

Land Use Capability classification assessment

'The Rest' site (55 ha)

(1073 Tauwhare Road)



Prepared for:	Shannon Leigh Trust
Prepared by:	Dr Tanya O'Neill
Reviewed by:	Dr Reece Hill
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1. Introduction

Landsystems undertook an on-site Land Use Capability (LUC) classification assessment of ‘The Rest’ proposed development site at 1073 Tauwhare Road, Tauwhare 3287 (the **Site**), to confirm the soils and LUC units at property scale, the presence of Waikato District Plan-Operative in Part defined high class soils, and highly productive land as defined by the National Policy Statement for Highly Productive Land.

Site Description

The Site is approximately 55 ha of predominantly flat to undulating land with some rolling topography and is situated within the Waikato District **Figure 1**. The Site is predominantly pasture with some area of non-productive land, and no notable stands of vegetation. The Site is accessed from Tauwhare Road to the south and east.

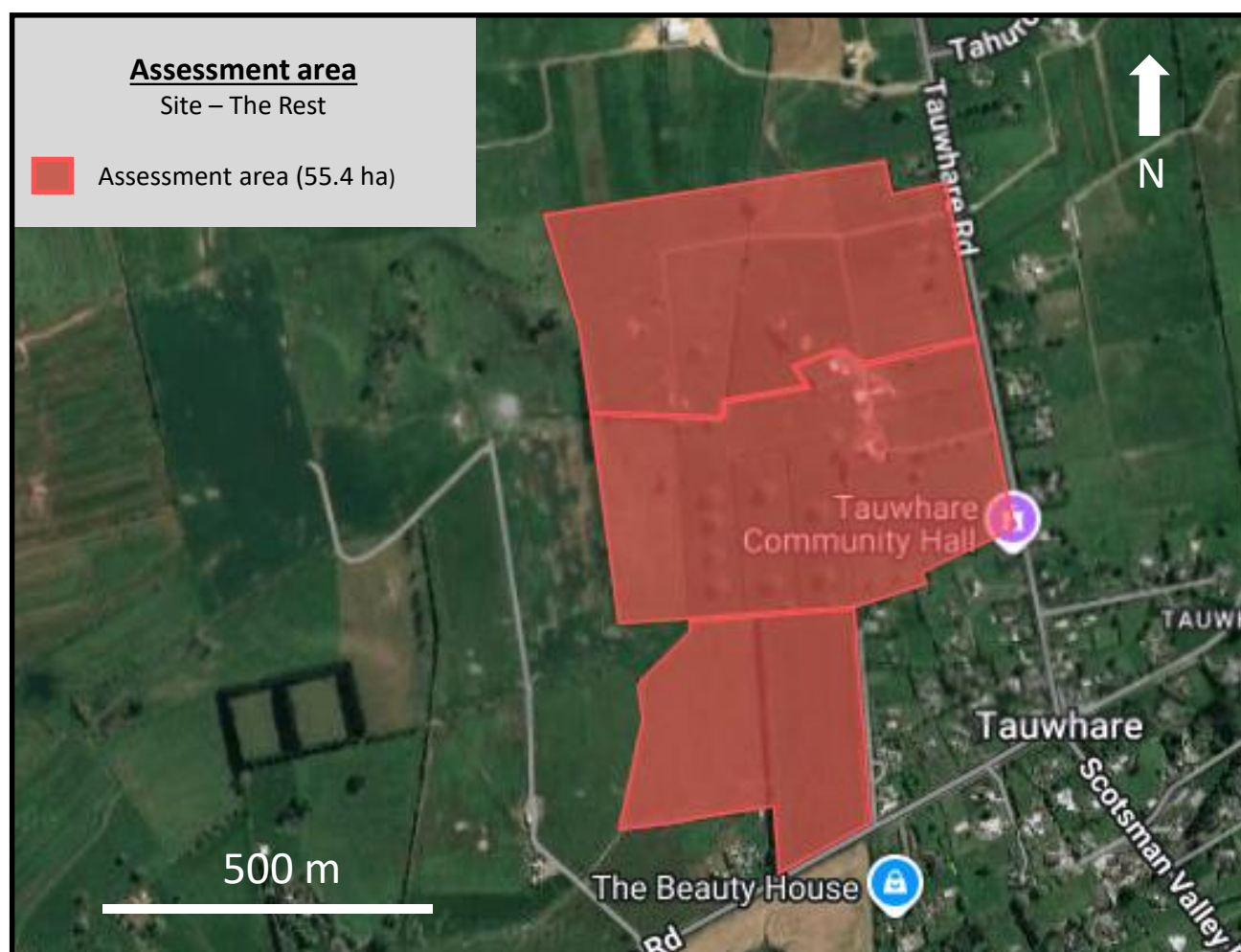


Figure 1: Site locality plan.

The Project

The proposal comprising an agri-education institute, rural lifestyle lots, a retirement village, small commercial centre, and storage facilities seeks to respond to the Waikato District Plan by providing a consolidated, well masterplanned development that:

- Supports rural education, employment and training opportunities;
- Provides lifestyle living options that maintain the rural character;

- Delivers community scale commercial and service functions that complement the Tauwhare community; and
- Integrates built form, open space, and landscape outcomes appropriate to the site's rural setting.

2. LUC background

LUC classification is the common method for assessing land in New Zealand; it uses the Land Use Capability System, which is part of the New Zealand Land Resource Inventory (NZLRI) as produced by the Water and Soil Division of the Ministry of Works, for the National Water and Soil Conservation Organization during the 1970s. In 2009 the 3rd Edition of the LUC Survey Handbook¹ was published and has been used for this assessment. The LUC uses a systematic arrangement of different kinds of land according to those properties that determine its capacity for permanent sustained production, where the word "capability" is used in the sense of "suitability for productive use" after taking into account the physical limitations the land may have.

The LUC classification is specifically designed to provide an index of versatility. There are eight LUC classes (**Figure 2**) arranged in order of increasing degree of limitation or hazard to use; and a decreasing order of use, from Class 1 to 8.

Increasing limitations to use ↓	LUC Class	Arable cropping suitability†	Pastoral grazing suitability	Production forestry suitability	General suitability	Decreasing versatility of use ↓
	1	High ↓ Low	High ↓ Low	High ↓ Low	Multiple use land	
	2					
	3					
	4					
	5	Unsuitable	Low ↓ Unsuitable	Low ↓ Unsuitable	Pastoral or forestry land	
	6					
	7					
8						
		Unsuitable	Unsuitable	Conservation land		

Figure 2: Increasing limitations to use and decreasing versatility of use from LUC Class 1-8.

Within each LUC Class the land is assigned a subclass according to the kind of limitation (e = Erodibility, w = Wetness, s = Soil limitations within the rooting zone, c = Climate). At the most detailed level LUC groups together those inventory units which respond similarly to the same management, and which are suitable for the same kinds of crops, pasture, or forest species with the same potential yield and which require the application of the same conservation measures.

¹ 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.

The LUC worksheets were compiled from all relevant databases of land resource documents available at the time, consequently some sheets suffered from a lack of information that only detailed soil and geological surveys could have provided. Therefore, there are **scale limitations**, which need to be considered, especially when interpretation is required at the individual property scale.

The LUC units displayed on the 1970s worksheets remain reasonably robust but are subject to change. For example, the second edition (1993) Northland region worksheets were mapped at the more detailed scale of 1:50 000, replacing the earlier first edition 1:63,360 maps. In the first edition, 69 LUC units were defined compared with 91 LUC units in the second edition - about 60 of the first edition classification units changed.

The average area for a map unit is 125 ha, however, at the 1:50 000 scale of mapping it is theoretically possible to delineate an unhooked inventory map unit (no vinculum) area of 60 ha (60 ha = 600 m by 1000 m) provided the geology, soil, vegetation, erosion and slope are uniform.

The **purpose of this background information** is to illustrate and emphasise that the NZLRI information provides excellent physical base data for planners (a planning tool) but is not fit for purpose as a plan (map) unless undertaken at the correct scale. The on-site soil LUC assessment fulfils that purpose.

3. Waikato District Plan definition of high class soil

Under the Waikato District Plan-Operative in Part (WDP-OiP) definition², high class soils are defined as:

those soils in Land Use Capability Classes I and II (excluding peat soils) and soils in Land Use Capability Class IIle1 and IIle5, classified as Allophanic Soils, using the New Zealand Soil Classification.

4. National Policy Statement for Highly Productive Land 2022

The National Policy Statement for Highly Productive Land 2022 (NPS-HPL) came into force on the 17th of October 2022. The NPS-HPL was amended in December 2025, with amendments taking effect from 15 January 2026.³

“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).

Our 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

² <https://eplan.waikatodistrict.govt.nz/>

³ Ministry for the Environment. 2025. National Policy Statement for Highly Productive Land 2022 (consolidated with December 2025 amendments). Ministry for the Environment. Wellington.

3.5. Under the December 2025 amendments, the deadline for regional councils to undertake this mapping was extended to 31 December 2027 (clause 4.1(2)).⁴ 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:

(a) is

(i) zoned general rural or rural production at the commencement date; and

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

(b) is not:

(i) identified for future urban development at the commencement date; 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 at the commencement date; or

(iii) subject to a resource consent application for subdivision, use or development on LUC 3 land for any activity other than rural lifestyle, where that consent has been lodged at or after the commencement date.

The NPS-HPL includes the following definition of LUC 1, 2, or 3 land:

“LUC 1, 2, or 3 land means land identified as Land Use Capability Class 1, 2, or 3, as mapped by the New Zealand Land Resource Inventory, or by any more detailed mapping in place at the commencement date that uses the Land Use Capability classification”.

Of relevance to this application, under clause 3.5(7)(b)(iii), LUC 3 land is excluded from the interim HPL definition where a resource consent application for any activity other than rural lifestyle has been lodged on or after 17 October 2022. For the purposes of this application, LUC 3 land identified by the on-site assessment must still be treated as HPL under the interim clause 3.5(7) definition. However, the December 2025 amendments signal a clear policy direction that LUC 3 land is not intended to carry the same level of protection as LUC 1 and 2 land.

5. Non-productive land and modified areas

For an accurate assessment of LUC classification for a property, the assessment should be based on the current condition of the area (i.e. mapped in current state). This is important because some land management practices (e.g. the placement of tracks, excavation of drains, and general earthworks) result in irreversible changes to the soil (i.e. changes other than those that can be remediated by management practices and return the soil to its intrinsic state). These areas are referred to as non-

⁴ “...regional councils are not required to undertake mapping of highly productive land in regional policy statements as required under clause 3.5 prior to 31 December 2027.”

productive land. Examples of non-productive land include native vegetation, wetlands and riparian areas, tracks, and buildings and curtilage.

