

Plants of Watercare Coastal Walkway and Manukau Coastal and Foreshore Restoration Areas, Mangere, Auckland

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Introduction

The Watercare Coastal Walkway (Fig. 1) by the Manukau Harbour, which links Ambury Park and Otuataua Stonefields in Mangere, south Auckland, was opened on 12 March 2005, after considerable landscaping work and native tree planting designed by Boffa Miskell Ltd (Cameron, Hayward & Murdoch 2008, p. 235; Collins & Moyle 2016). It extends 7 km and can be entered from Ambury Park, Wallace Road (path to Mangere Lagoon), Creamery Road carpark, Mark Ford Drive carpark, Oruarangi Stream carpark, Otuataua Stonefields, and the carpark on Puketutu Island at the end of Island Road (causeway). Accounts of the botany of neighbouring Otuataua Stonefields (Preston Jones 2001), Ambury Park (Wilcox 2004), Mangere Mountain (Wilcox & Maddison 2005), and Puketutu Island (Wilcox 2008) have been published by the Auckland Botanical Society.

We have found 543 species of plants on Watercare land at Mangere over the 15 years of our investigations. This includes natives (205) and exotics (338), both natural and planted (Table 1).

Artificial native forest thickets

A major part of the revegetation work involved the planting of approx. 270,000 native trees on land reclaimed by deposition of organic matter-rich and nutrient-rich, peat-like sludge following the decommissioning of oxidation ponds, including the fringe of Mangere Lagoon of volcanic origin (Wilcox & Gardner 2001; Hayward, Murdoch & Maitland 2011; Watercare 2018). Some 3.5 million cubic metres of sludge were removed from old ponds and

redeposited on adjoining land which was planted up with native trees from 1999 to 2004 over an area of approx. 35 ha.

Three native tree species make up the dominant component of the thickets: taupata (*Coprosma repens*), ngaio (*Myoporum laetum*) and karo (*Pittosporum crassifolium*) (Plate 1A). These have grown strongly, have formed a very dense canopy 6–8 m in height, and are mostly healthy and



Fig. 1. Watercare Coastal Walkway Map. Modified by Joshua Salter.

Table 1. Species numbers in all plant and fungal groups recorded on Watercare land, Mangere

Fungi	7	Mosses	22	Dicot trees & shrubs	98
Algae	28	Ferns	10	Dicot herbs	207
Lichens	21	Conifers	10		
Liverworts	8	Monocots	132	TOTAL SPECIES	543

vigorous (Fig. 2), though many of the trees are multi-stemmed. Planting was with containerised (polybags) nursery seedlings (reputedly eco-sourced), and planting espacement was approx. 1.20 m × 1.20 m, giving a tree density of 7000 stems/ha. The idea behind having such dense plantings was to prevent weed growth (Watercare 2010).

The steep tuffaceous slopes on the northern and eastern edges of the Mangere Lagoon have some older native trees: karaka (*Corynocarpus laevigatus*), taupata, ngaio, mahoe (*Melicytus ramiflorus*), puriri (*Vitex lucens*) – mostly from plantings made in the 1990s and now 10 m tall, but some of the biggest karaka could be much older. These shady slopes support in a few places a sparse flora of hardy terrestrial ferns: *Adiantum hispidulum*, *Doodia australis*, *Polystichum neozelandicum* subsp. *neozelandicum*, and *Pteris tremula*, and also *Adiantum diaphanum*, and plentiful weeds such as onion weed (*Allium triquetrum*), smilax (*Asparagus asparagoides*), cleavers (*Galium aparine*), small herb Robert (*Geranium purpureum*), veldt grass (*Ehrharta erecta*), cineraria (*Pericallis ×hybrida*, Madeira vine (*Anredera cordifolia*) (Fig. 3), and a few patches of tuber ladder fern (*Nephrolepis cordifolia*). Cineraria is a spectacular sight in October when it is at its peak flowering (Plate 1B).

Additional tree species found in the thickets are titoki (*Alectryon excelsum*), Three Kings karamu (*Coprosma macrocarpa* subsp. *macrocarpa*), karamu (*Coprosma robusta*), hybrid karamu (*Coprosma macrocarpa* subsp. *minor* × *C. robusta*), cabbage tree (*Cordyline australis*), karaka, whau (*Entelea arborescens*), kanuka (*Kunzea robusta*), manuka (*Leptospermum scoparium*), mahoe, pohutukawa (*Metrosideros excelsa*), Kermadec pohutukawa (*M. kermadecensis*), coastal shrub daisy (*Olearia solandri*), *Olearia albida* and *O. angulata*, and occasionally, totara *Podocarpus totara*, rewarewa (*Knightia excelsa*), wharangi (*Melicope ternata*), and puriri. The thickets alongside the walkway from Oruarangi Road carpark towards Mark Ford Drive (which links Ascot Road with Island Road) feature concentrated plantings of manuka, while westwards from the Oruarangi Road carpark (between private land near Otuataua Stonefields and the sea) there are extensive thickets of planted cabbage trees, notable for the presence of a thriving population of the native hybrid bindweed *Calystegia sepium* subsp. *roseata* × *C. soldanella*.

The thickets are mostly dense and dark, and bare underneath (Fig. 4) except for a few patches of the fern *Pteris tremula*. On the margins or where the canopy has been broken, some exotic weeds have become firmly established, notably moth plant (*Araujia hortorum*) (Fig. 5), woolly nightshade (*Solanum mauritianum*) and tree privet (*Ligustrum lucidum*). The open verges of the thickets have a



Fig. 2. Watercare track to bird hide by Ambury Park, 13 Mar 2018 (all photos by Mike Wilcox unless otherwise indicated).



Fig. 3. *Anredera cordifolia*, Watercare Coastal Walkway, from Wallace Rd, 7 Apr 2018.



Fig. 4. Native thicket near Ambury, 28 Mar 2018.



Fig. 5. Moth plant, slopes of the Mangere Lagoon, 17 May 2018.

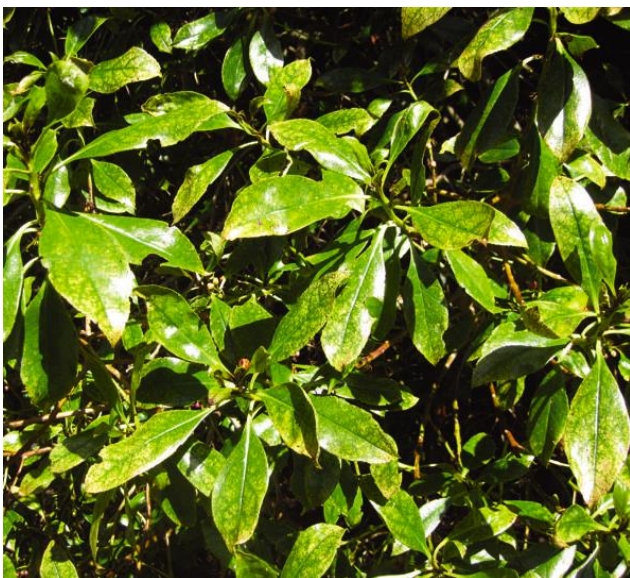


Fig. 6. Ngaio leaves infected with the ngaio mirid, Watercare land, 25 Jan 2019.

seasonal plant cover comprising an assemblage of mostly exotic herbs of fertile soils, the commonest being inkweed (*Phytolacca octandra*), hemlock (*Conium maculatum*), purslane (*Portulaca oleracea*), black nightshade (*Solanum nigrum*), small-flowered nightshade (*Solanum americanum*), green-berry nightshade (*Solanum opacum*), nettle-leaved fat-hen (*Chenopodium murale*), cut-leaf cranesbill (*Geranium dissectum*), creeping mallow (*Modiola caroliniana*), dwarf mallow (*Malva neglecta*), French mallow (*Malva nicaeensis*), Cretan mallow (*Malva pseudolavatera*), annual nettle (*Urtica urens*) and scrambling speedwell (*Veronica persica*). *Crassula decumbens* appears in winter on walkway margins. There is a plethora of tall exotic herbs in November and December bordering and amongst the native thickets between Mark Ford Drive and Greenwood Road, the dominants being stinking mayweed (*Anthemis cotula*), hemlock, ox tongue (*Helminthotheca echioides*), hawksbeard (*Crepis*

capillaris), wild carrot (*Daucus carota*), tall willow herb (*Epilobium ciliatum*), hairy buttercup (*Ranunculus sardous*) and Australian fireweed (*Senecio bipinnatisectus*). The grasses phalaris (*Phalaris aquatica*) and wind grass (*Lachnagrostis filiformis*) are also found here. Thickets on Puketutu Island alongside the perimeter service road heading south-west have a similar composition, but are more open, with kikuyu grass covering the ground and with some seedling regeneration of karo and wildings of phoenix palm (*Phoenix canariensis*) and bangalow palm (*Archontophoenix cunninghamiana*).

The question arises as to what is the longer-term future of these artificial thickets? What will they turn into? What is their life-span? It is significant that pohutukawa has not done well, with few trees now present, most having been suppressed by the competition. Karo, ngaio and taupata are not generally regarded as very long-lived trees, and there is little sign of regeneration of these or of colonization by other trees. At nearby Otutaua Stonefields the remnant 'rock forest' comprises tall trees of karaka, titoki, ngaio, and mahoe, along with whau, akeake (*Dodonaea viscosa*), puriri, coastal karamu (*Coprosma macrocarpa* subsp. *minor*), kawakawa (*Piper excelsum*), and pigeonwood (*Hedycarya arborea*). Thus, titoki, karaka and mahoe offer some prospect of growing into largish trees at Watercare, and together with puriri, could eventually form a tall coastal forest, once the thickets start thinning out. The desired understorey would comprise kawakawa, pigeonwood and coastal karamu, but the thickets are still too dense and dark, and infested with rabbits, to permit seedlings to become established and thrive.

Pohutukawa, ngaio and karo here each suffer some foliage attack from insects. Pohutukawa is attacked by the pohutukawa leaf miner (*Neomycta rubida*). Adults of this weevil create conspicuous holes in the leaves, while the larvae feed by tunneling (Martin 2010a, rev. 2017). Kermadec pohutukawa seems particularly susceptible. The main insect pest on ngaio is the ngaio mirid (*Chinamiris aurantiacus*), which is a sap-sucking bug. Adults and nymphs feed on the leaves, causing yellowish blotching (Martin 2015). In January 2019 ngaio trees throughout the Watercare estate were heavily attacked (Fig. 6), The main foliage pest of karo is the pittosporum psyllid (*Trioza vitroradiata*) which causes yellow areas and dimples to form on the leaves (Martin 2010b, rev. 2017). It must be said, though, that karo has been a consistently successful tree in the Watercare coastal environment, standing up well to strong, salt-laden winds.

There are younger native thickets of greater biodiversity planted alongside a new walkway between Greenwood Road and Mark Ford Drive (Fig. 7). Mark Ford Drive connects Ascot Road with Island

Road and was completed towards the end of 2016. There is no ngaio or pohutukawa here, and *Coprosma* has been only very sparsely deployed (*C. robusta*, *C. lucida*, *C. repens*). Prominent species are karo (some *Pittosporum eugenoides* and *P. tenuifolium* have also been planted), mahoe, kanuka, karaka, manuka, cabbage tree, puka (*Griselinia lucida*), wineberry (*Aristotelia serrata*), lacebark (*Hoheria populnea*, and some *H. sexstylosa*), mapou (*Myrsine australis*), Hamilton's kumaraho (*Pomaderris hamiltonii*), koromiko (*Veronica stricta* var. *stricta* and *V. stricta* var. *egmontiana*) – the latter distinguished by its more compact habit and short internodes – houpara (*Pseudopanax lessonii*), kawakawa (*Piper excelsum*), hangehange (*Geniostoma ligustrifolia*), kowhai (*Sophora microphylla*), toetoe (*Austroderia fulvida*) and the sedge *Carex lambertiana*. Plume grass (*Dichelachne crinita*) has colonized. There has been a generally high survival rate, and the thickets are mostly very dense. These plantings were carried out by HEB Construction in conjunction with the building of Watercare's new BNR (Biological Nutrient Removal) facility.



