PROJECT TWIN STREAMS CURRENT STATE REPORT

VOLUME 3: TERRESTRIAL

AUCKLAND COUNCIL

16238

30 JUNE 2016










Document Title:	Project Twin Streams Current State Report 2016, Volume 3: Terrestrial
Status:	FINAL
Date:	June 2016
Prepared For:	Auckland Council
Lead Author	Sarah Budd Ecologist Thomas Civil & Environmental Consultants Limited  30/6/2016 _____ _____ Signature Date
Reviewed and Approved By:	Melanie Dixon Principle Ecologist Thomas Civil & Environmental Consultants Limited  30/6/2016 _____ _____ Signature Date

1 BACKGROUND

1.1 RESTORING ECOLOGICAL CORRIDORS

Project Twin Streams aims to recreate and restore ecological corridors along the streams that flow from the forest-clad Waitakere Ranges, through the rural and urban parts of West Auckland, to the Waitematā Harbour. Functional ecological corridors contain healthy, self-sustaining vegetation communities that function both as habitat for native fauna, and areas which fauna can move through the landscape. For this reason an assessment of Project Twin Streams needs to look at changes in terrestrial biodiversity (both plant and animal), as well as water quality and in-stream habitat.

1.2 HISTORIC TERRESTRIAL MONITORING

The historical investigations of terrestrial fauna and flora in the PTS area are summarised in Table 1 below. Envirologic Limited initiated the first terrestrial monitoring programme in 2004, which ran for four years. More recently Boffa Miskell (2010) and Bioresearchers (2012) have completed monitoring of birds and bats respectively.

Table 1: Summary of Terrestrial Monitoring in Project Twin Streams Catchment

Topic	When	Methods	References
Long-tailed Bats	2004 2005 2006	Bat detector surveys	Envirologic 2004, 2005,2006, 2007) Bioresearchers (2012)
Invertebrates	2004 2006	Invertebrate pitfall trapping	Envirologic 2004, 2005,2006, 2007
Lizards	2004 2005 2006	Lizard artificial cover objects (ACOs) and spot-lighting night surveys	As discussed in Envirologic (2007). Original report not found. This was submitted separately and less widely circulated due to concern that collectors would target the species.
Birds	1997 - 2010	5-minute bird counts	1997-2004 Waitakere City Council monitoring. Envirologic (2004, 2005, 2006, 2007). Boffa Miskell (2010)
Vertebrate Pests	2005 2006	Vertebrate pest monitoring with tracking tunnels and wax tags	Envirologic 2004, 2005,2006, 2007)
Vegetation: Rapid transects	2004	Rapid vegetation assessments along 100 m transects	Envirologic (2004, 2006).
Vegetation: Phenology	2006 2007	Flowering and fruiting investigated along vegetation transects	Envirologic (2006, 2007).

1.3 INDIGENOUS TERRESTRIAL SPECIES PREVIOUSLY DETECTED IN THE PTS CATCHMENT AREA

The terrestrial species that have been found in the PTS catchment to date are summarised in Table 2 below. For fauna, more is known about the presence of birds than of other more cryptic and less well studied species. There is no summary available of the plant species found or vegetation communities.

Table 2: Indigenous Species Present in the PTS Catchment

Category	References
Bats	Long-tailed bats detected along Swanson Stream 2011/2012 (Bioresearchers, 2012) Long-tailed bats are considered nationally vulnerable (O'Donnell et al 2010)
Invertebrates	The following invertebrate groups were identified: carabids, other beetles, wetas, spiders, harvestmen, slaters, snails, slugs, millipedes, centipedes and litter hoppers (Envirologic 2004). The invertebrates were not identified to species level
Lizards	The known gecko fauna in West Auckland is forest gecko, pacific gecko, Auckland green gecko, copper skink and ornate skink. A report confirming which of these species are present in the PTS catchment has not been provided. Note this was not widely circulated due to concern that collectors would target these endangered species (Envirologic 2007) Plague (formerly known as rainbow) skinks now common in area
Birds	Tui, silvereye, kererū, grey warbler, kingfisher, fantail and pūkeko have been found during 5-minute bird counts The nocturnal morepork is also likely to be present in the catchment

1.4 2016 TERRESTRIAL MONITORING

Due to logistical constraints the current monitoring work was confined to May 2016. Given the time of year it was not possible to repeat fauna monitoring that is normally carried out during the summer months. For example, bats typically go into torpor during the cooler months, making them difficult to detect. The timeframe also meant some work was not repeatable – for example the plant phenology monitoring methodology required observations to be made monthly for 12 months so it was not possible to repeat this work in the three month timeframe provided for the 2016 monitoring work.

It was however, possible to repeat the rapid assessment vegetation transects that provide information about the structure and composition of the vegetation within riparian (i.e. streamside) corridors. Although some species are easier to identify when they are flowering, this work is not dependent on the time of year.

We also repeated 5-minute bird counts in eight locations where counts had been undertaken since 1997 and most recently in May 2010. Unfortunately our results were not able to be compared with previous data (see Section 3.1 for discussion).

2 BIRD MONITORING

2.1 INTRODUCTION

The riparian margin areas rehabilitated by PTS were expected to provide habitat corridors for native wild life, and that the number of native animal species found in these areas would also increase. The monitoring of birds within PTS catchment has been undertaken by the Waitakere City Council from as early as 1998 (as described in Boffa Miskell 2010), with Envirologic and Boffa Miskell undertaking bird surveys between 2004-2007 and 2008-2010 respectively at different locations. Unfortunately, the data collected during the current surveys is not directly comparable to these previous data sets. The reasons for this are summarised in Table 1 below.

This report therefore provides a snapshot of the birds that are currently present within the areas surveyed.

Table 3: Summary of Reasons Why Bird Data Could not be Compared with Historic Datasets

Data Set	Reasons Data Not Comparable
Waitakere City Council's Biodiversity Monitoring Programme	■ The average number of birds of each species observed at eight sampling sites was provided, but the raw data was not available ■ Details of counting station locations, number of surveys undertaken per sampling year, and the time of year the sampling was undertaken was not available
Envirologic Limited	■ Surveys were undertaken at 20 sites which were different to previous surveys ■ Surveys were undertaken during summer when the 2016 survey were undertaken in May. A survey in autumn in not comparable to a summer survey (as described in Hartley 2012)
Boffa Miskell	■ Surveys were undertaken three times at between one and five counting stations per site. Due to time constraints it was not possible to conduct as many bird counts during the 2016 study ■ Surveys undertaken at different times of the year across the three years (2008 = Feb/March; 2009 = March/April; 2010 = May). The 2016 surveys were undertaken in May only

2.2 METHODOLOGY

Five-minute bird counts (Dawson and Bull 1975) were undertaken at 8 sites across the PTS catchment (Table 2). These areas are similar to those used by Boffa Miskell in their bird monitoring work undertaken in 2010, however only one counting station was used at each site (on two different counting dates).

The counting station locations were estimated from the maps provided by Boffa Miskell (2010).

The first 5-minute bird count was carried out at each site during 2-3 May. The second was then carried out on 9 May at seven of the eight sites. During the second round of sampling the ecologist was unable to repeat the survey at Kelly's Bridge Road due to logistical constraints.

The five-minute bird count methodology was used as it is the standard method used in most cases to assess bird abundance. The number of individual birds of each species seen and/or heard was recorded. To the extent possible each individual was only recorded once. However,

when undertaking these counts it is not always possible to distinguish individuals and there is potential for some individuals to be recorded twice. This issue of possible duplication means that the results should be interpreted as a measure of the conspicuousness, which is an index of abundance. It is not a direct measure of actual abundance.

Table 4: Bird Monitoring Site Description (Map Provided in Appendix 1)

Site Name	Location	GPS NZTM Coordinates	
		Northing	Easting
Mountain Road Esplanade	Mountain Road, Henderson Valley	5915377	1739413
Henderson Valley Scenic Reserve	Candia Road, Henderson Valley	5915610	1742144
Shona Esplanade	Claret Place, Western Heights	5916693	1744364
Tram Valley Road	Tram Valley Road, Swanson	5917896	1739418
Swanson Scenic Reserve	Swanson Road, Swanson	5919179	1741713
Catherine Esplanade Reserve	Vitasovich Avenue, Henderson	5916883	1745606
Oratia Esplanade	Newham Road, McLaren Park	5915093	1745103
Kellys Bridge Esplanade	West Coast Road, Oratia	5912983	1743250

2.3 ANALYSIS

A total of 20 bird species were observed across the eight sites, which are made up of seven native species and 13 exotic species. In order to investigate the value of riparian corridors as habitat for native species the analysis of the data focuses on three key indicator species; tui, kererū and kingfisher (Fromont, Maseyk and Rutherford 1997). These species fill different ecological niches, and their presence is considered to provide an indication of ecosystem integrity. Table 3 provides a summary of the characteristics of these species that make them suitable indicator species. Silvereye, fantail and grey warbler were also present at many sites, but these species do not provide a good indication of habitat quality, as they are often found in fragmented environments with high proportions of non-native vegetation (Fromont, Maseyk and Rutherford 1997).

Table 5: Avian Indicator Species Characteristics (Fromont, Maseyk and Rutherford 1997)

Indicator Species	Characteristics
Tui	■ Nectarvore ■ Still present in urban forest fragments
Kererū	■ Frugivore important for seed dispersal of large seeded species ■ Not common in urban areas unless suitable habitat and food sources are present
Kingfisher	■ Diet includes fish ■ Presence may provide indicator of water quality

It was not possible to make comparisons between the diversity and relative abundance of birds at different sites from different habitat types, land uses or management regimes as the sites surveyed are unevenly distributed across these criteria (Table 4). For example four sites contained established native bush, while only one was in a residential garden. The difference in sampling effort therefore confounds any potential patterns in bird distribution. In order to investigate if PTS has increased the abundance or diversity of birds a comparison would need to be made with an urban control site. However, no such site was included in the original Boffa Miskell monitoring programme. Areas outside of the PTS management areas were surveyed, but a comparison between these sites is confounded by differences between urban and rural areas and would not provide insights into the impact of PTS on bird populations.