Non-productive land can include areas where the soil has been modified by truncation, placement of fill or extensive mixing. Where these areas do not resemble a functioning soil, the areas are not considered to be available for primary production (i.e. they are non-productive land). Where these areas do resemble a functioning soil (such as the reinstatement of a soil profile following gravel extraction) the land can be assigned a LUC classification.

For this assessment the productive area of the site (to which the LUC classification can be applied) is the Site area excluding non-productive land.

6. Regional scale soil and LUC map information

An initial desktop LUC assessment was undertaken for the Site. Available map information, soil reports and geospatial data included:

- New Zealand Land Resource Inventory (NZLRI) layers, including the New Zealand Fundamental Soil Layer (NZFSL) and Land Use Capability Layer (providing map units of dominant soil type and LUC unit)⁵
- S-Map Online (providing map units of Soil Siblings)⁶

Of the available map information sources, the S-Map Online soil map information, NZFSL and NZLRI map information are at a regional scale (approximately 1:50,000 scale).

NZLRI (1:50,000 scale) soil and LUC classification

Based on the available NZLRI and NZFSL map information the soils and LUC units the Site are mapped as shown in **Figure 3**. Available NZLRI map information maps the property⁷ as predominantly the Te Kowhai silt loam and peaty silt loam on flat to gently undulating slopes. The parent material of these soils is a combination of peat and the 'Hinuera Formation', namely, rhyolitic alluvial deposits deposited by the Ancestral Waikato River.⁸ The subdominant soil within the Site is the well drained Horotiu sandy loam on flat to undulating slopes. These soils and LUC units are mapped to occur in the northwest and northeast of the Site. The parent material of these soils is the Hinuera Formation⁹. There is a small, isolated area of Hamilton clay loam mapped in northwestern corner of the Site on strongly rolling slopes. The parent material of these soils is older, strongly weathered 'Hamilton Ash Formation'.

The Site contains 62% (or 34.6 ha) poorly drained Te Kowhai silt loam and peaty silt loam (Gley Soil) on flat to gently undulating slopes (0-3°) with an LUC classification of LUC 2w3. Thirty-seven percent

⁵ <https://iris.scinfo.org.nz/layer/48076-nzlri-land-use-capability-2021/>

⁶ <https://smap.landcareresearch.co.nz/maps-and-tools/app/>

⁷ <https://iris.scinfo.org.nz/layer/48134-nzlri-north-island-edition-2-all-attributes/>

⁸ McLeod M. 1992. Soils of part northern Matamata County, North Island, New Zealand. DSIR Land Resources Scientific Report No. 18.

⁹ McLeod M. 1992. Soils of part northern Matamata County, North Island, New Zealand. DSIR Land Resources Scientific Report No. 18.

(or 20.8 ha) of the Site comprises well drained Horotiu sandy loam (Allophanic Soil) on flat to undulating slopes (0-7°) with an LUC classification of LUC 1s1. Less than one percent (or 0.07 ha) of the Site comprises moderately well drained Hamilton clay loam (Granular Soil) on strongly rolling slopes (16-20°). These map units have an LUC classification of LUC 4e2.

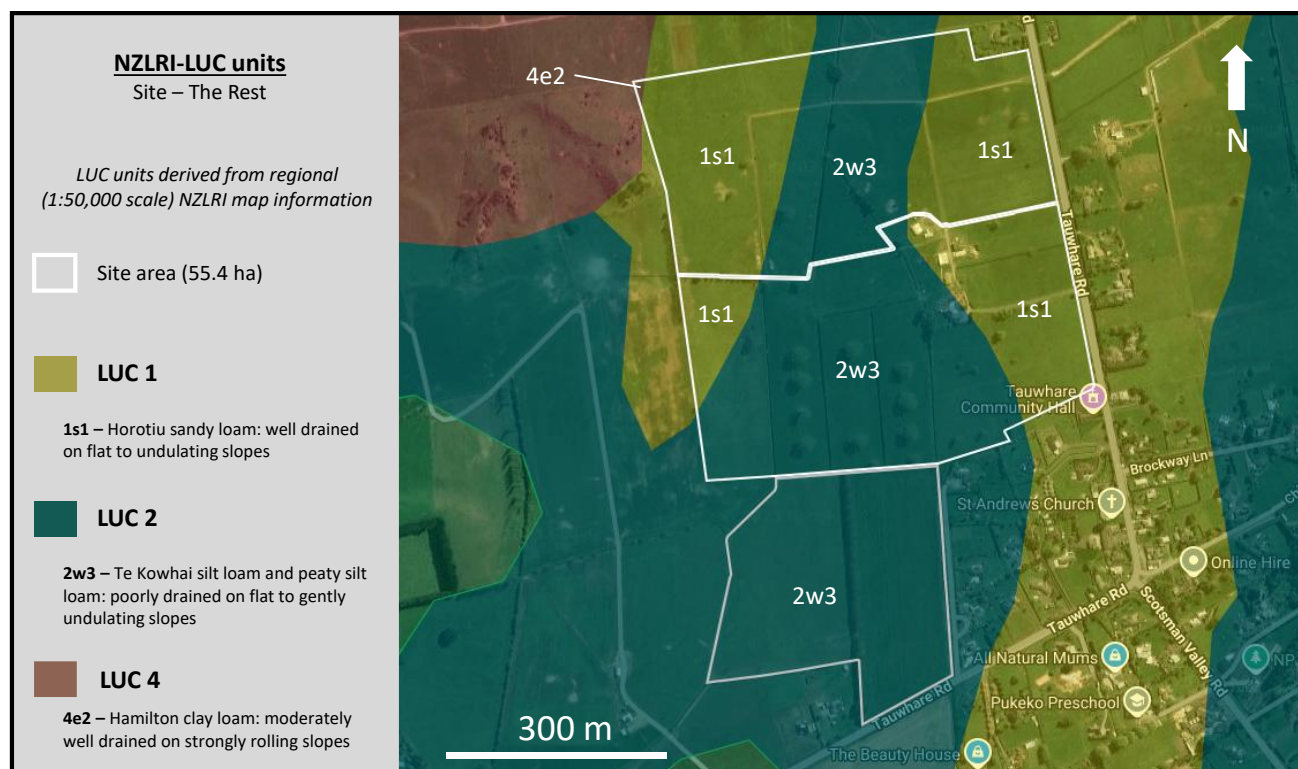


Figure 3: LUC units for the Site, derived from regional scale NZLRI-LUC map information.

Table 1 gives the general characteristics of the soils and LUC units as mapped in **Figure 3**. The approximate % cover of these regional NZLRI derived LUC units were estimated using Google MyMaps.

Table 1. Summary of the NZLRI soil and LUC map unit characteristics and approximate % cover (estimated from **Figure 3**) of regional NZLRI derived LUC units within the Site.

Soil type (NZSC Soil Order)	Parent material	Soil drainage	Slope class	LUC unit (limitation)	Area of total assessment area ha (%)*
Horotiu sandy loam (Allophanic Soil)	Hinuera Formation alluvial sediments	Well drained	A +B	1s1 (soil)	20.8 (37)
Te Kowhai silt loam and peaty silt loam (Gley Soil)	Hinuera Formation alluvial sediments and peat	Poorly drained	A	2w3 (wetness)	34.6 (62)
Hamilton clay loam (Granular Soil)	Strongly weathered “Hamilton Ash Formation”	Moderately well drained	D	4e2 (erosion)	0.07 (<1)

*% areas rounded to whole number.

Based on the available NZLRI and NZFSL map information the majority of the assessment area is a poorly drained Te Kowhai silt loam and peaty silt loam on flat to gently undulating slopes and classified as LUC 2w3 (62% of the Site); with an area comprising well drained Horotiu sandy loam on flat to undulating slopes and classified as LUC 1s1 (37% of the Site); and a small area of moderately

well drained Hamilton clay loam, on strongly rolling slopes classified as LUC 4e2 (less than 1% of the Site) (**Table 1**).

S-Map Online

The S-Map soil map information is sourced from S-Map Online and is mapped at 1:50,000 scale. S-Map soil polygons are only available on the S-Map Online website. The soil names for each map unit are “soil siblings”, with a probability of occurrence (%) and certainty rating provided for each soil sibling in a map unit.

S-Map Online identified the majority of the soils in the assessment areas as Gley Soils (62%), Brown Soils (20%), Allophanic Soils (16%), Granular Soils (less than 1%) and Ultic Soils (less than 1%) (**Figure 4** and **Table 2**).

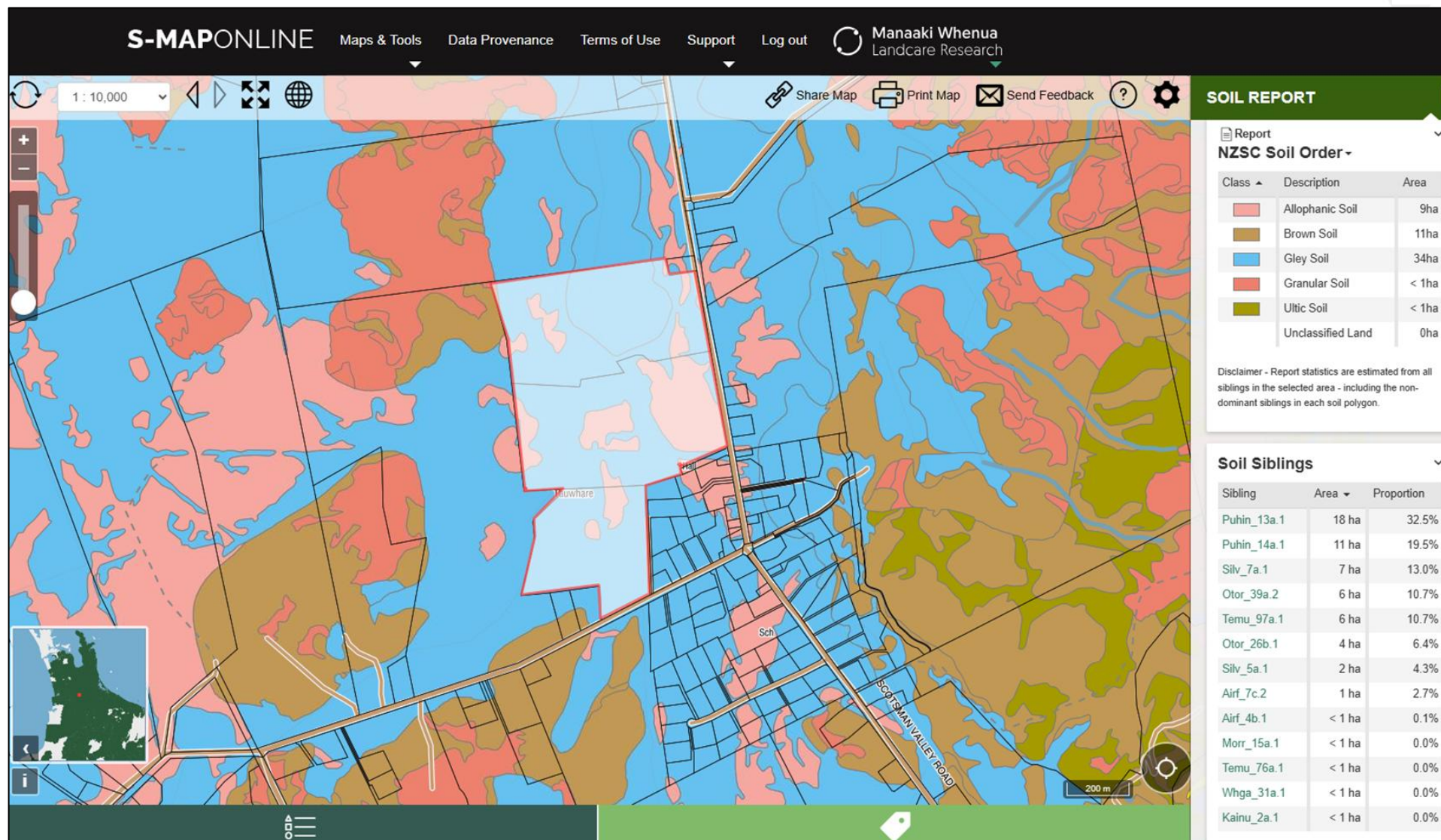


Figure 4: S-Map soil (Soil Order and soil sibling) distributions for the Site.

