Appendix G – Ecology Report

ASSESSMENT OF ECOLOGICAL EFFECTS FOR A PROPOSED SUBDIVISION AT OTAIHANGA ROAD, KĀPITI

providing outstanding ecological services to sustain and improve our environments

Wildlands

R5357a

ASSESSMENT OF ECOLOGICAL EFFECTS FOR A PROPOSED SUBDIVISION AT OTAIHANGA ROAD, KĀPITI

Retired pasture with gorse, blackberry and a stand of kānuka at the study site, Paraparaumu.

Contract Report No. 5357a

June 2021

Project Team:
Frances Forsyth - Report author and field assessment
Keely Paler - Report author
Trent Bell - Report author and field assessment
Nicki Papworth - Report author and field assessment
Jina Sagar- Field work
Jessica Reaburn – Report author
Nick Goldwater – Project management and peer review

Prepared for:
Richard Mansell
C/- Chris Hansen Consultants Ltd
220 Ross Road, RD 7
Whakamarama, Tauranga 3179

WELLINGTON OFFICE: 4 MOHUIA CRESCENT, ELSDON, PORIRUA 5022; P.O. BOX 50-539, PORIRUA 5240
Ph 04-237-7341; Fax 04-237-7496

HEAD OFFICE: 99 SALA STREET, P.O. BOX 7137, TE NGAE, ROTORUA
Ph 07-343-9017; Fax 07-343-9018, email ecology@wildlands.co.nz, www.wildlands.co.nz

CONTENTS

Reviewed and approved for release by:

Nick Goldwater
Principal Ecologist
Wildland Consultants Ltd

1. INTRODUCTION

Chris Hansen Consultants Ltd, on behalf of the Mansell family, is preparing a resource consent application for the Otiahanga Estates subdivision at 48 and 58 Tieko Street, and 131, 139, and 147 Otaihanga Road, Paraparaumu, and associated earthworks and infrastructure, and the discharge of roof water from buildings to land. Wildland Consultants Ltd has been commissioned to undertake an assessment of ecological effects of the proposed earthworks on terrestrial and freshwater features present at the property. A detailed Project Description is provided in Section 3 of the AEE accompanying the resource consent applications.

The proposal involves the subdivision of 17 hectares (western) portion of the Mansell Family Farm into 49 lots: 22 rural lifestyle lots in the northern part of the site, and 27 residential lots adjacent to Otaihanga Road in the south of the site. Access to 19 of the rural life-style lots in the north will be via Tieko Street, and the remainder of the rural-lifestyle and residential lots will be accessed via Otaihanga Road. The proposed subdivision of this area involves earthworks, construction of roads, installation of services, discharge of roof water from buildings to land, and the identification of a notional 20-metre building circle area on the rural lifestyle lots. It will link to local council waste water and stormwater infrastructure.

The subject site is zoned Rural Residential and is part of the Coastal Environment in the proposed Kāpiti Coast District Plan. It supports wetlands, dunes, and terrestrial vegetation, the latter of which mainly comprises exotic species and groves of mature kānuka (*Kunzea robusta*) trees. There are records of northern grass skink (*Oligosoma polychroma*) nearby and this species occurs on the property. The developer's intention is to minimise any adverse effects of earthworks on the main dune area and to provide a buffer around the wetlands. This will require accurate delineation of the wetland boundaries. Awa Environmental Ltd (2021) has a report outlining potential adverse effects of the proposed subdivision and earthworks on flood hazards and on groundwater and management of stormwater, which provides a basis to assess the potential adverse effects of proposed works on wetlands and other freshwater ecosystems and habitats.

The proposed subdivision lies within the Foxton Ecological District (ED) and does not contain any ecological features that have been designated as Significant Natural Areas (SNAs) under the proposed Kāpiti Coast District Plan.

Wildland Consultants Ltd has undertaken the following for this assessment of ecological effects of the proposed development:

- Mapped and described vegetation and habitats present;
- Surveyed for lizards on the property;
- Assessed the ecological values of vegetation and habitats;
- Assessed the potential adverse ecological effects of the proposed works; and
- Evaluated opportunities to avoid, minimise, or mitigate any potential adverse ecological effects.

2. SITE DESCRIPTION

The area to be developed comprises a long, narrow site between Tieko Street to the west, Otaihanga Road to the south, and the Kāpiti Expressway (SH1) to the east. It lies across duneland and includes swale and wetland areas. The vegetation is characterised by pasture with shelter belts and remnant kānuka groves, which originally formed part of a larger farm that was bisected by the recently constructed Kāpiti expressway.

3. ECOLOGICAL CONTEXT

3.1 Overview

This proposed subdivision is located in the Paraparaumu suburb of Otaihanga within the Foxton Ecological District. The characteristics of this ecological district have been summarised below from McEwen (1987).

The Foxton Ecological District is characterised by the most extensive sand-dune system in the country, extending from Patea to Paekakariki. The climate is characterised by warm summers and mild winters, with prevailing west to north-westerly winds and reliable and evenly distributed rainfall.

The Foxton Ecological District includes very extensive sand dunes, several estuaries, wetlands, dune lagoons and a few coastal swamp forest remnants containing nīkau (*Rhopalostylis sapida*), pūkatea (*Laurelia novae-zelandiae*), and kahikatea (*Dacrycarpus dacrydioides*). Dune vegetation has been greatly modified by the planting of pine forests, the introduction of marram grass (*Ammophila arenaria*) and the spread of weed species, particularly tree lupin (*Lupinus arboreus*), boxthorn (*Lycium ferocissimum*), and pampas grass (*Cortaderia selloana*). *Spartina* × *townsendii* is invading tidal rivers and streams. This ecological district is largely farmed largely using semi-intensive sheep and cattle.

Lizard species within the Foxton Ecological District have historically included Duvaucel's gecko (*Hoplodactylus duvaucelii*), Pacific gecko (*Dactylocnemis pacificus*), ngāhere gecko (*Mokopirirakau* "southern North Island"), barking gecko (*Naultinus punctatus*), Raukawa gecko (*Woodworthia maculata*), goldstripe gecko (*W. chrysosiretica*), copper skink (*Oligosoma aeneum*), Kupe skink (*Oligosoma* aff. *infrapunctatum* "southern North Island"), ornate skink (*O. ornatum*), northern grass skink (*O. aff. polychroma* Clade 1), and brown skink (*O. zelandicum*) (Bell & Wiles 2015).

3.2 Local context

Ecological Domains

Ecological Domains, also known as eco-domains, combine information on geology, geomorphology, meteorology, biology, and human use of natural resources with expert knowledge of the ecological processes and characteristics of the region (Greater Wellington Regional Council 2003). This property is located within the '53. Kāpiti Coast' Ecological Domain.

This Ecological Domain is a dominated by a complex wind derived dune system, where dune formation has impeded waterways, creating swamps and meandering streams in narrow, deep channels. The climate is warm with moderately seasonal rainfall and dry summers. Ground and air frosts are common, away from the foreshore. Habitat diversity is high within this ecological district, with vegetation determined by frost and salt tolerance, free draining soils and poorly drained acidic soils. Kānuka (*Kunzea robusta*) dominates sandy pioneering seral communities, and mānuka (*Leptospermum scoparium*) dominates swampy pioneering communities. High rabbit (*Oryctolagus cuniculus*) numbers are a problem for vegetation and erosion.

Threatened Land Environments

The Threatened Environment Classification (TEC) is a combination of three national databases: Land Environments New Zealand (LENZ), Land Cover Database (LCDB4) and the protected areas network. It shows how much indigenous vegetation remains within land environments, and how past vegetation loss and legal protection are distributed across New Zealand's landscape. The TEC is most appropriately applied to help identify places that are priorities for formal protection against clearance and/or incompatible land-uses, and for ecological restoration to restore lost species, linkages, and buffers (Cieraad *et al*. 2015).

The project area is located primarily on an 'Acutely Threatened' land environment, where indigenous vegetation has been reduced to less than 10% of its original extent.

4. METHODS

4.1 Vegetation survey

Vegetation and habitats at the site were surveyed on 5 February 2020, 9 March 2020, and 16 February 2021. All vegetation types were described and mapped. Areas visually recognisable as potential wetlands were identified and confirmed and delineated using the Clarkson methodology (Section 3.2). Any accessible indigenous trees were identified, marked with a handheld GPS device, and measured to meet Schedule 3.2 of the Kāpiti Coast District Plan (Appendix 1). Trees inaccessible due to steep topography and extensive blackberry (*Rubus fruticosus* agg.) growth were assessed from a distance. Current ecological values and the potential adverse effects of any proposed vegetation clearance were assessed. All vascular plant species observed were recorded and are presented in Appendix 2. Vegetation and habitat types were digitised onto aerial imagery using ArcGIS. A selection of site photographs is included in Appendix 6.

4.2 Wetland delineation

4.2.1 Background

The proposed Natural Resources Plan - decision version (Greater Wellington Regional Council) defines a **natural wetland** as:

> *"A permanently or intermittently wet area, shallow water and land water margin that supports a natural ecosystem of plants and animals that are adapted to wet conditions, including in the beds of lakes and rivers, the coastal marine area (e.g., saltmarsh), and groundwater-fed wetlands (e.g. springs). **Natural wetlands** do not include:*
>
> *b) wetted pasture, or pasture with patches of rushes.[1]"*

Note that, because of the rarity of wetlands in the Wellington Region, all **natural wetlands** will meet the representativeness and rarity criteria listed in Policy 23 of the Regional Policy Statement 2013 and therefore meet the definition of **significant natural wetland (**page 28 proposed Natural Resources Plan Appeals Version). This wording has been appealed to the Environment Court, but that appeal has not yet been resolved.

Standard methodologies for wetland delineation in New Zealand are being derived from a version of the USA wetland delineation protocol (U.S Army Corps of Engineers 1987), modified for New Zealand species and conditions. Under this protocol, an area is considered to be a wetland if the vegetation is at least periodically dominated by hydrophytes (aquatic and wetland plant species), AND the soils are predominantly undrained wetland soils (hydric), AND the area is at least seasonally wet (especially during the growing season) (Clarkson 2013).

Vegetation tools for wetland delineation in New Zealand are outlined in Clarkson (2013 and 2018). A hydric soils protocol has also been developed for New Zealand (Fraser *et al.* 2018), which describes how to identify hydric (water-logged) soils. Hydric soils are soils that are known to form under wetland conditions and can still be identifiable after a wetland has been drained or otherwise modified, e.g., peat soils. No hydrology tool is yet available for New Zealand.

Due to the relative infancy of delineation based on soils and hydrology in New Zealand, vegetation tools are the methods primarily used to identify wetlands. Wildlands has been informed by GWRC that in Wellington the preference is to use the vegetation tools in Clarkson (2013 and 2018) for delineating wetlands (Philippa Crisp, GWRC, 8 February 2019, pers. comm.). This has therefore been the primary approach carried out in this assessment as further described below.

[1] Full details in Appendix 1.

4.2.2 Vegetation tool for wetland delineation

The Clarkson (2013 and 2018) methodology was used to delineate the wetlands. The methodology uses a Dominance Test and a Prevalence Index for vegetation assessment. The Dominance Test weighs the percent cover of dominant hydrophytic plant species (i.e., wetland plants) against that of dominant upland species. Hydrophytic plants can be classified as obligate (OBL), facultative wetland (FAW), or facultative (FAC) (see Appendices 2 and 3). Facultative upland (FACU) and upland (UPL) plants are not wetland indicators. If the threshold is met but all of the dominant species are facultative plants then the Prevalence Index can be used to delineate wetlands. The Prevalence Index uses the cover values of all vascular species in the plant community to weigh averages of hydrophytic species cover against upland species. An area is considered to be wetland if the Prevalence Index threshold value is ≤3. If the index is >3 then the vegetation cannot be characterised as hydrophytic, therefore the site is not considered to be a wetland.

Areas of wetland were initially delineated using the distinct contours of the dunes and of grazed pasture between wetland vegetation and pasture vegetation.

Markers were placed along sections of the provisional boundary, close to an area of representative wetland vegetation, in order to refine the boundary of each wetland area. Two 1 m^2 plots were placed one metre on either side of a marker: one within the wetland, one outside (Figure 1). Vegetation assessments were then undertaken within each plot. An additional 2.5 metre radius semi-circle plot around the marker was then used to capture the presence of wetland species greater than one metre high.

4.2.3 Additional methods for wetland delineation

Clarkson (2013) indicates that routine wetland assessments (as undertaken for the other potential wetland areas on site) should not be applied in atypical situations, for example where wetlands have been filled, drained, or cleared. The potential Wetland 4 adjacent to Otaihanga Road fits into the 'drained' category and therefore a more comprehensive method was applied to this area to determine whether any natural wetland vegetation is present.

Within this potential wetland, it was difficult to visually identify distinct wetland vegetation types. Using the assumption that the contours of the dunes delineated the potential wetland area, stratified random sampling was undertaken to identify species and ascertain if the area was characterised by wetland vegetation. Four transects were run ~10 metres from each other from dune to dune, parallel to the drain along Otaihanga Road. Two-metre squared sample plots were placed at random intervals along each transect by generating a random number and counting out paces along the transect. Soil was exposed to *c.*15 centimetres at an outside corner of each plot to assess composition. Vegetation and soil assessments were undertaken in 16 randomly placed plots along the four transects.

Vegetation within all plots was assessed according the Clarkson 2018 methodology and GWRC's pasture assessment.

4.2.4 Exclusion of wetted pasture

The proposed Natural Resources Plan specifically excludes wetted pasture, or pasture with patches of rushes from its definition of wetlands. It is therefore critical to differentiate a wetland from a wetted pasture. Greater Wellington Regional Council has decided that *"Pasture has been defined in many ways; however, the overall emphasis is on plants that are grown for grazing animals i.e., the purpose of the grazing land is that it is managed for the production of livestock through the provision of forage plants grown for that purpose. This is a useful distinction as the New Zealand Grassland Association provides us with a list of the commercially available plants used in cultivation (Stewart et al. 2014) that can be used to define the presence of pasture.*" And "*So, 50% or more of the aerial cover should be dominated by these defined pasture species for a site to be labelled as pasture.*" (5 September 2019, GWRC).

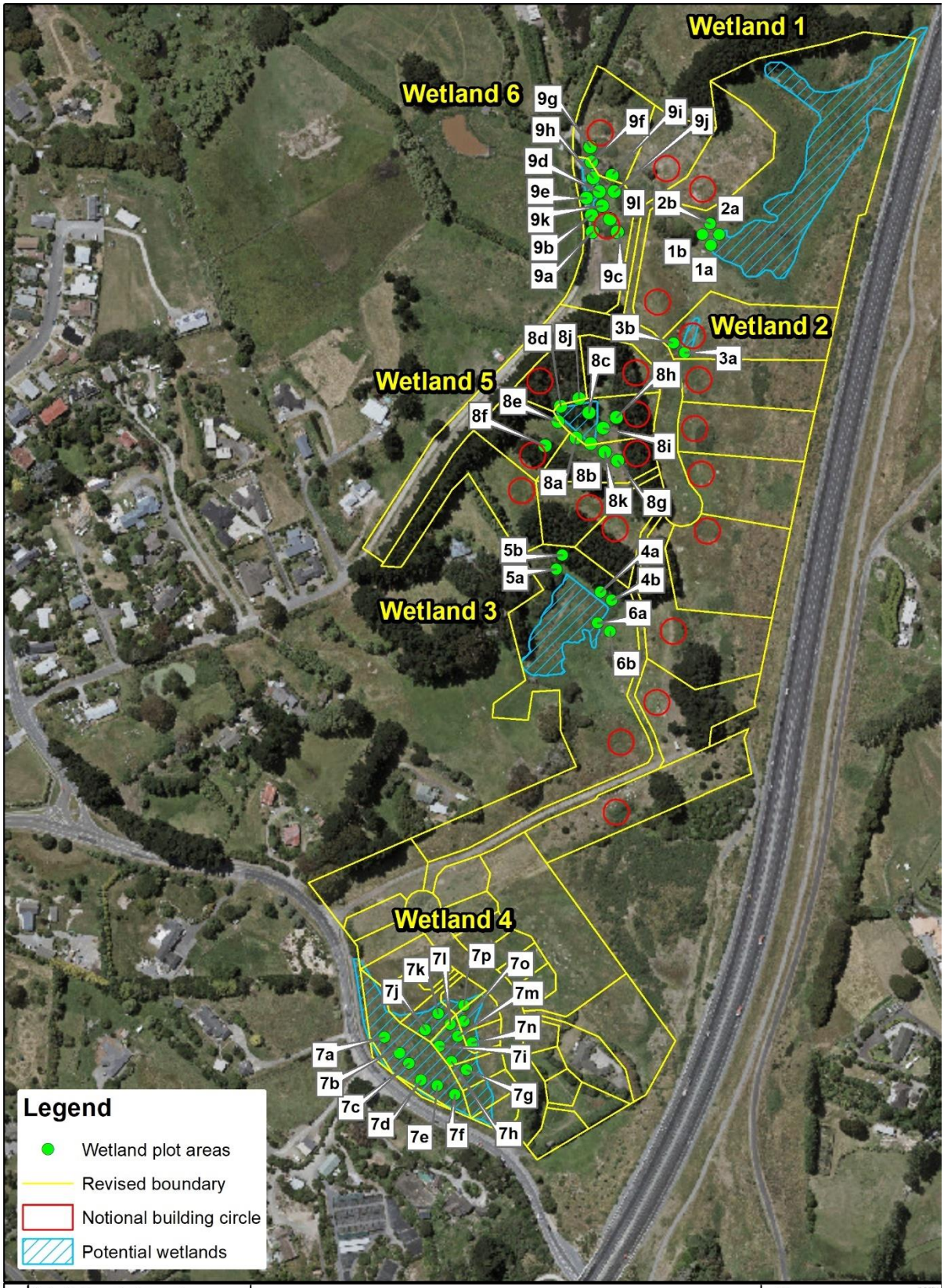
Where a wetland delineation plot meets the Dominance or Prevalence Index test for wetland species, then vegetation within the plot should be assessed for dominance by pasture species. Where pasture species exceed 50% of the relative cover, then that area will be considered to be wetted pasture (with or without rushes) and therefore not a natural wetland.

4.2.5 National Policy Statement for Freshwater Management

The National Policy Statement for Freshwater Management (NPS-FM) defines 'natural wetland' as outlined below.

> ***Natural wetland*** *- a wetland (as defined in the Act) that is not:*
>
> *(a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or*
>
> *(b) a geothermal wetland; or*
>
> *(c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.*

All wetlands identified through previously outlined methods were also assessed against the criteria for natural wetland as defined in the NPS-FM. In regards to the 'improved pasture' exclusion, it is noted this has a similar definition to the 'wetted pasture' exclusion for Greater Wellington as outlined in Section 4.2.4.



N

Data Acknowledgment

Map contains data sourced from LINZ
Crown Copyright Reserved

Report: R5357
Client:
Ref: 05 0442
Path: E:\gis\WellingtonOtaihangaAEE\mxd\
File: Figure1PotentialWetlandAreas1.mxd

Figure 1. Potential wetland areas, surveyed using the Clarkson(2018) wetland delineation protocol

0 100 200 m

Wildlands © 2021
www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:4,000
Date: 19/05/2021
Cartographer: DBM
Format: A4

4.3 Lizard survey

A targeted survey for lizards was undertaken which included three methods.

Pitfall Trapping

Forty pitfall traps, scattered across any potentially suitable habitat on the entire property, were operated between 03-09 March 2020, providing 200 trap days across the five days. The pitfall traps used were two-litre plastic buckets dug into the sandy ground, so that the top of the bucket is flush with the soil surface (Figure 2). Pitfall traps have four small holes drilled into the base to allow for drainage of rainwater. The traps were baited with tinned pear and a wet sponge placed in the bottom of the trap to prevent desiccation of trapped lizards. In addition, vegetation placed at the base of the trap to provide shelter for captured lizards. A 20 cm × 20 cm plywood square was also placed over the trap to act as a pitfall trap cover. Once opened, traps were checked every 24 hours. After capture, identification and data collection, the lizard is released on the ground next to the pitfall trap.

Day Searching

The project herpetologist undertook a search of vegetation and any terrestrial cover objects such as human-made ground cover objects and cut or fallen wood, and some raking of *Pinus* litter under some of the shelter belts.

Spotlighting

The project herpetologist used a H14.R LED Lenser head torch to undertake spotlighting across the property for two hours. Spotlighting effort was particularly concentrated around mānuka and kānuka trees, which is a limited habitat type on the property. Spotlighting was undertaken to locate arboreal geckos (both diurnal and nocturnal species). The spotlighting was carried out during a warm, dry and calm evening (15-20˚C, no wind, cloud cover ranging between 0-6/8, and no rain).

4.4 Other fauna

Targeted surveys for all other fauna species were beyond the scope of this study, although all fauna species observed at the site were recorded. Additionally, records of other fauna species were compiled and the suitability of the habitat at the site was assessed.

4.5 Flood hazard assessment of effects

The hydrology report (Awa 2021) describes the changes to runoff as a result of the proposed earthworks and subdivision and mitigation that would address these effects and meet the relevant flood hazard rules and standards under the proposed District Plan. This report was reviewed and assessed for potential ecological effects.

