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 Mary Dorrington de Winton – Freshwater Ecologist

on behalf of the Applicants

Dated: 11 July 2025

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Executive Summary

1. Submerged macrophytes (easily visible underwater plants) provide ecological values in inland waters and are considered good biological indicators of ecological quality. In Waituna Lagoon, a valued macrophyte assemblage is dominated by salinity-tolerant *Ruppia*, which was typical vegetation of large coastal lagoons, but one that has been largely lost from mainland New Zealand. Reconstructions of the past history of Waituna Lagoon from sediment records confirm *Ruppia* was present as a natural and intrinsic component prior to the advent of lagoon openings.

2. The 'open' and 'closed' status of Waituna Lagoon and durations influence submerged macrophytes and macroalgae (filamentous and frond-type alga) via physical and chemical drivers. Macrophytes may also compete for light with shading growths of macroalgae or phytoplankton (microscopic plants).

3. Multiple environmental stressors for submerged macrophytes can lead to their collapse and loss and a sustained switch to turbid conditions in waterbodies. The most significant stressor would be constraints to photosynthetic tissues receiving sufficient light for net plant growth.

4. Under the existing environment (no openings), the lagoon would be mostly closed, fresher and would rarely breach to the sea. Under these conditions, the submerged vegetation would continue to include *Ruppia,* but macrophytes typical of freshwaters would likely increase.

5. Responses of macrophytes and macroalgae to the past opening regime were monitored annually in summer between 2009 and 2025, and seasonally between 2014 and 2017. Resultant data confirmed *Ruppia* plants to be perennial (where conditions allowed) and to form a perennial seed bank that is likely to be important for recruitment following vegetation disturbance events. *Ruppia* flowering was highest in those summers when vegetation was abundant.

6. Annual summer monitoring results were assessed against six ecological targets. Four targets related to levels of *Ruppia* development (cover, 'biomass', flowering and *Ruppia megacarpa* occurrence), and another represented a limit to macroalgae cover. The achievement of a closed lagoon status during the critical spring/summer growth season for *Ruppia* (defined as the three months prior to monitoring) was an additional target.

7. In the eight monitoring years when the lagoon closure target was not achieved, only one or no ecological targets were met. Most targets (≥4) were met in the second consecutive year of meeting the lagoon closure target. Conversely, the target of macroalgae cover (limit of <10%) did not shown strong links to lagoon closure target.

8. This provides strong evidence that openings within spring/summer, or that extend into this critical growth and reproduction period, impact on the development of beneficial submerged vegetation in Waituna Lagoon. Previous Resource Consents were not effective in protecting the *Ruppia* vegetation from adverse effects of spring/summer openings.

9. Compared to existing environment scenario (no openings), the proposed resource consent conditions in the application allows for a water level trigger that will prevent high water levels in the lagoon. Established macrophytes can be expected to withstand short periods of light insufficiency that might occur close to the water level trigger of 2.5 m asl.

10. The proposed resource consent conditions in the application allows openings to disrupt algal blooms, or in response to other environmental events of concern. Reductions in algal blooms and water depth are likely to be important to maintain a light climate for macrophyte growth.

11. The application favours an opening site at Walkers Bay. This provides for continuation of a refuge for macrophyte abundance, especially for *Ruppia megacarpa* and for species diversity, in the eastern part of the lagoon.

12. Importantly, compared to previous consented opening regimes, the proposed resource consent conditions would lead to a reducing occurrence of spring/summer openings that disrupt the critical growing and reproduction season for *Ruppia.* The application is more likely to result in consecutive years of closed conditions over spring/summer that lead to an expansion in *Ruppia*, replenishment of seed banks, and ecological benefits that ensue from macrophyte dominance in the lagoon.

13. I am in agreement with the statements in the s42A report that are relevant to my evidence.

14. In my opinion, this application would progress the lagoon towards a more natural state, with a more stable, sustained presence of submerged vegetation, comprised of salinity tolerant plants that are typical of healthy coastal lagoons in New Zealand.

