IN THE MATTER	**of the Resource Management Act 1991**
AND	
IN THE MATTER	**of applications by TrustPower Limited to the Westland District Council and West Coast Regional Council for resource consents to operate and maintain the Kaniere Forks Hydro-Electric Power Scheme and enhance, construct, operate and maintain the McKays Creek Hydro-Electric Power Scheme**

STATEMENT OF EVIDENCE OF ROBERT PETER SHELTON

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1. INTRODUCTION

1.1. My full name is Robert Peter Shelton. I am a Chartered Professional Engineer and have the following qualifications:

- Bachelor of Science degree in Geology, University of Auckland (1984); and
- Bachelor of Engineering degree in Civil Engineering, University of Auckland (1986).

1.2. I am a member of the following organisations:

- Institute of Professional Engineers New Zealand;
- New Zealand Geotechnical Society;
- New Zealand Society of Large Dams; and
- New Zealand Society for Sustainable Engineering and Science.

1.3. I am a project manager in TrustPower Limited's (*TrustPower*) generation division. I have over 25 years' experience in the fields of geotechnical, water resources and civil engineering. I have been employed by TrustPower since 2010. Prior to that, I worked overseas for 16 years on the design and project management of infrastructure, pipeline and marine projects. During this time I worked on projects in Australia, Papua New Guinea, UK, India, Singapore, Oman, China and throughout Southeast Asia for the Norwegian company Aker Kvaerner and its predecessors.

1.4. I am currently a project manager in TrustPower's hydro-development group working on enhancements to existing, and the design of new, hydro-electric power schemes (*HEPS*).

1.5. I have undertaken the conceptual design and civil assessment for re-consenting of the Kaniere Forks and McKays Creek HEPS (*the Scheme*), together with the proposed enhancements to the McKays Creek HEPS (together, *the proposal*). In addition, I have specific experience in a wide range of dam and hydro-electric projects.

1.6. I have recently completed the design and construction supervision of TrustPower's Big Wainihinihi tunnel, Lake Rotorangi dredging and pontoon installation, Lake MacLaren boat ramp installation, Lake Mangaonui dredging and pontoon installation, and the design and installation of Lake Mangaonui spillway gates.

1.7. I have conducted annual civil inspections for the following TrustPower HEPS:

- Bay of Plenty – including Ruahihi, Lloyd Mandeno and Lower Mangapapa;
- West Coast – including McKay's, Kaniere, Dillmans, Duffers, Kumara and Wahapo stations; and
- Otago – Waipori 1, 2, 3 and 4 stations, and Deep Stream A and B stations, Paerau and Patearoa stations.

1.8. In addition to the proposal, I am currently working on the following projects:

- Esk HEPS, Hawkes Bay; and
- Arnold Valley HEPS.

1.9. I have read and agreed to comply with the Code of Conduct Expert Witnesses contained in the

Environment Court Practice Note 2011. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise. I have endeavoured to be accurate and to cover all relevant matters relating to the topic on which I am giving evidence. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

2. SCOPE OF EVIDENCE

2.1. My evidence addresses all matters relating to the civil engineering design, feasibility, construction and standards of the proposal. In particular, my evidence provides an overview of the entire proposal and its general context from an engineering perspective. Accordingly, my evidence covers:

- a description of the existing environment in so far as it relates to engineering;
- a description of the existing Schemes that are to be re-consented and enhanced in the case of the McKays HEPS;
- the design approach/criteria and parameters used for the McKays enhancements;
- the hydrology in context of the McKays enhancements design;
- the alternative designs considered as part of the project assessment;
- the physical design features – intake structures, races, penstocks, and power stations;
- risk management; and
- likely construction methods and programme.

3. EXECUTIVE SUMMARY

3.1. The engineering design and construction of the McKay's enhancements is presented in the context of the existing scheme. This scheme has operated successfully for over 80 years. The work required is minor in scale and lies within the footprint of the existing scheme.

3.2. The proposed enhancements are an incremental increase in capacity using existing infrastructure. The proposed enhancements will increase the renewable generation capacity of the McKays scheme by about 90%, and utilise its resources in a more effective and efficient manner.

3.3. Development of the McKays enhancements is feasible from an engineering point of view. The structures are all relatively small and the risks associated with the construction of the enhancements are minor and easily managed.

4. CONTEXT AND EXISTING ENVIRONMENT

4.1. The Scheme is located in the Kaniere Valley about 14km southeast of Hokitika.

4.2. The Kaniere valley topography is dominated by the Kaniere River, which flows in a northwest direction from Lake Kaniere. The topography is relatively low lying in the immediate region of the river and Scheme, with post-glacial outwash and alluvial terraces at various levels occurring on the sides of the river valley.

4.3. Kaniere Road is the primary vehicle access in the valley running approximately parallel to and on the true left of the river.