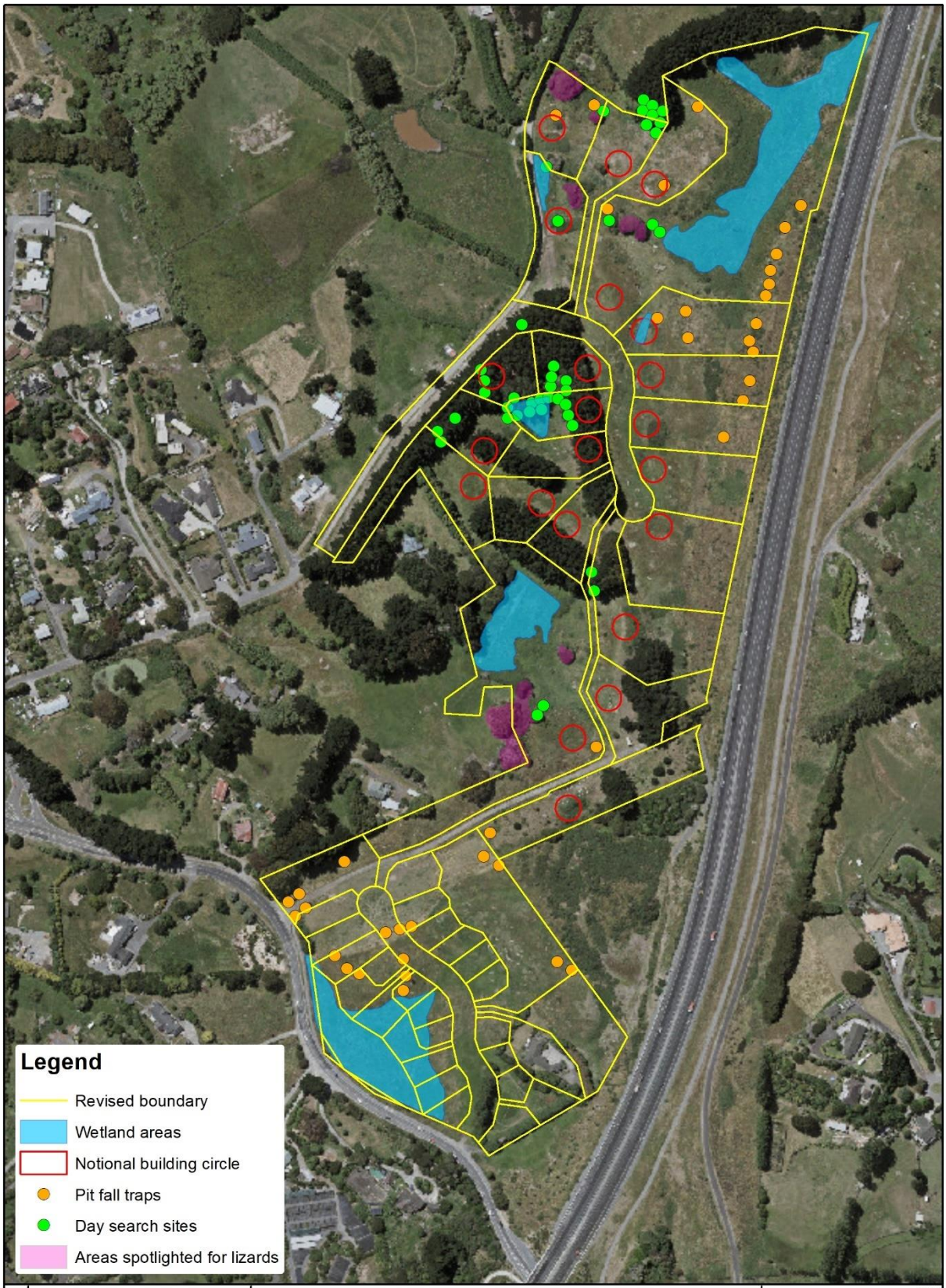


Figure 2. The search effort undertaken to search for lizards at the proposed Otaihanga subdivision

5. VEGETATION AND HABITATS

5.1 Overview

A low diversity of indigenous plant species was observed at the site (Appendix 2) and many of the indigenous plant communities present have been adversely impacted by edge effects such as wind, animal browse, and trampling. The understorey species present beneath the indigenous canopy were restricted to unpalatable pest plant species.

A number of potential wetland habitats are present in dune swales. These are generally heavily browsed by rabbits and have low indigenous species diversity.

5.2 Dune vegetation

Pasture

Most of the site comprises pasture that is currently grazed by horses (*Equus caballus*) with the remainder retired from grazing. There are areas in the north and south of the site where rabbits have created extensive warrens. Along a dune in the southern part of the site pasture has been stripped by the rabbits and the sand is likely to be susceptible to wind erosion.

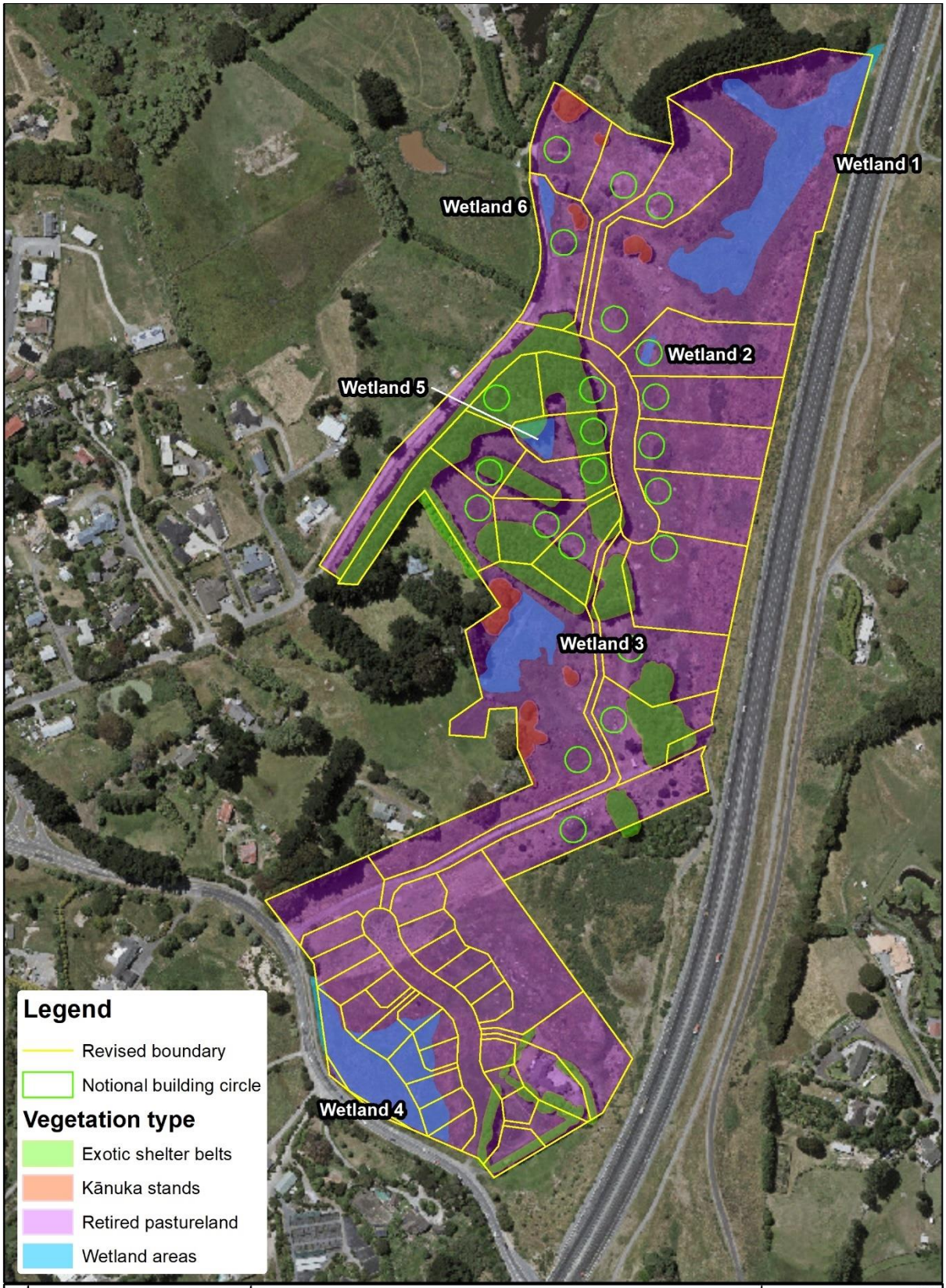
The pasture is dominated by Yorkshire fog (*Holcus lanatus*), with large patches of blackberry interspersed with inkweed (*Phytolacca octandra*), tree lupin (*Lupinus arboreus*), and gorse (*Ulex europaeus*). Cocksfoot (*Dactylis glomerata*) is co-dominant with Yorkshire fog in some areas.

Shelter belts

There are number of shelter belts across the northern part of the site (Plate 1). These comprise mature *Pinus radiata*, macrocarpa (*Cupressus macrocarpa*), and *Eucalyptus* sp. There is no understorey beneath these shelter belts. There are also amenity plantings and shelter belts of introduced trees around the only house on the site.

Kānuka groves

Seven small stands of kānuka occur sporadically in the northern and central part of the site (Figure 3). These vary in size from several to *c.*50 trees. In the northern part of the site the understorey below the kānuka is characterised by sparse inkweed and Scotch thistle (*Cirsium vulgare*). In the central part of the site, kānuka groves support a relatively dense understorey of inkweed and blackberry. All of the kānuka trees measured were greater than 15 centimetres diameter at breast height. The grove to the west of Wetland 3 consisted of very large trees that could not be accessed for measurement due to the dense blackberry and steep topography. All of the kānuka indicated in Figure 4 would meet the criteria in the District Plan for 'significant indigenous vegetation'.



Data Acknowledgment

Map contains data sourced from LINZ
Crown Copyright Reserved

Report: R5357
Client:
Ref: 05 0442
Path: E:\gis\WellingtonOtaihangaAEE\mxd\
File: Figure3VegetationTypes1.mxd

Figure 3. Vegetation types at the proposed Otaihanga subdivision

0 100 200 m

© 2021 Wildlands
www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:4,000
Date: 19/05/2021
Cartographer: DBM
Format: A4

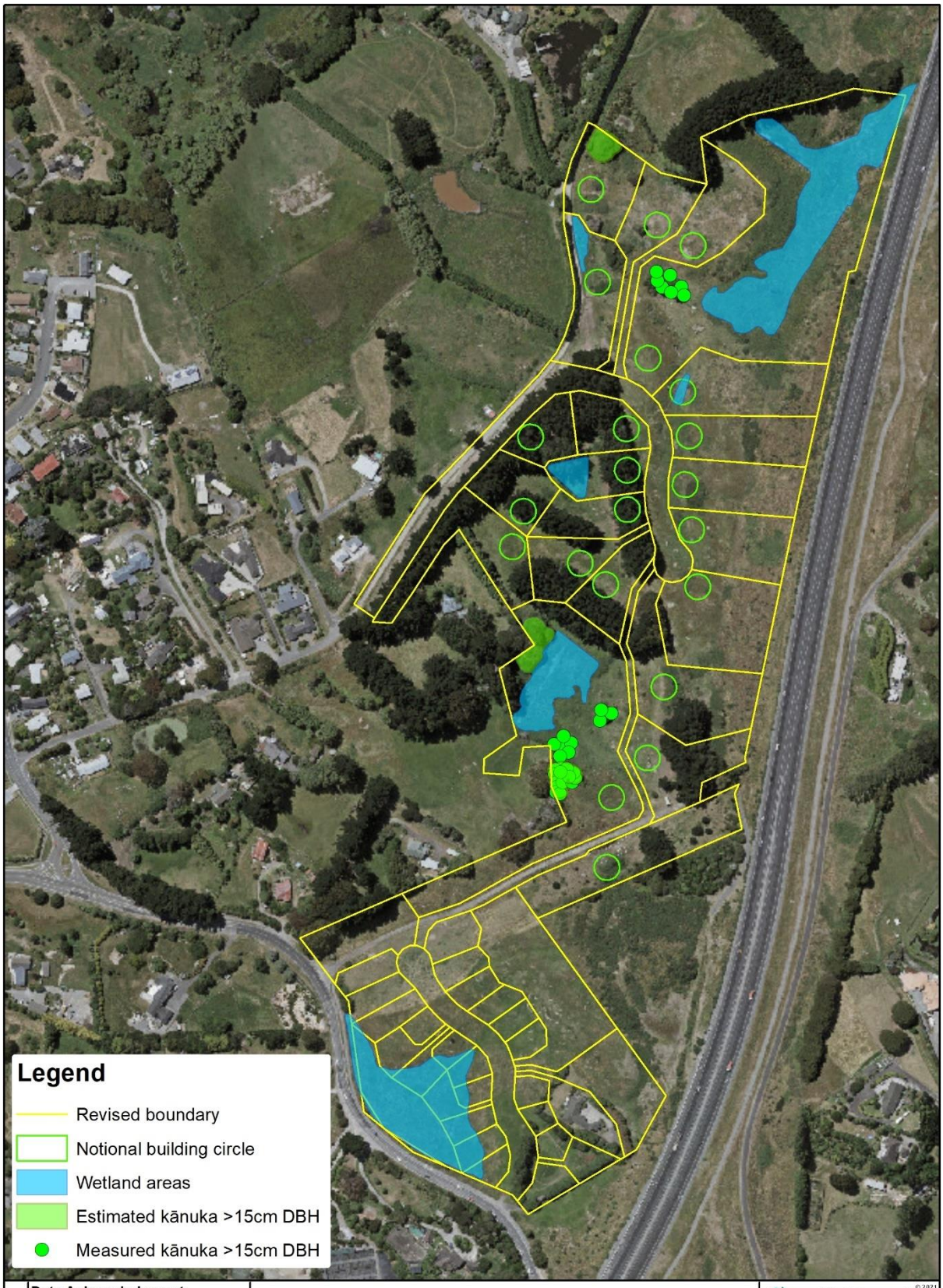


Figure 4. Kānuka trees which qualify for Schedule 3.2 of the Kāpiti Coast District Plan

5.3 Wetlands

All surveyed wetlands and potential wetlands occur within dune swales (Figure 1). Wetland 1 and Wetland 3 were assessed as natural wetlands (under both the Wellington Proposed Natural Resources Plan and the NPS-FM 2020 whilst Wetland 2 was assessed as wetted pasture and Wetland 4 was assessed as pasture. Neither Wetland 2 or 4 are therefore considered natural wetlands. It is noted that two small additional wetlands (Wetlands 5 and 6) were observed during a site walkover on 11 February 2021. These areas were subsequently confirmed to be 'natural inland wetlands' during delineation fieldwork undertaken on 16 February 2021.

Appendix 2 provides a list of vascular species at the site and whether they are considered wetland species or not. Results of the wetland delineation assessments are provided in **Appendix 5.**

Wetland 1

Wetland 1 is the larger of two potential wetlands in the northern part of the site (Plate 2). It occurs in a dune swale and connects to a constructed wetland/pond system on the neighbouring property to the north. SH1 runs along the northeastern boundary of the wetland and is raised above the natural contours of the land. Vegetation in Wetland 1 consists of abundant *Juncus sarophorus*, large patches of herbfield defined by creeping buttercup (*Ranunculus repens*) and water-pepper (*Persicaria hydropiper,*) and small patches of bracken fern (*Pteridium esculentum*) and matata (*Paesia scaberula*). All dominant species were identified as hydrophytic and soils were distinctly wet underfoot, despite dry, summer conditions during the field work. The surrounding steep dune slopes are dominated by blackberry, with patches of tree lupin and bare sandy soil with extensive rabbit warrens. A kānuka stand lies upslope from the south-eastern side of the wetland.

Vegetation assessment determined that Wetland 1 meets the criteria of a natural wetland rather than wetted pasture. The plots also included two indigenous species; Edgar's rush (*Juncus edgariae*) and waxweed pennywort (*Hydrocotyle heteromeria*).

Wetland 2

Wetland 2 is a very small area of rushes at the northern end of the site (Plate 3). This narrow strip occurs between two dunes, and consists of a north/south flow path carrying runoff from the surrounding steep dunes. Yorkshire fog, which is a pasture species, and creeping buttercup dominate this area, with smaller patches of Edgar's rush. The dune slope on the eastern side is dominated by blackberry, whilst the western slope is predominately pasture.

Vegetation assessment determined that this area was wetted pasture, and therefore does not meet the criteria of a natural wetland.

Wetland 3

Wetland 3 is located near the centre of the site in a natural dune swale with no outlet for ponded water (Plate 4). A channel has been excavated from the north to the south of the wetland in an apparent attempt to drain the land. The northern end of the wetland comprises rushland (*Juncus sarophorus*), with tall beggar's ticks (*Bidens frondosa*) dominant towards the southern end. This southern area is likely to be dominated by rushland once the beggar's ticks die back in autumn. The constructed channel comprises a sedgeland dominated by *Isolepis prolifera* and a number of other wetland obligate plant species, including water milfoil (*Myriophyllum propinquum*), water speedwell (*Veronica anagallis-aquatica*), and water forget-me-not (*Myosotis laxa* subsp. *caespitosa*). All dominant species were identified as hydrophytic. The area has been fenced, and has several groves of large kānuka on its western and southern slopes.

Vegetation assessment determined that this area meets the criteria of a natural wetland. Note that for the western boundary, plots 6a and 6b, came up as pasture (6b) and wetted pasture (6a), so the actual boundary for that side will be about one metre to the west of those plots.

Wetland 4

Wetland 4 is located at the southern end of the site adjacent to Otaihanga Road (Plate 5) and receives runoff from Otaihanga Road via a council culvert at the southeastern corner of the site. Flow from the culvert follows a drainage swale inside the southern boundary fence and discharges via a second council culvert under Otaihanga Road at the south western corner of the site. The outlet culvert is small and acts as a bottleneck, holding back ponded water, thereby reducing flooding on properties across the road and increasing the duration of ponded water at the site following rain.

The potential wetland is dominated by open pasture with occasional large patches of rushes. There is no discernible change in vegetation structure between the drainage swale and the open pasture area, which is interspersed with rushes.

Vegetation assessment in this area was to determine whether the dominant vegetation was hydrophytic. Of 16 plots, 13 were assessed as pasture, one plot as wetted pasture and two as non-wetland vegetation. All dominant species in plots were hydrophytic. However, all also failed the prevalence index by a very small margin, as almost all species present were facultative. These findings, combined with the hydrology report showing that the water table is 1.6 metres below ground level, indicate that the area was likely a wetland prior to human activities in the area. However, it is now degraded to the point of being solely pasture and therefore does not meet the criteria of a natural wetland.

Soils examined at each plot showed a consistent peat layer. Although GWRC does not include soils in its definition and assessment requirements of wetlands, it is important to note that peat itself is a scarce natural resource and significant carbon reserve.

Wetland 5

Wetland 5 occurs in the centre of the property and occupies the low-lying part of a dune basin. At the time of the survey, water-pepper was the dominant wetland plant species, occurring with locally common creeping buttercup and frequent emergent inkweed, Scotch thistle, and fleabane (*Erigeron sumatrensis* (Plate 6). Exotic grass species such as creeping bent and Yorkshire fog occur frequently amongst the ground-cover vegetation.

This wetland meets the criteria of a natural wetland.

Wetland 6

Wetland 6 occupies a small hollow immediately adjacent to an existing road in the northwestern corner of the site. The vegetation is characterised by frequent emergent *Juncus sarophorus* over a ground-cover of abundant creeping buttercup and frequent creeping bent and water-pepper (Plate 7). Occasional dryland species such as browntop (*Agrostis capillaris*), white clover (Trifolium repens), and narrow-leaved plantain (*Plantago lanceolata*).

This wetland meets the criteria of a natural wetland.

6. FLORA

Ten indigenous and 42 exotic plant species were recorded during the survey (Appendix 2). No additional plant species have been recorded in the Department of Conservation Bioweb Database covering the site.

Nine of the indigenous plant species are ranked as Not Threatened (de Lange *et al.* 2018). One species, kānuka (*Kunzea robusta*) is ranked as 'Threatened-Nationally Vulnerable'. This is a species in the Myrtaceae family, all of which are at risk of infection by myrtle rust (*Austropuccinia psidii*), a potentially devastating plant pathogen which has no known treatment. Along with other species in the Myrtaceae family, the threat status of this species has been elevated as a precautionary measure based on the potential threat posed by myrtle rust (see de Lange *et al*. 2018). However, kānuka is not currently considered rare in the region.

Of the indigenous species on site, kānuka and tī kōuka (*Cordyline australis*) have been listed for protection within the Kāpiti Coast District Plan (Schedule 3.2). Most of the trees on site, which qualify under Schedule 3.2, are listed in Appendix 1 and illustrated in Figure 4.

7. FAUNA

7.1 Avifauna

Indigenous bird species recorded during the site visit include warou (welcome swallow; *Hirundo neoxena*), riroriro (grey warbler; *Gerygone igata*), pūkeko (*Porphyrio melanotus*), paradise shelduck (*Tadorna variegata*), and kāhu (swamp harrier; *Circus approximans*). Introduced bird species recorded include blackbird (*Turdus merula*) and Australian magpie (*Gymnorhina tibicen*). The vegetation at the site may also provide habitat for other common indigenous species such as tauhou (silvereye; *Zosterops lateralis lateralis*) and pīwakawaka (fantail; *Rhipidura fuliginosa*). None of these species are classified as 'Threatened' or 'At Risk' by Robertson *et al.* (2017).

7.2 Herpetofauna

7.2.1 Desktop Assessment

Within the Foxton Ecological District, the Pacific gecko and Kupe skink extend only as far south as Whanganui, and are both highly unlikely to be present. The goldstripe gecko is recorded only from two islands, Mana Island and Kāpiti Island, and mainland Taranaki. It is highly unlikely to be found resident in the Otaihanga area and, accordingly, these species are excluded from the assessment. Given the existing habitat values at the Otaihanga site, the most likely species present are the copper skink, northern grass skink, and brown skink.

There are no lizard records in the Department of Conservation's Bioweb Herpetofauna Database for the property; however, there is a historical record for Raukawa gecko (from 1960; Bioweb Observation Record Number 483779) within the 10-kilometre radius of the site. There are two records for ngāhere geckos in the database: one from 1968 in Paraparaumu (488173), and the other from 1965 at the Akatarawa Summit (484390, 1965). There are a further three recent (2015/2016) records of this species from Maungakotukutuku Valley (Bell 2017). There are ten records each for barking gecko and northern grass skink throughout the Paraparaumu region, and two copper skink records to the south of Paraparaumu.

7.2.2 Field Survey

Northern grass skinks (Not Threatened, Plate 8) were observed during March 2020 field work. Three of these were observed using day searching methods, and five were captured in pitfall traps. See Appendix 3 for collection data and Figure 5 for the locations of lizards recorded from the site.

7.3 Long-tailed bats

Long-tailed bats (classified as 'Threatened-Nationally Critical' by O'Donnell *et al.* 2018) were recorded on Kapiti Island (*c*.9 kilometres from the study site) in 2016. The closest confirmed record of long-tailed bats is 32 kilometres to the east in the Tararua Range. There have also been surveys that did not detect bats within 25 kilometres of the study site (Department of Conservation Bat Database). Given the highly modified, fragmented context of the study site and its proximity to residential areas, it is highly

unlikely that bats utilise trees unless they are commuting between Kapiti Island and the Tararua Range.

7.4 Introduced pest mammals

Numerous feral rabbits and their burrows were observed on site and there is likely to be a dense population of this species (Plate 9). This species is listed in the Greater Wellington Regional Pest Management Plan as a pest to be managed under sustained control programmes. See Appendix 4 for a list of all fauna observed at the site. Other pest animals likely to be present at the site include brush-tailed 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 utilise the site.

8. ECOLOGICAL VALUES

8.1 Dune values

The vegetation present at the site is dominated by introduced species, with nine indigenous plant species observed during the site visit. The exotic trees present on the site form long narrow shelterbelts, providing limited habitat for common indigenous fauna species. Overall, the ecological values of the dunes at the property are considered to be low.

8.2 Wetland values

Four areas were initially identified on 5 February 2020 as potential wetlands due to their vegetation and location at the bottom of dune swales. Following vegetation surveys, two of these four (Wetlands 1 and 3) were determined to be natural wetlands using both the Dominance Test and Prevalence Index for wetland vegetation under the Clarkson methodology. Further, Wetlands 1 and 3 do not qualify as wetted pasture following the Regional Council's methodology, or improved pasture following the NPS-FM natural wetland definition. A further two natural wetlands were confirmed at the site in February 2021. A summary of the delineation results is presented in Appendix 5.

Due to the rarity of wetlands in the Wellington Region, all of the natural wetlands meet the 'representativeness' and 'rarity' criteria listed in Policy 23 of the Regional Policy Statement 2013, and therefore meet the definition of a significant natural wetland. Policy 37 (Values of wetlands) of the Natural Resources Plan - Appeals Version requires an assessment of values within natural wetland areas so that activities in and adjacent to natural wetlands can be managed to maintain and, where appropriate, restore their condition and their values. Table 1 summarises the ecological and other values for each wetland vegetation type.