Introduction

1. My full name is Mary Dorrington de Winton.

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 currently employed by the National Institute of Water and Atmospheric Research (NIWA) as a Freshwater Ecologist (Scientist). NIWA is about to undergo a merger and rebranding as Earth Sciences New Zealand (from 1 July 2025). I have worked for NIWA since 1992, initially as a Research Associate from 1992 to 1999 and as a scientist from 1999. I have also held the position of Group Manager of the Aquatic Plants Group, (NIWA Hamilton) from 2004 to 2024.
4. Before that I worked for the Ministry of Agriculture and Fisheries as a Science Technician from 1985 to 1992.

5. My qualifications are an MSc (1st Class Hons.) in Biology, from the University of Waikato in 1997, preceded by a BSc Biology, University of Waikato in 1984.

6. My work experience includes 40 years as a researcher in the field of freshwater ecology, specialising in aquatic plants (macrophytes) and freshwater biosecurity.
7. I have authored/coauthored 32 peer reviewed journal articles, 5 book chapters and over 200 client reports. I am a member of the New Zealand Freshwater Sciences Society and the New Zealand Biosecurity Institute.

8. I have previously prepared Environment Court evidence on the consent application by Waikato Regional Council for the Lower Waikato Waipa Flood Control Scheme in 2002 and for reconsenting of the Waitaki Power Scheme for Meridian Energy Limited in 2025, which is going to hearing later this year.
9. My role in relation to the application for various resource consents to open Waituna Lagoon to the sea relates to NIWA's monitoring of the submerged vegetation of the lagoon, as delivered by NIWA for the Department of Conservation (DOC) between 2011 and 2025. As part of this role, I have taken part in surveys of the lagoon (site visits) and I have authored 16 reports. I am also a member of the Science Advisory Group for the management of the Waituna Lagoon water level regime.

Code of Conduct

10. 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.

11. 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.

12. 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.

13. 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.

Scope

14. I have been asked to provide evidence in relation to macrophytes and macroalgae.

15. My evidence addresses the following matters:

    a. The natural macrophyte communities of New Zealand coastal lagoons and their botanical and ecological values.

    b. The status and trend of the macrophyte and macroalgal community at Waituna Lagoon in response to different opening regimes and water levels.

    c. The appropriateness of the proposed conditions outlined in the application.

    d. How the annual lagoon vegetation survey data supports proposed consent conditions.

Material Considered

16. 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) The Resource Consent Application and Assessment of Environmental Effects and associated appendices (Thorne, 2024).

(ii) Applicants' Recommended Changes to Consent Conditions dated 16.06.25

(b) Monitoring reports for macrophytes in Waituna Lagoon, in particular:

(i) Annual summer monitoring of the submerged vegetation of Waituna Lagoon between 2009 and 2025 (de Winton et al. 2025a and 2025b).

(ii) Seasonal monitoring data for submerged vegetation at Waituna Lagoon spanning 2014 to 2017 (de Winton and Mouton 2018).

(c) The Regional Council Notification report dated 5 August 2024.

(d) Submissions considered. I have reviewed opposing submissions and considered 18 that specifically mention *Ruppia*, lake plants or macrophytes, including: Amtink, GJH; Ballantine, L & B; Esler, L.; McCrostie, C; McKenzie, B; Munro, KG & RE; Paddon, LJ; Paterson, NC; Southern Star Farms Limited; Southland Federated Farmers; Spain, G; Stanley, K; Tatham, TR; Van Rossum, M; Van Rossum, W; Waituna Catchment Group; Waituna Investments Limited; Warnock, B. My evidence addresses specific concerns raised by submitters where there is sufficient information to respond.

(e) The s42A Reports including:

(i) The report prepared by Danielle Petricevich (SLR Consulting Ltd) in accordance with section 42A of the Resource Management Act 1991 (RMA), dated 4 July 2025.

(ii) Accompanying Appendices A-I.

17. I also have visited the Waituna Lagoon site on six occasions in the last 10 years for the purpose of carrying out vegetation monitoring (16-19/02/2015, 31/10 to 2/11/2016, 5-7/03/2018, 17-19/02/2020, 15-17/02/2021 and 24-26/01/2022).

