

BEFORE INDEPENDENT COMMISSIONERS APPOINTED BY THE SOUTHLAND REGIONAL COUNCIL

IN THE MATTER of the Resource Management Act 1991

AND IN THE MATTER of various resource consent applications for periodic openings of Waituna Lagoon Waipārera by Te Rūnanga o Awarua, the Department of Conservation and the Southland Regional Council (Environment Southland) [the Applicants]

Application No. **APP-20242456**

Evidence of Dr Hugh Allister Robertson – Freshwater Ecology
on behalf of the Applicants
Dated: 11 July 2025

Department of Conservation | *Te Papa Atawhai*

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Executive Summary

1. My evidence describes the cross-discipline approach that was applied to recommend the water level management regime to restore the ecological integrity (ecosystem health) of Waituna Lagoon. It describes how different hydrological scenarios were used to inform the proposed consent conditions, considering the effects (positive and negative) on key attributes of Waituna Lagoon.
2. The Awarua Wetland Ramsar Site meets eight of the nine criteria of international importance under the Convention on Wetlands, with Waituna Lagoon supporting many of the internationally recognised values.
3. The 'lagoon' ecosystem type is recognised as a naturally uncommon ecosystem and identified as an 'endangered' ecosystem type in New Zealand.
4. In my opinion, it is critical that the management and restoration of the ecological health of Waituna Lagoon, considers the environmental water requirements of multiple ecological values in a systematic assessment. By considering the response of fish, submerged plants, water quality, avifauna and fringing vegetation to different lagoon water level scenarios and compared to a no consent situation where the open/closed status is unmanaged.
5. The proposed consent conditions for lagoon opening have been directly informed by the technical review of consent conditions and in my opinion are appropriate to support the restoration of the ecological and cultural values of Waituna Lagoon.
6. Various submitters suggested alternative, typically lower, lagoon opening trigger levels. The recommended 2.0m, 2.2m or 2.3m trigger levels in these submissions did not provide the technical evidence of how lower thresholds would support restoration of the multiple ecological values present at Waituna Lagoon. Reverting to lower trigger levels will increase the likelihood of opening events and consequently the risk of ecosystem decline, as aquatic plants and other biota are not able to fulfil their life cycle.
7. While there are adverse effects associated with opening events, including reduction of aquatic and wetland habitat for rare and threatened species as water levels recede, adverse effects are also predicted to occur from leaving the system unmanaged. The risk of algal bloom events is high (refer evidence of Mr Rabel and Dr Schallenberg) and threatened fish may be unable to complete fish migration.

8. The proposed conditions are responsive to these issues, with specific processes to mitigate water quality decline, ecosystem health concerns and to promote fish passage.

Introduction

1. My full name is Hugh Allister Robertson.
2. I have been asked by the Applicants to provide expert evidence on their application for resource consents to provide for periodic openings of Waituna Lagoon to the sea.

Qualifications and experience

3. I am employed by the Department of Conservation (DOC) as a Principal Science Advisor. I have worked for DOC since 2008.
4. I have a PhD in wetland ecology from Deakin University, Melbourne, Australia (2007), and a BSc Hons (first class) from Otago University (1999). My PhD thesis was entitled 'Environmental Water Requirements of Isolated Floodplain Wetlands' and investigated the ecological functioning of wetland systems. My research specifically evaluated the effect of different water allocation scenarios to the restore wetland ecosystems.
5. I have 23 years of experience in the field of freshwater ecology and the conservation and restoration of degraded ecosystems in New Zealand and Australia, in both a research and water resource management capacity. This includes in depth understanding of the hydrological variation of different wetland types and response to drainage (e.g. Burge et al 2023).
6. Prior to working for DOC, I worked for the New South Wales Department of Environment and Climate Change (2006-2008) where I was responsible for providing technical input to catchment water sharing plans. I also worked for the regional government in South Australia (2005-2006) determining the environmental water requirements to maintain the ecological values of wetlands.
7. I was appointed New Zealand's National Science & Technical (STRP) Focal Point for the Ramsar Convention on Wetlands in 2008. In this role I provide scientific advice to the NZ Government on the status of wetlands of international importance, which includes Waituna Lagoon, and the sustainable management of wetlands in general. Note 'wetlands' under the Convention covers riverine, estuarine, lacustrine and palustrine hydrosystems.
8. I was an invited expert (2013-2015, and for recent amendments) for the Wetlands Panel convened by the Ministry for the Environment to develop recommendations on wetland

attributes and associated catchment policy in association with the development of the NPS Freshwater Management.

9. I was the lead author of the wetlands chapter in the NZ Freshwater Science Society publication *Advances in New Zealand Freshwater Science*. The chapter was titled: 'Wetland biodiversity, ecosystem processes and management' (Robertson et al. 2016).
10. I am the scientific lead for the national Arawai Kākāriki wetland restoration programme led by the Department that includes Waituna Lagoon. In this role, I directly support the ecological monitoring and reporting on the state and trend of natural values at Waituna Lagoon.
11. During 2018-2022 I was appointed the Oceania representative to the international scientific body under the Convention on Wetlands (Ramsar Convention), the Scientific and Technical Review Panel (STRP). I led the Convention's publications on sustainable agriculture and wetlands. I was also a contributing author for the Global Assessment of Peatlands published by the United Nations Environment Programme in 2022.
12. In 2023, I was appointed Chair of the Convention on Wetlands (Ramsar Convention) Scientific and Technical Review Panel, and I am lead author of the *Global Wetland Outlook 2025: Valuing, Conserving, Restoring and Financing Wetlands*.
13. I have contributed to various publications and technical reports in New Zealand and Internationally relating to the conservation of aquatic ecosystems. This includes scientific papers and technical Reports on Waituna Lagoon and the Southland region (e.g. Robertson & Funnell 2012, Lagoon Technical Group 2013, Schallenberg et al. 2017, Robertson et al. 2019).
14. I have been providing technical advice to the applicants since at least 2012 in support of the management of lagoon opening events, including as a member of a Technical Advisory Group.
15. I was the coordinating and lead author of the technical report prepared to support the consent application *Technical review of conditions for opening Waituna Lagoon* (Robertson et al. 2024).
16. I have previously provided evidence to the Environment Court and Council Hearings relating to the management of water resources and the effects on wetland ecosystems, including in relation to the Southland Regional Policy Statement provisions for Waituna Lagoon, groundwater extraction limits (Northland) and the Healthy Rivers Plan Change 1 (Waikato).

Code of Conduct

17. Although this is a Council hearing, I have read the code of conduct for expert witnesses as contained in the Environment Court's Practice Note 2023 (the Code). I have complied with the Code when preparing my written statement of evidence.
18. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence below. The reasons for the opinions expressed are also set out in the evidence below.
19. Unless I state otherwise, this evidence is within my sphere of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.
20. For the avoidance of doubt, in providing this evidence as an expert witness in accordance with the Environment Court Code of Conduct, I acknowledge that I have an overriding duty to impartially assist the Commissioners on matters within my area of expertise. The views expressed are my own expert views, and I do not speak on behalf of the Applicants and, in particular, I do not speak for the Department of Conservation.

Scope

21. I have been asked to provide evidence in relation to the conservation values of Waituna Lagoon, fringing wetlands, and the multi-value assessment approach used to inform the proposed consent conditions.
22. My evidence addresses the following matters:
 - a. Describe the ecological importance of Waituna Lagoon
 - b. Describe the multi-value approach to inform management of the water regime
 - c. Explain the hydrological scenarios examined and how these scenarios have guided the multi-value ecological assessment
 - d. Describe the status of fringing wetland vegetation in response to different water levels
 - e. Comment on the appropriateness of the proposed conditions

Material Considered

23. In preparing my evidence I have read and relied upon the following documents:
- a. Application documents, technical audits and s92 responses to request for information, in particular:
 - (i) Resource Consent Application and Assessment of Environmental Effects (Thorne 2024)
 - (ii) Technical review of conditions for opening Waituna Lagoon (Robertson et al. 2024)
 - (iii) Applicants' Recommended Changes to Consent Conditions dated 11.07.25
 - (iv) Supplementary information provided by the applicants relating to fringing wetland vegetation, the transitional water regime trigger levels, and review of water level model scenarios.
 - b. The Regional Council Notification report dated 5 August 2024.
 - c. Submissions on the application, particularly relating to the maximum (trigger) water levels, including (but not limited to) submissions from: L&B Ballantine, M Blacker, KF Bradley, NP De Haan, G Hayes, J Koenig, A Lawson, L McCallum, C McCrostie, R McNaughton, KG & RE Munro, ER Pirie, The Royal Forest and Bird Society, R Van Gool, M van Rossum, M Waghorn, and the Waituna Catchment Group.
 - d. The s42A Hearing Report APP-20242456, dated 4 July 2025.
24. I have visited the Waituna Lagoon site on numerous occasions since 2008. For example, in 2009 I coordinated the field programme to establish the long-term survey of 48 sites to evaluate the status and trend of submerged macrophytes and macroalgae in the lagoon. Most recently, I led the field assessment of the potential impact of water levels >2.4m on submerged aquatic plants in August-September 2024. I have also undertaken field assessments of wetland hydrology, wetland soils and plants in nearby wetland habitats in the Awarua-Waituna complex.

Application and supporting documents

25. My evidence describes the cross-discipline approach that was applied to recommend the water level management regime to restore the ecological integrity (ecosystem health) of Waituna Lagoon. It describes the multiple values of the lagoon ecosystem, and complex issues that need to be considered in efforts to restore the natural function of the coastal lake/lagoon, while being aware the lagoon is a receiving environment of a modified catchment. I describe how different hydrological scenarios were used to inform the proposed consent conditions, considering the effects (positive and negative) on key attributes of Waituna Lagoon, including submerged macrophytes, fish, avifauna, water quality, fringing wetlands, and cultural values.
26. My evidence also comments on matters raised in the s42A report (refer paragraphs 27-31 below) and by submitters, particularly in relation to the proposed transitional lagoon opening regime, in terms of maximum water level triggers.

