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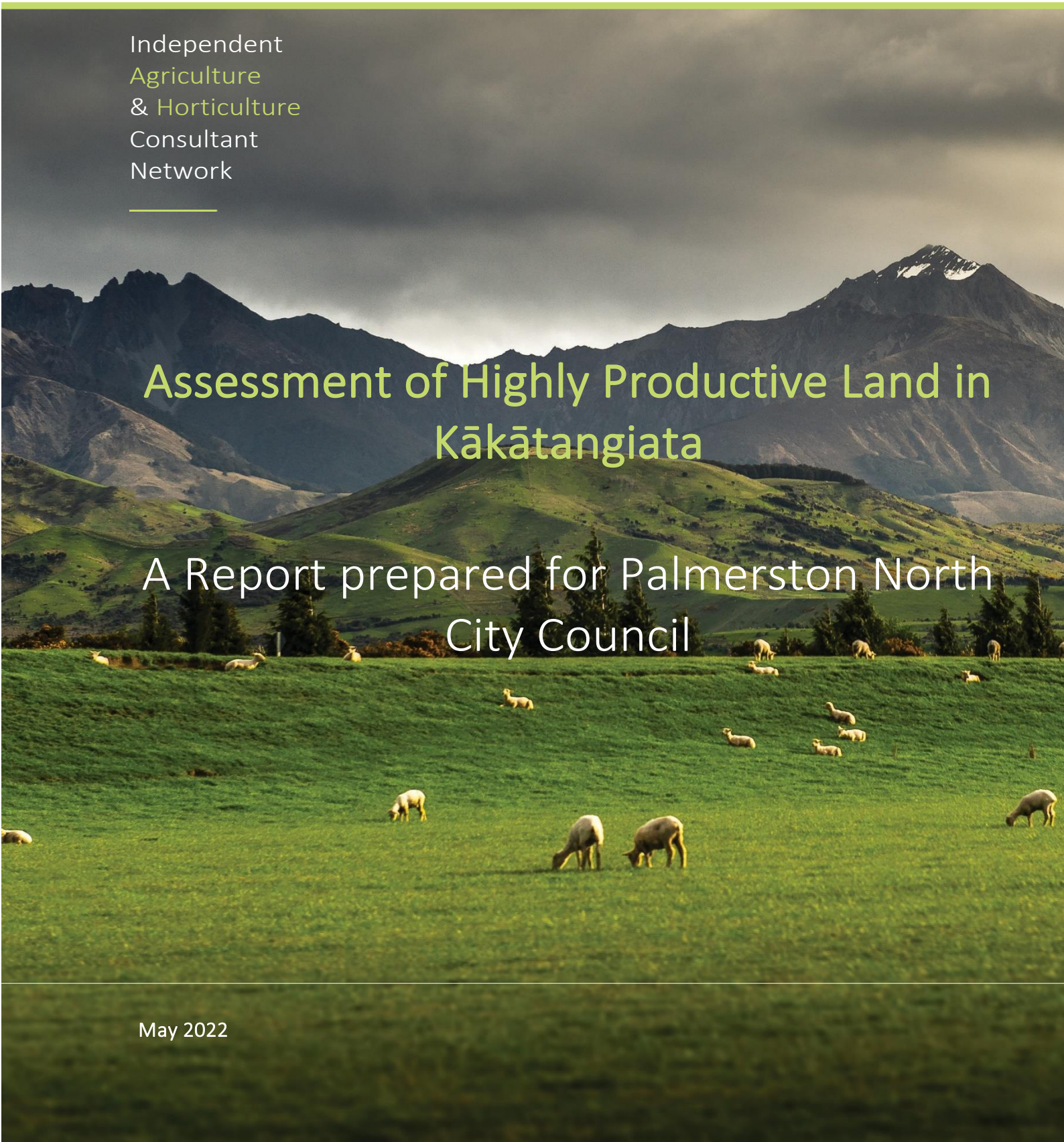

Assessment of Highly Productive Land in Kākātangiata

A Report prepared for Palmerston North City Council

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1.0 EXECUTIVE SUMMARY

The objective for this study was to carry out an assessment of the costs associated with the potential loss of highly productive land for residential development in Kākātangitata, an area of approximately 842 hectares (ha) on the western edge of Palmerston North.

The assessment shows that the area is made up of 816.1[1] ha of individual titles, with the remaining 26 hectares in roading and railway infrastructure, margins, and waterways. Current land use involves approximately half the area in land titles of less than 4ha, of which 273ha is in lifestyle blocks. The remainder is very largely in pastoral use, particularly dairying or dairy support, with a small area in horticulture or arable use.

Of the area, 96 hectares has been identified as Class 1 Land (Manawatu Soils). Of this 38.7ha is considered as being predominantly Class 1, while the remaining 57.3ha is mixed in as small pockets amongst predominantly Class 2 or 3 land. The vast bulk of the remaining area is Class 2 (largely Kairanga Soils), which have a wetness issue and would need to be drained in order to be fully productive.

The economic analysis was carried out using gross margins (GM - Gross Revenue less direct operating costs). These were ascribed to the various current land uses; in a number of cases reliable economic data is not available, so a GM for a similar land use, which is very likely to be higher than actual, was used.

The Future analysis was based on:

(i) No change in the "non-productive blocks"
(ii) The 38.7ha of Class 1 land is converted into potatoes (as a high value crop).
(iii) Of the remaining (Class 2) land, 3 scenarios were analysed:

- All the dairy/drystock/equestrian land is converted to dairying
- Half of the remaining land is converted to dairying, half to horticulture with the crops split 50:50 between potatoes and chestnuts.
- All of the remaining land is converted to horticulture, at again a 50:50 split between potatoes and chestnuts.

The results of the analysis shows

Agricultural Output ($m)

Current	$2.21
Future#1	$2.98
Future#2	$3.87
Future#3	$4.75

An estimate was made of the employment impacts of further development into higher productive land uses. While an analysis of such a small area was out of scope of the study, the estimate was based on the employment multipliers at a national level, derived from the 2016

[1] Note that hectares refer to total hectares throughout the report, not effective hectares. Effective hectares is defined on page 8 and does not include existing infrastructure on the blocks, such as houses

census. This showed that employment would increase by 30-50 FTEs if the land was developed further.

The current maize/horticultural/vegetable area within Kākātangitata is 45ha. This makes up 7.7% of the area in arable/horticulture within the PNCC boundary, 0.13% of the Horizons' Regional Council area, and 0.03% of the New Zealand area.

Under the assumption for "Future Land Use#3" the total potential area within Kākātangiata of horticulture/vegetables rises to 507 hectares, which means it would make up 46% of the area within PNCC, assuming the current area within PNCC, but outside of Kākātangiata, remains constant. Similarly, the increase in area would represent a rise to 0.7% of the national area.

On an LUC basis, the 816 ha of Class 1 and 2 land within Kākātangiata represents 15% of the Class 1 and 2 land within PNCC (ignoring land within the city itself), 0.4% at the Horizons' regional level, and 0.1% at a national level.