Table 6: Bird Survey Site Characteristics

Site Name	Habitat	Land Use	PTS Managed
Shona Esplanade	Established native bush	Urban	Yes
Swanson Scenic Reserve	Young native planting with emergent exotics	Urban	Yes
Catherine Esplanade Reserve	Young native planting with emergent exotics	Urban	Yes
Oratia Esplanade	Young Native Planting	Urban	Yes
Mountain Road Esplanade	Established native bush	Rural	No
Henderson Valley Scenic Reserve	Established native bush	Rural	No
Tram Valley Road	Established native bush	Rural	No
Kelly's Bridge Esplanade	Residential Garden	Rural	No

2.4 RESULTS

Raw data from this work was provided to the Environmental Services Unit. The paragraphs below provide a summary of the key findings.

2.4.1 *MOUNTAIN ROAD ESPLANADE*

Of the nine species observed at Mountain Road Esplanade, four were exotic and five were native. The native species included two indicator species (tui and kererū). The other three native species were fantail, grey warbler and silvereye (Table 5).

2.4.2 *HENDERSON VALLEY SCENIC RESERVE*

Eleven bird species were observed at Henderson Valley Scenic Reserve. This included eight exotic species. Native species observed were the indicator species tui; as well as fantail and silvereye (Table 5).

2.4.3 *SHONA ESPLANADE*

A total of ten species were detected at Shona Esplanade. The indicator species tui was present; as well as fantail, grey warbler and silvereye. A further six exotic species were also observed.

2.4.4 *TRAM VALLEY ROAD*

Fourteen bird species were observed at Tram Valley road. This included all three indicator species (tui, kererū and kingfisher). In addition, fantail, grey warbler, silvereye and pūkeko were also detected. A further seven exotic bird species were also observed (Table 5).

2.4.5 *SWANSON SCENIC RESERVE*

Of the 12 bird species observed at Swanson Scenic Reserve, seven were exotic and five were native. Two of the native species detected (tui and kingfisher) were indicator species. The remaining three native species were fantail, grey warbler and silvereye (Table 5).

2.4.6 *CATHERINE ESPLANADE*

No indicator species were observed at Catherine Esplanade Reserve. However fantail, silvereye, pūkeko and four exotic species were recorded. A total of seven bird species were detected (Table 5).

2.4.7 *ORATIA ESPLANADE*

The indicator species tui was recorded at Oratia Esplanade. In addition, fantail, grey warbler and nine exotic species were observed. A total of 12 bird species were detected (Table 5).

2.4.8 *KELLYS BRIDGE ESPLANADE*

Eight bird species were observed at Kellys Bridge Esplanade. This included only one indicator species (tui). In addition, fantail and silvereye were also detected. A further five exotic bird species were also observed (Table 5).

Table 7: Summary of Bird Species Detected at Each Site

Site Name	Tui	Kererū	Kingfisher	Other Native Species	Number of Exotic Species
Shona Esplanade	✓			Fantail, grey warbler & silvereye	6
Swanson Scenic Reserve	✓		✓	Fantail, grey warbler & silvereye	7
Catherine Esplanade Reserve				Fantail, silvereye & pūkeko	4
Oratia Esplanade	✓			Fantail & grey warbler	9
Mountain Road Esplanade	✓	✓		Fantail, grey warbler & silvereye	4
Henderson Valley Scenic Reserve	✓			Fantail & silvereye	8
Tram Valley Road	✓	✓	✓	Fantail, grey warbler, silvereye & pūkeko	7
Kellys Bridge Esplanade	✓			Fantail & silvereye	5

2.5 DISCUSSION

The sites surveyed all provided habitat for a mixture of native and exotic bird species. At least one indicator species was observed at seven out of the eight sites. Evidence that stray cats were being fed was observed at Catherine Esplanade. This may contribute to the absence of indicator species and generally low conspicuousness of birds at this site.

All three indicator species were observed at only one site.

Unfortunately, comparisons of bird diversity and levels of conspicuousness could not be made between sites or between previous years in order to assess the impact of PTS on bird populations. It is not possible to draw any conclusions as to whether bird numbers have increased, decreased or have been static since Project Twin Streams started in 2003. Future ecological restoration projects should prioritise the establishment of a robust monitoring programme as a key part of the project set up. This should ensure that monitoring work specifically deals with issues like seasonality, statistical power, balanced study design and the management of data. Such robust monitoring is essential if the goal is to detect meaningful trends in bird numbers and diversity. Specific advice relating to the use of five-minute bird counts to monitor changes in bird populations is provided in Hartley (2012).

3 VEGETATION MONITORING

3.1 INTRODUCTION

The Project Twin Streams project undertook extensive weed control and replanting along stream corridors. As well as potentially improving instream water quality values, the replanting had the purpose of creating an ecological linkage from the Waitakere Ranges to the Waitematā Harbour. The aim of the weed control and replanting of native plants was to return these areas to a state in which native plant species are dominant and self-sustaining.

Rapid assessments of vegetation transects were undertaken during May-June 2004 (Envirologic 2004 and Envirologic 2005). This methodology and the resulting data has been used to investigate changes in the vegetation present at these sites between 2004 and 2016, particularly looking at native dominance, weed abundance and seedling regeneration.

3.2 METHODOLOGY

The original reports by Envirologic (2004, 2005 & 2007) did not provide a detailed methodology, so a number of assumptions were made in order to repeat this work in May 2016. We were unable to repeat all 20 transects as the detail provided for one of the sites (Palomino Esplanade) was not sufficient to allow this transect to be repeated. As such, only 19 sites were assessed during the current surveys (Table 1). The sites were selected to provide a balanced geographical spread across the PTS catchments (Envirologic (2004, 2005 & 2007).

As Jack Colvin Park is outside of the current PTS area the results have not been reported here, but the data is provided in Appendix 2

Table 8: Vegetation Transect Details (Map of Locations Provided in Appendix 1)

Site Name	Transect Start Point GPS Coordinates		Transect End Point GPS NZTM Coordinates	
	Easting	Northing	Easting	Northing
Oratia Esplanade	1744752	5914504	1744769	5914590
Cranwell Esplanade	1745479	5917607	1745465	5917553
Catherine Esplanade	1745589	5916744	1745631	5916874
Opanuku Stream Esplanade Reserve	1743035	5915630	1743056	5915581
Plummer Domain	1744453	5916740	1744438	5916620
Henderson Park/Vintage Reserve	1744675	5917438	1744654	5917301
Woodside Glen*	1747465	5911230	1747526	5911219
Duck Park	1747024	5913385	1746999	5913514
Waikumete Subdivision	1746716	5913732	1746562	5913824
Ceramco Park	1747107	5912669	1747150	5912580
Kowhai Reserve	1746572	5912235	1746580	5912133
Parrs Park	1745484	5914856	1745557	5914715
Jack Colvin Park	1746812	5920024	1746708	5920073
Coletta Esplanade	1746016	5919016	1746019	5918934
Epping Esplanade	1745849	5918651	1745834	5918819
Swanson Stream Esplanade Reserve	1740730	5919171	1740650	5919230
Woodside Reserve	1743823	5919937	1743764	5919834
Urlich Esplanade Reserve	1742663	5919922	1742572	5919831
Swanson Stream Reserve	1740136	5919273	1740055	5919197

*Woodside Glen is the only site that has not undergone any restoration as part of PTS

The transects were walked by an experienced field ecologist, and the plants species observed within a 4m wide corridor were recorded and categorised by tier and abundance. Note that it appears from the 2004 data that transects were not in a direct straight line from the start to end points but rather followed landscape features such as paths and planting edges. As such, our field ecologist inferred the likely route on site.

The tier categories used in 2004 were:

- Seedling/Groundcover
- Sapling
- Shrub
- Subcanopy
- Canopy
- Emergent

As guidance was not provided as to how these categories were defined, new definitions had to be devised in order to provide consistency between sites during the 2016 work. These new definitions were inferred from the 2004 data and photographs, and are as follows:

- Seedling/Groundcover = 0.0-0.1m high
- Sapling = 0.1-1.0m high

- Shrub = low/young scrub
- Subcanopy = established scrub/revegetation planting
- Canopy = Mature vegetation 10-30m high
- Emergent = 30-50m high

We cannot be confident that these categories are the same as those used in 2004, and as such comparisons have been limited to overall diversity, regeneration within the seedling tier and changes in weed species presence. Weed species were defined as any species listed in the Invasive Weeds of Waitakere list or the National Pest Plant Accord.

The invasive weed *Tradescantia* was listed in the 2004 data within the sapling category. While this species is commonly considered a groundcover species, the 2016 survey lists it in the sapling category as well in order to remain consistent with the previous data.

In 2004 each species was given a score between one and five based on the following categories:

- 1 = <10% (Rare)
- 2 = 11-30% (occasional)
- 3 = 31-60% (common)
- 4 = 61-90% (very common)
- 5 = >90% (dominant)

This is described as a "relative abundance" measure in Envirologic (2004), but this does not appear to be how the term was applied[1]. As such, the 2016 survey used the simple common interpretations of the words "rare", "occasional", "common", "very common" and "dominant", and did not consider percent composition. Note that in order to be consistent with the methodology used in 2004, non-vascular species (e.g. mosses and lichens), groundcover species, epiphytes and climbers were generally not recorded unless these were considered to be serious weed species.

