2017 BAY OF PLENTY SAND DUNE VEGETATION MAPPING AND CONDITION ASSESSMENT ŌTAMARĀKAU TO CAPE RUNAWAY

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R2033b

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1. INTRODUCTION

Sand dunes are a prominent feature of the Bay of Plenty coastline. The area of active dunes in the Bay of Plenty has declined significantly from *c.*1,692 hectares in the 1950s to *c.*928 hectares in the 1990s (Hilton 2006). Reasons for this decline include coastal development, erosion, and invasion of exotic species. Community and council-led care-groups are taking action to restore the natural character of the sand dune vegetation and habitats within the Bay of Plenty.

Bay of Plenty Regional Council commissioned Wildland Consultants to undertake mapping of vegetation and an assessment of condition in "wild undeveloped" areas on sand dunes between Ōtamarākau and Cape Runaway. Sand dune vegetation and habitats were surveyed using transects and mapped in 2009 (Wildland Consultants 2008a; Environment Bay of Plenty 2009). In 2017 all of the transects (71 in total) that were measured in 2009 east of Ōtamarākau were remeasured. An additional seven transects were established and measured on sections of beach not measured in 2009. This followed on from work undertaken in 2016 where 53 transects west and north of Ōtamarākau were measured (Widland Consultants 2016). Thirty transects on Matakana Island (SDVC-003 to SDVC-008) are yet to be remeasured as landowner access has yet to be granted.

Information on the composition of vegetation units and the cover abundance of exotic species present within those units, as well as condition and impact factors associated with all vegetation units were collected from each of the measured transects. The 2016 and 2017 remeasurements of the transects and remapping of vegetation units can be used to determine change in vegetation cover and condition of the Bay of Plenty coastal dune system.

Methods that were used for identifying and mapping dune vegetation types, and assessing dune condition were based on those described previously (Wildland Consultants 2008b and 2016). This report presents the methods used during the 2017 field survey, identifies any issues encountered during the project, and provides recommendations for future field work.

2. METHODS

Methods used in 2017 were based on those described by Wildland Consultants (2008b, 2016). In 2008, 'Wild undeveloped areas' along the coastline between Orokawa Bay (Waihī Beach) and Ōtamarākau were identified and assigned a "Sand Dune Vegetation Mapping and Condition assessment site" (SDVC) number (e.g. Pukehina Spit: SDVC-018), ordered west to east along the Bay of Plenty coastline. Twenty-two sites were identified (Wildland Consultants 2008b). In 2009 sand dunes located between Ōtamarākau and Cape Runaway were mapped and belt transects established and measured at about one kilometre intervals at each sand dune site (Environment Bay of Plenty 2009). Belt transects extended from the strand line to the inland end of the wild undeveloped dune system, at managed margins or a change in landform. Most of the SDVC sites were bisected by more than one transect. Additional transects were located as required to ensure that at least one transect bisected each SDVC site and all vegetation types greater than one hectare

within each SDVC site were traversed by at least one transect, although no additional transects were established for this reason in 2017. Transects were assigned numbers reflecting their distance from the most north western transect. Additional transects were identified with a subsidiary number (for example SDVC-096.1).

In 2017, 81 transects at 20 sites were remeasured and mapped between Otamarakau and the eastern-most sand dunes in the Bay of Plenty Region at Whangaparaoa Bay near Cape Runaway.

The methods used in 2017 are summarised below:

- A walk-through survey of all dune vegetation at each SDVC site was conducted.
- Site Sheets were completed for each SDVC site and included: a description of each mapped vegetation type; cover of weed species and threatened or significant plants; and impacts to the site. Cover classes were updated from those used in 2008 to provide greater accuracy. The new classes used were 1 = <1-1%; 5 = 2-5%; 10 = 6-10%; 15 = 11-15%; 20 = 16-20% and so forth.
- In the field, changes to the 2008 vegetation map were drawn onto hard copies of the most recent aerial photographs (scale of 1:1000). The age of the most recent aerial photographs varied across the project area. Areas west of Opape were photographed in 2014. Recent photography for most areas east of Ōpape was 2015/16, with two small areas covered by 2011/12 aerials. After fieldwork, maps were digitised at a scale of 1:1000 and saved as GIS shape files. Any 'wild areas' that were missed during the 2008-2009 survey or that have established since then were included and identified as 'new 2017', or 'missed 2009' in the GIS files. Areas that were 'wild areas' in 2008, but were found to be managed or developed in 2017 were excluded from the 2017 maps.
- GPS waypoint data were used to identify the seaward and inland end of each belt transect.
- In 2017 81 belt transects along the Bay of Plenty coastline between Orokawa Bay (Waihī Beach) and Ōtamarākau were mapped (at a scale of 1:1,000) and described. For each belt transect, a Transect Sheet was completed, and a Vegetation Unit Condition Assessment Sheet was completed for each vegetation unit identified within each transect. Transect Sheets were used to record the GPS location at both ends of the transect, record the photograph numbers taken at each end of the transect, and describe the transect and its management priorities. The relative cover of exotic plants, relative cover of indigenous plants, relative cover of bare sand (where applicable), any changes since the previous survey, threatened or significant plants, and impacts in each unit were recorded on the Vegetation Unit Condition Assessment Sheets. Details of any occurences of four key threatened and significant plant species (*Poa billardierei*, *Kunzea toelkenii*, *Pimelea villosa* and *Tetragonia tetragonioides*), including GPS points and photograph numbers, were recorded on the Transect Sheets. An estimate of the percentage cover of a further 15 key species - *Calystegia soldanella, Carex pumila, Carex testacea, Coprosma acerosa, Coprosma repens, Dodonea viscosa, Euphorbia glauca, Ficinia spiralis, Lachnagrostis billardierei, Melicytus novae-*

