

Geology

The Palmerston North regional area lies on the boundary between the older (Late Jurassic/ Early Cretaceous) exposed greywacke basement rocks (Esk Head belt) in the Tararua ranges to the south-east and the younger (Pleistocene and Holocene) alluvial river deposits of gravel, sand and silts to the north-west (refer Tonkin+Taylor figure opposite).

The Esk Head belt (Te) forms the base of the Tararua mountain range, which is present on the far south-eastern corner of the Waters property.

North-west of the Esk Head belt towards Turitea, early Pleistocene alluvial river gravels and sands (eQa) have been deposited.

Further northwest, up to the cliffs adjacent to the Manawatū River, are Pleistocene gravels and sands more representative of marginal marine/ beach deposits (Q5b).

Cutting through these beach deposits and river gravels is a prominent flat river cut terrace containing gravels and silts eroded from the Tararua Ranges and deposited in a paleo-channel (Q2a). These geological materials underlie the majority of the site.

Younger Holocene deposits of river silts and sands (Q1a) are found in the many smaller river cut terraces. These are formed from the meandering watercourses which loosely follow the Turitea Stream. The stream itself follows the Q2a paleo-channel.

Active faults have been identified within 15km of the assessment area.

Geo-Hazards

In 2020, T+T carried out a preliminary geotechnical assessment of future residential and rural-residential land at Aokautere. This study comprised a desktop review of readily available information and a site walkover. During the site walkover, particular attention was given to hazards associated with ground instability, water flows and soft ground conditions (see T+T table 1.2 overleaf). Three main categories of geo-hazards were identified:

- Slope stability
- Uncontrolled fill
- Liquefaction

Slope stability

Following a preliminary slope angle analysis, landslide hazard classes have been mapped for the Aokautere development area.

Two lines have been mapped; a 20° line showing the extent of Class C land and a 30° line showing the extent of Class D land (see Fig.2.1 overleaf).

The District Plan currently recognises two classes of land at Aokautere: 'Developable' (equivalent to Classes A, B and C) and 'Limited Developable' (equivalent to Classes D and E).

To improve regulatory certainty and clarity, Tonkin+Taylor recommend that the District Plan's two categories are revised to become three categories:

- Land that is likely developable (Classes A, B and C).
- Land that is possibly developable (Class D).
- Land that is unlikely to be developable (Class E).

Class A and B land is not expected to be at risk of slippage, so should not require geotechnical slope stability assessment for resource or building consent. (Geotechnical input may be required for other matters.)

Class C land (slope 11° to 20°) is considered sufficiently sensitive so that erosion or slippage could occur due to cutting, filling or the disposal of water. Accordingly, applications for development of Class C land should be accompanied by a brief geotechnical report, which provides an opinion on land stability.

On Class D land (slope 21° to 30°), applications for subdivision, building or other development should be supported by a geotechnical report that includes a stability assessment. For the development to proceed, the report should demonstrate that the proposed activity will not cause or accelerate erosion or slippage.

Class E land has a slope over 30° and/or exhibits evidence of past or present erosion or slippage. In this case, development is likely to require substantial topographical modification. Any development of Class C land would require substantial geotechnical engineering input and analysis.

Table 1.2: Summary of observations and associated hazards

Site observations	Associated hazards
Evidence of landslip, both recent and historic	Potential slope and land instability.
Evidence of land creep	Potential slope and land instability. May indicate future landslip failures.
Slope direction and gradients	Provides land fall direction indicating areas of water runoff catchments.
Watercourses, both current and ephemeral	Potential for erosion of land along with erosion induced landslips. Path of water runoff may indicate areas of saturated ground. Potential for flood inundation.
Saturated ground conditions and swamp land	Settlement of ground and potential for flood inundation.
Groundwater outflows	Potential for instability on slopes, erosion, internal gully erosion.
Uncontrolled fill	Settlement of ground and loss of bearing.

Larger lots offer greater flexibility in selecting building locations and carrying out earthworks. As a result, Class E land may be developable at lower densities e.g., rural-residential lots proposed for the southern portion of Aokautere.

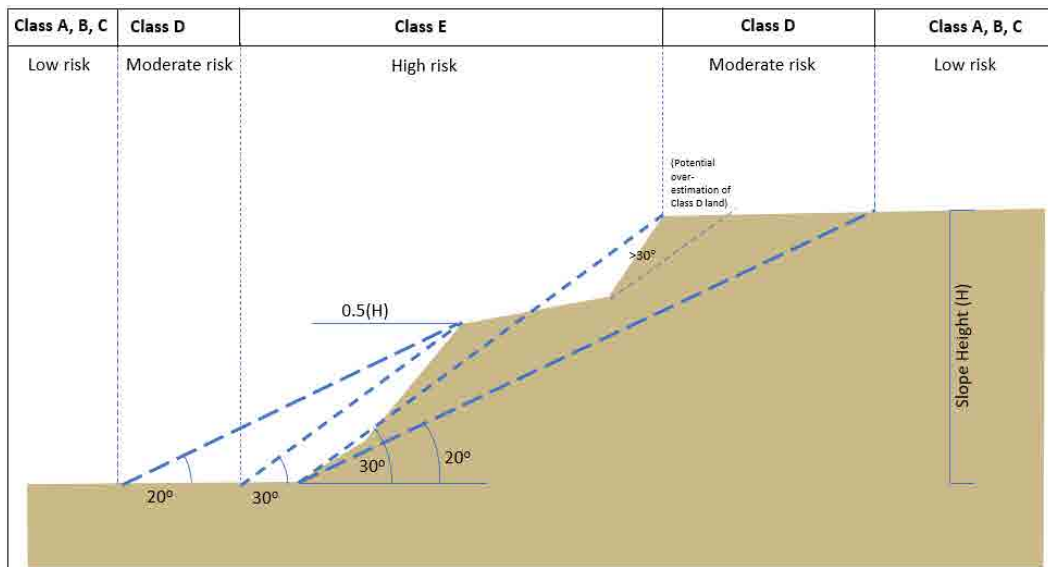
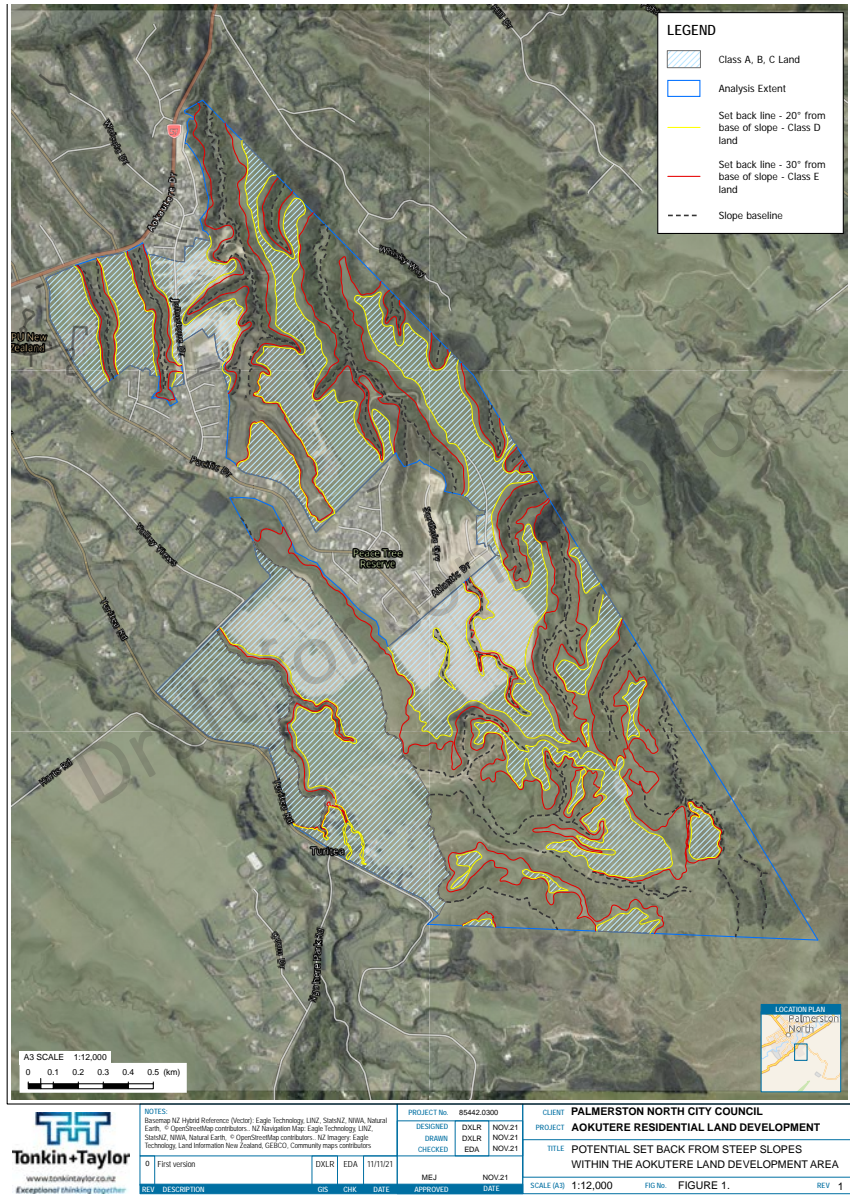
Uncontrolled fill

