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LAND USE CAPABILITY AND SOIL ASSESSMENT – CONSTABLE RD, WAIUKU

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SUMMARY

A 29 ha site on Constable Road near the township of Waiuku, was assessed for its Land Use Capability (LUC) and soil characteristics. The site was mainly flat to undulating with rolling sides which dipped down toward Constable Road in the south and toward a creek in the northwest. The site had been used as a drystock farm for many years.

The LUC assessment showed the land was predominantly LUC class 2 land. The remainder was mainly LUC class 3 or steeper LUC class 4 or 6 land. The land was a mixture of well and poorly drained soils and flat to rolling slopes.

The soils were Allophanic (Karaka silt loam), Organic (Ake Aka peat), Gley (Whatapaka clay loam) and Brown soils (Te Hihi clay loam).

There was no Elite land at the site. Well drained and moderately well drained Allophanic soils were Prime land as defined by the Auckland Council Unitary Plan. Prime land covered 46.3 % of the site. Soils that were imperfectly or poorly drained (Mottled Orthic Allophanic soils, Organic & Gley soils), or on strongly rolling to steep slopes (some Allophanic soils, Brown soils) were not Prime land. These areas were 47.9 % of the site. The remaining area was non-productive land such as tracks and building. Non-productive land was 5.8 % of the area.

INTRODUCTION

An onsite soil and land assessment of was undertaken to assess the area of Elite and Prime land within an approximately 29 hectare site along Constable Road near the western boundary of Waiuku township (Figures 1 & 2).

The site was in two lots (92 & 130 Constable Road, Figure 2) and mainly flat to undulating land. The land has a section of rolling slopes in the south and northwest. These slopes extend down to Constable Road, and those in the northwest slope toward a creek. The site was a drystock farm and has been used for that purpose for many years.

The site had formed from ancient pumiceous alluvium covered in ash and loess. Peat occurred in some low parts that were former swamps.

To help guide land use decisions, Auckland Council requires a detailed Land Use Capability (LUC) report. LUC Class 1 land is the most versatile, multiple use land on flat to undulating slopes. Classes 2 and 3 are also very good agricultural and horticultural land with slight (Class 2) or moderate (Class 3) physical limitations to arable use. For the purposes of this investigation, LUC Class 1 land would be defined as 'elite'. LUC Class 2 and 3 land that was well or moderately well drained was defined as 'prime' land. These criteria were in accordance with the Auckland Unitary Plan definitions for elite and prime land (October 2019).

Natural Knowledge Ltd was commissioned to provide a LUC and soil assessment of the site. The site was inspected and assessed by Dr Peter Singleton in early September 2020. Dr Singleton has over 35 years experience mapping land for LUC and soil assessments.



Figure 1. Location of the site (in yellow) on Constable Road, Waiuku.

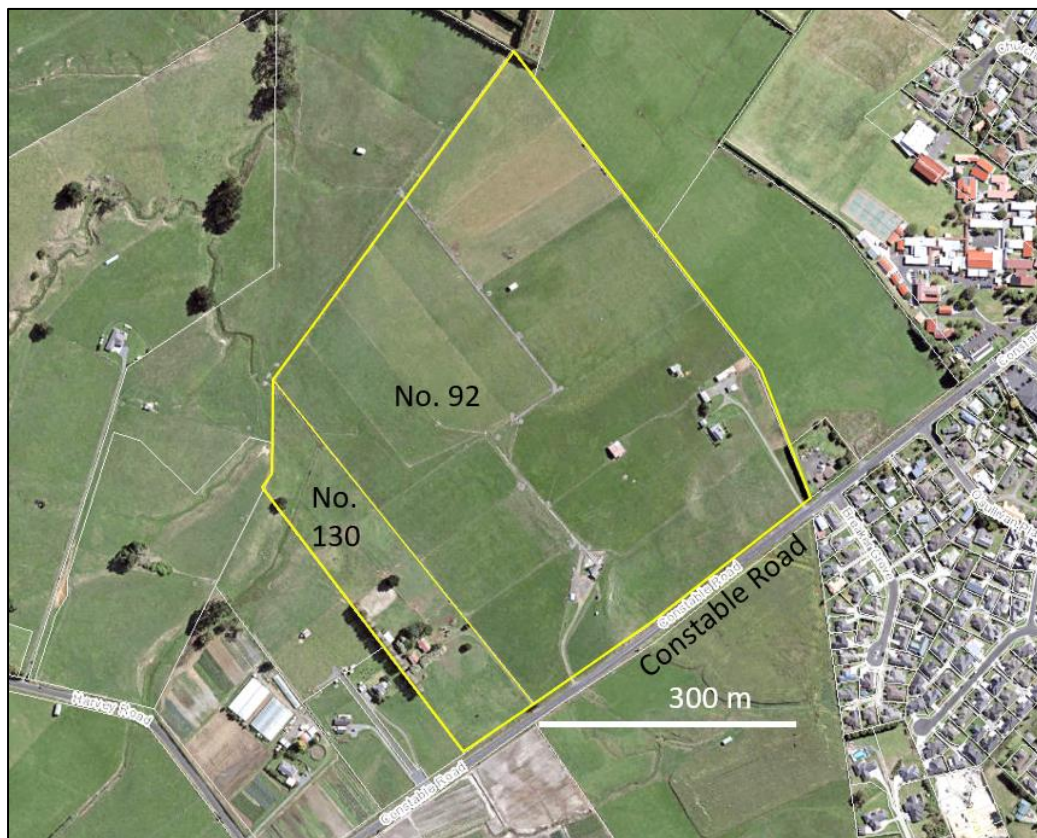


Figure 2. The site and its position on the western boundary of Waiuku.