3.3 RESULTS

Descriptions of the finding from each site are provided below. Tables of the data are provided in Appendix 2 and summary graphs are provided in section 3.3.19.

3.3.1 *ORATIA ESPLANADE*

A total of 20 plant species were identified within the transect corridor at Oratia Esplanade in 2004, 65% of which were native species. In 2016 the overall species richness had increased to 24 species, and the proportion of natives had increased to 79%.

In 2004, one weed species (*Ligustrum lucidum*) and two native species (*Coprosma robusta* and *Macropiper excelsum*) were present within the seedling tier of the transect corridor. In 2016, no weed species were observed in the seedling tier and four native species were observed to be naturally regenerating at the site (*Coprosma robusta, Melicytus ramiflorus, Pittosporum crassifolium* and *Pittosporum eugenioides*).

Of the five weed species observed within the transect corridor in 2004, three were not present in 2016 (*Ligustrum lucidum, Phyllostachys aurea* and *Tradescantia fluminensis*). *Pinus radiata* and *Salix fragilis* are still present within the transect area although their abundance appears to be reduced.

[1] This can be seen in the data from Oratia Esplanade, where the shrub tier contained 14 species whose scores varied from 1 to 3. Total scores of these 14 species provide a minimum of 229% composition, greater than the 100% that would be expected.

3.3.2 *CRANWELL ESPLANADE*

Of the 15 plant species observed within the transect corridor at Cranwell Esplanade in 2004, 87% were native. In 2016 the total number of species had increased to 17, 94% of which were native.

In 2004 the seedling tier of the transect corridor contained just two species. These were the weed species *Ligustrum lucidum* and the native species *Coprosma robusta*, which were observed at similar abundances. In 2016 an additional five native species (including one canopy species) were observed in the seedling tier within the transect corridor (*Beilschmedia taraire, Coprosma lucida, Cordyline australis, Myrsine australis* and *Pseudopanax lessonii*). The non-weedy exotic species *Solanum nigrum* was also present within the seedling tier in 2016.

Ligustrum lucidum was the only weed species observed within the transect corridor in 2004. This species was not observed in 2016.

3.3.3 *CATHERINE ESPLANADE*

Seventeen plant species were observed within the transect corridor at Catherine Esplanade in 2004. Of these seventeen species 82% were native. Since this time the overall plant diversity within the transect area has increased to 29 species, 90% of which are native.

In 2004 three species were observed within the seedling tier of the transect corridor, these were the weed species *Ligustrum lucidum* and the native species *Cordyline australis* and *Myrsine australis*. In 2016, 13 native species were observed to be producing seedlings within the transect corridor. *Ligustrum lucidum* and the non-weedy exotic *Nandina domestica* were also observed in the seedling tier in 2016.

The weed species present within the transect corridor at Catherine Esplanade in 2004 included *Arajia sericifera*, *Ligustrum lucidum* and *Ligustrum sinense*. Of these *Ligustrum lucidum* is the only species still present. The climber, *Lonicera japonica* was present in 2016 but was not observed in 2004.

3.3.4 *OPANUKU STREAM ESPLANADE RESERVE*

A total of 12 plant species were identified within the transect corridor at Opanuku Stream Esplanade Reserve in 2004, 58% of which were native species. In 2016 the overall species richness had decreased to 11 species, but the proportion of natives had increased to 100%.

In 2004, one weed species (*Ligustrum lucidum*) and one native species (*Coprosma robusta*) were present within the seedling tier of the transect corridor. In 2016, no weed species were observed in the seedling tier and four native species were observed to be producing seedlings. These were *Coprosma robusta, Corynocarpus laevigatus, Cyperus ustulatus* and *Myrsine australis*.

None of the five weed species observed within the transect corridor in 2004 (*Hedychium gardnerianum, Ligustrum lucidum, Phyllostachys aurea, Salix fragilis* and *Tradescantia fluminensis*), were present in 2016.

3.3.5 *PLUMMER DOMAIN*

Of the 16 plant species observed within the transect corridor at Plummer Domain in 2004, 94% were native. In 2016 the total number of species had increased to 30 but the proportion of native species had decreased to 83%.

In 2004 the seedling tier of the transect corridor contained two native species (*Myrsine australis* and *Oleria furfuracea*), and no exotic species. In 2016 *Oleria furfuracea* was no longer present in this tier, but an additional nine native species were observed to be regenerating (*Alectryon excelsus, Carex secta, Cyathea dealbata, Cyperus ustulatus, Dacrycarpus dacrydiodies, Podocarpus tōtara, Pseudopanax arboreus, Rhopalostylis sapida,* and *Solanum aviculare)*. In addition, four weed species were observed in the seedling tier of the transect corridor in 2016. These were *Homalanthus populifolius, Ligustrum sinense, Racosperma mearnsii* and *Solanum mauritianum*.

Racosperma mearnsii was the only weed species observed within the transect corridor in 2004. This species is still present, although its abundance appears to have reduced. An additional four species have occupied the site since 2004. These are *Homalanthus populifolius, Ligustrum lucidum, Ligustrum sinense* and *Solanum mauritianum*.

3.3.6 *HENDERSON PARK / VINTAGE RESERVE*

Eighteen plant species were observed within the transect corridor at Henderson Park in 2004. Of these 18 species 72% were native. Since this time the overall plant diversity at within the transect corridor has increased to 26 species, 96% of which are native.

In 2004 four species were observed within the seedling tier of the transect corridor. These were the weed species *Ligustrum lucidum* and *Ligustrum sinense,* and the native species *Coprosma robusta* and *Myrsine australis*. Since then the number of native species within the seedling tier has increased. In 2016 13 native species were observed to be producing seedlings within the transect corridor. The weed species *Selaginella kraussiana* was also observed in the seedling tier in 2016.

The weed species present within the transect corridor at Henderson Park in 2004 were *Ligustrum lucidum, Ligustrum sinense* and *Elaeagnus x reflexal*. All of these species were not present in 2016. *Selaginella* was not listed on the species list in 2004 but was observed in 2016.

3.3.7 *WOODSIDE GLEN*

A total of 20 plant species were identified within the transect corridor at Woodside Glen in 2004, 85% of which were native species. In 2016 the overall species richness has increased to 32 species, but the proportion of natives had decreased to 59%.

In the seedling tier in 2004, there were three weed species (*Acmena smithii, Hedychium gardnerianum* and *Ligustrum lucidum*) and eight native species (*Coprosma spathulata*, *Geniostoma ligustrifolium, Hedycarya arborea, Melicytus ramiflorus, Myrsine australis, Pseudopanax crassifolius, Rhopalostylis sapida* and *Ripogonum scandens*). In 2016, the previously observed weed species had been replaced by *Acantus mollis, Agapanthus praecox, Asparagus scandens, Hedera helix, Nephrolepis cordifolia, Paraserianthes lophantha* and *Plectranthus ciliatus*. Native seedling diversity also changed between 2004 and 2016. *Geniostoma ligustrifolium* was the only species within this tier in both the 2004 and 2016 surveys. The other native species observed in 2016 were *Carpodetus serratus, Coprosma robusta* and *Kunzea ericoides.*

A similar pattern occurred with all weeds in all tiers; the three weed species (*Acmena smithii, Hedychium gardnerianum* and *Ligustrum lucidum*) were not observed in 2016, but appear to have been replaced by 10 new weed species within the transect corridor. These are *Acantus mollis, Agapanthus praecox, Asparagus scandens, Cotoneaster simonsii, Hedera helix, Hydrangea sp., Nephrolepis cordifolia, Paraserianthes lophanth, Plectranthus ciliatus* and *Tradescantia fluminesis*.

3.3.8 *DUCK PARK*

Of the 16 plant species observed within the transect corridor at Duck Park in 2004, 37% were native. In 2016 the total number of species had increased to 25, 64% of which were native.

In 2004 the seedling tier of the transect corridor contained three weed species (*Acmena smithii, Leycesteria, formosa* and *Ligustrum lucidum)*, and no native species. In 2016 *Acmena smithii* was no longer present in this tier, but an additional four weed species were observed (*Cyperus rotundus, Hedera helix, Solanum mauritianum* and *Zantedeschia aethiopica).* The seedlings of five native species were also observed within the transect corridor in 2016 (*Corynocarpus laevigatus, Cyathea dealbata, Macropiper excelsum, Myrsine australis* and *Pittosporum*)

Nine weed species were observed within the transect corridor at Duck Park in 2004. Of these *Acmena smithii, Cotoneaster simonsii, Hedychium gardnerianum* and *Racosperma mearnsii* were not present in 2016, while *Leycesteria, formosa, Ligustrum lucidum, Ligustrum sinense, Solanum mauritianum* and *Tradescantia fluminesis* were detected in 2016. Three weed species appear to have invaded into the site since 2004. These are *Cyperus rotundus*, *Hedera Helix* and *Zantedeschia aethiopica.*

3.3.9 *WAIKUMETE SUBDIVISION*

A total of 13 plant species were identified within the transect corridor at Waikumete Subdivision in 2004, 15% of which were native. In 2016 the overall species richness had increased to 36 species, and the proportion of natives had increased to 69%.

In 2004, one native species (*Coprosma robusta*) was observed in the seedling tier of the transect corridor. In 2016, *Coprosma robusta* was not present in this tier, but the seedlings of eight weed species (*Cyperus rotundus, Eriobotrya japonica, Ligustrum lucidum, Ligustrum sinense, Phyllostachys aurea, Selaginella kraussiana* and *Pseudosasa japonica*) and eight native species (*Coprosma rhamnoides, Corynocarpus laevigatus*, *Myrsine australis, Phormium* hybrid*, Podocarpus tōtara, Pteridium esculentum, Hebe stricta* and *Vitex lucens*) were observed.