Areas of uncontrolled fill have been identified at Aokautere. These areas pose challenges for development because additional loads can produce large total and differential settlements. Where earth fills are present, the soil supporting residential foundations cannot be assumed to be 'good ground' in accordance with NZS3604:2011. As a result, construction

will require a geotechnical assessment and specific engineering design.

Liquefaction

Tonkin+Taylor have considered the potential for liquefaction in the Turitea Stream valley bordering the northeast side of Turitea Road. There is neither geotechnical information nor groundwater data for this area. As a result, both the upper and lower terraces should be classified as "Liquefaction Category is Undetermined in accordance with MBIE/MfE guidelines. Any development proposal in these areas should assess liquefaction potential.

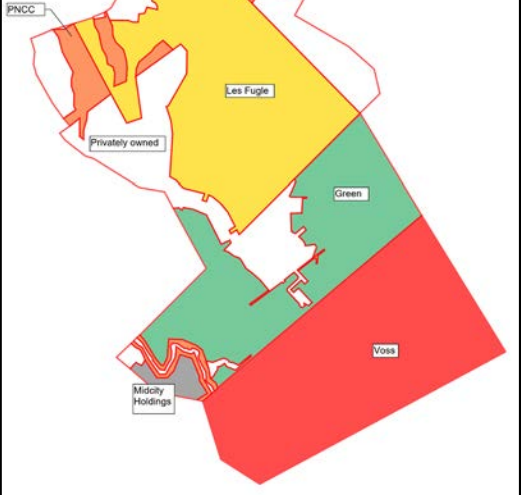
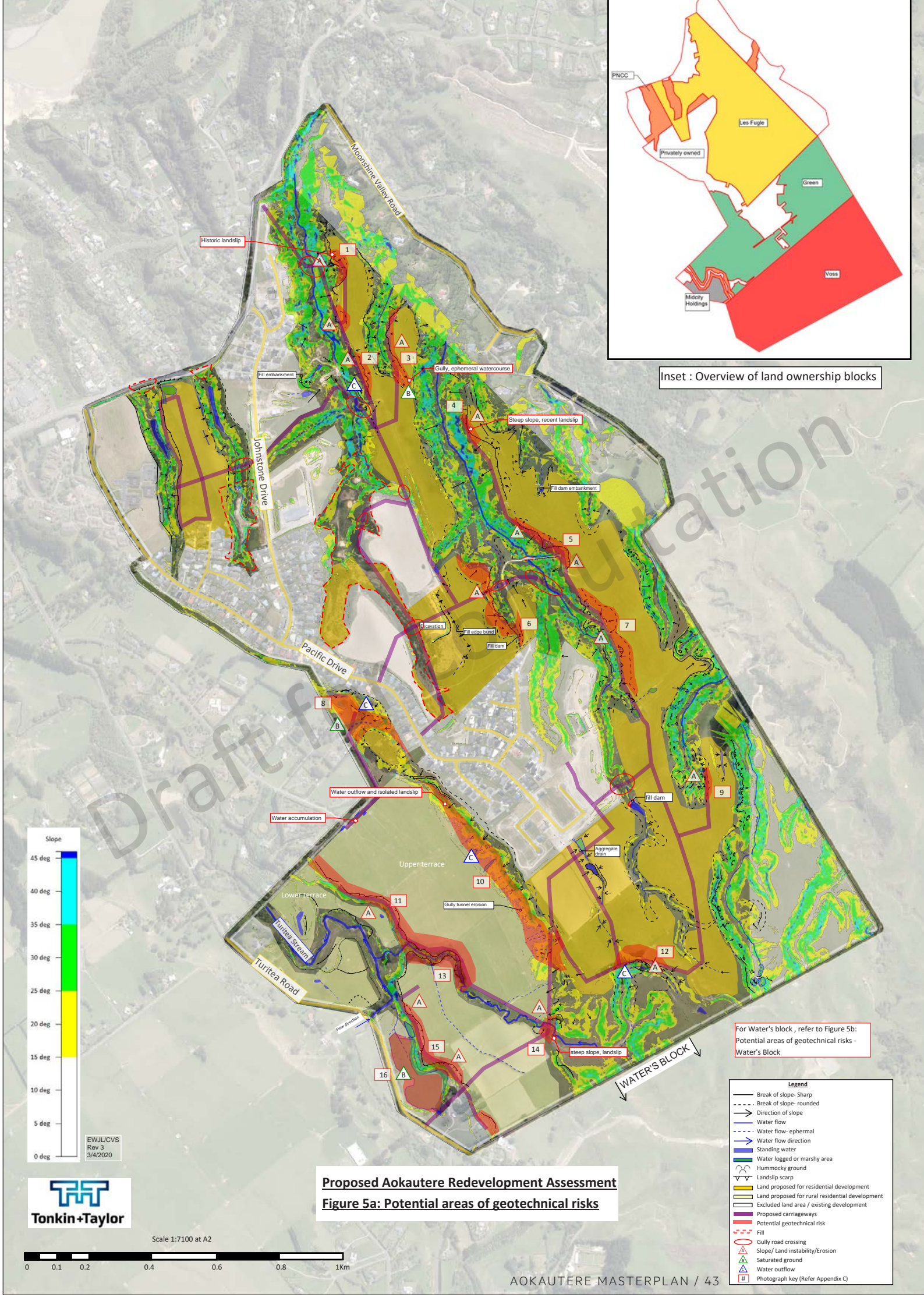