Section 42A Report

27. It is noted in the s42A report that the assessment of effects for which the proposed consent conditions are evaluated against, relates to the adverse effects of opening the lagoon, relative to a 'do nothing' approach where natural processes alone influence lagoon ecosystem water levels and function (refer 2.4.5).
28. The report also commented: "When considering the adverse ecological effects in light of the policy direction, I consider that they are mitigated or remedied (once closed) and are a result of providing for positive outcomes in the lagoon e.g. avoiding an algal bloom or providing for fish passage, or are part of the transition to a more optimal opening regime for the ecological values of the lagoon. These positive outcomes align with the direction of the SWLP and the protection/restoration requirement of the NPS-FM". This observation aligns with the technical approach used to evaluate proposed consent conditions (Robertson et al. 2024), to manage the multiple values and attributes of the lagoon ecosystem.

Areas of Alignment

29. The s42A report also notes the proposed activities (opening regime) are for the purposes of wetland restoration and/or maintenance (refer 2.5.6), which I agree with. The objective of the technical assessment (Robertson et al. 2024) was to identify the best options available to manage and restore the ecosystem health of Waituna Lagoon.

30. The report also recommended the monitoring of fringing wetland plant communities, to observe any potential changes in vegetation that I support, subject to minor changes set out further in my evidence. Establishing baseline monitoring (near to start of consent period) and at 5-yearly intervals thereafter would enable any persistent changes in fringing vegetation to be evaluated.
31. Finally, the s42A report concluded that the ‘the effects on ecological values are likely to be neutral to positive and will result in the movement towards a more natural environment while protecting the lagoon’. I agree with this statement.

Ecological significance of Waituna Lagoon

32. Waituna Lagoon is one of the few remaining coastal lagoons in New Zealand that exhibits relatively natural flora and fauna and supports significant ecological values. The lagoon covers an area of approximately 1350 hectares and is Southland’s largest coastal lake.
33. The Conservation Management Strategy (CMS) for Southland Murihiku 2016 (DOC 2016) identified ‘Awarua Place’, which includes Waituna Lagoon, as a priority area for conservation of natural resources. This recognised the ecological significance of the Awarua-Waituna wetland complex.
34. Waituna Lagoon and associated Awarua wetland is one of the largest remaining wetland complexes in New Zealand, although the Waituna Plains has been subject to significant and ongoing wetland loss (Robertson et al. 2019).
35. Waituna Lagoon is identified by the Department of Conservation (DOC) as a priority ecosystem for the conservation of New Zealand’s natural heritage and it is one of three nationally significant wetland systems in DOC’s national Arawai Kākāriki wetland restoration programme.
36. The significance of the lagoon and its margins were recognised internationally in 1976 when it was designated a Ramsar Site (Wetland of International Importance) under the Convention on Wetlands (Ramsar Convention) and nationally by gaining Scientific Reserve status in 1983.
37. The Awarua Wetland Ramsar Site covers an area of approximately 20,000 ha, and includes estuaries of Awarua Bay, New River Estuary and Toetoes Harbour, as well as the peatlands of the Awarua Plain dominated by wire rush and shrubland, and Waituna Lagoon (Figure 1). Along the coastal margin of Waituna Lagoon the boundary with the sea is generally at Mean High-Water Level, consistent with the extent of the Scientific Reserve.

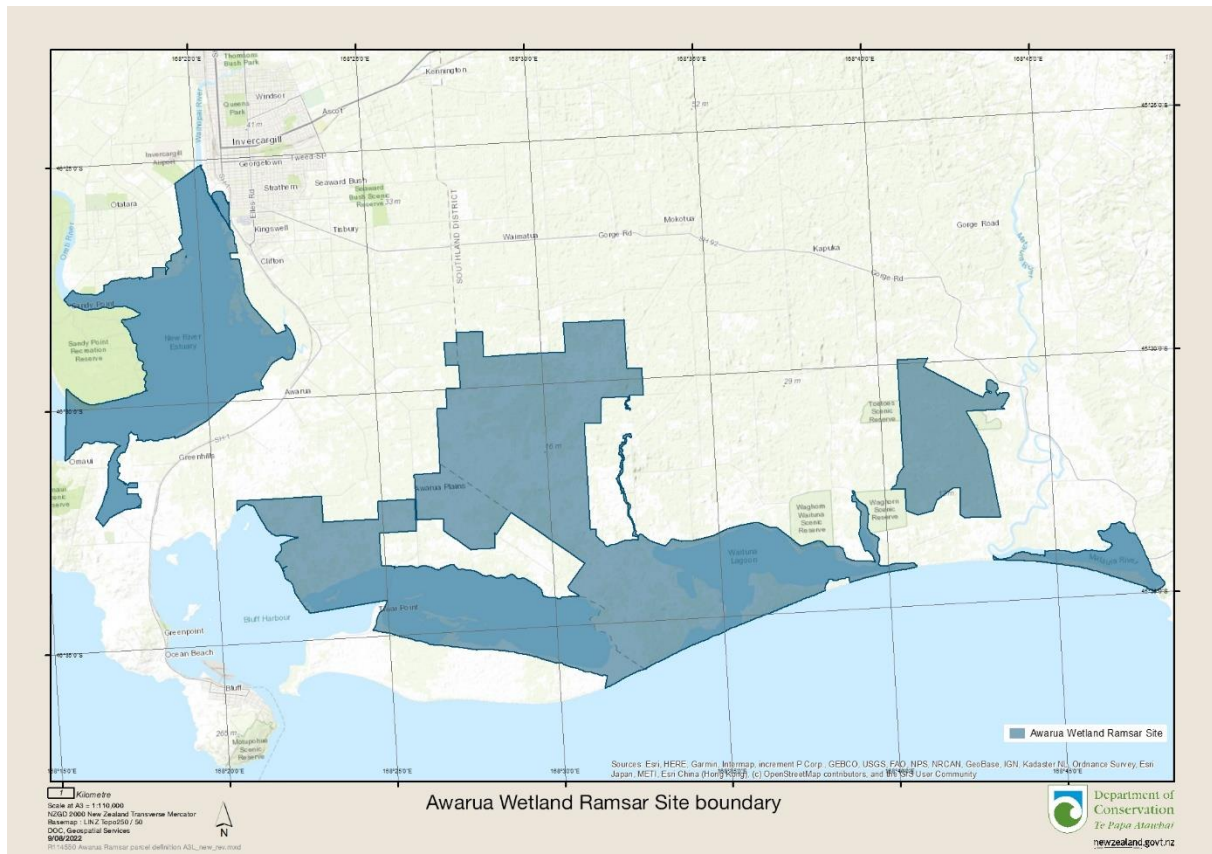


Figure 1. Awarua Wetland Ramsar Site Boundary – as of 2008

38. Awarua Wetland Ramsar Site meets eight of the nine criteria of international importance under the Convention on Wetlands, with Waituna Lagoon supporting many of the internationally recognised values (Table 1).

Table 1. Criteria for Wetlands of International Importance under the Convention on Wetlands.

Criterion (A wetland should be considered internationally important if it)	Awarua Wetlands Ramsar Site Source: Based on Ramsar Information Sheet prepared by DOC (2022)
Criterion 1: Contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	The Awarua Ramsar site is a near-natural wetland that is one of the largest and most diverse areas of contiguous peatland, coastal lagoon, tidal estuary and lowland peatland streams in New Zealand. Assessment of representativeness is based on the extent to which the site is, or contains wetland types that are among the best examples in the relevant bioregion
Criterion 2: Supports vulnerable, endangered, or critically endangered species or threatened ecological communities.	Up to one third of the nationally critical southern New Zealand dotterel (<i>Charadrius obscurus</i> ssp. <i>obscurus</i>) population spends its winter feeding in Awarua Bay. Another 11 nationally threatened bird species are resident or regular visitors to the wetland, including Australasian Bittern. The wetland also contains threatened and uncommon plant species (e.g. <i>Ruppia megacarpa</i>)

Criterion 3: supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	The flora is very diverse and highly representative of southern New Zealand peatland, coastal lake and estuarine communities. Intact vegetation sequences extend from mudflats with eelgrass (<i>Zostera muelleri</i> subsp. <i>novazelandica</i>), saltmarsh foreshore, a coastal lake characterised by aquatic macrophyte beds, rushland dominated by jointed rush (<i>Apodasmia similis</i>), shrubland dominated by manuka (<i>Leptospermum scoparium</i>) and mature podocarp forest.
Criterion 4: supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	Waituna Lagoon is the principal black swan (<i>Cygnus atratus</i>) breeding and moulting site. There is a black shag (<i>Phalacrocorax carbo</i>) and royal spoonbill (<i>Platalea regia</i>) colony on one of the ponds, while New River Estuary supports the world's southern-most colonies of Caspian tern (<i>Hydroprogne caspia</i>). White-fronted tern (<i>Sterna striata aucklandiana</i>) breed on Tiwai Spit, and the wetland also supports one the life-cycle of the wetland-dependent Australasian bittern (<i>Botaurus poiciloptilus</i>) that is 'Nationally Critical'. Through the late spring to early autumn, migratory waders (including up to 21 species of trans-equatorial migrants) visit the area to build up their food reserves before returning to the northern hemisphere for their summer breeding season. Internal migratory waders spend their winter feeding in the estuaries of the wetland and in the summer disperse inland. Waterfowl also utilise the estuaries and Waituna Lagoon as well as the numerous small ponds and lakes.
Criterion 5: Regularly supports 20,000 or more waterbirds.	<i>Not applicable</i>
Criterion 6: Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	Awarua Bay annually supports 37% of the total population of NZ dotterel (<i>Charadrius obscurus</i>).
Criterion 7: Supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.	The wetland contains marine, estuarine and freshwater fish species with 18 species reported in Waituna lagoon.
Criterion 8: Is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	The estuaries, lagoon and streams are important sources of food for fishes, spawning ground, nursery and/or migration path on which fish stocks that are regularly sought after for food, cultural use, or recreational harvest. Many such species are migratory for part of their life and pass through the estuaries, while the galaxiid species harvested as whitebait live in the wetland for much or all of their life.
Criterion 9: Regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.	The critically endangered moth species <i>Asaphodes frivola</i> is endemic to the Invercargill area, with its stronghold in the Awarua Wetland at Tiwai. No absolute population data are available for this species, but local experts estimate that Awarua wetlands support more than 1% of the global population of <i>Asaphodes frivola</i> .