Fig. 7. A young native thicket, walkway from Greenwood Rd to Mark Ford, 8 Apr 2018.



Fig. 8. *Casuarina glauca*, naturalised, Watercare Coastal Walkway, Oruarangi Stream mouth, 28 Feb 2018.

The odour buffer zone (Greenwood Road Park) features numerous blocks of native thickets, with the older ones dominated by manuka, karamu and cabbage tree. Flax (*Phormium tenax*) has been abundantly planted on the thicket margins, with some *Phormium cookianum* planted as well. More recent plantings (2016/2017), which have been fenced off and mulched with wood chips, are of similar composition to the thickets between Greenwood Road and Mark Ford Drive and include kanuka. An additional feature of Greenwood Road Park is totara which was planted many years ago in rows near Greenwood Road, probably as shelter for houses that used to be there. Wind grass is abundant on the open margins of the thickets adjoining the grassed areas. There is a small wetland adjoining Greenwood Road which has a prominent patch of yellow flag (*Iris pseudacorus*), and a colony of stinking iris (*Iris foetidissima*) has become established in the shade of a willow tree by one of the drains.

Exotic trees

Although exotic trees were not used in the afforestation of the sludge lands, there are a number in various parts of the Watercare area. The walkway from Wallace Road and westward around the lagoon has plantings of Monterey pine (*Pinus radiata*), and a few Monterey cypress trees or macrocarpas (*Cupressus macrocarpa*), Lawsons cypress (*Chamaecyparis lawsoniana*) and bangalay (*Eucalyptus botryoides*). There are also several large macrocarpa trees along the lagoon circuit from the Creamery Road carpark, and Monterey pines westwards from Oruarangi Stream. Common alder (*Alnus glutinosa*) has been planted in a few places fringing ponds or major ditches. Watercare land on the eastern side of Puketutu Island adjoining the intertidal storage basin features some narrow strip plantings of Mexican alder (*Alnus acuminata*), blackbutt (*Eucalyptus pilularis*), and yellow stringybark (*Eucalyptus muelleriana*), together with native thickets and interspersed with mown grass. These plantings were designed to screen out midges (Garton & Bickers 2016). Sydney blue gum (*Eucalyptus saligna*) is present on the south-western side of the island, on Watercare land. At the mouth of Oruarangi Stream there is a swamp gum (*Eucalyptus ovata*) and numerous swamp she-oaks (*Casuarina glauca*), including some that have naturalised (Fig. 8), and the carpark off Mark Ford Drive has an impressive grove of river she-oak (*Casuarina cunninghamiana*) also naturalising, with a stand of tall hybrid willows (*Salix matsudana* × *S. alba*) and Monterey pines across the road. Australian ngaio or boobialla (*Myoporum insulare*) is occasionally seen in some of the thickets.

Greenwood Road Park has several well-grown exotic trees that date back to the days when there

were some staff houses on the site. There are two fine specimens of Moreton Bay fig (*Ficus macrophylla*), a 20 m-tall swamp cypress (*Taxodium distichum*), a splendid specimen of Illawarra flame tree (*Brachychiton acerifolius*), a row of Holm oak (*Quercus ilex*) adjoining Greenwood Road, two specimens of pedunculate oak (*Quercus robur*), numerous hybrid poplars (*Populus ×canadensis*) along Greenwood Road, a few crack willow (*Salix ×fragilis*), and a single river sheoak (*Casuarina cunninghamiana*) and a phoenix palm (*Phoenix canariensis*). A small holly (*Ilex aquifolium*) grows beneath one of the Moreton Bay fig trees.

The Watercare Treatment Plant headquarters and 'plant' area feature landscaping with maturing trees. As well as native species – kauri (*Agathis australis*), pohutukawa (including several of the yellow-flowered cultivar – see McCarroll 2019), puriri, broadleaf (*Griselinia littoralis*) – there are several well-grown specimens of exotic trees, namely Norfolk Island pine (*Araucaria heterophylla*), *Juniperus chinensis* 'Kaizuka', sweet gum (*Liquidambar styraciflua*), pin oak (*Quercus palustris*), Turkey oak (*Quercus cerris*) – a very fine specimen, claret ash (*Fraxinus angustifolia* subsp. *oxycarpa* 'Raywood'), weeping bottlebrush (*Callistemon viminalis*), willow myrtle (*Agonis flexuosa*), and Norfolk Island hibiscus (*Lagunaria patersonii*). Gardens in the parking area have borders of *Libertia peregrinans*, *Corokia ×cheesemanii*, a dwarf *Agapanthus* cultivar, and day lily (*Hemerocallis lilioasphodelus*).

Weed trees or shrubs found on Watercare land are Sydney golden wattle (*Acacia longifolia*), barberry (*Berberis glaucocarpa*), boneseed (*Chrysanthemoides monilifera*), Madeira broom (*Genista stenopetala*) (Plate 1C), lantana (*Lantana camara*), boxthorn (*Lycium ferocissimum*) (Plate 1D), brush wattle (*Paraserianthes lophantha*), tree privet, Chinese privet (*Ligustrum sinense*), loquat (*Eriobotrya japonica*), tamarillo (*Cyphomandra betacea*), cape gooseberry (*Physalis peruviana*), blackberry (*Rubus fruticosus*), grey willow (*Salix cinerea*), woolly nightshade and gorse (*Ulex europaeus*). Grape vine (*Vitis vinifera*) has colonized the causeway wetland. Madeira vine (Fig. 3), and moth plant (Fig. 5) are conspicuous climbers, being most prevalent in the native copses on the northern side of Mangere Lagoon. Woolly nightshade is the most prevalent weed tree.

Open meadows

There is one extensive sown meadow (Fig. 9) and several other narrow grassy areas on sludge that were not planted up with trees. These are covered with a mixture of grasses and herbaceous weeds. In summer the principal grasses are paspalum (*Paspalum dilatatum*), Indian doab (*Cynodon dactylon*), and kikuyu (*Cenchrus clandestinum*), with annual ryegrass (*Lolium rigidum*) in drier places.



Fig. 9. Meadow, Watercare land, 20 Mar 2018.



Fig. 10. *Carex divisa*, Oruarangi walkway, 21 Sep 2018.

Prairie grass (*Bromus catharticus*), cocksfoot (*Dactylis glomerata*) and tall oat grass (*Arrhenatherum elatius*) are common throughout the year. Ripgut brome (*Bromus diandrus*) and meadow grass (*Poa trivialis*) are abundant spring grasses. Large-flowered mallow (*Malva sylvestris*) (Plate 1E), and French mallow are the dominant herbs in large patches, growing to 0.5 m tall (but usually much shorter here because of the regular mowing). Small-flowered mallow (*Malva parviflora*) is also present. Other common herbs are curled dock (*Rumex crispus*), broadleaved dock (*Rumex obtusifolius*), hemlock, creeping mallow, annual nettle (*Urtica urens*), redroot (*Amaranthus powellii*), scrambling speedwell, chicory (*Cichorium intybus*), and chickweed (*Stellaria media*). Hairy buttercup becomes very prominent in spring. An area with shallow soil over gravel supports a population of Argentine cress (*Lepidium bonariense*).

Newly-sown meadows in the Greenwood Road Park are primarily ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*). Paspalum is ubiquitous, and path-side weeds include redroot, small-leaved wireweed (*Polygonum arenastrum*), creeping mallow, and abundant dwarf mallow.



Fig. 11. Watercare sludge restoration, Pond 2, 4 April 2005.

Natural meadows westwards from Oruarangi Stream carpark feature very extensive masses of the salt marsh carex, *Carex divisa*, growing in spectacular expanses on flat, damp sites (Fig. 10). Kikuyu grass is also abundant, but favours somewhat more elevated sites. Other abundant grasses here are tall oat grass (*Arrhenatherum elatius*), tall fescue (*Lolium arundinaceum*), prairie grass, soft brome (*Bromus hordeaceus*), rough meadow grass, Yorkshire fog (*Holcus lanatus*), and cocksfoot.

Pond 2

There is a 44-ha reclaimed area south of the causeway that was formed from 1998 to 2010 (Fig. 11) by depositing lime-stabilised de-watered biosolids (Watercare, no date). It was formerly a seabed that contained oxidation pond sludge and is known as Pond 2. Pond 2 is divided into a series of cells, where biosolids were placed in layers of approximately 600 to 800 millimetres deep. The pond is lined with a high-density polyethylene liner, an environmental protection measure designed to contain leachate. A network of perforated PVC pipes within the heart of Pond 2 intercepts leachates and conveys it back to the treatment plant. Watercare continually monitors the aquifer via groundwater bores surrounding Pond 2. At the end of each placement day, a layer of dried aged oxidation pond sludge was used to cover the biosolids to control odour. It has become vegetated by natural colonization, sowing of grass and planting. It is a hazardous site, with still-active release of methane gas from anaerobic digestion *in situ*, and is closed to the public.

Much of it has been grassed (Fig. 12), but typical native plantings have been carried out, with flax and cabbage tree being particularly favoured. Pampas grass is a prominent invader. The edge of the road which encircles Pond 2, and which adjoins the treated effluent channel, has been landscaped with a mixture of prostrate native plants, mainly: *Coprosma × kirkii* and *Muehlenbeckia complexa*. The edges of



Fig. 12. Pond 2, grassed, 12 May 2018.

other parts of the road in summer have spectacular growth of *Echinochloa crus-galli* together with *Anthemis cotula*, *Malva sylvestris* (on Pond 2 land), *Lepidium bonariensis* (Plate 1F), *Panicum capillare* and *Polygonum arenastrum*.

Carpark and road-side landscaping

The various carparks have been landscaped with mostly low-growing native plants, the most recent project being the carpark off Mark Ford Drive. Monocots feature strongly here, with flax, oioi (*Apodasmia similis*), knobby sedge (*Ficinia nodosa*) (Fig. 13), swamp sedge (*Carex virgata*), toetoe, umbrella sedge (*Cyperus ustulatus*), karetu (*Machaerina sinclairii*), cabbage tree, and broad-leaved rengarenga lily (*Arthropodium bifurcatum*) particularly prominent. Pohuehue (*Muehlenbeckia complexa*) has been deployed extensively as a ground cover. Native shrubs and trees planted are koromiko (*Veronica stricta* var. *stricta*), manuka, karo, houpara, karamu, karaka, puka, Hamilton's kumarahou, and toatoa or shrubby haloragis (*Haloragis erecta*). The margins of Mark Ford Drive



Fig. 13. *Ficinia nodosa*, Mark Ford Drive carpark, 31 Mar 2018.

have a similar low (1–2 m) vegetation, designed to retain views to the Manukau Heads, and in places have thriving plantings of sand coprosma (*Coprosma acerosa*) and a peculiar form of sea rush (*Juncus kraussii* var. *australiensis*) with vegetative shoots proliferating from the flower heads (Fig. 14). This form has also been recorded from apparently-natural plants in salt marsh on Puketutu Island.

Freshwater habitat: ditches, springs, ponds and wetlands

Numerous freshwater sites occur along the Walkway. On 17 November 2018 two of these were explored by a group from the Auckland Botanical Society (Fig. 15): Jenny Andrew, Maureen Bourke, Frances Duff, Ian Geary, Ben Goodwin, Leslie Haines, Shelley Heiss-Dunlop, Peter Hutton, Eric Johnston, John Millett, Helen Preston Jones, Juliet Richmond, Bernie Salmon, Joshua Salter, Sam Sutherland, Elizabeth Walker, Alison Wesley, Mike Wilcox, Dave Wilson and Maureen Young.

