Prestons Park, 12 Cameo Grove Subdivision Extension

Geotechnical Completion Report

CDL Land New Zealand Ltd.

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Document control record

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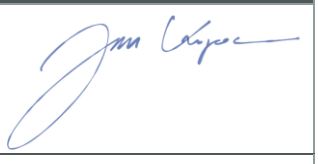
Author signature		Approver signature	
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Appendices

Executive Summary

CDL Land New Zealand Limited is developing the Cameo Grove Block of the Prestons Park Subdivision, located on Prestons Road, Christchurch. This block forms the residential lots at 12 Cameo Grove at the eastern end of the subdivision. As part of the work, a geotechnical completion report is required to confirm that the site works have been carried out to the required standard and provide recommendations for building developments. This report describes the earthworks involved with the Cameo Grove Block of the Prestons Park Subdivision.

Based on Aurecon's geotechnical assessment, the Cameo Gove Block comprised eights lots classified as Technical Category TC2 equivalent prior to earthworks commencing.

Aurecon's role was to monitor the earthworks and fill compaction testing and observe the construction of the low height retaining wall along the western boundary of the site.

Extensive earthworks comprising cutting and filling have occurred on the site. The quality assurance testing of the engineered earth fill indicates that the earth fill placed within the Cameo Grove Block area has achieved the required compaction levels.

As-Built records and photographs provided by the contractor indicate that the retaining wall has been constructed in accordance with the design drawings and relevant standards.

From the monitoring and testing undertaken as part of the development of the Cameo Grove Block the following is concluded:

Certificate of Compliance

The standard of bulk earthworks generally meets the earthworks specification and the applicable codes, including NZS4431:1989 (since superseded by the NZS 4431:2022 *Engineered fill construction for lightweight structures*). Aurecon's signed Statement of Suitability of Engineered Fill for Lightweight Structures has been included as Appendix D.

Building Considerations

General

This report shall not be used for building consent application for buildings on individual lots.

Site specific geotechnical investigations, in-line with NZS3604:2011, shall be undertaken at building consent application stage.

TC2 Foundations

For lots identified as TC2, dwellings shall be founded on TC2 type *'enhanced foundation slabs'* as per Options 2, 3 or 4 from the MBIE Guidelines (2012) Section 5.3 to mitigate the effects of liquefaction induced vertical settlement. Alternatively, a specific design in accordance with MBIE Guidelines Section 5.4 could be undertaken by a suitably qualified chartered professional engineer.

Retaining Wall

A low height, embedded timber pole retaining wall (up to 1m retaining height) has been constructed along the western boundary of the site. Foundations for any dwellings on the lots adjacent to the wall must be set back a minimum of 2m from the crest of this retaining wall or at a depth where the foundations will not load the retaining wall.

Explanatory Statement

This report shall be read as a whole, and our explanatory statement is presented in Section 5.

1 Introduction

1.1 Geotechnical Completion

CDL Land New Zealand Limited (CDL Land) is extending the Prestons Park subdivision by developing an adjacent block of land at 12 Cameo Grove. The site works in the Cameo Grove block included bulk earthworks for the development of the lots and the construction of a low height retaining wall along the western boundary. As part of this work, a geotechnical completion report is required to certify the site works have been carried out to the required standard and provide recommendations for building developments.

This report has been prepared for CDL Land and issued to Christchurch City Council (CCC). It describes the earthworks involved within the Cameo Grove block of the Prestons Park subdivision (see Drawing 235361-093-SKT-GG-001, Appendix A).

The purpose of this geotechnical completion report is to present the following:

- Summary of information from previous investigations carried out as part of the subdivision consent and detailed design.
- Summary of the ground conditions and liquefaction potential.
- Extent of earthworks on the lots and compliance testing of bulk earthworks.
- A summary of the findings, land technical category, and recommendations for building development.

This report has been prepared based on geotechnical data from site observations and compaction testing during and after earthworks construction. All references to cut-fill depths are based on subgrade levels.

This report shall be read as a whole, and our explanatory statement is presented in Section 5.

1.2 Site Description

CDL Land is developing Prestons Park subdivision, which comprises a large-scale residential development with associated commercial lots. The subdivision is located on an area of land between Prestons Road and Mairehau Roa on the north-east side of Christchurch. The Prestons Park subdivision is part of the larger Prestons subdivision which extends north to Lower Styx Road. The greater Prestons subdivision is 150ha, whilst Prestons Park is approximately 75ha.