There are a range of barriers to land use change, including:

- Biophysical
- Economic
- Technological change
- Societal pressures
- Personal factors

Of these, usually economic issues are the main factor. Within Kākātangiata, key issues that would need to be addressed would include:

- The need to drain much of the area in order for it to move to a higher productive use.
- Much of the land is in relatively small blocks, and the capital required to amalgamate these would be significant. While this could be addressed via leasing, this in itself presents significant administrative and logistical issues.

In addition to this, current environmental legislation, in the form of both the National Environmental Standards for Freshwater Regulations 2020, and Horizons Regional Council One Plan, place significant impediments to developing the land into more intensive land uses.

Overall, while it could be possible to develop the land to a higher productive use, this is not regarded as very probable; outside of significant economic and technological change, the most likely use would be similar to the current one – the larger areas remain in pastoral production, with some smaller areas of cropping/horticulture.

2.0 BACKGROUND

Achieving a balance between urban growth and protecting the region's highly productive soils can be challenging. Understanding the current and potential productive potential of these areas from an agricultural and economic perspective can help form part of the overall assessment required to make these decisions in line with policy requirements.

Palmerston North City Council (PNCC) have identified an area of approximately 842 hectares on the western edge of Palmerston North as an urban growth area. The area is called Kākātangiata.

To assist PNCC in assessing the proposed development against the Regional Policy Statement, the District Plan and the proposed National Policy Statement – Highly Productive Land, they have requested a comprehensive assessment of the costs associated with the potential loss of highly productive land for residential development in Kākātangitata.

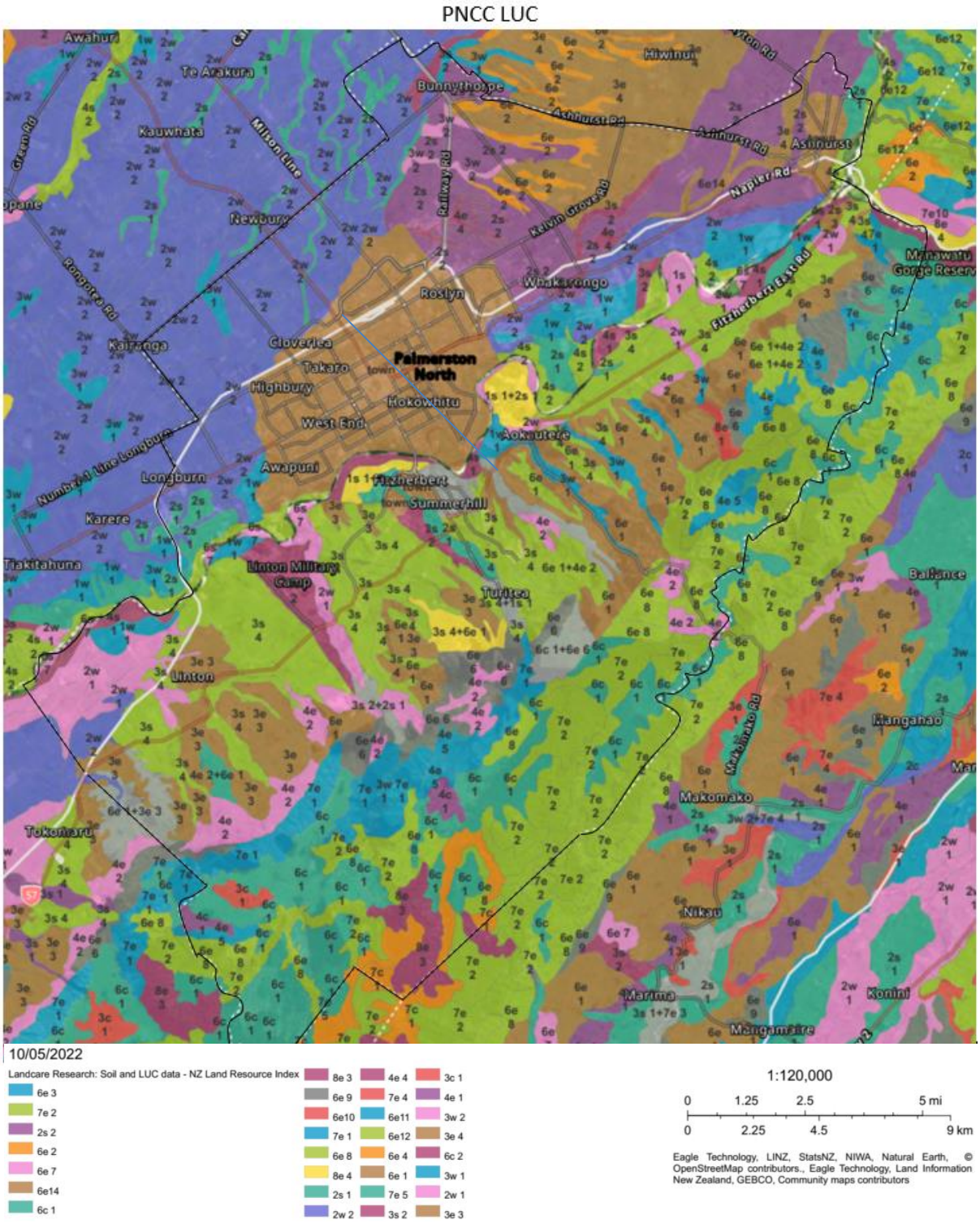
The proposed NPS-HPL identifies highly productive land through the Land Use Capability (LUC) system, which considers factors such as soil, erosion, and climate. Land is categorised from Class 1 (high production) to Class 8 (low production) based on its versatility and ability to sustain productive uses. The proposed definition of 'highly productive land' includes Classes 1, 2, and 3; this covers 14% of the land in New Zealand. However, the NPS-HPL is also designed to enable local authorities to recognise highly productive properties in Classes 4-8 in light of other features such as land size or water availability. The proposed objectives and policies of the NPS-HPL include decision making guidance to Council's looking to rezone highly productive land, with factors to consider such as cost-benefit analyses associated with irreversible loss of highly productive land.

PNCC has a total area of 43,129 hectares, with approximately 33,612 hectares zoned as Rural and Rural-Residential land (November 2014, PNCC District Plan). This working part of the rural community includes agriculture which ranges from horticulture through dairying, drystock to arable farming. Generally, horticulture is confined to quite limited areas, mainly in the Staces Road and Te Matai Road areas (eastern side of the city), where orcharding, market gardening and plant production predominate.

In terms of Highly Productive Land, PNCC has a high proportion of Class 1 -3 soils with 52% of the total area considered Class 1-3, which according to the Ministry for Primary Industries, Proposed National Policy Statement - Highly Productive Land - Indicative Cost-Benefit Analysis, August 2019, is considered the 6th highest proportion of Council's in New Zealand[2]. As demonstrated in Figure 1 below, a lot of these highly productive soils are surrounding the city, which places greater challenges on urban growth options.

[2] Ministry for Primary Industries, Proposed National Policy Statement - Highly Productive Land - Indicative Cost-Benefit Analysis. MPI Technical Paper No. 2019/10. August 2010. Page 28-29.

