15 December 2022

951 COATESVILLE-RIVERHEAD HIGHWAY

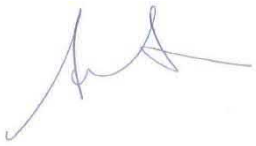
RESIDENTIAL SUBDIVISION

GEOTECHNICAL COMPLETION REPORT

Cabra Developments Limited

AKL2018-0182AB Rev 0

AKL2018-0182AB		
Date	**Revision**	**Comments**
13 December 2022	A	Initial draft for internal review
15 December 2022	0	Final issue to client

	Name	**Signature**	**Position**
Prepared by	Matt Illingworth		Project Engineering Geologist
Reviewed by	Andrew Linton		Principal Geotechnical Engineer CMEngNZ, CPEng
Authorised by	Sam Gibb		Principal Geotechnical Engineer CMEngNZ, CPEng

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Appendices

1 INTRODUCTION

In accordance with our instructions, this Geotechnical Completion Report has been prepared for Cabra Developments Limited as part of the documentation to be submitted to Auckland Council following earthworks to form a new residential subdivision. Construction of this residential subdivision has been undertaken in accordance with the Auckland Council Resource Consent number SUB60382055.

This report contains our Suitability Statement, specific comments related to items raised in the Resource Consent, relevant test data and the Cato Bolam Consultants Limited as-built plan set as provided in the appended drawings.

This report covers the construction period from April 2022 to November 2022 and is intended to be used for certification purposes for four new lots as follows:

- 5 new residential lots numbered Lots 1, 2 and 4 to 6 inclusive;
- 1 new Right-of-Way (ROW) numbered Lot 100.
- Lot 3 comprises the existing dwelling on the site and is excluded from this Completion Reporting.

The 951 Coatesville-Riverhead Highway residential subdivision can be accessed by the newly constructed Right-Of-Way (ROW) off Barrett Road, Riverhead. As can be seen from the as-built plans, 3 of the lots have been affected by filling as part of the earthworks operations to a maximum depth of approximately 1.5 metres.

Construction of this subdivision has been undertaken in general accordance with:

- Auckland Council's Resource Consent number BUN60382053
- NZS4431:2022
- Auckland Council's Code of Practice for Land Development and Subdivision, Chapter 2 - Earthworks and Geotechnical, Version 2.0, July 2022
- Cato Bolam Consultants Limited consented drawing set referenced 43252 dated 17 November 2022
- CMW Geosciences' Preliminary Geotechnical Investigation Report referenced AKL2018-0182, Rev 0, dated 27 September 2018

For the construction of this development, the following roles were fulfilled as defined in NZS 4402:2002 and the Ministry for the Environment Contaminated Land Management Guidelines:

- Geotechnical Designer: CMW Geotechnical NZ Limited
- Certifier: CMW Geotechnical NZ Limited
- Recognised Laboratory: CMW Geotechnical NZ Limited
- Sub-contractor (earthworks): Gideon Contractors Limited

As CMW has fulfilled the roles of both earth fill Certifier and Geotechnical Designer, this report has been prepared as a combined report covering both of these aspects of the project work.

2 DESCRIPTION OF WORKS

The earthworks operations within the 951 Coatesville-Riverhead Highway residential subdivision began in late April 2022 with the stripping of topsoil to form the central and western portions of the ROW. Portions of this section were lime stabilised before being trimmed to finished subgrade level.

The remainder of the ROW was formed in early May 2022 and backfilled with subbase aggregate. At this time topsoil was being stripped within Lots 4 to 6, with filling works in these lots commencing shortly after.

By June 2022 the ROW subbase had been compacted and prepped for concrete. The ROW construction was completed by early July 2022.

Minor filling works recommenced in October 2022 with Lot 6 being filled to finished subgrade level, and by November 2022 the site works were essentially complete.

The main items of plant used by the contractors included:

- 20T Excavator
- CAT Grader
- 12T Sheepsfoot Roller
- Dump Truck

3 GEOTECHNICAL QUALITY CONTROL

3.1 Site Observations

During the works, site visits were typically undertaken several times each week to assess compliance with NZS 4431 and project specific design recommendations and specifications.

Site visits were carried out to observe and confirm compliance relating to:

- Adequate topsoil stripping;
- ROW subgrade and subbase testing;
- Fill areas prior to the placement of fill materials to ascertain that all soft inorganic subsoils had been removed;
- Placement and compaction of engineered fills.

3.2 Compaction Control

Compaction of engineered earth fills was controlled by undrained shear strength measured by handheld shear vane calibrated using the NZGS 2001 method and by air voids as defined by NZS4402.

The criteria for undrained shear strength were a minimum single value of 110 kPa and minimum average of any 10 consecutive tests of 140 kPa.

The criteria for air voids were a maximum single value of 12% and maximum average of any 10 consecutive tests of 10%.

Vane shear strength, water content and in situ density tests were carried out on all areas of the engineered filling to at least the frequency required by the project specification.

While these tests showed on occasions that the contractor was struggling to achieve the required compaction standards with the prevailing site and soil conditions, to the best of our knowledge, all areas of fill were re-worked as necessary. Subsequent testing confirmed compliance with the specification.

4 EVALUATION OF COMPLETED EARTHWORKS

4.1 Natural Hazards

The appended as-built drawings depict a designated building platform on each lot (refer Cato Bolam Drawing 43252-DR-SU-1301). We are satisfied that all designated building platform areas are not subject to the natural hazards described in Section 71(3) of the Building Act, i.e. erosion, falling debris, subsidence, slippage, and inundation. Consideration of the inundation hazard was outside the scope of CMW's brief and has been assessed by others. The applied zones include:

- No consideration of the geotechnical risks has been given to areas outside the designated building platform and therefore specific design of foundations and cuts/fills is required on all lots outside the designated building platform.

- Specific design of any cuts/fills in excess of 600mm (including subfloor filling) is required on all lots within the designated building platform. This is to protect the slopes from inappropriate loading or undermining.

Full descriptions of the restrictions associated with each of the above are presented in our Opinion on Suitability in ***Appendix A***. Additional information is also provided in some of the following sections.

4.2 Liquefaction

The liquefaction risk for the lots on this development has been assessed as follows:

- Review of Auckland Council GIS maps confirms the damage category to be: Very Low Vulnerability
- In accordance with MBIE/NZGS guidance[1] the liquefaction susceptibility of the soils at this site has been assessed with respect to geological age and compositional (soil fabric and density) criteria, based on the soils encountered during initial investigations and during the earthworks operations. Our assessment considers the site soils to be at very low risk of liquefaction.

