# DESKTOP ASSESSMENT OF ECOLOGICAL EFFECTS FOR THE TARA-IKA RESIDENTIAL DEVELOPMENT MASTER PLAN, LEVIN

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Ornate skink *(Oligosoma ornatum)* found in April 2021 during invertebrate surveys at Arapaepae Bush Block 1.

## Contract Report No. 6086

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# 1. INTRODUCTION

Muaūpoko Tribal Authority (Muaūpoko) requires a desktop ecological assessment for the Proposed Tara-Ika Plan Change Development (Tara-Ika) proposed by Horowhenua District Council. The rationale for this plan change is described in the Horowhenua District Plan Change (2021):

"*In response to population growth, the Horowhenua Growth Strategy 2040 identified Taraika (formerly known as Gladstone Green) as a growth area. This means the area has been identified as potentially suitable to be rezoned from Greenbelt Residential to a residential/urban zoning to allow for residential development and associated non-residential development (eg supportive commercial activities). Under the proposed zoning, the area could contain approximately 2,500 dwellings, a commercial centre, public parks/reserves, and potentially a primary school*."

The proposed development will cover a 420-hectare area of low-lying land to the southeast of Levin. This area is bounded to the north by Queen Street East, to the east by Gladstone Road, to the south by Tararua Road, and to the west by State Highway 57 (Arapaepae Road). The site  is located within the Manawatū Plains Ecological District, which is characterised by low-lying plains and terraces that formerly included semi-swamp flax and forests near rivers with mixed podocarp forest on free-draining soils. Formerly forested areas have been largely cleared for farms and modified by agricultural uses.

The proposed Tara-Ika development is adjacent to the Waiopehu Scenic Reserve and two other remnant forest areas where nationally 'Threatened' and 'At Risk' fauna species have previously been recorded. Muaūpoko is seeking to understand the ecological effects of the proposed urban development on these threatened fauna populations. To this end, Muaūpoko has asked Wildland Consultants Ltd to undertake a desktop ecological assessment of the Master Plan for the proposed Tara-Ika residential development. This assessment provides:

- A description and assessment of the ecological values of vegetation, habitat types, and fauna present within, and immediately surrounding, Tara-Ika (Sections 5-8);
- Estimation of the magnitude and level of ecological effects directly and indirectly resulting from the proposed subdivision and construction of the residential development, and ongoing effects of an increase in residential density (Section 10);
- An identification of opportunities to avoid, minimise, or mitigate potential adverse ecological effects (Section 10); and
- An identification of opportuntpart to provide positive outcomes for 'Threatened' and 'At Risk 'species inhabiting Waiopehu Scenic Reserve and the two forest remnants south of Queen Street East (Arapaepae Bush Blocks 1 & 2) (Section 11).

# 2. DESCRIPTION OF THE PROPOSED WORKS

The Horowhenua District Council has started the formal Resource Management Act (RMA) process (known as the Plan Change process), publicly notifying the Proposed Plan Change on 16 November 2020 (Horowhenua District Council 2020 and 2021). The Tara-Ika Master Plan is available online, with public submissions open to the Proposed Plan Change 4 – Taraika Growth Area. The proposed plan would rezoned the area from Greenbelt Residential to a residential/urban zoning to allow for residential development and associated non-residential development (e.g., supportive commercial activities; Appendix 1).

Under the proposed zoning, the area could contain approximately 2,500 dwellings, a commercial centre, public parks/reserves, and potentially a primary school. The area around Waiopehu Scenic Reserve and to the south would remain zoned as Greenbelt Residential. A number of roads, safety improvements to existing roads and stormwater infrastructure would be built to accommodate the new development. Tara-Ika is scheduled to be built prior to the O2NL highway's completion and therefore potential impacts to the area may occur sequentially.

# 3. ECOLOGICAL CONTEXT

## 3.1 Overview

The proposed Tara-Ika development is located on the eastern fringe of Levin within the Manawatū Plains Ecological District, which is described by McEwen (1987) as characterised by low altitude, predominantly undissected, loess-covered plains and terraces of Holocene alluvium. The climate within this ecological district has warm summers and mild winters, with prevailing west to northwest winds and a reliable and evenly distributed rainfall of between 800-1,200 millimetres per annum.

Vegetation within this ecological district formerly included semi-swamp forests dominated by kahikatea (*Dacrycarpus dacrydioides*) and pukatea (*Laurelia novae-zelandiae*) on low-lying land near rivers, with tōtara (*Podocarpus totara*) forest on free-draining soils. Mixed podocarp forest (rimu; *Dacrydium cupressinum*), mataī (*Prumnopitys taxifolia*), tōtara, and kahikatea occurred on parts of the plains and terraces east of Manawatū River, black beech (*Fuscospora solandri*) forest at Aokautere, and a large area of flax swamp surrounded the lower Manawatū. Currently, small, isolated, areas of harakeke (flax; *Phormium tenax*) swamp and forest remain, including locally characteristic tōtara forest and some black beech (*Fuscospora solandri*). However, the vegetation in this ecological district has been largely cleared for farms and, increasingly, for areas of orchards and market gardens.

## 3.2 Local context

Tara-Ika is located between the city of Levin and Lake Horowhenua to the northwest and the foothills of the Tararua Range to the east (Figure 1). The local landscape comprises a mosaic of agricultural and horticultural land, fragments of indigenous and exotic forest, shelterbelts, riparian corridors, and rural housing.

The proposed subdivision is within the close vicinity of two notable forested areas, Waiopehu Scenic Reserve and Arapaepae Bush Reserves[1] (consisting of two forest remnants) that are *c*.1.3 kilometres from each other (Figure 1). The Arapaepae Bush remnants are located on private land and the Waiopehu Scenic Reserve is a publicly accessible natural area owned by the Horowhenua District Council. The three forest remnants within the vicinity of the proposed subdivision are described below.

<u>Waiopehu Scenic Reserve</u>

The *c*.9.1-hectare Waiopehu Scenic Reserve (classified under the Reserves Act 1977) is located within the proposed development, in the northeast corner of the proposed plan. The land was acquired by the local government in 1889 for a waterworks reserve, was designated in 1901 for scenic purposes, and designated as a scenic reserve in 1912 and 1915 (Horowhenua District Council 2016). Waiopehu Scenic Reserve is zoned Open Space and the properties that adjoin the reserve are zoned Greenbelt Residential (Deferred) in the Horowhenua District Plan.

The reserve is notable as it is the only significant remnant of intact indigenous forest on the Horowhenua plain and one of the few remaining populations of the indigenous giant land snail *Powelliphanta traversi traversi* (NZ Botanical Society 2001, HDC 2016). The vegetation currently in the reserve is remnant podocarp-broadleaved forest that contains tawa, rewarewa (*Knightia excelsa*), pukatea, tōtara, māhoe (*Melicytus ramiflorus*), mataī, and tītoki (*Alectryon excelsus subsp. excelsus*) (HDC Council 2016, Kāhu Environmental 2021, S. Herbert and N. Fea pers. obs. 2021). Large areas of the forest floor are dominated by the invasive exotic plant tradescantia (*Tradescantia fluminensis*). Koputaroa stream traverses the reserve and feeds into a larger catchment to the northeast of Waiopehu Scenic Reserve which eventually joins the Manawatū River. The reserve is used for public recreation by walkers and cyclists. The presence of *P. traversi* in Waiopehu Scenic Reserve qualifies it as an ‘At Risk’ habitat type in the One Plan (Horizons Regional Council 2018).

<u>Arapaepae Bush Blocks</u>

The two remnant forest areas occur on properties 1006 Queen Street East (Arapaepae Bush Block 1) and 1024 Queen Street East (Arapaepae Bush Block 2). The mature forest areas cover *c*.1.40 hectares on Arapaepae Bush Block 1, and *c*.2.31 hectares on Arapaepae Bush Block 2 (Wildland Consultants 2021). Both forest areas are largely surrounded by pasture, and both are fenced. The substrate beneath both forest areas comprises a thin layer of topsoil over dry, dense sandy gravels to at least 3.5 metres depth.

Arapaepae Bush Block 1 is listed as a natural area in the Protected Natural Areas Programme Survey Report for the Manawatū Plains Ecological District (Ravine 1995). The forest is on a terrace tread and is described as:

> “*Flat and stony. Diverse forest dominated by tawa, mahoe over mahoe, kawakawa, hangehange; understorey of kawakawa and hen and chicken*

[1] The bush remnants referred to as “Arapaepae Bush Blocks” in this report are the same sites referred to as the “Queen Street East bush” in Kāhu Environmental (2021).

*fern. Windthrows from radiata pine shelter has created gaps which have a dense vine cover. Though dense and fenced weeds are becoming a problem. Shelter now old and creating problems.* Powelliphanta traversi *snail present*" (p. 200).

The presence of *P. traversi* in Arapaepae Bush Block 1 qualifies it as an 'At Risk' habitat type in the One Plan, however, Arapaepae Bush Block 2 does not meet the Schedule F habitats of significance criteria in the Horizons One Plan (Horizons Regional Council 2018). The Ōtaki to North Levin Expressway (Ō2NL) is proposed to pass between the Arapaepae Bush remnants (Figure 1).

Threatened Environment Classification

The Threatened Environment Classification is a combination of three national databases: Land Environments New Zealand (LENZ), Land Cover Database (LCDB) and the protected areas network (reflecting areas legally protected for the purpose of natural heritage protection). The classification combines this information into a simple and practical GIS tool, which illustrates the degree to which indigenous vegetation has been cleared and/or legally protected (Cieraad *et al.* 2015, Walker *et al.* 2015).

Tara-Ika is entirely located on Category 1 (<10% indigenous cover left) land environments (Figure 1). Land in Category 1 is considered to be a threatened environment (Walker *et al.* 2015).

## 3.3 Site description

The *c.*420-hectare proposed development, southeast of Levin, is bounded to the north by Queen Street East, to the east by Gladstone Road, to the south by Tararua Road, and to the west by State Highway 57 (Arapaepae Road). The area within the proposed development is currently agricultural land and grazed pastureland with a few residential dwellings, shelterbelts, rank grassland and gardens. The *c.*9.1-hectare Waiopehu Scenic Reserve is within the project footprint. There is a small unnamed streams that flows through Tara-Ika, in addition to the larger Waiopehu Stream. These streams all join and flow along a drain that lies beside Queen Street East and then head west to Lake Horowhenua.

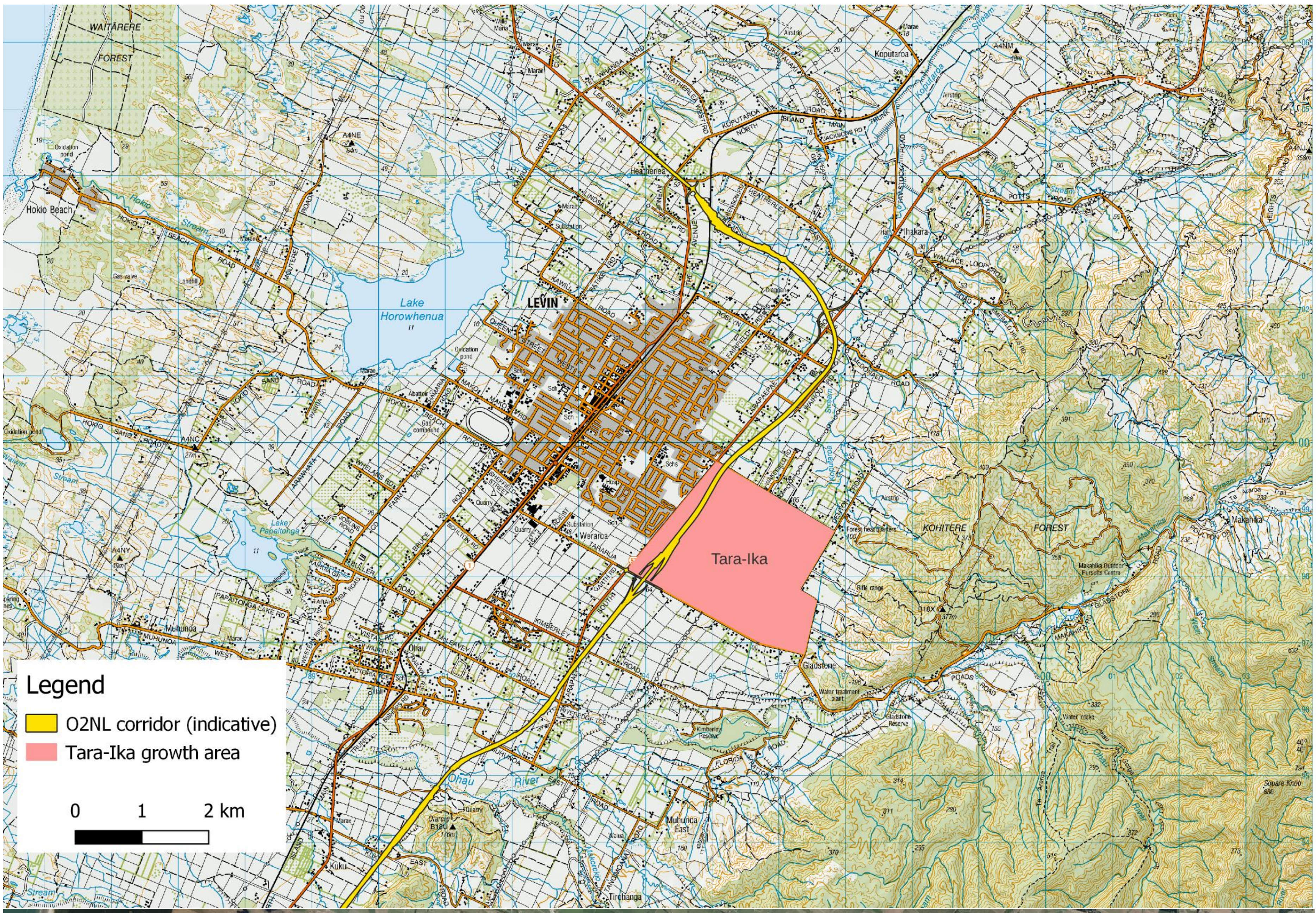



Figure 1. The location of the proposed Tara-Ika growth area in relation to Levin town, Lake Horowhenua, and the Ōtaki to North of Levin expressway corridor (Ō2NL), shown on Topo50 imagery (top) and aerial Manawatū-Whanganui rual aerial imagery (0.3 m) from 2015-2016[1] (bottom).