Application and supporting documents

18. My evidence provides background on the nature of macrophytes and macroalgae, their ecological roles and values. I outline the natural vegetation expected in coastal lagoons and the status and significance of *Ruppia* vegetation at Waituna Lagoon. I introduce the physico-

chemical and other drivers for macrophytes in the lagoon and the concept of regime-shifts to a de-vegetated state. I briefly consider the 'existing environment' as it would pertain to macrophyte communities. I outline monitoring for macrophytes and macroalgae at Waituna Lagoon and their status and trends based on monitoring results, with an emphasis on opening regime and water levels. I specifically consider how the proposed resource consent conditions in the application, and proposed amended conditions, would affect the lagoon vegetation. I have identified matters in the s42A report that pertain to my evidence. I consider the themes of submitters and respond to specific concerns raised.

Background on submerged macrophytes and macroalgae at Waituna Lagoon

19. Submerged 'macrophytes' refers to aquatic plants that grow predominantly underwater and are easily seen by eye and which inhabit inland waters. Submerged macrophytes have an important ecological role in waterbodies, providing habitat complexity, shelter and refuges for other freshwater life. Submerged macrophytes can baffle wave action onshore and secure sediments against re-suspension and erosion. Dense macrophyte beds can also limit water mixing and influence dissolved oxygen and pH of lake waters. It is generally recognised that a diverse assemblage of native macrophytes is beneficial in waterbodies.

20. The composition and development of resident macrophytes integrate and reflect environmental conditions within a waterbody over timeframes of months to years. Therefore, macrophytes represent good biological indicators of waterbody condition.

21. The submerged vegetation of Waituna Lagoon is unusual, comprising a range of saline tolerant species, the dominant being two *Ruppia* species but also recorded is a charophyte of the genus *Lamprothamnium*, which has not been identified to species level. Plant species typical of freshwater conditions may also occur within the lagoon at times, such as milfoil (*Myriophyllum triphyllum*).

22. The conservation status of submerged vegetation components of Waituna Lagoon includes a national threat designation of At Risk - Naturally Uncommon for *Ruppia megacarpa* (de Lange et al. 2024). NIWA has submitted on the conservation status of *Lamprothamnium* sp. as Threatened – Nationally Vulnerable because of recognised declines in distribution and abundance on the New Zealand mainland (Champion et al. 2021).

23. There are historical accounts of the dominance of *Ruppia* vegetation in New Zealand coastal lagoons under more natural, less impacted conditions than is the case today. Examples include Te Waihora (Lake Ellesmere), where extensive macrophyte beds were dominated by

Ruppia species (Mason 1946, 1951, Miers and Williams 1969), that persisted until 1968 (Gerbeaux 1989). *Ruppia megacarpa* was one of the submerged plants at Wainono Lagoon, South Canterbury, between 1968 and 1978 (Pierce 1980) and both *Ruppia* species were recorded from Washdyke Lagoon, South Canterbury, in the 1940's (Mason 1967). Permanent macrophyte declines have occurred in all these large lagoons. By contrast, Te Whanga Lagoon on the Chatham Islands retains *Ruppia megacarpa* as the dominant macrophyte (Bolton-Richie 2009) and *Ruppia* has recently been re-recorded from the Wairau Lagoons, Marlborough (Roberts et al. 2021).

24. A paleolimnology study (reconstruction of past history from sediment records) in Waituna Lagoon provided evidence for longer open and closed periods of time in the past under a natural opening regime (Cosgrove 2012). The evidence from sediment cores confirmed *Ruppia* was present as a natural and intrinsic component of the Waituna Lagoon ecosystem prior to the advent of artificial openings in the 20th century (Cosgrove 2012). *Ruppia* pollen was found to be more abundant in association with lagoon openings, probably due to more extensive flowering at the water surface at lower lagoon levels.

25. I conclude that Waituna Lagoon represents one of the few remaining, large coastal waterbodies on the mainland to regularly support extensive submerged macrophytes that are dominated by the *Ruppia* dominated plant assemblage typical of coastal lagoons.

26. Key physical and chemical drivers for submerged macrophytes in Waituna Lagoon include water clarity influencing light for plant photosynthesis, water depth, macrophyte disturbance by waves or tidal currents, temperature effects on growth, and water chemistry, in particular salinity levels. Interactions between these drivers and responses by macrophytes are complex. These key drivers are strongly influenced by lagoon openings to the sea and duration of open or closed status (Figure 1).

