LakeSPI surveys of Lake Roto Kawau & Wairarapa lakes: 2025

A report prepared for Greater Wellington by NIWA

Greater Wellington
Te Pane Matua Taiao

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Prepared for Greater Wellington Regional Council

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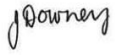	Formatting checked by:	Jo Downey
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Greater Wellington Regional Council contracted Earth Sciences New Zealand to survey six waterbodies in the Wellington Region in 2025 using the LakeSPI (Submerged Plant Indicators) survey method. The LakeSPI method was developed to assess the ecological condition of lakes and has been incorporated under the National Policy Statement for Freshwater Management (NPS–FM) as ecosystem health attributes that have bands (A-D) and national bottom lines (threshold between C and D bands). A higher LakeSPI and Native Condition Index denotes better lake ecological condition and higher Invasive Impact Index denotes poorer lake condition. Lakes that do not have submerged vegetation (<10% plant cover) are termed 'non-vegetated' and receive default Indices values of 0%.

Lakes Nganoke and Rototawai, Matthew's and Barton's Lagoon, Boggy Pond and Roto Kawau (Zealandia) were surveyed in November 2025.

Fourteen waterbodies have now been surveyed in the Wellington Region using LakeSPI. Addition of the 2025 results for Lake Nganoke currently categorises three lakes in an 'excellent' ecological condition based on a high LakeSPI Index (>75%). Repeated surveys for two Wairarapa Moana lagoons (Matthews and Bartons) bring the number of waterbodies in 'high' ecological condition (LakeSPI Index >50-75%) to five. The addition of Lake Rototawai gives two regional lakes in the 'moderate' category (LakeSPI Index >20-50%). Just one lake remains in the 'poor' category (LakeSPI Index >0-20%). However, a vegetation decline in Boggy Pond and the addition of Lake Roto Kawau at Zealandia bring the total of non-vegetated' lakes (LakeSPI Index 0%) to three.

Compared to LakeSPI surveyed lakes nationally, there is a higher proportion of Wellington waterbodies that fall into the excellent and high category, a smaller proportion in the moderate and poor category and a similar proportion in the non-vegetated category.

Under the NPS-FM attribute entitled "Submerged plants - natives" (Native Condition Index), Lake Nganoke and the Parangarahu Lakes were assigned to the A band; five waterbodies (including three Wairarapa Moana lagoons) were assigned to the B band; Lake Rototawai and one other waterbody were assigned to the C band; while four lakes including Boggy Pond and Roto Kawau fall below the national bottom line into the D band.

Under the attribute "Submerged plants - invasive species" (Invasive Condition Index) one lake is placed into the A band; Lake Nganoke joins three other waterbodies in the B band; five of the remaining waterbodies fall into the C band (including three Wairarapa Moana lagoons); while Lake Waitawa falls below the national bottom line into the D band. No band was assigned for non-vegetated lakes, as by definition they cannot be considered invaded by weeds.

The Wellington Region has slightly more waterbodies in the A band for the attribute "Submerged plants - natives" and noticeably more within the B band, but fewer in the C band. For the attribute "Submerged plants - invasive species", there are also more waterbodies in the B band and fewer in the A or C band.

1 Introduction

Greater Wellington Regional Council (GWRC) undertakes statutory environmental monitoring, including meeting requirements under the National Policy Statement for Freshwater Management (NPS–FM 2025). In 2025, GWRC contracted Earth Sciences New Zealand (ESNZ) to survey six waterbodies in the Wellington Region using the LakeSPI (Submerged Plant Indicators) survey method.

The LakeSPI method was developed by ESNZ to assess the ecological condition of lakes (Clayton and Edwards 2006, de Winton et al. 2012). Under the NPS–FM (2025), two indices derived from LakeSPI have been incorporated as ecosystem health attributes that have bands and national bottom lines.

The LakeSPI method measures the diversity and extent of native submerged vegetation and the degree to which invasive introduced weeds have altered the vegetated littoral zone. LakeSPI complements traditional water quality monitoring, such as the Trophic Level Index method (Burns et al. 2000), by providing additional ecological information. For example, LakeSPI focuses on the littoral edges of lakes where human interaction is the greatest and where impacts from water quality resulting from catchment activities is often most apparent (Clayton and Edwards 2006). Three scores are generated from LakeSPI; a measure of native vegetation presence, extent and diversity (Native Condition Index), the level of impact by any weed species that may be present (Invasive Impact Index), and an overall score (LakeSPI Index) that combines these values and impacts.

In this report, we present the LakeSPI results for six waterbodies surveyed in 2025 to describe their current ecological condition, as well as a comparison of regional and national results for all suitable surveyed waterbodies in the Wellington Region. LakeSPI scores are reported for each lake surveyed in 2025, accompanied by a brief description of the vegetation character driving the scoring. Current LakeSPI scores are collated and ranked in order with the other Wellington Region waterbodies and compared to LakeSPI results for lakes nationally. Finally, lakes are assigned to attribute bands (A-D) according to the NPS–FM.

2 Methods

2.1 LakeSPI surveys

Fieldwork was completed in November 2025. The surveyed lakes are listed in Table 1. Existing baseline sites were resurveyed in each lake with reference to site maps, GPS references (Appendix A) and shoreline photos established during the initial surveys.

At each site, divers recorded relevant vegetation characteristics on data sheets. A full description of the vegetation features that are assessed for the LakeSPI method is found in the technical report and user manual on the web-reporting pages (LakeSPI outputs | NIWA) but included measures of diversity from the presence of key plant communities, the depth extent of vegetation and the extent that invasive weeds were represented.

In addition to the LakeSPI survey data, ESNZ inventoried all plant species observed during the surveys. Recent nomenclature changes for several species are used in this report. These changes are tabulated along with names used in previous reports in Appendix B.

Table 1: The area, waterbody name, location, and date of survey for the 2025 LakeSPI surveys in Wellington Region.

Area	Waterbody	Location	Survey date
Wellington	Roto Kawau (Lower Karori Reservoir)	41°17'30.55"S 174°45'7.36"E	17/11/2025
Wairarapa	Lake Nganoke	41°21'21.70"S 175°11'9.75"E	19/11/2025
	Lake Rototawai	41°12'55.19"S 175°20'45.31"E	19/11/2025
	Barton's Lagoon	41°10'5.20"S 175°18'50.30"E	18/11/2025
	Matthew's Lagoon	41°15'35.78"S 175°16'8.94"E	19/11/2025
	Boggy Pond	41°15'2.57"S 175°15'59.41"E	18/11/2025

2.2 LakeSPI analysis

2.2.1 Data processing

Observations were entered into ESNZ's secure LakeSPI database which calculated three indices:

- A Native Condition Index, providing a measure (score) of the diversity, quality and abundance of indigenous submerged vegetation. A higher score means healthier, deeper, diverse native plant beds.
- The Invasive Impact Index, scoring the impact by any of ten invasive alien plant species, if present. A higher score means more impact from exotic species, which is often undesirable.
- These indices were also integrated into an overall LakeSPI index. This is a synthesis of components from both indices above. The higher the score the better the lake condition.

LakeSPI indices are expressed as a percentage of their maximum potential score (i.e., 100%) by adjusting for lake depth to enable direct comparisons of small, shallow water bodies with different lake types (e.g., larger, deeper ones). Lakes are also placed into one of five narrative categories including 'Poor', 'Moderate', 'High' and 'Excellent'. If vegetation cover is insignificant (average <10%) lakes are classified as 'Non-vegetated'.

Score		**LakeSPI Category**
>75%	=	Excellent
>50-75%	=	High
>20-50%	=	Moderate
>0-20%	=	Poor
0%	=	Non-vegetated

2.2.1 LakeSPI stability

Previous LakeSPI surveys were conducted in 2022 (de Winton et al. 2022) for four of the Wairarapa waterbodies. Lake Roto Kawau in Wellington's Zealandia and Lake Rototawai in the Wairarapa region have not previously been surveyed.

For lakes that had been assessed more than once using LakeSPI, the likelihood of an ecologically significant change in lake status over time was based on analysis of the direction and magnitude of change in LakeSPI Indices across sites.

Guidelines (Figure 1) based on expert judgement suggest a scale of probabilities for ecologically significant change in lake condition over longer periods and multiple surveys, using averaged LakeSPI indices over repeated surveys. These guidelines have considered variation by different observers and the response of LakeSPI scores to major ecological events in lakes.

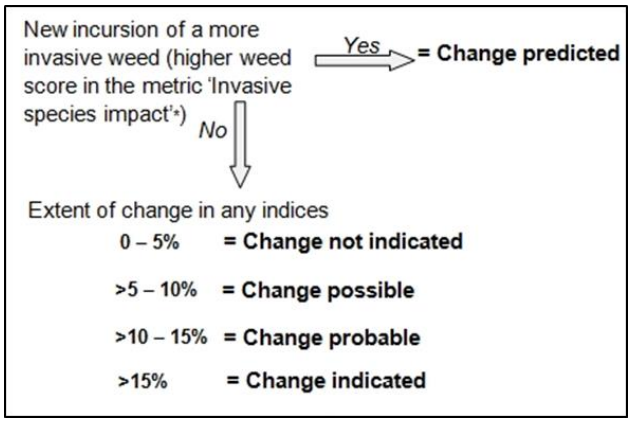


Figure 1: Guidelines for assessing the ecological significance of change in LakeSPI Indices over multiple surveys of a given lake.

