Before the Hearings Commissioners
at Christchurch

**In the matter of:** a submission and further submission on the proposed
Canterbury Land and Water Regional Plan under the
Resource Management Act 1991

to: **Environment Canterbury**

*submitter* **Meridian Energy Limited**

Statement of evidence of Kenneth Alexander Smales

**Date:** 4 February 2012
STATEMENT OF EVIDENCE OF KENNTH ALEXANDER SMALES

INTRODUCTION

1 My name is Kenneth Alexander Smales

2 I am Meridian Energy Limited’s (‘Meridian’) Renewable Development General Manager, and have been in this role for seven years. In this role I oversee Meridian’s team who investigate, secure, design, build and commission new renewable electricity generation sites, and who manage the consents for existing generation facilities in New Zealand. This includes obtaining resource consents for new and existing generation facilities, as well as managing the identification, design and engineering to take these generation projects from concept to production.

3 Prior to my current role at Meridian, I held the position of Meridian’s Generation Director from company establishment in 1999. In that role I was responsible for operating and maintaining Meridian’s hydro generation assets in the Waitaki and at Manapouri, and oversaw the delivery of the Second Manapouri Tailrace Tunnel project from 1999 until project completion.

4 Before joining Meridian I was employed by the Electricity Corporation of New Zealand (ECNZ) and formerly the New Zealand Electricity Department (NZED). As part of this role I was directly involved in the investigation and construction of parts of the Waitaki Power Scheme.

5 I have worked in engineering, operations and maintenance, and construction roles in the electricity industry around New Zealand over this time, starting at Manapouri Power Station during the last phases of its construction in 1969.

6 I hold the qualifications of New Zealand Certificate in Engineering (NZCE) (Elec) and am a Registered Engineer Associate (since 1973). I have been a member of Meridian’s Senior Executive Team since it was established in 1999.

7 I am authorised to give this evidence on behalf of Meridian.

8 In preparing my evidence I have reviewed the evidence of:

8.1 Mr Jim Truesdale; and

8.2 Mr Jeffrey Page.

SCOPE OF EVIDENCE

9 In my statement I have been authorised by Meridian to:
9.1 Provide a brief overview of Meridian;

9.2 Provide an overview of the Waitaki Power Scheme, including:

(a) Discuss the importance of an appropriate regional plan framework for the Waitaki Power Scheme.

(b) Provide details relating to asset management of the Waitaki Power Scheme.

OVERVIEW OF MERIDIAN ENERGY

In this part of my statement I will provide an overview of Meridian. The purpose of this is to provide context to Meridian as a significant user of natural and physical resources within New Zealand and Canterbury. In doing this, I will demonstrate that Meridian is an experienced and responsible user of natural and physical resources, and its activities are closely aligned with and support the government's renewable energy generation policies.

Meridian is a limited liability company currently wholly owned by the New Zealand Government. It is one of three companies formed from the split of ECNZ on 1 April 1999. As a State Owned Enterprise, Meridian is required by statute to operate as a successful business. A component of that requirement is to be an organisation that exhibits a sense of social responsibility by having regard to the interests of the community.

Meridian’s Statement of Corporate Intent states that: "Meridian Energy's nature and scope of activities are the generation of electricity (including the ownership and operation of related assets), the management of water related infrastructure, and the marketing, trading and retailing of energy and wider complementary and adjacent products, solutions and services, primarily within New Zealand."

Meridian’s objectives include maximising long-term shareholder value by its commitment to the environment and the sustainable management and development of the natural, physical and human resources utilised in its business.

Meridian is committed to continue to generating electricity solely from renewable sources into the future. Meridian has chosen this path because it considers it is the right thing commercially for its business and it is an environmentally responsible choice for New Zealand, now and in the future. Meridian's commitment is also aligned with past and current Government policy.

Meridian is the single largest generator of electricity in New Zealand. Following the transfer of the Tekapo A and Tekapo B hydro
generation assets to Genesis Energy, Meridian’s total generation capacity in New Zealand is currently 2,693 MW. Its hydro generation accounts for approximately 44% of New Zealand’s electricity generating capacity and 55% of New Zealand’s hydro storage capacity. 