Figure 1: Land Use Capability map of Palmerston North City Council



The proposed Kākātangitata urban growth area is zoned Rural with some smaller areas zoned as industrial and race training. Of this area most of the land is classified as Class 1 and 2, indicating that it is highly productive land. However, the Class of the land alone does not determine how fit for purpose those areas are in terms of productive potential and other factors such as soil limitations, climate, access to water, land fragmentation and access to markets can also play an important role. To enable a comprehensive assessment of the proposed urban growth area, this assessment looks at the area available for productive land use, current use and the identification of LUC and soils within this area. The information from this assessment has been used to identify 3 potential land uses that could be grown in the area and a discussion of the barriers to effective availability of productive land use.

3.0 OBJECTIVES

The key objectives of this analysis are:

(i) Review of the context of the productive land within Kākātangiata relative to the local, regional and national situation
(ii) Assessment of the current land and potential land uses within the area
(iii) Barriers to effective availability of land for productive use
(iv) Assessment of the economic value of the land under primary production
(v) Estimation of the employment contribution

4.0 METHODOLOGY

The approach entailed:

(i) An overview of extent and location of highly productive land within Kākātangiata, including a city-council wide, regional and national context.
(ii) Identification of current use/s of land within Kākātangiata.
(iii) Identification of the area of land available for productive use and soil class.
(iv) Identification of versatility of soils for primary production use. (What productive uses could be, recognising limitations in soils and locations). Other than pastoral farming, this will be restricted to 3 main horticultural crops.
(v) Barriers to effective availability of land for productive use (e.g. the effect of existing lot sizes).
(vi) Assessment of the current economic value of the primary production use in this area, including the contribution to local food supply from this area.
(vii) Assessment of the contribution of the area to local primary sector export earnings; and
(viii) Assessment of the primary production employment in this area / level of primary production business / ownership.

5.0 THE KĀKĀTANGITATA AREA

To enable the assessment of the current land use and resources the Kākātangitata urban growth area was split into the relevant land titles using data provided by Palmerston North City Council while land use was assessed visually (by visiting the area) and using aerial imagery over the past five years.

Other data provided was the soil data (soil characteristics) and Land Use Capability (LUC) data. The LUC classification is a system whereby land is categorised into eight classes according to its long-term capability to sustain one or more productive uses[3], as illustrated in Figure 1. The LUC is represented as a number followed by a letter and then another number. The first number is the class of land, whereby one is the most versatile and eight is the least. The letters are the subclass which correspond to the main limitation. This includes w (wetness), s (soil), e (erosion) and c (climate). The final letter is the LUC unit which groups similar landscape units. There are other factors that can make land more or less productive which are not recognised under the LUC system, such as property size, water availability, access to transport routes and appropriate labour markets.

Figure 2: LUC Classification and land use suitability

<table>
<tr><th>LUC Class</th><th>Arable Cropping/Horticulture Suitability</th><th>Pastoral grazing suitability</th><th>Production forestry suitability</th><th>General Suitability</th></tr>
<tr><td>1</td><td rowspan="4">High
↓
Low</td><td rowspan="4">High
↓
Low</td><td rowspan="4">High
↓
Low</td><td rowspan="4">Multiple use land</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="4">Unsuitable</td><td rowspan="3">Pastoral or forestry land</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td rowspan="2">Conservation land</td></tr>
<tr><td>8</td><td>Unsuitable</td><td>Unsuitable</td></tr>
</table>

This system has been used in the proposed national policy statement for highly productive land, whereby land, which is LUC one, two and three, are deemed to be highly productive land which should be preserved for primary production.

Much of the soil and Land Use Capability (LUC) information was sourced from an AgResearch report (2010)[4], while some regional scale soil and LUC data was also used for the area outside of this evaluation. It is worthwhile noting that the AgResearch report further differentiated land based on practicality of drainage.

For this assessment, the total area of the title has been used; it is worth noting that the area of the title is the total area, not the effective area. The effective area has been defined as "area available [for production]; this does not include houses, sheds, tracks, bush, waterways, and steep areas which are not grazed but may include areas sown in crop"[5]. Given that most of the

[3] Land Use Capability Survey Book – a New Zealand handbook for the classification of land 3rd ed. https://wwwuat.landcareresearch.co.nz/__data/assets/pdf_file/0017/50048/luc_handbook.pdf

[4] Manderson, A. K., & Mackay, A. (2010). Evaluation of soils for the PNCC Residential Growth Review. AgResearch, Palmerston North.

[5] MPI. (2016). Feed Use in the NZ Dairy Industry. https://www.mpi.govt.nz/dmsdocument/20897/direct

titles have a house, other infrastructure, and possibly waterways, there is likely to be an over estimation of the agricultural or horticultural productivity on the land.

5.1 Kākātangiata Land Use

The Kākātangitata urban growth area is 842 hectares, of which 816.1 hectares has been identified as individual land titles, with 203 titles in total. The size of these titles' ranges from 0.08 to 74.3 hectares. The remaining 26 hectares are in roading and railway infrastructure, margins, and waterways.

Figure 3: The proposed Kākātangitata urban growth area

Figure 4: Aerial View

The titles were split according to their size to help identify the practicality for agricultural or horticultural productivity. These include:

- 0-1.49 hectares – predominantly houses with large sections but little ability to be productive.
- 1.5-4 hectares – predominantly lifestyle blocks and a threshold for the management of intensive farming land for commercial vegetable cropping under the Horizons Regional Council One Plan [6].
- 4-9.99 hectares – larger properties which could be viable for horticulture operations but still considered lifestyle blocks.
- Over 10 hectares – blocks which could be commercially viable.

The information has been summarised in Table 1 below.

Table 1: Area by Size

Area range (ha)	% Area	Area (ha)	Number of sections
0-1.49	5.2%	42.4	70
1.5-3.99	25.0%	203.9	90
4-9.99	18.5%	151.1	30
>10	51.3%	418.7	13
Total	100%	816.1	203

The titles to 1.49 hectares have no significant agricultural or horticultural production identified, although it was worth noting that some have orchards or a small paddock with some animals. There were no commercial operations identified.

The land titles from 1.5 to 3.99 hectares predominantly have a house and some paddocks with either horses, cattle or sheep which are likely for personal use. Of the 90 titles, one had a small blueberry orchard (0.8ha effective), three titles had maize for either silage or grain and some had vegetables growing in what appeared to be non-commercial operations. There was one title with pumpkins which was 3.7 hectares located next to a larger title also planted in pumpkins.

Of the 30 titles between 4 to 9.99 hectares, most have paddocks with drystock (sheep and cattle) or horses (equine). There were a small number of properties which do not partake in agriculture or horticultural land use, such as a Go-Kart facility (4.5ha) and the Mangaone Stream Reserve (6.8ha). Some of the sections grazed by livestock had historically been in maize, with one 4-hectare block in maize, and two commercial equine operations. One section (5 hectares) was registered as a horticultural operation but has since been subdivided into four properties with drystock. Other commercial operations included Awapuni Nurseries (8.27ha over two titles), a 9-hectare block in pumpkins, and a 4-hectare property with several non-hydroponic glass houses. This operation supplies cut flowers into the domestic flower market. Historically it has grown Asparagus, Nashi pears, Strawberries, Raspberries and Bulbs[7].