2.3 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management (NPS-FM 2025) includes two LakeSPI indices as attributes in its National Objectives Framework (NOF) that require action plans (NPS-FM 2025[1], Appendix 2B, Tables 11 and 12). Attribute bands are related to Native Condition Index and Invasive Impact Index values as shown in Table 2. Any lake that falls below the national bottom line is considered degraded and may require councils to prepare a time-based action plan to achieve a target status. If the current state is below the national bottom line due to natural processes (e.g., naturally non-vegetated geothermal or peat lakes), a target attribute state below the national bottom line may be set. Currently, the Ministry for the Environment state that the Native Condition Index and Invasive Impact Index should be assessed every three years.

Table 2: National Objectives Framework attribute table for LakeSPI indices. Native Condition Index and Invasive Impact Index attribute bands from the NPS-FM (2025, Appendix 2B, Tables 11 and 12).

Attribute band	Native Condition Index	Invasive Impact Index
A	>75%	0*
B	>50 and ≤75%	≥1 and ≤25%
C	≥20 and ≤50%	>25 and ≤90%
National bottom line	20%	90%
D	<20%	>90%

*Note Invasive Impact Index for non-vegetated lakes is not included in the A band.

[1] https://environment.govt.nz/assets/publications/npsfm-2020-amended-december-2025.pdf

3 LakeSPI Results

3.1 Roto Kawau (Lower Karori Reservoir)

Lake condition:	Non-vegetated
Stability:	-
Lake depth:	13.0

Results

In 2025, vegetation was absent from all surveyed sites. Therefore, Roto Kawau received a default score of 0% for all indices and was categorised as non-vegetated.

Divers undertook six dives to a depth of 5 m. Substrate, littoral slope and light conditions appeared suitable for plant establishment. However, submerged plants were only documented from an additional area (outside of the survey sites) at the south of the lake, adjacent to a raupō wetland (*Typha orientalis*) that extended to a depth of 1.1 m. Here, a fringe of the non-native swamp lily (*Otellia ovalifolia*) grew at the margins to 1.2 m depth. The swamp lily grew as a juvenile form with submerged, ribbon-like leaves and few mature floating leaves were seen. The native tape measure plant (*Lilaeopsis novae-zelandiae*) was recorded as a short turf to 1.3 m depth at a cover of 26-50%.

Also seen by divers were common bully (*Gobiomorphus cotidianus*), native clams (sphaeriids) and freshwater sponges.

Discussion

This is the first time Roto Kawau has been surveyed using LakeSPI. No aquatic plants were recorded on any of the surveyed sites. Because submerged plants did not exceed 10% cover at any site, the lake was categorised as non-vegetated.

The off-site observation of *Lilaeopsis novae-zelandiae* growing to 1.3 m depth suggests the lake has adequate water clarity to support other plants to deeper depths, as this small turf plant requires moderately high levels of light. The non-native swamp lily seemed to have established recently as plants were still in a juvenile form, without floating leaves or flowers. Swamp lily is spread by waterfowl after they have fed on produced seed.

An earlier investigation of Roto Kawau as the ‘lower Reservoir at Karori’ in c. 2006 (unpublished ESNZ records) showed very sparce submerged plants including the native charophyte, *Chara australis*, swamp lily and what was likely the alien invasive pondweed *Potamogeton crispus*. *P. crispus* is currently the focus of hand removal in the wetlands upstream of Roto Kawau.

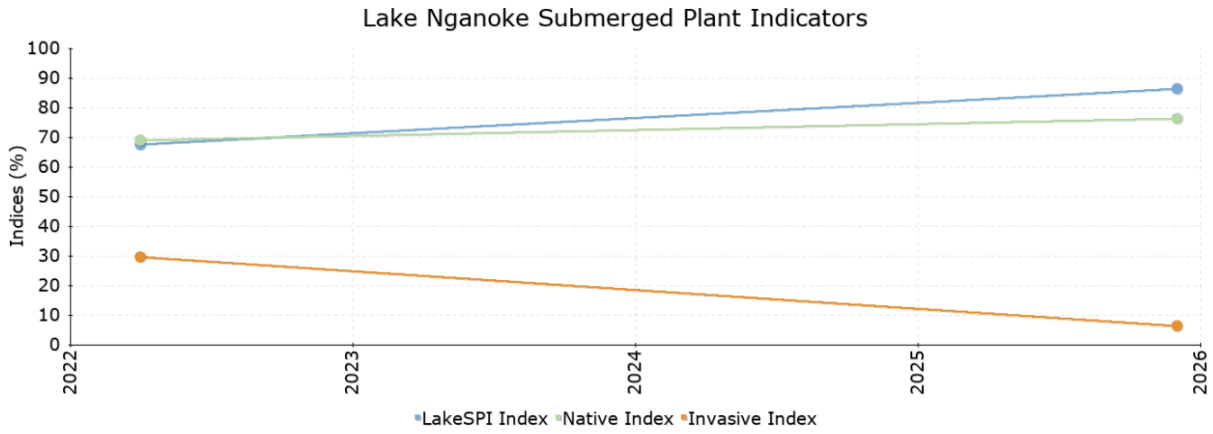
Currently it appears submerged vegetation is limited by available propagules and planting efforts are likely to be beneficial in hastening re-vegetation.

3.2 Lake Nganoke

Lake condition:	Excellent
Stability:	Improving
Lake depth:	1.6

Results

In 2025, Lake Nganoke had an excellent ecological condition according to a LakeSPI Index of 86% (Figure 2). This score was driven mainly by a Native Condition Index of 76%, and a low Invasive Index score of 6%.



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
November 2025	Excellent	86.3%	76.2%	6.2%
March 2022	High	67.6%	69.0%	29.6%

Figure 2: LakeSPI results for Lake Nganoke from the 2025 survey.

In 2025, the charophytes, *Chara australis* (Figure 3A and B) and *Nitella* sp. aff. *cristata* together formed high cover meadows across most of the lake bed to 1.4 m depth. Only small areas of the deepest part of the lake were unvegetated (1.4 to 1.5 m), where there was also a layer of suspended solids settled just above the sediment surface. Charophytes at ≥1.4 m depth were patchy, looked unhealthy and smelt of sulphide. This suggested low oxygen levels in the deepest part of the basin, with plants under light and anoxia stress.

The native blunt pondweed, *Potamogeton ochreatus*, was common as small patches and individual plants that were growing taller than the charophytes.

The only alien submerged plan was curled pondweed (*Potamogeton crispus*), which was largely confined to an area around the mai-mai at the access point to the lake.

Small floating plants, *Azolla rubra* and *Lemna disperma*, were sparsely distributed, or collected at the margins. Filamentous algae were common on the surfaces of plant beds and a visible algal bloom was in the water column.

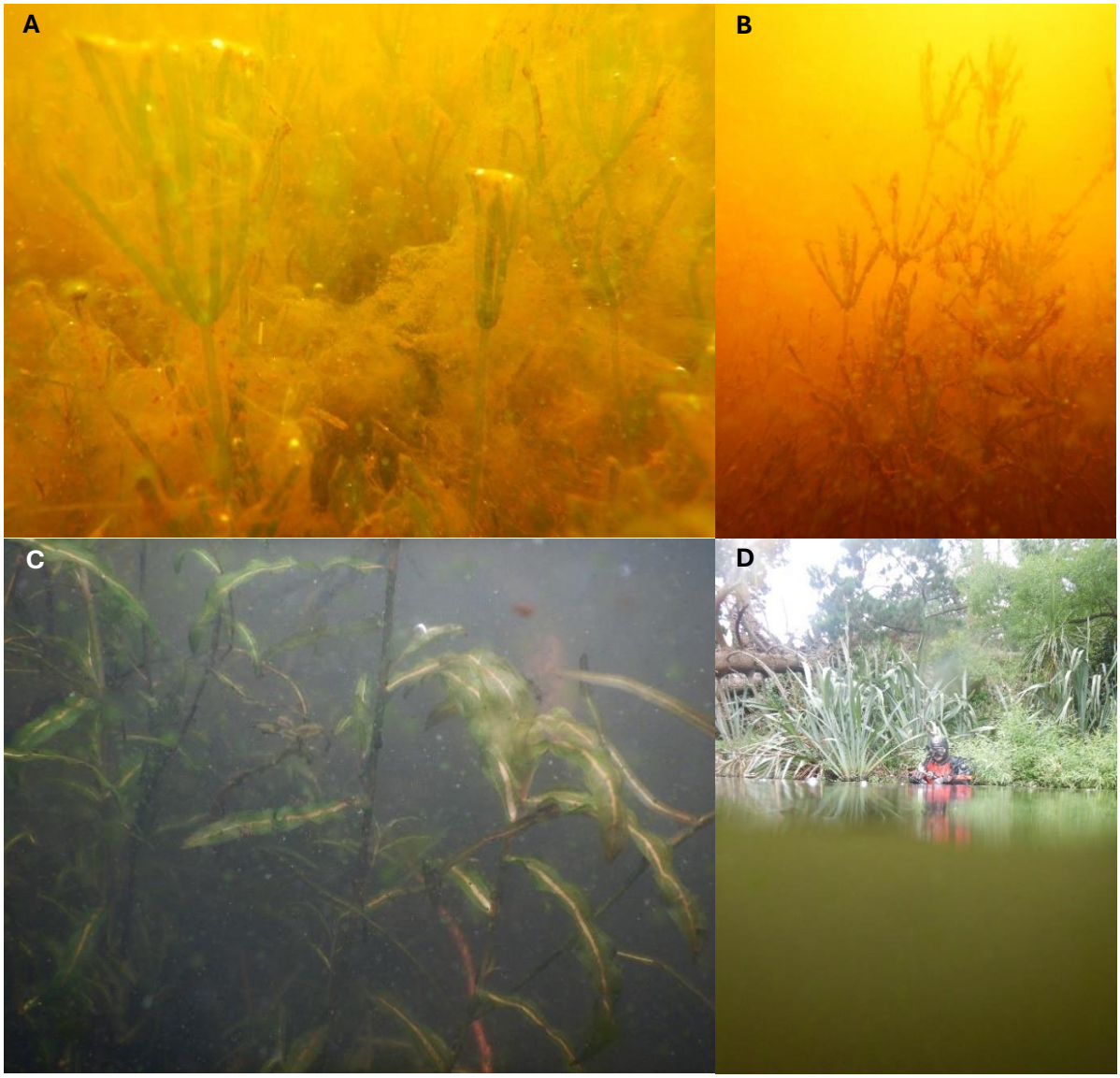


Figure 3: Vegetation at Lake Nganoke in 2025. A) and B) *Chara australis* with coverings of filamentous algae; C) the alien weed *Potamogeton crispus* found next to the mai-mai at the access point; C) diver surveys the shallow shoreline.

