

National Policy Statement for Highly Productive Land assessment of the Sunfield site, Ardmore.



Photo: Dr Peter Singleton (Natural Knowledge).

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Executive summary

This report presents an assessment of Sunfield Developments Limited's Sunfield site in Ardmore, focusing on its soil and land use capability under the National Policy Statement for Highly Productive Land 2022 (NPS-HPL). The assessment is based on a property-scale study conducted prior to the implementation of the NPS-HPL by Dr. Peter Singleton in 2020 (see Appendix 1), supplemented with desktop analyses and discussions with Dr. Singleton.

The Sunfield site spans approximately 244.5 hectares, comprising a rural zoned area of 188.0 hectares and a 56.5 hectare Future Urban Development area. The assessment specifically covers the rural zoned area. Dr. Singleton's report provides detailed soil observations and land use capability classification, following New Zealand's accepted guidelines (Milne et al., 1995, and Lynn et al., 2009).

The NPS-HPL, in effect from October 17, 2022, defines "highly productive land" based on mapping and regional policy statements. However, since regional policy statement maps are not yet operational, the NPS-HPL requires identifying highly productive land by mapping based on New Zealand Land Resource Inventory (NZLRI) or more detailed mapping using Land Use Capability (LUC) classification.

The property-scale mapping provided in Dr. Singleton's report meets NPS-HPL requirements for identifying highly productive land. However, the assessment highlights several limitations on the site, particularly due to heavy clay soil textures (LUC 2e5 and 3e4) and wetness limitations (LUC 3w2 and 2w2). These restrictions reduce the range of viable primary production land uses, making intensive horticulture and cropping during wet periods unsustainable.

The site contains highly productive land areas (LUC 2s4) suitable for vegetable production and deep-rooting horticulture. However, their individual size and isolation from similar land with good drainage (LUC 2s4) or surrounding heavy clay soils (LUC 2e5 and 3e4) make them less practical for intensive primary production.

Soil factors that restrict land use options and may have relevance only when maps produced in accordance with clause 3.4 have been included in an operative regional policy statement:

- The poorly drained soils (LUC 3w2 and 2w2), although deemed to be highly productive land, are not LUC class 1 land (with deep and well drained soils) and are of lesser productive value and not suitable for intensive horticulture crops requiring deep, well drained soils.

1. Introduction

Sunfield Developments Limited have requested an assessment of the soil and LUC map units present on the site against the National Policy Statement for Highly Productive Land 2022 (NPS-HPL).

A field based property-scale soil and land use capability study for part of the site was conducted prior to the implementation of the NPS-HPL by Dr. Peter Singleton in 2020¹ (refer **Appendix 1**).

I have not undertaken a field visit or assessment and so the assessment provided is based on the site assessment information provided in Dr Singleton's report, discussion with Dr Singleton, and additional desktop analyses using regional scale soil and LUC map information and aerial photograph interpretation.

2. Sunfield site description

The Sunfield site is located in Ardmore, bounded by Ardmore Road to the north and Mill and Cosgrave Roads to the west. The site is approximately 244.5 ha, including a Future Urban Zone area of 56.5 ha and a Rural Zone area of 188.0 ha (**Figure 1**). This area is referred to as the "Sunfield site" in this assessment.

¹ Singleton P. 2020. Land use capability and soil assessment – Hamlin Road, Ardmore. Natural Knowledge, Hamilton.

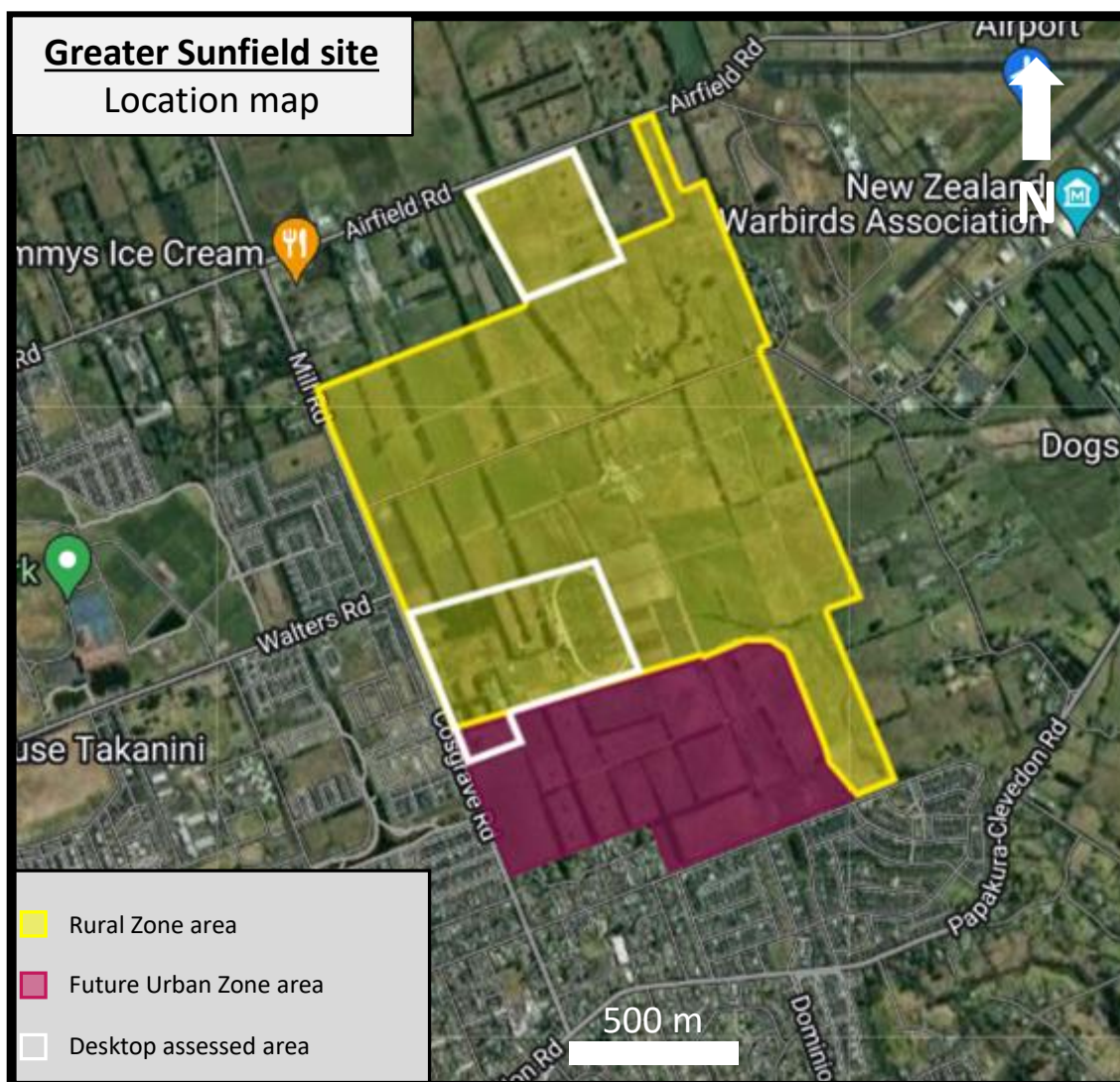


Figure 1. Greater Sunfield site, including the Future Urban Zone area.

As Future Urban Zoned land is not covered under the NPS-HPL I have excluded the portion of the Sunfield site which is Future Urban Zoned land from this assessment.

It should be noted that the Future Urban Zoned land, like the balance of the Sunfield site, is not LUC class 1 land and has similar soil limitations. Similarly the land in the Future Urban Zone is of lesser productive value and not suitable for intensive horticulture crops requiring deep, well drained soils.

The NPS-HPL assessment presented in this report covers the rural zoned area (188.0 ha) shaded yellow shown in **Figure 1**.

A property scale land use capability and soil field assessment² is available for the site, excluding the desktop assessed areas (40.7 ha) shown by the blue boundary lines in **Figure 1**.

² Singleton P. 2020. Land use capability and soil assessment – Hamlin Road, Ardmore. Natural Knowledge, Hamilton.

For the desktop assessed areas, aerial photo interpretation was used to delineate the non-productive areas, and available regional scale soil and LUC map information in combination with the maps provided in Singleton (2020) were used to approximate the LUC classes for the purpose of NPS-HPL assessment.

3. National Policy Statement for Highly Productive Land 2022

The National Policy Statement for Highly Productive Land 2022 (NPS-HPL)³ came into force on the 17th of October 2022 (clause 1.2(1)).

“Highly productive land” is defined as:

means land that has been mapped in accordance with clause 3.4 and is included in an operative regional policy statement as required by clause 3.5 (but see clause 3.5(7) for what is treated as highly productive land before the maps are included in an operative regional policy statement and clause 3.5(6) for when land is rezoned and therefore ceases to be highly productive land).

My understanding is that NPS-HPL clause 3.5(7) applies because maps produced in accordance with clause 3.4 have not yet been included in an operative regional policy statement as required by clause 3.5. Clause 3.5(7) says:

(7) Until a regional policy statement containing maps of highly productive land in the region is operative, each relevant territorial authority and consent authority must apply this National Policy Statement as if references to highly productive land were references to land that, at the commencement date:

(a) is

(i) zoned general rural or rural production; and

(ii) LUC 1, 2, or 3 land; but

(b) is not:

(i) identified for future urban development; or

(ii) subject to a Council initiated, or an adopted, notified plan change to rezone it from general rural or rural production to urban or rural lifestyle.