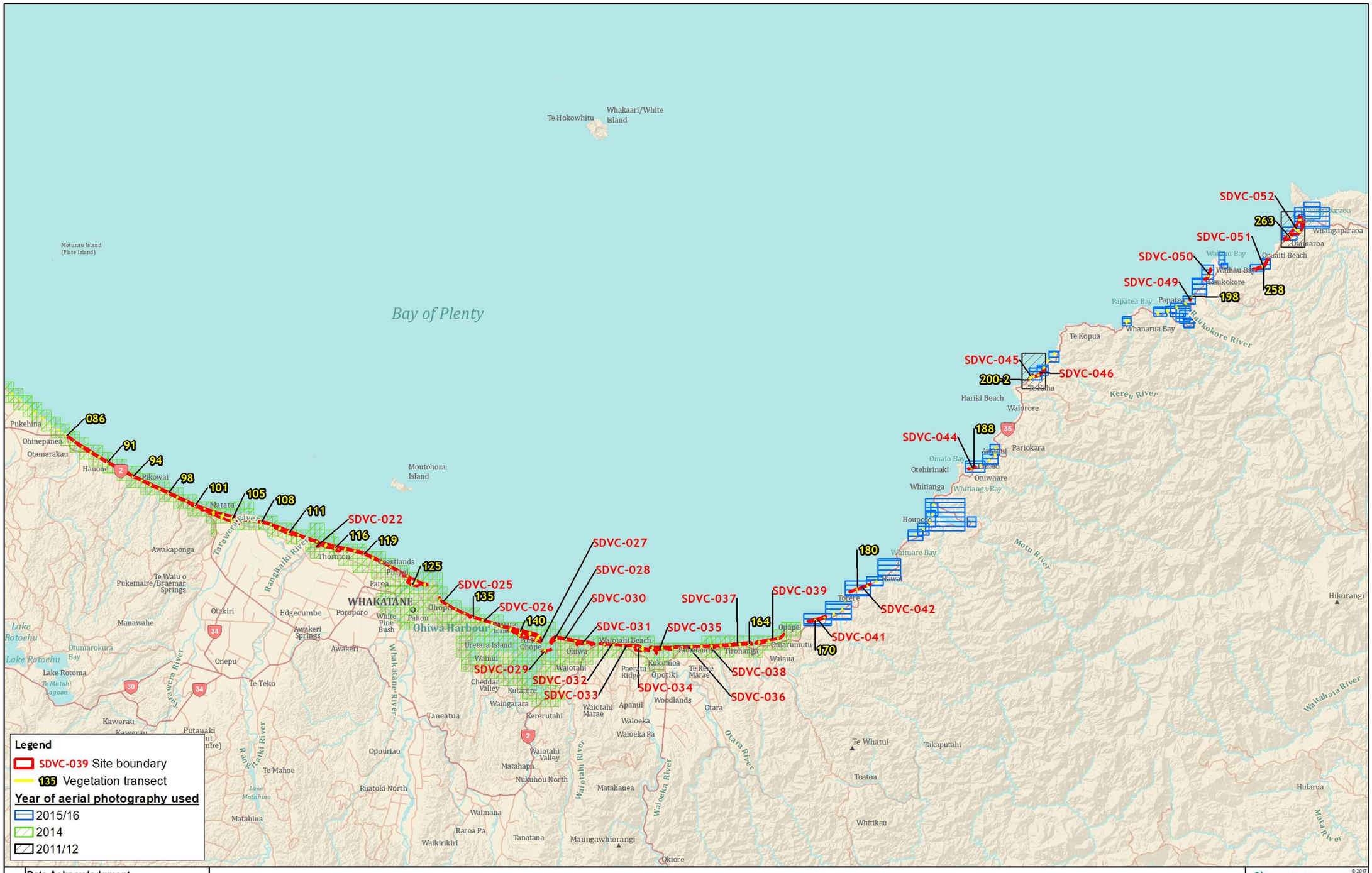

Figure 1. Year of aerial photography used for sand dune field survey in 2017: Ōtamarākau to Cape Runaway

zelandiae, Metrosideros excelsa, Myoporum laetum, Oxalis rubens, Ozothamnus leptophylla, Zoysia pauciflora - was made within each Unit within a transect, and also within each site.

- Photographs were taken of each transect from *c.*1.70 metres above ground level. One photograph was taken at the seaward end of the transect facing inland, down the transect line. In most cases, two additional photographs were taken from the seaward end of the transect, facing inland, and offset at 45° on both sides of the transect line. Photographs were also taken looking along the beach to the east and west and at both the inland and seaward photopoints, although these photo have not been entered into the database. These may be useful to show change on the beaches in future monitoring. Three photographs were taken at the inland end of the transect, facing the ocean. One of these was taken down the transect line and the other two were taken offset at 45° either side of the transect line. Where these photographs did not adequately replicate the 2009 photographs (and GPS locations), additional photographs were taken to replicate the 2009 photographs. At a number of transects, photographs in 2009 were not taken from the transect end point, but were located 50 metres from the end point coinciding with the transect boundary. Photopoints were repeated at the same location as 2009 for continuity in 2017, and additional photographs were taken looking down the transect towards the ocean, and these photos were entered into the database.