This geotechnical completion report focuses on approximately 0.44ha area site being developed to the east of Prestons Park, known as the 12 Cameo Grove Extension (see Drawing 235361-093-SKT-GG-001, Appendix A).

2 Pre-Development Geotechnical Work

2.1 Geotechnical Testing

The subdivision consent and detailed geotechnical design for the subdivision extension included an extensive series of geotechnical investigations. These comprised Cone Penetration Tests (CPTs), Hand Augers (HA), and Test Pits (TP) undertaken between 2017 and 2025. The details of these investigations are presented in the Aureon report *Prestons Park, 12 Cameo Grove Subdivision Extension* Ref.235361, dated 1 March 2024.

The investigation tests carried out within the Cameo Grove block of Prestons Park are presented in Drawing 235361-093-SKT-GG-002 in Appendix A.

2.2 Ground Conditions

The ground conditions within the Cameo Grove block varied but predominantly comprised sand with minor silt and peat lenses. Uncontrolled fill and topsoil were encountered at varying depths and thickness across the western portion of the site. The typical ground conditions are presented in Table 1.

Table 1: Typical ground conditions within the Cameo Grove block

Depth to top of unit (m)	Depth to base of unit (m)	Description
Surface	0.2 to 2.7	TOPSOIL / UNCONTROLLED FILL: *Fine to coarse SAND with minor to trace silt and rootlets.*
Surface to 2.7	0.35 to 2.0	Fine to Coarse SAND with interbedded lenses of silt and localised 150mm to 300mm thick PEAT layers.
1.7 to 2.7	10m+	Fine to Coarse SAND.

Groundwater levels ranged from 1m to 3m below ground level.

2.3 Liquefaction Potential

As part of the geotechnical assessment and detailed design, a liquefaction assessment was carried out. The details of the liquefaction assessment are presented in the *Prestons Park, Cameo Grove Subdivision Extension*. The land categorisation was based on the criteria of Ministry of Business, Innovation and Employment (MBIE), Technical Category deformation performance limits are set out in Table 2.

Table 2: Technical category definitions and foundation implications (MBIE, 2012).

Technical Category	Liquefaction Deformation Limits				Likely Implications for House Foundations (Subject to individual assessment)
	Vertical		Lateral Spread		
	SLS	ULS	SLS	ULS	
TC1	15mm	25mm	nil	nil	Standard 3604-like foundation with tied slabs
TC2	50mm	100mm	50mm	100mm	MBIE Enhanced Foundation Solutions
TC3	>50mm	>100mm	>50mm	>100mm	Site Specific Measures – Piles or Ground Improvement

The results from the liquefaction assessment indicated that the Cameo Grove block can be classified as Technical Category 1 (TC1) and Technical Category 2 (TC2), however the majority of the testing indicates it was predominantly TC2.

3 Subdivision Earthworks

3.1 General

Bulk Earthworks for Cameo Grove were carried out in accordance with the requirements of NZS 4404:2010, *Code of Practice for Urban Subdivision* and NZS4431:1989 *Code of Practice for Earthfill for Residential Development* (since superseded by the NZS 4431:2022 *Engineered fill construction for lightweight structures*). The earthworks typically comprised stripping the site of topsoil, organic silt material, and general waste, filling using imported pit run gravel (Lots 1 – 4) or imported and/or site-won sand (Lots 5 – 8) and then replacing the topsoil. Excavation to remove in-situ organic material (peat) was typically undertaken across the western extent of the site and under Lot 7. A septic tank located on Lot 6 was also removed and backfilled with imported sand.

3.2 Areas of Cut and Fill

Site earthworks within Cameo Grove have included cuts to unsuitable ground levels which were then refilled to finished ground level. The fill material comprises site-won sand, imported sand and/or pit run gravel overlying a natural sand subgrade. A layer of topsoil overlies the fill material. The extent of the cutting and filling sequence is shown in Drawing 235361-DW-AB-PS-S4K-EW-01[0] in Appendix A. The drawing shows the amount of fill required to replace the cut unsuitable ground.