Table 2 provides a summary of the S-Map soil sibling map unit characteristics, including S-Map Family, S-Map Sibling, correlating Soil Series name, NZSC Soil Order, soil drainage, and their approximate proportions, for the Site. All soils are deep (> 100 cm), have either silt loam or clay loam textures, with variable drainage. This information is derived from S-Map Online factsheets and can be sourced from the S-Map Online website¹⁰.

Table 2. S-Map soil sibling map unit characteristics for the Site.

S-Map Family	S-Map Sibling	Soil Series name	NZSC (Soil Order)	Soil drainage	Proportion (%)
Pukehina	Puhin_13a.1	Te Kowhai	Gley (GOT)	Poorly drained	32.5
Pukehina	Puhin_14a.1	Te Kowhai	Gley (GOT)	Poorly drained	19.5
Silverdale	Silv_7a.1	Bruntwood	Brown (BOM)	Imperfectly drained	13.0
Otorohanga	Otor_39a.2	Horotiu	Allophanic (LOT)	Well drained	10.7
Temuka	Temu_97a.1	Topehaehae	Gley (GOT)	Poorly drained	10.7
Otorohanga	Otor_26b.1	Horotiu	Allophanic (LOT)	Moderately well drained	6.4
Silverdale	Silv_5a.1	Bruntwood	Brown (BOM)	Imperfectly drained	4.3
Airfield	Airf_7c.2	-	Brown (BOM)	Imperfectly drained	2.7
Airfield	Airf_4b.1	Horsham	Brown (BOM)	Imperfectly drained	0.1
Morrinsville	Morr_15a.1	Hamilton	Granular (NOT)	Moderately well drained	<0.1
Temuka	Temu_76a.1	Rotokauri	Gley (GOT)	Poorly drained	<0.1
Whangaripo	Whga_31a.1	Whangaripo	Ultic (UYM)	Imperfectly drained	<0.1
Kainui	Kainu_2a.1	Kainui	Ultic (UYBG)	Imperfectly drained	<0.1

The S-Map soil map information provides a more spatially detailed representation of the soils on the site than the NZLRI 1:50,000 soil map information. However, because of the absence of land characteristics information (e.g. slope) for the soil map units, there is currently no direct correlation with LUC units. Some, but not all, of the S-Map soil map units correlate to the soil series identified by the NZLRI map information. In this report, we have retained the DSIR's soil nomenclature (e.g. soil type and series names) in preference to the S-Map soil sibling nomenclature to allow for direct correlation of the soils with the LUC units provided by the NZLRI map information and associated NZLRI Extended Legends.

¹⁰ <https://smap.landcareresearch.co.nz/maps-and-tools/app/>

7. NPS-HPL classification

Based on the available 1:50,000 scale NZLRI information and applying the NPS-HPL, LUC 1s1, and 2w3 land is considered highly productive land. LUC class 4e2 land is not considered highly productive land (Figure 5).

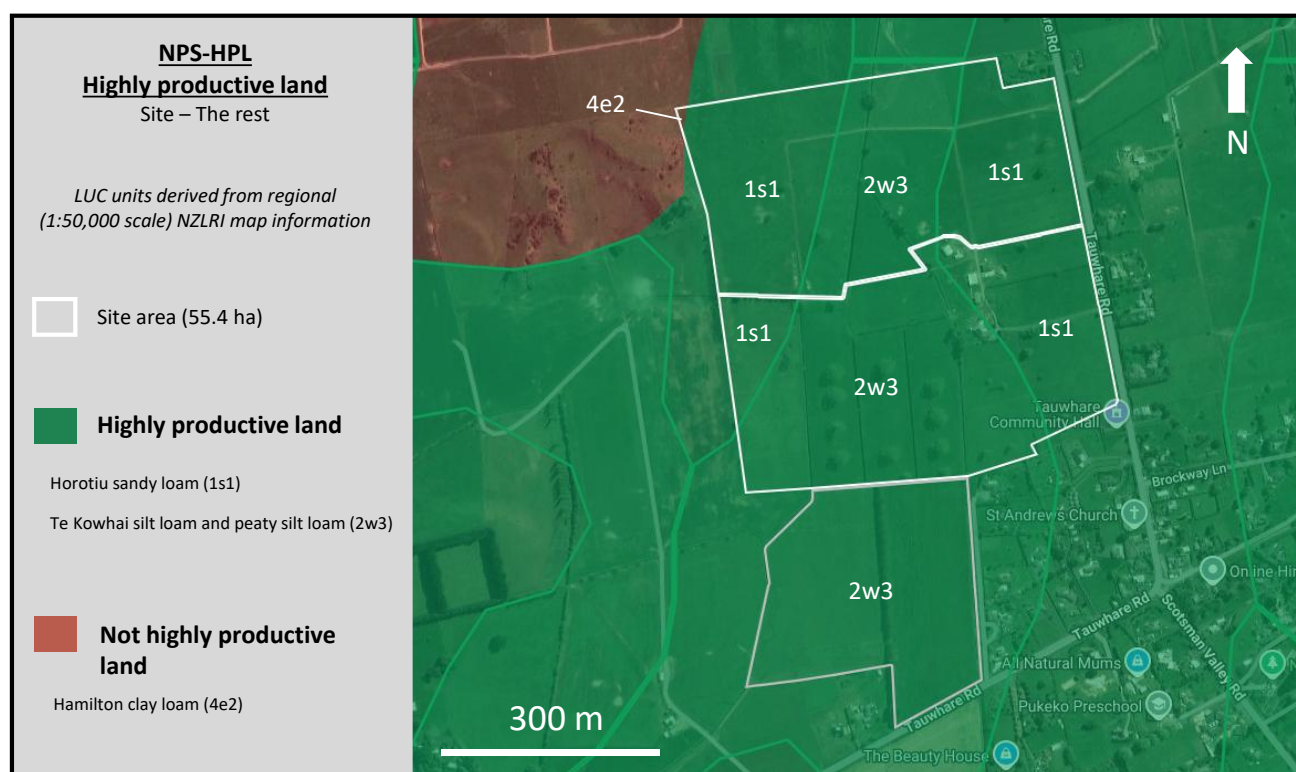


Figure 5. The distribution of NPS-HPL highly productive land for the Site, based on the NZLRI (1:50,000 scale) map information.

8. Regional scale map information limitations

The LUC classification can be applied (mapped) at any scale and regional scale LUC map units can differ from those identified at property scale. Property scale mapping is typically mapped at a scale between 1:5,000 and 1:15,000, while catchment and regional maps are generally mapped at 1:50,000 scale. The LUC Handbook sets out recommended mapping scales for inventory surveys and LUC mapping (p100).

Mapping LUC at a property scale can identify different LUC units (and map units) than depicted by regional scale LUC mapping. This is because property scale mapping includes more observations compared with regional scale mapping.

Soil and LUC maps are usually drawn at a specific scale depending on the smallest area of interest for a particular use and the density of field observations. For example, a 1:5,000 scale map requires on average four observations/ha while a 1:50,000 scale map requires 0.04 observations/ha (or four observations per 100 ha). With GIS tools and geospatial databases, it has become easy to manipulate maps, creating the temptation to rescale a map beyond its original scale of collection. Enlarging maps from their original scale will not provide the same accuracy or contain more detail than a coarse scale map. This is because they are not based on sufficient field observations to delineate soil map units at the finer scales portrayed. For the regional scale LUC map information, map unit boundaries may not align with the topography (slope) and other geographic features (such as rivers or terraces).

Therefore, to correctly identify and map the LUC units at property scale, assessment using the LUC classification criteria described in the LUC Handbook is required.

The 1:50,000 scale NZLRI data provides good foundational physical information for regional planning. However, its use as a definitive map requires an appropriate scale. For this report's objective of assessing high-class soil and soil resources, their productive capacity, and informing land productivity, the on-site assessment is more accurate and fit for purpose in providing the necessary soil and Land Use Capability (LUC) information.

9. On-site LUC assessment

Method

Landsystems undertook an on-site property scale LUC assessment of the 55.4 ha Site according to standard methods (Milne et al., 1993¹¹ and Lynn et al., 2009¹²). The on-site assessment was undertaken on Tuesday 30th of September and Wednesday 1st of October 2025.

The on-site mapping does not constitute a detailed soil survey rather the focus is on characterisation of soil and land properties to apply the LUC classification, in turn used to determine the extent of NPS-HPL highly productive land on the site. However, recorded soil properties are used to identify limitations that may affect the productivity of the site.

The on-site assessment included soil observations by hand auger across the site using a free survey approach. Approximately 170 soil auger observations (excluding additional observations for checking boundaries) were used to determine the LUC map units. A higher proportion of observations were undertaken on the site area with potential highly productive land.

Observations of slope angle, topography and soil parent material were made over the relevant area. Soil augering up to 100 cm depth was used to assess soil properties such as soil horizons, drainage, plant root depths, depth to gravels, soil texture, structure, and colour.

All soils were assessed in current condition and areas with modified soils and areas considered to be non-productive land were identified and mapped. Soil series and types have been used for this report (as opposed to S-Map Soil Siblings) to provided clearer correlation with LUC units provided by the regional NZLRI LUC map information. LUC classification was assigned based on the criteria provided in Lynn et al. (2009). LUC units were assigned based on the closest fitting LUC unit provided by the regional NZLRI LUC map information.