- In June 2017, a survey was undertaken of beaches between Torere and Raukokore to check whether there were beaches with sand dunes that had not been included in the 2009 study (Table 1). Additonal transects were established and measured (following the methods of Wildland Consultants 2008b) at the following sites: Torere (two transects), Omaio (one transect), Maraetai Bay (one transect), East of Wharekura Point (one transect), and Raukokore East (one transect). An additional transect was established at Hawai Beach (SDVC35). Sand dune mapping was also undertaken at beaches where there were sand dunes. Some beaches visited had a gravel or cobble substrate and were not included in the current study: Maraehako Bay, the beach at the Kereu River mouth, and the beach Haupoto (Motu River Mouth). The western end of Papatea Bay (west of the Raukokore River mouth) was unable to be accessed during the current survey because the access road was closed. Most of the beach at Papatea Bay was viewed from nearby places and it appeared to be mostly gravel. It is possible small dune systems are present on this beach, particularly at the western end.

Table 1: List of additional sites and transects measured in June 2017 that were not measured in 2009. These transects are all located east of Torere.

Site Number	Site Name	Transect Numbers	GPS Location-Seaward	GPS Location-Landward	Transect Bearing
041	Torere	170	E1991751 N5789134	E1991715 N5789266	145
041	Torere	171	E1992704 N5789449	E1992651 N5789568	160
042	Hawai	181	E1997045 N5792773	E1997060 N5799273	130
044	Omaia	188	E2007702 N5804667	E2007612 N5804691	110
045	Maraetai bay	200-3	E2013727 N5813902	E2013682 N5813910	080

Site Number	Site Name	Transect Numbers	GPS Location-Seaward	GPS Location-Landward	Transect Bearing
046	East of Wharekura Point	202	E2014490 N5816166	E2014465 N5814199	145
049	Raukokore East	198-1	E2029840 N5852186	E2029893 N5821885	085

- An updated vegetation and habitat list is presented in Appendix 1. This includes new vegetation types described in 2016 and 2017.
- This work was undertaken by Wildland Consultants staff in conjunction with Regional Council staff.

3. LOCATION OF DATA

Completed Site Sheets, Transect Sheets and Vegetation Unit Condition Assessment Sheets (collated by site, in order of site number) were scanned and provided as PDFs to the Council. Hard copy sheets will also be provided to Council following data entry. GIS shape files for the digitised vegetation maps were provided to the Council. Photographs taken for each site/transect were labelled with site/transect name and number, and provided to the Council.

4. ISSUES EXPERIENCED

No health and safety issues were experienced. Generally if photopoints were previously located on railway lines, they were moved slightly seaward to avoid standing on railway tracks.

5. DATA THAT HAS NOT BEEN CAPTURED ELECTRONICALLY

- The 2016 and 2017 written descriptions of sand dune transects have not been entered. These descriptions would be useful when this dune assessment is repeated in the future, to identify and interpret change. It is suggested that these are typed, checked, and finalised.
- Vegetatation descriptions of each vegetation and habitat type at each sand dune site have also not been entered electronically. This is a lower priority than transect descriptions, but could be undertaken prior to future remeasurements.

6. DATA ANALYSIS

No analysis of data has been undertaken. An assessment of change in the dune systems between 2008/9 and 2016/17 could be undertaken now or following remeasurement of the Matakana transects.

7. AERIAL PHOTOGRAPHY

In some parts of the eastern Bay of Plenty there is extensive beach erosion evident since the 2014 aerial photographs were flown (Figure 1 shows the location of the 2014 aerial photographs). This made mapping of vegetation at times somewhat difficult in the field and some boundaries (particularly the beach end of the dune system) had to be walked and mapped with readings taken from a GPS units. Examples of recent rapid erosion was near the mouth of the Waioeka River at Opotiki, the eastern side of the Waiotahi River mouth, and the eastern end of the dune system at Ohope.

Consideration should be given to coordinating the next survey to be undertaken shortly following the flying and processing of digital aerial photographs.

8. SHINGLE BEACHES

Shingle beaches[1] are listed as an Endangered ecosystem in an assessment of Naturally Uncommon ecosystem of New Zealand in Holdaway (2014). Almost all shingle beaches in the Bay of Plenty region occur from Torere eastwards. It often a very gradual transition between sandy beaches and shingle beaches at some site (e.g. Torere, Hāwai, and Omaio) and a judgment call had to be made in the field to classify the beach as a dune system or as a shingle/gravel beach. The Bay of Plenty Regional Council may consider a similar study of shingle beaches would be useful in monitoring change of this vegetation and habitat type in the Bay of Plenty Region. It is recommended that a minimum beach size would be used to monitor gravel, as many very small beaches are present. A shingle beach of 500 metres or more in length could be the minimum size for monitoring.

9. ASSIGNMENT OF SAND DUNE SITES

A review of sand dunes sites would be useful. SDVC22 has 40 transects on it. It is recommended that it is divided into small units (for example) as per the units in the Coastal Plan.

10. FUTURE REMEASUREMENTS

Remeasurement of the vegetation mapping and sand dune monitoring transects in the Bay of Plenty should be undertaken every eight to ten years, and should ideally be timed to coincide with the availability of up-to-date aerial photographs. This will provide an understanding of changes in condition and extent of natural dune vegetation.

[1] Shingle beaches are comprised primarily of a mixture of sand, water-smoothed gravel (>50%, particles 2-64 mm), and cobbles. http://www.landcareresearch.co.nz/publications/factsheets/rare-ecosystems/coastal/shingle-beaches: Accessed 8 November 2017.

The current survey was conducted between March and June. Late March-early May is ideal timing for field work as the weather is generally relatively stable and cooler at this time. It is recommended that future fieldwork on sand dunes is carried out during this time frame to improve replicability and minimise the duration of time that fieldworkers are exposed to high temperatures and high levels of UV light.

ACKNOWLEDGMENTS

Shay Dean (Bay of Plenty Regional Council) instigated this project and provided logistical support. Lisa Bevan (Bay of Plenty Regional Council) assisted with fieldwork.