[1] https://basemaps.linz.govt.nz/v1/tiles/aerial/WMTSCapabilities.xml?api=c01fkekvrkpj2jfmr299tg8f0yx

# 4. STATUTORY CONTEXT

Aside from the Resource Management Act 1991, which governs the sustainable management of natural and physical resources (including the resource consenting process), additional pieces of legislation may apply to Tara-Ika. While National Policy Statements, National Environmental Standards and Regulations, and Regional and Local government policies and plans fall under the Resource Management Act, the Wildlife Act 1953 and Freshwater Fisheries Regulations 1983 are additional legislative provisions for the protection of indigenous fauna.

The information in this section has been included to provide an indication of the statutory context relevant to the ecological impact of the proposed activity, and is by no means an exhaustive list. It is recommended that an environmental planner and/or the relevant governing body is consulted for more detailed advice around the pertinent legislation.

## 4.1 Wildlife Act 1953

Irrespective of the level of effects on indigenous fauna, all indigenous lizards, frogs, bats, birds, and some indigenous invertebrates are protected under the Wildlife Act (1953). A permit under the Wildlife Act must be obtained from the Department of Conservation before any indigenous lizards, bats, birds, or snails can be disturbed, handled, translocated, or killed, and/or their habitats can be disturbed.

A Wildlife Act Authority (WAA) must be applied for and approved by the Department of Conservation before activities affecting fauna may commence. Depending on the fauna affected, this requires the submission of one or more species-specific management plans along with the appropriate application form.

## 4.2 Horizons One Plan

Horizons Regional Council's One Plan is a document that contains the Regional Policy Statement and Regional Plan for the Manawatū-Wanganui Region. As a local regulatory body, Horowhenua District Council is required to comply with the requirements of the One Plan in managing its reserves and protecting regionally significant natural features. Objectives and policies of this plan relevant to Tara-Ika are:

Objective 6-1 for Indigenous Biological Diversity:

*"Protect areas of significant indigenous vegetation and significant habitats of indigenous fauna and maintain indigenous biological diversity, including enhancement where appropriate."*

Policy 13-4 states that consent decision-making activities are regulated, having regard for significant habitats of indigenous fauna.

Under Policy 13-5, resource consent must not be granted unless:

- Any more than minor adverse effects on the habitat's representativeness, rarity, or distinctiveness are avoided.

- Where these effects are not avoided, they are remedied or mitigated.
- Where these effects are not avoided, remedied or mitigated, they are offset to result in a net biological diversity gain.

### 4.3 Horowhenua District Plan

The Horowhenua District Plan (2015) was prepared as a requirement of the Resource Management Act (1991). The District Plan zones the Council's parks and reserves as Open Space and designates a framework for managing the Open Space Zone. Future development rules are established for each zone. Objective 3.2.1 (Indigenous Biological Diversity) in the District Plan requires the protection of significant indigenous vegetation and significant habitats of indigenous fauna. Policies 3.2.2 and 3.2.3 are key elements.

## 5. METHODS

### 5.1 Desktop assessment

Background information on the biodiversity at, and immediately surrounding, the site was collated, including a search of local indigenous aquatic invertebrate and fish records in the New Zealand Freshwater Fish Database (NIWA 2021), bat records in the Department of Conservation bat distribution database (Version June 2020), and herpetofauna[1] records in the Department of Conservation's Bioweb Herpetofauna database (updated 25 May 2020), and iNaturalist (updated 4 July 2020). Existing ecological literature, and data previously collected by Wildland Consultants, from the general vicinity of Tara-Ika were compiled and reviewed.

### 5.2 Evaluation of ecological effects

The Environment Institute of Australia and New Zealand (EIANZ) guidelines for undertaking assessments of ecological effects in New Zealand (Roper-Lindsay *et al*. 2018) have been referred to when preparing this report. The ecological values of affected vegetation and habitats, and the magnitude and extent of the potential adverse ecological effects associated with the proposed subdivision have been evaluated using the methods described in the EIANZ guidelines. Professional opinion and expertise have been applied throughout the assessment to ensure that the results are ecologically robust.

## 6. VEGETATION AND HABITATS

### 6.1 Overview

The vegetation and habitat types in the proposed Tara-Ika were assessed using a combination of aerial photography, existing literature, a visit previously conducted to Waiopehu Scenic Reserve by two of the authors (S. Herbert and N. Fea pers. obs. 2021), and from an Ecological Impact Assessment of Arapaepae Bush Blocks prepared by

[1] That is, amphibians and reptiles.

Wildland Consultants (2021). Twelve terrestrial habitat types were identified from the area and are mapped in Figure 1. No wetlands were visible from aerial photography within the proposed development envelope of Tara-Ika.

## 6.2 Terrestrial habitats

### 6.2.1 Tawa-pukatea forest (*c*.9.1 hectares)

The vegetation in the Waiopehu Scenic Reserve (Figures 1 & 3) comprises remnant podocarp-broadleaved forest that supports tawa, rewarewa, rimu, pukatea, tōtara, māhoe, and tītoki (Horowhenua District Council 2016, Kahū Environmental 2021, S. Herbert and N. Fea pers. obs. 2021). Karaka (*Corynocarpus laevigatus*), pūriri (*Vitex lucens*), and rangiora (*Brachyglottis repanda*) are present in the subcanopy tier. Large areas of the forest floor are dominated by tradescantia. A few redwoods (*Sequoia sempervirens*), and hyrdrangeas (*Hydrangea macrophylla*) are present along the eastern edge of the reserve where it borders Gladstone Road.

### 6.2.2 Tītoki forest (*c.*0.2 hectare)

Tītoki forest occurs in the western corner of the Arapaepae Bush Block (Plate 1, Figures 3 & 4). Tītoki is abundant in the canopy, with occasional ornamental cherry (*Prunus* sp.), redwood, karaka, and poataniwha (*Melicope simplex*). The understorey is sparse, dominated by leaf litter with occasional tradescantia.

Plate 1: Tītoki forest at Property 465 in Arapaepae Bush Block 1. Sourced from Wildland Consultants (2021a). 18 June 2021.

### 6.2.3 False acacia-tītoki-cherry forest (*c.*0.4 hectare)

In this vegetation type, false acacia (*Robinia pseudoacacia*) is abundant, and tītoki and ornamental cherry are common (Plate 2, Figures 3 & 4). The understorey vegetation is limited to locally common inkweed (*Phytolacca octandra*) and tradescantia with occasional kawakawa (*Piper excelsum subsp. excelsum*).

Plate 2: False acacia-tītoki-cherry forest in Arapaepae Bush Block 1. Sourced from Wildland Consultants (2021a). 18 June 2021.

### 6.2.4 Vegetation Type 4: Tītoki-karaka forest (*c.*0.2 hectare)

Tītoki-karaka forest occurs in the south-eastern corner of Arapaepae Bush Block 1 (Plate 3, Figures 3 & 4). Tītoki and karaka are co-dominant in the canopy, while ornamental cherry trees are locally common along the margin. The understorey is relatively sparse and includes frequent māpou (*Myrsine australis*) and occasional poataniwha.

### 6.2.5 Tītoki-false acacia-poataniwha-karaka forest (0.34 hectare)

The canopy comprises tītoki, false acacia, poataniwha, and karaka (Plate 4, Figures 3 & 4). The understorey is relatively sparse with occasional kawakawa, while tradescantia is common in the ground tier.

Plate 3: Tītoki-karaka forest in Arapaepae Bush Block 1. Sourced from Wildland Consultants (2021a). 18 June 2021.

Plate 4: Tītoki-false acacia-poataniwha-karaka forest at Arapaepae Bush Block 1. Sourced from Wildland Consultants (2021a). 18 June 2021.

### 6.2.6 Ornamental cherry forest (0.05 hectare)

Along the southern margin of Arapaepae Bush Block 1, the canopy is dominated by ornamental cherry (Plate 5, Figures 3 & 4). This vegetation type includes one mature redwood tree and has a very sparse understorey.

### 6.2.7 Redwood forest (*c.*0.3 hectare)

Redwood dominates the canopy along the eastern margin of the Arapaepae Bush Block 1 (Plate 6, Figures 3 & 4). There are occasional tītoki, tarata (*Pittosporum eugenioides*), karaka, sweet cherry and false acacia present. In the understorey, there are occasional kawakawa, cape gooseberry (*Physalis peruviana*) and inkweed, while the ground cover is dominated by the indigenous grass species pātītī (*Microlaena stipoides*).

### 6.2.8 False acacia-karaka forest (*c.*1.2 hectares)

Mixed indigenous-exotic forest occurring in Arapaepae Bush Block 2 (Plate 7, Figures 3 & 4). The canopy of this vegetation type is dominated by false acacia, and karaka (a non-local indigenous species) is common. Māpou, tītoki, māhoe, Chinese windmill palm (*Trachycarpus fortunei*), and ornamental cherry are frequent. Emergent macrocarpa (*Cupressus macrocarpa*) are occasional.

Plate 5: Ornamental cherry forest at Arapaepae Bush Block 1. Source from Wildland Consultants (2021a). 18 June 2021.

Plate 6: Redwood forest at Arapaepae Bush Block 1. Sourced from Wildland Consultants (2021a). 12 April 2021.

Plate 7: False acacia-karaka forest at Arapaepae Bush Block 2. Sourced from Wildland Consultants (2021a). 22 March 2021.

### 6.2.9 Macrocarpa-radiata pine-false acacia forest (*c.*1.0 hectare)

Along the northern margin of the Arapaepae Bush Block 2, macrocarpa, radiata pine and false acacia are common in the canopy, with occasional English oak (*Quercus robur*) and redwood (Plate 8, Figures 3 & 4). Frequent poataniwha, karaka, māhoe, kawakawa, Jerusalem cherry (*Solanum pseudocapsicum*) and barberry (*Berberis glaucocarpa*) occur in the understorey.

Plate 8: Macrocarpa-radiata pine-false acacia forest at Arapaepae Bush Block 2. Sourced from Wildland Consultants (2021a). 18 June 2021.

### 6.2.10 Karaka-māhoe-kawakawa scrub (*c.*0.1 hectare)

There is an area of scrub dominated by karaka, māhoe and kawakawa, with frequent ornamental cherry, locally common old man's beard (*Clematis vitalba*) and occasional porokaiwhiri in Arapaepae Bush Block 2 (*Hedycarya arborea*). The reduced abundance of false acacia within this vegetation type differentiates it from the other vegetation types within this forest area (Figures 3 & 4).

### 6.2.11 Exotic grassland with shelterbelts (*c.*407 hectares)

Most of the site appears to be grazed pasture with shelterbelts dividing fields in some places. Based on the plant records from the two Arapaepae Bush Blocks (see Appendices 1 & 2), this habitat type is most likely to be comprised of browntop (*Agrostis capillaris*), cocksfoot (*Dactylis glomerata*), and common pasture-inhabiting herbaceous species including thistles (*Cirsium arvense* and *C. vulgare*), and white clover (*Trifolium repens*). The shelterbelts are most likely to comprise a mixture of macrocarpa and pine, but may also include some of the other exotic tree species noted within the area such as redwoods and false acacia.

## 6.3 Wetland habitats

No wetlands are visible from aerial photography, nor was there evidence in the literature reviewed of any wetlands being present within the proposed development envelope of Tara-Ika.

## 6.4 Aquatic habitats

According to topographic mapping, there appears to be one minor (un-named) stream running through the block of land targeted for development, plus a tributary of the Koputaroa Stream that runs through the existing residences at the north-eastern end of Pohutukawa Drive where it meets Gladstone Road and Waiopehu Scenic Reserve (Figure 2). While the un-named stream appearson the topographic map to flow south into the Ōhau river, no stream channel is visible on aerial imagery of this site (Figure 3). Koputaroa Stream runs northward from the site to eventually join the Manawatū River.