The NPS-HPL includes the following guidance in clause 3.4(5):

(5) For the purpose of identifying land referred to in subclause (1):

(a) mapping based on the New Zealand Land Resource Inventory is conclusive of LUC status, unless a regional council accepts any more detailed mapping that uses the Land Use Capability classification in the New Zealand Land Resource Inventory.

4. Soil and LUC classification on the site

The 2020 land use capability and soil field assessment by Dr Singleton provides property scale soil and LUC map information covering most of the Sunfield site in this assessment.

The assessment by Dr Singleton included 25 detailed soil observations, augmented the soil observations with landform boundaries to assist land use capability classification of the soils. Underlying geology, surface soil, and other relevant physical features - slope, site

³ National Policy Statement for Highly Productive Land 2022. September 2022.

wetness, and erosion or deposition were noted for each landform following the criteria provided in Lynn et al. (2009).

The methods used for the soil assessment and LUC classification followed the accepted approach and guidelines used in New Zealand for soil and LUC assessment, namely Milne et al. (1995)⁴ and Lynn et al. (2009)⁵, and other relevant reference sources which were referred to in the report and listed in the reference section of the report.

Soil names identified and LUC units used were those provided in the Manukau City Soil Map compiled by DSIR Soil Bureau (Purdie et al., 1981)⁶ and the NZLRI South Auckland – Waikato region land use capability extended legend Jessen (1984)⁷. Dr Singleton likely retained the DSIR’s nomenclature (soil names) for his soil map of the subject area (as opposed to S-Map soil sibling names) on the basis that planners and consultants generally use the same names, when supplying published (and unpublished) information about soil properties to local landowners.

The LUC classification method correctly describes, adopts, and applies the relevant existing LUC units provided by the LUC classes, sub-classes and units as defined for South Auckland (Jessen 1984).

A comparison of the NZLRI LUC classes for the area covering the site and that mapped at property scale and shown in Figure 6 of the report is provided in **Figure 2**.

⁴ Milne JDG, Clayden B, Singleton PL, Wilson AD. (1995). Soil Description Handbook. Lincoln, New Zealand, Manaaki Whenua Press. 157p.

⁵ Lynn IH, Manderson AK, Page MJ, Harmsworth GR, Eyles GO, Douglas GB, Mackay AD, Newsome PJF. 2009. Land Use Capability survey handbook – a New Zealand handbook for the classification of land. AgResearch Hamilton; Manaaki Whenua Lincoln; GNS Science Lower Hutt, New Zealand.

⁶ Purdie BR et al. (1981). Manukau City Soil Survey Progress Report. District Office Report HV5, Soil Bureau, DSIR.

⁷ Jessen MR (1984). Additions to NZLRI South Auckland – Waikato region land use capability extended legend (2nd edition). Unpublished document, Water & Soil Division, MWD.

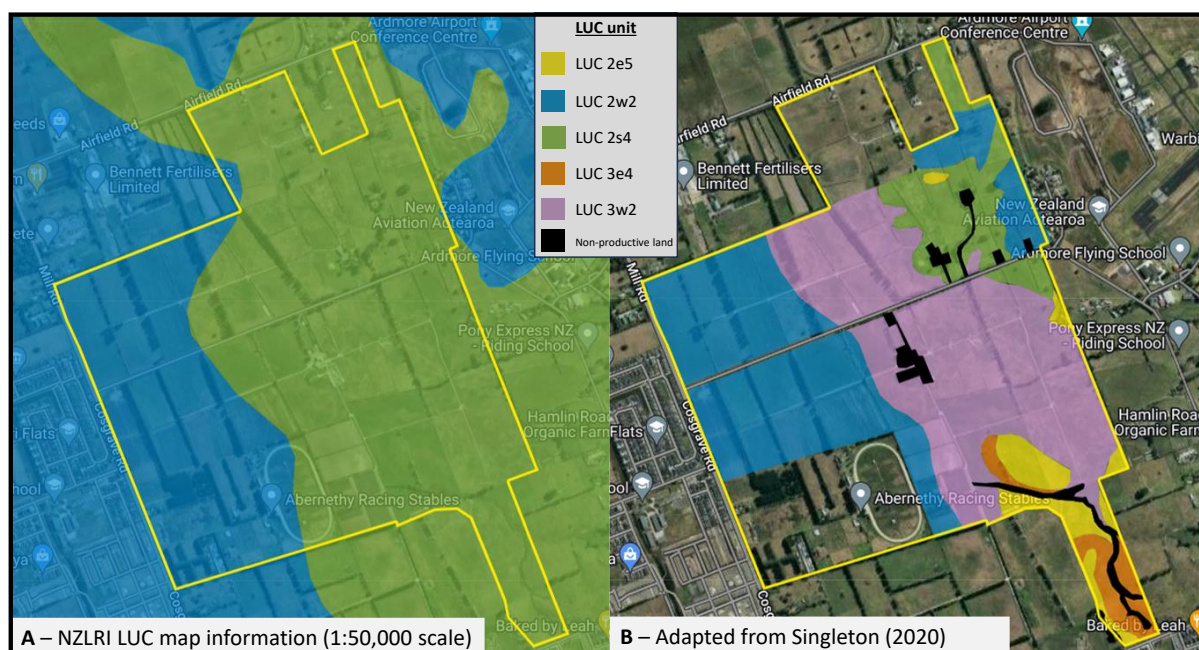


Figure 2. A comparison of (A) NZLRI LUC classes for the area covering the site and (B) LUC classes mapped at property scale by Dr Singleton for the Sunfield site.

The main difference between the regional scale (NZLRI) and the property scale (Singleton 2020) LUC map information is the extent of the 2w2 and 2s4 land. The property scale mapping identified a greater area of 2w2 and a smaller area of 2s4, which was correctly mapped as predominantly 3w2. In general, the soil drainage of the site is poorer (not well drained) than indicated by the NZLRI map information.

The map information provided in Dr Singleton's report correctly uses LUC classification methods and is of greater detail and accuracy than the regional scale NZLRI map information.

As such, the map information provided in Dr Singleton's report meets the requirements for identifying NPS-HPL highly productive land at property scale as required by NPS-HPL clause 3.4(7).

5. Soil features and sustainable land use options

Limiting soil features (as indicated by LUC class limitation criteria) may impact on the range of land use options available to the Sunfield site. The estimated distribution of soils with a wetness limitation is shown in **Figure 3**.

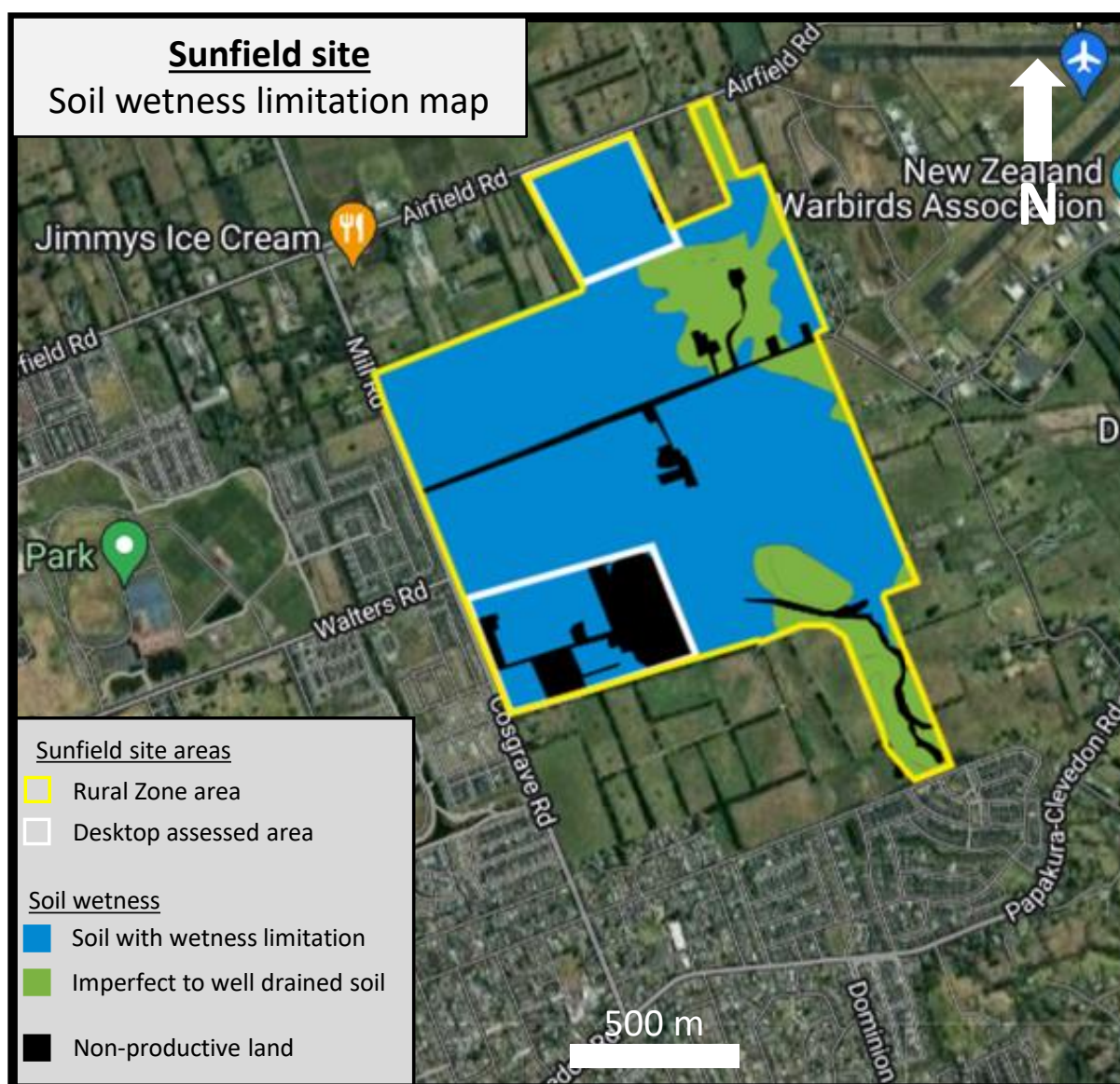


Figure 3. The distribution of soil with a wetness limitation (LUC 3w2 and 2w2) identified at property scale for the Sunfield site.