[6] Horizons Regional Council One Plan states that **Commercial vegetable growing** means using an area of land greater than 4 ha for producing vegetable crops for human consumption. It includes the whole rotational cycle, being the period of time that is required for the full sequence of crops, including any pasture phase in the rotation. Fruit crops, vegetables that are perennial, dry field peas or beans are not included.

[7] https://palmerstonnorth.century21.co.nz/property/commercial/buy/nz/44/longburn/324749

Of the 13 properties which are 10 hectares and above, the majority are in dairy or dairy support and drystock, with one farm grazing deer. It is worth noting that one dairy farm is 74 hectares, two are around 50 hectares and the rest of the titles are below 30 hectares. Some of these properties appeared to have been run in conjunction with other land titles, while others were not. There is an equestrian centre of 23.5 hectares and two non-productive areas including a lake of 18.6 hectares and the Mangaone Stream Reserve and Palmerston North City Council facilities of 37.8 hectares.

The area by land use is illustrated below.

Table 2: Area by Land use

Land Use	% Area	Area (ha)
Dairy/dairy support	33.8%	275.9
"Non-productive" sections under 4ha	29.1%	237.4
Drystock 4-9.9ha	10.3%	84.3
Drystock >10ha	7.7%	63.0
Equestrian	4.8%	38.8
Maize	2.2%	17.9
Horticulture	1.8%	14.3
Vegetables	1.6%	12.8
Non-effective	8.8%	71.7
Total		816.1

5.2 Soil Types and LUC Class

The Kākātangitata urban growth area consists of three main soil series:

- Manawatu – considered to be the most versatile soils in the region with very few limitations (deep, fertile soils which are well to moderately well drained). These soils would fit the description of a highly productive soil.
- Kairanga - fertile soils which are in swamp or semi-swamp conditions (Recent Gley Soils) due to poor natural drainage and high-water tables. These soils need to be artificially drained to be highly productive.
- Te Arakura – like the Kairanga series but more weathered (Typic Orthic Gley Soils) but with finer texture classes. The AgResearch report also pointed out that much of the silt loams would be difficult to drain due to fall of the land and issues if the drainage system is not maintained (i.e. reliant on neighbouring properties to maintain their drains).

In depth descriptions of these soil series can be found in the AgResearch report. This report was limited to the southern area of the Kākātangitata urban growth area, excluding land to the west of Shirriffs Road, Longburn-Rongotea Road and north of No. 1 Line Longburn., According to S-maps most of the land north of No.1 Line. is Kairanga Silt Loam, with some Te Arakura Silt Loam. This area includes the most properties which are above 10 hectares, therefore has options for further potential productive opportunities.

The report also contained LUC mapping. The main LUC classes identified were 1s1, 1w1, 2s2, 2w2 and 3w1, with smaller amounts of 5w and 6s land predominantly being the stop banks of the Mangaone Stream. Generally, the Class 1 land correlated to be the freely drained

Manawatu soil series, while the Class 2 land was predominantly Kairanga and Te Arakura soils, both which are either imperfectly or poorly drained, resulting in the LUC of 2w2. Based off regional scale mapping, the area to the south of the report boundary is predominantly Manawatu sandy loam and silt loam, which is well drained and is an LUC of 4s2. The 4s2 LUC unit in the Manawatu is deemed to have significant limitations to arable use due to shallow depth, sandy or stony texture seasonal moisture deficit and risk of flooding. This area includes the lake of 18.6 hectares and the Awapuni Resource Recovery Park along with Mt Cleese, all of which are non-productive regarding agricultural or horticultural production given their current use.

The most productive soils are the Manawatu series which is primarily located to the west of the Mangaone Stream south of Pioneer highway and along a narrow band of former stream and spring channels (footnote Page 17 of the AgResearch report). Based off regional scale soil maps and S-maps, the land to the west of Shirriffs Road is predominantly Kairanga Silt Loam, with some Kairanga Fine Sandy Loam closer to Pioneer highway. The area around Anders Road is predominantly Te Arakura silt loam, while above No. 1 line is Kairanga silt loam.

While the AgResearch report identified 96 hectares of Class 1 Land (Manawatu Soils), for this assessment only those land titles that were predominantly Class 1 south of Pioneer Highway were included, as shapefiles were not provided of the AgResearch LUC assessment, and therefore Regional Scale LUC was used. This gave a total area of 38.7ha as being predominantly Class 1. The remaining 57.3ha are titles that have areas of Class 2 or 3 land. Of the Class 1 land identified in the AgResearch report north of Pioneer Highway, along the narrow band of former stream and spring channels, from a visual assessment of the LUC map of Anders Road and Racecourse Growth Options[8] there were 3-4 titles that were predominantly Class 1 that were less than 4-hectare lifestyle properties. The remaining Class 1 land has areas of Class 2 or 3 land throughout the title.

Of the 38.7 ha of Class 1 land, there are no blocks above 10 hectares which would be deemed productive for food production. There was an 11-hectare block which is a petting zoo (defined as livestock with considerable infrastructure), and an equestrian centre of 23.5 hectares (considerable infrastructure). There are two blocks between 5 and 9.99 hectares on this land which are involved with equine operations, while the rest of the properties are below 5 hectares. The five largest properties in this range are 3 hectares, of which three were in Maize, one in livestock and one equine. The rest of the properties are below 1.8 hectares consisting of a mixture of livestock, equine, and houses below 0.5 hectares.

There is a very small amount of class one land (1.3 hectares) to the west of Shirriffs road which is currently in pumpkins. The section itself it 8.9 hectares, although not all of this was in pumpkins. Furthermore, the rest of this section is in Kairanga silt loam which is poorly drained and may cause issues such as higher risk for disease and delay sowing dates etc. There are no major blocks along the Mangaone Stream or along the narrow band of former stream and spring channels, of which most of the surrounding property area in Kairanga or Te Arakura soils.

[8] Page 34, Manderson, A. K., & Mackay, A. (2010). Evaluation of soils for the PNCC Residential Growth Review. AgResearch, Palmerston North

The makeup of the Manawatu soils, or Class 1 land, is given below whereby most of the section are Manawatu soils or LUC 1w1 or 1s1 land.

Table 3: Land size on Manawatu soils/LUC 1

Range (ha)	Area (ha)	% Total	# of Properties
0-1.49	5.1	13.1%	9
1.5-3.99	18.3	47.3%	7
4-9.99	15.3	39.6%	2
>10	0	0.0%	0
TOTAL	38.7	100%	18

The land use of the Manawatu soils or Class 1 land is given below, as both a percentage of the total area and area of each enterprise.