39. One of the key commitments following the designation of wetlands as internationally important Ramsar Sites under the Convention on Wetlands is to maintain and/or enhance the ecological character of the wetland, that is to promote their conservation (refer Article 3.1 of the Convention). Ecological character is defined as: ‘the combination of the ecosystem components, processes and benefits/services that characterise the wetland’ and is more encompassing than those values that relate specifically to Ramsar Site criteria (Table 1).
40. Where an adverse change has occurred to a Ramsar Site’s ecological character, it is expected that the Administering Authority (DOC) report these changes to the Convention on Wetlands (refer Article 3.2) and put in place measures to address any negative changes. Efforts to restore the ecological health of Waituna Lagoon, as proposed in the consent application, are in my opinion are consistent with the commitment under the Convention to promote conservation of designated Ramsar Sites.
41. The ‘lagoon’ ecosystem type is recognised as one of 72 types of naturally uncommon ecosystems occurring in New Zealand (Williams et al. 2007) and based on IUCN Red List criteria is identified as an ‘endangered’ ecosystem type in New Zealand (Holdaway et al. 2012).
42. The coastal hydrosystems classification of New Zealand (Hume et al. 2016) classifies the system as a ‘Waituna-type lagoon’, which encompasses coastal lakes/lagoons with similar geomorphological function and natural features, such as Wainono Lagoon (South Canterbury) and Lake Ellesmere/Te Waihora. The distinguishing natural characteristics of these lagoons are (from Hume et al. 2016):

Large (several km²), shallow (mean depth 2 to 3m) coastal lagoons barred from the sea by a barrier or barrier beach (no tidal inflow). Waterbody is typically fresh, fed by small streams, with brackish pockets in time or space. Drainage to the sea is generally by percolation through the barrier. Their most frequent state is closed to the sea. Short-lived openings occur when water levels build a sufficient hydraulic head in the lagoon to breach the enclosing barrier, due to river inflows and/or severe storm wave overtopping. Sustained openings to the sea are rare (decadal-century time scales) unless created artificially. They may experience tidal inflows for short periods (1-2 tidal cycles) after natural barrier breaches whereas recent observations indicate that artificial breaches can result in openings that experience tidal ingress for up to several weeks (e.g., Te Waihora Lake Ellesmere). Wind waves and wind-induced currents are important agents for mixing. Observations of historical lagoon ridges suggest that these agents were even more important in pre-human times when depth and

fetch of the waterbodies were greater than today. Situated on wave-dominated high-energy mixed sand/gravel coasts. Dominant substrate is very fine sand and mud. Two subclasses are recognised: coastal plain depressions (2A) are the most common type occupying depressions on low-lying coastal land that were typically coastal embayments during the early Holocene but have since been isolated from the ocean by barriers (e.g., Wainono Lagoon); valley basins (2B) occur in river valleys as more elongate-shaped and slightly deeper water bodies (e.g., Te Roto o Wairewa Lake Forsyth). Sometimes incorrectly labelled ICOLLs (Intermittently Closed and Opened Lakes and Lagoons of Haines et al. 2006). However, waituna barriers typically comprise coarser sediment and are therefore more permeable than those of ICOLLs. This, for most of the time, allows the lake to drain by percolation through the barrier, preventing build-up of water and hydraulic head. Hence the barrier breaches less often than in the case of ICOLLs.

43. In my opinion, this description of the natural features on Waituna-type lagoons is of high relevance for guiding the conservation and restoration of the natural character of New Zealand's indigenous ecosystems. Without understanding natural environmental processes, there may be a risk that a restricted set of biodiversity or other values are used to guide the management of water levels Waituna Lagoon.
44. Additional description of the natural characteristics of coastal lake/lagoon systems is provided in the evidence of Dr Schallenberg. Specific ecological and cultural values of Waituna Lagoon are described in the evidence of Dr Holmes (native fish), Mr Jacques (avifauna), Mr Rabel (water quality), Mr Whaanga (cultural perspective) and Ms de Winton (aquatic plants), while I present information on fringing wetland vegetation.

Multi-value assessment approach

45. The long-term objective for opening the Waituna Lagoon to the sea is to maintain and restore the ecological health and cultural values of the lagoon ecosystem (Robertson et al. 2024). It is recognised, however, that Waituna-type lagoons are complex environments and support a broad range of ecological values, in terms of indigenous plants, animals, water quality, cultural values and the lagoon's overall natural character. The different values of Waituna Lagoon will have different responses to water level variation. This may include opportunistic responses, where particular biota do better in an environment modified by human intervention, although this may not reflect the natural processes of the ecosystem.

46. In my opinion, it is critical that the management and restoration of the ecological health of Waituna Lagoon, considers the environmental water requirements of multiple ecological values in a systematic assessment. That is, by considering the response of fish, submerged plants, water quality, avifauna and fringing vegetation to different lagoon water level scenarios and compared to a no consent situation where water levels and the open/closed status is unmanaged.
47. The technical review of the conditions for opening Waituna Lagoon implemented a systematic assessment of multiple ecological values (Robertson et al. 2024). It involved four key steps. These were:
- i. **Identify ecological and cultural values:** Reconfirm the suite of key ecological and cultural values that are affected by lagoon opening and, therefore, need to be considered in relation to any change in opening regime.
 - ii. **Review the previous consent conditions:** Review the impact of the previous consent conditions and monitoring information on key ecological and cultural values of the lagoon.
 - iii. **Propose new consent conditions:** Conduct an integrated assessment of ecological and cultural values and identify conditions that will maintain or enhance the values identified.
 - iv. **Assess the impact of proposed consent conditions on other values:** Assess the impact of the proposed consent conditions on other key values for the Waituna Community including on land drainage, trout fishing, bird populations and duck hunting.
48. The key ecological values of Waituna Lagoon considered in the technical review and the associated aims of an open/closed water regime for each value is summarised in Table 2.

Table 2. Ecological and cultural values of Waituna Lagoon and surrounding wetland. Source: Robertson et al. (2024)

	Value	Impacted by	Aims of an opening regime
Taonga species	Iwi recognise a range of taonga species present in the Waituna wetland system, including (but not limited to); tuna (longfin and shortfin eel), kanakana (lamprey), inanga (whitebait), koura (freshwater crayfish), pātiki (flounder), smelt, kōkopu (whitebait), kākahi (freshwater mussel). Around and within the fringes of the lagoon, taonga include swan, water fowl, pukeko, cabbage trees, flax, mānuka and	- a closed lagoon prevents fish species migrations to and from the sea, including several taonga species - opening the lagoon for long periods may increase the presence of exotic weed species in fringing wetlands to the detriment of native species, and reduce food and habitat for taonga freshwater species - high salinity favours estuarine species over freshwater species	- enhance taonga species - maintain the lagoon as close to natural (unmanipulated) state as possible without compromising overall lagoon health

	Value	Impacted by	Aims of an opening regime
	other plant species. Māori use local black mud (paru) for dyeing textiles.		
Cultural significance	Cultural values of the lagoon include (but are not limited to): aesthetic appeal, mahinga kai, safety of access, identity, landscape and connection to landscape and human health.	- prolonged opening may alter the identity, aesthetic appeal and connection to the lagoon ecosystem - also refer to impacts on taonga species above	move towards a natural opening regime (if it can be done without compromising lagoon health)
Water quality	Water quality of the lagoon supports a desirable aquatic ecosystem without algal blooms and anoxic “dead zones”. Toxicants and detrimental contaminants don’t detract from a state of Hauora	- high nutrients (concentrations in the water column and in lagoon bed sediments) - elevated water temperature - high inflows (increasing nutrient & sediment delivery) - fine sediments (in the water column and in lagoon bed sediments) <i>Faecal contamination</i> (<i>E. coli</i> and <i>Enterococci</i>, affecting human contact, food gathering & cultural values) - Lagoon flushing (openings and closings) - water levels - contaminant loads from farming activities in the catchment - extent and status of fringing wetlands - changes in biomass of macrophyte communities or other photosynthetic organisms may contribute to nutrient release or reduce dissolved oxygen	- provide a mechanism for excessive nutrients, sediment and algae to be flushed to the ocean - provide a mechanism to disrupt prolonged algal blooms - manage algae proliferations including cyanobacteria blooms and macroalgae - reduce levels of faecal contamination - improve or maintain the health of fringing wetlands, which buffer against contaminants in overland flow - maintain <i>Ruppia</i> within optimal >30-60% cover abundance - mechanism to address contaminant or toxin issues - re-oxygenation of lagoon waters - protect against events that cause large-scale macrophyte decline and lagoon to shift to algal-dominated state
Submerged macrophytes	Sustain and enhance the population of submerged macrophytes including the keystone taxa, <i>Ruppia</i> spp. The macrophyte community also supports at-risk <i>Ruppia megacarpa</i> .	- poor water clarity which may be exacerbated under high water levels >2.5m (light limitation of macrophyte growth) or low water levels (enhanced sediment resuspension) - low water levels resulting in loss of habitat - elevated salinity when the lagoon is opened - wave action and sediment resuspension when the lagoon is shallow - macroalgae and phytoplankton proliferation caused by high nutrient concentrations	- prevent frequent spring/summer opening to enable macrophyte regeneration (benefit from low salinity during germination) - at least two consecutive years of closed lagoon over the main vegetation growth period to enable <i>Ruppia</i> development/flowering - ensure maximum water levels do not exceed 2.5m (may cause negative effects on aquatic/wetland plants due to light limitation) - provide a mechanism for excessive nutrients to be flushed to the ocean - reduce the risk of high salinity during key <i>Ruppia</i> growing period

