the fresh concrete at high tide, but it can set underwater. The concrete wall was up to 3 metres high.

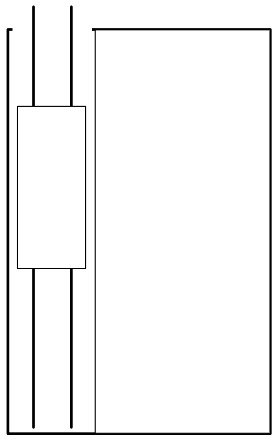
At mean high water, the water at the landing was 1.8 metres deep. At mean low water, the water was 2.4 metres lower, and craft at the landing rested on the mud. A barge required about 1 metre of water to float. There would have been enough water at the landing to float a barge about a third of the time. Barges and launches had to arrive or depart around high tide.

Buildings at the landing had wood frames covered with corrugated iron. There were 2 small sheds beside the tramline just up from the landing, near the road bridge.

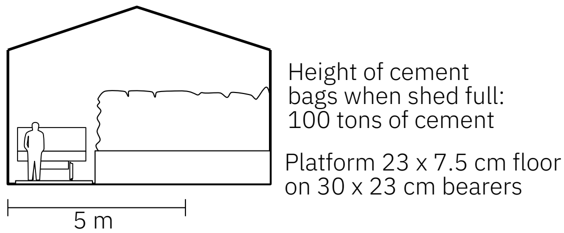
↓ Huia Stream mouth. 2008. The landing's wall is in the distance. The old tramline route slopes up from the landing to the road.

The landing 1929

Cement shed

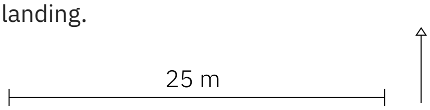


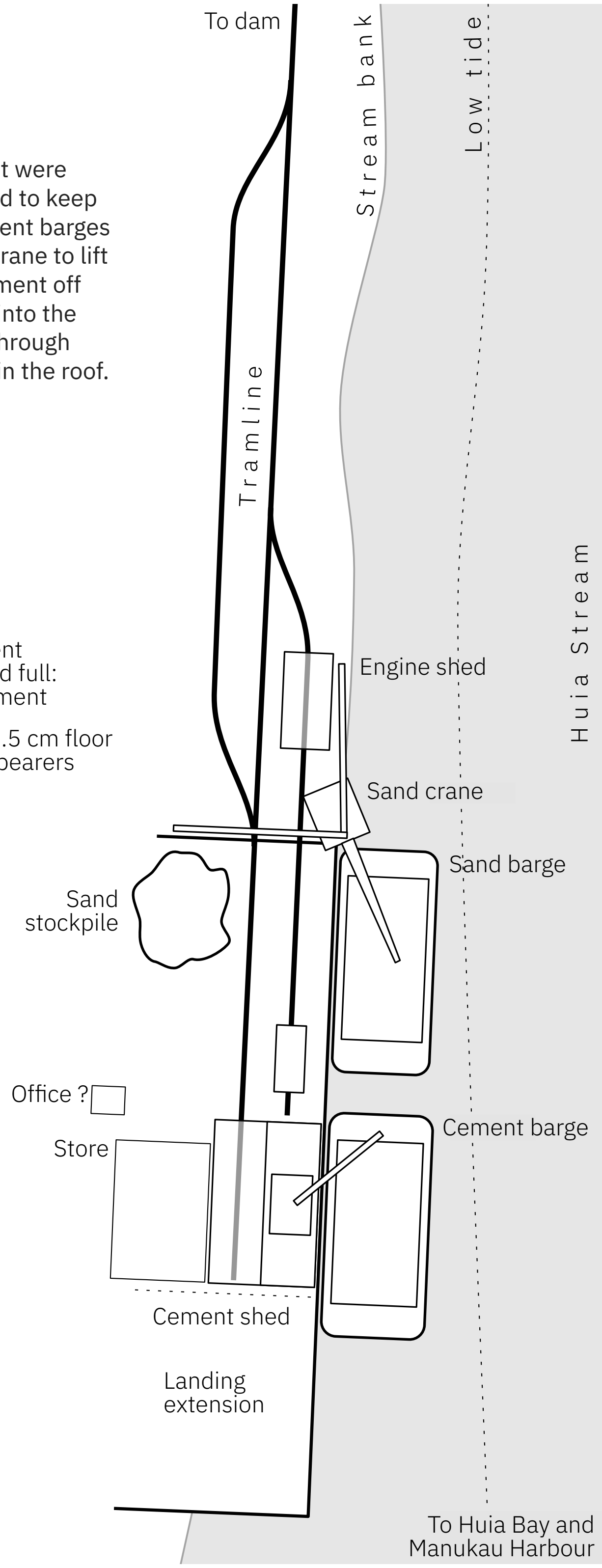
Bags of cement were stored in a shed to keep them dry. Cement barges had a derrick crane to lift the bags of cement off the barge and into the cement shed through sliding panels in the roof.

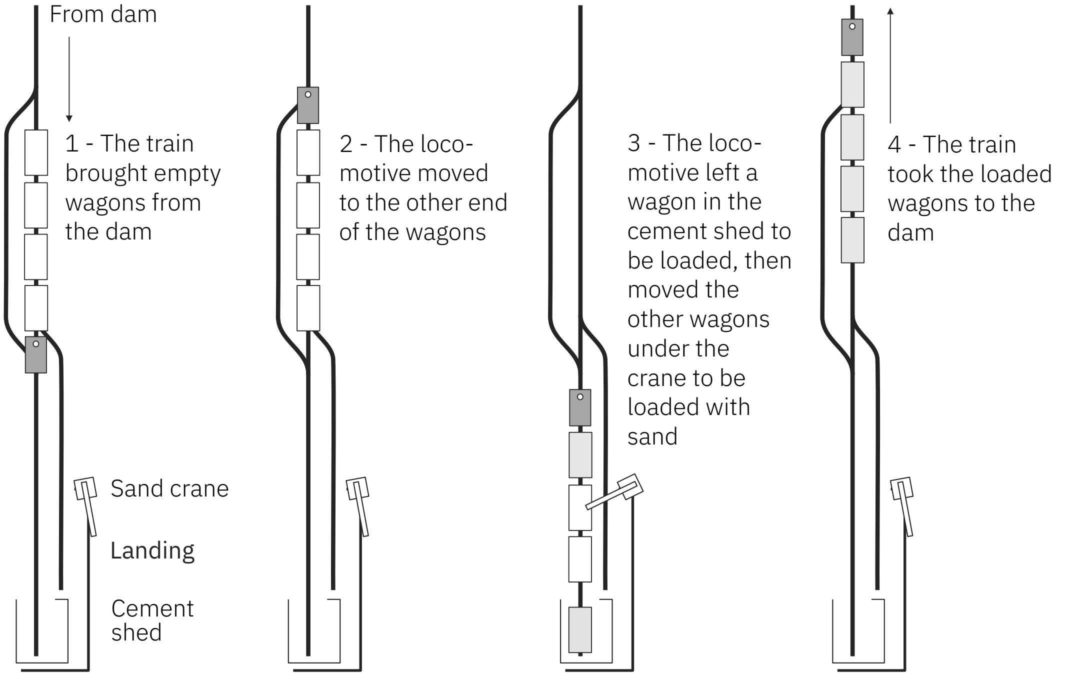


A Beaney steam crane with a grab lifted the sand from a barge into waiting tramline wagons, or stockpiled it beside the tramline to load later.

The landing was originally 30 metres long, which was space for 2 barges. It was extended by 15 metres in early 1928, when double shifts started. This enabled a 3rd barge or more launches to be at the landing.







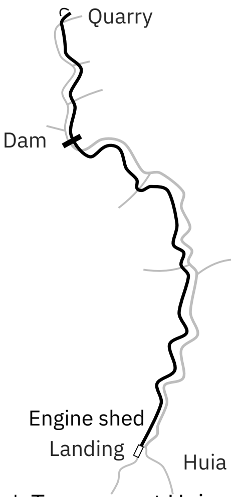
↑ Loading the wagons at the landing.

↓ Waiting for a launch. December 1929. The photo seems to have been taken from the launch's wheelhouse roof — the bow is just visible. The dam is finished, the buildings have been demolished and supplies are being taken away.

↑ The landing at high tide. 1976. This road bridge replaced the timber bridge in 1935.

↓ The landing work gang. At the 2 sheds beside the tramline near the Huia road bridge.

Huia engine shed



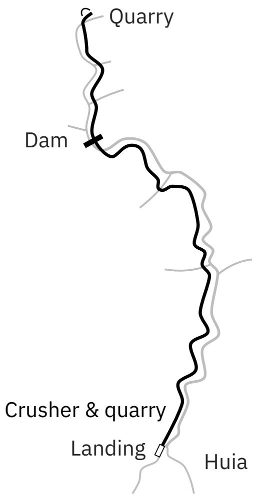
There was an engine shed for the Price Cb locomotive half a kilometre up the tramline from the landing. The shed was a workshop to maintain and repair the locomotive, and somewhere to store the locomotive at night.

Charlie Williams drove the Price locomotive. He and the fireman had long, hard days. His daughter, Gwyn, wrote:

> On summer nights, when his day's work in the hot loco. is over, the engine-driver and fireman, covered with soot, dive from the high top of the [Huia road] bridge into the smoothly running creek, and emerge comparatively clean. The engine-driver's daughters sometimes accompany them, as I know from experience.

↓ Trampers at Huia road bridge. 1933.

Huia Bay crusher and quarry



The dam workers' first job was to open up a small quarry about half a kilometre up the valley, and to build a crusher for its rock. The crusher's first job was to crush rock for concrete for the landing.

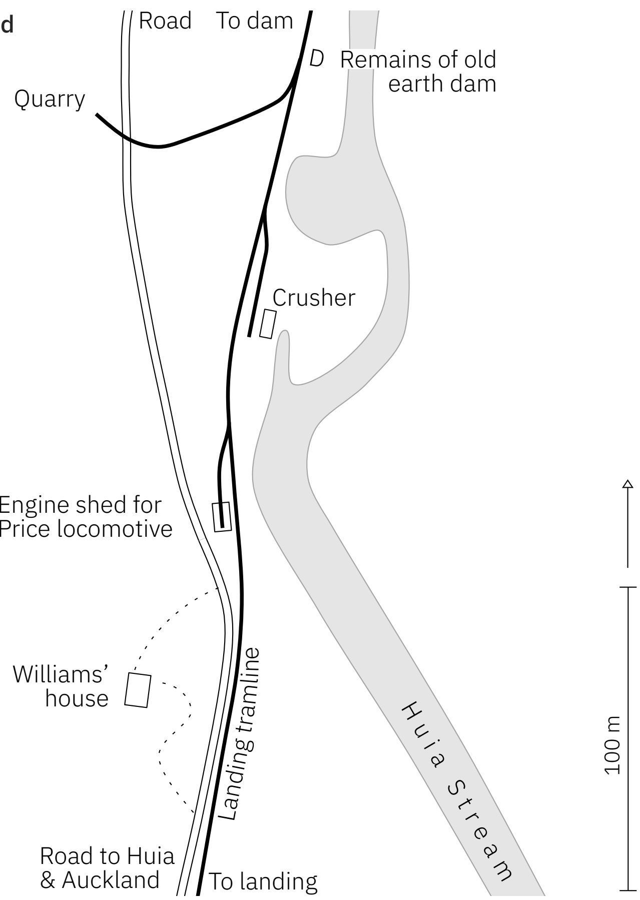
The crusher's main job was to crush ballast for the tramline. Ballast is the small rocks that support the track. The tramline had about half a cubic metre of ballast for every metre of track. The tramline to the dam was 6.6 kilometres long and built in 2 years. That's about 4.5 cubic metres, or 6 tonnes, a day. It also crushed rock for concrete for the dam foundations, and to form roads and paths.

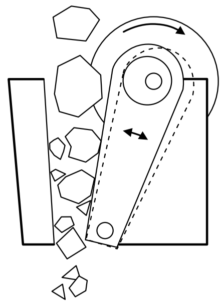
The crusher itself was a 15 by 9 inch jaw crusher, driven by a Tangye kerosene engine. The Huia records have data for a Collets stationary stone crusher: capacity 10 cubic yards per hour; weight 3 tons 5 cwt; horse-power required, 6; flywheel 34 by 7 inches, 260 rpm.

Huia Bay crusher, quarry and engine shed

The tramline to the quarry ran beside an old earth dam that had been built for an earlier sawmill. You can see remains of this earth dam beside the road, just below the swing-bridge. The rest of the dam, the path of the tramline to the quarry, and the quarry are now covered with spoil from making the lower Huia dam.

Charlie Williams drove the Price Cb locomotive. He lived with Gwyn, his daughter, in a house on a small hill overlooking the engine shed.





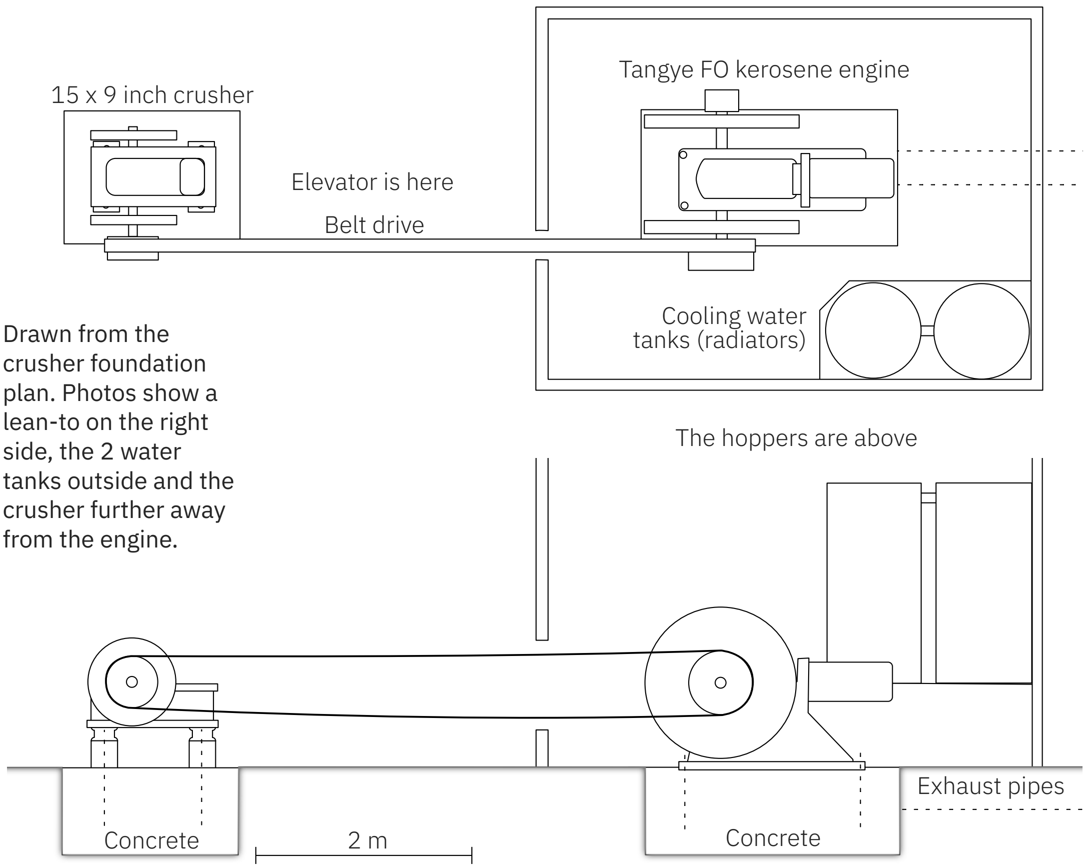
Jaw crusher

Leslie Williams described starting the crusher engine:

> The engine for this plant was a large kerosene one, with a single cylinder and two large flywheels about 5 feet diameter. The cylinder was fitted with a hot point [glowplug], which I heated with two blowlamps. When the hot point was at the correct heat, I required two men, one on each wheel, to turn them to get speed up, while I held down on the timing gear. On speed being sufficient, I called to the men to stand away. I then tripped the gear so that the engine took up its own running. I then had to open the water cock sufficiently to allow a fine jet of water to mix with the kerosene. This jet of water had to be correct in amount, otherwise it would back fire.

When the dam was finished, they dismantled the crusher and lent the parts to Waitematā County Council. To make crushed rock after this, workers gathered stones from beside Huia Stream and crushed them in a new crusher, halfway up the valley. I assume they didn't need enough rock to warrant keeping the Huia quarry going.

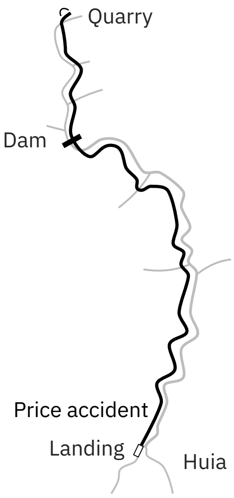
↓ The crusher. The hoppers above are not shown.



Drawn from the crusher foundation plan. Photos show a lean-to on the right side, the 2 water tanks outside and the crusher further away from the engine.

Huia Bay crusher, about 1925. The crusher, on the left, is driven by a belt from the kerosene engine under the hopper. The elevator lifts the crushed rock to the rotating cylindrical screen on top. The hopper has 2 compartments. Smaller rocks fall through the screen into the near compartment. Larger rocks fall out the end of the screen into the far compartment.

Price locomotive accident



In September 1928, the Price locomotive fell off the rails while it was pushing some wagons through the points leading to the Huia crusher. Norm Laing, who was 8 years old at the time, told me that there was coal everywhere, and that the only injury was to the fireman Bill Brown's foot.

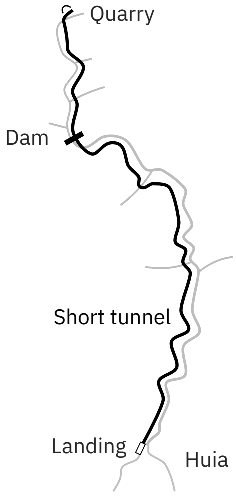
It took a week for the workers to repair the locomotive. The Bagnall locomotive would have been used instead, and the volume of concrete laid per day was not affected. Problems on the landing tramline never delayed work on the dam. Problems on the quarry tramline did delay work on a few days.

In the photo below, the Gibbons and Harris locomotive has bought equipment and a winch down the tramline to right the Price. Gear from the Price has been moved to the front right: a toolbox, bags of coal and a bar that coupled the locomotives and wagons together.

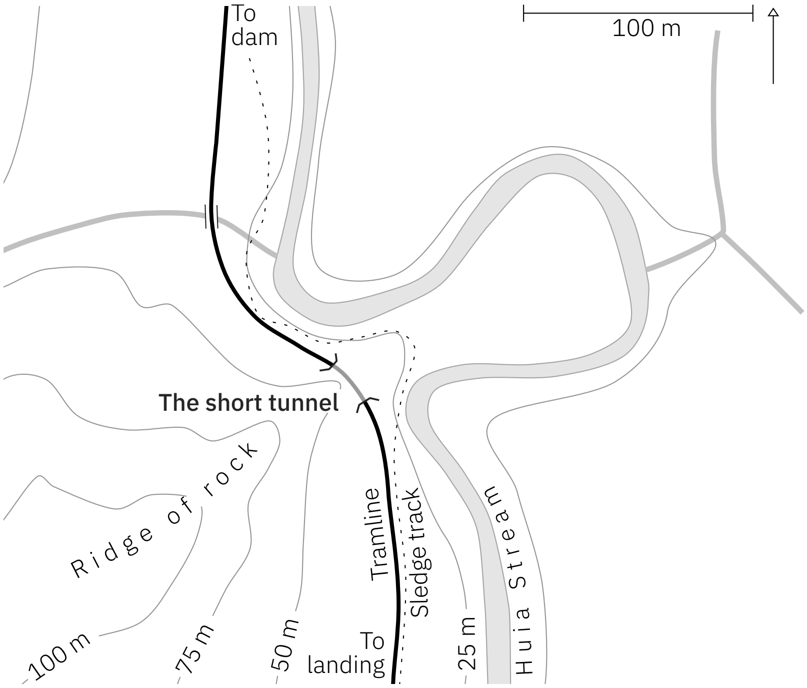
The Price's fuel compartment was big, sized for wood. At Huia they burned coal, which needed much less space. Photos show passengers, adults and children, riding in the fuel compartment.

↓ A rare top view of a locomotive. The big fuel compartment is on the left.

The short tunnel

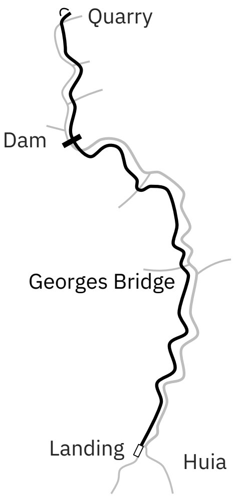


About 2 kilometres up the Huia valley, a ridge of rock lies across the valley. The stream has eroded its way past the rock, forming a sharp horseshoe bend. The bend is too sharp for the tramline to go around; it has to tunnel through the rock.



Looking down the valley to the tunnel, partly revealed when lower Huia reservoir was low in 2007. The line of stones in the right foreground was a low retaining wall along the side of the tramline.

Georges Bridge



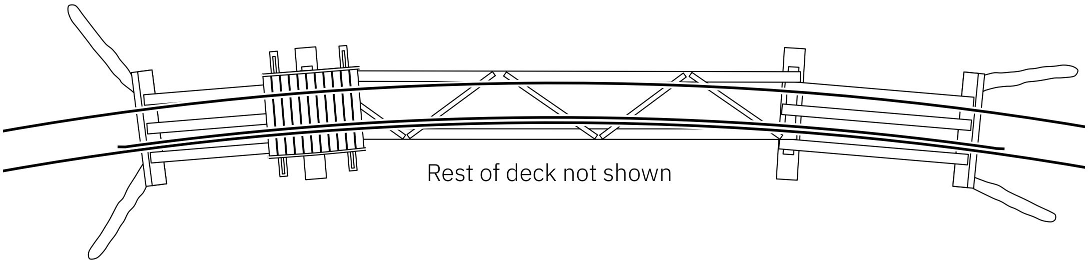
Like other bridges on the landing tramline, Georges Bridge had 2 vertical piers, which supported 3 horizontal beams. The middle beam was longer than the outer two. This enabled the pier foundations to be on the creek bank rather than in the creek.

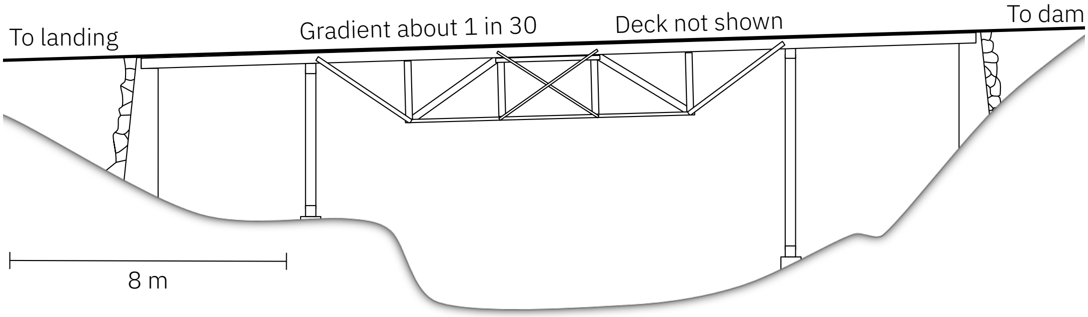
The bridge's middle beam was too long to use single pieces of timber. Instead, it had 2 trusses, 1 hanging from each side of the bridge. A truss is an arrangement of horizontal, vertical and diagonal beams joined together. When a train crosses the bridge, the weight of the train compresses some of the beams and stretches others. A truss is much stronger than a solid beam of the same weight. The beams that were compressed were usually made of timber. Timber is cheap, easy to work and strong when compressed. The beams that were stretched could be made of timber or thin steel bars or rods. Steel is very strong when stretched. Georges Bridge is called a Howe truss bridge. Some of its beams are steel.

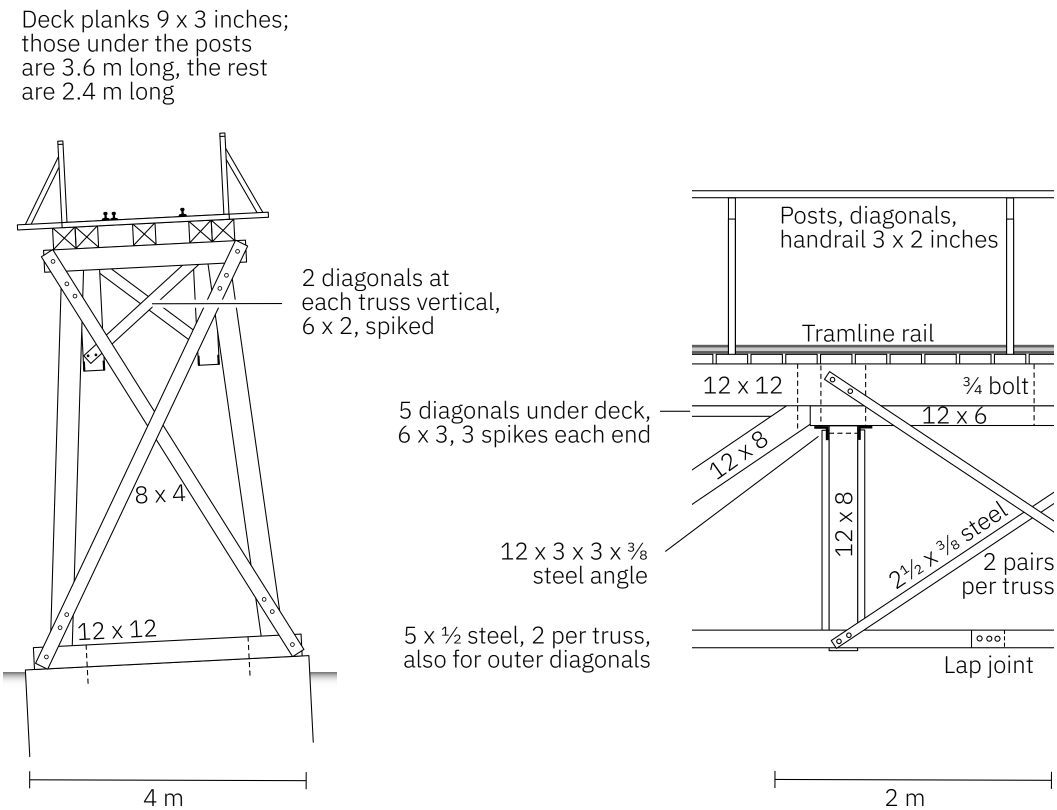
All-timber and timber-steel truss bridges were often built in New Zealand before the 1920s. Most truss bridges have the trusses above the deck, perhaps to keep them above the stream. Georges Bridge had the trusses hanging below the deck. This made it possible to fit diagonal braces between the trusses.

↓ The Gibbons and Harris locomotive on the bridge with wagons of crushed rock for tramline ballast.