METHODS

Land Use Capability Assessment was carried out using methods based on the national land classification system used by soil conservators for farm planning since the 1950s. To assist land use capability classification of the soils, landform boundaries were mapped. Underlying geology, surface soil, and other relevant physical features - slope, site wetness, and erosion or deposition (if any) - were noted for each landform i.e. standard procedure as described in the Land Use Capability Survey Handbook. A detailed description of the system can be obtained from the Land Use Capability Survey Handbook, 3rd edition (Lynn *et al.*, 2009).

LUC Class 1 land is the most versatile, multiple use land on flat to undulating slopes. Classes 2 and 3 are also very good agricultural and horticultural land with slight (Class 2) or moderate (Class 3) physical limitations to arable use. For the purposes of this investigation, LUC classes are defined as 'elite' or 'prime' in accordance with the Auckland Council Regional Policy Statement definitions (October 2019).

The LUC classes were correlated with Auckland Councils farm-scale land use capability classification for Auckland (Hicks & Vujcich, 2017).

The soil survey and assessment was based on standard soil survey methods and the Soil Description Handbook (Milne *et al.*, revised edition 1995). General observations and twenty-five detailed soil borings were made and described using standard soil description methods. Photographs of the soils and landscape were taken, and locations of detailed soil observations were recorded by GPS. Soil were classified according to the New Zealand Soil Classification (Hewett, 2010)

Other resource information used included 1:250,000 geological map of Auckland (Schofield 1973), Soils of part Franklin County, South Auckland (Orbell 1977) and Landcare Research's online S-Map.

LAND USE CAPABILITY ASSESSMENT

Land Use Capability (LUC) assesses an area's capacity for sustained productive use, considering physical limitations, soil type, management requirements and soil conservation needs.

A Land Use Capability assessment is a systematic arrangement of the different types of land according to those properties that affect its capacity for long term and sustained production. It is a system that primarily assesses the land for arable (cropping) use.

The LUC assessment identifies areas with similar rock type, soil, slope, erosion types and degree and vegetation cover. Where any one of these factors changes significantly a boundary is drawn and a new map unit created. Based on this physical inventory, together with an understanding of climate an assessment is made of each unit's capacity for long term sustained use. Thus, the property is completely covered by mapped units which identify areas having similar physical attributes.

The LUC class is the broadest grouping in the classification, identifying the general degree of limitation to arable use. It comprises eight classes. Formerly represented as classes I to VIII and now superseded by a recent change in nomenclature to numerals 1 to 8. Classes 1 to 4 are classified on their suitability for cultivation, with Class 1 being the most versatile with few

limitations to use, through to LUC class 4 which has limitations so severe it is marginal for cultivation for cropping. Classes 5 to 7 are not suitable for cropping but are suitable for non-cropping uses such as pastoral farming, tree crops or forestry. Physical limitations increase from LUC class 5 to 7. LUC class 8 has such severe physical limitations it is not suited for any commercial farming system and is considered suitable only for retirement and protection use.

LUC MAPPING UNITS AT THE SITE

The LUC mapping for the site followed the methods of the Land Use Capability Survey Handbook (Lynn et al, 2009). The Land Use Capability (LUC) mapped units were correlated with those in the New Zealand Land Resource Inventory (NZLRI), Waikato Region Land Use Capability Classification (Ministry of Works and Development- Jessen et al 1984). This national survey was undertaken to provide standards for LUC mapping. It was carried out at the 1:63360 scale with 10 regional classifications covering the North Island and one for the South Island. The Waikato Region NZLRI extends from Papakura to the southern boundary of the Mokau River and from the west coast eastwards to the Coromandel Peninsula and Kaimai Ranges. Descriptive bulletins were prepared for most regions, but not for the Waikato. The definitions for the regional LUC units can be found in the 'Waikato Region: Land Use Capability Extended Legend'.

For this property, the relevant LUC units in the locality have been identified (from the NZLRI) and where possible have been used for the map of the site. The site was located on mainly flat to undulating land. This composed the bulk of the site (79 %). This flat to undulating land (0-7 degree slopes) was in pasture and included several soil types and a range of drainage classes. The remainder of the area was mainly rolling and strongly rolling land and also in pasture. Rolling slopes (8 to 15 degrees slopes) occurred along the western part of Constable Road and in the north west where they sloped down toward flatland and a creek. The eastern part of Constable Road was steeper and strongly rolling (16 to 20 degree slopes) with a small area of steep slope (21 degrees or steeper).