4.3 Land Stability and Erosion Control

The subdivision scheme layout comprises 5 new building platform locations, with Lots 4, 5 and 6 having been subject to minor earthworks in order to ease gradients across the lots.

We consider that the stability is satisfactory for all building platform areas, and we are therefore satisfied that these areas are not subject to the natural stability hazards described in the Building Act.

On all steep land, surface stability can be compromised by indiscriminate disposal of stormwater onto the ground surface and/ or by removal of vegetation. Accordingly, the disposal of excess stormwater flows will need to be specifically designed and located to minimise the risk of initiating instability.

Building and landscape designers must ensure that all runoff from solid surfaces is directed into the building stormwater system. It is also important that care is paid to the disposal of stormwater during construction so that concentrated discharges (e.g. from unconnected spouting) are not directed towards steep ground.

Depths of mulch and topsoil applied to sloping areas should be limited to less than 150mm to minimise the risks of saturation leading to localised slumping on batter faces. Wherever practical on such land, and particularly on steep batters, existing vegetation and grass cover should be well maintained. Any vegetation cleared beyond the immediate area of building platforms for temporary construction purposes should be replanted or replaced as soon as possible. The roots of an established vegetation cover can serve to bind the surface soils while the foliage can reduce rain infiltration and soil saturation, resulting in better resistance to erosion and shallow slumping.

4.4 Topsoil Landscaping Bunds

The appended Cato Bolam Limited as-built plans show the positions of topsoil landscaping bunds which were constructed during the earthworks operation. These landscaping bunds are all positioned outside the designated building platforms and therefore any future building/earthworks associated with these bunds is also required to be specifically designed.

4.5 Fill Induced Settlement

On the basis of the relatively minor magnitude of fill depths on this site, together with the elapsed time since it was placed, we consider that remaining post-construction settlements will be within code limits.

[1] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (November 2021)

4.6 Service Line Trenches

As part of the civil works, stormwater services associated with the ROW were, in select locations, trenched throughout the development as shown on the appended Cato Bolam Consultants Limited 43252-DR-SU-9300 and 9301 Stormwater As-built Plans.

As is normal on all subdivisions, building developments involving foundations within a 45 degree zone of influence from pipe inverts will require engineering input. The Auckland Council drawing referenced SW22 provided in Appendix B extracted from Chapter 4 of the Auckland Council Code of Practice for Land development and Subdivision depicts their requirements for stormwater pipes.

4.7 Subsoil Drains

The appended cut/fill as-built plan (ref. 43253-DR-SU-9010) shows the positions of a subsoil drain and its outlet within Lot 1 that was installed during the earthworks.

Descriptions of restrictions associated with this drain and outlet is contained in our appended Opinion on Suitability in ***Appendix A***.

4.8 ROW Subgrade

Penetration resistance testing was carried out on the right-of-way (ROW) subgrade during construction and the results of this testing were forwarded to Cato Bolam Limited for pavement remedial design. Where soft ground with low equivalent CBR values was identified it was generally lime stabilised or undercut and replaced with engineered clay fill.

4.9 Wastewater Disposal

The subdivision did not include construction of reticulated wastewater systems and therefore all residential lots are to use onsite wastewater disposal methods

Based on the soils observed during our investigation we have assessed the site classification for effluent disposal, as defined in Table 16 of Auckland Council Technical Publication GD06; Onsite Wastewater Management, in Table 1 below.

Table 1 Soil Categories for Effluent Disposal

Subsoil	**Recommended Soil Category for Effluent Disposal**
Topsoil	4
Pleistocene Formation Soils (Clayey Silts)	6

Table 17 of GD06 outlines the different disposal system appropriate for each soil category. However, construction of deep bores or trenched systems should be excluded as disposal design options, on account of potential stability concerns.

There are suitable locations within the site for dispersal fields from onsite sanitary sewer treatment systems. Dispersal fields should be located away from buildings or steep ground.

All septic tanks should be buried to fully compensate for their weight influence. All system designers should ensure that treatment fields are positioned outside the required setback from boundaries, buildings and watercourses. With the expansive nature of the soils on site, care should be taken to ensure the backfill around the tanks is sealed from surface infiltration as fluctuations in moisture content of the soils due to concentrated water inflow may lead to shrinking and swelling of the soils

4.10 Stormwater Disposal

All lots require onsite stormwater disposal methods. Concentrated stormwater discharges can lead to scour and instability, especially on steeper portions of the site.

Should tanks be used to collect or detain rainwater or stormwater, these tanks should be partially buried to compensate for their weight influence. Any overflow systems must be outlet via a solid pipe to the stormwater outlet position. Stormwater discharge locations should be set at lower elevations well beyond building platform areas, with appropriate scour protection at the outlet.

The design of the stormwater disposal systems should be carried out with regard to the site geotechnical hazards. All excess stormwater from roofs, water tank overflows, retaining wall outlets, subsoil drains, decks and driveways should be piped to carefully considered outlet locations such as gully bases.

Under no circumstances should any concentrated stormwater runoff be allowed to discharge directly onto the ground or into soakpits.

All tanks for stormwater and/or potable water should be partially buried to compensate for their weight influence. With the expansive nature of the soils on site, care should be taken to ensure the backfill around the tanks is sealed from surface infiltration as fluctuations in moisture content of the soils due to concentrated water inflow may lead to shrinking and swelling of the soils

4.11 Design of Shallow Foundations

4.11.1 Bearing Capacity

Once bulk earthworks and top-soiling of the building platforms had been completed, our staff drilled hand auger boreholes within the building platforms on Lots 2 and 4 to 6 inclusive to determine representative finished ground conditions and hence evaluate likely foundation options for future building development. The original investigation results were used for ground conditions within Lot 1. Our assessments of bearing capacity for the design of shallow foundations on each building platform are contained in our Statement of Suitability in ***Appendix A.***

At current subgrade levels the nominated building platforms on Lots 1, 2 and 4 to 6 inclusive have been assessed as having a geotechnical ultimate bearing capacity of 300 kPa within the influence of conventional shallow residential building foundation loads.

If higher geotechnical ultimate bearing capacities are required than have been specified, further specific site investigation and design of foundations should be carried out prior to Building Consent application.