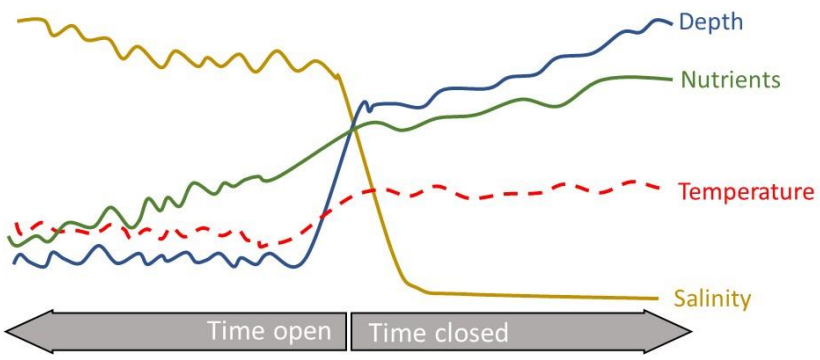

Figure 1. Key changes in the waters of Waituna Lagoon with time after opening or closing to the sea.

27. Other ecological influences affecting submerged macrophytes in Waituna Lagoon include shading by macroalgae or phytoplankton (microscopic plants) and waterfowl grazing. These influences may in turn be influenced by lagoon open or closed status.

28. Macroalgae are multicellular alga visible to the unaided eye. In Waituna Lagoon, macroalgae typically comprise filamentous (fine thread) green algae such as *Cladophora* and *Spirogyra* genera or thallus-forming (frond-type) such as Enteromorpha genera. Macroalgae may be attached to the substrate or plants, free-floating in the water column and/or forming floating mats on the surface.

29. In Waituna Lagoon, large accumulations of macroalgae are considered deleterious. High macroalgae abundance is likely to signal nutrient enrichment, would have a shading effect on macrophytes and can create areas of low dissolved oxygen when they die and decay.

30. The long-term loss of macrophyte communities from lakes and lagoons signals ecological deterioration. This switch is termed de-vegetation, a regime-shift or 'flipping' and occurs when multiple environmental stressors overwhelm macrophytes' ability to survive, reproduce and reestablish. The most significant stressor would be constraints to photosynthetic tissues receiving sufficient light for net plant growth.

31. Macroalgae competing for light with macrophytes is a potential precursor to aquatic plant collapse. Excessive growths of macroalgae are considered indicative of nutrient enrichment (Lagoon Technical Group 2013). However, a switch to phytoplankton dominance is anticipated at higher nutrient loading rates (Lagoon Technical Group 2013) that could shade both macrophyte and macroalgae communities.

32. The risk of Waituna Lagoon undergoing a rapid "flip" to a more degraded phytoplankton dominated state has been recognised (Lagoon Technical Group 2013). Specific concerns included increases in nutrient concentrations and sediments contributed from the catchment, expansion by macroalgae, anoxic sediment, wind-induced turbidity, and sediment smothering of *Ruppia*.

Macrophytes and the existing environment

33. In this application, the 'existing environment' is the current state of the lagoon without any consent to open being in place.

34. Under a natural water level regime, the lagoon would have been closed to the sea with openings occurring in the decadal to century time scales (Hume et al. 2016). Periods where the barrier opened would have been short-lived in comparison. The barrier would have only breached naturally when sufficient pressure built from high water levels in the lagoon, and/or when severe storm waves overtopped the barrier.

35. Under this scenario, macrophytes would likely experience increasingly freshwater conditions as the lagoon filled and retained water for longer. Although both *Ruppia* species are capable of persisting under freshwater conditions, they tend to dominate under conditions where other competing macrophytes are limited by salinity levels beyond optimum for obligate freshwater plants. Therefore, theoretically the existing environment would lead to a slow shift in the community type from salinity tolerant *Ruppia*, to obligate freshwater species such as milfoils (*Myriophyllum* species), and pondweeds (*Potamogeton* species) until natural breaches to the sea again favoured salinity tolerant species.