3.3 Compaction Quality Control Testing

Independent testing of earthfill compaction completed using conventional earthworks techniques was carried out using a Nuclear Densometer (NDM). The acceptance criterion was based on the Prestons Park Subdivision earthworks specification as follows:

- Compaction of fill was to be in accordance with NZS 4431: 1989 (since superseded by the NZS 4431:2022 *Engineered fill construction for lightweight structures*).
- Compaction standard is 95% Maximum Dry Density (MDD) for all areas of bulk filling, per NZS4402 Test 4.1.3.

Fill materials comprised of site-won sand, imported sand and imported pit run gravel. Compaction curves for each of the fill materials are presented in Appendix B.

The MDD from the compaction curves were used to determine the level of compaction required for the fill material. A summary of these NDM results is presented in Appendix C and the NDM testing locations are shown in Drawing 235361-DW-AB-PS-S4K-EW-02[0] in Appendix A.

On those occasions where quality control testing did not meet the specification, the Contractor was required to rework the fill to achieve the required compaction.

3.4 Compaction Results

The results presented in Appendix C indicate that 95% MDD or greater compaction has been consistently achieved in the areas of bulk fill. Where NDM results indicated the required compaction had not been achieved, the Contractor completed additional compaction effort and conforming NDM results were achieved. From these results and our site observations, we confirm that the earthfill placed within Cameo Grove has achieved the required compaction. Aurecon's signed NZS 4431:2022 Statement of Suitability of Engineered Fill for Lightweight Structures has been included as Appendix D.

3.5 Retaining Wall

A low height, embedded timber pole retaining wall (up to 1m retaining height) has been constructed along the western boundary of the site. The retaining wall was required to ensure the design finished surface levels could be constructed to meet the stormwater design requirements. Low height retaining walls have been widely used around the Prestons Park development boundaries to retain the subdivision against neighbouring properties, and internally to facilitate stormwater design requirements.

The Contractor has provided photographic records and an As-Built plan (Drawing 235361-DW-AB-PS-S4K-RW-01[A] in Appendix A) for the completed wall. Geotextile installation, along with placement and compaction of the free draining granular backfill, was observed by an Aurecon Civil Engineer.

Based on Aurecon's site observations and the documentation provided, we consider the retaining wall to have been constructed generally in accordance with the design drawings and relevant standards.

4 Building Development

4.1 Technical Category

Geotechnical testing and a liquefaction assessment was carried out prior to the bulk earthworks. The testing indicates the lots with Cameo Grove are likely to perform to TC2 equivalent, which is in line with the adjacent properties to the north and east. The technical category classification of the lots is provided in Drawing 235361-093-SKT-GG-003 in Appendix A.

4.2 Earthworks on Building Lots

The extent of earthfill on the lots in Cameo Grove is shown on Drawing 235361-DW-AB-PS-S4K-EW-01 in Appendix A.

The fill areas have been constructed using materials and processes that have been randomly measured by independent testing. The testing shows that the placement of filling is generally in accordance with the specification and relevant standards.

4.3 Soil Suitability Criteria

Section 3 of New Zealand Standard NZS 3604:2011 *Timber Framed Buildings not requiring specific Engineering Design* provides several criteria for defining foundation soil suitability for lightweight timber or steel framed residential buildings.

Clauses 3.1.3 and 3.3 of NZS 3604:2011 provide criteria for determining strength and suitability of founding soils. Clauses 3.4.1 and 3.4.2 of NZS 3604:2011 discuss depths to competent founding. For purposes of this report, we have interpreted these clauses as meaning that for sound bearing at depths of 200mm to 600mm, standard shallow type foundations can be used.

For depths greater than this, specific foundation designs could be used or alternatively excavations can be backfilled to the required level with 10MPa site concrete or compacted hardfill. In line with the Client's brief, Aurecon will be undertaking site specific investigations on each residential lot. We will prepare site specific geotechnical reports addressing the foundation requirements on individual building lots. The testing data for the lot specific investigations will be uploaded to the New Zealand Geotechnical Database. For building consent purposes reports prepared for individual lots shall be used.

4.4 Building Recommendations

The recommendations in this report shall not be used for individual building consent applications. Site specific investigations in accordance with NZS 3604:2011 are required.