The 10-ha final outlet distribution channel for treated sewage effluent runs parallel with Island Road to Puketutu Island (Fig. 16), then turns north into a 9-ha lagoon (intertidal storage basin) leading to the outlet to the Manukau Harbour (Fig. 17) via a discharge pump. The basin was originally 18 ha in area and part of the No. 3 oxidation pond and was formed in 2003. The channel margins have an assemblage of freshwater plants, including some turf species (Fig. 15). Mud surfaces on the edges of the lagoon support copious mudwort (*Limosella lineata*) (Plate 1G), pygmyweed (*Crassula helmsii*) (Wilcox 2017), nahuia (*Alternanthera nahuia*) (Plate 1H), purslane, swamp willow weed (*Persicaria decipiens*), and purple loosestrife (*Lythrum hyssopifolia*), and – recorded for the first time there during the Bot Soc field trip – Australian hydrocotyle (*Hydrocotyle tripartita*) and wandering speedwell (*Veronica peregrina* subsp. *peregrina*) (Plate 2A). This latter, an American plant, was first recorded in New

Zealand by Colin Ogle near Wellington (Heenan et al. 2004), and subsequently at Auckland by Peter de Lange). The channel and basin are favoured habitats of the midge *Chironomus zealandicus* (Garton & Bickers 2016).

North of the causeway (Island Road) lies a 9-ha area of land formed in 2005, separated by a bund from the original 18 ha intertidal effluent storage basin, and a rock wall from the sea (Fig. 16). It was left to infill naturally. The area contains several freshwater or brackish ponds, and drains out when flooded into a large canal, and to the effluent storage basin. The wetland is rain-fed but at high spring tides there is some seawater seepage into the area, and at times it gets inundated from overflow from the effluent storage basin and main channel. The Bot Soc group enthusiastically checked out the plants in this unusual wetland. The predominant vegetation is a mixed cover of tall herbs and grasses that have thickly colonized the site. Swamp paspalum or Mercer grass (*Paspalum distichum*) and creeping bent (*Agrostis stolonifera*) cover extensive areas. Other common associated species are umbrella sedge (*Cyperus eragrostis*), brown umbrella sedge (*Cyperus congestus*), trip-me-up (*Carex flagellifera*), wind grass, paspalum, salt-marsh carex, hairy willowherb (*Epilobium hirtigerum*), gravel groundsel (*Senecio skirrhodon*), sea aster (*Symphotrichum subulatum*), wiry rush (*Juncus homalocaulis*), Australian fireweed, Scotch thistle (*Cirsium vulgare*), ox-tongue, broad-leaved plantain (*Plantago major*), narrow-leaved plantain (*Plantago lanceolata*), Jersey cudweed (*Pseudognaphalium luteoalbum*), hawksbeard, curled dock, clustered dock (*Rumex conglomeratus*), browntop (*Agrostis capillaris*), birdsfoot trefoil (*Lotus pedunculatus*), hairy birdsfoot trefoil (*Lotus suaveolens*), black medick (*Medicago lupulina*), white clover, red clover (*Trifolium pratense*) and haresfoot trefoil (*T. arvense*). Tall rushes present are *Juncus amabilis*, *J. australis*, *J. edgariae*, *Juncus effusus*, *J. kraussii*, *J. pallidus* (very



Fig. 14. *Juncus kraussii* proliferating, Mark Ford Drive, 31 Mar 2018.



Fig. 15. Bot Soc group at margin of intertidal storage basin, Puketutu Island, 17 Nov 2018.



Fig. 16. Watercare Causeway Wetland (Map from Auckland Council GeoMaps).

tall and robust) and *J. sarophorus*, together with pampas (*Cortaderia selloana*), bulrush (*Schoenoplectus tabernaemontani*) and purua grass (*Bolboschoenus fluviatilis*). Forked rush (*Juncus tenuis* subsp. *dichotomus*), wallaby grass (*Rytidosperma racemosum*) and *Polypogon fugax* are of local occurrence.

Several ponds of semi-permanent standing water support aquatic plants, including mixed aggregations of the floating plants *Azolla rubra* and *Landoltia punctata*. The *Azolla*-covered ponds were spectacular during the Bot Soc visit (Plate 2B).

The damp drain margins have abundant bachelor's button (*Cotula coronopifolia*) and buck's horn plantain (*Plantago coronopus*), together with celery-leaved buttercup (*Ranunculus sceleratus*), creeping buttercup (*R. repens*), swamp willow weed, hyssop loosestrife, water cress (*Nasturtium officinale*), Mercer grass, annual beard grass (*Polypogon monspeliensis*), creeping bent, *Isolepis cernua*, orache (*Atriplex prostrata*), tall willow herb (*Epilobium tetragonum*), water speedwell (*Veronica anallaxis-aquatica*), sea spurrey (*Spergularia marina*), jointed rush (*Juncus articulatus*), wiry rush, *Isolepis prolifera* and *Isolepis sepulcralis*. In late summer appears plants of pale willow weed, *Persicaria lapathifolia*, a very stout species up to 2 m tall, with a semi-woody stem and very prominent swollen nodes (Fig. 2C). Mexican tea (*Dysphania ambrosioides*) is another late-summer tall herb.

An elevated bund has been colonized by brush wattle and Sydney golden wattle, and there are extensive patches of blackberry, honeysuckle

(*Lonicera japonica*), and an occasional grey willow (*Salix cinerea*). Other species on the better-drained ditch bunds are inkweed, small-flowered nightshade, broad-leaved fleabane (*Erigeron sumatrensis*), wavy-leaved fleabane (*Erigeron bonariensis*), wild radish (*Raphanus raphanistrum* subsp. *raphanistrum*), prickly lettuce (*Lactuca serriola*), stinkwort (*Dittrichia graveolens*), wild carrot, French mallow, thorn apple (*Datura stramonium*) (Plate 2D), King Island melilot (*Melilotus indica*), wild opium poppy (*Papaver somniferum* subsp. *setigerum*), moth mullein (*Verbascum virgatum*), purple top (*Verbena bonariensis*), *Verbena incompta*, fennel (*Foeniculum vulgare*), toatoa (*Haloragis erecta*), and moth plant. In January 2007 we found African mallow *Anisodonteia capensis* naturalised on a bund. This appears to be the first record of this shrub naturalised in New Zealand. There is a cultivated specimen at 85A Wallace Rd, Mangere Bridge,



Fig. 17. Treated wastewater outfall, 1 May 2018.

approx. 2 km away. In April, June and November 2018, cleavers (*Galium aparine*) was observed with heavy infestation by the gall mite, *Cecidophyes rouhollahi*. During the Bot Soc visit green and golden bell frogs (*Litoria aurea*) were heard croaking, and tadpoles were seen – co-existing with gambusia fish (*Gambusia affinis*).

Prominent native plants on the site are *Bolboschoenus fluviatilis*, *Cotula coronopifolia*, *Eleocharis acuta*, *Epilobium hirtigerum*, *Haloragis erecta*, *Isolepis cernua*, *Isolepis prolifera*, *Juncus australis*, *Juncus edgariae*, *Juncus kraussii*, *Lachnagrostis filiformis*, *Schoenoplectus tabernaemontani*, *Senecio hispidulus*, *Spergularia marina*, *Thyridia repens*, and *Triglochin striata*. The spectacular abundance of *Lachnagrostis filiformis*, along with the extensive colonies of the introduced wiry rush, the numerous colonies of the shrub-like *Epilobium hirtigerum* (Fig. 18), and an extensive patch of *Thyridia repens* (Fig. 19 and cover illustration) (Gardner 1988, Benham 2005) are noteworthy botanical features of this site. *Crassula helmsii* is found sparsely in the *Thyridia repens* colony (Fig 20). The conservation of *Epilobium hirtigerum* has recently been highlighted with its discovery at Hobsonville (Auckland Council 2016), while the discovery here by MDW, on 6 April 2018, of *Thyridia repens* (formerly known as *Mimulus repens*) represents a new Auckland locality for this uncommon plant (Anon. 2019).

Although cut off from the sea, the underlying substrate of drainage deposits is evidently somewhat salty and decidedly alkaline, judging by the presence of several halophytes such as *Atriplex prostrata*, *Isolepis cernua*, *Juncus kraussii* var. *australiensis*, *Polypogon monspeliensis*, *Spergularia marina*, *Triglochin striata*, *Plantago coronopus*, and *Cotula coronopifolia*.

A narrow wetland alongside the sewage treatment plant has an impressive amount of reed canary grass (*Phalaris arundinacea*) (Fig. 21). It has probably been planted there as it is reputed to grow well and help purify contaminated industrial water. This wetland also has water celery (*Apium nodiflorum*), *Carex secta*, *Paspalum distichum* and *Persicaria decipiens*.

There is a freshwater spring (puna) and outlet drain on Watercare land adjacent to Ambury Park Centre for horse-riding therapy. There is a complete absence of tall sedges and rushes fringing the pond where the dominant wetland plants are *Persicaria decipiens* (and occasional *P. lapathifolium*) and *Paspalum distichum*, together with celery-leaved buttercup, *Cyperus eragrostis*, *Juncus articulatus*, and a very stout form of broad-leaved plantain. Curly pondweed (*Potamogeton crispus*) is the only submerged water weed. The grassy margins have



Fig. 18. Mike Wilcox knee-deep in *Epilobium hirtigerum*, causeway wetland, 17 Nov 2018. (Photo: Ben Goodwin)



Fig. 19. *Thyridia repens*, causeway wetland, from drone, 14 Nov 2018. Liam Templeton in picture.



Fig. 20. *Crassula helmsii* amongst *Thyridia repens*, causeway wetland, 20 Nov 2018.

extensive patches of the sedge *Cyperus brevifolius*, and there is a population of field pansy (*Viola arvensis*). In November 2018 the outlet drain was thickly vegetated with water speedwell and water cress.



Fig. 21. *Phalaris arundinacea*, Watercare Wastewater Treatment plant, 17 Dec 2018.



Fig. 22. *Dysphania pumilio*, causeway, 3 Apr 2018.

A walkway connecting Greenwood Road and Mark Ford Drive features wetland plantings along a creek and surrounding a large pond. *Phormium tenax* is common, and wetland species include *Apodasmia similis*, *Carex virgata*, *Persicaria decipiens*, *Cyperus ustulatus*, and some sizeable sedgelands of *Carex lessoniana* and *Bolboschoenus fluviatilis* with occasional *Typha orientalis* and *Schoenoplectus tabernaemontani*.

Greenwood Road Park has several wet areas, mainly along drains and creeks, with the dominant plants there being water celery, willow weed – with some water pepper (*Persicaria hydropiper*) as well, swamp paspalum, floating sweet grass (*Glyceria declinata*), Yorkshire fog, and creeping buttercup. *Lemna disperma* is often abundant as a floating plant. Watercress is also present. Other wetland plants there (including plantings) are *Carex lessoniana*, *C. secta* and *C. virgata*.

The Walkway from near the Oruarangi Stream mouth westwards to the Otutataua Stonefields passes by various wetlands. In January and December 2004

we examined a wetland in the lower Oruarangi Stream, recording *Bolboschoenus caldwellii*, *Schoenoplectus tabernaemontani*, *Carex fascicularis*, *Cyperus eragrostis*, *Cyperus congestus*, *Isolepis prolifera*, *Juncus articulatus*, *Agrostis stolonifera*, *Alisma plantago-aquatica*, *Apium nodiflorum*, *Bidens frondosa*, *Calystegia sepium*, *Alternanthera sessilis*, *Trifolium fragiferum*, *Salix cinerea*, *Potamogeton cheesemanii*, *Potentilla reptans*, *Lythrum hyssopifolia*, *Myriophyllum aquaticum*, *Myosotis laxa*, *Persicaria decipiens*, *Canna indica*, *Lantana camara* and *Phalaris arundinacea*. In spring the Walkway margins are damp and support abundant *Callitriche stagnalis*, *Juncus articulatus*, *Isolepis levynsiana* and *I. sepulcralis*, and a large patch of water speedwell.

As part of Project Manukau (Watercare 2015) excavation work resulted in the reconnection of the Oruarangi Stream with the Manukau Harbour in April 2005. In the process, it seems that some of the above plants (notably *Bolboschoenus caldwellii*, *Carex fascicularis* and *Potamogeton cheesemanii*) were eliminated, as they are no longer present there.