Monitoring of the macrophyte and macroalgae community at Waituna Lagoon

36. Field monitoring of submerged vegetation and macroalgae has been carried out annually in summer to autumn from 2009 to 2025 (de Winton et al. 2025). Monitoring was conducted at 47 to 48 sites distributed across the lagoon (Figure 2). At each site there were four measurements for the cover of macrophyte species and macroalgae, and height and reproductive status of *Ruppia*. Results were supported by additional snorkel observations since 2013.

Figure 2. Sites for monitoring submerged vegetation and macroalgae at Waituna Lagoon

37. Additional seasonal monitoring of vegetation was carried out at 16 of the sites in spring 2014, 2015 and 2016, summer 2015, 2016 and 2017, and winter 2016 and 2017 (de Winton and Mouton 2018). *Ruppia* height and reproductive status, cover and biomass of macrophyte species and macroalgae were measured five times at each site on each occasion.

38. Single sediment core samples were taken in spring 2014 and 2016, and summer 2016, cultured under conditions suitable for germination with seedling numbers for species recorded.

Status and trend of the macrophyte community at Waituna Lagoon

39. Based on statistical analysis of seasonal vegetation occurrence data between 2014 and 2017, *Ruppia* tended to be present year-round. For instance, highest *Ruppia* occurrence from all seasonal monitoring events was recorded in winter 2016 after the lagoon was open for 18 days and in winter 2017 after it was closed for 161 days. There was no pronounced seasonal reduction in biomass between consecutive sampling over summer and winter 2015. I conclude that *Ruppia* species would be perennial at Waituna Lagoon, so long as environmental conditions permit.

40. Seed banks are a means for *Ruppia* to recover after perturbation. Most *Ruppia polycarpa* seeds (>90%) from collected samples germinated over 2 to 4 weeks of culture under freshwater conditions maintained for two months. Seed banks appeared to be perennial, laid down over time and persisting from year to year, as shown by very similar germination

results obtained over three samplings and two seasons. Therefore, the seedbank is unlikely to be depleted over the medium-term (e.g., >one to two years) without fruiting events.

41. *In situ* observations of germination of *R. megacarpa* at Hansen's Bay in 2020 (de Winton 2020) and of germlings of *Lamprothamnium* sp. (de Winton and Taumoepeau 2017) suggests a similar seed bank role and recruitment occurs for these additional species.

42. Flowering *Ruppia* was recorded in all monitored seasons between 2014 and 2017. Flowering was greatest in the summers, but only when *Ruppia* vegetation was more developed. Higher plant covers, heights and biomass tended to be associated with flowering status.

43. The annual summer monitoring results for macrophytes and macroalgae at Waituna Lagoon are assessed against six ecological targets as determined by the Lagoon Technical Group (2013) or subsequently agreed with DOC. These ecological targets are provided in Table 1.

Table 1: Description for six ecological targets to assess vegetation monitoring at Waituna Lagoon.

Ecological Target	Description
Lagoon Closure	Lagoon closed during *Ruppia* growing season (spring and summer), defined as the three months before monitoring
Ruppia cover	>30–60% for average % cover of *Ruppia* (and other native macrophytes)
Macroalgae cover	<10% cover of benthic and epiphytic filamentous algae (macroalgae)
Ruppia biomass index	>1000 average for *Ruppia* 'biomass index' (% cover × cm height)
Ruppia reproductive success	≥40% of *Ruppia* samples in a flowering or post-flowering life-stage
Status of *Ruppia megacarpa*	≥20% of the sites record *Ruppia megacarpa*

44. The summary of outcomes against ecological targets for each monitoring year is shown in Table 2.

Table 2: Summary of results for six ecological targets over all monitoring years. Darker rows indicate greater numbers of targets were met.

Year	Lagoon closure	*Ruppia* cover	*Ruppia* biomass index	Macroalgae cover	*Ruppia* reproductive success	Status of *Ruppia megacarpa*	Targets met
2009	✓	×	×	✓	×	×	2
2010	✓	×	×	✓	×	✓	3
2011	×	×	×	✓	×	×	1
2012	✓	×	×	✓	✓	×	3
2013	×	×	×	×	×	×	0
2014	×	×	×	✓	×	×	1
2015	✓	×	✓	×	✓	×	3
2016	✓	✓	✓	×	✓	×	4
2017	×	×	×	×	×	×	0
2018	✓	×	✓	✓	✓	✓	5
2019	✓	✓	✓	×	✓	✓	5
2020	×	×	×	×	×	✓	1
2021	×	×	×	×	×	×	0
2022	✓	×	×	×	×	✓	2
2023	✓	✓	✓	✓	✓	✓	6
2024	×	×	×	✓	×	×	1
2025	×	×	×	×	×	×	0