4.11.2 Site (Seismic) Class

Our assessments of NZS 1170.5 site Class(es) is provided in our Opinion of Suitability and the Summary Table, both in ***Appendix A***.

4.11.3 Foundation Settlements

At the bearing pressures specified above and subject to the design requirements for soil expansiveness provided below, differential settlement of shallow foundations for buildings designed in accordance with NZS 3604 (including the 600mm subfloor fill depth limit) should be within code limits.

4.11.4 Soil Expansiveness Classification

Seasonal shrinking and swelling results in vertical surface ground movement which can cause significant cracking of floor slabs and walls. NZS 3604:2011[2] excludes from the definition of 'good ground', soils with a liquid limit of more than 50% and a linear shrinkage of more than 15% due to their potential to shrink and swell as a result of seasonal fluctuations in water content. For soils exceeding these limits, NZS 3604 has historically referenced AS 2870[3] for foundation design advice. However, the November 2019 update of Acceptable Solution B1/AS1[4] provides amendments to NZS 3604 that define a method for testing and

[2] Standards New Zealand (2011) Timber-framed buildings, NZS 3604:2011, NZ Standard

[3] Standards Australia Limited (2011) *Residential slabs and footings*, AS 2870-2011, Australian Standard, NSW

[4] Ministry of Business, Innovation and Employment (2019) *Acceptable Solutions and Verification Methods for NZ Building Code Clause B1 Structure,* B1/AS1, Amendment 19

classifying the soils and provides foundation designs for specific, simple house configurations across the range of expansive soil conditions.

Nevertheless, there is evidence[5] indicating that the use of the B1/AS1 method of assessment of expansiveness may be inaccurate.

Testing of samples obtained from the site was carried out by Road Test Limited an IANZ registered Testing Authority to provide the geotechnical parameters required for our assessment as presented in Table 1.

Table 1: Soil Expansiveness Testing Schedule

Type of Test	Test Method	Quantity
Water Content	NZS4402 – 1986 2.1	3
Cone Penetration Limit	NZS4402 – 1986 2.5	3
Linear shrinkage	NZS4402 – 1986 2.6	3

Certificates for the test results outlined above are presented in ***Appendix C.***

Test results were used in conjunction with visual-tactile assessment of the site soils and BRANZ Report SR120A[6] to determine expansive site Classes as defined in AS 2870, "Residential Slabs and Footings – Construction". Resulting classifications are provided in the Statement of Suitability in ***Appendix A***.

The expansive soil hazard is addressed by a combination of design that is appropriate for the expansive Class described in our Statement on Suitability in ***Appendix A***, together with care during site preparation for foundations and diligent maintenance of plantings near the foundations.

Site Preparation

There have been many instances of concrete floors and/ or foundations that have been poured on dry, desiccated subgrades in summer months on expansive soils and have undergone heaving and cracking requiring extensive repairs or even complete house re-builds once the soil moisture contents have returned to higher levels. In some instances, perimeter foundations have been appropriately treated but floor slabs have been poured on dry ground. Infiltration of moisture via pipe bedding has then occurred.

Foundation contractors need to be made aware of the extreme damage potentially caused by these circumstances and the need to maintain appropriate moisture contents in both the footings and building platform subgrade between the time of excavation and the pouring of concrete.

Remedial actions that may be appropriate include combinations of platform protection with a hard fill layer, pouring of a blinding layer of concrete in footing bases and soaking of the building platform with sprinklers for an extended period.

Site Maintenance

Landowners must be mindful that either the planting or removal of high water demand plants where their roots may extend close to footings (i.e. within a lateral distance of 1.5 times the mature tree height) can cause settlement or heave damage.

4.12 Topsoil Depths

Topsoil depths have been checked by the drilling of a borehole in the approximate centre of the building platform on each lot. The results are considered indicative for each lot, but may be subject to variations. Topsoil depths are between 150 and 300mm at this development.

[5] Rogers, N., McDougall, N., Twose, G., Teal, J. & Smith, T. (2020) The Shrink Swell Test: A Critical Analysis, *NZ Geomechanics News,* Issue 99, pages 66-80.

[6] Fraser Thomas Limited (2008) - Addendum Study Report (BRANZ SR120A), Soil Expansivity in the Auckland Region – Final Report

Site specific findings are contained in our Statement on Suitability Summary in ***Appendix A***. However, it is possible that further levelling works have been undertaken since our investigations and accordingly, we strongly recommend that lot purchasers complete their own checks of topsoil depths.

5 CLOSURE

Additional important information regarding the use of your CMW report is provided in the '*Using your CMW Report*' document attached to this report.

This report has been prepared for use by Cabra Developments Limited in relation to the 951 Coatesville-Riverhead Highway residential subdivision project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Although regular site visits have been undertaken for observation, for providing guidance and instruction and for testing purposes, the geotechnical services scope did not include full time site presence. To this end, our Statement of Suitability in ***Appendix A*** also rely on the Contractors' work practices and assumes that when we have not been present to observe the work, it has been completed to high standards and in accordance with the drawings, instructions and consent conditions provided to them.

Similarly, they assume that all as-built information and other details provided to the Client and/ or CMW by other members of the project team are accurate and correct in all respects.

Where a party other than Cabra Developments Limited seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

