

Before the Central Otago District Council Hearing Panel

Under the Resource Management Act 1991

In the matter of Plan Change 19 to the Central Otago District Plan - Hearings
Panel Minute 1 – 129 Lowburn Valley Road

Statement of evidence of Dr Reece Hill on behalf of Henry van der Velden

16 May 2023

Introduction

- 1 My full name is Dr Reece Blackburn Hill.
- 2 I hold a Doctor of Philosophy in Soil Science from Lincoln University (2000), a Master of Applied Science in Soil Science from Lincoln University (1994), and a Bachelor of Science with a double major in Biological Sciences and Earth Sciences from University of Waikato (1988).
- 3 I am a past President of the New Zealand Society of Soil Science (2014-2016), and a current member of the New Zealand Society of Soil Science, New Zealand Association of Resource Management, and the New Zealand Institute of Agricultural & Horticultural Science.
- 4 I have 19 years' experience as a Soil Scientist at Waikato Regional Council, six years' experience as a Soil Consultant at Landsystems, of which I have been full time for the past three years, and three years' experience mapping forest soils in Tasmania.
- 5 I specialise in soil characterisation, soil mapping, land use capability assessment, regional soil policy, soil quality and catchment and land management. I have applied these skills in numerous projects within Waikato Regional Council and Landsystems, working with individual landowners including farmers and growers, regional and district council staff, Crown Research Organisations, Universities, and Ministry staff (MPI and MfE).
- 6 I was lead reviewer for the Ministry for the Environment review of national soil quality monitoring and indicators and established the soil quality monitoring programmes for Waikato Regional Council and Nelson City Council. I was lead author of the soil quality monitoring chapter of "Land and Soil Monitoring: A guide for SOE and regional council reporting".
- 7 I have advised central government and district and regional councils throughout New Zealand in relation to soil management, land use capability, high class soils and the use of soil map information. This included regional council representation on the Land Use Capability Classification System (LUCCS) Governance Group.
- 8 I have undertaken property scale soil and Land Use Capability (LUC) assessments to identify high class soils for subdivision applications in the Waikato, Auckland, Bay of Plenty, Marlborough and Otago regions.
- 9 As part of my role at Waikato Regional Council, I was Lead Technical Writer for the Soils chapter (Chapter 14) of the Waikato Regional Policy Statement

which became operative in 2016. Chapter 14 included a policy on High Class Soils (Policy 14.2).

- 10 In 2020, I provided technical soil expertise to support The Waikato District Plan (Stage 1) review, with my main input focussing on Subdivision Rules and high class soils.
- 11 In 2021, I provided a review of the Productive Land Classification for Tasman District Council.
- 12 I have undertaken soil and Land Use Capability (LUC) assessments for subdivision that have required assessment against the NPS-HPL.

Scope of evidence

- 13 My evidence covers matters relating to the classification of soils on the 5.61 hectare land parcel (Section 27 Block V Cromwell SD) at 129 Lowburn Valley Road (Site).
- 14 In preparing this evidence, I have reviewed the following reports and statements:
 - (a) Available regional scale (New Zealand Land Resource Inventory (NZLRI) LUC map information.
 - (b) Land Use Capability Survey Handbook (3rd Edition).
 - (c) Available aerial photography of the Site.
 - (d) A contour map of the Site.
 - (e) Soil observation photos of the Site.
- 15 I have prepared this evidence in relation to:
 - (a) Land Use Capability Classification system definitions,
 - (b) the Land Use Capability classification of the Site, and
 - (c) assessment against the National Policy Statement for Highly Productive Land.
- 16 I have not undertaken a field assessment of the subject site. My evidence is based on a desktop analysis of available LUC map information, interpretation of aerial photography, a detailed contour map, and on-site soil observation photos for the Site prepared under my direction.