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VEGETATION AND HABITATS USED IN MAPPING SAND DUNES IN THE BAY OF PLENTY REGION BETWEEN 2008 AND 2017

Structural Class		Vegetation Class		Vegetation Types and Habitats	
01	Forest	01	Pine forest	01.01.01	Pine forest
		02	Banksia forest	01.02.01	Banksia forest
		03	Willow forest	01.03.01	Willow forest
				01.03.02	Crack willow forest
				01.03.03	Grey willow forest
		04	Indigenous forest	01.04.01	Indigenous forest
				01.04.02	Ti kōuka-Thornton kānuka forest
		05	Pōhutukawa forest	01.05.01	Pōhutukawa forest
		06	Silver poplar forest	01.06.01	Silver poplar forest
				01.06.02	Poplar forest[1]
		07	Mixed coastal broadleaved forest	01.07.01	Mixed coastal broadleaved forest (ngaio, akeake, taupata, māhoe, etc)
		08	Eucalyptus forest	01.08.01	Eucalyptus forest
				01.08.02	Eucalyptus-mixed indigenous forest
		09	Mixed indigenous-exotic forest	01.09.01	Mixed indigenous-exotic forest
		10	Brush wattle forest	01.10.01	Brush wattle forest
		11	Ti kōuka forest	01.11.01	Tī kōuka forest
02	Treeland	01	Pine treeland	02.01.01	Pine treeland
				02.01.02	Pine-mixed indigenous treeland
		02	Banksia treeland	02.02.01	Banksia treeland
		03	Eucalyptus treeland	02.03.01	Eucalyptus-mixed indigenous treeland
		04	Silver poplar treeland	02.04.01	Silver poplar treeland
		05	Mixed exotic treeland	02.05.01	Mixed exotic treeland
		06	Mixed indigenous treeland	02.06.01	Mixed indigenous treeland
		07	Pōhutukawa treeland	02.07.01	Pōhutukawa-dominant treeland
		08	Macrocarpa treeland	02.08.01	Macrocarpa-mixed indigenous treeland
		09	Willow treeland	02.09.01	Grey willow treeland
				02.09.02	Crack willow treeland
		10	*Kunzea toelkenii* treeland	2.10.01	*Kunzea toelkenii* treeland
		11	*Acacia sophorae* treeland	2.11.01	*Acacia sophorae* treeland
		12	Casuarina treeland	2.12.01	Casuarina treeland
		13	Tī kōuka treeland	2.13.01	Tī kōuka treeland
03	Vineland	01	Pōhuehue vineland	03.01.01	Pōhuehue[2]-*Ficinia nodosa* vineland
				03.01.02	Pōhuehue-bracken vineland
				03.01.03	Pōhuehue-marram vineland
				03.01.04	Pōhuehue-kikuyu vineland
				03.01.05	Pōhuehue-agapanthus vineland
				03.01.06	Lupin/pōhuehue vineland with exotic grasses and herbs, e.g. Sea couch, kikuyu, *Osteospermum fruticosum*
				03.01.07	Pōhuehue-dominant vineland
				03.01.08	Pōhuehue-panahi vineland
				03.01.09	African boxthorn/pōhuehue-dominant vineland
				03.01.10	Pōhuehue-exotic grasses vineland
				03.01.11	Pōhuehue-spinifex vineland
				03.01.12	Pōhuehue-South African iceplant vineland
				03.01.13	Pōhuehue-bracken-exotic grasses vineland
				03.01.14	Pōhuehue-garden escapes and broad weeds and exotic grasses mosaic vineland
				03.01.15	Pōhuehue-periwinkle vineland
				03.01.16	Pōhuehue-planted indigenous shrubs-harakeke-whariiriki-exotic grasses vineland[3]
		02	Cape ivy vineland	03.02.01	Cape ivy vineland
		03	Periwinkle vineland	03.03.01	Periwinkle vineland
		04	Japanese honeysuckle vineland	03.04.01	Japanese honeysuckle vineland

[1] Field survey undertaken in winter, may be species other than silver poplar.

[2] Pōhuehue in this table refers to vegetation dominated by *Muehlenbeckia complexa*. *Muehlenbeckia australis*, which is also known as pōhuehue is identified by species name where it is the dominant species.

[3] e.g. Harakeke, whaririki, and mixed coastal broadleaved species with some exotic grasses (e.g. cocksfoot, veldt grass, tall fescue), and scattered emergent African boxthorn.