TC2 Foundations

For lots identified as TC2 we recommend founding dwellings on TC2 type *'enhanced foundation slabs'* as per Option 3 or 4 from the MBIE Guidelines (2012) Section 5.1.3 to mitigate the effects of liquefaction. Alternatively, in accordance with MBIE Guidelines Section 5.4 a specific design could be undertaken by a suitably qualified chartered professional engineer.

4.5 Retaining Wall

A low height, embedded timber pole retaining wall (up to 1m retaining height) has been constructed along the western boundary of the site. The retaining wall was required to ensure the design finished surface levels could be constructed to meet the stormwater design requirements. Foundations for any dwellings on the lots adjacent to the wall must be set back a minimum of 2m from the crest of this retaining wall or at a depth where the foundations will not load the retaining wall.

4.6 Future Earthworks

We do not anticipate that future earthworks will be required on most of the lots, however, should such work be required the following should be noted.

- All earthworks should be carried out in accordance with the Health and Safety at Work Act 2015 and the WorkSafe New Zealand Excavation Safety Good Practice Guidelines, 2016.
- Cuts that exceed 0.6m high around any of the house sites must be retained by a suitable retaining wall designed by a Chartered Professional Engineer.
- We recommend that no more than 450mm of fill is placed on the allotment without detailed engineering design.
- Earthworks (cut and fill) should not be undertaken adjacent to any timber retaining wall, if present.
- Any development where excavations greater than 1.2m in depth are proposed, must be subject to specific investigation and design to confirm these works will have no adverse effects on land stability, infrastructure and/or structures on adjacent lots. Excavations near sensitive structures or near boundaries may require geotechnical engineering input even if shallower than 1.2m.

4.7 Construction Observation

The suitability of foundation conditions must be verified at the time of construction. Foundation inspections by a Building Inspector or a Chartered Professional Engineer who are familiar with this report must be carried out to ensure the adequacy of the foundation subgrade prior to the placement of granular hardfill or the construction of foundations.

5 Explanatory Statement

This report has been prepared for CDL Land New Zealand Limited. It may be made available to others but only in full. As noted above, it shall not be used by any person as a substitute for specific field observations and testing once house sites are confirmed.

This report has been prepared as part of the development of the Prestons Park Cameo Grove Subdivision extension. It has been prepared to provide the following information:

- To report on the management of the earthworks during construction, including compaction standards of fills.
- To report on the extent of ground improvement and the resulting land technical category.

This report does not remove the responsibility of the Owner / Builder / Building Certifier to satisfy themselves of foundation depth and suitability at the finally selected house location.

Subsurface conditions relevant to construction works should be assessed by experienced Contractors and designers who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes. Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay or in wet weather.

It is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or amendments to the original plans and specifications, are reviewed by Aurecon to verify that the intent of our recommendations is properly reflected in the design. During construction we request the opportunity to review our interpretations if the exposed site conditions are significantly different from those inferred in this report.

This report is not to be reproduced either wholly or in part without our prior written permission.

6 References

Aurecon New Zealand Limited, 2024. *Prestons Park, 12 Cameo Grove Subdivision Extension,* Rev 1. Christchurch, New Zealand.

Christchurch City Council, 2010. *Infrastructure Design Standards – Part 4: Geotechnical Requirements*.

Ministry of Business Innovation and Employment (MBIE), 2012. *Repairing and rebuilding houses affected by the Canterbury earthquakes*.

Ministry for the Environment, 2017. *Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects.* New Zealand

NZGS, 2005. *Guidelines for the Classification and Field Description of Soils and Rocks in Engineering*. NZ Geotechnical Society Inc, Wellington, New Zealand.

NZGS/MBIE, 2021. Earthquake geotechnical engineering practice, Module 1: Overview of the guidelines. NZ Geotechnical Society Inc, Wellington, New Zealand, Ministry of Business, Innovation and Employment, Wellington, New Zealand.

NZS1170.0:2002. *Australia/New Zealand Standard, Structural Design Actions, Part 0: General Principals.* Standards New Zealand, Wellington, New Zealand.

NZS1170.5:2002. *Australia/New Zealand Standard, Structural Design Actions, Part 5: Earthquake Actions – New Zealand.* Standards New Zealand, Wellington, New Zealand.