Executive summary

- 17 My evidence is based on a desktop analysis of NZLRI LUC map information as it relates to the Site, a detailed contour map of the Site, interpretation of aerial photography, and on-site soil observation photos for the Site obtained by Mr Woodward under my direction.
- 18 The NZLRI LUC map information indicates the presence of LUC map units 7e24+6e19 and 3s6 on the Site. My interpretation of the available NZLRI LUC map information is that the LUC 3s6 map unit is characterised by shallow Waenga soils, located on flat to undulating slopes associated with alluvial terraces.
- 19 Based on my analysis of a detailed contour map for the Site, in combination with Google Earth imagery and on-site photos, it is clear that part of the Site classified as LUC 3s6 in the NZLRI contains slopes greater than 15 degrees. This does not align with description of LUC 3s6 land in the NZLRI. Furthermore, the Land Use Capability Survey Handbook¹ provides that slopes of this gradient is not LUC class 3 land. I consider that part of these slopes are more properly classified as LUC 7e24+6e19 land.
- 20 The on-site soil observation photos indicate that the remainder of the NZLRI LUC 3s6 area (i.e. where slopes are less than 15 degrees) is extensively modified and any remnants of the original soil (if present) are very shallow and derived from mixed colluvium eroded from the steeper land on the subject site. As such, this the area is more correctly classified as LUC class 4 land with areas of non-productive land.
- 21 Land that is LUC class 4 or greater is not defined as 'highly productive land' for the purposes of applying the National Policy Statement for Highly Productive Land (NPS-HPL).

National Policy Statement for Highly Productive Land (NPS-HPL)

- 22 Aspects of the NPS-HPL that relate to LUC classification are within my expertise.
- 23 "Highly productive land" is defined in the NPS-HPL 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

¹ p56-58; Lynn, IH, Manderson, AK, Harmsworth, GR, Eyles, GO, Douglas, GB, Mackay, AD, Newsome PJF. 2009. Land Use Capability Handbook - a New Zealand handbook for the classification of land 3rd Ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science 163pp.

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)

24 My understanding is that clause 3.5(7) applies presently 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.

25 Clause 3.5(7) states:

(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.

"LUC 1, 2 and 3" is defined as:

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 that uses the Land Use Capability classification.

LUC classification system

26 The Land Use Capability Classification (LUC) is a system in use in New Zealand since the 1950s that classifies all of New Zealand's rural land into one of eight classes, based on its physical characteristics and attributes. Class 1 land is the most versatile and can be used for a wide range of land uses. Class 8 land is the least versatile and has many physical limitations: it may be extremely steep, and not generally suitable for arable, pastoral or commercial forestry use.

27 LUC maps are maps created to represent the potential uses of a unit of land and its ability to sustain agricultural production based on an assessment of various indicators such as rock type, soil type, slope, erosion degree and type, vegetation, climate, the effects of past land use, and the potential for erosion. The productive capacity of the land is determined by

the physical qualities of the land, soil and environment and its limitations. Limitations include susceptibility to erosion, steepness of slope, susceptibility to flooding, liability to wetness or drought, salinity, depth of soil, soil texture, structure and nutrient supply and climate². Increasing limitations reduce the land's versatility for use.

- 28 The LUC Classification criteria and their use are defined according to the Land Use Capability Survey Handbook 3rd Edition³ (Land Use Capability Handbook).

Regional scale LUC map information limitations

- 29 The LUC Classification can be applied (mapped) at any scale and regional scale LUC map units can differ from those identified at property scale⁴. Property scale mapping is typically mapped at a scale between 1:5,000 and 1:15,000, while catchment and regional maps are mapped at 1:15,000 to 1:50,000 scale. The Land Use Capability Handbook sets out recommended mapping scales for inventory surveys and LUC mapping (p100).
- 30 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.
- 31 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 observation/ha while a 1:50,000 scale map requires 0.04 observation/ha (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.
- 32 For the regional scale LUC map information, map unit boundaries may not align with the topography (slope) and other geographic features (such as rivers).

² Lynn, IH, Manderson, AK, Harmsworth, GR, Eyles, GO, Douglas, GB, Mackay, AD, Newsome PJF. 2009. Land Use Capability Handbook - a New Zealand handbook for the classification of land 3rd Ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science 163pp.

³ Lynn, IH, Manderson, AK, Harmsworth, GR, Eyles, GO, Douglas, GB, Mackay, AD, Newsome PJF. 2009. Land Use Capability Handbook - a New Zealand handbook for the classification of land 3rd Ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science 163pp.

