

## LakeSPI survey of Lake Kohangatera - 2013

Prepared for Greater Wellington Regional Council

June 2013



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NIWA Client Report No: HAM2013-052  
Report date: June 2013  
NIWA Project: WRC13206

Lake Kohangatera in 2013, viewed from the north. (Photo: A Taumoepeau, NIWA).

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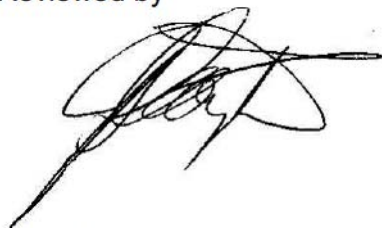
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## Executive summary

Greater Wellington Regional Council (GWRC) contracted NIWA to reassess the ecological condition of Lake Kohangatera using the LakeSPI (Submerged Plant Indicators) method.

An earlier LakeSPI assessment in 2011 established an excellent ecological status and nationally outstanding botanical values. However, the discovery of the exotic weed elodea (*Elodea canadensis*) within the lake at this time raised questions about how long it had been present and the threat this weed posed to the lake ecology. The re-assessment in 2013 was undertaken to update the current condition of the lake, and establish the performance of elodea under the current lake conditions. A simultaneous surveillance in the lake for egeria (*Egeria densa*), which is known to be present in the upper catchment, did not detect this submerged weed.

The 2013 LakeSPI Index of 87% indicated the lake is still in an excellent condition (i.e., higher score = better ecological condition). This score was driven by the presence of a diverse, primarily native vegetation (Native Condition Index 83%). Elodea was recorded at one LakeSPI site at the shoreline where weed surveillance observations showed it to be most abundant. However, the overall restricted distribution and low cover of elodea resulted in a low Invasive Impact Index of 8.1% (i.e., lower scores = better ecological condition) and little impact on ecological values.

There was no significant change in LakeSPI scores between 2011 and 2013. Compared to the LakeSPI index of 242 lakes assessed nationally, Lake Kohangatera was ranked 9<sup>th</sup> from top in order of ecological condition.

It was concluded that elodea does not pose a substantial ecological risk to the botanical values of Lake Kohangatera under present conditions. It has likely been present in the system for a number of years judging from a wide distribution in the tributary stream (GWRC observations), and weed performance in the lake is still limited. By contrast, the presence of the exotic weed egeria (*Egeria densa*) within the upper catchment remains a large threat.

In view of the stability in the results of LakeSPI 2011 and 2013 assessments for Lake Kohangatera, we recommend a resurvey interval of c. 5 years, or earlier if change is suspected.

## 1. Introduction

Lake Kohangatera is one of the two Parangarahu Lakes located within a regional park in the Wellington region. In 2011, Greater Wellington Regional Council (GWRC) contracted NIWA to undertake an assessment of the Parangarahu Lakes and Lake Pounui (reported in de Winton et al. 2011) using the LakeSPI (Submerged Plant Indicators) method of determining ecological condition. These assessments confirmed an excellent ecological status for Lake Kohangatera and highlighted nationally outstanding botanical values (de Winton et al. 2011).

However, at the same time threats to the ecosystem of Lake Kohangatera were identified in the form of a new record for the exotic weed elodea (*Elodea canadensis*) and the discovery of another weed, egeria (*Egeria densa*), in an open water area in the wetland upstream in the lake catchment (Wells et al. 2011).

Recommendations from NIWA's 2011 reports included a repeat LakeSPI monitoring and re-assessment of weed extent and impacts in Lake Kohangatera after two years. The purpose of this was to update the current condition of the lake, establish the performance of elodea under lake conditions and clarify the threat this weed poses to the lake.

This report presents the results from a 2013 reassessment of Lake Kohangatera using the LakeSPI method. Results are compared to the previous 2011 lake condition. The status of elodea is re-examined and its impact on the LakeSPI scores is identified.

This LakeSPI assessment was undertaken in conjunction with additional surveys investigating the extent of the two weed species (elodea and egeria) in the lake and the upstream wetland. The results from these surveys, along with management options for the lake, are reported separately in de Winton (2013).

