DIAL 111 – TAKAKA FIRE FIGHTING SCHEME

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ABSTRACT

The township of Takaka, in the Tasman district previously had no reticulated water supply. Water for fire fighting was drawn from numerous wells around the central business district (CBD), but these were not reliable and deemed inadequate.

Originally, the Council proposed installing a fully reticulated water supply funded by a Ministry of Health subsidy and from rates. Due to several aspects including cost, this was opposed by sections of the community; however it was acknowledged that the risk of fire, especially in the CBD would severely impact the town.

A working party was set up and the final recommendation was to install a fire fighting reticulation network around the CBD only. The completed design now allows local and immediate access to water supplies required by the fire service.

The design and construction phase required significant consultation with affected businesses through which the timing and management of the project was agreed to minimise disruption within the busy Christmas period and construction season.

This paper presents the issues in implementing a scheme that began after the Fonterra fire of 2005 through to the challenges during design and construction. It also highlights what many Local Authorities can face in addressing the needs of smaller communities with an adequate level of service at an affordable and practical level.

KEYWORDS

Water Supply, Fire Fighting, Headworks, Pressure Vessel, Level of Service

1 INTRODUCTION

This paper details the issues in implementing the Takaka fire fighting scheme from 2005 through to 2011.

MWH NZ Ltd (MWH) role as the Tasman District Council's Professional Service Consultant was to:

- Facilitate and provide engineering advice to the working party, including optioneering.
- Preliminary Design and Detail Design.
- Procurement.
- Contract Management.

The Takaka Fire Fighting scheme began as a local issue after the Fonterra fire of 2005, and this paper discusses how the early engagement with residents and key stakeholders helped ensure the challenges during the design and construction were minimal and that the final solution met the needs of the community.

1.1 BACKGROUND AND LOCATION OF WORKS

Takaka is a small town with a population of over 1,100 people situated at the south eastern end of Golden Bay on the lower reaches of the Takaka River. It is also the main business, service and shopping centre for Golden Bay.

The town and surrounding area is a popular tourist destination and experiences significant increase in population over the summer months.

Figure 1: Location of Takaka township

Takaka had no reticulated water supply and local businesses, schools and around 356 houses source drinking water from on-site private bores or roof water supplies.

Water for fire fighting was drawn from numerous wells dotted around the town. However; these bores were not often used by the New Zealand Fire Service (NZFS) for the following reasons:

- Many of bores were in-operable, of limited or unsuitable flow for fire fighting or simply could not be located.
- Wells were rendered unsuitable through vandalism/tampering.
- Risk of damage from the entrainment of gravel from the wells and therefore the NZFS would not connect their trucks to the bores due to the potential damage to the front line equipment.

In the Takaka CBD, the risk of fire spread is high due to the close proximity of old style wooden buildings. In a significant building fire, the NZFS would need several water sources available to adequately control the spread of the fire to neighbouring buildings, including buildings behind and across the street. The distribution and effectiveness of the fire wells made controlling any sizable fire very difficult.

Photograph 1: Wooden buildings within the Takaka CBD

It was clear that the existing infrastructure presented a significant risk that any fire could destroy a large part of the CBD.

On Wednesday 22 June 2005, a blaze nearly destroyed the Fonterra milk processing plant on the edge of Takaka. Over 500 residents were evacuated due to concerns of the blaze igniting noxious chemicals at the plant site. The NZFS investigators determined the cause of the fire was due to welding being carried out as part of the off-season maintenance.

During this event, fire fighters had to rely on the tanks within their trucks to manage the fire. These tanks were filled from a nearby stream.

The fire nearly caused the factory to close down which would have had a huge impact on the community. A similar fire in the CBD would be catastrophic.

Prior to the fire, the Tasman District Council had been exploring a fully reticulated drinking water supply for Takaka, however, even with a Ministry of Health Drinking Water Assistance Programme (DWAP) subsidy, the community opposed this proposal because of cost and the high quality of the available ground water. Following the events of the 2005 fire, the community understood the risk a fire posed to the future of the town.

Photograph 2: Fonterra fire in 2005

Photograph 3: Aftermath of Fonterra fire

This event led to the Council initiating a working party to determine how to address the fire risk. The working party included Takaka community representatives, the Tasman District Council (Councilors and Council staff), MWH and members of the NZFS. The working party determined that the existing fire fighting infrastructure was inadequate to protect the community.