Source: Tonkin + Taylor

Table 4: Geotechnical hazard areas to be addressed

ID*	Geotechnical hazard	Urban Residential	Rural residential	Infrastructure
1	Slope and land instability Erosion	<p>Consequences: Damage to service connections due to ground and building deformations.</p> <p>Community disruption and displacement due to damage to buildings then the complex and lengthy process of repairing and rebuilding.</p> <p>Large magnitude total and differential settlement due to soft soil, peat, and/or uncontrolled fill.</p> <p>Loss of foundation-bearing capacity, resulting in settlement/slope instability.</p> <p>Stretch of the foundation due to slope instability, pulling the structure apart.</p> <p>Additional design cost</p> <p>Development consideration: Additional site specific geotechnical investigations, Enhanced foundations; Ground improvement</p>	<p>Consequences: Damage to service connections due to ground deformations.</p> <p>Additional design cost</p> <p>Limited land use</p> <p>Development consideration: Additional site specific geotechnical investigations, Limited land use, Placement of the proposed structures away from hazard</p>	<p>Consequences: Damage to roads (cracking due to settlement/slope instability, sinkholes due to erosion).</p> <p>Damage to underground services due to ground deformation (e.g. 'three waters', utility networks).</p> <p>Disruption of stormwater drainage.</p> <p>Community disruption and displacement – initially due to damage to infrastructure, then the complex and lengthy process of repairing and rebuilding.</p> <p>Additional design cost</p> <p>Development considerations: Placement of proposed infrastructure away from hazard; Slope stabilisation; Additional site specific investigation; Ground improvement; Additional resilience; Redundant utility and road networks</p>
2	Slope and land instability Erosion Tunnel gully erosion			
3	Slope and land instability Erosion Uncontrolled fill			
4	Slope and land instability Erosion			
5	Slope and land instability Erosion			
6	Slope and land instability Erosion			
7	Slope and land instability Erosion			
8	Slope and land instability Tunnel gully erosion Flooding Soft soil/Peat Uncontrolled Fill			
9	Slope and land instability Tunnel gully erosion Flooding Soft soil/Peat			
10	Slope and land instability Erosion Tunnel gully erosion			
11	Slope and land instability Erosion			
12	Slope and land instability Erosion			
13	Slope and land instability Erosion			
14	Slope and land instability Erosion			
15	Slope and land instability Erosion			
16	Flooding Soft soil/Peat			
17	Slope and land instability Erosion			
18	Slope and land instability Erosion			
19	Slope and land instability Erosion			
20	Slope and land instability Flooding Soft soil/Peat			
21	Slope and land instability Erosion Tunnel gully erosion			
22	Slope and land instability Erosion			
Fill	Uncontrolled fill			

*Refer to Appendix B for documented photographs of site observations.



Inset : Overview of land ownership blocks

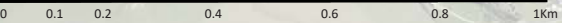


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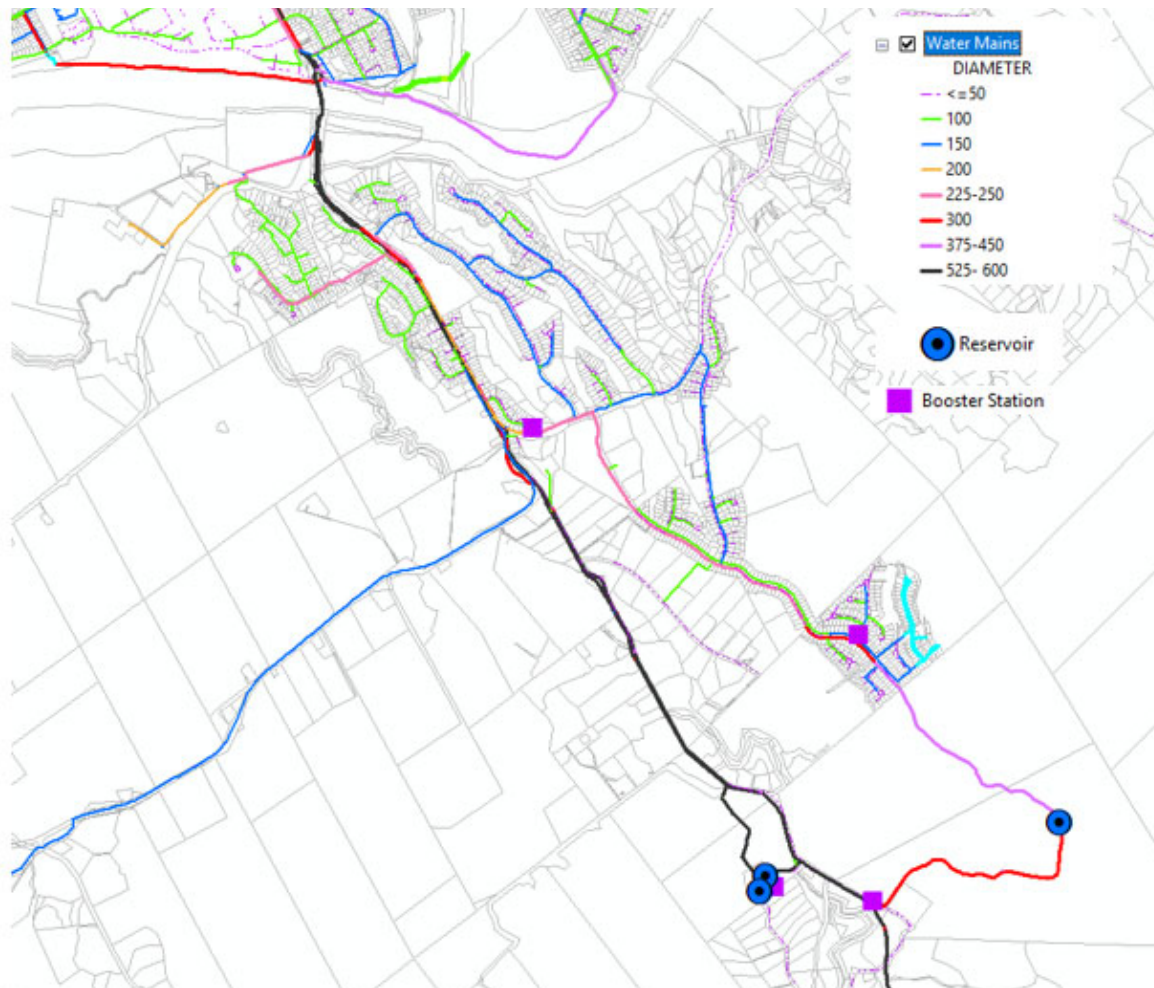
Proposed Aokautere Redevelopment Assessment
Figure 5a: Potential areas of geotechnical risks

Scale 1:7100 at A2



For Water's block , refer to Figure 5b:
Potential areas of geotechnical risks -
Water's Block

- Legend**
- Break of slope- Sharp
 - - - Break of slope- rounded
 - Direction of slope
 - Water flow
 - - - Water flow- ephemeral
 - Water flow direction
 - Standing water
 - Water logged or marshy area
 - Hummocky ground
 - ∇ Landslip scarp
 - Land proposed for residential development
 - Land proposed for rural residential development
 - Excluded land area / existing development
 - Proposed carriageways
 - Potential geotechnical risk
 - Fill
 - Gully road crossing
 - △ Slope/ Land instability/Erosion
 - △ Saturated ground
 - △ Water outflow
 - # Photograph key (Refer Appendix C)