The site contained LUC class 2 to 6 land.

LUC CLASS 2

LUC Class 2 (43 %) land occurred on the tops and edges of the higher ground, or on lower flat land. The separate units within the class were based on drainage and slope.

LUC unit 2s4 land was well drained and occurred on flat to gently undulating (0 to 3 degrees, Figure 3) higher ground which had Karaka soils from ash and loess on ancient alluvium. Undulating slopes (4 to 7 degrees) with Karaka soils were LUC class 2e4 and a mixture of well or moderately well drainage classes. Both these LUC units were friable soils with nil to negligible erosion hazard when cultivated.

LUC class 2w3 land was imperfectly drained Karaka mottled soils or Te Hihi soils, or poorly drained Whatapaka soils. These were all on lower flat to undulating slopes (0 to 7 degrees). Class 2w3 occurred in wet locations and had a continuing slight wetness limitation even after drainage.

OTHER LUC CLASSES

Class 3 land (28.9 %) occurred mainly on the rolling hill sides and there were also some wetter areas that were also class 3. Steeper sections of slopes were class 4 and some were class 6 (3.2 %). Land in buildings, farm tracks and creek were all unsuitable for agricultural production (5.8 %).

LUC class 3e5 land (Figure 4) was Karaka soil on rolling slopes and has a slight to moderate sheet and rill erosion hazard when cultivated. LUC class 3w2 land (Figure 5) was Aka Aka peat and occurred in wet low areas with a moderately high water table and poor internal drainage. Any crops are limited by soil wetness and this can delay planting and harvesting.

LUC class 4e5 land was Karaka soils that occurred on strongly rolling slopes (16 to 20 degrees). This land has a moderate to severe erosion hazard when cultivated. Class 6e land was on steep slopes and was unsuitable for cultivation.

Table 1 correlates LUC classes with Auckland Council Farm LUC units. Figure 6 shows the LUC classes for the site.

Table 1. Correlation with Waikato (South Auckland) LUC units and Farm LUC units.

| Soil type | Waikato LUC | Farm LUC | Features |
|----------------|-------------|----------|--|
| Karaka | 2s4 | 1c | Flat to gently undulating slopes |
| Karaka | 2e4 | 2c | Undulating slopes |
| Whatapaka | 2w3 | 2w | Poorly drained flat to gently undulating slopes |
| Karaka mottled | 2w3 | 2w | Imperfectly drained flat to gently undulating slopes |
| Te Hihi | 2w3 | 2w | slopes |
| Karaka | 3e5 | 3 c+t | Rolling slopes |
| Aka Aka | 3w2 | 3a | Poorly drained flat to gently undulating slopes |
| Karaka | 4e5 | 4 c+t | Strongly rolling slopes |
| Te Hihi | 6e | 6t | Steep slopes |



Figure 3. LUC Class 2s4 land looking north.



Figure 4. A mixture of LUC classes at the base of rolling slopes in the northeast corner of the site.



Figure 5. LUC Class 2 and 3 land looking south toward Constable Road.

