Under the Resource Management Act 1991 (**RMA**)

In the hearing of submissions and further submissions by Meridian Energy Limited on proposed Plan Changes 28–30 to the Mackenzie District Plan

Meridian Energy Limited

Submitter

Mackenzie District Council (the **Council**)

Territorial Authority

Statement of Evidence of James William Walker on behalf of Meridian Energy Limited

9 May 2025

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SUMMARY OF EVIDENCE

1. The WPS is nationally important infrastructure comprising several dams, canals, and hydroelectric power stations from Lake Tekapo down to Lake Waitaki. It provides a significant portion of New Zealand's renewable electricity and requires continuous maintenance and monitoring to ensure efficient and safe operation.

2. In my evidence, I explain how increased development within the Hydro Inundation Hazard Overlay areas could have further significant reverse sensitivity effects on the dam safety management of the Ōhau Chain elements of the Waitaki Power Scheme (**WPS**), and why provisions within the Waitaki District Plan (the **Plan**) such as those within Plan Changes 28 and 30 are important to avoid these effects.

3. My evidence highlights the changes that Meridian has already made to its Dam Safety Management in response to current development within the Inundation Hazard Overlay area. It further outlines Meridian's concerns regarding possible intensive development within the Hydro Inundation Hazard Overlay where development and the resulting Population at Risk is located such that water from a dam break would reach the developments in a short period, where it would be unlikely that people could safely evacuate if a dam break scenario were to eventuate. I also explain our concerns regarding the Ostler fault hazard and how that intersects with Dam Safety Management.

4. My evidence provides responses to points raised by submitters concerning:
   (a) **Design of the Ōhau A reservoir structures:** I believe these comments to be incorrect and provide my understanding of the relevant aspects of the structures.

   (b) **'Downstream' mitigation:** I believe this is not an appropriate solution, either technically or financially, given the very low likelihood of the residual risk of dam break inundation to the Hydro Inundation Hazard Overlay areas.

(c) **Removal of the Hydro Inundation Hazard Overlay:** Providing Dam Break inundation hazard to regional and local authorities is a legal requirement of the DS regulations. Removing the Hydro Inundation Hazard Overlay would expose Mackenzie District Council (**MDC**) and the landowners to risk, and Meridian to further reverse sensitivity effects.

(d) **Risk based approach to the Hydro Inundation Hazard Overlay area hazard:** I contend that the approach Meridian and MDC are taking is risk based. Meridian manages Dam Safety risk down to a very low level through its DSAP and the Plan Change provisions are an appropriate means to manage the residual risk from this hazard.

(e) **Activity Status for Residential Visitor Accommodation:** I believe changing the status would not adequately address the potential risk to visitors or protect Meridian from reverse sensitivity effects.

INTRODUCTION

5. My full name is James William Walker. I am the Principal Dam Safety and Civil Engineer at Meridian Energy Limited (**Meridian**). I have over 43 years' professional experience, with 25 of those years at Meridian, looking after the safety of the Meridian dam and civil assets, including the Waitaki hydroelectric scheme dams. I am well versed in the complexities of managing dam safety in large-scale hydroelectric infrastructure.

6. I am a member of the Institution of Civil Engineers UK, and the New Zealand Society on Large Dams (**NZSOLD**). I represent Meridian as its nominee on the NZSOLD committee. I was a member of the technical working group consulted by MBIE in its development of Dam Safety Regulations and was an author and reviewer of the NZSOLD Dam Safety Guidelines.

7. I have read summaries of the relevant submissions, the planning documents supporting Plan Changes 28 and 30 to the Mackenzie District Plan (the **Plan**), and the evidence of Mr Veale, Ms Ruston and Mr Feierabend on behalf of Meridian.

8. Meridian has made several submissions and further submission points on matters relating to the plan changes; however, my evidence relates primarily to Plan Change 28.