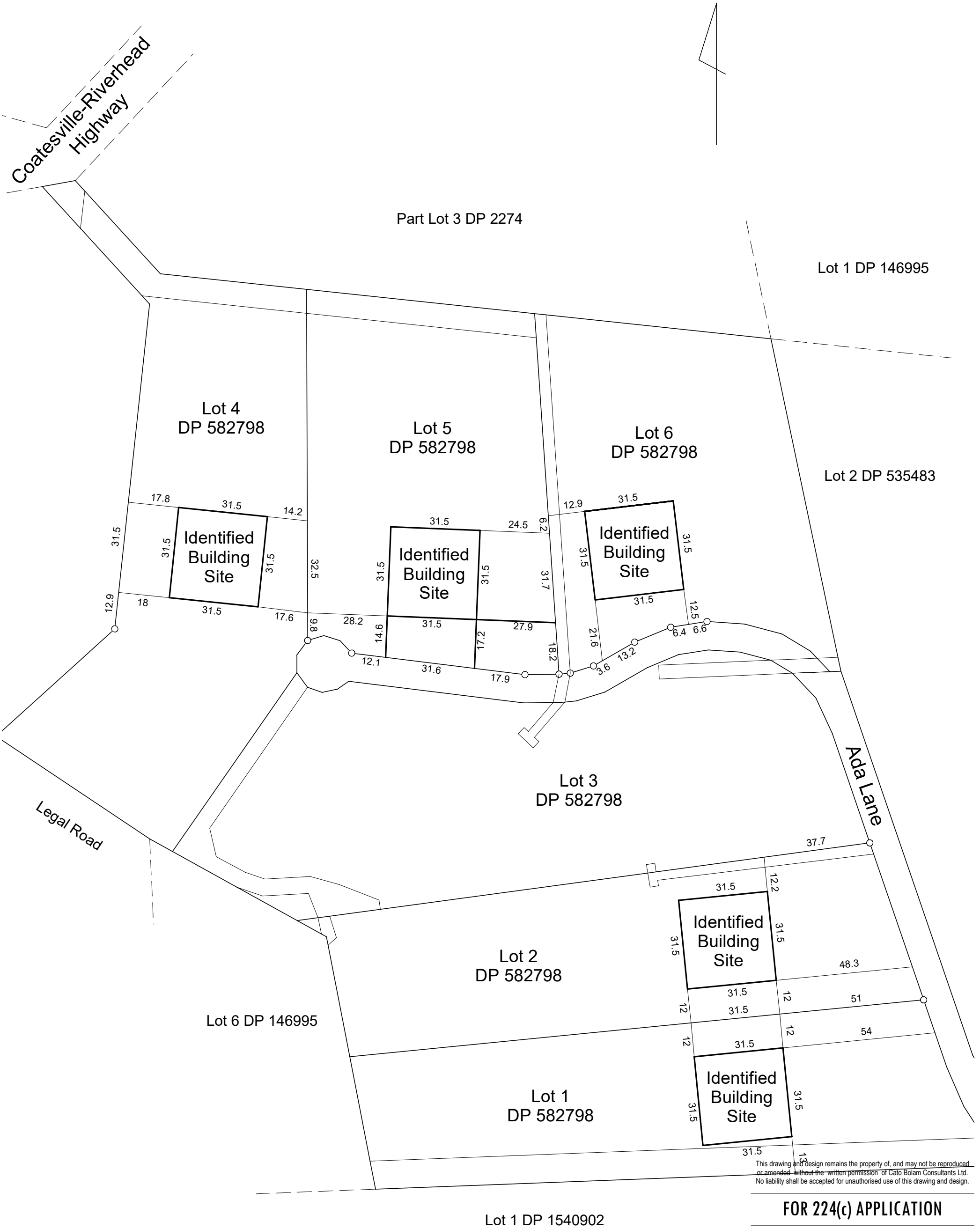
Environmental Matters Are Not Covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

Drawings

Title	Reference No.	Date	Revision
Identified Building Sites Lots 1, 2, 4, 5 & 6 DP 582798	43252-DR-SU-1301	22/11/2022	A
As-Built Plans			
Cover Page	403252-DR-SU-0001-1	December 2022	-
Final Contours As-Built Plan	43252-DR-SU-9000	05/12/2022	1
Cut to Fill As-Built Plan	43252.DR-SU-9010	05/12/2022	1
Driveway As-Built Plan	43252.DR-SU-9100	05/12/2022	1
Stormwater As-Built Plan	43252.DR-SU-9300	05/12/2022	1
Enlarged Stormwater As-Built Plan	43252.DR-SU-9301	25/11/2022	0



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FOR 224(c) APPLICATION

No.	REVISION (DESCRIPTIONS)	NAME	DATE
A			

SURVEYED			
DESIGNED			
DRAWN		JC	23/11/22
DATE	ORIGINAL SCALE	ORIGINAL SIZE	
22/11/2022	1:1250	A3	
DRAWING NO.		REVISION	
43252-DR-SU-1301		A	

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951 Coatesville-Riverhead Highway
Riverhead

Identified Building Sites
Lots 1, 2, 4, 5 & 6 DP 582798

CCAD

43252 - Cabra Developments Limited, 951 Coatesville Riverhead Highway, Riverhead

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For Completion

Plan No	Rev	Plan Title
		Earthworks
9000	1	Final Contours As-Built Plan
9010	1	Cut to Fill As-Built Plan
		Roading
9100	1	Driveway As-Built Plan
		Stormwater
9300	1	Stormwater As-Built Plan
9301	0	Enlarged Stormwater As-Built Plan