Further westwards there is a mosaic of wetlands, featuring sedgelands of *Bolboschoenus fluviatilis*, *Carex divisa*, *Carex lessoniana* and *Carex secta*, meadows of *Paspalum distichum*, stands of *Phormium tenax* and groves of *Cordyline australis*. Sprinkled through these wetlands or on the margins are *Bidens frondosa*, *Cyperus ustulatus* (mostly planted by Boffa-Miskell Ltd.), *Eleocharis acuta*, *Galium palustre*, *Juncus articulatus*, *Lycopus europaeus* (only locally present), *Persicaria decipiens* (pond margins), *Ranunculus repens* and *Rumex conglomeratus*. Reed canary grass and phalaris (*Phalaris aquatica*) are present in several places. On the boundary of the Watercare Walkway and adjoining private farmland there is a shallow pond supporting abundant *Echinochloa crus-gavonis*, duckweeds (*Landoltia punctata* and *Lemna disperma*), and a thriving population of *Myriophyllum aquaticum*.

Plants on the edges of Island Road and other roads

Island Road is a tar-sealed road which serves as the causeway to Puketutu Island. The edges are of gravel or rock rubble and support a rich assemblage of mainly introduced herbs and monocots, periodically destroyed by herbicide spraying. The Autumn flora here features several prostrate plants growing in the gravel: *Cotula australis*, *Digitaria sanguinalis*, *Dysphania pumilio* (Fig. 22), *Eleusine indica*, *Eragrostis brownii*, *Euphorbia maculata*, *Lepidium didymum*, *Panicum dichotomiflorum*, *Plantago lanceolata*, *Polygonum arenastrum*, *Portulaca oleracea* and *Trifolium repens*. Other plants of more upright habit are *Capsella bursa-pastoris*, *Chenopodium album*, *Cyperus congestus*, *Cyperus eragrostis*, *Datura stramonium*, *Digitaria ciliaris*,



Fig. 23. Mangrove trunks and branches green with marine algae, 9 Apr 2018.

Digitaria sanguinalis, *Fumaria muralis*, *Galinsoga quadriradiata*, *Galium aparine*, *Juncus bufonius*, *Malva parviflora*, *Nicandra physalodes* (Plate 2E), *Paspalum dilatatum*, *Poa annua*, *Raphanus raphanistrum*, *Senecio skirrhodon*, *Senecio vulgaris*, *Setaria gracilis*, *Solanum nigrum*, *Sonchus oleraceus*, *Sporobolus africanus*, *Veronica persica* and *Vulpia myuros* var. *megallura*.

The edges of gravel roads in other parts of the Watercare estate commonly have a flora which includes annuals such as silver hair grass (*Aira caryophyllea*), slender centaury (*Centaureum tenuiflorum*), allseed (*Polycarpon tetraphyllum*), slender bedstraw (*Galium divaricatum*) and *Vulpia bromoides*. The edges of a service road adjoining the causeway wetland has a summer flora of *Senecio skirrhodon* (Plate 2F) *Cyperus eragrostis*, *Cyperus congestus*, *Pseudognaphalium luteoalbum*, *Medicago lupulina*, *Medicago nigra*, *Galium divaricatum*, *Melilotus indica* and numerous grasses (*Digitaria sanguinalis*, *Echinochloa crus-galli*, *Eleusine indica*, *Paspalum dilatatum*, *Setaria pumila*). In summer the sprawling herb fluellin (*Kickxia elatine*) becomes common in rocky places.

Coastal margin: mangrove forest, salt meadow, shell banks and beaches

Mangrove (*Avicennia marina*) has an intermittent and mainly low presence on the Watercare shores of the Manukau Harbour. One of the most concentrated populations is on basalt lava flows near the boundary of Ambury Park, where there are fine stands of mature trees with epiphytic marine algae on pneumatophores (*Catenella nipa*), branches (*Rhizoclonium curvatum*) and trunks (*Pseudorhizoclonium australe*) (Fig. 23). Mangroves are also present on Puketutu Island, near the mouth of Oruarangi Stream, and lining the harbour shallows adjoining the sewage treatment plant. The mangrove erineum mite (*Acalitus avicenniae*) – see Martin (2017) – occurs as pimply disfigurements on mangrove foliage on trees next to Ambury Park (Fig. 24).



Fig. 24. Mangrove leaves infected with the mangrove erineum mite, 9 Apr 2018.



Fig. 25. Salt marsh, crater lagoon, 26 Mar 2018.



Fig. 26. *Polypogon monspeliensis*, 28 Dec 2005.

Salt meadow here is dominated by glasswort (*Sarcocornia quinqueflora*) and orache and is particularly well developed on the south-western shore of Puketutu Island, and on the shores of the Mangere Lagoon (Fig. 25), which is tidal and

connects to the sea via a culvert. Elsewhere it occurs on shores alongside the Walkway on Puketutu Island, near the bird hides, and adjoining Ambury Park. Other plants in the salt meadow are arrow grass (*Triglochin striata*), buck's horn plantain, bachelor's button, sea aster (*Symphotrichum subulatus*), saltwater paspalum (*Paspalum vaginatum*), sea blite (*Suaeda novaezelandiae*), sea primrose (*Samolus repens*), sea spurrey, remuremu (*Selliera radicans*), glaucous goosefoot (*Oxybasis ambigua*) (Plate 2G), oioi, knobby sedge, sea rush and shore needle grass (*Austrostipa stipoides*). During the Bot Soc visit we noted that King Island melilot (*Melilotus indicus*) and annual beard grass (Fig. 26) were abundant on the fringes of the Puketutu Island salt meadow. Other maritime grasses recorded are sea couch (*Elytrigia pycnantha*), salt grass (*Puccinellia stricta*), coast barb grass (*Parapholis incurva*), and slender barb grass (*P. strigosa*). Other sedges present are salt marsh carex, *Bolboschoenus caldwellii*, *Isolepis cernua*, and *Machaerina juncea*. Shore ribbonwood (*Plagianthus divaricatus*) is common in a zone between the mangroves and salt meadows, with some extensive thickets on Puketutu Island. Further information on the coastal vegetation in the Manukau Harbour has been recorded by Chapman & Ronaldson (1958), and the report by Kelly (2008) has a wealth of information about the Manukau Harbour.

Several artificial beaches and shell banks were created during the restoration project. The beach vegetation is typically weedy, with kikuyu, tall fescue, orache, saltwater paspalum, Indian doab (also known as Bermuda grass) and shore bindweed (*Calystegia soldanella*) (Fig. 27) being the most prevalent plants. Hairy vetch (*Vicia hirsuta*) is prominent at the back of beaches below Otutata Stonefields. The shell banks are "no go" zones because they are roosts for migratory birds, so we have not explored them on foot.



Fig. 27. *Calystegia soldanella*, Oruarangi walkway, 16 Nov 2018.

Odour buffer land

There are two areas of adjoining Watercare land classified as odour buffer land whose main purpose is to shield the neighbouring community (including houses and horticultural land in Kirkbride Road) from odours from the treatment plant. This land is thus not suitable for housing. The large area east of Greenwood Road (25 ha) has been developed into a recreational asset (especially dog-walking) and features extensive landscape plantings. It is known as Greenwood Road Park. There used to be some houses there. The plants present there have been mentioned previously (see native thickets, meadows, exotic trees and wetlands). The site has been used for biosolids re-use trials, comparing fallow ground rehabilitation, turf and recreational lands, pasture establishment, and crop refurbishment.

The odour buffer land north of Ascot Road is in pasture, and covers 9 ha, and includes the vegetated walkway from Greenwood Road to Mark Ford Drive.

Some noteworthy plants

Coprosma robusta: this is common in the native thickets and was evidently supplied by a nursery as "karamu" planting stock for the revegetation work. It has grown well. It is noteworthy because plantings on sludge have atypical wavy-edged, narrow leaves, and commonly have the fruits in 3s. They are possibly *C. macrocarpa* subsp. *minor* × *C. robusta* hybrids (Gardner 2005). More recent plantings, between Mark Ford Drive and Greenwood Road, have normal flat, broad leaves typical of *C. robusta*.

Crassula helmsii: well established along the shores of the treated effluent channel and intertidal storage basin, and in the causeway wetland, with *Thyridia repens* (Fig. 20).

Datura stramonium: widespread on open ground beside walkways (Plate 2D).

Epilobium hirtigerum: a threatened plant, abundant and woody in the causeway wetland (Fig. 18). It now has the conservation status of **at risk: recovering** (de Lange et al. 2018) in recognition of its now widespread occurrence on disturbed sites in Auckland. It was previously classified as Nationally Critical.

Geranium gardneri: locally abundant and weedy on disturbed open sites.

Juncus homalocaulis: several extensive colonies in the causeway wetland.

Lachnagrostis filiformis: native wind grass is abundant in many parts of the Watercare Walkway system.



Plate 1A-1H: **1A.** *Pittosporum crassifolium*, Oruarangi walkway, Watercare, 21 Sep 2018. **1B.** *Pericallis ×hybrida* (cineraria), crater lagoon slopes, 4 Oct 2018. **1C.** *Genista stenopetala*, track to crater lagoon from Wallace Road, 22 Sep 2018. **1D.** *Lycium ferocissimum*, crater lagoon walkway 2 April 2005. **1E.** *Malva sylvestris*, meadow, 17 Dec 2018. **1F.** *Lepidium bonariensis*, road seaward side of Pond 2, 6 Jan 2019. **1G.** *Limosella lineata*, causeway shell bank, 3 Apr 2018. **1H.** *Alternanthera nahui*, margin of intertidal storage basin, 7 Mar 2018.



Plate 2A-2G: **2A.** *Veronica peregrina*, margin of intertidal storage basin, 17 Nov 2018. (Photo: Frances Duff). **2B.** *Azolla rubra*, causeway wetland, 17 Nov 2018. **2C.** *Persicaria lapathifolia*, intertidal storage basin, 18 Mar 2019. **2D.** *Datura stramonium*, edge of causeway, 4 April 2005. **2E.** *Nicandra physalodes*, walkway from Greenwood Road to Mark Ford Drive, 8 Apr 2018. **2F.** *Senecio skirrhodon*, causeway wetland bund, 28 Dec 2018. **2G.** *Oxybasis ambigua*, near Ambury Park, 9 Apr 2018.

Limosella lineata: abundant on the edge of the treated effluent channel and intertidal storage basin (Plate 1G). This is a very slender, green freshwater form, with the leaves being undifferentiated into petiole and lamina, unlike the form typically seen in coastal dune slacks with thick, greyish petiolate leaves.

Oxybasis ambigua: thriving in various salt marsh patches adjoining Ambury Park and near the main bird hide (Plate 2G). It is classified as **at risk: declining** in de Lange et al. (2018). See Mosyakin & de Lange 2018 regarding the recognition and recent re-naming of this plant.

Phalaris arundinacea: one of Auckland's tallest grasses (excluding the bamboos). Found in the wetlands below Otuaatua Stonefields and at the Watercare Treatment Plant (Fig. 21).

Thyridia repens: one of Auckland's largest colonies of this threatened plant (formerly *Mimulus repens*) was discovered in April 2018 in the causeway wetland (Fig. 19, and cover illustration) (Anon. 2019). It is classified as **naturally uncommon** (de Lange et al. 2018). It was abundantly in flower in November 2018, but the colony disappeared temporarily by late January 2019 during a prolonged drought, re-emerging more sparsely and flowering again in March, though facing competition from *Cotula coronopifolia* and *Spergularia marina*.

Veronica peregrina subsp. *peregrina*: an American plant first recorded in Auckland in 2015 (Plate 2A).

Lower plants

To complete this botanical description of Watercare's Mangere land we conclude with mention of the lower plants – algae, lichens, and bryophytes – and one of the fungi as well.

Fungi

The most notable fungus here is the giant puffball *Calvatia gigantea* which appears in colonies in May on the ground in some of the native thickets.