9. I am authorised to present this evidence as a representative of Meridian and on behalf of the company.

SCOPE OF EVIDENCE

10. The purpose of this evidence is to provide an understanding of Meridian's operations and interests in the Mackenzie district and the reasons why Meridian supports the planning framework proposed in Plan Changes 28 and, subject to amendments, Plan Change 30 in relation to controls on subdivision, use and development within the existing and proposed Hydro Inundation Hazard Overlay areas.

11. In particular, I will be presenting evidence on:

    (a) How increased development within the Hydro Inundation Hazard Overlay areas could have further significant reverse sensitivity effects on the dam safety management of the Ōhau Chain elements of the Waitaki Power Scheme (WPS).

    (b) The changes that Meridian has already made to its Dam Safety Management in response to current development within the Inundation Hazard Overlay area; our concerns regarding possible intensive development in Inundation Hazard Overlay areas where development and the resulting Population at Risk is located such that water from a dam break would reach the developments in a short period, where it would be unlikely that people could safety evacuate if a dam break scenario were to eventuate; our concerns regarding the Ostler fault hazard.

    (c) Responses to points raised by submitters concerning:

        (i) Design of the Ōhau A reservoir structures.

        (ii) ‘Downstream’ mitigation.

(iii) Removal of the Hydro Inundation Hazard Overlay.

(iv) Risk based approach to managing the area within the Hydro Inundation Hazard Overlay.

MERIDIAN'S POSITION ON PLAN CHANGES 28 AND 30

12. Meridian's general position is that the provisions proposed in Plan Change 28 are shaped correctly to achieve the outcomes set out in Meridian's primary submissions, with further amendments required to achieve the same in relation to Plan Change 30. This position and the specific amendments being sought are set out in more detail in the planning evidence of Ms Ruston and the company evidence of Mr Feierabend[1].

13. Meridian seeks the relief promoted in Annexure 1 of Ms Ruston's evidence.

THE WAITAKI POWER SCHEME AND DAM SAFETY MANAGEMENT

14. The WPS is nationally important infrastructure, comprising several dams, canals and hydroelectric power stations from Lake Tekapo down to Lake Waitaki. Its continued operation, including its protection from reverse sensitivity effects, should be provided for by the District Plan, as proposed through Plan Changes 28–30.

15. The current Waitaki Power Scheme was developed as an integrated scheme, between the 1920s and 1990s, to maximise the use of the inflows to Lakes Tekapo, Pūkaki and Ōhau to generate renewable electricity, at a series of power stations located within the Waitaki valley. The current configuration is as shown in Figure 1 below. The Ōhau Chain structures are the Meridian structures relevant to the Plan Changes and this evidence.