This issue was further compounded in 2009 following the fire at the Takaka War Memorial Library building.

2 OPTIONEERING

2.1 WORKING PARTY

In order to determine the most appropriate new fire fighting infrastructure, the Tasman District Council, the Golden Bay Community Board, the NZFS, MWH and an interested party from the community met in numerous workshops to identify potential options based on the adopted goal:

"*To select and construct the most appropriate, cost effective and affordable fire fighting infrastructure to serve Takaka."*

Several options were considered and evaluated, these were:

1. Pressurised Fire Main – the system consisting of a 150 mm fire main, pressure controlled and located throughout the CBD and/or all of Takaka.

2. Pressurised Fire Main with Reservoir Storage – the system consisting of a 150 mm fire main with an elevated storage reservoir (instead of a pressure control system). This system would be located throughout the CBD and/or all of Takaka.

3. High Capacity Wells – replace the existing fire wells with higher quality wells that are deeper, more adequately screened and provided at suitable spacing to meet the Fire Service requirements. These wells would be located throughout the CBD and/or all of Takaka

4. Pumped Fire Wells – replace the existing fire wells with higher quality wells that are deeper, more adequately screened and have submersible pumps and control system to provide a suitable fire fighting water supply. This is the same as option 3 above, but includes a pumping system at each well to supply water. These pumped wells would be located only within the CBD.

5. Water tanker for outside the CBD only – the Council would provide a dedicated water tanker for the Fire Service to provide a minimum supply capability that meets the fire fighting needs outside the CBD.

Each option was assessed under the following criteria:

- Construction cost.
- Feasibility and practicality.
- Effectiveness for fire fighting.
- Risks and uncertainties.

The working party recommendation was a pressured fire main system for the CBD and a water tanker for the area outside the CBD. The proposed reticulation would not extend up to the Fonterra milk processing plant, as they had undertaken a significant upgrade of their own fire fighting capabilities following the fire.

3 DETAIL DESIGN

The aim of the scheme was to provide a dedicated, reticulated fire fighting supply for the Takaka CBD. The scope of the works included:

- Water Bores – utilising the existing bore behind the fire station as well as drilling a new bore and a monitoring well at the same location.
- Headworks – new bore pumps, pressure vessel and system controls.
- Reticulation – pipes, hydrants and values.

3.1 DESIGN PARAMETERS

3.1.1 FIRE CLASSIFICATION

Water supply requirements for fire fighting are detailed in SNZ PAS 4509:2008 New Zealand Fire Service Fire Fighting Water Supplies Code of Practice (Fire Code).

With consideration of the fire hazards in Takaka and the limited capacity of the bores, it was agreed with the Council to base the design upon a FW3 Classification. The requirements for a FW3 is for the water supply to be capable of delivering 25l/s within a distance of 135m of each properties building platform, with an additional 25l/s within 270m, combining to give a total of 50l/s at all points within the service area.