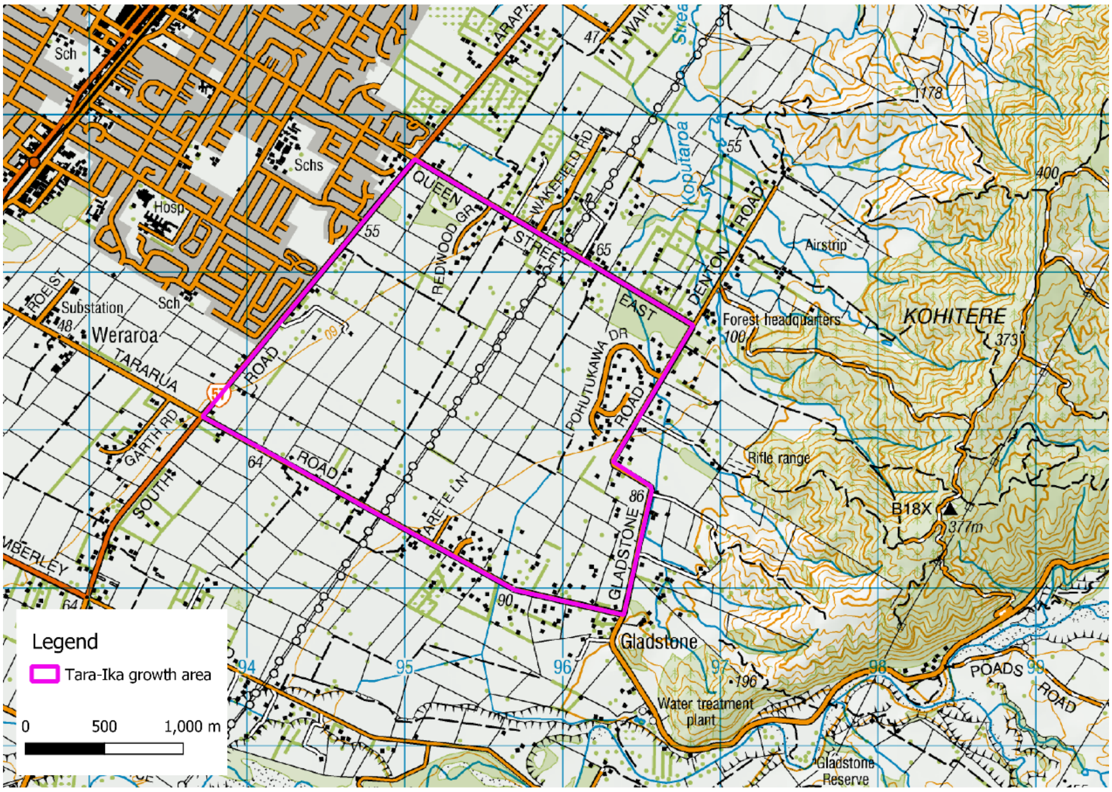


Figure 2. Topographic (Topo50 series) map indicating two streams within the proposed Tara-Ika growth area.

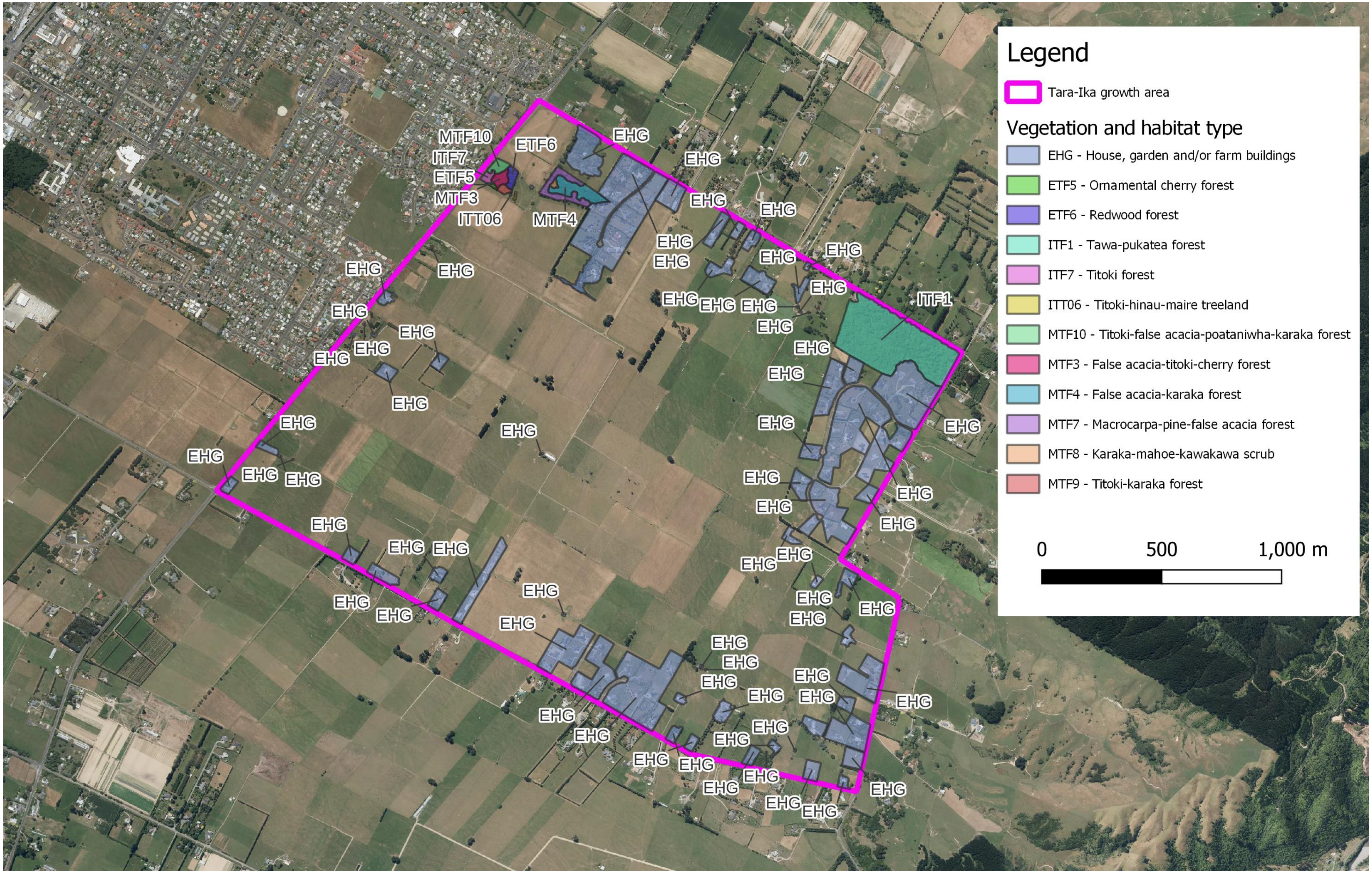


Figure 3. Overview of the proposed Tara-Ika growth area showing the forest types that could be mapped from existing information. With the exception of the area immediately surrounding the Arapaepae Bush Blocks, houses, gardens and/or farm buildings (EHG) have been mapped using 2015-2016 aerial imagery. The vegetation not mapped appears to be a mixture of exotic grassland with shelterbelts.

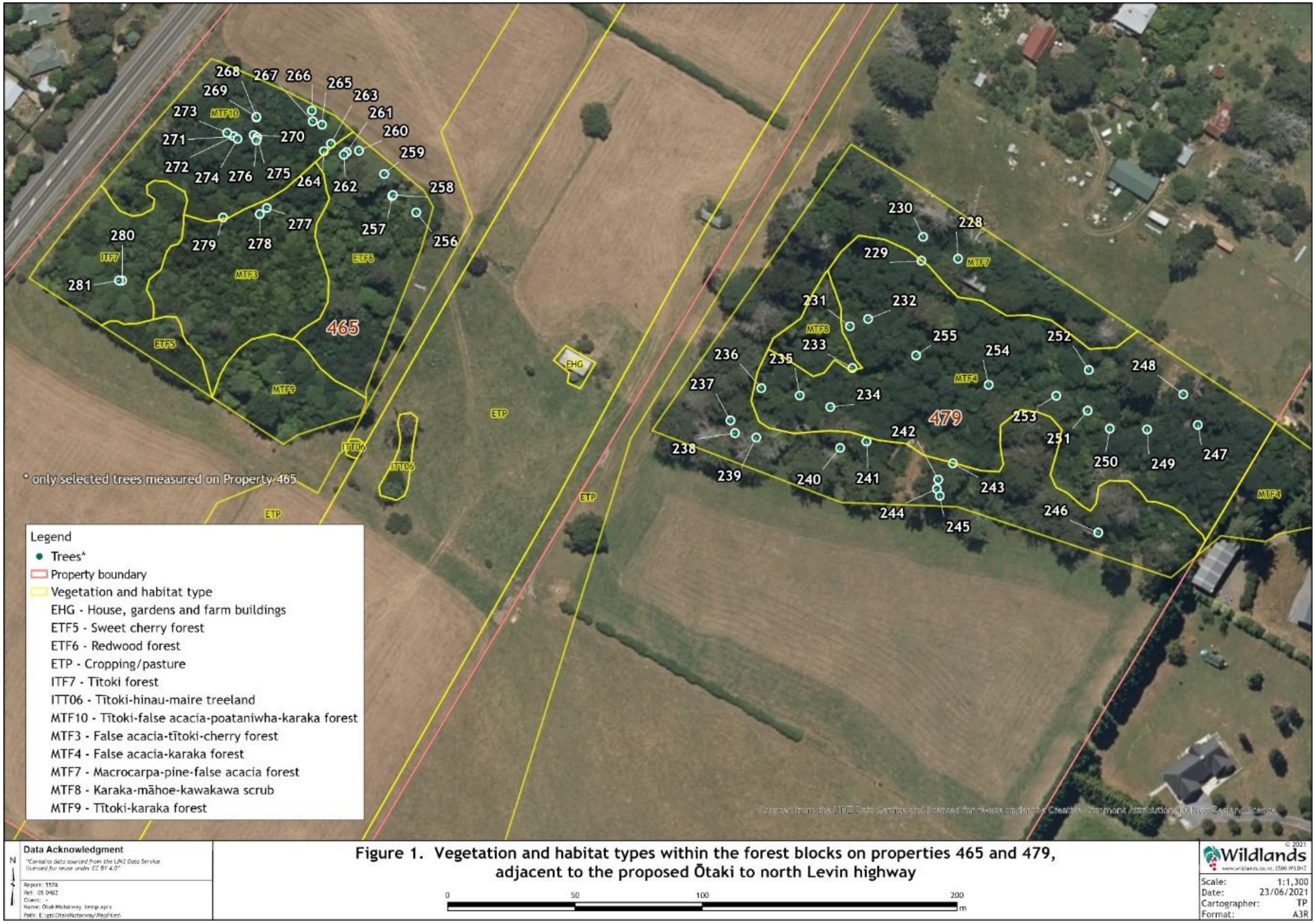


Figure 4. Map of the vegetation and habitat types within, and immediately surrounding, the Arapaepae Bush Blocks. Reproduced from Wildland Consultants (2021a).

# 7. FLORA

## 7.1 Arapaepae Bush Blocks

The flora of the Arapaepae Bush Blocks was surveyed for the Ō2NL project (Wildlands 2021). At Arapaepae Bush Block 1, 26 indigenous and 35 exotic plant species were recorded during the survey (Appendix 2). At Arapaepae Bush Block 2, 32 indigenous and 25 exotic plant species were recorded during the survey (Appendix 3). None of the plant species recorded are nationally threatened as per de Lange *et al*. (2018).

Mature tītoki, poataniwha, rewarewa (*Knightia excelsa*), mataī, porokaiwhiri, māpou and kaikōmako (*Pennantia corymbosa*) trees were recorded within the Arapaepae Bush Blocks, and these trees are what remains of the vegetation that would have once been widespread within the local landscape.

Exotic and pest plant species are widespread throughout both of the forest areas. The National Pest Plan Accord (NPPA) includes six pest plant species recorded within the forests, including:

- Old man's beard
- Japanese honeysuckle (*Lonicera japonica*)
- Tradescantia
- Tree privet (*Ligustrum lucidum*)
- Italian evergreen buckthorn (*Rhamnus alaternus*)
- Banana passionfruit (*Passiflora tarminiana*, and *Passiflora tripartita*)

The Horizons Regional Council Regional Pest Management Plan 2017-2037, lists four pest plant species recorded within the forests as 'Progressive Containment' pest species, including:

- Old man's beard
- Blackberry
- Italian evergreen buckthorn
- Banana passionfruit

There are an additional nine species recorded within the forests that have the potential to become pest plant species at the site, including:

- Ornamental cherry
- Tasmanian blackwood (*Acacia melanoxylon*)
- Elaeagnus (*Elaeagnus* × *reflexa*)
- Cherry laurel (*Prunus laurocerasus*)
- Barberry
- Chinese windmill palm
- False acacia
- Karaka
- Jerusalem cherry
- Himalayan honeysuckle

# 8. FAUNA

## 8.1 Birds

Few records are available from both the eBird and iNaturalist databases for the area within Tara-Ika. The New Zealand Bird Atlas shows that kākā (*Nestor meridionalis*; At Risk - Recovering), red-crowned parakeet (*Cyanoramphus novaezelandiae*; At Risk - Relict) and bush falcon (*Falco novaeseelandiae* “bush”; At Risk - Recovering) have been seen nearby. Pīhoihoi (New Zealand pipit; *Anthus novaeseelandiae*; At Risk - Declining) have also been seen nearby in the foothills of the Tararua Range, and the pasture environments at the site would be capable of supporting this species.