4.4. The geology of the area is dominated by glacial outwash deposits of the Quaternary and recent alluvial deposits. Lake Kaniere was formed by glacial erosion and melting during the last ice age about 13,000 years ago. The glacial outwash gravels comprise well graded rounded coarse sandy gravel with some cobbles and boulders.

4.5. Younger alluvial deposits associated with the current floodplain occur along the axis of the Kaniere River, and in isolated areas within minor stream tributaries. They comprise gravel with minor sand, silt and occasional swamp deposits.

4.6. Areas of the Kaniere River alluvial deposits and the glacial outwash terraces have been worked by alluvial mining operations, most of which occurred in the early part of last century. The mining process generally leaves behind areas of re-deposited mine tailings, which are typically loose and poorly graded sand and gravel mixtures.

4.7. The West Coast region is seismically active, and the Hohonu Fault crosses the Kaniere River just downstream of Lake Kaniere. The active Alpine Fault lies approximately 10km south-east of the site.

5. DESCRIPTION OF THE EXISTING SCHEMES

Overview of layout

5.1. The Scheme is two separate HEPS that operate almost independently of each other. Project Overview Sheet 1, in the graphic supplement, shows an overview of the Scheme.

5.2. The water for the Scheme comes from Lake Kaniere via three separate outlet control gates. One gate controls the consented flows of 1 cumec to the Kaniere HEPS via the Kaniere race, and the other two gates control the 5 cumec flow to McKays weir and HEPS via the Kaniere River.

Kaniere HEPS

5.3. Hydro-electricity has been generated at the Kaniere Forks power station for just over 100 years. The water race from Lake Kaniere was constructed in the late 1800s for gold mining, following a similar alignment to that visible today, and was enhanced prior to the power station being commissioned in 1909.

5.4. The race was originally built by hand with a number of tunnels, timber races, and channels along the true right of the Kaniere River. It has about 4.7km of tunnels over the total length of 9.63km. All but 200m of the tunnels are downstream of Wards Road.

5.5. The intake for existing Kaniere HEPS is part of the Lake Kaniere outlet structure. This structure has three gates that control outflows from the lake as described above. The top left photograph in Figure B30 of the Graphic Supplement shows the Lake Kaniere control gates and outlet weir.

5.6. TrustPower originally planned to enhance the Kaniere HEPS as part of this resource consent process. However this enhancement has been put on hold as land acquisition matters necessary for the enhancement and mitigation activities could not be resolved. Hence TrustPower is proceeding on the basis of simply reconsenting the existing Kaniere HEPS.

5.7. By way of the present applications, TrustPower is therefore seeking to reconsent the existing Kaniere HEPS. This involves taking a 1 cumec (maximum) flow from Lake Kaniere via the Lake Kaniere outlet control gates, and conveying this to the power station via the Kaniere Race. The power station tail race discharges back to the Kaniere River, below the McKays weir intake for the McKays HEPS.

McKays HEPS

5.8. The McKays HEPS was built approximately 80 years ago and the station was commissioned in 1931. The scheme utilises a consented flow of 5 cumec available from Lake Kaniere to generate electricity.

5.9. The McKays intake receives the consented 5 cumec (maximum) flow from Lake Kaniere via the Kaniere River and conveys it to the power station through a series of canals, syphons and a tunnel. The 'McKays Creek Hydro-Electric Power Scheme Enhancement, Feasibility and Scoping Report Prepared for Scheme Reconsenting'[1] provides details of the existing 5 cumec capacity scheme components. A number of photographs illustrating the existing canal, flume, siphon and tunnel are also provided in that report.

5.10. The Lake Kaniere control gates release water for the McKays HEPS and this flows approximately 7km down Kaniere River to the existing McKays weir and intake.

5.11. The canal is excavated through the glacial terrace deposits adjoining the Kaniere River and it is about 4m wide and 1.5m deep. The canal is not lined except for some natural rock armouring in the initial areas.

5.12. The existing flow capacity is constrained in four locations: Coal Creek Flume, the Kaniere Road bridge, the twin siphon, and McKays tunnel.

5.13. The Coal Creek Flume (Bottom right photograph Figure B30 Graphic Supplement) 3.2.1 in the McKays Feasibility Report) is an old timber flume across Coal Creek that is at full capacity under normal flow.

5.14. The Kaniere Road bridge over the canal has adequate capacity for the 5 cumec consented capacity but limited ability to pass higher flows.

5.15. The twin McKays Creek siphons were installed in 2006 to replace an old flume that was in serious disrepair. These siphons have a flow capacity of about 8 cumec, although the flow is currently restricted to the consented 5 cumec flow.

[1] Attached as Appendix A to the Assessment of Environmental Effects filed with TrustPower's resource consent applications for the Scheme (*McKays Feasibility Report*).