Structural Class	Vegetation Class		Vegetation Types and Habitats	
			03.04.02	Japanese honeysuckle-exotic and indigenous shrubs vineland
			03.04.03	Japanese honeysuckle-broad mosaic of exotic grasses, pōhuehue, and other shrubs herbs, and grasses vineland.
	05	*Muehlenbeckia australis* vineland	03.05.01	*Muehlenbeckia australis* vineland
			03.05.02	*Muehlenbeckia australis*-inkweed vineland
			03.05.03	*Muehlenbeckia australis*-kikuyu vineland
	06	Moth plant vineland	03.06.01	Moth plant-dominant vineland
	07	Pink bindweed vineland	03.07.01	Pink bindweed-kikuyu vineland
	08	Cape honeysuckle vineland	03.08.01	Cape honeysuckle (*Tecomaria capensis*) vineland
04 Scrub	01	Mixed indigenous scrub	04.01.01	Ti kōuka-karamu scrub
			04.01.02	Ti kōuka-mamaku-karamu scrub
			04.01.03	Mixed indigenous scrub
			04.01.04	Mixed coastal broadleaved species scrub[1]
	02	Gorse scrub	04.02.01	Gorse-pōhuehue scrub
			04.02.02	Gorse-broom/pōhuehue scrub
			04.02.03	Gorse-pampas scrub
			04.02.04	Gorse-dominant scrub
			04.02.05	Gorse-African boxthorn scrub
			04.02.06	Gorse-lupin/spinifex scrub
	03	Coast tea tree scrub	04.03.01	Coast tea tree scrub
	04	Grey willow scrub	04.04.01	Grey willow scrub
			04.04.02	Grey willow-tutu scrub
	05	Blackberry scrub	04.05.01	Blackberry scrub
			04.05.02	Blackberry-exotic grasses scrub
	06	Lupin scrub	04.06.01	Lupin/saltwater paspalum scrub
			04.06.02	Lupin scrub
	07	Mānuka scrub	04.07.01	Mānuka-dominant scrub
	08	Poplar scrub	04.08.01	Silver poplar scrub
	09	*Coprosma repens* scrub	04.09.01	*Coprosma repens* scrub
	10	Tauhinu scrub	4.10.01	Tauhinu scrub
	11	*Rhaphiolepis umbellata* scrub	4.11.01	Sexton's bridge scrub
	12	*Acacia sophorae* scrub	4.12.01	*Acacia sophorae* scrub
	13	Brush wattle scrub	4.13.01	Brush wattle scrub
	14	*Kunzea toelkenii* scrub	4.14.01	*Kunzea toelkenii* scrub
	15	*Coprosma acerosa* scrub	4.15.01	*Coprosma acerosa* scrub
05 Shrubland	01	Mānuka shrubland	05.01.01	Mānuka-mixed indigenous shrubland
	02	Ti kouka-taupata shrubland	05.02.01	Ti kouka-taupata shrubland
	03	Lupin shrubland	05.03.01	Lupin/spinifex shrubland
			05.03.02	Lupin-dominant shrubland
			05.03.03	Lupin-marram shrubland
			05.03.04	Lupin-pōhuehue-exotic grasses shrubland
			05.03.05	Lupin/sand shrubland
			05.03.06	Lupin/exotic grasses shrubland
			05.03.07	Burnt *Kunzea toelkenii* shrubland, lupin and cocksfoot abundant[2]
	04	Gorse shrubland	05.04.01	Gorse/oioi-kikuyu shrubland
			05.04.02	Gorse/exotic grasses shrubland
			05.04.03	Gorse-pampas shrubland
			05.04.04	Gorse-mixed indigenous and exotic shrubs shrubland (broad mosaic)
	05	Coast tea tree shrubland	05.05.01	*Kunzea toelkenii* -pine shrubland
	06	African boxthorn shrubland	05.06.01	African boxthorn/pōhuehue shrubland
			05.06.02	African boxthorn/bracken shrubland
			05.06.03	African boxthorn-dominant shrubland
			05.06.04	African boxthorn-woolly nightshade shrubland
			05.06.05	*African boxthorn* exotic grasses-pōhuehue-bracken mosaic shrubland
	07	Grey willow shrubland	05.07.01	Grey willow shrubland
			05.07.02	Grey willow-mixed indigenous shrubland
	08	*Kunzea toelkenii* shrubland	05.08.01	*Kunzea toelkenii* shrubland
	09	Saltmarsh ribbonwood shrubland	05.09.01	Saltmarsh ribbonwood shrubland
	10	Kānuka shrubland	05.10.01	Kānuka-dominant shrubland
	11	Mixed indigenous shrubland	05.11.01	Mixed indigenous shrubland
	12	Blackberry shrubland	05.12.01	Blackberry shrubland
			05.12.02	Blackberry-pampas shrubland

[1] e.g. Ngaio, taupata, akeake, māhoe, kawakawa.

[2] In 2017 all *Kunzea toelkenii* was dead, with abundant lupin and cocksfoot.