Mapping scale

The number of soil auger observations across the 55.4 ha site equated to an observation density of 3.0 observations per hectare (or one observation per 0.33 ha). Considering the Site area as a whole,

¹¹ Milne JDG, Clayden B, Singleton P.L, Wilson AD. 1995. Soil Description Handbook. Lincoln, New Zealand, Manaaki Whenua Press. 157p.

¹² 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.

this density of observations (using conventional mapping techniques) is sufficient to support a map scale of 1:10,000.¹³

10. On-site LUC assessment

A generalised physiographic distribution of soils within the assessment area is shown below in **Figure 6**¹⁴. The Waikato Plains consist of volcanogenic alluvium deposited by the Waikato River during its fan building stage which ended about 12,000 years ago. The volcanogenic alluvium, known as the Hinuera Formation, consists of rhyolitic sands, silts and gravels, which infilled the existing hilly ash covered landscape and in the present day only low rolling ridge crests protrude through the alluvium. The emplacement of alluvium altered the original drainage patterns and caused formation of lakes. Peat subsequently formed in many of the lakes, back swamp areas, and adjacent low-lying land. As a result, the Waikato Plains comprise two distinct sub-patterns: a mineral soil pattern based on the volcanogenic alluvium deposited by the Waikato River and an organic soil pattern, with intergrades between the two.¹⁵

The main landform units and soils of the assessment area include mineral soils formed on the plains (Horotiu-Te Kowhai soil complex), low hills in the Hamilton Basin (Hamilton Series), and modified soil areas (not shown in **Figure 6**).

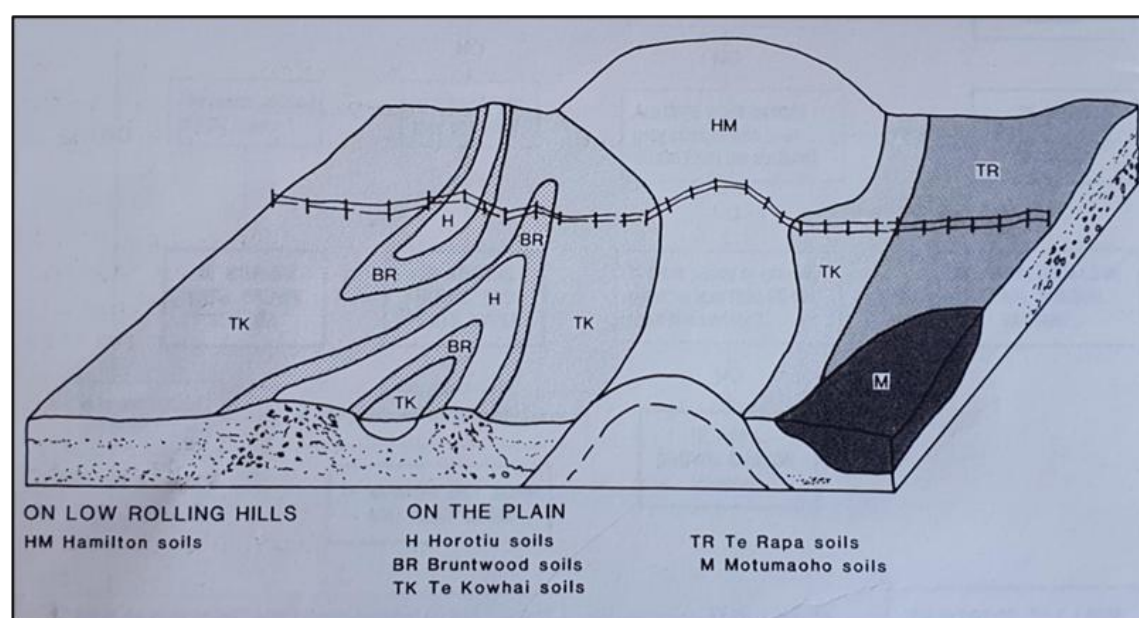


Figure 6: Schematic showing the position of main soils in the landscape (from Singleton¹⁶)

A summary of the soils and LUC units identified in the assessment area are provided in **Table 3**. The main soils observed and examples of poorly to very poorly drained and non-productive land in the

¹³ Page 12 - Grealish G. 2017. New Zealand soil mapping protocols and guidelines. Envirolink Grant: C09X1606. Manaaki Whenua –Landcare Research.

¹⁴ Singleton, P. 1991. Soils of Ruakura – a window on the Waikato. DSIR Land Resources, Scientific Report No. 5. Image from pg. 30.

¹⁵ Singleton, P. 1991. Soils of Ruakura – a window on the Waikato. DSIR Land Resources, Scientific Report No. 5.

¹⁶ Singleton, P. 1991. Soils of Ruakura – a window on the Waikato. DSIR Land Resources, Scientific Report No. 5. Image from pg. 30.

assessment area are shown in **Figures 7 to 9**. The soil profiles should be considered example soil profiles for each soil as the profile for actual soil observed in the field at any given point may differ slightly from the example shown.

Table 3. Soils and dominant LUC units identified for the Site (in order of increasing limitations).

Soil type (NZSC Soil Order)	Parent material	Texture profile	Slope class	Soil depth	Soil drainage	Dominant LUC unit (limitation)
Horotiu sandy loam (Allophanic Soil)	Rhyolitic alluvial deposits of the 'Hinuera Formation'	Sandy loam over sand	A+B (0-4°)	Deep (100+ cm)	Well drained	1s1 (soil)
Horotiu-Te Kowhai complex, <i>Horotiu silt loam dominant</i> (Allophanic Soil)	Rhyolitic alluvial deposits of the 'Hinuera Formation'	Silt loam over silt or sand	A+B (0-5°)	Deep (100+ cm)	Well to imperfectly drained	2s1 (soil)
Horotiu-Te Kowhai complex, <i>Te Kowhai silt loam dominant</i> (Gley Soil + Allophanic Soil)	Rhyolitic alluvial deposits of the 'Hinuera Formation'	Silt loam over mottled silt loam over silt or sand	A (0-3°)	Deep (100+ cm)	Poorly to imperfectly drained	2w3 (wetness)
Horotiu sandy loam (Allophanic Soil)	Rhyolitic alluvial deposits of the 'Hinuera Formation'	Sandy loam over sand	A (0-3°)	Shallow (<30 cm)	Moderately well to imperfectly drained	3s1 (soil)
Te Kowhai silt loam (Gley Soil)	Rhyolitic alluvial deposits of the 'Hinuera Formation'	Mottled silt loam over silt or sand	A (0-3°)	Deep (100+ cm)	Poorly to very poorly drained	3w1 (wetness)
Hamilton clay loam (Granular Soil)	Strongly weathered tephra on 'Hamilton Ash Formation'	Silty clay loam on clay loam on clay	C+D (10-18°)	Deep (100+ cm)	Moderately well drained	4e2 (slope)
Modified soil (Fill + Truncated Anthropo- genic Soil)	Deposited fill on soils derived from 'Hinuera Formation' sediments or 'Hamilton Ash Formation' sediments OR truncated material derived from those parent materials mentioned above	Areas of fill >30 cm, areas of no topsoil, gravel at surface or at very shallow depths, unable to auger	A-C (0-12°)	Very shallow (cannot auger) to deep	Imperfectly to very poorly drained	4s* (soil)
Modified soil / non- productive land	Existing houses and curtilage, farm races, drains, gravelled storage areas, concrete areas, farm infrastructure and sheds					-

#Jessen, MR. 1992. Waikato LUC units correlated. Unpublished file note, Land Resources Division, Department of Scientific and Industrial Research; *LUC class and limitation only as no corresponding LUC unit in NZLRI Extended Legend.

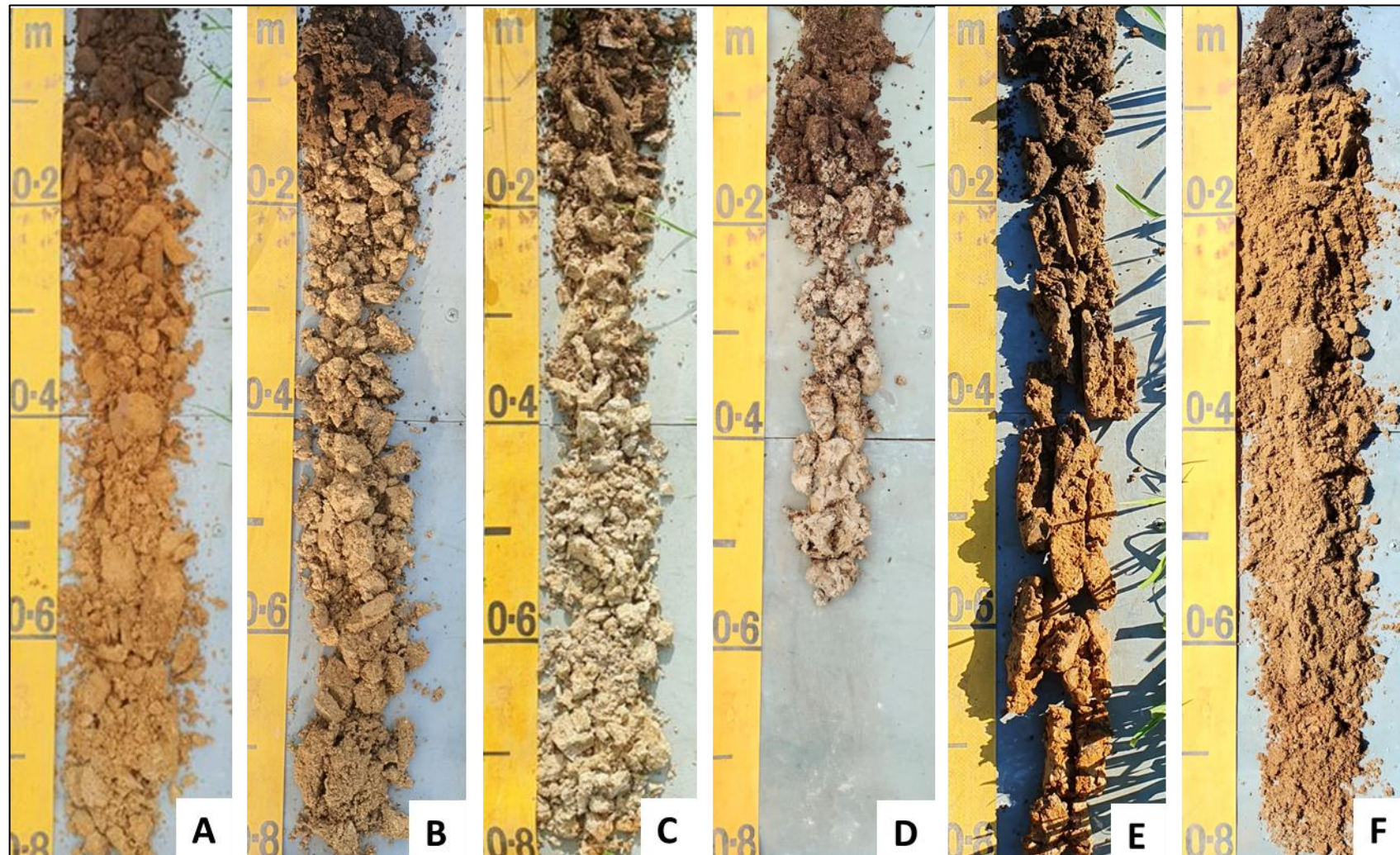


Figure 7: Example soil profiles of the dominant soils identified in the Site. A) Horotiu silt loam, LUC 2s1 on A+B slopes; B) Bruntwood silt loam, LUC 2s1 on A+B slopes; C) Te Kowhai silt loam, LUC 2w3 on A slopes; D) Te Kowhai silt loam (very poorly drained), LUC 3w1 on A slopes; E) Hamilton clay loam, LUC 4e2 on C+D slopes; F) Fill Anthropic Soil (modified soil), LUC 4s on A slopes.