[1] Evidence of Mr Feierabend paragraphs 16–20

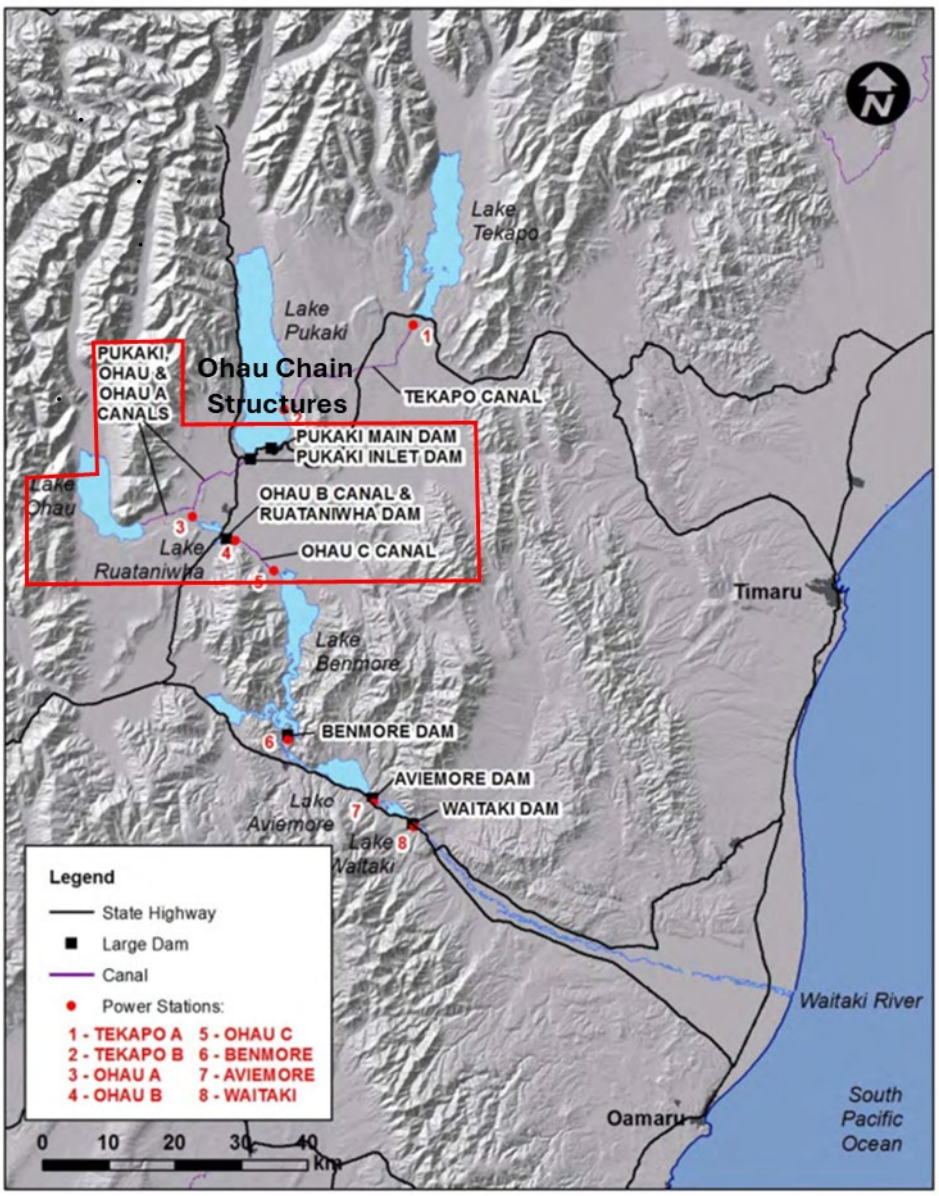


Figure 1: Waitaki Power Scheme – Indicating Ōhau Chain Structures

16. The operation of the WPS is a major and ongoing engineering enterprise and requires the management of complex hydrological and environmental factors, including reservoir inflows, river flows, reservoir levels, and ecological impacts. The scheme requires continuous supervision, maintenance and monitoring to ensure it operates efficiently and safely, and as required to meet Meridian's obligations as a responsible Dam Owner, the Dam Safety Regulations, and the resource consent conditions.

17. Meridian manages dam safety through a comprehensive Dam Safety Assurance Programme (**DSAP**) for its hydroelectricity assets, including the Ōhau Chain structures (Refer Figure 1). The Inundation Hazard Overlay relates to the dam break inundation from these Ōhau Chain Structures.

Meridian's DSAP aligns to the NZSOLD Dam Safety Guidelines (**DSG**) and exceeds the requirements of the Building (Dam Safety) Regulations 2022 (the **Dam Safety Regulations**).

POTENTIAL ADVERSE EFFECTS OF DEVELOPMENT ON THE WPS

18. The proposed Hydro Inundation Hazard Overlay and associated provisions provide for the management of land use and subdivision in the areas within the Hydro Inundation Hazard Overlay and allow a decision maker to provide for the safety of people, property and infrastructure, and to avoid the potential for further reverse sensitivity effects on the WPS. I consider that the provisions of the Plan should be aimed at achieving an appropriate balance between enabling landowners to develop and use their land in line with the core purpose of the underlying zoning, while minimising risks to people, property and infrastructure, and avoiding the reverse sensitivity effects of development.