Structural Class	Vegetation Class		Vegetation Types and Habitats	
			05.12.03	Blackberry-exotic grasses shrubland
	13	Mixed exotic shrubs shrubland	05.13.01	Mixed exotic shrubs/pōhuehue/exotic grasses shrubland
			05.13.02	Mixed exotic shrubs-indigenous shrubs (may include garden plants) shrubland
			05.13.03	Mixed exotic and indigenous trees and shrubs (too broad to map in other types)
	14	Coastal broadleaved species shrubland	05.14.01	Coastal broadleaved species shrubland (e.g. karo, ngaio, *Coprosma repens*)
			05.14.02	Planted mixed indigenous coastal broadleaved species shrubland
	15		05.15.01	Available for use
	16	Mangrove/sand shrubland	05.16.01	Mangrove/sand shrubland
	17	Marsh ribbonwood shrubland	05.17.01	Marsh ribbonwood shrubland
	18	*Helichrysum petiolare* shrubland	05.18.01	*Helichrysum petiolare* shrubland
06 Tussockland	01	Sea rush tussockland	06.01.01	Sea rush tussockland[1]
			06.01.02	Sea rush-saltwater paspalum tussockland
	02	Pampas tussockland	06.02.01	Pampas-mixed indigenous tussockland
			06.02.02	Pampas-*Ficinia nodosa* tussockland
			06.02.03	Pampas-gorse tussockland
			06.02.04	Pampas-grey willow tussockland
			06.02.05	Pampas-dominant tussockland
07 Fernland	01	Bracken fernland	07.01.01	Bracken-Pōhuehue fernland
			07.01.02	Bracken dominant fernland
			07.01.03	Bracken-kikuyu fernland
			07.01.04	Bracken-ripgut brome fernland (can use)
			07.01.05	Brush wattle/bracken fernland
			07.01.06	Bracken-pōhuehue-exotic grasses fernland
			07.01.07	Bracken-exotic grasses fernland
08 Grassland	01	Spinifex grassland	08.01.01	Spinifex-pingao/*Calystegia soldanella* grassland
			08.01.02	Spinifex/*Calystegia soldanella* grassland
			08.01.03	Spininfex-marram grassland
			08.01.04	Spinifex-dominant grassland
			08.01.05	Spinifex-sea rocket grassland
			08.01.06	Spinifex-pingao grassland
			08.01.07	Lupin/spinifex grassland
			08.01.08	Spinifex-*Carex pumila* grassland
			08.01.09	Gorse/spinifex grassland
	02	Marram grassland	08.02.01	Marram grassland
			08.02.02	Marram-*Ficinia nodosa* grassland
			08.02.03	Marram-sea couch grassland
			08.02.04	Marram-pōhuehue-exotic grasses grassland
	03	Buffalo grass grassland	08.03.01	Buffalo grass-pōhuehue grassland
			08.03.02	Buffalo grass-kikuyu-sea couch grassland
			08.03.03	Buffalo grass grassland
	04	Kikuyu grassland	08.04.01	Kikuyu-pōhuehue grassland
			08.04.02	Kikuyu-blackberry grassland
			08.04.03	Kikuyu grassland
			08.04.04	Exotic shrubs/kikuyu grassland
			08.04.05	Kikuyu-cocksfoot grassland
			08.04.06	Kikuyu-sea couch grassland
			08.04.07	African boxthorn/kikuyu grassland
			08.04.08	(Indigenous trees and shrubs)/kikuyu grassland
	05	Cocksfoot grassland	08.05.01	Cocksfoot grassland
			08.05.02	Cocksfoot-dominant grassland
			08.05.03	Cocksfoot-pōhuehue-other exotic grassland
			08.05.04	Cocksfoot-exotic grasses-pōhuehue grassland
	06	Knot-root bristle-grass grassland	08.06.01	Knot-root bristle-grass grassland
	07	Tall fescue grassland	08.07.01	Tall fescue-pōhuehue grassland
			08.07.02	Tall fescue-kikuyu grassland
			08.07.03	Tall fescue or cocksfoot/pōhuehue grassland
			08.07.04	Tall fescue-cocksfoot grassland
	08	Sea couch grassland	08.08.01	Sea couch dominant grassland
			08.08.02	Sea couch-pōhuehue grassland
			08.08.03	Sea couch-kikuyu grassland
			08.08.04	Sea couch-spinifex grassland
			08.08.05	Sea couch-bracken grassland
			08.08.06	African boxthorn/sea couch grassland

[1] Note at next survey 10.03.01 should be mapped as this type (10.03.01 and 06.01.01 are essentially the same/very similar vegetation types).

Structural Class	Vegetation Class	Vegetation Types and Habitats
		08.08.07 Sea couch-*Carex pumila* grassland
		08.08.08 Sea couch-cocksfoot grassland
		08.08.09 Sea couch-mixed mosaic vegetation grassland
	09 Reed sweet grass grassland	08.09.01 Reed sweet grass grassland
		08.09.02 Grey willow/reed sweet grass grassland
	10 Indian doab grassland	08.10.01 Indian doab grassland
		08.10.02 Indian doab-saltwater paspalum grassland
		08.10.03 Indian doab-sea couch grassland
		08.10.04 Indian doab-pōhuehue grassland
		08.10.05 Indian doab-ripgut brome grassland
		08.10.06 Indian doab-buffalo grass grassland
		08.10.07 Indian doab-*Carex pumila*/sand grassland
	11 Saltwater paspalum grassland	08.11.01 Saltwater paspalum grassland
		08.11.02 Saltwater paspalum *Carex pumila* grassland
		08.11.03 Saltwater paspalum-*Ficinia nodosa* grassland
	12 Smooth brome grassland	08.12.01 Smooth brome grassland
	13 Ratstail grassland	08.13.01 Ratstail-dominant grassland
	14 Harestail grassland	08.14.01 Harestail-sea couch grassland
		08.14.02 Harestail-kikuyu grassland
	15 Ripgut brome	08.15.01 Ripgut brome-dominant grassland
	16 Mixed exotic grass-exotic herb grassland	08.16.01 Mixed exotic grass-exotic herb grassland
		08.16.02 Exotic grasses-exotic herbs-pōhuehue grassland
	17 Paspalum grassland	08.17.01 Paspalum grassland
	18 Veldt grass grassland	08.18.01 Veldt grass grassland
09 Sedgeland	01 Pingao sedgeland	09.01.01 Pingao sedgeland
		09.01.02 Pingao-spinifex sedgeland
	02 *Carex testacea* sedgeland	09.02.01 *Carex testacea*-pōhuehue-*Ficinia nodosa* sedgeland
		09.02.02 *Carex testacea* (planted) sedgeland
	03 *Ficinia nodosa* sedgeland	09.03.01 *Ficinia nodosa*-pōhuehue sedgeland
		09.03.02 *Ficinia nodosa*-pōhuehue-eoxtic grasses sedgeland
		09.03.03 Gorse/*Ficinia nodosa* sedgeland
		09.03.04 *Ficinia nodosa*-exotic grasses mosaic (sometimes other wetland species) sedgeland
		09.03.05 *Ficinia nodosa*-dominant sedgeland
	04 *Machaerina juncea* sedgeland	09.04.01 *Machaerina juncea* sedgeland
		09.04.02 *Machaerina juncea-Apodasmia similis* sedgeland
	05 Giant umbrella sedge sedgeland	09.05.01 Giant umbrella-dominant sedgeland
	06 *Carex pumila* sedgeland	09.06.01 *Carex pumila*-dominant sedgeland
		09.06.02 *Carex pumila*-mixed exotic grasses-*Carex solandri* sedgeland
	07 *Machaerina articulata* sedgeland	09.07.01 *Machaerina articulata*-saltwater paspalum sedgeland
		09.07.02 *Machaerina articulata*-dominant sedgeland
		09.07.03 *Machaerina articulata*-marsh ribbonwood-*Bolboschoenus fluviatilis* sedgeland
	08 *Carex geminata* sedgeland	09.08.01 *Carex geminata*-dominant sedgeland
	09 Marsh clubrush sedgeland	09.09.01 Marsh clubrush sedgeland
	10 *Machaerina rubiginosa* sedgeland	09.10.01 *Machaerina rubiginosa* sedgeland
	11 *Isolepis prolifer* sedgeland	09.11.01 *Isolepis prolifer* sedgeland
	12 Mixed sedgeland	09.12.01 Mixed sedgeland[1]
10 Rushland	01 Oioi rushland	10.01.01 Oioi rushland
		10.01.02 Oioi-wiwi rushland
		10.01.03 Kānuka/oioi rushland
		10.01.04 Saltmarsh ribbonwood/oioi rushland
		10.01.05 Oioi-*Machaerina juncea* rushland
		10.01.06 Raupo-pampas reedland
	02 Wiwi rushland	10.02.01 Wiwi rushland
	03 Sea rush rushland	10.03.01 Sea rush rushland
11 Reedland	01 Raupo reedland	11.01.01 Raupo reedland
		11.01.02 Raupō-harakeke reedland
		11.01.03 Raupō/reed sweet grass reedland
		11.01.04 Raupō/marsh clubrush reedland
		11.01.05 Grey willow/raupō reedland
	02 *Schoenoplectus tabernaemontani-Machaerina articulata* reedland	11.02.01 *Schoenoplectus tabernaemontani- Machaerina articulata* reedland
	03 Mixed reedland	11.03.01 Mixed reedland