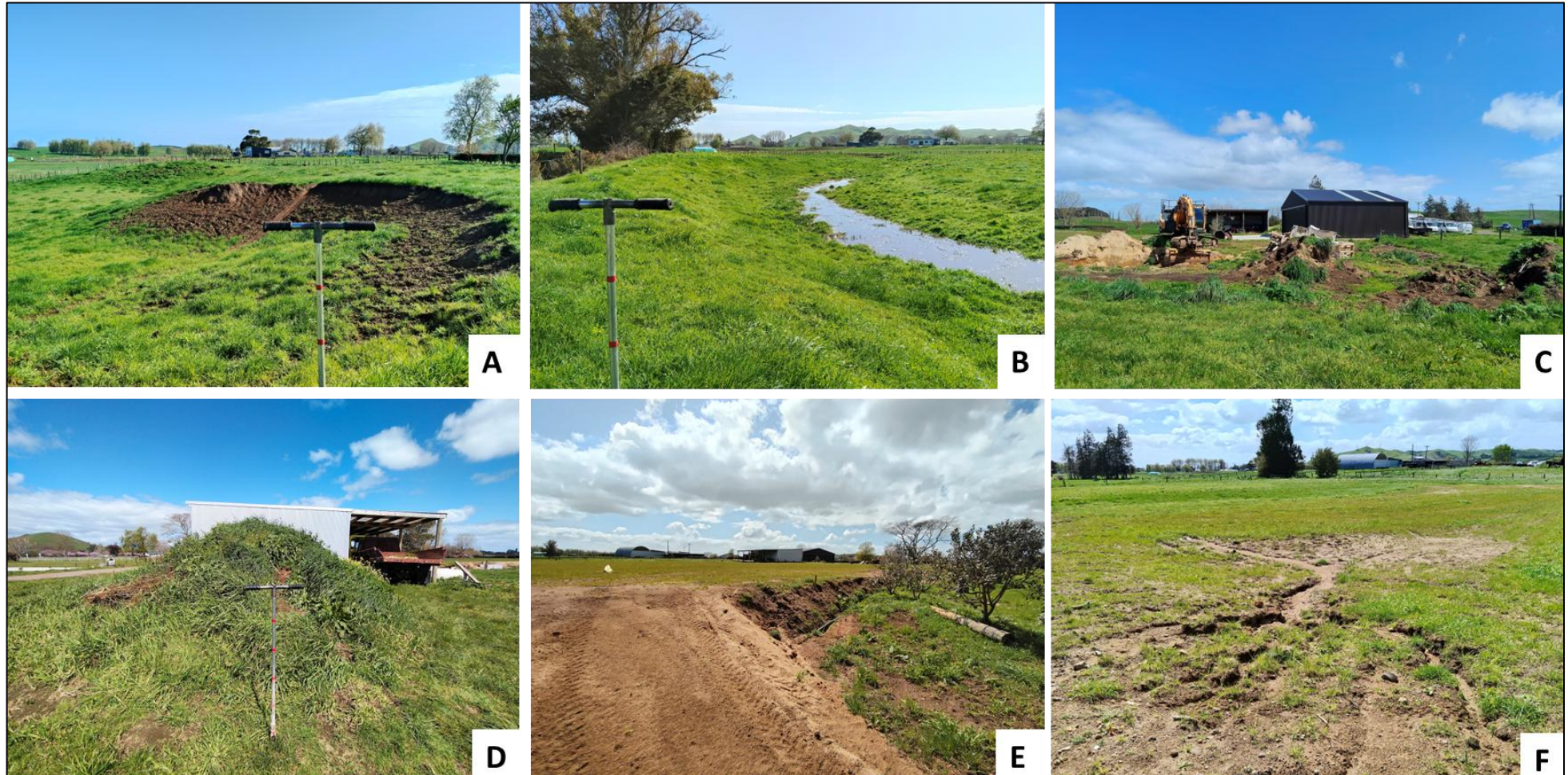


Figure 8: Example non-productive land and modified soils identified at the Site. A) Old sand quarry area (LUC 4s) in NE of Site, Truncated Anthropic Soil (modified soil); B) Drain and mounded drain material in central north of Site; C) Landfill site and surrounding modified soil areas, LUC 4s, central part of Site; D) Fill Anthropic Soil (high mounds) near farm shed, gravel and concreted areas; E) Recontoured area immediately north of existing dwelling, an extensive area of Fill Anthropic Soil (LUC 4s); F) Area of rill erosion (and deposition) downslope of recontoured area.



Figure 9: Examples of areas with poor to very poor drainage and drains identified at the Site. A) Very poorly drained Te Kowhai silt loam (LUC 3w1) near low hills on western boundary; B) Drains and newly gravelled race; C) Low-lying area in SW of Site with free-standing/ponded water (LUC 3w1).

The detailed on-site assessment confirmed the Site comprises areas that are the alluvial surface of the Hinuera Formation, left by the ancestral Waikato River, which although relatively flat, contains ridges and swales of old levees and channels, a series of rolling to strongly rolling low hills, and modified soil areas. The dominant soils of the Site are the Horotiu-Te Kowhai soil complex (Allophanic Soil and Gley Soil). The Horotiu-Te Kowhai soil complex is a mosaic of poorly drained Te Kowhai soil series to imperfectly drained Bruntwood soil series to well drained Horotiu soil series, often found in close proximity to one another¹⁷ (Figure 6).

Extending along the eastern boundary of the Site is a slightly higher ridge of well drained, deep, Horotiu sandy loam (Table 3, Figure 10) on flat to undulating slopes. The Horotiu sandy loam (Allophanic Soil) is deep, well drained, and a typical soil profile comprises a dark brown sandy loam topsoil of 20-25 cm on a yellowish brown sandy loam subsoil on yellowish brown coarse sand of the Hinuera Formation from 60-70 cm depth. The 'island' of Horotiu sandy loam has an LUC classification of LUC 1s1 (Figure 11) and is surrounded by slightly lower ground comprising Horotiu silt loam dominated, Horotiu-Te Kowhai soil complex (Table 3, Figure 10). Horotiu silt loam (Allophanic Soil) is a well drained, deep soil with a 20-25 cm dark brown silt loam topsoil, over 30-40 cm yellowish brown silt loam subsoil, over coarse yellowish brown Hinuera Formation sands (Figure 7A). The Horotiu silt loam dominated, Horotiu-Te Kowhai soil complex has small pockets of imperfectly drained, deep, Bruntwood silt loam (Allophanic Soil) (Figure 7B) and a LUC classification of LUC 2s1 (Figure 11). The Horotiu silt loam dominated, Horotiu-Te Kowhai soil complex (LUC 2s1) is the most dominant LUC unit across the Site (Table 4).

On the swales (lower lying areas) of the alluvial surface of the Hinuera Formation the Te Kowhai silt loam dominated, Horotiu-Te Kowhai soil complex is found. This complex is the subdominant soil found on Site (Table 4). The Te Kowhai silt loam (Gley Soil) is a poorly to very poorly drained, deep soil found on flat to gently undulating slopes (Table 3, Figure 10). A typical soil profile comprises a

¹⁷ Singleton P. 1991. Soils of Ruakura – a window on the Waikato. DSIR Land Resources Scientific Report No. 5.

dark greyish brown silt loam topsoil of 18-25 cm (sometimes mottled within 10 cm of surface if very poorly drained) over light grey silt loam or silty clay loam subsoil with many mottles, over light grey silt or sand from 60-70 cm (**Figure 7C**). The Te Kowhai silt loam dominated, Horotiu-Te Kowhai soil complex has an LUC classification of LUC 2w3. Also found within this LUC 2w3 land were small pockets of imperfectly drained, deep, Bruntwood silt loam (Allophanic Soil) (**Figure 7B**).

Small areas of wetter Gley Soils were common at the base of low hills within the Site or low-lying areas within the Hinuera Surface (**Figure 10**). These soils were poorly to very poorly drained, can have mottled silt loam or clay loam topsoil textures, with mottled silt loam or clay loam to clay subsoils. At the base of the western boundary low hills, poorly to very poorly drained Te Kowhai silt and clay loam (**Figure 7D**) was found and had an LUC classification of 3w1 (**Table 3**). At the base of these low hills and in the southwest of the Site ponded surface water was observed (**Figures 9A and 9C**).

On the western boundary of the Site, older low hills protrude through the younger volcanogenic alluvium of the Hinuera Surface and the Hamilton Series soils were found. Toe slopes extend into the assessment area from rolling to strongly rolling slopes. The Hamilton clay loam (Granular Soil) was found and is a moderately well drained, deep, heavy clay soil, and assigned an LUC classification of 4e2 (**Table 3, Figure 7E, Figure 11**).

There were isolated pockets of modified soil areas, usually associated with farming operations or drains, particularly in the central area of the Site. Drainage is variable in these areas ranging from imperfectly to very poorly drained. An expansive area directly to the north of the existing dwelling has had substantial earthworks and has been recontoured (presumably to improve drainage) (**Figure 8E**). The soil found in this area was a Fill Anthropic Soil (modified soil) and has been completely reinstated from local soil materials. The soil profile consisted of a very thin 8 cm dark brown silt loam topsoil over 14 cm of yellowish brown silt loam subsoil over yellowish brown coarse Hinuera Formation sand (**Figure 7F**). The recontoured soil surface has sparse gravel (can auger through) on top and currently poor grass growth was observed. The shallow nature of the topsoil and upper subsoil over coarse sand from 22 cm gave this area an LUC classification of LUC 4s (**Table 3, Figure 11**).