Discussion

The main difference since the earlier LakeSPI survey was a substantial reduction in the depth and distribution of curled pondweed. In 2022, curled pondweed had triggered a higher Invasive Impact Index (30%), which reduced the Native Condition Index (69%) due to lower native vegetation cover and limited the LakeSPI Index (68%).

In 2022, the hypertrophic status of the lake (Perrie and Royal 2022) and the wind shelter provided by tall riparian trees had allowed an abundance of floating plants to develop. These small plants may shade submerged plants but also would likely reduce the abundance of algae.

Floating plants were much reduced in occurrence in 2025, but they may develop seasonally over summer.

The lake is known to occasionally dry and expose marginal lake substrates[2] and the extent of drying can be seen on the Google Earth image for April 2016. The plants that dominate this lake are capable of periodically regenerating from seed and propagule banks laid down in the substrate, but the absence of marginal turf plants (e.g., *Glossostigma*) suggests that there are no regular drying and wetting cycles for the lake.

[2] https://ourlakesourfuture.co.nz/lake_story/lake-nganoke/

3.3 Lake Rototawai

Lake condition:	Moderate
Stability:	-
Lake depth:	1.7 m

Results

In 2025, Lake Rototawai had a moderate ecological condition according to LakeSPI, with a LakeSPI Index of 38% (Figure 4). The Invasive Impact Index of 69% was due to most of the lake bed being dominated by the invasive curled pondweed (*Potamogeton crispus*). However, the Native Condition Index of 50% reflected pockets of native vegetation, particularly in the deepest basin.

Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
November 2025	Moderate	38.2%	50.0%	68.5%

Figure 4: LakeSPI results for Lake Rototawai from the 2025 survey.

A large proportion (c. three-quarters) of the water surface of Lake Rototawai was covered with surface reaching curled pondweed (Figure 5A) down to depths between 1.0 to 1.3 m, and these plants were flowering and fruiting (Figure 5B). Curled pondweed also formed specialised vegetative propagules, turions, underwater (Figure 5C).

Where covers and heights of curled pondweed were lower in the deepest part of the lake (1.3 to 1.7 m depth), native blunt pondweed was also abundant and starting to flower (Figure 5D).

High cover but patchy meadows of charophytes, mainly *Chara australis* (Figure 6A) but also *Nitella* sp. aff. *cristata*, were present deeper than the surface-reaching bed of curled pondweed. Native milfoil (*Myriophyllum triphyllum*) occurred as scattered plants in deeper areas on the western shore (Figure 6B).

Floating plants including *Azolla rubra* and *Lemna disperma* were distributed amongst the surface reaching curled pondweed and had also collected along some shorelines. Marginal stands of raupō (*Typha orientalis*) were common. Numerous black swans (*Cygnus atratus*) were browsing on the surface reaching plants near the centre of the lake. Shortfin eel (*Anguilla australis*), freshwater sponges, abundant daphnia and backswimmers were also observed.

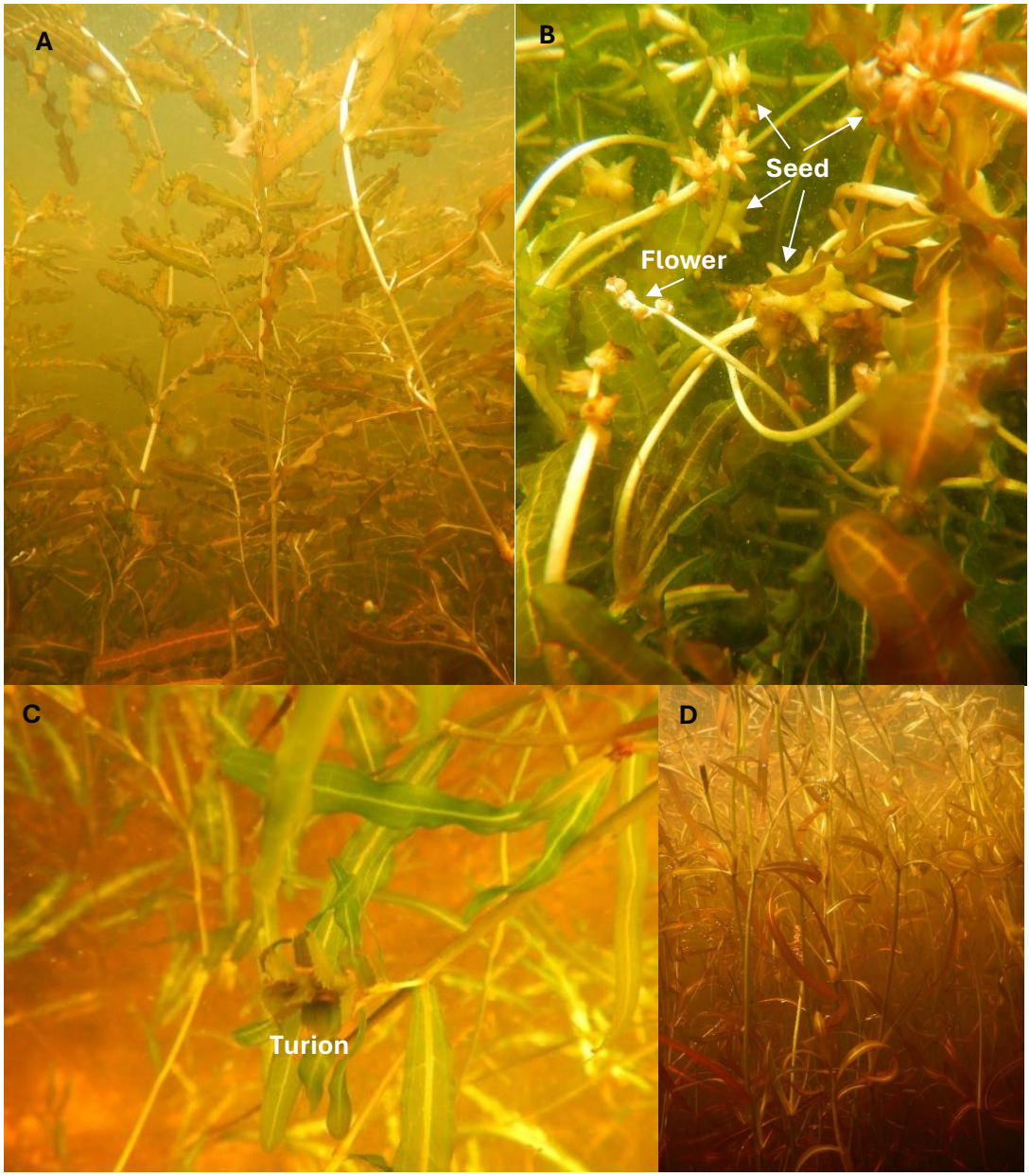


Figure 5: Submerged pondweeds in Lake Rototawai in 2025. A) tall-growing curled pondweed (*Potamogeton crispus*); B) flowering curled pondweed with abundant developing seed; C) a turion of curled pondweed (centre); D) tall native blunt pondweed (*Potamogeton ochreatus*) with developing flowers.