[1] e.g. *Carex geminata*, *Carex secta*, often with occasional raupō, NZ flax and ti kōuka present.

Structural Class	Vegetation Class	Vegetation Types and Habitats
13 Herbfield	01 South African iceplant herbfield	13.01.01 South African iceplant herbfield 13.01.02 *Carpobrotus edulis*-exotic grasses and herbs often with some *Muehlenbeckia complexa*
	02 Gazania herbfield	13.02.01 *Gazania linearis-Arctotis*-South African iceplant herbfield 13.02.02 *Gazania linearis*-dominant herbfield
	03 Flatweed herbfield	13.03.01 Flatweed herbfield 13.03.02 Flatweed-pōhuehue herbfield
	04 Mixed exotic herbfield	13.04.01 Mixed exotics herbfield
	05 *Asparagus densiflorus* herbfield	13.05.01 *Ficinia nodosa*/*Asparagus densiflorus-Gazania linearis*-pōhuehue herbfield 13.05.02 *Asparagus densiflorus*-buffalo grass herbfield
	06 Agapanthus herbfield	13.06.01 *Agapanthus praecox-Gazania linearis*-South African iceplant herbfield 13.06.02 *Agapanthus praecox* herbfield
	07 Canna lily herbfield	13.07.01 Canna lily herbfield
	08 *Rorripa palustris* herbfield	13.08.01 *Rorippa palustris* herbfield
	09 *Aster subulatus* herbfield	13.09.01 *Aster subulatus* herbfield
	10 Panahi herbfield	13.10.01 Panahi-*Carex pumila* herbfield 13.10.02 *Calystegia soldanella* mixed exotic grasses and exotic herbs herbfield 13.10.03 Panahi-*Muehlenbeckia australis*/sand herbfield
	11 Inkweed herbfield	13.11.01 Inkweed-Indian doab herbfield 13.11.02 Inkweed-bracken-*Muehlenbeckia australis* herbfield 13.11.03 Inweed herbfield
	12 *Osteospermum fruticosum* herbfield	13.12.01 *Osteospermum fruticosum* herbfield
	13 *Persicaria decipiens* herbfield	13.13.01 *Persicaria decipiens* herbfield
	14 *Selliera radicans* herbfield	13.14.01 *Selliera radicans* herbfield, often with arrow grass
	15 *Arctotis stoechadifolia* herbfield	13.15.01 *Arctotis stoechadifolia* herbfield
	16 *Tropaeolum majus* herbfield	13.16.01 *Tropaeolum majus* herbfield
16 Rockland	01 Rocky beach rockland	16.01.01 Rocky beach rockland
18 Stonefield/ gravelfield	01 Gravelfield	18.01.01 Gravelfield 18.01.02 Panahi-sea rocket/gravel gravelfield 18.01.03 Scattered sedges, other herbs and grasses/gravel gravelfield
19 Sandfield	01 Sandfield	19.01.01 Spinifex-dominant sandfield 19.01.02 Pingao-spinifex sandfield 19.01.03 *Carex pumila*-dominant sandfield 19.01.04 *Ficinia nodosa*-panahi sandfield 19.01.05 Sea rocket sandfield 19.01.06 *Carpodrotus edulis* sandfield 19.01.07 Panahi sandfield 19.01.08 Beach sand sandfield 19.01.09 Sea rocket-spinifex sandfield 19.01.10 Sand-stone-debris sandfield 19.01.11 Panahi-*Carex pumila* sandfield 19.01.12 Sea rocket-kikuyu sandfield 19.01.13 Sand-driftwood debris sandfield 19.01.14 Sea couch-panihi sandfield 19.01.15 Panahi-inkweed-wiwi sandfield 19.01.16 Marram sandfield 19.01.17 Broad mosaic, including lupin, spinifex, sea couch, sea rocket, other exotic shrubs, herbs, grasses/sand sandfield (foredune) 19.01.18 (Mixed exotic grasses)-(herbs)/sand sandfield - recent river disturbance 19.01.19 Sand-gravel sandfield
21 Flaxland	01 Harakeke flaxland	21.01.01 Harakeke flaxland 21.01.02 Harakeke/mixed sedges-mixed rushes-marsh ribbonwood flaxland
22 Open water	01 Open water	22.01.01 Open freshwater 22.01.02 Impounded open water 22.01.03 Open saltwater
23 Bare ground	01 Bare ground	23.01.01 Exotic grass-*Muehlenbeckia complexa* bare ground
	02 Rock wall	23.02.01 Rock wall