Six indigenous bird species were recorded from the Arapaepae Bush Blocks (Wildland Consultants 2021a). These were:

- Pīwakawaka (fantail; *Rhipidura fuliginosa*)
- Tūī (*Prosthemadera novaeseelandiae novaeseelandiae*)
- Kererū (*Hemiphaga novaeseelandiae*)
- Kāhu (swamp harrier; *Circus approximans*)
- Pūkeko (*Porphyrio melanotus*)
- Riroriro (grey warbler; *Gerygone igata*)

The vegetation at the site may also provide habitat for other common indigenous species such as silvereye (*Zosterops lateralis lateralis*). None of these species are classified as nationally ‘Threatened’ or ‘At Risk’ as per Robertson *et al.* (2017). Forest remnants like the ones within Tara-Ika and Waiopehu are important for birds for providing food and connecting habitat in the wider region.

## 8.2 Aquatic fauna

Based on a search of the NZ Freshwater Fish Database (NIWA 2021), there are records of indigenous freshwater fish and invertebrates from Tara-Ika (Table 1). The longfin eel (*Anguilla dieffenbachii*) is an At Risk - Declining species and possibly in the Waiopehu Stream, however, the local *Anguilla* sp. record was not identified to a species level (Goodman *et al.* 2014; Table 1).

Brown mudfish (*Neochanna apoda*; At Risk - Declining) are known from the Koputaroa catchment (according to the New Zealand Freshwater Fish Database and eDNA sampling by Horizons). These species may also be present in the area of stream running through Waiopehu Scenic Reserve, which was not surveyed.

Table 1. Freshwater fauna records for contributing and receiving waterways of the Tara-Ika development envelope (NIWA 2021).

| Stream | Stream name in database | Database record no. | Common name | Scientific name |
|---|---|---|---|---|
| Waiopehu Stream | Koputaroa Stream Manawatū River | 21609 | Common bully | *Gobiomorphus cotidianus* |
| | | | Banded kōkopu | *Galaxias fasciatus* |
| | | | Unid. eel | *Anguilla* sp. |
| | | | Kōura | *Paranephrops planifrons* |
| Waiopehu Stream | Koputaroa Stream Manawatū River | 9237 | Kōura | *Paranephrops planifrons* |
| | | | Unid. bully | *Gobiomorphus sp.* |
| | | | Banded kōkopu | *Galaxias fasciatus* |
| Koputaroa Stream | Koputaroa Stream Manawatū River | 20713 | Upland bully | *Gobiomorphus breviceps* |
| | | | Longfin eel | *Anguilla dieffenbachii* * |
| | | | Shortfin eel | *Anguilla australis* |
| Koputaroa Stream | Koputaroa Stream tributary Manawatū River | 19601 | Shortfin eel | *Anguilla australis* |
| | | | Kōura | *Paranephrops planifrons* |
| | | | Upland bully | *Gobiomorphus breviceps* |
| | | | Unid. eel | *Anguilla* sp. |
| Koputaroa Stream | Koputaroa Stream tributary Manawatū River | 19600 | Common bully | *Gobiomorphus cotidianus* |
| | | | Unid. bully | *Gobiomorphus* sp. |
| | | | Kōura | *Paranephrops planifrons* |
| | | | Shortfin eel | *Anguilla australis* |
| | | | Unid. eel | *Anguilla* sp. |
| | | | Banded kōkopu | *Galaxias fasciatus* |

* National Threat Classification: At Risk - Declining

## 8.3 Bats

Long-tailed bats are classified as 'Threatened – Nationally Critical' by O'Donnell *et al.* (2018). They preferentially forage in forest edge and riparian habitats of both indigenous and exotic forest types (Griffiths 2007, Rockell 2017), and have adapted to roosting in exotic tree species such as pine (*Pinus* spp.) and macrocarpa. They also forage over farmland and urban areas (Griffiths 2007, O'Donnell and Borkin 2021). Long-tailed bats have very large home ranges (O'Donnell and Borkin 2021).

There are three subspecies of lesser short-tailed bat recognised in New Zealand and the subspecies present in the central and southern North Island and Taranaki (central lesser short-tailed bat, *Mystacina tuberculata rhyacobi)* is classified as 'At Risk – Declining' by O'Donnell *et al.* (2018). Short-tailed bats are only found in large areas of indigenous forest, although they will forage and commute outside of these areas (Parsons and Toth 2021). Currently, short-tailed bat roosts are exclusively found in large areas of intact indigenous forest (Parsons and Toth 2021). No potential short-tailed bat roosting habitat is present within the proposed alignment of Ō2NL.

The Department of Conservation Bat Distribution Database (July 2020) was used to search for records of long-tailed bats and short-tailed bats within 19 kilometres of the Ō2NL Project Area (Wildlands 2021). This search radius was chosen as it is the maximum home range length recorded for long-tailed bats in forested habitats in the Eglington Valley, Fiordland (O'Donnell 2001).

According to the records search conducted during the Ō2NL Project, there is a 1999 record from a survey on the eastern side of the Tararua Forest Park *c.*21 kilometres east of the Ō2NL alignment. Long-tailed bats are known from the eastern side of the Tararua Forest Park at Waiohine, approximately 30 kilometres southeast of Ōtaki. A short-tailed bat was recorded in the front yard of a dwelling on Bowen Street in Levin in 1958, which is approximately one kilometre west of the Ō2NL Project Area. However, no further short-tailed bats have been detected during surveys within a 19 kilometre radius of the Ō2NL Project Area and it is extremely unlikely that they would utilise the local area. Short-tailed bats are known to be present on the eastern side of the Tararua Forest Park at Waiohine, approximately 30 kilometres southeast of Ōtaki. However, this population may have gone extinct as it has not been detected since 2017 (Jim O'Malley, Sustainable Wairarapa, pers. comm.).

Potential long-tailed bat foraging habitat and roosting habitat (in cracks and crevices in live and dead trees) was identified in the Arapaepae Bush Blocks. Anecdotal reports of bat presence at 102 Kuku East Road and the Muhunoa East Road bridge were received during the course of the project and this, together with the fact that no surveys have been undertaken close to the Ō2NL Project Area since 1999, means that additional surveys for long-tailed bats were required. Based on the information held in the Department of Conservation Bat Distribution Database, and the absence of potential roosting habitat within the highway alignment, it was considered highly unlikely that short-tailed bats are present within the Ō2NL Project Area, however, the Acoustic Bat Monitors (ABMs) used can detect and record short-tailed bats calls and they were searched for during ABM analysis.

On 16 March 2021 one ABM was placed in Arapaepae Bush Block 1 (for 14 nights of recording) and three ABMs were placed in Arapaepae Bush Block 2 (for 22 nights of recording. All ABMs in the Arapaepae Bush Blocks were placed on the edge of the indigenous forest remnant. Bat surveys along the full length of the Ō2NL Project (and consequently in the two Arapaepae Bush Blocks) in Autumn 2021 did not result in the detection of any bats (Wildlands 2021).

The indigenous forest in Waiopehu Scenic Reserve, with large trees with cavities and crevices, are potential roosting and foraging habitat for both species of bat. Although the Ō2NL surveys did not detect bats, the range of the ABMs for those surveys did not include the Waiopehu Scenic Reserve.

## 8.4 Herpetofauna

Existing lizard records in the Department of Conservation BioWeb Herpetofauna Database that are within a 15-kilometre radius of Tara-Ika include:

- A single record of ngāhere gecko (*Mokopirirakau* "southern North Island") in the Tararua Ranges from 1990.
- A single historical record of barking gecko (*Naultinus punctatus*) from Waikawa Beach, 13 kilometres south-west of Levin from 1972.
- An iNaturalist record of a Raukawa gecko from 2014 *c.*10 kilometres southwest of Tara-Ika.
- An unidentified gecko species found at a property on Roslyn Road in Levin from 2020, *c.*2.7 kilometres from Tara-Ika.
- Two historical records of glossy brown skink one from 1965 from within the Tara-Ika development envelope and the other from the town of Shannon (*c.*13 kilometres northeast from 1970).
- A single record of an ornate skink at Waiopehu Scenic Reserve from 1976. Numerous records of ornate skink exist throughout Ōtaki to north of Levin. Five of the seven records are of individual animals, while two of the seven consist of a total of 16 animals found at one-hectare Brown's Bush. All these records are either historical (two records from 1970s) to relatively historical (pre-1995, including the two Brown's Bush records).
- Two records from Brown's Bush from 1994. Seven more recent records for northern grass skink from iNaturalist records are from the coast at Waikawa (from 2019 and 2020) and Waitārere Beaches (from 2016, 2017 and 2018) between *c.*12 and 15 kilometres east of Tara-Ika (from 2019, 2020).

Ornate skink (*Oligosoma ornatum*; At Risk – Declining) are present in the forest and forest-edge habitats at both of the Arapaepae Bush Blocks. Their presence was recently confirmed during March-April 2021 surveys carried out by Wildlands (Wildlands 2021). Wildlands conducted lizard surveys (using pitfall traps, hand searching and spotlighting) in the two Arapaepae Bush Blocks for the Ō2NL Expressway project. A total of five ornate skink were recorded; one in Arapaepae Bush Block 1 and four in Arapaepae Bush Block 2. These skinks were found either under artificial cover objects (corrugated iron), in rank kikuyu (*Cenchrus clandestinus*) grassland on farmland just outside of the bush block in rough grassland/gardens, or in tradescantia or under fallen logs in mixed forest habitat.

Table 2: Lizard species present in the Manawatū Plains Ecological District (Bell and Wiles 2015, van Winkel *et al.* 2018) within the immediate vicinity of Tara-Ika and their threat status (Hitchmough *et al.* 2021), and habitat requirements. In this table, species are ordered first by geckos and skinks, then by their scientific name.

| Species | Conservation status | Life history and habitat requirements |
|---|---|---|
| Ngāhere gecko *Mokopirirakau* "Southern North Island" | At Risk – Declining | Arboreal. Indigenous mature and secondary forest and scrubland, mixed forest, indigenous vineland. |
| Barking gecko *Naultinus punctatus* | At Risk – Declining | Arboreal. Indigenous mature and secondary forest, mixed forest, scrubland, and indigenous vineland. |
| Raukawa gecko *Woodworthia maculata* | Not Threatened | Semi-arboreal.Indigenous mature and secondary forest, mixed forest, scrubland, indigenous vineland, and rocks. |
| Copper skink *Oligosoma aeneum* | At Risk – Declining | Terrestrial. Indigenous mature and secondary forest, mixed forest, scrubland, indigenous fernland indigenous grassland, rough grassland, indigenous sedgeland, indigenous herbfield, indigenous rushland, house and gardens, and rocks. Damp leaf-litter and ground cover vegetation such as tradescantia. |
| Ornate skink *Oligosoma ornatum* | At Risk – Declining | Terrestrial. Indigenous mature and secondary forest, mixed forest, scrubland, indigenous fernland, indigenous grassland, rough grassland, indigenous sedgeland, indigenous herbfield, indigenous rushland, house and gardens, and rock. Damp leaf-litter and ground cover vegetation such as tradescantia. |
| Northern grass skink *Oligosoma polychroma* | Not Threatened | Terrestrial. Indigenous scrubland, indigenous grassland, indigenous fernland, rough grassland, indigenous sedgeland, indigenous herbfield, indigenous rushland, house and gardens, and rocks. |
| Glossy brown skink *Oligosoma zelandicum* | At Risk – Declining | Terrestrial. Indigenous scrubland, indigenous fernland, indigenous grassland, rough grassland, indigenous sedgeland, indigenous herbfield, indigenous rushland, house and gardens, and rocks. Damp leaf-litter and ground cover vegetation such as tradescantia. |

No other lizards were found in the Arapaepae Bush Blocks during March-April 2021 surveys, however, Onduline Artificial Cover Objects and spotlighting by Wildland

Consultants are planned for those areas in November 2021. These are likely to result in additional lizard records, which may include further populations of ornate skink, as well as copper skink, glossy brown skink, and northern grass skink. These are likely to be found in open, rank grassland sites (found just outside the Arapaepae Bush Blocks) and occasionally under forest canopy.

It should be noted that three of the ornate skinks at Arapaepae Bush Block 2 were found outside the forest and in grassland. The edge habitats in the remainder of Tara-Ika, which include rank grassland, tradescantia in indigenous forest, mixed forest and gardens, should not be undervalued as ecological habitats, as they can provide important habitat for lizards, especially in highly developed landscapes. Lizard surveys have not been conducted in Waiopehu Scenic Reserve, although these mature forest habitats and associated adjacent edge habitats are likely to support lizard populations.

It is certain that ornate skinks were once more widespread and abundant throughout the North Island, but the loss of original forest and associated microhabitats along with the arrival of predatory mammals has led to significant population declines. The current distribution of ornate skink is therefore likely relictual, confined to habitat refuges that provide the necessary microhabitat features (providing stable thermal and humidity characteristics) along with the qualities essential for protection from predatory mammals (Porter 1987).

The Lizard Management Plan for the Arapaepae Bush Blocks is in development and part of the mitigation measures will be to increase the habitats on the eastern and southern sides of the forest remnants. The overlap between these areas of habitat expansion that are planned for Ō2NL will need to be carefully coordinated with Tara-Ika plans for that area.

### 8.5 Powelliphanta traversi

The range of the giant land snail species *Powelliphanta traversi traversi* (Threatened - Nationally Endangered) has greatly contracted and populations are now found only on the northeastern shores of Lake Papaitonga, in the Waiopehu Scenic Reserve, and in a few fragments of trees in and around Levin City (a total area of about 40 hectares) (Walker 2003). The loss of most of the prime habitat for *Powelliphanta traversi traversi* is the cause of its decline, in addition to predation by introduced pest animals.