## 2. Methods

The LakeSPI method (Clayton and Edwards 2006, de Winton et al. 2012) was applied at five baseline sites (selected in 2011) in Lake Kohangatera (Figure 2-1, Appendix A) on the 20<sup>th</sup> March 2013. At each site scuba divers scored 11 metrics over a 2 m wide transect from shore to the deepest vegetation limit. Metrics included measures of diversity from the presence of key plant communities, the depth of vegetation growth, and the extent that invasive weeds were represented. A complete description of measured characters is given in the technical report at <http://lakespi.niwa.co.nz/>. An inventory of all plant species encountered was also made (Appendix B).



**Figure 2-1: Location of 5 survey sites in Lake Kohangatera.**

Results were entered to NIWA's LakeSPI database for the generation of three indices. The Native Condition Index measures the diversity and extent of native vegetation, the Invasive Impact Index measures invasive weed extent, and these are integrated within an overall LakeSPI Index. Indices are expressed as a percentage of expected pre-European (pristine) state. LakeSPI Index scores place lakes into one of five narrative classes of lake condition, either as Non-vegetated (0%), Poor (>0-20%), Moderate (>20-50%), High (>50-75%) and Excellent (>75%).

### 3. Data analyses

The 2013 results were compared to LakeSPI scores from the same baseline sites in 2011 to gauge if changes in ecological condition had occurred. Although a limited vegetation survey was undertaken in 2004, generated LakeSPI results cannot be directly compared to the 2011 and 2013 results as observations were at different sites.

The likelihood of a significant change in lake status over time is based on agreement in the direction and magnitude of change in LakeSPI Indices across all 5 sites. A paired t-test (GraphPad InStat) compared site results from 2011 to those in 2013 to identify change at a significance level of  $p < 0.05$ .

In addition to statistical significance, the ecological significance of change was assessed using the guidelines below (Figure 3-1) which give a scale of probabilities for ecologically significant change in lake condition based on change in averaged LakeSPI indices (LakeSPI units as %) over repeated surveys. These guidelines, based on expert judgment, have considered observer-based variation and the response of LakeSPI scores to major ecological events in lakes (NIWA unpublished data).

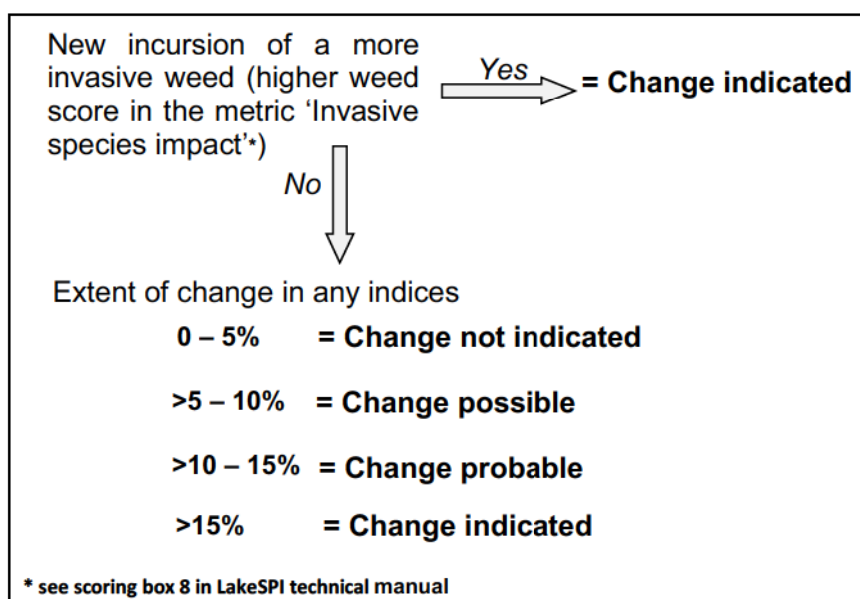


Figure 3-1: Guidelines for assessing the significance of change in LakeSPI Indices over multiple surveys of a lake.



## 4. Results



Lake condition:	Excellent
Stability:	Stable
Lake depth:	2.3

In 2013 a LakeSPI Index of 87% showed the lake to be in excellent condition, with no significant ecological change and no statistical difference (paired t-test,  $p > 0.05$ ,  $df = 4$ ) from the previous assessment in 2011 (Table 1). This score was driven by the presence of a diverse, primarily native vegetation (Native Condition Index 83%). A low Invasive Impact Index of 8.1% reflected the lack of development by elodea (*Elodea canadensis*), the only exotic weed species encountered at the surveyed sites.