A summary of the soil features and assessment of the sustainable land use options based on the limitations of the soils mapped at property scale on the Sunfield site is as follows:

Karaka (LUC 2s4 - well to moderately well drained)

The Karaka soils (LUC 2s4) on the site is well drained and moderately well drained, on flat to gently undulating slopes, and capable of continuous cultivation.

Brookby (LUC 3e4 and 2e5 – imperfectly drained)

The Brookby soils (LUC 2e5 and 3e4) on the site are imperfectly drained, on undulating to rolling slopes. Although classed as highly productive land when applying the NPS-HPL, imperfect drainage and heavy clay textures make cropping (cultivation) very difficult. It should be noted that these clays are heavier and stickier than those of the Patumahoe soils which in contrast are favourable for continuous cultivation. Where situated on rolling slopes

there is an increased erosion risk if cultivated. They are productive land but at best limited to pastoral land uses.

Clevedon (LUC 2w2 and 3w2 – poorly drained)

The Clevedon soils (LUC 2w2 and 3w2) on the site are poorly drained on flat to gently undulating slopes. Although classed as highly productive land when applying the NPS-HPL, these soils have poor drainage and clay texture that makes cropping (cultivation) unsustainable over winter months and very difficult throughout the remainder of the year. Again, it should be noted that these clays are heavier and stickier than those of the Patumahoe soils which in contrast are favourable for continuous cultivation. Also noted is the limitation of acidic conditions which requires ongoing soil pH management to enable production. They are productive land but at best limited to pastoral land uses.

Ardmore (LUC 2w2 – poorly drained)

The Ardmore soils (LUC 2w2) on the site are poorly drained on flat to gently undulating slopes. Although classed as highly productive land when applying the NPS-HPL, these soils have poor drainage and peat texture that makes cropping very difficult throughout the year. With excessive drainage and cultivation the soils are prone to increased subsidence. Also of note is the limitation of acidic conditions which requires ongoing soil pH management to enable production. They are productive land but at best limited to pastoral land uses and occasional seasonal cropping.

6. LUC classes surrounding the site

The distribution of LUC classes for the area surrounding the Sunfield site (based on the NZLRI 1:50,000 scale map information) is shown in **Figure 4**.

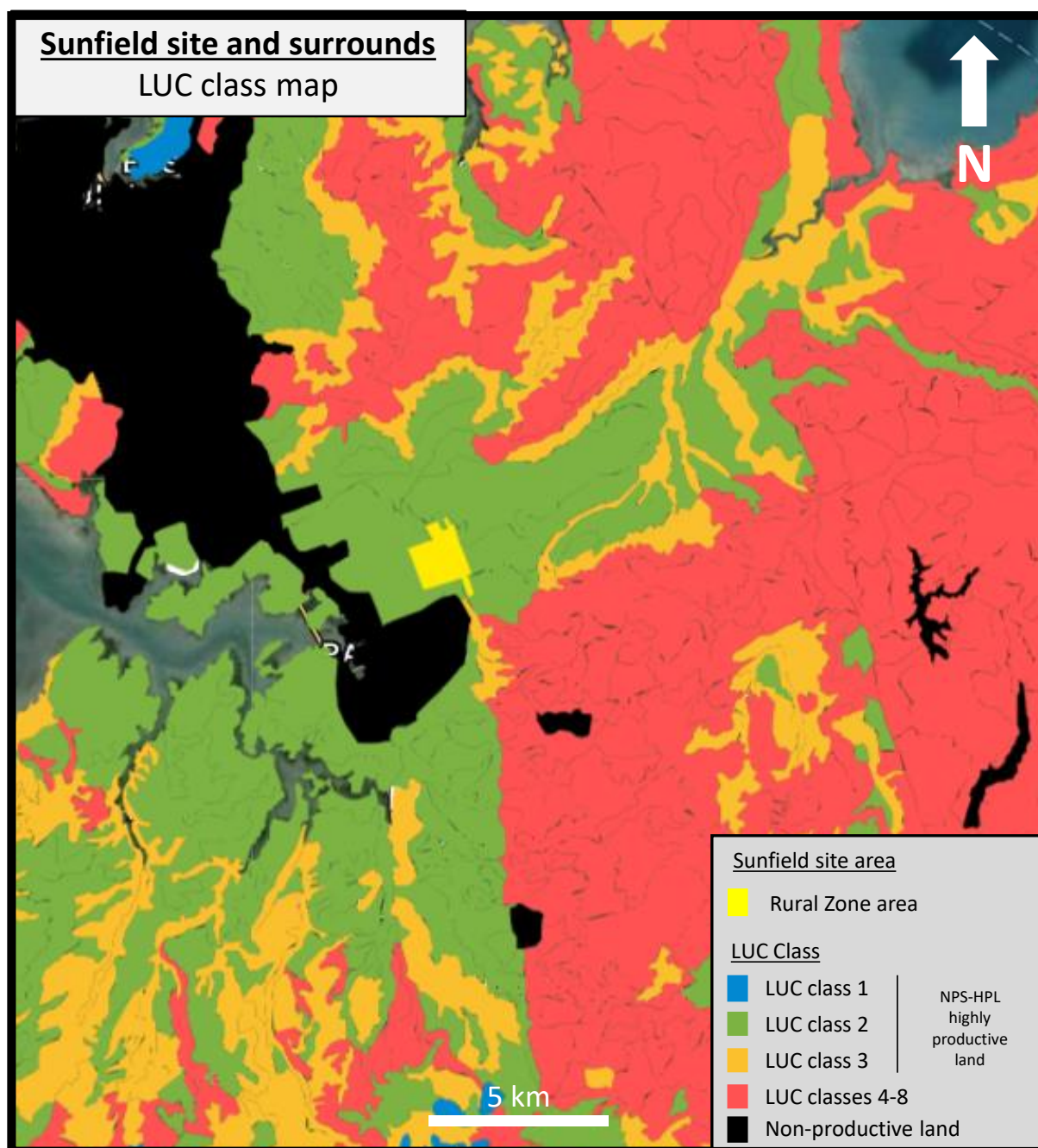


Figure 4. The distribution of NZLRI LUC classes surrounding the Sunfield site.

Figure 4 shows that there is no LUC class 1 land surrounding the Sunfield site, only LUC class 2 (green) and non-productive land (black).

7. NPS-HPL highly productive land on the site

The estimated distribution of NPS-HPL highly productive land is shown in **Figure 5**.