Other modified soil areas (Fill or Truncated Anthropic Soils) included an old sand quarry area (LUC 4s) in NE of Site (**Figure 8A**), mounded subsoil and topsoil material from drains in the central north of the Site (**Figure 8B**), a landfill site and surrounding modified soil areas (LUC 4s) in central area (**Figure 8C**), Fill Anthropic Soil (high mounds) near farm shed (LUC 4s), gravel and concreted areas (**Figure 8D**), and areas of rill erosion (and deposition) downslope of recontoured area (LUC 4s) (**Figure 8F**). There is a small area of modified soil (Fill Anthropic Soil) directly east of the existing house. This area was previously a horse arena (sand on compacted subsoil). The sand has since been removed and soil in this area consists of a shallow (28 cm) mixed topsoil and upper subsoil horizon on original Horotiu sandy loam lower subsoil and original Hinuera Formation coarse sand. The shallow mixed nature of the topsoil and moderately well to imperfect drainage status give this area an LUC classification of LUC 3s (**Table 3, Figure 11**).

There were also areas of non-productive land within the Site (**Figure 10**), including farm infrastructure, existing house and curtilage, gravelled storage areas, concrete pads, drains, and gravelled farm races (see **Figure 8**).

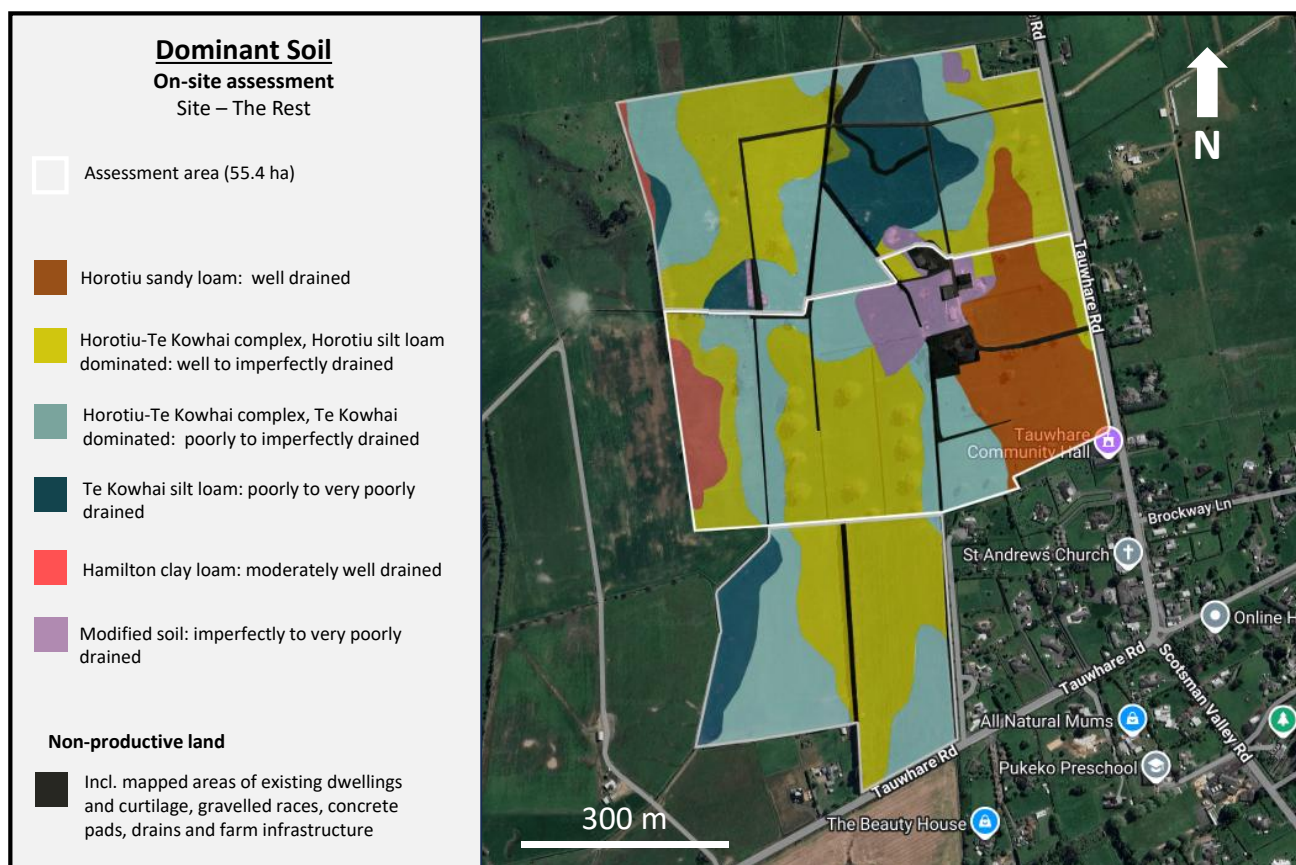


Figure 10: The on-site mapped distribution of the dominant soils for the Site.

The estimated distribution of dominant soils, LUC classes and LUC units are given in **Figure 11** (a larger map is provided at the end of the report).

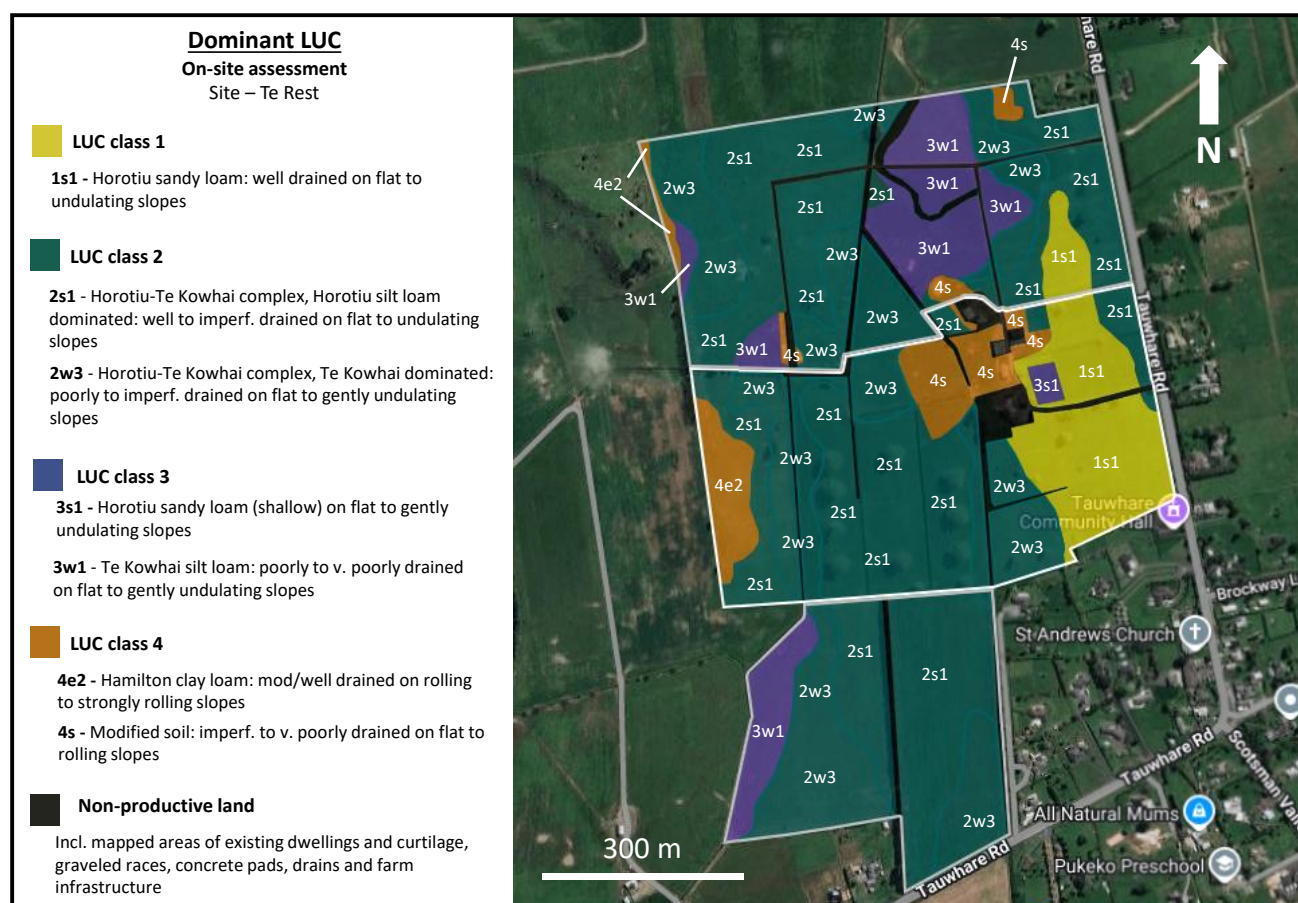


Figure 11: The on-site mapped distribution of dominant LUC units for the Site.

11. Revised LUC classification

Based on the on-site assessment, aerial photographs of the assessment area and surrounding areas and soil auger observations, the original NZLRI delineated LUC map units differ from the LUC map units identified and mapped in the on-site assessment.

Based on the available NZLRI and NZFSL map information (**Figure 3**) the majority of the Site was mapped as poorly drained Te Kowhai silt loam and peaty silt loam (Gley Soil) on flat to gently undulating slopes (0-3°) with an LUC classification of LUC 2w3 (62% of the Site). A smaller area (37%) of the Site was mapped as well drained Horotiu sandy loam (Allophanic Soil) on flat to undulating slopes (0-7°) with an LUC classification of LUC 1s1. Less than one percent of the Site was mapped as moderately well drained Hamilton clay loam (Granular Soil) on strongly rolling slopes (16-20°); assigned LUC 4e2.

However, detailed on-site mapping showed discrepancies in the extent of LUC class 1 and 3 land and modified soil areas (refer **Table 4** and **Table 5** below and **Figures 10** and **11**).

Specific comments are as follows:

- Thirty-seven percent of the Site was mapped as LUC 1s1 at a regional scale. Detailed LUC mapping showed this to be an overestimation of LUC 1s1 land, with 10% of the Site LUC 1s1.
- Sixty-two percent of the Site was mapped at LUC 2w3 at a regional scale. Detailed LUC mapping showed this to be an overestimation of LUC 2w3 land, with 28% of the Site LUC 2w3.

- Within the Site the dominant LUC unit is LUC 2s1 (39% of the Site), comprising Horotiu silt loam dominated, Horotiu-Te Kowhai complex. LUC 2s1 land was well drained to imperfectly drained.
- Regional mapping gave 62% of the Site as LUC class 2 land, similar to the on-site mapped showed 67% of the land as LUC class 2.
- Very poor drainage classes were missing from regional scale maps. On-site mapping showed 10% of the Site to have poor to very poor drainage (LUC 3w1), sometimes despite artificial drainage (**Table 4**).
- On-site mapping showed a slightly greater area of LUC 4e2 land (3% of the Site).
- Within the Site an area of 2.2 ha (~4% of the Site) was mapped as modified soil, either Fill Anthropic Soil or Truncated Anthropic Soil (LUC 4s).
- Six percent of the Site was mapped as non-productive land, including mapped areas of gravelled races, extensive drains, an existing dwelling, concrete areas, and farm infrastructure (**Table 4, Figures 8, 10-11**).