5.16. Downstream of McKays Creek, the siphons receive another 1 cumec from Blue Bottle Creek and other tributaries, reaching the consented station and discharge flow of 6 cumec.

5.17. The McKays Creek tunnel is 440m long and was installed in 1930. It is nominally 1.7m wide by 2m high and supported by rectangular sets comprising wood columns and steel beams. The tunnel has a 6 cumec flow capacity.

5.18. The McKays Creek station is supplied with water from the forebay by one steel penstock, with a gross elevation difference of 33m between the forebay and the tailrace. The powerhouse has a single 1.1 MW capacity horizontal Francis turbine that generates an average of 8 GWh per annum. The flow is discharged into a tailrace, which runs parallel to the Kaniere River for about 600m, before it is returned to the river.

6. DESIGN STANDARDS AND CRITERIA

6.1. The design standards for any large civil engineering structure are critical as they determine the loading conditions the individual components must sustain without failure. Unlike buildings, there are currently no codes of practice for dams and canals. Legislation for dams falls under the Building Act 2004, which also defines canals as dams in terms of their design and operational requirements. The Building Act itself does not include any specific design standards. Instead, relevant details are contained in the Building (Dam Safety) Regulations 2008 (*the Regulations*).

6.2. The Regulations refer heavily to, and require compliance with, the New Zealand Dam Safety Guidelines (NZSOLD, 2000) (*the Guidelines*). The Guidelines have been adopted by those designing, building, maintaining and operating dams as appropriate design standards for dams and their associated structures. They represent industry best practice in New Zealand. Accordingly, the Guidelines have been adopted as relevant design standards for the proposal.

6.3. The Building Act and Guidelines determine the appropriate risk standard on the basis of the potential consequences of failure, and set a range of Potential Impact Categories (*PIC*) to describe the range of consequence. The existing McKays race and headpond are low PIC structures. **Appendix A** provides a description of the PIC categories from the Guidelines. The structures were built over 80 years ago and have stood the test of time. The enhancements to these hydraulic structures are minor in nature and will be designed by a Chartered Professional Engineer to meet the requirements of the Building Act and Guidelines.

7. HYDROLOGY AND OPERATIONAL HYDRAULICS

7.1. Investigations into the hydrological aspects of the proposal are provided in Mr Lennie Palmer's evidence. Mr Palmer's work has been used in the preliminary design of the proposal.

7.2. The long-term hydrology records show that, on average, around 7 cumec flows out of Lake Kaniere to the Kaniere River. Most of the flow is passed through the existing gates, with 5 cumec flowing down the river to the McKays intake and 1 cumec flowing down the existing Kaniere race. The existing (cumulative) consented take for the two power stations is 6 cumec.

7.3. The remaining water flows represent the water spilt over the top of the weir when lake levels are high.

7.4. The Scheme has very high capacity factors – that is the stations generate at near full capacity most of the time as there is water available most of the time. It is only when lake levels drop below about 0.5m, and no rain is forecast, that the existing schemes cut back on generation and the flows to McKays and Kaniere intakes are reduced.

7.5. As the Scheme has consents to take only a total of 6 cumecs, and the hydraulic structures and generation plant are sized for 7 cumec (including the additional 1 cumec provided from tributaries to the McKays scheme downstream of the McKays weir), the Scheme cannot increase generation during periods of high demand (peaking) – even if the lake is spilling. The Scheme typically relies on a uniform outflow of water and generate at the same level during day and night.

7.6. Because the consented flow and capacity of the Scheme is less than the mean inflow to the lake, the lake spills about 40% of the time at an average of spill of 1.7 cumecs.

7.7. There is no significant storage within the Scheme, which is operated hydraulically using level control. This means that the Scheme is operated within a small range of operating levels in the canal, and inflows and generation outflows are balanced to maintain the level within this range. The proposal will continue to be operated in the same way.

8. ALTERNATIVE DESIGNS CONSIDERED

8.1. A number of alternative scheme configurations were considered to utilise the water more efficiently and reduce spills. At present, scheme configuration only allows the Kaniere HEPS water to be used once for generation, as the outlet from the Kaniere power station is downstream of the McKays weir. In addition, the water used in McKays power station drops about 40m in elevation from Lake Kaniere to the intake weir without utilising this gradient differential to generate any electricity.

8.2. TrustPower detailed a number of the alternatives considered early in the feasibility assessment process as part of its section 92 response dated 18 October 2011. These were narrowed down to two main concepts that were developed and modified as discussed further below.

8.3. TrustPower does not plan to pursue consent to enhance the Kaniere HEPS at this time, as acquisition of land necessary for the enhanced scheme has not been achieved. The application for the Kaniere HEPS is therefore to reconsent the existing scheme (status quo).