LOCATION DIAGRAM
Scale 1:7500

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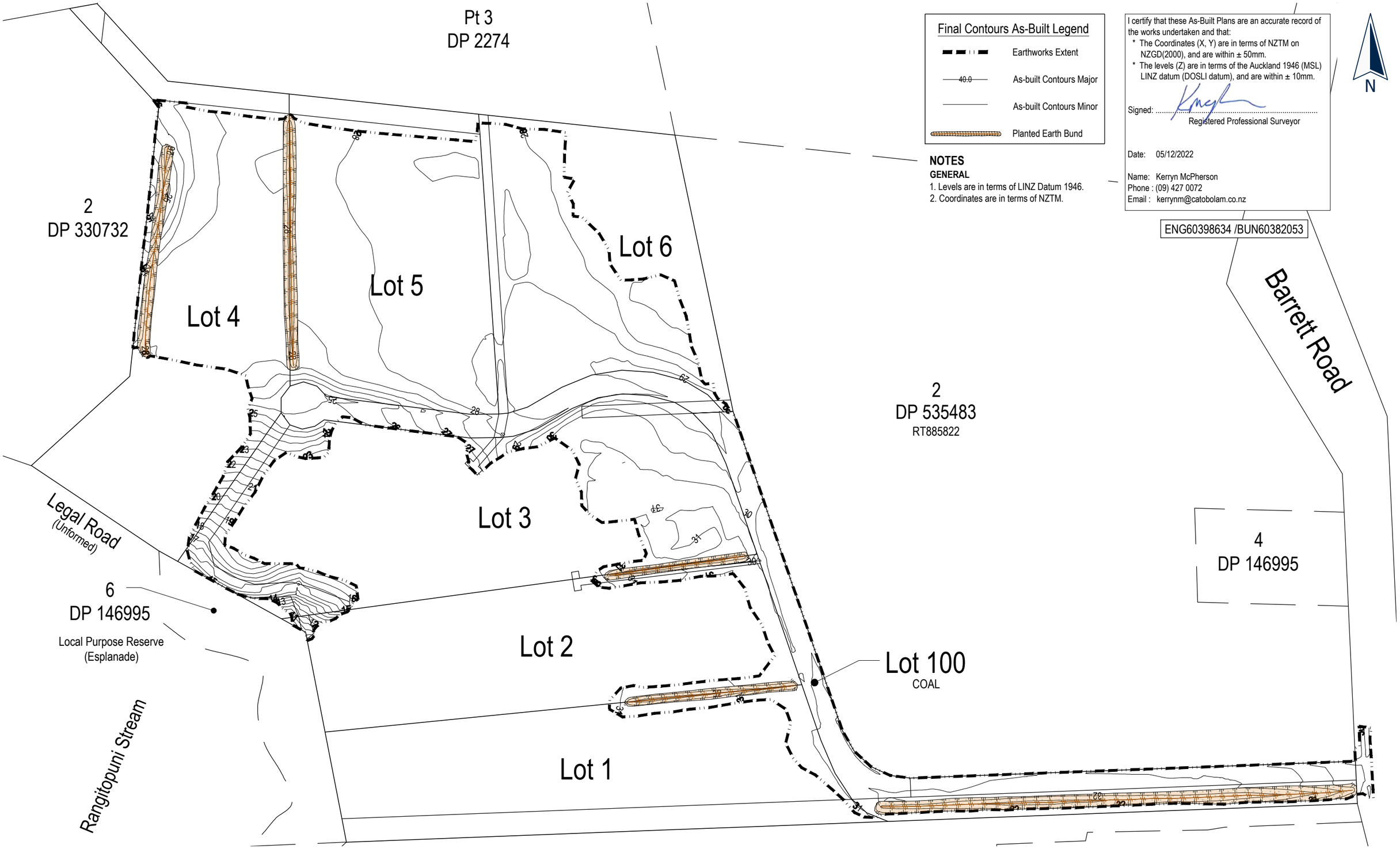
CABRA
Land & Property Development

DATE December 2022
ORIGINAL SIZE A3
DRAWING NO. 43252-DR-SU-0001-1



Final Contours As-Built Legend

- Earthworks Extent
- 40.0 — As-built Contours Major
- As-built Contours Minor
- Planted Earth Bund

NOTES

GENERAL

1. Levels are in terms of LINZ Datum 1946.
2. Coordinates are in terms of NZTM.

I certify that these As-Built Plans are an accurate record of the works undertaken and that:

* The Coordinates (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The levels (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....

Registered Professional Surveyor

Date: 05/12/2022

Name: Kerryn McPherson
Phone : (09) 427 0072
Email : kerrynm@catobolam.co.nz

ENG60398634 /BUN60382053

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Cabra Developments Limited
951 Coatesville Riverhead Highway
Riverhead

Final Contours
As-Built
Plan

No.	REVISION (DESCRIPTIONS)	NAME	DATE
0	Issued For Completion	K.McPherson	25/11/2022
1	Extent of Earthworks Updated Issued For Completion	K.McPherson	05/12/2022

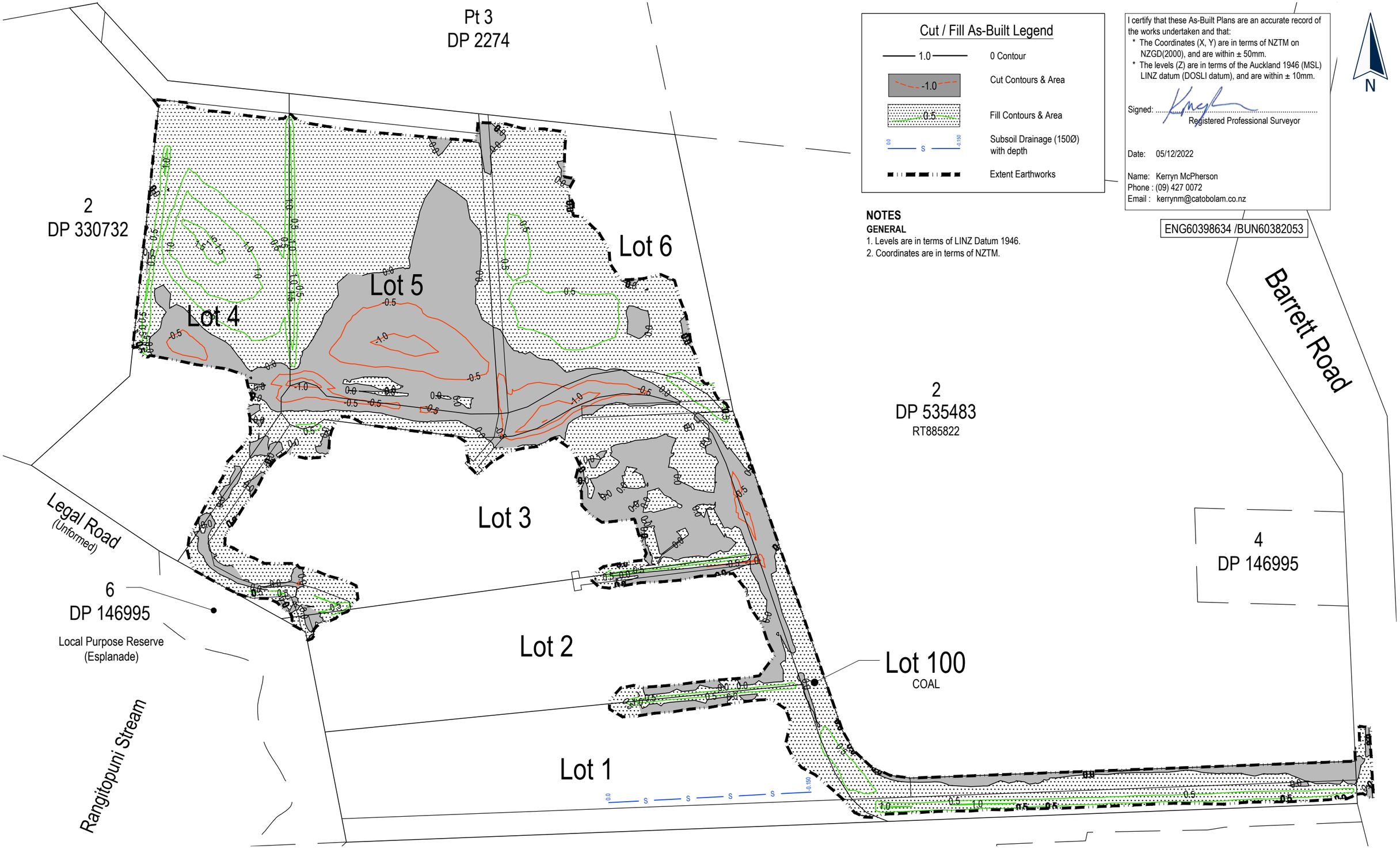
FOR COMPLETION

	NAME	DATE
SURVEYED	H.Baker	16/11/2022
DESIGNED	-	-
DRAWN	B.Nel	17/11/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
17/11/2022	1:1500	A3