Table 4. LUC classes, LUC units and dominant soil type within the Site, based on the LUC map units identified by the on-site assessment.

LUC class	Dominant LUC unit	Dominant soil type	LUC unit area (ha)	LUC class area, ha, (%) [§]
1	1s1	Horotiu sandy loam	5.62	5.62 (10)
2	2s1	Horotiu-Te Kowhai complex, Horotiu silt loam dominant	21.34	36.82 (67)
	2w3	Horotiu-Te Kowhai complex, Te Kowhai dominant	15.48	
3	3s1	Horotiu sandy loam (shallow)	0.21	5.77 (10)
	3w1	Te Kowhai silt loam	5.56	
4	4e2	Hamilton clay loam	1.57	3.73 (7)
	4s	Modified soil	2.16	
Non-productive land/modified soil			3.46 (6)	

[§]% areas rounded to whole number.

12. On-site WDP-OiP high class soil classification

Detailed on-site assessment showed 77% of the assessment area as high class soil (LUC 1s1, 2s1 and 2w3) under the WDP-OiP definition for high class soil (**Table 5, Figure 12**).

Of the balance, 17% of the Site was LUC 3s1, LUC 3w1, LUC 4e2 and LUC 4s, which is not high class soil. Non-productive areas (6% of the Site) including mapped areas of gravelled races, extensive

drains, an existing dwelling, concrete areas, and farm infrastructure, are not high class soil (**Table 5, Figure 12**).

Table 5. WDP-OiP high class soil for the Site based on the on-site mapped LUC map units.

LUC unit (dominant)	High class soil	Area ha, (%) ^s
1s1	High class soil	5.62 (10)
2s1	High class soil	21.34 (39)
2w3	High class soil	15.48 (28)
High class soil total		High class soil = 42.44 (77)
3s1	Not high class soil	0.21 (<1)
3w1	Not high class soil	5.56 (10)
4e2	Not high class soil	1.57 (3)
4s (Fill +Truncated Anthropic)	Not high class soil	2.16 (4)
NPL [#]	Not high class soil	3.46 (6)
Not high class soil total		Not high class soil = 12.96 (23)

^s% areas rounded to whole number; [#]NPL = Non-productive land.

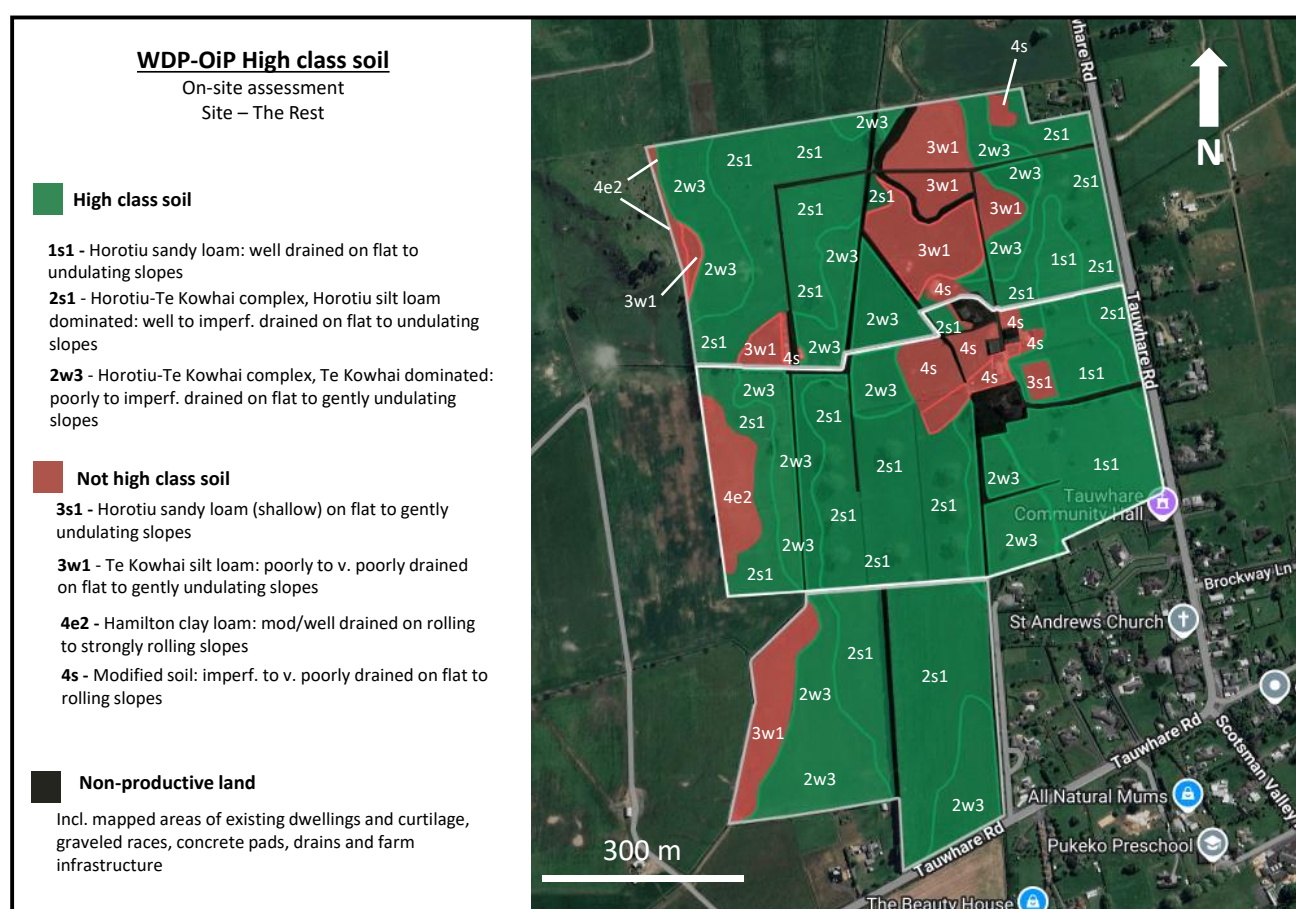


Figure 12: On-site mapped distribution of WDP-OiP defined high class soil for the Site.

13. LUC classification and drainage considerations

The main land use limitation at the Site is soil wetness (high water table, slow internal drainage, susceptibility to flooding)¹⁸.

Detailed on-site mapping showed soils to have a mix of drainage classes, with 28% of land poorly to imperfectly drained (LUC 2w3), 10% poorly to very poorly drained (LUC 3w1) and 4% imperfectly to very poorly drained (LUC 4s). The soil wetness limitations of LUC 2w3 and 3w1 land will restrict year-round cropping (summer months only) and horticultural use. Seasonally high water tables, and days in which soil is inundated by water on LUC 2w3 and 3w1 land is likely to affect the yield and/or survival of water sensitive crops¹⁹. Therefore, these LUC 2w3 and 3w1 areas are most suited to pastoral land uses, with no or lighter stocking in wetter months.

14. Comment on productive capacity

The detailed on-site assessment confirmed the presence of different LUC units and their distribution across the Site, which showed significant differences when compared to the regional-scale mapping. The regional-scale NZLRI LUC indicated that 99% of the Site was LUC Class 1 or 2 land. The on-site assessment, however, revealed that the actual productive land and its productive capacity are lower than indicated by the NZLRI LUC map information. This reduction is due to the presence of non-productive land and LUC units with lesser capability (LUC Class 3 and 4). The on-site assessment confirmed that the actual extent of high class soils (LUC 1s1, 2s1, and 2w3), as defined by the WDP-OiP, collectively comprises 77% of the Site. Conversely, 23% of the Site is designated as either not high class soil (17%) or non-productive land (6%).

Constraints on productive use

The main land use limitation at the Site is soil wetness (high water table, slow internal drainage, susceptibility to flooding or ponding surface water). The on-site mapping showed that 28% of the land is poorly to imperfectly drained (LUC 2w3) and 10% is poorly to very poorly drained (LUC 3w1).

The soil wetness limitations present in LUC 2w3 and LUC 3w1 land units will restrict the potential for continuous year-round cropping (limiting it to summer months only) and extensive horticultural use. Seasonally high water tables and temporary inundation on land classified as LUC 2w3 and 3w1 are likely to negatively affect the yield and/or survival of water-sensitive crops. Consequently, these specific areas are most appropriately suited to pastoral land uses, with management requiring either no stocking or lighter stocking rates during the wetter months of the year. Specifically, the LUC 2w3 classification presents a major constraint for water-sensitive horticultural crops such as kiwifruit and many orchard trees, which require deep, well-drained soil profiles for optimal growth.

¹⁸ 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.

¹⁹ 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

Fragmentation and cohesion

The actual productive capacity of a landholding is not solely defined by the total area of high-class soil but is also dependent on the cohesion and spatial continuity of that land.

The location and prevalence of lower class land (LUC 3s1, 3w1, 4e2, 4s), combined with the non-productive areas (6% of the Site) (spanning from the near centre of the Site through into the centre-north portion), restricts continuous land-based primary production under a single land use.

This pattern of fragmentation, caused by intervening areas of lower capability land (LUC Class 3 or 4) and non-productive features, isolates surrounding high-class soils. This directly limits the size and contiguous nature of areas that can be utilised for more intensive land uses, such as large-scale horticulture and intensive cropping activities. This ultimately reduces the site's overall long-term productive capacity for land-based primary production.

15. Summary

Based on NZLRI LUC map information, 99% of the land on the Site is classified as highly productive land when applying NPS-HPL clause 3.5(7).

The detailed on-site assessment showed soils across the Site predominantly consisted Horotiu-Te Kowhai soil complex (Horotiu silt loam dominated) on flat to undulating slopes, Horotiu-Te Kowhai soil complex (Te Kowhai silt loam dominated) on flat to gently undulating slopes, an isolated area of Horotiu sandy loam on flat to undulating slopes, pockets of wetter Te Kowhai silt loam in low-lying swales, a small area of rolling to strongly rolling Hamilton clay loam on low hills, and some areas of modified soils and non-productive land.

Well drained to imperfectly drained Horotiu-Te Kowhai complex (Horotiu silt loam dominated) on flat to undulating slopes is classified as LUC 2s1. The poorly to imperfectly drained Horotiu-Te Kowhai complex on flat to gently undulating slopes is classified as LUC 2w3, and the isolated areas of well drained Horotiu sandy loam on flat to undulating slopes is classified as LUC 1s1. Small areas of poorly to very poorly drained soils on flat slopes: Te Kowhai silt loam is classified as LUC 3w1. The low hills of moderately well drained Hamilton clay loam on rolling to strongly rolling slopes is classified as LUC 4e2. The isolated pocket of shallow Horotiu sandy loam has an LUC classification of 3s1. Finally, areas of Fill and Truncated Anthropogenic Soil (modified soil) were observed and classified as LUC 4s.