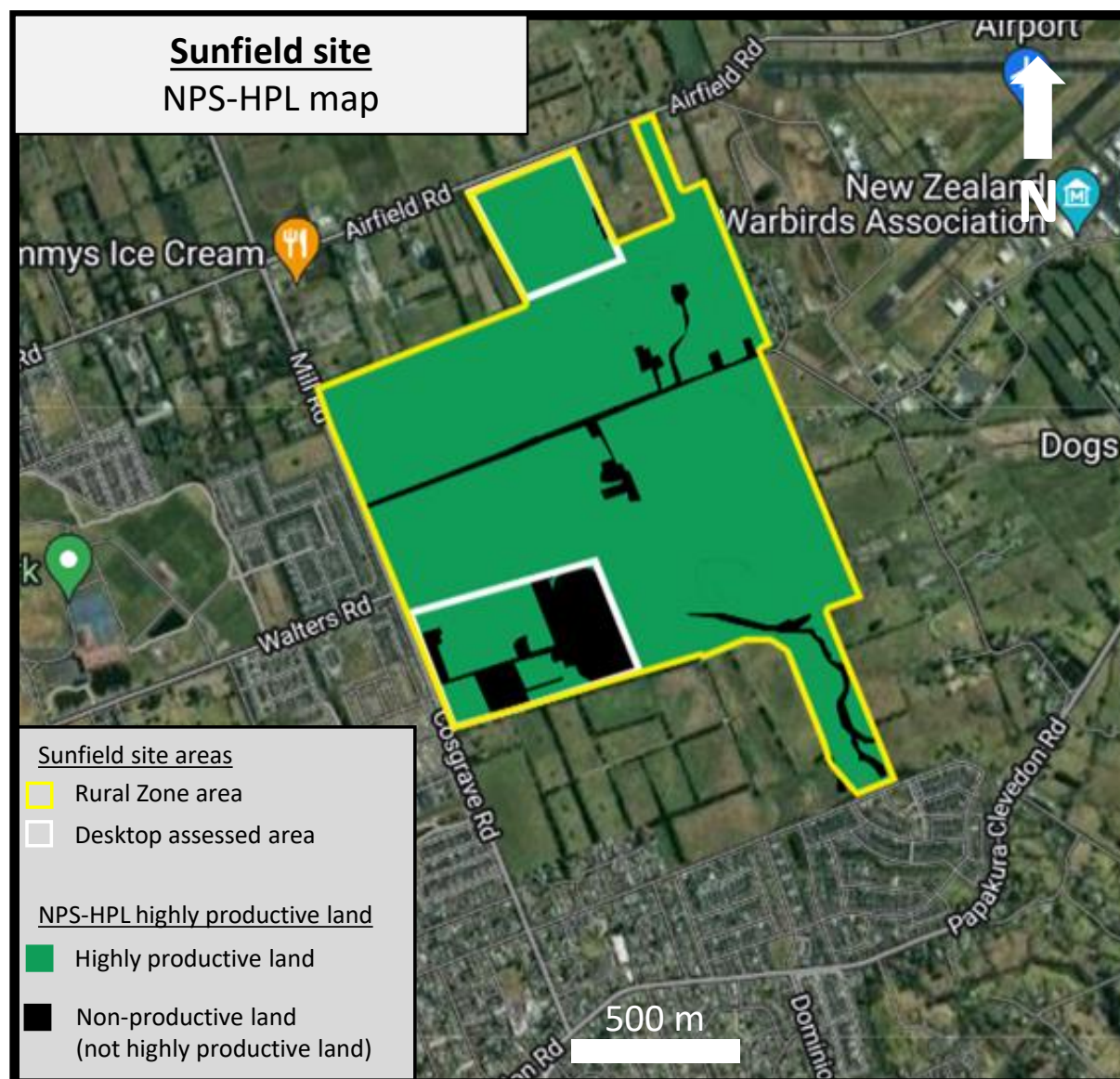


Figure 5. The distribution of NPS-HPL highly productive land identified at property scale for the Sunfield site.

Applying the NPS-HPL, the productive land on the site is classed as highly productive land.

The highly productive land on the site is LUC class 2 and 3 land but the site does not contain any LUC class 1 land.

The areas on the site that are not classed as highly productive land are the areas of non-productive land, which include a racetrack, buildings and curtilage, tracks and roads, and riparian areas.

8. NPS-HPL highly productive land surrounding the site

The distribution of NPS-HPL highly productive land for the area surrounding the Sunfield site (based on the NZLRI 1:50,000 scale map information) is shown in **Figure 6**.

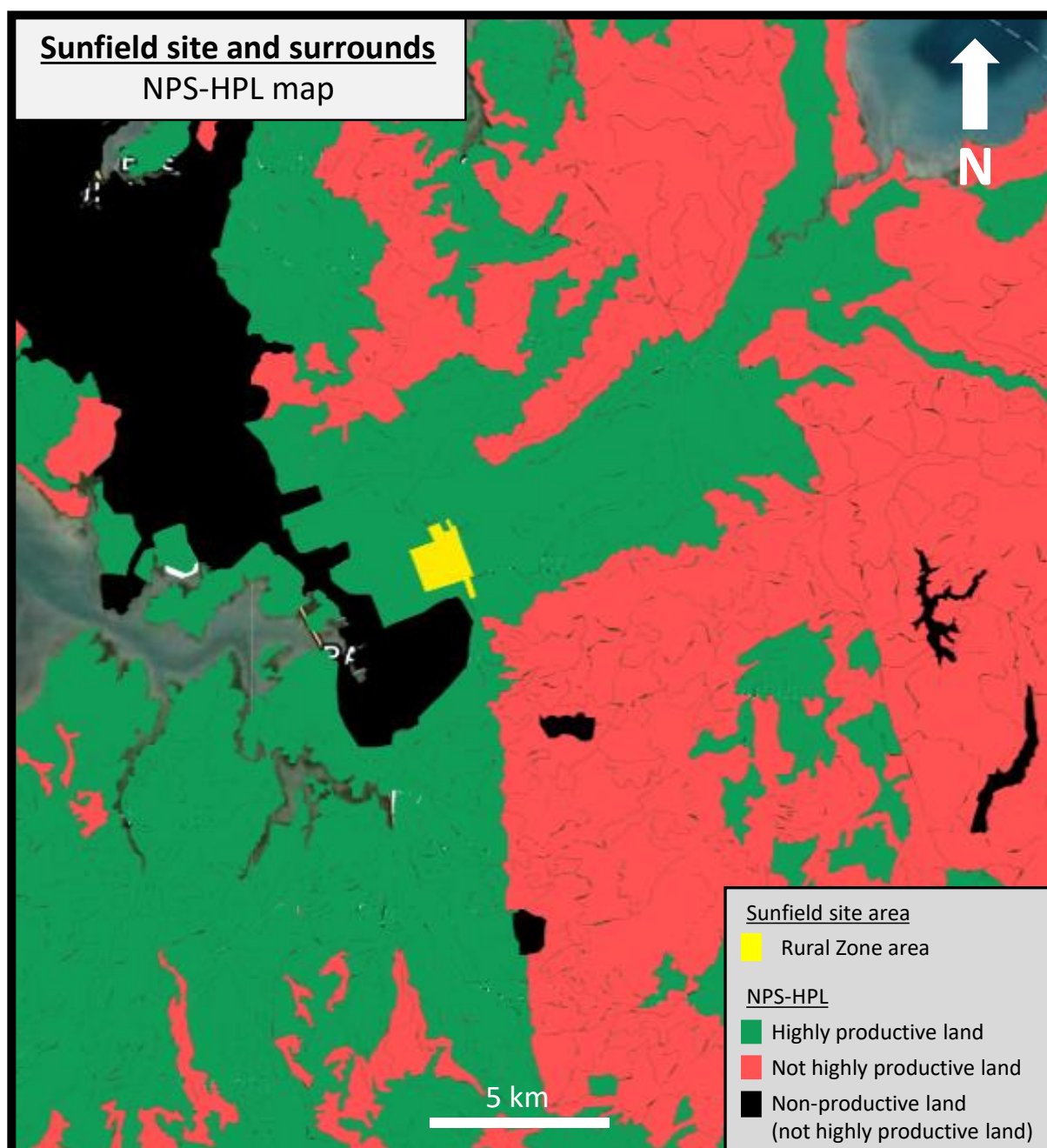


Figure 6. The distribution of NPS-HPL highly productive land surrounding the Sunfield site.

Figure 6 shows that there is NPS-HPL highly productive land (green) bordering the Sunfield site to the north and east. However, some parts of the Sunfield site boundary in these directions is bordered by non-productive land.

Additionally, **Figure 6** shows that the Sunfield site is bordered to the west by existing urban development, to the east by Ardmore airport and urban development, and to the south by existing and future urban development. These areas are non-productive land.

9. NPS-HPL comments

Although the land on the Sunfield site is classed as NPS-HPL highly productive land, the majority of the soils (excepting the areas of LUC 2s4) on the site have heavy clay soil textures (LUC 2e5 and 3e4) and/or wetness limitations (LUC 3w2 and 2w2) that restrict the range of primary production land uses that would be viable. For these areas, cultivation during wetter periods is not sustainable and the soils are not suitable for deeper rooting horticultural crops requiring deep, friable, well drained soils (i.e. the range of sustainable land uses is restricted).

The highly productive land areas that are moderately well to well drained (LUC 2s4) do have soils suited to vegetable production and deep rooting horticulture. However, individually they are limited in area and use of these areas for such primary production enterprises is not likely to be practical. Additionally, the areas are isolated from other land with similar characteristics. They are surrounded by areas that have heavy clay soil textures (LUC 2e5 and 3e4) or are poorly drained (LUC 2w2 and 3w2) highly productive land. The soil wetness limitations, and limited distribution of the well drained soils reduce the productive potential of the highly productive land on the site as a whole.

Soil factors that restrict land use options and may have relevance only when maps produced in accordance with clause 3.4 have been included in an operative regional policy statement, include:

- The poorly drained soils on the site (LUC units 3w2 and 2w2), although considered highly productive land, are not LUC class 1 land (with deep and well drained soils) and are of lesser productive value and not suitable for intensive horticulture crops requiring deep, well drained soils.

10. Key points

The highly productive land on the Sunfield site is LUC class 2 and 3 land but the site does not contain any LUC class 1 land.

The poorly drained soils (LUC units 3w2 and 2w2) on the site, although considered highly productive land, are not suitable for intensive horticulture crops requiring deep, well drained soils.

Appendix 1: Singleton P. 2020. Land use capability and soil assessment – Hamlin Road, Ardmore. Natural Knowledge, Hamilton.