**Table 1: LakeSPI results for Lake Kohangatera from surveys in 2004 (Wells and Champion 2004) and 2011.**

Date	LakeSPI Index	Native Condition Index	Invasive Impact Index
2004	72	70	23
2011	89	83	5
2013	87	83	8.1

NB 2004 scores indicative only, with calculations based on a general reconnoitre.

Submerged vegetation formed a heterogeneous mosaic of diverse species (Appendix B). Commonly there was a dense (100% cover) vegetated band on the outside of the emergent beds. Sparser vegetation was present below 1.8 m, which extended to the maximum lake depth of 2.3 m at the time of survey. Bare areas were apparent; e.g., between Sites A and B was a region of harder substrates, with discernible current movement, which was considered to be less suited for submerged plant growth.

Blunt pondweed (*Potamogeton ochreatus*) dominated the vegetation except for the site closest to the coast (Site E), where sago pondweed (*Stuckenia pectinata*) and horse's mane (*Ruppia polycarpa*) became more abundant. Milfoil (*Myriophyllum triphyllum*) and *Lepilaena bilocularis* commonly co-dominated with blunt pondweed. Elodea was present at Site B (Figure 2-1), in 1.5 to 1.6 m depth, usually at  $\leq 5\%$  cover, but with some patches up to 25% cover and 0.6 m in height. Additional observations suggested this development was typical of the north-western shoreline.



Figure 4-1: Turf plants (*Lilaeopsis*) intergrading to milfoil in 2011 (Photo: R. Wells).

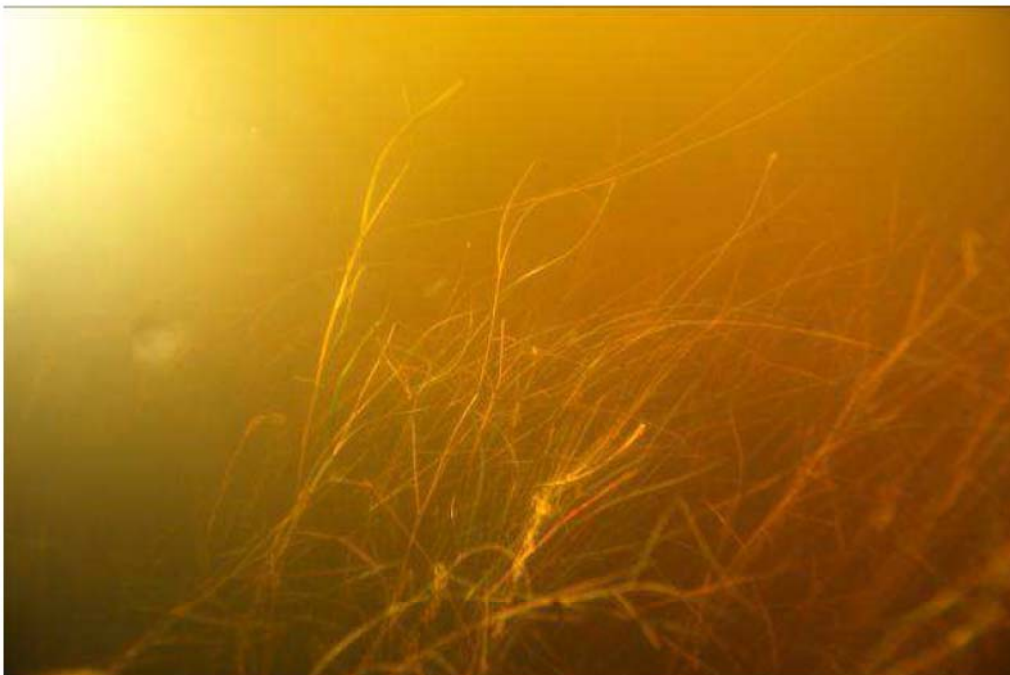


Figure 4-2: *Stuckenia pectinata* and flowering *Ruppia polycarpa* at the southern end of the lake in 2011 (Photo: R. Wells).