*Powelliphanta traversi traversi* were recorded within the Arapaepae Bush Blocks in 1995 (Ravine 1995). Surveys for this species in the Arapaepae Bush Blocks in Autumn 2021 did not find any *Powelliphanta* (Wildlands 2021), but the persistence of a very small and or localised population of this species here cannot be ruled out. This species is assumed to still occur within the forest at Arapaepae Bush Block 1, and could also be present at Arapaepae Bush Block 2.

*Powelliphanta traversi traversi* have also been found in Waiopehu Scenic Reserve, in 2001/2002 and in May 2021 (NZ Botanical Society, Standish *et al.* 2002, Walker 2003, Tim Martin & Nick Goldwater pers. comm.). Waiopehu Scenic Reserve is one of only two known locations of this snail and is therefore of high importance to the species. *Powelliphanta* are generally associated with forested areas that contain dense moist leaf litter and/or groundcover (Meads *et al.* 1984, Standish *et al.* 2002). These snails live mostly in moist indigenous lowland forest, and tradescantia is known to provide an important refuge for juvenile and adult snails.

*Powelliphanta traversi traversi* are present historically in the Arapaepae Bush Blocks (Wildlands 2021) and Waiopehu Scenic Reserve currently (T. Martin and N. Goldwater pers. comm.) thus these habitats would be classified as ‘At Risk’ as per Schedule F of the Horizons One Plan, and any vegetation clearance or land disturbance would require a resource consent (Rule 13-8).

### 8.6 Introduced pest mammals

Pest animals likely to be present at Tara-Ika and the adjacent Arapaepae Bush Blocks include possums (*Trichosurus vulpecula*), ship rats (*Rattus rattus*), Norway rats (*R. norvegicus*), mice (*Mus musculus*), and hedgehogs (*Erinaceus europaeus*). Mustelids (stoats, *Mustela erminea*; ferrets, *M. furo*; and weasels, *M. nivalis vulgaris*) and feral and domestic cats (*Felis catus*) may also use the site occasionally.

Bait stations were observed in Waiopehu Scenic Reserve (N. Fea and S. Herbert pers. obs. 2021), so presumably there is some predator control in place although the extent is not known.

## 9. ECOLOGICAL VALUES

### 9.1 Overview

Both of the Arapaepae Bush Blocks and Waiopehu Scenic Reserve contain mature indigenous forest species that are representative of the typical structure and composition of original forests in the area. Mature tītoki, poataniwha, rewarewa, mataī, porokaiwhiri, māpou and kaikōmako trees were recorded within the forest areas, and these trees are what remains of the vegetation that would have once been widespread within lowland environments in the area. These forest areas include indigenous vegetation on an Acutely Threatened land environment, where >10% indigenous vegetation remains.

Pest plant species are abundant in the forest areas, and have an altered species composition from what was originally recorded by Ravine (1995); at this time the forest at Arapaepae Bush Block 1 was described as tawa-māhoe forest, and tawa is now absent. These changes are possibly due to a history of alterations to the local hydrology, edge effects, stock browse, and the impacts of humans (e.g., removal of trees for firewood). The landowner at Arapaepae Bush Block 2 noted that a water race along the southern boundary of the forest at Arapaepae Bush Block 1 used to carry water until a few decades ago. It is possible that this water race increased soil moisture in this forest, at least closer to its southern edge. Despite fencing around both forest areas, there is a notable lack of regenerating indigenous species beneath the canopy at Arapaepae Bush Block 1.

*Powelliphanta traversi* (Threatened - Nationally Endangered) were previously recorded within Arapaepae Bush (Ravine 1995). Surveys for this species at Arapaepae Bush Blocks 1 and 2 have not found any *Powelliphanta*, but the persistence of a very small and or localised population of this species here cannot be ruled out. For the purposes of this assessment, it is assumed that *Powelliphanta* are still present, and that the habitat is 'At Risk' as per Schedule F of the Horizons One Plan.

The forest areas provide habitat for common indigenous bird species, and lizards, including ornate skink which has a conservation status of 'At Risk – Declining' (Hitchmough *et al*. 2021).

## 9.2 Terrestrial vegetation and habitat values

The ecological values of key vegetation and habitat types within the forest areas are described in more detail in Table 3. These assessments are based on the key ecological attributes identified in the EIANZ guidelines (Roper-Lindsay *et al*. 2018) and are further informed by professional opinion and expertise.

Table 3: Ecological value assessment for affected vegetation and habitat types on Arapaepae Bush Block 1 (as per the Roper-Lindsay *et al.* 2018).

| Vegetation/ Habitat Type | Attributes to be Considered | Assigned Value |
|---|---|---|
| Tītoki forest | Representativeness – *This vegetation type supports mature indigenous forest species, representative of the typical structure and composition of original forests in the area. This forest remnant is listed as a natural area within the Protected Natural Area Programme.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk-Declining) and historic records of Powelliphanta traversi (Threatened – Nationally Endangered), which may or may not still be present.* | High |
| | Diversity & Pattern – *Supports a moderate diversity of indigenous species.* | Moderate |
| | Ecological Context - *Small, relatively isolated forest remnants that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| False acacia-tītoki-cherry forest | Representativeness – *Despite the prevalence of false acacia and cherry, this vegetation type supports mature indigenous forest species, representative of the typical structure and composition of original forests in the area. This forest remnant is listed as a natural area within the Protected Natural Area Programme.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk-Declining) and historic records of Powelliphanta traversi (Threatened - Nationally Endangered), which may or may not still be present.* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |

| Vegetation/ Habitat Type | Attributes to be Considered | Assigned Value |
|---|---|---|
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Tītoki-karaka forest | Representativeness – *Despite the prevalence of a non-local indigenous species, this vegetation type supports mature indigenous forest species, representative of the typical structure and composition of original forests in the area. This forest remnant is listed as a natural area within the Protected Natural Area Programme.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk - Declining) and historic records of Powelliphanta traversi (Threatened - Nationally Endangered), which may or may not still be present.* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Tītoki-false acacia-poataniwha-karaka forest | Representativeness – *Despite the prevalence of a non-local indigenous species, this vegetation type supports mature indigenous forest species, representative of the typical structure and composition of original forests in the area. This forest remnant is listed as a natural area within the Protected Natural Area Programme.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk - Declining) and historic records of Powelliphanta traversi (Threatened - Nationally Endangered), which may or may not still be present.* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Ornamental cherry forest | Representativeness – *Dominated by exotic species.* | Low |
| | Rarity/distinctiveness – *Habitat for ornate skink (At Risk - Declining) and historic records of* | High |

| Vegetation/ Habitat Type | Attributes to be Considered | Assigned Value |
|---|---|---|
| | *Powelliphanta traversi (Threatened-Nationally Endangered) may or may not still be present.* | |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |
| | Ecological Context – *May provide some limited stepping stone habitat for indigenous fauna species as very few areas of indigenous forest habitat remain on the Horowhenua Plains.* | Low |
| | **Overall Ecological Value:** | **Moderate** |
| Redwood forest | Representativeness – *Dominated by exotic species, but includes areas of indigenous species, beneath the exotic canopy.* | Low |
| | Rarity/distinctiveness – *Habitat for ornate skink (At Risk - Declining) and historic records of Powelliphanta traversi (Threatened - Nationally Endangered), which may or may not still be present.* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |
| | Ecological Context – *May provide some limited stepping stone habitat for indigenous fauna species as very few areas of indigenous forest habitat remain on the Horowhenua Plains.* | Low |
| | **Overall Ecological Value:** | **Moderate** |
| False acacia-karaka forest | Representativeness – *Supports some indigenous species, including mature species representative of the Horowhenua plains, however is dominated by exotic and non-local indigenous species.* | Low |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk - Declining) and potential presence of Powelliphanta traversi (Threatened - Nationally Endangered).* | High |
| | Diversity & Pattern – *Supports a moderate diversity of indigenous species.* | Moderate |
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Macrocarpa-pine-false acacia forest | Representativeness – *Supports some indigenous species, including mature species representative of the Horowhenua plains, however is dominated by exotic and non-local indigenous species.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk - Declining) and potential presence of Powelliphanta traversi (Threatened - Nationally Endangered).* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |

| Vegetation/ Habitat Type | Attributes to be Considered | Assigned Value |
|---|---|---|
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Karaka-māhoe-kawakawa scrub | Representativeness – *Supports some indigenous species, including mature species representative of the Horowhenua plains, however is dominated by exotic and non-local indigenous species.* | Moderate |
| | Rarity/distinctiveness – *Includes indigenous vegetation on an Acutely Threatened land environment. Habitat for ornate skink (At Risk - Declining) and potential presence of Powelliphanta traversi (Threatened - Nationally Endangered).* | High |
| | Diversity & Pattern – *Supports a low diversity of indigenous species.* | Low |
| | Ecological Context - *Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |
| Exotic grassland and shelterbelts | *Representativeness - Dominated by exotic species* | Very low |
| | *Rarity/Distinctiveness - No rare features known. Potential habitat for New Zealand Pipit (Anthus novaeseelandiae; At Risk – Declining), but not recorded during field surveys. May be revised following Spring 2021 lizard surveys.* | Low |
| | *Diversity & Pattern – Supports a low diversity of indigenous species.* | Low |
| | *Ecological Context - Limited ecological context values, but may provide limited infiltration and water filtering.* | Low |
| | **Overall Ecological Value:** | **Low** |
| Tawa-puketea | *Representativeness – This vegetation type supports mature indigenous forest species, representative of the typical structure and composition of original forests in the area. This forest remnant is protected as a Scenic Reserve.* | High |
| | *Rarity/distinctiveness – Includes indigenous vegetation on an Acutely Threatened land environment. Habitat and a historic record for ornate skink (At Risk - Declining) and recent records (2021) of Powelliphanta traversi (Threatened - Nationally Endangered. Long-tailed bats (Threatened -Nationally Critical) habitat potential.* | High |
| | *Diversity & Pattern – Supports a high diversity of indigenous canopy and understory species. Likely high diversity of inidigenous fauna.* | High |

| Vegetation/ Habitat Type | Attributes to be Considered | Assigned Value |
|---|---|---|
| | *Ecological Context - Small, relatively isolated forest remnants, that provide habitat for indigenous fauna. Very few areas of indigenous forest habitat remain on the Horowhenua Plains, and these remnants provide stepping stone habitat for mobile fauna species.* | Moderate |
| | **Overall Ecological Value:** | **High** |

## 9.3 Freshwater stream habitat values

There are two streams that flow through Tara-Ika proposed development. No wetlands have been identified on the site. The tributary of Koputaroa Stream in the northeast corner of the development is perennial and are likely to support indigenous fish and aquatic invertebrates. Longfin eel (*Anguilla dieffenbachii*) is an At Risk - Declining species and possibly occurs in the Waiopehu Stream. Brown mudfish (*Neochanna apoda*; At Risk - Declining) are known from the Koputaroa catchment and may also be present in the area of stream running through Waiopehu Scenic Reserve (Goodman *et al.* 2014.

These small streams provide corridors for fish passage and can have an important influence on catchment hydrology and water quality, and may therefore influence the overall ecological value of the receiving environments. Maintaining the natural functions and sediment inputs of these watercourses will play an important part in helping to protect downstream receiving aquatic habitats within the Koputaroa Stream and Manawatū River.

The ecological values of the streams mapped at the site are described in more detail in Table  below.

Table 4: Ecological value assessment for streams at the site (as per Roper-Lindsay *et al*. 2018).

| Vegetation/Habitat Type | Attributes to be considered | Assigned Value |
|---|---|---|
| Permanent Streams | Representativeness – *Catchment is highly modified due to agricultural land use.* | Low |
| | Rarity/distinctiveness – *May provide habitat for indigenous fish species classified as At Risk – Declining (e.g., longfin eel,).* | Moderate |
| | Diversity & Pattern – *Habitat heterogeneity, complexity and patterns disrupted by past vegetation clearance in places.* | Low |
| | Ecological Context – *Some reaches well shaded by indigenous canopy.* | Moderate |
| | **Overall Ecological Value:** | **Moderate** |

## 9.4 Indigenous fauna values

Although a large portion of the Tara-Ika development area comprises highly modified landscapes such as agricultural and grazing lands, houses and gardens, the three forest remnants (Waiopehu Scenic Reserve and the two Arapaepae Bush Blocks) provide habitat for high value indigenous species. Ornate skink (At Risk – Declining) is present in the forest and forest-edge habitats at both of the Arapaepae Bush Blocks and historically in Waiopehu Scenic Reserve. *Powelliphanta traversi* (Threatened - Nationally Endangered) has been confirmed historically and recently in Waiopehu Scenic Reserve and is likely to still be present in the Arapaepae Bush Blocks. Waiopehu Scenic Reserve potentially provides roosting and foraging habitat for both bat species, although these species are unlikely to use the local area, particularly short-tailed bats. The ecological value of these remnant forest areas are high due to the presence of these rare species and their habitats. The ecological value across each taxa is summarised below in Table 5.