When Meridian was formed the assets associated with the Waitaki Power Scheme, the Manapouri Power Scheme, and the Brooklyn wind turbine were assigned to it. Since then Meridian has successfully developed in New Zealand:

- Te Apiti wind farm (90MW)
- White Hill wind farm (58MW)
- West Wind wind farm (143MW)
- Te Uku wind farm (64MW).

Meridian is also currently constructing the Mill Creek wind farm (60MW) near Wellington.

Meridian has a proven track record in the operation and development of energy projects both in New Zealand and overseas. Meridian’s adherence to best practice ensures that its generation assets are managed to the highest standards. Meridian undergoes independent reviews from a number of sources to measure its performance against other international hydro electricity generators that have plant of a similar age and size. The most recent benchmarking showed Meridian’s Waitaki assets performance is world class, falling within the top quartile internationally (see Appendix 1 for further details of performance management and improvement).

As well as making improvements to existing assets and pursuing new generation opportunities, Meridian is supportive of, and involved in, demand side management initiatives to reduce energy consumption.

OVERVIEW OF THE WAITAKI POWER SCHEME

In this section of my statement, drawing on the statement of Mr Truesdale, I describe the Waitaki Power Scheme and discuss its importance to New Zealand and hence Canterbury. The purpose of this is to reinforce that the Waitaki Power Scheme is central to New Zealand having a secure and affordable supply of electricity.

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1 Meridian hydro storage (Waitaki system and Manapouri) is 2,118GWh. Nationally, hydro generation capacity is approximately 5,361MW and storage is 3,845GWh. Source: Meridian.
The Waitaki Power Scheme includes eight hydro power stations, four canal systems, and numerous dams, weirs, and other control structures with a combined generation capacity of 1,723 MW. Two of the eight hydro power stations (Tekapo A and Tekapo B) are owned by Genesis Energy as outlined earlier as outlined earlier in this statement. A fuller description of the Waitaki Power Scheme is contained in Appendix 2.

The 6 hydro power stations owned by Meridian have a combined generation capacity of 1,538 MW, having a combined asset value of $3.99 billion as of 30 June 2012.

The Waitaki Power Scheme was designed to operate as a single scheme. As a consequence of the sale of Tekapo A and B, operating the scheme requires Genesis and Meridian to co-operate at a practical (non commercial) level to manage things such as high flow events. To achieve this, Meridian and Genesis have a formal agreement on such matters.

As described by Mr Truesdale, Lakes Tekapo and Pukaki provide almost 60% of New Zealand's national hydro storage. This storage is critical to enabling the traditionally higher summer inflows into Lakes Tekapo and Pukaki to be retained so that hydro power can be generated cheaply and reliably during the winter periods when consumer demand is highest. The storage within the Waitaki Power Scheme is also used to effectively enable the variable supply of electricity that goes with the daily cycle of use - that is, peaks in the morning and evening, and lower supply requirements overnight and at weekends.

The Waitaki Power Scheme also has a critical role in supporting the transfer of electricity to the North Island through the High Voltage Direct Current (HVDC) link during certain conditions (acknowledging that more recently the HVDC link is being used to bring electricity from the North Island to the South Island due to increasing demand in the South Island in recent years).

This flexibility enables North Island thermal stations to be supplemented with South Island peak capacity generation during the morning and evening consumer peaks, or South Island hydro storage to be conserved and South Island generation to be supplemented from North Island generation when hydro storage and inflows are low. Without this variability, both the North Island and South Island would need to install more, but poorly utilised, standby generating capacity to provide a reliable and secure electricity supply.

From an energy supply perspective the Waitaki Power Scheme is an exceptionally strong scheme. Its location is ideal in terms of its relationship to other generation assets, transmission assets and
consumer demand. Its renewable nature and flexibility provides valuable electricity to New Zealand

THE NEED FOR A PLANNING FRAMEWORK WHICH RECOGNISES THE REGIONAL AND NATIONAL SIGNIFICANCE OF THE WAITAKI

27 In this section I comment on the importance of recognition of the operation and management of the Waitaki Power Scheme within the resource management planning framework. This is in direct recognition that the planning framework can and will meaningfully influence how Meridian operates and manages the Waitaki Power Scheme, and the resource management compliance costs associated with that operation and management.