McKays enhancements options

8.4. The McKays HEPS is currently designed to accommodate a flow of between 5 and 6 cumec. The initial flow, from Kaniere River is 5 cumec and an additional 1 cumec flows in from tributaries to the McKays race. From Blue Bottle Creek to the forebay, the race is accordingly designed for 6 cumec.

8.5. The existing weir, intake and conveyance system up to Blue Bottle Creek can be enhanced to 8 cumec capacity as described in the McKays Feasibility Report. McKays tunnel is over 80 years old and can only just accommodate 6 cumec flow. Three options have been considered to enhance the flow from upstream of the tunnel to the power station forebay area.

8.6. The first option is to enlarge and re-build the existing tunnel so that it can pass a 9 cumec flow (i.e. the 8 cumec take and 1 cumec race tributary flow). The tunnel has been assessed and parts of the tunnel are in poor condition. A detailed investigation of the tunnel enlargement and refurbishment would be needed to determine if the tunnel can be economically and safely enhanced.

8.7. The second option is to install an 850m long canal to bypass the tunnel. Two alternative routes around McKays Tunnel have been developed and these are shown on the design drawings.[2] Both involve large earthworks volumes (up to 650,000 cubic meters) and extensive excavation work to create a new canal at-grade from near Blue Bottle Creek to the current tunnel outlet.

8.8. The two alternative routes are provided in case the tunnel cannot be economically or safely enlarged/refurbished. The decision on whether to enlarge and re-build the existing tunnel, or to bypass it with an open cut canal, will depend on a number of factors. The main factor is the safety of the existing tunnel and integrity of the ground around it, as the existing tunnel is over 80 years old and the supports are of a similar age.

8.9. A condition assessment of this tunnel, with respect to safely refurbishing or replacing it, and the surrounding ground conditions will determine the methodology, design, timeframe and cost for the tunnel enhancement. If the work can be completed safely and economically then the tunnel option will proceed. If it cannot then the bypass option will be selected.

9. SCHEME LAYOUT AND OPERATION

9.1. This section of my evidence is presented in two parts. The first describes the common features of the McKays HEPS enhancements and existing Kaniere HEPS. The second describes additional matters relating solely to the McKays enhancements.

Common features of Kaniere and McKays reconsenting

9.2. At a broad level, the proposal is to increase the maximum consented take for the McKay's HEPS from 5 cumecs to 8 cumecs. The Kaniere HEPS take will remain at 1 cumec. The increased capacity will enable increased generation, in particular allowing for more electricity generation to meet peak demand. Generally of the 8 cumecs consented for take at the Lake Kaniere outlet, 1 cumec will be diverted to the Kaniere Race, and the remaining 7 cumecs will flow down the Kaniere River for diversion at the McKays weir. However, when the Kaniere HEPS is not operating (because, for example, it is under maintenance), the consents will allow for the full 8 cumec take to be passed down the Kaniere River to the McKays weir.

9.3. The 2 cumecs of additional consented take from Lake Kaniere will enable more generation when lake levels are high and reduce the spill down the river. During dry periods or low lake levels, the

[2] Refer to Drawing No 08MKY/KWU-150 (Rev3) "Possible Tunnel Bypass Options".

Scheme outputs will be reduced, or the Scheme will be shut down, in order to maintain amenity for the public and store energy for when it is needed.

9.4. Over the long–term, water will leave the lake as it does now. However, the proposal will allow an approximate 90% increase in generation capacity during times of peak demand and high water levels.

9.5. As discussed in further detail in Mr Peter Clough's evidence, this locally generated electricity will replace that which currently needs to be imported to the coast during peak times. This imported electricity has transmission losses of over 10% due to the distance between generation and end use.

Lake Kaniere control gates

9.6. Enhancement of the existing Lake Kaniere control gates is the one aspect of the proposal that is common to reconsenting of both the McKays and Kaniere HEPS.

9.7. The existing Kaniere Forks control gate is configured to pass 1 cumec to the Kaniere race. This gate will remain unchanged.

9.8. The existing control gate structure has five gate slots that can release flow for the McKays HEPS via the Kaniere River. Automatic gates are only installed in two of these slots and the 5 cumec flow can be passed by these gates. The other three slots are fitted with stop logs that can be removed manually when required.

9.9. One additional control gate will be installed in one of the three existing stop log slots, so that a flow of up to 8 cumec can be passed to the McKays and Kaniere intakes. The control gates settings will continue to ensure the Kaniere River residual flow is maintained at all times.

9.10. Native fish passage between Lake Kaniere and the Kaniere River will be provided as described in Dr Greg Ryder's evidence. A fish pass will be installed on the true left of the control gate structures, most likely passing over the left-most stop logs and then lowering to the river bed at the gradient recommended for fish passage.