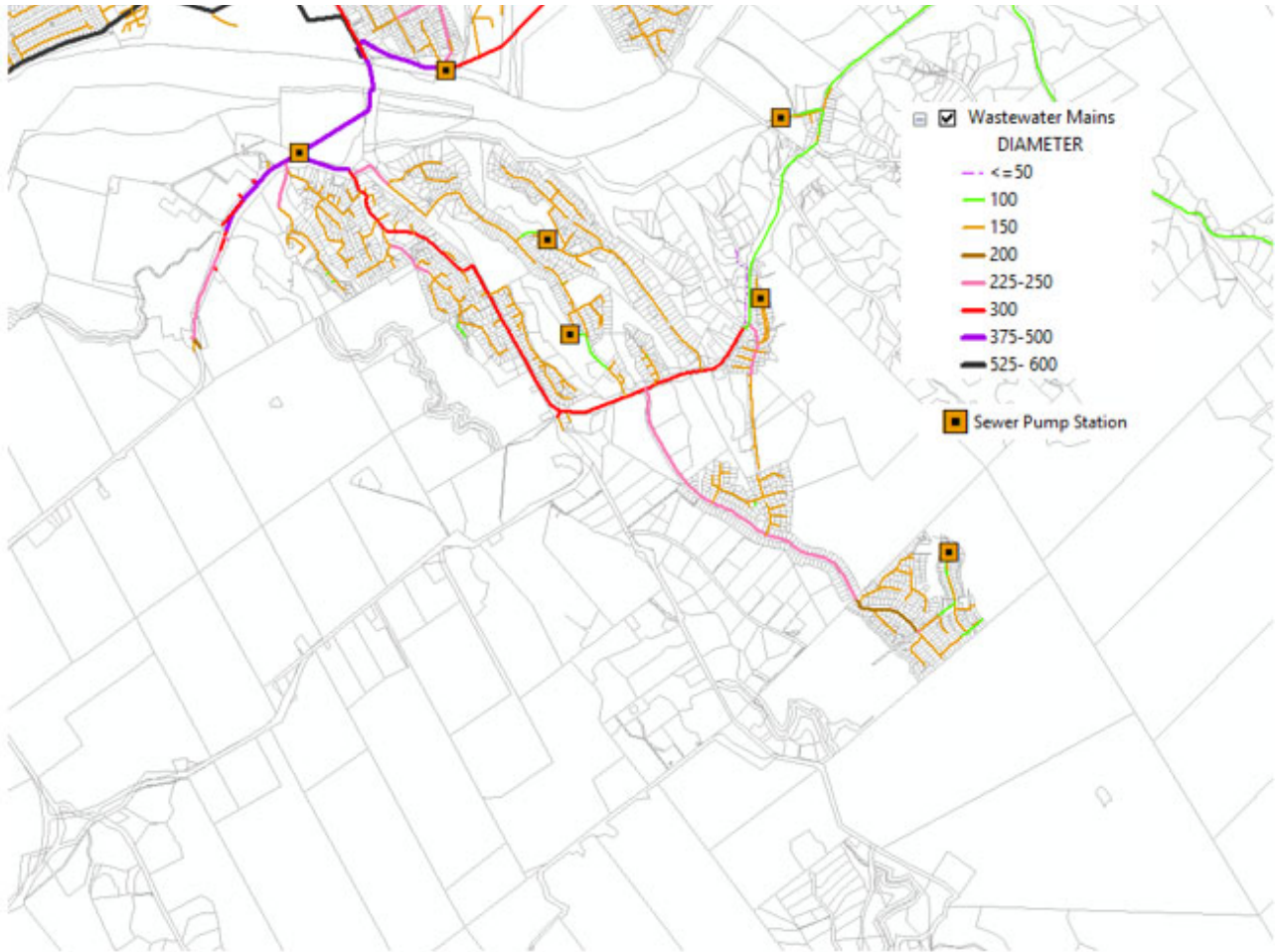
Source: PNCC

Infrastructure Utilities & Servicing

Water Supply

The source of the water supply for the Aokautere Structure Plan area is from the Turitea water treatment plant. The water is boosted from the supply mains at Turitea Road to the Aokautere reservoir (2500 m³) situated in the “Waters” block of land. The bulk reticulation consists of the 300 dia rising mains/ 400 dia falling mains and the 300/250 dia trunk mains along Pacific Drive. Residential properties

above elevation RL 100m are supplied by a booster station at Silicon Way. In future a second 2500 m³ reservoir will be constructed next to the existing, to provide for residential growth in this area. Upgrade of the Silicon booster pumps would be required to service a greater area at higher elevation. Where possible, water pipe network to be looped rather than one ended. The old booster station at Aokautere Drive remains as a standby for



Source: PNCC

supply disruption from the Aokautere reservoir. While some properties on Valley Views Road and Kingsdale Park Drive have restricted trickle feed water supply, current planning policy requires all future rural and rural residential properties to be self-sufficient in terms of water supply.

Wastewater

Existing residential properties within the Aokautere Structure Plan are

serviced by traditional wastewater gravity pipeline network. There are a number of small pump stations used to convey the sewer to collector mains. The major collector mains are the 225/250 dia mains along Pacific Drive and the 300 dia mains on Aokautere/ Summerhill Drive. Wastewater is ultimately pumped via Fitzherbert Bridge to the City's pipe network by the Massey wastewater pump station.

Future residential development will most likely require more pump stations. Low pressure sewer system may be considered if it satisfies PNCC Pressure Sewer Policy. It is anticipated that part of the existing collector mains will need to be augmented to meet demand from residential growth. Rural and rural residential properties are expected to be self sufficient for wastewater disposal.

2.4 The Social & Cultural Context

The 2018 census provides a snapshot of Aokautere's population. The suburb is located within the Poutoa Statistical Area along with more established Summerhill. Almost three quarters of the area's residents describe themselves as European/Pakeha. This is the same proportion found within Palmerston North as a whole. In other ways, the area's ethnic composition is distinctive. The area has more Asian residents but fewer who identify as Maori or Pasifika. People are more likely to be married if they live in Poutoa: 57% compared with 44% overall. Residents of the area are particularly well educated. Almost 40% of people there hold a bachelor's degree or higher qualification. They also earn more and are more likely to be professionals and managers. In one respect, Poutoa residents are just like other Palmerston North people: more than 60% drive to work.

Well educated, prosperous and family oriented, Aokautere residents enjoy the some of the best lifestyles that the city has to offer. However, Aokautere's allure brings its own challenges. Growth continues apace, even though houses are less affordable and school rolls are full. For an aging population, large homes and gardens lose some of their appeal.

Community Needs & Expectations

Housing affordability has diminished in Palmerston North, primarily because of escalating land costs. According to MBIE's price/cost ratio, the city's residential sections are not overpriced. However, valuation data shows that land accounts for almost 60% of total capital value; up from 35% a generation ago. Rents have increased faster than the CPI but not as rapidly as capital values.

The Aokautere/Poutoa area will need a new 400-place primary school within the next decade. With this in mind, the Ministry of Education has purchased land on Ruapehu Drive near the Summerhill shopping centre. The new school will consolidate community facilities at Summerhill, which remains the principal hub for the area's expanding residential population.