Of the nine weed species observed within the transect corridor in 2004, five are no longer present. (*Hedychium gardnerianum, Leycesteria formosa, Racosperma mearnsii, Salix fragilis* and *Tradescantia fluminesis*). The four that are still present are *Ligustrum lucidum, Ligustrum sinense, Phyllostachys aurea* and *Solanum mauritianum,* all of which appear to have reduced in abundance.

Between 2004 and 2016 an additional six weed species have invaded into the transect corridor at the site. These are *Cyperus rotundus, Eriobotrya japonica, Selaginella kraussiana, Hypericum androsaemum, Pseudosasa japonica* and *Pennisetum clandestinum*.

3.3.10 *CERAMCO PARK*

Of the 14 plant species observed within the transect corridor at Ceramco Park in 2004, 64% were native. In 2016 the total number of species had increased to 16, 88% of which were native.

In 2004, the seedling tier of the transect corridor included four species. These were the weed species *Ligustrum lucidum, Ligustrum sinense* and *Racosperma mearnsii*, and the native species *Geniostoma ligustrifolium*. In 2016 *Geniostoma ligustrifolium, Ligustrum sinense* and *Racosperma mearnsii* were no longer present within the transect area as seedlings. New species observed in this tier in 2016 were the weed species *Phoenix canariensis,* and the native species *Alectryon excelsus, Corynocarpus laevigatus, Hoheria populnea, Myrsine australis, Pittosporum crassifolium* and *Solanum laciniatum*.

Five out of the six weed species present within the transect corridor in 2004 were not observed in 2016. Only *Ligustrum sinense* is still present within the transect corridor and only in low numbers within the seedling tier. Since 2004 only one weed species (*Phoenix canariensis)* has invaded the transect corridor.

3.3.11 *KOWHAI RESERVE*

Seventeen plant species were observed within the transect corridor at Kowhai Reserve in 2004. Of these 17 species 88% were native. Since this time the overall plant diversity within the transect corridor has increased to 25 species, 96% of which are native.

In 2004 three native species were observed within the seedling tier of the transect corridor. These were *Geniostoma ligustrifolium, Leucopogon fasciculatus* and *Myrsine australis*. Since then the number of native species within the seedling tier has increased. In 2016, 15 native

species were observed as seedlings within the transect corridor. The weed *Paraserianthes lophantha* was also present in the seedling tier in 2016.

The weed species present within the transect corridor at Kowhai Reserve in 2004 were *Pinus radiata* and *Racosperma mearnsii.* Neither of these species were present within the transect area in 2016. *Paraserianthes lophantha* was not observed in 2004 but was present in 2016.

3.3.12 *PARRS PARK*

A total of 13 plant species were identified within the transect area at Parrs Park in 2004, 69% of which were native species. In 2016 the overall species richness within the transect area had increased to 30, and the proportion of natives had increased to 83%.

In 2004, two weed species (*Leycesteria formosa* and *Ligustrum lucidum*) and three native species (*Coprosma robusta*, *Knightia excelsa* and *Leucopogon fasciculatus*) were observed in the seedling tier within the transect area. In 2016 *Leycesteria formosa* and *Ligustrum lucidum* were not present in the transect area, but four new weed species were observed (*Ligustrum sinense, Lonicera japonica, Selaginella kraussiana* and *Solanum mauritianum)*. Native seedling diversity within the transect corridor increased to ten species between 2004 and 2016.

Of the four weed species observed within the transect corridor in 2004, three were not seen in 2016. These were *Leycesteria formosa, Ligustrum lucidum* and *Racosperma mearnsii*. However, four new weed species were observed (*Ligustrum sinense, Lonicera japonica, Selaginella kraussiana* and *Solanum mauritianum*).

3.3.13 *COLETTA ESPLANADE*

Sixteen plant species were observed within the transect area at Coletta Esplanade in 2004. Of these sixteen species 94% were native. Since this time the overall plant diversity in the transect area has increased to 18 species, 89% of which are native.

In 2004 two native species were observed within the seedling tier of the transect area. These were *Myrsine australis* and *Oleria furfuracea.* In 2016 only *Myrsine australis* was still present in the seedling tier of the transect area. This species had been joined by two weed species, *Solanum mauritianum* and *Ulex europaeus.*

In 2004 *Racosperma mearnsii* was the only weed species present within the transect area at Coletta Esplanade. In 2016 *Solanum mauritianum* and *Ulex europaeus* were present but *Racosperma mearnsii* was not observed.

3.3.14 *EPPING ESPLANADE*

A total of 11 plant species were identified within the transect area at Epping Esplanade in 2004, 72% of which were native species. In 2016, the overall species richness within the transect area had increased to 34 species, and the proportion of natives had increased to 85%.

In 2004, one weed species (*Ligustrum lucidum*) was present within the seedling tier of the transect area. In 2016, *Ligustrum lucidum* was joined by *Paraserianthes lophantha* in the seedling tier, along with nine native species.

All of the three species observed in the transect area in 2004 (*Ligustrum lucidum, Ligustrum sinense* and *Solanum mauritianum*), were still present in 2016. In addition *Ligustrum sinense* has invaded the transect area and was recorded in 2016

3.3.15 *SWANSON STREAM ESPLANADE RESERVE*

Of the 16 plant species observed within the transect area at Swanson Stream Esplanade Reserve, 63% were native. In 2016 the total number of species had increased to 27, 78% of which were native.

In 2004 the seedling tier within the transect area contained three species. These were the non-weedy exotic species *Solanum nigrum*, and the native species *Coprosma robusta* and *Hebe stricta*. Seedling diversity within the transect area had increased by 2016, at which time five weed species and 11 native species were present.

Five weed species were identified in the transect area at Swanson Stream Esplanade Reserve in 2004. While the number of weed species observed in 2016 was similar to 2004 (six species), the composition of weeds had changed. Two of the weeds present in 2004 were not present in 2016 (*Acmena smithii* and *Paraserianthes lophantha*), while three new species were present (*Hedychium gardnerianum, Selaginella kraussiana* and *Tradescantia fluminensis*).

3.3.16 *WOODSIDE RESERVE*

Fourteen plant species were observed within the transect area at Woodside Reserve in 2004. Of these fourteen species 64% were native. Since this time the overall plant diversity within the transect area has increased to 22 species, 86% of which are native.

In 2004 four species were observed within the seedling tier of the transect area. These were the weed species *Ulex europaeus* and the native species *Coprosma robusta, Kunzea ericoides* and *Myrsine australis.* Since then the number of native species with the seedling tier of the transect area has increased. In 2016, eight native species were observed in the seedling tier along with three weed species (*Ligustrum sinense, Racosperma mearnsii* and *Ulex europaeus)*.

The weed species present within the transect area at Woodside Reserve in 2004 were *Ligustrum lucidum, Racosperma mearnsii, Salix fragilis, Solanum mauritianum* and *Ulex europaeus*. Of these *Racosperma mearnsii* and *Ulex europaeus* were the only species still present in 2016.

3.3.17 *URLICH ESPLANADE RESERVE*

A total of ten plant species were identified within the transect area at Urlich Esplanade Reserve in 2004, 60% of which were native species. In 2016 the overall species richness within the transect area had increased to 17 species, all of which were native.

In 2004, two weed species (*Leycesteria, formosa* and *Ligustrum sinense*) and one native species (*Mysine australis*) were present within the seedling tier of the transect corridor. In 2016, no weed seedlings were observed, while the number of native species within this tier increased to nine.

Of the four weed species observed within the transect area in 2004, all were no longer present in 2016. No new weeds were observed in this area in 2016.

3.3.18 *SWANSON STREAM RESERVE*

Of the 15 plant species observed in the transect corridor at Swanson Stream Reserve in 2004, 73% were native. In 2016 the total number of species within this area had increased to 22 and the native proportion had increased to 86%.

In 2004 the seedling tier included just two species. There were the weed species *Leycesteria, formosa* and the native species *Myrsine australis*. In 2016 an additional eight native species were observed in the seedling tier. The weed species *Rubus fruiticosus* and *Selaginella kraussiana* were also within the seedling tier of the transect corridor in 2016.

The four weed species present within the transect corridor in 2004 were *Leycesteria, formosa, Ligustrum lucidum, Pinus radiata* and *Tradescantia fluminensis.* In 2016 only *Pinus radiata* was still present and had been joined by *Rubus fruiticosus* and *Selaginella kraussiana.*

3.3.19 *OVERALL*

Within the transect areas the overall proportion of native species present has increased at 84% of sites (Figure 1), the diversity of native seedlings has increased at 89% of sites (Figure 2) and the diversity of weed species has reduced at 63% of sites (Figure 3).