Table 4: Land type on Manawatu soils/LUC 1

Enterprise	%	Area
Dairy	0.0%	0.0
Drystock >10ha	0.0%	0.0
Drystock 4-9.9ha	0.0%	0.0
Drystock <4ha	17.5%	6.8
Horticulture	0.0%	0.0
Vegetables	0.0%	0.0
Maize	23.3%	9.0
Equestrian	55.1%	21.3
Non-effective	0.0%	0.0
Houses	4.1%	1.6
TOTAL	100%	38.7

All other land which is on the Te Arakura and Kairanga soil series is deemed to be LUC 2w2 which is a soil with a wetness limitation. The only other LUC land are some parts of the Mangaone Stream (LUC 6s, stop bank which is predominantly owned by Palmerston North City Council or Horizons) and the class 4s2 land (Refer Figure 5)

Figure 5: Kakatangiata LUC map

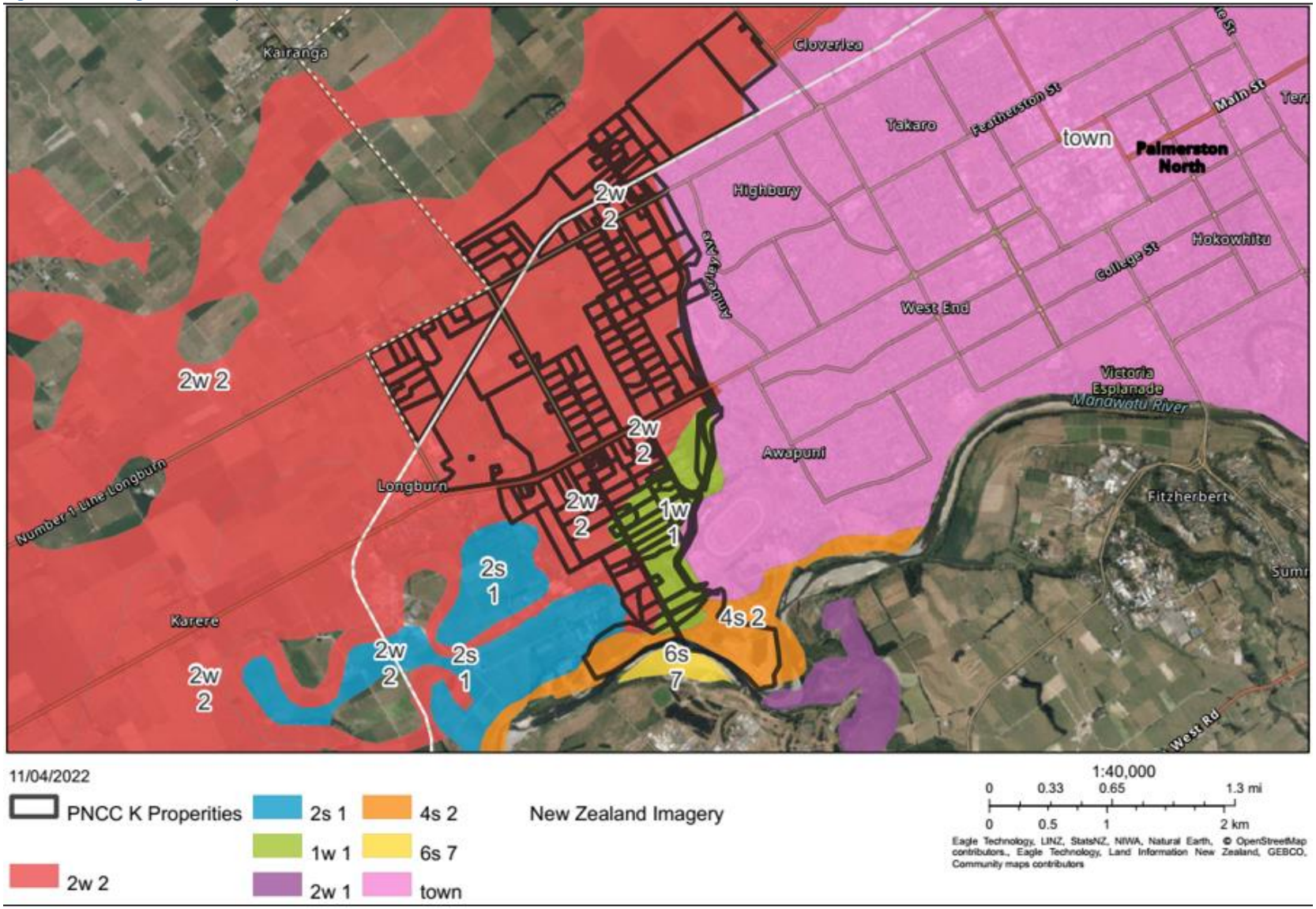
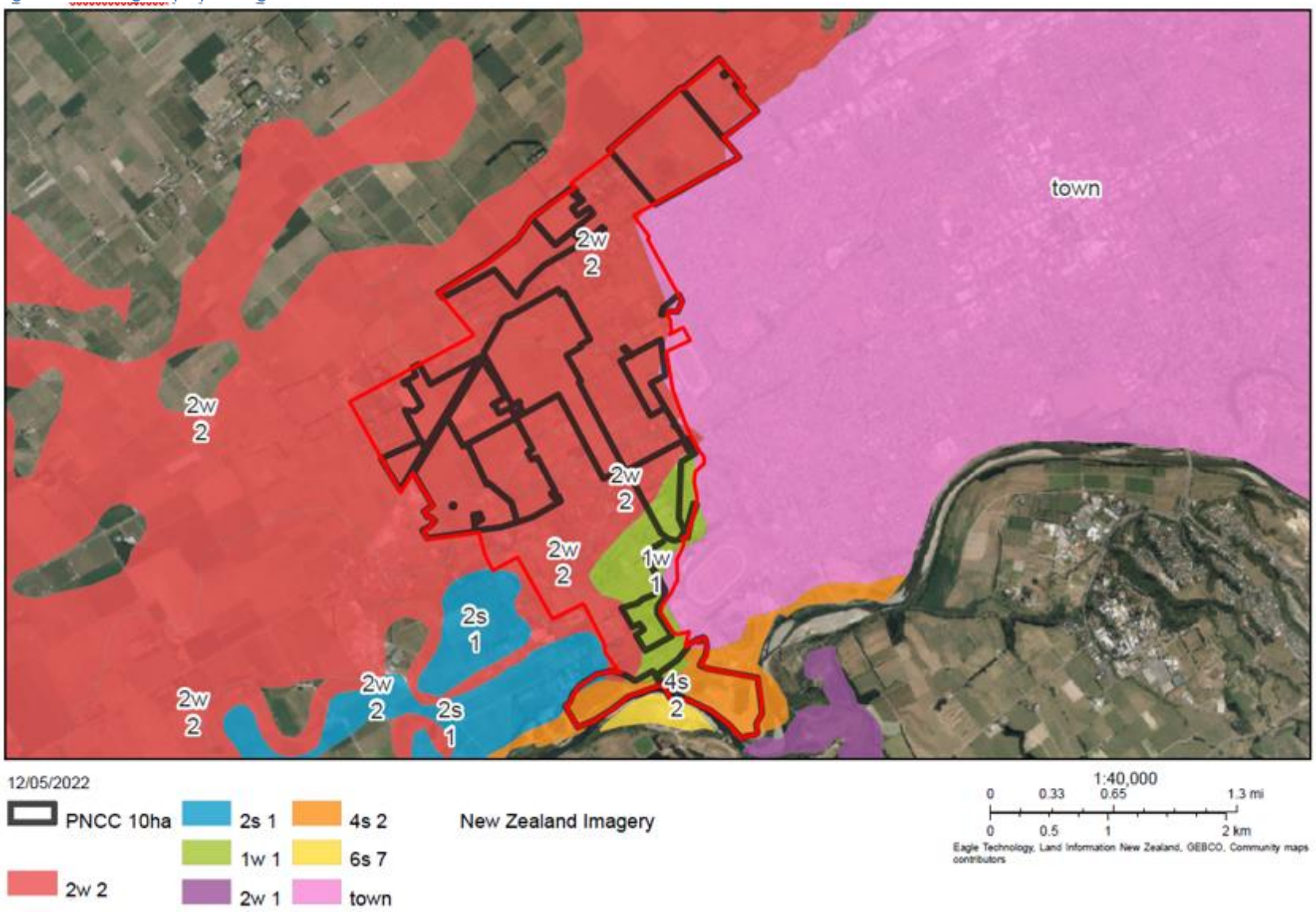