	Value	Impacted by	Aims of an opening regime
Fish and aquatic invertebrate populations	A diverse population of freshwater fish is present in the lagoon system, including a number of migratory species (refer above to taonga species) as well as marine wanderers such as kahawai. Aquatic invertebrates in the lagoon include benthic and pelagic species which likely play important roles in the lagoon's food web. Large invertebrates such as koura (freshwater crayfish) and kākahi (freshwater mussel) are also present in low numbers near the tributary inflows.	• a closed lagoon limits fish migration • low water levels may reduce or degrade spawning habitat • an open lagoon reduces food and habitat for freshwater species, while providing habitat for brackish/estuarine species • poor water quality (including high nutrients, high turbidity, low dissolved oxygen and elevated water temperatures) negatively impact fish and invertebrates	• allow for the timing of opening events to benefit fish spawning and migration where possible • ensure that closures are sufficient in duration to provide food and habitat for multiple species, including for spawning • managing openings for water quality and macrophytes (incl. <i>Ruppia</i>) to support migration/movement of fish and invertebrate populations
Indigenous species dominance of coastal lake	The flora and fauna of Waituna Lagoon is dominated by native species that are characteristic of coastal lake ecosystems.	• extended freshwater phase may permit invasion by non-native freshwater pests (weeds, fish, invertebrates). • extended estuarine phase may permit invasion by non-native saltwater pests (weeds, fish, invertebrates)	• Allow for openings to disrupt freshwater pest invasions that are a significant biosecurity risk to the ecological health of Waituna Lagoon
Bird populations	The lagoon and associated wetlands provides habitat for a broad range of bird species including many native and threatened species, migratory waterbirds, and waterfowl.	• an open lagoon reduces habitat for wetland bird species and waterfowl in that it affects optimal feeding depths, but increases habitat for waders • a closed lagoon reduces habitat for migratory wading birds, while recognising estuarine habitat for waders is nearby	• provide for water levels that support wetland birds, although it is recognised that differing water levels will favour different bird species over others (e.g., waders vs swimmers, i.e., different functional groups) • provision of habitat for migratory wading birds
Fringing wetlands	A diverse native plant community is present within the fringing wetlands surrounding the lagoon. These wetlands provide habitat to support indigenous fauna, including threatened species.	• persistent low water levels and very high-water levels can alter native plant communities, with some species/community-types benefiting at the expense of others • high water levels may protect wetland vegetation from exotic plant invasion	• manage a fluctuating water regime to support fringing wetlands, e.g., oioi, turf plants • avoid prolonged periods of low water levels that de-water the fringing wetlands

49. The technical review (Robertson et al. 2024) also examined the impact of the previous consent conditions on key ecological and cultural values of Waituna Lagoon. This assessment identified five key issues to address in developing conditions for the long-term management of Waituna Lagoon. The five issues were:

- *Incorporating conditions that aim to reduce the frequency of spring/summer opening events. Previous 2.0m and 2.2m water level thresholds were not sufficient to prevent such openings.*
- *Reviewing the mechanisms for lagoon openings to address poor water quality and ecosystem health concerns.*

- *Providing lagoon openings to facilitate fish passage, during key migration periods, particularly if there are prolonged periods when the lagoon is closed.*
- *Ensuring the proposed lagoon opening regime considers the benefits/risks to all ecological and cultural values, including recreational values and risk to surrounding wetlands.*
- *Consideration of the potential impacts of the opening regime on land drainage.*

50. Of particular importance is understanding the history of water level fluctuations, and the impact of previous water level triggers for lagoon opening (Robertson et al. 2024). Figure 2 illustrates the water level variation in Waituna Lagoon for the period 2015-2022. During this period water levels oscillated between closed and open conditions, due to a series of human-induced opening events.

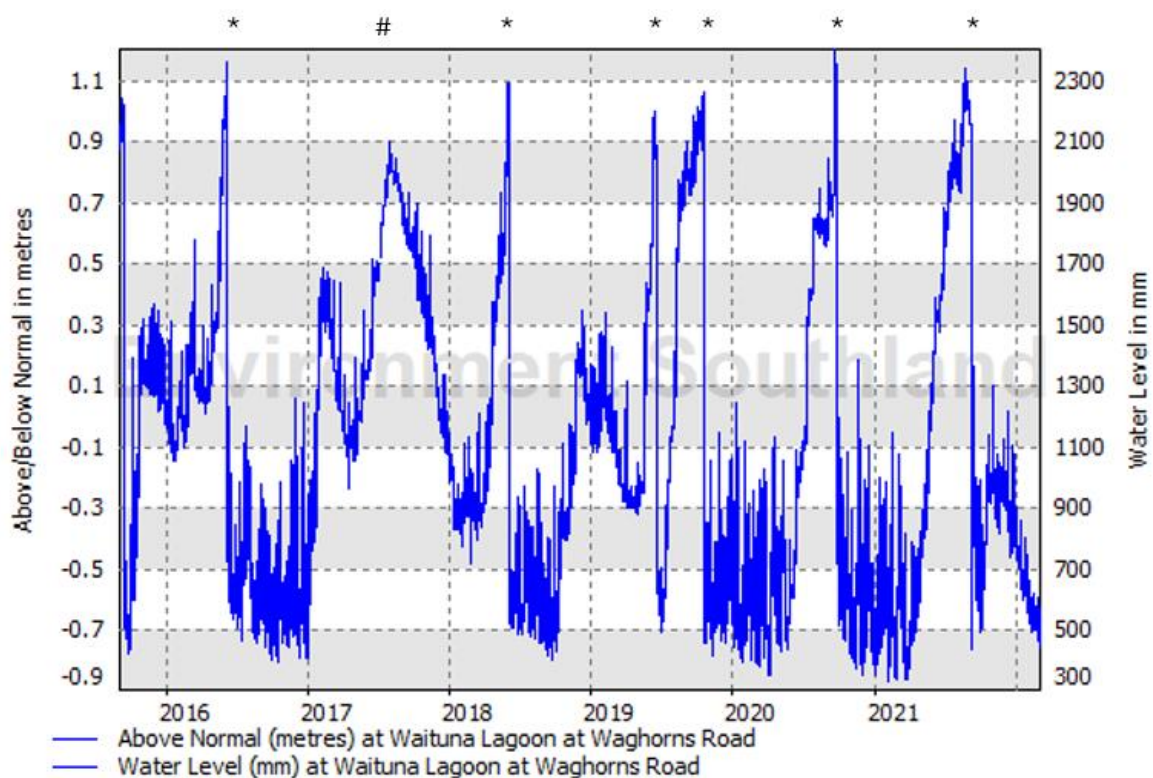


Figure 2. Water levels in Waituna Lagoon for the period September 2015 to February 2022. Asterisks (*) indicate lagoon openings. Hash (#) indicates where the 2.0m winter opening threshold under previous consent conditions were reached, however water levels naturally receded, and the lagoon was not opened.

51. One of the main pressures on Waituna Lagoon is the frequency of opening events during the spring/summer period, a critical period for the growth and reproduction of submerged plants in the lagoon. During the period of the last consent (2017-2022), water levels often exceeded the trigger level for opening, that led to an opening event. The consequence of these events was often a prolonged open period with tidal influence (Figure 3). The frequent opening events, as noted in the evidence of Ms de Winton, had a direct and negative impact on submerged plants.

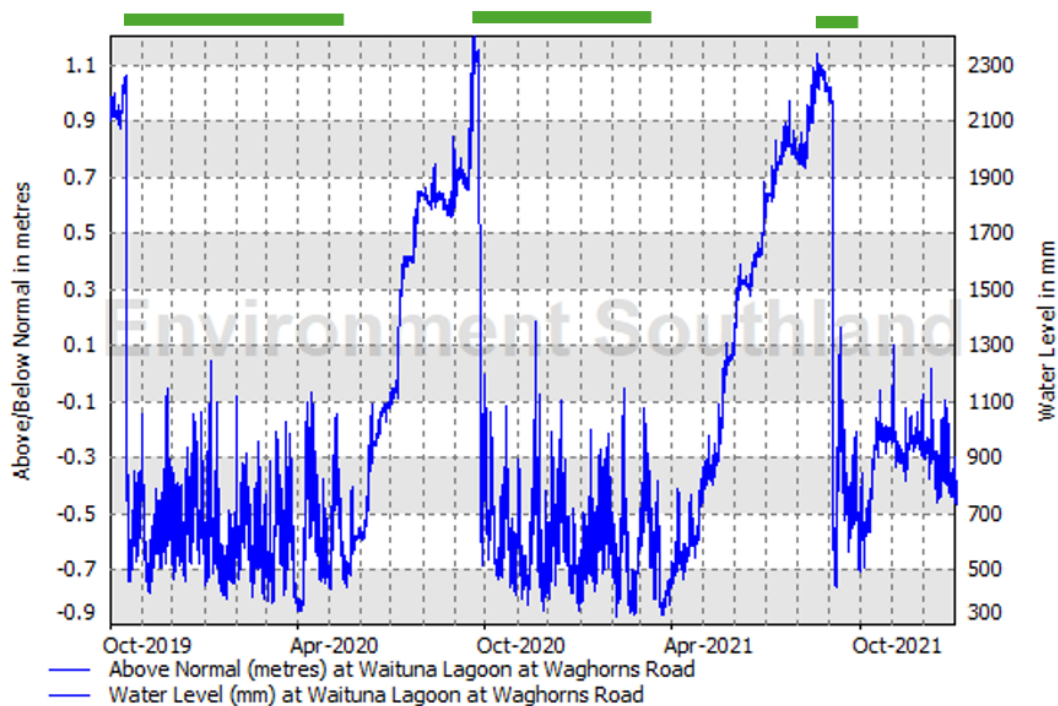


Figure 3. Water levels in Waituna Lagoon for the period September 2019 to January 2022. Green bars indicate when the lagoon was open during spring/summer months.

52. However, as detailed in the evidence of Mr Rabel and Dr Schallenberg, given the changes in land use in the catchment and the relatively high concentrations of nutrients from catchment sources, the occurrence of prolonged closed conditions also significantly increases the risk of water quality decline and algal proliferation.
53. Consequently, while enabling the restoration of natural hydrological and ecological processes remains an important conservation goal in my opinion, the proposed water level regime must consider the benefits and risks for multiple lagoon values.

Hydrological scenarios used to inform multi-value ecological assessment

54. A range of hydrological scenarios were considered in preparation of the technical report supporting the application applying the water level balance model maintained by Environment Southland. This model has been peer-reviewed, refer evidence of Mr Measures.
55. The modelled hydrological scenarios considered technical advice on the maximum water level thresholds for different ecological values and drivers (Table 3). This advice indicated a maximum water level threshold of 2.5m was recommended for lagoon management, although for some attributes (e.g. mechanism to disrupt algal bloom) the provision for lagoon opening at lower levels is important.