Algae: Both marine and freshwater algae occur here. Marine species present are mostly those typical of estuarine conditions, with **green algae** predominant. The newly-described wool-like *Pseudorhizoclonium australe* (Sherwood et al. 2019) occurs widely in the Manukau Harbour (listed as *Pseudorhizoclonium* sp. in Wilcox 2018), including in salt meadows, shore ribbonwood thickets, and mangrove forests on Watercare land. *Rhizoclonium curvatum* (type locality is Puketutu Island) grows on mangrove branches, and *R. riparium* is common in brackish ponds. *Blidingia marginata* is winter seasonally abundant on basalt seawalls (e.g. beside the island causeway) and on wooden debris and glasswort on the shaded margins of the crater

lagoon. *Gayralia oxysperma* is another winter species, growing as shiny green sheets on small stones on shaded banks of the crater lagoon and in broader sheets in tidal ditches. The slender, tubular *Ulva ralfsii* occurs in this same habitat (and has been observed as a bloom in September 2018), with *Ulva intestinalis* frequent near freshwater inflows. The broad-bladed sea lettuce *Ulva laetevirens* occurs mainly as unattached thalli. **Red algae** recorded associated with mangroves (e.g. on pneumatophores) are *Bostrychia tenuissima*, *Caloglossa vieillardii* and *Catenella nipae*, while *Gracilaria* sp. "Blockhouse Bay" forms beds on mud. No brown algae have been recorded, but the **yellow-green alga** *Vaucheria* forms velvety turfs in winter on soil at the edge of the sea and in damp depressions beside the walkway, and another *Vaucheria* species occurs in ponds.

Filamentous freshwater algae identified from ponds are *Mougeotia* sp., *Ulothrix zonata*, *Rhizoclonium riparium*, *Spirogyra* spp., and *Oedogonium* sp., and there are numerous species of microalgae inhabiting ponds and the effluent treatment tanks. **Blue-green algae** (cyanobacteria) recorded are *Nostoc commune* from beside some paths and *Phormidium nigroviride* in *Vaucheria* turf.

In addition to the marine and freshwater algae, there is a subaerial green alga commonly present, forming a fine green coating on fence posts and on the bark of trees. This is *Desmococcus olivaceus*. It is unicellular, but with the cells aggregated in clusters.

Lichens: Basalt lava flows, old farm walls, and embankments provide abundant habitat for saxicolous lichens. A conspicuously abundant yellow species close to the shore line is *Dufourea ligulata*, and with it is often found a greyish crustose lichen, *Buellia cranwelliae*. Other grey or yellow-grey lichens recorded here on basalt are *Flavoparmelia soledians*, *Parmelia reticulatum*, *Xanthoparmelia scabrosa* and *X. verisidiosa*, while *Cladonia darwinii* is found on old farm stone walls. Trunks of larger exotic trees provide a habitat for *Dirinaria appplanata*, *Heterodermia speciosa* and *Parmelia perlatum*. The trunks of native trees in the thickets do not yet have a very prominent lichen flora, though planted totara trees in Greenwood Road Park have abundant *Dirinaria appplanata* on the bark, and the twigs and branches of dead ngaio trees support *Amandinea punctata*, *Ramalina celastri*, *Teloschistes chrysophthalmus* and *Xanthoria parietina*, while branchlets of *Plagianthus divaricatus* and *Olearia solandri* have epiphytic *Parmelia perlatum*, *Ramalina celastri* and *Usnea rubicunda*. The assemblage comprising *Ramalina celastri*, *Teloschistes chrysophthalmus* and *Xanthoria parietina* is also frequent on the branches of *Coprosma repens* near the shoreline.

Liverworts: The two most prominent liverworts here are the thalloid *Lunularia cruciata* on bare soil, particularly where weeds have been sprayed, and the foliose species *Chiloscyphus semiteres* which is a feature of shaded embankments and stone walls. *Fossombronia wondraczeckii* and the hornwort *Anthoceros laminiferus* have been found on damp ground. The only liverworts so far recorded from tree trunks in the native thickets are *Siphonolejeunea nudipes* which favours ngaio and taupata bark as its substrate, and *Frullania rostellata* on the bark of taupata.

Mosses: These have been a revelation, with a good number of mainly hardy terrestrial species recorded on damp ground, beside paths, and on rock. Regular spraying with Roundup (glyphosate) along the edges of the walkways seems to encourage moss growth. Mosses recorded on basalt rock in the open are *Barbula convoluta*, *Grimmia pulvinata*, *Brachythecium rutabulum*, and *Tortula muralis*, and in shade *Hypopterygium tamarisci* and *Racopilum cuspidigerum* var. *convolutaceum*. The latter has also been found on exposed rock in the open. Several species thrive on banks beside the walkways,

including on ground that has been sprayed with herbicide: *Barbula unguiculata*, *Bryum argenteum*, *Bryum dichotomum*, *Campylopus clavatus*, *Ceratodon purpureus*, *Eurhynchium praelongum*, *Funaria hygrometrica*, *Rhynchostegium tenuifolium*, *Rosulabryum capillare* and *Weissia controversa*. *Ptychomnion aciculare* occurs sparsely on shaded banks, while the invasive *Fissidens taxifolius* is found on both shaded banks and rock. *Brachythecium albicans* is a grassland species, found here in a few places near the walkways, while *B. rutabulum* also occurs in grassy places on road edges. *Amblystegium serpens* has been recorded as a semi-aquatic moss from a culvert. The native thickets have so far not developed much of a moss flora, the only record being *Syntrichia antarctica* from the bark of a large planted tree.

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Appendix. List of plants recorded, 17 January 2004 to 18 March 2019, on Watercare Coastal Walkway and adjoining land, Mangere, Auckland. (* = exotic; cult. = planted)

Incorporating records from MDW & PM 17 Jan 2004, 31 Dec 2004; MDW 2005 (5 visits); Auckland Botanical Society visit on 9 December 2006; MDW 2007 (2 visits); 2008 (2 visits); 2009 (3 visits); 2012 (1 visit); 2018 (53 visits) plus 24 Apr 2018 (with Liam Templeton, Watercare) & 17 Nov 2018 (Bot Soc group); MDW 2019 (5 visits).

Fungi

<i>Agrocybe praecox</i>	Wood chip mulch, native thickets, Mark Ford Drive to Greenwood Road.
<i>Aseroe rubra</i>	Stinkhorn. On wood chip mulch, native thickets, Mark Ford Drive to Greenwood Road.
<i>Auricularia polytricha</i>	Wood ear fungus. Dead branches of <i>Coprosma repens</i> , native thickets.
<i>Calvatia gigantea</i> (syn. <i>Langermannia gigantea</i>) *	Giant puffball. Along the edge of a drain, service road, Puketutu Island; abundant on ground in native thickets near Ambury Park (May 2018).
<i>Favolaschia calocera</i>	Orange pore fungus. On dead wood, lagoon crater.
<i>Pycnoporus coccineus</i>	Pine branches on ground by Mark Ford Dr carpark.
<i>Stropharia aurantiaca</i>	Wood chip mulch, native thickets, Mark Ford Drive to Greenwood Road.

Algae

<i>Blidingia marginata</i>	Basalt rocks alongside causeway road to Puketutu Island; crater lagoon, on branch debris.
<i>Bostrychia tenuissima</i>	On stones, edge of crater lagoon.
<i>Caloglossa vieillardii</i>	On stones and <i>Sarcocornia</i> , edge of crater lagoon.
<i>Catenella nipae</i>	Mangrove pneumatophores.
<i>Cephaleuros lagerheimii</i>	Mahoe leaves.
<i>Coleofasciculus chthonoplastes</i>	Ponds to north of causeway.
<i>Desmococcus olivaceus</i> (syn. <i>Protococcus viridis</i>)	Green coating of fence posts and battens; on bark of taupata. A subaerial green alga.
<i>Gayralia oxysperma</i>	Stones at back of mangroves by Ambury Park; in saline ditch flowing from the puna (spring-fed pond), <i>M.D. Wilcox 6236</i> , 29 Sep 2018, AK 373192
<i>Gracilaria</i> sp. "Blockhouse Bay" *	Mud banks, Puketutu Island.
<i>Mougeotia</i> sp.	Walkway from Oruarangi carpark, in puddles, <i>M.D. Wilcox 6233</i> , 21 Sep 2018, AK 373189.
<i>Mougeotia</i> sp.	Spring pond (puna), abundant scum on surface, <i>M.D. Wilcox 6242</i> , 22 Nov 2018, AK 373198.
<i>Nostoc commune</i>	Beside pathways, <i>M.D. Wilcox 6237</i> , 29 Sep 2018, AK 373193.
<i>Oedogonium</i> sp.	Ponds to north of causeway
<i>Phormidium nigroviride</i>	Shallow saline puddles, Puketutu Island and causeway wetland.
<i>Pleurostira laevis</i>	Ponds to north of causeway
<i>Pseudodorhizoclonium australe</i>	Mature mangrove forest on basalt rock and mangrove trunks and pneumatophores. Also in salt meadow.
<i>Rhizoclonium curvatum</i>	Mangrove branches.
<i>Rhizoclonium riparium</i>	Ponds to north of causeway; roadside seeps on Puketutu Island; creek next to Ambury Park.
<i>Solieria</i> cf. <i>chordalis</i> *	Washed up.
<i>Spirogyra</i> sp.	Freshwater pond at start of causeway;
<i>Spirogyra</i> sp.	Puna (springs), floating in skeins on the surface, cells 25µm× 75 µm, <i>M.D. Wilcox 6235</i> , 22 Sep 2018, AK 373191.
<i>Spirogyra</i> sp.	Puna (springs), floating in skeins on the surface, cells 65µm× 65 µm, <i>M.D. Wilcox 6234</i> , 22 Sep 2018, AK 373190
<i>Ulothrix zonata</i>	Freshwater pond at start of causeway.

<i>Ulva laetevirens</i>	Basalt reefs washed up.
<i>Ulva intestinalis</i>	Cobble rocks by shell beach; northern edge of lagoon.
<i>Ulva ralfsii</i>	Edge of crater lagoon; creek next to Ambury Park
<i>Vaucheria geminata</i>	Freshwater seeps by gravel road to treated effluent outfall
<i>Vaucheria</i> sp.	In dried puddles beside path and on soil under taupata trees by shore near Ambury Park (sterile).

Lichens

<i>Amandinea punctata</i>	Bark of ngaio twigs and branchlets.
<i>Buellia cranwelliae</i>	Basalt rock, Oruarangi Stream mouth; basalt rocks on embankment at bird hide.
<i>Chrysothrix candelaris</i>	Shaded rock on bank on Lagoon Walkway.
<i>Cladonia darwinii</i>	Basalt wall, Wallace Road entrance.
Crustose lichen	Basalt wall, Wallace Road entrance.
<i>Dirinaria applanata</i>	Bark of pine trees, crater lagoon; bark of totara trees, Greenwood Road Park.
<i>Dufourea ligulata</i>	Basalt rock, Oruarangi Stream mouth; basalt rocks on embankment at bird hide and on causeway.
<i>Flavoparmelia soledians</i>	Basalt rocks on bund.
<i>Heterodermia speciosa</i>	Bark of trunk and branches of 20-year-old pine tree, crater lagoon slopes; bark of <i>Casuarina cunninghamiana</i> , Mark Ford Dr carpark.
<i>Lepraria finkii</i>	Shaded bank, Lagoon Walkway.
<i>Parmotrema perlatum</i>	Stone wall, Wallace Road entrance.
<i>Parmotrema reticulatum</i>	Bark of pine trees, lagoon crater walkway. Abundant on twigs of <i>Plagianthus divaricatus</i> and <i>Olearia solandri</i> , salt marsh.
<i>Phaeographis mucronata</i>	Common on bark of <i>Pittosporum crassifolium</i> .
<i>Ramalina celastri</i>	Bark of <i>Myoporum laetum</i> , <i>Pittosporum crassifolium</i> , <i>Plagianthus divaricatus</i> and <i>Olearia solandri</i>
<i>Teloschistes chrysophthalmus</i>	On twigs and branches of dead ngaio trees; on branches of taupata.
<i>Usnea cornuta</i>	Base of living cabbage tree.
<i>Usnea</i> sp.	Base of living cabbage tree.
<i>Usnea rubicunda</i>	Dead branchlets.
<i>Xanthoparmelia scabrosa</i>	Concrete slab, outlet; basalt rock outcrop near Ambury Park.
<i>Xanthoparmelia verisidiosa</i>	Basalt rock wall, Wallace Road entrance.
<i>Xanthoria parietina</i>	On stems and branches of <i>Myoporum laetum</i> and <i>Coprosma repens</i> on seaward margins. Also on branchlets of <i>Plagianthus divaricatus</i> and <i>Olearia solandri</i> .