28 In summary, the generation of electricity from the Waitaki Power Scheme relies upon Meridian (and Genesis) being able to:

28.1 Store and use water to generate electricity.

28.2 Use, maintain and upgrade the Waitaki Power Scheme assets.

28.3 Manage changes in the natural environment in order to maintain generation potential.

29 As I will describe more fully later in this statement, Meridian operates a robust and comprehensive asset management programme to ensure the efficient and effective operation of the Waitaki Power Scheme. This results in a constant and ongoing level of maintenance and upgrading activity (see Appendix 3).

30 As described by Mr Page, in resource management terms Meridian relies upon its activities being permitted or that it holds the necessary resource consents. Over time, the Proposed Plan has the potential to influence both what consents are required and Meridian's ability to obtain new and replacement consents. In my experience, the time and cost to Meridian of obtaining consent is often considerable.

31 Recognising this, Meridian's expectation is that its activities will be subject to appropriate regulation by Environment Canterbury (ECAN). By appropriate, I mean a level of regulation that recognises:

31.1 The existence and importance of the operation and management of the Waitaki Power Scheme;

31.2 The impact Meridian's activities are likely to have on the management of the natural and physical resources of the
Waitaki catchment in the context of the provisions of the RMA; and

31.3 Duplication and overlap in regulation should be avoided where similar outcomes will be achieved.

32 Overall it is critical that existing renewable energy projects like the Waitaki Power Scheme are subject to an appropriate planning framework that allows for their operation and maintenance. The consequence of not ensuring the planning framework is appropriate may be real increases in the cost of electricity generation and may potentially affect security of supply.

**ASSET MANAGEMENT OF THE WAITAKI POWER SCHEME**

33 In this section of evidence I summarise Meridian's asset management approach and programme in relation to the Waitaki Power Scheme. I describe this so that it is understood that Meridian continually undertakes asset management works within the Waitaki Catchment that are subject to ECAN's control. When planning for and undertaking these activities, Meridian exercises a high degree of professionalism and responsibility, both in term of the investment made and in responding to regulation.

**Approach**

34 The Waitaki Power Scheme is comprised of assets of variable age, some approaching 80 years, and as a consequence requires appropriate maintenance and upgrading. With this maintenance and upgrading, I would expect these assets still to be operating for the foreseeable future.

35 The long term sustainable performance and reliability of Meridian's hydro assets underwrites its economic efficiency and commercial success and is critical to the success of businesses and the nation. Failure or significant inefficiency of these large assets would have a large impact on the economy. To manage these risks, Meridian ensures its generating assets are maintained and enhanced to meet current and anticipated future market requirements.

36 Accordingly, Meridian has developed a robust, sophisticated and comprehensive Asset Management System. The components of this system are illustrated in the figure contained in Appendix 1.

37 The Asset Management Plans lies at the core of Meridian's asset management approach. Meridian's Asset Management Plans provide a 20-year view of individual projects and expenditure that is required. Meridian's current view of major works on the Waitaki Power Scheme is summarised in Appendix 3.
Meridian’s asset management is designed to maximise economic return on physical assets over their life by achieving desired performance outcomes, while effectively managing the risks inherent in owning, managing and operating a large asset base. These activities can be categorised as strategic, maintenance and defensive. I will now describe each of these activities.

**Strategic activities**

Meridian’s assets are typically high value, long-life (for example its dams are designed for a life of 150 years) and robust assets. The electrical and mechanical components (e.g. generators and transformers) of many of these assets are approaching or past their mid-point of their designed life. Consequently, a strategy of half-life refurbishment and major component capital investment is built into the Asset Management Plan. This results in continual maintenance and enhancement activity being undertaken.

Central to this type of lifecycle management is Meridian’s approach to dam safety through its well-established Dam Safety Assurance Policy and Programme (developed from that created by ECNZ in the 1980s). The Policy and Programme are consistent with the New Zealand Society of Large Dams (NZSOLD) Dam Safety guidelines, international best practice, and has been adopted for the basis of the Dam Safety Scheme that the Government incorporated into the amendment of the Building Act 2004. Meridian is confident that it does and will meet the requirements of the Building Act. In my view this is the appropriate legislation under which dam safety should be managed. Mr Page describes the Building Act requirements in more detail in his evidence.

In addition, Meridian’s assets undergo regular external assessment for public liability purposes. Demonstrating a very high degree of rigour around asset monitoring, maintenance and compliance is crucial to manage Meridian’s public liability risks and obtain affordable insurance. This provides direct company and financial incentives for Meridian to adhere to a best practice dam safety assurance programme.