⁴ Lynn, IH, Manderson, AK, Harmsworth, GR, Eyles, GO, Douglas, GB, Mackay, AD, Newsome PJF. 2009. Land Use Capability Handbook - a New Zealand handbook for the classification of land 3rd Ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science 163pp.

- 33 Technology such as high resolution aerial photography (and its interpretation), and detailed contour mapping enable a closer examination of the accuracy of the regional scale LUC map information to identify areas that may not agree with the mapped LUC unit(s).

New Zealand Land Resource Inventory

- 34 The NZLRI is a multi-factor (soil, slope, and erosion) national land resource database designed for soil conservation, erosion planning and farm management. It comprises mapping units each classified using LUC classification of eight main classes.
- 35 Between 1971 and 1979, New Zealand was mapped (1st edition) using LUC at a scale of 1:63 360 (1 inch to 1 mile). In the 1980s the maps were adapted to the metric 1:50,000 scale. Several regions¹ were later remapped (2nd edition). The NZLRI LUC maps can be accessed via the Manaaki Whenua Landcare Research LRIS portal⁵.
- 36 The NZLRI mapped LUC unit boundaries do not always align with topography (e.g. slope) and other geographic features (such as rivers). This is primarily because the NZLRI LUC mapping is based on hard copy maps showing 20 metre topography. As noted above, more recent technology enables a much closer examination of the land.
- 37 For farm-level mapping, soil descriptions from existing soil surveys, reference to the NZLRI, together with detailed field observation of landform and landscape processes, rock type regolith composition, and soil profile characteristics, can be used to delineate soil boundaries appropriate to the scale of mapping⁷. New Zealand soil manuals and handbooks provide modern standards for describing soil profiles⁸, and criteria and standards for classifying soils using the New Zealand Soil Classification system⁹.

Anthropic Soils

- 38 The New Zealand Soil Classification system provides the definition and criteria for Anthropic Soils:

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

⁷ p19, Lynn, IH, Manderson, AK, Harmsworth, GR, Eyles, GO, Douglas, GB, Mackay, AD, Newsome PJF. 2009. Land Use Capability Handbook - a New Zealand handbook for the classification of land 3rd Ed. Hamilton, AgResearch; Lincoln, Landcare Research; Lower Hutt, GNS Science 163pp.

⁸ Milne JDG, Clayden B, Singleton P.L, Wilson AD. 1995. Soil Description Handbook. Lincoln, New Zealand, Manaaki Whenua Press. 157p.

⁹ Hewitt AE (2010) New Zealand Soil Classification. 3rd ed. Landcare Research Science Series No. 1. Lincoln, Manaaki Whenua Press.

Anthropic Soils are soils that have been made by the direct action of people, including truncation of natural soils by earth-moving equipment, drastic mixing of natural soils so that their original character is lost, or by deposition of thick layers of organic or inorganic material. Anthropic Soils occur in land surfaces that are made by people. Their classification reflects the way in which they were made and the kinds of materials used.

Note that soils that have been drastically disturbed but have been restored to the extent that they will meet the requirements of orders other than Recent Soils or Raw Soils, will not be assigned to Anthropic Soils. For this reason Anthropic soils are placed late in the Key to Orders but before Recent Soils and Raw Soils.

On-site assessment

- 39 In the following parts of my evidence I provide an assessment of LUC classification of the Site using the NZLRI LUC maps, aerial photography from Google Earth, a detailed contour map provided by Southern Horizons (provided in Appendix 1), and on-site soil observation photos provided by Mr Woodward under my direction (refer Appendix 3 for photo locations, and Appendix 4 for photos).
- 40 As part of my assessment I did not undertake the on-site assessment, However, on-site soil and site observations were made under my direction. These observations in combination with slope measurements and aerial photo interpretation is equivalent to the information I would collect and use to determine the LUC classification for a site.
- 41 In my opinion, this assessment provides a more detailed representation of the soils and LUC classes present on the Site in its current state than the regional scale NZLRI LUC map.