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LAND USE CAPABILITY AND SOIL ASSESSMENT – HAMLIN RD, ARDMORE

Dr Peter Singleton

December 2020



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SUMMARY

A 203 ha site on Hamlin Road, Ardmore, was assessed for its Land Use Capability (LUC) and soil characteristics. The site was mainly flat to gently undulating lowland with a smaller area of rolling and undulating hill. The site had been used as a drystock farm for many years and parts were now used for market gardening.

The LUC assessment showed the site to be predominantly LUC class 2 land. The remainder was either LUC class 3 or 6 land. The land was a mixture of well and poorly drained soils.

The soils were Allophanic (Karaka silt loam), Organic (Ardmore peat), Gley (Clevedon clay loam, humic silt loam & peaty loam) and Ultic soils (Brookby clay loam). The soils were LUC class 2 or class 3 land.

The Karaka soil was LUC class 2 land. It was a friable, well drained soil on flat to gently undulating slopes. Because of these soil and site features the land was assessed as Elite as defined by the Auckland Council Unitary Plan. Elite land covered 8.1 % of the site.

Imperfectly or poorly drained soil types (Ardmore, Clevedon & Brookby) made up the remaining LUC class 2 or 3 land. These soils had drainage issues and additional limitations such as clay, acid conditions, subsidence or rolling slopes. Because of these limitations they were productive soils but not Elite or Prime land. These areas were 89.7 % of the site. The remaining area was non-productive land such as tracks and building. Non-productive land was 2.2 % of the site.

The majority of the site was composed of land which was neither elite nor prime. The soils had a range of physical and chemical limitations which meant they unsuitable for a variety of agricultural uses. Urban growth onto these soils is preferable to using land with fewer limitations, or land which is elite or prime.

INTRODUCTION

An onsite soil and land assessment of was undertaken to assess the area of Elite and Prime land within an approximately 203 hectare site divided by Hamlin Road, Ardmore near the eastern boundary of Papakura (Figures 1 & 2).

The site was in several lots and included an area zoned as future urban (Figure 2). The land was mainly flat to undulating lowland. In the southeast along Old Waharoa Road was a section of hill with rolling slopes which slopes down to the lowland on the west, and to an ephemeral stream on the east. In the northeast, between Hamlin and Airfield roads, about five metres above the lowland was a flat to undulating terrace. The site had been used as a drystock farm for many years and parts were now used for market gardening.

The land had formed from ancient swamp that formed peat and poorly drained clay soils in the lowland. The low terrace was from pumiceous alluvium and dune deposits and the rolling hills from sandstone now weathered to clay.

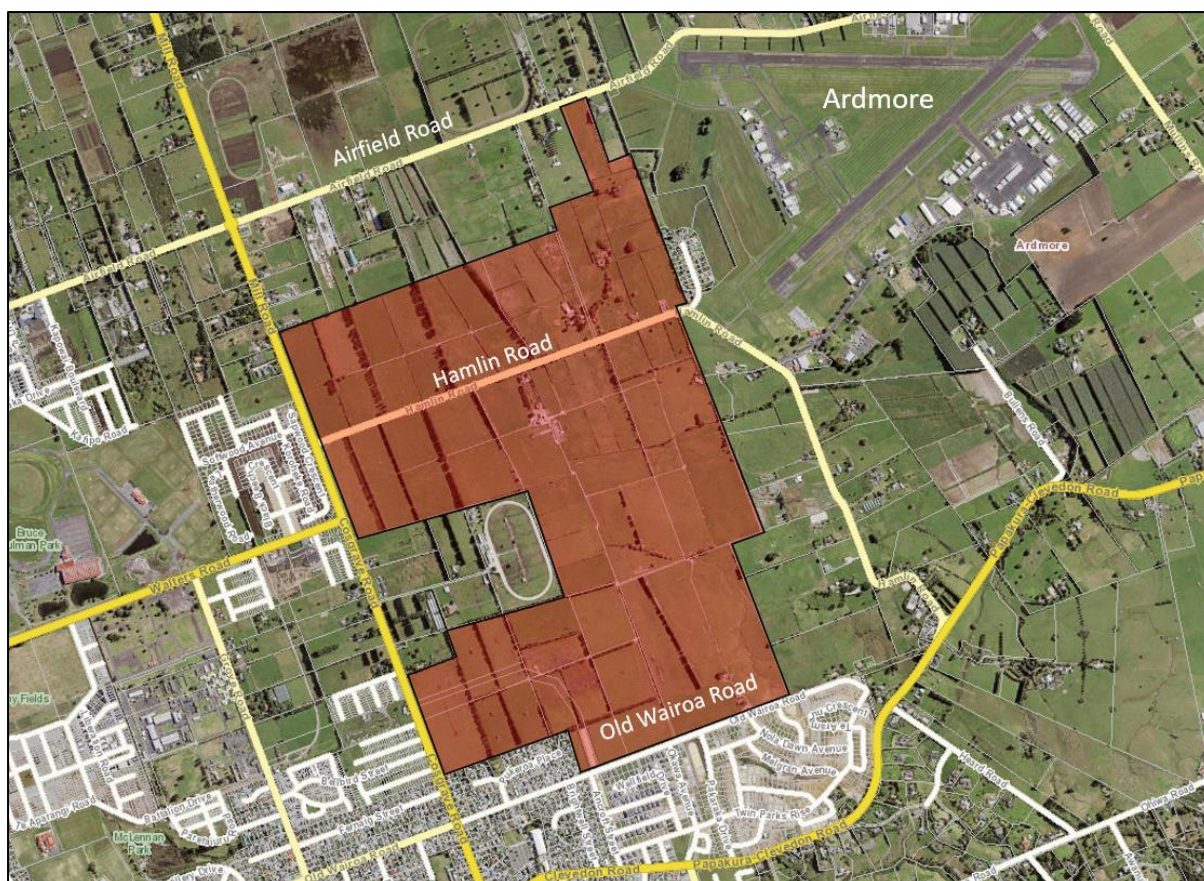


Figure 1. Location of the site (in red) between Airfield and Old Wairoa roads, Ardmore.

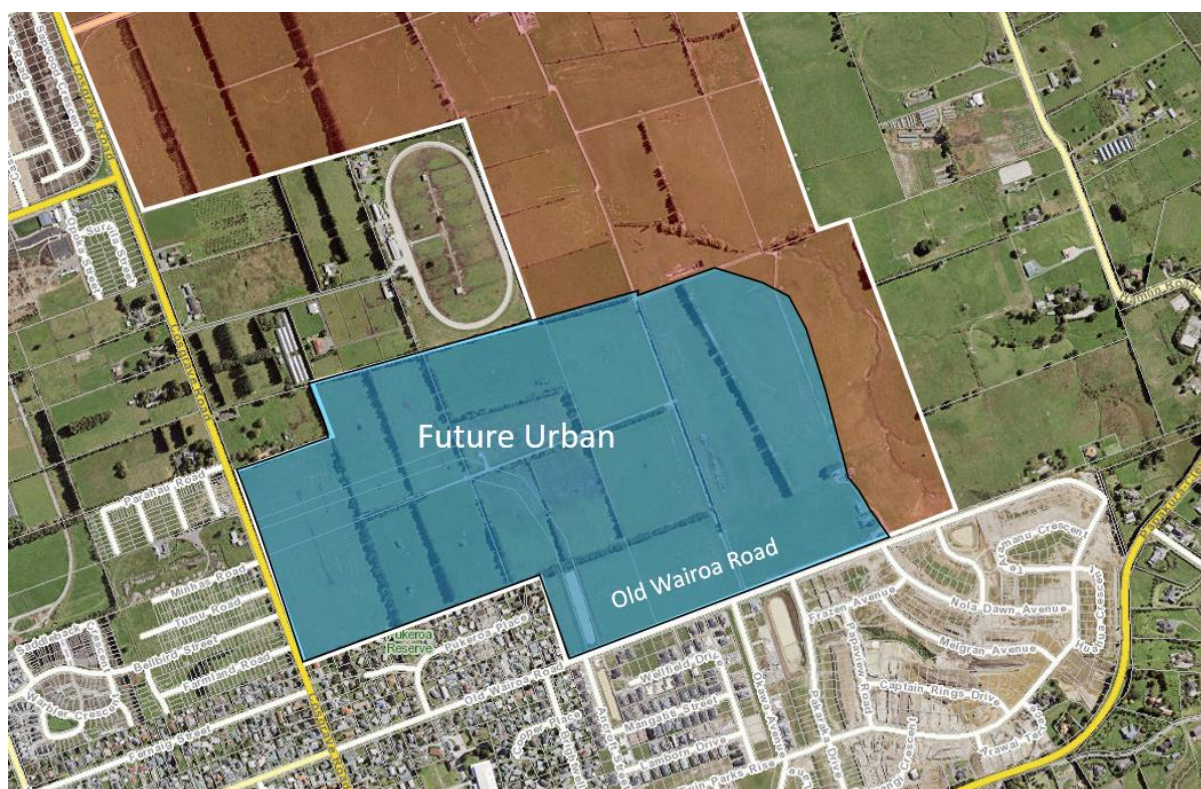


Figure 2. Within the site is an area zoned for future urban development (marked in blue).

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 was used to place the land into elite, prime or other productive land 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 mid-November 2020. Dr Singleton has over 35 years experience mapping land for LUC and soil assessments.