Table 1: Wetland values as assessed against NRP Policy 37: Activities in and adjacent to natural wetlands shall be managed to maintain and, where appropriate, restore their condition and their values

Policy 37: Values of Wetlands Criteria	Wetland 1	Wetland 3	Wetland 5	Wetland 6
a) as habitat for indigenous flora and fauna.	**Low:** The percentage and diversity of indigenous plant species is low. This wetland may provide habitat for common indigenous bird species such as pūkeko, but due to seasonally low water levels is unlikely to provide core or seasonal habitat for indigenous aquatic species, or lizards.	**Low:** The percentage and diversity of indigenous plant species is low. This wetland may provide habitat for common indigenous bird species such as pūkeko, but due to seasonally low water levels is unlikely to provide core or seasonal habitat for indigenous aquatic species, or lizards.	**Low:** The percentage and diversity of indigenous plant species is low. This wetland may provide habitat for common indigenous bird species such as pūkeko, but due to seasonally low water levels is unlikely to provide core or seasonal habitat for indigenous aquatic species, or lizards.	**Low:** The percentage and diversity of indigenous plant species is low. This wetland may provide habitat for common indigenous bird species such as pūkeko, but due to seasonally low water levels is unlikely to provide core or seasonal habitat for indigenous aquatic species, or lizards.
b) for their significance to mana whenua.	**Unknown**	**Unknown**	**Unknown**	**Unknown**
c) for their role in the hydrological cycle including flood protection.	Moderate capacity for flood flow attenuation.	Moderate capacity for flood flow attenuation but this would flood and limit grazing on a neighbouring property to the southwest.	Minimal capacity for flood flow attenuation given that most of the wetland covers sloping ground.	Moderate capacity for flood flow attenuation, particularly with water flowing from the adjacent road.
d) for nutrient attenuation and sediment trapping.	Being a self-contained basin, the wetland is a sink for nutrients and sediment but may transition to a dryland should sediment inputs increase.	Being a self-contained basin, the wetland is a sink for nutrients and sediment but may transition to a dryland should sediment inputs increase.	Being a self-contained basin, the wetland is a sink for nutrients and sediment but may transition to a dryland should sediment inputs increase.	Moderate capacity for trapping run-off from the adjacent road and pasture.
e) as a fisheries resource.	**Nil:** Unlikely to support fish.	**Nil:** Unlikely to support fish.	**Nil:** Does not support fish species.	**Nil:** Unlikely to support fish.
f) for recreation.	**Moderate:** Moderate amenity values	**Moderate:** Moderate amenity values.	**Low:** Low amenity values.	**Low:** Low amenity values.
g) for education and scientific research.	**Low:** Private land.	**Low:** Private land.	**Low:** Private land.	**Low:** Private land.

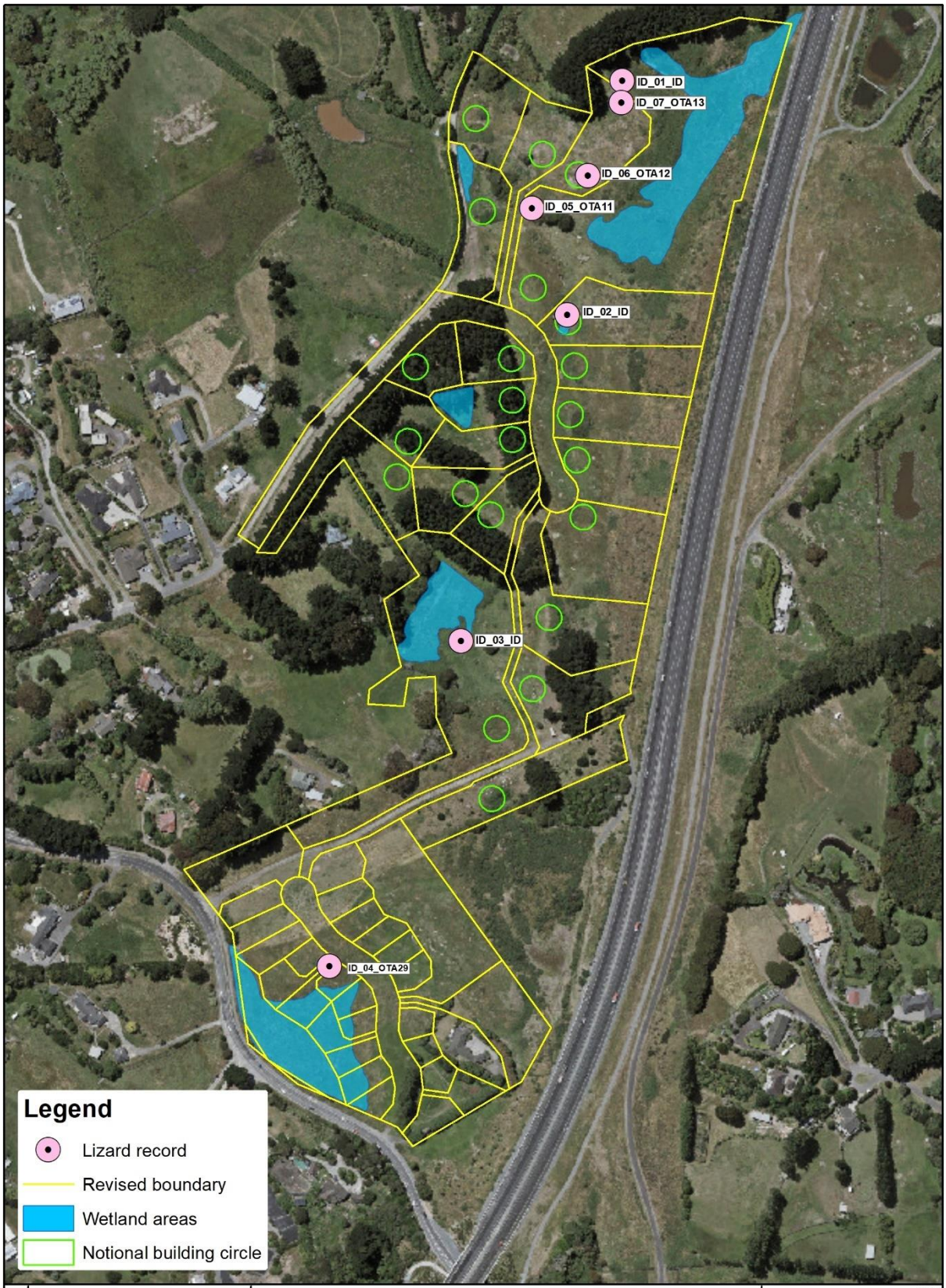


Figure 5. Lizards Found at the proposed Otaihanga Subdivision

8.3 Fauna values

The exotic shelterbelts and kānuka groves on site provide some habitat for common indigenous fauna species and may act as stepping stones for indigenous avifauna species as they move across the landscape.

Duneland and pastureland provide habitat for a relatively sparse population of northern grass skinks, a Not Threatened indigenous lizard species that is legally protected by the Wildlife Act (1953).

9. HYDROLOGY

9.1 Northern rural life-style area

The northern rural life-style area includes an area with the lowest elevation of any part of the site, at less than four metres above sea level. It is unsurprising that the northern wetland area is identified in the proposed District Plan as a flood hazard area. However, earthworks immediately south of the wetland will raise that land above the flood hazard. This will not reduce the capacity of the wetland to hold and attenuate flood waters, but is likely to result in longer periods of inundation. With current climate change predictions that rain will fall less frequently and rainfall will be heavier, this will result in a higher variability of the hydrological regime of the wetland. This is a result of natural change and has nothing to do with the proposed earthworks. The water levels within the wetland may benefit from garden watering and associated runoff.

9.2 Southern residential area

Building density will be higher in the southern part of the subdivision. Much of the swale areas in this part of the site are predicted to be inundated during a 100-year average recurrence interval rainfall event (Figure 6). Several of the eastern areas of dune swale, plus the northern part of Wetland 4 (which is not classified as a natural wetland and has been assessed as having low value) are to be filled as part of the proposed earthworks. An existing open drain alongside Otaihanga Road and the southern part of Wetland 4 are to be modified to create a constructed wetland with increased flood storage capacity in proposed Lot 200. Further, an area of ponding adjacent to the Kāpiti Expressway at the southernmost end of the site will be maintained to its existing extent and depth and connected via a pipe with a non-return valve to the open drain.

Figure 6: 100-year ARI CC peak inundation depths- base scenario for the southern part of the site (Awa 2021).

Traditional kerb and channel will carry run off from lots to a road sag half way along the new access road where the flow will be captured in a sump and conveyed via a pipe to the flood storage area.

10. POTENTIAL ADVERSE ECOLOGICAL EFFECTS

10.1 Overview

Potential adverse effects of the proposed earthworks and subdivision on ecology can be summarised as:

1. Localised loss of exotic vegetation;
2. Loss of habitat for avifauna;
3. Injury to and/or mortality and loss of habitat for indigenous lizards;
4. Wetland sedimentation;
5. Adverse impacts on wetland hydrology; and
6. Stormwater run-off and contamination of receiving environments

Each of these is addressed in more detail below.

10.2 Loss of exotic vegetation

The proposed subdivision plan will endeavour to avoid the loss of all indigenous vegetation, which primarily comprises kānuka. The retired pasture grassland and exotic shelterbelt trees are of limited ecological value and the potential ecological effects of removing vegetation from those areas are considered no more than minor. Table 2 below shows the current extent of all vegetation types at the property and the amounts proposed to be removed.

Table 2: The quantity of each vegetation type on site and the amount of this proposed to be removed to develop the subdivision.

Vegetation Type	Total area on the site (hectares)	Area to be removed (hectares)	Estimated wetland buffer planting (hectares)
Kānuka	0.19	0.00	n/a
Exotic shelterbelt	2.28	0.05	n/a
Natural inland wetland	1.2	0.00	2.1*
Retired pastureland	14.52	9.69	n/a
Total	**18.19**	**9.74**	**2.1**

* relates to wetlands 1 and 3; no planting is proposed for wetlands 5 and 6.

10.3 Loss of dune habitat

Approximately 9.74 hectares of lower-lying modified dune habitat will be adversely affected by the proposed development. Policy 11(b)iii of the New Zealand Coastal Policy Statement 2010 aims to *"avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh".*

As discussed in Section 8.1 of the report, there are no indigenous dune plant communities at the site given the extent of modification by farming activities and the dominance of exotic plant species. In addition, the dunes are no longer functioning as 'active dune systems' due to the stabilising effect of pasture grass and exotic shelterbelts. The applicant is intending to retain the dominant dunes at the site, some of which will be planted with appropriate indigenous tree and shrub species. Accordingly, the adverse effects on indigenous dune communities and dune function are considered to be negligible.

10.4 Effects on avifauna

Noise and movement associated with construction may disturb or temporarily displace bird species. However, these effects are likely to be no more than minor as the bird species present are all common and mobile. Disturbance during the breeding season is unlikely to result in more than minor adverse effects as any breeding individuals will be able to produce extra clutches to compensate for failed breeding attempts.

The subdivision has been planned to retain habitat for wetland birds, but the removal of the exotic shelterbelts will result in the localised loss of feeding and breeding habitat for indigenous bird species. The bird species recorded at the property are all common and widespread and there is an abundance of similar habitat within the local area to which displaced birds can disperse.

10.5 Effects on herpetofauna

There is a population of northern grass skink onsite, in low, but detectable numbers. The northern grass skink is classified as 'Not Threatened' by Hitchmough *et al*. (2016). Earthworks onsite will adversely affect this population through injuries and/or deaths and loss of habitat. The species is legally protected from harm or destruction via the Wildlife Act 1953 and permits will be sought under that Act.

10.6 Wetland sedimentation

The proposed earthworks footprint is approximately 75,000m² with a total cut volume of approximately 70,000m³ and total fill volume of approximately 54,000m³. The earthworks have been designed to achieve a cut/fill balance, meaning that other than roading materials, no soil will be imported or removed to/from the site (Cuttriss 2021).

There are four natural wetlands at the site, as defined by the NPS-FM. The subdivision has been planned to avoid any works near these areas (Wetlands 1, 3, 5 and 6) and earthworks have been designed in order to avoid the 10-metre setback as per the NES-FW. These wetlands are not individually identified in the proposed District Plan; however, they are significant natural wetlands under the criteria in Policy 23 of the Wellington Regional Policy Statement.

Undertaking earthworks in the vicinity of wetlands has the potential to result in sediment discharge into the wetland environment. The soil at the site is predominantly sand, which is easily mobilised during strong wind and rain events. This could result in reclamation of a wetland and a reduction in ecosystem services provided by wetlands such as water quality management and carbon sequestration.

10.7 Adverse impacts on wetland hydrology

The requirement for the site to be stormwater neutral means there can be no additional flooding downstream. Roofs, roads, and driveways which are the main contributors to surface run-off are all to be directed to infiltration areas in the northern part of the subdivision and a stormwater ponding area in the south.

To mitigate any adverse impacts of development on the existing hydrological processes occurring within the wetland areas, the design methodology proposed in the Awa (2021) report will consider the following:

- Aim to direct all stormwater back into the ground as close as possible to where it is collected by focusing on localised soakage solutions.
- This will be achieved by having swales along the roads and soakage fields at household rain tank overflows.

- For larger events run-off from roads will be directed via the swales to under-drained bio-infiltration devices, at the low point in the road. These devices are designed to return all the run-off to ground.

As outlined in Section 2.1.6. of the Awa (2021) report, it is intended that the rain that falls on impervious surfaces will be returned to ground as close to source as possible. This means the groundwater hydrology is unlikely to be altered and the only rainfall diverted away from groundwater will be the water that is collected in the rain tanks of each dwelling, ensuring that the hydrological functioning of the wetland is maintained.

10.8 Stormwater run-off and contamination of receiving environments

The proposed development will increase the area of impermeable surfaces at the property. Surface run-off from impermeable ground can greatly increase the amount and rate of stormwater flow. Roofs, roads, and driveways are the main contributors to surface run-off. Stormwater can transport a range of contaminants such as heavy metals that can persist in aquatic environments for considerable periods of time, particularly in sediment. As a consequence, these contaminants can accumulate in the tissues of organisms and their predators at higher trophic levels. In residential areas, contamination can occur through activities such as washing cars on impermeable surfaces, whereby cleaning chemicals, detergents and break dust are readily transported into drains and discharged to aquatic and estuarine receiving environments.

11. NATIONAL ENVIRONMENTAL STANDARDS FOR FRESHWATER

11.1 Overview

Under the National Environmental Standards for Freshwater (NES-FW), which became operative on 3 September 2020, vegetation removal and land disturbance activities are only controlled in and within 10 metres of a natural wetland, whereas the taking, use, damming, diversion or discharge of water is controlled in or within 100 metres of a natural wetland. As outlined previously, Wetlands 1, 3, 5, and 6 (Figure 1) qualify as 'natural inland' wetlands. Accordingly, both the NES-FW and the over-arching New Zealand National Policy Statement for Freshwater Management 2020 (NPS-FM) are required to be considered under this assessment.

The NPS-FM is a national policy statement that sits above the regional plan and is required to be addressed in resource consent applications. The overall objective of the NPS-FM is to ensure that natural and physical resources are managed in a way that prioritises the health and well-being of water bodies and freshwater ecosystems (Objective 2.1(1)(a)), among other priorities related to the human environment.

The current proposal is considered to align with this objective and policy directives of the NPS-FM, including the following:

- The subdivision will consider the freshwater networks present in the form of natural wetlands on a collective basis (Policy 2.2.3);
- Freshwater wetland ecosystems on the site will be maintained and improved through the proposed ecological management (Policy 2.2.5); and
- There will be no loss in extent of natural inland wetlands resulting from the proposal, and the wetlands present will be protected and enhanced (Policy 2.2.6).

A discussion of regulations in the NES-FW that may be applicable to the proposed subdivision is provided below.

11.2 Consent is required under Regulation 54 of the NES (non-complying activities)

> ***54 Non-complying activities***
> *The following activities are non-complying activities* ***if they do not have another status under this subpart:***
>
> *(a) vegetation clearance within, or within a 10 m setback from, a natural wetland:*
>
> *(b) earthworks within, or within a 10 m setback from, a natural wetland:*
>
> ***(c) the taking, use, damming, diversion, or discharge of water within, or within a 100 m setback from, a natural wetland.***

Consent is required to discharge stormwater within 100 metres of a natural wetland in circumstances where it will not result in any changes to the hydrology of the wetland.

11.3 Regulation 52 non-complying activities

(1) Earthworks outside, but within a 100 m setback from, a natural wetland is a non-complying activity if it—

(a) results, or is likely to result, in the complete or partial drainage of all or part of a natural wetland; and
(b) does not have another status under any of regulations 38 to 51.

(2) The taking, use, damming, diversion, or discharge of water outside, but within a 100 m setback from, a natural wetland is a non-complying activity if it—

(a) results, or is likely to result, in the complete or partial drainage of all or part of a natural wetland; and
(b) does not have another status under any of regulations 38 to 51.

Regulation 52 does not apply to the proposed development given that earthworks at the site will **not** result in the complete or partial drainage of any natural wetland. The justification for this is as follows:

- In the northern development area run-off will be diverted to individual lot rain tanks and soak pit.
- Run-off from the access road (extension of Tieko Street) will be captured by swale and under-drained bio-infiltration devices.
- In the southern development area, run-off will be directed to the constructed wetland.

Potential changes in water levels in the wetland are likely to increase (see Section 9 of this report), which will reduce the possibility of wetland drainage rather than increasing it.

11.4 Regulation 53 (prohibited activities) prohibits the reclamation of wetlands.

This regulation does not apply to the proposed subdivision, as no earthworks are proposed within the natural wetland areas.

11.5 Regulation 55 (General conditions on natural wetland activities)

General conditions relating to water quality and movement, earth stability and land disturbance, vegetation clearance, and indigenous habitat, as outlined in Regulation 55, should be adhered to throughout the proposed development.

12. OPPORTUNITIES TO AVOID, REMEDY OR MITIGATE POTENTIAL ADVERSE EFFECTS

12.1 Indigenous terrestrial vegetation

The groves of kānuka comprise significant indigenous vegetation as identified within Schedule 3.2 of the Kāpiti Coast District Plan. The layout of lots and the proposed earthworks has been planned so as to avoid the removal of the larger, mature groves of kānuka trees. These groves will be legally protected in perpetuity under covenants. The following measures are recommended should it not be feasible to avoid the removal of some of the kānuka on site (e.g., small groups and/or individual trees):

- Pest plant management and underplanting within the retained kānuka groves.

12.2 Avifauna management

Habitat for avifauna will be enhanced through buffer planting of the larger wetland areas, and protection of an area of *c.*1,900 m^2 of existing kānuka. If possible, all woody vegetation that is to be removed should be removed outside of the bird breeding season (September-March inclusive) to reduce the disruption to those species. The potential adverse effects on birds will be less than minor should vegetation removal take place outside of breeding season.

12.3 Herpetofauna management

The lizard fauna on the property is relatively depauperate, with low numbers of northern grass skink, and it is unlikely that any other 'Threatened' or 'At Risk' lizard species are present at the property. However, all indigenous lizards are protected by the Wildlife Act (1953) and a reasonable mitigation effort will be required through a Lizard Management Plan prepared specifically for the proposed earthworks and subdivision, with the actions undertaken by a Wildlife-permitted herpetologist. The following measures will be required in order to mitigate adverse effects on indigenous lizards:

- Prepare a Lizard Management Plan, with potential management focussing on covenanting and ecological restoration of the duneland sections along the boundary of the site closest to SH1 to benefit the local lizard population.
- Apply for a Wildlife Act Authorisation from the Department of Conservation for lizard management at the property (this is a legal requirement).

If the abovementioned measures are appropriately implemented, the adverse effects on indigenous lizards will be no more than minor.

12.4 Development near wetland areas

Wetland areas have been identified and earthworks have been designed in order to avoid the 10-metre setback around all four natural wetlands at the site. Individual lot soakage will accommodate runoff to wetlands 1, 3, 5 and 6 from impervious surfaces in the northern and central parts of the subdivision, and a bio-infiltration swale is proposed to mitigate the adverse effects of runoff from the vehicle access. This will result in rainfall remaining onsite and continuing to recharge groundwater, which is of particular benefit to Wetland 3 because it will slightly increase its catchment size.

12.5 Protection and enhancement of wetlands

12.5.1 Overview

The proposed measures to protect and enhance the wetlands include:

- Fencing all wetlands using seven-wire post and batten fencing with barbed upper and middle wires;
- Ten-metre buffer planting of wetlands 1 and 3 to protect them from works on the adjacent land;

- Pest plant control within all the natural wetlands and planted buffer areas (Wetlands 1 and 3) including, but not limited to, gorse and blackberry; and
- Legally protect each natural inland wetland under covenants.

The proposed wetland restoration measures are in line with Policy 38 of the Proposed Natural Resources Plan (PNRP), given the habitat for indigenous flora and fauna within the wetlands will be improved through pest plant control, buffer planting, and fencing. The subdivision would also be in line with Policy 6 of the NPS-FM, i.e., there is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted. In addition, the removal of pest plant species within the bed of a significant natural wetland is a permitted activity under Rule R105 of the PNP, subject to the following conditions are met:

(a) only indigenous wetland species typical of the area and wetland type are deliberately introduced or planted, and

(b) only plant species that are not typical of the area and wetland type are deliberately removed or controlled, and

(c) only agrichemicals approved by the Environmental Protection Authority for use into and over water are used and the conditions of Rule R37 (excluding clause (d)) are met, and

(d) agrichemicals are not applied by aerial spraying, and

(e) only hand-held machinery is used in any area of the significant natural wetland, or outstanding natural wetland, and

(f) the activity shall comply with the wetland general conditions for activities in significant natural wetlands and outstanding natural wetlands specified above in Section 5.5.2 of the PNRP (Activities in wetlands general conditions).

12.5.2 Buffer planting

Buffer planting will be established to a width of 10 metres around Wetland 1 and 3, noting that restoration planting around the perimeter of the significant natural wetland, but outside of the bed of the wetland, is not controlled by the PNRP.

All plants should be appropriately eco-sourced from the Foxton Ecological District. Maintenance and pest plant control will be required for a minimum of two years to ensure that the plants establish successfully. An indicative plant schedule for the wetland buffers is provided in Table 3, to be finalised within a planting plan.

Table 3: Planting schedule for wetland buffer planting.

Species	Common Name	Grade	Spacing (m)	Percentage
Carex geminata[1]	Rautahi	0.5L	0.75	10
Coprosma propinqua[1]	Mingimingi	0.5L	1.4	5
Coprosma robusta[2]	Karamū	0.5L	1.4	10
Cordyline australis[3]	Tī kōuka	0.5L	1.4	10
Dacrycarpus dacrydioides[3]	Kahikatea	2L	5	5
Kunzea robusta[2]	Kānuka	0.5L	1.4	20
Leptospermum scoparium[3]	Mānuka	0.5L	1.4	15
Muehlenbeckia complexa[2]	Pōhuehue	0.5L	1	10
Phormium tenax[3]	Harakeke	0.5L	1.4	10
Podocarpus totara[2]	Tōtara	2L	5	5

[1] Plant along wetland margin.
[2] Plant on dry land upslope from wetland margin.