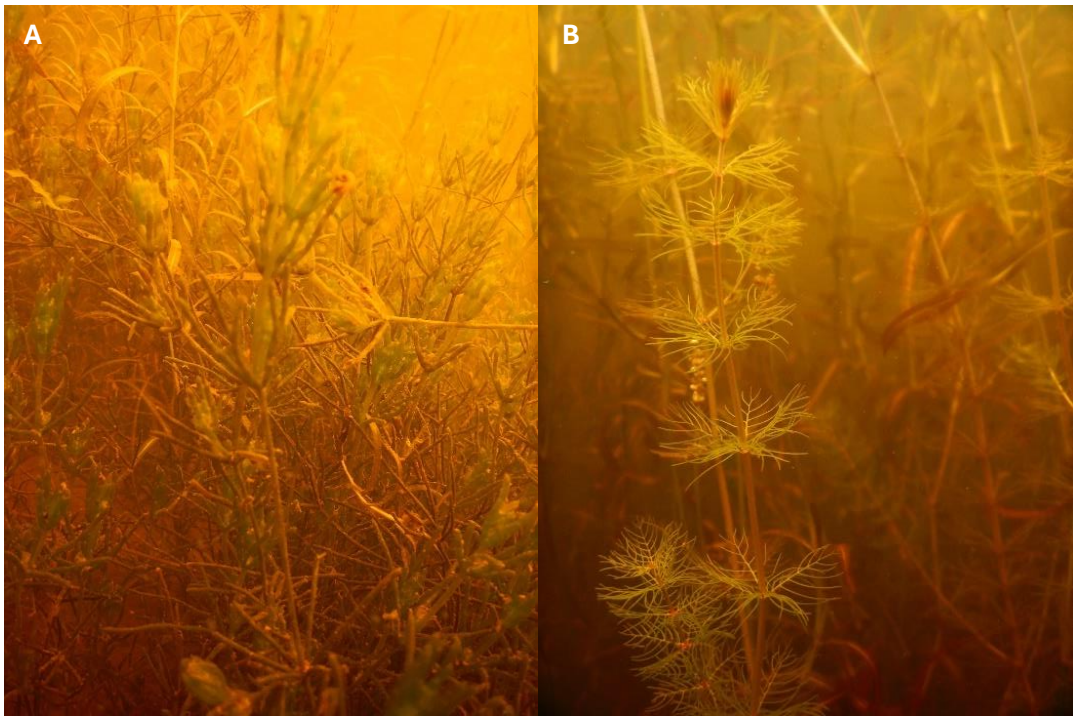


Figure 6: Charophytes and milfoil in Lake Rototawai 2025. A) Charophyte meadow of *Chara australis*; B) the native milfoil *Myriophyllum triphyllum*.

Discussion

This is the first time Lake Rototawai has been surveyed using LakeSPI. The 2025 survey found the lake dominated by curled pondweed, one of the less problematic invasive submerged weeds in New Zealand in comparison to egeria (*Egeria densa*), hornwort (*Ceratophyllum demersum*) or lagarosiphon (*Lagarosiphon major*). The extremely large seed and turion production by curled pondweed suggests a large propagule bank present in the sediment. Therefore, the weed population is likely to be well buffered again impacts such as swan grazing, filamentous algal development or turbidity events. An earlier (undated) description of the lake mentions it was 'thick with green algae' and 'degraded'[3], suggesting that the submerged vegetation may be stressed at times.

The deeper central area of the lake additionally supported several species of native submerged plants in 2025. Curled pondweed may have been less competitive at these deeper depths, allowing the natives to co-dominate. Alternatively, swan browsing focused within the central lake may have thinned out the curled pondweed bed here.

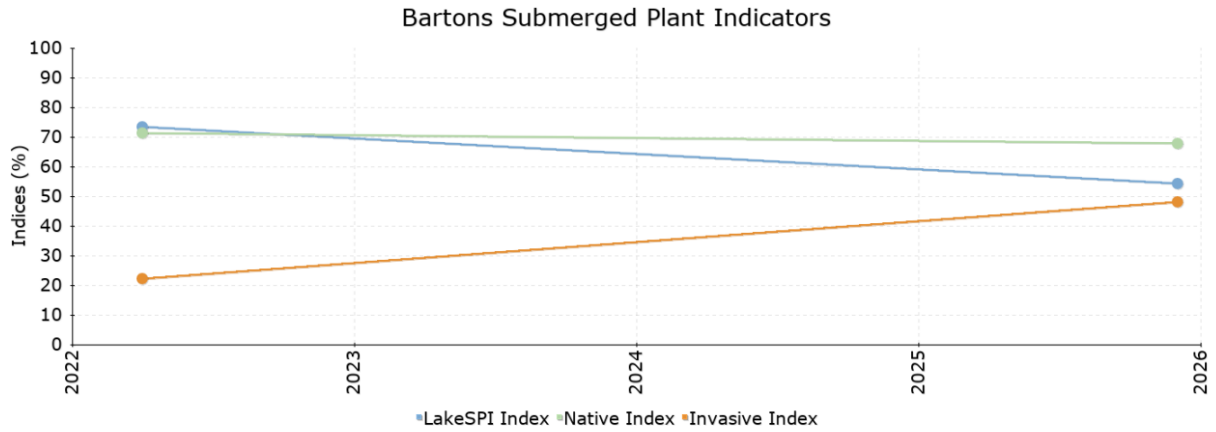
[3] https://ourlakesourfuture.co.nz/lakes/lake-rototawai/

3.4 Barton's Lagoon

Lake condition:	High
Stability:	Declining?
Lake depth:	1 m

Results

In 2025, Barton's Lagoon continued to have a high ecological condition according to LakeSPI, with a LakeSPI Index of 54%, a Native Condition Index of 68%, but an increased Invasive Impact Index of 48% (Figure 7).



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
November 2025	High	54.4%	67.9%	48.1%
March 2022	High	73.5%	71.4%	22.2%

Figure 7: LakeSPI results for Barton's Lagoon from the 2025 survey.

Native milfoils (*Myriophyllum propinquum* and *M. triphyllum*) dominated the submerged vegetation of this shallow (c. 0.7m) lagoon in 2025. Near surface-reaching beds patches of *M. propinquum* appeared to have been swan grazed, with many dark, defoliated stems apparent amongst the fresh growth (Figure 8A and B). Native blunt pondweed (*Potamogeton ochreatus*) occurred as short-growing, scattered plants, while the charophyte *Nitella* sp. aff. *cristata* was rarely encountered. The alien invasive weed curled pondweed (*Potamogeton crispus*) was widespread (Figure 8C), while elodea (*Elodea canadensis)* was also recorded.

Between the patches of taller submerged plants were blankets of the free-floating liverwort *Riccia fluitans* (Figure 8D). Short turfs of *Zannichellia palustris* (Figure 8E) and *Ruppia polycarpa* were common in shallower areas, together with the turf plant *Glossostigma diandrum*. Stands of raupō (*Typha orientalis*) were the most common marginal plant. Throughout the lagoon, on submerged wood, was the Threatened – Nationally Vulnerable moss, *Fissidens berteroi* (Figure 8F).

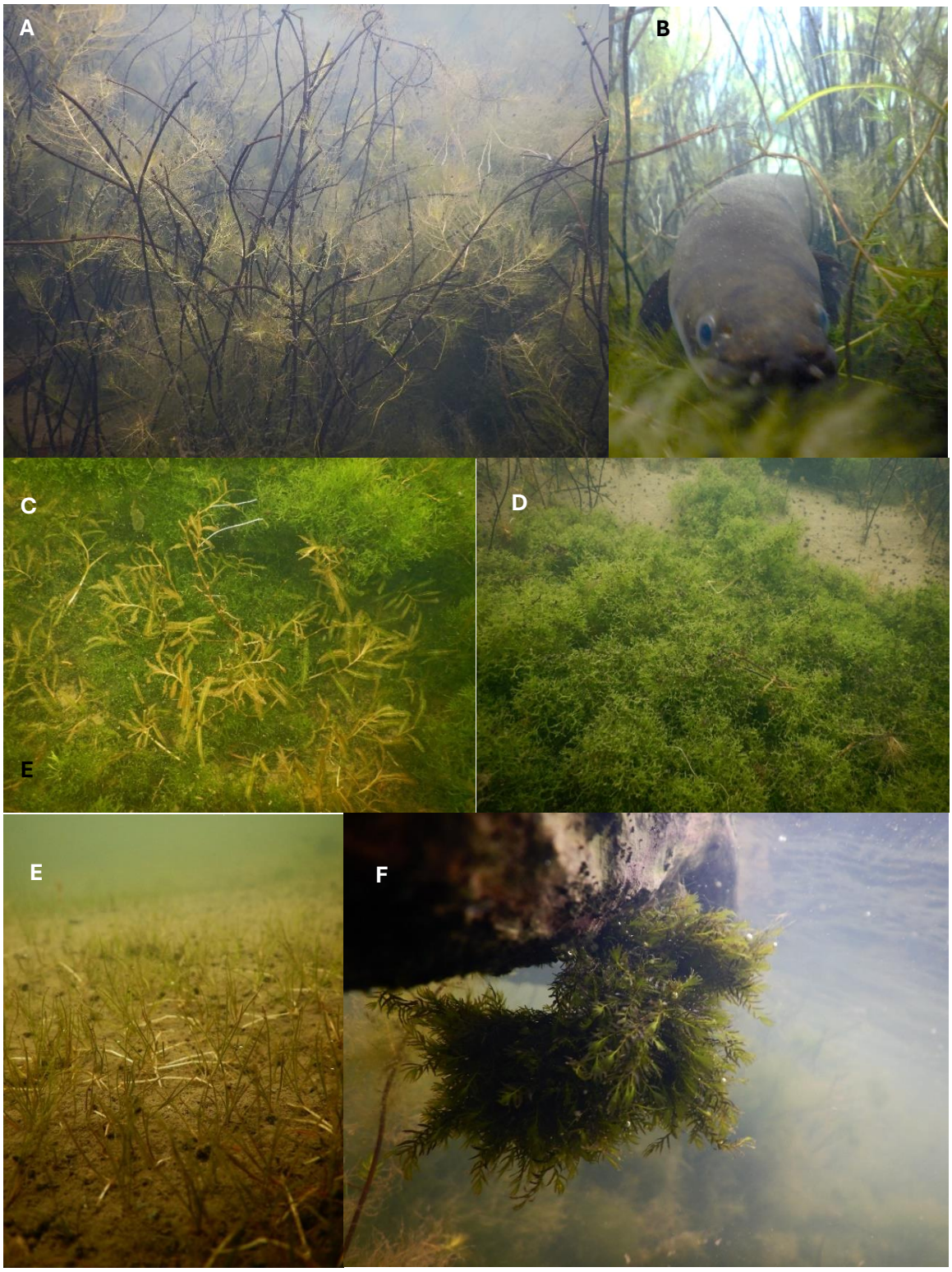


Figure 8: Submerged vegetation in Barton's Lagoon in 2025. A) *Myriophyllum propinquum* exhibiting signs of waterfowl grazing; B) tuna (*Anguilla* sp.) within the milfoil; C) The alien invasive curled pondweed (*Potamogeton crispus*); D) a dense patch of the liverwort *Riccia fluitans*; E) short, spreading growths of *Zannichellia palustris*; F) the native moss *Fissidens berteroi* attached to a log.