Three charophyte species were scattered at generally low covers ( $\leq 5\%$ ). Low-growing turf plants (*Lilaeopsis novae-zelandiae*, *Limosella lineata*) were found in shallow areas, only where the large emergent beds of raupō (*Typha orientalis*) and kāpūngāwhā (*Schoenoplectus tabernaemontani*) were not present. Bryophytes (*Drepanocladus aduncus*, *Riccardia* sp.) formed cushion-like clumps amongst the other vegetation (Appendix B).

All of the common species found in 2013 (Appendix B) had been recorded in 2011 (de Winton et al. 2011). A more limited survey in 2004 (Wells and Champion 2004) also recorded most of the dominant species (Appendix B). However, at this time charophytes and elodea were not recorded and areas of the lake that were deeper than 2 m appeared devoid of vegetation. Two weeds, *Ranunculus trichophyllus* and *Potamogeton crispus*, which are regarded as more benign than elodea, were recorded at this time. These are seed spread species that are transported by waterfowl and can be intermittent in occurrence. For example, *Ranunculus trichophyllus* was re-recorded in 2013 outside of the LakeSPI sites (Appendix B).

In 1950 a number of the common plant species in NIWA's surveys were recorded by Moar (1950) for Lake Kohangatera and the Gollans Wetland (Appendix B). The 1950 survey recorded *Lamprothamnium macropogon*, a charophyte species that generally requires some degree of salinity, which was not recorded in 2004, 2011 or 2013 (Appendix B).