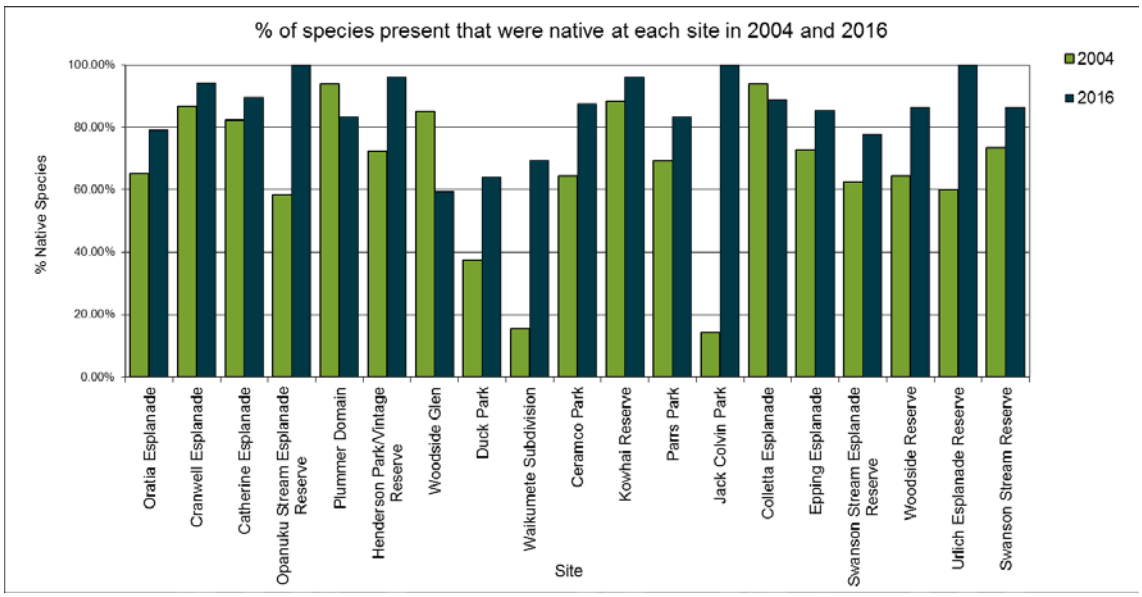


Figure 1: Percent of Species Present Within the Transect Corridor at Each Site that were Native in 2004 and 2016

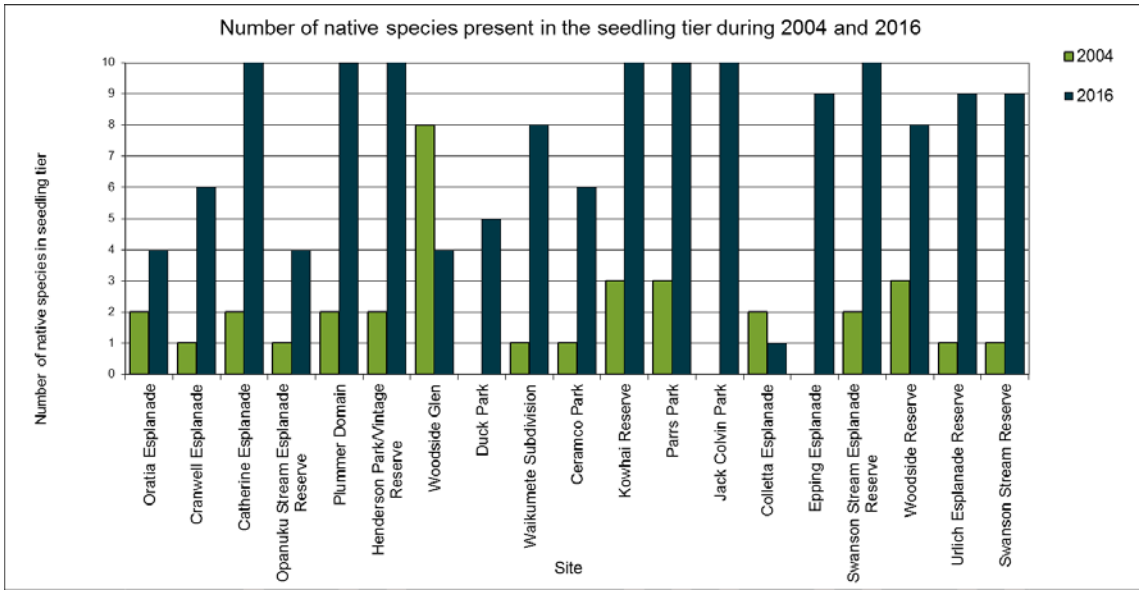


Figure 2: The Number of Native Species Observed within the Seeding Tier of the Transect Corridor at Each Site in 2004 and 2016

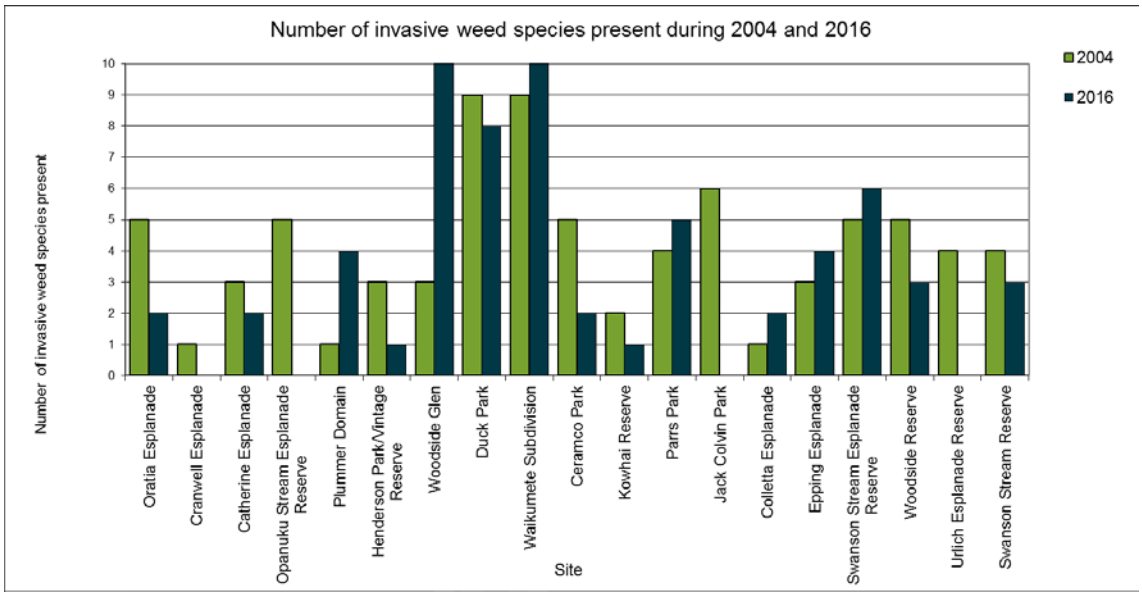


Figure 3: The Number of Invasive Species Observed Within the Transect Corridor at Each Site in 2004 and 2016

3.4 DISCUSSION

Most of the sites have shown an increase in the proportion of native species within the transect corridor. This is expected given that extensive planting has occurred at all but one site (Woodside Glen). The sites where the proportion of native species has not increased were Plummer Domain, Colletta Esplanade and Woodside Glen.

At Plummer domain the total number of native species at the site has increased from 15 in 2004 to 25 in 2016. However the diversity of weed species has also increased from one species in 2014 to five in 2016. The weed species at the site are now limited to the seedling and shrub tiers, indicating that while weed control may have been effective, ongoing work will be essential to prevent the site from becoming overrun by weeds in the future.

At Colletta Esplanade the decline in the proportion of natives is minimal and reflects the fact that the number of native species and weed species at the site both increased by one between 2004 and 2016. In 2004 *Racosperma mearnsii* was present in the shrub and subcanopy tiers, while in

2016 *Solanum mauritianum* and *Ulex europaeus* were limited to the seedling tier. This also indicates that, ongoing weed control will be essential to maintain the site.

The reduced proportion of native species at Woodside Glen in 2016 is primarily due to an increase in weed diversity while native diversity has remained relatively stable. This site has not undergone any weeding or planting work through PTS, and as such can be considered a reference site. While it is difficult to draw strong conclusions from a single reference site, it is possible that the work undertaken by PTS may have prevented a similar trend of increasing weed diversity from occurring elsewhere.

More significantly, the results also indicate that the populations of native species planted by PTS are now successfully producing seedlings. The two sites where the diversity of native seedlings did not increase were Woodside Glen and Colletta Esplanade. Again, Woodside Glen can be considered to act as a reference site and provides an indication of what may have occurred elsewhere if PTS had not been established. The reduction of native seedling diversity at this site coincided with an increase in weed seedling diversity and the establishment of *Tradescantia fluminensis* at the site. *Tradescantia fluminensis* is generally considered to be one of the worst weeds in Waitakere as it forms a ground cover that inhibits native regeneration. The reduction in native seedling diversity at Colletta Esplanade is partially due to the establishment of *Solanum mauritianum* and *Ulex europaeus* seedlings, as discussed above.

The abundance of weeds at most sites seems to have reduced. For example, *Tradescantia fluminensis* has reduced in extent and dominance. In 2004 it was found to be “occasional”, “common”, “very common” or “dominant” at seven of the sites. In 2016 it was only “rare” at two PTS managed sites, and “occasional” at Woodside Glen.

Despite this reduction in weeds, 79% of the sites surveyed still had weed species present. At most sites in 2016 the weed species were primarily within the seedling tier, again indicating that weed reinvasion is an ongoing risk.

Overall, the results of this study indicate that the weeding and planting work undertaken by PTS has moved the sites toward a state where native species are dominant and self-sustaining (i.e. producing seedlings). However it is also clear that weed species are continuing to establish. Although the amount of weed control required to keep these sites relatively weed-free is now much less than in 2004, weed control is required on an on-going basis. Riparian corridors are by their nature long and thin and subject to strong edge effects. As such, they are more prone to weed invasion than large and compact forest remnants.

4 REFERENCES

Bioresearchers (2012) Assessment of potential long-tailed bat habitat in the Auckland Region. Unpublished report for Auckland Council.

Boffa Miskell (2010). Waitakere Freshwater Fish & Bird Monitoring Programme. Report for Waitakere City Council.

Dawson, D. G. and Bull, P. C. (1975). Counting Birds in New Zealand Forests. Notornis, 22(2): 101-109.