Kākahi (*Echyridella* species) were common and freshwater sponges were also seen.

Discussion

Changes since the 2022 survey include an increase in the status of curled pondweed that has driven a doubling of the Invasive Impact Index and consequential reductions in the LakeSPI Index in 2025. However, the Native Condition Index showed little impact suggesting little impact by the weed on vegetation diversity.

An improvement was also apparent by the large reduction of 'blanketweed' algae (likely *Cladophora*) since the earlier 2022 survey. The likely mesotrophic to eutrophic nutrient status (Perrie and Royal 2022) of the lagoon may allow such filamentous macroalgal blooms at times.

Again in 2025, we noted the patchy development of vegetation, with some bare (or liverwort covered) areas. Also noted in the recent survey was the level of waterfowl browsing damage on taller plants. High levels of disturbance may be promoting the diversity of native submerged plants in the lagoon, by opening gaps in the vegetation for less competitive species to colonise.

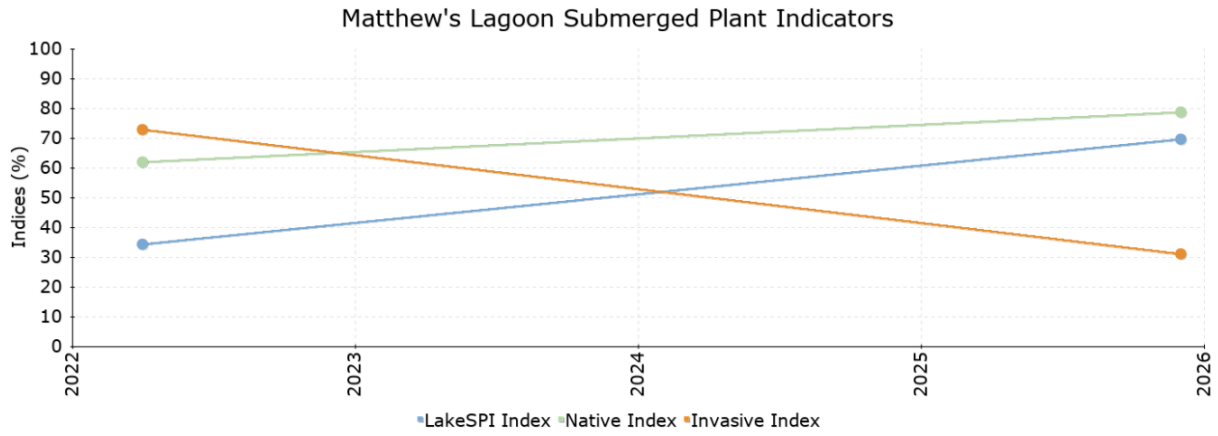
Hornwort (*Ceratophyllum demersum*) and lagarosiphon (*Lagarosiphon major*) have been present in the outflow from Bartons Lagoon for many years (Champion and Taumoepeau 2007), but neither weed has been recorded in the lagoon during the two LakeSPI surveys.

3.5 Matthew's Lagoon

Lake condition:	High
Stability:	Improving
Lake depth:	1.3 m

Results

Matthew's Lagoon had changed from moderate to high ecological condition in 2025, according to a LakeSPI Index of 70% (Figure 9). While the Native Condition Index was relatively high at 79%, the Invasive Impact Index had decreased substantially to 31% (Figure 9).



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
November 2025	High	69.6%	78.6%	30.9%
March 2022	Moderate	34.3%	61.9%	72.8%

Figure 9: LakeSPI results for Matthew's Lagoon from the 2025 survey.

Native milfoil (*Myriophyllum triphyllum*) was the most abundant submerged plant in 2025, growing almost to the water surface from the lagoon depth of c. 1.1 m (Figure 10A and B). The charophyte *Chara australis* was very common (Figure 10C) but never exceeded 75% cover. Native blunt pondweed (*Potamogeton ochreatus*) was also common and sago pondweed (*Stuckenia pectinata*) occurred widely as scattered plants (Figure 10D).

Alien invasive plants included hornwort (*Ceratophyllum demersum*), elodea (*Elodea canadensis*) and curled pondweed (*Potamogeton crispus*). However, none of these weeds individually exceeded an average cover of 5%.

Floating plants that collected at the lake margins included the native fern *Azolla rubra,* duckweed *Lemna disperma,* and the liverworts *Ricciocarpos natans* and *Riccia fluitans*. The moss *Drepanocladus aduncus* was also observed forming loose masses in the milfoil canopy. All surveyed shorelines were fringed by dense beds of raupō (*Typha orientalis*).

Divers noted abundant hydra on the milfoil canopy (Figure 10B), freshwater sponges and abundant small daphnia.

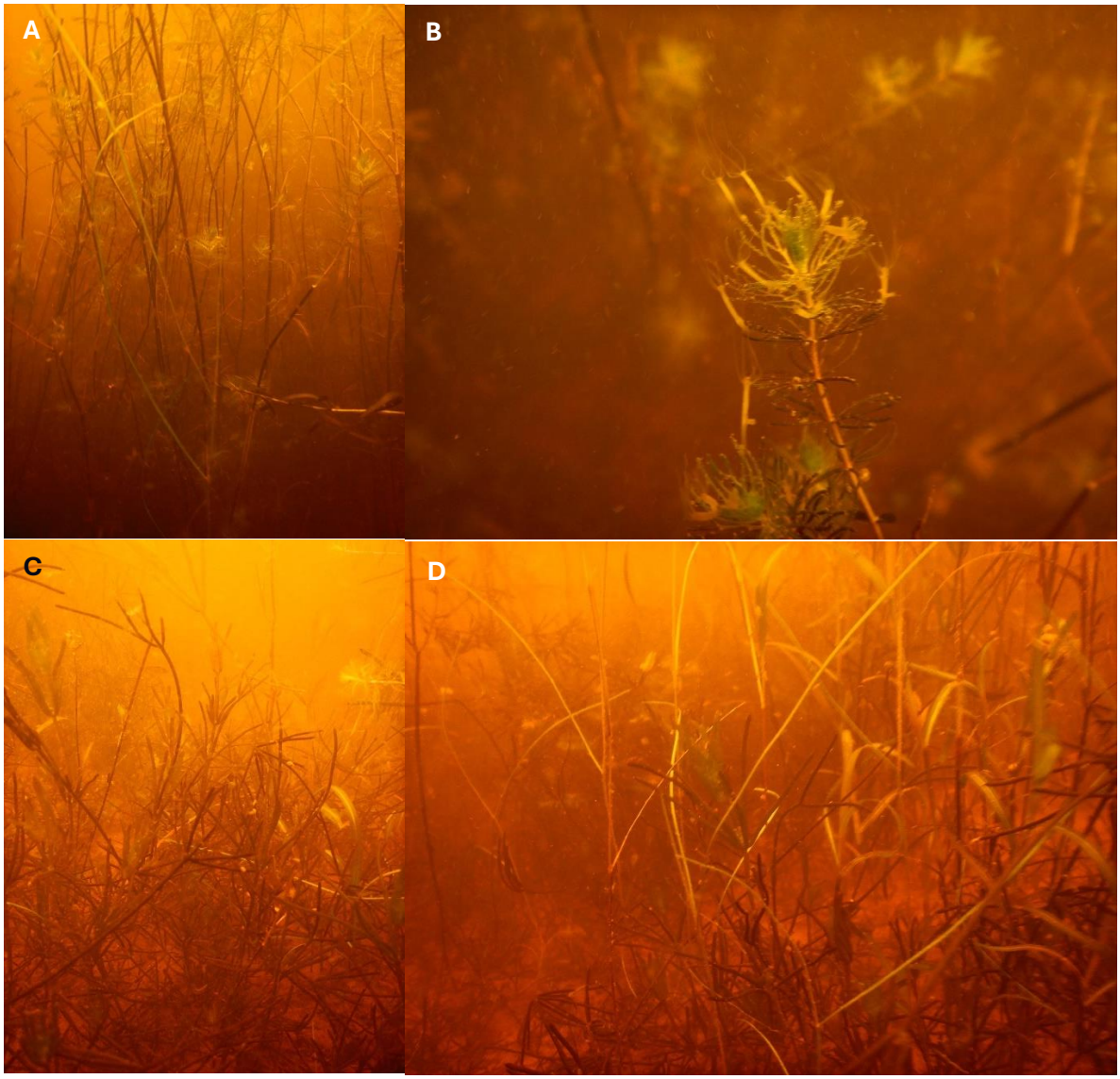


Figure 10: Submerged vegetation in Matthew's Lagoon in 2025. A) Tall-growing native milfoil (*Myriophyllum triphyllum*); B) close-up of milfoil with hydra attached; C) a patch of charophytes, *Chara australis*; D) Native sago pondweed (*Stuckenia pectinata*) with a narrow leaf and blunt pondweed (*Potamogeton ochreatus*) with a wider leaf blade.