Liverworts & hornworts

<i>Anthoceros laminiferus</i>	Bare ground, track round crater lagoon (MDW, 17 Aug 2005).
<i>Chiloscyphus semiteres</i>	Rock wall, Wallace Road entrance; rock, crater lagoon walkway.
<i>Fossombronia wondraczeckii</i>	Damp ground on edge of native copse.
<i>Frullania rostellata</i>	Bark of ngaio and taupata in native thickets.
<i>Frullania solanderiana</i>	Rock wall, Wallace Road entrance.
<i>Lunularia cruciata</i> *	Bare ground beside road; banks along lagoon walkway.
<i>Metzgeria decipiens</i>	On rock in shade, crater lagoon walkway.
<i>Siphonolejeunea nudipes</i> (syn. <i>Austrolejeunea nudipes</i>)	Bark of ngaio and taupata, native thickets.

Mosses

<i>Amblystegium serpens</i>	Concrete in culvert exit at spring.
<i>Barbula convoluta</i> *	Rock outcrop enclosure near Ambury Park boundary.
<i>Barbula unguiculata</i> *	Tuff bank beside lagoon crater track.
<i>Brachythecium albicans</i>	Grassy area, walkway from Creamery Rd carpark.
<i>Brachythecium rutabulum</i>	On ground by ngaio hedgerow, track from Wallace Road; beside road and ditch, service road, Puketutu Island; rocks, causeway wetland bund; rock outcrop near Ambury Park.
<i>Bryum argenteum</i>	Bare ground on earth banks and by carparks.
<i>Bryum dichotomum</i>	Bare ground on earth banks; edges of copses.
<i>Campylopus clavatus</i>	Grassy bank.

<i>Ceratodon purpureus</i>	Bare ground on earth banks and beside paths.
<i>Eurhynchium praelongum</i>	Shaded path beside ngaio windbreak from Wallace Road. Bare ground at edge of copse, often torn up as if scratched by birds; grassy banks, Lagoon Walkway.
<i>Fissidens taxifolius</i> *	Shaded rocks, crater lagoon slopes; shaded path beside ngaio windbreak from Wallace Road.
<i>Funaria hygrometrica</i>	On bare ground on earth banks
<i>Grimmia pulvinata</i>	Rock outcrop enclosure near Ambury Park boundary.
<i>Hypopterygium tamarisci</i>	Umbrella moss. On rocks on shady crater lagoon slopes.
<i>Philonotis tenuis</i>	Damp ground on crater lagoon slopes.
<i>Ptychomnion aciculare</i>	Lagoon walkway, on bank in shade. Uncommon.
<i>Racopilum cuspidigerum</i> var. <i>convolutaceum</i>	On basalt rock in shade, crater lagoon walkway; on exposed fenced-off rock outcrop near Ambury Park.
<i>Rhynchostegium tenuifolium</i>	Crater lagoon bush slopes.
<i>Rosulabryum capillare</i>	Bare ground and on soil over rock on crater lagoon walkway.
<i>Syntrichia antarctica</i>	On bark at base of <i>Brachychiton acerifolius</i> , Greenwood Road Park.
<i>Tortula muralis</i>	Rock wall, Wallace Rad entrance.
<i>Weissia controversa</i>	Damp ground by copse, with <i>Fossombronia</i> ; bare ground beside Mark Ford Dr carpark; path from Mark Ford Dr to Greenwood Rd.

Ferns

<i>Adiantum diaphanum</i>	small maidenhair
<i>Adiantum hispidulum</i>	rosy maidenhair
<i>Asplenium oblongifolium</i>	shining spleenwort
<i>Azolla rubra</i>	floating water fern. Ponds in causeway wetland; wetland west of Oruarangi carpark.
<i>Doodia australis</i> (syn. <i>Blechnum parrisiae</i>)	rasp fern
<i>Nephrolepis cordifolia</i> *	tuber ladder fern
<i>Polystichum neozelandicum</i> subsp. <i>neozelandicum</i>	shield fern
<i>Pteridium esculentum</i>	bracken
<i>Pteris tremula</i>	shaking brake. Banks on Lagoon Walkway; in native copses near entrance from Ambury Park.
<i>Pyrrosia eleagnifolia</i>	leather fern. Lagoon slopes.

Conifers

<i>Agathis australis</i> (cult.)	kauri
<i>Araucaria heterophylla</i> * (cult.)	Norfolk Island pine
<i>Chamaecyparis lawsoniana</i> * (cult.)	Lawsons cypress
<i>Cupressus lusitanica</i> * (cult.)	Mexican cypress
<i>Cupressus macrocarpa</i> * (cult.)	Monterey cypress, macrocarpa
<i>Dacrycarpus dacrydioides</i> (cult.)	kahikatea
<i>Juniperus chinensis</i> 'Kaizuka' * (cult.)	kaizuka juniper
<i>Pinus radiata</i> * (cult.)	Monterey pine
<i>Podocarpus totara</i> (cult.)	totara
<i>Taxodium distichum</i> * (cult.)	swamp cypress

Monocots

<i>Agapanthus</i> * (cult.)	a dwarf cultivar
<i>Agrostis capillaris</i> *	browntop
<i>Agrostis stolonifera</i> *	creeping bent
<i>Aira caryophylla</i> *	silver hair grass
<i>Alisma plantago-aquatica</i> *	water plantain
<i>Allium triquetrum</i> *	onion weed

<i>Alocasia brisbanensis</i> *	elephant's ear
<i>Apodasmia similis</i> (cult. & wild)	oioi
<i>Archontophoenix cunninghamiana</i> *	bangalow palm
<i>Arrhenatherum elatius</i> *	tall oat grass
<i>Arthropodium bifurcatum</i> (cult.)	rengarenga lily 'Matapouri Bay'
<i>Arthropodium cirratum</i> (cult.)	rengarenga lily
<i>Arum italicum</i> *	Italian arum
<i>Asparagus asparagoides</i> *	smilax
<i>Astelia chathamica</i> (cult.)	silver sword
<i>Austroderia fulvida</i> (cult.)	toetoe
<i>Austrostipa stipoides</i> (cult. & wild)	coastal needle grass
<i>Bolboschoenus caldwellii</i>	saltmarsh club-rush
<i>Bolboschoenus fluviatilis</i>	marsh club-rush, kukuraho
<i>Bolboschoenus medianus</i>	club-rush
<i>Briza minor</i> *	shivery grass
<i>Bromus diandrus</i> *	ripgut brome
<i>Bromus catharticus</i> (syn. <i>B. willdenowii</i>) *	prairie grass

<i>Bromus hordeaceus</i> (syn. <i>B. mollis</i>) *	soft brome	<i>Iris pseudacorus</i> *	yellow flag
<i>Bromus lithobius</i> *	Chilean brome	<i>Isolepis cernua</i>	slender club-rush
<i>Bromus valdivianus</i> *	stripey brome	<i>Isolepis levynsiana</i> (<i>Cyperus tenellus</i>) *	
<i>Carex divisa</i> *	salt marsh carex	<i>Isolepis prolifera</i>	
<i>Carex divulsa</i> *	grey sedge	<i>Isolepis sepulcralis</i> *	
<i>Carex inversa</i>		<i>Juncus amabilis</i> *	
<i>Carex fascicularis</i>		<i>Juncus articulatus</i> *	jointed rush
<i>Carex flagellifera</i> (cult. and wild)	trip-me-up	<i>Juncus australis</i>	hollow rush
<i>Carex lambertiana</i> (cult.)		<i>Juncus bufonius</i> var. <i>bufonius</i> *	toad rush
<i>Carex lessoniana</i>		<i>Juncus edgariae</i>	wiwi
<i>Carex secta</i> (cult.)	swamp tussock sedge	<i>Juncus effusus</i> *	soft rush
<i>Carex testacea</i> (cult.)		<i>Juncus homalocaulis</i> *	wiry rush
<i>Carex virgata</i> (cult.)	tussock sedge	<i>Juncus kraussii</i> var. <i>australiensis</i> (wild & cult.)	salt marsh rush
<i>Cenchrus clandestinus</i> *	kikuyu grass	<i>Juncus microcephalus</i> *	South American rush
<i>Cordyline australis</i> (cult.)	cabbage tree, ti rakau	<i>Juncus pallidus</i>	giant rush
<i>Cordyline rubra</i> *	palm lily	<i>Juncus sarophorus</i>	fan rush
<i>Cortaderia selloana</i> subsp. <i>jubata</i> *	purple pampas grass	<i>Juncus tenuis</i> subsp. <i>dichotomus</i>	forked rush
<i>Cortaderia selloana</i> subsp. <i>selloana</i> *	pampas grass	<i>Juncus tenuis</i> subsp. <i>tenuis</i> *	track rush
<i>Critesion murinum</i> *	barley grass	<i>Lachnagrostis filiformis</i>	wind grass
<i>Cynodon dactylon</i> *	Indian doab	<i>Landoltia punctata</i> *	duckweed
<i>Cyperus brevifolius</i> (<i>Kyllingia brevifolia</i>) *		<i>Lemna disperma</i>	duckweed
<i>Cyperus congestus</i> *	brown umbrella sedge	<i>Libertia peregrinans</i> (cult.)	
<i>Cyperus eragrostis</i> *	umbrella sedge	<i>Lolium arundinaceum</i> *	tall fescue
<i>Cyperus esculentus</i> *		<i>Lolium multiflorum</i> *	Italian rye grass
<i>Cyperus ustulatus</i>	giant umbrella sedge	<i>Lolium perenne</i> *	perennial rye grass
<i>Dactylis glomerata</i> *	cocksfoot	<i>Lolium rigidum</i> *	annual rye grass
<i>Dichelachne crinita</i>	plume grass	<i>Lomandra longifolia</i> * (cult.)	basket grass, mat rush
<i>Digitaria ciliaris</i> *	summer grass, crab grass	<i>Machaerina juncea</i>	
<i>Digitaria sanguinalis</i> *	summer grass, crab grass	<i>Machaerina sinclairii</i> (cult.)	
<i>Digitaria violascens</i> *	smooth summer grass	<i>Microlaena stipoides</i>	patiti
<i>Echinochloa crus-galli</i> *	barnyard grass	<i>Panicum dichotomiflorum</i> *	smooth witchgrass
<i>Echinochloa crus-pavonis</i> *	South American barnyard grass	<i>Parapholis incurva</i> *	coast barb grass, sickle grass
<i>Ehrharta erecta</i> *	veldt grass	<i>Parapholis strigosa</i> *	slender barb grass
<i>Eleocharis acuta</i>		<i>Paspalum dilatatum</i> *	paspalum
<i>Eleusine indica</i> *	crowsfoot	<i>Paspalum distichum</i> *	swamp paspalum, mercer grass
<i>Elytrigia pycnantha</i> *	sea couch	<i>Paspalum urvillei</i> *	vasey grass
<i>Elytrigia repens</i> *	garden couch, twitch	<i>Paspalum vaginatum</i> *	salt water paspalum
<i>Eragrostis brownii</i> *	bay grass	<i>Phalaris aquatica</i> *	Phalaris
<i>Festuca rubra</i> subsp. <i>commutata</i> *	chewings fescue	<i>Phalaris arundinacea</i> *	reed canary grass
<i>Ficinia nodosa</i> (cult. & wild)	knobby club-rush	<i>Phalaris minor</i> *	canary grass
<i>Gladiolus undulatus</i> *	wild gladiolus	<i>Phoenix canariensis</i> * (cult. & wild)	phoenix palm
<i>Glyceria declinata</i> *	floating sweet grass	<i>Phormium cookianum</i> (cult.)	wharariki
<i>Hedychium gardnerianum</i> *	khalili ginger	<i>Phormium tenax</i> (cult. & wild)	New Zealand flax, harakeke
<i>Hemerocallis</i> <i>lilioasphodelus</i> * (cult.)	day lily	<i>Poa annua</i> *	annual poa
<i>Holcus lanatus</i> *	Yorkshire fog	<i>Poa trivialis</i> *	rough-stalked meadow grass
<i>Iris foetidissima</i> *	stinking iris	<i>Polypogon monspeliensis</i> *	annual beard grass