Annually Meridian spends in the order of $3.4 to $4.5 million on its dam safety assurance programme, over and above the cost of retaining the necessary staff resource to run this programme.

By way of example, the Structural Safety Evaluation for Aviemore Dam, which was concluded in 2004, identified that the Aviemore dam met the criteria of withstanding, without damage ‘unusual loads’ being a 1 in 150yr earthquake or flood, and without failure ‘extreme load scenario’ being a maximum credible earthquake or a probable maximum flood. Notwithstanding this, works with a value of $6 million were completed over a 2 year period on the spill gates,
dam crest wave wall and the control systems to assure the reservoir can be safely managed following a Maximum Credible earthquake event.

44 Looking forward, work planning for similar strategic activities includes, for example, the Structural Safety Evaluation which is scheduled to take place at Benmore power station between 2017 and 2019. Following this, the physical upgrade is scheduled to take place between 2019 and 2021. Similar evaluations are programmed for Meridian’s other dams (refer to Appendix 3 for further details).

Maintenance Activities

45 The aim of asset maintenance is to retain an asset in, or restore it to, a state in which it can perform its required function with the necessary degree of reliability. A successful maintenance programme ensures that work effort is executed as cost-effectively and efficiently as possible and that the equipment performs in accordance with the needs of the business.

46 There are three core principles which underpin Meridian’s delivery of maintenance activities:

46.1 Maintenance is an investment in the plant that delivers value in today’s market while ensuring future capability is protected.

46.2 Planned maintenance of generating plant is invariably more cost-effective than un-planned maintenance (anecdotally by a factor of two). Prediction and prevention of equipment failure is a key focus of the reliability and maintenance strategic plan.

46.3 Improvements in plant performance are achieved through better understanding of plant condition which in turn is directly dependent on the capability of our people and the application of best practice processes.

47 An example of a maintenance activity recently undertaken by Meridian in the Waitaki was the replacement of transformers at Aviemore power station. This project has seen the replacement of four main transformers at Aviemore that were old and presented a risk of generation failure and ultimately inability to dispatch electricity generated. All four transformers were installed and commissioned without incident.

48 Looking forward, work planning for maintenance activities includes, for example, generator refurbishment at Ohau A power station scheduled to occur between 2019 and 2021. Other such maintenance activities are detailed in Appendix 3.
Defensive Activities

Meridian undertakes a number of activities that are not directly attributable to the safety and performance of its assets. These activities are focussed on managing changes in the environment caused by or that may impact on, the Waitaki Power Scheme. These activities include lake shore erosion management and gravel and vegetation management to maintain hydraulic capacity and structure integrity. As such there can be short or long lead in times to plan for and undertake these activities.

One example is the management of elodea in the Waitaki. Elodea has existed in some canals of the Waitaki for a number of years but biomass levels over recent year have reached a point where annual sloughing of the weed is requiring increased operational and maintenance effort to manage associated risks and impacts, particularly in relation to Ohau B and C power stations. This has the potential to result in reduced generation capacity, and at its worst this can cause individual machines or the station to cease generating (an outage). A two stage project was established in 2011 to manage the weed. The first stage of this project was trial weed spraying techniques, the installation of weed booms to collect weed before it reaches the intake screens, and improvements to screen cleaning so that accumulated weed is easier to remove from affected screens. Meridian is now considering its next actions.

Meridian has a programme of defensive activities; this programme is reactive to changes in the environment. This programme tends to operate over a shorter time frame reflecting the need to manage the integrity of Meridian’s structures and generation capacity. By way of example, as a result of the recent high flow events such defensive works are required at Gate 19 in order to protect the integrity of the spill structure in the next high flow event.

Conclusion

In conclusion:

52.1 Meridian is a large and responsible renewable energy generator whose activities align well with government renewable energy generation policy.

52.2 The Waitaki Power Scheme is nationally important to provide secure and affordable electricity.

52.3 The ongoing efficient and effective operation of the Waitaki Power Scheme requires continual and significant maintenance and improvement activity. Meridian operates an industry best practice asset management regime to deliver on this.
52.4 Meridian accepts that its activities will be subject to appropriate regulation by ECAN but considers this should;

- recognise the importance of the Waitaki Power Scheme;

- be targeted at those matters which are likely to have real impacts on the natural resources ECAN is concerned about;

- avoid duplication in regulation.