DRAWING NO. 43252-DR-SU-9000

REVISION 1



Cut / Fill As-Built Legend

- 1.0 — 0 Contour
- -1.0 — Cut Contours & Area
- 0.5 — Fill Contours & Area
- 0.0 S 0.150 — Subsoil Drainage (150Ø) with depth
- Extent Earthworks

I certify that these As-Built Plans are an accurate record of the works undertaken and that:

* The Coordinates (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The levels (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....
Registered Professional Surveyor

Date: 05/12/2022

Name: Kerryn McPherson
Phone : (09) 427 0072
Email : kerrynm@catobolam.co.nz

ENG60398634 /BUN60382053

NOTES

GENERAL

1. Levels are in terms of LINZ Datum 1946.
2. Coordinates are in terms of NZTM.

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Riverhead

Cut to Fill
As-Built
Plan

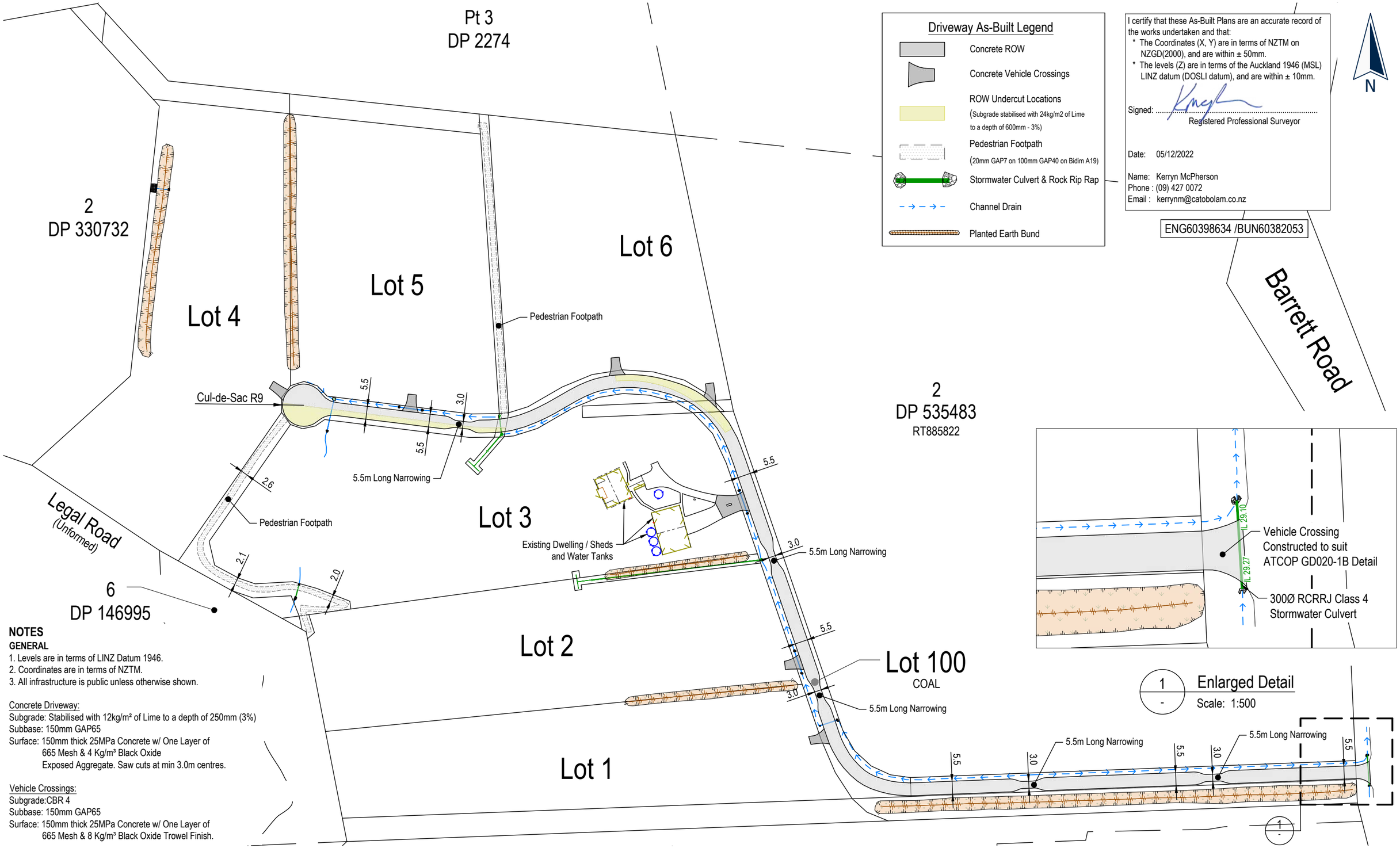
No.	REVISION (DESCRIPTIONS)	NAME	DATE
0	Issued For Completion	K.McPherson	25/11/2022
1	Extent of Earthworks Updated Issued For Completion	K.McPherson	05/12/2022

FOR COMPLETION

	NAME	DATE
SURVEYED	H.Baker	16/11/2022
DESIGNED	-	-
DRAWN	B.Nel	17/11/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
17/11/2022	1:1500	A3

DRAWING NO. 43252-DR-SU-9010
REVISION 1



Driveway As-Built Legend

- Concrete ROW
- Concrete Vehicle Crossings
- ROW Undercut Locations (Subgrade stabilised with 24kg/m2 of Lime to a depth of 600mm - 3%)
- Pedestrian Footpath (20mm GAP7 on 100mm GAP40 on Bidim A19)
- Stormwater Culvert & Rock Rip Rap
- Channel Drain
- Planted Earth Bund

I certify that these As-Built Plans are an accurate record of the works undertaken and that:

* The Coordinates (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The levels (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....
Registered Professional Surveyor

Date: 05/12/2022

Name: Kerryn McPherson
Phone : (09) 427 0072
Email : kerrynm@catobolam.co.nz

ENG60398634 /BUN60382053

N

NOTES

GENERAL

1. Levels are in terms of LINZ Datum 1946.
2. Coordinates are in terms of NZTM.
3. All infrastructure is public unless otherwise shown.