<i>Polypogon fugax</i> *	
<i>Polypogon viridis</i> *	water bent
<i>Potamogeton cheesemanii</i>	common pondweed
<i>Potamogeton crispus</i> *	curly pondweed
<i>Puccinellia stricta</i>	salt grass
<i>Rytidosperma racemosum</i> *	wallaby grass
<i>Schoenoplectus tabernaemontani</i>	bulrush
<i>Setaria gracilis</i> (syn. <i>Setaria geniculata</i>) *	knot-root bristle grass
<i>Setaria pumila</i> *	yellow bristle grass
<i>Setaria verticillata</i> *	
<i>Sporobolus indicus</i> var. <i>capensis</i>	ratstail
<i>Triglochin striata</i>	arrow grass
<i>Typha orientalis</i>	raupo
<i>Vulpia bromoides</i> *	hair grass
<i>Vulpia myuros</i> var. <i>megalura</i> *	hair grass
<i>Vulpia myuros</i> var. <i>myuros</i>	hair grass
<i>Zantedeschia aethiopica</i> *	arum lily

Dicot trees, shrubs & woody climbers

<i>Acacia longifolia</i> *	Sydney golden wattle
<i>Acacia melanoxylon</i> * (cult.)	blackwood
<i>Agonis flexuosa</i> * (cult.)	willow myrtle
<i>Alectryon excelsus</i> (cult.)	titoki
<i>Alnus acuminata</i> subsp. <i>glabrata</i> * (cult.)	Mexican alder
<i>Alnus glutinosa</i> * (cult.)	common alder
<i>Anisodonteia capensis</i> *	Cape mallow
<i>Anredera cordifolia</i> *	Madeira vine
<i>Araujia hortorum</i> *	moth plant
<i>Aristotelia serrata</i> (cult.)	wineberry
<i>Avicennia marina</i> subsp. <i>australasica</i>	manawa, mangrove
<i>Berberis glaucocarpa</i> *	barberry
<i>Brachychiton acerifolius</i> * (cult.)	Illawarra flame tree
<i>Callistemon viminalis</i> * (cult.)	weeping bottlebrush
<i>Casuarina cunninghamiana</i> * (cult. and wild)	river she oak
<i>Casuarina glauca</i> * (cult. and wild)	swamp she oak
<i>Chrysanthemoides monilifera</i> *	boneseed
<i>Coprosma acerosa</i> (cult.)	sand coprosma
<i>Coprosma × kirkii</i> (cult.)	
<i>Coprosma lucida</i> (cult.)	shining karamu
<i>Coprosma macrocarpa</i> subsp. <i>macrocarpa</i> (cult.)	Three Kings karamu
<i>Coprosma macrocarpa</i> subsp. <i>minor</i> (cult.)	coastal karamu
<i>Coprosma macrocarpa</i> subsp. <i>minor</i> × <i>C. robusta</i> (cult.)	hybrid karamu
<i>Coprosma repens</i> (cult. and possibly natural)	taupata
<i>Coprosma robusta</i> (cult.)	karamu
<i>Corynocarpus laevigatus</i> (cult. and possibly natural)	karaka

<i>Corokia × cheesemanii</i> (cult.)	hybrid Corokia
<i>Cyphomandra betacea</i> *	tamarillo
<i>Dodonaea viscosa</i> subsp. <i>viscosa</i> (cult.)	akeake
<i>Dysoxylum spectabile</i> (cult.)	kohekohe
<i>Entelea arborescens</i> (cult.)	whau
<i>Eriobotrya japonica</i> *	loquat
<i>Eucalyptus botryoides</i> * (cult.)	southern mahogany
<i>Eucalyptus muelleriana</i> * (cult.)	yellow stringybark
<i>Eucalyptus ovata</i> * (cult.)	swamp gum
<i>Eucalyptus pilularis</i> * (cult.)	blackbutt
<i>Eucalyptus saligna</i> * (cult.)	Sydney blue gum
<i>Feijoa sellowiana</i> (syn. <i>Acca sellowiana</i>) * (cult.)	feijoa
<i>Ficus carica</i> * (cult.)	common edible fig
<i>Fraxinus angustifolia</i> subsp. <i>oxycarpa</i> 'Raywood' * (cult.)	claret ash
<i>Genista stenopetala</i> *	Madeira broom
<i>Geniostoma ligustrifolia</i> (cult.)	hangehange
<i>Gomphocarpus fruticosus</i> *	swan plant
<i>Griselinia littoralis</i> (cult.)	broadleaf
<i>Griselinia lucida</i> (cult.)	puka
<i>Haloragis erecta</i> subsp. <i>erecta</i> (cult. & wild)	shrubby haloragis, toatoa
<i>Hoheria populnea</i> (cult.)	lacebark
<i>Hoheria sexstylosa</i> (cult.)	narrow-leaved lacebark
<i>Ilex aquifolium</i> * (cult.)	holly
<i>Knightia excelsa</i> (cult.)	rewarewa
<i>Kunzea robusta</i> (cult.)	kanuka
<i>Lagunaria patersonii</i> * (cult.)	Norfolk Island hibiscus
<i>Leptospermum scoparium</i> (cult.)	manuka
<i>Ligustrum lucidum</i> *	tree privet
<i>Ligustrum sinense</i> *	Chinese privet
<i>Liquidambar styraciflua</i> * (cult.)	sweet gum
<i>Lonicera japonica</i> *	Japanese honeysuckle
<i>Lycium ferocissimum</i> *	boxthorn
<i>Melicope ternata</i> (cult.)	wharangi
<i>Melicotus ramiflorus</i> subsp. <i>ramiflorus</i> (cult.)	mahoe
<i>Metrosideros excelsa</i> (cult.)	pohutukawa
<i>Metrosideros kermadecensis</i> (cult.)	Kermadec pohutukawa
<i>Muehlenbeckia complexa</i> * (cult. & wild)	wire vine, beach pohuehue
<i>Myoporum insulare</i> * (cult.)	Australian ngaio, boobialla
<i>Myoporum laetum</i> (cult. and possibly natural)	ngaio
<i>Myrsine australis</i> (cult.)	mapou
<i>Olearia albida</i> (cult.)	
<i>Olearia angulata</i> (cult.)	
<i>Olearia solandri</i> (cult.)	salt marsh tree daisy
<i>Paraserianthes lophantha</i> subsp. <i>lophantha</i> *	brush wattle
<i>Physalis peruviana</i> *	cape gooseberry

<i>Piper excelsum</i> (cult.)	kawakawa
<i>Pittosporum crassifolium</i> (cult. & wild)	karo
<i>Pittosporum eugenoides</i> (cult.)	lemonwood
<i>Pittosporum tenuifolium</i> (cult.)	kohuhu
<i>Plagianthus divaricatus</i> (cult. & wild)	shore ribbonwood
<i>Pomaderris hamiltonii</i> (cult.)	Hamilton's kumerahou
<i>Pseudopanax lessonii</i> (cult.)	houpara
<i>Quercus cerris</i> * (cult.)	Turkey oak
<i>Quercus ilex</i> * (cult.)	holm oak
<i>Quercus palustris</i> * (cult.)	pin oak
<i>Quercus robur</i> * (cult.)	pedunculate oak
<i>Populus × canadensis</i> * (cult.)	hybrid poplar
<i>Ricinus communis</i> *	castor oil plant
<i>Rubus fruticosus</i> *	blackberry
<i>Salix cinerea</i> *	grey willow
<i>Salix × fragilis</i> * (cult.)	crack willow
<i>Salix matsudana</i> * (cult.)	Peking willow
<i>Salix matsudana</i> × <i>S. alba</i> * (cult.)	hybrid willow
<i>Solanum linnaeanum</i> *	apple of Sodom
<i>Solanum mauritianum</i> *	woolly nightshade, tobacco weed
<i>Sophora microphylla</i> (cult.)	kowhai
<i>Tecomaria capensis</i> *	Cape honeysuckle
<i>Ulex europaeus</i> *	gorse
<i>Veronica stricta</i> var. <i>egmontiana</i> (cult.)	Mt Egmont koromiko
<i>Veronica stricta</i> var. <i>stricta</i> (cult.)	koromiko
<i>Vitex lucens</i> (cult.)	puriri
<i>Vitis vinifera</i> *	grape

Dicot herbs

<i>Acanthus mollis</i> *	bear's breeches
<i>Alternanthera nahui</i>	nahui
<i>Alternanthera denticulata</i> *	
<i>Amaranthus deflexus</i> *	prostrate amaranth
<i>Amaranthus graecizans</i> *	mat amaranth
<i>Amaranthus lividus</i> *	purple amaranth
<i>Amaranthus powellii</i> *	redroot
<i>Anthemis cotula</i> *	stinking mayweed
<i>Antirrhinum orontium</i> *	wild antirrhinum
<i>Apium nodiflorum</i> *	water celery
<i>Apium prostratum</i>	native celery
<i>Arctium minus</i> *	burdock
<i>Arctotheca calendula</i> *	Cape weed
<i>Artemisia annua</i> *	annual wormwood
<i>Artemisia verlotiorum</i> *	mugwort
<i>Atriplex prostrata</i> *	orache
<i>Bellis perennis</i> *	lawn daisy
<i>Bidens frondosa</i> *	beggar's ticks
<i>Brassica oleracea</i> *	wild cabbage

<i>Callitriche stagnalis</i> *	starwort
<i>Calystegia sepium</i> subsp. <i>roseata</i>	pink bindweed
<i>Calystegia sepium</i> subsp. <i>sepium</i> *	pink bindweed
<i>Calystegia sepium</i> subsp. <i>roseata</i> × <i>C. soldanella</i>	hybrid bindweed
<i>Calystegia silvatica</i> *	great bindweed
<i>Calystegia soldanella</i>	shore bindweed
<i>Capsella bursa-pastoris</i> *	shepherd's purse
<i>Cardamine flexuosa</i> *	wavy bitter cress
<i>Cardamine hirsuta</i> *	bitter cress
<i>Carduus pycnocephalus</i> *	slender winged thistle
<i>Centaureum erythraea</i> *	centaury
<i>Centaureum tenuiflorum</i> *	slender centaury
<i>Cerastium fontanum</i> *	mouse-ear chickweed
<i>Cerastium glomeratum</i> *	annual mouse-ear chickweed
<i>Chenopodium murale</i> (syn. <i>Chenopodium murale</i>) *	nettle-leaved fat-hen
<i>Chenopodium album</i> *	fat-hen
<i>Cichorium intybus</i> *	chicory
<i>Ciclospermum leptophyllum</i> *	slender celery
<i>Cirsium arvense</i> *	Californian thistle
<i>Cirsium vulgare</i> *	Scotch thistle
<i>Conium maculatum</i> *	hemlock
<i>Cotula australis</i>	soldier's button
<i>Cotula coronopifolia</i>	bachelor's button
<i>Crassula decumbens</i> *	Cape Crassula
<i>Crassula helmsii</i>	pygmyweed
<i>Crepis capillaris</i> *	hawksbeard
<i>Cucurbita pepo</i> *	marrow
<i>Datura stramonium</i> *	thorn apple, jimson weed
<i>Daucus carota</i> *	wild carrot
<i>Delairea odorata</i> *	German ivy
<i>Dichondra repens</i>	native Mercury Bay weed
<i>Dittrichia graveolens</i> *	stinkwort
<i>Dysphania chenopodioides</i> (syn. <i>Chenopodium ambrosioides</i>) *	Mexican tea
<i>Dysphania pumilio</i> (syn. <i>Chenopodium pumilio</i>) *	clammy goosefoot
<i>Epilobium billardieranum</i> subsp. <i>cinereum</i>	willow-herb
<i>Epilobium ciliatum</i> *	tall willow-herb
<i>Epilobium hirtigerum</i>	hairy willow-herb
<i>Epilobium tetragonum</i> *	tall willow-herb
<i>Erechtites hieracifolia</i> *	American fireweed
<i>Erigeron sumatrensis</i> (syn. <i>Conyza albida</i>) *	broad-leaved fleabane
<i>Erigeron bonariensis</i> (syn. <i>Conyza bonariensis</i>) *	wavy-leaved fleabane
<i>Erodium cicutarium</i> *	storksbill
<i>Euphorbia helioscopia</i> *	sun spurge
<i>Euphorbia maculata</i> (syn. <i>Chamaesyce maculata</i>) *	spotted spurge