Dated: 4 February 2012

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Kenneth Alexander Smale
APPENDIX 1

Performance Management and Improvement

1 Asset management performance measurement aims to drive appropriate behaviours and focus attention on the delivery of business plans and achievement of required plant and financial performance targets.

2 The Asset Management Team provides high performing and compliant plant to the Trading Team who use the plant to maximise daily revenues. Accordingly, plant performance metrics are principally determined by the business requirements for reliability and availability. These requirements then drive the asset management plan and associated risk position and forward-spend profiles.

Performance Measures

3 Asset Management performance measures are applied across all functions, using best practice or industry standard metrics, which are collated and analysed monthly using a balanced scorecard approach.

4 Plant metrics have a distinct focus on improvement and performance outcomes. The improvement metrics that are applied are derived from a database of traditional and best practice measures, both lagging and leading. This selection of metrics is reviewed annually and ratified by the Reference Group before and as input to setting annual business plan targets. Asset management metrics measure the items listed below:

- plant performance;
- finance;
- asset performance improvement;
- compliance;
- health and safety;
- plan delivery; and
- continuous improvement.

Continuous Improvement

5 The Asset Management team has a commitment to continuous improvement, quality and application of best practice asset management principles. Improvement opportunities are identified through:
• benchmarking with other organisations;
• subscription and membership with organisations committed to best practice;
• outcomes from external audits; and
• internal processes and knowledge.

6 Meridian subscribes to a service known as the Generation Knowledge Service (GKS) which is run by Navigant. The GKS hydro database contains data and information from a large number of predominantly North American hydro power facilities. Benchmarking enables a direct comparison of cost and performance against comparable sized generating plant from those participating organisations. The GKS service includes:
• a software program for analysing generating cost, performance and reliability (the GKS Software);
• databases including a collective pool of information and data submitted by all subscribers to GKS (the GKS Databases); and
• reports for comparing costs and performance information to appropriate peer groups assembled from all subscribers.

7 Using GKS every 2 years provides Meridian with a view of how it compares to international hydro electricity generators that have plant of a similar age and size, and provides an opportunity to network and share information with those plants that are performing at the highest levels. The most recent benchmarking by GKS showed Meridian’s Waitaki assets performance is world class, falling within the top quartile internationally.

8 In addition to this, Meridian also uses the Asset Management Council (AMC) Australia Awards process to obtain an independent and expert assessment as to how we manage our assets. The AMC awards process requires a written submission in accordance with criteria that include:
• management and leadership;
• management culture;
• asset acquisition;
• asset management plan development and implementation;
• performance measurement; and
• analysis and improvement.
The AMC evaluators also undertake a site visit to verify the content and veracity of the submission then issue a report with findings, observations and recommendations. These recommendations are then evaluated, prioritised and incorporated into the Continuous Improvement Plan for implementation.

Figure 1 – Meridian Asset Management System
APPENDIX 2 - SUMMARY OF THE WAITAKI POWER SCHEME

1 The Waitaki River has been recognised as a major potential source of hydro-electricity since the turn of the twentieth century. As is discussed below the development of this potential commenced with the construction of Waitaki Power Station, and the subsequent commissioning of a further seven power stations in the upper and middle Waitaki Catchment.

2 A diagram outlining the arrangements of the Waitaki Power Scheme is shown in Figure 2, while a description of the Scheme is outlined below. The key details of each of the power stations are summarised in Table 1.