The ecological benefits of the proposed buffer planting will include:

- Additional habitat for terrestrial indigenous fauna species such as birds and lizards;
- Protecting the natural wetland areas from 'edge effects' associated with the surrounding development, such as vegetation clearance and pest plant invasion; and
- Increase in diversity of indigenous plant species within the subdivision.
- Buffering the wetland areas and encourage the natural regeneration of indigenous wetland plants which, in turn, will improve wetland ecological value and habitat for indigenous wetland fauna (e.g., birds).

12.5.3 Fencing

Completion of fencing around the perimeter of the four natural wetlands (1, 3, 5 and 6) and buffer areas will exclude stock and clearly mark the edge of the protected vegetation. To ensure protection from stock and dogs, seven-wire post and batten fencing will be used for the wetland areas and defined lizard habitat.

12.5.4 Pest plant control

Existing pest plant species present on the site, such as gorse and blackberry, will be controlled within the wetland protection areas prior to planting (wetlands 1 and 3 only). Pest plant control will continue for two years following the planting of the wetland buffers.

In order to control the spread of pest plants from domestic gardens, no plant species listed in the National Plant Pest Accord (NPPA) or the Greater Wellington Regional Pest Management Plan (GWRC 2019), 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 will be difficult to enforce.

12.6 Stormwater management

The likelihood of road-run-off containing contaminants such as heavy metals and hydrocarbons is low as the northern and southern access roads only serve the development with no throughfare. A constructed wetland proposed for the low-lying area in Lot 200 (Wetland 4 in Figure 3), which is not considered to be a natural wetland, will treat run-off (sediment and inorganic pollutants) generated by the southern development area. As outlined in the Preliminary Erosion and Sediment and Control Plan prepared Cuttriss (2021), the constructed wetland has been designed to accommodate post-development run-off from Lots 23-49 and as such will be able to receive run-off from the earthworks in a 1% AEP event during construction. In addition, plants in the constructed wetland, once established, will help to treat the water as it passes through the wetland, noting there is some initial filtering in the forebay before the water enters the main body of the wetland.

The constructed wetland also offers a good opportunity to improve the ecology of the site through the planting of appropriate indigenous wetland species. The final species selection, number, and placement of plants would be guided by the gradient of the banks on the perimeter of the constructed wetland, the presence/size of forebays, and depth of standing water. Sedge species that tolerate constant inundation provide excellent filtration and water polishing services as well as providing local habitat for water fowl and cryptic wetland bird species. Key species would include jointed twig rush (*Machaerina articulata*), kuta (*Eleocharis sphacelata*), *Carex secta*, pūrei (*C. virgata*), harakeke (*Phormium tenax*), and mānuka (*Leptospermum scoparium*). Species selection should be undertaken in consultation with local iwi.

Overall, the adverse effects of stormwater run-off on natural wetlands at the site are considered to be negligible.

12.7 Sediment management

In order to reduce the risk of sediment adversely affecting any wetlands or watercourses, best practice sediment and erosion control will be implemented as per the guidelines prepared by Greater Wellington Regional Council (2021). To this end, the Preliminary Erosion and Sediment Control Plan will ensure that construction methodologies avoid the sedimentation of the four natural inland wetlands identified at the site. The protection of the wetlands is a primary objective of the ESCP. It is anticipated that by constructing and stabilising the works in stages and by utilising the natural filtration of the existing sandy soils, surface runoff velocities will be kept to a minimum. As a result, the risk of sedimentation outside of the earthwork areas will be minimal (Cuttriss 2021). No earthworks will be undertaken within ten metres of any natural wetland at this site, and haul roads will be located clear of the wetlands and their buffer zones (Cuttriss 2021).

Overall, the adverse effects of sedimentation on natural wetlands at the site are considered to be negligible.

13. CONCLUSIONS

A subdivision is proposed for 17 hectares of rural land on dunes between Tieko Street, Otaihanga Road, and SH1, Paraparaumu. The vegetation on the property comprises pasture, shelterbelts, kānuka groves, and wetlands. There are four wetlands on the property which are determined to be natural wetlands and are thus significant due to the rarity of wetlands in the Wellington Region. All the natural wetlands will be fenced and legally protected, and buffer planting of indigenous species will be undertaken around the two larger wetlands. Some areas of shelterbelt will be removed during earthworks.

No part of the property falls within a Significant Natural Area, although specimens of one indigenous tree species (kānuka) are protected under the proposed Kapiti Coast District Plan (i.e., trees with diameters greater than 15 centimetres qualify under Schedule 3.2). Based on the latest version of the scheme plan, none of these trees will be cleared during the earthworks. Exotic trees on the property provide habitat for common indigenous bird species and clearance of these tree is also likely. Legally protected lizards are present at the site, and earthworks will likely result in injuries, death and habitat losses for these lizards in the absence of management.

Opportunities to mitigate the potential adverse effects of vegetation clearance include the protection and enhancement of wetlands and, if required, the kānuka groves. This would largely involve revegetation and pest plant and animal control, and should be guided by a Council-approved management plan. All the natural wetlands (1, 3, 5 and 6) and larger groves of kānuka mapped in Figure 4 above will be protected in perpetuity under covenants. In addition, a Lizard Management Plan should be prepared and implemented, and a Wildlife Authority Act permit applied for.

Controls for stormwater run-off and sediment and erosion are appropriately addressed in the reports prepared by Cuttriss (2021) and Awa (2021). The construction of the constructed wetland in Lot 200 will provide effective flood mitigation and treatment of run-off. Over time, indigenous plantings in the constructed wetland will provide local habitat for indigenous waterfowl and wetland bird species, as well as providing important ecosystem services such as nutrient uptake and additional bio-filtration.

In summary, should the mitigation measures described in this report be properly implemented then the overall effects of the proposed development on indigenous vegetation, dune habitat and function, natural wetlands (extent and hydrology), and aquatic receiving environments are considered to be negligible. Similarly, potential adverse effects of the loss of exotic vegetation and effects on indigenous birds are considered to be less than minor, while potential adverse effects on herpetofauna are no more than minor.

It is noted that the proposed protection and enhancement of the four natural wetlands will have a positive ecological effect.

ACKNOWLEDGMENTS

Chris Hansen from Chris Hansen Consultants Ltd is thanked for useful discussions and for providing information about the development. Nick Taylor (Cuttriss Consultants Ltd) and Phernne Tancock (Barrister, Harbour Chambers) provided useful background information and client liaison.

REFERENCES

Awa Environmental Ltd 2021: Otaihanga Road Subdivision (including bulk earthworks and infrstructure). Flood hazard assessment of effects. *Awa Environmental Project No. 010*. Produced for Otaihanga Development.

Bell T. 2017: Herpetofauna desktop assessment: A review of herpetofauna records in RMS forest plantations within the Greater Wellington Region. Technical report prepared by EcoGecko Consultants for Resource Management Service FGI New Zealand Ltd. 15 pp.

Bell T. and Wiles A. 2015: Describing lizard and frog distribution and species assemblages using the Ecological Districts framework. *BioGecko*, 2015, 3: 19-34.

Clarkson BR 2014. A vegetation tool for wetland delineation in New Zealand. *Landcare Research Contract Report LC1793*. 42 p. Available: http://www.landcareresearch.co.nz/__data/assets/pdf_file/0003/71949/vegetation_tool_wetland_delineation.pdf.

Clarkson, B.R., Champion, P.D., Johnson, P.N., Bodmin K.A., Forester l., Gerbeaux P. and Reeves P.N.; 2013. *Wetland indicator status ratings for New Zealand species*. Landcare Research, Hamilton. Available: https://www.landcareresearch.co.nz/__data/assets/pdf_file/0014/64400/wetland_rating_species_December_2013.pdfv

Clarkson B. 2018: *Wetland delineation protocols. Manaaki Whenua – Landcare Research*, Hamilton. Available: http://www.biodiversitynz.org/uploads/1/0/7/9/107923093/clarkson-bev-wetland-delineation-protocols-2018.pdf.

Cuttriss 2021: Preliminary Erosion & Sediment Control Plan – 131-155 Otaihanga Road and 48-58 Tieko Street, Otaihanga. Ref: 22208. Prepared for Mansell Family.

de Lange P., Rolfe J., Champion P., Courtney S., Heenan P., Barkla J., Cameron E., Norton D., and Hitchmough R. 2013: Conservation status of New Zealand indigenous vascular plants, 2012. *New Zealand Threat Classification Series 3*. Department of Conservation, Wellington. 70 pp.

Fraser S., Singleton P., and Clarkson B. 2018: Hydric soils - field identification guide. Prepared for Tasman District Council, *Landcare Research Contract Report No. LC3233*: 83 pp.

Greater Wellington Regional Council. Eco-domains for the Wellington Region: Processes and patterns for defining diversity and distinctiveness. 47 pp.

Greater Wellington Regional Council 2021: Erosion and Sediment Control Guide for Land Disturbing Activities in the Wellington Region. Published in February 2021.

Greater Wellington Regional Council. 2019: Greater Wellington Regional Pest Management Plan, 2019-2039. 104 pp.

Hitchmough R, Barr B., Lettink M., Monks J., Reardon J., Tocher M., van Winkel D, and Rolfe J. 2016: Conservation status of New Zealand reptiles, 2015. *New Zealand Threat Classification Series 17*. Department of Conservation. Wellington.

Klem D. 2014: Landscape, legal and biodiversity threats that windows pose to birds: A review of an important conservation issue. *Land 3*: 351-361.

Klem D., Keck D.C., Marty L., Miller Ball A.J., Niciu E.E., and Platt C.T. 2004: Effects of window angling, feeder placement and scavengers on avial mortality at plate glass. *Wilson Bull 116*: 69-73.

Loss S.R., Will T., Loss S.S., and Marra P.P. 2014: Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability. *Condor 116*: 8-23.

New Zealand Coastal Policy Statement 2010. Published by the Department of Conservation, Wellington.

NIWA 2016: New Zealand Freshwater Fish Database. National Institute of Water and Atmospheric Research. https://nzffdms.niwa.co.nz/.

O'Donnell C.F.J., Borkin K.M., Christie J.E., Lloyd B., Parsons S., and Hitchmough R.A. 2018: Conservation status of New Zealand bats, 2017. New Zealand threat classification series. Department of Conservation, Wellington.

O'Donnell C.F.J., Christie J.E., Lloyd B., Parsons S., and Hitchmough R.A. 2013: Conservation status of New Zealand bats, 2012. *New Zealand Threat Classification Series 6*. Department of Conservation, Wellington. 8 pp.

Robertson H.A., Baird K., Dowding J.E., Elliott G.P., Hitchmough R.A., Miskelly C.M., McArthur N., O'Donnell C.F.J., Sagar P.M., Scofield R.P., and Taylor G.A. 2017: Conservation status of New Zealand birds, 2016. *New Zealand Threat Classification Series 19*. Department of Conservation, Wellington. 23 pp.

Stewart A., Kerr G., Lissama W., and Rowarth J. 2014: Pasture and Forage Plants for New Zealand. NZ Grassland Association with additional details sourced from Charlton J.F.L., and Stewart A.V. 1999: Pasture species and cultivars used in New Zealand - a list. *Proceedings of the New Zealand Grassland Association 61*: 147-166.

U.S. Army Corps of Engineers 1987: Wetlands Delineation Manual. *Wetlands Research Program Technical Report No. Y-87-1* (*on-line edition*). 143 pp.

Widianarko *et al.* 2001: Toxicokinetics and toxicity of zinc under time-varying exposure in the guppy (*Poecilia reticulata*). *Environmental Toxicology and Chemistry 20*(4): 763-768.

SCHEDULE 3.2 KEY INDIGENOUS TREES RECORDED AT 48 AND 58 TIEKO STREET; AND 131, 139, AND 147 OTAIHANGA ROAD, PARAPARAUMU[1]

Species	Northing	Easting	Stems	DBH	Does this Tree Qualify for Schedule 3.2[2]
Kānuka	5472311	1770512	4	64.7	Yes
Kānuka	5472313	1770513	1	38.4	Yes
Kānuka	5472316	1770500	1	78.2	Yes
Kānuka	5472312	1770497	1	37.3	Yes
Kānuka	5472312	1770497	1	23.0	Yes
Kānuka	5472316	1770496	3	44.0	Yes
Kānuka	5472320	1770495	1	29.7	Yes
Kānuka	5471977	1770453	2	35.4	Yes
Kānuka	5471973	1770450	2	49.2	Yes
Kānuka	5471981	1770448	1	39.8	Yes
Kānuka	5471948	1770418	1	23.0	Yes
Kānuka	5471950	1770417	1	37.0	Yes
Kānuka	5471950	1770422	2	41.4	Yes
Kānuka	5471953	1770418	1	22.0	Yes
Kānuka	5471947	1770422	1	28.8	Yes
Kānuka	5471940	1770418	3	28.8	Yes
Kānuka	5471930	1770417	1	20.3	Yes
Kānuka	5471928	1770417	1	22.2	Yes
Kānuka	5471927	1770417	1	24.7	Yes
Kānuka	5471929	1770413	1	15.0	Yes
Kānuka	5471927	1770414	2	42.8	Yes
Kānuka	5471926	1770417	1	18.3	Yes
Kānuka	5471926	1770416	2	37.4	Yes
Kānuka	5471919	1770413	1	16.5	Yes
Kānuka	5471917	1770413	1	14.6	No
Kānuka	5471915	1770413	2	22.3	Yes
Kānuka	5471912	1770413	1	30.5	Yes
Kānuka	5471923	1770418	1	22.9	Yes
Kānuka	5471927	1770420	1	17.5	Yes
Kānuka	5471925	1770426	1	42.4	Yes
Kānuka	5471926	1770426	2	36.5	Yes
Kānuka	5471929	1770427	1	22.5	Yes
Kānuka	5471929	1770419	1	32.8	Yes
Kānuka	5471927	1770421	1	22.5	Yes
Kānuka	5471929	1770417	1	21.0	Yes

[1] Not all qualifiing indigenous trees were measured during the 2020 field work due to limitations in accessing these and time restrictions

[2] Kānuka trees that qualify for Schedule 3.2 of the Kāpiti Coast District Plan have a DBH equal to or greater than 15 centimetres or heights greater than 3 metres.

APPENDIX 2

VASCULAR PLANT SPECIES RECORDED AT 48 AND 58 TIEKO STREET; AND 131, 139, AND 147 OTAIHANGA ROAD, PARAPARAUMU

Scientific Name	Common Name	Threat Ranking	Wetland Species[1]
INDIGENOUS			
Monocotyledonous Trees and Shrubs			
Cordyline australis	Tī kōuka	Not Threatened	FACW
Dicotyledonous Trees and Shrubs			
Kunzea robusta	Kānuka	Threatened-Nationally Vulnerable	N/A
Pittosporum crassifolium	Karo	Not Threatened/Non-local indigenous species	N/A
Solanum laciniatum	Poroporo	Not Threatened	N/A
Ferns			
Paesia scaberula	Matata	Not Threatened	N/A
Pteridium esculentum	Bracken	Not Threatened	FACU
Dicotyledonous Herbs other than Composites			
Hydrocotyle heteromeria	Waxweed pennywort	Not Threatened	FACU
Myriophyllum propinquum	Common water milfoil	Not Threatened	OBL
Rushes and Allied Plants			
Juncus edgariae	Edgar's rush, wiwi	Not Threatened	FACW
Juncus pallidus	Giant rush	Not Threatened	FACW
Juncus sarophorus	Broom rush	Not Threatened	FACW
EXOTIC			
Gymnosperm Trees and Shrubs			
Pinus radiata	Pine	Introduced and Naturalised	N/A
Dicotyledonous Trees and Shrubs			
Eucalyptus sp.	Gum tree	Introduced and Naturalised	N/A
Lupinus arboreus	Tree lupin	Introduced and Naturalised	UPL
Phytolacca octandra	Inkweed	Introduced and Naturalised	N/A
Quercus robur	Oak	Introduced and Naturalised	N/A
Rubus fruticosus agg.	Blackberry	Introduced and Naturalised	FAC
Ulex europaeus	Gorse	Introduced and Naturalised	FACU
Dicotyledonous Herbs - Composites			
Achillea millefolium	Yarrow	Introduced and Naturalised	FACU
Bellis perennis	Bellis daisy	Introduced and Naturalised	UPL
Bidens frondosa	Beggar's ticks	Introduced and Naturalised	FACW
Cirsium vulgare	Scotch thistle	Introduced and Naturalised	FACU
Crepis capillaris	Hawksbeard	Introduced and Naturalised	FACU
Gamochaeta sp.	Cudweed	Introduced and Naturalised	N/A

[1] Wetland indicator status ranking as per Clarkson (2013). OBL= Obligate, FACW = Facultative Wetland, FAC = Facultative, FACU = Facultative Upland, UPL = Upland, N/A = Not listed in Clarkson (2013) or Lichvar et al. (2016) and therefore presumed to be UPL species.

Scientific Name	Common Name	Threat Ranking	Wetland Species[1]
Hypochaeris radicata	Cat's ear	Introduced and Naturalised	FACU
Jacobaea vulgaris	Ragwort	Introduced and Naturalised	FACU
Taraxacum officinale agg.	Dandelion	Introduced and Naturalised	FACU
Dicotyledonous Herbs other than Composites			
Cerastium fontanum	Mouse ear chickweed	Introduced and Naturalised	FACU
Galium aparine	Cleavers	Introduced and Naturalised	FACU
Galium palustre	Marsh bedstraw	Introduced and Naturalised	OBL
Geranium molle	Doves foot cranesbill	Introduced and Naturalised	FACU
Lotus pedunculatus	Lotus	Introduced and Naturalised	FAC
Myosotis laxa subsp. *caespitosa*	Water forget-me-not	Introduced and Naturalised	OBL
Persicaria hydropiper	Water pepper	Introduced and Naturalised	FACW
Plantago lanceolata	Narrow-leaved plantain	Introduced and Naturalised	FACU
Plantago major	Broad-leaved plantain	Introduced and Naturalised	FACU
Portulaca oleracea	Purslane	Introduced and Naturalised	FAC
Prunella vulgaris	Selfheal	Introduced and Naturalised	FACU
Ranunculus acris	Giant buttercup	Introduced and Naturalised	FAC
Ranunculus repens	Creeping buttercup	Introduced and Naturalised	FAC
Rumex acetosella	Sheep's sorrel	Introduced and Naturalised	FACU
Rumex conglomeratus	Clustered dock	Introduced and Naturalised	FAC
Rumex obtusifolius	Broad-leaved dock	Introduced and Naturalised	FAC
Trifolium repens	White clover	Introduced and Naturalised	FACU
Veronica anagallis-aquatica	Water speedwell	Introduced and Naturalised	OBL
Sedges			
Carex divulsa	Grey sedge	Introduced and Naturalised	FAC
Grasses			
Agrostis capillaris	Browntop	Introduced and Naturalised	FACU
Agrostis stolonifera	Creeping Bent	Introduced and Naturalised	FACW
Anthoxanthum odoratum	Sweet vernal	Introduced and Naturalised	FACU
Dactylis glomerata	Cock's Foot	Introduced and Naturalised	FACU
Holcus lanatus	Yorkshire Fog	Introduced and Naturalised	FAC
Paspalum dilatatum	Paspalum	Introduced and Naturalised	FACU
Rushes and Allied Plants			
Juncus effusus	Soft rush	Introduced and Naturalised	FACW

LIZARDS RECORDED DURING THE SITE SURVEY

Table 1: All lizard species observed at 48, 58 Tieko Street; and 131, 139, 147 Otaihanga Road, Paraparaumu, during the 03-09 March 2020 field work

Date	Method	Identification Number	Northing	Easting	Species	Sex	SVL[1]	TL/Break[2]
5/03/2020	Handsearching	ID_01_ID	5472406	1770555	*Oligosoma polychroma*	N/A	N/A	N/A
5/03/2020	Handsearching	ID_02_ID	5472235	1770513	*Oligosoma polychroma*	N/A	N/A	N/A
5/03/2020	Handsearching	ID_03_ID	5471978	1770429	*Oligosoma polychroma*	N/A	N/A	N/A
7/03/2020	Pitfall trap	ID_04_OTA29	5471721	1770325	*Oligosoma polychroma*	M	66	45/36
7/03/2020	Pitfall trap	ID_05_OTA11	5472319	1770485	*Oligosoma polychroma*	F	70	58/32
7/03/2020	Pitfall trap	ID_06_OTA12	5472344	1770529	*Oligosoma polychroma*	M	65	50/36
8/08/2020	Pitfall trap	ID_07_OTA13	5472406	1770555	*Oligosoma polychroma*	F	66	55/42
8/08/2020	Pitfall trap	ID_08_OTA12	5472344	1770529	*Oligosoma polychroma*	M	65	50/41

[1] SVL (snout-to-vent) = The length between snout to vent at the base of the tail, the standard measurement for lizards.
[2] TL / break= (tail length) is the length between vent to the tip of tail; break is the length of the regenerated portion of the tail (if any).