19. In my view, a key benefit of including the Hydro Inundation Hazard Overlay in the planning maps is that it is a clear source of information for current and potential landowners. This overlay highlights to the residents that this long-standing hazard exists, and the areas it may affect; that development in these areas which is not in line with what is envisioned by the Plan will be discouraged; and that an emergency response may be required from residents and visitors in the very unlikely event of a canal or dam failure.

REVERSE SENSITIVITY – DAM SAFETY MANAGEMENT

20. As set out in Mr Veale's evidence, Meridian is subject to regulatory and industry-accepted protocols on the operation and maintenance of its dams. Many of these protocols and regulations are linked to the potential impacts (consequences) of dam failure, which in turn are dependent on what is present within the potential dam break inundation area.

21. As covered in Mr Veale's evidence, development or land use change within a potential Dam Break inundation area can increase the consequences of dam or canal breach, which can in turn increase the Potential Impact Classification (**PIC**) of the dam or canal, and/or the

requirements of the DSAP. Higher potential dam break consequences increase the dam safety management obligations on the dam owner. Increased PIC can require a dam to be able to withstand more extreme load events, and require additional monitoring, surveillance, and safety review.

22. Development in the Hydro Inundation Hazard Overlay areas has already increased the PIC of some reaches of the Ōhau Chain canals to 'High PIC'. As a result, Meridian has had to change its Dam Safety management for these canal reaches. These changes include changes to the structural safety evaluation programme to assess and confirm these structures will safely withstand extreme seismic and flood loadings. It should be noted that while these hydroelectricity canals were very well designed and constructed at the time, they were not designed for the current criteria associated with a High PIC structure. Therefore, it is possible that Meridian may already be faced with making costly and complex upgrades to some parts of these structures to meet these criteria.

23. The most significant impact of more intensive development in the Hydro Inundation Hazard Overlay area is that where development, and the associated Population at Risk, is located such that water from a dam break would reach the developments in a short period (< 90 mins). International experience has shown that it is extremely difficult for the Population at Risk to safely evacuate, and the likelihood of loss of life in a dam break event is much higher than areas with a longer warning time[2].

24. The ability to evacuate safely would be particularly problematic if a dam break event were associated with an extreme seismic event such as rupture of the Ostler fault, as buildings, bridges and other infrastructure would be affected by very strong ground shaking (Modified Mercalli – MM X), and there would be no pre-warning of a developing dam failure.

25. Meridian is particularly concerned about the hazard posed to the Ōhau A reservoir (Pūkaki and Ōhau Canal Structures) from rupture of the Ostler

[2] *A procedure for estimating loss of life caused by dam failure* – W. Graham USBR – DSO-99-06 – Sept 1999.

Fault, as the characteristics of the fault itself are not well understood. This in turn means that the potential effects of a fault rupture on the Ōhau A reservoir structures, and developments in the dam break inundation zone are also not well understood. This package of plan changes includes updates to the hazard zones associated with the Ostler Fault, and the evidence provided by Helen Jack for Canterbury Regional Council will provide additional information on this hazard.

26. The period for arrival of a dam break flow is assessed to be 30 minutes or less for the Flanagan Lane and Lyford Lane areas[3]. These periods are short for much of the Hydro Inundation Hazard Overlay area. International experience shows that successful evacuation of people from potential inundation areas in such a short period is often not possible, and loss of life in such circumstances becomes very likely[2]. The greater the population exposed to the hazard, and the less familiar they are with the area, the hazard and the evacuation procedures, the greater the potential loss of life. This may be further exacerbated for visitors to the area whose first language is not English.