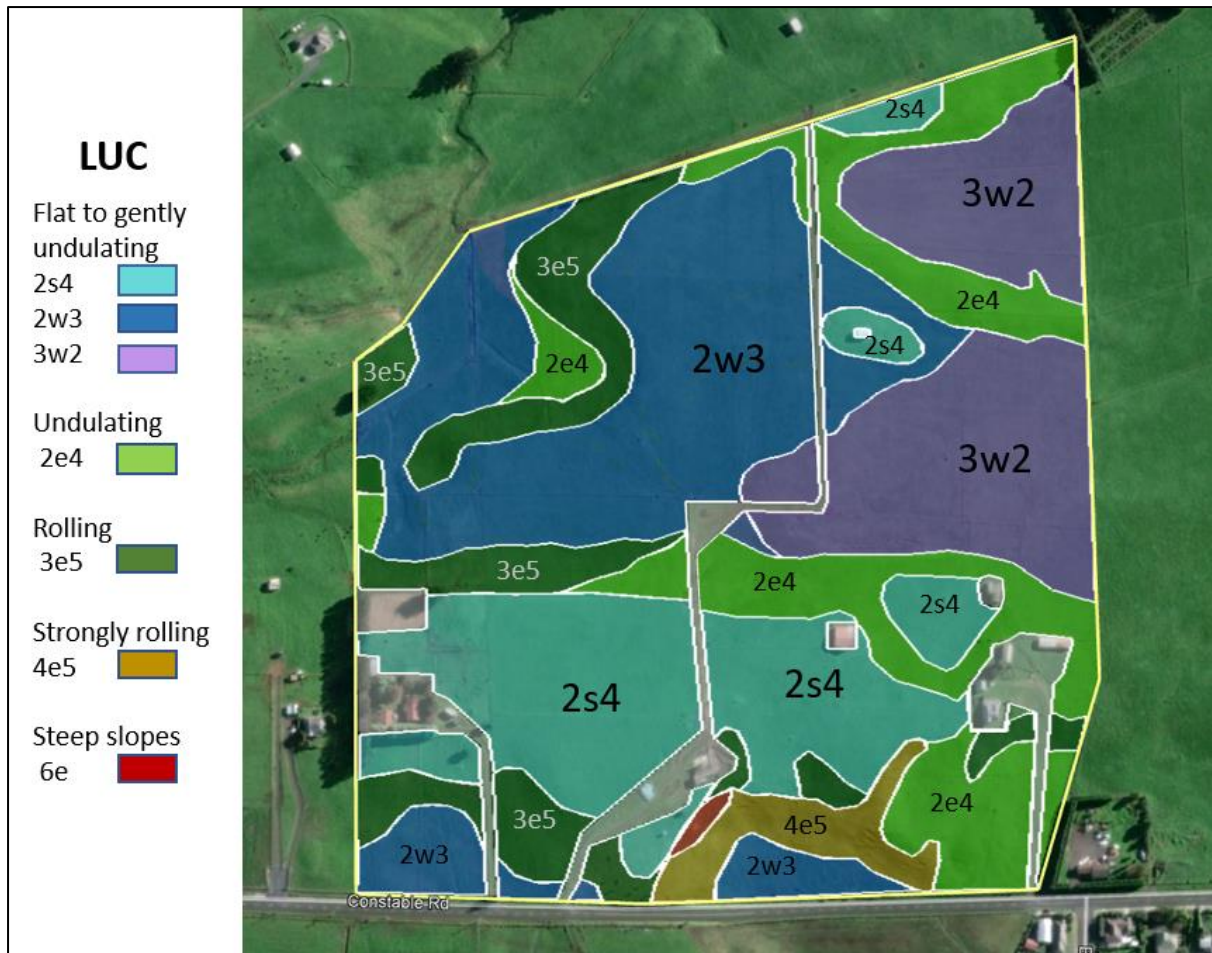


Figure 6. LUC classes for the site.

SOILS AT THE SITE

A soil survey of the site was carried out using standard methods. Field investigations showed the soil in the southern half of the site was mainly well drained Karaka silt loam. In the northern half the soils were mainly poorly drained Ake Ake loamy peats, Whatapaka clay loams and peaty loams and imperfectly drained Karaka mottled silt loams. Te Hihi clay loams were uncommon and occurred on parts of slopes that dropped down to the creek in the northwest of the site (Figure 7).

Karaka silt loam and mottled silt loam formed from younger volcanic ash and loess which covers older clayey Hamilton ash material or weathered ancient pumiceous alluvium. Karaka soils typically occur on flatter or stable slopes which have preserved the younger ash cover from erosion.

The Karaka silt loams are well or moderately well drained. Those on the flat higher tops tended to be well drained, and those on the sloping edges were well to moderately well drained. It was difficult to map out the drainage classes separately, so both are included in the same map unit. Karaka soils have very dark greyish brown silt loam or silty clay loam topsoil which is friable and moderately weak. This is on a yellowish brown, friable silt loam subsoil. Moderately weak to firm clay from the older Hamilton ash may be encountered from 60 to 80 cm depth.

Well drained Karakas were predominantly silt loams to at least 90 cm depth, or silt loams with silty clay lower subsoils which are strong brown in colour. These friable soils have good drainage and good root penetration to at least 90 cm depth. These features make them ideal for a wide range of uses including horticulture, vegetable growing, cropping and pasture.

Karaka silt loams with moderate drainage have firmer lower subsoils or are in lower landscape locations more likely to receive drainage water. They are similar in appearance to well drained soils but below 60 cm depth have light yellowish brown lower subsoil with dark yellowish brown mottles. These soils have similar characteristics for agriculture as well drained versions but have the disadvantage of a saturation for brief periods between 60 and 90 cm depth.

The Karaka mottled silt loams are imperfectly drained with light yellowish brown upper subsoil on light grey lower subsoil with yellow mottles. Karaka mottled silt loams are limited by having a seasonal water table in the lower subsoil and so are less versatile than the Karaka silt loam. Karaka mottled silt loams occur between Karaka silt loams and poorly drained soils, or on slightly higher areas within poorly drained soils.