Rangitane o Manawatū



The following text summarises the Cultural Impact Assessment (CIA) prepared by Te Ao Turoa on behalf of Rangitāne o Manawatū (Appendix E).

The objective of the CIA is to identify the significance of the Aokautere landscape to Rangitāne along with the likely effects of redevelopment. These issues and effects are contextualised within a statutory environment that gives certain rights and responsibilities to Rangitāne and other stakeholders.

Aokautere is one of Rangitāne's earliest settlements. The area's attractions included access to the Tararuas and terraces suited for cultivation.

Aokautere Pā on the eastern bank of the Manawatū River took its name from Te Aokautere, a Rangitāne chief whose life spanned the 18th and 19th centuries. Other local Rangitāne settlements include Te Motu o Poutoa and Turitea Pā. Rangitāne would like their

longstanding association with the area to be expressed through placenames, artworks and interpretive material.

As mana whenua, Rangitāne o Manawatū view all of Aokautere as Wāhi Tapu, i.e. as a valued cultural landscape containing many inter-connected locations, elements and conditions. These include urupa, former settlement sites and trails along with natural features and forces.

Accordingly, Rangitāne have a close interest in the impact of urbanisation on local landscape and ecology.

Rangitāne supports and seeks an active role in the restoration of indigenous ecologies within Aokautere's gully system. Healthy waterways are a key part of this environment. To this end, Rangitāne favour rain gardens and other low-impact stormwater management practices. Preventing contamination and sedimentation is particularly important during redevelopment.

Rangitāne's lengthy occupation of Aokautere suggests that taonga could be disturbed when initial earthworks are carried out. During this phase of construction, the best way to recognise, respect and if necessary retrieve taonga is to have well-understood protocols and on-site cultural monitoring.

Rangitāne supports higher residential densities at Aokautere as a step towards more affordable accommodation solutions. On its own, proposed development is unlikely to improve housing access for local whānau. So, the masterplan framework needs to be accompanied by further initiatives such as new sources of finance and innovative forms of tenure.

Rangitāne o Manawatū look forward to working with PNCC and other stakeholders on the mitigation of cultural impacts at Aokautere.



Demographic Trends

Aokautere has grown rapidly since the turn of the century: much faster than the city as a whole. Census data shows that the suburb's population increased more than 50% between 2001 and 2013. Since then, the area has grown more slowly (approximately 17%), although this occurred off a higher base. Aokautere has some of Palmerston North's most expensive residential real estate. With just over three people per

occupied dwelling, Aokautere's households are slightly larger than the city's average. The 2013 census revealed Aokautere's inhabitants to be significantly older than their fellow citizens. However, this trend was partially offset by more young adults living in the area. 2018 census data shows little difference in median age between Poutoa and the city as a whole.



Housing Market

In Palmerston North, greenfield development usually has 13-15 dwellings per hectare. The minimum lot size is 350m². Although relatively cheap at about \$220,000, sections this small are likely to occur only as infill. On a greenfield site, 600m² lots are more typical, and each could cost \$320,000. In the local context, medium-density multi-unit housing suggests up to 30 dwellings per hectare.

Historically, greenfield development has been more responsive to peaks and troughs in housing demand. Infill development has remained relatively stable throughout each economic cycle. However, extrapolating from these patterns is risky for two reasons. First, household composition is changing. Second, District Plan changes make it easier to build minor dwellings and multi-unit housing.

3

Masterplan

3.1 Concept & Development Content

Natural water-cut gullies, distinctive plateaus, pronounced escarpments and stream systems at the foothills to the Tararuas set the scene for a unique place to live in Palmerston North. The masterplan responds by promoting a landscape-led design balancing the need to create sustainable communities with a genuine concern for natural systems.

The Aokautere Masterplan presents the preferred development outcome for further residential development in Aokautere and Turitea Valley. This plan has been prepared to inform a Structure Plan.

Underpinning the plan are a set of Principles (see section 3.2). These articulate key moves that are necessary for sustainable growth. The plan takes the disparate pieces of the existing suburb and knits these together to form a cohesive whole. Conceptually the masterplan adopts a 'gullies first' approach, maintaining the integrity of natural water-cut ravines and privileging public access to these unique landscape features. At the same time, the desire to create well-connected high-amenity communities drives decisions around: local centre provision, character areas, residential densities, street typologies and townscape creation. The Masterplan includes two optional development scenarios: a retirement village and an alternative layout for the extension of Abby Road. These are depicted as windows within the main Masterplan drawing. Whichever scenario is chosen, the end result offers a step change in neighbourhood design and development practice in Palmerston North.

The masterplan primarily delivers suburban residential development with variations in density and lot type. Supporting an expanded population, the plan proposes a new local centre positioned to support walking, cycling and public transport. A generous network of recreational spaces and reserves, along with streets that incorporate water-sensitive design, ensure a high level of amenity is achieved.

The plan delivers the following new development content:

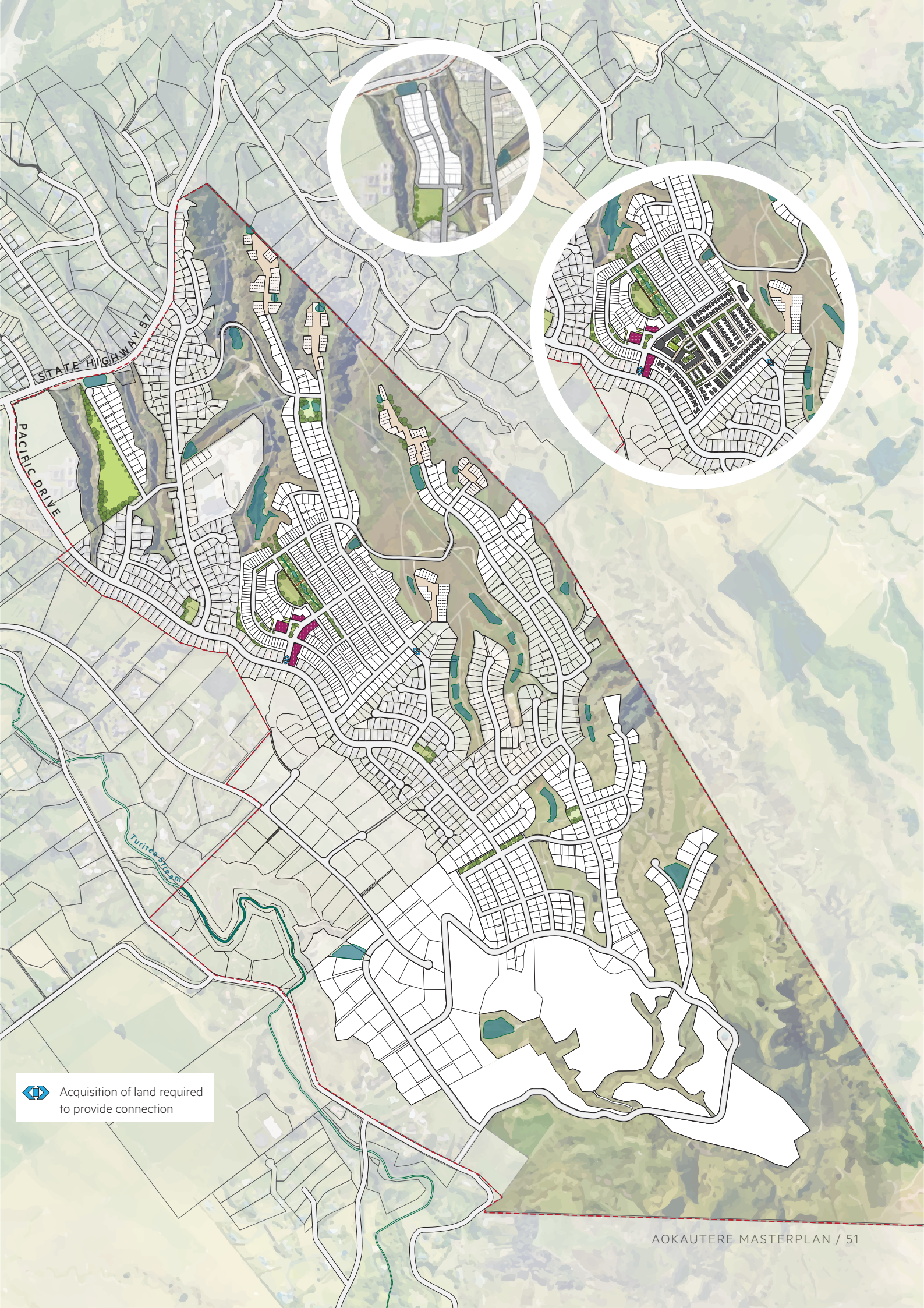
- Rural Residential: 79 lots
- Suburban Low Density: 437 lots
- Medium Density Village: 338 lots
- Medium-Density Clusters: 119 lots
- Park Edge Apartments: 33 units
- Mixed-Use Apartments: 44 units
- Local centre: 0.79Ha net site area