Georges Bridge







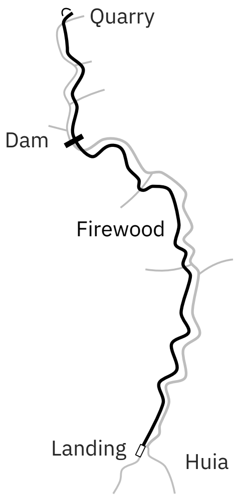
↑ Building Georges Bridge. Early 1926. One truss is in place and the second is being slid across.

Truss bridges were well understood, easy to design and forgiving of mistakes in design. However, they needed a lot of parts and would have been time-consuming to assemble. John Chapman writes of a truss bridge: 'One is left in awe of their designers and constructors. The carpentry involved in preparing and fitting the heavy timber elements with no power tools is remarkable.' After the 1920s, steel and concrete became the material of choice. Auckland's reinforced-concrete Grafton bridge had opened in 1910. Georges Creek bridge probably looked old-fashioned when it was built.

The parts for the bridge were bought up on the tramline and assembled flat on the ground at the south end of the bridge. First the piers were assembled, then winched down into the creek onto their foundations, raised to the vertical and held in place with beams between the bridge abutments and the tops of the piers. A winch and flying fox pulled the trusses across and into place. Fitting the trusses was a big event — there are more photos of this than any other event at the dam. It must have been nerve-wracking, with the first heavy truss suspended by a wire.

The bridge was rebuilt in 1952, see page 123. In 1959 the tramline was lifted and became a road. In about 1970, a new concrete road bridge was built beside Georges Bridge.

Collecting firewood



The Waitākere ranges were originally covered with mature trees. Many were cut for timber to build Auckland. By the 1920s the easily accessible trees and the loggers were gone from Huia. But ti tree (mānuka and kānuka) remained. It is too thin for building timber but ideal firewood. A Huia couple, the Kelseys, cut ti tree firewood to sell. Gwyn Williams wrote,

> There is now however, only one resident who chops the ti-tree and ships it to Onehunga. His bullock train used to lumber up the clay road and return with a load of ti-tree stakes.

The Auckland council bought several properties in Huia valley as part of the dam works. When they bought the Kelseys' property, the Kelseys negotiated to use the tramline to carry their firewood. In 1926, the city engineer wrote to them:

> It is suggested we might haul your wagons up to the bush in the evening, if you were to pay the drivers' over-time, which would be about an hour, say 4 shillings per day. I have no objection to your using as many wagons as can be handled.

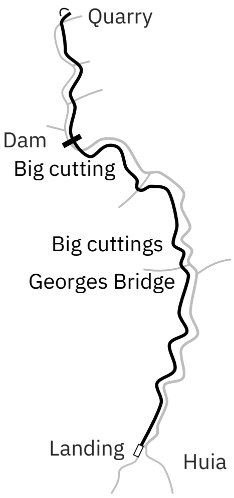
A labourer's wages then were about 20 shillings a day.

Gwyn continued:

> The timberman and his wife and dog are now towed up the line by the locomotive, and dropped at their working. There upon the hillside, he chops timber while his wife sends it down the hillside along the chute. Together they load their wagon, give a mighty push, and travel down the grade to their punt anchored in the creek, among the rushes. After they have loaded their punt, it is towed to Onehunga by launch, and work is started gathering a new load.

I assume the couple had light 4-wheeled tramline wagons to carry the cut wood. They must have taken their wagons off the track during the day so that trains could pass. And they would have needed an arrangement to avoid the chance of a train colliding with them as they coasted down.

Cuttings



There are many small cuttings on the tramline, but few big ones. The tramline curve radius would have been small enough that the tramline could usually have gone around, instead of through, hills. On the landing tramline, there were big cuttings just above Georges Bridge and beside the main camp.

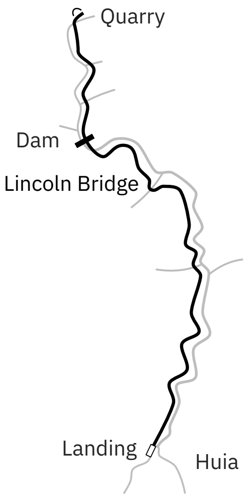
Arthur Mead wrote: 'The formation was 9 feet wide, with ½ to 1 batters [the sides were 25 degrees off the vertical] on cuttings. There were several heavy [cuttings], up to 30 feet deep, as well as much steep side cut, but the quantity shifted was not recorded. It was considerably increased by slips.'

The 2 cuttings just above Georges Creek are a bit over 3 metres wide. The sides are steeper than Mead's ½ to 1 batters. David Hoyle, an engineer on the lower Huia dam, said that these are the original cuttings. The big cutting closer to the dam was widened when the water pipeline was replaced in about 1970.

The valley is steep and heavy rain often causes slips. Yet, the ground itself seems remarkably stable and almost-vertical faces cut in the ground don't slip. Photos of dam excavations show faces over 15 metres high that were expected to last for several months before being filled with concrete.

↓ One of the big cuttings just above Georges Bridge. 2022.

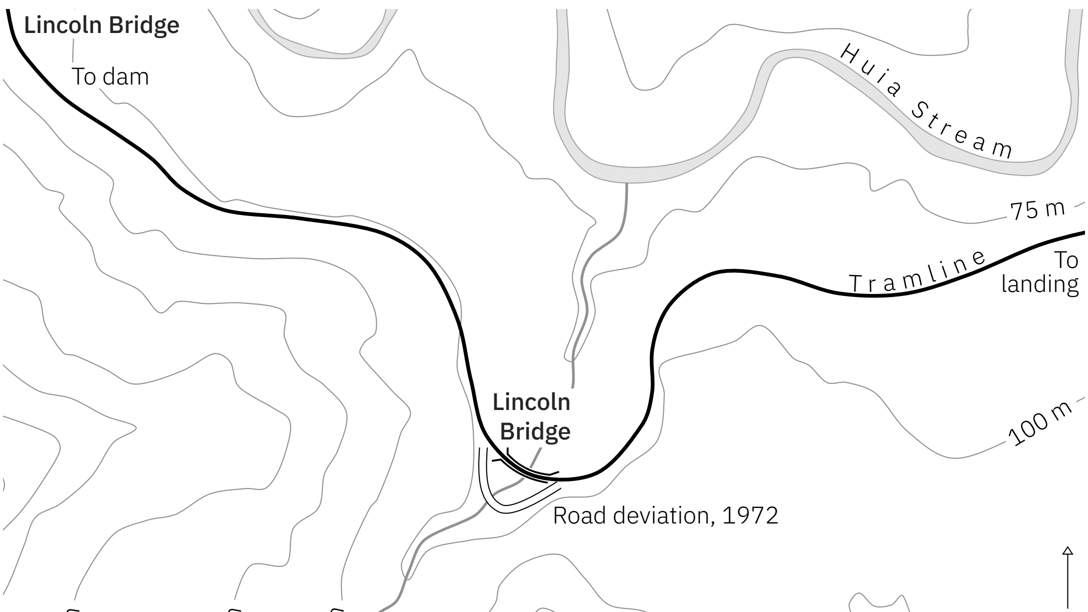
Lincoln Bridge



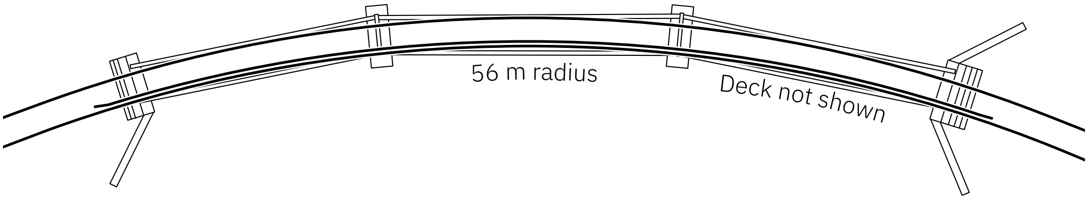
Where the Huia tramline encountered Lincoln Creek, its valley was too wide and deep for a bridge straight across the valley. Instead, the tramline ran up the valley, made a 180-degree turn over a bridge where the valley is narrower and shallower, then returned down the other side of the valley.

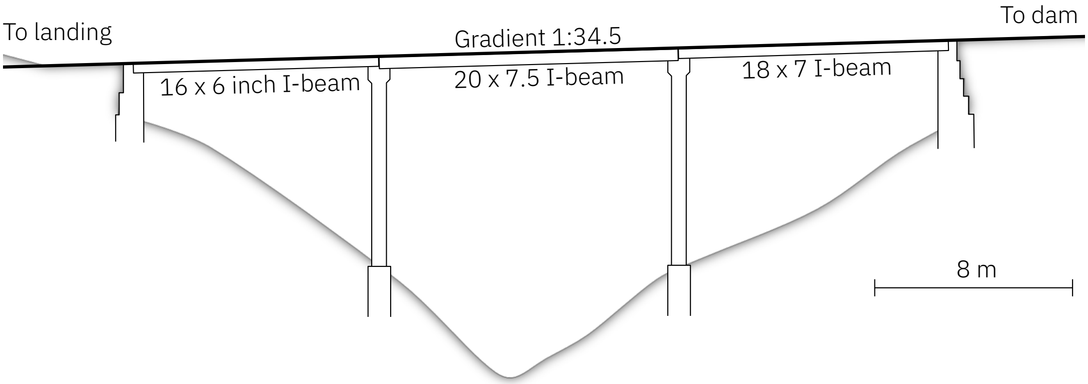
The smaller the tramline's curve radius at the 180-degree turn, the further up the valley the line could go and the smaller the bridge could be. The curve radius across Lincoln Bridge was 56 metres. I am puzzled why the engineers didn't build a shorter bridge, with a smaller radius, further up the valley. Just up from Lincoln Bridge, the tramline has 40 and 46 metre radius curves.

Lincoln Bridge had concrete piers and steel beams, both fairly new materials in 1926. It looks quite different to Georges Bridge, which is mostly timber with timber-steel composite trusses, old-fashioned in 1926. Yet Lincoln bridge is just up the tramline from Georges Bridge, and must have been made only a few months later. Perhaps an engineer with more modern ideas arrived. Perhaps steel beams became available.

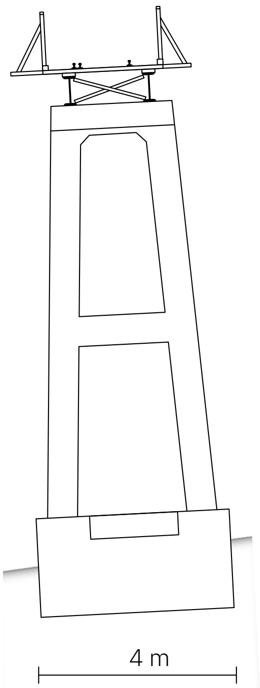


Lincoln Bridge



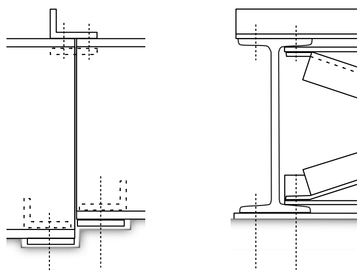


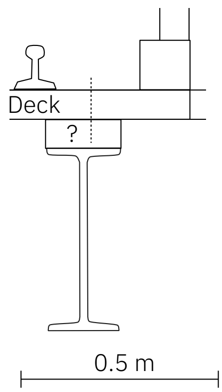
Deck & handrails similar to Georges Creek bridge



Pier is 2.9 degrees to the vertical

Details of girders and deck





At the piers and abutments, the steel I beams were joined with lengths of 4½ x 3 x ⅜ inch steel angle and 4½ x ⅜ inch flat

The Lincoln and Huia bridges both had 2 horizontal steel I-beams. An I-beam has an I shape in cross section. When a train crosses the bridge, the top plate of each beam is compressed and the bottom is stretched. Steel is strong when compressed and when stretched. The I shape is one of the best ways for a beam to get the most strength from the least amount of steel. I-beam bridges are easy to design, simple to make and reliable.

Lincoln Bridge had reinforced concrete piers. All other tramline bridges had piers that were simply bolted together flat on the ground and winched to vertical on their foundations. In contrast the Lincoln Bridge concrete piers were complicated to make. They needed temporary wooden forms to hold the concrete while it dried, temporary scaffolding to build the forms and a flying fox above the bridge to carry materials to the piers. Huia Bridge, which was the same size as Lincoln bridge, had simple steel piers. Though both bridges cost about the same: Lincoln 900 and Huia 850 pounds.

In 1959 the tramline was lifted and became a road. In 1972 the bridge was abandoned because the abutments were cracking, and the road was deviated 30 metres further up the valley. Road vehicles can turn sharp corners, and the road has a small curve radius where it crosses the creek. No bridge is needed, just a pipe under the road.

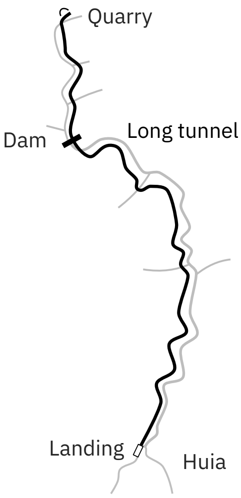
Lincoln Creek is now called Nugget Stream, after Nugget Thompson, a Huia dam caretaker from 1930 to 1953.

A bridge pier, 2004.

↑ Lincoln Bridge in 1962, after the tramline had been converted to a road.

↓ The north end of the long tunnel, just up from Lincoln Bridge. This end originally had a timber roof to deflect falling rocks, but it was soon replaced with this concrete lining.

The long tunnel



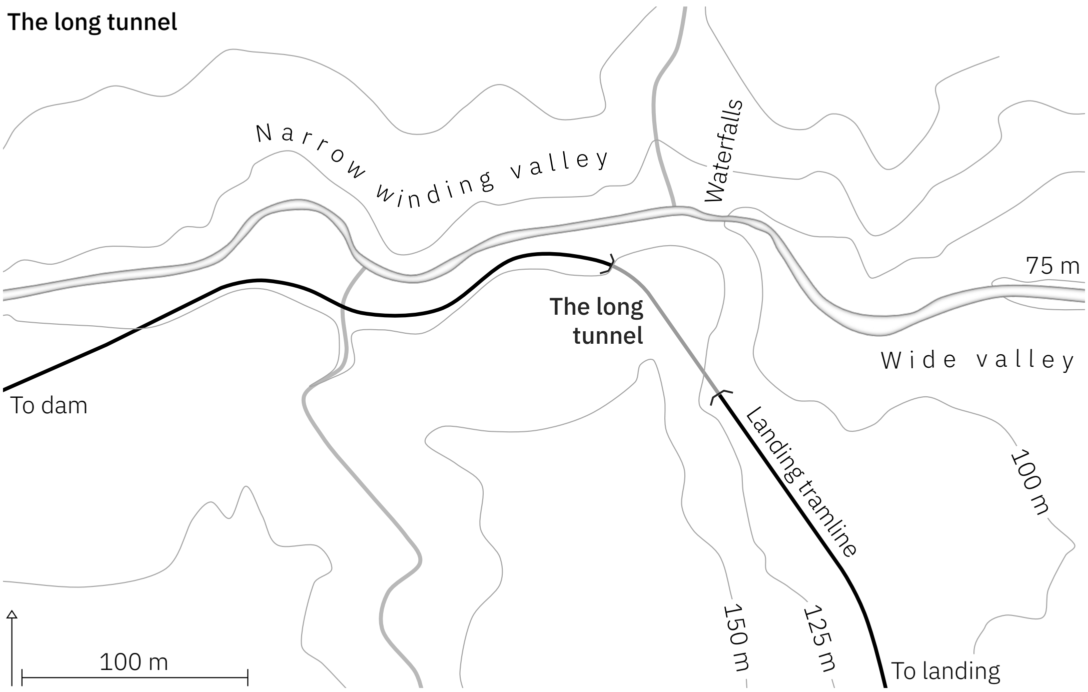
The landing tramline tunnels were, '12 feet high by 10 feet wide, driven by co-operative contract at £3/5/0 per foot for labour only, Council providing compressors, tools, benzine, explosives and all materials.'

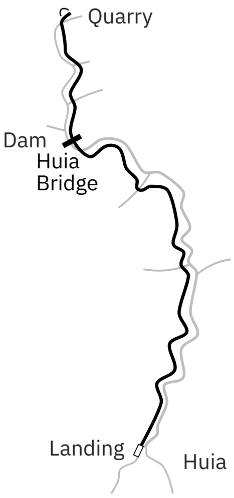
The long tunnel rock is unstable:

- The rock is a tuff that is water-bound and crumbles when exposed to air. Pieces break off. The whole of the inside is now strengthened with sprayed concrete reinforced by glass fibres.
- About 10 metres of the south end of the tunnel seem to have slipped away over the years. The rock above this tunnel entrance is now reinforced by bolts and wire mesh.
- Twelve metres of the north end of the tunnel originally had a timber roof to deflect falling rocks (like in the top tunnel, see page 82). Within a year, the engineers replaced this with a concrete lining.

The tunnel is about 3.5 metres wide. The pipeline to Auckland ran along one side of the tunnel. When the tramline was converted to a road in 1959, there was barely enough room to drive a truck through. In about 1970, when the pipeline was replaced, it was buried under the road through the tunnel.

The long tunnel





Huia Bridge

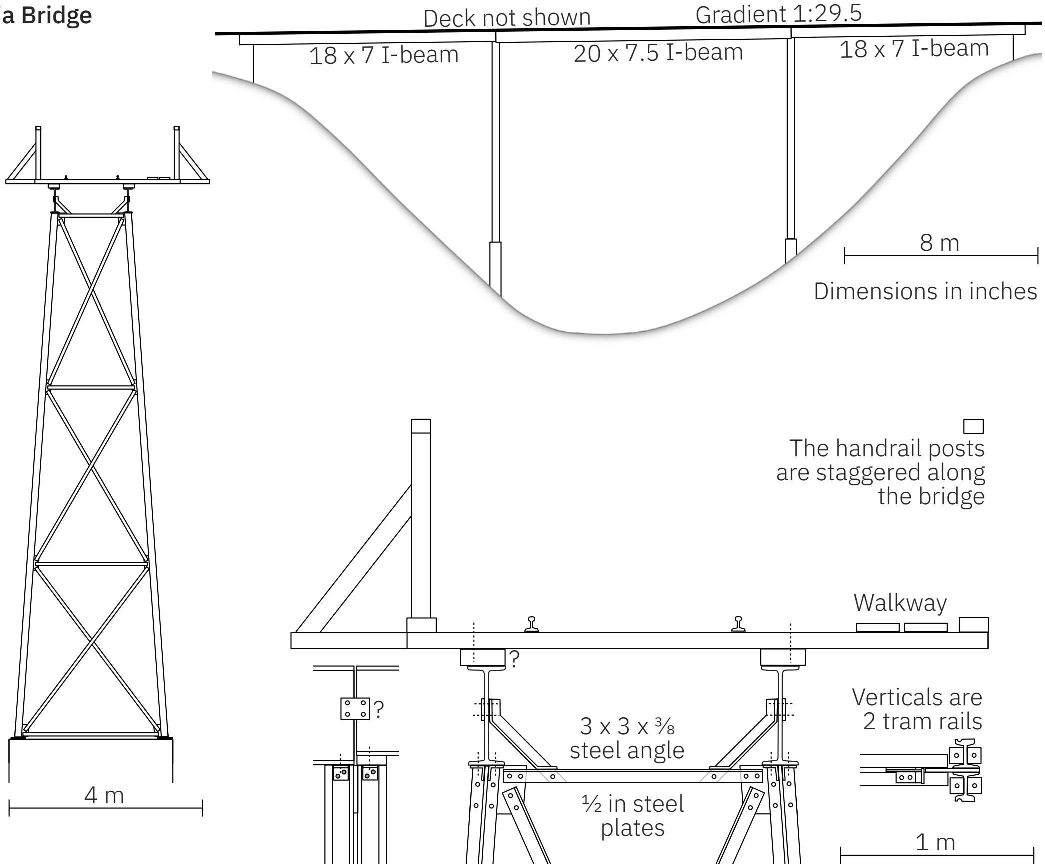
Georges, Lincoln and Huia bridges were the biggest bridges on the tramline. They were all made in the same year, but are all different. Georges Bridge, the first, was an old-fashioned timber and steel truss bridge. Lincoln Bridge had simple steel beams with concrete piers, which were complicated to make. Huia Bridge is all-steel, simple and elegant.

The Huia Bridge steel piers were made in Auckland, unbolted, barged to Huia and taken up the tramline, reassembled and winched to vertical on their foundations. The hand-drilled and hand-cut steel parts were supposed to be interchangeable.

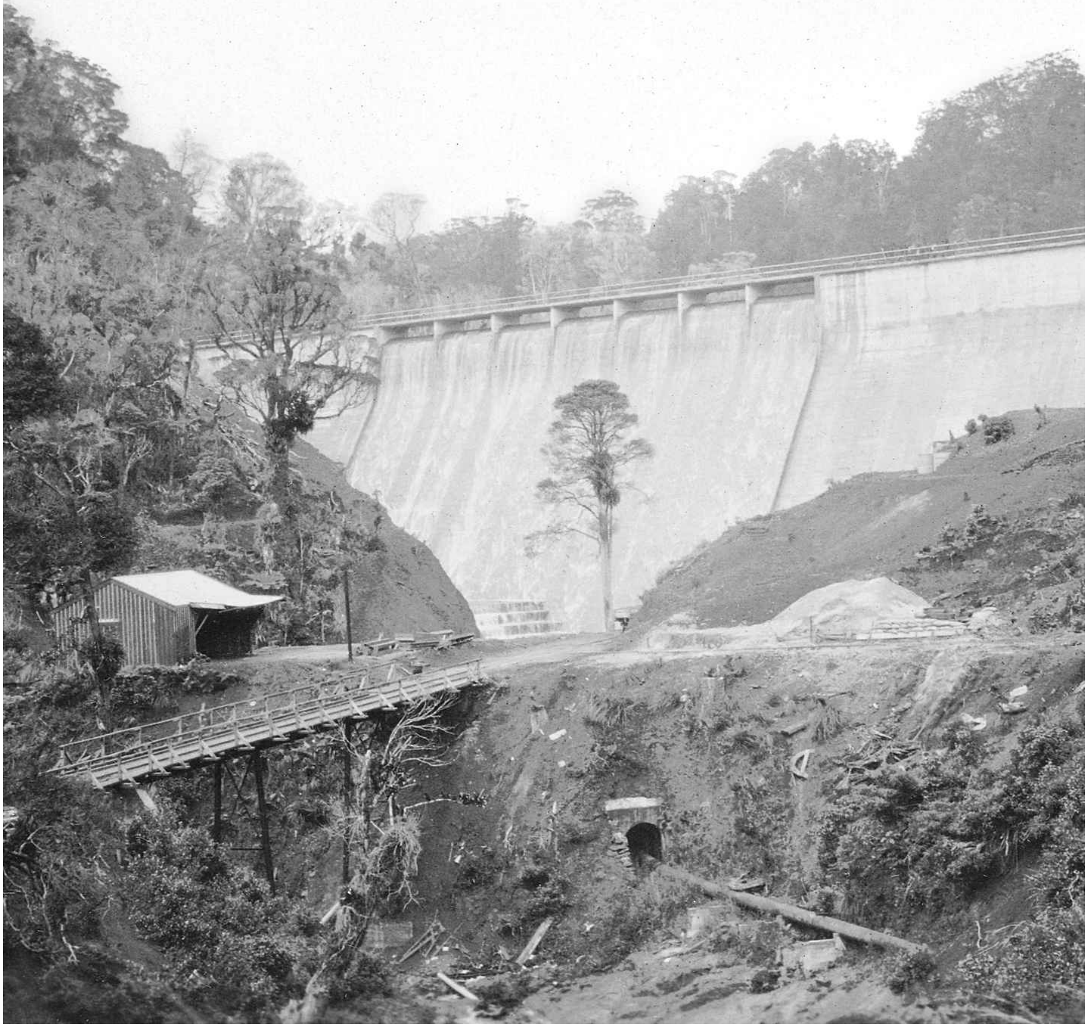
Workers walked across the bridge between their camp and the dam. The timber deck is similar to the decks on Georges and Lincoln bridges, except that it is wider, with a walkway on one side.

The bridge was replaced in 1973. You can still see the original pier foundations and abutments. The abutments have the gas-axed ends of the original steel I-beams.

Huia Bridge



Huia dam

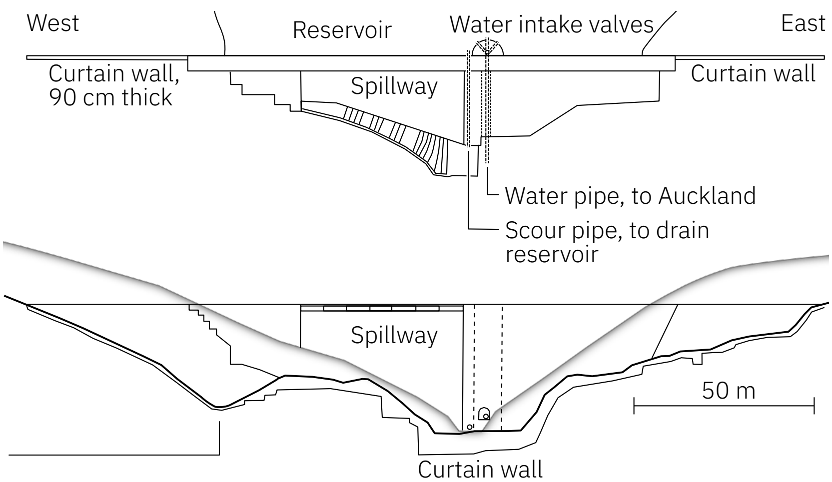


The dam

The dam is a concrete gravity dam. It depends on the weight of the dam to withstand the weight of the water in the reservoir.

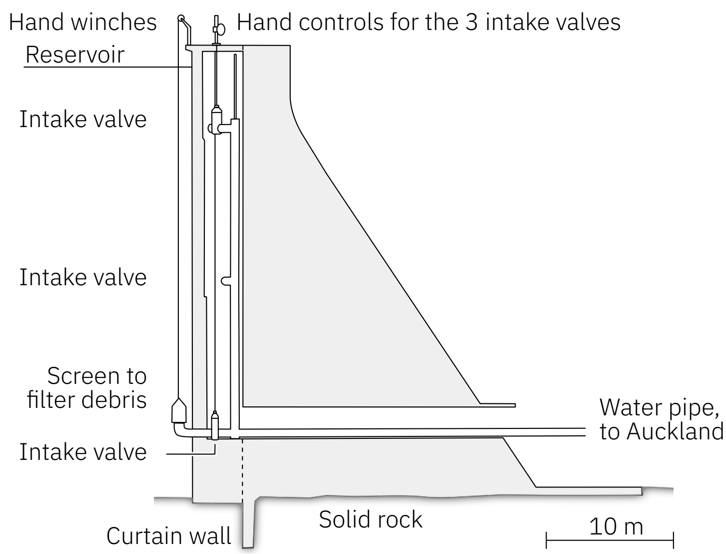
If the dam is too light, the weight of the water in the reservoir would push it downstream or topple it over. If the dam is too thin, the weight of the water would bend it and it would break. The dam is wide at the bottom and thinner at the top, to resist this pushing and bending while using the least amount of concrete.