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 Unitary Plan 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 Manukau City map (unpublished) 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 Land Use Capability (LUC) units used for this site are primarily based on those in the New Zealand Land Resource Inventory (NZLRI), Waikato Region Land Use Capability Classification (Ministry of Works and Development- v 1.2 1983 & Jessen 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'.

The site was located on mainly flat to gently undulating lowland which had poorly drained soil types. This land composed the bulk of the site. This land was in pasture or market gardening. The low terrace in the northeast also had a flat to gently undulating surface and was well drained. The hill in the southeast had undulating lower slopes and top, with rolling sides. The western side of the hill sloped down to the lowland, in the east it sloped to a narrow ephemeral creek with steep sides.

For this property, the relevant LUC units in the locality were identified (using NZLRI) and used for the map of the site. The majority of the site was LUC Class 2 (60.2 %) and occurred on the lowland and undulating hill slopes. Class 3 land (37.6 %) occurred on the lowland in the eastern part of the site, and on rolling hill slopes. Land in buildings, accessways and creek were all unsuitable for agricultural production (2.2 %).

LUC class 2s4 land occurred on flat to gently undulating (0 to 3 degrees) tops of a low terrace located in the northeast of the site (Figure 3) and about five metres above the lowland. The terrace was from volcanic material deposited as alluvium and dunes. Also, on the terrace were undulating slopes (LUC class 2e4, 4 to 7 degrees), but these were too small to map. All these LUC units were well to moderately well drained Karaka soils and had nil to negligible erosion hazard. They were friable silt loam soils capable of continuous cultivation and suited to a variety of produce uses.

LUC class 2w2 land was poorly drained lowland (Figure 4). These were Ardmore soils from peat, or Clevedon soils which had a peaty influence. In places the peat contained buried kauri stumps and logs.

Subsidence, acid conditions and low fertility are limitations for these soils, addition to poor drainage and high water tables. Also on the lowland were LUC class 3w2 Clevedon soils from poorly drained clay (Figure 5). The clay has heavy and very sticky. The soils had a seasonally high water table and some also received slope runoff. The limitations of this LUC class 3 and 3 land limits its productive potential and versatility for agricultural use.

On undulating hill slopes and hill top was class 2e5 land. On the rolling hill sides (8 to 15 degrees) was LUC class 3e4 land (Figure 4). Soil were imperfectly drained Brookby clay soils from weathered sandstone. They were heavy clay soils and very sticky.

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 a map of the LUC classes for the site.



Figure 3. LUC Class 2s4 land on a flat to undulating terrace, Hamlin Road.



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



Figure 5. LUC Class 3 land looking southeast toward Old Wairoa Road.

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

Soil type	Waikato LUC	Farm LUC	Features
Karaka	2s4	1c	Well to moderately well drained flat to gently undulating slopes
Clevedon			Poorly drained flat to gently undulating slopes
- Typic	3w2	3a	○ Clay
- Humose	2w2	2w	○ Humic clayey top
- Peaty	2w2	2w	○ Humic clayey top on shallow buried peat
Brookby	2e5	2p	Undulating slopes, imperfectly drained clay
Brookby	3e4	3e	Rolling slopes, imperfectly drained clay
Ardmore	2w2	2w	Poorly drained flat to gently undulating slopes, peat

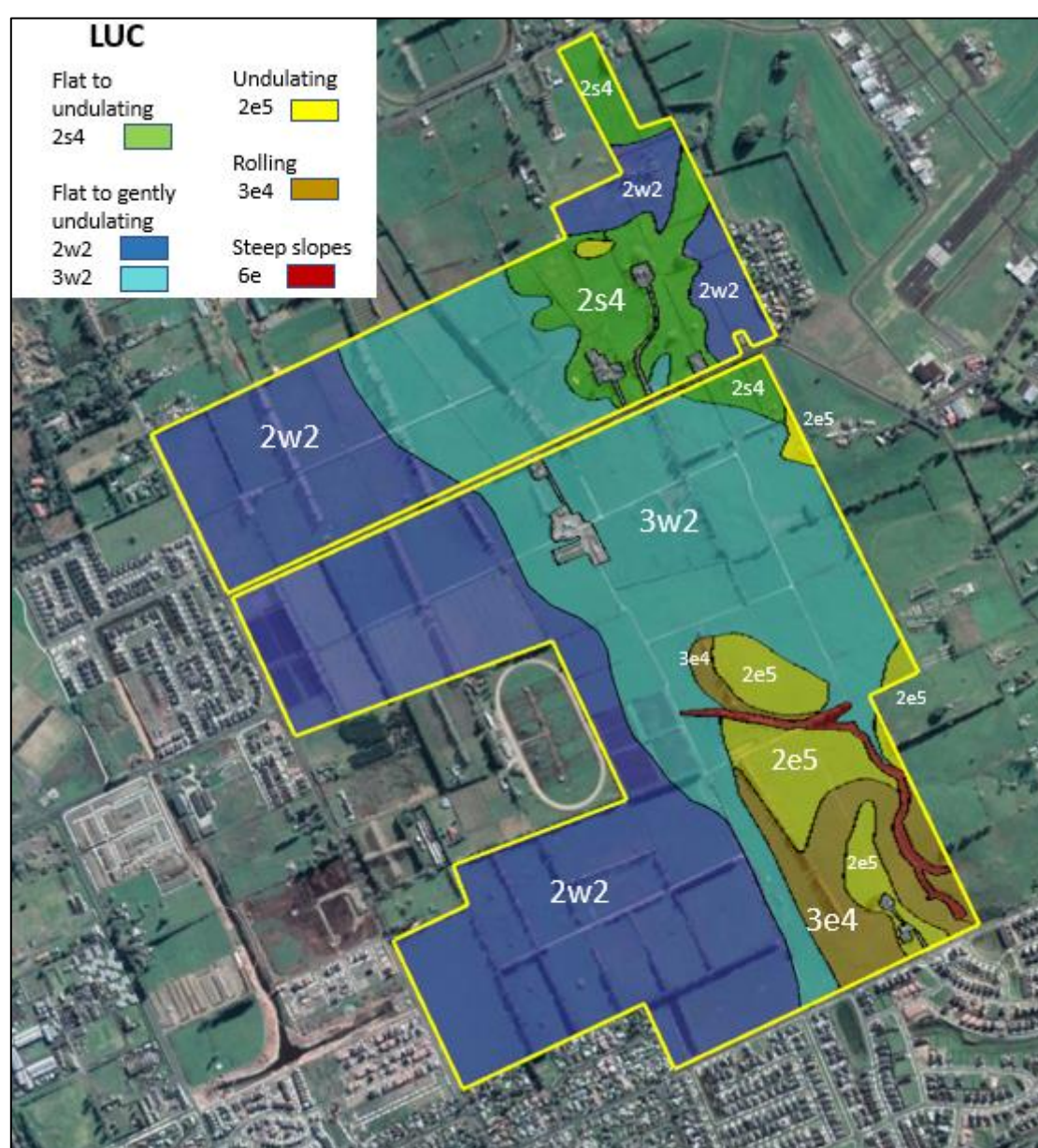


Figure 6. LUC classes for the site.

SOILS AT THE SITE

Field investigations showed the soil in the western half of the site was mainly poorly drained Ardmore peaty loam and Clevedon soils with a peat influence. In the east was the poorly drained Clevedon clay. Karaka soils from volcanic material occurred on the low terrace in the northeast and Brookby soils on the sandstone hill in the southeast.

Ardmore peaty loams are formed from completely decomposed peat which can have buried layers of alluvium. Topsoils are very dark brown loamy peat or humic silt loam on soft black clayey peat. Watertables are high, even in summer, and the soil is wet for prolonged periods. These poorly drained soils have poor natural fertility, are difficult to drain and prone to subsidence and pugging damage.

Clevedon soils occurred on the lowland and have a high water table in winter and spring. There are several types of Clevedon soil. They are all poorly drained soils and ponding can be an issue. The most common Clevedon soil is the Clevedon clay loam. These occur in the east and are from clay alluvium and colluvium. The soils have dark greyish brown clay loam topsoils and light grey sticky clay subsoils with yellowish brown mottles. They have firm sticky clay subsoils which can be plastic and soft when moist. In places there may be a very dark brown humic stained clay layer in the lower subsoil. When wet they are easily damaged by stock, vehicles and cultivation. Even with drainage they remain difficult soils to manage.

The Clevedon humic silt loam and peaty loam occur on the edge of the Ardmore loamy peat. The humic silt loam had a former peat cover which has now completely decomposed. This gives the soil a dark colour and higher organic content than usual. Clevedon humic silt loams had 20 cm of very dark grey humic silt loam topsoil on dark brown humic clay loam or clay upper subsoil. The lower subsoil was often black humic clay or peaty clay which was soft, slightly sticky and plastic. These are poorly drained soils, but the high organic content of the topsoil and upper subsoil creates a finer soil structure that is often friable. This improves their ability to drain. Lower subsoils are moderately sticky and plastic when moist. These soils are prone to wetness unless drained and have low natural fertility. They are best suited to pasture and some drained areas can be suitable for market gardening at drier times of the year.