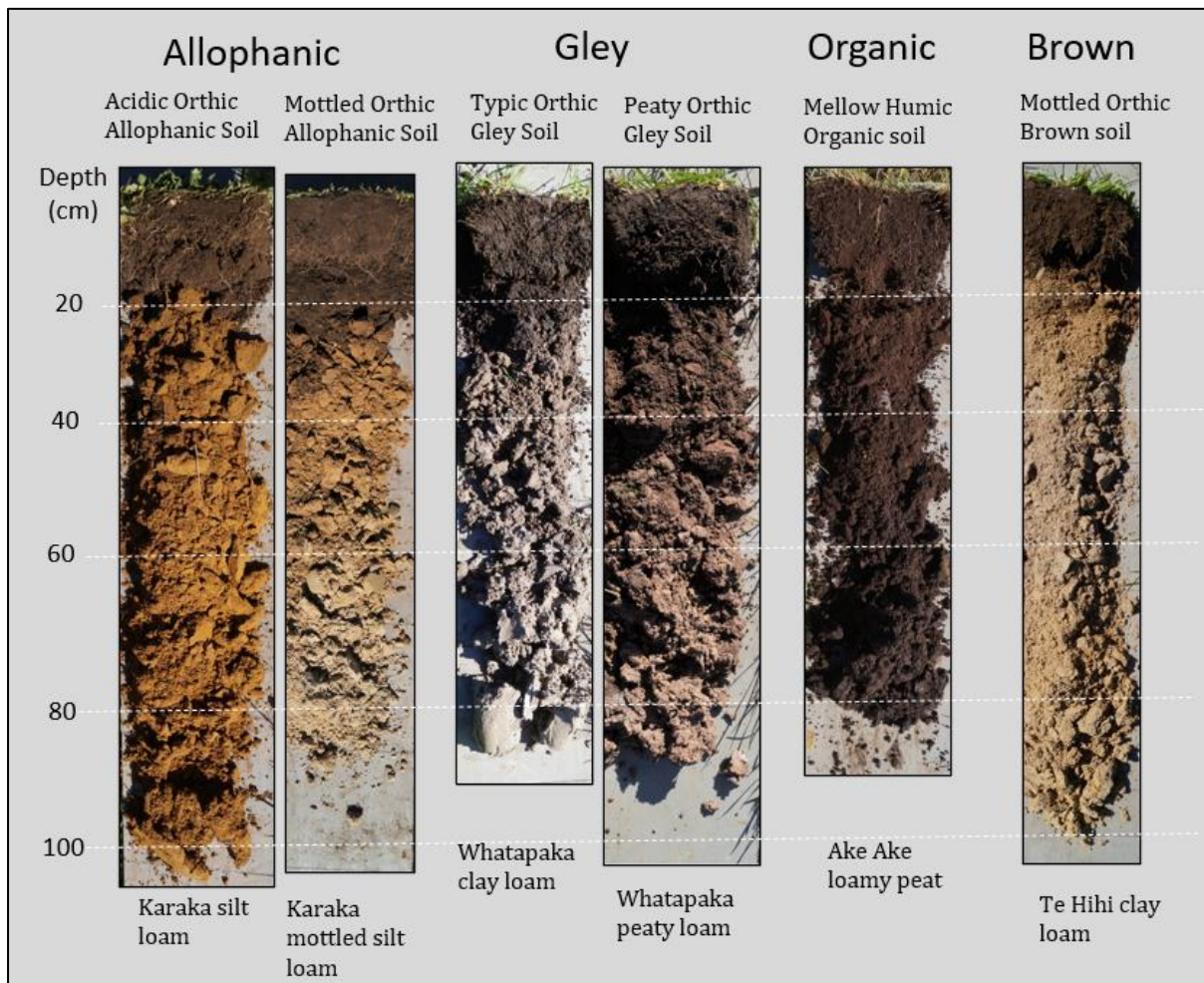


Figure 7. Soils at the site.

Whatapaka soils occurred in low areas that receive runoff from surrounding land and have restricted subsoil drainage. They have a high water table in winter and early spring. These are poorly drained soils and ponding can be an issue. They are formed from alluvium and colluvium from the surrounding slopes. The soils have clay loam topsoils and clay subsoils. When they are

wet, they are easily damaged by stock, vehicles and cultivation. Even with drainage they remain difficult soils to manage.

The Whatapaka clay loam at the site had 20 cm of dark grey clay loam topsoil on firm light grey or grayish brown clay or silty clay subsoil with yellowish brown mottles. These are poorly drained soils and can be sticky and plastic when wet. Prolonged wetness and clay textures make these soils difficult to drain and cultivate. These soils are prone to pugging damage and have low natural fertility. They are best suited to pasture and some areas can be suitable for fodder crops.

The Whatapaka peaty loam occurs on the edge of the Organic soils where the peat cover is thin (less than 30 cm). The soil has a peaty loam or humic silt loam topsoil. This is on brown humic stained silt loam to silty clay upper subsoil on light greyish brown silty clay.

Ake Ake loamy peats are formed from decomposed peat which can have thin layers of alluvium. Topsoils are black loamy peat or humic silt loam on soft very dark brown silty peat. This can be on peat stained humic clay. Water table are high, and the soil is wet for prolonged periods. These poorly drained soils have poor natural fertility, are difficult to drain and prone to pugging damage.