Discussion

A major reduction in the abundance of hornwort has occurred in Matthew's Lagoon since 2022. Previously, hornwort formed patches of near complete cover, occupying a much greater proportion of lake bed than in 2025 and resulting in an Invasive Impact Index that was twice as high in 2022. By contrast, hornwort was of lesser abundance than other weeds, elodea and curled pondweed in 2025.

This reduction in hornwort abundance cannot be explained with certainty. However, we note significant weather events in May 2025[4] and late October 2025[5], resulted especially in high wind damage. The reduction in hornwort did not seem to be reflected in the abundance of vegetation overall, which was similar to the levels reported in 2022. Hornwort, as an unrooted plant with no seed bank, may be more susceptible to wind-wave disturbance than native plants.

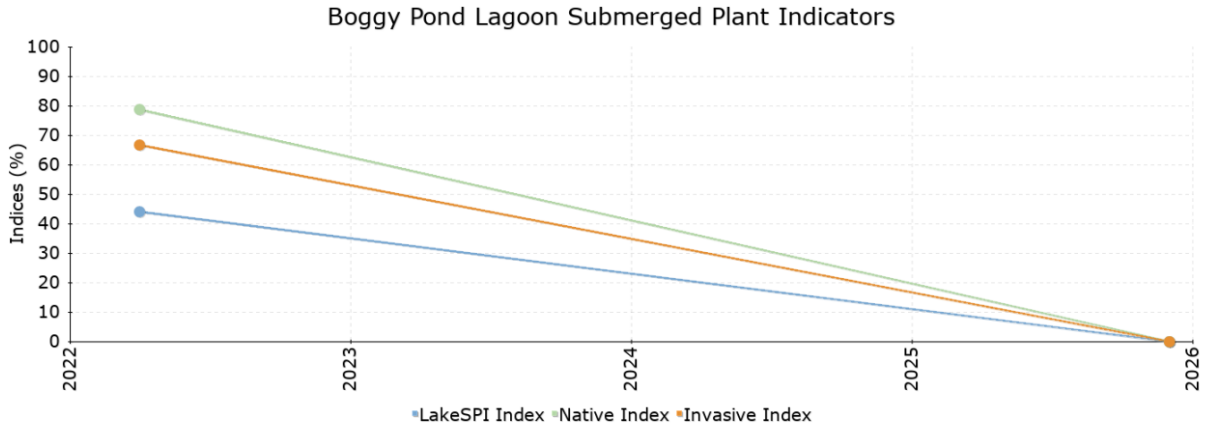
[4] https://thespinoff.co.nz/the-bulletin/02-05-2025/wild-weather-wreaks-havoc-as-wellington-and-canterbury-hit-hard
[5] https://www.rnz.co.nz/news/ldr/577433/hundreds-of-storm-insurance-claims-across-wairarapa

3.6 Boggy Pond

Lake condition:	Non-vegetated
Stability:	Declining
Lake depth:	1.1 m

Results

In 2025, Boggy Pond had declined from a moderate ecological condition to a non-vegetated status, with default LakeSPI Index scores of 0% (Figure 11).



Survey Date	Status	LakeSPI %	Native Condition %	Invasive Impact %
November 2025	Non-vegetated	0.0%	0.0%	0.0%
March 2022	Moderate	44.1%	78.6%	66.7%

Figure 11: LakeSPI results for Boggy Pond from the 2025 survey.

Water clarity was extremely poor in Boggy Pond in 2025 (estimated visibility <0.3 m), requiring divers to retrieve vegetation detected on the lake bed to the surface to identify the species (Figure 12A). The only submerged plant species detected on LakeSPI profiles was the native milfoil (*Myriophyllum triphyllum*), which occurred at <5% cover over a depth range of 0.6 to 0.8 m (Figure 12B). None of the three invasive weeds that were previously recorded in 2022 were re-recorded in 2025.

Fringing raupō (*Typha orientalis*) beds were recorded to 0.5 m depth (Figure 12C), however the rotting bases of the emergent could be detected by feel for >10 m out into the open water area. The floating plants *Azolla rubra*, *Landoltia punctata* and the liverwort *Ricciocarpos natans* (Figure 12D*)* occurred at low covers at the edge of the raupō beds.

Figure 12: Submerged and marginal vegetation in Boggy Pond in 2025. A) and B) the native milfoil (*Myriophyllum triphyllum*); C) fringing margins of raupō (*Typha orientalis*); D) the native liverwort *Ricciocarpos natans*.

Discussion

A major loss of vegetation has occurred in Boggy Pond since the 2022 survey, with the ecological condition declining from moderate to non-vegetated status. Previously, the lagoon was entirely vegetated across the 1m deep lakebed. Only occasional tall plants of native milfoil persisted near the lagoon margins in 2025, while six additional submerged plants were recorded in 2022.

It is possible that this vegetation collapse was driven by gale-force wind events prior to the 2025 survey, Boggy Pond likely being more exposed to winds moving across Lake Wairarapa than the adjacent Matthew's Lagoon. A well developed and diverse seedbank is likely present in the lake sediments, which would promote the recovery of vegetation should the water clarity improve. However, we note herbivorous, exotic rudd (*Scardinius erythrophthalmus*) are recorded in Boggy Pond (New Zealand Freshwater Fish Database), with the possibility that grazing of recovering plants may delay revegetation.

In 2022, the fringing raupō (*Typha orientalis*) beds typically extended to 0.9 m depth, compared to 0.5 m in 2025. There also appears to be a retraction in the extent of the raupō beds seen in Google Earth images between December 2022 and April 2024.

4 Discussion

4.1 Current lake state

This section presents the most recent results for all 14 LakeSPI assessed waterbodies in the Wellington Region, ranked in order of ecological condition (Table 3). The status and ranking of these 14 waterbodies are plotted relative to the most recent results for all lakes nationally that have been surveyed using LakeSPI (Figure 13).

Waterbodies span a LakeSPI Index from 87% down to the default score of 0% (Table 3). Three regional lakes fall into the excellent category for ecological condition on account of high representation by native vegetation and little impact by invasive weeds. Five waterbodies fall into the high category for ecological condition, having either predominantly native vegetation of low diversity (Roto Māhanga, Pounui) or high diversity but moderate impact by invasive weeds (three Wairarapa lagoons). Two small lakes fall into the moderate category for ecological condition, having almost equal Native Condition Index and Invasive Impact Index (Ngarara, Rototawai). Lake Waitawa is the only lake in the region in the poor ecological condition category, due to a submerged vegetation that almost exclusively comprises alien weeds. Three waterbodies were assessed as non-vegetated, with Boggy Pond entering this category for the first time.

Table 3: Summary of current LakeSPI results for assessed lakes in Wellington Region, with date of survey and overall condition category.

Waterbody	Survey date	LakeSPI Index (%	Native Condition Index (%)	Invasive Impact Index (%)	Overall Condition
Lake Kohangapiripiri	31/3/2025	87	81	8.1	Excellent
Lake Kohangatera	01/04/2025	87	77	5.9	Excellent
Lake Nganoke	19/11/2025	86	76	6.2	Excellent
Lake Pounui	23/03/2022	72	52	6.7	High
Roto Māhanga*	19/03/2013	73	49	0	High
Matthew's Lagoon	19/11/2025	70	79	31	High
Turner's Lagoon	24/03/2022	68	74	31	High
Barton's Lagoon	18/11/2025	54	68	48	High
Lake Ngarara	21/03/2022	46	64	58	Moderate
Lake Rototawai	19/11/2025	38	50	69	Moderate
Lake Waitawa	22/03/2022	6	0	96	Poor
Boggy Pond	18/11/2025	0	0	0	Non-vegetated
Roto Kawau†	17/11/2025	0	0	0	Non-vegetated
Lake Waiorongomai	22/03/2022	0	0	0	Non-vegetated