3.1.2 WATER PRESSURE AND STORAGE

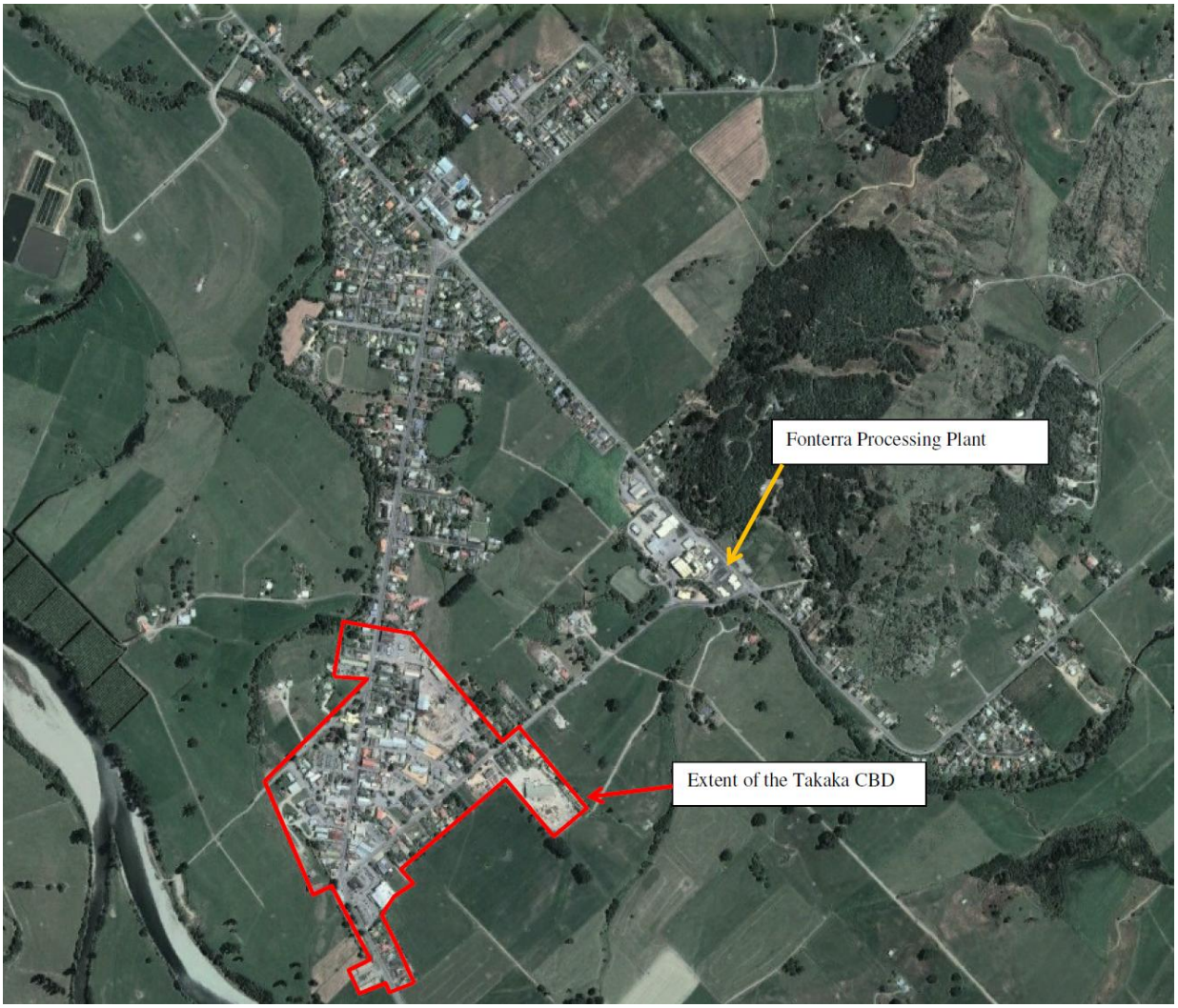
SNZ PAS 4509:2008 requires the following for water pressure and water storage:

- a minimum working pressure of 100kPa when fire flows are extracted from any point in the network.
- $180m^3$ storage for a FW3 water supply classification; the equivalent of 50l/s for 60 minutes (as an emergency generator was proposed and the aquifer supply guaranteed, it was deemed that the fire fighting storage was provided in the aquifer).

3.1.3 SUPPLY AREA

The new fire fighting water supply services the Takaka CBD as outlined in Figure 2 below.

Figure 2: Extent of the Takaka CBD



3.2 DESIGN ANALYSIS

3.2.1 HYDRAULIC AND SURGE

A hydraulic analysis, using KYpipe software, of the new water main was undertaken to assess the pump requirements and optimum size of the reticulation main.

In conjunction with the hydraulic analysis, a surge analysis was also completed to assess the fire mains susceptibility to water hammer. The pressure vessel was sized to be 4,000 litres to eliminate negative pressure from the pipeline which would have a detrimental effect upon the lifespan of the asset.

3.2.2 POWER

Based upon the kilowatt rating of the pumps and allowance of flexibility of the pumps supplied, the power supply to the site was sized at 37kW. The generator was sized to provide sufficient capacity to operate the pumps in the event of a power outage.

3.2.3 BORE CAPACITY

A series of pump tests were previously carried out on the existing bore located behind the Takaka fire station. It was found that the maximum draw-down of the water level for the bore was 323mm from a step-discharge test and that the peak yield was 52l/s from a constant discharge test. The low draw-down and high yield indicated a very high transmissivity (porosity) aquifer in the area.

4 PREFERRED OPTION

4.1 LAYOUT

A layout of the new fire fighting water supply scheme within the Takaka CBD is shown in Figure 3.