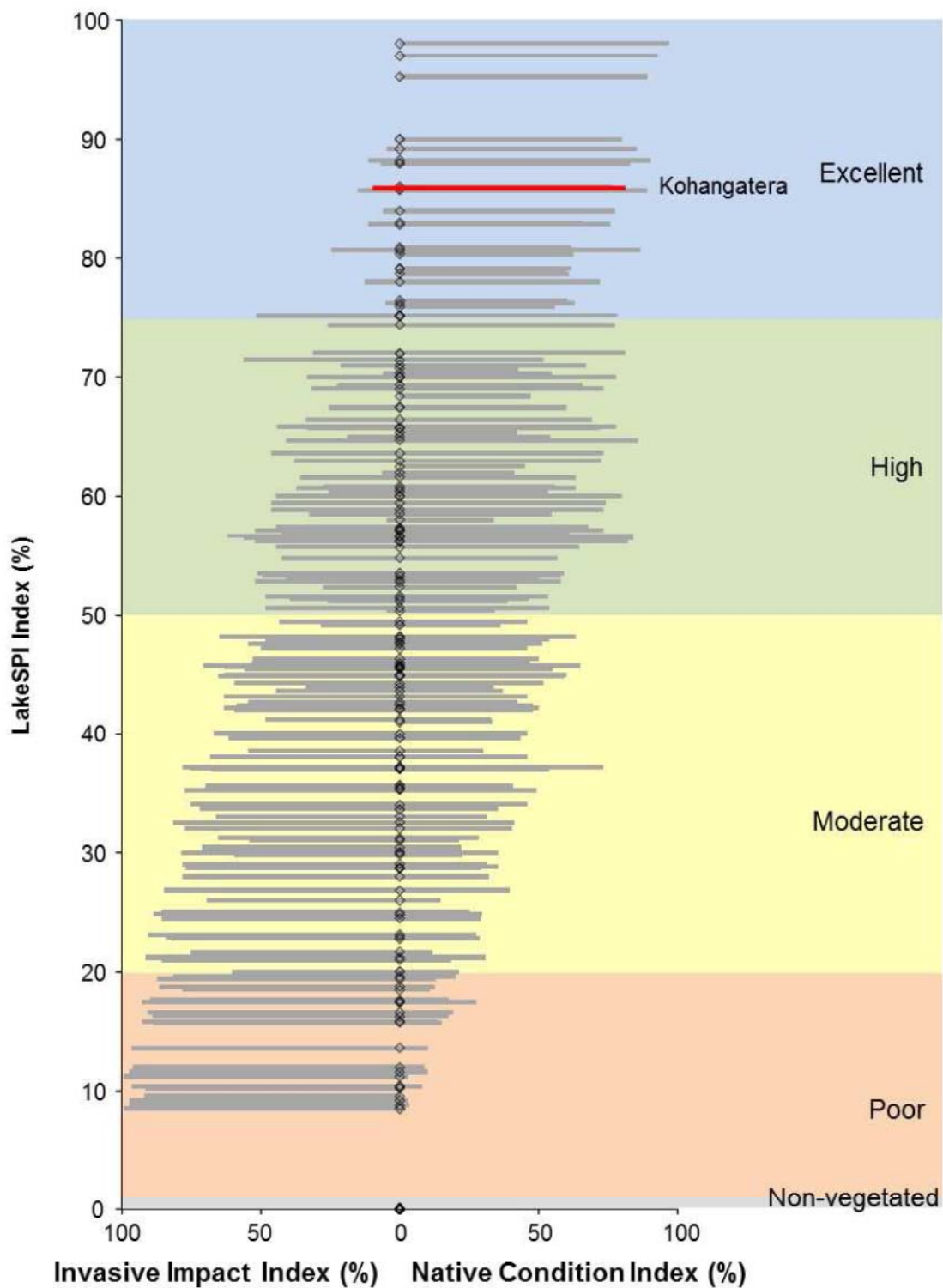
## 5. Discussion

LakeSPI scores from the 2011 and 2013 surveys were not significantly different and indicate that Lake Kohangatera is in an 'excellent' and stable condition. Native submerged vegetation values are still nationally outstanding as identified in de Winton et al. (2011), and the lake provides one of the few examples of a little impacted, lowland coastal waterbody. Compared to 242 lakes assessed nationally using LakeSPI, Lake Kohangatera is ranked 9<sup>th</sup> from top in order of the LakeSPI index (Figure 5-1).

Elodea was not observed in 2004 (Wells and Champion 2004) and was detected for the first time at a LakeSPI survey site in 2011 and at the same site in 2013. This site is located along the shoreline where elodea covers were highest, based on associated weed surveillance observations in 2013 (de Winton 2013). Elsewhere, it was of insufficient abundance to be detected at LakeSPI sites, although it was widespread in the lake at sparse covers (de Winton 2013). Current Invasive Impact Index scores are low (8.1%) because the weed status at one site is diluted by the other four elodea-free sites.

In light of the widespread presence of elodea in the lake and catchment, it is likely that elodea has been present for some time and has reached an ecological equilibrium in the lake. The limited current distribution, depth range, and competitive performance of this weed suggests it does not pose an ecological risk to the botanical values of the lake under present conditions. Elodea is generally considered a freshwater species, but is reported to occur in brackish water and tolerates salinities up to 2.5 practical salinity units (PSU used hereafter) (Sand-Jensen 2000) to 3 (Luther, 1951). The upper salinity of 0.59 PSU recorded within Lake Kohangatera in 2011 (converted from a conductivity of 954  $\mu\text{S}/\text{cm}$  using a spreadsheet based on Fofonoff and Millard 1983) is well within this range, suggesting that other factors limit elodea's performance in Lake Kohangatera.

Elsewhere in New Zealand lakes where elodea occurs, and it has not been displaced by worse weeds, it is most abundant under mesotrophic to mildly eutrophic lake conditions, over depth ranges between c. 2 to 8 m. Elodea is frequently a pioneer species on flow disturbed areas around stream and river inflows to larger lakes and grows particularly well where terrigenous sediments have collected (NIWA unpublished observations). Therefore, the performance of elodea in Lake Kohangatera might be expected to increase in the event that the lake trophic status shifts (nutrient enrichment), or if large deposits of erosional catchment sediments enter the lake.



**Figure 5-1: LakeSPI Indices based on the latest results for 242 lakes in grey, showing the score for Lake Kohangatera as a red line.** LakeSPI scores are plotted on the vertical axis, with the Native Condition Index plotted on the right hand horizontal axis, and Invasive Impact Index on the left hand to show the negative influence on LakeSPI scores.

## **6. Recommendations**

LakeSPI scores for Lake Kohangatera have not changed over a period of 2 years and provide a good current baseline for the lake. For relatively stable systems, LakeSPI resurvey is recommended at an interval of c. 5 years, or earlier if change is suspected.

## **7. Acknowledgements**

Aleki Taumoepeau (NIWA) provided diving and field assistance. Many thanks to Owen Spearpoint (GWRC) and Alton Perrie (GWRC) for accompanying the field team on Lake Kohangatera.