LUC units on the Site

- 42 The NZLRI LUC map information indicates that the LUC map units for the Site are 7e24+6e19 and 3s6 (refer Appendix 2 and Appendix 3).
- 43 Land classified as LUC 7 is non-arable. It has moderate to very severe limitations to pastoral use, is high risk and requires active management to achieve sustainable production. It can be suited to grazing with intensive soil conservation measures but is more suited to forestry.¹⁰ It is not considered productive land.

¹⁰ https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Land%20Capability/Iri_luc_main

- 44 The particular limitations for the LUC 7 area of the Site are indicated by the “7e24+6e19” unit. This unit indicates the presence of Letts steepland soils on the steep and moderately steep slopes of terrace scarps. The soils are stony shallow soils, formed in older alluvium with a thin cover of loess in places and are prone to moderate to severe erosion. The terrace scarps are characteristically dissected by small gullies with washout colluvium deposits¹¹.
- 45 An example soil profile¹² is 18 cm of brown stony loam over 15 cm of loose yellowish brown very stony loam, on fine angular greywacke-schist-quartz gravel.
- 46 LUC 3 land is arable. It has moderate limitations, restricting crop types and intensity of cultivation, suitable for cropping, viticulture, berry fruit, pastoralism, tree crops and forestry. It is considered productive land. The Land Use Capability Handbook provides the most common limitations that define LUC 3 land (p56). These are:
- (a) Moderate susceptibility to erosion under cultivation.
 - (b) Rolling slopes (8-15°).
 - (c) Shallow (20-45 cm) or stony soils.
 - (d) Wetness or waterlogging after drainage.
 - (e) Occasional damaging overflow.
 - (f) Low moisture holding capacity.
 - (g) Moderate structural impediments to cultivation.
 - (h) Low natural fertility.
 - (i) Weak salinity.
 - (j) Moderate climatic limitations.
- 47 The LUC unit 3s6 is characterised by Waenga soils (Waenga shallow sandy loam bouldery phase and Waenga fine sandy loam) on the main flat terrace, with Fraser soils occupying the lower river flats in the LUC unit¹³. These soils are formed from alluvium and occur on flat to undulating slopes.

¹¹ Leamy ML, Saunders WMH. (1967) Soils and land use in the upper Clutha Valley. Otago. Soil Bureau Bulletin 28. DSIR, Wellington.

¹² p30, Leamy ML, Saunders WMH. (1967) Soils and land use in the upper Clutha Valley. Otago. Soil Bureau Bulletin 28. DSIR, Wellington.

¹³ <https://iris.scinfo.org.nz/layer/48076-nzlri-land-use-capability-2021/>; Leamy ML, Saunders WMH. (1967) Soils and land use in the upper Clutha Valley. Otago. Soil Bureau Bulletin 28. DSIR, Wellington.

- 48 Of the limitations above, shallow (20-45 cm) or stony soils, (f) low moisture holding capacity, and (g) moderate structural impediments to cultivation are most relevant to the Site.

LUC 7e124+6e19 Area

- 49 Based on the contour map in Appendix 1, taking account of slope, which for most of the Site exceeds 15 degrees, I have delineated a boundary that I consider to be a more accurate representation of the boundary between the Letts soils with LUC 7e24+6e19 and LUC 3s6 map units than provided by the NZLRI map information. This is shown in Appendix 2.
- 50 Based on the revised boundary, the LUC unit 7e24+6e19 on the Site is greater in area than that shown on the NZLRI maps.

LUC 3s6 Area

- 51 The part of the Site identified as LUC 3s6 by the NZLRI map information that has slopes less than 15 degrees contains areas that have been extensively modified by the placement of tracks, fill and minor buildings.
- 52 Where there is no soil present (i.e. there is fill sediment without an A horizon (topsoil) formed or the soil has been removed by excavation), the area is not soil and is classed as non-productive land.
- 53 Where there is an A horizon (topsoil) present the modified soil area is classified as Anthropogenic Soils¹⁴ and an LUC class can be assigned.
- 54 On-site photos obtained by Mr Woodward and aerial photos (available on Google Earth) indicate that earthworks in the Site over the past 10 years has resulted in substantial modification by excavation or the placement of fill.
- 55 The LUC 3s6 area shown in the NZLRI map information is extensively modified by such earthworks.
- 56 The soil observation photos obtained by Mr Woodward indicate modified soil at each of the nine soil observation locations and no observations of the Waenga soil. Soil modification includes the presence of fill overlying a buried soil, a mixed soil profile, or a truncated soil profile.