APPENDIX 4

FAUNA SPECIES RECORDED AT 48 AND 58 TIEKO STREET; AND 131, 139, AND 147 OTAIHANGA ROAD, PARAPARAUMU

Common Name	Scientific Name	Threat Ranking
Birds		
Warou/welcome swallow	*Hirundo neoxena*	Not Threatened
Kērangi/swamp harrier	*Circus approximans*	Not Threatened
Paradise shelduck	*Tadorna variegata*	Not Threatened
Pūkeko	*Porphyrio melanotus*	Not Threatened
Riroriro/grey warbler	*Gerygone igata*	Not Threatened
Blackbird	*Turdus merula*	Naturalised
Australian magpie	*Gymnorhina tibicen*	Naturalised
Lizards		
Northern grass skink	*Oligosoma polychroma*	Not Threatened

SUMMARY OF RESULTS FROM WETLAND DELINEATION PLOTS

Wetland	Plot #	Plot Type	Plot Location		Dominance Test		Prevalence Index		Pasture Species % Cover	Wetland Assessment
			Easting	Northing	% Hydrophytic Species Dominant	Wetland?	Prevalence Index Score	Wetland?		
1	1a	Delineation Pair; wet side	1770529	5472302	100%	Yes	2.77	Yes	40%	Wetland
1	1b	Delineation Pair; dry side	1770526	5472305	50%	No	3.41	No	53%	Pasture
1	2a	Delineation Pair; wet side	1770534	5472309	100%	Yes	2.72	Yes	17%	Wetland
1	2b	Delineation Pair; dry side	1770534	5472311	100%	Yes	3.05	No	94%	Pasture
2	3a	Delineation Pair; wet side	1770510	5472223	100%	Yes	2.96	Yes	51%	Wetted pasture
2	3b	Delineation Pair; dry side	1770507	5472226	100%	Yes	3.20	No	86%	Pasture
3	4a	Delineation Pair; wet side	1770441	5472027	100%	Yes	2.88	Yes	38%	Wetland
3	4b	Delineation Pair; dry side	1770443	5472025	100%	Yes	3.07	No	55%	Pasture
3	5a	Delineation Pair; wet side	1770411	5472056	100%	Yes	2.00	Yes	3%	Wetland
3	5b	Delineation Pair; dry side	1770409	5472051	100%	Yes	3.09	No	62%	Pasture
3	6a[1]	Delineation Pair; wet side	1770439	5472003	100%	Yes	2.72	Yes	55%	Wetted pasture
3	6b	Delineation Pair; dry side	1770441	5472001	100%	Yes	3.13	No	76%	Pasture
4	7a	Vegetation assessment, wet side	1770270	5471676	100%	Yes	3.02	No	46%	Not wetland
4	7b	Vegetation assessment, wet side	1770282	5471664	100%	Yes	3.07	No	57%	Pasture
4	7c	Vegetation assessment, wet side	1770290	5471656	100%	Yes	3.03	No	52%	Pasture
4	7d	Vegetation assessment, wet side	1770299	5471642	100%	Yes	3.04	No	53%	Pasture
4	7e	Vegetation assessment, wet side	1770312	5471638	100%	Yes	3.03	No	52%	Pasture
4	7f	Vegetation assessment, wet side	1770326	5471631	100%	Yes	3.05	No	53%	Pasture
4	7g	Vegetation assessment, wet side	1770335	5471650	67%	Yes	3.36	No	69%	Pasture
4	7h	Vegetation assessment, wet side	1770323	5471657	100%	Yes	3.03	No	58%	Pasture

[1] Plot Pair 6a and 6b were used to delineate the eastern edge of Wetland 3. Due to the exclusion of stock from this area, there was no natural demarcation to clearly define the edge of this wetland, and the plots were both placed within areas dominated by pasture grasses. The actual wetland was therefore delineated to the west of the wet plot. Other plots within this wetland (Plot Pairs 4 and 5) have the lowest Prevalence Index scores and lowest pasture plant cover, indicating that overall, this area comprises a natural wetland.

Wetland	Plot #	Plot Type	Plot Location		Dominance Test		Prevalence Index		Pasture Species % Cover	Wetland Assessment
			Easting	Northing	% Hydrophytic Species Dominant	Wetland?	Prevalence Index Score	Wetland?		
4	7i	Vegetation assessment, wet side	1770314	5471661	100%	Yes	2.94	Yes	65%	Wetted pasture
4	7j	Vegetation assessment, wet side	1770303	5471682	100%	Yes	3.05	No	54%	Pasture
4	7k	Vegetation assessment, wet side	1770313	5471695	100%	Yes	3.11	No	67%	Pasture
4	7l	Vegetation assessment, wet side	1770322	5471686	100%	Yes	3.13	No	64%	Pasture
4	7m	Vegetation assessment, wet side	1770325	5471678	100%	Yes	3.02	No	59%	Pasture
4	7n	Vegetation assessment, wet side	1770333	5471673	100%	Yes	3.01	No	32%	Not wetland
4	7o	Vegetation assessment, wet side	1770333	5471689	100%	Yes	3.02	No	60%	Pasture
4	7p	Vegetation assessment, wet side	1770333	5471693	100%	Yes	3.04	No	49%	Pasture
5	8a	Delineation pair; dry side	1770422	5472149	50%	Yes	3.59	No	88%	Pasture
5	8b	Delineation pair; wet side	1770433	5472144	100%	Yes	2.20	Yes	9%	Wetland
5	8c	Vegetation assessment, wet side	1770432	5472169	100%	Yes	2.28	Yes	8%	Wetland
5	8d	Delineation pair; wet side	1770409	5472174	100%	Yes	2.11	Yes	1%	Wetland
5	8e	Delineation pair; dry side	1770407	5472162	33%	No	3.35	No	23%	Grassland
5	8f	Vegetation assessment, dry side	1770397	5472143	50%	Yes	3.51	No	89%	Pasture
5	8g	Vegetation assessment, dry side	1770454	5472131	0%	No	3.97	No	47%	Grassland
5	8h	Delineation pair; dry side	1770453	5472165	0%	No	3.68	No	29%	Grassland
5	8i	Delineation pair; wet side	1770443	5472157	100%	Yes	2.70	Yes	8%	Wetland
5	8j	Delineation pair; wet side	1770424	5472180	100%	Yes	2.58	Yes	5%	Wetland
5	8k	Delineation pair; dry side	1770444	5472138	100%	Yes	2.94	Yes	45%	Wetland
6	9a	Delineation pair; wet side	1770422	5472149	100%	Yes	2.52	Yes	0%	Wetland
6	9b	Vegetation assessment, wet side	1770433	5472144	100%	Yes	2.91	Yes	2%	Wetland
6	9c	Vegetation assessment, wet side	1770432	5472169	100%	Yes	2.52	Yes	11%	Wetland
6	9d	Delineation pair; wet side	1770409	5472174	100%	Yes	1.92	Yes	0%	Wetland
6	9e	Delineation pair; dry side	1770407	5472162	50%	Yes	3.33	No	62%	Pasture
6	9f	Delineation pair; wet side	1770397	5472143	100%	Yes	1.85	Yes	1%	Wetland
6	9g	Delineation pair; dry side	1770454	5472131	50%	Yes	3.35	No	65%	Pasture
6	9h	Delineation pair; dry side	1770453	5472165	100%	Yes	3.17	No	42%	Grassland
6	9i	Delineation pair; wet side	1770443	5472157	100%	Yes	2.14	Yes	0%	Wetland
6	9j	Delineation pair; dry side	1770424	5472180	100%	Yes	3.14	No	58%	Pasture

SITE PHOTOGRAPHS

Plate 1: Pine shelterbelts in the central part of the site. 5 February 2020.

Plate 2: Vegetation within lots 41 and 42. Wetland 1 is in the distance. 9 March 2020.

Plate 3: Wetted pasture vegetation at Wetland 2. 9 March 2020.

Plate 4: Wetland 3, lot 32. The house in the background is not part of the proposed subdivision. 9 March 2020.

Plate 5: Wetland 4. Retired pasture with patches of wetland vegetation adjacent to Otaihanga Road. 9 March 2020.

Plate 6: Wetland 5. Water-pepper dominates this with occasional emergent inkweed. 11 February 2021.

Plate 7: Wetland 6. Water-pepper is locally common with abundant creeping buttercup and frequent *Juncus sarophorus*. 11 February 2021.

Plate 8: Northern grass skink (*Oligosoma polychroma* Clade 1) captured at the property. Photograph: Trent Bell. 8 March 2020.

Plate 9: Evidence of rabbit browsing and burrows at the site. 9 March 2020.

Plate 10: Stands of kānuka and blackberry and gorse infestations within retired pasture. 5 February 2020.

Providing outstanding ecological services to sustain and improve our environments

Call Free 0508 WILDNZ
Ph: +64 7 343 9017
Fax: +64 7 3439018
ecology@wildlands.co.nz

99 Sala Street
PO Box 7137, Te Ngae
Rotorua 3042,
New Zealand

Regional Offices located in
Auckland, Hamilton, Tauranga,
Whakatane, Wellington,
Christchurch and Dunedin

ECOLOGY RESTORATION BIODIVERSITY SUSTAINABILITY

www.wildlands.co.nz

Appendix H – Flood Hazard Report

Otaihanga Road Subdivision (including bulk earthworks and infrastructure)

Flood Hazard Assessment of Effects

Doc Number: 10

Date 29/06/2021

Excellence Heart Innovation

OTAIHANGA ROAD SUBDIVISION (INCLUDING BULK EARTHWORKS AND INFRASTRUCTURE)

Project number	J000225
Document title	Otaihanga Road Subdivision (including bulk earthworks and infrastructure) – Flood Hazard Assessment of Effects
Document number	010
Version number	10
Date	29/06/2021
Project manager	Tony Trueman
Author	Tony Trueman

VERSION	DATE	DESCRIPTION	AUTHOR	REVIEWED
01	15/11/19	Draft	Tony Trueman	Craig Martell
02	14/01/19	Preliminary	Tony Trueman	Craig Martell
03	23/01/20	Revision	Tony Trueman	Chris Hansen
04	18/03/20	Draft Revision	Tony Trueman	Chris Hansen
05	28/04/20	Revision	Tony Trueman	Chris Hansen
06	30/06/20	Final	Tony Trueman	Craig Martell
07	19/02/21	Draft Revision	Tony Trueman	Chris Hansen
08	25/02/21	Draft Revision	Tony Trueman	Chris Hansen
09	27/02/21	Revision	Tony Trueman	Craig Martell
10	29/06/21	Final	Tony Trueman	Chris Hansen

EXECUTIVE SUMMARY

Awa Environmental Limited (Awa) was requested by Chris Hansen Consultants Limited, on behalf of their client, to undertake an assessment of effects for subdivision (including bulk earthworks and Infrastructure) of the site adjacent to Otaihanga Road in Paraparaumu. Where this report subsequently references the term "subdivision", it is to be read as including bulk earthworks and infrastructure. The subdivision will be built upon an existing greenfield site and will consist of 49 lots accessed off a right of way from Otaihanga Road.

The Kāpiti Coast District Council Flood Hazard Planning Maps shows a portion of the site affected by ponding associated with the local network and flooding from local waterways.

The effects of the subdivision have been assessed against the Proposed District Plan Appeals Version 2018 as it relates to ponding and the requirements under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 as it relates to the discharge of water within 100m setback from a natural wetland.

Largely the flood effects will be managed across the area with on-site stormwater solutions. Any effects not managed by on-site soakage are proposed to be managed by on site compensatory storage.

A Mike Flood hydraulic model of the southern (residential) area has been built for both the existing (base) scenario and the proposed (subdivision) scenario.

The model has been used to:

- Determine the extent and depth of flooding within the base greenfield site.
- Determine the extent and depth of flooding within the proposed subdivision site.
- Options assessment of mitigating the effects of subdivision of the site.

Flood mitigation measures modelled include:

- Elevating building platforms above the modelled flood hazard.
- Excavation to provide compensatory storage.
- Modelling of additional stormwater network
- Alteration of existing drain layout

Modelling results indicate the subdivision can be implemented with less than minor effects on surrounding flood levels and, within the subdivision, the proposed mitigation measures are sufficient to ensure the subdivision will not be flooded in a 100-YR ARI event including the impacts of climate change.

The implementation of soakage solutions for the disposal of runoff to ground will focus on retaining the natural hydrological function of the wetland areas.

CONTENTS

1. INTRODUCTION

1.1. PROPOSED SUBDIVISION

1.1.1. SITE LOCATION

The site is located in Paraparaumu, on the Kāpiti Coast, adjacent to Otaihanga Road as shown in Figure 1.

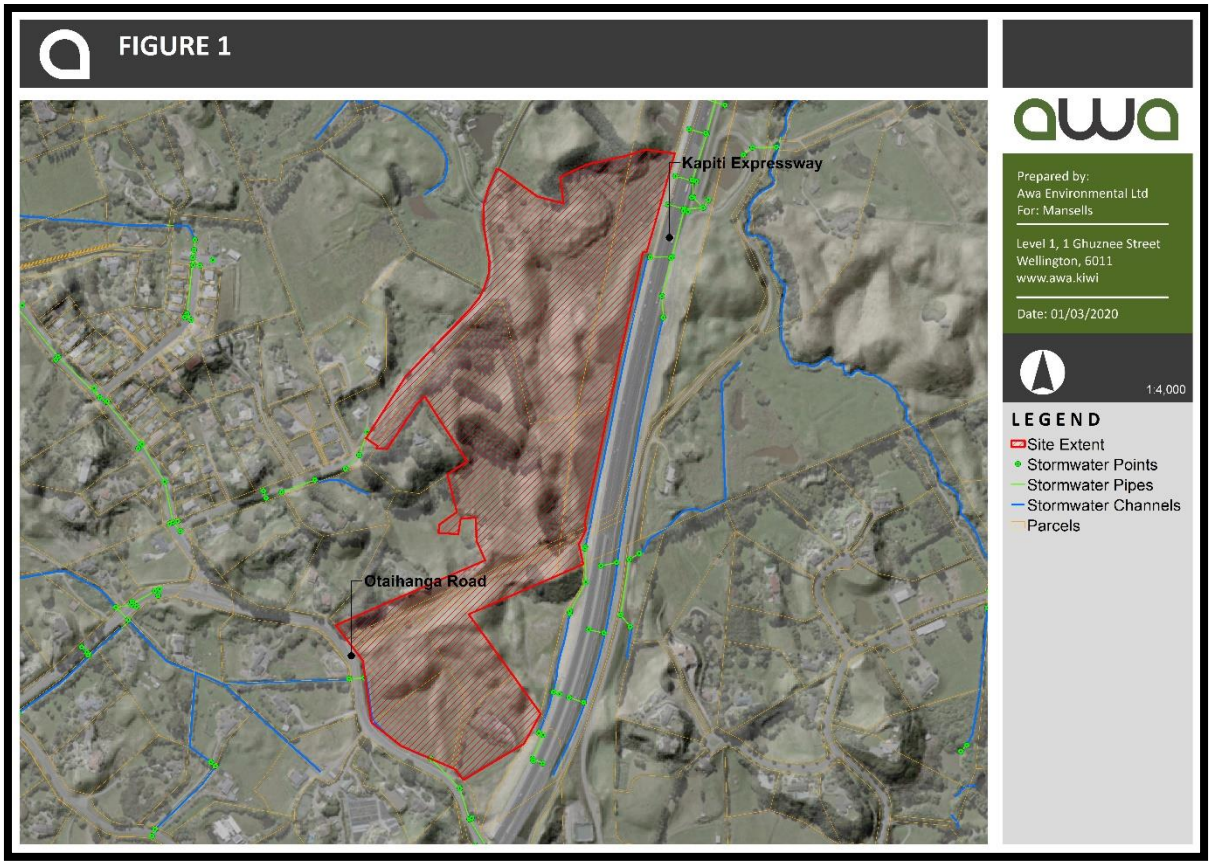


Figure 1: Site Location - Paraparaumu

1.1.2. ASSESSMENT OVERVIEW

The site has been split into two distinct areas reflecting the two different subdivision methodologies and proposed mitigation measures. The extents of the northern (rural life-style) and southern (residential) areas are shown in Figure 2.

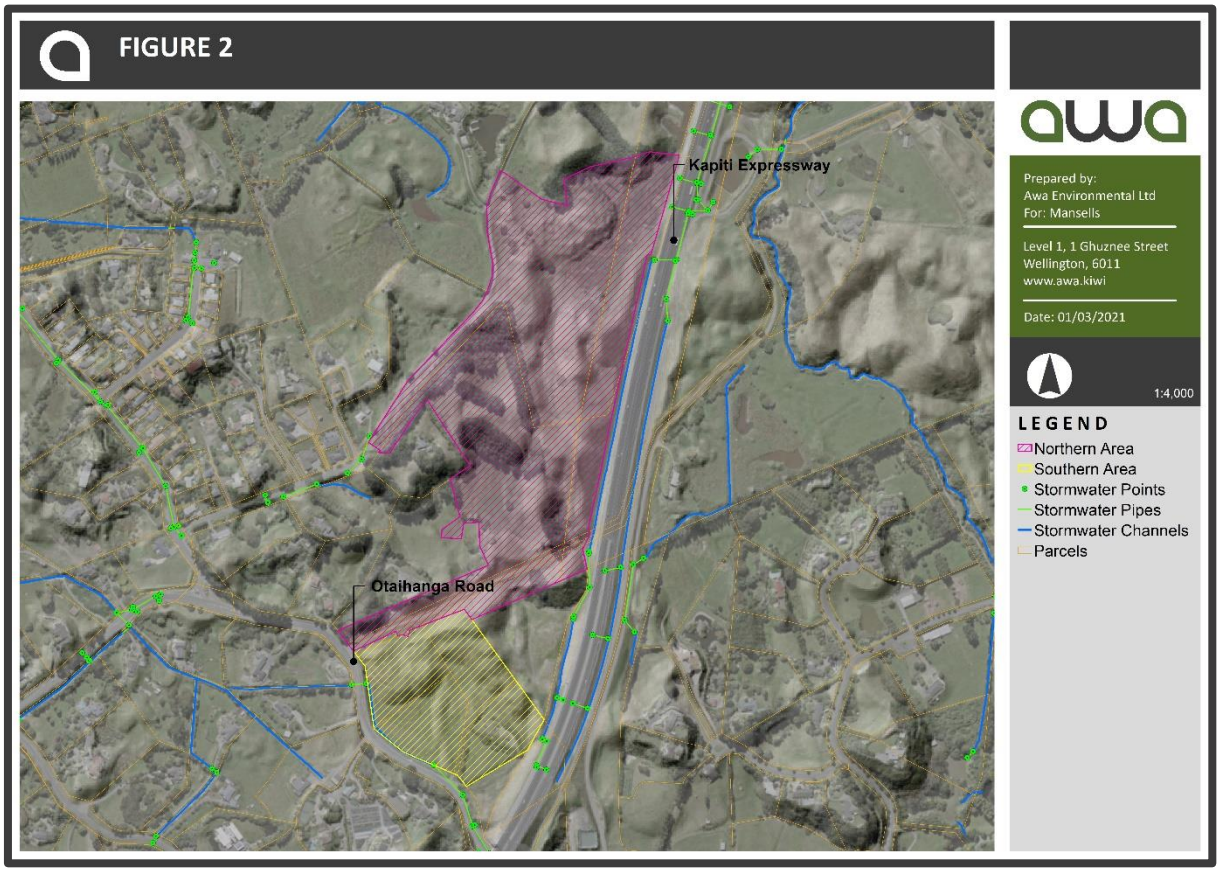


Figure 2: Subdivision Areas

1.1.3. NORTHERN (RURAL LIFE-STYLE) AREA

The northern (rural life-style) area will encompass larger lot sizes in the order of 2400 to 2800 m^2. The primary form of stormwater mitigation for these lots will be via individual lot soakage.

Soakage tests undertaken on site returned varying rates between 120 mm and 1200 mm/hour, as discussed in section 2.1.1. Given the larger lot sizes and natural soakage rates associated with the dune environment, mitigation via soakage field on the property is considered achievable. This methodology distributes the soakage over a dispersed area rather than concentrating discharge at a single location. Individual lot soakage devices will be sized at building consent stage for individual properties.

The hydrological impacts of the vehicle/pedestrian/cycle access to the northern (rural life-style) area, including formalisation of the Tieko Street entrance, has been assessed in HEC-HMS. Under-

drained bio-infiltration devices are proposed as the primary form of stormwater disposal and have been sized using a standard soakage calculation spreadsheet.

1.1.4. SOUTHERN (RESIDENTIAL) AREA

The southern (residential) area will encompass smaller lot sizes with a majority in the order of 500 to 1000 m^2. Two larger lots, in the order of 4000 to 7000 m^2 are included in this area. The primary form of mitigation for these lots will be stormwater retention in a single retention device adjacent to Otaihanga Road.

Assessment of the hydrological impacts of the southern (residential) area has been undertaken in HEC-HMS while the assessment of effects has been modelled using Mike Flood.

1.1.5. PROPOSED SITE LAYOUT

The site layout consists of 49 lots as shown in Figure 3. Access to the southern (residential) area, containing lots 23 to 49 will be off Otaihanga Road with access to the northern (rural life-style) area, containing lots 1 to 22 off Tieko Street.

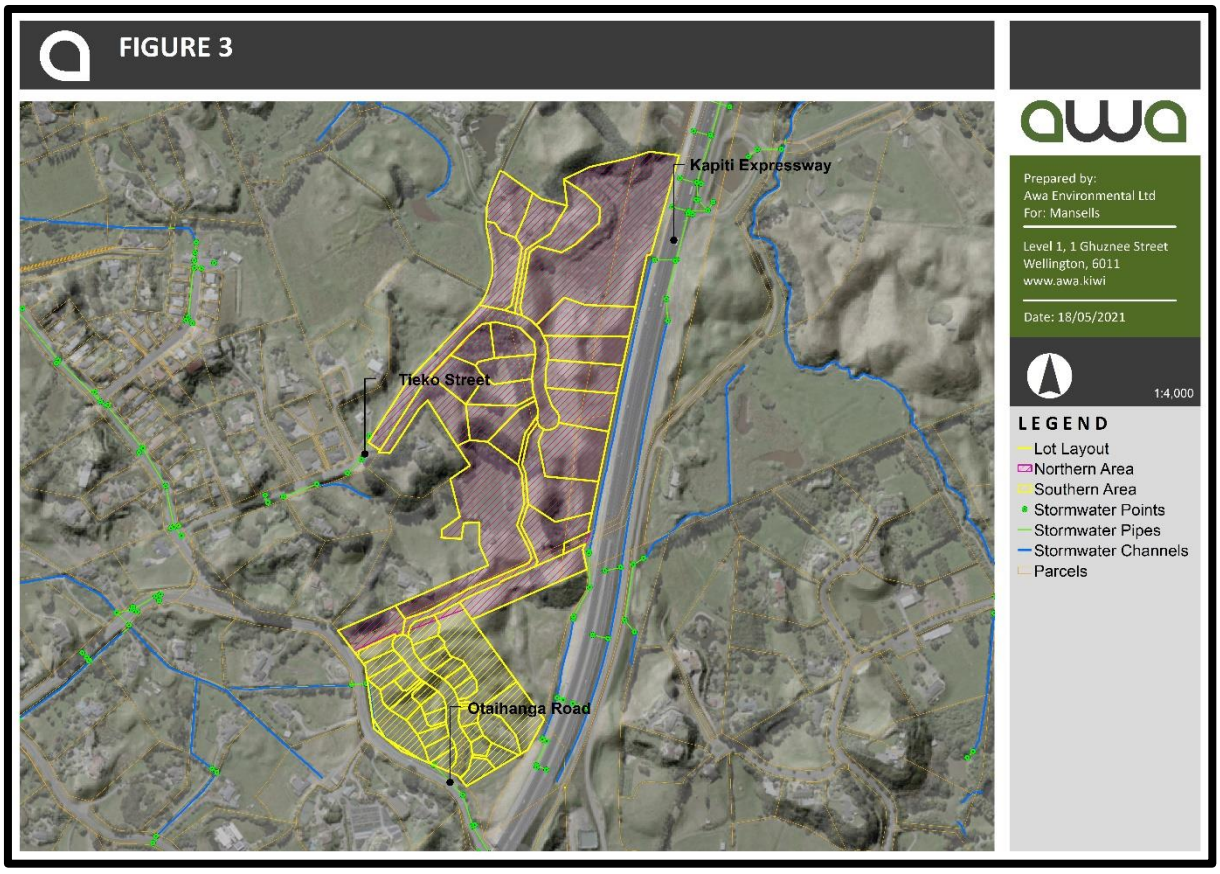


Figure 3: Proposed Site Layout

1.1.6. EARTHWORKS OVERVIEW

The final earthworks plan for the site is shown in Figure 4. Generally, cut/fill is proposed across much of the site to create building platforms and provide for vehicle/pedestrian/cycle access and infrastructure.