Concrete Driveway:
Subgrade: Stabilised with 12kg/m² of Lime to a depth of 250mm (3%)
Subbase: 150mm GAP65
Surface: 150mm thick 25MPa Concrete w/ One Layer of
665 Mesh & 4 Kg/m³ Black Oxide
Exposed Aggregate. Saw cuts at min 3.0m centres.

Vehicle Crossings:
Subgrade:CBR 4
Subbase: 150mm GAP65
Surface: 150mm thick 25MPa Concrete w/ One Layer of
665 Mesh & 8 Kg/m³ Black Oxide Trowel Finish.

C:\12dSynergy\Workspace\data\CATOAPP1\43252 - Cabra Developments Limited_53835\Technical\Drawings\As-Built Drawings\43252-DR-SU-9100 - Roading As-Built

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CABRA
Land & Property Development

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Cabra Developments Limited
951 Coatesville Riverhead Highway
Riverhead

Driveway
As-Built
Plan

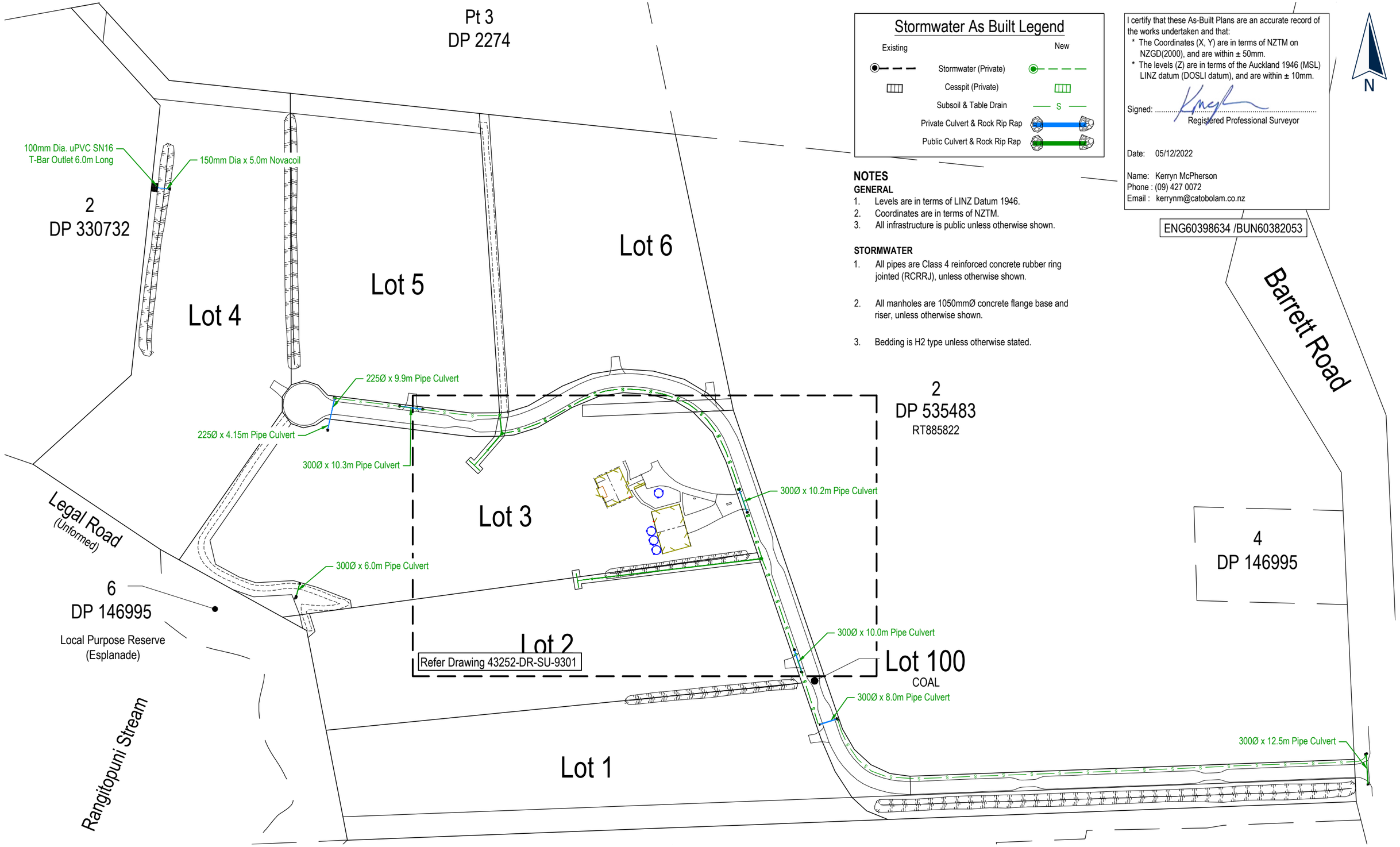
No.	REVISION (DESCRIPTIONS)	NAME	DATE
0	Issued For Completion	K.McPherson	25/11/2022
1	T-Bar and Bund Culvert Added Issued For Completion	K.McPherson	05/12/2022

FOR COMPLETION

	NAME	DATE
SURVEYED	H.Baker	16/11/2022
DESIGNED	-	-
DRAWN	B.Nel	17/11/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
17/11/2022	1:1500	A3

DRAWING NO. 43252-DR-SU-9100
REVISION 1



Stormwater As Built Legend

Existing		New
	Stormwater (Private)	
	Cesspit (Private)	
	Subsoil & Table Drain	S
	Private Culvert & Rock Rip Rap	
	Public Culvert & Rock Rip Rap	

I certify that these As-Built Plans are an accurate record of the works undertaken and that:

* The Coordinates (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The levels (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....
Registered Professional Surveyor

Date: 05/12/2022

Name: Kerryn McPherson
Phone : (09) 427 0072
Email : kerrynm@catobolam.co.nz

ENG60398634 /BUN60382053

NOTES

GENERAL

1. Levels are in terms of LINZ Datum 1946.
2. Coordinates are in terms of NZTM.
3. All infrastructure is public unless otherwise shown.