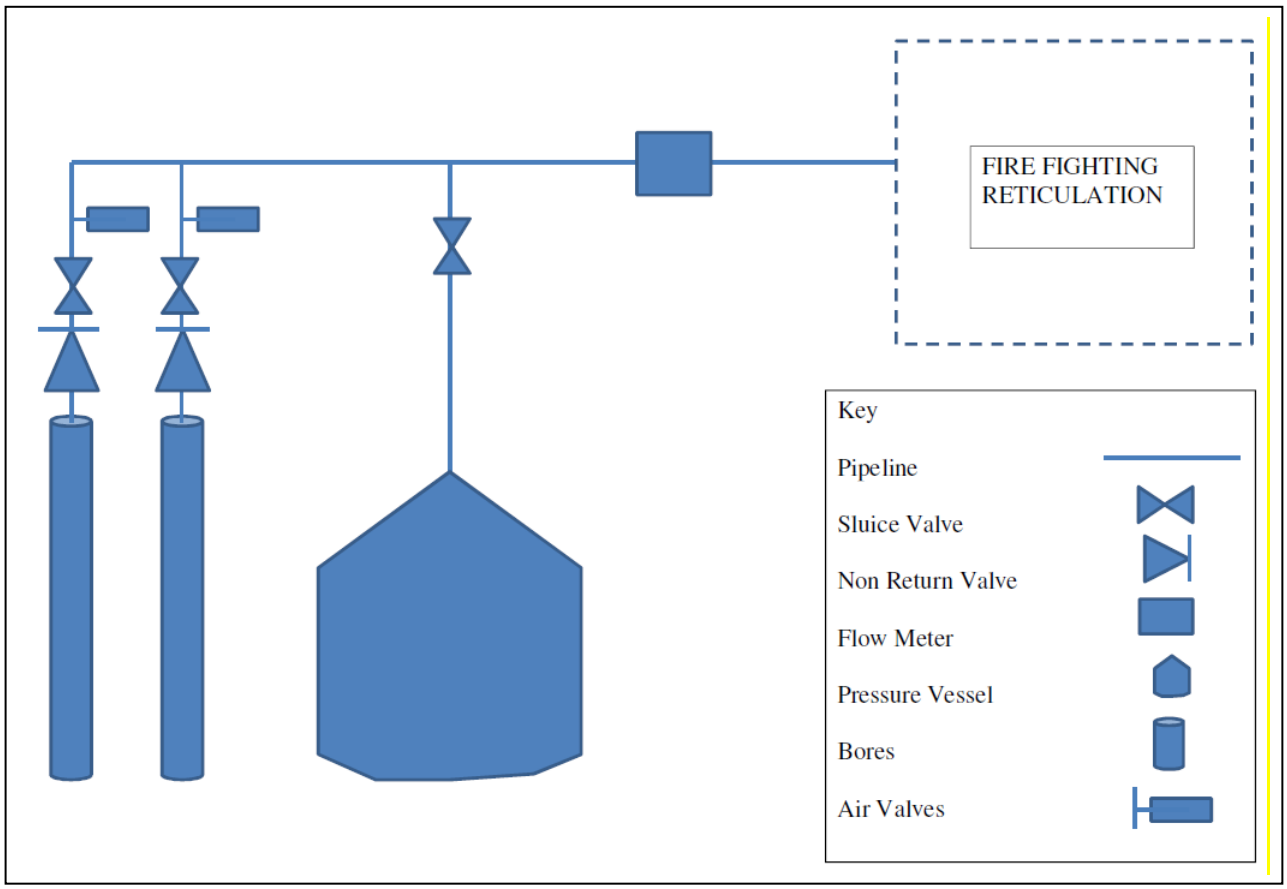
Figure 3: Layout of the new scheme


Key
Fire Main
Borefield
Hydrant

4.2 SCHEMATIC OF NEW SCHEME

A schematic of the new fire fighting water supply scheme within the Takaka CBD is shown in Figure 4.

Figure 4: Headworks schematic



4.3 WATER SOURCE

The aquifer beneath Takaka provided a reliable supply of high quality water and so bores had been selected to provide the water for the fire fighting main.

The existing bore at the Takaka Fire station is a 250mm dia bore. Two new bores were identified, one 300mm dia bore to accommodate the standby pump and one 150mm dia bore as a monitoring well.