Figure 6: Kakatangiata properties greater than 10ha



The regional scale LUC and soil mapping had a similar trend, with predominantly Kairanga silt loam with smaller amounts of Te Arakura silt loam. As stated in the Land Use Capability Classification of the Taranaki-Manawatu Region (1987)[9] this land must have subsurface drainage, shelter from the wind and good water (irrigation) in order to have permanent horticultural operations, while intensive dairy farming requires standoff areas to reduce pugging over the winter months.

Much of the land, especially the larger land titles (refer Figure 6), which is LUC 2w2 in the AgResearch report is scattered with patches of LUC 3w1, which are defined to be inundated by water for one to three days per year, and are therefore not suited to permanent horticultural crops, although barley, wheat, grass seed, maize and root or green fodder crops can be grown if the ponding risk is accepted[10]. Class 3 land is not considered highly productive, and it is worth noting that a lot of the properties on 2w2 have patches of 3w1.

As the LUC mapping outside of the AgResearch report is based off mapping at a regional scale, it is possible that the trend of LUC 3w1 patches amongst the 2w2 land would be throughout much of this land. From visual inspection it appeared that some paddocks were pugged, which would support this concept.

Overall, the majority of the soils in the Kākātangitata area are 2w2, which is still considered to be highly productive land. There is a smaller amount of class one land near the Manawatu River and a very small historic riverbed which would be some of the best soils in the region and have few limitations. Much of the 2w2 land mapped by AgResearch had patches of 3w1 which were identified to be challenging to drain and could create higher risk when looking at a higher end land use such as intensive horticulture or vegetable growing.

Of the land surveyed, most was subdivided into smaller sections which limits the economies of scale for operations. Furthermore, there were few sections which were actually in horticulture operations, with only two being in pumpkins located on Manawatu and Kairanga soils. Most sections were lifestyle blocks and there did not appear to be any irrigation on most of the sections which would be required for a conversion to a permanent horticultural operation.

Finally, the survey area was based on total area, not effective area meaning that much of this land would be restricted for agricultural or horticultural purposes as there is existing infrastructure such as buildings on the properties.

Table 5: Areas in Class 1 & 2 Soils (ha)

	PNCC*	Horizons	New Zealand
Class 1	5,286	33,940	187,171
Class 2		171,531	1,202,811

*Total area is 9,044ha including the city[11]

[9] Pg. 75-84 Fletcher, J. R. 1987. Land Use Classification of the Taranaki-Manawatu Region: A bulletin to accompany the New Zealand Land Resource Inventory Worksheets. Water and soil miscellaneous publication No. 110. Land Resource Group, Ministry of Works and Development, Wellington.

[10] Ibid

[11] https://www.horizons.govt.nz/HRC/media/Media/One%20Plan%20Documents/S42A-Report-by-John-Maassen-Regarding-Versitale-Soils-Infrastructure-Energy-and-Waste.pdf?ext=.pdf

As can be seen from Table 5, Class 1 and 2 soils in the PNCC make up 2.6% of the land within the Horizons Regional Council region, and 0.4% of the total New Zealand area.

6.0 KEY ANALYSIS ASSUMPTIONS

The analysis very largely compares the economic returns from the current land use, relative to what might be considered "highest and best use" if the productive potential of the land was realised.

For the purposes of this analysis therefore, the following assumptions were made, based on the land use as outlined in Table 2:

6.1 Current Land Use

(i) "Non-productive" sections under 4ha. This area (237.4ha) is very largely developed as lifestyle blocks. While these can be productive in the sense that they often run some livestock for household consumption, they cannot be considered as commercial units. For the purposes of the analysis, 50% of the gross margin for sheep & beef farming was ascribed to this area.

(ii) Dairy/dairy support (275.9ha) was assumed to be in dairying.

(iii) The drystock (4-9.9ha) and drystock (>10ha) were ascribed the sheep & beef gross margin.

(iv) Equestrian. There is no financial data available on equestrian enterprises, so this area was ascribed the "dairying" gross margin.

(v) Horticulture. There is no information readily available on glasshouse operations, flowers, or the other minor crops currently grown. For the purposes of the analysis, the "potato" gross margin (being the highest) was ascribed to this area.

(vi) Maize/vegetables – the relevant Gross margins are applied to these, with vegetables split into squash[12] and potatoes.

(vii) The "non-effective" area was ignored.

6.2 Future Land Use

The key question here is the likelihood of the land being developed into a higher-productive use. For the 38.7ha of Class 1 land, the assumption was that this would develop into a combination of maize, pumpkins, and potatoes. The current area in these crops is 45ha, so the larger figure was used.

The issue is to the degree that the remaining Class 2 land would be developed. While classified as a highly productive soil, it has issues with wetness, and it depends as to whether much of this land was drained and then converted into a higher-productive horticultural use. While individual blocks could be drained, they then need a discharge point off the block. Which means that any drainage effort would need to be coordinated across a large area.

[12] Some of the crops were pumpkins rather than squash, but inasmuch as the current GM for pumpkins is negative, the assumption was to use the squash GM, given it is positive.

Similarly, any significant expansion of permanent horticulture would require irrigation, especially in light of the anticipated drier summers under climate change. Assuming water is available for this purpose, a significant capital expenditure would be required, which would slow any horticultural development.

Which means that any large-scale expansion into horticulture falls into the "not very probable but not impossible" category.

Any "higher and better" use of the land would also require a gross margin (GM) higher than dairying (at $5,216/ha – Table 6 below). In this sense the only proposed vegetable GM with a higher GM is potatoes. Other possibilities could include blueberries (at a GM of $8,600/ha, if grown undercover, they are normally planted in substrate and therefore, soil type is irrelevant).