27. Effectively managing such a hazard for these areas by normal civil defence emergency planning and response measures alone is unlikely to be viable. If large scale development is permitted in areas subject to very short dam break flood arrival times, that would commit Meridian, MDC and the property owners to a significant ongoing effort and cost for the lifetime of the WPS to establish and maintain enhanced Civil Defence Emergency Planning and Response measures.

28. Such measures may require MDC to prepare very detailed emergency response plans, including identifying and maintaining appropriate safe evacuation routes for people in the potential dam break inundation zone. It will also require that residents and visitors in these zones are informed of these plans on an ongoing basis, and that regular emergency response and evacuation exercises are held involving both residents and visitors.

[3] Ohau A Reservoir – Dam-Break Inundation Maps for Emergency Management, Issue 2, Damwatch Engineering Limited, 2018

29. These measures could also require Meridian to install additional dam and canal structure monitoring and alert systems on the reservoir structures, as the current traditional visual surveillance methodologies may not give adequate warning of a developing potential failure mode. This could involve very expensive monitoring systems along 20 km to 30 km of canal embankment to detect seepage, deformation or other key indicators.

30. The measures may also require Meridian to develop and install monitoring systems for seismic shaking and fault displacement, to give warning of the scale and sense of fault displacement within the Ostler fault zone. The Ostler fault zone is several kilometres in length and hundreds of metres wide, and ground shaking from an earthquake on this fault would significantly affect the areas subject to the proposed plan change (MM X felt effects)[4].

31. Such systems would be very novel, I'm not aware of any similar systems in NZ, so identifying suitable and effective systems would require research and development. The capital cost of establishing such systems would run into many millions of dollars, and they would require significant ongoing operating costs.

32. This is a significant reverse sensitivity effect on Meridian and, if required, would take funds away from other dam safety assessment and upgrade projects which currently have higher priority, as well as other activities to maintain the generation capacity of the WPS. It could also divert funds away from the development of new generation capacity which is needed to increase national renewable electricity generation output to meet climate change targets; reduction in non-renewable generation output; and the projected increase in demand resulting from the growth and electrification of the New Zealand economy.

[4] Waitaki Seismic Loads assessment – Isoseismals for M7.2 Event on Ostler fault – Drawing G-004

RESPONSE TO POINTS RAISED IN SUBMISSIONS

33. I have considered submissions relevant to my area of expertise and provide the below responses.

Design of the Ōhau A Reservoir Structures

34. Mr White has made some points in his submission on the design and construction of the Ōhau A Reservoir canals which are incorrect. Mr White considers that one side of the canal was designed "to break uphill" and that one side of the canal was "designed broader and also with stronger more robust materials than when compared to the topside canal wall". Mr White considers that Ministry of Works engineers intentionally designed weak points on the topside of the canal so that "no inundation or canal break would occur on the bottom side in the event of earthquake."

35. Mr White is correct that the engineers thought extensively about the natural hazards and the implications of a hypothetical dam break, in the context of the consequence at that time, but there is no evidence of what he asserts in the extensive design and construction records, or in the 'as-built' configuration of the Ōhau A reservoir structures as they exist today.

36. The Ōhau A reservoir was designed with a toppling block spillweir structure located on the upper end of the Pūkaki canal. The crest of the weir is approximately 1.0m lower than the nominal minimum embankment crest level. This is the designed spill outlet for the reservoir.

37. The reason that the embankment crests are of different widths is that one side of the canals was designed to carry a sealed two-lane road, with side verges, and the other was designed for a narrower unsealed road, with no side verges. The embankment side slopes are consistent across all structures, but where you have a taller section of fill embankment, the resulting base will be broader base. However, the crest width is substantially similar throughout all fill canal reaches.

38. There is no evidence from construction records of any differentiation of the materials used in construction of the embankment as suggested by Mr White.

'Downstream' Mitigation

39. Several submitters have proposed that the more appropriate approach to mitigation of the hydro inundation hazard is for Meridian to install 'downstream' measures, construction of earth bunds or 'protective dams'[5],that could reduce the extent of the Hydro Inundation Hazard Overlay.