Table 1: Waitaki Power Scheme – Key Statistics

<table>
<thead>
<tr>
<th>Item</th>
<th>Tekapo A*</th>
<th>Tekapo B*</th>
<th>Ohau A</th>
<th>Ohau B/C</th>
<th>Benmore</th>
<th>Aviemore</th>
<th>Waitaki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual energy output</td>
<td>160 GWh</td>
<td>820 GWh</td>
<td>1140 GWh (x2)</td>
<td>960 GWh (x2)</td>
<td>2200 GWh</td>
<td>940 GWh</td>
<td>500 GWh</td>
</tr>
<tr>
<td>Station generation capacity</td>
<td>25 MW</td>
<td>160 MW</td>
<td>264 MW</td>
<td>212 MW (x2)</td>
<td>540 MW</td>
<td>220 MW</td>
<td>90 MW</td>
</tr>
<tr>
<td>Number of generating units</td>
<td>1 x 25 MW</td>
<td>2 x 80 MW</td>
<td>4 x 66 MW</td>
<td>4 x 53 MW</td>
<td>6 x 90 MW</td>
<td>4 x 55 MW</td>
<td>6 x 15 MW (unit 3 retired)</td>
</tr>
<tr>
<td>Net head</td>
<td>30.5 m</td>
<td>145.7 m</td>
<td>59 m</td>
<td>47.5 m</td>
<td>92 m</td>
<td>37 m</td>
<td>21.5 m</td>
</tr>
<tr>
<td>Turbine details</td>
<td>1 x vertical Kaplan turbine</td>
<td>2 x vertical Francis turbines</td>
<td>4 x vertical Francis turbines</td>
<td>4 x vertical Francis turbines</td>
<td>6 x vertical Francis turbines</td>
<td>4 x vertical Francis turbines</td>
<td>7 x vertical Francis turbines (1 retired)</td>
</tr>
</tbody>
</table>

* Note – Tekapo A and Tekapo B owned by Genesis Energy

3 The Waitaki Power Scheme begins at Lake Tekapo in the north-east corner of the Mackenzie Basin, with control of the level of the lake and use of this stored water (largely) for electricity generation purposes.

4 The level of Lake Tekapo is managed as a result of a control gate across the natural lake outlet to the Tekapo River. The operating range of Lake Tekapo is controlled by resource consents granted to Meridian and subsequently transferred to Genesis.
The intake on the southern shoreline of Lake Tekapo allows water to be conveyed via a tunnel to the Tekapo A Power Station, the tailrace of which is the commencement of the Tekapo Canal. While water from Lake Tekapo most frequently enters the Tekapo Canal via the Tekapo A Power Station, it can also be released from the lake control gate at State Highway 8 and diverted back into the canal through a gate structure at Lake George Scott.

The Tekapo Canal effectively enables the transfer of water from Lake Tekapo to Lake Pukaki. It is 27km long and travels in a south-west, then western direction to the shore of Lake Pukaki. The canal is constructed in sections, some sections being ‘cut’ through terrain and others being constructed from ‘fill’ material. It is consented to carry a flow of approximately 130 cusecs. It traverses some major tributaries of the Upper Waitaki Catchment, including Fork Stream, Irishman Creek and the Mary Burn.

At the conclusion of the Tekapo Canal, water is discharged, via penstocks, to the Tekapo B Power Station which sits in the bed of Lake Pukaki. The generation of electricity at the Tekapo B Power Station is entirely dependent on the water being delivered by the Tekapo Canal (i.e. there are no supplementary flows that contribute to generation at the Station).

Lake Pukaki is New Zealand’s principal hydro storage lake and is impounded by the Pukaki High Dam across the outlet of the Pukaki River. The lake level has been raised twice in history, once when the Pukaki Low Dam was constructed in the late 1940’s/early 1950’s, and then again in the mid-1970’s when the Pukaki High Dam was constructed to increase its storage capabilities. The current consents held by Meridian for the Pukaki (High) Dam set an minimum control level of 518m and a maximum control level of 532.5m. Further, the Waitaki Catchment Water Allocation Regional Plan permits Meridian to operate the lake down to a minimum level of 513m in the event the system operator declares an electricity emergency. Water is released from the lake either through the spillway to the Pukaki River (during times of flood or for recreational releases) or, as is the norm, into the Pukaki Canal. The resource consents for the spillway enable Meridian to discharge a flow of up to 3,400 cusecs down the Pukaki River. As with the Tekapo River, Meridian is not required to provide a minimum flow or flushing flow down the Pukaki River. Recreational releases are required on an annual basis for kayaking in the river.

The Pukaki Canal is 12km long and travels in a south-west direction, passing behind Twizel township and traversing the Twizel River and Tay Stream. The canal is also constructed in sections of ‘cut’ and ‘fill’ and is designed to take a maximum flow of 560 cusecs. In combination with water which flows from Lake Ohau into the Ohau Canal, the Pukaki Canal enables water to be used for generation at the Ohau A, B and C Power Stations. Of note is that the Pukaki Canal has an overtopping spillway structure approximately 950m downstream of its outfall from Lake Pukaki.
This spillway is provided to prevent overtopping of the canal embankments in an emergency situation and is not intended for routine use. Meridian is authorised to discharge up to 560 cumecs from the canal, across land, to the Pukaki River.