Table 3. Summary of threshold level considerations. Source: Robertson et al. (2024)

Value/Driver	Maximum level (mASL)	Details
Preventing spring/summer openings during 'years of concern' to enable macrophyte regeneration.	2.5	Summer openings stress macrophytes and favour macroalgae. <i>Ruppia</i> benefits from closure and low salinity during key growth stage (spring/summer).
Allowing the timing of opening events to benefit fish spawning and migration where possible.	na	Issues for fish include timing of events and the maximum water level.
Managing a fluctuating water regime to support fringing wetlands – e.g., Oioi, turf plants.	2.5	LiDAR elevation models indicate that most wetland vegetation will be inundated when lagoon levels are ~2.3m. Irregular inundation at higher levels is positive for these systems.
Providing a mechanism for excessive nutrients to be flushed to the ocean.	>1.8*	Flushing of nutrients can occur when there is sufficient hydraulic gradient. The higher the water level, the better the flushing when opened.
Providing a mechanism to disrupt a prolonged algal bloom.	>1.5	Ecological guidelines suggested that if needed an opening could occur at 1.5m to disrupt a prolonged algal bloom. A minimum height is needed for a mechanically effective opening, not a maximum.
Ensuring maximum water levels do not cause negative effects on aquatic/wetland plants (e.g., light limitation).	2.0**	Light limitation is likely to have an impact on submerged vegetation in deeper parts of the lagoon. Prolonged inundation (>20 days per annum) at higher water levels (e.g., >2.3m) may limit productivity.
Recommendation	2.5 mASL	

Notes: * Flushing of nutrients may be feasible at lower levels if there is sufficient hydraulic gradient. **Because the gravel barrier is leaky, prolonged events (e.g. ~ 2.3m) may be unlikely. Unknown potential positive effect of raised water level on sediment resuspension/turbidity and light penetration.

56. The hydrological scenarios initially assessed as part of the technical review of conditions were (Robertson et al. 2024):

- **Previous consent:** open when level is at 2.0 m for the period May – 19 September, and open when level is at 2.2 m for the period 20 September – 30 April
- **Scenario 1:** open when level is at 2.2 m or above for 7 consecutive days

- **Scenario A:** open when level is at 2.5 m or above for 7 consecutive days
- **Scenario B:** open when level is 2.5 m or above for 7 consecutive days or, if no opening occurred in the previous year, open if the level exceeds 1.5 m (for fish passage)
- **Scenario C:** open when level is 2.5 m or above for 7 consecutive days or, if no opening occurred in the previous 2 years, open if the level exceeds 1.5 m (for fish passage)
- **Scenario D:** open when level is 2.5m for 1 day for the period 1 September to 30 April, and open when level is 2.3m for 7 consecutive days for the period of 1 May to 30 August or, if no opening occurred in the previous 2 years, open if the level exceeds 2 m (for fish passage)

57. Scenario D corresponds to the preliminary period of the transitional regime in the consent application. The outputs of the hydrological model are re-presented below (Table 4). While Scenario C represents the end period of the proposed transitional regime.
58. The model indicated that compared to the previous short-term consent, Scenario D would result in a much lower frequency of openings per year, and lower frequency of openings during the spring-summer period (Sept-April). While the number or duration of events above 2.4m did not increase substantially.

Table 4. Opening scenarios and probabilities of the lagoon opening and for how long based on historic data (data supplied by Chris Jenkins, Environment Southland, December 2023).

Summary statistics	Short term Consent	Scenario				
		1	A	B	C	D
Average Openings per Year	1.07	0.85	0.42	0.79	0.55	0.67
Average Num. Openings 1 Sep to 30 April	0.24	0.33	0.14	0.25	0.17	0.15
Annual average days above 2.0m	10.21	23.2	55.48	36.42	49.16	36.23
Annual average total events of 2.0m	1.31	1.79	2.11	1.59	1.93	1.93
Average duration of events above 2.0m (days)	8.9	21.41	53.37	34.84	47.23	18.75
Annual average days above 2.2m	2.01	4.61	24.18	15.11	21.24	11.72
Annual average total events of 2.2m	0.62	0.95	1.59	1.04	1.37	1.23
Average duration of events above 2.2m (days)	1.39	3.66	22.6	14.06	19.88	9.54
Annual average days above 2.4m	0.38	0.69	5.78	4.03	4.98	1.66

Summary statistics	Short term Consent	Scenario				
		1	A	B	C	D
Annual average total events of 2.4m	0.1	0.18	0.78	0.54	0.67	0.44
Average duration of events above 2.4m (days)	0.28	0.51	5	3.49	4.3	3.75

59. As part of the application and pre-hearing process refinement to hydrological scenarios were made, including to apply a recent (slower) seepage rate through the gravel bar (refer evidence of Mr Measures) and to explore the potential for application of 2.4m maximum trigger level, as opposed to 2.5m applied in Table 4.
60. Based on this, if applying a 2.4m threshold for Scenario D *‘there is a minor difference between the frequency of summer openings between the 2.4 m and 2.5m trigger levels. Under the ‘recent’ seepage rate there is a slightly higher chance of a summer opening at 2.4m (e.g. Scenario D = 0.37 probability of opening in summer) when compared to 2.5m (Scenario D = 0.30 probability). Although the difference between 2.4m and 2.5m is negligible under the ‘historic’ seepage rate’* (refer Applicant Further Information Response 26 June 2025 at Appendix F).

Status of fringing wetland vegetation in response to different water levels

61. The fringing wetland plant communities of Waituna Lagoon were described by Johnson and Partridge (1998) and Johnson (2004). Following these surveys, a repeat assessment of the fringing wetland plant communities was undertaken during 2012-2013 (Blythell 2013). The 2013 survey involved vegetation monitoring of 15 transects at Waituna Lagoon (refer to Appendix 1). Transects extended from the lagoon edge and continued perpendicular to the shoreline.
62. The dominant wetland plant communities recorded during the Blythell (2013) survey were:
- Oioi restiad-rushland/reedland
 - Manuka-tangle fern scrub/fernland
 - Herbfield / Lakeshore turf
 - Modified flaxland
 - Carex Schoenus sedgeland
 - Oioi, knobby clubrush sedgeland

63. The exotic and non-wetland plant communities recorded were:
- Exotic grassland
 - Exotic ruderal beach community
 - Manuka scrub
 - Shore bindweed, knobby clubbrush gravel-field-stonefield
 - Bracken fernland
64. Fringing wetland vegetation within the influence of lagoon water levels (<2.5m) is dominated, in terms of extent, by the wirerush/ Oioi (*Apodasmia similis*).
65. The fringing vegetation supports four at-risk (de Lange et al. 2024) plant species, these are: *Isolepis basilaris* (pygmy clubbrush), *Deschampsia cespitosa* (tufted hair grass), *Urtica perconfusa* (swamp nettle), and *Thyridia repens* (native musk). None of these species were abundant in the last comprehensive monitoring survey (Blythell 2013).
66. Wetland plant communities have different environmental water requirements depending on their adaptation or resilience to inundation, or dry soil conditions. Some plant species are obligate wetland plants and always occur in wetlands due to the presence of water, while others are facultative (often associated with wetlands). Upland species are associated with terrestrial landforms and not typically associated with inundation.
67. An assessment of the expected response of fringing vegetation to different water levels in Waituna Lagoon is described in the additional information that I prepared on request of the s42A Officer (Applicant Further Information Response 26 June 2025, excerpt included as Appendix 1).
68. This assessment concluded that '*native wetland plant communities will not be adversely affected by the increased duration of inundation at water levels >2.0m and 2.2m (relative to the previous resource consent) as the wetland species are adapted or resilient of wet conditions, and because the increased duration is relatively small. Irregular inundation at higher levels is positive for these systems as they will also make growing conditions for exotic species, such as introduced grasses and gorse, more difficult.*'
69. Appendix 1 also notes '*there may be some transition and dieback of native terrestrial species that migrated downslope in response to a prolonged period of modified hydrology. During September 2024 water levels in Waituna Lagoon remained above 2.4m for a period of ~2-3 weeks. Following this event, reports were received from community of dieback of some*

vegetation in discrete areas, such as manuka. This reversion (and associated dieback) from terrestrial plants to more wetland plant communities can be viewed as part of the ecological restoration of the natural hydrological and ecological function of the lagoon ecosystem. In other wetlands of New Zealand, manuka has established because of altered hydrology (e.g. Whangamarino wetland) and has subsequently declined as the water levels were restored. The proposed transitional regime is supported to allow the native wetland vegetation to transition gradually overtime. The relatively short-periods above 2.3m (in winter) and 2.4m (in summer) for the initial 5 years will ensure that the Oioi rushland and other fringing wetland vegetation is not subject to a rapid shift in hydrological conditions.

70. As noted in paragraph 30 of my evidence, the s42A report recommended the monitoring of fringing wetland plant communities, to observe any potential changes in vegetation. I support the inclusion of monitoring of fringing vegetation and would recommend the methodology is aligned to the Blythell (2013) survey, where practicable.
71. In terms of the frequency of monitoring, I would recommend a baseline assessment of fringing vegetation (within 6-12 months of granting the consent) and thereafter assessment of vegetation at 5-year intervals. The s42A report suggested additional monitoring (at year 2) however, I do not consider this necessary. The effect of water level variation on the growth and recruitment of plant communities will only be reliably detected after several seasons, and the monitoring undertaken at year 5 will provide a better reflection of the overall response of fringing wetland vegetation to the transitional water regime. The cost-benefit of the additional monitoring information also needs to be considered.