9.11. The existing approach channel is capable of passing 8 cumec when lake levels are above the mean annual flow. Up to 50 cubic metres (8 truck loads) of gravel built-up near the approach channel may need to be removed to enable full use of the increased take over the consented lake level range.

9.12. Existing and proposed scheme control is via a dedicated computer system and SCADA (Supervisory Control and Data Acquisition) system that is continuously (24 hour) monitored and operated from TrustPower's Tauranga Operations Centre. The system is separated into three main components in terms of the control, being the Lake Kaniere level, intake gate setting, and release from the tailrace to the Kaniere River.

9.13. The main measurements for control of the upstream part of the Scheme are water levels in Lake Kaniere, level at McKays weir, and levels down the length of the McKays canal (specifically near the forebay area).

Lake Kaniere boat ramps

9.14. The minimum lake level will not change under the proposed scheme and will remain at -0.2m. However, in order to provide amenity access to the lake, minor upgrades to the existing boat ramps at Sunny Bight and Hans Bay are required.

9.15. The boat ramp at Sunny Bight will be extended by an additional 4m, which results in an additional 0.4m water depth.[3] This will increase the ability to use the boat ramp over what is currently experienced.

9.16. The boat ramp at Hans Bay already provides access to the lake at low lake levels, and the only work necessary is some erosion protection works at the downstream end of the ramp.[4]

McKays enhancements

9.17. Most of the McKay's HEPS can be upgraded to accommodate a flow of 8 cumec, increasing to 9 cumec from Greens Creek, within the envelope of the existing scheme.

9.18. Details of the scheme engineering are provided in the McKays Feasibility Report and summarised below. These enhancements can be treated as a series of individual projects as most of them are located at specific locations along the existing alignment. The exceptions are the Coal Creek Flume replacement and the two options to by-pass the tunnel. These are described in more detail in the Feasibility report and paragraphs 9.21 and to 9.23 to 9.24 below.

9.19. The existing McKay's weir and intake will be retained. It is currently passing a flow of 5 cumec into the McKay's HEPS and the intake and gates are capable of handling an 8 cumec flow with only minor modification. The existing intake does not have a fish pass and a new fish pass will be included into the design modifications. Details of the works required for the fish pass at the intake are provided in Figure B2, Drawing 08MKY-KWU-01 (Rev 2) of the Graphic Supplement.

9.20. Most of the conveyance canal work will involve minor canal widening, hydraulic smoothening and deepening within the existing scheme footprint. There are two structures that will need to be enhanced or replaced; the Coal Creek Flume, and the McKay's Tunnel.

9.21. The Coal Creek flume is an old timber structure that cannot pass 8 cumec flow. This timber flume, which has significant leakage, will be replaced by a pipe-bridge with two or three pipes as per the McKay's siphon located further downstream. Detailed design will determine whether two or three 1300mm diameter pipes are utilised and determine whether the flume's existing concrete foundations can be reused for the pipe bridge. The existing McKay's siphon has adequate flow capacity for 8 cumec and will not need modification.

9.22. The existing McKay's Tunnel is 440m long and it can barely accommodate the consented flow of 6

[3] See drawing 10KNF/RUG-132 rev.0.
[4] See drawing 10KNF/RUG-131 rev.0.

cumec. Increasing the tunnel capacity to accommodate a flow of 9 cumec (the tunnel is downstream of the Greens Creek flow into the canal) will be a substantial exercise that is difficult to do in a safe and cost-effective manner.

9.23. The first option is to increase the tunnel cross-section and hydraulic performance by widening, hydraulic smoothening, and increasing the flow depth. The existing tunnel is braced and lined with timber and this bracing and lining would need to be replaced with a new structural lining. The earthworks volumes from this enhancement are relatively minor (less than 2000 cubic metres) and the spoil can be placed adjacent to the existing canal at the Marshall Farms property. A consideration of tunnel construction methodologies will also be developed during detailed design.

9.24. The alternative to re-building the tunnel is to bypass it with a new section of open-cut canal. Two alternative routes around the tunnel have been investigated and these are shown on Figure B29 Drawing 08MKY/KWU-150(3) in the Graphic Supplement. The two tunnel bypass options are similar and the option with the least earthworks will be selected if the tunnel enhancement is not viable for safety or cost reasons, as described in paragraphs 8.8 and 8.9.

Headpond

9.25. The new headpond will be formed by engineered cut-to-fill earthworks and lead to the new intake and penstock created adjacent to the existing race. TrustPower owns the low-lying land adjacent to the forebay and the headpond will be sited on this land. Either the spill and sediment removal facility will be retained or new facilities provided in a similar location to suit the new configuration.