4.4 HEADWORKS AND PUMPS

The headworks comprise of a duty/standby bore arrangement. Additionally, an electrical control cabinet, RTU aerial, back-up generator and pressure vessel was also provided.

The duty point for the two submersible pumps were determined as 36.6m at 52.5l/s from the hydraulic analysis. A 5% factor of safety was added to the flow rate.

4.4.1 PRESSURE VESSEL

The pressure vessel was originally proposed to be used to compensate for the unavoidable losses (leakage) from the system and provide instantaneous flow to the hydrants, while the pumps ramped up. After the hydraulic analysis was performed, the optimum size for the pressure vessel was determined as being 4,000l. This would also eliminate negative pressure from surge effects of the pipeline.

4.4.2 CONTROL SYSTEM

The fire main is controlled by means of pressure transducers linked to the pump controllers. The pressure transducer will allow the system to be primed and ready for use, while also be able to respond quickly to hydrants being opened.

The PLC unit is also used to control the duty/standby arrangement of the pumps, and the back-up generator. These were also linked into the Council's remote telemetry.

4.5 RETICULATION

4.5.1 PIPE SPECIFICATION

The fire main in the CBD network is approximately 1,740m long. The hydraulic analysis found that for the required design flow and pressure, a combination of 1170m of 150mm NB and 570m of 200mm NB was required.

Whilst the operating pressure of the system is low, less than 500kPa, PVC-U PN12 pipe was used in line with the Council's Engineering Standards.

4.5.2 HYDRANTS AND VALVES

The NZ Fire Code requires that there is a maximum hydrant spacing of 135m within the area to be serviced. This equates to 16 hydrants throughout the network. Both the NZ Fire Code and the Council's Engineering Standards required that the hydrants are located at least 6m from any building to allow for adequate working room. This generally meant the main had to be located within the roadway.

At each tee intersection, sluice valves on each branch and for all sections of pipeline in between them have a maximum spacing of 250m, as required in the Council's Engineering Standard. This equated to 14 valves throughout the network.

4.6 FUTURE PROOFING

Sections of the community have historically opposed the installation of the fully reticulated water supply; however a short section of flanged pipe has been included at the headworks, which will provide a convenient connection point for additional treatment if the scheme is to be used for potable water in the future.

It was also intended that the new 300mm dia bore be made suitable for potable supply and therefore the screen for the bore was below 30m depth to ensure that the well can be considered secure for drinking water.

5 CONSTRUCTION

5.1 PROCUREMENT

The construction was procured through two contracts.

The first (referred to as the main contract), was for the installation of the new headworks, reticulation and pressure control system and consisted of:

- Pipe laying in the Takaka CBD in public roads and private property including approximately 1,740m of DN150mm and DN200 PVC-U water main.
- Supply and installation of air valves, hydrants and associated fittings.
- Supply and installation of submersible bore pumps and pressure vessel, flow meter and associated pipe work.
- Supply and installation of generator, electrical control and telemetry equipment.

This contract was awarded to Ching Contracting for a price of approximately $1,050,000.00

The second contract included the drilling of two new bores on the NZFS land behind the Takaka fire station. This work involved the drilling of a 300mm dia production bore to be used in conjunction with the existing well for fire fighting water supply and a 150mm dia monitoring bore down to a maximum depth of 35 metres. This contract was awarded to Waimea Drilling for a price of approximately $94,000.00.

5.2 PROGRAMME

The main contract was awarded on 8 November 2010 with a construction period of 12 weeks. Due to the tourism season over Christmas, New Year and January, it was agreed with the community and local businesses that construction would begin after 14 February 2011. Furthermore, the NZ Transport Agency (NZTA) had stipulated that the section of work (600m of pipe laying) on Commercial Street (State Highway 60) could only take place from 1 March 2011 to 31 March 2011.

Due to the isolated location, the drilling of the new bores was able to start before the 14 February 2011 and was completed over a two week period on 30 January 2011.

5.3 CONSULTATION

With this project originally being community led, it was important that they were kept up to date with how the project was progressing on a weekly basis. Prior to the construction of the scheme, a news flyer was produced specifically for this project and distributed to the local community and businesses. During construction, weekly updates were also provided with milestones achieved that week, and also the areas likely to be affected the following week.