APPENDIX 2

COMMON NAMES USED IN APPENDIX 1

Common Name	Scientific Name
Agapanthus	*Agapanthus praecox*
Akeake	*Dodonaea viscosa*
Banksia and other banksia species	*Banksia integrifolia*
Blackberry	*Rubus* sp. (*R. fruticosus* agg.)
Boxthorn	*Lycium ferocissimum*
Broom	*Cytisus scoparius*
Brush wattle	*Paraserianthes lophantha*
Buffalo grass	*Stenotaphrum secundatum*
Canna lily, Indian shoot	*Canna indica*
Cape honeysuckle	*Tecomaria capensis*
Cape ivy	*Senecio angulatus*
Coast tea tree	*Leptospermum laevigatum*
Coastal wattle	*Acacia sophorae*
Cocksfoot	*Dactylis glomerata*
Crack willow	*Salix ×fragilis*
Eucalyptus	*Eucalyptus* sp.
Garden nasturtium	*Tropaeolum majus*
Gazania	*Gazania linearis*
Giant umbrella sedge, toetoe, upoko-tangata	*Cyperus ustulatus* f. *ustulatus*
Gorse	*Ulex europaeus*
Grey willow	*Salix cinerea*
Harakeke, flax	*Phormium tenax*
Harestail	*Lagurus ovatus*
Indian doab	*Cynodon dactylon*
Inkweed	*Phytolacca octandra*
Japanese honeysuckle	*Lonicera japonica*
Kāpūngāwhā	*Schoenoplectus tabernaemontani*
Karamū, kāramuramu	*Coprosma robusta*
Karo	*Pittosporum crassifolium*
Kikuyu grass	*Cenchrus clandestinus*
Knot-root bristle grass	*Setaria gracilis*
Kōwhangatara, spinifex	*Spinifex sericeus*
Lupin	*Lupinus arboreus*
Macrocarpa	*Cupressus macrocarpa*
Māhoe	*Melicytus ramiflorus* subsp. *ramiflorus*
Mānawa, mangrove	*Avicennia marina* subsp. *australasica*
Mānuka	*Leptospermum scoparium* agg.
Marram	*Ammophila arenaria*
Marsh clubrush, pūrua grass, kukuraho	*Bolboschoenus fluviatilis*
Marsh ribbonwood mākaka	*Plagianthus divaricatus*
Moth plant	*Araujia hortorum*
Ngaio	*Myoporum laetum*
Oioi	*Apodasmia similis*
Palm grass	*Setaria palmifolia*
Pampas	*Cortaderia selloana*
Panahi, shore bindweed	*Calystegia soldanella*
Paspalum	*Paspalum dilatatum*
Periwinkle	*Vinca major*
Pīngao	*Ficinia spiralis*
Pōhue	*Calystegia sepium* subsp. *roseata*

Common Name	Scientific Name
Pōhuehue[1]	*Muehlenbeckia complexa*
Pōhutukawa	*Metrosideros excelsa*
Poplar	*Populus* sp.
Radiata pine and other pine sp.	*Pinus* sp.
Rain daisy, dimorphotheca	*Osteospermum fruticosum*
Rārahu, bracken	*Pteridium esculentum*
Ratstail	*Sporobolus africanus*
Raupō	*Typha orientalis*
Rautahi	*Carex geminata* agg.
Ripgut brome	*Bromus diandrus*
Saltwater paspalum	*Paspalum vaginatum*
Sand coprosma, tarakupenga, tātaraheke	*Coprosma acerosa* s.s
Sea aster	*Aster subulatus*
Sea couch	*Elytrigia pycnantha*
Sea rocket	*Cakile maritima* subsp*. maritima*
Sea rush, wi, wīwī	*Juncus kraussii* var. *australiensis*
Sexton's bridge	*Rhaphiolepis umbellata*
Sheoak	*Casuarina* sp.
Silver poplar	*Populus alba* 'Nivea'
Smooth brome[2]	*Bromus inermis*
South African ice plant	*Carpobrotus edulis*
Tall fescue	*Schedonorus arundinaceus*
Tauhinu	*Ozothamnus leptophyllus*
Taupata	*Coprosma repens*
Thornton kānuka	*Kunzea toelkenii*
Tī kōuka, cabbage tree	*Cordyline australis*
Tutu	*Coriaria arborea* var. *arborea*
Veldt grass	*Ehrharta erecta*
Whaririki, mountain flax	*Phormium cookianum* subsp. *hookeri*
Willow sp.	*Salix* sp.
Wīwī	*Ficinia nodosa*
Woolly nightshade	*Solanum mauritianum*

[1] *Muehlenbeckia australis* is also often referred to as pōhuehue, but in this report pōhuehue refers to *Muehlenbeckia complexa*.

[2] Not seen in 2017.

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