Table 5: Ecological value of indigenous fauna species in the local area.

| Species | Determining Factors | Assigned Value | Presence |
|---|---|---|---|
| Long-tailed bat | Threatened – Nationally Critical | Very High | Possible |
| Common indigenous birds<br>• Pīwakawaka<br>• Pūkeko<br>• Riroriro<br>• Kāhu<br>• Tūī<br>• Kererū | Not Threatened.<br>Nationally and locally common indigenous species. | Low | Confirmed present |
| Indigenous lizards<br>• Ornate skink<br>• Copper skink<br>• Glossy brown skink<br>• Ngāhere gecko | At Risk – Declining | High | Confirmed present or likely |
| Indigenous lizards<br>• Northern grass skink<br>• Raukawa gecko | Not Threatened | Low | Likely |
| Indigenous fish and aquatic invertebrates<br>• Longfin eel<br>• Brown mudfish | At Risk – Declining | High | Likely |
| Indigenous fish and aquatic invertebrates | Not Threatened<br>• Common bully<br>• Banded kōkopu<br>• Upland bully<br>• Kōura<br>• Shortfin eel | Low | Likely |
| *Powelliphanta traversi traversi* | (Threatened - Nationally Endangered) | Very High | Confirmed present |

# 10. POTENTIAL ECOLOGICAL EFFECTS AND PROPOSED ACTIONS TO AVOID, REMEDY, OR MITIGATE THESE EFFECTS

## 10.1 Overview

Potential adverse effects of the proposed Tara-Ika development can be summarised as:

- Disturbance, modification, and/or loss of vegetation
- Loss or degradation of indigenous fauna habitat
- Harm to indigenous birds
- Harm to indigenous lizards
- Harm to indigenous snails
- Harm to aquatic fauna
- Increased impervious surfaces
- Decrease in groundwater
- Stream sedimentation
- Cumulative effects

Each of these effects is described in further detail below. The magnitude[1] and the level[2] of each effect of has been classified as per the EIANZ guidelines (Roper-Lindsay *et al.* 2018).

## 10.2 Disturbance, modification, and/or or loss of vegetation

A number of mitigation measures have been set out in the Tara-Ika Master Plan (Horowhenua District Council 2020 and 2021) to reduce the potential adverse effects of the development on the ecology of the area.

- Tara-Ika development area is classified as Land Use Class 3 by the district and there are therefore constraints on the land due to presence of stony soils at the surface. Concentrating development in this area supports the protection of other higher class agricultural soils provided by the current Horowhenua District Plan.

- Clearance of indigenous forest for the Tara-Ika development has been avoided, given that the plans do not seek to develop within the Arapaepae Bush Blocks or Waiopehu Scenic Reserve. The effects on indigenous forest have been minimised by the creation of a buffer area around Waiopehu Scenic Reserve

[1] That is, 'positive', 'negligible', 'low', 'moderate', 'high' and 'very high'.
[2] That is, 'net gain', 'very low', 'low', 'moderate', 'high' and 'very high'.

with the Greenbelt Residential Zone that would surround the Reserve, precluding high density development from occurring on the border of the Reserve.

At least *c*.407 hectares of intensively managed exotic grassland and exotic shelterbelts will be cleared, modified, or otherwise disturbed to facilitate the proposed Tara-Ika development.

Conversion of arable pasture to residential lots carries a risk of residents introducing additional pest plant species to the site as garden plants, which could threaten the ecological values of indigenous vegetation in the Arapaepae Bush Blocks and Waiopehu Reserve. These potential adverse ecological effects could be addressed with subdivision consent conditions specifying prohibitions on the planting of particular pest plant species and encouraging the planting of indigenous species. Planting of fruit trees and edibles is encouraged, but will still be limited only to species that are not listed in the Horizons OnePlan or NPPA, and do not pose a threat to adjacent forest areas. Edible pest plant species such as loquat (*Eriobotrya japonica*) and blackberry (*Rubus fruticosus* agg.) should be prohibited.

Natural areas, especially along lot boundaries and forest edges, will be surveyed annually for new pest plant incursions. Exotic plants within natural areas should be controlled when they are first recorded in order to increase the likelihood and efficiency of achieving total control. The dumping of garden waste into any of the Bush Blocks and green spaces areas at the site should also be strictly prohibited.

It should be noted that conversion of pasture to residential lots can also produce positive ecological outcomes. For example, well-executed amenity plantings can increase the area of habitat available for common indigenous fauna.

With these controls in place, the overall level of this effect will be 'low'.

The adverse ecological effects of the Stage 1 development on vegetation have been minimised by situating most of the development envelope entirely within intensively managed exotic grassland. However, suggestions to further reduce actual and potential adverse ecological effects on vegetation are provided in Sections 10.2.1 and 10.2.2.

### 10.2.1 Enhancement of retained vegetation

The main opportunities for new plantings to replace lost vegetation are in the designated green spaces and amenity areas in the Tara-Ika development. If implemented in accordance with an Ecological Management Plan (EMP) prepared by a suitably qualified and experienced ecologist, the planting and pest plant control work should adequately remediate the effects of vegetation loss to a 'very low' level. This EMP will need to be approved by Horizons before works commence. The following measures are recommended:

- Control of pest plant species throughout the site, including in the Arapaepae Bush blocks and in Waiopehui Reserve. Note that the benefits of control of tradescantia will need to be weighed against the value of this plant species as a habitat for *Powelliphanta traversi* and ornate skink and may need to be left in place.

- Plant ecologically appropriate[1] indigenous plant species into road reserves and designated green spaces where practicable.

- Enhance the existing vegetation in the Arapaepae Bush blocks and in Waiopehu Scenic Reserve by planting a 10-metre buffer of wind-tolerant indigenous plant species.

- Comply with the HDC Tara-Ika deveopment's plan to to "identify and protect the Maunu Wahine refuge and Waihau waterhole, protect the rural setting of the Prouse Homestead (Arapaepae Bush Block 2), prioritise use of native planting over exotic plants within the open spaces to provide habitats that encourage native fauna" (HDC Tara-Ika Master Plan).

- Encourage residents to plant ecologically appropriate indigenous plant species in residential areas, through provision of a list of species suitable for these sites, especially species that have particular habitat value for indigenous fauna (e.g. kowhai; *Sophora microphylla*).

### 10.2.2 Management of cultivated pest plants

In order to avoid the spread of pest plants from domestic gardens, no plant species listed in the National Plant Pest Accord (NPPA) or Greater Wellington Regional Council Regional Pest Strategy (https://www.gw.govt.nz/greater-wellington-regional-pest-management-plan-2019-2039/), in any category, should be permitted to be planted or cultivated, either in the ground or in pots. This should be a condition of consent, although it is acknowledged that it may be difficult to enforce.

Many species not listed in the NPPA or RPMS can also establish from dumped garden refuse (for example, hydrangeas *Hydrangea macrophylla*). Natural areas, especially along stream margins and in wetlands, should be surveyed annually for new pest plant incursions. Exotic plants within natural areas should be controlled when they are first recorded in order to increase the likelihood and efficiency of achieving total control.

## 10.3 Loss or degradation of indigenous fauna habitat

As stated in Section 10.2, implementation of Stage 1 of the proposed development will require at least *c.*407 hectares of exotic grassland and shelterbelts to be cleared, modified, or otherwise disturbed. Additional dwellings on the property may result in increased numbers of domestic and/or stray cats on the properties (Aguilar and Farnworth 2013, Woolley and Hartley 2019). Domestic (and feral) cats are known predators of birds, lizards, bats, and aquatic fauna. It is unknown whether cats hunt indigenous snails. Although it would be beneficial to prohibit cat ownership in future residences, feral cats may already frequent the properties and it is difficult to gauge the additional adverse effects that would be caused by additional cats being kept on the properties. Rodent (rats and mice) densities also tend to increase around human-occupied areas due to more food and shelter being available. Both rats and mice are

[1] That is, all plants should be sourced from the Manawatū Plains Ecological District (see regional guides in addition to https://www.gw.govt.nz/assets/Be-the-Difference/Biodiversity/Wellington-Regional-Native-Plant-Guide-Revised-Edition-2010-Web.pdf.).

predators of lizards, and rats are known predators of *Powelliphantha* spp. (*Standish et al.* 2002, Walker 2003).

Because intensively managed exotic grassland does not provide high-quality habitat for indigenous terrestrial fauna such as snails and lizards, the loss of this habitat for indigenous terrestrial fauna will represent only a minor shift away from the baseline condition. Therefore, although the magnitude of the change is high with respect to the exotic grassland being converted to residential development, the effect on indigenous terrestrial fauna is considered to be 'low' due to the low ecological value of the exotic grassland.

Both Waiopehu Reserve and the Arapaepae Bush blocks are known to provide habitat for threatened fauna (ornate skinks and *Powelliphanta traversi traversi*). An increase in the number of cats would likely be harmful to both species. While it is possible to place a covenant on new subdivisions banning pet cats, or limiting the number of pet cats per household, these are difficult to enforce. A better long-term solution for avoiding the effects of an increase in domestic cats and rodents on indigenous fauna in Arapaepae Bush and Waiopehu would be to either put a cat-exlusion fence around the bush remnants and control rodents within the bush blocks, or to put a predator-proof fence around the bush remnants. Public access to the bush blocks can be maintined through double-gated entrances, such as at Opouahi kiwi creche in Hawke's Bay. When installed in smaller areas, predator-proof fences are more cost-efficient than sustained predator control (Norbury *et al.* 2014).

Ornate skink populations at the two Arapaepae Bush Blocks will be permanently bisected and fragmented by the Ō2NL highway, an effect that could potentially be exacerbated by the increase in residential development. Given that the Arapaepae Bush Blocks will be impacted by the Ō2NL project, a Lizard Management Plan and Ecological Management Plan will be prepared and include the sites. Increasing habitat at these sites and implementing pest control will assist in reducing these impacts. These actions are required to maximise potential habitat availability and connectivity for less mobile fauna such as lizards.

## 10.4 Harm to individual birds

The bird species that occur at the site are highly mobile and the noise and movement associated with the vegetation removal or alteration and future construction of residential dwellings is likely to scare most of them away from the site before they are harmed. All of the indigenous bird species identified at the site are common throughout New Zealand. However, if active indigenous bird nests are present in the affected vegetation at the time of removal the adult birds, chicks, and/or eggs may be harmed or destroyed. Any such harm to individual birds is likely to have a negligible effect on the overall population of these species, and as such the magnitude of this effect is expected to be 'low'. The level of this effect is considered to be 'very low'.

Glass windows in buildings are a hazard to birds that inadvertently fly into them. While window strike on a single dwelling is a relatively rare event, at a global level such incidents are through to kill between 100 million to one billion birds per year (Klem 2014). Fatal strikes can occur wherever birds and windows coexist and the risk is heightened when large areas of glass are includes as an architectural feature of a structure or when the structure is located in valuable bird habitats such as forests (Klem 2014). There has been little research carried out regarding the cumulative effects of bird strike in New Zealand. However, research from the United States indicates that building collisions are second only to predation by feral and domestic cats as the most significant human induced threat to birds (Loss *et al*. 2014).

Birds can die instantly when flying into windows or sustain multiple soft tissue injuries and fractures to bones around the chest area. Other types of injuries include crop rupture and bleeding around the heart. Although no studies to date have been undertaken on bird window strike in New Zealand, there is anecdotal evidence to suggest that species such as kererū, kākā (*Nestor meridionalis*) and ruru (*Ninox novaeseelandiae*) are vulnerable to window strike. Migratory species such as shining cuckoo (*Chrysococcyx lucidus lucidus*) have also been killed by window strike (N. Goldwater, pers. obs.).

Within the project area, there is the potential for birds travelling between the forest fragments to collide with windows, particularly if the dwellings occur in existing flight paths. As the development will result in the construction of several dwellings in close proximity to forest fragments where birds are not habituated to the presence of such structures, bird strike deaths are likely to occur. However, as the species likely to be affected are relatively common in the local area, the potential magnitude of this effect on the wider population is considered to be 'low'.

There are options that can be implemented to further reduce the likelihood of birds striking windows, and for minimising injury to birds involved in collisions. For rural residences, mitigation techniques could include reducing vegetation near windows, applying closely spaced UV light-reflecting decals to windows (e.g., WindowAlert™), or installing UV light-reflecting glass (Klem *et al*. 2004). Note that UV light is not visible to humans so these features will not exacerbate the visual effects of the proposal.

In addition, structural design controls could also be considered, including avoiding large expanses of glass or placing windows directly opposite one another to create the illusion of a throughfare.

## 10.5 Harm to indigenous lizards

Potential adverse effects of the proposed development on indigenous lizards during construction include permanent habitat loss and/or modification of habitat due to vegetation clearance, injury and/or mortality of indigenous lizards, disturbance, reduced habitat connectivity through fragmentation of habitat or introduction of barriers, creation of edge effects that alter microclimates, and reduction of critical moisture regimes due to the draw down of the water table and increase in impervious surfaces.

There are also potential ongoing adverse ecological effects of residential development on indigenous lizards once operational which include:

- Ongoing disturbance of indigenous lizards (by streetlight, vibration, movement, dust and/or noise, increased human presence).
- Mortality or injury on roads through road kill.
- Increased presence of and likelihood of invasion by non-native plant and animal species.

A future increase in housing density is likely to have adverse ecological effects on lizard species that are present within the development envelope, and in the Arapaepae Bush Blocks and Waiopehu Scenic Reserve.

Intensively grazed areas of exotic grassland present on parts of the properties do not provide habitat for lizards, unless there are areas of rank grassland, non-palatable indigenous vegetation, rocks, or other debris providing terrestrial cover. It is in these micro-habitats that lizard populations are able to persist locally in otherwise unfavourable habitats. However, construction of additional dwellings in these habitats is likely to impact lizards living in adjacent habitats through the potential introduction of domestic cats and increased rodent populations in close proximity to buildings.