*Upper Karori Reservoir

†Lower Karori Reservoir

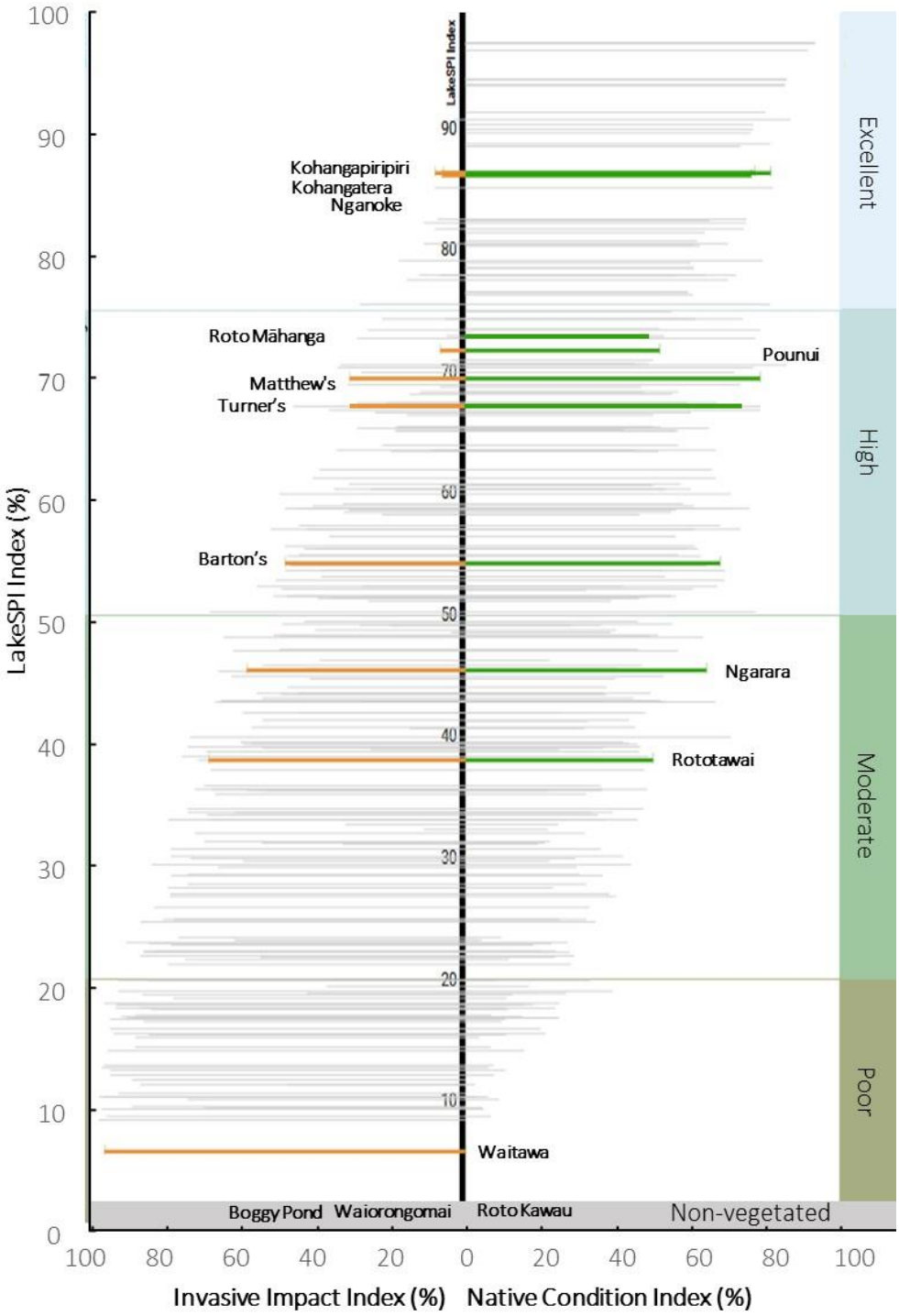


Figure 13: The most recent LakeSPI scores for lakes of the Wellington Region (red lines) are plotted with scores for a total of 331 New Zealand lakes. LakeSPI Index is plotted on the y-axis (points), Native Condition Index as lines to the right and Invasive Impact Index lines to the left. Five categories of LakeSPI condition are indicated on the right.

4.2 National comparison

Comparing the categories of lake ecological condition based on current LakeSPI Indices for the Wellington Region waterbodies to lakes nationally (Figure 14) shows that:

- A higher proportion of Wellington waterbodies fell into the excellent and high category than is the case nationally.
- A smaller proportion of Wellington lakes were recorded in the moderate and poor category.
- A similar proportion of Wellington waterbodies were recorded in the non-vegetated category compared to nationally.

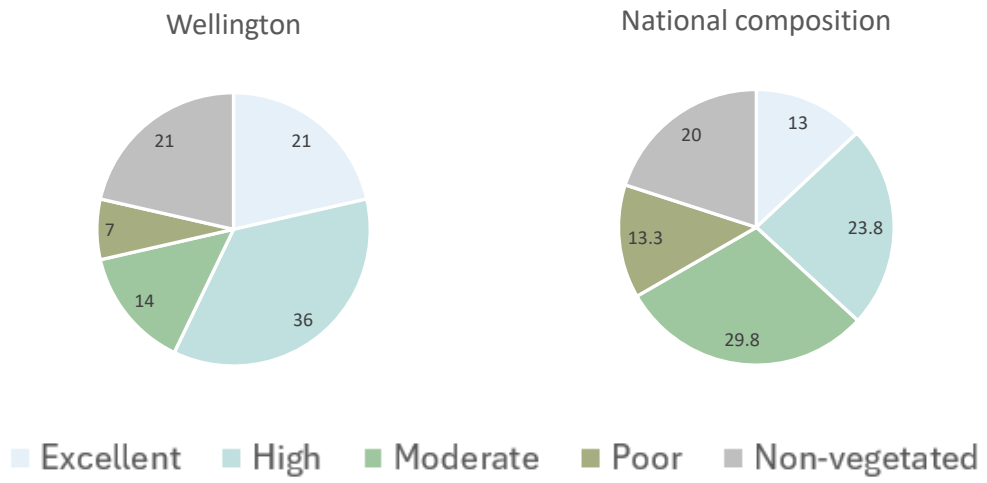


Figure 14: Proportion (%) of lakes that fall into each of five categories of LakeSPI Index for Wellington Region and lakes nationally.

4.3 NPS-FM scoring

The attribute bands for 14 waterbodies in the Wellington region are provided in Table 4. According to the attribute entitled 'Submerged plants – natives' (Native Condition Index): Lakes Kohangapiripiri, Kohangatera and Nganoke were assigned to the A band; five waterbodies were assigned to the B band; Roto Māhanga and Lake Rototawai were assigned to the C band and Lake Waitawa, Boggy Pond, Roto Kawau and Lake Waiorongomai fall below the national bottom line into the D band.

The attribute Submerged plants - invasive species (Invasive Condition Index) is not assigned for non-vegetated lakes, as these by definition cannot be invaded by weeds. Therefore, no band was assigned for Boggy Pond, Roto Kawau and Lake Waiorongomai in Table 4. This attribute placed: Upper Karori Reservoir into Band A; Lakes Kohangapiripiri, Kohangatera, Nganoke and Pounui in band B; Matthew's, Barton's and Turner's Lagoons and Lake Ngarara fell into band C; while Lake Waitawa dropped below the national bottom line into band D (Table 4).

Figure 15 shows the proportion of lakes within attribute bands under the NPS-FM (2025) for lakes nationally and the Wellington Region. For the Native Condition Index, the Wellington Region has slightly more waterbodies in the A band and noticeably more within the B band, but fewer in the C band. For Invasive Impact Index, there are also more waterbodies in the B band and fewer in the A or C band (Figure 15).

Table 4: Attribute bands for the Native condition Index and Invasive Impact Index of 14 Wellington waterbodies.

Waterbody	Native Condition Index (%)	Invasive Impact Index (%)
Lake Kohangapiripiri	A	B
Lake Kohangatera	A	B
Lake Nganoke	A	B
Lake Pounui	B	B
Roto Māhanga	C	A
Matthew's Lagoon	B	C
Turner's Lagoon	B	C
Barton's Lagoon	B	C
Lake Ngarara	B	C
Lake Rototawai	C	C
Lakes Waitawa	D	D
Boggy Pond	D	
Roto Kawau	D	
Lake Waiorongomai	D	

*Non-vegetated lakes are not scored for Invasive Impact Index under the NPS-FM.

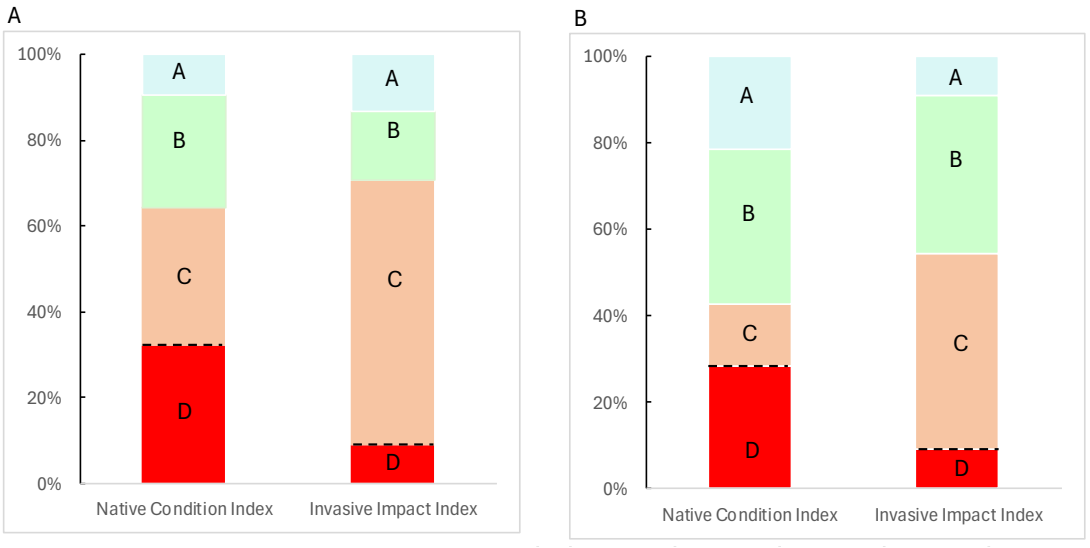


Figure 15: Condition Index and Invasive Impact Index, A) nationally and B) for Wellington Region.

5 Acknowledgements

We thank Alton Perrie of Greater Wellington Regional Council for his planning and preparation, which ensured the surveys were conducted smoothly and efficiently. We also thank Kari Beaven and Jo Ledington of Zealandia Te Māra a Tāne for granting access to Lake Roto Kawau and for their support during the LakeSPI survey. We also appreciate the landowners at Lake Nganoke and Lake Rototawai for providing access. We are grateful to Katie Brasell and Sam Ludden of Ngāti Kahungunu ki Wairarapa for accompanying and supporting our fieldwork in the Wairarapa region.