The Clevedon peaty loam occurs on the edge of the Ardmore peat where the surface peat cover is thin (less than 30 cm) or buried (less than 60 cm deep). The soil has a peaty loam or humic silt loam topsoil. This is on very dark brown humic silt loam to humic silty clay upper subsoil on black completely decomposed soft clayey peat. These soils are prone to wetness unless drained and have low natural fertility. Water tables are often high, even in summer.

Karaka 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 soils. Topsoils are very dark greyish brown friable silt loam on a yellowish brown friable silt loam upper subsoil. The topsoil and upper subsoil are non-sticky and friable even when wet. Firm yellow clay from the older material can be encountered from 60 to 80 cm depth. Those that are moderately well drained have yellow mottles in the lower subsoil. Karaka soils are ideal for a wide range of uses including horticulture, vegetable growing, cropping and pasture.

Brookby soils are imperfectly drained and occur on the hills on a variety of slopes. They are clay soils from deeply weathered sandstone. Topsoils are brown silt loam or clay loam on very firm yellow clay upper subsoil with pale brown mottles. This is on a lower subsoil of very firm very pale brown clay with brownish yellow mottles. The subsoil clay is very sticky when wet. Brookby soils are soft and plastic when wet and hard and firm when dry. They are mainly suited to pasture and forestry and not suited to cultivation.

Figure 7 shows examples of soils from the site, Table 2 shows soil and land characteristics, and Figure 8 shows the soil map for the site.

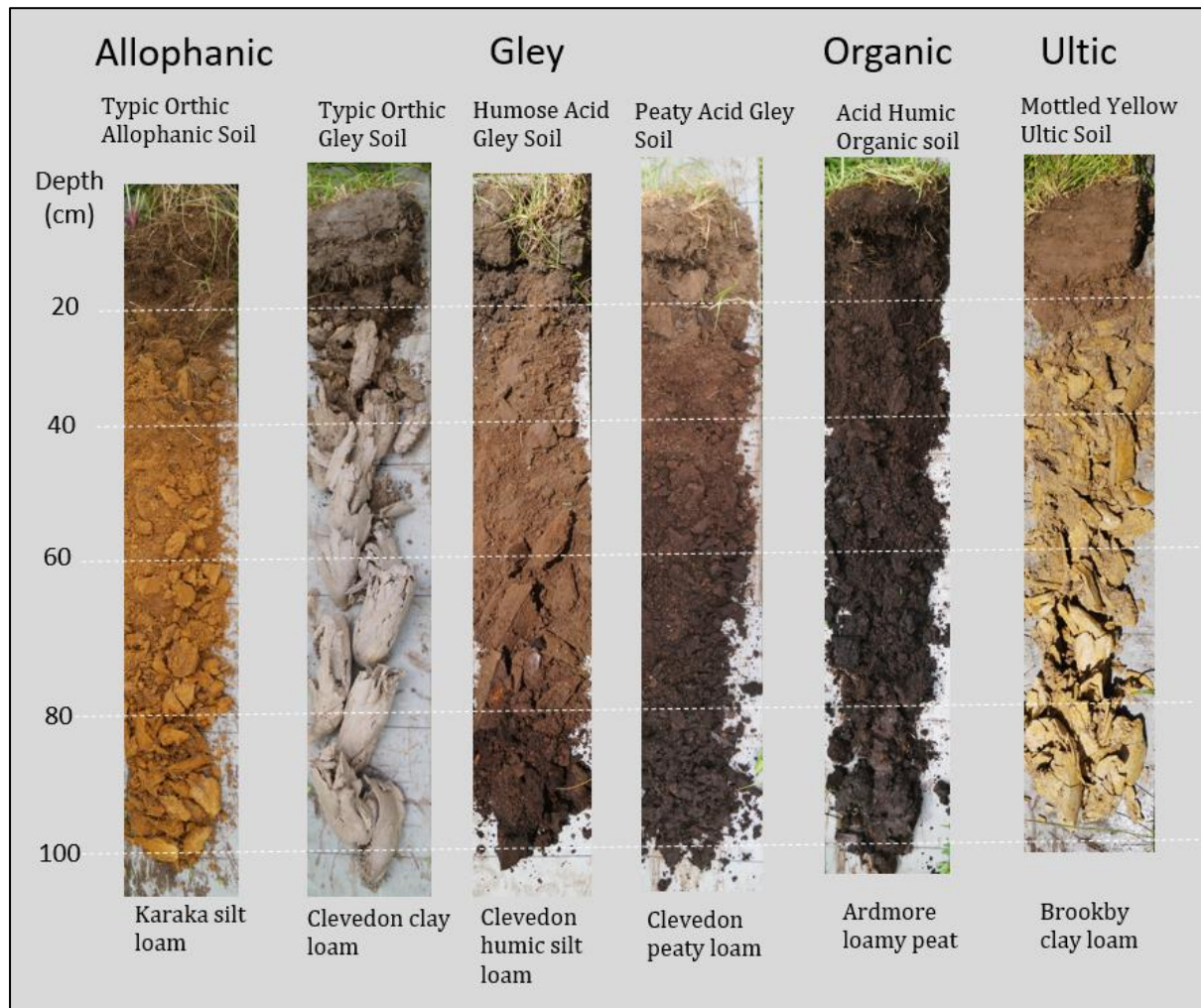


Figure 7. Soils at the site.

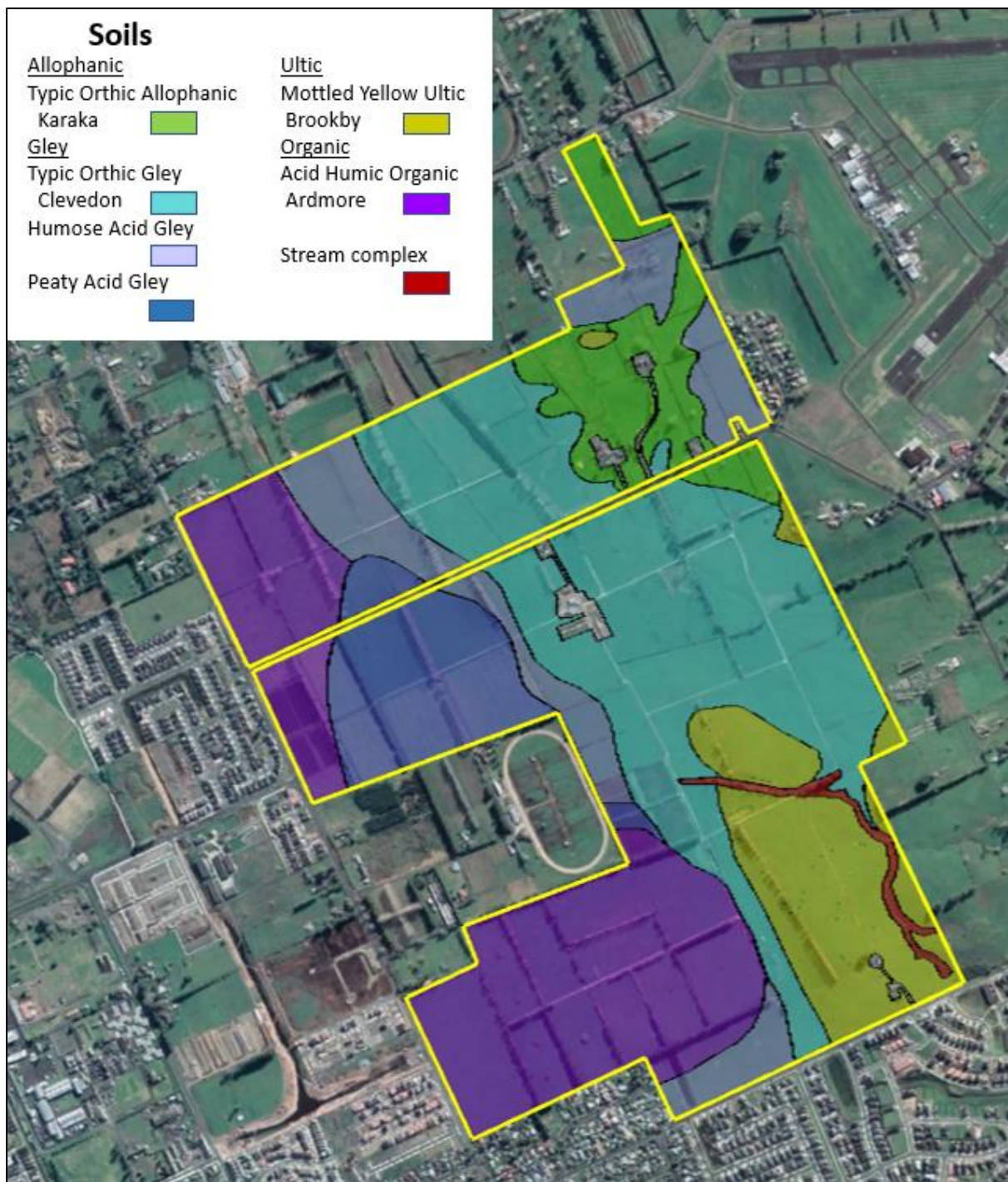


Figure 8. Soil map of the site.