Comment on the appropriateness of the proposed conditions

72. The proposed consent conditions recommended by the applicants include provisions for:
- The establishment of a Science Advisory Group to provide advice on lagoon opening events.
 - Monitoring and reporting.
 - A lagoon opening trigger level of 2.5m (above msl) to enhance ecological health and cultural values;
 - A transitional regime with the lagoon opening trigger level at 2.4m initially, and a lower threshold (2.3m) during the winter period;

- Inclusion of new conditions to facilitate fish passage; and
 - Refinement of the conditions providing for emergency lagoon opening to mitigate risks to water quality and ecosystem health.
73. I support the establishment of the Science Advisory Group (SAG) as outlined in the proposed conditions, which includes suitably qualified expert representatives, an independent Chair, and opportunity for the Waituna Catchment Community to nominate a representative.
74. The advice of the SAG is critical to the effective implementation of lagoon opening events, particularly in situations where conditions relating to water quality/ecosystem health and/or fish passage are applied. The role of the SAG in considering the multiple values of Waituna Lagoon is important to evaluate the benefits and risks of lagoon opening events, including and positive or negative effects on the primary and secondary indicators set out in Appendix 1 and 2 of the proposed consent.
75. In the past I have been a member of a multi-disciplinary Waituna Technical Advisory Group (TAG) that provided informal advice to the applicants on lagoon opening events, including advice on emergency opening events in 2024. The TAG was largely informal but did include a wide range of experts from different organisations. The proposed Science Advisory Group under the consent provides a formal and clear process to ensure decision-making is supported by adequate technical advice.
76. I also support the monitoring and reporting outlined in the proposed consent conditions. This establishes the requirement to regularly monitor changes in the primary and secondary indicators in Appendix 1 and Appendix 2, and to review the effectiveness of the consent overall.
77. The proposed consent conditions for lagoon opening (including the transitional water level triggers) have been directly informed by the technical review of consent conditions (Robertson et al. 2024) and in my opinion are appropriate to support the restoration of the ecological and cultural values of Waituna Lagoon.
78. An integrated assessment of ecological and cultural values was compiled during the technical review (Table 5). I concluded, as the lead author of the assessment and with support of experts across several disciplines, that the proposed conditions will have an overall beneficial impact on the ecosystem health of Waituna Lagoon, although for some values the response may be neutral (bird populations, water quality).

Table 5. Integrated assessment of impact of proposed conditions (Robertson et al. 2024).

Value	Impact of previous consent conditions	Predicted impact of recommended conditions (Scenario C)	Predicted change in value due to proposed conditions
Taonga species	Does not specifically provide for fish passage for taonga species. Opening events may or may not align with key migratory periods	Specific provisions for fish migration. Increased focus on monitoring	Improvement/Neutral
Cultural significance	Frequent opening events (>1x/year) not aligned with restoring ecosystem to more natural regime	Conditions specifically target a transition to a more natural state (longer freshwater phase)	Improvement
Water quality	Included provision for emergency opening to disrupt phytoplankton bloom	Conditions for emergency opening retained in case of poor water quality. Lagoon flushing will still occur (given conditions for fish passage)	Neutral
Submerged macrophytes	Spring/summer openings led to regular decline in abundance of submerged macrophytes	Conditions specifically target improved management of macrophytes due to higher (2.5m) opening threshold	Improvement
Fish and invertebrate populations	Does not specifically provide for fish passage. Opening events may or may not align with key migratory periods. Kōura and kākahi habitat maybe limited with lower lagoon levels and more frequent saline conditions.	Specific provisions for fish migration. Increased focus on monitoring Kōura and kākahi may benefit from increased habitat from higher lagoon levels and less frequent openings and lower salinity	Improvement
Bird populations	Conditions provide for both open and closed lagoon conditions that support broad range of bird species.	Conditions provide for both open and closed lagoon conditions that support broad range of bird species. Longer freshwater phase will benefit threatened species (bittern) and waterfowl (incl. ducks). A reduction in the estuarine phase is not considered to have a significant impact on the bird species that favour an open lagoon due to the availability of other estuarine habitats in the area (e.g., New River estuary, Awarua Bay, Fortrose estuary)	Neutral
Fringing Wetlands	Lack of high (>2.2m) water levels promoted more exotic weed species. Frequent draining of fringing wetlands.	Conditions provide for greater water level fluctuation to support fringing native plant communities, e.g. oioi, turf plants. Avoids prolonged periods of lower water levels that dewater fringing wetlands. .	Improvement

79. The evidence of other experts further supplements this assessment predicted response of different ecological and cultural values, refer to evidence of Dr Holmes (fish), Ms de Winton

(aquatic plants/macroalgae), Mr Jacques (avifauna), Mr Whaanga (cultural values), Mr Rabel (water quality), Dr Schallenberg (lagoon processes and function).

80. In summary, the transitional regime effectively balances:

- The restoration of the natural hydrological and ecological processes of Waituna Lagoon, by seeking to reduce the frequency of human-induced opening events that disrupt the natural characteristics of the endangered ecosystem type;
- Promotes suitable conditions for submerged plants by applying a 2.5m maximum trigger level (initially a 2.4m maximum) to reduce the frequency of human-induced opening events, relative to the conditions of the previous expired consent;
- Provides a mechanism to mitigate water quality events such as algal blooms;
- Provides a mechanism to support fish passage during key fish migration periods; and
- Supports the inundation of fringing vegetation, including habitat that may be used for breeding by threatened wetland bird species.

81. During the application and pre-hearing process, I note the applicants have proposed amendments to the transitional water regime. That is, in years 1-5 the summer trigger level is now proposed at 2.4m (previously 2.5m), and for years 6-10 the trigger level (winter and summer) is proposed at 2.4m (an additional transition step).

82. This amendment was informed by technical advice. As noted previously *'there is a minor difference between the frequency of summer openings between the 2.4 m and 2.5m trigger levels. Under the 'recent' seepage rate there is a slightly higher chance of a summer opening at 2.4m (e.g. Scenario D = 0.37 probability of opening in summer) when compared to 2.5m (Scenario D = 0.30 probability). Although the difference between 2.4m and 2.5m is negligible under the 'historic' seepage rate'* (refer Applicant Further Information Response 26 June 2025 at Appendix F).

83. While a 2.5m maximum trigger level is more appropriate for the long-term restoration of Waituna Lagoon, given it provides greater opportunity for water levels to recede naturally to avoid unnecessary opening events, the application of a 2.4m trigger level will enable many human-induced opening events to be avoided. Further, it was noted (refer Applicant Further Information Response 26 June 2025, Appendix F) that *'2.5m remains the recommended*

maximum trigger for Waituna Lagoon in the long-term, given the goal to minimise the frequency of lagoon opening events (annually and in summer periods) and enable restoration of ecosystem health and transition to a more natural regime. Applying a 2.4m maximum trigger level will likely have some minor negative impacts on target ecological and cultural values and result in a slightly less natural opening regime’.

84. Various submitters suggested alternative, typically lower, lagoon opening trigger levels. However, the recommended 2.0m, 2.2m or 2.3m trigger levels in these submissions did not provide detailed technical evidence of how lower thresholds would support restoration of the multiple ecological values present at Waituna Lagoon. Reverting to lower trigger levels will increase the likelihood of opening events and consequently the risk of ecosystem decline, as aquatic plants and other biota are not able to fulfil their life cycle.
85. While there are adverse effects associated with opening events, including reduction of aquatic and wetland habitat for rare and threatened species as water levels recede there is also significant risk of leaving the system unmanaged. The risk of algal bloom events is high (refer evidence of Mr Rabel and Dr Schallenberg) and threatened fish may be unable to complete fish migration. The proposed conditions are responsive to these issues, with specific processes to mitigate water quality decline, ecosystem health concerns and to promote fish passage.
86. Overall, the challenge is to enable the restoration of a natural and significant coastal lake ecosystem, while balancing the environmental water requirements for different attributes and values of Waituna Lagoon. Some submitters suggest modifying the coastal lake environment for a small selection of species (e.g. birds, fish), or for water quality only. This is not appropriate in my view. An integrated assessment is important to promote an ecosystem-based approach to conservation and restoration.



Hugh Allister Robertson

Dated 11 July 2025

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Appendix 1

2.4 Fringing Wetland Effects

Information Requested

Overall, there is a high degree of information and analysis that provides reasonable certainty as to the potential adverse and positive effects of the proposal on water quality and fish communities. However, we are of the opinion that insufficient information has been provided to enable a clear understanding of the adverse or positive effects on native avifauna populations and fringing wetland vegetation communities. We recommend further information be sought, specifically:

Further commentary on the potential effects of lagoon opening on fringing wetland vegetation communities and their extent should be provided. This will allow for some certainty that any effect will be at an acceptable level.

Response

Response prepared by Dr Hugh Robertson, Principal Science Advisor, Department of Conservation

1. The 'Technical review of conditions for opening Waituna Lagoon' recognised fringing or shoreline wetlands as a key ecological value of Waituna Lagoon (Robertson et al. 2024). The report noted a 'diverse native plant community is present within the fringing wetlands surrounding the lagoon. These wetlands provide habitat to support indigenous fauna, including threatened species.'
2. The fringing wetland plant communities of Waituna Lagoon were described by Johnson and Partridge (1998) and Johnson (2004). Following these surveys, a repeat assessment of the fringing wetland plant communities was undertaken during 2012-2013 as part of the DOC Arawai Kākāriki wetland restoration programme (Blythell 2013). The 2013 survey involved vegetation monitoring of 15 transects at Waituna Lagoon (Figure 1), with transects ranging in length from 22m - 292m. Transects extended from the lagoon edge and continued perpendicular to the shoreline.



Figure 1. Map indicating position of shoreline transects around the margins of Waituna Lagoon.

3. The dominant wetland plant communities recorded during the Blythell (2013) survey, applying the Singers and Rogers classification system (2014), were:
 - Oioi restiad-rushland/reedland (most dominant in terms of extent)
 - Manuka-tangle fern scrub/fernland
 - Herbfield / Lakeshore turf
 - Modified flaxland
 - Carex Schoenus sedgeland
 - Oioi, knobby clubrush sedgeland
4. The exotic and non-wetland plant communities recorded were:
 - Exotic grassland
 - Exotic ruderal beach community
 - Manuka scrub
 - Shore bindweed, knobby clubrush gravelfield-stonefield
 - Bracken fernland
5. Wetland plant communities have different environmental water requirements depending on their adaptation or resilience to inundation, or dry soil conditions. Some plant species are obligate wetland plants and always occur in wetlands due to the presence of water, while others are facultative (often associated with wetlands). Upland species are associated with terrestrial landforms and not typically associated with inundation.
6. Figure 2 provides a schematic illustration of the zonation of plant communities at Waituna Lagoon. Close to the lagoon edge fringing wetland vegetation is often dominated by the wirerush Oioi *Apodasmia similis*. There is a marked increase in land elevation where the landforms influenced by lacustrine (lake) processes change to landforms associated with the development of peatland soils and are often dominated by Mānuka *Leptospermum scoparium*.