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## Appendix A GPS positions (NZMG) for the survey sites in Lake Kohangatera

Lake Kohangatera	NZMG (Easting, Northing)
A	2666187 5980630
B	2666009 5980606
C	2666068 5980198
D	2666261 5980117
E	2666160 5980030



**Appendix B Species list for Lake Kohangatera based on surveys in 1950 (Moar 1950), 2004, 2011 and 2013 (synonyms in parenthesis).**

LakeSPI plant community	Species	Taxonomic Authority	1950	2004	2011	2013
Emergents	<i>Apodasmia similis</i> ( <i>Leptocarpus similis</i> )	(Edgar) B.G. Briggs & L.A.S.	✓		✓	✓
	<i>Eleocharis acuta</i>	R. Br.	✓			
	<i>Schoenoplectus tabernaemontani</i> ( <i>S. validus</i> , <i>Scirpus lacustris</i> )	(Gmel.) Palla	✓	✓	✓	✓
	<i>Typha orientalis</i>	C.B. Presl.	✓	✓	✓	✓
Turf plants	<i>Crassula kirkii</i> ‡	(Allan) A.P. Druce et Given		✓		
	<i>Glossostigma cleistanthum</i>	W.R. Barker		✓	✓	✓
	<i>Glossostigma elatinooides</i>	Benth.	✓	✓	✓	
	<i>Lilaeopsis novae-zelandiae</i>	(Gand.) A.W. Hill	✓	✓	✓	✓
	<i>Limosella lineata</i>	Gleuck			✓	✓
Milfoils	<i>Myriophyllum triphyllum</i> ( <i>M. elatinooides</i> )	Orchard		✓	✓	✓
	<i>Myriophyllum propinquum</i>	A. Cunn.	✓			✓
Pondweeds	<i>Potamogeton cheesemani</i>	A. Bennett	✓	✓		
	<i>Potamogeton ochreateus</i>	Raoul	✓	✓	✓	✓
	<i>Stuckenia pectinata</i> ( <i>Potamogeton pectinatus</i> ) ‡	(L.) Boerner			✓	✓
Charophytes	<i>Chara australis</i> ( <i>C. corallina</i> )	Brown	✓*		✓	✓
	<i>Chara globularis</i>	Thuill.			✓	✓
	<i>Lamprothamnium macropogon</i> ( <i>L. papulosum</i> )	(A.Braun) J.L. Ophel	✓*			
	<i>Nitella hyalina</i>	(DC.) Ag.			✓	✓
	<i>Nitella pseudoflabellata</i>	A. Br.			✓	
	<i>Nitella stuartii</i>	A. Br.			✓	✓

LakeSPI plant community	Species	Taxonomic Authority	1950	2004	2011	2013
Invasive species	<i>Elodea canadensis</i>	Michaux			✓	✓
	<i>Potamogeton crispus</i>	L.		✓		
	<i>Ranunculus trichophyllus</i>	Chaix		✓		✓
Brackish water	<i>Lepilaena bilocularis</i> †	Kirk			✓	✓
	<i>Zannichellia palustris</i> ‡	L.		✓	✓	✓
	<i>Ruppia polycarpa</i> ( <i>R. spiralis</i> )	R. Mason	✓	✓	✓	✓
Other	<i>Azolla filiculoides</i> ( <i>A. rubra</i> )	Lam.		✓	✓	✓
	<i>Callitriche petriei</i>	R. Mason		✓	✓	✓
	<i>Isolepis prolifer</i>	(Rottb.) R.Br. (1810)		✓	✓	
	<i>Lemna minor</i>	L.		✓		✓
	<i>Ludwigia palustris</i>	(L.) Elliott	✓			✓
	<i>Triglochin striata</i>	Ruiz Lopez et Pav.			✓	
Bryophytes	<sup>γ</sup> <i>Riccardia</i> sp. ? <i>R. furtiva</i> (NZ) / <i>R. reducta</i> (Australia) group?	L.			✓	✓
	<sup>⌈</sup> <i>Drepanocladus aduncus</i>					✓
Rhodominaceae	Red algae?					✓

\* Cited in Wood and Mason 1977.

† Classified as Nationally vulnerable according to the New Zealand Threat Classification (de Lange et al. in press).

‡ Classified as Naturally uncommon according to the New Zealand Threat Classification (de Lange et al. in press).

<sup>γ</sup>Rodney Lewington, pers comm. 2011

<sup>⌈</sup>Owen Spearpoint, pers comm. 2013