Much of the concrete dam is underground, invisible. The bottom extends into solid rock to prevent leaks.

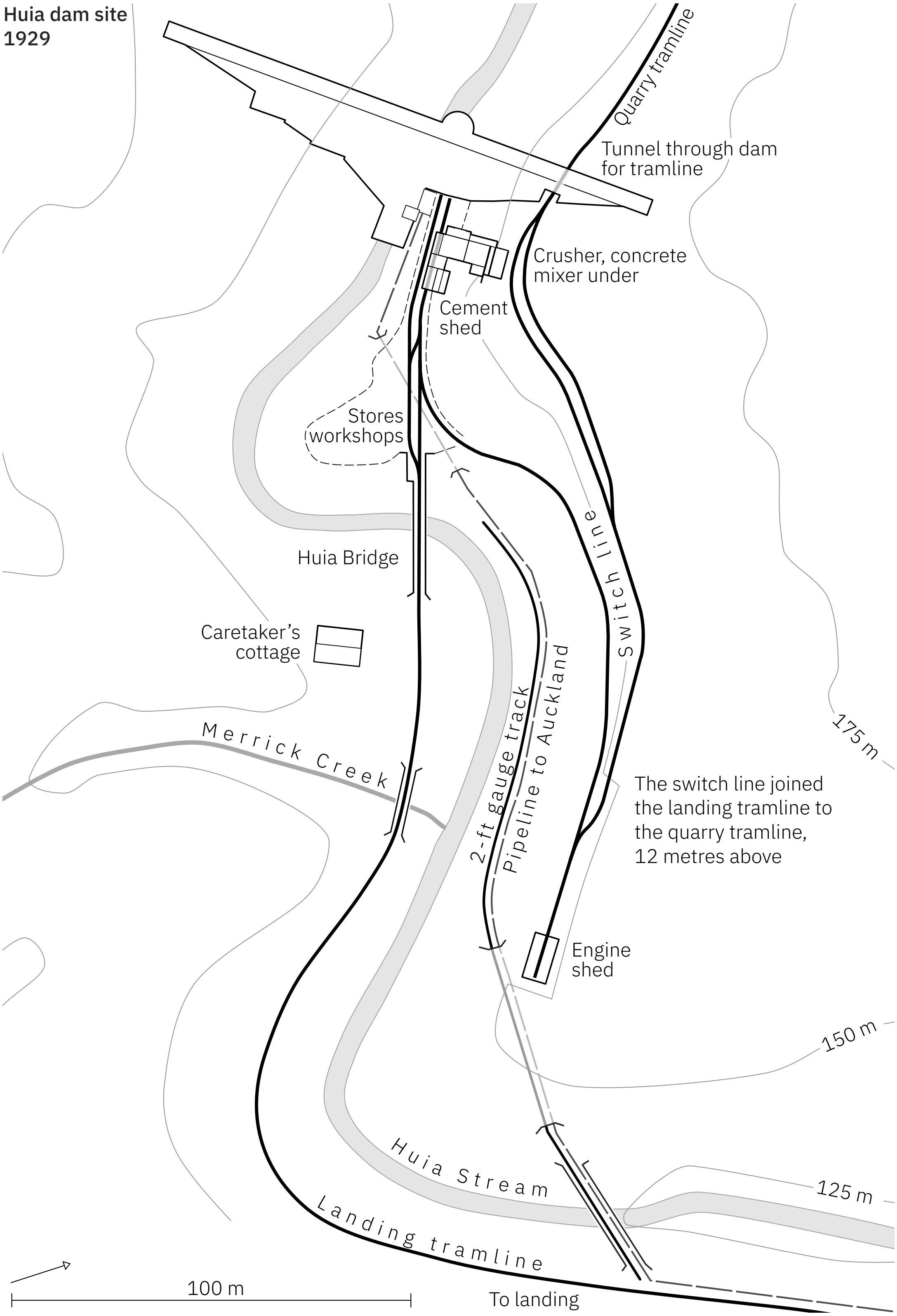


Only 1 intake valve is open at a time: the highest one that is under water.

The reservoir water is clearest at the top; the bottom is muddy and full of eels.

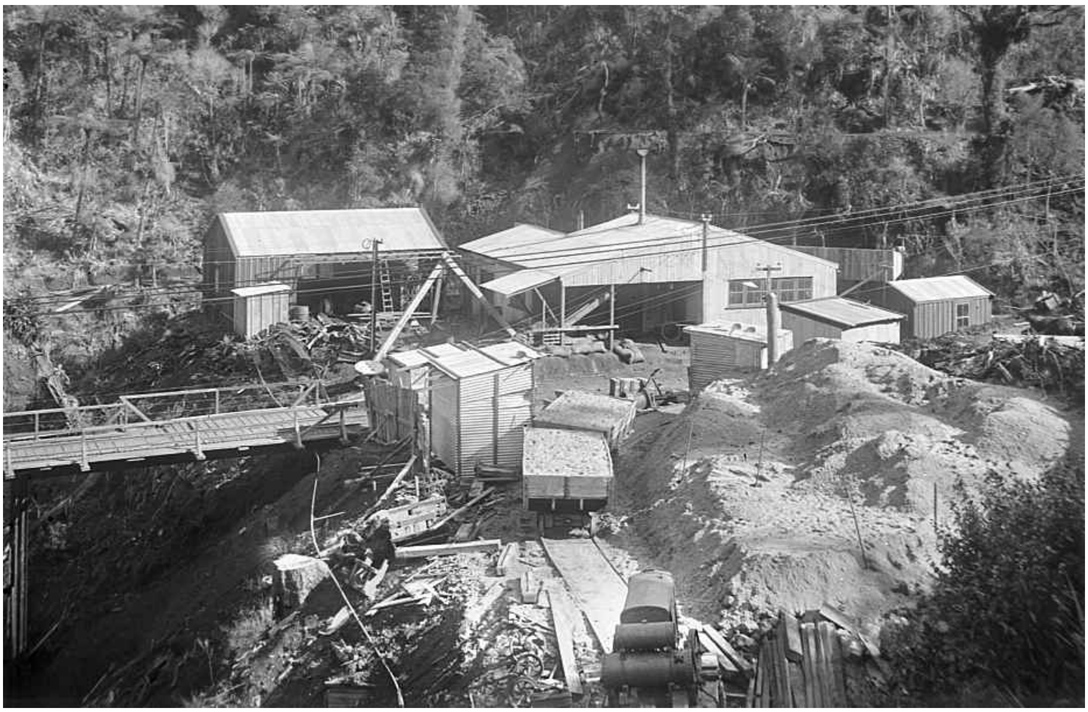


Huia dam site
1929



↑ The Price locomotive with water pipes, about 120 metres down from the dam. February 1928. The Price is on Huia Bridge. The new cottage is for the engineers, then the caretaker.

↓ Looking down the switch line to workshops and store about 50 metres down from the dam. About February 1928.



↑ Looking downstream to the dam. June 1928. The building is the crusher, with a wagon of sand beside it. The concrete mixer is under the crusher, to the left of and below the wagon.

↓ Looking downstream from the dam. December 1928. From left: quarry tramline, rock crusher, landing tramline, workshops, stores and cottage. Back left is the switch line and engine shed.

Concrete mixer & crusher

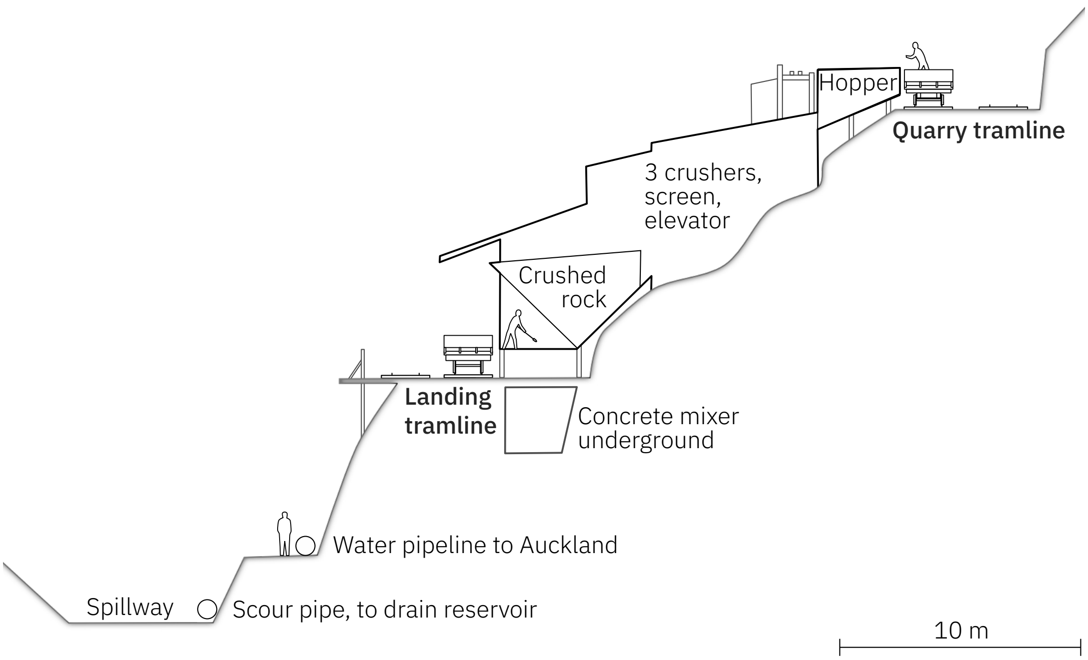
The concrete mixer was the focus of work at the dam.

> The mixer was a one-yard gravity-feed machine made by Fraser & Sons. The lay-out of the mixing plant enabled a portion of the concrete, about 5,000 cubic yards, to be deposited by gravity. The balance was elevated on an inclined tower, having the slope of the back of the dam, on a one-yard tilting skip operated by a two-ton friction winch driven by 25 H.P. motor, delivering by chute into a side-tip truck, running on temporary tracks supported on the shuttering laid lengthwise of the dam.

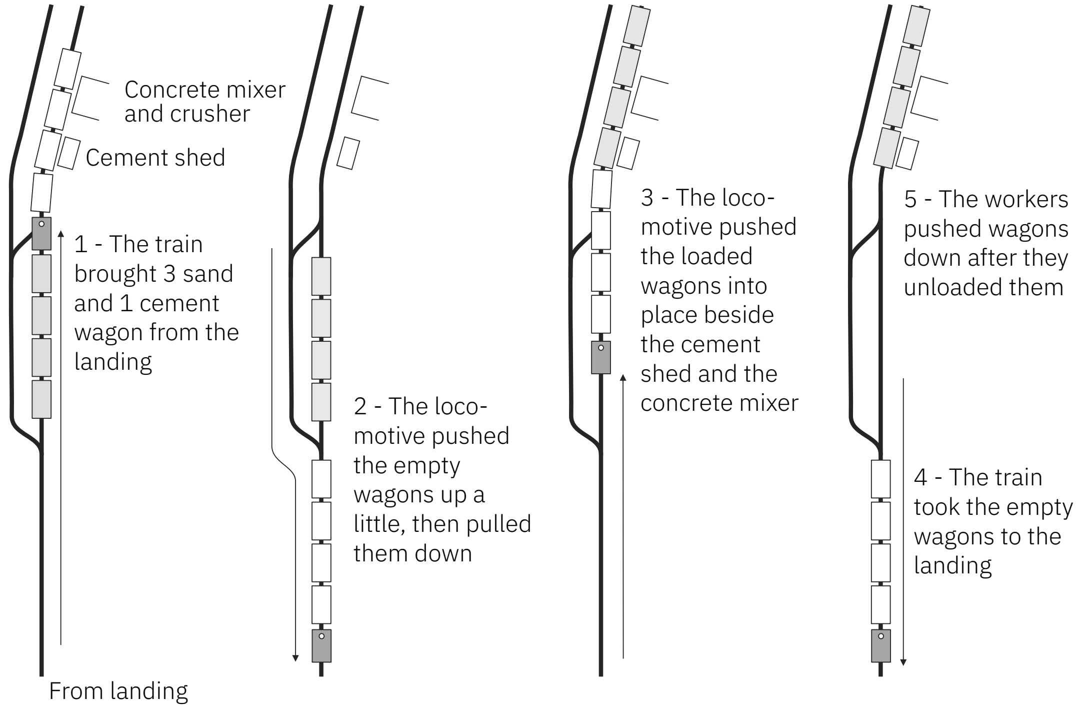
The train bringing cement and sand from the landing made up to 4 round trips a day. Workers unloaded the cement bags into the cement shed and shovelled sand from the wagons straight into the mixer. The concrete mixer had to be close to the dam, so the cement shed had to be just south of the mixer. This meant that at the landing, the cement shed had to be at the south end.

The train bringing rocks from the quarry made up to 10 round trips a day. Workers unloaded rocks from the wagons into the crusher hopper beside the tramline. If the hopper got full, the workers would stack the rocks to beside the tramline track, on the side away from the hopper. Later they had to pick up these rocks, carry them to the hopper and throw them in. Hard work.

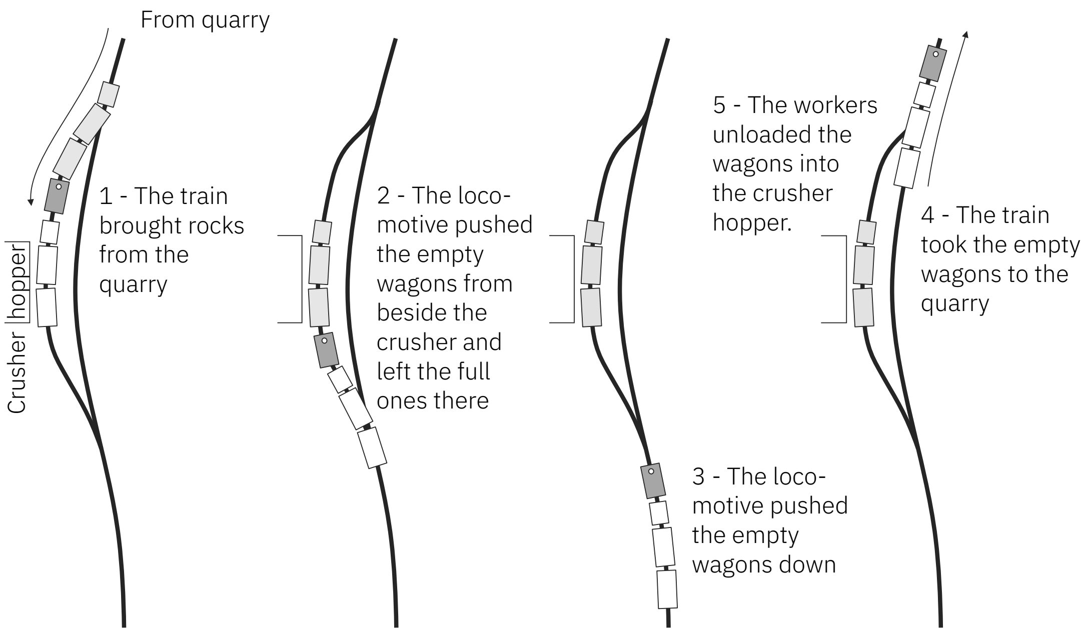
↓ Profile of the concrete mixer and crusher. Looking upstream, towards the dam.

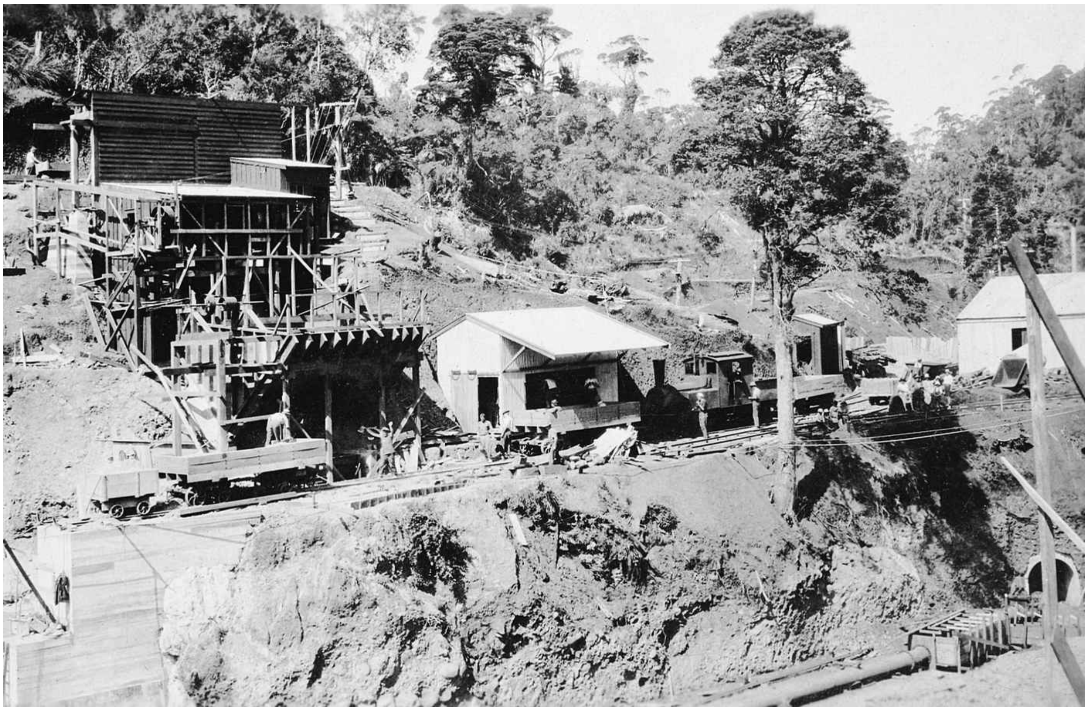


Exchanging landing tramline wagons at the concrete mixer



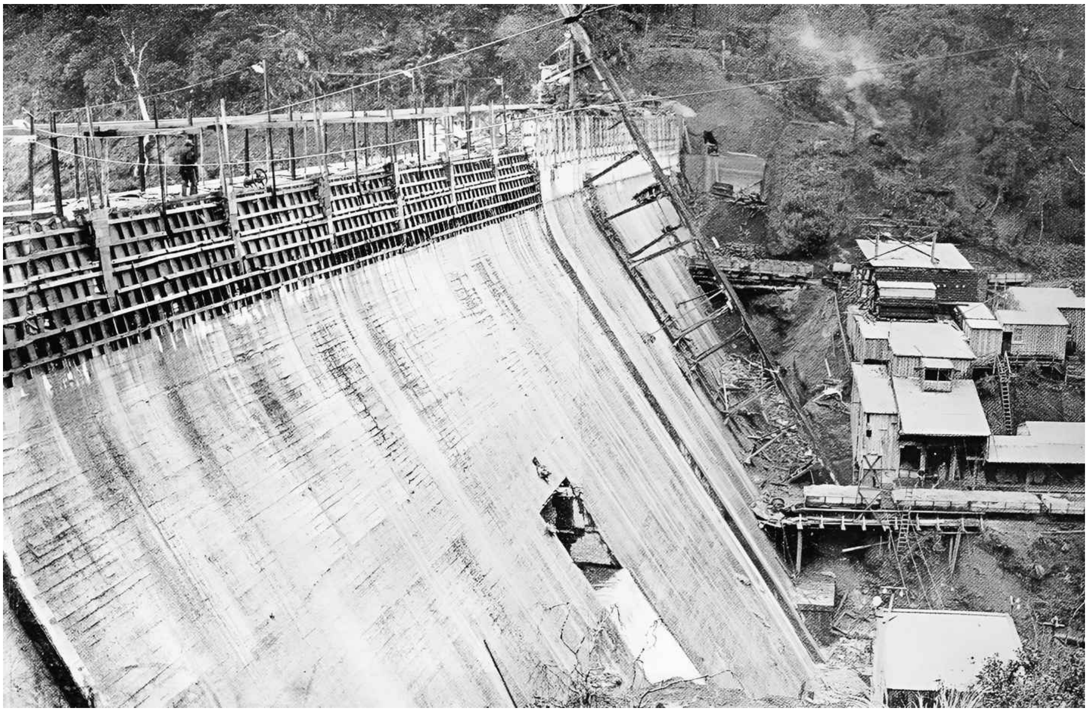
Exchanging quarry tramline wagons at the crusher





↑ Crushing plant at dam under construction. February 1928. Bottom right is the pipeline that will take water from the dam to Auckland. The photo has 8 workers, 5 women and 10 children.

↓ The dam is almost finished. September 1929. The building is the crusher, with quarry tramline wagons behind and landing tramline wagons in front.



The quarry tramline

Carrying rocks

Loads

The quarry tramline train usually carried rocks from the quarry to the dam. On a typical day, it carried 107 cubic metres (165 tonnes) of rocks; see page 13. The train made an average of 9.3 round trips a day, so each trip carried 11.5 cubic metres (17.7 tonnes) of rocks. Each train had two 5-yard wagons (4 cubic metres capacity) and one 2-yard wagon (1.5 cubic metres capacity). Ten cubic metres capacity altogether. The rocks were piled above the wagon sides and were not covered.

The quarry train used 3 sets of 3 wagons. One set was being loaded at the quarry, one set was being unloaded at the dam crusher and one set was going up or down the line. The train made over 2,200 round trips altogether.

Speeds and distances

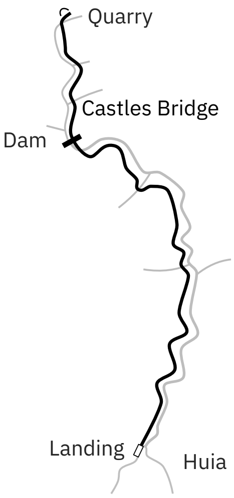
The tramline was 2.1 kilometres long from the quarry incline to the crusher. The train made an average of 9.3 round trips a day. Assuming a 9-hour day, that's a bit under an hour for a round trip. Assuming the train went up at 16 kilometres per hour and down at 8 kilometres per hour, the total travelling time is about 25 minutes. If it took 5 minutes to exchange the wagons at the dam then there was a bit under 30 minutes to exchange the 3 empty and the 3 loaded wagons at the quarry incline.

Braking

It is difficult to bring a train of heavy wagons down a steep track. If the driver brakes too hard the wheels will skid. Because the friction of skidding is less than the friction of rolling, it is hard to stop the skid. The best strategy is to apply the wagon brakes just the right amount, and have the locomotive, at the downhill end of the train, pull the wagons down. The driver uses the locomotive's throttle and brakes to control the speed. A brakeman would have run alongside the moving train and adjusted the wagon brakes when the gradient changed, for example at Castles Bridge. On at least one occasion the train ran away:

> [The driver] had arranged with his brakeman that if ever there was a need to abandon their engine he would give the signal to jump. In his broad Lancashire accent he told me that one day, while going down the gully his brakes failed. He called to the brakeman to "yomp", and they "yomped", leaving the engine and 2 wagons to go sailing on.

Castles Bridge



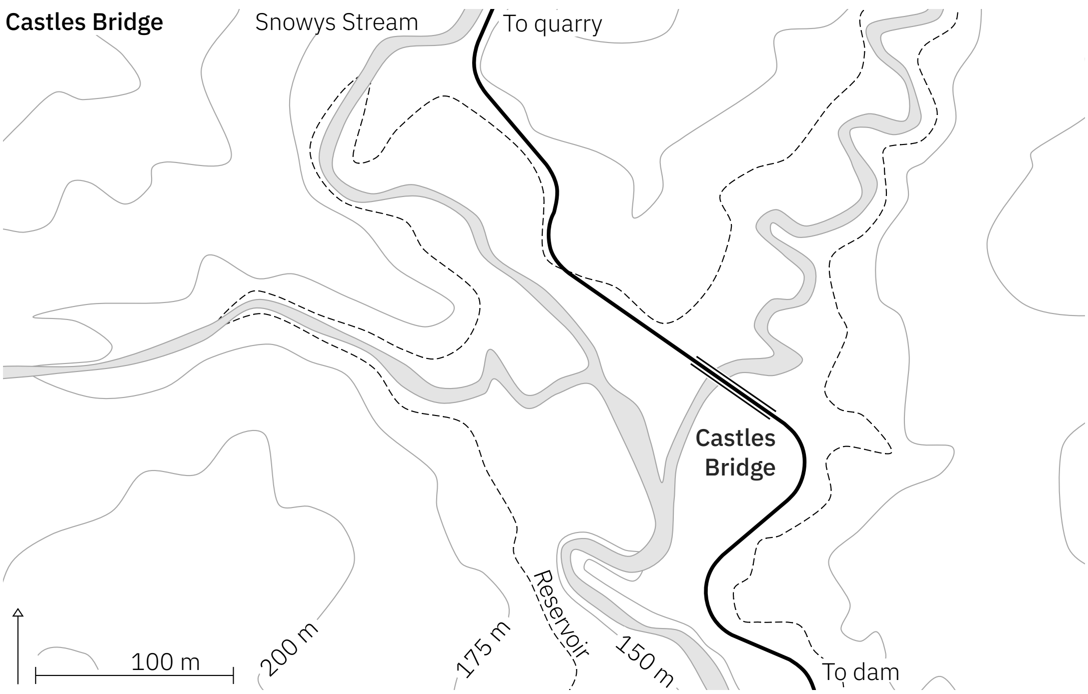
Between the dam and Castles Bridge, the valley is wide, with a gentle gradient. This valley became the dam's reservoir. Above the bridge, the tramline climbs steeply to the quarry.