Envirologic Limited (2004). Project Twin Streams Ecological Monitoring Programme: 1) Avifauna, 2) Vegetation & Phenology, 3) Terrestrial Invertebrates, 4) Lizards, 5) Long-Tailed Bats. Unpublished report for the Waitakere City Council

Envirologic Limited (2005). Project Twin Streams Ecological Monitoring Programme: 1) Avifauna, 2) Vegetation & Phenology, 3) Lizards, 4) Long-Tailed Bats, 5) Pest monitoring. Summer 2005. Unpublished report for the Waitakere City Council.

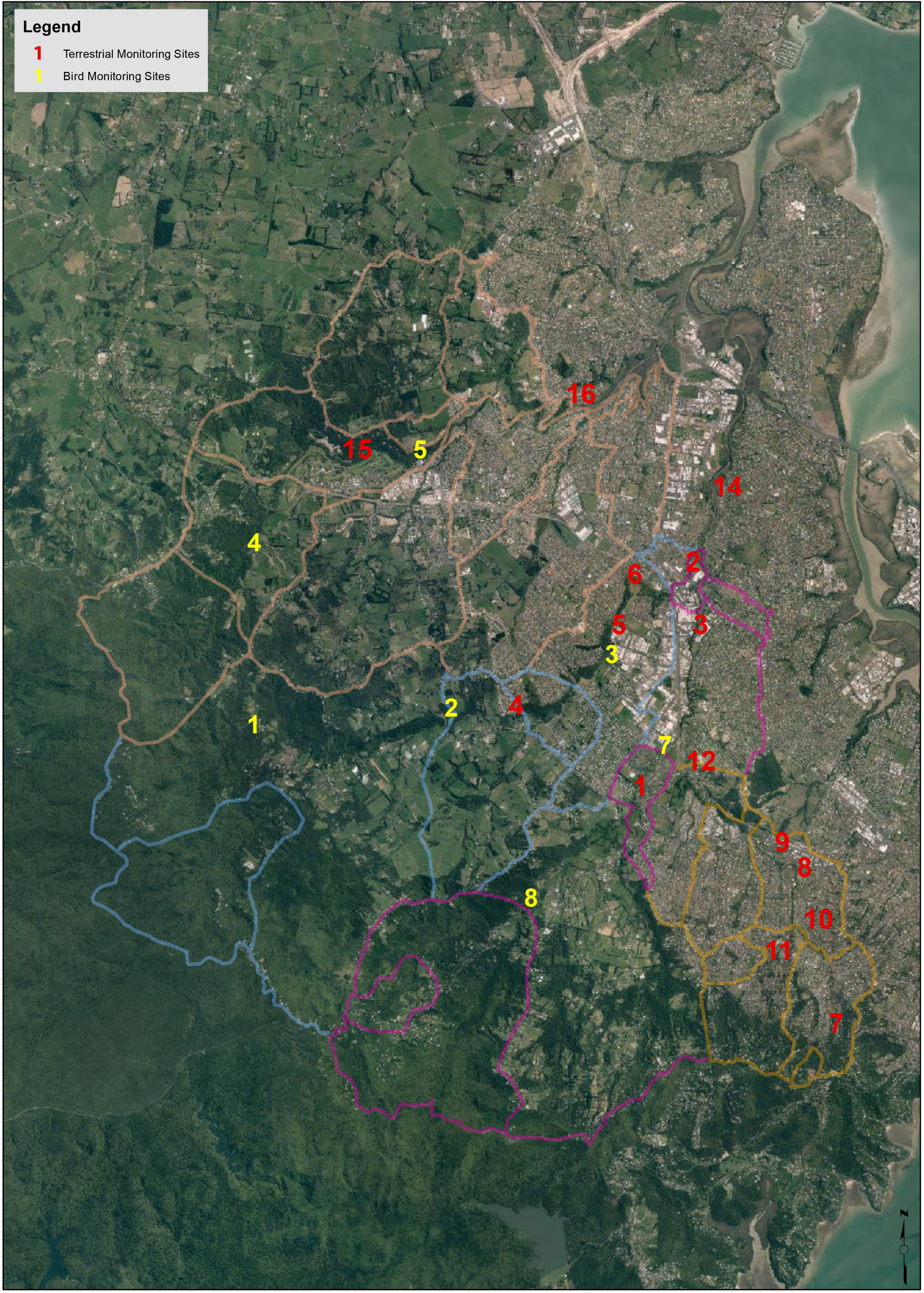
Envirologic Limited (2007). Project Twin Streams Ecological Monitoring Programme: Vegetation & Phenology January - December 2006. Unpublished report for the Waitakere City Council.

Fromont, M., Maseyk, F. and Rutherford, G. (1997) Clean Stream Waitakere: Pilot and Control Area Flora and Fauna Survey – Year 2. Report for Waitakere City Council.

Hartley, L. J. (2012) Five-minute bird counts in New Zealand. New Zealand Journal of Ecology. 36(3): 1-11.

O'Donnell, CFJ., JE., Hitchmough, RA., Lloyd, B. and Parsons, S. 2010: The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology, 37: 4, 297-311

APPENDIX 1: MAP OF THE LOCATIONS OF BIRD AND VEGETATION MONITORING LOCATIONS



16238 PTS Synthesis - Terrestrial and Bird monitoring sites

1:45,000

APPENDIX 2: VEGETATION TRANSECT TABLES

ORATIA VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus				1								
Aristotelia serrata					2							
Austroderia fulvida				1								
Coprosma repens					3							
Coprosma rhamnoides					2	2						
Coprosma robusta	2	1	2	2	3	1						
Cordyline australis			3	4	2	2						
Corynocarpus laevigatus				1								
*Cupressus macrocarpa**									2	1		
Cyathea dealbata				1								
Hebe stricta				2								
Hoheria populnea				2								
Kunzea ericoides					2	3						
*Ligustrum lucidum***	2		2		3							
Macropiper excelsum	1											
Melicytus ramiflorus		1		2	2	1						
*Metasequoia glyptostroboides**				1								1
Myrsine australis				3	2	3						
Passiflora tetrandra					2							
Phormium tenax					3	2						
*Phyllostachys aurea***					3							
*Pinus radiata***							2		2	1		
Pittosporum crassifolium		1										
Pittosporum eugenioides		1		1	1	1						
Pittosprum tenuifolium				3		1						
Plantanus sp.*									2	1		
Podocarpus totara				1								
Pseudopanax arboreus					1	1						
*Salix fragilis***							2		2	1		
*Tradescantia fluminensis***			4									
Vitex lucens				1								

Note: * = Exotic, ** = Weed

CRANWELL VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Beilschmedia tarairi		1										
Coprosma lucida		1										
Coprosma robusta	2	2	2	4	3	4		2				
Cordyline australis		1				2	3	1				
Dacrycarpus dacrydioides				1								
Dicksonia squarrosa					1		1					
Griselinia litoralis					2			1				
Hebe stricta					1	2						
Hoheria populnea			1									
Knightia excelsa						1						
Kunzea ericoides					3	2	2		1			
*Ligustrum lucidum***	2											
Melicytus ramiflorus				1								
Myrsine australis		1		1	2	1						
Phormium tenax					3	2						
Pittosporum tenuifolium					2							
*Plantanus sp.**							1					
Pomerderous kumeraho				1								
Pseudopanax arboreus					1							
Pseudopanax lessonii		1						2				
Pteridium esculentum				1								
Solanum aviculare					2							
*Solanum nigra**		1										
Sophora fulvida						1	1			1		

Note: * = Exotic, ** = Weed

CATHERINE ESPLANADE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus		2					3	1				
*Araujia sericifera***					2							
Arthropodium cirratum		1										
Carex secta		1										
Coprosma robusta					3	4						
Coprosma spathulata		1										
Cordyline australis	1	3	2		2		3	2				
Corynocarpus laevigatus		2						1				
Dicksonia squarrosa					2							
Dodonaea viscosa					1							
Dysoxylum spectabile				1								
Geniostoma ligustrifolium		1				2						
Hedycarya arborea				1		1						
Knightia excelsa				1			2					
Kunzea ericoides					2		2	3	3			
Leptospermum scoparium								2				
Leucopogon fasticulatum						1						
*Ligustrum lucidum***	2	2	2									
*Ligustrum sinense***					2							
*Lonicera japonica***				1								
Macropiper excelsum						1						
Melicytus ramiflorus		2			4	2		1				
Metrosideros excelsa							1	1				
Myoporum laetum						1						
Myrsine australis	2	3	2	3	3							
*Nandina domestica**		1										
Phormum tenax						2						
Pittosporum crassifolium		2										
Pittosporum euginiodies								1				
Pittosporum tenuifolium					2		2	3				
Podocarpus totara		1			1			1				
Prumnopitys frugeniodies		1										
Pseudopanax arboreus					2							
Rhopalostylis sapida		1										
Sophora fulvida							2					

Note: * = Exotic, ** = Weed

OPANUKU VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Carex disita				3								
Coprosma robusta	3	1	2		1	3						
Cordyline australis						3		2				
Corynocarpus laevigatus		3		3					1			
Cyperus ustulatus		1										
Dacrycarpus dacrydioides							2					
Dacrydium cupressinum							2					
Hebe stricta			1									
*Hedychium gardnerianum***					3							
Hoheria populnea						2						
Kunzea ericoides						3	3	3				
*Ligustrum lucidum***	3		3		3							
Melicytus ramiflorus				2	2	3		1				
Myrsine australis		1		2		1						
*Phyllostachys aurea***					3							
Pittosporum tenuifoium						2						
Psuedopanax arboreus						1						
*Salix fragilis***							3					
*Tradescantia fluminensis***			3									