45. These results highlight the importance for *Ruppia* dominated vegetation of providing closed lagoon conditions for most of the spring-summer growth season. On the eight monitoring occasions when only one or no ecological targets were met (Table 2), these were also the years that did not meet the lagoon closure target. Higher numbers of targets (≥4) were achieved in the second consecutive year of meeting the lagoon closure target (Table 2).

46. Conversely, the target of macroalgae cover (limit of <10% cover) has not shown strong links to the lagoon closure target (Table 2).

47. The achievement of the 'status of *Ruppia megacarpa'* target (Table 2) was associated with taller, denser submerged vegetation in Waituna Lagoon. This target capturing the performance of *R. megacarpa* (Table 2) was met more frequently in the second consecutive year of meeting the lagoon closure target. *R. megacarpa* has an important 'ecological engineer' role in Waituna Lagoon but requires interannual periods of suitable conditions over the spring/summer period (e.g., November to April) to establish and expand widely.

48. My interpretation from the 17 years of summer vegetation monitoring is that open lagoon conditions during the critical spring/summer growing and reproduction season for *Ruppia* led

to depressed growth rates (e.g., due to higher salinity and cooler temperatures) combined with greater levels of plant disturbance at low water levels (e.g., due to tidal currents, wave action and waterfowl grazing).

49. Conversely, consecutive years of favourable closed conditions during the critical spring/summer period for *Ruppia* growth and reproduction allowed vegetation expansion, particularly for *R. megacarpa*, with higher biomass, plant height and reproduction leading to seed bank replenishment.

50. From this monitoring it can also be seen that the previous Resource Consents (most recent expired in 2022) were not effective in protecting the *Ruppia* vegetation from impacts of open lagoon conditions over the critical spring/summer period.

How the proposed resource consent conditions would support *Ruppia* dominated vegetation

51. The consent application and AEE (Thorne 2024) describes results from hydrological modelling of several opening scenarios, which were then considered by the Science Advisory Group (SAG) for effects on lagoon values. The optimal scenario identified was opening the lagoon when level was 2.5 m asl or above for 7 consecutive days or, if no opening had occurred in the previous 2 years, opening if the level exceeds 1.5 m asl for fish passage.

52. The proposed resource consent conditions in the application outlined a transitional regime. Winter opening levels are initially lower at 2.3 m asl, and the duration of time required at the trigger level before opening was increased over a 15 year period to arrive at the optimal scenario above (i.e., in years 16-20).

53. Associated modelling identified that under the optimal scenario, the average number of openings per year would be 0.55, compared to 1.07 per year under the previous 2017 resource consent that permitted openings at lagoon levels of 2.0-2.2 m asl. The number of openings falling into the spring/summer period (September to April inclusive) would be 0.17 per year, substantially fewer than the 0.24 openings per year expected in the same spring/summer period under the previous 2017 resource consent.

54. Therefore, the proposed conditions in the current application would reduce spring/summer openings that disrupt the critical growing and reproduction season for *Ruppia* when compared to the previous resource consent. The application is also more likely to result in consecutive years of closed conditions over spring/summer that lead to an expansion in

Ruppia, especially *R. megacarpa*, replenishment of seed banks, and ecological benefits that ensue from macrophyte dominance in the lagoon.

55. The proposed openings for fish passage at least every two years would continue to promote salinity-tolerant *Ruppia* species and *Lamprothamnium* sp. over dominance by typical freshwater macrophytes and hereby preserve the vegetation elements typical of Waituna Lagoon.

56. As part of the technical assessment by the SAG, potential negative effects on aquatic plants due to light limitation were considered. Under the proposed conditions in the application, prolonged periods of time at high lagoon level are not expected. The hydrological modelling suggested annual average days above 2.2 m asl as 21.24 per year, or 4.03 days per year above 2.4 m asl.