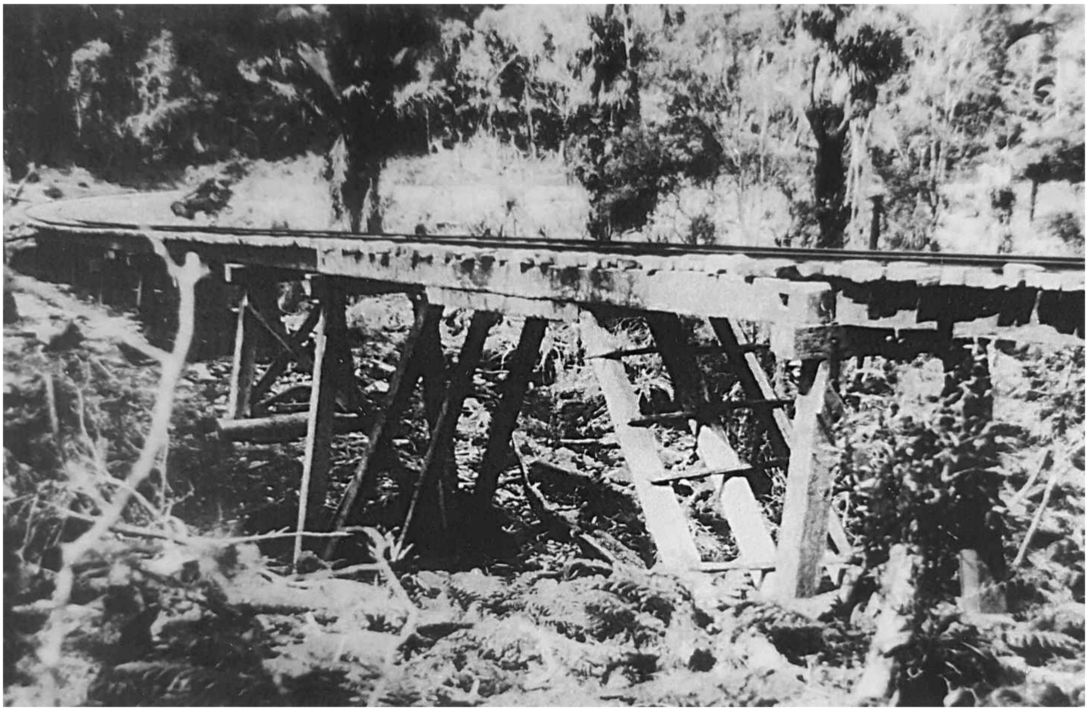
After the dam was finished and the quarry tramline lifted, Castles Bridge was demolished. To keep vegetation out of the reservoir:

> The reservoir site was felled and burned in the ordinary way. Then the timber was gathered and the logs burned, and the whole of the ground was grubbed to about six inches to remove the roots. These roots were then heaped up and burned and the logs were split up and burned … the cost exceeded their estimate very considerably.

In the 1960s when the lower Huia dam was built, workers felled and burned the reservoir site, split what remained and burned it again. They didn't grub the soil and they left ferns and regrowth 'to see what happened.' Nothing much did.

Castles Camp was in West Coast Road, north east of Huia Valley. In the 1920s, workers on the upper Nihotupu dam lived there.

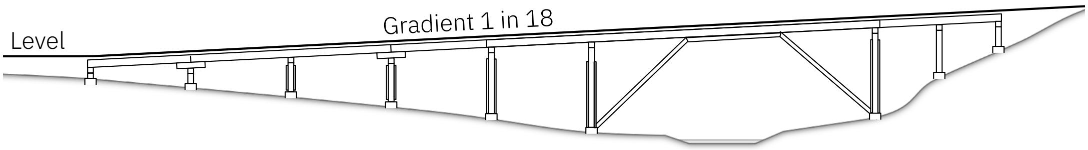




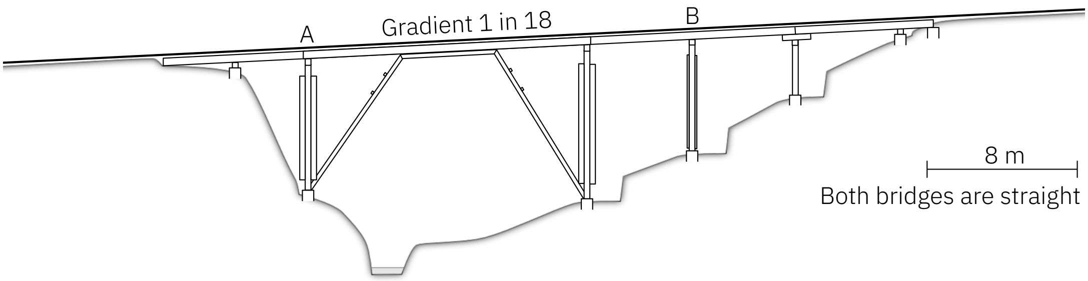
↑ Castles Bridge, looking down Huia Valley.

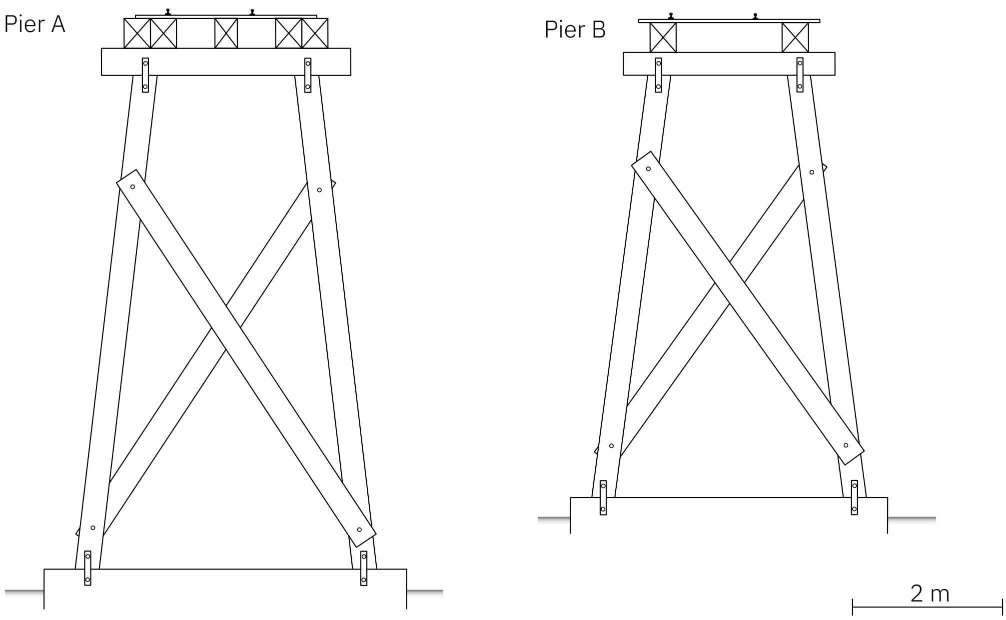
↓ Blizzard Bridge, looking up Huia Valley.

Castles Bridge

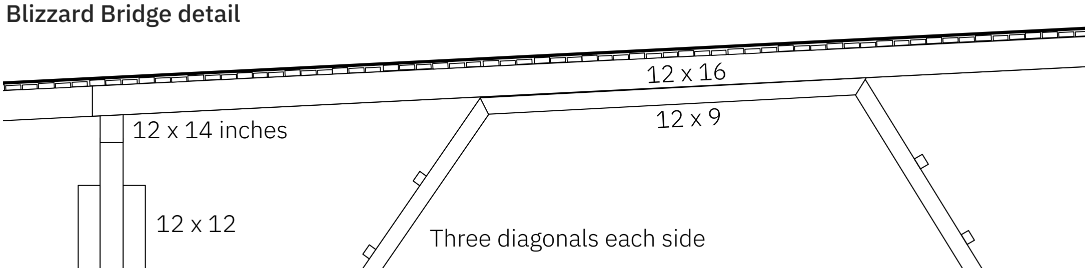


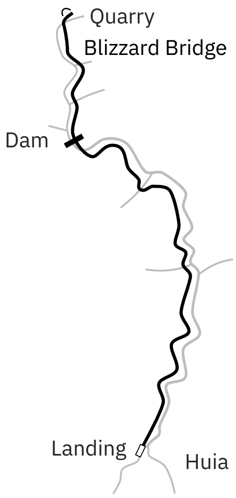
Blizzard Bridge





Blizzard Bridge detail





Blizzard Bridge

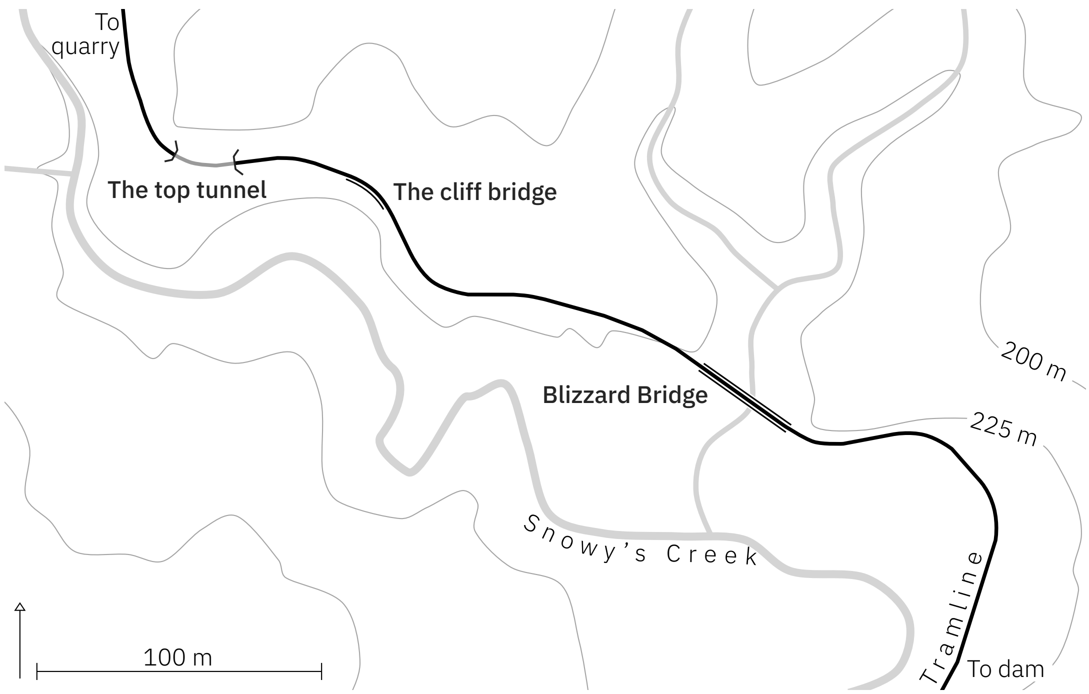
There were 2 bridges on the quarry tramline, Castles and Blizzard. They were ‘of bush timber construction’: made from lengths of timber joined with bolts and steel spikes. Timbers meeting at right angles had mortise and tenon joints, with small steel straps bolted on to hold the joint together. The piers sat on timber foundations.

All timber for the dam and tramline was from trees felled in Huia valley. Even though the valley had been logged earlier, many substantial trees remained. Most trees were pitsawn into lengths 23 by 30 or 30 by 30 centimetres across. Then, if required, they were cut into smaller sizes at a sawmill just up from the dam site.

The long spans of the Castles and Blizzard Bridges curved up a few centimetres in the middle, to allow for them sagging with use. It was easy for the pit-sawyers to cut timbers with a slight curve.

The deck boards were cut in the valley and adzed roughly to shape. Most are 20 by 6 centimetres. Every 3rd one is thicker, and the rails are spiked to these. The deck boards were joined to the beams with spikes about 8 millimetres diameter, with the top few centimetres hammered over flat against the deck board.

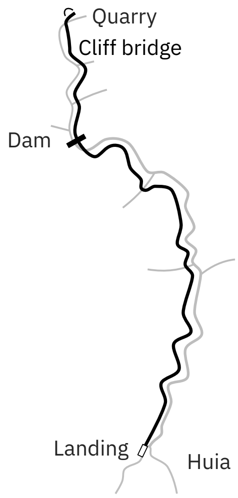
Ken Blizzard worked on the Huia valley survey, then on tramline construction.



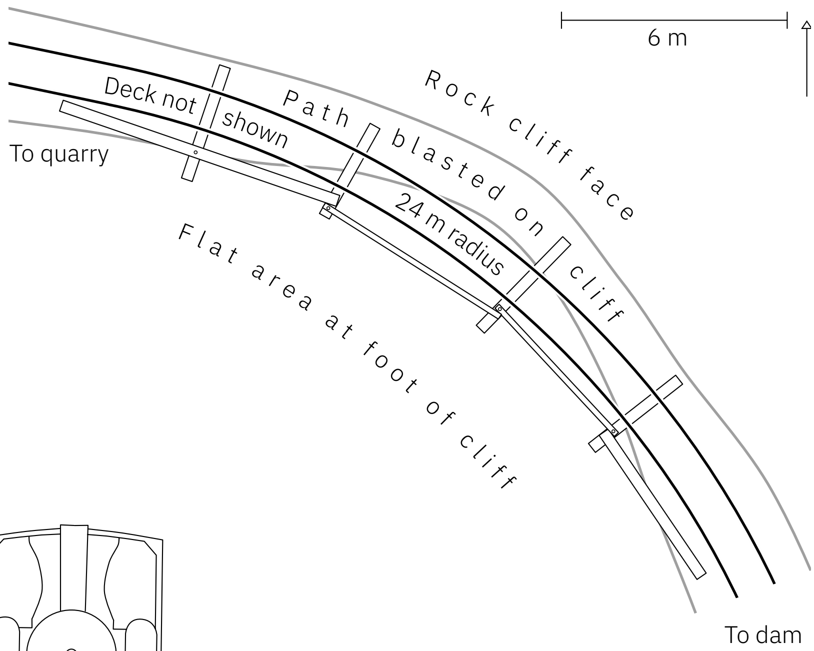
↑ A derailment on the quarry tramline. March 1928. 'There were some derailments in the first few weeks on the quarry line, until it settled into position, but on the whole, accidents were very few.'

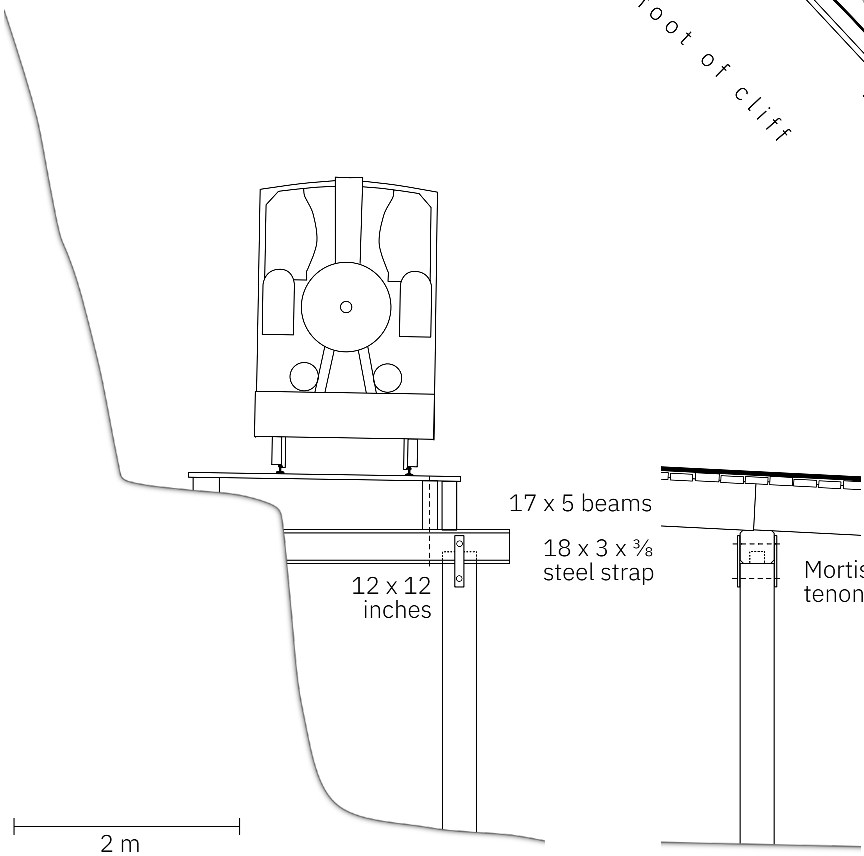
↓ Workers have unloaded the rocks from the wagon. The man in the white shirt holds a timber jack, to push and lift the wagon into place.

The cliff bridge

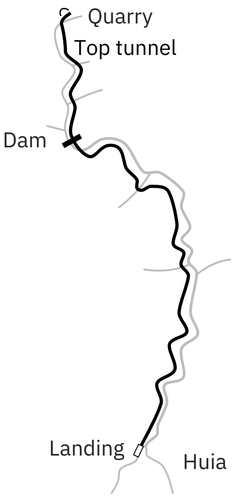


Half a kilometre down from the quarry, the tramline has to run along the face of a rock cliff, 2 to 3 metres up the cliff. It was too high for an embankment. The workers blasted a narrow path along the cliff to support the inner ends of the sleepers, and made a timber construction to hold the outer ends of the sleepers.



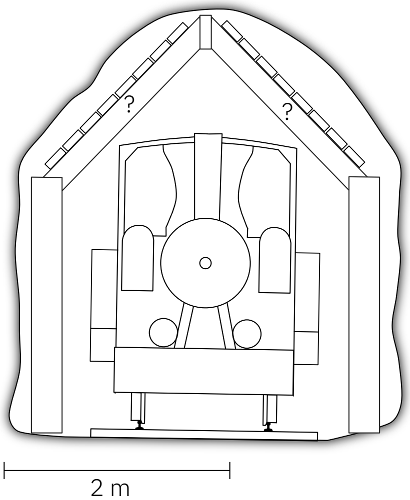


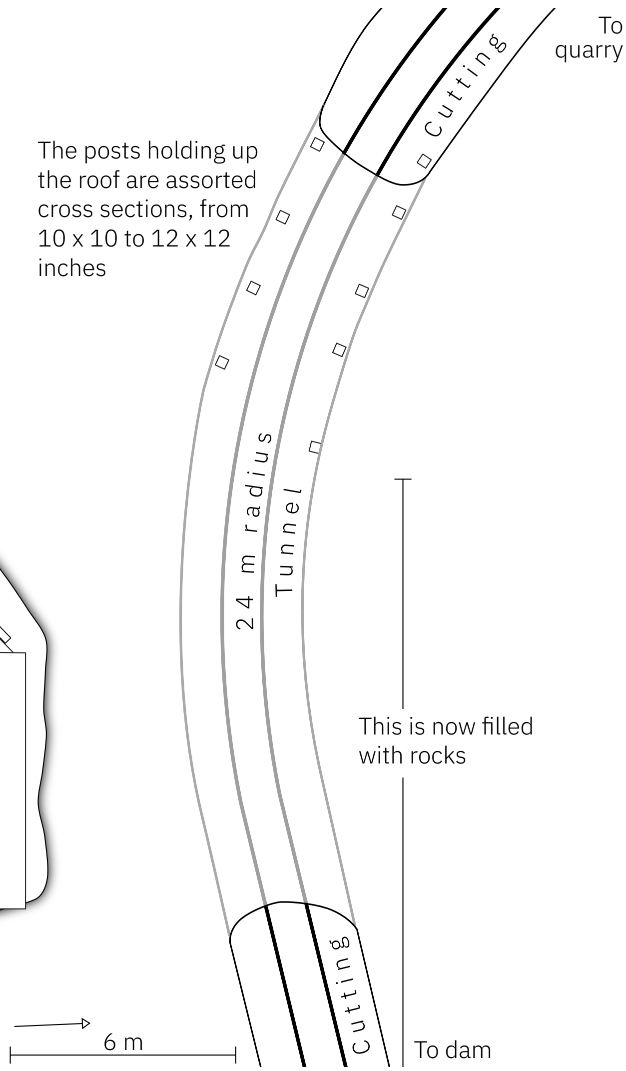
The top tunnel



Just up from the cliff bridge, the valley turns sharply. The bend is too sharp for the tramline to go around the hill and the ground is too high for a cutting. The engineers made a tunnel, with a short cutting at each end.

The valley is steep and heavy rain often causes slips. The common bedrock in the ranges is a tuff that is water-bound and crumbles when exposed to air. Some parts of the quarry tramline had small timber roofs to deflect slips and rockfalls, and the top tunnel was lined with a timber roof. Now, a rockfall fills the dam end of the tunnel and its cutting.



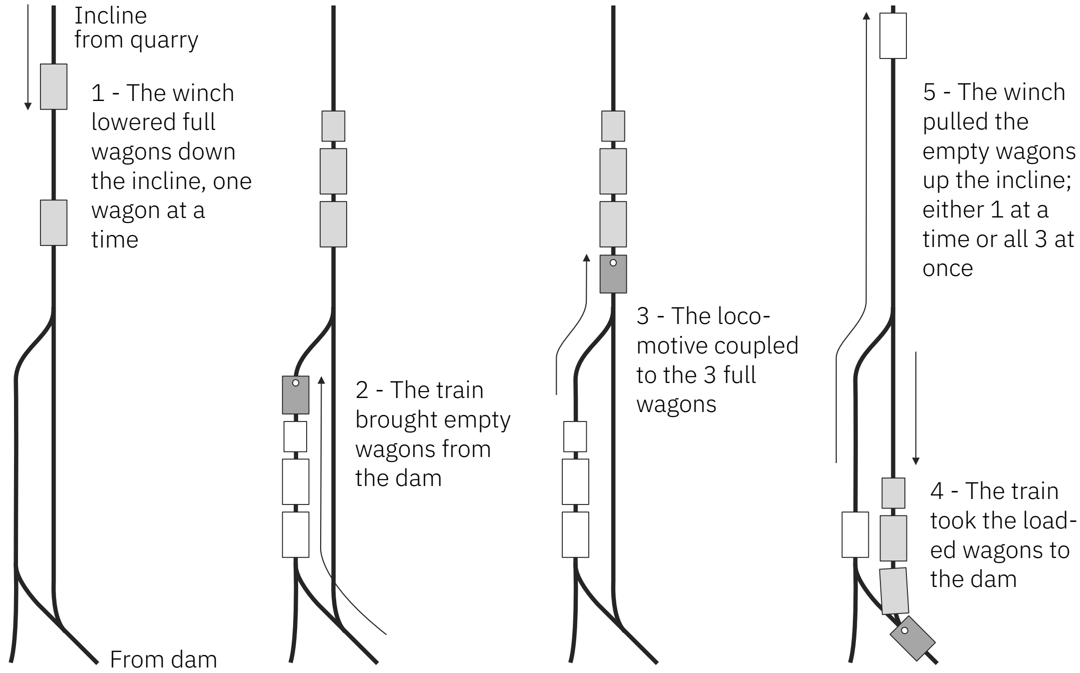


The incline

The last hundred metres of the tramline had to be steep to reach the quarry. Too steep for a locomotive. The engineers built an incline, and hauled wagons up and down with a winch. In the photo below, loaded wagons have been lowered down the incline to the locomotive and 3 empty wagons wait to be hauled up.

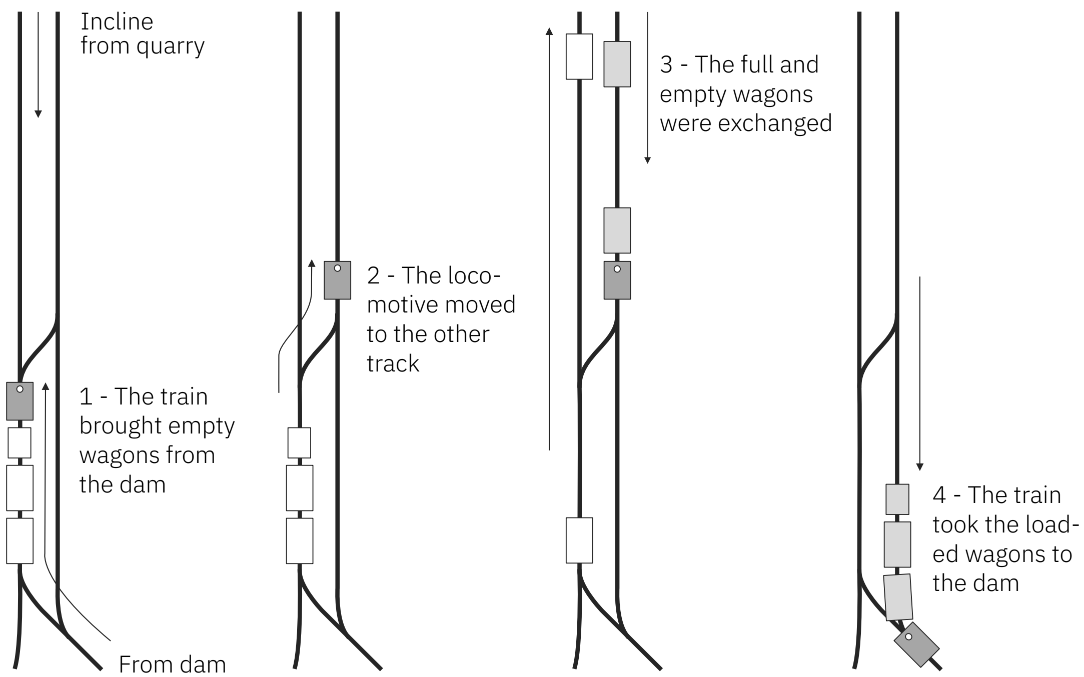
1 - Exchanging wagons at the incline, 1928

A winch at the top of the incline hauled wagons up or down



2 - Exchanging wagons at the incline, 1929

The incline was made self-acting: a full wagon going down hauled (via a drum and brake at the top) an empty wagon up



Blasting for beginners

To blast rock, workers drill holes in the rock, fill them with explosives and fire them. It is fast and dangerous. Workers at Huia blasted rock at the quarries to make rock for concrete, and blasted rock to dig tunnels and cuttings for the tramline and pipeline.

The quarry face

A quarry has a face, the vertical wall of rock that is being quarried. It has a floor, the flat area left when rock is removed and where the workers stand. As the rock is blasted away, the faces form semicircles and move into the rock.

Popper drills

The Huia workers used popper drills to drill holes in the rock. They were used in New Zealand from about 1910. Popper drills were the first rock drills that were small and light enough for one man to hold and use. They were powered by compressed air.

The drill bit was a steel rod, about 3 feet long. The cutting end was formed into a chisel shape or an X shape. In the drill, compressed air drove a hammer to strike the other end of the drill bit about 500 blows a minute. Pop pop pop … When the hammer struck the bit it rotated the bit slightly, to make a round hole. The compressed air exhausted through a hole along the drill bit to blow stone chips out of the hole.

A popper drill. The drills at Huia were bigger. But where is the noise, the dust and the danger?

There could not be more than 3 feet of drill shaft out of the hole being drilled, or the shaft would bend. To avoid this, the driller screwed on combinations of 3-foot and 6-foot extensions as they drilled the hole deeper.

Popper drills were loud. A newspaper article claimed:

> It is strangely incongruous to hear the staccato tat-tat-tat of the popper drill and the clear fluted call of the tui simultaneously, but industry has invaded the gloriously wooded Huia Valley.

But the same article went on to note that the birds had actually fled:

> It is strange that bird life is curiously absent in that wooded country. One might walk for hours through a silent forest.

Drilling the holes

Explosives shatter more rock if several neighbouring holes are detonated at about the same time. Different situations call for different patterns and depths of holes:

- Quarrymen often drill one or more lines of holes several metres deep into the quarry face. The goal is to leave the face fairly vertical and to leave a heap of rocks of about the right size on the quarry floor.
- Tunnellers drill several holes about 2 metres deep at an angle into the tunnel face. The goal is to extend the tunnel or shaft into the rock.

The blacksmith

A blacksmith at the quarry sharpened the bits. The blacksmith heated the cutter to soften it, hammered it to shape, heated it again, plunged it into water to make it hard, then heated it gently to the right hardness.

A good blacksmith was essential:

> The blacksmith is usually a privileged person, and very few superintendents have the ability or the nerve to instruct him. He is always an interesting character, generally intelligent, rarely well instructed, and invariably obstinate. … The average blacksmith with a helper can sharpen by hand about 140 bits a day.

Explosives

An explosive is something that will suddenly produce a large volume of hot gas. Striking a match causes a small explosion. Chemical explosives are used to blast rock.