Another possibility is nut-tree crops, which could be grown on the soils in question (although again drainage would definitely assist this). An example of this is Chestnuts, with a current GM of $9,285/ha (sold on a "nut in shell" basis)[13]. The issue with nut crops is there is no real supply chain in place with respect to processing/storage/marketing, so large scale develop is likely to take some time as the accompanying infrastructure/value chain is developed in tandem. In noting this, there is significant potential in further processing of chestnuts into such products as baby formula, flour, and confectionary.

In this respect, the "higher and better" use for this analysis is assumed to be in potatoes and chestnuts.

The Future analysis is therefore based on:

- No change in the "non-productive blocks"; and
- The 38.7ha of Class 1 land converted into potatoes.

Of the remaining (Class 2) land, 3 scenarios were analysed:

1. All the dairy/drystock/equestrian land is converted to dairying
2. Half of the remaining land is converted to dairying, half to horticulture with the crops split 50:50 between potatoes and chestnuts.
3. All the remaining land is converted to horticulture, at again a 50:50 split between potatoes and chestnuts.

These are somewhat contrived, as, for example, the drystock blocks of 4-9.9ha are again unlikely to convert (being too small), although they potentially could lease land out to a larger operation. The analysis therefore could be considered "best case".

[13] The capital cost of establishing chestnuts is circa $35,000/ha, and it takes 10 years to reach full production.

6.3 Gross Margins

The financial analysis is based on gross margins – Gross Farm Revenue less direct operating costs. These were derived from several sources:

Table 6: Gross Margins

	GM ($/Ha)	Source
Dairy	$5,216	3-year average Lower North Island, Dairy NZ Economic Survey 2018-2020
Sheep & Beef	$1,453	3-year average Western North Island Class 5, Beef+ Lamb NZ Economic Service, 2018-2020
Maize Silage*	$2,232	Corson Maize 2021
Maize Grain*	$2,343	
Squash	$1,206	Growers, Lincoln Budget Manual
Potatoes	$8,822	Growers, Lincoln Budget Manual
Chestnuts	$9,285	Fruition Horticulture

*The 2017 Agricultural Census shows 199ha of maize silage grown in PNCC, and 55ha of maize grain. This relative proportion of each was used in the analysis.

7.0 RESULTS

A summary of the results shows the agricultural output, in $ terms: (Detail in Appendix 1)

Table 7: Sum of Agricultural Output

Current Land Use	$2,210,136	Difference from Current
Future Land Use#1	$2,980,774	$770,638
Future Land Use#2	$3,866,837	$1,656,701
Future Land Use#3	$4,753,184	$2,543,048

8.0 KĀKĀTANGITATA PROPORTIONAL PRODUCTION

Analysis of the 2017 Agricultural census data shows:

Table 8: Proportion of Crops Grown

	PNCC (ha)	Horizons (ha)	PNCC as a %	NZ (ha)	PNCC as a %
Broccoli	26	394	6.6%	2,082	1.2%
Cabbage	22	137	16.1%	804	2.7%
Cauliflower	84	164	51.2%	746	11.3%
Lettuce	81	315	25.7%	1,532	5.3%
Peas	27	358	7.5%	10,113	0.3%
Pumpkin	25	135	18.5%	1,158	2.2%
Squash	4	6	66.7%	5,794	0.1%
Sweet corn	18	25	72.0%	3,871	0.5%
Potatoes	0	984	0.0%	9,450	0.0%
Maize	254	32,630	0.8%	58,727	0.4%
Total vegetables	322	2,594	12.4%	35,179	0.9%
Total Horticulture	6	382	1.6%	67,219	0.01%

There are no statistics available below a Territorial Authority level. The areas for Kākātangiata shown in Table 2 shows a total area in maize/horticulture/vegetables of 45 hectares. This is equivalent of 7.7% of the PNCC area in 2017, 0.13% of the Horizons' area, and 0.03% of the New Zealand area.

Under the assumption for "Future Land Use#3" the total potential area within Kākātangiata of horticulture/vegetables rises to 507 hectares, which would make up 46% of the area within the PNCC area, assuming the current area within PNCC, but outside of Kākātangiata, remains constant.

Assuming that the extra food is grown for local consumption, the increased area would make a substantial contribution to this. It is difficult to be too precise however, given vegetable crops are readily transported around New Zealand depending on supply and demand requirements. Furthermore, the increased area would represent a 0.7% increase at a national level, assuming the current area remains constant. On the assumption that some of the area would be developed into chestnuts, and further processed, it would be likely that much of the product would be exported.

9.0 BARRIERS TO LAND USE CHANGE

There are a range of factors which influence land use change. This has been described in detail by Journeaux et al (2017)[14]. A summary of some of the key factors are:

(i) Biophysical
- Soil type and soil characteristics
- Topography, particularly slope
- Climate
- Water – availability for irrigation, impact of land use system on water quality

(ii) Economic
- Relative profitability of the land use
- Access to capital
- Infrastructure
- Markets
- Access to information
- Access to skilled labour
- Land tenure

(iii) Technological change, which often impacts via improving profitability.

(iv) Societal pressures and "license to farm". This is usually manifested in regulations affecting the sector, e.g. around animal welfare, food safety, human welfare, and environmental impacts.

(v) Personal factors. This covers the wide range of difference in individuals which may affect their thinking around land use change. It would include aspects such as age, education and experience, family circumstances, attitude to risk, access to capital, access to information, and attitude to change.

All of these factors interact as an amalgam as drivers and/or barriers for land use; they all interact in different ways and usually never in the same combination. Overall, the research shows that economic factors are often the most powerful in driving land use change decisions.

Personal preference usually relates to the use the land would be put to. For the Kākātangiata area, this could work somewhat in reverse, in that, given 29% of the area is already in lifestyle blocks, the locals may not want to see a conversion of land use resulting in increased noise, dust, spray, heavy machinery moving about etc., which have various rules around under the Horizon One Plan, as discussed below.

For the Kākātangiata area, while the soils are classified as high quality, most of the area not already subdivided into lifestyle blocks, classified as Class 2 soils, have an issue with wetness and would need to be drained in order to fully utilise them in a horticultural sense. Similarly, while Chestnuts have been used to illustrate a "higher and better" land use, the probability of such a crop being grown is slim, until a wider supply chain network is developed. Many

[14] Journeaux, P., van Reenen, E., Manjala, T., Pike, S., Hanmore, I., Millar, S. Analysis of Drivers and Barriers to Land Use Change. https://www.mpi.govt.nz/dmsdocument/23056-ANALYSIS-OF-DRIVERS-AND-BARRIERS-TO-LAND-USE-CHANGE

horticultural crops are also higher risk operations, involving significant capital expenditure, and requiring access to significant labour pools, particularly for harvest. There are also environmental issues, particularly nutrient and soil run-off involved in intensive vegetable production.

9.1 Environmental Legislation

Under the Horizons Regional Council One Plan, conversion to certain intensive land use activities requires consent due to the potential impacts on groundwater and surface water quality. Intensive land use under the One Plan is defined as:

- Dairy Farming
  means using any area of land greater than 4 ha for the farming of dairy cattle for milk production. This includes land used as a dairy cattle grazing runoff but excludes any dairy grazing arrangement. A dairy grazing arrangement is a third-party commercial arrangement between the owner of dairy cattle and another landowner for the purpose of temporary grazing.