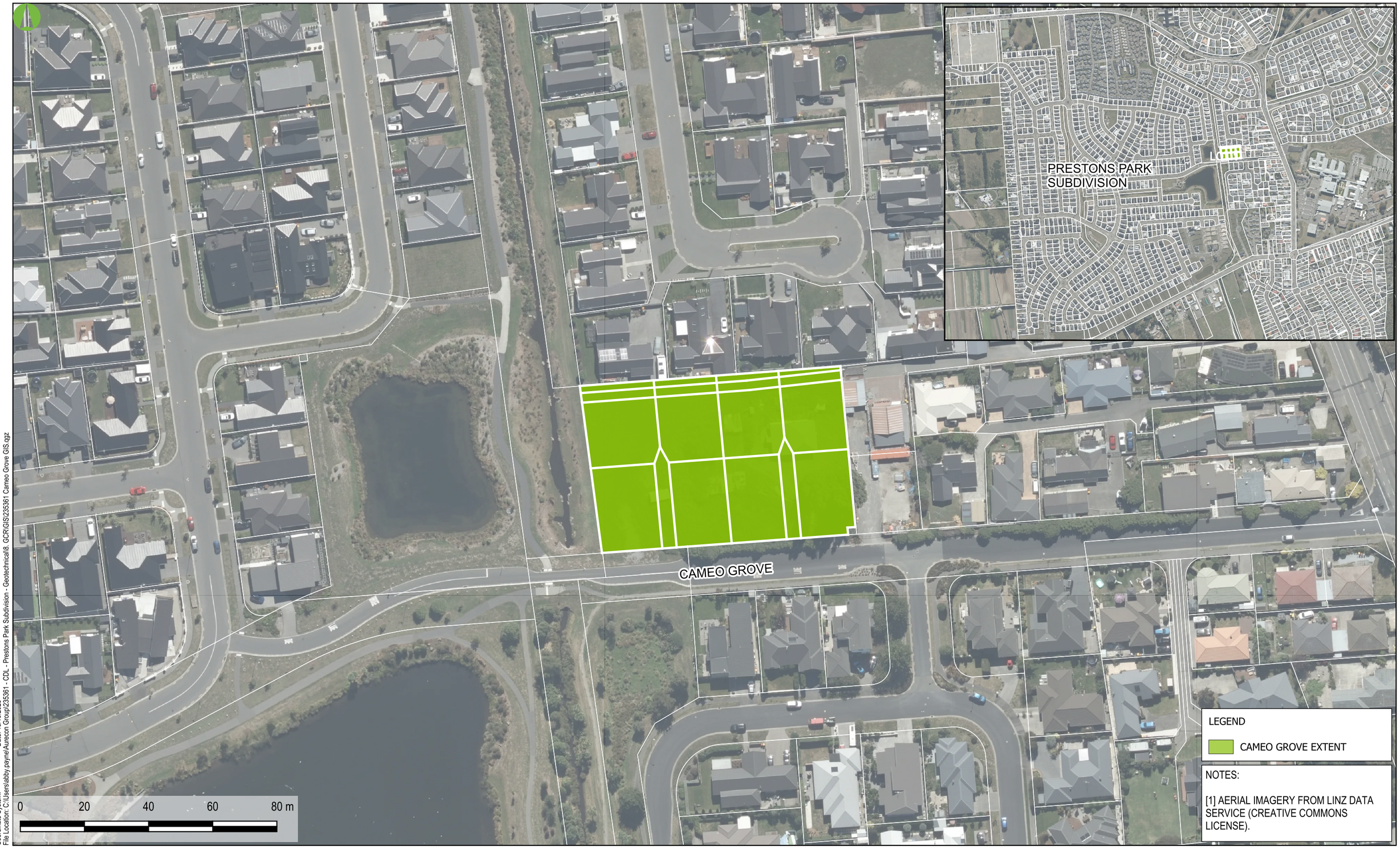
NZS 3604:2011. *Timber Framed Buildings*. Standards New Zealand, Wellington, New Zealand.

NZS 4404:2010. *Land development and subdivision infrastructure*. Standards New Zealand, Wellington, New Zealand.

NZS 4431:1989. *Code of practice for earth fill for residential development*. Standards New Zealand, Wellington, New Zealand.

NZS 4431:2022 *Engineered Fill Construction for Lightweight Structures*. Standards New Zealand, Wellington, New Zealand.

Appendix A
Figures



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REFEERENCE DRAWINGS

REFEERENCE MODELS

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