There are 2 kinds of chemical explosives:

- Low explosives, like gunpowder, contain chemicals that produce oxygen when heated and chemicals that burn easily. They explode when they burn. It takes time for the burning to spread through the explosive. Therefore the explosion is relatively slow: 'bang.'
- High explosives contain chemicals that react together spontaneously to form a gas. They explode when they receive a shock from a detonator or a nearby explosion. The shock wave travels through the explosive almost instantaneously. Therefore the explosion is relatively fast: 'crack.'

High explosives are better than low for breaking rock because their faster explosion shocks the rock more. By the 1920s high explosives had mostly replaced low in New Zealand. A 1928 Huia dam stocktake showed 20 cases of gelignite, a high explosive. Gelignite is cheap, fairly stable and fairly safe to use, though it explodes if mishandled. It comes in sticks about 3 centimetres diameter and 25 long. The rock drill's diameter is chosen to match the gelignite's diameter.

A stick of gelignite is covered with wax paper, with a label printed with black ink. When the gelignite gets old, it deteriorates and nitroglycerine leaks out. Nitroglycerine is poisonous and readily explodes. You can tell if nitroglycerine has leaked out, because the ink turns purple.

Firing the explosives

First, the quarrymen loaded the holes with explosives: They pushed sticks of gelignite into each hole with a wooden pole, attaching a detonator with a fuse to the last stick in each hole. Then they packed the top of the hole with clay or sand to confine the explosion.

Finally, they fired the explosives. The fuses at Huia would have been the kind that were lit with a flame, as opposed to fuses fired by electricity. Probably more than one worker lit the fuses, each with a lighter like a big sparkler. They then ran to safety at the side of the quarry to avoid any rocks thrown out from the face. A safety fuse burns slowly. A metre length, the minimum, gave them 90 seconds to run.

The holes didn't all fire at exactly the same time. They would have counted the explosions to check that all holes had fired. If any had not, they would have waited 30 minutes, replaced the hole's detonator and fuse and tried again.

Blasting created cracks in the face. It was easy for rocks to break off the face and fall on the workers below. To try to avoid this, after each blast workers were lowered on ropes down the quarry face. They tapped the rock with crowbars. If it sounded hollow it was loose and they knocked it off with the crowbar.

Safety

Blasting was and is dangerous.

At Huia, workers were trained on the job by others who had been trained on the job. Writers of a hundred years ago note that workers were put in danger by ignorance, for example:

> At the present time mine officials, miners and quarrymen possess, as a rule, singularly little knowledge of the materials they use, when one considers the enormous development during recent years of educational facilities. Generally, they have only a vague and inarticulate idea of the risks they run during the operations of priming, stemming and firing a charge.

Loose rocks on the quarry face often fell onto the Huia quarry floor:

> I heard a man call "Look out!" This is the usual cry when rock is falling. I called out too, and looked up to see a piece of rock rolling down the face of the quarry.

In New Zealand between 1926 and 1929 there were about 2,000 employed in quarries, and 6 deaths. William Langlands was killed by a rock that flew 80 metres from a blast at the Nihotupu dam. John Urquhart was killed by a falling rock at the Huia quarry. The 1932 New Zealand yearbook dryly noted: 'Accidents in [quarrying] are apt to be exceptionally severe, as is also the case in the sawmilling industry'.

Andy Loader explained: 'An accident is a mistake, usually a concentration lapse. Today quarry workers are trained so they work instinctively and will work safely when their concentration lapses.'

Quarry work was dangerous, but many workers at Huia had been in World War I, and that was far more dangerous.

The Huia quarry

The Huia dam required a huge volume of rock to make concrete. Too much rock to be barged to Huia and bought up on the tramline. The dam engineers needed to find a quarry in the Huia valley.

Andesite

The common rock in the Waitākere ranges is too soft for making concrete. The surveyors looked for volumes of andesite, a hard rock. About 15 million years ago, volcanoes under the Waitākere area pushed andesite lava up to the surface through cracks in the surrounding rock, where it solidified. Since then, the softer surrounding rock has eroded, leaving andesite flows visible. Their sides are usually too steep to hold dirt and plants. To find andesite, the surveyors simply walked up the creek beds looking for this bare rock. You can see such bare rock just upstream from the quarry, beside the walking track.

Quarry problems

The surveyors found only one possible quarry site in the Huia valley. It was not very good.

Arthur Mead wrote that the quarry at Huia 'was much less favourably situated' than those at the earlier Waitākere and Nihotupu dams. The reasons were:

- There was no space for the steam crane from the Nihotupu quarry that had loaded rocks straight into the tramline wagons. Workers had to load rocks by hand.
- The Huia quarry was 2½ kilometres up an isolated valley.
- The tramline from Huia quarry down to the dam had a gradient of 1 in 19, which was about as steep as it could be.
- The last 100 metres of the tramline had to be very steep to reach the quarry. Too steep for a locomotive. Wagons had to be winched up and down an incline, which took time and effort.

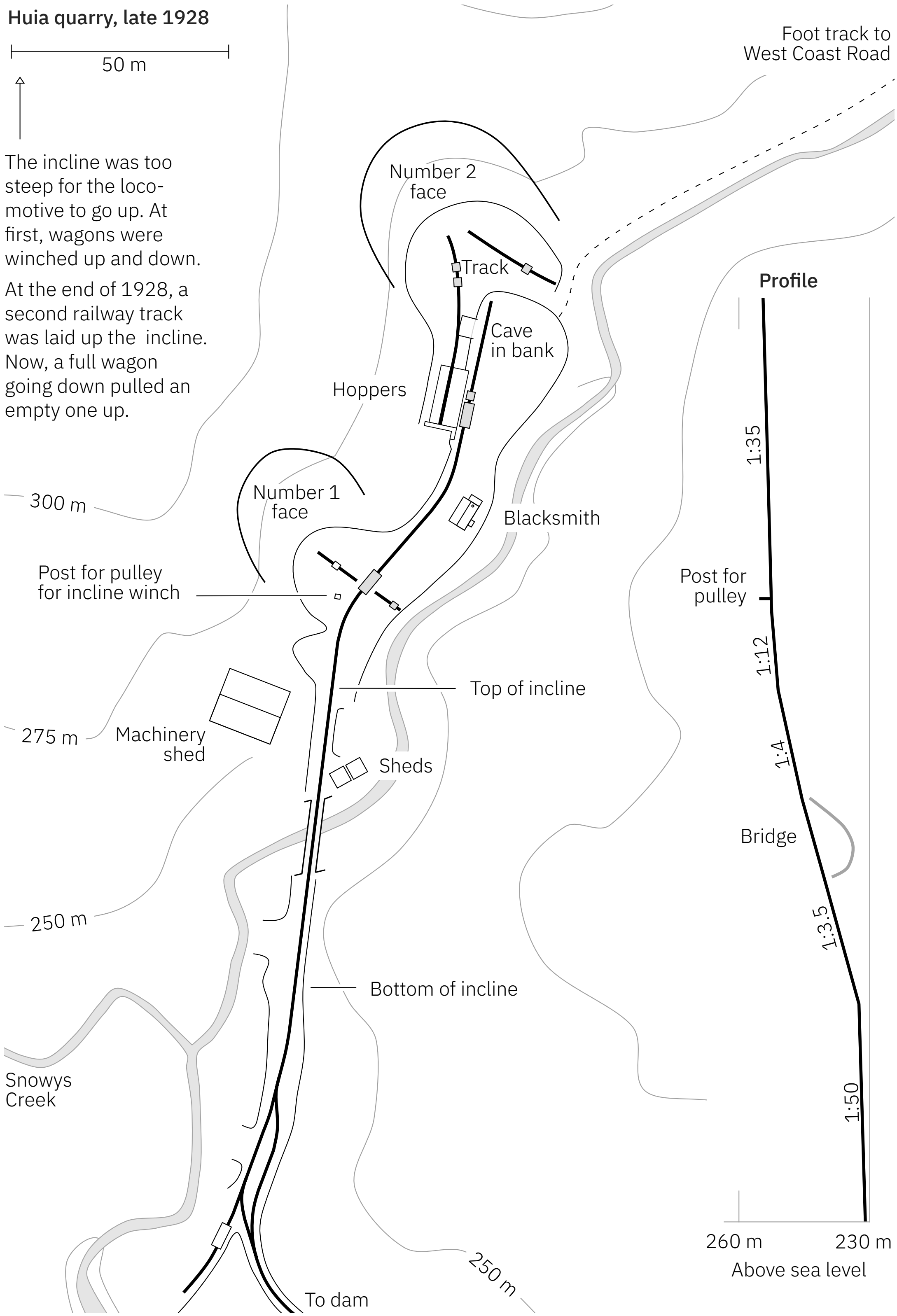
Mead also wrote:

> The stone was of [poor] quality. Not only had a great deal of overburden to be removed, but the solid stone, when reached, was found to be closely [cracked] in a vertical direction. Clay and weathering had penetrated the joints to such an extent that nearly all the smaller stone, say from 4 inches and under, amounting to probably one-third of the output had to be rejected. … The output of the quarry proved to be the limiting factor in the rate of progress of the dam.

Huia quarry, late 1928

The incline was too steep for the locomotive to go up. At first, wagons were winched up and down.

At the end of 1928, a second railway track was laid up the incline. Now, a full wagon going down pulled an empty one up.



Quarry operation

The quarry provided the rocks for the concrete for the dam.

The quarry would have employed:

- a quarry manager, who needed a certificate
- a foreman, probably the manager
- a blacksmith to sharpen the steel rock drills
- a blaster (powder monkey) to take responsibility for the explosives and detonators: to store them in strong, locked magazines and ensure they are used before they get too old
- about 15 to 25 workers.

Government quarry and sanitation inspectors visited.

There were several buildings at the quarry:

- A machinery shed, containing the compressor for the rock drills, a generator for the floodlights for night work, the winch for the incline, plus the diesel engines to power these.
- The blacksmith. This might have had a lunchroom attached.
- The hoppers. These were built in April 1928 when the work changed to 2 shifts a day. It was too dangerous to work the quarry faces at night. The hoppers were filled during the day with rocks from number 2 face, and taken down the tramline during the evening shift.
- Two small sheds near the top of the incline. One of these could have been the toilet, built in January 1928.
- There is a small cave just up from the hoppers. It was too close to face 2 to be an explosives magazine or a refuge during a blast. Perhaps the men sheltered there from the rain.

Blasting

Quarry workers used gelignite to blast apart the solid rock.

The rock at the Huia quarry had cracked into vertical columns when the molten lava cooled and shrank. The workers would have simply stood on the quarry floor and drilled a line of horizontal holes into the quarry face, just above the quarry floor. A blast would shatter the columns.

Arthur Mead wrote,

> The stone was quarried in shots of round about 200 cubic yards [150 cubic metres], by simultaneously firing several holes up to 20 feet deep … probably one-third of the output had to be rejected.

Assuming he means that the blast gave 150 cubic metres of broken rock, and a third of that was rejected, then a blast gave 100 cubic metres of broken rock, almost enough for one day's output of 107 cubic metres, see page 13.

I estimate they might have drilled 6 holes, each 4 metres deep for each blast. Each hole would have taken about an hour to drill. The drill bit would have got blunt while drilling the hole, and been replaced with a sharp one. The cracks between the rock could jam a drill bit or make the hole wander. The driller had to abandon the hole and drill a new one beside it.

Te Henga quarry, also in the Waitākere ranges near Auckland. The quarry face is cracked into vertical columns, like at the Huia quarry. The pile of rocks at the bottom of the face has just been blasted.

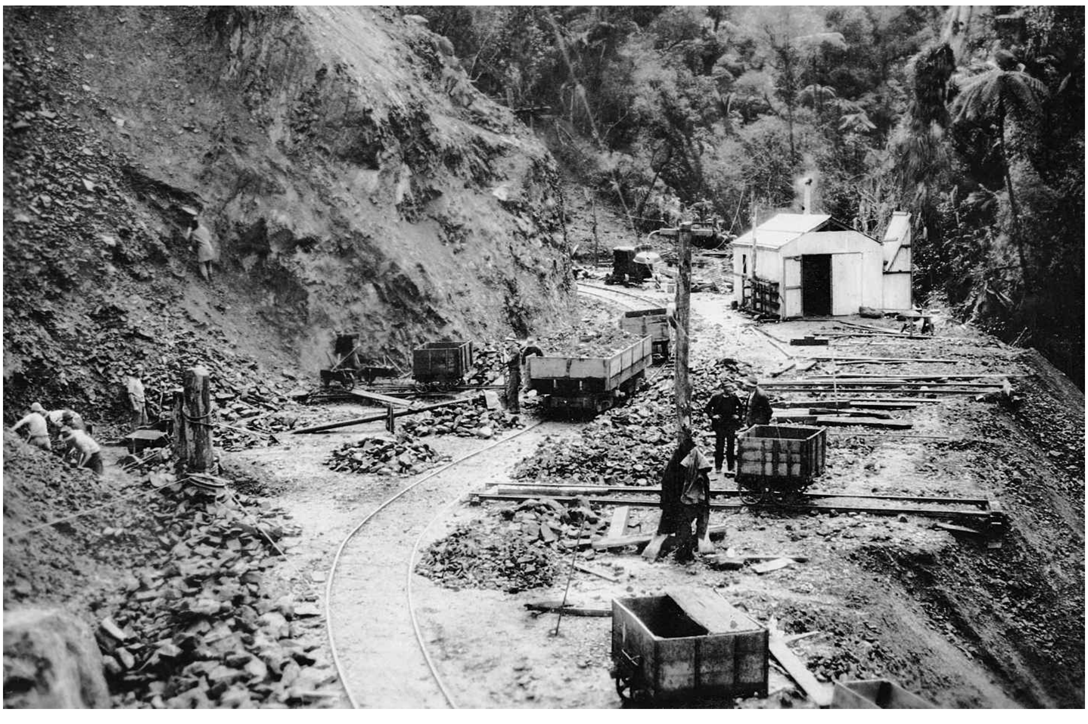
Loading the rock

A blast left a jumble of material on the quarry floor: different size rocks, plus dirt and vegetation from above the face. Workers broke up large rocks to less than 20 centimetres across, to fit in the rock crushers at the dam:

- They blasted apart large rocks, either drilling a hole for the explosive or placing explosive on top of the rock.
- They broke up smaller rocks with heavy hammers designed for this, called spawling hammers. The head can weigh up to 25 kilograms and the handle can be up to 2 metres long. One blow by a skilled worker would split a rock. Once I tried hammering some basalt, a rock similar to andesite. After a lot of hammering, a small piece flaked off.

The quarry workers moved material in wheelbarrows or in small wagons running on temporary railway track and pushed by hand. Workers picked out the usable rocks, probably using forks with widely spaced tines to pick up the the bigger rocks that they wanted. They moved them to the tramline to load into tramline wagons to go to the dam, or to stack beside the tramline to load later. They loaded the smaller reject rocks and other waste into other small wagons and dumped them into the nearby stream. This is on the right of the photo below.

↓ Workers loading rocks on the floor of number 1 face. September 1928. The building is the blacksmith. Bottom left is the pulley for the incline.



The beautiful quarry horse

A horse pulled tramline wagons between the top of the incline and the quarry. Ray Allen described an accident with the horse:

> Our quarry boss had a nephew whom he wanted to give an easy job to, so he put him in charge of the beautiful quarry horse. The lad didn't know how to treat a horse properly — to get behind it and talk quietly to it. He hit it over the head to make it go forward. Of course this made the horse jerk back, dislocating the chocks behind the wheels of the wagons.

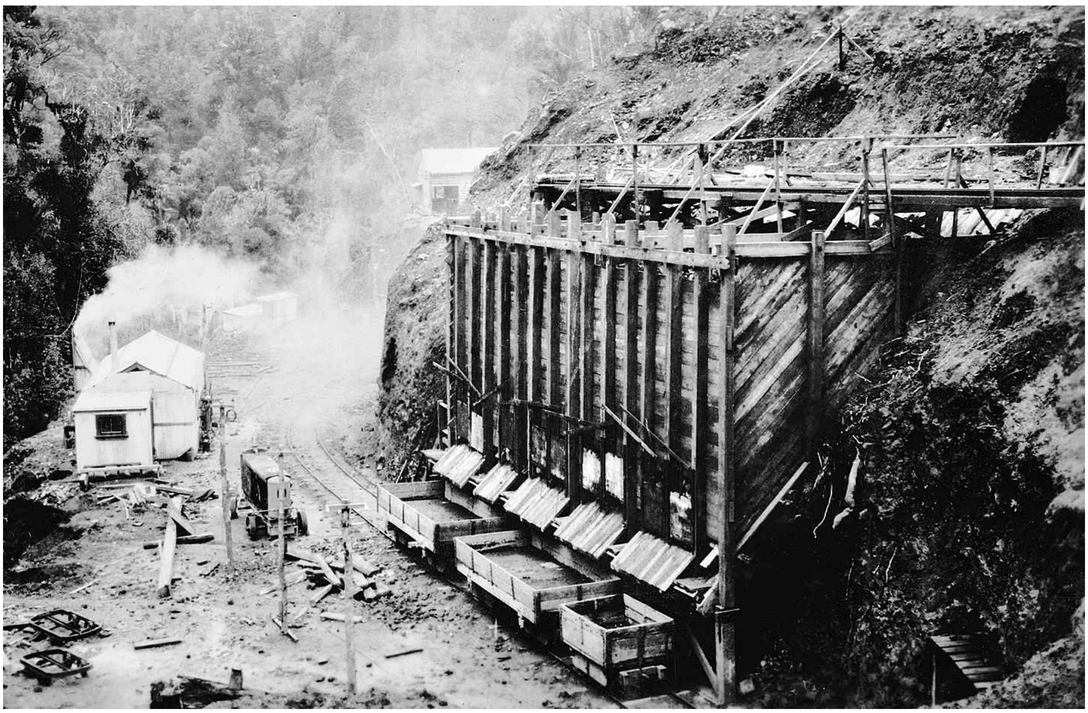
The wagons ran down the incline, pulling the horse with them. He ended up on the bridge halfway down the incline with his legs dangling through the sleepers. When he was released, 'To our utter amazement he staggered to his feet!'

Other quarry problems

In July 1928, the quarry workers complained through their union:

> The men working in the Huia quarry are compelled by distance to take their lunch to work, and they require an alteration to the quality of their lunches, as it is far from what it aught to be. Bread with heated cheese spread over is insufficient for a man to give good results working in a quarry.

↓ Huia quarry hoppers, September 1928. This is the top end of the tramline. The building is the blacksmith.

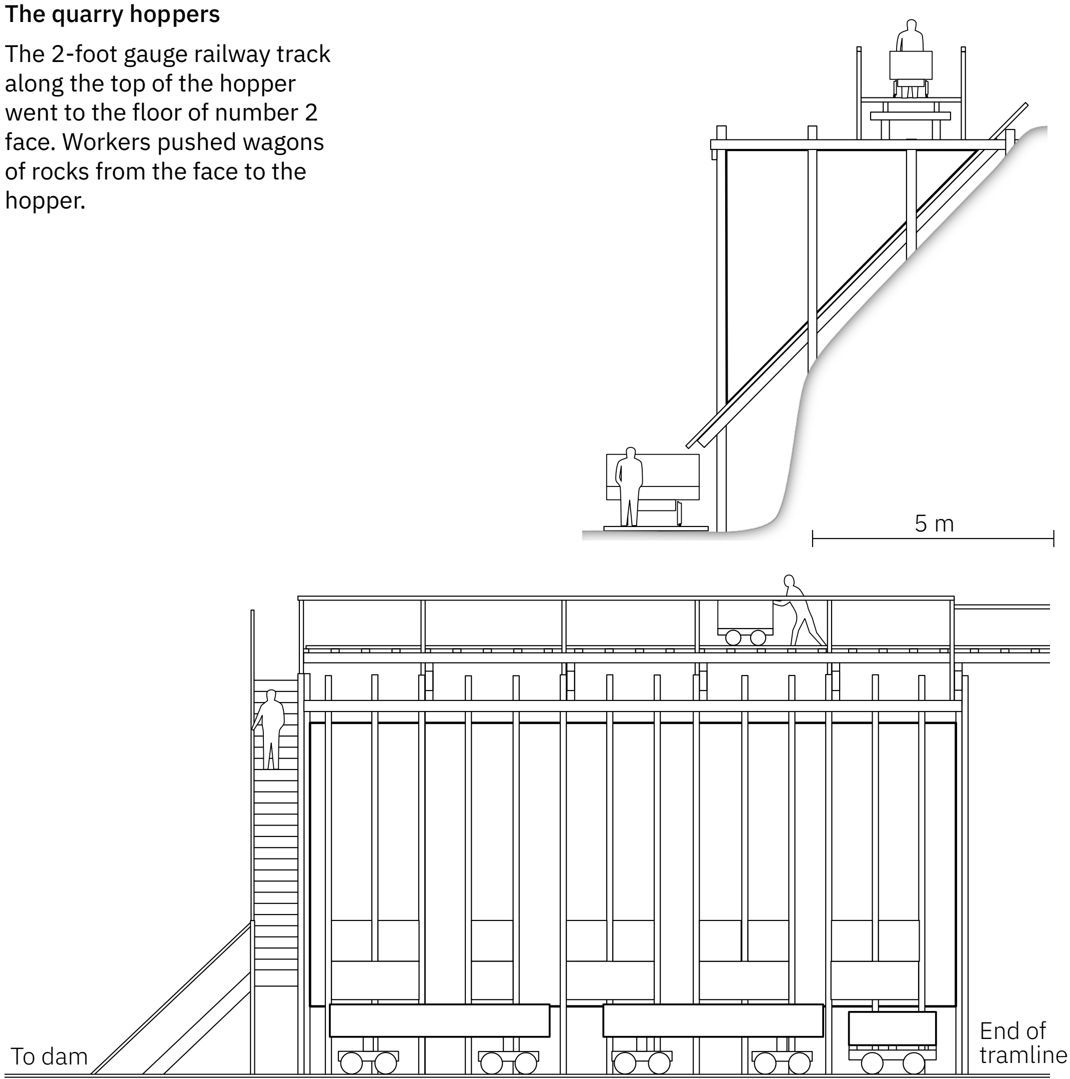


In 1920, traces of faecal contamination were found in water from Waitākere dam. One of the city council's many responses was to ban work camps in dam catchments. Workers at Huia quarry lived at the main camp, below the dam site.

In 1927 and 1928, government health inspectors found problems in the valley. One was the toilets at the quarry, within the catchment area. At first, there were 'Two pits, one at the top of the quarry and the other in the gully below … about seven feet long by five feet deep and are only used to a slight extent.' Because 'the men used the scrub.' A health officer asked that the pits be filled in, pan toilets be provided, and the contents be buried below the dam site. Six months later, he complained that nothing had changed.

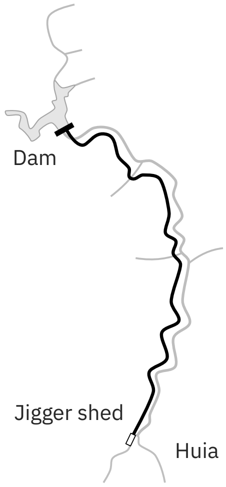
The quarry hoppers

The 2-foot gauge railway track along the top of the hopper went to the floor of number 2 face. Workers pushed wagons of rocks from the face to the hopper.



1930 to 1959

The transition

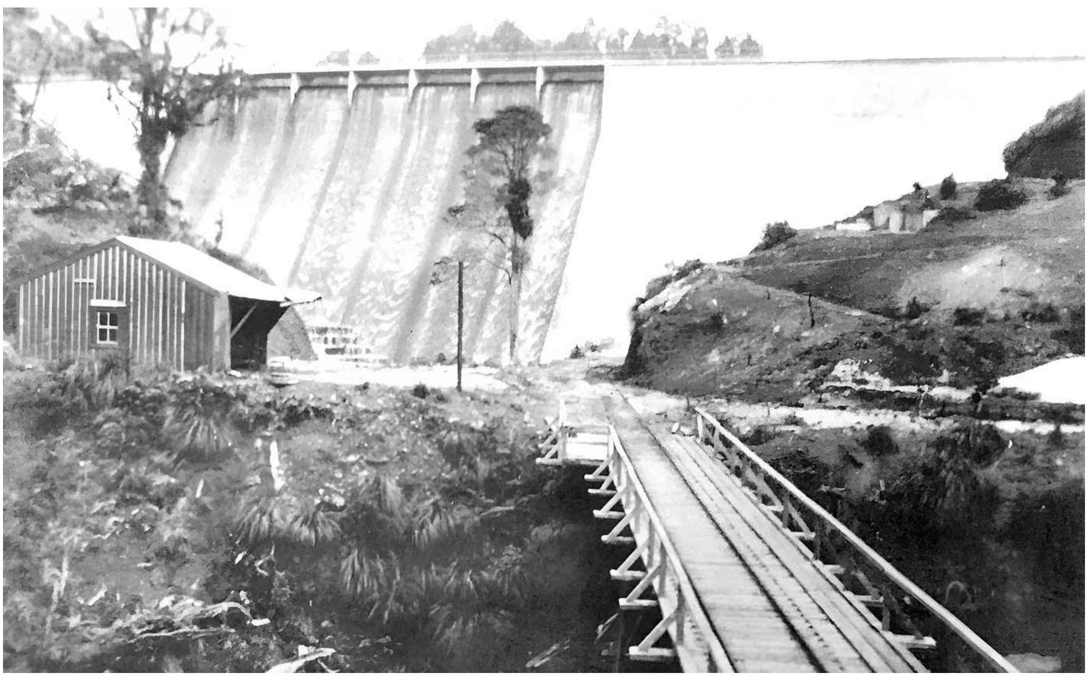


The dam was finished in September 1929. Immediately, the workers lifted the quarry tramline and most of the switch line, and demolished the buildings, except for a shed at the dam. They sent everything valuable down the tramline to the landing to barge away. The rest they burned or left where it was. Norman Laing wrote:

> The completed dam was an impressive spectacle when it was officially opened in December 1929, with the reservoir full and the surplus water cascading down the concrete steps of the overflow face.
>
> Then it was all over. During its construction, the Huia Dam had affected the lives of practically every inhabitant of The Huia at that time. Most of the men and their sons worked on the project in some capacity, either directly or by providing a support service such as transport, supplies, or sub-contracting, use of a bullock team, a horse and dray or a boat etc. When the job was wound down and employment ceased, a vacuum was created, which forced a number of Huia families to move out of the district in search of employment elsewhere.