Te Hihi soils are on the flat to gently undulating land on slopes that receive drainage or seepage from upslope. On this land deposits of volcanic ash have mostly been eroded away and the soils are formed from weathered ancient sandy pumiceous deposits. Often, they have a greyish brown clay loam topsoil on yellowish brown clay or sandy clay upper subsoil, on pale brown mottled clay. The soil at the site was imperfectly drained. In general, the soils are moderately leached and with phosphate topdressing will support good pasture, and cropping if the slope is suitable.

Table 2 shows land and soil characteristics and Figure 8 shows the distribution of soil types at the site.

Table 2. Table showing some of the main soil characteristics.

| Soil type | Soil Order | Soil subgroup | Drainage class | Soil material |
|--------------------------|------------|--------------------------------|--------------------------|---|
| Karaka silt loam | Allophanic | Acidic Orthic Allophanic Soil | Well and moderately well | Silt loam on silty clay from volcanic ash and loess |
| Karaka mottled silt loam | Allophanic | Mottled Orthic Allophanic soil | Imperfectly drained | Silt loam on silty clay from volcanic ash and loess |
| Whatapaka clay loam | Gley | Typic Orthic Gley Soil | Poorly drained | Clay loam on clay from alluvium and colluvium |
| Whatapaka peaty loam | Gley | Peaty Orthic Gley soil | Poorly drained | Thin decomposed peat or humic silt loam on alluvium |
| Ake Ake loamy peat | Organic | Mellow Humic Organic soil | Poorly drained | Decomposed peat and alluvium |
| Te Hihi clay loam | Brown | Mottled Orthic Brown soil | Imperfectly drained | Clay loam on clay from ancient pumiceous alluvium |

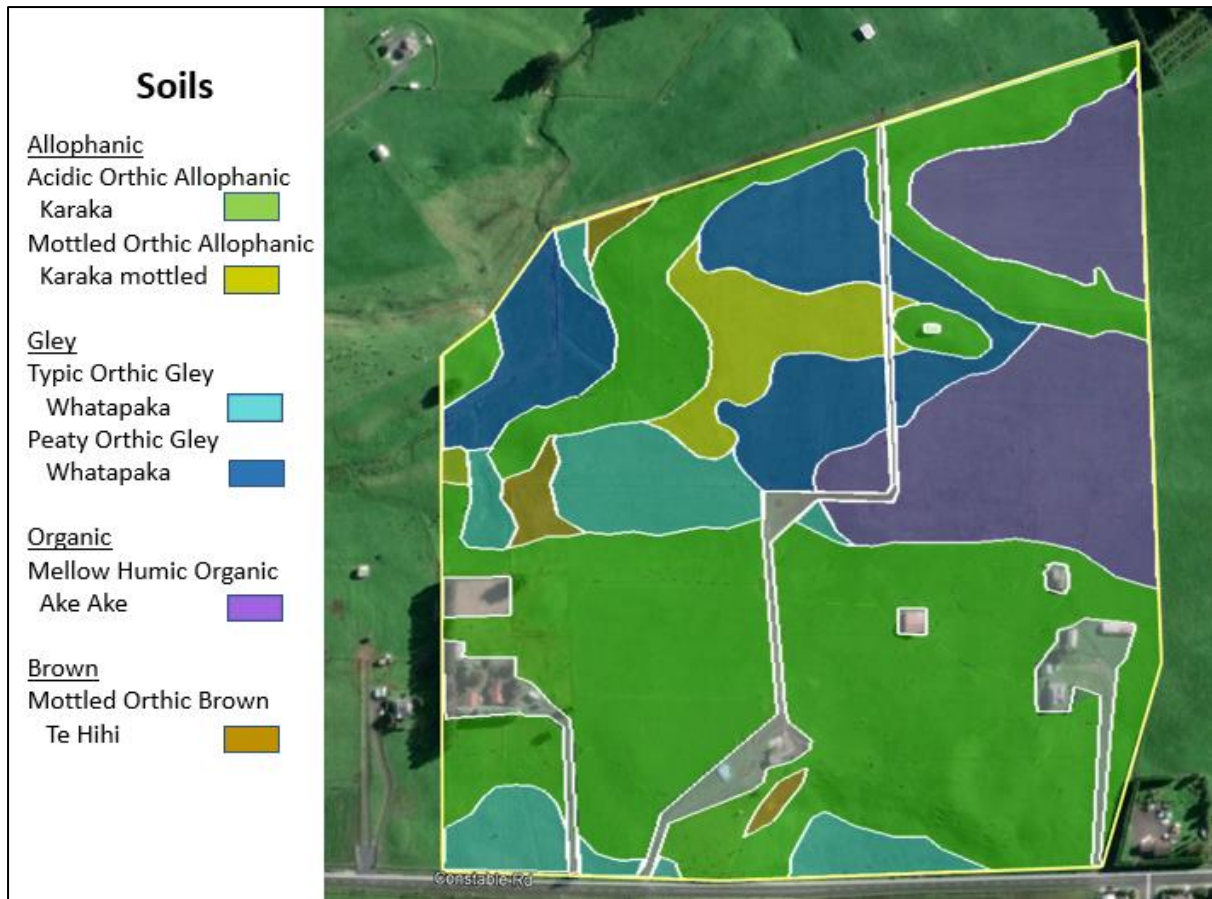


Figure 8. Soil map of the site.