Local businesses were also given the opportunity to connect their fire sprinkler systems to the new network.

5.4 CONSTRUCTION ISSUES

5.4.1 SITE CONSTRAINTS

Access for the NZFS had to be maintained at all times. Prior to construction, the contractor met with the NZFS to discuss the works, ensure all their concerns were addressed, and put in place measures to manage an emergency event, such as providing access for fire trucks at all times.

Part of the watermain was installed down a private lane, known as Buxton Lane, this lane contained several large businesses including building materials supplier, ITM. Access for businesses (and their customers) had to be maintained at all times and so again the contractor met to discuss the works and ensure all concerns were addressed.

5.4.2 WORK IN STATE HIGHWAY

As previously mentioned, the construction window authorised by NZTA for working within Commercial Street (State Highway 60) was from 1 March 2011 through to 31 March 2011.

The alignment of the new fire main was in the centre of one traffic lane for approximately 600m, due to service clashes. As a result of the alignment, the traffic lane and associated parking bays were closed around the work site. During construction, the traffic management was controlled by stop/go personnel. Works within Commercial Street were completed within a three week period, with final reinstatement being completed on 4 April 2011 (this delay was due to wet weather).

Photograph 4: Construction of fire main on SH60

Photograph 5: Construction of fire main on Reilly Street

The reinstatement of the trench line within state highway included a full lane width reinstatement of 40mm depth of Hotmix 16. Prior to resealing the road, the entire lane and parking was closed off so the existing surface could be milled (as shown in Photograph 6).

Photograph 6: Milling along SH60

Photograph 7: Final reinstatement along SH60

5.4.3 BOREFIELD AND HEADWORKS

Construction of the new bores, headworks and control equipment were located within a grassed area behind the fire station. One of the main design changes during construction was the increase of the plinth height that supported the generator. Following detail design, a flood analysis showed this plinth would need to be raised from 550mm to over 1m above ground level to ensure the generator would remain above a 100 year flood level.

Photograph 8: Early construction of the borefield

Photograph 9: Plinth for the generator

Photograph 10: Bores and generator nearing completion

Photograph 11: Installation of the pressure vessel following completion

5.4.4 COMMISSIONING AND OPERATION AND MAINTENANCE

The commissioning of the pipeline took place through two hydrants located at the end of the fire main on Junction Street. This line was the longest length of main and was a dead leg. The NZFS assisted in the flow test, where both the flow rate and pressure were recorded from two hydrants to confirm the system was achieving FW3 requirements.

Photograph 12: Flow test assisted by the NZFS

As the system is only to be used for an emergency, the Council's Operation and Maintenance Contractor, Downer, undertake monthly testing on the bores and electrics to ensure the system is operating sufficiently. In addition to this, the NZFS perform their monthly training on the system, where various hydrants are tested to ensure they are operating correctly.

5.4.5 CONSTRUCTION OUTCOMES

The overall construction ran smoothly and the contract was completed on time and under budget.

No negative reaction was received from the community during construction. This was partly down to the pro-active efforts of the contractor, but also due to the amount of interaction up front with the community on this project.

The system was officially opened on 12 July 2011 and was attended by over 40 Takaka business owners, volunteer fire personnel and Council staff. The turn-out demonstrates the level of engagement and final satisfaction of the affected stakeholders.

6 CONCLUSIONS

This project highlights that early involvement with residents and key stakeholders has enabled the community of Takaka to achieve their goal of selecting and constructing the most appropriate, cost effective and affordable fire fighting scheme. A proposal that was once deemed to be cost prohibitive to local residents was re-defined and is now in place to safeguard the town's vital CBD area.

During the opening of the scheme, retired Councilor Noel Riley spoke of the thorough consultation process Council had carried out with the Takaka community to ensure this important asset was achieved. "The Council and Community Board along with the New Zealand Fire Service personnel worked well together to ensure that everyone had their say in the best fire fighting water supply for our town".

The Takaka Fire Fighting Scheme is also a prime example of the challenges faced by many New Zealand Local Authorities in addressing the needs of smaller communities with an adequate level of service at an affordable and practical level.

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Photograph 2, POLYPHEN®, www.polyphen.co.nz/

Photograph 3, Steel Construction New Zealand, www.scnz.org

Photographs 4, 9 and 10, Ching Contracting.