57. Such short durations at a higher lake level are unlikely to impact on submerged macrophytes in my opinion. Established macrophytes are likely to persist under insufficient light conditions for 1-4 months, based on experimental observations of plant senescence under light levels below that required for net photosynthesis in other macrophytes (Hawes et al. 1999).

58. Proposed openings to disrupt algal blooms would be important to maintain a light climate for macrophyte growth. For instance, under 5a of the draft proposed conditions (4 July 2025), a primary indicator comprising a sustained visible bloom over ≥14 days would allow for openings if recommended by the SAG. This would help to prevent excessive shading of macrophyte communities by dense phytoplankton blooms.

59. Openings for fish passage at least every two years would also limit the build up of nutrients likely to fuel algal blooms and macroalgae that would otherwise shade or smother submerged macrophytes.

60. The proposed opening location detailed in the application is Walkers Bay (Thorne 2024). The preference is for this opening location over others that have been used in the past, including Hansens Bay or 'the fence'. Vegetation monitoring results have shown the importance of the eastern part of the lagoon as a refuge for macrophyte abundance, especially for *Ruppia megacarpa* and for species diversity. When an opening was made at 'the fence' under emergency powers in 2024, a lower macrophyte occurrence was noted east of T6 (Figure 2) compared to the west. Therefore, an opening at the Walkers Bay location is seen to pose less risk for disruption of submerged vegetation.

61. Proposed monitoring of macrophytes and macroalgae is included under the proposed Condition 14 of the application as secondary indicators. Critical Indicator Levels for secondary indicators are based on ecological targets as identified in Table 1, being *Ruppia* cover <20%, status of *Ruppia megacarpa* <10% and macroalgal cover >30%. Annual summer monitoring would establish if Critical Indicator Levels were breached. This monitoring would assist the SAG in identifying if a lagoon opening would mitigate significant adverse ecological effects on the lagoon.

62. Subsequent to lodging of the application described above (Thorne 2024), the SAG considered amendments to the proposed conditions of the consent. These were informed by new modelling scenarios using an updated hydrological model that included a recalculation of seepage rates through the gravel barrier. Modelling scenarios for trigger levels of 2.4 m asl or 2.5 m asl were considered by the SAG for effects on lagoon values.

63. Under the proposed optimal scenario described previously (i.e., years 16-20), and using the updated hydrological model, the average number of openings per year would be 1.11 and the number of openings falling into the spring/summer period (September to April inclusive) would be 0.38 per year.

64. An amended transitional regime was proposed, with differences being an initial water level trigger of 2.4 masl over three or more days in summer for years 1-10 and for winter for years 6-10 (i.e., a more moderate progression towards natural regime).

65. Compared to original proposed conditions in the application, these amendments would initially result in a slightly lower likelihood of consecutive years of closed lagoon conditions over the critical spring/summer period for *Ruppia* growth and reproduction.

Section 42A Report

66. The s42A report provided an analysis of the resource management issues in respect of the consent application lodged by the Applicant. My review of the report identified the following statements with relevance to my evidence.

67. The s42A report agreed that the definition of existing environment is a '*do nothing' approach to management of the lagoon, its water levels and water quality'*. Therefore, it is '*the adverse effects of opening the lagoon must be assessed, rather than the effects of not opening the lagoon (allowing natural processes to take place)'*.

68. The report also noted that submitters '*concerns are largely related to the impacts of increased water levels within the lagoon, rather than the decrease in water level as a result of opening the lagoon'*.

69. The report identifies that the proposal could potentially have '*adverse impacts on macrophytes and macroalgae and submerged plant communities as a result of openings'*. However, it concludes overall that '*the actual/potential adverse effects will* be *no more than minor and acceptable, with many of the effects being temporary*'.

70. The amended transitional regime proposed in the application (i.e., lower initial opening levels) was considered '*not optimal for lagoon health*' because they would result in a slightly less natural opening regime but was considered to '*represent a step towards the enhancement of ecosystem health*'.