<i>Euphorbia peplus</i> *	milkweed	<i>Medicago arabica</i> *	spotted bur medick
<i>Foeniculum vulgare</i> var. <i>azoricum</i> *	fennel	<i>Medicago lupulina</i> *	black medick
<i>Fumaria capreolata</i> *	rampant fumitory	<i>Medicago nigra</i> *	bur medick
<i>Fumaria muralis</i> *	scrambling fumitory	<i>Medicago sativa</i> *	lucerne
<i>Galinsoga quadriradiata</i> *	galinsoga, gallant soldier	<i>Melilotus indicus</i> *	King Island melilot
<i>Galium aparine</i> *	cleavers	<i>Modiola caroliniana</i> *	creeping mallow
<i>Galium divaricatum</i> *	slender bedstraw	<i>Myosotis discolor</i> *	grassland forget-me-not
<i>Galium palustre</i> *	marsh bedstraw	<i>Myosotis laxa</i> *	water forget-me-not
<i>Gamochaeta coarctata</i> *	cudweed	<i>Myosotis sylvatica</i> *	garden forget-me-not
<i>Geranium dissectum</i> *	cut-leaved cranesbill	<i>Myriophyllum aquaticum</i> *	parrot's feather
<i>Geranium gardneri</i> *	Gardner's geranium	<i>Nasturtium officinale</i> (syn. <i>Rorippa nasturtium-aquaticum</i>) *	water cress
<i>Geranium homeanum</i>	native geranium	<i>Nicandra physalodes</i> *	apple of Peru
<i>Geranium molle</i> *	doves's foot cranesbill	<i>Oenanthe pimpinelloides</i> *	parsley dropwort
<i>Geranium purpureum</i> *	small herb Robert	<i>Orobancha minor</i> *	broomrape
<i>Helminthotheca echioides</i> (syn. <i>Picris echioides</i>) *	ox-tongue	<i>Oxalis corniculata</i> *	horned oxalis, wood sorrel
<i>Hydrocotyle tripartita</i> *	Australian hydrocotyle	<i>Oxalis exilis</i>	creeping oxalis
<i>Hypochaeris radicata</i> *	catsear	<i>Oxalis incarnata</i> *	
<i>Kickxia elatine</i> *	fluellin	<i>Oxalis pes-caprae</i> *	Bermuda buttercup
<i>Lactuca serriola</i> *	prickly lettuce	<i>Oxybasis ambigua</i> (syn. <i>Chenopodium glaucum</i>)	glaucous goosefoot
<i>Lactuca virosa</i> *	acrid lettuce	<i>Papaver somniferum</i> subsp. <i>setigerum</i> *	wild opium poppy
<i>Lamium purpureum</i> *	dead nettle	<i>Parentucellia viscosa</i> *	Tarweed
<i>Lapsana communis</i> *	nipplewort	<i>Pericallis</i> × <i>hybrida</i> *	cineraria
<i>Leontodon saxatilis</i> (syn. <i>L. taraxacoides</i>) *	hawkbit	<i>Persicaria decipiens</i> (syn. <i>Polygonum salicifolium</i>)	swamp willow weed
<i>Lepidium bonariense</i> *	Argentine cress	<i>Persicaria hydropiper</i> *	water pepper
<i>Lepidium didymum</i> (syn. <i>Coronopus didymus</i>) *	twin cress	<i>Persicaria</i> "long spike" (<i>Polygonum</i> "long spike" of Esler 2004) *	Perhaps just a robust form of <i>P. decipiens</i> . Very common in Auckland on wetland margins.
<i>Lepidium squamatum</i> (syn. <i>Coronopus squamatus</i>) *	wart cress	<i>Persicaria lapathifolia</i> *	pale willow weed
<i>Leucanthemum vulgare</i> *	oxeye daisy	<i>Persicaria maculosa</i> (syn. <i>Polygonum persicaria</i>) *	red shank, willow weed
<i>Lilaeopsis novae-zelandiae</i>		<i>Phytolacca octandra</i> *	inkweed
<i>Limosella lineata</i>	starwort	<i>Plantago coronopus</i> *	buck's horn plantain
<i>Linaria purpurea</i> *	purple linaria	<i>Plantago lanceolata</i> *	ribwort, narrow-leaved plantain
<i>Linum bienne</i> *	pale flax	<i>Plantago major</i> *	broad-leaved plantain
<i>Lobularia maritima</i> *	alyssum	<i>Polycarpon tetraphyllum</i> *	allseed
<i>Lotus angustissimus</i> *	slender birdsfoot trefoil	<i>Polygonum arenastrum</i> *	small-leaved wireweed
<i>Lotus pedunculatus</i> *	birdsfoot trefoil	<i>Polygonum aviculare</i> *	wireweed
<i>Lotus suaveolens</i> *	hairy birdsfoot trefoil	<i>Portulaca oleracea</i> *	purslane
<i>Lycopus europaeus</i> *	gypsywort	<i>Potentilla reptans</i> *	creeping cinquefoil
<i>Lysimachia arvensis</i> subsp. <i>arvensis</i> var. <i>arvensis</i> (formerly <i>Anagallis</i>) *	scarlet pimpernel	<i>Pseudognaphalium luteoalbum</i>	Jersey cudweed
<i>Lysimachia arvensis</i> subsp. <i>caerulea</i> (formerly <i>Anagallis</i>) *	blue pimpernel	<i>Ranunculus bulbosus</i> *	bulbous buttercup
<i>Lythrum hyssopifolia</i> *	hyssop loosestrife	<i>Ranunculus muricatus</i> *	spiny buttercup
<i>Malva arborea</i> (syn. <i>Lavatera arborea</i> ,) *	tree mallow	<i>Ranunculus parviflorus</i> *	small-flowered buttercup
<i>Malva neglecta</i> *	dwarf mallow	<i>Ranunculus repens</i> *	creeping buttercup
<i>Malva nicaeensis</i> *	French mallow	<i>Ranunculus sardous</i> *	hairy buttercup
<i>Malva parviflora</i> *	small-flowered mallow	<i>Ranunculus sceleratus</i> *	celery-leaved buttercup
<i>Malva pseudolavatera</i> (syn. <i>Lavatera cretica</i>) *	Cretan mallow	<i>Raphanus raphanistrum</i> subsp. <i>raphanistrum</i> *	wild radish
<i>Malva sylvestris</i> *	large-flowered mallow	<i>Rumex conglomeratus</i> *	clustered dock

<i>Rumex crispus</i> *	curled dock	<i>Thyridia repens</i> (syn. <i>Mimulus repens</i>)	native monkey musk
<i>Rumex obtusifolius</i> *	broad-leaved dock	<i>Torilis arvensis</i> *	spreading hedge parsley
<i>Rumex pulcher</i> *	fiddle dock	<i>Trifolium arvense</i> *	haresfoot trefoil
<i>Sagina apetala</i>	pearlwort	<i>Trifolium fragiferum</i> *	strawberry clover
<i>Sagina procumbens</i> *	procumbent pearlwort	<i>Trifolium pratense</i> *	red clover
<i>Samolus repens</i>	sea primrose, maakoako	<i>Trifolium repens</i> *	white clover
<i>Sarcocornia quinqueflora</i>	glasswort	<i>Trifolium resupinatum</i> *	Persian clover, reversed clover
<i>Selliera radicans</i>	remuremu	<i>Trifolium subterraneum</i> *	subterranean clover
<i>Senecio bipinnatisectus</i>	Australian fireweed	<i>Tripleurospermum inodorum</i> *	scentless mayweed
<i>Senecio esleri</i>	hairy groundsel	<i>Tropaeolum majus</i> *	garden nasturtium, Indian cress
<i>Senecio skirrhodon</i> *	gravel groundsel	<i>Urtica urens</i> *	stinging nettle
<i>Senecio vulgaris</i> *	groundsel	<i>Verbascum thapsus</i> *	woolly mullein, flannel plant
<i>Sherardia arvensis</i> *	field madder	<i>Verbascum virgatum</i> *	moth mullein
<i>Silybum marianum</i> *	variegated thistle	<i>Verbena brasiliensis</i> *	Brazilian vervain
<i>Sisymbrium officinale</i> *	hedge mustard	<i>Verbena incompta</i> *	purple top
<i>Solanum americanum</i>	small-flowered nightshade	<i>Veronica anagallis-aquatica</i> *	water speedwell
<i>Solanum chenopodioides</i> *	velvety nightshade	<i>Veronica arvensis</i> *	field speedwell
<i>Solanum nigrum</i> *	black nightshade	<i>Veronica peregrina</i> subsp. <i>peregrina</i> *	wandering speedwell
<i>Solanum opacum</i>	green-berry nightshade	<i>Veronica persica</i> *	scrambling speedwell
<i>Sonchus asper</i> *	prickly sow thistle	<i>Vicia disperma</i> *	small French tare
<i>Sonchus oleraceus</i> *	sow thistle, puha	<i>Vicia hirsuta</i> *	hairy vetch
<i>Spergula arvensis</i> *	corn spurrey	<i>Vicia sativa</i> *	vetch
<i>Spergularia marina</i>	sea spurrey	<i>Vicia tetrasperma</i> *	smooth tare
<i>Spergularia rubra</i> *	sand spurrey	<i>Vinca major</i> *	periwinkle
<i>Stachys arvensis</i> *	stagger weed, field woundwort	<i>Viola arvensis</i> *	field pansy
<i>Stachys sylvatica</i> *	hedge woundwort	<i>Xanthium spinosum</i> *	clotbur, Bathurst bur
<i>Stellaria media</i> *	common stitchwort, chickweed		
<i>Suaeda novae-zelandiae</i>	sea blite		
<i>Symphotrichum subulata</i> (syn. <i>Aster subulatus</i>) *	sea aster		

Occurrence of the grass *Brachypodium sylvaticum* at Thames

Mike Wilcox

Slender false brome or wood perennial brome (*Brachypodium sylvaticum*) is a European forest grass (Hubbard 1954) that has become naturalised in New Zealand (Edgar & Connor 2010). There are herbarium records of it from the Kaikoura coast in the South Island (Conway River, Kowhai River), from Hawkes Bay (Tiniroto), and Auckland (Albany, Waitakere Ranges, Waiheke Island). The first published mention of it being in New Zealand is probably Smith (1903), though Thomson (1922) records it from near Dunedin in 1897. Its favoured habitat is shaded open forest.

In March 2019 I came across a large population of this grass in the historic Shortland Cemetery, Thames. This picturesque cemetery was opened in the 1870s but there have been no burials for many years. It is on steep ground overlooking the Firth of Thames and has numerous planted pedunculate oak trees (*Quercus robur*) and several old Monterey pines (*Pinus radiata*) amongst the graves. The grass was growing in dense stands beside access paths through the pine and oak trees in the cemetery (Fig. 1), in places with other grasses, namely smilo grass (*Piptatherum*