Total new residential lots/units: 1,050

Retirement Village Option (within site):

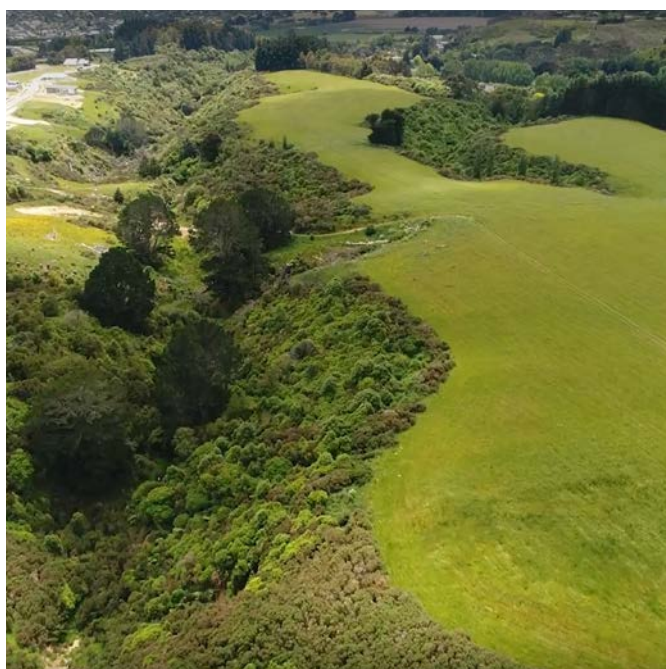
- On-Ground Dwellings: 160 units
- LTO Apartments: 54 units
- Resthome/dementia care: 92 units

Total new residential lots/units: 1,154



Acquisition of land required to provide connection

3.2 Plan Principles



01

Nature is the Mother of Invention

Aokautere's special landscape character is protected and enhanced: development works with the natural pattern of gullies and plateaus.

Aokautere's plateaus provide ready-made building platforms. If streets and lots are carefully configured, little re-grading is required to prepare the Site for development. When natural contours remain unaltered, there is less disruption to drainage and vegetation. By keeping the gully system intact, the masterplan facilitates the retention of watercourses and the remediation of local ecologies. These measures reinforce Aokautere's distinctive identity. The area's elevated and incised terrain help to set Aokautere apart from other suburbs.

02

Everything is Aok

Design best practice sets a local benchmark for high-quality housing and amenity-rich suburban lifestyles.

The masterplan applies a single design ethos to every aspect of Aokautere's development. Coordinated treatment of streets, lots and dwellings produces a more coherent neighbourhood and greater certainty about long-term outcomes. The masterplan employs the latest design thinking. Variations in lot size and housing type are matched to local character and amenity. Pockets of higher density are complemented by generous open space reserves. This approach makes the best use of valuable peri-urban land. It also increases housing choices and avoids carpeting the landscape with a single kind of suburban home.

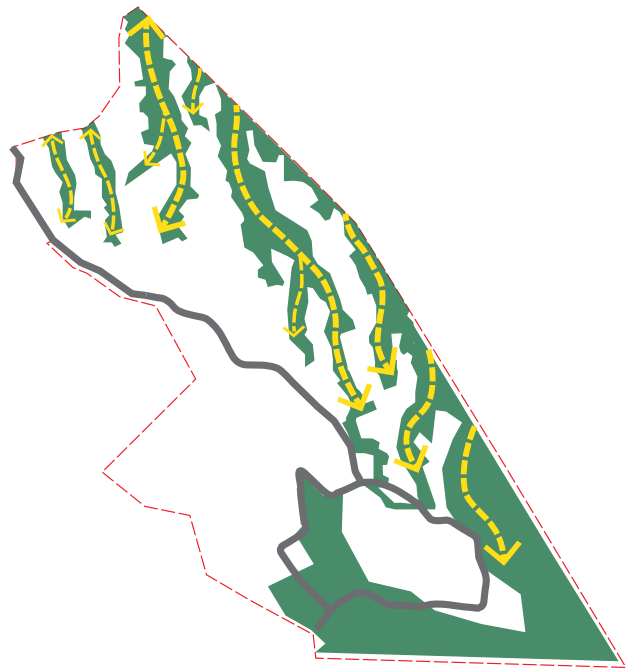


Life in the Big Outdoors

Bush-clad gullies provide widespread access to open space: a network of ecological corridors and recreational trails complements the street layout.

Aokautere's network of recreational trails is almost as extensive as its street system. Plateaus and gullies interlock to form alternating bands of housing and open space. In some locations, parks and road reserves continue the "green fingers" as formal landscapes. This arrangement gives many residents direct access to off-road pathways and areas of regenerating bush. No one is more than a few minutes walk from the nearest reserve. The abundance of shared open space means less reliance on private outdoor areas. This facilitates some townhouse style development on smaller lots. Although moderately high densities are achieved in places, the gullies' proximity means that no one feels hemmed in.