Aside from the potential impacts of a change in predator guild addressed in Section 10.3, the overall risk to lizards is likely to be low given the relatively small areas of indigenous vegetation that would be disturbed under the proposed development plan. While ornate skinks have only been recorded in and around the Arapaepae Bush Blocks, they will use areas of rank grass, therefore there is a risk that lizards may be injured or killed during development works. Ornate skink, which have been found in the Arapaepae Bush blocks, are classified as At Risk – Declining in the national threat classification lists (Hitchmough *et al.* 2021). This species meets Criterion C(2/1) where the total area of occupancy is >10,000 hectares (100 $km^2$) nationally and the species is predicted to undergo annual population declines of 10-70%. As a result, it has been qualified as Conservation Dependent, meaning that habitat protection and predator control are essential requirements for the persistence of remnant populations.

Due to the uncertainty around whether lizards are present within the areas planned for development, and what their population densities are, the risk to lizards cannot currently be quantified and would need to be addressed as part of the processes for gaining resource consent for any future subdivision by a targeted survey effort. While the effects of development projects on indigenous lizards must be accounted for under Section 31 of the Resource Management Act 1991, indigenous lizards are also protected by the Wildlife Act 1953 thus disturbance to their habitats is likely to require a Wildlife Act Authority (DOC Lizard TAG 2019)[1].

A Lizard Management Plan (LMP) for the site should be prepared and submitted to Horizons for approval. As indigenous skinks are extremely cryptic and difficult to detect during winter, the LMP should include a survey for their presence or absence during warmer months (between September and April) when skink activity and detectability is higher. The LMP must be implemented in full before any vegetation clearance takes place. In addition, some of the logs and debris that results from the

[1] Further information about applying to develop land on which indigenous lizards are present can be found here: https://www.doc.govt.nz/get-involved/apply-for-permits/interacting-with-wildlife/applying-to-develop-land-with-native-lizards-and-frog-species/

removal of the trees should be left on site to provide habitat for indigenous lizards and invertebrates.

## 10.6 Harm to *Powelliphanta* snails

Potential adverse effects of the Tara-Ika Project on *Powelliphanta* snails during construction include the further creation of edge effects that alter microclimates and the reduction of critical moisture regimes due to the draw down of the water table and increase in impervious surfaces.

The forest remnants (Waiopehu Scenic Reserve and the Arapaepae Bush Blocks) that support *Powelliphanta* will not be cleared or modified under both the current Ō2NL expressway alignment plan and the master plan for Tara-Ika. Though the vegetation will not be cleared, there are likely to be adverse ecological effects on *Powelliphanta* that are present within and adjacent to the development.

- Invasive mammal predators, in addition to habitat loss, are the main drivers in population declines for *Powelliphanta* (Meads *et al*. 1984). The Department of Conservation recovery plan (Walker 2003) recommends a predator-proof fence for the Waiopehu Scenic Reserve for the long-term control of predators. Given the small size of the Waiopehu Scenic Reserve, the loss of *Powelliphanta traversii* across its range and the impact of the residential development, a predator-proof fence would provide the most sustainable option for this population. Predator trapping within the reserve could then focus on any incursions of invasive predators into the fence.

- *Powelliphanta* are not able to conserve moisture and are prone to dehydration and are therefore dependent on forest floor moisture levels. Monitoring of soil moisture would enable a quick response if other conservation measures were needed. Additionally, thick leaf litter acts as a mulch that retains soil moisture. The restoration of an indigenous understory, with special attention to potentially keeping tradescantia, would increase inputs to this important habitat feature.

A management plan for *Powelliphanta* for the three forest remnants (Arapaepae Bush Blocks and Waiopehu Scenic Reserve) should be developed that addresses moisture monitoring, stream management, and habitat enhancement at these three forest remnant sites. Signage should be posted in the forest remnants that encourages the public and their dogs to adhere to the walking tracks to avoid trampling vegetation and snails. This management plan would need to work in concert with the Lizard Management Plan for Ō2NL so enhancement of the two Arapaepae Bush Blocks and along the highway alignment are coordinated.

## 10.7 Harm to indigenous aquatic fauna

Watercourses present within the development envelope are likely to support several species of indigenous aquatic fauna. As such, the piping or infilling of watercourses (both natural and artificial) may result in species, such as eels, being harmed or killed. The magnitude and level of effect cannot be assessed until further information is provided with regards to the development plans for streams, and whether they will be retained and enhanced.

Under the Freshwater Fisheries Regulations 1983 it is an offence to intentionally kill or destroy indigenous fish, unless they are taken for the purpose of scientific research or for human consumption. As such, regardless of the level of the effect associated potential harm to indigenous fish described above, a Fish Management Plan (FMP) will need to be prepared, approved by Horizons, and implemented before any works take place within the streams. The FMP will detail methods for capturing indigenous fish species and identify a suitable release site for indigenous fish beyond the extent of works. It will also need to detail methods of capture and euthanasia for pest fish species (gambusia) to ensure that they are not inadvertently introduced to neighbouring watercourses or catchments.

## 10.8 Increased impervious surfaces

The proposed development will increase the area of impermeable surfaces at the property. Run-off from impermeable surfaces can greatly increase the amount and rate of stormwater flow. After heavy rainfall events, large volumes of fast-moving water can flow into gullies and streams, creating a scouring effect that is harmful to aquatic fauna and can result in streambank erosion and sedimentation. There are two minor watercourses within the proposed Tara-Ika development in which water now runs. Roofs, roads, and driveways are the main contributors to surface run-off.

Stormwater from impervious surfaces can also transport a range of contaminants such as heavy metals, which accumulate in estuarine receiving environments. Heavy metals such as zinc (commonly used in roofing) can persist in the aquatic environment for considerable periods of time, particularly in sediment. As a consequence, metals can accumulate in the tissues of benthic organisms and their predators at higher trophic levels. Zinc is toxic to aquatic plants and animals (Widianarko *et al.* 2001). In residential areas, contamination can also occur through activities such as washing cars on impermeable surfaces, whereby cleaning chemicals and detergents are readily transported into drains and into aquatic and estuarine receiving environments.

In the context of the wider catchment, the effect of increased stormwater run-off will result in a moderate shift away from existing baseline conditions. While the change arising may be discernible, the underlying character, composition and attributes of the receiving environments will remain similar. As such, the magnitude of this effect is ‘moderate’ due to the conversion of *c.*407 hectares of permeable surfaces into largely impermeable surfaces.

A range of low impact design features are also proposed to reduce the effects of high flows and contaminated run off from impervious surfaces. Specific features that will be used at the site include:

- Retention tanks to capture roof water for domestic use and to provide for the temporary storage and controlled release of roof runoff.
- Swales and filter strips to provide treatment of stormwater runoff from impervious surfaces such as driveways.
- Rain gardens, and/or proprietary devices for the treatment of stormwater runoff from reticulated areas.

Captured run-off will be discharged at appropriate locations, incorporating energy dissipation and flow dispersion structures.

## 10.9 Decrease in ground water

While it is not anticipated that construction of the proposed Ō2NL expressway will require the removal of any vegetation within the Arapaepae Bush Blocks, the adjacent road cut will extend below ground level, with potential for a lowering of the groundwater table. If a lowering of the groundwater table did result from the road cutting, it is possible that that this could affect vegetation and habitats within the adjacent forest areas. Tara-Ika is likely to have effects on groundwater inputs and withdrawls from increased impervious surfaces and potential roadcuts. The relative dryness of Waiopehu Scenic Reserve has also increased over the last century as water from the stream has been taken out and the headwaters of the Koputaroa Stream have become channelised (Walker 2003). Both ornate skink and *Powelliphanta traversi traversi* have specific habitat requirements that are dependent on damp leaf litter and ground vegetation and may be sensitive to decrease in ground water, particularly when impacted on multiple fronts.

A management plan for *Powelliphanta* and lizards for the three forest remnants (Arapaepae Bush Blocks and Waiopehu Scenic Reserve) should be developed that includes monitoring moisture levels, stream management, groundwater inputs/withdrawl and habitat enhancement at these three forest remnant sites to enable adaptive management of these taxa. This management plan would need to work in concert with the Lizard Management Plan for Ō2NL to ensure that enhancement of the two Arapaepae Bush Blocks and along the highway alignment are coordinated.

## 10.10 Stream sedimentation

For the most part, new residential development planned for Tara-Ika appears to avoid major adverse impacts on the tributary of Koputaroa Stream in the northeast of the site. The impact of development around the un-named stream in the southeast of the site is unclear, given that a stream is indicated in the topographical maps but is not visible in aerial imagery. It would be useful to ground-truth the length of this stream to determine its status (not a stream, ephemeral, intermittent, or permanent).

As a precaution, it is suggested that any further earthworks and residential construction be avoided within 10 metres of any streams. A range of low impact design measures such as swales, sediment settling ponds, and silt fences can be used during the design and construction to minimise the impact of sediment on waterways. Prior to the commencement of construction, an Erosion and Sediment Control Plan will need to be prepared and approved by Horizons.

If these measures are suitably implemented, the level of effect of sedimentation on streams is likely to be 'low'.

## 10.11 Cumulative effects

The proximity and timing of the Ō2NL Expressway alignment and adjacent the Tara-Ika development increases the potential for cumulative effects stemming from both developments. The increase of noise, light levels, vibration from vehicles, increased human disturbance, increase in contaminants and stormwater in runoff from new roads and buildings and loss of buffer habitats is compounded with both projects occurring adjacent to each other and adjacent to the Arapaepae Bush Blocks.

Mitigation measures from the Ō2NL Expressway alignment will need to be carefully coordinated with the Tara-Ika plans for the areas adjacent to the Arapaepae Bush Blocks. Although there is the potential for cumulative negative effects, the potential for habitat creation by both projects, if conducted in concert, has the potential for synergistic positive effects.

# 11. OPPORTUNITIES FOR ENHANCEMENT OF NATURAL HABITATS AND BIODIVERSITY FOR THE TARA-IKA DEVELOPMENT

There is an opportunity for habitats within the proposed Tara-Ika growth area to be managed in a way that the development produces a net positive ecological effect. This may be achieved through the ecological restoration and/or reconciliation of habitats on the property. Ecological restoration seeks to return habitat to an 'original' or 'natural' state, whereas the end-goal of ecological reconciliation is to improve the ability of a habitat to support biodiversity without reference to an original state (Rosenzweig 2003; SER 2004; Mcdonald *et al.*,= 2016). In this section, advice is provided on options for ecological enhancement over and above the specific recommendations listed in Section 10.

As a reconciliation measure, planting areas of dry pasture with toetoe, flax, indigenous vines, and/or indigenous shrubs (i.e., creation and maintenance of areas of open shrubland) would enhance habitat quality for pīhoihoi (if present), kāhu, skinks, and invertebrates while avoiding any potential conflicts between residential land uses and large trees or dense vegetation such as shading or impedance of air movement around housing, or blocking views (Beauchamp 2013, Seaton *et al.* 2013). This habitat type would also be suitable for enhancing small areas of habitat such as road reserves, where ecological restoration would not be feasible. Addition of woody debris, large boulders, and/or rock-filled gabion baskets would also provide additional habitat for lizards and invertebrates and could potentially be landscaped in a visually pleasing way (Gabites 2015).

The biodiversity outcomes from any habitat enhancement measures undertaken at the property should be monitored for at least five years following implementation to ensure that the net effect is positive and to allow adaptive management if any problems arise[1].

[1] For example, habitat enhancement measures can also benefit invasive predatory animals such as mustelids and rodents, and therefore can result in an unexpected net negative effect on indigenous fauna. In this example, monitoring could be an annual pest animal survey, and an adaptive management strategy could be to implement a pest control programme if invasive mammal abundances increases in planted areas.

# 12. CONCLUSIONS

The area indicated for the Tara-Ika growth plan contains two indigenous fauna species of high ecological value (the ornate skink, *Oligosoma ornatum,* and the giant land snail *Powelliphanta traversi traversi*) and forested areas that are considered to be 'At Risk' in the Horizons One Plan. There are two streams within the area, and a possibility that the tributary of the Koputaroa Stream that runs through Waiopehu Reserve supports two 'At Risk - Declining' fish species.

Potential adverse effects of the development that require mitigation include:

- Disturbance, modification, and/or loss of vegetation
- Loss or degradation of indigenous fauna habitat
- Harm to individual birds
- Harm to indigenous lizards
- Harm to *Powelliphanta* snails
- Harm to indigenous aquatic fauna
- Increased impervious surfaces
- Decrease in groundwater
- Stream sedimentation
- Cumulative effects due to the co-development of Ō2NL

For those areas of low to high ecological value within the development footprint, removal or damage must be adequately mitigated through planting in other parts of the site, and indigenous fauna should be protected during vegetation removal where this threatens the integrity of their habitats. Control of pest plants will also provide benefits for the condition and on-going viability of natural areas, although the benefits of controlling tradescantia should be carefully weighed agsinst their value as habitats for *Powelliphanta* and indigenous skinks. Ecological restoration can be further enhanced through sustained pest animal control or installing predator-proof fencing around high-value habitats of indigneous lizards and snails, noting that these actions would also benefit a range of other indigenous fauna species. The likely significant increase in domestic cats following construction further justifies the option of predator-proof fences.