40. These submitters may be confusing hazard and risk. There can never be no risk of dam failure, and hence Dam Safety Guidelines and Dam Safety Regulations require owners to assess the Potential Impact of a hypothetical dam break, so that:

    (a) The dam safety management applied by the owner is appropriate to assure the risk associated with the hazard is acceptably low.

    (b) Appropriate measures (such as the proposed Plan Changes) can be put in place by authorities to assure that the residual risk from the hazard is appropriately avoided.

41. The hazard (stored energy in the form of reservoir of retained water) is managed at the critical point of control, which are the dams, canals and associated infrastructure that retain the reservoir. Dam safety management for these structures includes comprehensive measures to understand, control and minimise the hazard in line with industry recommended practice, and regulatory requirements.

42. As responsible dam owners, Meridian aims to ensure that its dams are as safe as reasonably practicable, and that they will meet current dam safety criteria (including consideration of extreme seismic and flood load cases) with no uncontrolled release of the reservoir. This is done through our

[5] High Country Properties Ltd (14.01); Mackenzie Properties Ltd (13.01); Grant and Natasha Hocken (12.01); Anthony Honeybone (08.01); Michael Beauchamp (30.01); Elizabeth Shadbolt (37.01)

well-established and industry standard dam safety management practices. Mr Veale has covered the elements of dam safety management programmes in more detail in his evidence.

43. I consider that bunding, or similar, would not be an appropriate solution, either technically or financially, given the very low likelihood of the residual risk of dam break inundation to the Hydro Inundation Hazard Overlay areas.

44. Creating bunds to protect third party properties would be a huge reverse sensitivity impact to Meridian. These types of structures would cost many tens of millions of dollars to design and construct, in addition to the cost of acquiring the land for them to stand on, and there would be a significant further ongoing cost to for their management and maintenance. The bunds themselves would be considered appurtenant dam structures under the Dam Safety Guidelines and Regulations, meaning they would need to be designed and constructed to meet the same criteria as the existing structures, and would be subject to a dam safety management programme.

45. It is important to be aware that even if bunding were constructed, the Hydro Inundation Hazard Overlay areas would still be subject to a dam break hazard, as the bunds themselves would have a potential consequence of failure. In essence, the hazard is unlikely to be different to the current hazard.

Removal of Hazard Inundation Chapter or Hydro Inundation Hazard Overlay

46. Several submitters have sought the removal of the Hydro Inundation Hazard Overlay mapping and/or Chapter from the Plan, or the removal of their property from the overlay[5].

47. The Hydro Inundation Hazard Overlay provides an important function to inform authorities and communities of the hazard from these long existing dams and canals, and to allow planning to minimise the potential for reverse sensitivity effects on dam owners and hydroelectricity schemes.

Removing the Hydro Inundation Hazard Overlay or providing ad hoc exemptions would leave people and property at risk and would expose the WPS to significant further reverse sensitivity effects.

48. A key aim of the Government in developing and introducing the Dam Safety Regulations in May 2022 is to ensure that all 'large dams' in New Zealand are identified, classified, and notified to the relevant regional authority. And that for all large dams with a High or Medium Potential Impact Classification (PIC) (those which if they were to fail may cause loss of life), the owners provide 'Dam Break Inundation Hazard' maps to the Regional and District authorities so that the presence of the dams and the hazards they present can be taken into account in Regional and District development planning and in Civil Defence planning.

49. Complying with the Dam Safety regulations is a legal requirement and embeds the good dam safety management practice that Meridian has been following since its inception in developing this information on the existing hazard and sharing it with Canterbury Regional Council and Mackenzie District Council.

Risk Based Approach to the Hydro Inundation Hazard Overlay Hazard

50. Several submitters have called for the Plan to take a 'risk-based approach', criticising the fact that the mapping shows the consequence of a dam or canal failure rather than focussing on the likelihood of the failure[6].