03

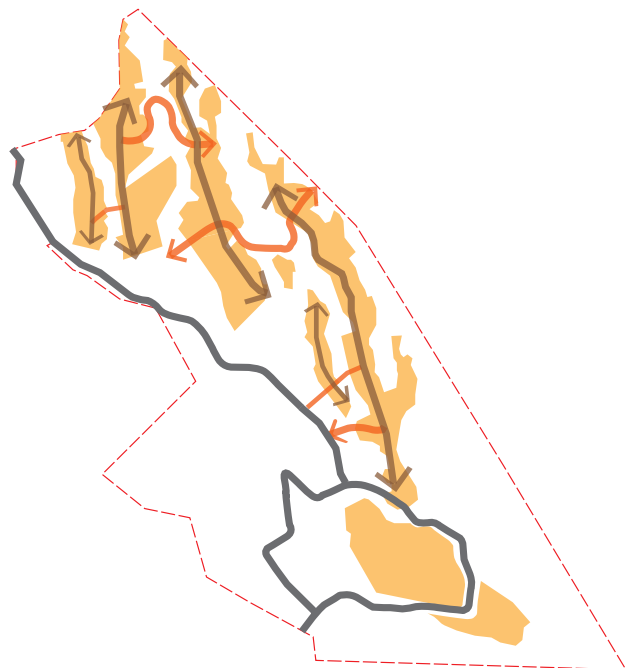


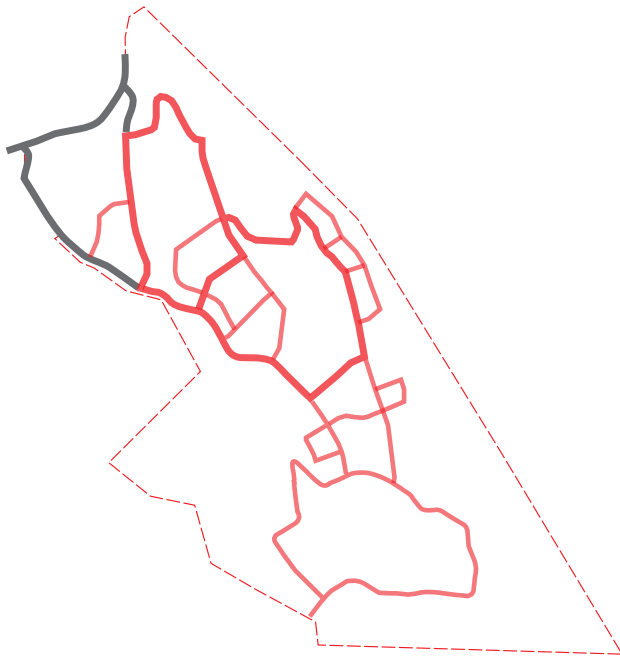
Travel Is its Own Reward

Connecting streets offer direct experience of the terrain: major routes intermittently traverse gullies and hug the edges of plateaus.

Aokautere has two kinds of connecting street: ridge routes and gully crossings. Each provides a distinct landscape experience. North-south ridge routes travel the length of the plateaus. In places, these roads resemble conventional suburban streets. However, at intervals, they emerge onto a gully edge - affording motorists, cyclists and pedestrians an elevated view of the adjacent reserve. Other connecting streets leave the built-up area altogether. They cross the gullies from east to west, frequently taking a meandering route to lessen the gradient. Bridges punctuate these journeys and reduce disruption to trails and watercourses on the gully floors.

04



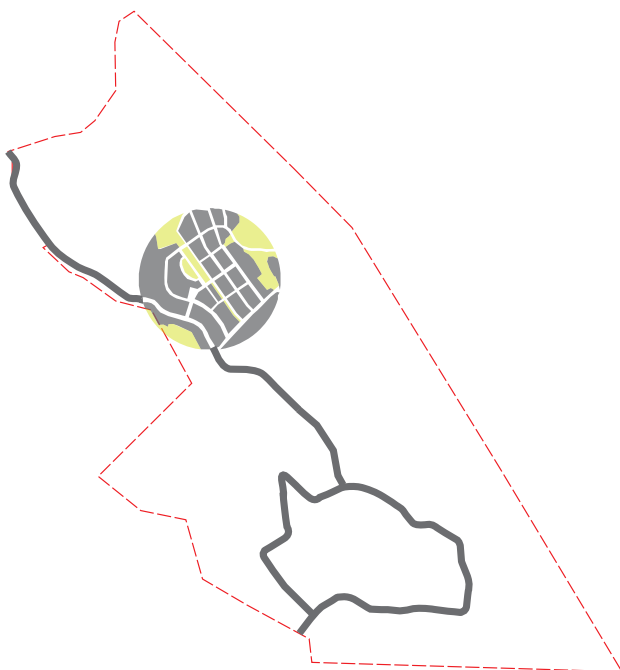


05

Going Around in Circuits

Networks of streets create permeable and connected neighbourhoods: circuits increase resilience by offering a choice of pathways.

At present, Aokautere has little internal connectivity. The combination of broken terrain and piecemeal subdivision has produced a tree-like path structure with a single trunk - Pacific Drive - and many branches. The masterplan transforms this rudimentary street layout into a joined-up system that contains few dead ends. Cross-gully routes prevent the plateaus becoming giant cul-de-sacs. Most locations are accessible from two directions. Permeability is greatest within "North Village" where small blocks and gridded streets maximise the choice of pathways. Streets feed into a network of cycleways and recreational trails, which increase travel options.



06

It Takes a Village to Raise Density

A local centre has higher density, exceptional amenities and a broader range of dwellings: "North Village" is distinguished by more formal geometry.

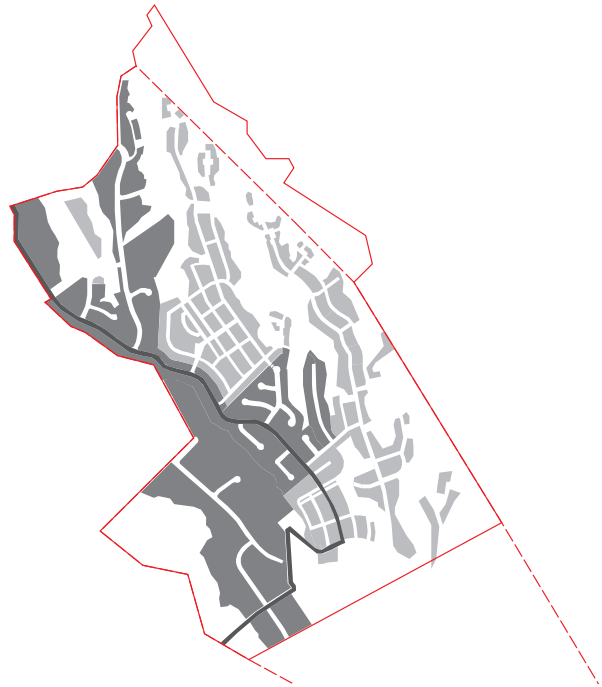
Higher density housing should occupy advantageous locations. In Aokautere, these include a neighbourhood centre where amenities are concentrated. 'North Village' contains a small area of commercial development as well as attractive open spaces. One Masterplan option includes a retirement complex. Village retail functions do not match those of the Summerhill shopping centre. However, North Village provides Aokautere residents with a walkable destination where a range of goods and services are available. The Village also has a distinctive street pattern. Smaller and more regular, its blocks accommodate intensive development and give the precinct a demonstrably urban character.

Thinking Outside the Property Boundary

Aokautere's masterplan knits together new and existing developments: outcomes improve as big-picture thinking replaces piecemeal subdivision.

Aokautere is not a greenfield site. Rural property boundaries are overlaid with areas of suburban subdivision, which have occurred incrementally over several decades. The masterplan assembles these fragments into a coherent entity. Making a few strategic connections, the plan achieves order and efficiency while causing minimal disruption to existing residents. New development is fully coordinated, the product of large-scale long-range decisions and an overarching design logic. When the masterplan is fully implemented, the disparate origins of early subdivisions will still be evident. However, Aokautere as a whole will have a legible structure and a pleasing degree of unity.

07



Here, There and Not Just Anywhere

Aokautere is a mosaic of place-based identities: streetscapes, lot sizes and building types combine to give each location a recognisable character.