71. I agree with the s42A report that there would be temporary impacts from lagoon opening on the macrophyte community. I suggest that the ability to open the lagoon provides longer-term advantages for macrophytes over the existing environment scenario (no openings) by safeguarding habitat quality for submerged vegetation. Openings in response to algal blooms (or their imminent development), and to limit the duration of high water levels, would both provide relief for submerged macrophytes from sustained light limitation. Therefore, I'm in agreement with the statement in the s42A report that *'effects in large are likely to be positive and for the purpose of maintenance and restoration of ecological health and cultural values of Waituna Lagoon*'.

72. I also agree with the s42A report that the proposal will '*decrease the likelihood of a summer opening*' (or an opening duration extending into the spring/summer period). My evidence shows a key reliance of submerged vegetation development on consecutive years of closed conditions over the spring/summer period. Whilst the amended transitional regime of the proposal represents a slightly higher risk of open lagoon conditions in spring/summer, the direction of travel over time is for fewer openings in response to water level triggers.

Submissions

73. Out of the submissions that oppose the application, 18 specifically mentioned *Ruppia* or plants in the lagoon. One submission questioned the emphasis on *Ruppia* as an indicator. Five submissions did not state a specific concern. Eleven submissions stated concerns about high water levels and shading of *Ruppia*. Five of these specifically mention tannins. Two submissions reference Schallenberg and Tyrrell (2006).

74. The most specific submission, from Southern Star Farms, cites information from Schallenberg and Tyrrell (2006) as evidence that that: '*The lagoon level should be maintained as close as possible to 1.8 m to 2.2 m above sea level. The length of time at higher levels should be short and not exceed 2 months. This provides conditions where the bottom of the lagoon has its largest surface area for* Ruppia *growth based on sufficient light levels'*.

75. Schallenberg and Tyrrell (2006) used a modelling approach that they considered 'preliminary'. The modelling was based on a single light measurement and considered light levels at the lagoon bed to identify the areal extent of *Ruppia*. Importantly, the model did '*not account for plant height or for the ability of plants to survive temporary periods of insufficient light by respiring their energy reserves*'.

76. As acknowledged by Schallenberg and Tyrrell (2006), the model '*more accurately illustrates the capacity of the lagoon to regenerate aquatic macrophytes under various scenarios, if they were lost from the system'* (i.e., recovery from seed banks).

77. Plants growing in Waituna Lagoon experience higher light levels than modelled by Schallenberg and Tyrrell (2006), because photosynthetic tissues are held above the lake bed. In years of high *Ruppia* development after two consecutive years of closed lagoon conditions, plants were tall and could form a photosynthetic canopy near or at the water surface. For instance, in summer 2023, the average *Ruppia* height across the lagoon was 0.65 m.

78. Plant height can compensate for increased overlying water depth (at a specific water clarity), with an 0.5 m increase in potential water level triggers from 2.0 (previous consented regimes) to 2.5 m (current proposal) being within potential canopy height development. Taller plant development would be expected under conditions promoted by the proposed consent conditions in this application.

79. The submission of Lloyd Esler (Esler, L) questions the use of *Ruppia* as an indicator species of a well-functioning lagoon. *Ruppia* was suggested to be not the only, or not a desirable indicator. Instead, saltmarsh was suggested as an indicator of desirable lagoon ecology. It was suggested that *Ruppia* likes muddy, nutrient-rich water at a range of optimal depths.

80. As laid out in my evidence, *Ruppia* is a natural and valued component of coastal lagoons such as Waituna and macrophytes are useful indicators of ecological health of waterbodies. 'Saltmarsh' would not be a sensitive indicator of in-water conditions of the lagoon. I cannot comment on what 'nutrient-rich' nor 'optimal depths' would mean in the context of the submitter's statements.

Conclusion

81. The proposed and amended conditions of this application around the water level regime for opening Waituna Lagoon would reduce the frequency of opening events and decrease the probability of an open lagoon status within spring-summer compared with the previous consented opening regime.

82. Vegetation monitoring over 17 years has demonstrated the advantages of avoiding spring/summer openings in enabling *Ruppia* development and increasing the probability of reproductive success and replenishment of seed banks.

83. This application would therefore progress the lagoon towards a more natural state, with a more stable, sustained presence of submerged vegetation, comprised of salinity tolerant plants that are typical of healthy coastal lagoons in New Zealand.

Mary de Winton

Dated 11 July 2025

Appendix 1

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