Note: * = Exotic, ** = Weed

PLUMBER VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus		2										
Austroderia fulvida				3								
Austroderia fulvida				3								
Carex secter		1										
Coprosma rhamnoidies				1								
Coprosma robusta			2	3	3	3						
Cordyline australis				3	2	3						
Corynocarpus laevigatus					2							
Cyathea dealbata		2										
Cyperus australia		1										
Dacrycarpus dacrydiodies		1		1								
Dicksonia squarrosa					2							
Genistoma ligustrifolium				1								
Hebe stricta				2	2							
Hoheria populnea						2						
*Homalanthus populifolius***		1										
Kunzea ericiodies				3				3				
Leptospermum scoparium					3							
*Ligustrum lucidium***						1						
*Ligustrum sinense***		1										
Melicytus ramiflorus					3	3						
Myrsine australis	2	1	2		2	3		2				
Olearia furfuracea	2		2		2							
Olearia solandri					2							
Phormium cookianum					3							
Phormium tenax					3	2						
Pittosporum crassifolium				2	2							
Pittosporum eugenioides				2	3							
Pittosporum teniufolium				3								
Podocarpus totara		2								1		
Pseudopanax arboreus		1										
*Racosperma mearnsii***		1			2		3					
Rhopalostylis sapida		1		1								
Solanum aviculare		1										
*Solanum mauritianum***		1										
Sophora fulvida					2	1						

Note: * = Exotic, ** = Weed

HENDERSON PARK VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus					2		2	1				
Beilschmiedia tawa		1										
Carex disita		3										
Coprosma lucida				1								
Coprosma robusta	3		3	3	3							
Coprosma spathulata		1			2		3					
Cordyline australis		1		1								
Corynocarpus laevigatus		2		2								
Cupressus macrocarpa					2				3	2		
Cyathea medularus		1										
Dacrycarpus dacrydioides									1	1		
Dysoxylum spectabile				1								
*Elaeagnus x reflexa***					2							
Genistoma ligustrifolium						1						
Hebe stricta		1		1								
Hoheria populnea				2	1							
Kunzea ericoides		2	2	2		1						
*Ligustrum lucidum***	3		3		3							
*Ligustrum sinense***	3		3		3							
Macropiper excelsum				1								
Melicytus ramiflorus				3	2	3						
Myrsine australis	2	1	2	3	2	3						
Phormium tenax					2							
Pittosporum crassifolium				1								
Podocarpus totara		1		1			2	2	2	2		
Pseudopanax crassifolius				1	2							
Psudonpanax arboreus		1		1								
Quercus sp.*									2			
Rhopalostylis sapida		1										
*Selaninella kraussiana***		1										
*Solanum nigrum**			3		3							
Streblus banksii							1					
Vitex lucens		1										

Note: * = Exotic, ** = Weed

WOODSIDE GLEN VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
*Acanthus mollis***		1										
*Acmena smithii***	2											
*Agapanthus praecox***		2										
Agathis australis									2		2	
*Asparagus scandens***		1										
Carpodetus serratus		1										
Coprosma arborea							2					
Coprosma grandiflora					3							
Coprosma lucida				2	2		2					
Coprosma robusta		1		1								
Coprosma spathulata	2		2		3							
*Cotoneaster simonsii***						1						
Cyathea dealbata				1								
Dacrycarpus dacrydiodies				1								
Dicksonia squarrosa			3		3		3					
*Eucalyptus sp.**										1		
*Ficus elastica**								1				
Geniostoma ligutrifolium	2	1		2	3							
*Hedera helix***		1										
Hedycarya arborea	2		2		3	2						
*Hedychium gardnerianum***	2		3									
Hoheria populnea			1			2						
*Hydrangea sp***				1								
Knightia excelsa				1								
Kunzea ericoides		2							4	1		
Leucopogon fasciculatus				2								
*Ligustrum lucidum***	2				2							
Macropiper excelsum				2								
Melicytus ramiflorus	2		2	2	2	2	1					
Myrsine australis	2		2	2	2		3					
*Nephrolepis cordifolia***		2										
*Paraserianthes lophantha***		1										
Phormium tenax						1						
Phyllocladus trichomanoides				1					3			
Pittosporum eugenioides			1									
*Plectranthus ciliatus***		2										
*Prunus avium**						1						

Note: * = Exotic, ** = Weed

WOODSIDE GLEN VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Pseudopanax crassifolius	1					2						
Rhopalostylis sapida	1		2									
Ripogonum scandens	2											
Schefflera digitata				1								
*Tradescantia fluminesis***				2								

Note: * = Exotic, ** = Weed

DUCK PARK VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
*Acmena smithii***	4		3		3		3					
Coprosma robusta					3	3						
Cordyline australis					2	1	1					
Corynocarpus laegivatus		4				1						
*Cotoneaster simonsii***					2							
Cyathea dealbata		1		1								
*Cyperus rotundus***		1										
Dicksonia squarrosa					2		2					
*Eucalyptus saligna**									4	2		
Hebe stricta			2									
*Hedera helix***		1										
*Hedychium gardnerianum***			2		2							
Hoheria populnea						1						
Knightia excelsa				1								
Kunzea ericiodies				3		2		2				
Leptospernum scoparium				2								
*Leycesteria formosa***	2	1	3		4							
*Ligustrum lucidum***	2	1	3		3							
*Ligustrum sinense***			2		3	1	2					
Macropiper excelsum		1										
Melicytus ramiflorus					2	2	2					
Myrsine australis		3		3								
Phormium tenax					1	3						
Pittosporum cassiflolia		1										
Pittosporum euginiodies								1				
Pittosporum tenuifolium				2								
Podocarpus totara						1						
*Racosperma mearnsii***							3		2			
*Solanum mauritianum***		1	2		2							
*Tradescantia fluminensis***			5	1								
*Zantedeschia aethipopica***		1										

Note: * = Exotic, ** = Weed

WAIKUMETE SUBDIVISION VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus				1								
Austroderia fulvida				1								
Carex secta				1								
Carpodentus serratus				1								
Coprosma lucida				1								
Coprosma rhamniodies		1		1								
Coprosma robusta	2		2	3	3	3						
Cordyline australis				3	2	2	2					
Corynocarpus laevigatus		1										
*Cupressus macrocarpa**									3	1		
Cyathea dealbata				1								
*Cyperus rotundus***		1										
*Eriobotrya japonica***		1										
Hebe stricta		1		2								
*Hedychium gardnerianum***					2							
Hoheria populnea				3								
*Hypericum androsaemum***				2								
Kunzea ericiodes				2								
Leptospermum scoparium				3								
*Leycesteria formosa***					2							
*Ligustrum lucidum***		1	3		3							
*Ligustrum sinense***		1		1	2		3	1				
Macropiper excelsum				1								
Melicytus ramiflorus				3								
Myrsine australis		1										
*Pennisetum clanddestinum***		1										
Phormium "hybrid"		1										
Phormium tenax				4								
*Phyllostachys aurea***		1			5		4					
Pittosporum tenifolium				3								
Podocarpus totara		1		1								
Pseudopanax crassifolia				1								
*Pseudosasa japonica***		1										
Pteridium esculantum		1										
*Quercus sp.**											1	
*Racosperma mearnsii***									3			
*Salix fragilis***							3		3			

Note: * = Exotic, ** = Weed

WAIKUMETE SUBDIVISION VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
*Selanginella kraussiana***		1										
*Solanum mauritianum***				1	2							
Sophora sp.				1								
*Tradescantia fluminensis***			4									
Vitex lucens		1										

Note: * = Exotic, ** = Weed

CERAMCO PLACE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelcus		2		1								
Coprosma grandiflora			2		3							
Coprosma robusta				2	2		2					
Cordyline australis						1						
Corynocarpus laevigatus		2		1		1						
Cyathea medullaris							3					
Dacrycarpus dacrydioides											1	
Dicksonia squarrosa							3					
Geniostoma rupestre	2		2		3		2					
Hebe stricta				2								
*Hedychium gardnerianum***			3		3							
Hoheria populnea		3		3	1		1					
Kunzea ericiodes						1		2				
Leptospernum scoparium				1		1						
*Ligustrum lucidum***	3		3		3		2					
*Ligustrum sinense***	2	1	2		2							
Melicytus ramiflorus			3		3		2					
Myrsine australis		2	2	2	3							
Oleria rani				1								
*Phoenix canariensis***		1										
Phormium tenax				3								
Pittosporum crassifolium		2		2		2						
Podocarpus totara						1						
*Racosperma mearnsii***	2						3		3			
Solanum laciniatum		1		1								
*Tradescantia fluminensis***			5									

Note: * = Exotic, ** = Weed

KOWHAI RESERVE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alectryon excelsus				1								
Blechnum novae-zealandia		1										
Carex disata		1										
Coprosma lucida				2	2							
Coprosma rhamnoides		1			2							
Coprosma robusta				2	2							
Coprosma spathulata		1	2									
Cordyline australis		2		2	2		2					
Corynocarpus laevigatus		2		1								
Cyathea dealbata		1										
Dacrycarpus dacrydioides				1								
Dianella nigrum		1										
Dicksonia squarrosa			2		2							
Ficina nodosa		1										
Gahnia lacera				1								
Geniostoma rupestre	3	2	3	1	3							
Hedycarpa arborea				1	2							
Kunzea ericoides		2		1	2		4	3	2			
Lepidosperma laterale		1										
Leptospermum scoparium						2						
Leucopogon fasciculatus	2	2	2	2	2							
Myrsine australis	2	2	2	1	2							
*Paraserianthes lophantha***		1										
Phyllocaldus trichomaniodies						1						
*Pinus radiata***									2			
Pittosporum tenuifolium					2							
Podocarpus totara					2							
Pomaderris kumerahou					2							
Pseudopanax arboreus					2							
Pteridium esculentum		1										
*Racosperma mearnsii***									3			
Sophora sp.						1						