¹⁴ Hewitt AE (2010) New Zealand Soil Classification. 3rd ed. Landcare Research Science Series No. 1. Lincoln, Manaaki Whenua Press.

- 57 Additionally, the original parent material in this area is a mix of colluvium from erosion of the steeper (LUC 7e24+6e19) land and not the parent material associated with the broader flats across the road.
- 58 As such, I consider the area shown as LUC 3s6 in the NZLRI maps with slopes less than 15 degrees (i.e. the flatter part of the Site) is not Waenga soils with LUC 3s6 but is dominated by a complex of shallow to very shallow stony Anthropoc Soils¹⁵ on undulating to rolling slopes (slope class B+C) and non-productive land.
- 59 I consider that this area of the Site is more properly classified as LUC class of 4s+non-productive land.

NPS highly productive land on the subject site

- 60 NPS-HPL clause 3.5(7)(a) allows for detailed mapping that uses the Land Use Capability classification.
- 61 I have used the Land Use Capability classification criteria provided by the Land Use Capability Handbook in combination with detailed slope class map and information, including on site photographs, to identify the likely LUC class(s) for the subject site at property scale.
- 62 In my opinion, this assessment provides a more spatially accurate property scale estimate of the LUC classes present on the Site than the regional scale NZLRI LUC map information.
- 63 Based on the NZLRI map information for the Site, the Site contains LUC 7e24+6e19 and LUC 3s6 land. LUC class 7 land is not considered highly productive land under the NPS-HPL, while LCU class 3 land is considered highly productive land.
- 64 Based on my analysis, the Site has steeper slopes (greater than the slopes described for the LUC 3s6 map unit) that extend into the NZLRI LUC 3s6 map unit, and, at property scale, and in combination with the soil observations of soil depth, is more appropriately classified as LUC 7e24+6e19.
- 65 The gentler sloping land in Site is undulating to rolling and meets the slope requirement for the LUC 3s6 unit. However, the parent material is a mix of colluvium from erosion of the steeper (LUC 7e24+6e19) land and not the parent material associated with the broader flats across the road that is

¹⁵ Truncated Anthropoc Soils and Fill Anthropoc Soils; Hewitt AE (2010) New Zealand Soil Classification. 3rd ed. Landcare Research Science Series No. 1. Lincoln, Manaaki Whenua Press.

classed as LUC 3s6. Additionally, the soil observation photos indicate extensive modification of the area by earthworks meaning that in its current state, the area is dominated by Anthropogenic Soils and non-productive land, with only small remnant areas of the original soil present.

- 66 In my opinion, this NZLRI LUC 3s6 area is most accurately Anthropogenic Soils classed as LUC class 4 land and non-productive land.
- 67 As such, I conclude that the Site is not LUC class 1, 2 or 3 and is not NPS-HPL highly productive land.

Conclusion

- 68 The regional scale Land Use Capability (LUC) map information available for the Site is provided by the 1:50,000 scale New Land Resource Inventory.
- 69 The NZLRI LUC map information indicates that the LUC map units for the Site are 7e24+6e19 and 3s6, where the 7e24+6e19 land occupies a greater portion of the Site.
- 70 However, my assessment based on the interpretation of on-site soil observation photos, aerial photographs and a detailed contour map indicates that the Site is not LUC class 3 land.
- 71 Analysis using the detailed contour map and on-site photos indicates that a greater portion of the subject site is 7e24+6e19 land than indicated by the NZLRI map information.
- 72 The remainder of the NZLRI LUC 3s6 area is dominated by Anthropogenic Soils at best classed as LUC class 4, and non-productive land.
- 73 In my opinion, the subject site land in its current state does not contain land that is characteristic of the LUC 3s6 with Waenga soils formed from river alluvium and is not highly productive land as defined by the NPS-HPL.