9.26. The slope from the headpond to the powerhouse is approximately 35 degrees and the penstock will be provided with anchor blocks and supports founded upon competent natural ground. Vegetation will need to be cleared from the slope prior to penstock installation and erosion protection measures employed to minimise run-off prior to works commencing as per Section 6 of the Draft Construction Plan.

9.27. The powerhouse design for the enhanced scheme has not been completed. However it will be similar in size to the existing station and be installed at the same location. The ‘worst case’ design for consenting would be if the enhancement were to utilise an additional penstock and powerhouse expansion for an additional turbine and generator adjacent to the existing station. This is possible, but the most likely scenario is that the existing penstock and powerhouse will be replaced by a slightly larger one in the same location.

9.28. The existing, approx 1.6m diameter penstock is contained in a larger tunnel and the new penstock would be smaller than the existing tunnel. The enhanced station footprint will be similar to the existing station (perhaps 4m larger in plan dimension).

Tailrace

9.29. The additional flow from the enhancement will be routed through the existing tailrace adjacent to McKays power station. The outlet structure will be modified, or an additional outlet to the tailrace provided adjacent to the existing power station. Additional scour protection will be provided as necessary. Other than maintenance work, no tailrace modification is envisaged to be necessary, as the existing tailrace is robust in size and over 700m long.

9.30. If required in accordance with the proffered consent conditions, a small fish bypass will be installed between the tailrace and the Kaniere River as shown in Figure B18 Drawing 8MKY/KWU-123 (rev 3) of the Graphic Supplement. The bypass will be a small pipe, with diameter and gradient confirmed by a freshwater ecologist, to allow fish to return to the river. Natural rock erosion protection will be provided at the inlet and outlet. It is expected that the construction corridor for installing this pipe will be no more than 5m in width and natural revegetation will occur.

10. ASSESSMENT OF RISKS ASSOCIATED WITH THE STRUCTURES

10.1. This section summarises the assessment of risks associated with structures for the McKays enhancements.

10.2. The McKay's HEPS has been installed and operating for over 80 years with no significant events. The main structures associated with the scheme (intake, gates, weir, canal, penstock, power station and tailrace) have proven to be robust over this time.

10.3. The two structures, within the canal conveyance system, that are at a higher risk of failure are the Coal Creek Flume and the McKays tunnel. Both of these structures will be replaced or significantly increased in capacity. This will significantly reduce the possibility of failure of the system as a whole.

10.4. The existing structures will only require minor modification to pass the increased flow. This work will decrease any risks from the structures as they are primarily modernisation and increasing the capacity of the HEPS components.

11. SCHEME ENHANCEMENT RISKS, QUALITY ASSURANCE AND SAFETY MANAGEMENT PROCEDURES

11.1. This section describes in general the procedures and documentation that are proposed for the life of the McKays enhancements, from design through to operation, to ensure that any risks are managed appropriately. The Guidelines describe in some detail the appropriate procedures for dam management based on low PIC structures.

Design Stage

11.2. There will be one civil engineer (*the Designer*) who will have overall management control of the design process. A team of engineers and support personnel will carry out detailed design and documentation activities. The Guidelines specify the minimum level of qualification for the Designer for low PIC structures. A quality assurance system will be developed for design of the McKays enhancements, which defines formal in-house systems for the planning, checking and reviewing of all work.

11.3. A formal review of the Designer's work will be carried out by an independent experienced engineer (*Peer Reviewer*). The qualifications of the Peer Reviewer will be in accordance with the recommendations of the Guidelines. Building consents are not required for the McKays enhancements as they are primarily minor modifications to the existing structures. However Producer Statements for design and construction will be prepared and submitted if required.

Construction

11.4. There a number of contractual options for delivery of the McKays enhancements. No decision has been made on the most appropriate method at this stage. Provided appropriate measures are included in the construction requirements, this will not influence quality and safety management during construction.

11.5. The contractor (and its relevant personnel) will be required to have had prior relevant company experience, and the work will be managed by a representative who has been actively involved in comparable work. Quality control testing of the works will be carried out to ensure compliance with the specification and drawings. If departures from the specified design are identified, the Designer will review the issue and consider possible remedial works.

11.6. Full time supervision of the construction will be maintained by personnel experienced in the same types of construction, and in direct liaison with the Designer.

Commissioning

11.7. Commissioning consists of filling the canals and ponds to their design levels, and carrying out tests/observations to ensure that the structures perform in accordance with their design intent. All electrical and mechanical equipment will be put through a series of operation tests as filling is progressed.

11.8. Prior to full or partial commissioning, the Designer will carry out a thorough inspection of the enhancements and any outstanding areas of work will be completed. Once the work is sufficiently completed, a formal set of commissioning instructions will be prepared that describe the steps to be followed for safe commissioning, the predicted instrument readings, and procedures for unexpected conditions.