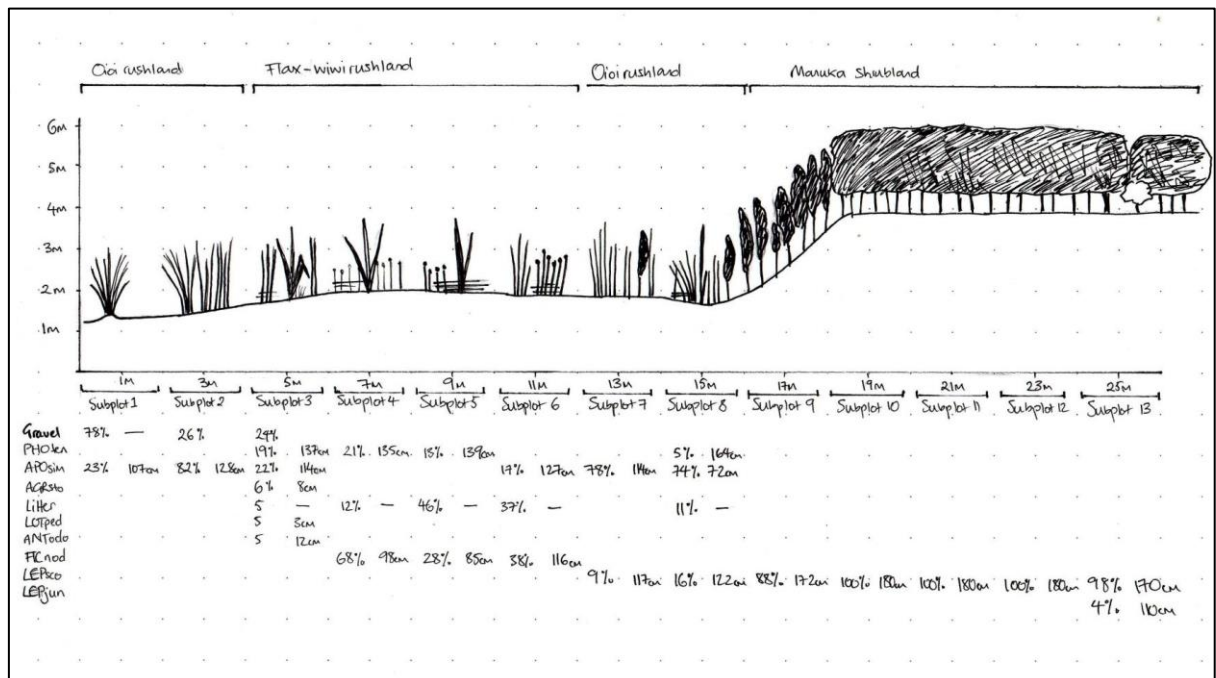


Figure 2. Schematic diagram of Transect 2 monitored during 2012-13 illustrating a typical transition of vegetation from the shoreline of Waituna Lagoon. Note some Mānuka (LEPsc) was observed at lower elevations (subplot 7). Source: Blythell (2013).

7. The proposed transitional regime for Waituna Lagoon, with provisions for regular opening to allow for fish passage, allows for gradual change in how water levels are managed in Waituna

Lagoon. For the initial five (5) years of the consent, it is proposed opening events when water levels exceed 2.3m for seven consecutive days (in winter), and 2.4m for 3 consecutive days (in summer). *Note this reflects the latest version of proposed transitional regime.* Eventually, the maximum trigger level for lagoon opening will increase to 2.5m for 7 consecutive days. The extent of inundation at different water levels is shown in Figure 3, reproduced from the technical report (Robertson et al. 2024).

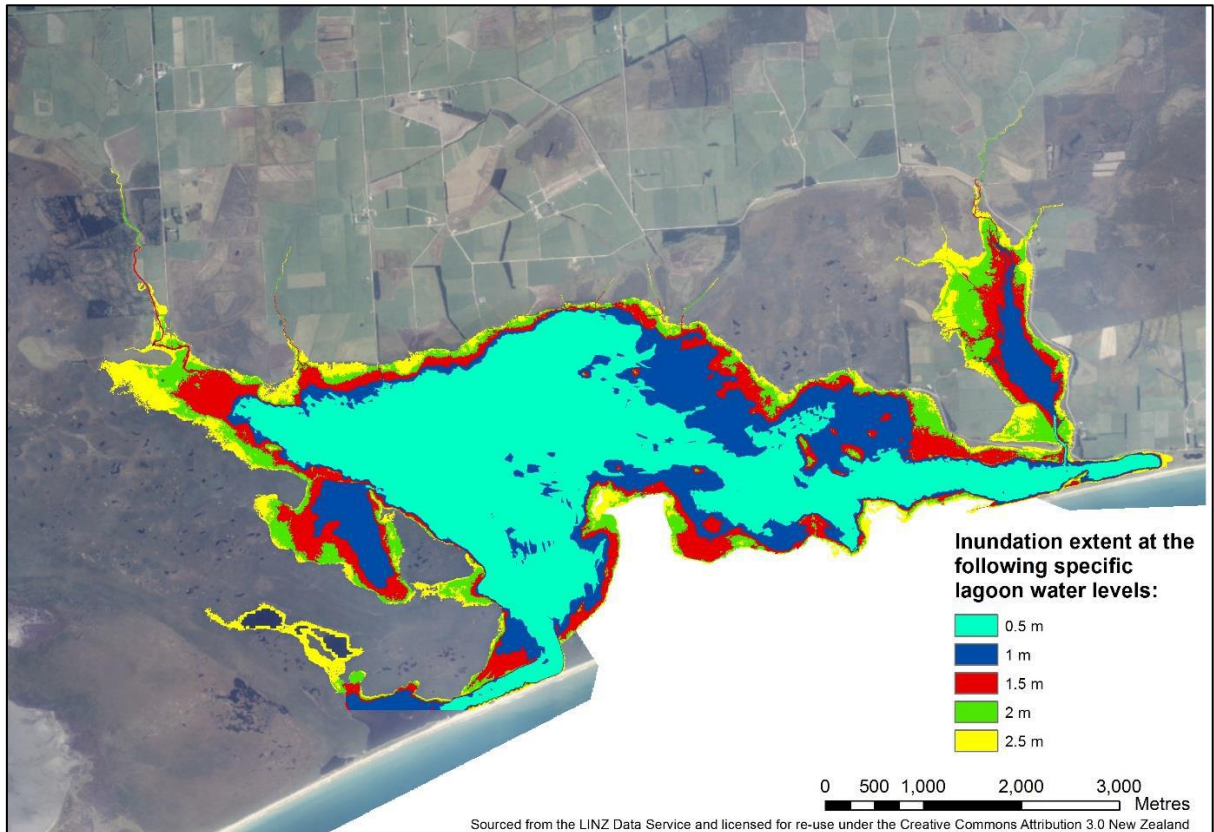


Figure 3. Waituna Lagoon inundation extent at different water depths. Source: Walsh et al. (2016).

8. The distribution of the fringing plant communities at Waituna Lagoon, relative to a lagoon water level (land elevation) of 2.4 m is shown in Figure 4. The vegetation mapping was undertaken in 2008 when delineating wetland plant communities across the Awarua-Waituna complex (Boffa Miskell & Urtica 2010). The classification system is slightly different than that applied by Blythell (2013) but is comparable.
9. The dominate wetland plant community between <2.4 m in the fringing wetland habitat is *Oioi restiad-rushland/reedland* (Figure 4). In relatively small areas dense manuka and flaxland are also present as observed in the eastern areas of Waituna Lagoon. (Figure 4b).