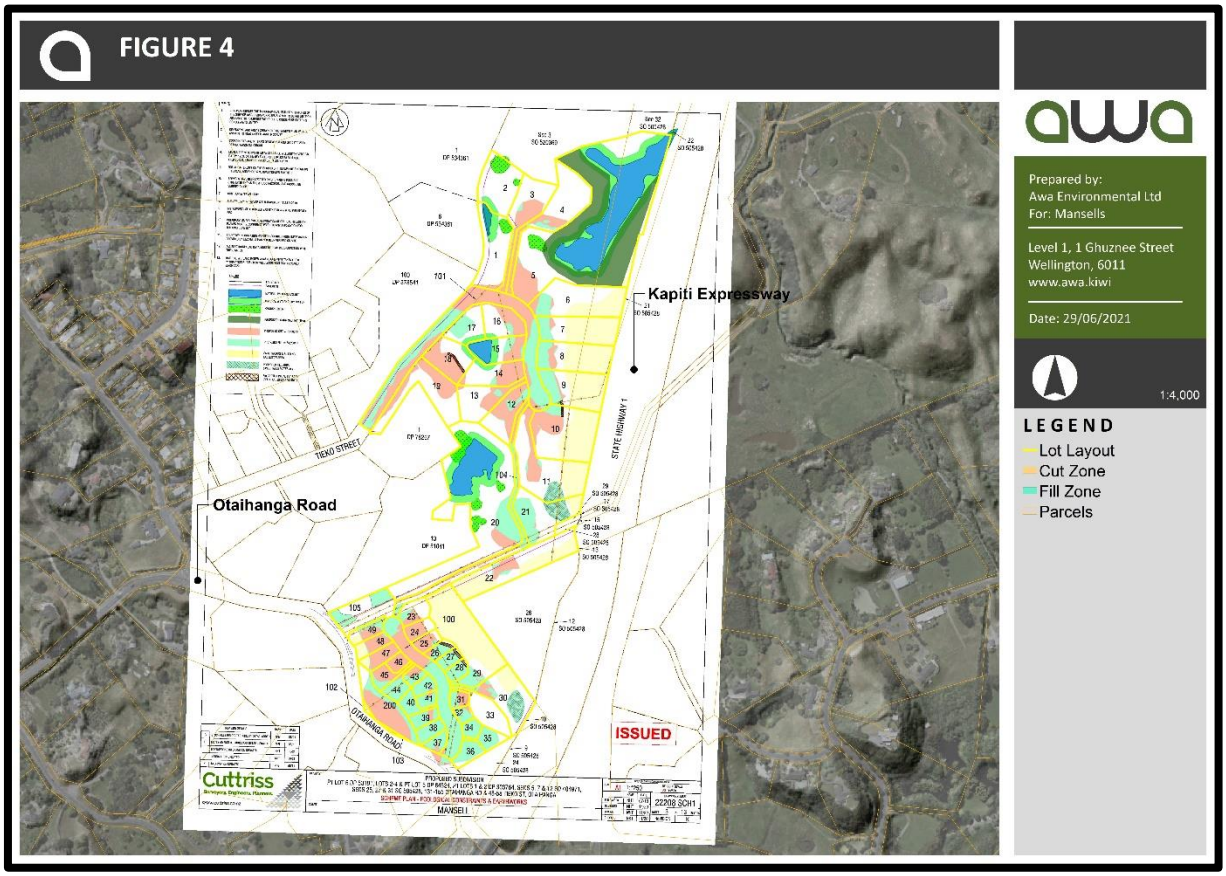


Figure 4: Final Earthworks Overview

1.1.7. KCDC & GW – FLOOD HAZARD

The northern extent of the site is currently shown as affected by ponding in the Kāpiti Coast District Council's flood hazard planning map as shown in Figure 5. This plan incorporates flooding from sources including ponding and overflow paths from the local stormwater network and flooding from local waterways. It also incorporates a freeboard component, 500mm in the vicinity of open channels and 300mm on the ground surface ponding and is used to inform recommended building levels.

The inclusion of the M2PP expressway into the Waikanae River flood hazard model has modified the flood extent and depth in this location. The impact of this is discussed in section 1.1.8.

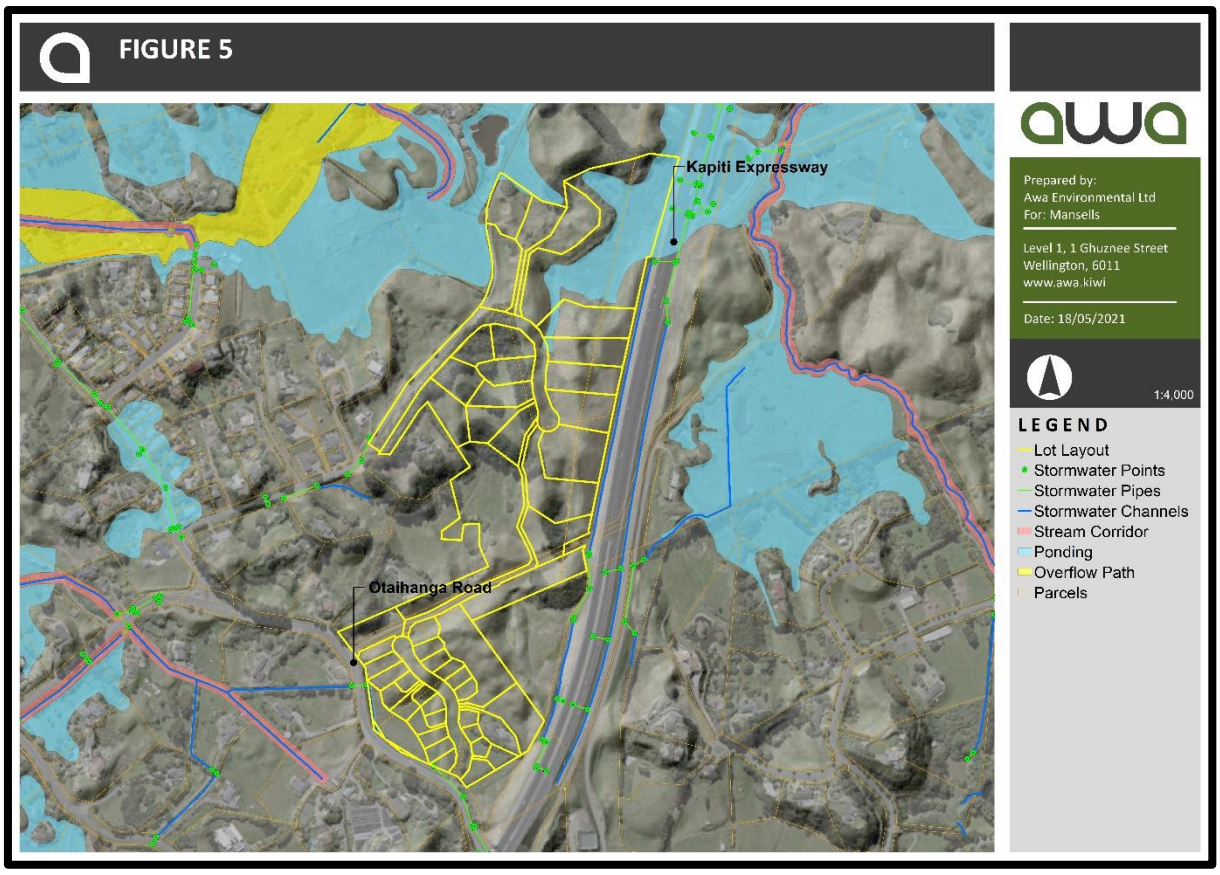


Figure 5: KCDC/GWRC Flood Hazard Management Plans

1.1.8. BASE FLOOD HAZARD - GWRC

The Greater Wellington Regional Council Waikanae model results of peak flood depth for the 100-Year ARI climate change base scenario event including the M2PP Expressway are shown in Figure 6. As this scenario does not include freeboard, we have assumed a freeboard of 500 mm which gives a peak water surface level of RL 6.1, as shown by the contour in Figure 6.

While lots 2, 3 and 5 have flooding within their boundaries in the base scenario no earthworks or dwellings will be located within the base flood hazard extent therefore, no compensatory storage needs to be considered.

While lots 6 and 7 are located within the freeboard water surface level of RL 6.1 fill earthworks will raise the building pad levels above this to RL 7.05 and RL 7.90, respectively.

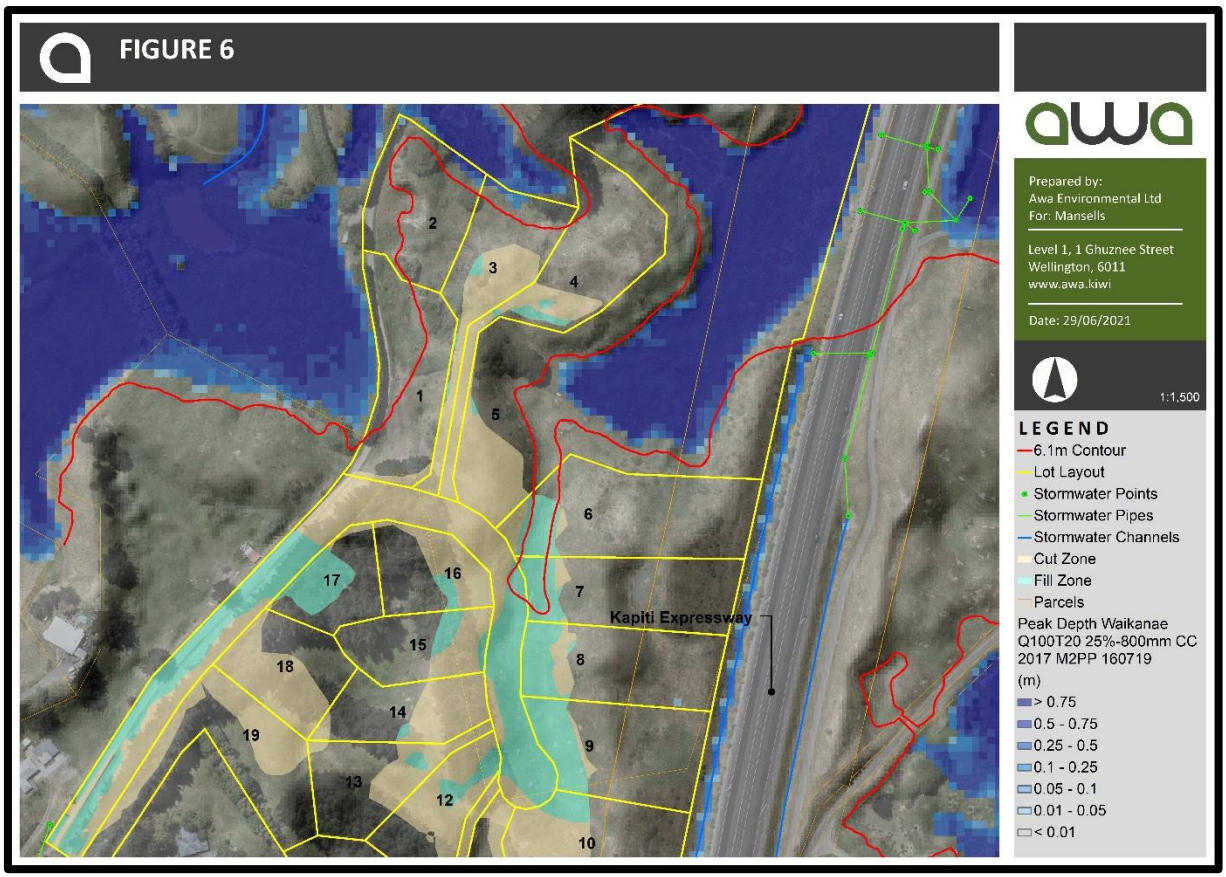


Figure 6: Northern Area Flood Hazard

1.1.9. PROPOSED DISTRICT PLAN

When property being considered for subdivision is affected by flood risk it is a requirement under the RMA that the effects of the development are considered before approval is given to manage the long-term costs of flooding to the wider community. This requirement is expressed under the Proposed District Plan as follows;

> *Policy 9.13 – Ponding, Residual Ponding, Shallow Surface Flow, Flood Storage and Fill Control Areas.*
>
> *When assessing applications for subdivision, use or development within a ponding, residual ponding, shallow surface flow, flood storage or fill control area, consider the following;*
>
> *a) the effects of the development on existing flood mitigation structures;*
> *b) the effects of the development on the flood hazard – in particular flood levels and flow;*
> *c) whether the development redirects floodwater onto adjoining properties or other parts of the floodplain;*
> *d) whether access to the site will adversely affect the flood hazard;*
> *e) the extent to which buildings can be located on areas of the property not subject to flooding; and*

f) whether any subdivision or development will or may result in damage to property or harm to people.

The relevant flood hazard rules and standards under the proposed District Plan which apply to subdivision and development are shown in Table 1;

*Table 9A.3. Restricted Discretionary Activities The following activities are **restricted discretionary** activities, provided that they comply with all corresponding permitted activity standards in this table, and all relevant rules and permitted activity standards in other Chapters (unless otherwise specified).*

Table 1: *(Table 9A.3) PDP Restricted Discretionary Activities*

RESTRICTED DISCRETIONARY ACTIVITIES	STANDARDS	MATTERS OVER WHICH COUNCIL WILL RESTRICT ITS DESCRETION
1. Any activity listed as a permitted activity in Table 9A.1 or a controlled activity in Table 9A.2 which does not comply with one or more of the associated standards, unless otherwise specified.		1. Consideration of the effects of the standard not met. 2. Measures to avoid, remedy or mitigate adverse effects 3. Cumulative effects
2. Subdivision where any part of the land contains flood storage, ponding, residual ponding or shallow surface flow areas.	1. Each lot shall have a building area located outside any river or stream corridor, overflow path or residual overflow path. 2. Each building area shall be located above the estimated 1% AEP flood event level. 3. Formed vehicle access does not adversely affect the 1% AEP flood hazard risk on other properties in the same flood catchment. 4. Compliance with all other relevant subdivision rules and standards in other chapters.	1. The design and layout of the subdivision. 2. Council's Subdivision and Development Principles and Requirements 2012. 3. The imposition of financial contributions in accordance with Chapter 12 of this Plan. 4. The location of any building platform or area relative to the natural hazards, historic heritage features, ecological sites, outstanding natural features and landscapes, and geological sites. 5. The location and design of any servicing of the subdivision. 6. The extent and effects of earthworks.
4. In a ponding or shallow surface flow area, earthworks which do not comply with one or more of the permitted activity standards under Rule 9A.1.4.		1. The effect of the earthworks on the effective functioning of the overflow path, residual overflow path or ponding or shallow surface flow area. 2. The avoidance or mitigation of adverse effects on the effective functioning of the overflow path, residual overflow path or ponding or shallow surface flow area.

As demonstrated in section 1.1.8 no earthworks will be undertaken within the base flood hazard. Local flooding has been mitigated as demonstrated in section 5.1.

2. SOAKAGE ASSESSMENT

2.1.1. SOAKAGE

Soakage testing has been undertaken at 7 locations across the site to determine soakage rates. An overview of the soakage locations is shown in Figure 7.

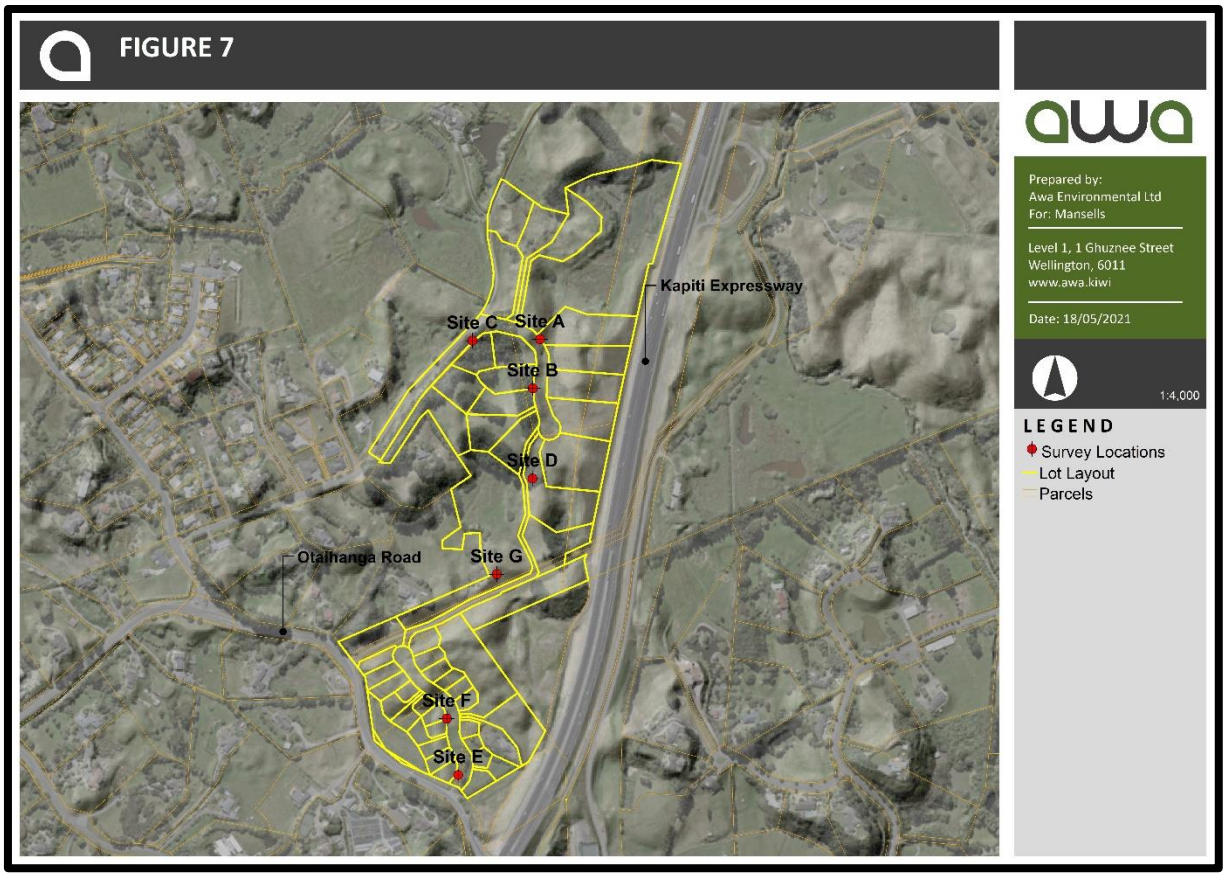


Figure 7 Soakage Test Locations

The wider Waikanae dune environment, in which this site is located, has been shown to have good natural drainage on elevated dunes. Soakage tests undertaken on site returned rates between 120 to 1200 mm/hour.

KCDC's Subdivision and Development Principles and Requirements document considers 0.25 (a Factor of Safety of 4) to be an appropriate reduction factor to be applied to the rate of soakage.

Applying the 0.25 reduction factor to the soakage rate returns values shown in Table 2.

Table 2 Soakage test results

Area Description	Average Soakage Rate mm/hr	Reduction Factor (0.25) (mm/hr)
Site A	120	30
Site B	160	40
Site C	320	80
Site D	146	36
Site E	200	50
Site F	1200	300
Site G	905	226

Soakage test sites A, B and C are located adjacent the vehicle/pedestrian/cycle access to the northern (rural life-style) area, including the Tieko Street entrance, and are therefore considered representative of soakage rates in this area.

For sizing of the under-drained bio-infiltration devices a conservative average soakage rate of 40 mm/hr has been used.

2.1.2. NORTHERN ACCESS - SOAKAGE DEVICE SIZING

Run-off from the vehicle/pedestrian/cycle access in the northern (rural life-style) area, including formalisation of the Tieko Street entrance, will require mitigation to ensure the increased discharge does not adversely affect the surrounding area.

To undertake this assessment the Cuttriss Consultants supplied roading scheme plan was used to determine the extents of the connected impervious areas which were split into two catchment areas. Catchment area 01 represents the impervious area associated with the formalisation of the Tieko Street entrance area and catchment area 02 represents the impervious area associated with the vehicle/pedestrian/cycle access in the northern (rural life-style) area.

The roading scheme plan was then referenced against the Cuttriss supplied earthworks plan to determine the location of the under-drained bio-infiltration devices and their associated swales. The swales will be used to convey run-off from the connected impervious areas to the devices, as shown in Figure 8. The under-drained bio-infiltration devices have been sized to accommodate the peak discharge from the 100 YR ARI Climate Change rainfall event.

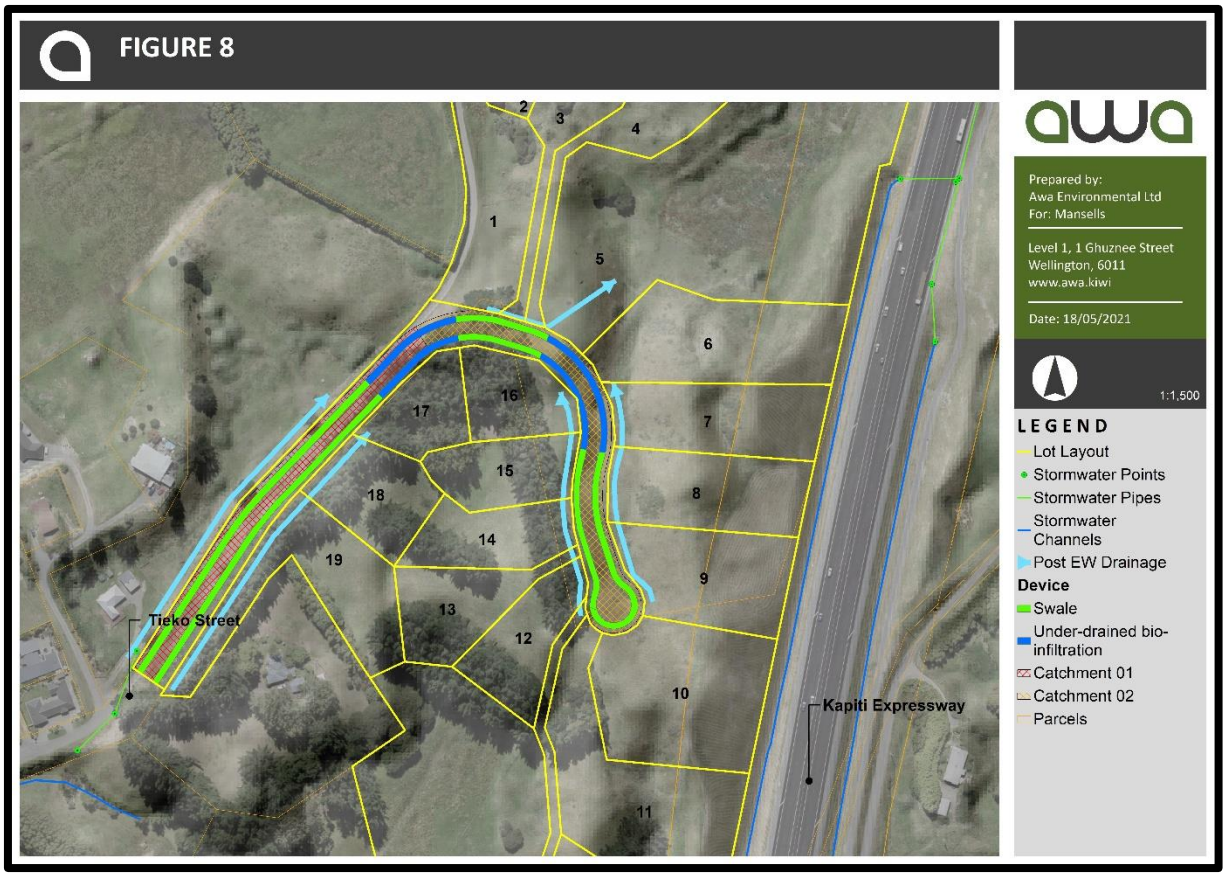


Figure 8: Vehicle/Pedestrian/Cycle Access North - Soakage Device Overview

The soakage design calculations, see section 2.1.3 & 2.1.4, show the length of the under-drained bio-infiltration device for catchment area 01 is 110 m and catchment area 02 is 150 m. Over the remainder of the catchments length a traditional swale will be used to convey run-off to the under-drained bio-infiltration devices.