Habitat restoration and/or enhancement opportunities available at the property, if used, are expected to provide ecological benefits. Proposed restoration initiatives will improve the condition of the existing forested areas, thus helping to reduce edge effects and the establishment of pest plants, and will promote habitat suitable for indigenous fauna.

A Lizard Management Plan (LMP) and a management plan for *Powelliphanta* will need to be prepared and implemented as a consent condition by a qualified and permitted ecologist to guide effective mitigation measures for these taxa. There is a possibility that these two plans could be combined, given that these taxa share some similar conservation requirements. The LMP should also cover the possibility of requiring salvage and relocation of indigenous lizards into appropriate habitat. This will need to be submitted to and approved by the Department of Conservation prior to any tree felling and vegetation removal works take place.

An Ecological Management Plan (EMP) should be prepared as a condition of consent to underpin effective ecological restoration. All restoration works should be undertaken by professional ecological restoration contractors.

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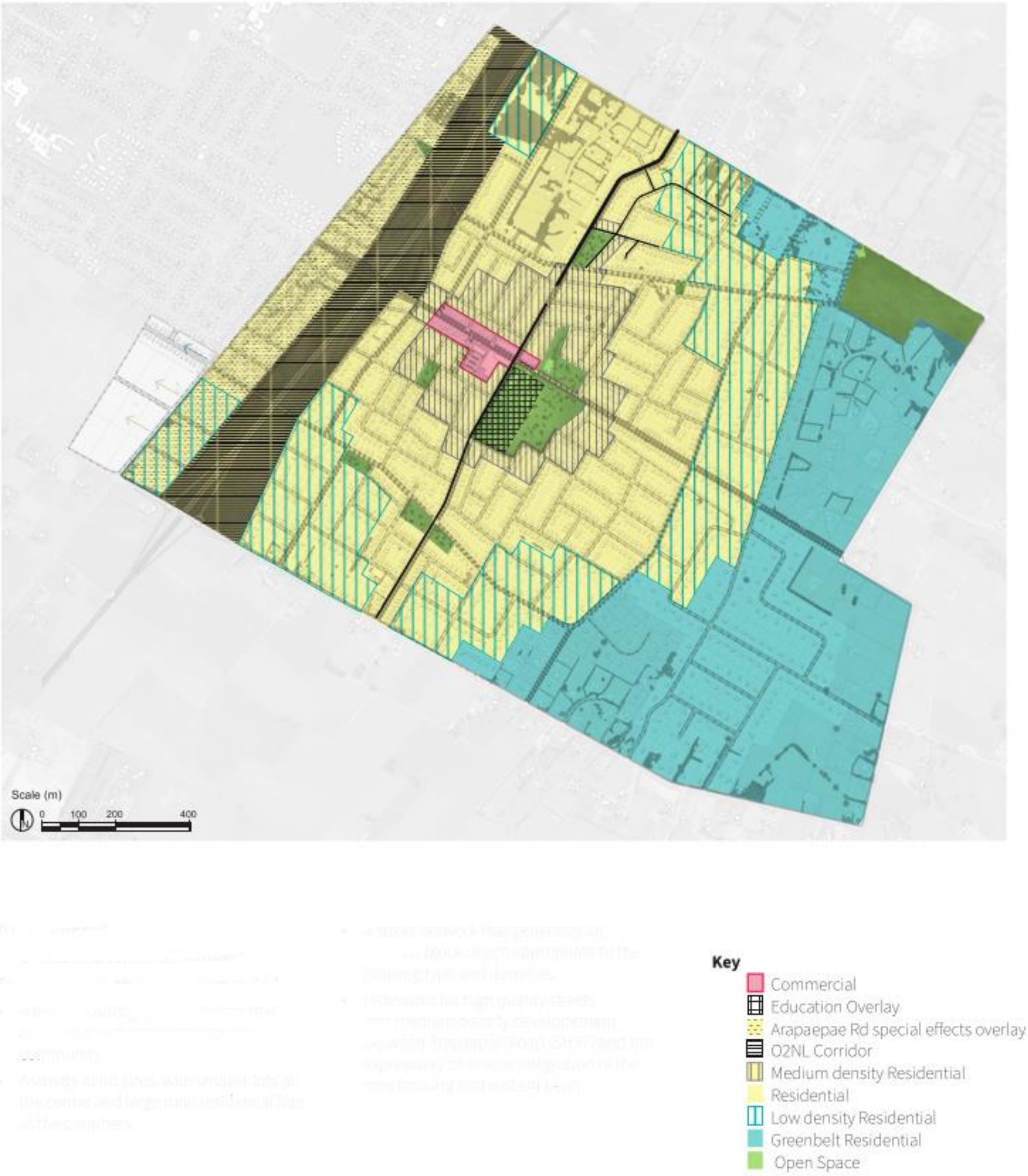
APPENDIX 1

# TARA-IKA MASTER PLAN MAP



APPENDIX 2

# VASCULAR PLANT SPECIES RECORDED AT ARAPAEPAE BUSH BLOCK 1: 1006 QUEEN STREET EAST, LEVIN

## INDIGENOUS SPECIES

### Gymnosperms

| | |
|---|---|
| *Pectinopitys ferruginea* | miro |
| *Podocarpus totara* var. *totara* | tōtara |

### Monocot. trees and shrubs

| | |
|---|---|
| *Cordyline australis* | tī kōuka, cabbage tree |

### Dicot. trees and shrubs

| | |
|---|---|
| *Alectryon excelsus* subsp. *excelsus* | tītoki |
| *Coprosma autumnalis* | kanono, raurēkau, raurākau, manono |
| *Corynocarpus laevigatus* | karaka |
| *Elaeocarpus dentatus* | hīnau, whīnau |
| *Geniostoma ligustrifolium* var. *ligustrifolium* | hangehange |
| *Knightia excelsa* | rewarewa |
| *Melicope simplex* | poataniwha |
| *Melicytus ramiflorus* subsp. *ramiflorus* | māhoe |
| *Myrsine australis* | māpou, matipou, māpau |
| *Piper excelsum* subsp. *excelsum* | kawakawa |
| *Pittosporum eugenioides* | tarata; lemonwood |
| *Streblus heterophyllus* | tūrepo |

### Dicot. lianes

| | |
|---|---|
| *Muehlenbeckia australis* | puka |
| *Parsonsia heterophylla* | akakaikiore |

### Ferns

| | |
|---|---|
| *Asplenium oblongifolium* | huruhuru whenua |
| *Dicksonia squarrosa* | whekī |
| *Histiopteris incisa* | mātātā, water fern |
| *Pteridium esculentum* | rārahu, bracken |
| *Pteris tremula* | turawera, shaking brake |
| *Pyrrosia elaeagnifolia* | leather-leaf fern |

### Grasses

| | |
|---|---|
| *Microlaena stipoides* | pātītī, meadow rice grass |

Composite herbs

| | |
|---|---|
| *Senecio bipinnatisectus* | Australian fireweed |
| *Haloragis erecta* subsp. *erecta* | toatoa |

## NATURALISED AND EXOTIC SPECIES

Gymnosperms

| | |
|---|---|
| *Pinus radiata* | radiata pine |
| *Sequoia sempervirens* | coast redwood |

Dicot. trees and shrubs

| | |
|---|---|
| *Acacia melanoxylon* | Tasmanian blackwood |
| *Berberis glaucocarpa* | barberry |
| *Elaeagnus ×reflexa* | elaeagnus |
| *Ilex aquifolium* | holly |
| *Leycesteria formosa* | Himalayan honeysuckle |
| *Ligustrum lucidum* | tree privet |
| *Prunus laurocerasus* | cherry laurel |
| *Prunus* sp. | ornamental cherry |
| *Quercus robur* | English oak |
| *Robinia pseudoacacia* | false acacia, black locust, robinia |
| *Rubus idaeus* | raspberry |
| *Rubus* sp. (*R. fruticosus* agg.) | blackberry |
| *Solanum pseudocapsicum* | Jerusalem cherry |

Dicot. lianes

| | |
|---|---|
| *Clematis vitalba* | old man's beard |
| *Lonicera japonica* | Japanese honeysuckle |
| *Vinca major* | periwinkle |

Grasses

| | |
|---|---|
| *Agrostis capillaris* | browntop |
| *Dactylis glomerata* | cocksfoot |

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

| | |
|---|---|
| *Tradescantia fluminensis* | tradescantia |

Composite herbs

| | |
|---|---|
| *Cirsium arvense* | Californian thistle |
| *Cirsium vulgare* | Scotch thistle |

Dicot. herbs (other than composites)

| | |
|---|---|
| *Digitalis purpurea* | foxglove |
| *Foeniculum vulgare* | fennel |
| *Oxalis chnoodes* | oxalis |
| *Physalis peruviana* | cape gooseberry |
| *Phytolacca octandra* | inkweed |
| *Ranunculus repens* | creeping buttercup |
| *Rumex obtusifolius* | broad-leaved dock |
| *Solanum chenopodioides* | velvety nightshade |
| *Solanum nigrum* | black nightshade |
| *Stachys sylvatica* | hedge woundwort |
| *Trifolium repens* | white clover |
| *Viola riviniana* | dog violet |

APPENDIX 3

# VASCULAR PLANT SPECIES RECORDED AT ARAPAEPAE BUSH BLOCK 2: 1024 QUEEN STREET EAST, LEVIN

## INDIGENOUS SPECIES

### Gymnosperms

| | |
|---|---|
| *Prumnopitys taxifolia* | mataī |

### Dicot. trees and shrubs

| | |
|---|---|
| *Alectryon excelsus* subsp. *excelsus* | tītoki |
| *Coprosma autumnalis* | kanono, raurēkau, raurākau, manono |
| *Coprosma lucida* | karamū, kāramuramu, glossy karamū |
| *Coprosma robusta* | karamū, kāramuramu |
| *Corynocarpus laevigatus* | karaka |
| *Geniostoma ligustrifolium* var. *ligustrifolium* | hangehange |
| *Hedycarya arborea* | porokaiwhiri; pigeonwood |
| *Melicope simplex* | poataniwha |
| *Melicytus ramiflorus* subsp. *ramiflorus* | māhoe |
| *Myrsine australis* | māpou, matipou, māpau |
| *Pennantia corymbosa* | kaikōmako |
| *Piper excelsum* subsp. *excelsum* | kawakawa |
| *Pittosporum crassifolium* | karo |
| *Pittosporum eugenioides* | tarata; lemonwood |
| *Pseudopanax crassifolius × P. lessonii* | |
| *Streblus heterophyllus* | tūrepo |

### Monocot. lianes

| | |
|---|---|
| *Ripogonum scandens* | supplejack, kareao |

### Dicot. lianes

| | |
|---|---|
| *Muehlenbeckia australis* | puka |
| *Parsonsia heterophylla* | akakaikiore |

### Ferns

| | |
|---|---|
| *Asplenium flaccidum* | makawe, ngā makawe o Raukatauri |
| *Asplenium oblongifolium* | huruhuru whenua |
| *Asplenium polyodon* | petako |
| *Dicksonia squarrosa* | whekī |
| *Histiopteris incisa* | mātātā, water fern |
| *Microsorum scandens* | mokimoki |
| *Pyrrosia elaeagnifolia* | leather-leaf fern |

| | |
|---|---|
| *Zealandia pustulata subsp. pustulata* | kōwaowao, pāraharaha, hound's tongue fern |

Orchids

| | |
|---|---|
| *Earina autumnalis* | raupeka |
| *Earina mucronata* | peka-a-waka |

Grasses

| | |
|---|---|
| *Microlaena stipoides* | pātītī, meadow rice grass |

Composite herbs

| | |
|---|---|
| *Senecio bipinnatisectus* | Australian fireweed |

## NATURALISED AND EXOTIC SPECIES

Gymnosperms

| | |
|---|---|
| *Cupressus macrocarpa* | macrocarpa |
| *Pinus radiata* | radiata pine |
| *Sequoia sempervirens* | coast redwood |

Monocot. trees and shrubs

| | |
|---|---|
| *Trachycarpus fortunei* | Chinese windmill palm |

Dicot. trees and shrubs

| | |
|---|---|
| *Berberis glaucocarpa* | barberry |
| *Ligustrum lucidum* | tree privet |
| *Paraserianthes lophantha* | brush wattle |
| *Prunus* sp. | ornamental cherry |
| *Rhamnus alaternus* | Italian evergreen buckthorn |
| *Robinia pseudoacacia* | false acacia, black locust, robinia |
| *Rubus idaeus* | raspberry |
| *Rubus* sp. (*R. fruticosus* agg.) | blackberry |
| *Solanum pseudocapsicum* | Jerusalem cherry |

Dicot. lianes

| | |
|---|---|
| *Clematis vitalba* | old man's beard |
| *Lonicera japonica* | Japanese honeysuckle |
| *Passiflora tarminiana* | banana passionfruit |
| *Passiflora tripartita* var. *mollissima* | banana passionfruit |
| *Rubus idaeus* | raspberry |

Monocot. herbs (other than orchids, grasses, sedges, and rushes)

| | |
|---|---|
| *Allium triquetrum* | onion weed |
| *Tradescantia fluminensis* | tradescantia |

Composite herbs

| | |
|---|---|
| *Erigeron sumatrensis* | broad-leaved fleabane |

Dicot. herbs (other than composites)

| | |
|---|---|
| *Phytolacca octandra* | inkweed |
| *Solanum nigrum* | black nightshade |
| *Stachys sylvatica* | hedge woundwort |
| *Viola* sp. | violet |

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