ELITE AND PRIME LAND

The Auckland Unitary Plan (Updated 24 October, 2019) defines elite and prime land as:-

Elite land:

Land classified as Land Use Capability Class 1 (LUC1). This land is the most highly versatile and productive land in Auckland. It is:

- *well-drained, friable, and has well-structured soils;*
- *flat or gently undulating; and*
- *capable of continuous cultivation.*

Includes:

- *LUC1 land as mapped by the New Zealand Land Resource Inventory (NZLRI);*
- *other lands identified as LUC1 by more detailed site mapping;*
- *land with other unique location or climatic features, such as the frost-free slopes of Bombay Hill;*
- *Bombay clay loam;*
- *Patumahoe clay loam;*
- *Patumahoe sandy clay loam; and*
- *Whatitiri soils.*

Land containing prime soil:

Land identified as Land Use Capability classes two and three (LUC2, LUC3) with slight to moderate physical limitations for arable use. Factors contributing to this classification are:

- readily available water;
- favourable climate;
- favourable topography;
- good drainage; and
- versatile soils easily adapted to a wide range of agricultural uses.

It is our assessment that the site contained 'prime soil' as per the Unitary Plan definition. There were no Elite soils on the site.

The area investigated had well drained Karaka soils on flat to gently undulating slopes (LUC class 2s4) which corresponds to Auckland Council's Farm LUC 1c unit. These soils are suited to a wide range of uses and have many features in common with LUC class 1. They are also well suited to horticultural crops such as kiwifruit and avocados. However, they do have slight limitations for arable farming such as very loose soil structure when cultivated, slight susceptibility to wind erosion, and low natural fertility.

Karaka soils on undulating slopes (LUC class 2e4) are good arable land and assessed as 'Prime land'. Karaka soils on rolling slopes (LUC class 3e5) that were well drained or moderately well drained were assessed as 'Prime land'.

Soils on strongly rolling or steeper slopes, or imperfectly or poorly drained soils, were assessed as 'Other productive land'. 'Non-productive land' were areas of farm track and buildings not suitable for agricultural production.

Tables 3 and 4 show characteristics of the LUC classes and how they relate to Prime and other land types. The map of Prime, Other productive land and Non-productive land is shown in Figure 9.

Table 3. Table showing soil, slope, erosion risk and drainage for LUC and land classes.

| LUC class | Soil | Slope | Erosion risk | Drainage | Elite/prime |
|--------------------|----------------|---------------------------|--------------------|-------------------------|----------------|
| 2s4 | Karaka | Flat to gently undulating | negligible | Well | Prime land |
| 2e4 | Karaka | Undulating | negligible | Well & moderately well | Prime land |
| 3e5 | Karaka | Rolling | Slight to moderate | Well & moderately well | Prime land |
| 2w3 | Karaka mottled | Undulating | negligible | Imperfectly | Other |
| 2w3 | Te Hihi | Flat to gently undulating | negligible | Imperfectly | Other |
| 2w3 | Whatapaka | Flat to gently undulating | negligible | Poor | Other |
| 3w2 | Ake Ake | Flat to gently undulating | negligible | Poor | Other |
| 4e & 6e | various | Strongly rolling to steep | Moderate to severe | Well to moderately well | Other |
| Tracks & buildings | | | | | Non-productive |

Table 4. Table areas for the LUC and land classes.

| LUC class | Soil | Slope | Hectares | Per cent | Elite/prime |
|--------------------|----------------|---------------------------|-------------|--------------|----------------|
| 2s4 | Karaka | Flat to gently undulating | 5.5 | 19.0 | Prime land |
| 2e4 | Karaka | Undulating | 4.6 | 16.0 | Prime land |
| 3e5 | Karaka | Rolling | 3.3 | 11.3 | Prime land |
| 2w3 | Karaka mottled | Undulating | 1.4 | 4.9 | Other |
| 2w3 | Te Hihi | Flat to gently undulating | 0.3 | 1.5 | Other |
| 2w3 | Whatapaka | Flat to gently undulating | 6.1 | 20.9 | Other |
| 3w2 | Ake Ake | Flat to gently undulating | 5.0 | 17.3 | Other |
| 4e & 6e | various | Strongly rolling to steep | 0.9 | 3.3 | Other |
| Tracks & buildings | | | 1.7 | 5.8 | Non-productive |
| Total | | | 28.9 | 100.0 | |