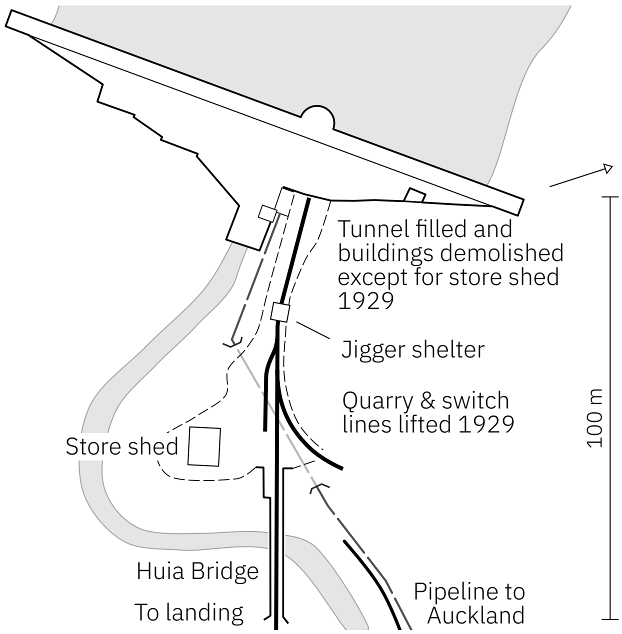
The council now employed 2 caretaker couples at the dam, and a small gang of workers at Huia to maintain the tramline and to work in the valley. The pace slowed right down.

↓ The finished dam. The buildings have been demolished, except for this shed.

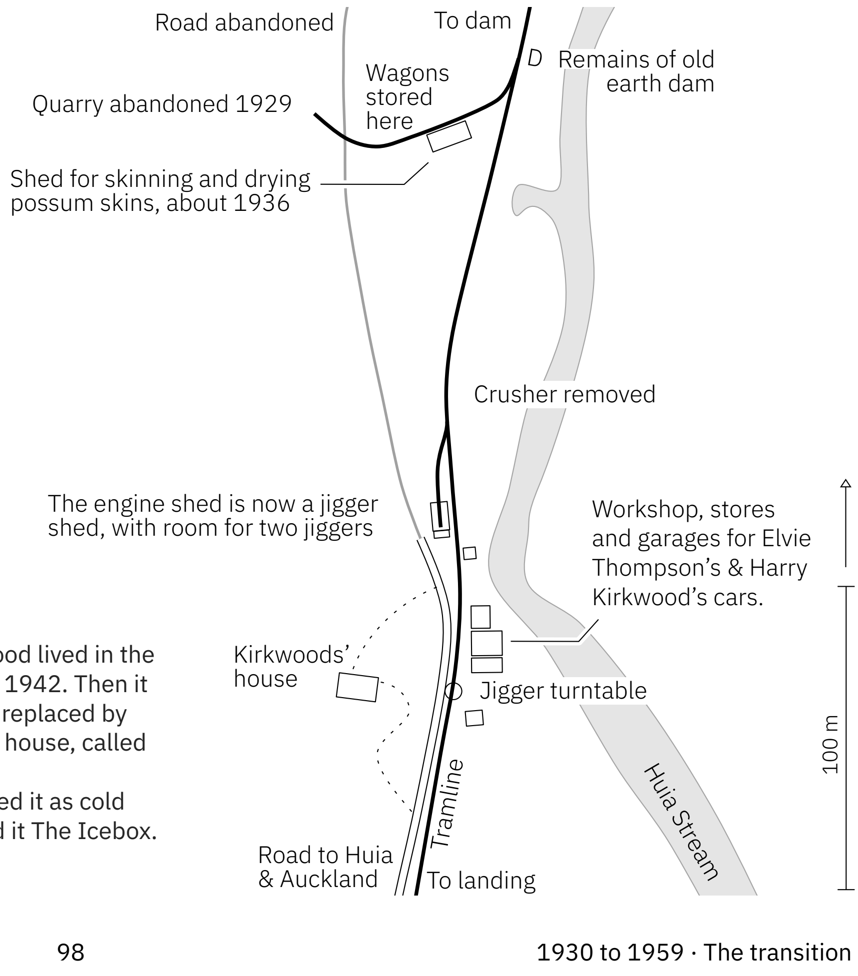


Changes after the dam was finished

At the dam



At Huia



Dot and Harry Kirkwood lived in the Williams' house until 1942. Then it was demolished and replaced by the present concrete house, called Whare Puke.
Violet Moore described it as cold and damp, and called it The Icebox.

The people

The workers

Elvie and Nugget (Ken) Thompson lived in a house just down from the bridge at the dam. They were dam caretakers. Nugget had been a circus wrestler. Several people described him as being tough and 'nuggety'. One described him as looking like Popeye, with his pipe. He was a keen reader and naturalist, and he spent much of his time in the bush, researching plants, frogs, snails and middens. Elvie did most of the work of looking after the dam. A second caretaker couple, the Stewarts, lived where the main work camp had been.

Dot (Dorothy) and Harry Kirkwood lived near the jigger shed. Harry was the foreman of the workers in the valley. He was 'a hothead, but ok when you knew him,' and 'a terrible boss.' A toilet at the old main camp was a pit with 2 ti tree sticks to sit on. Workers cut the sticks partly through, and Kirkwood fell in. Children found him 'a lovely fellow.'

The work gang included Took Moore, Neil Farley, Cyril O'Donnel and Roy Reimenschneider. They lived in or around Huia settlement. Took started working for the council at Huia in 1948, trapping possums. He became overseer of the Waitākere dams, managing about 30 men.

Arthur Mead was now the city waterworks engineer, with an office in Auckland. He was responsible for all city waterworks and often visited Huia. He loved the bush.

The bush

Even in the 1950s, Huia seemed remote from Auckland. Some men enjoyed being there, and working in the bush:

- Ray Allen: 'I used to enjoy working by myself because I could absorb the serenity of the bush. The friendly flitting fantails and the deep-throated tuis made beautiful music.'
- Leslie Williams: 'I have always enjoyed the forest of the Western Ranges, there seemed to me to be a sort of mystic influence in the atmosphere of the bush, a feeling of wellbeing which is hard to describe.'
- Merv Woon: 'Everyone had a love of nature, a knowledge of trees and animals.'

But the isolation was hard on the workers' wives. When the Thompsons retired in 1953, Elvie was 'busting a gut to live in the city.'

However, they first lived at Whatipu, on the coast west of Huia, even further from the city. Dot Kirkwood complained that the only time she saw people was at holiday time, when families came from Auckland to stay at Huia. Violet Moore said that when Took worked a night shift in the valley she was frightened of the drunks nearby.

Ann Riemenschneider's complaint

In 1936, Ann Riemenschneider wrote to Arthur Mead:

> I was told by [Harry Kirkwood] in the most abusive language (reserved only for women) to mind my own business, before a crowd of people.
>
> I am writing this to get a wrong put right. The two wives of the caretakers are decent women, and they are not getting a fair deal. You know women keep the men at the outposts of the Waterworks and also deserve consideration. These two can only move subject to the whim of [Harry Kirkwood], with the mentality and liver of an ex tommy, whose standard of truthfulness does not compare with any I know.
>
> I was in the [Huia] store and saw dam supplies being packed. Meat, matches, soap at the bottom of bag the rest on top. Someone laughed and was told “oh well, yer don't get medals for this” … The goods were then dumped into the shed at the bridge, rats, dogs, children, and grown ups use it for eliminations. If the meat arrives only flyblown, or not bad, they think they are lucky, but would you like your food treated this way?
>
> I know you are a very tolerant man and do not know the true facts, if you will call on me I will supply them, and I think a happy atmosphere will greet you on your trips out here.

But Mead preferred to keep Kirkwood happy, not the women:

> Referring to your letter dated 31st ultimo, I think you have written under a complete misapprehension of the character of Mr. Kirkwood, whom I have known for some considerable time, and have always found to be of the kindliest nature. He has an abrupt and sharp manner of speaking which is probably natural to him, and means no harm.
>
> I am aware that there has been some trouble in regard to delivery of goods from the store to the landing, but am endeavouring to have this rectified.

Tramline business

The dam caretakers adjusted the flow of water through the pipeline to Auckland, opened and closed the dam intake valves, read the reservoir level, measured rainfall and the water flow in the 2 drains under the dam, and checked the dam and the surrounding valley for problems.

The gang of workers based at Huia under Harry Kirkwood maintained the waterworks in the valley. The workers:

- Checked and maintained the tramline, the pipeline to Auckland, walking tracks, bridges, tunnels and firebreaks.
- Patrolled the valley and nearby reserves looking for trespassers, bush fires and any other problems.
- Gathered stones from the stream and crushed them for tramline ballast, for making concrete, and to sell.
- Manned a pump station half way up the valley during water shortages in the 1940s and 1950s.
- Replanted with native seedlings and encouraged regeneration.
- Killed possums and processed their skins to be sold, after 1936.
- Showed official and unofficial visitors the valley and the dam.

During World War II many workers were called away on military service. Maintenance of the waterworks was an essential activity, and some workers were exempted from military service. There were restrictions on petrol and ammunition, and new patrols to check waterworks security. After Japan entered the war in 1941, these patrols were increased. Mead asked for military help for the patrols but was refused.

Around 1960, the Huia workers did pipeline patrols and maintenance on Mondays, bush and track work during the rest of the week, and rostered work and fire patrols in the weekends. In the Nihotupu valley, the older workers normally maintained pipelines, tramlines and tunnels, while the younger workers maintained tracks and bridges.

The work could be dangerous and the workers needed experience. But the pace was relaxed, except if there was a fire, or if the pipe carrying the water to Auckland burst. Then, 'every man and his dog worked to fit a new length of pipe.'

Jiggers and wagons

After 1929, the workers made occasional, short trips on the tramline. Steam locomotives were not suitable. Instead, the workers made their own small locomotives, called jiggers. The engine shed became a jigger shed, with room for 2 jiggers.

A jigger had a timber body, a second-hand car motor and gear box, with a chain drive to an axle. Cars and trucks were first sold in New Zealand in the 1910s. It must have been fun making a jigger.

Even before the dam was finished, Charlie Flowerday had made a jigger. In 1929, 'The men who lived off the waterworks reserve used to travel to and from their work on the corporation's locomotive or on a jigger owned by one of the men, who had permission to run it on the tramline.'

The Huia waterworks owned at least 5 jiggers: the caretaker's first and second jiggers, the big jigger, the light jigger and Kirkwood's jigger. The caretaker's jiggers might have been made at council workshops in Auckland. The others were made at Huia.

↓ Elvie Thompson in the caretaker's first jigger. About 1950.

Jiggers were like cars. Their gearbox had several forward and one reverse gear. The driver had to sit on a seat to operate the accelerator and clutch, and they faced forwards. Like a car, a jigger was hard to drive backwards for any distance. The tramline had turntables to turn the jiggers, so they could go forwards. There was a turntable just down from the jigger shed at Huia, at Smiths Creek, and at other places where there was railway track from the tramline down to Huia Stream to gather stones to crush. Most people I talked to agreed that there was no turntable at the dam. Some said that there was. All agreed that jiggers from the dam came down front-first.

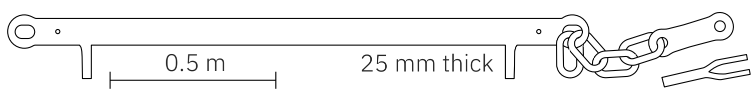
A turntable was a steel plate 2.4 metres diameter, level with the ground. They would push on the jigger to turn it. Jiggers were sized to fit on a turntable.

Wagons

There were 2 common kinds of wagon, both made mostly of wood:

- Metal wagons had sides about half a metre high and often carried crushed stone or people. The workers called crushed stone 'metal'. Side or end boards were removable for loading or unloading.
- Flat tops had a flat deck with no sides or low sides. They could carry a load tied on, or a long load slung between 2 wagons. People used flat tops to freewheel down the tramline. Elvie Thompson had a flat top for that purpose that held 10 children.

The steel spine of a wooden Huia wagon. I assume it was sandwiched between the floor planks.



The wagons were timber with a few steel parts. In 1947, Harry Kirkwood requested 2 new metal wagons: chassis 8 by 4 feet and 18 inches high; made from 9 by 2 and 6 by 4 inch timber. He wrote 'Two trucks made while on the job' and signed his request.

↑ The caretaker's first jigger near the dam. The wagons are flat tops with sides. There are 2 people holding small children in the jigger and 6 men behind.

↓ I assume this is Elvie Thompson's mother, with the caretaker's second jigger. The jigger ended its days as a chicken coop at Lower Nihotupu Dam.

↑ The big jigger at the jigger shed. The wagon is a flat top with sides.

↓ The light jigger at the shed at the dam, with a party of enthusiasts. The wagon is a metal wagon.

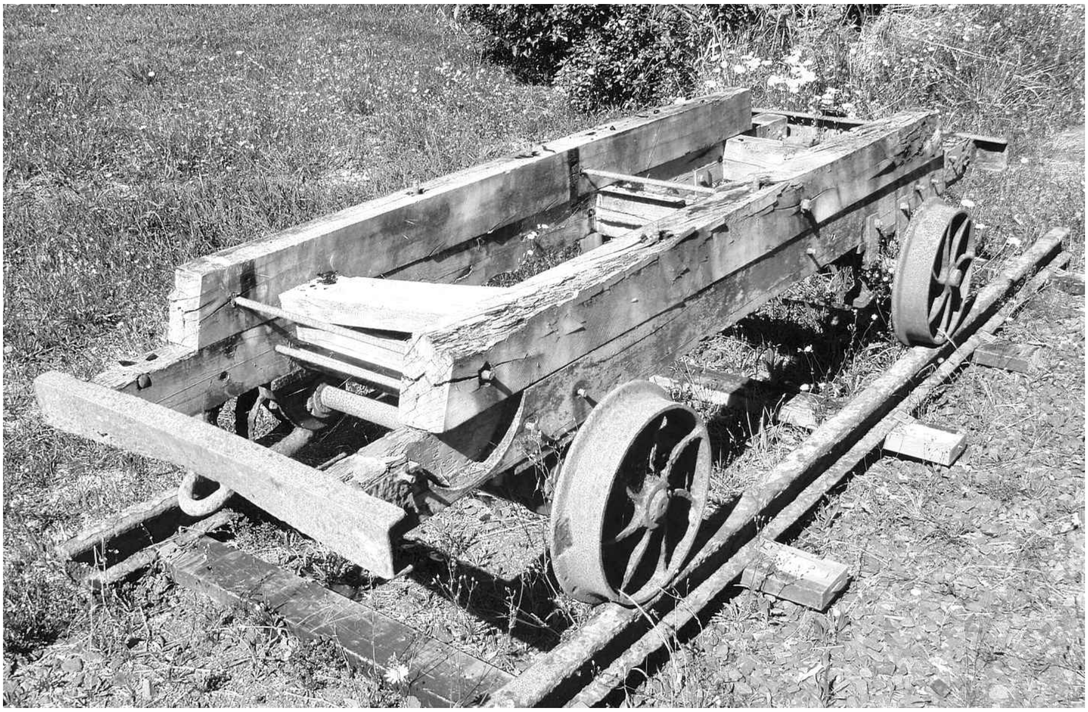
↑ Kirkwood's jigger. —, Nugget Thompson, —, Mrs Bishop, Gus Bishop, Joe Beveridge, Clive Thompson (Nugget's son).

↓ A substantial jigger, pulling a metal wagon. At the jigger shed.

Tramline operation

A 1951 newspaper article describes the tramline:

> *Primitive Signalling.* Members of the waterworks staff perform the tasks of engine-driver, shunter and train controller. The method of signalling is crude. If, for example, the caretaker at the dam decides to run a train, he notifies the works foreman at Lower Huia, Mr H. Kirkwood, of the approximate time of departure. To obviate mishaps through the fallibility of human memory, this information is recorded on paper and also on a blackboard placed on a train ready for use in the opposite direction.
>
> In spite of grade of one in 30, the locomotives, powered with ancient motor-car engines bought cheaply from second-hand dealers, attain speeds approaching 20 miles an hour on the upward journey. Neither Mrs Thompson nor Mrs Stewart has qualms about making a run alone. From the dam the line is almost a continuous decline and frequently men make the journey without a locomotive, in a wagon with nothing more than a heavy piece of timber bearing against a bogey wheel to act as the brake.
>
> *Unexpected Incident.* A ride on the railway was a feature of yesterday's tour for the councillors, who included Mrs M Wright, the first woman member of the Works Committee. The journey from Lower Huia was made on the flat wagons specially fitted for the occasion with wooden seats padded with sacks. A stop was made for lunch at the two-mile peg, where there is a branch line to serve the auxiliary pumping station on banks of the Huia Stream.
>
> The return trip was not without its thrill. As there is no turntable at the top, the train travelled with the wagons ahead of the locomotive. Unknown to the driver, a gate across the line had been closed and the train crashed through it. The journey to the bottom occupied about 20 minutes.
>
> Like most single tracks, the railway has its record of accidents. Some years ago, through a breakdown in the signalling system, two trains met in a head-on collision and Mr. Thompson suffered severe injury. When a party of Australians was being taken for a ride on another occasion, the train collided with a cow, which had strayed on to the track, but neither the passengers nor the cow suffered any ill-effects.



↑ A jigger chassis. Greenwoods corner, Waitākere Ranges. 2008.

↓ Elvie Thompson and, I assume, her mother. They are at the sheds just down from the jigger shed near Huia village. Elvie kept a car here for going to Auckland.

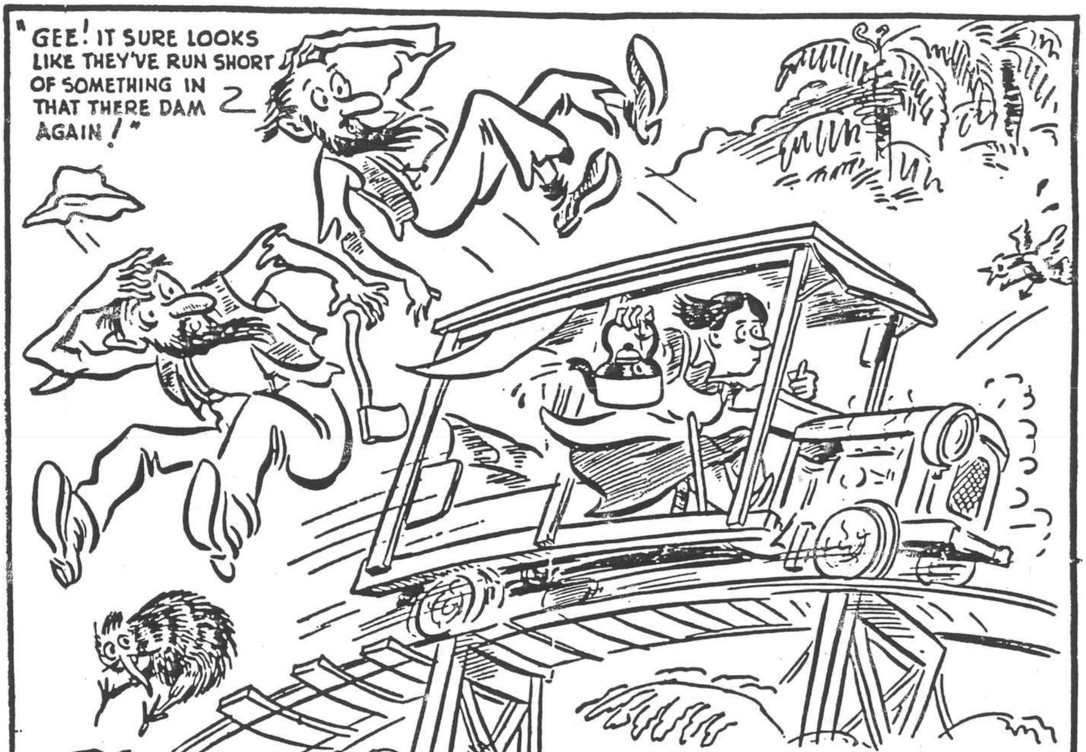
Going shopping

Elvie Thompson and Mrs Stewart, who lived at the dam, had to drive a jigger down to Huia to shop. I assume the women looked forward to these trips, because they could meet other people.

> Mrs Thompson … soon discovered that she must learn to drive a motor locomotive if she wanted to get into civilization regularly. Punching the locomotive along serpentine track which seldom allowed more than 30 yards clear vision ahead, through tunnels, and over points, took quite a bit of learning. But Mrs Thompson now knows the line so well she can reach fairly high speeds. She goes into Huia twice a week. There, if she needs it to go on to Auckland, is an old model tourer car.

They could also ring the Huia shop from the dam and order supplies. When the supplies arrived, the shop would put them in a shed by the landing, for a worker to take up the tramline to the dam.

↓ HUIA OR BUST



Visiting the valley

Until the early 1900s, the springs or wells that supplied Auckland's water could become polluted with toxic bacteria, usually typhoid. Chlorinating the water kills any bacteria, but most of New Zealand's water supplies were not chlorinated until the 1950s. Auckland kept the water from the dams in the Waitākere ranges pure by banning visitors from the valleys above the dams and by discouraging visitors to the lower valleys.

But people that the workers knew were allowed to visit the lower Huia valley and to ride on the tramline. Harry Kirkwood, the waterworks foreman at Huia, would take visitors on a tour up the tramline, to show them the dam, the big kauri tree and the pump house at Smiths Creek. Ken Lawrence remembered his father and his friends walking to the jigger shed, to get a ride on a work train going up the valley. Gloria Rae explained:

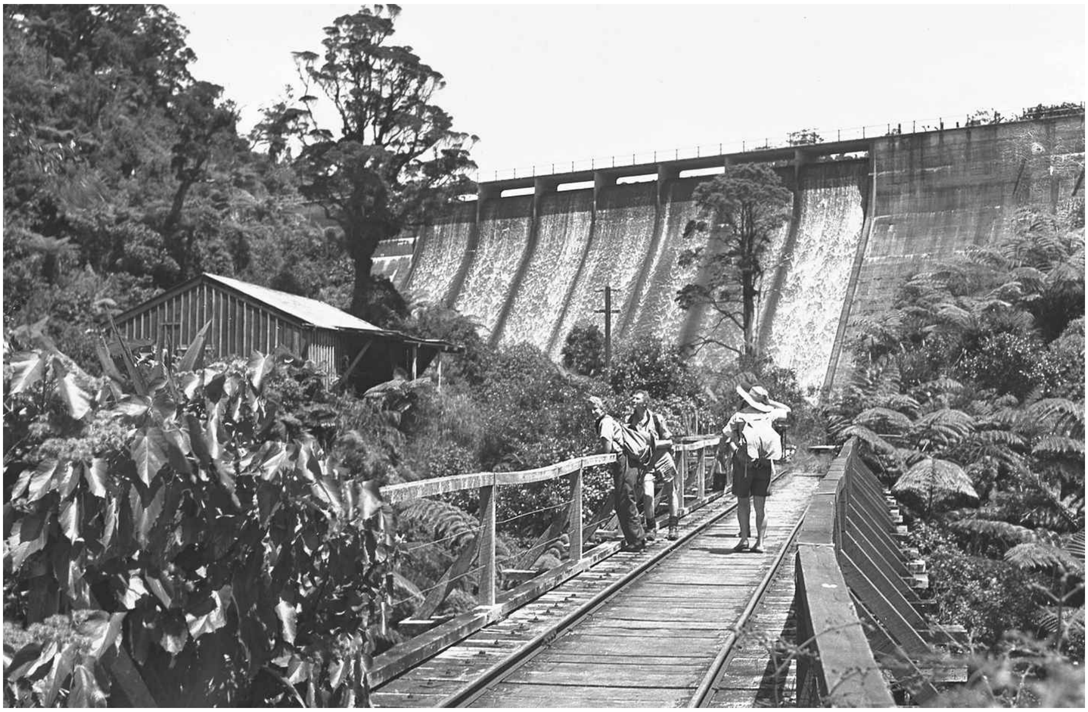
> Mrs Thompson was up and down the line a lot, and if they were going up and somebody's coming back, all hop in. It was pretty informal, especially if you lived down there … There were no rules in those days, I don't think too many people worried too much about the safety angle, you were so unaware of all that.

↓ Elvie Thompson and friends at her jigger. Eve Laing (Norm's wife), Elvie Thompson, Glenys Laing, Marilyn Smith, Lesley Laing, Cath Smith, Suzanne Smith, Bob Smith.

Several people I spoke to recalled how Elvie Thompson, one of the dam caretakers, loved taking people up to the dam for the day. Gloria Rae spent holidays with her family at their bach at Huia. In 2004, she vividly remembered her first jigger ride:

> The year was 1948, when as a 10 year old, I was first introduced to the jigger. Our army hut bach was only two doors away from Mr Kirkwood, the man in charge of the Huia dam railway. On seeing the jigger for the first time, although it was sitting on rails, I did not associate it with a train or even a tram, but "a car". A homemade wooden car, very square with front and back seats. I caused great mirth when I was anxious about the car having no steering wheel. There were also small tramline wagons, some with sides, some not, that were towed behind.
>
> With great excitement I climbed aboard. Me in the backseat of "the car". Mrs Thompson started the engine. Boy! was it loud! A coarse, hard roar, we blocked our ears. She slowly released the brake, and we moved forward quickly to gather speed. Wow! it was scary, so fast, so loud, with the feeling of no protection and holding fast to whatever I could find.
>
> The vibration, with the noise and hard wooden seats with no padding or no springs was particularly hard on a skinny kid with a boney bum. … Then came the bridge. Not with sides, but just a lot of spaces showing the water way below. I hung on. Then a tunnel. Everybody shouts, then straight out the other side. Frightening, but I wished it was longer.
>
> Every so often, Mrs Thompson would shovel a small amount of sand into a hopper that fed it onto the wheels. This was to give it grip, perhaps to keep us on the tracks. Does that mean we could fly off the rails? Any slight bend filled me with apprehension. Will we go straight ahead instead of turning the corner.
>
> I was never aware of the steep grade up hill in the last two miles as it was gradual, and the faithful jigger just kept rolling at the same speed. Once we arrived at "the top", and the engine turned off, I staggered away with shaky legs and ringing ears. I felt shattered but excited, I had survived. Then, watching the jigger being driven onto the turntable, I realised I had to go back and that was the only way. I swallowed hard, turned and ran after the others; "I will face that when I have to." I did, many times in the next 10 years. It always felt the same.

Elvie Thompson (right) and friends. About 1950, probably on Lincoln Bridge. Gloria Rae is in the middle row, second from left.



↑ Trampers on Huia Bridge at the dam. 1941. The rails are offset to the left side of the bridge so that a train and walkers can pass.

↓ Nugget Thompson on horse.

Freewheeling down

Several people I talked to about the tramline had loved freewheeling down from the dam on a small wagon. The top half of the tramline was steep and the wagon would stop somewhere on the bottom half. It was 'lovely stuff for youngsters,' and the young-at-heart. Merv Woon told me:

> Harry Kirkwood, the waterworks manager in the lower valley, took us up to the dam in a jigger pulling 3 flat top wagons. We picnicked for several hours at the dam. Then we children got on the flat tops, with an adult to work the brake, and we coasted down the tramline.