51. Meridian contends that the planning rules that MDC have proposed reflect a 'risk-based approach' to managing the residual risk from this hazard.

52. Meridian manages the risk of dam failure down to a very low level, through its Dam Safety Assurance Programme. However, as Meridian has said in

[6] Anthony Honeybone (08.01); Peter Finnegan (04.01); Grant and Natasha Hocken (12.01); Mackenzie Properties Ltd (13.01); High Country Properties Ltd (14.01); Brent Lovelock (41.01); Anna Carr (60.01); Nick Ashley (48.01); Jason Wakelin (32.01)

its submissions, while the likelihood of a dam failure is extremely low, it is not zero, and a hazard to these areas always remains.

53. As discussed above, Plan Change 28 and Plan Change 30 should limit the population at risk in Hydro Inundation Hazard Overlay areas subject to a very short dam break flood arrival times and assist in assuring that people living in these areas are aware of the hazard and have appropriate and effective emergency response plans in place.

Activity Status for Residential Visitor Accommodation

54. Some submitters consider that the non-complying activity status of residential visitor accommodation within the parts of the Rural Lifestyle Zone affected by the Hydro Inundation Hazard Overlay should be changed to 'permitted', subject to the property owner providing a community or emergency response plan[7].

55. Ms Ruston will speak to the planning rationale for the non-complying status, but I wish to add that as set out in paragraphs 22 to 32, the reverse sensitivity effects that could flow from allowing this intensification could be significant.

56. My concerns about allowing intensive development in Hydro Inundation Hazard Overlay areas in close proximity to the Canal structures, and the significant reverse sensitivity effects if such development were allowed are set out in paragraphs 22 to 32 above.

57. As stated in paragraph 23, the most significant impact of more intensive development in the Hydro Inundation Hazard Overlay area, is that where development, and the associated Population at Risk, is located such that water from a dam break would reach the developments in a short period (< 90 minutes). International experience has shown that it is extremely difficult for the Population at Risk to safely evacuate, and the likelihood of

[7] Springwater Trust (02.01)

loss of life in a dam break event is much higher than areas with a longer warning time.

58. As stated in paragraph 26, the period for arrival of a dam break flow is assessed to be 30 minutes or less for the Flanagan Lane and Lyford Lane areas. These periods are short for much of the Hydro Inundation Hazard Overlay area. The greater the population exposed to the hazard, and the less familiar they are with the area, the hazard and the evacuation procedures, the greater the potential loss of life. This may be further exacerbated for visitors to the area whose first language is not English. These conditions would particularly apply to visitor accommodation.

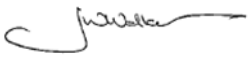
59. With reference to paragraphs 22 to 32, I consider that the provisions proposed in Plan Change 28 are appropriately set to manage the residual risk to the Hydro Inundation Hazard Overlay areas.

CONCLUSIONS

60. Subject to the changes identified by Ms Ruston, Meridian considers that Plan Changes 28 and 30 are an appropriate risk-based means to manage the residual risk from dam break hazard to the Hydro Inundation Hazard Overlay area. Particularly for those areas and people subject to a very short dam break flood arrival time should a dam break occur.

61. Meridian is already subject to significant reverse sensitivity effects to its Dam Safety Management Programme, and Structural Safety Evaluation Programme for the Ohau Chain reservoir as a result of current development in the Hydro Inundation Hazard Overlay areas. Should intensive development be permitted within the Hydro Inundation Hazard Overlay area in close proximity to the canal and dam structures, Meridian would be exposed to further very significant reverse sensitivity effects. This would include capital costs expected to be many millions of dollars, plus significant ongoing operating costs, thorough the need to establish

enhanced structure monitoring systems and enhanced Emergency Response Plans and systems.



Jim Walker

9 May 2025