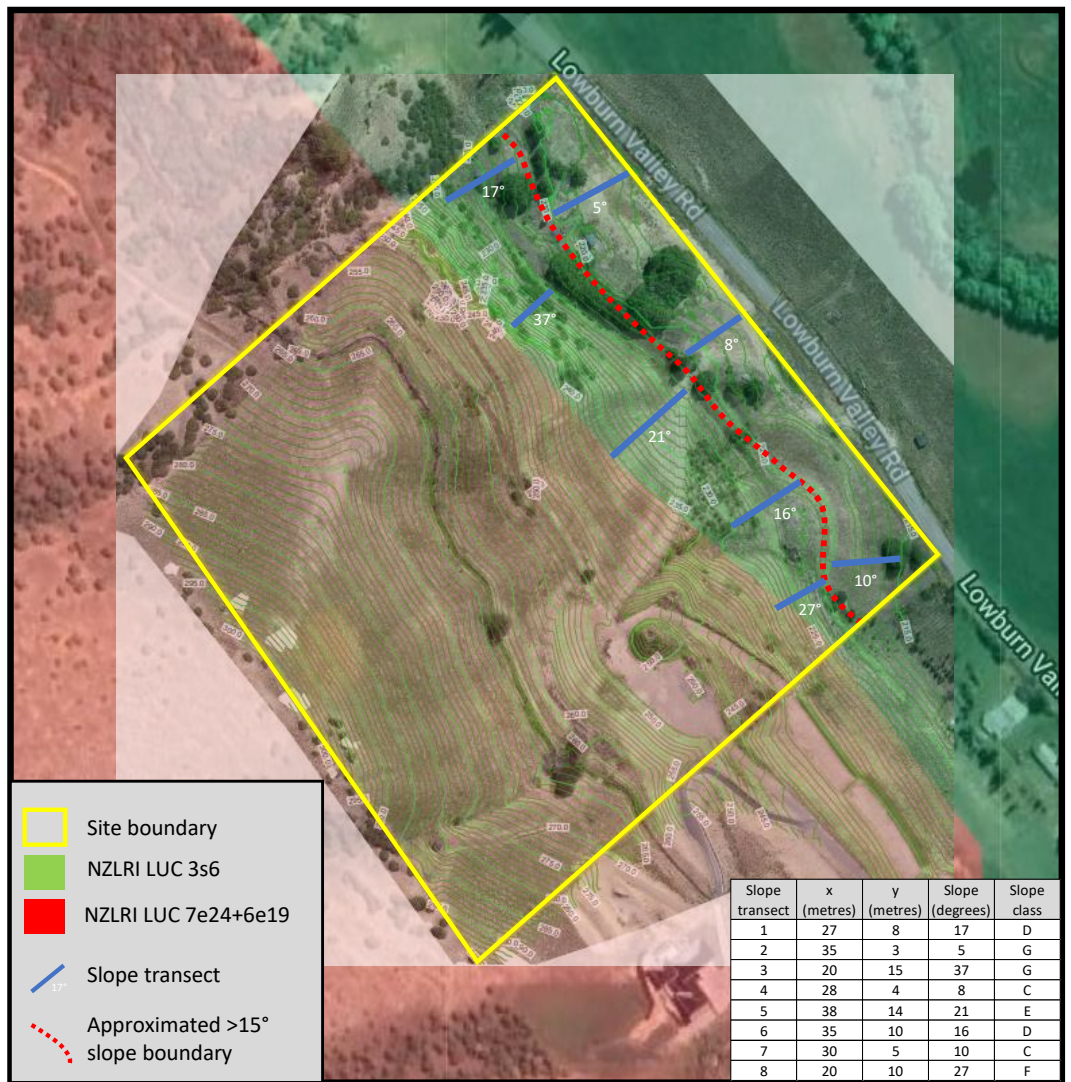
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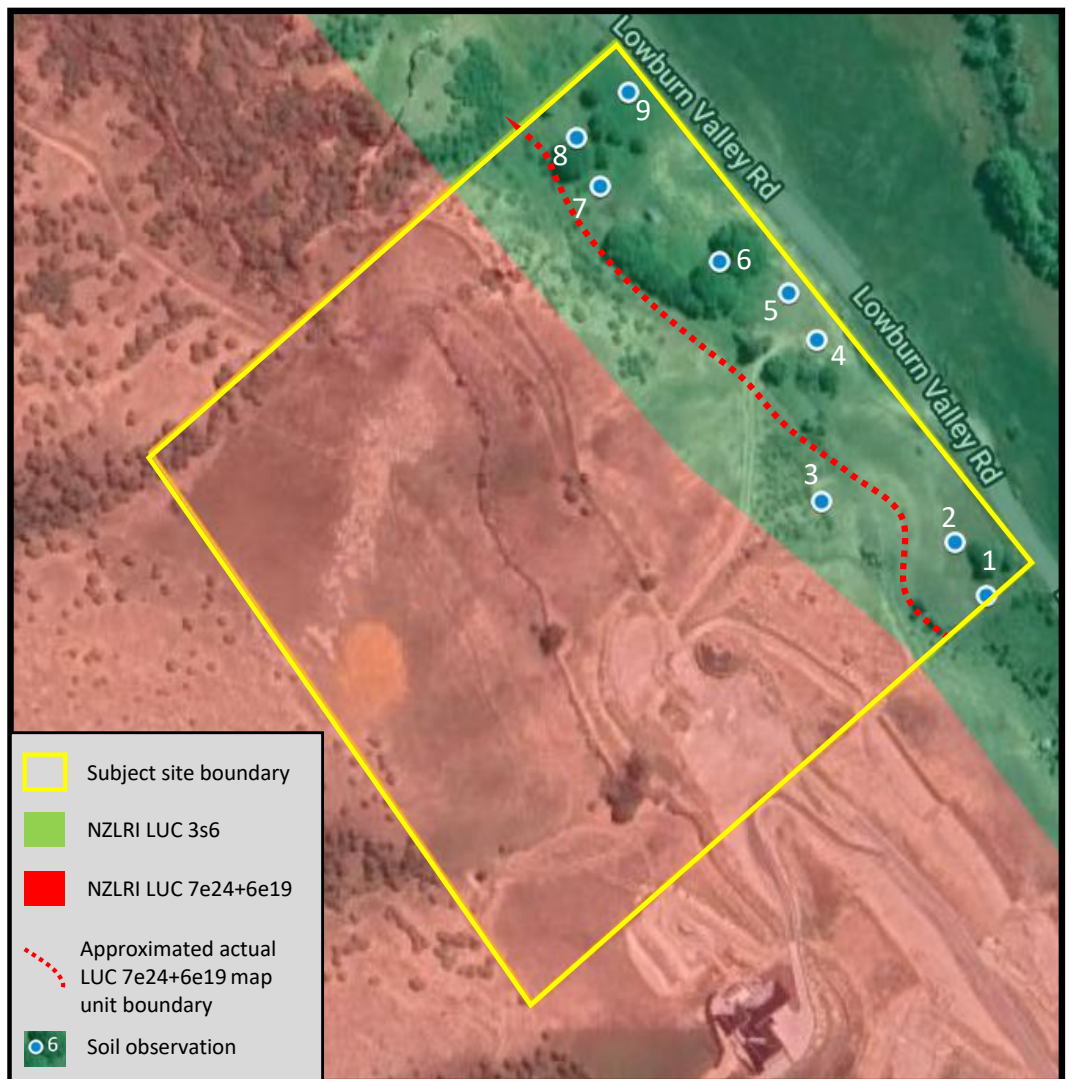
Appendix 1: Detailed contour map provided by Southern Horizons.



Appendix 2: Location of slope measurements.



Appendix 3: Location of on-site soil observation photo locations.



Appendix 4: On-site soil observation photos.



1. Fill or very shallow disturbed stony soil with minimal topsoil present.



2. Fill or very shallow disturbed stony soil with minimal topsoil present.



3. Fill or very shallow disturbed stony soil with minimal topsoil present.



4. Fill with no topsoil present over stones and gravel.



5. Fill or very shallow disturbed stony soil with minimal topsoil present.



6. Fill overlying buried shallow soil over gravels.



7. Fill overlying buried shallow soil over gravels.



8. Fill with mixed subsoil and stones.



9. Fill or very shallow disturbed stony soil with minimal topsoil present.