11.9. As the canals are earth lined, there is likely to be some minor erosion of the finer silty material near the lining surface until self-armouring occurs. Much of this material is likely to settle out in the head pond, but there may be some suspended sediment discharge to the Kaniere River during the early stages of commissioning. This effect will be temporary and is expected to last no more than a few weeks.

Operation and Maintenance

11.10. The existing HEPS each have an operation and maintenance manual. The McKays manual will be modified for the enhancement prior to starting normal operation. Maintenance activities will be concentrated more on mechanical and electrical items than on civil items. Typical maintenance activities on the civil components of the HEPS will include:

- control of growth on embankments and cuts to acceptable levels;
- maintenance of access tracks (for example where potholes form);
- maintenance of access to drainage systems and other monitoring installations;
- clearing of sediment from culverts under the canal;
- possible maintenance or repair of fences or similar; and
- other activities which may arise from time to time.

Surveillance

11.11. There will be routine inspection and surveillance of the HEPS to monitor its performance with respect to that anticipated by the Designer, and to identify any issues that may develop. Routine inspection and surveillance is of prime importance in detecting potential problems early, allowing them to be dealt with in the safest and most cost-effective manner.

11.12. Routine surveillance will include the following:

- weekly visual inspection of the entire scheme;
- weekly measurement of all drainage and other seepage flows;
- monthly measurement of all piezometers and other instruments (excluding deformation monitoring installations); and
- annual survey of deformation monitoring installations.

11.13. Observations and data will be promptly recorded and maintained in a centralised database with systems enabled to identify any unusual readings. Unusual readings would be directed to senior staff in TrustPower, and may be referred to the Designer for identification of any required action.

Inspections and reviews

11.14. Inspection and review by qualified professionals needs to be carried out in addition to the regular surveillance. There are three types of inspections:

- intermediate inspections;
- five yearly reviews; and
- inspections following an unusual event (such as a large flood or earthquake in the region of the Scheme).

12. CONSTRUCTION METHODOLOGY

12.1. This section briefly outlines the significant construction methodology aspects of the McKays enhancements. More detail on this is provided in the draft Construction Plan. This plan, together with the draft Environmental Construction Management Plan, is in draft form and will be revised as appropriate based on the final design and finalised construction methodology.

12.2. Much of the draft construction methodology has been developed in consultation with Mr Scott Hooson, Dr Ryder, Dr Rod Clough and Mr Palmer so that the effects of construction on the environment, amenity and community are minimised as far as practicable.

McKays enhancements

12.3. Due to the combination of maintenance-type works and specialist construction and fabrication works, TrustPower intends to construct the McKays enhancements as a series of separate projects, utilising a number of specialist contractors and subcontractors. The application and proposed conditions of consent reflect this approach.

12.4. The intake and conveyance work described in Section 9 are minor in nature and lie within the envelope of the existing scheme. Typical maintenance-type equipment (15-25 tonne excavators and trucks) will be used for the work.

12.5. If the tunnel enhancement option is selected the earthworks volumes will be minor (estimated at less than 2000 cubic metres) and within the footprint of the existing scheme.

12.6. The two alternative routes around the tunnel result in earthworks volumes of approximately 650,000 cubic meters. This is a significant quantity of earthworks and the construction period is likely to be more than one year. Large construction spreads, as described in the draft Construction Plan, will be needed to complete this work. The spoil will be spread over the adjoining land, which is currently covered with old mine workings, gorse and some grazing. The ecological impacts of the spoil disposal have been discussed with Mr Hooson, and spoil disposal areas chosen to minimise impacts on ecological values.

12.7. Exposed slopes will be re-vegetated with low vegetation to control erosion over the longer term. Particular attention will be paid to the interface of fill and concrete components with careful compaction of fill adjacent to concrete features.

12.8. The penstock intake and penstock would be constructed in parallel, where possible, with the powerhouse. As the powerhouse structure, penstock and penstock intake near completion, the turbine and generator would be installed in the powerhouse, together with ancillary equipment. These structures are all within the footprint of the existing scheme.

12.9. The draft Construction and Environmental Construction Management Plans will be finalised based on the selected equipment and methodology.

13. SUBMISSIONS

13.1. I have reviewed submissions to the application and comment on those associated with my field of expertise in the following paragraphs.

13.2. Submissions 39 and 42 are opposed to the proposal due to the loss of bush and effect of construction on the bush. Both of these submissions appear to relate only to the Kaniere enhancements, which are not being pursued at this stage. The concerns raised in these submissions do not relate to the proposed McKays enhancements.

13.3. Submissions 45 and 46 are generally opposed to the proposal, on the basis of visual and recreational effects. However these submissions also relate only to the Kaniere enhancements, which are not being pursued at this stage. The concerns raised in these submissions do not relate to the proposed McKays enhancements.