Suburbs are often criticised for their homogeneity. Streets of single-family homes can be particularly monotonous when development occurs rapidly and appeals to a narrow demographic profile. Assisted by Aokautere's topography, the masterplan creates residential precincts with distinct qualities. Some are strongly influenced by the natural landscape. Others have a more formal character, which is derived from geometrically laid out streets and orderly buildings. Location and appearance are linked to the size and configuration of dwellings. So, each sub-area is likely to acquire a different mix of household types. Ultimately, it is the diversity of Aokautere's inhabitants that give the place its mature urban character.

08



3.3 Landscape

Aokautere's unique landscape characteristics will be maintained and enhanced. These include the distinct landform of the incised gully and raised plateau system as well as the native habitat present in the gullies.

Street planting will complement Aokautere's natural ecology, while providing a high quality urban environment. The planting adds to diversity by reinforcing the character of the different street types found throughout the subdivision.

Together the open spaces, recreational paths, vegetated gullies, amenity street planting and sustainable stormwater design will ensure Aokautere is a desirable place to live. As a result, the residents of Aokautere will feel connected to the surrounding landscape.



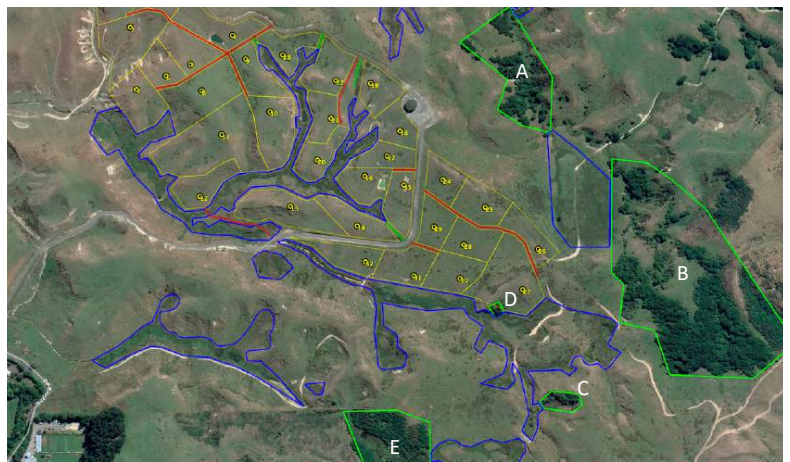
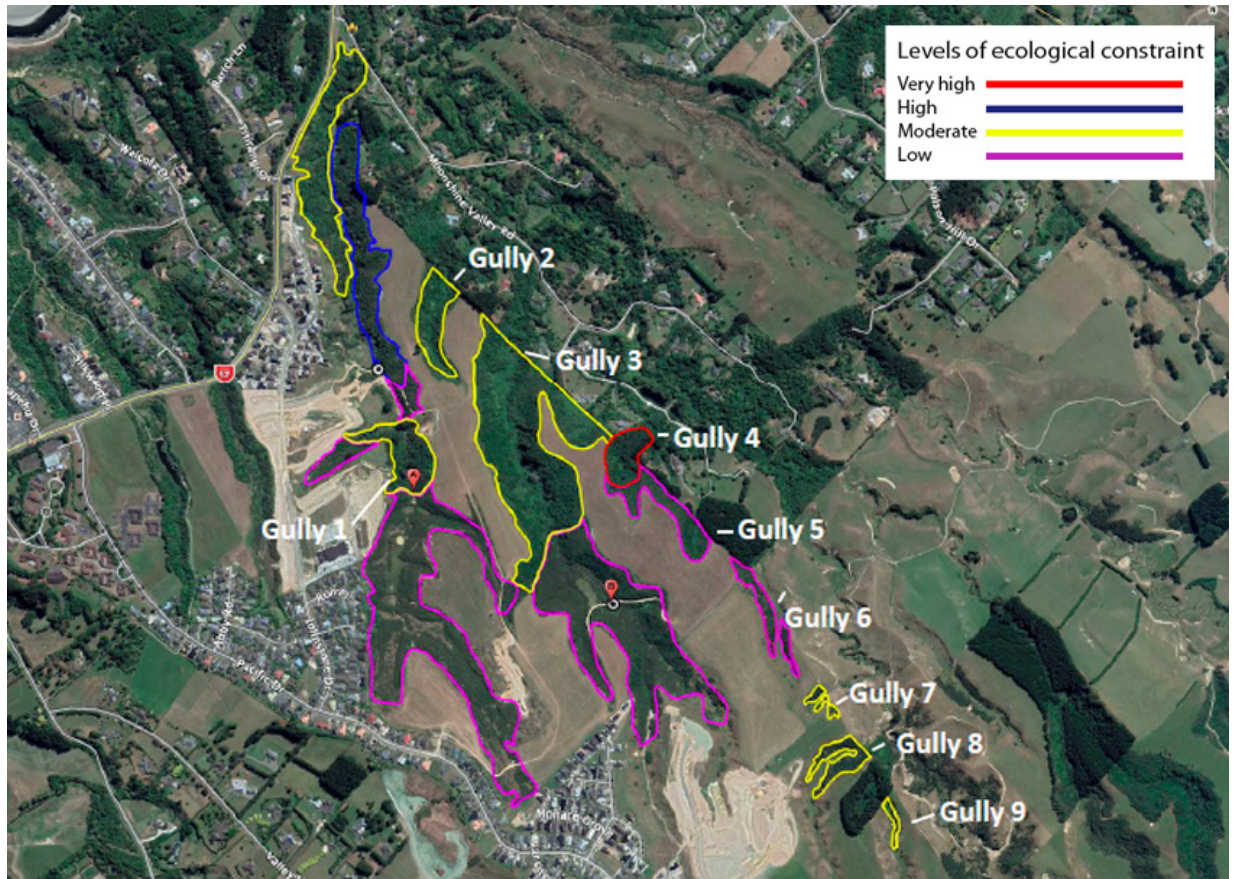
Landscape Strategy

The design strategy takes a landscape-led approach that is centred on preserving the gullies, water sensitive design (WSD), walkability, connectivity, and high amenity streets. Habitat enhancement and creation will be fully embraced within the gullies. Street planting will add to this, strengthening biodiversity corridors and green links.

The gullies present a unique recreational opportunity. Biking and walking tracks will be constructed

throughout the gully system, and these routes will be used to improve connectivity between the plateaus

WSD will be incorporated through the use of raingardens, swales and detention basins. Together, these features will improve water quality and reduce gully erosion. They will also contribute to attractive high-quality streetscapes.



Habitat Enhancement & Creation

The gully ecosystems provide an opportunity for the community to act as kaitiaki of indigenous fauna and flora in Aokautere. The protection of existing biodiversity and the enhancement of degraded areas in the gully systems will enable interrelationships among te hauora o te tangata (the health of the people), te hauora o te koiora (the health of indigenous biodiversity), te hauora o te taonga (the health of species and ecosystems that are taonga) and te hauora o te taiao (the health of the wider environment).

The integrity of existing indigenous biodiversity in the gullies has been identified, and development has been diverted from high value areas. Overall, the Structure Plan provides indigenous vegetation cover on more than 10% of the urban area. Enrichment plantings in gorse areas, planting grasslands and weed control in regenerating forests will help to achieve this level of cover. Native birds will also aid restoration efforts by spreading native seeds.