Norm Laing wrote:

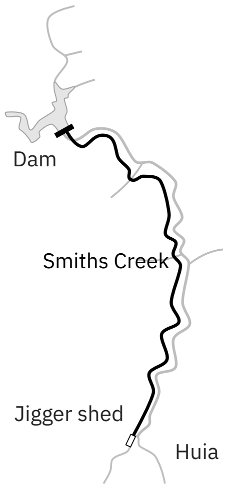
> Visitors to the dam could if they wished, pull a flat topped wagon up with them, then later, freewheel all the way home. An exhilarating ride it was too, down the long ti tree and ponga lined track, gathering speed and vibrating madly, crouched on the rough boards with nothing to hold on to. Clackity clack, clackity clack over the echoing bridges, whoosh through the tunnels, faster and faster with always the chance of the wagon jumping the rails on the curves. The crude wooden brake lever rubbing ineffectually against the screaming iron wheels. Conversations were shouted and unheard among the roar of sound rising, falling, changing tone with the nature of the surroundings hurtling past. At last the long flattish straight, past the swing bridge, and up to the old engine shed. What a sense of relief.

The wagons had brakes, a vertical, pivoted rod with a shaped piece of wood at the bottom that pressed against the wheel. These brakes would not have been useful for normal work on the tramline, which suggests that the brakes were specially fitted for coasting down the tramline.

Different people had different memories of how fast the wagons went. Merv Woon, a child, said that they didn't go particularly fast, and he didn't remember the brake being used. Norm Laing and Took Moore, adults, said they did go fast, the brake was needed, and if it was wet or the wagon had good bearings, they would need to sprinkle sand on the brake. Perhaps they sent the children down on the slower wagons.

Nugget Thompson, a dam caretaker, used to send wagons of firewood from the dam to Huia by letting them freewheel down.

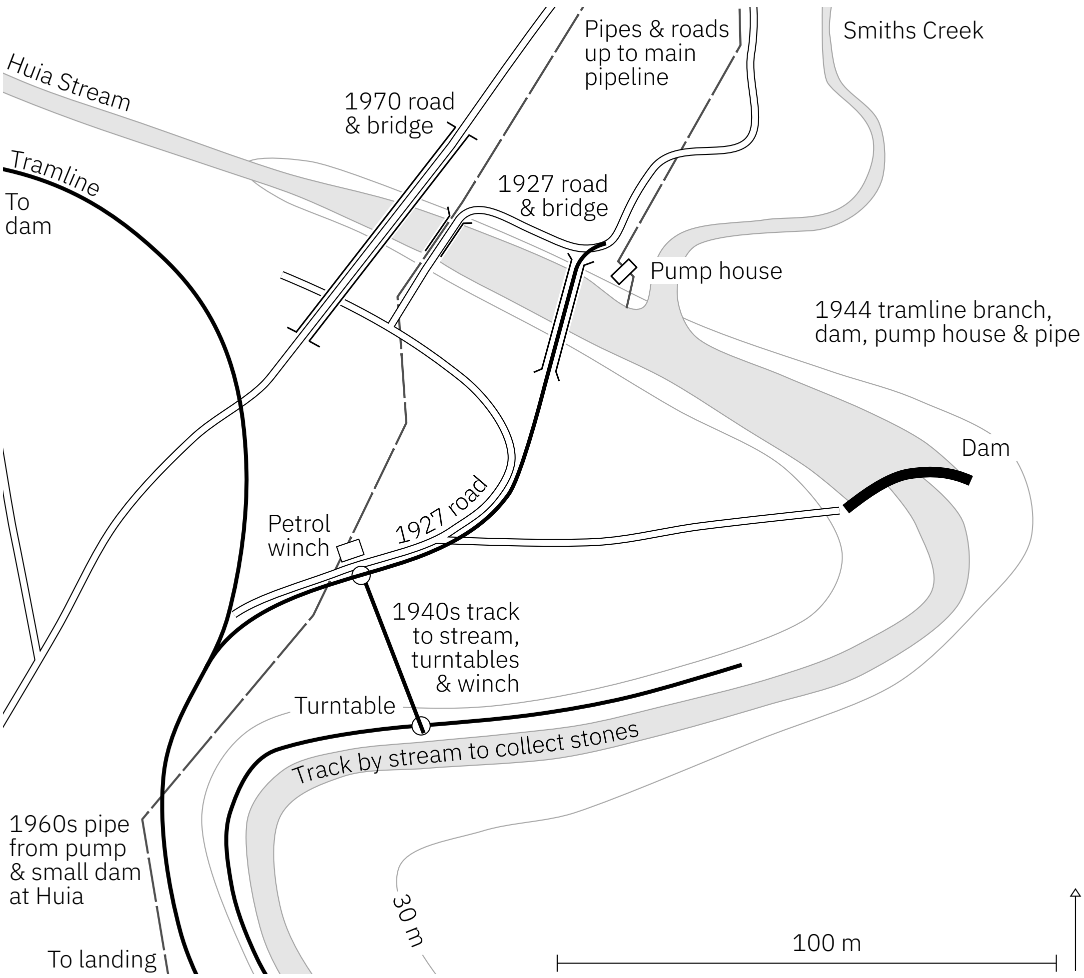
Smiths Creek



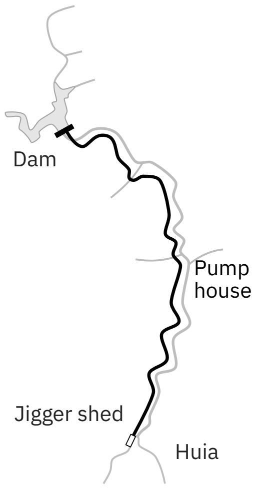
In about 1927, the dam engineers built a road from the tramline, across Huia Stream on a bridge and up the hill, to where the main pipeline from Huia dam to Auckland was to run. A truck carried pipes, people and supplies up the hill. There was a work camp up there, at the mouth of the pipeline tunnel to the Nihotupu valley.

In 1944 there was a water shortage. The engineers built a tramline branch across Huia Stream, and built a small dam and pump house to pump water up to the main pipeline. About this time, the workers laid railway track down to the stream and along the stream bed. They collected stones from the stream bed to crush.

In about 1970, the engineers replaced the main pipeline, building a new bridge and road to the pipeline. In 1971, the Lower Huia Dam reservoir flooded the valley, to above where the tramline had been.



Pumping water



Auckland had water shortages in the 1940s and 1950s. To augment the supply, the council pumped water from Huia stream up to the pipeline from the dam to Auckland.

During the 1930s depression, Auckland's water consumption rose slowly and the council postponed the next big dam, planned for Lower Nihotupu. But in the early 1940s, new industry, sales of water to North Shore, new military establishments and the growing number of home vegetable gardens (victory gardens) all needed water. The average consumption rose from 40,000 cubic metres a day in 1936 to 70,000 in 1943. Up to 80,000 in summer. A very dry summer in 1942-43 caused another Auckland water crisis. The council responded by:

- Introducing water restrictions and preparing for severe water rationing. (It rained in January 1944 and rationing was avoided.)
- Starting work on the Lower Nihotupu dam, though wartime shortages delayed the finish.
- Installing temporary pumps at streams around Auckland to augment the water supply. In 1943 they placed fire trailer pumps beside the Huia and the Nihotupu streams, just below the pipeline from Huia dam to Titirangi. The creeks in the upper valleys dry up during summer, but creeks in the lower valleys keep flowing.

In 1944 the council replaced the Huia trailer pump with a small dam and pump house further down the stream, at Smiths Creek.

> The dam was sketch-designed by AD Mead on site, on a scrap of paper, and handed to Jack Simmons, Water Department foreman carpenter, for implementation. Work was started within a week and finished 8 weeks later, concurrently with all pipework and pump installation.

The engineers built a tramline branch to the pump house, with a bridge across Huia Stream. The bridge was about 22 m long, with a gradient of about 1 in 15 down to the pump house. Each bridge abutment was a semicircle of vertical timber posts, about 3 metres diameter, closed by horizontal planks and filled with rubble. The posts remain.

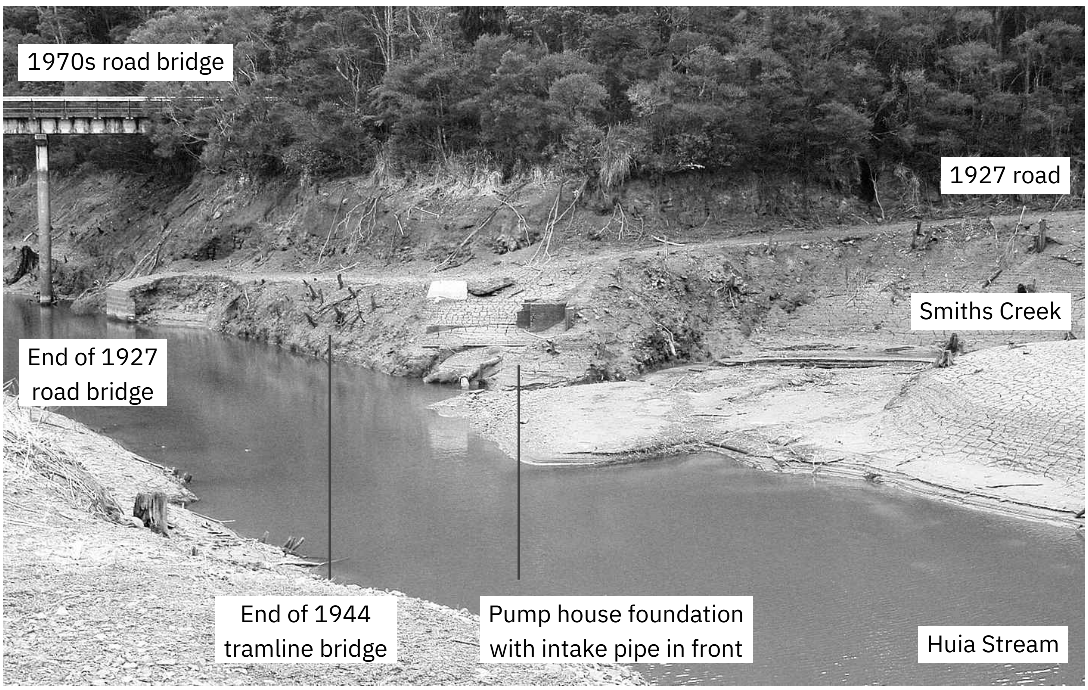
The flow of the stream was 9,000 cubic metres a day. The pump typically supplied 7,000 cubic metres of water a day, about a twelfth of Auckland's summer needs.

The pump house was about 5 metres long and 2.5 wide. It had 2 floors. The top floor was storage for fuel and supplies. The bottom floor had a 140 hp diesel motor and its petrol motor starter, both bolted to the concrete floor. The diesel motor came from the Western Springs pump house. The pipe from the pump went up to the pipeline from Huia dam to Auckland. It was 20 centimetres diameter, of thin steel, about 700 metres long and it rose about 70 metres. The pump was set into the concrete pump house floor, to take the pressure of the water in the pipe.

The dam held less than half a day's supply of water. The purpose of a small dam like this was not to hold water for dry times, but to slow the flow of water so that sediment could fall to the bottom and not be pumped up the pipeline. The intake would have been about half a metre above the reservoir bottom, above the sediment. The dam had 2 sliding gates near the bottom, operated by hand wheels, to empty the reservoir occasionally. The sudden flow of water scoured out sediment and eels from the bottom of the reservoir.

The Huia pump house was used as needed, first from 1944 until the Lower Nihotupu dam was finished in 1948, then again in the 1950s.

↓ The pump house site. 2005.



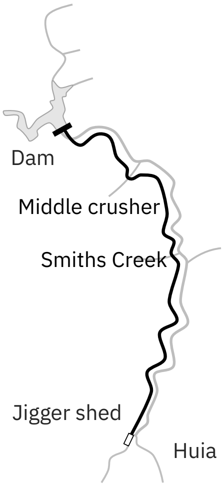
↑ Smiths Creek dam. 'It looked brilliant, with bush on both sides and water streaming over the dam.'

When the pump was used in the 1950s, it was manned by 3 shifts, changing at 8 am, 4 pm and midnight. Took Moore described a shift at the pump house. He lived about 3 kilometres west of Huia, and walked to and from work. At the engine shed he took a jigger and coupled it to a flat top wagon. He loaded it with drums of diesel and any other supplies he needed. Diesel fuel came in 44 gallon drums, moved by rolling their rims on the ground. At the pump house, Took unloaded the supplies onto the ground, then into the pump house. The motor was noisy and the work boring. He spent a lot of time walking in the bush nearby. When his shift was over, he turned the jigger on the nearby turntable and drove back.

Merv Woon saw the pump working when he was a boy. He said that the pump motor looked huge and turned slowly.

By the late 1960s, this pump and weir had been replaced by a larger weir and pump near where Lower Huia dam is now. The site was flooded when the lower Huia dam reservoir filled in 1971. It emerges when the water level drops.

Crushing stones

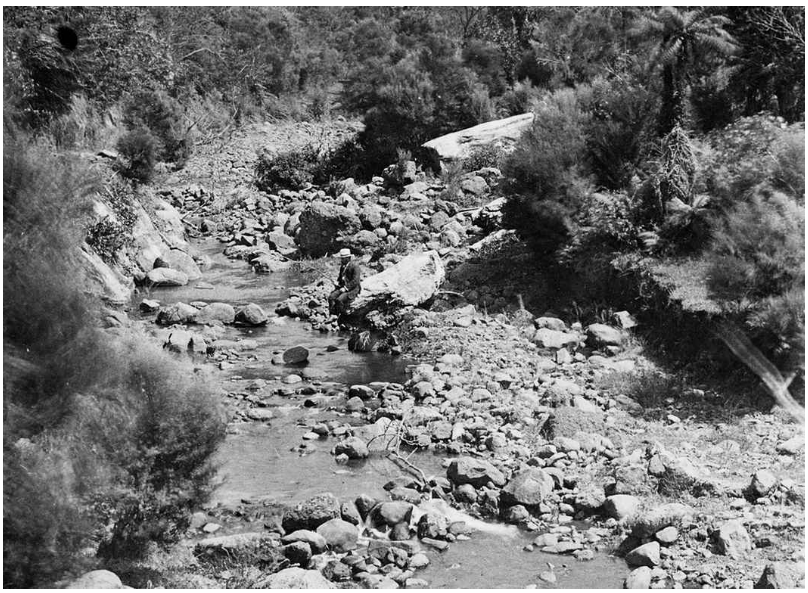


Workers collected stones from Huia Stream and crushed them in the middle crusher, a small crusher beside the tramline. The crushed stone was used to replace tramline ballast, surface roads, make concrete, and sell. To collect the stones:

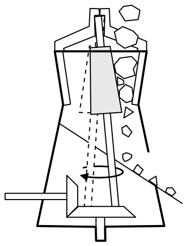
- Workers fitted a turntable on the tramline and laid railway track down to the stream. A petrol winch at the top hauled a metal wagon down and up. These installations were usually temporary. There was a more permanent track down to the Huia stream at Smiths Creek, with another turntable at the stream bed and track beside the stream. Workers pushed the wagons along the stream bed by hand. It was used 'for years'.
- The big jigger had a winch to pull a bucket of stones up from the stream to the tramline.

Took Moore recalled the work: They'd couple up a jigger to a metal wagon, drive up the tramline, and use the winch to lower the wagon down to the stream. To fit into the crusher, the stones had to be smaller than about 15 centimetres across. They would break stones up to 60 centimetres across with a spawling hammer. They turned the stone so its grain was vertical, then split it with one blow. When they had loaded the wagon, they would winch it back up to the tramline and turn the jigger on the turntable at Smiths Creek. Then they would take the wagon to the middle crusher and unload the stones beside the crusher.

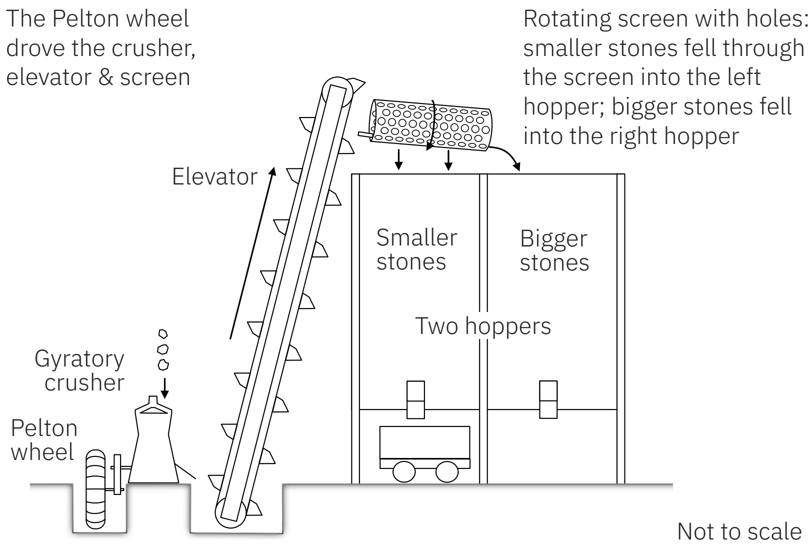
Huia Stream with stones and person.



The middle crusher



Gyratory crusher



The middle crusher

When there were enough stones at the crusher, the workers crushed them. They opened the Pelton wheel valve to start the crusher, then threw the rocks in. ‘A rock would go part way in, the outer layers splinter off, it would fall further in and crush some more till it fell out the bottom.’ But, ‘The crusher was hard to load, a round stone could be thrown out and brain you. You had to stand clear and throw the stones into the crusher.’

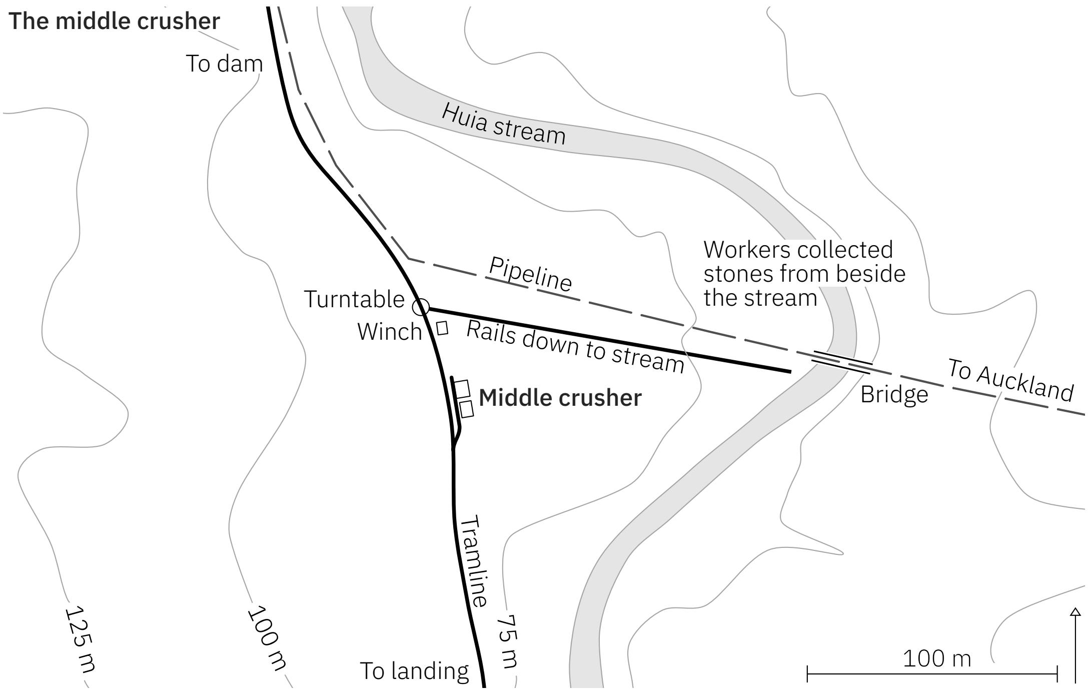
The workers used the smaller crushed stone, called chip, to make concrete. They mixed it with beach sand from high up the beach, where rain had washed the salt out.

They used most of the bigger crushed stone to replace ballast lost by the vibration of passing trains or washed away by rain. They would load a wagon with crushed stone at the middle crusher, take it to the job, pull an end board off the wagon, shovel the stone off, and pack it under the sleepers with a sledge hammer.

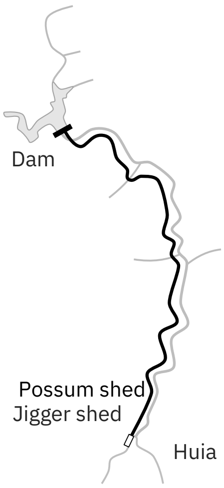
Harry Kirkwood sold crushed stone, mostly to the local Waitematā County Council. A 1947 crusher report listed ‘200 yds of Road Metal taken from the Huia stream for Mr Page has now been stacked at Lower Huia; Time taken on job: 92 hours; Men employed 6; Benzine used in winch and jigger: approximately 70 gals.’ The charge was 12 shillings per yard, including loading.

When the tramline was lifted and converted into a road in 1959, the crusher crushed the stone for the road surface.

The middle crusher. The Pelton wheel and crusher are under cover on the left.



Possums and pigs



In 1932, Nugget Thompson released bellbirds from Little Barrier Island in the Huia valley. He wrote, ‘the birds’ morning songs are charming, and sound as if there were many more singers than there actually are.’

But the bellbirds disappeared. Then, a 1936 newspaper reported:

> One of the least-known industries which flourishes close to the city is the trapping of opossums in the Auckland City Council’s watershed reserve in the Waitakere Ranges, a work which is being undertaken by two experienced trappers. The opossum “bag” ranges from about 20 to 30 a week, which suggests that the animals are fairly plentiful in that locality. The traps also yield weasels, an occasional polecat, and a great many rats. The destruction of the latter is viewed with satisfaction owing to the steps taken to preserve wild bird life in the Waitakeres.

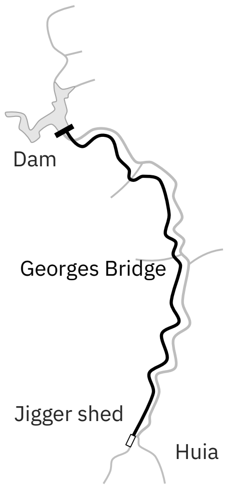
An industry it was. In 1944, Arthur Mead wrote to J Wallace of Auckland, allowing him to trap possums on the waterworks reserve at Huia. On skins he sold for 5 shillings or more he was to pay the council 1 shilling. For lesser value skins he was to pay 6 pence. Wallace was to mark the skins in accordance with regulations and sell them through a licensed dealer. He could rent about 70 council traps for 6 pence per trap per season. He would need to get a trapping licence.

In 1948, Mead asked Kirkwood to employ a man to trap possums. He employed Took Moore, who was looking for a job at Huia.

The tramline carried the dead possums down the valley. They were processed in a big shed, built for the purpose beside the siding that used to serve the quarry near Huia. Here, the possums were skinned and the skins nailed to boards to dry. The boards were put outside on fine days and bought into the shed at night. Ken Lawrence said that the shed stank.

Merv Woon saw that as the possums were killed, the bush and then the pigs returned. Took recalled coming down the tramline in a jigger and finding 2 piglets on the tramline at Stoney Creek. He grabbed the piglets and sped off in the jigger, chased by the mother. He reared the piglets to eat.

Rebuilding Georges Bridge



In 1952, Arthur Mead 'urgently' wanted girders to rebuild Georges Bridge. A & G Price had suitable steel C-section girders in stock, approximately 8 by 3 inches. He needed 8 girders, 39 feet 8 inches long. The price was 20 pounds a ton.

Mead cut 4 of the girders in half and used 4 of these half girders at each end of the bridge, for the short spans. He used the other 4 full-length girders to make 2 steel trusses for the middle span. Each truss had a girder top and bottom, 60 centimetres apart, with 50 x 50 x 9 millimetre steel angle welded between.

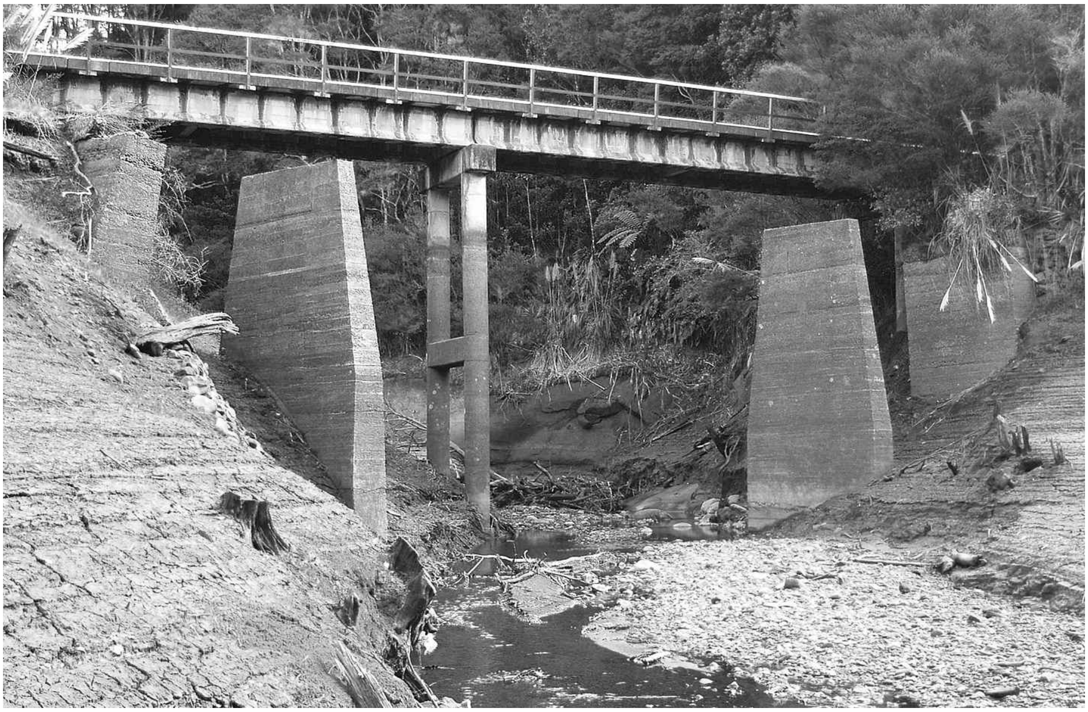
Took Moore remembered building the bridge. It was all done by hand. They pulled the old bridge down and built new concrete piers on the existing concrete pier foundations. There were shortages and they had no reinforcing steel.

To position a girder, they secured a jigger at the uphill end, and strung a steel cable between that and an anchor at the downhill end of the bridge. They slung each girder under the cable from 2 pulleys, pulled the girder across by hand and lowered it into place. Harry Kirkwood got too anxious and couldn't bear to watch. Finally, the workers welded a few lengths of 125 x 9 millimetre steel bar between the 2 trusses.

↓ The rebuilt Georges Creek bridge. About 1970. Looking down Georges Creek. Workers are starting to build the present concrete road bridge.

↑ In about 1970, the workers who built the present concrete bridge demolished the tramline bridge. They tossed the trusses down beside the stream. They are upside down now.

↓ The concrete piers, 2007.



The end, 1959

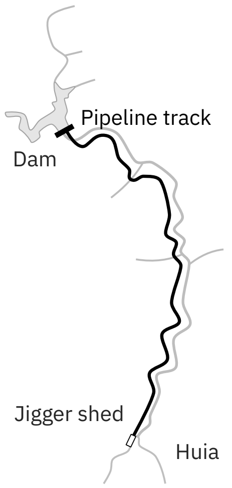
Norm Laing saw the tramline being built. He wrote about its end:

> And yet, sadly the old line had to go. The rough sleepers and light rails had had their day. It was all ripped up and replaced with a road. With the passing of the line, went all the romance and nostalgia of this fascinating episode in the history of The Huia. At the time of writing, 1985, there are still many people who vividly recall their participation in these events with the greatest fondness for "The Good Old Days" at the Huia Dam.