13.4. There do not appear to be any other submissions opposing the McKays enhancement that are relevant to my field of expertise.

14. OFFICER'S REPORT

14.1. I have reviewed the section 42A Officer's Report on the application and provide comment on those matters relevant to my brief below.

Criteria for deciding between tunnel refurbishment and bypass options

14.2. The Officers' Report (at page 27) requests details as to the criteria that will be used to make the final decision between refurbishment or bypassing of the McKays tunnel, as part of the McKays enhancements. This is addressed in section 8 above.

Effects on local water supplies

14.3. Page 30 of the Officers' Report indicates that TrustPower will provide further information regarding the proposal's effects on local water supplies at the hearing. Effects on the Hokitika community water supply have been addressed in detail elsewhere. In terms of effects on other water supplies, I acknowledge that the higher consented outflow from Lake Kaniere is likely to result in a lower average lake level. However, the existing consent does not place limits on the period of time that the lake level can be in the lower range of the consented limits. By contrast, and as outlined by other witnesses, the proffered consent conditions will restrict the amount of time that the lake level can be at lower levels under the proposal, by way of a proposed seasonal operating regime. This, together with the minimum lake level remaining unchanged, will mean that the proposal will have negligible effect on any existing local water supplies.

Details of fish passage installation works

14.4. Details of the fish passage installation works at the McKays intake and tailrace are provided in paragraphs 9.19 and 9.30 above, as requested at pages 32 and 48-49 of the Officers' Report.

15. RECOMMENDED CONDITIONS OF CONSENT

15.1. I recommend that the following conditions of consent be included from an engineering perspective:

- although the scale of works required for the McKays enhancements are relatively minor, the proposed works should be designed to the standards recommended in the Guidelines and/or any new standards defined for dams under the Building Act;
- the design and quality assurance process for the McKays enhancements should be in accordance with the Guidelines;
- construction of the McKays enhancements should be carried out by contractors with suitable qualifications and experience, as defined by the Guidelines;
- there should be thorough peer review of the design and construction of the McKays

enhancements in accordance with the recommendations of the Guidelines;

- prior to construction of the McKays enhancements the draft Construction Plan should be further developed by the Contractor in conjunction with TrustPower, describing the work practices and methodologies to meet the relevant consent conditions;
- a detailed commissioning procedure should be developed for the McKays enhancements prior to commissioning. Both the designer(s) of the McKays enhancements and TrustPower's Operations staff should be involved in review of performance of the structures during commissioning;
- the existing Mckays Operation, Maintenance and Surveillance Manual should be updated for the scheme, and set out details on normal operational and maintenance requirements, inspections and reviews required to maintain the safety of the scheme. This Manual follows the recommendations of the Guidelines;
- annual civil inspections should be carried out on the McKays scheme (including the McKays enhancements, once commissioned), and;
- comprehensive safety reviews of the McKays enhancements should be carried out at intervals of five years following the completion of commissioning, to a scope that meets the recommendations of the Guidelines.

15.2. TrustPower has incorporated these recommendations into its proposed conditions of consent.

16. CONCLUSION

16.1. Development of the McKays enhancements is feasible from an engineering point of view. The structures are all relatively small and similar structures have been built in the area.

16.2. The McKays enhancements have been designed in consultation with independent experts in terrestrial ecology, landscape, amenity and heritage. The design incorporates the recommendations of these experts.

16.3. The hypothetical hazards presented from the proposed structures, and their construction, can be effectively managed through the principles of dam safety management.

Robert Peter Shelton
June 2012

STATEMENT OF EVIDENCE OF ROBERT PETER SHELTON

APPENDIX A – NZSOLD GUIDELINES ON POTENTIAL IMPACT CATEGORY

Table 1. Potential Impact Categories for Dams in Terms of Failure Consequences (after Table III.1 of [11]). PIC for McKays enhancements highlighted for clarity.

Potential Impact Category	Potential Incremental Consequences of Failure	
	Life	Socio-economic, Financial & Environmental
High	Fatalities	Catastrophic damages
Medium	A few fatalities are possible	Major damages
Low	No fatalities expected	Moderate damages
Very Low	No fatalities	Minimal damages beyond owner's properties

Table 2. Seismic Design Standards.

PIC	Design Standard	
	OBE	MDE
High	1 in 150 years	1 in 1,000 years to MCE
Medium	1 in 150 years	1 in 1,000 to 1 in 10,000 years
Low	1 in 150 years	1 in 1,000 years
Very Low	1 in 150 years	Less than 1 in 1,000 years

Table 3. Flood Design Standards.

PIC	Design Flood
High	1 in 10,000 year to PMF
Medium	1 in 1,000 to 1 in 10,000 year
Low	1 in 1,000 year
Very Low	Less than 1 in 1,000 year