- Commercial vegetable growing
  means using an area of land greater than 4 ha for producing vegetable crops for human consumption. It includes the whole rotational cycle, being the period of time that is required for the full sequence of crops, including any pasture phase in the rotation. Fruit crops, vegetables that are perennial, dry field peas or beans are not included.

- Cropping
  means using an area of land in excess of 20 ha to grow crops. A "crop" is defined as cereal, coarse grains, oilseed, peanuts, lupins, dry field peas or dry field beans. This definition does not include crops fed to animals or grazed on by animals on the same property.

- Intensive sheep and beef farming
  refers to properties greater than 4 ha engaged in the farming of sheep and cattle, where any of the land grazed is irrigated.

No consents have been processed for Vegetable growing or Cropping under the One Plan to date due to the complexities with consenting these activities under the current regulatory approach. Furthermore, the consent framework for these intensive land use activities is based on nitrogen discharge numbers based on Overseer. Since the Central Government report on Overseer in August 2021, Horizons has been reassessing this approach. For now, this is likely to be a barrier to converting land to the intensive land uses identified. For the land uses modelled in the future analysis, consent would be required for conversion to potatoes and conversion of dry stock/equine land to dairy.

At a paddock scale there are also rules under the One Plan regarding discharge of effluent, cultivation, fertiliser use, spraying and odour which may impact on the available land to use "intensively" and/or make compliance with some of these rules difficult due to the smaller sections, proximity of neighbours and sensitivity of the receiving environment to certain agricultural activities.

Furthermore, the Resource Management (National Environmental Standards for Freshwater) Regulations 2020, places restrictions on conversion of dairy farm, dairy support or irrigated dairy land greater than 10 hectares as of 2 September 2020. Consent is required beyond this, where it must be proved that the conversion will not cause a greater effect on the environment than the previous use.

9.2 Economic Units

Possibly the biggest hindrance to further development within the area is that many of the blocks are relatively small, which significantly complicates the development of economic units; either significant capital expenditure is required to amalgamate blocks, which in most cases would not be economic, or there is significant administrative and logistical work required if a number of blocks are to be leased.

Overall, significant development into higher value crops would be considered as not very probable, but at the same time not necessarily impossible; the most likely future land use would be similar to the current one – the larger areas remain in pastoral production, with some smaller areas of cropping/horticulture.

10.0 ESTIMATE OF EMPLOYMENT IMPACT

The objectives for the study included an estimate of likely employment effects of developing the land into the assumed "higher and better uses". To carry out this analysis would require a detailed investigation using input/output multipliers which is outside of the scope of this study, notwithstanding that the multipliers at a territorial authority level are not readily available.

To give an indication of likely employment impacts, the national-level multipliers based on the 2016 census have been used, as discussed below.

The multiplier effect is where a change in spending in one area of the economy stimulates a change in spending in other areas. In the current analysis, it is assumed that the land is converted into more profitable uses, thereby generating more money which is spent by the landowners. In turn this means that the companies and contractors providing the materials and services to the new enterprises spend the money on replacing inputs such as the materials used and wages, with the workers in turn spending money on further services they need, and so on (Journeaux et al 2019)[15].

This accords with economic theory which states that if there is an increase in final demand for a particular product (or service), it can be assumed that there will be an increase in the output of that product, as producers react to meet the increased demand: in economic jargon, this is the 'direct effect'. As these producers increase their output, there will also be an increase in demand on their suppliers and so on down the supply chain: this is the 'indirect effect' (i.e. Type I multipliers). As a result of the direct and indirect effects the level of household income throughout the economy will increase as a result of increased employment. A proportion of

[15] Journeaux PR, Wilton J, Archer L, Ford S, McDonald G. 2019. The Value of Nitrogen Fertiliser to the New Zealand Economy. https://www.fertiliser.org.nz/site/research/projects/the-value-of-nitrogen-fertiliser-to-the-new-zealand-economy.aspx

this increased income will be re-spent on final goods and services: this is the 'induced effect' (i.e. Type II multipliers) (Butcher, 1985)[16].

In addition, there are both forward and backward linkages: backward relate to the services each industry buys in to provide their goods, while forward linkages relate to the processing/manufacturing process through to the wharf.

The multiplier effect also depends on whether the expenditure is (a) permanent, and (b) new; both of these are assumed in the example below, noting that there is a netting-off effect in that the horticulture expenditure increases, whereas the dairy expenditure decreases.

Table 9: Multipliers (based on 2016 Census) per $ million Change

		Horticulture and fruit growing	Dairy cattle farming
Employment: Gross Output Ratio (MECs/$m)		9.25	4.54
Employment: Backward linkage multipliers	Type I	1.57	1.98
	Type II	1.58	2.00

Based on the above figures, the estimate of increased employment is:

Table 10: Increased Employment

	Future#1	Future#2	Future#3
FTEs	38.6	32.2	49.4

Note that in the Future#1 scenario, both horticulture and dairying increase, in the Future#2 scenario horticulture increases while dairying decreases, and in the Future#3 scenario horticulture is dominant with no dairying. The estimates are made relative to the base (current) land use.

[16] Butcher GV. 1985. *Regional Income output and employment multipliers: Their uses and estimates of them. Cost Benefit Handbook, Volume Four*. A commissioned study for the Economics Division, Ministry of Agriculture and Fisheries, 1985

11.0 APPENDIX ONE: AGRICULTURAL OUTPUT ANALYSIS

Current Land Use			
	ha	GM	Total
Dairy	314.7	$5,216	$1,641,633
Drystock	147.3	$1,453	$214,047
Non-Productive	237.4	$727	$172,483
Maize Grain	3.9	$2,343	$9,063
Maize Silage	14.0	$2,232	$31,239
Squash	12.8	$1,206	$15,436
Potatoes	14.3	$8,822	$126,234
Total	744.4		$2,210,136
Non-Effective	71.7		
Total Land Area	816.1		

Future#1				Future#2				Future#3			
	ha	GM	Total		ha	GM	Total		ha	GM	Total
Dairy	462.0	$5,216	$2,410,024	Dairy	231.0	$5,216	$1,205,012	Non-Productive	237.4	$727	$172,483
Non-Productive	237.4	726.5	$172,483	Non-Productive	237.4	$727	$172,483	Potatoes Class 1	38.7	$8,822	$341,411
Potatoes Class 1	38.7	$8,822	$341,411	Potatoes Class 1	38.7	$8,822	$341,411	Potatoes Class 2	234.2	$8,822	$2,065,671
Potatoes Class 2	3.14	$8,822	$27,701	Potatoes Class 2	118.7	$8,822	$1,046,730	Chestnuts	234.1	$9,285	$2,173,619
Chestnuts	3.14	$9,285	$29,155	Chestnuts	118.6	$9,285	$1,101,201				
Total	744.4		$2,980,774		744.4		$3,866,837		744.4		$4,753,184

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