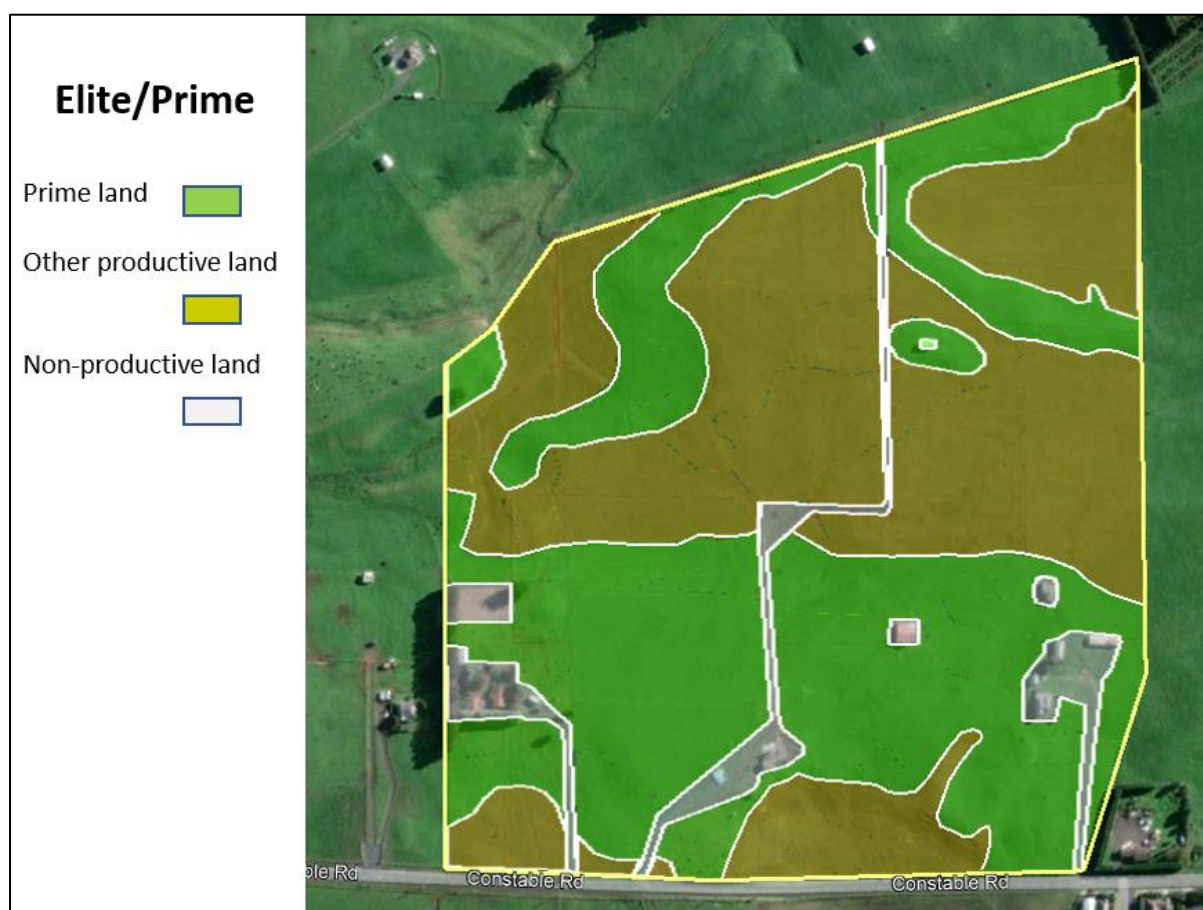


Figure 9. Prime and other land within the site. Elite land was not present.

PROPORTIONS OF PRIME & OTHER LAND

The area and proportions of Prime and Other land was calculated from the mapped areas using Google Earth. The summary of the areas and proportions of land at the site are shown in Table 5.

Prime land was Karaka soils and covered 46.3 % of the site. Other productive land was 47.9 % and non-productive land was 5.8 %.

Table 5. Summary of the area and proportions of land types.

| Land type | hectares | % |
|-----------------------|----------|------|
| Prime land | 13.4 | 46.3 |
| Other productive land | 13.9 | 47.9 |
| Non-productive | 1.7 | 5.8 |
| Total | 29 | 100 |

Table 6 shows the amounts of each LUC class in the Auckland region and a map showing the regional extent of elite and prime soils is in Appendix 1. Both are from Curran-Cournane *et al*, (2013)

Table 6. Breakdown and proportion of Land Use Capability (LUC) Classes 1-8 in Auckland.

| LUC Class | Hectares | % of region |
|-----------|----------|-------------|
| 1 | 4397 | 1 |
| 2 | 55356 | 12 |
| 3 | 65090 | 15 |
| 4 | 79641 | 18 |
| 5 | 0 | 0 |
| 6 | 174067 | 39 |
| 7 | 52420 | 12 |
| 8 | 12886 | 3 |

CONCLUSIONS

The site was predominantly other productive land (47.9 %). These were areas of poorly drained and imperfectly drained soils, or steep slopes. Prime land made up the majority of the remaining land (46.3 %) and was largely well and moderately well drained Karaka soils on flat to rolling slopes. Non-productive land was 5.8 % of the area.

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APPENDIX 1: REGIONAL DISTRIBUTION OF ELITE & PRIME LAND