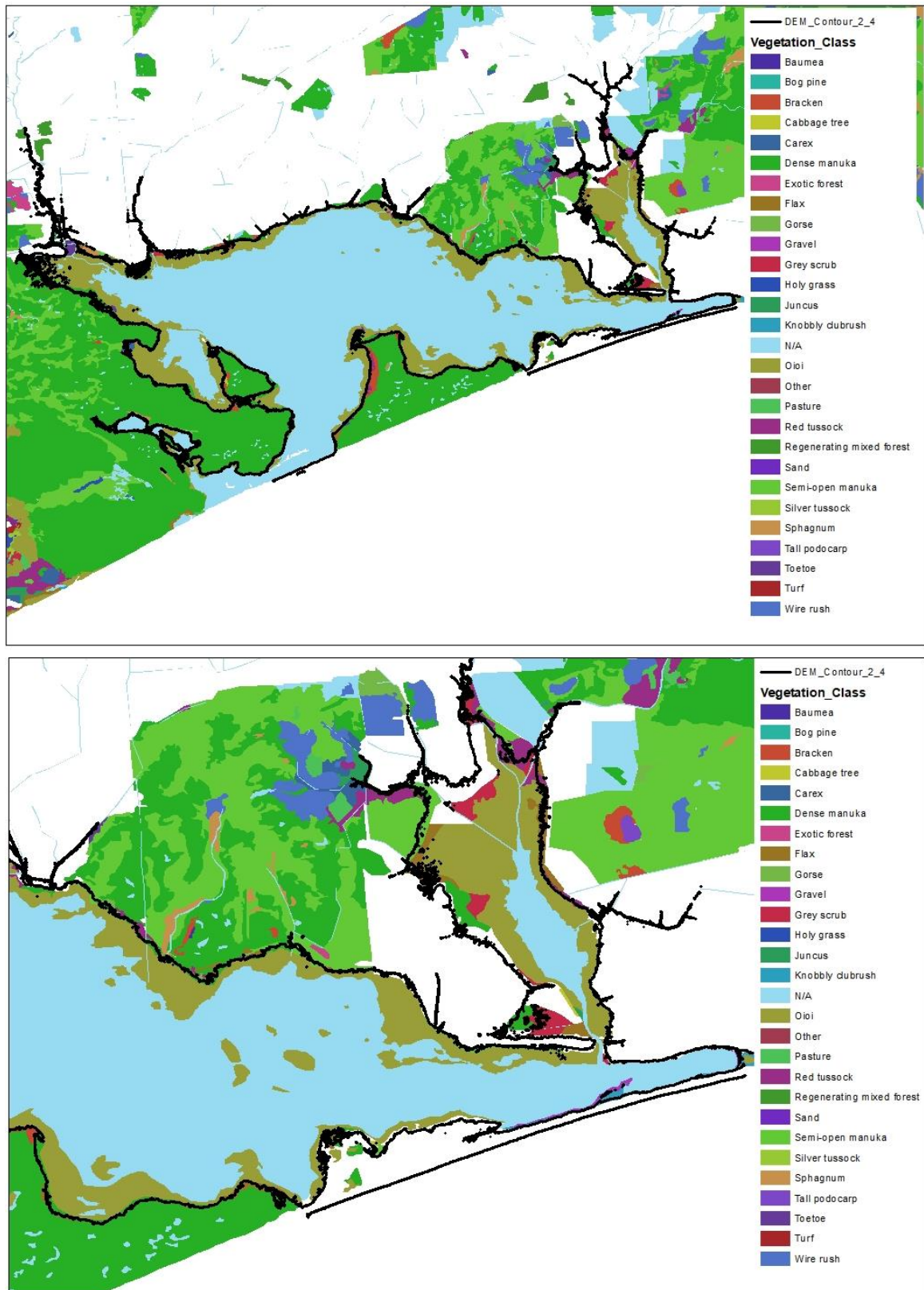


Figure 4. Extent of fringing wetland vegetation communities at Waituna Lagoon, relative to lagoon water level of 2.4 m. **a)** Full lagoon extent; **b)** East lagoon area. Source: Boffa Miskell & Urtica (2010).

- Updated hydrological modelling of lagoon opening scenarios was completed by Environment Southland (Jenkins March 2025, internal memo). Table 1 provides a summary of the *Scenario D*. In this scenario opening events occur when the 'level is 2.4 m for 1 day for the period 1

September to 20 April, and open when level is 2.3 m for 7 consecutive days for the period 1 May to 30 August or, if no opening occurred in the previous 2 years, open if the level exceeds 2 m (for fish passage)’.

Table 1. Number of days water levels projected to be >2.0m, 2.2m and 2.4m under Scenario D water level scenario, compared to the previous short-term consent. Source: Jenkins 2025, internal memo.

Summary information	Scenario D (transition regime)	Previous short-term consent
Annual days above 2.0m	31.7 days	10.2 days
Annual days above 2.2m	8.2 days	2.0 days
Annual days above 2.4m	0.9 days	0.4 days

11. Table 1 indicates there is anticipated to be an increase in the duration of inundation >2.0m and >2.2m for the transitional opening regime compared to how the lagoon has been managed previously. However, when compared to the previous short-term consent this does not exhibit a major change in the duration of ‘higher water’ periods. For example, it is modelled that water levels will be >2.2m above msl for 8.2 days per annum (compared to 2.0 days previously). Although, using the more conservative seepage rate, this may increase marginally to 12 days per annum >2.2m (Jenkins, 2025).
12. Further, it is important to note that the baseline state against which the consent application to open the lagoon is being assessed against is a ‘no consent’ scenario where water levels would fluctuate naturally. In an unmanaged scenario the fringing wetland vegetation would be subject to more frequent and prolonged inundation at high water levels >2.4m.
13. Using the wetland and non-wetland/exotic plant communities described by Blythell (2013) an assessment of the likely effect of the proposed water regime is presented (Table 2).

Table 2a. Expected effect of transitional water regime on wetland plant communities

Wetland plant communities	Occurrence (Blythell 2013)	Effect of proposed water regime (Scenario D)
Oioi restiad-rushland/reedland	Oioi rushland was the most abundant community type recorded, representing in 142 of the 221 subplots.	Apodasmia similis (Oioi) is the most common and widespread plant community. The rushes are tolerant of inundation and the 6-20 day increase in days inundated (compared to previous water level) is not considered a risk.
Manuka-tangle fern scrub/fernland	Only one subplot exhibited this community type.	Not common in fringing vegetation. Less tolerant of wet conditions. Likely present due to some terrestrial wetland plants to migrating downslope associated with the historical lower-water level.
Herbfield (Lakeshore turf)	Lakeshore turf communities occurred in 19 different subplots across nine of the fifteen transects.	Lakeshore turf plants are by their nature adapted to fluctuating water levels. The extended duration of events (6-20 day increase in days inundated) is not anticipated to have adverse effect on turf species, e.g. <i>Lilaeopsis novae-zelandiae</i> , <i>Limosella lineata</i>
Modified flaxland	This community type was only found in two subplots along a single transect.	Not common in fringing vegetation. Flax (<i>Phormium tenax</i>) is tolerant of wet conditions.
Carex Schoenus sedgeland	This community type occurred in three subplots along two different transects.	Not common in fringing vegetation. The key plant species <i>Carex coriacea</i> and <i>C. gaudichaudiana</i> are considered tolerant of wet conditions.

Oioi, knobby clubrush sedgeland	This community occurred in three subplots across two different transects.	Not common in fringing vegetation. <i>Ficinia nodosa</i> (clubrush) and Oioi are tolerant of wet conditions. The extended duration of events (6-20 day increase in days inundated) is not anticipated to have adverse effect on turf species.
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Table 2b. Expected effect of transitional water regime on exotic and non-wetland plant communities

Non-wetland and exotic plant communities	Occurrence and elevation	
Exotic grassland	This community is widespread was found in 26 subplots from eight different transects.	Exotic grass species, e.g. tall fescue, Yorkshire fog <i>Holcus lanatus</i> are partly tolerant of wetland conditions. Increase in inundation anticipated to cause reduction of exotic grasses.
Exotic ruderal beach community	This community type occurred in five subplots along three different transects.	Exotic species that may establish quickly when conditions favourable (e.g. <i>Lepidium didymium</i> , <i>Rumex acetosella</i> , and <i>Atriplex prostrata</i>). Increase in inundation anticipated to cause reduction of exotic herbs.
Manuka scrub	This community occurred in nine different transects. There were eleven subplots containing an intact manuka scrub community as well six subplots containing a mix of manuka scrub and oioi rushland. An estimated elevation range for intact manuka scrub is ≥ 270 cm above the lagoon bed, while a mix of manuka scrub and oioi rushland has an estimated elevation range of 80 – 150 cm above the lagoon bed.	Manuka has generally established at higher elevations in the fringing vegetation, although with some outliers where manuka is in associated with Oioi. Manuka is less tolerant or prolonged inundation. The extent of manuka is likely associated with the historical lower-water level allowing manuka to migrate downslope. Some limited dieback of manuka may occur as a result of reinstating a more natural water regime.
Shore bindweed, knobby clubrush gravelfield-stonefield	This community type occurred in five subplots along a single transect on the gravel bar which separates the lagoon from the sea.	Occurs at sites on the gravel bar in general above the influence of lagoon water levels.
Bracken fernland	This community occurred in seven subplots within three different transects.	Bracken has generally established at higher elevations in the fringing vegetation. Bracken and associated species (e.g. gorse, manuka) is less tolerant or prolonged inundation. The extent of bracken is likely associated with the historical lower-water level.

14. Johnson and Partridge (1998) commented there were 'several lines of evidence that the nature of the lagoon margin vegetation has changed in response to a generally lower lagoon level, combined with apparent increases in sedimentation. The resilient *Apodasmia similis* (Oioi) rushland has responded to these changes, by increasing its extent, and maintaining, at least so far, a predominantly native feel to the lagoon shores'.

15. Similarly, Blythell (2013) commented *‘Some comparison of the vertical elevation range of some species is possible using the list of 39 species with elevation ranges in Johnson and Partridge (1998). The majority of these species (35 out of 39) appear to have extended their range down slope. However, nineteen are versatile species which can adapt quickly to take advantage of new habitat and their range extension may be recent (primarily herbs and short some monocotyledons). Nine of these versatile species are exotic and ten are native. However, twelve of the species which have moved down slope are not short-lived species and this possible extension in their elevation range implies that reduced water levels in the lagoon have affected their distribution.’* Blythell (2013) concluded that *‘Lagoon levels should not be managed any lower than current levels to halt any continual downward creep of shoreline communities.’*
16. Both the 1998 and 2013 studies observed a downslope migration of some plant communities that is not necessarily associated with a natural lagoon hydrology, but a modified environment. Nonetheless, many of the fringing wetlands that have established (e.g. extensive Oioi rushlands) provide valuable habitat for threatened and at-risk species (e.g. Fernbird) and are ecological important wetlands.
17. Overall, the assessment in Table 2 indicates **native wetland plant communities will not be adversely affected by the increased duration of inundation >2.0m and 2.2m** as the wetland species are adapted or resilient of wet conditions, and because the increased duration is relatively small, compared to the previous short-term consent. Irregular inundation at higher levels is positive for these systems as they will also make growing conditions for exotic species, such as introduced grasses and gorse, more difficult.
18. However, there may be some transition and dieback of native terrestrial species that migrated downslope in response to a prolonged period of modified hydrology. During September 2024 water levels in Waituna Lagoon remained above 2.4m for a period of ~2-3 weeks. Following this event, reports were received from community of dieback of some vegetation in discrete areas, such as manuka. This reversion (and associated dieback) from terrestrial plants to more wetland plant communities can be viewed as part of the ecological restoration of the natural hydrological and ecological function of the lagoon ecosystem. In other wetlands of New Zealand, manuka has established because of altered hydrology (e.g. Whangamarino wetland) and has subsequently declined as the water levels were restored.
19. The proposed transitional regime is supported to allow the native wetland vegetation to transition gradually overtime. The relatively short-periods above 2.3m (in winter) and 2.4m (in summer) for the initial 5 years will ensure that the Oioi rushland and other fringing wetland vegetation is not subject to a rapid shift in hydrological conditions.

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