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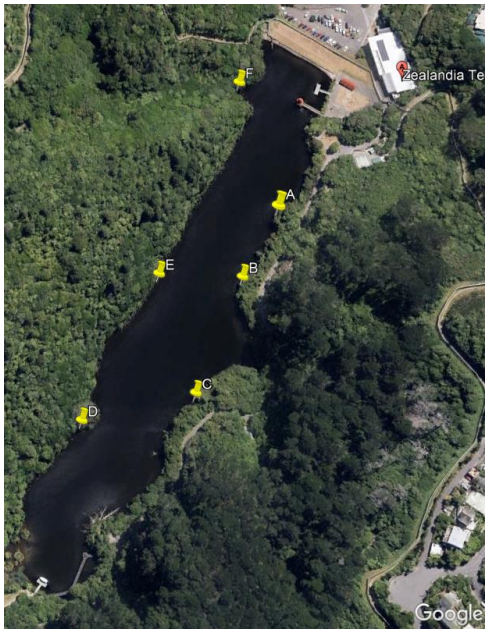
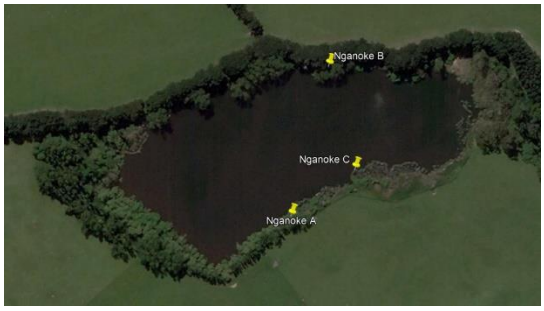
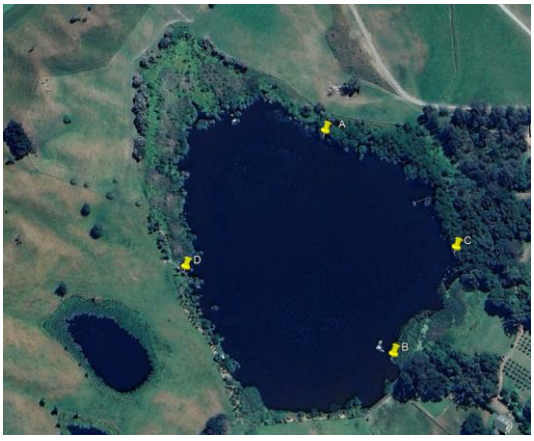
Appendix A Location of LakeSPI sites

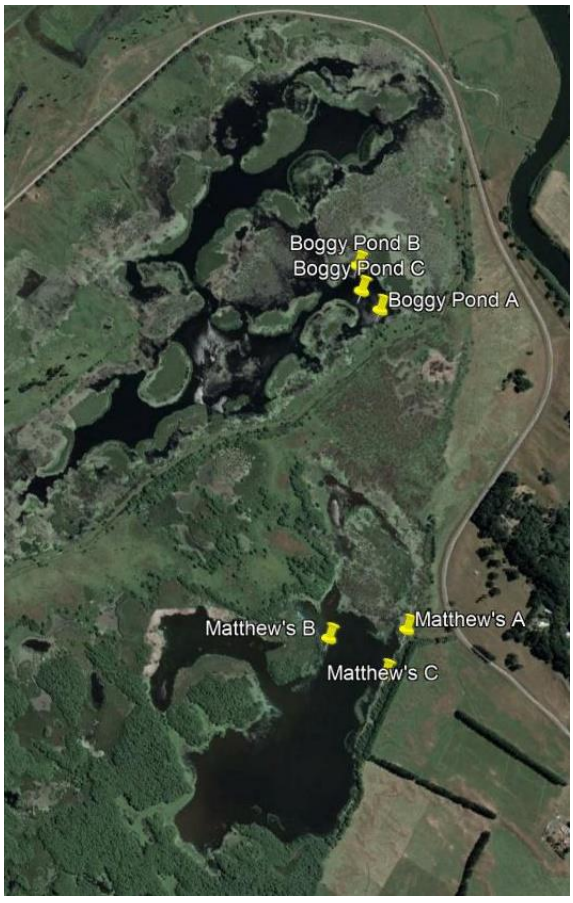
Maps and tables show the location of survey sites selected for each waterbody.

Lake Roto Kawau map	Sites	NZMG (Easting, Northing)
	A	2656752 5989077
	B	2656726 5989029
	C	2656691 5988948
	D	2656610 5988930
	E	2656667 5989032
	F	2656727 5989166

Lake Nganoke map	Sites	NZMG (Easting, Northing)
	A	2692894 5981078
	B	2692935 5981227
	C	2692959 5981123

Lake Rototawai map	Sites	NZMG (Easting, Northing)
	A	2706677 5996538
	B	2706763 5996334
	C	2706814 5996440
	D	2706577 5996386

Barton's Lagoon map	Sites	NZMG (Easting, Northing)
	A	2703991 6001788
	B	2704151 6001650

Matthew's Lagoon and Boggy Pond map	Sites	NZMG (Easting, Northing)
	Matthew's	
	A	2700366 5991860
	B	2700149 5991841
	C	2700303 5991737
	Boggy Pond	
	A	2700315 5992748
	B	2700256 5992872
	C	2700265 5992802

Appendix B Plant species lists

Table 5: Species list for Lake Nganoke. Records based on records from the current survey (synonyms in parenthesis).

Plant community	Species	2022	2025
Emergents	*Typha orientalis*	✓	
Pondweeds	*Potamogeton ochreatus*	✓	✓
Charophytes	*Chara australis*	✓	✓
	Nitella sp. aff. *cristata*	✓	✓
Invasive species	*Potamogeton crispus*	✓	✓
Floating species	*Lemna disperma*	✓	✓
	Azolla rubra (*A. filiculoides*)	✓	✓
	Wolffia australiana	✓	
	Persicaria decipiens	✓	
	Ludwigia palustris	✓	

Table 6: Species list for Lake Rototawai. Records based on records from the current survey (synonyms in parenthesis).

Plant community	Species	2025
Emergents	*Typha orientalis*	✓
Pondweeds	*Potamogeton ochreatus*	✓
Charophytes	*Chara australis*	✓
	Nitella sp. aff. *cristata*	✓
Milfoils	*Myriophyllum triphyllum*	✓
Invasive species	*Potamogeton crispus*	✓
Floating species	*Lemna disperma*	✓
	Azolla rubra (*A. filiculoides*)	✓
	Landoltia punctata	✓

Table 7: Species list for Barton's Lagoon. Records based on records from the current survey.

Plant community	Species	2022	2025
Emergents	*Typha orientalis*	✓	✓
Turf plants	*Glossostigma diandrum*		✓
Milfoils	*Myriophyllum triphyllum*	✓	✓
	Myriophyllum propinquum	✓	✓
Pondweeds	*Potamogeton ochreatus*	✓	✓
Invasive species	*Ceratophyllum demersum**	✓	
	Potamogeton crispus	✓	✓
	Elodea canadensis		✓
Floating species	*Riccia fluitans*	✓	✓
Other	*Ruppia polycarpa*	✓	✓
	Zannichellia palustris†	✓	✓
	Persicaria decipiens	✓	
	Fissidens berteroi		✓

* Only seen in lagoon outlet.

† At Risk – Naturally Uncommon under the New Zealand Threat Classification System (de Lange et al. 2018).

Table 8: Species list for Matthew's Lagoon. Records based on records from the current survey (synonyms in parenthesis).

Plant community	Species	2022	2025
Emergents	*Typha orientalis*	✓	✓
Milfoils	*Myriophyllum triphyllum*	✓	✓
Pondweeds	*Potamogeton ochreatus*	✓	✓
	Stuckenia pectinata		✓
Charophytes	*Chara australis*	✓	✓
Invasive species	*Elodea canadensis*	✓	✓
	Potamogeton crispus		✓
	Ceratophyllum demersum	✓	✓
Floating species	*Lemna disperma*	✓	✓
	Landoltia punctata	✓	
	Azolla rubra (*A. filiculoides*)	✓	✓
	*Ricciocarpos natans**	✓	✓
	Wolffia australiana	✓	
	Riccia fluitans	✓	✓
Other	*Unidentified bryophytes*	✓	

* Classified as At Risk, Declining according to the New Zealand Threat Classification (de Lange et al. 2020).

Table 9: Species list for Boggy Pond. Records based on records from the current survey (synonyms in parenthesis).

Plant community	Species	2022	2025
Emergents	*Typha orientalis*	✓	✓
	Bolboschoenus fluviatilis	✓	
Milfoils	*Myriophyllum triphyllum*	✓	✓
Pondweeds	*Potamogeton ochreatus*	✓	
Charophytes	*Chara australis*	✓	
	Nitella sp. aff. *cristata*	✓	
Invasive species	*Elodea canadensis*	✓	
	Ceratophyllum demersum	✓	
	Potamogeton crispus	✓	
Floating species	*Landoltia punctata*	✓	
	Azolla rubra (*A. filiculoides*)	✓	✓
	*Ricciocarpos natans**	✓	✓

* Classified as At Risk, Declining according to the New Zealand Threat Classification (de Lange et al. 2020).

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