10 The Pukaki Canal converges with the Ohau Canal near Old Glen Lyon Road. The Ohau Canal enables water from Lake Ohau to be diverted for electricity generation through the Ohau A, B and C Power Stations (in combination with Lake Pukaki water). It is 8.4km long and has a maximum flow capacity of approximately 200 cumecs. The waters of Lake Ohau are impounded by a control weir across the natural outlet of the lake to the Ohau River. The lake has an extreme minimum control level of 519.45m and a maximum control level of 519.75m. Meridian is required to maintain a minimum flow down the Upper Ohau River as part of its resource consent conditions. The required flow is 8 cumecs between the 1st of May and the 31st of October and 12 cumecs between the 1st of November and the 30th of April.

11 The combined flow of the Pukaki - Ohau Canal is diverted through the Ohau A Power Station which discharges into Lake Ruataniwha.

12 Lake Ruataniwha only has a small operating range of 300mm (458.5m – 458.8m) and was formed by the construction of the Ruataniwha Dam across the bed of the lower Ohau River. Meridian is not required to provide a minimum flow or flushing flow down the Lower Ohau River and spill events down the river are infrequent.

13 Water from Lake Ruataniwha is diverted into the Ohau B – C Canal, which feeds the Ohau B and Ohau C Power Stations (both ‘in canal’ stations). The Ohau B – C Canal is approximately 10km long and designed to carry a maximum flow of 560 cumecs. Immediately downstream of the Ruataniwha Dam and the commencement of the Ohau B – C Canal is the Wairepo Arm. The Wairepo Arm was created by large borrow pits from canal construction being incorporated into the right bank of the Ohau B – C Canal to provide a recreational area. It is called the Wairepo Arm after the Wairepo Creek, the waters of which flow into this area and are included in the canal flows.

14 The collective inflows of Lakes Tekapo, Pukaki and Ohau normally discharge into Lake Benmore via the tailrace of the Ohau C Power Station. Lake Benmore was created by the formation of the Benmore Dam in the bed of the Waitaki River and primarily collects flows from the Ohau C tailrace and the Ahuriri Catchment. The lake has an operating range of 0.95m and water can be discharged to Lake Aviemore (the lake below) either through the Benmore Power Station or the spillway gates. The Benmore Power Station is also the South Island end point for the HVDC link between the South and North Islands.
15 Lake Aviemore receives almost all of its inflows from Lake Benmore and has an operating range of 0.6m. As with the Benmore Power Station, flows are discharged via either the Aviemore Power Station or the spillway gates on the dam structure to Lake Waitaki.

16 The final (built) station in the Waitaki Power Scheme is the Waitaki Power Station, which is also the oldest. The Waitaki Power Station is a concrete arch dam that has an overtopping spillway as opposed to spillway gates like at the Benmore and Aviemore Dams. Lake Waitaki has a consented operating range of 2.1m (228.7m to 230.8m) and the discharge of generation flows through the station controls the flow in the Lower Waitaki River. Meridian’s consent for the Waitaki Power Station requires a minimum discharge of 120 cumecs into the Lower Waitaki River, although the mean flow provided to the Lower Waitaki River is approximately 362 cumecs based on 73 year hydrology records.

17 Meridian has been granted the principal water use consents for the North Bank Hydro Project. The projected net gain of approximately 1,400 GWh per year of energy would be an increase in generation on the total Waitaki power scheme of approximately 18% based on an average of 7,600 GWh per annum being generated from the existing scheme.
FIGURE 2 – ARRANGEMENTS OF THE WAITAKI POWER SCHEME
**APPENDIX 3 – ASSET MANAGEMENT PLAN - MAJOR WORKS ON WAITAKI POWER SCHEME**

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<tbody>
<tr>
<td>Aviemore</td>
<td>Excitation replacement</td>
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<td>Control &amp; Instrumentation replacement</td>
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<tr>
<td>Benmore</td>
<td>Generator - stator replacement</td>
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