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

Soil type	Soil Order	Soil subgroup	Drainage class	Soil material
Karaka silt loam	Allophanic	Typic Orthic Allophanic Soil	Well or moderately well drained	Silt loam from volcanic material
Clevedon clay loam	Gley	Typic Orthic Gley	Poorly drained	Clay loam on clay from alluvium and colluvium
Clevedon humic silt loam	Gley	Humose Acid Gley Soil	Poorly drained	Humic silty clay on clay from alluvium
Clevedon peaty loam	Gley	Peaty Acid Gley soil	Poorly drained	Humic silt loam on humic silty or humic clay alluvium on peat
Ardmore loamy peat	Organic	Acid Humic Organic soil	Poorly drained	Decomposed peat and alluvium
Brookby clay loam	Ultic	Mottled Yellow Ultic soil	Imperfectly drained	Clay loam or silt loam on firm clay from sandstone

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.*

The area investigated had Karaka soils on flat to gently undulating slopes (LUC class 2s4). Karaka soils are well drained, friable silt loam soils capable of continuous cultivation. They were assessed as 'Elite land' as per the Unitary Plan definition and correspond to Auckland Council's Farm LUC 1c unit (Table 1).

Imperfectly or poorly drained soil types (Ardmore, Clevedon & Brookby) made up the remaining LUC class 2 or 3 land. These soils had drainage issues and additional limitations such as high clay contents (Clevedon, Brookby), acid conditions (Clevedon, Ardmore), subsidence risk (Ardmore) or rolling slopes (Brookby). Because of these limitations they were productive soils but were not Elite or Prime land.

'Non-productive land' was areas of stream, farm track and buildings not suitable for agricultural production.

Tables 3 and 4 show characteristics of the LUC classes and how they relate to Elite and other land types. The map of Elite, 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	nil	Well & moderately well	Elite land
3w2	Clevedon clay	Flat to gently undulating	nil	Poor	Other
2w2	Clevedon humic & peaty	Flat to gently undulating	nil	Poor	Other
2w2	Ardmore	Flat to gently undulating	nil	Poor	Other
2e5	Brookby	Undulating	Slight	Imperfect	Other
3e4	Brookby	Rolling	Slight to moderate	Imperfect	Other
6e	Stream complex	Strongly rolling to steep	Moderate to severe	Imperfect to poor	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	16.3	8.1	Elite land
3w2	Clevedon clay	Flat to gently undulating	64.7	31.9	Other
2w2	Clevedon humic	Flat to gently undulating	22.3	11.0	Other
2w2	Clevedon peaty	Flat to gently undulating	19.4	9.6	Other
2w2	Ardmore peat	Flat to gently undulating	51.4	25.4	Other
2e5	Brookby	Undulating slopes	12.6	6.2	Other
3e4	Brookby	Rolling slopes	11.5	5.7	Other
6e	Stream complex	Strongly rolling to steep	2.1	1.0	Non-productive
	Buildings and accessways		2.3	1.2	
Total			202.7	100	

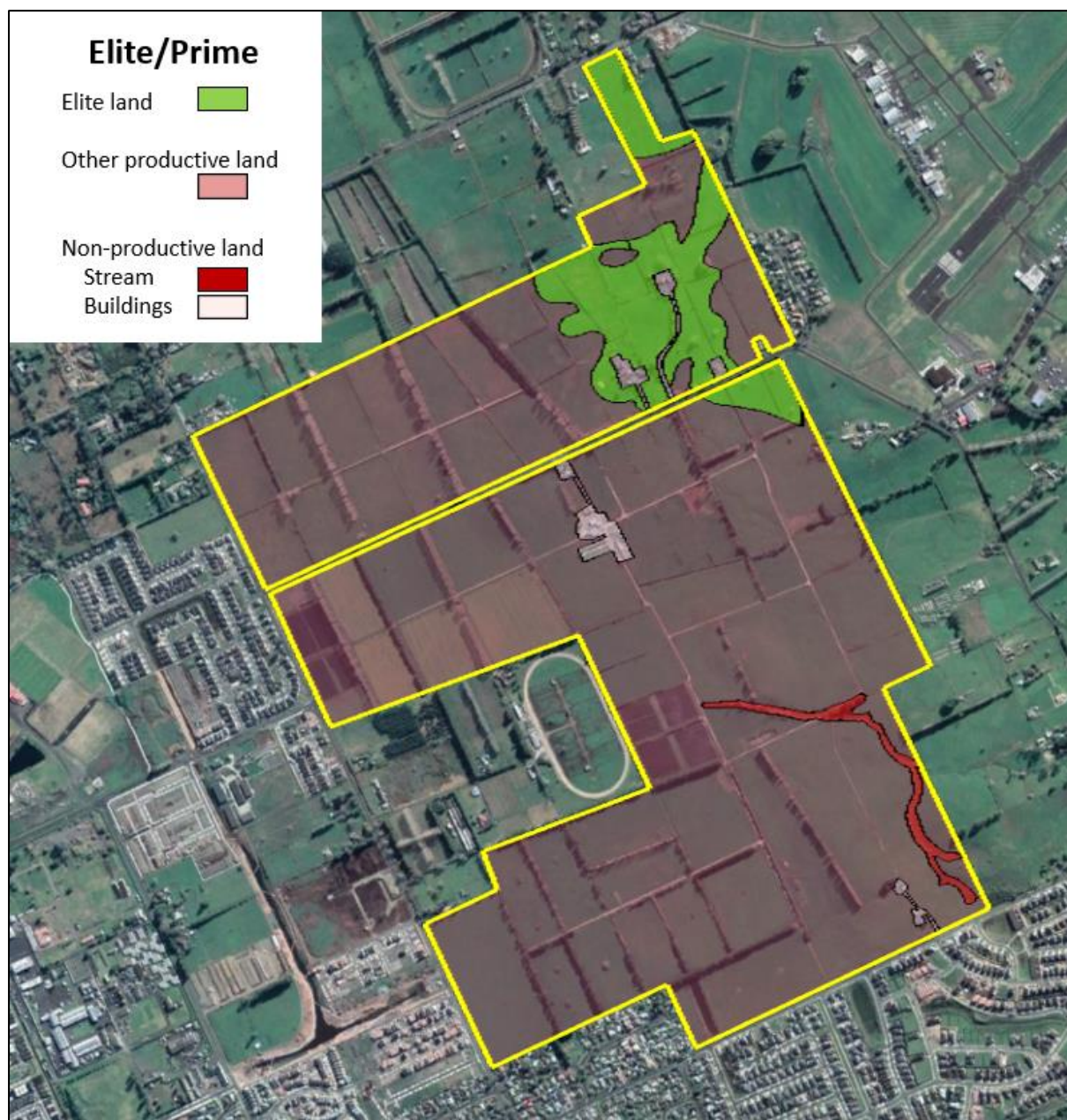


Figure 9. Elite and other land within the site. No prime land was present at the site.

PROPORTIONS OF ELITE AND PRIME LAND

The area and proportions of Elite, 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.

Elite land was 8.1 % of the site and located mainly in the northeast on Karaka soils between Airfield and Hamlin roads. There was no prime land. Other productive land was 89.7 % of the site and non-productive land was 2.2 %.

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

Land type	hectares	%
Elite land	16.3	8.1
Prime land	0.0	0.0
Other productive land	181.9	89.7
Non-productive	4.5	2.2
Total	202.7	100

The majority of the site was composed of land which was neither elite nor prime. The soils had a range of physical and chemical limitations which meant they unsuitable for a variety of agricultural uses. Urban growth onto these soils is preferable to using land with fewer limitation, or land which is elite or prime.

CONCLUSIONS

The site was predominantly LUC class 2 land with some LUC class 3 land. Most of the soils had drainage issues and additional limitations such as clay, acid conditions, subsidence or rolling slopes. Because of these limitations they were assessed as productive soils but not Elite or Prime land. This land was 89.7 % of the area.

Some LUC class 2 land was well to moderately well drained and on flat to gently undulating slopes. The soil was silt loam, friable and suited to a wide range of uses. This land was assessed as Elite land. Elite land composed 8.1 % of the area.

Non-productive land was 2.2 % of the area.

REFERENCES

- Hewitt, A.E. 2010. New Zealand Soil Classification 3rd edition. Landcare Research Science series No 1. Manakē Whenua Press.
- Hicks, D and Vujcich, V. 2017. Farm-scale land use capability classification for Auckland. Auckland Council technical report, TR2017/016
- Jessen M R 1984. Additions to NZLRI South Auckland - Waikato region land use capability extended legend (2nd edition). Unpublished document, Water & Soil Division, MWD
- Lynn, I., Manderson, A., Page, M., Harmsworth, G., Eyles, G., Douglas, G., Mackay, A. & Newsome, P. 2009. Land Use Capability Survey Handbook. A New Zealand handbook for the classification of land- 3rd edition, 163p; AgResearch Ltd, Hamilton; Landcare

Research New Zealand Ltd, Lincoln; Institute of Geological and Nuclear Sciences Ltd,
Lower Hutt.

Milne J D G., Clayden B., Singleton PL., & Wilson AD. 1995. Soil Description Handbook -
Revised Edition. 157 p; Manaki Whenua Press, Lincoln, Canterbury, NZ.

Schofield, J.C. 1973. Geological Map of New Zealand, sheet 3 – Auckland. 1:250,000.