A typical section through an under-drained bio-infiltration device is shown in Figure 9. Dimensions of the device will be sized during engineering detailed design as components of the device can be modified including replacement of coarse sand transition layer with geo-technical wrap.

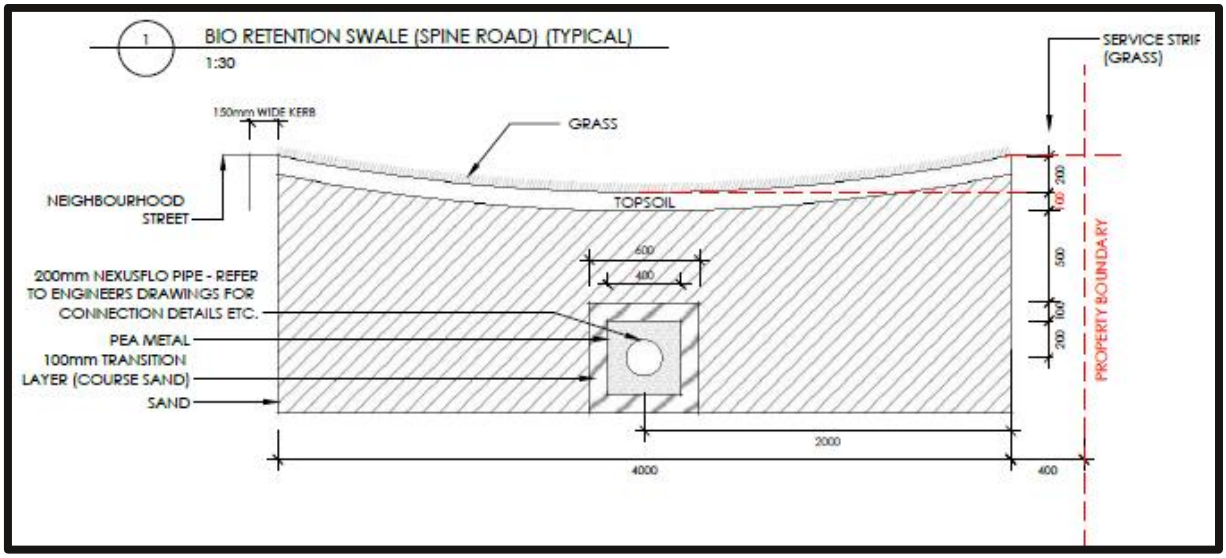


Figure 9 Under-drained Bio-Infiltration Device Section

2.1.3. CATCHMENT RUN-OFF

The two impervious catchment areas have been input into HEC-HMS to calculate their volume and peak discharges as shown in Table 3. The site falls within the 170 mm rainfall isohyet band associated with a 100 YR ARI Climate Change rainfall event.

Table 3: Discharge results from the HEC-HMS rainfall/run-off analysis

Catchment	Area Description	Peak Discharge (l/s)	Volume (m3)
Catchment area 01	Impervious Area 01	56	316
Catchment area 02	Impervious Area 02	65	368

2.1.4. SOAKAGE DESIGN CALCULATIONS

Discharge hydrographs from the HEC catchment analysis have been input into a standard soakage calculation spreadsheet.

The sizing of the under-drained bio-infiltration devices is shown in Table 4, see Appendix A for full calculations.

Table 4: Under-drained bio-infiltration device sizing

Catchment	Soakage Rate (mm/hr)	Device Name	Length (m)	Width (m)	Depth (m)	Porosity
Catchment area 01	40	under-drained device A1	110	3	1	0.3
Catchment area 02	40	under-drained device A2	150	2.5	1	0.3

2.1.5. GROUNDWATER

Resource Development Consultants Limited (RDCL) have undertaken geotechnical investigations across the site including the excavation of a number of test pits which noted soil profiles and the level at which groundwater, if any, was encountered.

NORTHERN (RURAL LIFE-STYLE) AREA

Several test pits undertaken on site within the northern (rural life-style) area, TP10 – 13, encountered groundwater levels at varying depths below ground, as shown in Figure 10.

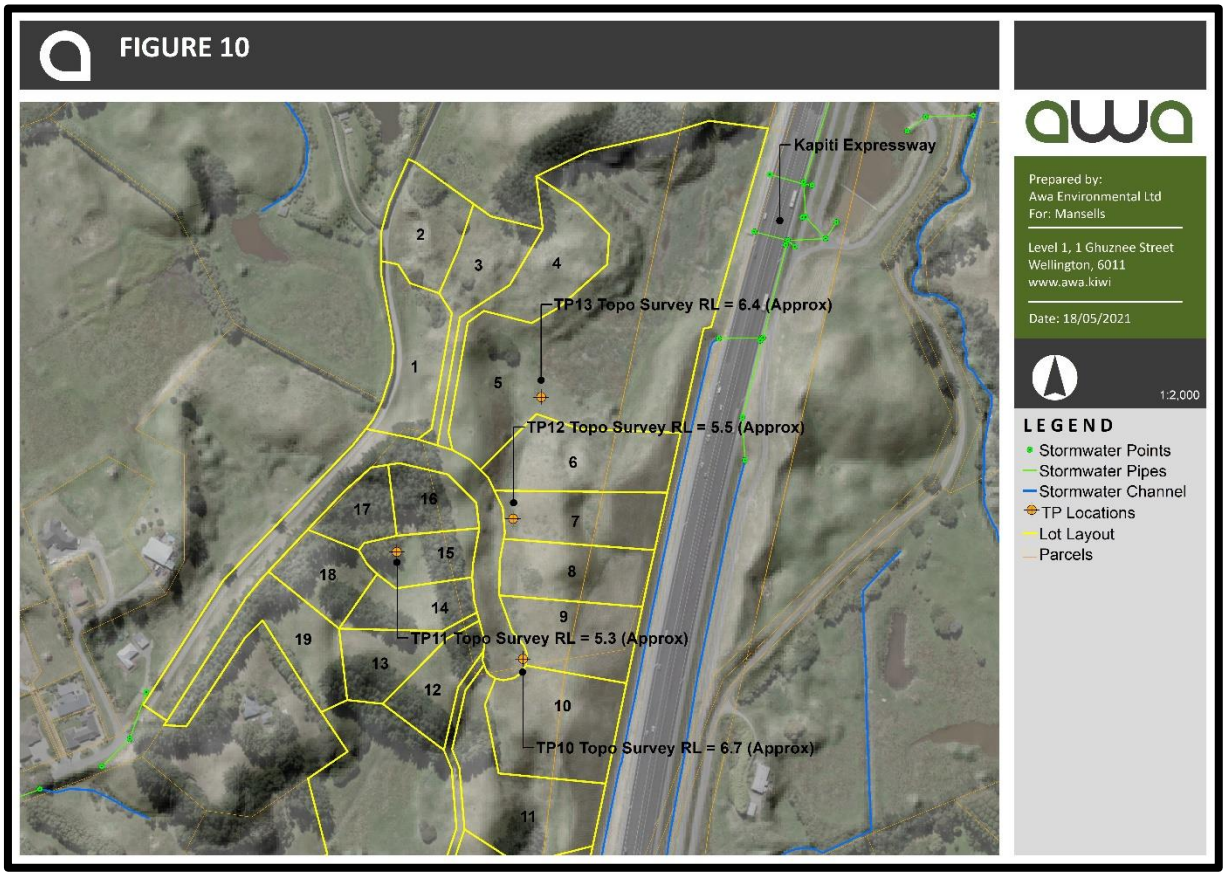


Figure 10 Test Pit Locations Encountering Groundwater

Groundwater depths vary between 1.4 to 2.9 metres below ground level as shown in Table 5.

Table 5: *Groundwater depths*

Test Pit	Ground Level	Groundwater (m bgl)	Groundwater Level
TP10	Approx. RL 6.7	1.8	Approx. RL 4.9
TP11	Approx. RL 5.3	1.4	Approx. RL 3.9
TP12	Approx. RL 5.5	2.1	Approx. RL 3.4
TP13	Approx. RL 6.4	2.9	Approx. RL 3.5

The low point in the post-earthworks design, located on the boundary of lot 5 and 6, will be at approx. RL 7.0. At this location groundwater levels in TP13 are approx. RL 3.5 leaving 3.5 metres between the design ground level and groundwater.

The under-drained bio-infiltration devices are also located adjacent this design low point. Given a depth of 1 metre to the base of the devices leaves a depth between the base of the device and groundwater of 2.5 metres.

SOUTHERN (RESIDENTIAL) AREA

A test pit undertaken on site within the southern (residential) area, TP03, encountered groundwater levels at 1.6m below ground or approximately RL 5.0. The location of Test Pit 03 is shown in Figure 11.

The site drains under Otaihanga Road through a dip and dune landscape out to the Mazengarb Stream. Existing groundwater levels within the area are being controlled by the surrounding drains and culvert network which would have originally been constructed to drain low lying land for farming.

The culvert under Otaihanga Road, is at an invert level of 5.75. Given the underlying, highly transmissive, poorly graded sands our experience is that groundwater will largely be controlled at a level similar to this invert.

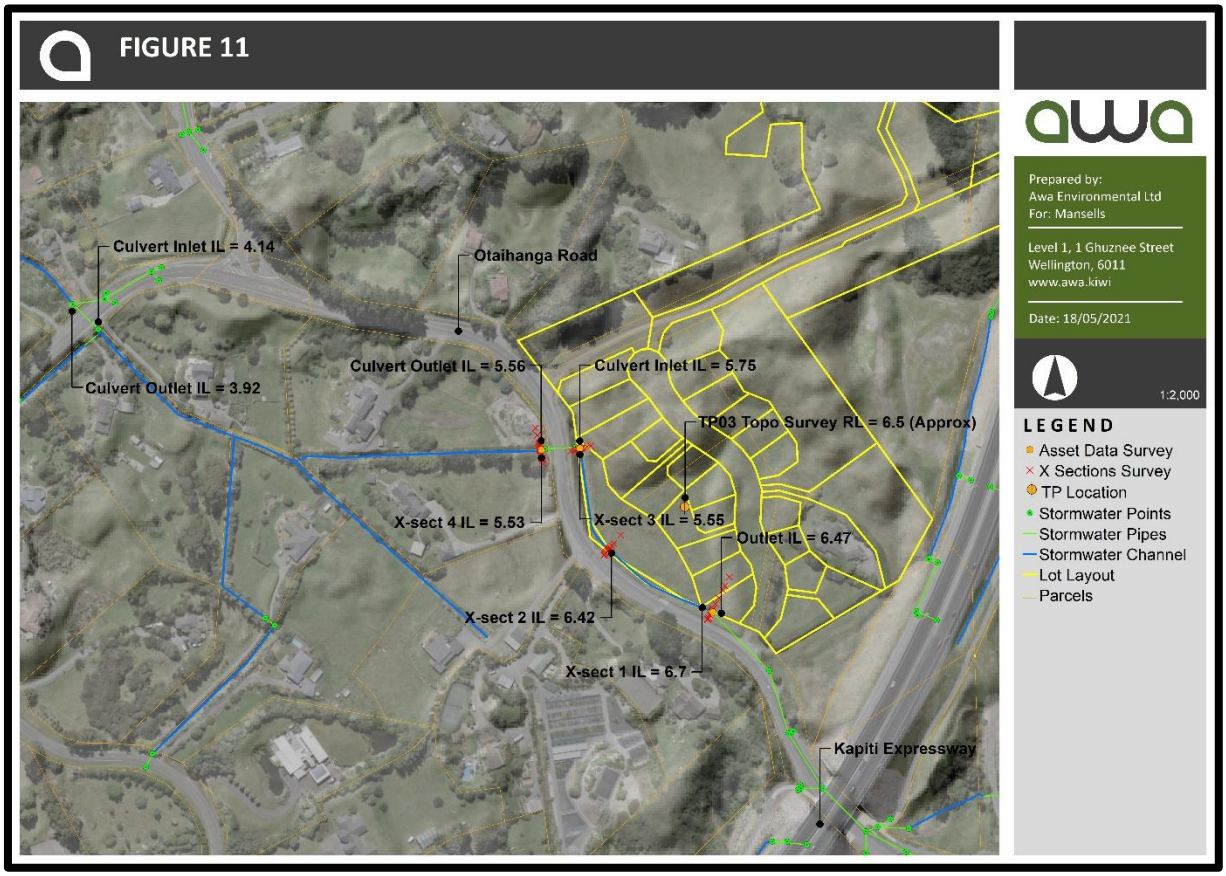


Figure 11 Groundwater Controls

2.1.6. ECOLOGICAL EFFECTS - STORMWATER

Under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 it is a requirement to consider the implications on the natural wetlands where the discharge of water within 100m requires a non-complying activity consent.

The stormwater design for this development has therefore been to focus on retaining the natural hydrological function of the wetland areas.

To mitigate any negative impacts of development on the existing hydrological processes occurring within the wetland areas, the proposed design methodology will;

- Look to put all stormwater back into the ground by focusing on soakage solutions.
- Look to do this in a distributed way by having swales along the roads and soakage fields at household raintank overflows.
- For larger events runoff from roads will be directed via the swales to under-drained bio-infiltration devices at the low point in the road. These devices are designed to return all the runoff to ground.

In undertaking this approach, we intend that the rain that falls on impervious surfaces (roofs, driveways and roads) will be returned to ground as close to source as possible. As such the groundwater hydrology is unlikely to be altered and the only rainfall diverted away from groundwater will be the water that ends up in each homes raintank.

It is our expectation in rural dune soils that there will rarely be significant runoff overland due to high natural soakage rates. For this reason, focusing our design on soakage to accommodate up to a 100-year climate change event, will in our opinion map natural system responses to rainfall. Overland flows that do occur in events above the 100-year climate change event will be directed towards wetlands as is currently the case.

3. FLOOD HAZARD ASSESSMENT

3.1. BASE FLOOD HAZARD

Model results of peak flood depths for the 100-Year ARI climate change base scenario event for the southern (residential) area are shown in Figure 12. Results show on-site flooding, within the site extent, is localised to isolated low-lying areas.

Flooding in the wider catchment, to the east, is a result of the throttling effect of the culverts and network along Otaihanga Road. To the west of Otaihanga Road the effect of the downstream tailwater level can be seen with flooding in this location.

There is no flooding from the open channel adjacent the site due to the throttling of flow from upstream restricting the volume and peak discharge into the channel.

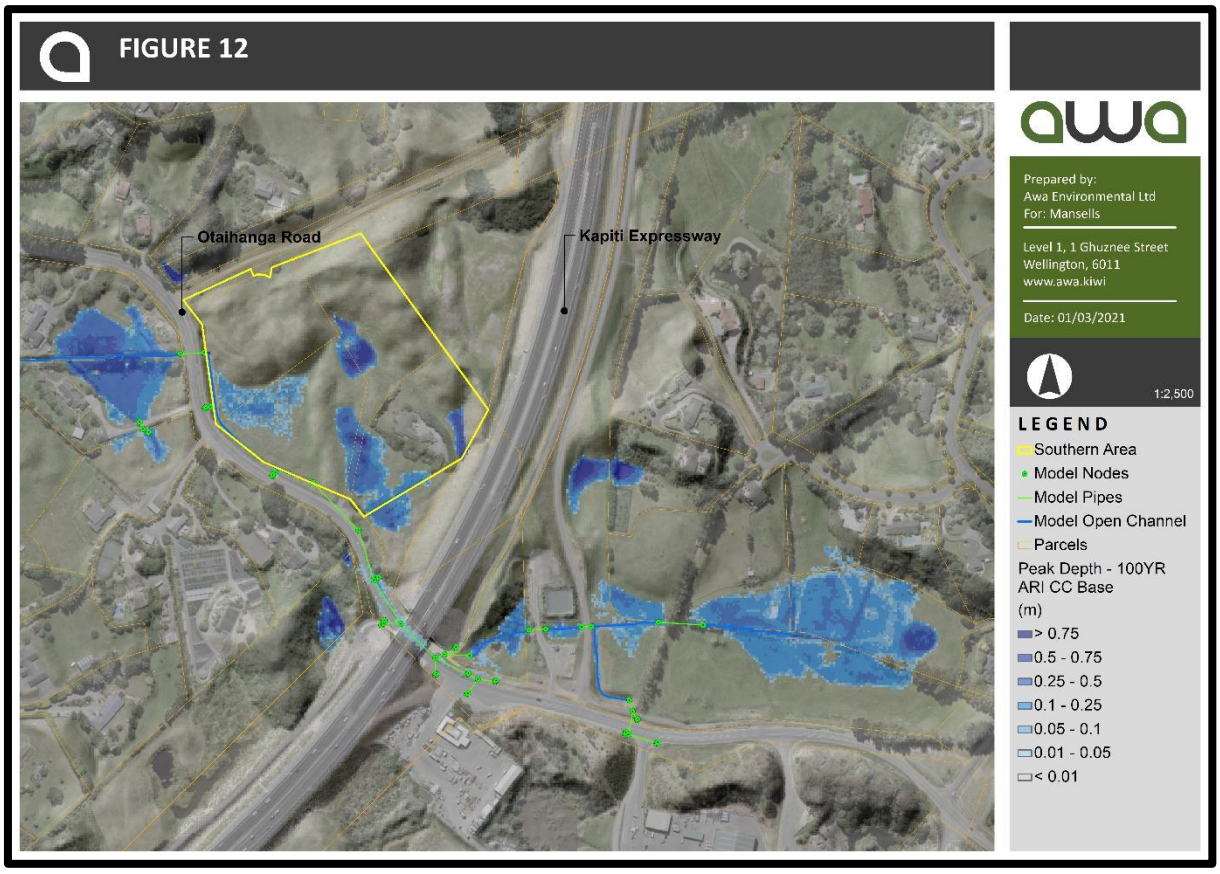


Figure 12: 100YR ARI CC Peak Inundation Depths - Base Scenario Flood Hazard

4. PROPOSED SUBDIVISION

4.1. SOUTHERN (RESIDENTIAL) SITE ALTERATIONS

The modification of land use from greenfield to residential will increase peak discharge and volume associated with an increase in impervious cover. An overview of the proposed lot layout and landcover is shown in Figure 13.

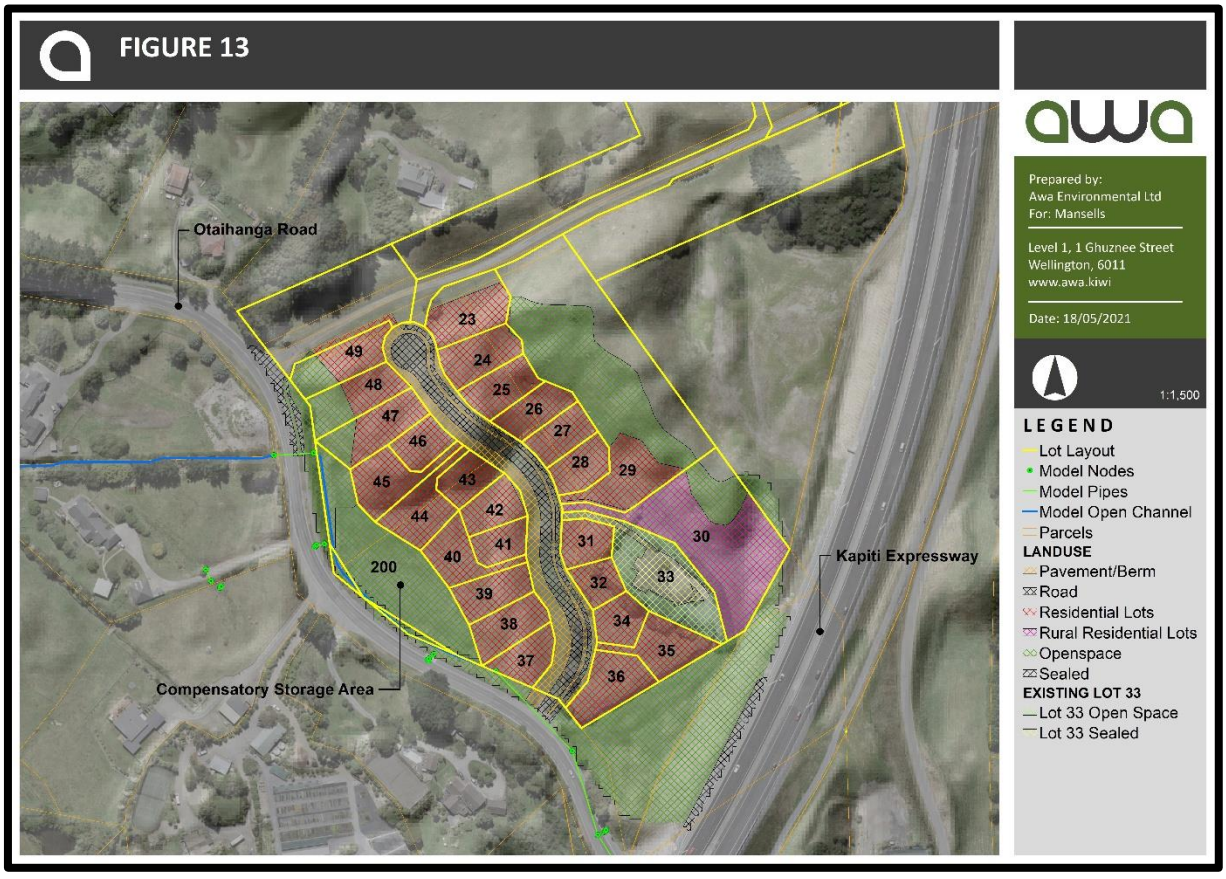


Figure 13: Southern (Residential) Area Overview

There is an existing lot 33 within the area identified in Figure 13. The existing impervious area for this lot has been accounted for in the subdivision scenario run-off calculations. The existing lot driveway access will be modified from its current connection to Otaihanga Road, to between future lots 30 and 31 to connect directly to the road access.

The assumed connected impervious area (CIA) for each land use type is shown in Table 6.