Note: * = Exotic, ** = Weed

PARRS PARK VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Aristotelia serrata				1								
Austroderia fulvida				1								
Beilschmedia tarairi			1									
Carex dissata		1										
Carpodetus serratus		2				2						
Coprosma rhamniodes				1								
Coprosma robusta	2	2	2	2	2							
Cordyline australis		1		2	2	2	2					
Cyathea dealbata		1				1		1				
Dacrycarpus dacrydiodies		1										
Dicksonia squarrosa					2							
Dysoxylum spectabile		1										
Genistoma ligustrifolium				2								
Hebe stricta				1	2							
Hedycarya arborea				1								
Hoheria populnea						4						
Knightia excelsa	3		3		2							
Kunzea ericoides				2	3		4			3		
Leucopogon fasciculatus	2		2		2							
*Leycesteria formosa***	2		2		3							
*Ligustrum lucidum***	3		3		4							
*Ligustrum sinense***		1										
*Lonicera japonica***		1										
Macropiper excelsum				1								
Melicystus ramiflorus						3						
Myrsine australis		3		3		3						
Phormium tenax					2							
*Pinus radiata***									2	1		
Pittosprorum crassifolium		2		2								
Pittosprorum tenuifolium						2						
Podocarpus totara				1								
Pseudopanax arboreous				1								
Pteridium esculentum		1										
*Racosperma mearnsii***							3					
Scheflera digitata				1								
*Selanginella kraussiana***		1										
*Solanum mauritianum***		1										
Vitex lucens				1								

Note: * = Exotic, ** = Weed

JACK COLVIN VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Austroderia fulvida				1								
Blechnum novae zealandia		1										
Carex dissita		1										
Carex secta		1										
Coprosma rahmniodes		1										
Coprosma robusta				2	2							
Cordyline australis				2								
Cyperus ustulatus		1										
Dianella nigra		1										
Geniostoma ligustrifloium		1										
Hebe stricta				2								
*Jasminum polyanthum***					3							
Kunzea ericoides				2								
*Leycesteria formosa***					2							
*Ligustrum sinense***					2		2					
Macropiper excelsum		1										
Myrsine australis		1										
Pittosporum crassifolium		2		2								
Pittosporum euginiodies		1										
*Rubus fruticosus***					2							
*Salix fragilis***									2			
*Ulex europaeus***					3							

Note: * = Exotic, ** = Weed

COLLETTA ESPLANADE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Apodisma similus				1								
Coprosma robusta			2		3							
Cordyline australis					2	2						
Corynocarpus laevigatus					2	2						
Cyathea dealbata				1								
Dicksonia squarrosa					2							
Hebe stricta				1	2							
Kunzea ericiodies				2		2		1				
Leptosporum scoparium						4						
Melicytus ramiflorus					3	3						
Myrsine australis	2	2	2	2	2	1						
Olearia furfuracea	2		2	1	2							
Olearia solandri					2							
Phormium cookianum					3							
Phormium tenax					3	3						
Pittosporum crassifolium				4	2	3		1				
Pittosporum eugenioides					3	2		1				
Pittosporum tenuifolium					3							
Pomaderris kumeraho				1								
Pteridium esculentum				1								
*Racosperma mearnsii***					2		3					
*Solanum mauritianum***		1										
Sophora sp.					2							
Typha orientalis				1								
*Ulex europeaus***		1										

Note: * = Exotic, ** = Weed

EPPING VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Apodisma similus		1										
Aristotelia serrata				1		1						
Austroderia fulvida				2								
Beilschmiedia tarairi		1										
*Calystegia sepium x silvatica**				1								
Carex secta				1								
Carpodeus serrata				1								
Coprosma rhamniodies				1								
Coprosma robusta		3		3	3	3						
Cordyline australis						3						
Cyathea medularus				1								
Entelea arborescens						1						
Genistoma ligustrifolium		1										
Hebe stricta				2								
Hoheria populnea						1						
Knightia excelsus				1								
Kunzea ericoides						2	2	2				
Leptospermum scoparium						2						
*Ligustrum lucidum***	2	1	2									
*Ligustrum sinense***						1						
Macropiper excelsum				1								
Melicytus ramiflorus				1								
Metrosideros excelsa				1								
Muehlenbeckia australus				3								
Muehlenbeckia complexa		1		2								
Muelenbeckia sp.					3							
Myoporum laetum								2				
Myrsine australis		3	2		2	2						
*Paraserianthes lophantha***	2	1	2		3		2					
Phormium tenax			1	3	3							
Pittosporum crassifolium		2			2	3						
Pittosporum tenufolium				2		2						
Plagianthus divaricata					3	1						
Podocarpus totara				2								
Pseudopanax lessonii				1								
Pteridium esculentum					2							
Rhopalosylis sapida		1										
Solanum laciniatum		1		1								
*Solanum mauritianum**					2							

Note: * = Exotic, ** = Weed

SWANSON STREAM ESPLANADE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
*Acmena smithii***					2							
Austroderia fulvida		1										
Blechnum novae zealandia		1										
Carpodetus serratus				1	2							
Coprosma lucida		1		1								
Coprosma robusta	3		2	2	3	2						
Cordyline australis		1		2	2	2						
Cyathea dealbata		2										
Cyathea medularis						1						
Dacrycarpus dacrydioides		1		1			3					
Dicksonia squarrosa					2							
Eucalyptus sp.*									3			
Gahnia sp.				2								
Genistoma ligustrifolium		1		1								
Hebe stricta	2		2		2							
*Hedcyhium gardnerianum***		1										
Hedycarya arborea		2	2		2	2						
Hoheria populnea		2				2						
Kunzia ericiodes				2								
Leptospermum scoparium						3						
Leucopogon fasciculatus			2		2							
*Ligustrum lucidum***		1	2		2							
Maropiper excelsum				1								
Melycitus ramiflorus		1		1		2						
Myrsine australis				2	3	2		1				
*Paraserianthes lophantha***					2							
Podocarpus totara				1								
Rhopalostylis sapida		1		2	2	1						
*Salix fragilis***									2	1		
*Selaginella kraussiana***		1										
*Solanum nigrum***	3	1	2		2							
*Tradescantia fluminensis***		1										
Vitex lucens						1						

Note: * = Exotic, ** = Weed

WOODSIDE RESERVE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Aristotelia serrata				1								
Austroderia fulvida				2								
Carex secta		1										
Coprosma lucida		2		3								
Coprosma robusta	3	3	2	3	2	3	1					
Cordyline australis		1				3						
Cyathea dealbata				2		1						
Dacryidum dacryoidies				1								
Dicksonia squarrosa					2		2					
Geniostoma rupestre					2							
Kniightia excelsa				1								
Kunzea ericoides	4		4		3	4		3				
Leucopogon fasciculatus		1	1	1	2							
*Ligustrum lucidum***			2		2							
*Ligustrum sinense***		1										
Melicytus ramiflorus			2	1	2		2					
Myrsine australis	2	1	2	2	2							
Olearia solandri			1		1							
Phormium tenax					2	1						
Pittosporum crassifolium		1		1								
*Racosperma mearnsii***		1							3			
*Salix fragilis***							2					
*Solanum mauritianum***			2		2							
Sophora sp.				1								
Tperidium esculentum				1								
*Ulex europaeus***	3	1	3		4							
Veronica stricta		1		2								
Vitex lucens				1		1						

Note: * = Exotic, ** = Weed

URLICH ESPLANADE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Carpodetous serrata		1										
Coprosma robusta		2	2	2	3							
Cordyline australis		1		1	3		3					
Corynocarpus laegivatus				2								
Cyathea dealbata				1								
Cyathea medullaris					2		2					
Dicksonia squarrosa					2		2					
Genistoma ligustrifolium		1										
Hebe stricta		1		2								
Hoheria populnea		1		2		1						
Knightia excelsa				1								
Kunzea ericoides				1		3	3		4			
*Leycesteria formosa***	3		3		3							
*Ligustrum lucidum***					4							
*Ligustrum sinense***	2		2		3		4					
Melicytus ramiflorus				1								
Myrsine australis	2	3	2	2	3	3	2					
Phormium tenax				2								
Pittosporum crasssifloia				1								
Podocarpus totara		1		1								
Pseudopanax arbora		1										
*Tradescantia fluminensis***			3									
Vitex lucens				1								

Note: * = Exotic, ** = Weed

SWANSON STREAM RESERVE VEGETATION RAW DATA

Species	Seedlings		Saplings		Shrubs		Subcanopy		Canopy		Emergent	
	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016	2004	2016
Alsueosmia macrophyla				1								
Coprosma robusta		3		2	3							
Cordyline australis		1	2	1	2		2					
Corynocarpus laegivatus						1						
Cyathea dealbata				2		2						
Cyathea medularas		1										
Dacrycarpus cupressinum										1		
Dacrycarpus dacrydioides									1		1	1
Dicksonia squarrosa					3		2					
Geniostoma rupestre		3			3	2						
Hedycarya arborea					2							
Kunzea ericoides					3	3	4			2		
Leucopogon fasciculatus			2		2							
*Leycesteria formosa***	3		3		2							
*Ligustrum lucidum***					2							
Melicytus ramiflorus		2	2		2		3					
Myrsine australis	2	2	2		3	2						
Phyllocladis trichomanoides		1										
*Pinus radiata***									2	2		
Podocarpus totara				1								
Pseudopanax arboreus				1	2		2					
Rophalostylis sapida		1										
*Rubus fruticosus***		1										
*Selanginella kraussiana***		1										
Sophora sp.						1						
*Tradescantia fluminensis***			3									
Unicia uncinata		1										
Veronica stricta				1								

Note: * = Exotic, ** = Weed