The non-productive land and modified soil areas (e.g. mapped areas of gravelled races, extensive drains, an existing dwelling, and farm infrastructure) are excluded from productive land (i.e. they are non-productive land).

Regional scale NZLRI and NZFSL map information showed 62% of the total assessment area was mapped as LUC 2w3 (poorly drained Te Kowhai silt loam and peaty silt loam (Gley Soil) on flat to gently undulating slopes), 37% of the assessment area well drained Horotiu sandy loam (Allophanic Soil) on flat to undulating slopes with an LUC classification of LUC 1s1, and <1% of the Site as moderately well drained Hamilton clay loam (Granular Soil) on rolling slopes (LUC 4e2).

However, detailed on-site mapping showed discrepancies in the extent of LUC class 1 and 3 land and modified soil areas.

Regional scale map information showed 37% of the Site as LUC class 1 land, however, on-site mapping showed 10% of the land as LUC class 1. On-site mapping showed dominant LUC unit across the Site was LUC 2s1 (39% of the Site), followed by LUC 2w3 (28% of the Site). Despite artificial drainage on site there was a greater proportion land with poorer soil drainage, including 10% mapped as poorly

to very poorly drained LUC 3w1. These poorly to very poorly drainage class soils, often associated with low-lying areas or wet toe slope areas beneath low, but short hills, were not shown on the regional scale NZLRI map information. Within the Site 4% of the land was mapped as modified soil, either Fill Anthropogenic Soil or Truncated Anthropogenic Soil (LUC 4s).

Discrepancies between regional scale NZLRI delineated LUC maps and detailed field mapping within the Site were as follows (% of LUC class in each assessment area in descending order for comparative purposes):

Site – The Rest:

Regional scale NZLRI-LUC: LUC class 1 - 37%
 LUC class 2 - 62%
 LUC class 4 - <1%

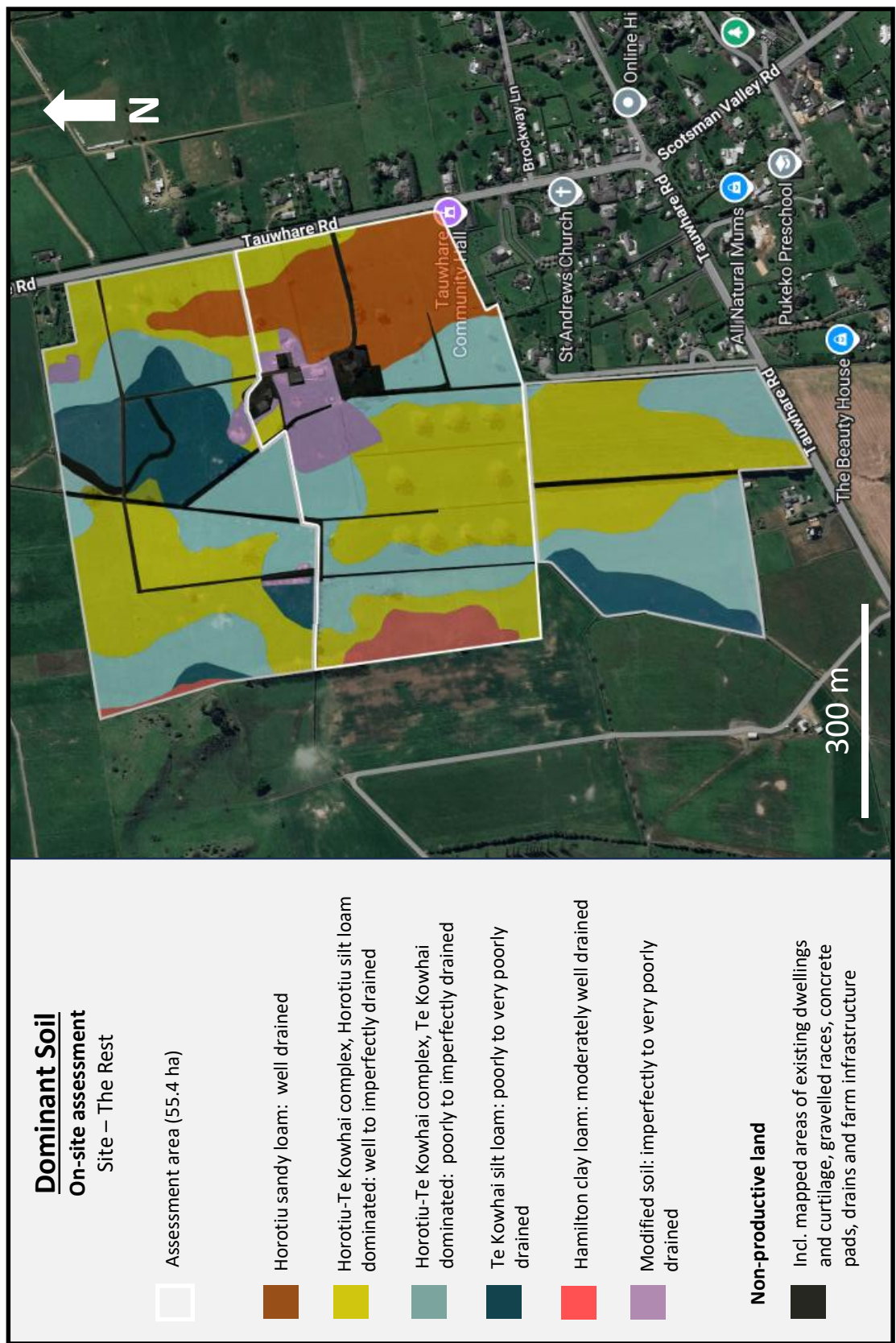
On-site LUC: LUC class 1 - 10%
 LUC class 2 - 67%
 LUC class 3 - 10%
 LUC class 4 - 7%
 NPL - 6%

Detailed on-site assessment showed 77% of the assessment area as high class soil (LUC 1s1, 2s1 and 2w3) under the WDP-OiP definition for high class soil. Of the balance, 17% of the Site was LUC 3s1, LUC 3w1, LUC 4e2 and LUC 4s (modified soil), which are not high class soil. Non-productive areas (6% of the Site) including mapped areas of gravelled races, extensive drains, an existing dwelling, farm infrastructure, are not high class soil.

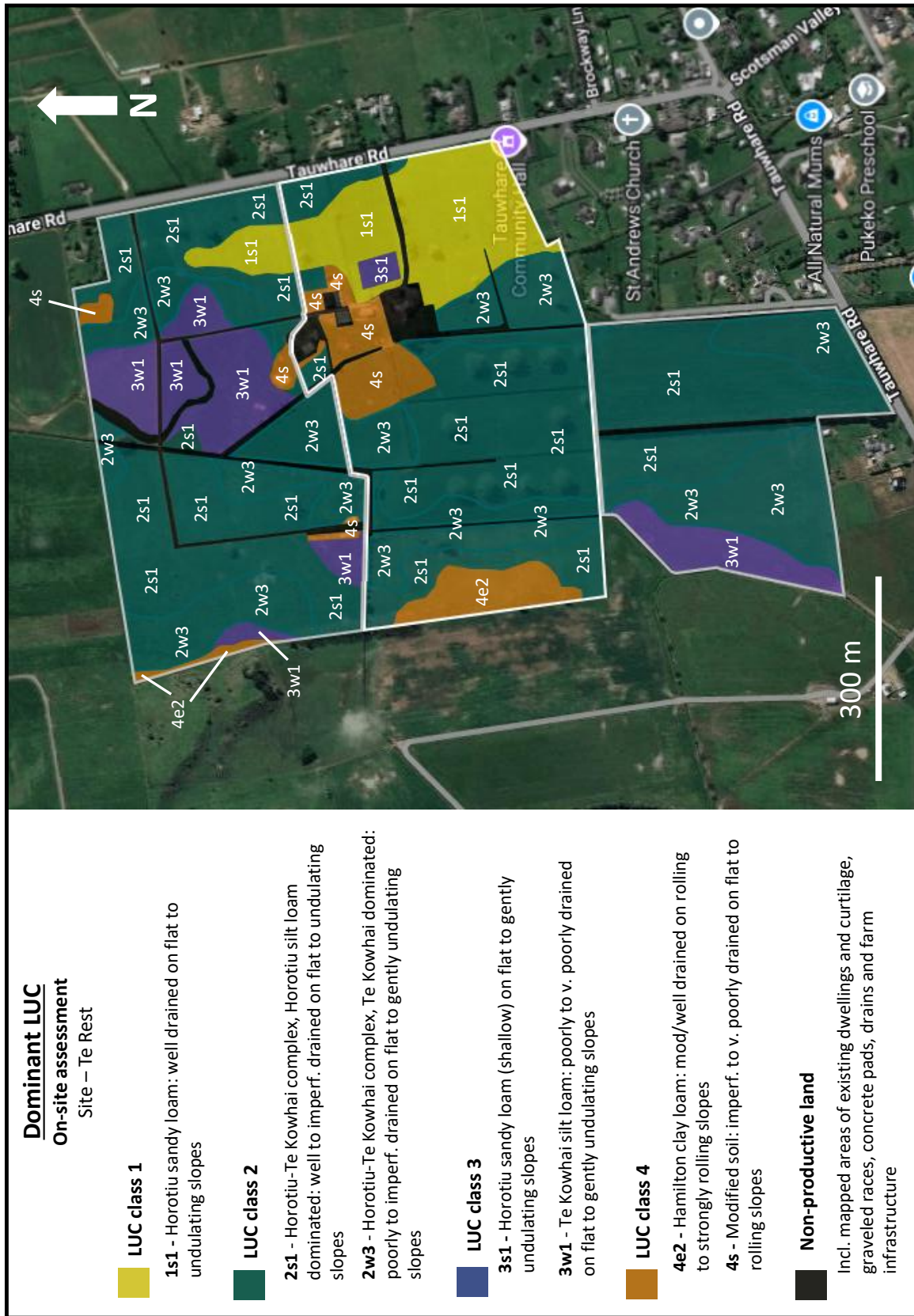
Based on the on-site assessment, the actual available productive land and productive capacity of the Site are less than indicated by the regional scale NZLRI LUC map information. This is primarily because detailed mapping identified that a significant portion of the Site consists of non-productive areas and land with lower capability (LUC Class 3 and 4).

The distribution of these soil limitations (wetness and soil depth soil constraints) and non-productive land restricts the range of suitable land uses and fragments the high-class soils. This, in turn, limits the contiguous nature of areas available for single, intensive land uses, thus reducing the Site's overall long-term productive capacity.

Appendix 1: Enlarged map image from Figure 10.



Appendix 2: Enlarged map image from Figure 11.



Appendix 3: Enlarged map image from Figure 12.