The rails from the Huia line were relaid as parts of the tramlines at the Nihotupu and Waitākere dams.

↓ The caretaker's second jigger, abandoned in its shelter at the dam. It's 1962, three years after the tramline rails were lifted.

Postscript



A pipeline carries water from the dam to Auckland. Just below the dam, a 200 metre length of this pipeline runs from the dam, on the north side of the stream, through a tunnel and over a bridge, to where the landing tramline was. Two-foot gauge railway track runs beside this pipeline. See map, page 68.

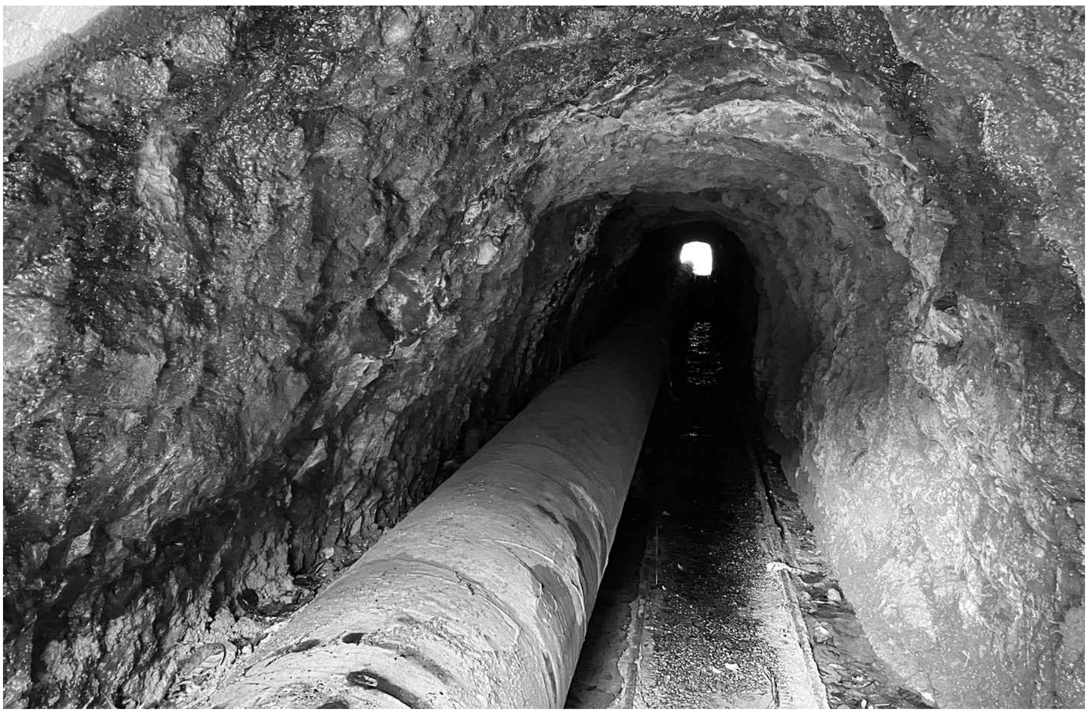
The railway track was laid in the late 1920s to carry the pipes into place. Men or a horse would have pulled the wagons. Similar 2-foot gauge track was laid in the Nihotupu valley to carry pipes and supplies. This was one of the only sections of pipeline in the Huia valley that was not close to the tramline or a road, so the separate railway track was needed here.

The track's purpose now is to carry in new pipes if the pipeline bursts. In about 1970, the pipeline was upgraded with the pipes you see here. Harvey Stewart, who worked on this job, found the pipeline and track in poor condition. At the north end of the tunnel, it was covered by a slip. They cleared the slip and repaired the track. They laid the new pipes where the railway track was and then laid new track where the old pipe had been. So as not to interrupt the flow of water.

↓ From the north end of the tunnel, looking up the valley towards the dam. Slips are common here. 2022.

↑ From the south end of the tunnel, looking across pipe bridge number 1, over Huia Stream, to where the landing tramline ran. The concrete bridge piers and crossbeam are original. 2022.

↓ The tunnel. Tunnels were simply blasted through the rock and the loose pieces knocked off with a crowbar. 2022.



Appendices

Maps, drawings and profiles

To draw my maps, drawings and ground profiles, I used:

- Maps and aerial photos from Auckland Council GeoMaps, geomapspublic.aucklandcouncil.govt.nz.
- Historical aerial photos from the Retrolens photo archive, retrolens.co.nz.
- GIS (geographic information system) maps and profiles. I used LINZ dataset *Auckland LiDAR 1m DEM (2013)* and QGIS, a free and open source GIS app from qgis.org. The lidar data is smoothed, and I could rarely find detail like tramline cuttings.
- My surveys with a compass, a long tape measure, a distance-measuring wheel, an aneroid barometer and an inclinometer.
- *Upper Huia Dam lake bed contours - 1986*, Auckland Regional Authority, 1986.
- *Lower Huia headworks, General site plan*, Auckland City Council, about 1965.
- *Landing at Huia Bay*, Auckland City Council, about 1925.
- *Huia water supply proposed tramway route*, Joe Clarke, about 1926, 6 sheets, sheets 4 & 5 missing.
- *Huia pipe line 21 inch main*, Auckland City Council, about 1927, Council Archives number 6591, sheets 1 to 3 of 6.
- *Huia pipe line 21 inch main*, Auckland City Council, about 1927, Council Archives number 6751, sheets 1 to 7 of 8.

Heights above sea level

Sea level changes with the tide. Surveyors have to choose one exact height to be their sea level. This height is called a datum. All heights above sea level in this book are to NZVD 2016 datum.

The top of the Huia dam's spillway is today given as 165.9 metres above sea level to NZVD 2016. The dam surveyors gave the top of the spillway as 540 feet (164.6 metres). This means their datum was 1.3 metres above NZVD 2016 at the dam.

What datum did the dam surveyors use? They might have chosen an arbitrary point in Huia Valley to be their datum. Or, they might have used the 'The old ACC and ARA datum', which is 0.9 metres above NZVD 2016 in the Huia valley. The difference between 0.9 and 1.3 metres is 0.4 metres, which would be their error here.

AI

I used an online AI image upscaler to enhance some of my photos, aiseesoft.com/image-upscaler. It can increase the number of pixels, make details clearer and reduce noise. For a good original, there was little improvement. For a poor original the improvement could be worthwhile. I usually blended the AI image with the original in different amounts. The AI was great at making blurry man-made objects crisper. It was not so good with faces, because it tended to make them all look 35 years old.

I created some images from scratch using the online Stable Diffusion, stablediffusionweb.com. You enter some words, called a prompt, to describe the image you want. Stable Diffusion then creates the image. It didn't do too well on the image below, though it did know that old photos usually have dust and spots. I thought it did a useful job on the image on page 8.

Stable Diffusion's response to my prompt 'Building the concrete Huia dam in Huia valley in 1928.'

Abbreviations

ACA: Auckland Council Archives. The reference is the record number. In 2004, records 27-134, 28-380 and W4696 were with the Auckland Regional Council and stored at Archives New Zealand, Auckland.

ALI: Personal interviews with Andy Loader, 2004 and 2021. Andy kindly explained how the Huia dam quarry would have operated. He has wide experience in quarrying and health and safety in New Zealand.

ALHC: Auckland Libraries Heritage Collections.

EBTNZ: Mahoney P, *The era of the bush tram in New Zealand*, Tranzpress, 2004.

GR: Gloria Rae (née Woon). Gloria spent holidays with her family in their Huia bach in the late 1940s and 50s. She was a teenager.

GRI: Personal interviews with Gloria Rae, 2004.

HOH: Williams G, *History of Huia*, about 1928, Huia Settler's Museum. Gwyn Williams was the daughter of Charlie Williams, the Price locomotive driver. Gwyn wrote this for a training college assignment.

HSI: Personal interview with Harvey Stewart, November 2022.

HWMA: Murdoch G, *A history of the water supply of metropolitan Auckland*, Auckland regional authority, unpublished document, about 1990.

HWS: Mead A, 'The Huia water supply extension for the city of Auckland', *Proceedings of the New Zealand Society of Civil Engineers*, Volume XVII, 1931.

NZH: New Zealand Herald.

KLI: Personal interview with Ken Lawrence, 2004.

LTW: Volume 12 - Original Manuscripts of Leslie Thomas Williams, ALHC, JTD-038-0012.

MWI: Personal interview with Merv Woon, September 2004. Merv spent holidays with his family in their Huia bach in the late 1940s and 50s. He was a teenager.

NL: Norm Laing. Norm lived at Huia. He saw the dam being built when he was a child, and he promoted Huia history.

NLI: Personal interviews with Norm Laing, 2004.

OMV: Allen WR (Ray), *Oratia my Valley*, Self-published, 1984. See also his oral history: ALHC, WOH-1028.

PH: Peter Hopcroft.

PSI: Personal interview with Phil Sharpe, 2004.

RRE: Hay W, *Railroad Engineering*, Volume 1, John Wiley, 1953, at archive.org.

STAR: Auckland Star.

SUN: Sun (Auckland).

TSOH: Laing N, *The Settlement of the Huia*, Huia settlers museum, 1985.

VTMI: Personal interviews with Violet and Took Moore, August and September 2004. Took started working in Huia valley in 1948 and became supervisor of the Waitākere water supply dams.

WC: Watercare.

Notes

Front cover photo of the Gibbons and Harris locomotive on Georges Bridge: ALHC, CMI-PA-013-01, photographer Les Mills.

'With its three feet six inch gauge … ': NZH, 12 January 1927.

7 **Introduction**

'a quiet and deeply religious man … ': HWMA.

8 **At a glance**

Image of a reservoir: Stable Diffusion's response my prompt 'The upper Huia dam 1929.'

9 **Introducing the tramline**

Huia dam photo: Whites Aviation Ltd, WA-05539-G, Alexander Turnbull Library, Wellington, New Zealand.

10 **Huia dam construction timeline**

Timeline data and progress reports: ACA, 23-976 parts 1, 2 and 3 and 26-468.

At last water supply exceeded … : Star, 16 January 1923.

'It is desirable that the tramway … ': ACA, 23-976 part 1.

Consumption increased faster: STAR, 7 April 1927.

'The exceptionally dry summer … ': HWS.

'Owing to the very heavy floods … ': ACA, 23-976 p3.

12 **The tramline**

Photo of workers building the tramline: ALHC, CMI-PA-015-01, photographer Les Mills.

13 **Cement, sand and rock**

Concrete data: HWS.

14 **Why a tramline?**

Logging railways, horses and rail tractors: EBTNZ.

Waitākere dam tramlines: Photos of the time in ALHC.

Waitākere dam rail tractor: HSI.

Council tenders for a locomotive: ACA, 26-515 and 27-135.

Nihotupu auxiliary dam and 'Sand and cement were … ': OMV.

Douglas Motor bike, and a light and a medium truck: ACA, 23-495.

A Ford owners book: www.fordmodelt.net/m/how-to-drive.htm

The 1928 stocktake: ACA, 28-380.

Earth cheaper than concrete dams … : Petheram C and McMahon T, *Dams, dam costs and damnable cost overruns*, sciencedirect.com/science/article/pii/S2589915519300100.

16 **Tramway licence**

Tramway licence: ACA, 25-694.

17 **Surveying the tramline**

Railway surveying: RRE.

Photo of Joe Clarke at his drawing office: WC.

Joe Clarke surveying, job costing, and 'I did my work in a tent … ': ALHC, OH-1371 tapes 5 and 8.

Photo of Arthur Mead surveying: ALHC, 1166-ALB226-06.

19 **Designing the tramline**

Tramline route details: HWS.

Calculations for curve compensation, transition curves and superelevation: RRE.

'The upper two miles … ' and 'Owing to the gorge-like valley … ': HWS.

Curve compensation graph: From *Huia water supply proposed tramway route*, Joe Clarke, about 1926. drawing 6 of 6.

'A short transition was given … ': HWS.

dam engineer's 1926 specification … : ACA 27-135.

'that little sideways shift … ':GRI.

'Introducing curve compensation … ': RRE.

24 **Building the tramline**

Railway design, surveying and construction: These books and more are at archive.org: Turneaure F and others, *Cyclopedia Of Civil Engineering*, Volume 9, American technical society, 1921; Webb W, *Railroad Engineering*, Part 1, American school of correspondence, 1915; see also RRE.

Moving spoil and 'We lived under canvas … ': OMV.

Photo of men digging a cutting: ALHC, CMI-PA-015-04, photographer Les Mills.

'The formation was 9 feet wide … ': HWS.

Stoney Creek is now called Paddy Stream.

Sleeper details: ACA, 23-495.

half a cubic metre of ballast … : ACA, 27-134.

'There were some derailments … ', 'The tramlines were maintained … ': and A fifth of the total cost: HWS.

'With its three feet six inch gauge … ': NZH, 12 January 1927.

28 **Locomotives and wagons**

Photo of Price Cb locomotive from Huia dam. Restored at Pukimiro, 2007. Harvey Stewart, the champion of today's tramline in the Nihotupu valley, is in the cab: PH.

29 **Tramline locomotives**

Tramline locomotives: EBTNZ.

'I had to have a large tin … ': LJW.

31 **Price locomotive**

Price locomotive history: Stott B, *Prices of Thames*, Southern press, 1983.

Price locomotive tender and details: ACA, 26-515 and 27-135.

Drawing of price locomotive: Dyer P, NZ Railway & Locomotive Society.

'The small 16-tons locomotive … ': NZH, 8 October 1929.

'A rather prehistoric … ': NZH, 30 May 1927.

'a rather shaky-looking species … ': HOH.

33 **Gibbons and Harris locomotive**

Gibbons & Harris locomotive history: Coghlan M, 'The last Gibbons & Harris Locomotive', *New Zealand Railway Observer*, Volume 221, 1995.

Drawing of Gibbons and Harris locomotive: Dyer P, NZ Railway & Locomotive Society.

'At Huia a quaint little locomotive … ': NZH, 18 February 1926.

Hector name: ACA, 28-380.

'It was approaching … ': HWS.

'The weight of 8 tons … ': ACA, 23-976 part 3.

Photo of locomotive at Nihotupu quarry: ALHC, 1-W1804.

Photo of councillor's visit: WC.

Photo of payday exodus: ALHC, CMI-PA-017-01, photographer Les Mills.

36 **Bagnall locomotive**

Bagnall locomotive history: Millar S, *Bagnall locomotives in New Zealand*, Sean Miller, 2002.

They asked the government's … : ACA, 27-134.

Drawing of Bagnall locomotive: Dyer P, NZ Railway & Locomotive Society.

The Bagnall locomotive was at the dam … : ACA, 28-380.

Used for shunting: HWS.

Shipping weight 9 tons … : ACA, 23-976 part 3.

37 **Tramline wagons**

Wagons based on log bogies: HWS.

20 log bogies … and 32 wheel sets … : ACA, 23-976 part 3.

Drawing of 5-yard wagon: Drawn from wagon photos.

The 1928 stocktake and '3/16 plate, pin and link … ': ACA, 28-380.

40 **The landing tramline**

Photo of landing: ALHC, CMI-PA-030-03, photographer Les Mills.

41 **Carrying cement and sand**

'ordinary load was about 32 tons … ' and 'Running down empty … ': HWS.

8 canvas covers … : ACA, 28-380.

42 **Manukau harbour**

'The Council launch … ': HOH.

Cement and sand shipments: ACA, 27-134; HWS.

Weights of cement and sand required: see page 13.

Photo of launch Outlaw: ALHC, 282-66.

15 metres long … : a barge 6 by 22 metres carried 88 cubic metres, 123 tonnes, of sand: SUN, 19 April 1927.

Photo of workers unloading a sand barge: ALHC, JTD-08B-03298-2.

Sheds contained crushers, concrete mixers …: STAR, 29 September 1926.

45 **The landing**

Landing details: HWS.

Photo of Huia stream mouth: PH.

Cement shed dimensions and capacity: ACA, 46-96 and 26-468. The capacity was 100 tons, not 250 tons.

Photo waiting for a launch: ALHC, CMI-PA-054-01, photographer Les Mills.

Photo of landing from the air: Whites Aviation Ltd, WA-74853-F, Alexander Turnbull Library, Wellington, New Zealand.

Photo of the landing gang: ALHC, CMI-PA-024-01, photographer Les Mills.

49 **Huia engine shed**

'On summer nights … ': HOH.

Photo of trampers on bridge: ALHC, JTD-07J-02137-G, photographer CC Roberts.

50 **Huia Bay crusher and quarry**

Half a cubic metre of ballast, and Collets crusher data: ACA, 27-134.

'The engine for this plant … ': LJW.

Drawing of crusher and engine: Redrawn from ACA, 6178.

Photo of Huia crusher, about 1925: ALHC, CMI-PA-002-03, photographer Les Mills.

Dismantled the crusher … : ACA, 46-96.

53 **Price locomotive accident**

Norm Laing description: NLI,

Photo of Price locomotive on its side: ALHC, CMI-PA-032-01, photographer Les Mills.

54 **The short tunnel**

Photo looking down the valley: PH.

55 **Georges Bridge**

Photo of the Gibbons and Harris locomotive on bridge: ALHC, CMI-PA-013-01, photographer Les Mills.

Drawing of Georges Bridge: Redrawn from *Huia tramline, Bridge at George's Creek*, numbered 6257, Auckland City Council, about 1926.

Photo of Building Georges Bridge, early 1926: ALHC, CMI-PA-010-02, photographer Les Mills.

'One is left in awe … ': Chapman J, 'Historic Timber Bridges in New Zealand', *Structural Analysis of Historical Constructions*, New Delhi 2006

58 **Collecting firewood**

Gwyn Williams quotations: HOH.

When they bought the Kelseys': ACA, 25-694.

'It is suggested we might … ': ACA, 23-495.

59 **Cuttings**

'The formation was 9 feet wide … ': HWS.

David Hoyle: Personal interview with David Hoyle, September 2004.

Photo of cutting: PH.

60 **Lincoln Bridge**

Drawing of Lincoln Bridge: Redrawn from *Huia tramway, Lincoln Creek Bridge*, Auckland City Council, no drawing number, about 1925.

Photos of bridge pier and north end of long tunnel: PH.

Photo of bridge converted to road: ALHC, 904-0164, photographer HL Wakelin.

64 **The long tunnel**

'12 feet high by 10 feet wide … ': HWS.

Concrete lining: ACA, 23-976 part 3.

Burying the pipeline: HSI.

65 **Huia Bridge**

Drawing of Huia Bridge: Redrawn from *Trestle for tramway bridge, Huia dam*, ACA, 6653B, and Auckland Regional Authority drawing of replacement bridge, about 1970.

66 **Huia dam**

Photo of Huia dam on opening day: ALHC, CMI-PA-059-01, photographer Les Mills.

67 **The dam**

Drawing of dam: Redrawn from HWS.

Photo of Price locomotive with pipes: ALHC, CMI-PA-019-03, photographer Les Mills.

Photo looking down switch line: ALHC, 4-10520, photographer J Richardson.

Photo looking downstream to dam: ALHC, CMI-PA-028-03, photographer Les Mills.

Photo looking downstream from dam: ALHC, CMI-PA-038-02, photographer Les Mills.

71 **Concrete mixer & crusher**

'The mixer was a one-yard … ': HWS.

Photo of Crushing plant at dam: ALHC, CMI-PA-016-04, photographer Les Mills.

Photo of dam almost finished: ALHC, AWNS-19290904-45-2.

74 **The quarry tramline**

Photo of wagons at quarry number 1 face: ALHC, CMI-PA-032-03, photographer Les Mills.

75 **Carrying rocks**

'The driver had arranged … ': OMV.

76 **Castles Bridge**

Photo of Castles Bridge: ALHC, CMI-PA-025-01, photographer Les Mills.

Photo of Blizzard Bridge: ALHC, CMI-PA-025-02, photographer Les Mills.

Drawings of 2 bridges: From site measurements, contour maps and photos.

79 **Blizzard Bridge**

'There were some derailments in the first few weeks … ': HWS.

Two photos of locomotive derailed: ALHC, CMI-PA-022-03, and CMI-PA-022-01, photographer Les Mills.

83 **The incline**

Photo of bottom of incline: ALHC, CMI-PA-034-02, photographer Les Mills.

85 **Blasting for beginners**

Information about blasting: ALI.

First popper drills: *Maoriland Worker*, 23 August 1912.

Drawing of man using popper drill: *ICS reference library - Rock drilling*, ICS, London, 1920.

'It is strangely incongruous … ': STAR, 13 October 1927.

'The blacksmith is usually … ': Dana R and Saunders W, *Rock drilling*, John Wiley, 1911, from archive.org.

The 1928 stocktake: ACA, 28-380.

'At the present time mine officials … ': Maurice W, *The shot-firer's guide*, The Electrician Printing and Publishing Company Limited, about 1910, from archive.org.

'I heard a man call … ', and John Urquhart was killed: STAR, 27 November 1928.

William Langlands was killed … : NZH, 8 April 1916.

89 **The Huia quarry**

Arthur Mead quotations: HWS.

91 **Quarry operation**

Details of quarry operation in the 1920s: ALI.

'The stone was quarried in shots … ': HWS.

Photo of Te Henga quarry: ALHC, JTD-02G-01133-1, photographer JT Diamond.

Photo of wagons at quarry number 1 face: ALHC, CMI-PA-032-03, photographer Les Mills.

The quarry horse: OMV.

Insufficient lunch: ACA, 28-380.

Photo of quarry hoppers: ALHC, CMI-PA-035-01, photographer Les Mills.

Ban work camps: STAR, 28 January 1921.

Toilet problems: ACA, 23-976 part 3.

Drawing of quarry hoppers: Drawn from site measurements and the photo.

96 **1930 to 1959**

Photo of a train of enthusiasts: NL.

97 **The transition**

'The completed dam was an … ': TSOTH.

Photo of the finished dam: WC.

99 **The people**

'Popeye' and a keen naturalist: PSI.

Elvie did most of the work: VTMI.

'a hothead, but ok … ', and Violet Moore said that: VTMI.

'a terrible boss … ' and a toilet at the old main camp: KLI.

'I used to enjoy …': OMV.

'I have always enjoyed … ': LJW.

'nuggety', 'a lovely fellow … ', 'Everyone had a love of nature … ' and 'busting a gut … ' and The isolation was hard: MWI.

Ann Riemenschneider's letter and Arthur Mead's reply: ACA, 46-96.

101 **Tramline business**

The work during World War II, and around 1960: HWMA.

Details of the work in the valley and the danger of the work: VTMI.

'every man and his dog … ': MWI.

102 **Jiggers and wagons**

Charlie Flowerday's jigger: NZH, 1 March 1930, and STAR, 14 March 1930.

Photo of Elvie Thompson in first jigger: NL.

Details of turntable and types of wagon: VTMI.

Drawing of steel spine: From measurements of spine found near Upper Huia dam.

Kirkwood's 2 new metal wagons: ACA, 46-96.

Photo of caretaker's first jigger near the dam: WC.

Photo of Elvie's mother and caretaker's second jigger: WC.

Photo of big jigger at jigger shed: NL.

Photo of light jigger at dam: NL.

Photo of Kirkwood's jigger: ALHC, JTD-08M-05414, photographer Bill Beveridge.

Photo of a substantial jigger: NL.

107 **Tramline operation**

A 1951 newspaper article … : NZH, 31 March 1951.

Photo of jigger chassis: PH.

Photo of Elvie and her mother: WC.

109 **Going shopping**

'Mrs Thompson soon discovered … ': STAR, 5 October 1950.

Cartoon 'Huia or Bust': NL.

110 **Visiting the valley**

Kirkwood tour: MWI.

Ken Lawrence remembered: KLI.

Gloria Rae explained: GRI.

Photo of Elvie and friends: NL.

'The year was 1948 … ': Gloria Rae, *The Jigger*, handwritten description, 2004.

Photo of people on wagon: GR.

Photo of Trampers on Huia Bridge: ALHC, JTD-07B-03190, photographer Isabel Hooker.

Photo of Nugget Thompson on horse: WC.

114 **Freewheeling down**

'Lovely stuff for youngsters … ', and 'Harry Kirkwood, the waterworks … ': MWI.

'Visitors to the dam … ': TSOH.

Memories of how fast the wagons went and brake details: MW, NLI, and VTMI.

Send wagons of firewood: NLI.

116 **Pumping water**

Details of water consumption and the council's response: See articles in NZH and STAR of the time.

Details of dam and pump house: NZH, 12 Jan 1944.

'The weir was sketch-designed … ': HWMA.

The diesel motor came from the Western Springs: ACA, 46-96

Photo of pump house site, 2005: PH.

Recommissioned in 1950 : NZH, 15 Sep 1950, and ACA, 46-96.

Took Moore's description: VTMI.

Merv Woon saw the pump, and 'It looked brilliant … ': MWI.

Photo of dam: GR.

119 **Crushing stones**

Details of collecting and crushing stones, and 'The crusher was hard to load … ': VTMI.

Workers fitted a temporary turntable: NLI.

The big jigger had a winch: Lowe D, *Rails across the Ranges*, Lodestar Press, 1970s.

Photo of Huia stream stones: ALHC, 1043-ALB248-07-1, photographer SG Firth.

'A rock would go part way in … ': MWI.

1947 crusher report: ACA, 46-96.

Photo of middle crusher: GR.

Details of middle crusher: NLI.

122 **Possums and pigs**

Bellbirds from Little Barrier Island: NZH, 24 March 1932.

'One of the least-known industries … ': STAR, 8 December 1936.

In 1944, Arthur Mead wrote, and In 1948, Mead asked: ACA, 46-96.

Ken Lawrence and Merv Woon recollections: KLI and MWI.

Details of processing possums and grabbing piglets: VTMI.

123 **Rebuilding Georges Bridge**

In 1952, Arthur Mead wrote: ACA, 46-96.

Took Moore recollections: VTMI.

Photo of second bridge: WC.

Photo of bridge girder, and photo of concrete piers: PH.

125 **The end, 1959**

'And yet … sadly … ': TSOH.

Photo of abandoned jigger: ALHC, 904-0165, photographer HL Wakelin.

126 **Postscript**

Harvey Stewart's work: HSI.

Three photos of pipeline: PH.

128 **Appendices**

Photo of 4 workers, Shackleton, Basson, Naughton and O'Neill, who fed the concrete mixer at the dam: ALHC, CMI-PA-037-02, photographer Les Mills.

129 **Maps, drawings and profiles**

165.9 metres … : ARA drawing 0315 353-51 gives the height as 166.22 metres to the Auckland 1947 datum. I converted this to 165.9 metres to NZVD 2016 using an elevation converter at linz.govt.nz.

540 feet … : HWS.

Back cover photo of payday exodus: ALHC, CMI-PA-017-01, photographer Les Mills..

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