Table 6: Land use CIA

Land use Type	CIA
Residential Lots	55%
Rural Residential Lots	30%
Road	100%

Pavement/Berm	50%
Open Space	0%

The site will also require earth working to create building platforms. Alteration of the existing ground levels will impact on the existing flood hazard across the site where fill displaces storage volume. An overview of the proposed terrain is shown in Figure 14.

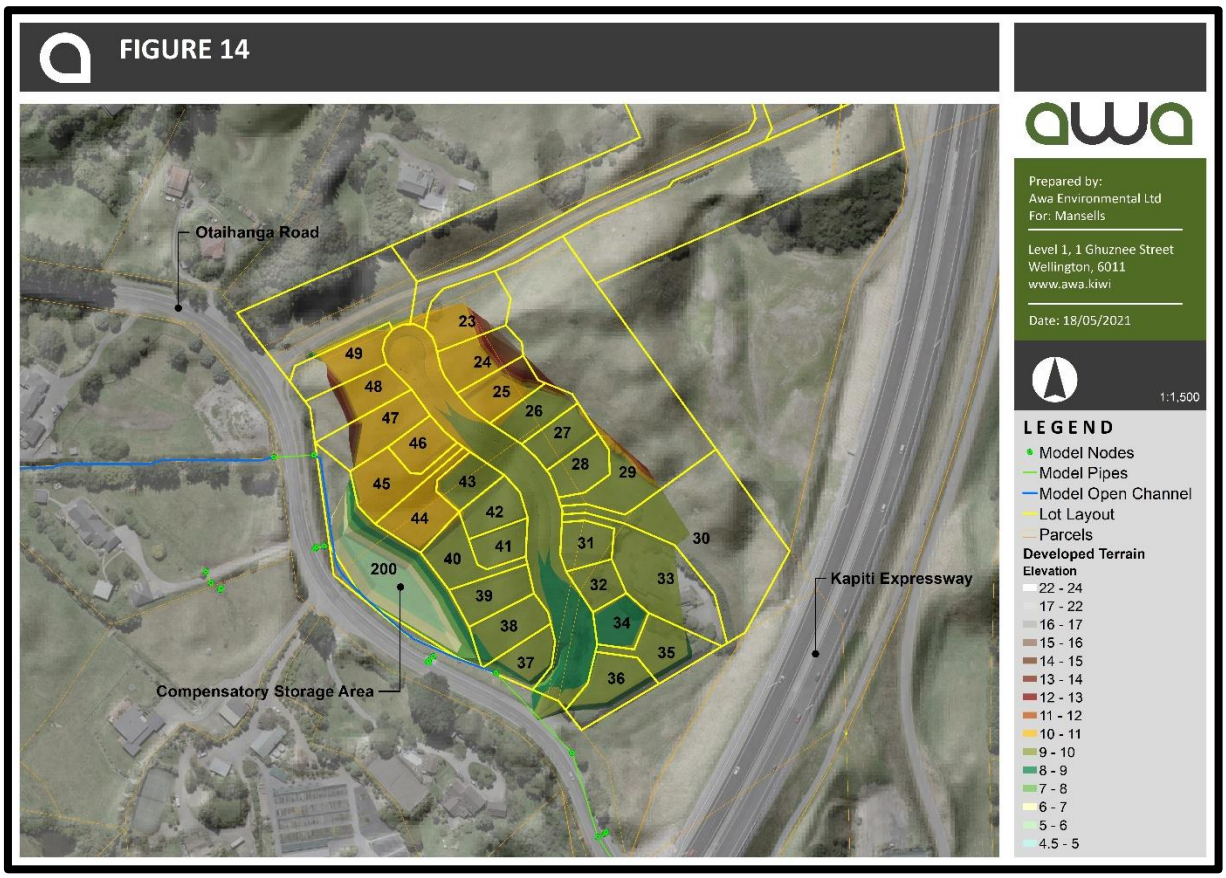


Figure 14: Proposed Terrain

To mitigate the adverse effects of subdivision and meet the relevant flood hazard rules and standards under the Proposed District Plan the following measures are proposed for the southern (residential) area as shown in Figure 15.

- Provide an outlet controlled compensatory storage area to manage the impacts associated with earthworks (loss of existing flood storage) and subdivision (increased run-off). The concept design of the storage area has an invert level at RL 5.8 with a 'throttling' culvert leaving the storage area at RL 5.8. The downstream controlling culvert is at RL 5.75.

- Modify the open channel adjacent to Otaihanga Road as part of the formalisation of the compensatory storage area.

- Traditional kerb and channel will convey run-off from the subdivision to the low point adjacent to lots 36 and 37 where it will be captured by sumps and conveyed via pipe to the compensatory storage area.

- In the existing scenario an isolated area of ponding occurs adjacent to the Kāpiti Expressway. This will be maintained to its existing extent and depth in the subdivision scenario using an overflow pipe connected into the existing stormwater network which outlets to the compensatory storage area.

- A non-return valve upstream of the storage pond to mitigate the potential for backflow.

- Ground levels will be located above the top level of the pond and above the crest level of Otaihanga Road.

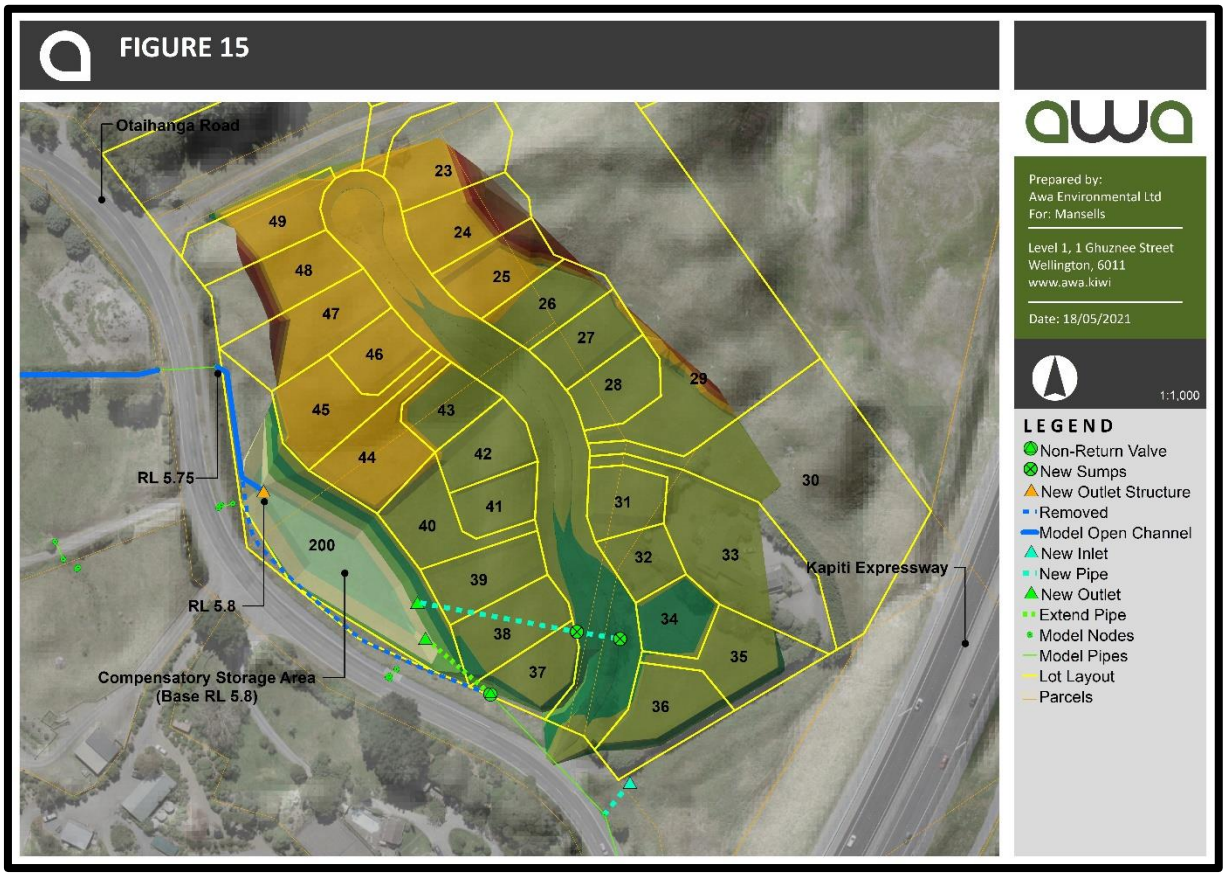


Figure 15: Mitigation Overview

5. SUBDIVISION FLOOD HAZARD

5.1. SUBDIVISION FLOOD HAZARD

Model results of peak flood depths for the 100-Year ARI climate change subdivision scenario are shown in Figure 16.

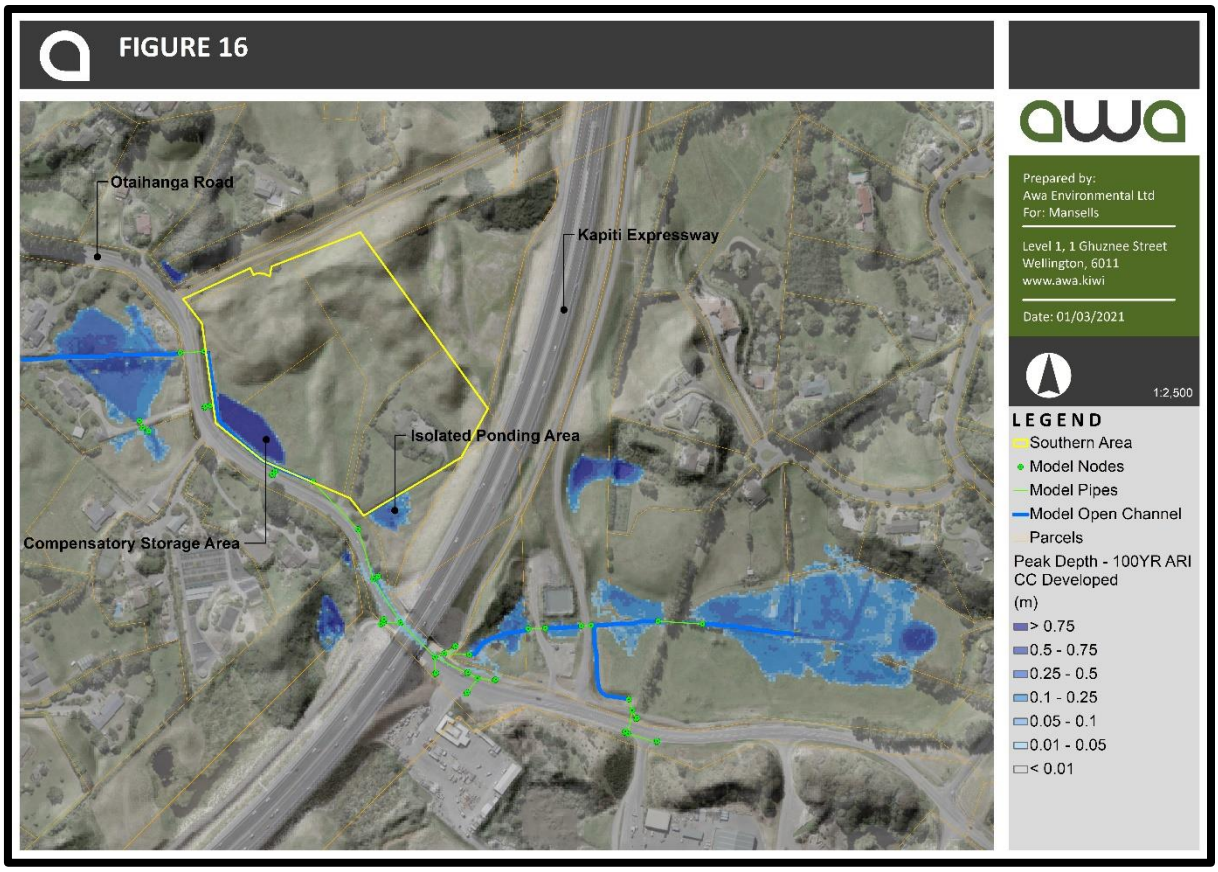


Figure 16: 100YR ARI CC Peak Inundation Depths - Subdivision Scenario Flood Hazard

Earth working of the site for subdivision, vehicle/pedestrian/cycle access and infrastructure has removed the isolated flooding within the southern (residential) area. This loss of storage has been off-set by the addition of the compensatory storage area.

The addition of the overflow pipe from the isolated ponding area adjacent to the Kāpiti Expressway, outside of the site, has mitigated any increase in off-site flood levels in this location.

The inclusion of the compensatory storage area and modifications to the upstream pipe and open channel connectivity has mitigated any increase in off-site flood depths and levels in the upstream ponding area to the east.

The inclusion of the compensatory storage area and modifications to the downstream open channel connectivity has mitigated any increase in off-site flood depths and levels in the downstream ponding area to the west.

5.2. INUNDATION DEPTH DIFFERENCE

A comparison of the depth difference within the site and surrounding area has been undertaken by taking the peak inundation depth results from the subdivision scenario and subtracting the peak inundation results from the base scenario, as shown in Figure 17.

Any increase/decrease in peak flood depth +/- 10 mm has been excluded as this is outside the tolerance of flood modelling.

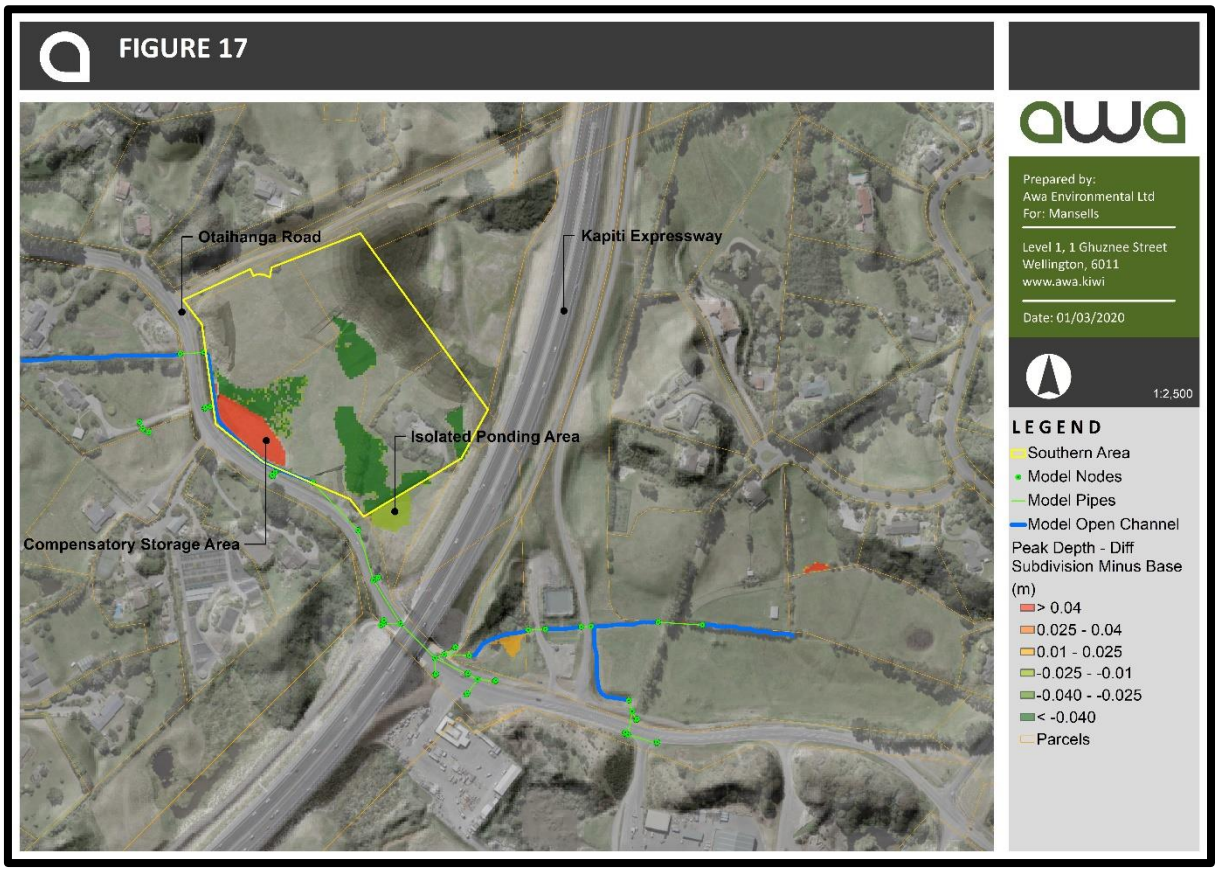


Figure 17: 100 YR ARI CC Inundation Depth Difference (Subdivision Scenario Minus Base Scenario)

Colours (orange to red) represent an increase in peak residual inundation depth with (yellow to green) representing a decrease in peak residual inundation depth.

Generally, within the site results show the proposed earth working of the site for building platforms, vehicle/pedestrian/cycle access and infrastructure will result in the greatest decrease in flood depths while the compensatory storage area results in the greatest increase in flood depths. Flood depths are reduced in the isolated ponding area adjacent the Kāpiti Expressway.

A minor instability in the model is resulting in some isolated increases in off-site peak flood depths to the east of the expressway which can be ignored.

5.3. SUMMARY

Southern (residential) area

Model results of peak flood depths for the 100-Year ARI climate change base scenario event for the southern (residential) area show on-site flooding, within the site, is localised to isolated low-lying areas.

Flooding in the wider catchment, to the east, is a result of the throttling effect of the culverts and network along Otaihanga Road. To the west of Otaihanga Road the effect of the downstream tailwater level can be seen with flooding in this location.

It is proposed to subdivide the southern (residential) area into 27 residential lots accessed of a ROW from Otaihanga Road. The site will require fill for building platforms, vehicle/pedestrian/cycle access and infrastructure. This fill will remove storage from the floodplain so compensatory storage adjacent Otaihanga Road is proposed to mitigate this loss of storage.

Modelling results show the subdivision can be implemented with less than minor effects on surrounding flood levels.

Northern (rural life-style) area

It is proposed to subdivide the northern (rural life-style) area into 22 rural residential lots accessed off Tieko Street. The primary form of stormwater mitigation to achieve hydrologic neutrality for these lots will be via individual lot soakage.

Given the larger lot sizes and good soakage rates associated with the dune environment, mitigation via soakage is considered achievable. This methodology distributes the soakage over a dispersed area rather than concentrating discharge at a single location. Individual lot soakage devices will be sized at building consent stage.

Swales will be used to convey run-off from the connected impervious areas to the under-drained bio-infiltration devices. The under-drained bio-infiltration devices have been sized to accommodate the peak discharge from the 100-YR ARI Climate Change rainfall event.

The effects of the proposed subdivision have been assessed against the relevant provisions of the Proposed District Plan Appeals Version 2018 and requirements under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020. If subdivision occurs as outlined in this report our professional opinion is that it will meet these relevant provisions and requirements.

5.4. REFERENCES

Kāpiti Coast District Council, Appendix 1 - Updated Isohyet Based Calculation of Design Peak flows, 11 October 2011

Guidelines for Stormwater Modelling using Mike Flood, DHI, November 2013

Begg, J.G.; Johnston, M.R. (compilers) 2000: Geology of the Wellington area: scale 1:250,000. Wellington: Institute of Geological & Nuclear Sciences. Institute of Geological & Nuclear Sciences 1:250,000 geological map 10. 64 p. + 1 folded map

Quick Reference Guide for Design Storm Hydrology, Cardno, February 2016

M2PP-131-M-REPG-1022; MacKays to Peka Peka Expressway Annual Groundwater (Level) Monitoring Report May 2017 to April 2018; Prepared for NZTA Transport Agency by Mackays to Peka Peka Expressway Alliance, June 2018.

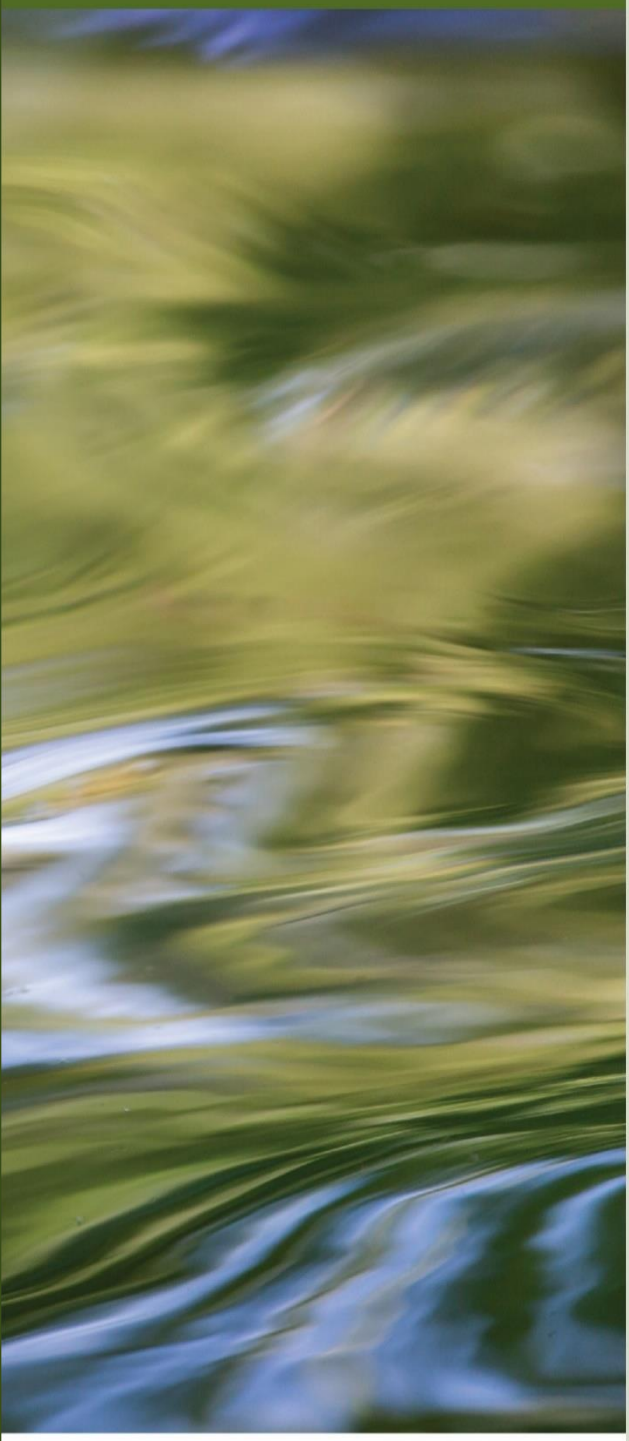
Report On: Geotechnical Investigation, RDCL, April 2020

APPENDIX A1 IMPERVIOUS AREA 1 - 100YR

APPENDIX A2 IMPERVIOUS AREA 2 - 100YR

APPENDIX B – NZTA TECHNICAL REPORT

Refer attachment



Awa environmental limited
a: 60 Cuba Street, Wellington
t: +64 4 455 0990
w: www.awa.kiwi

Prepared by Awa Environmental Limited

For Mansells