STORMWATER

1. All pipes are Class 4 reinforced concrete rubber ring jointed (RCRRJ), unless otherwise shown.
2. All manholes are 1050mmØ concrete flange base and riser, unless otherwise shown.
3. Bedding is H2 type unless otherwise stated.

C:\12dSynergy\Workspace\data\CATOAPP\143252 - Cabra Developments Limited_53835\Technical\Drawings\As-Built Drawings\43252-DR-SU-9300-9301 - SW As-Built

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Cabra Developments Limited
951 Coatesville Riverhead Highway
Riverhead

Stormwater
As-Built
Plan

No.	REVISION (DESCRIPTIONS)	NAME	DATE
0	Issued For Completion	K.McPherson	25/11/2022
1	T-Bar and Bund Culvert Added Issued For Completion	K.McPherson	05/12/2022

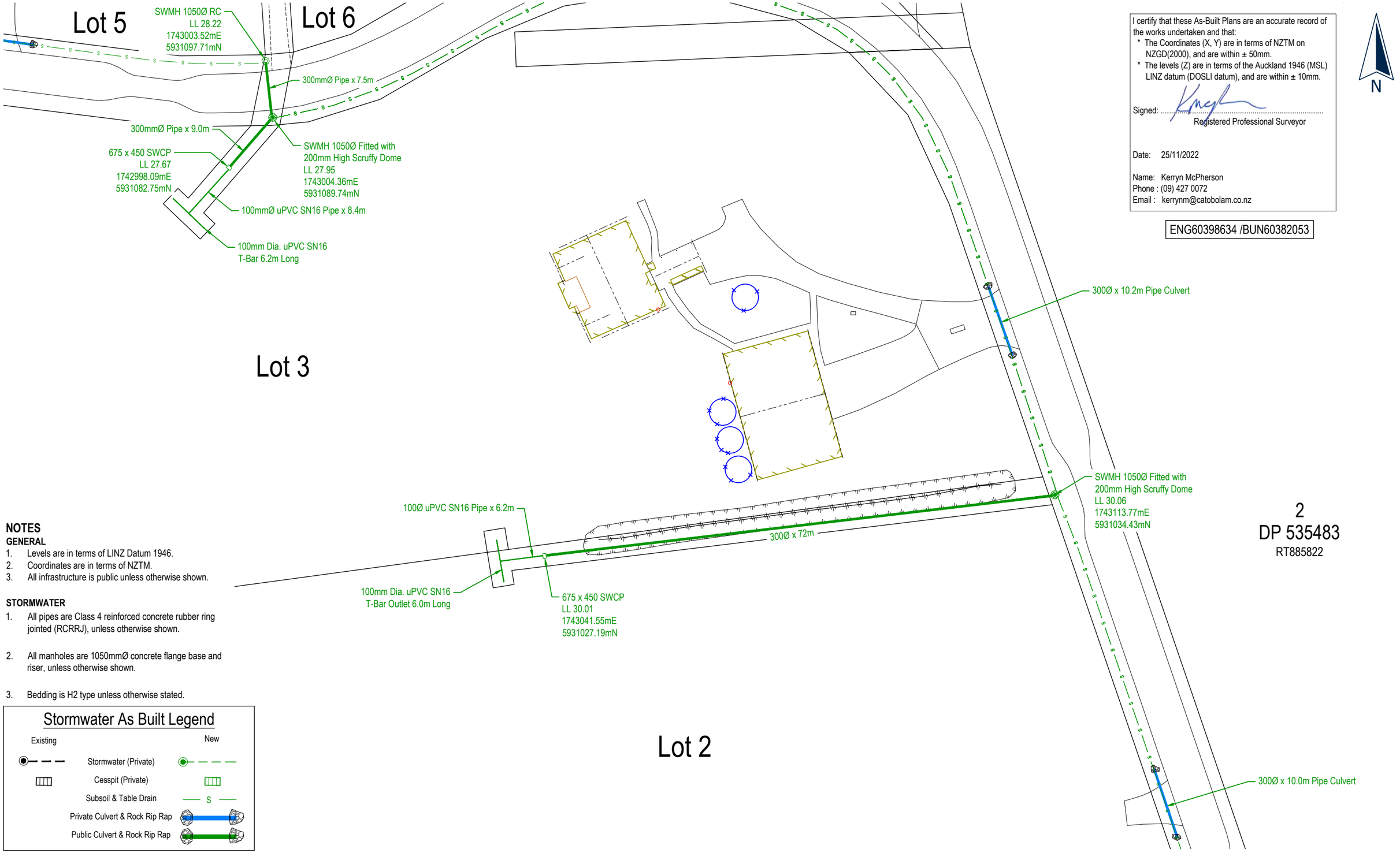
FOR COMPLETION

	NAME	DATE
SURVEYED	H.Baker	16/11/2022
DESIGNED	-	-
DRAWN	B.Nel	17/11/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
17/11/2022	1:1500	A3

DRAWING NO. 43252-DR-SU-9300

REVISION 1



I certify that these As-Built Plans are an accurate record of the works undertaken and that:

* The Coordinates (X, Y) are in terms of NZTM on NZGD(2000), and are within ± 50mm.
* The levels (Z) are in terms of the Auckland 1946 (MSL) LINZ datum (DOSLI datum), and are within ± 10mm.

Signed: .....
Registered Professional Surveyor

Date: 25/11/2022

Name: Kerryn McPherson
Phone : (09) 427 0072
Email : kerrynm@catobolam.co.nz

ENG60398634 /BUN60382053

2
DP 535483
RT885822

NOTES

GENERAL

1. Levels are in terms of LINZ Datum 1946.
2. Coordinates are in terms of NZTM.
3. All infrastructure is public unless otherwise shown.

STORMWATER

1. All pipes are Class 4 reinforced concrete rubber ring jointed (RCRRJ), unless otherwise shown.
2. All manholes are 1050mmØ concrete flange base and riser, unless otherwise shown.
3. Bedding is H2 type unless otherwise stated.

Stormwater As Built Legend

Existing		New
	Stormwater (Private)	
	Cesspit (Private)	
	Subsoil & Table Drain	S
	Private Culvert & Rock Rip Rap	
	Public Culvert & Rock Rip Rap	

C:\12dSynergy\data\CATOAPP1\43252 - Cabra Developments Limited_53835\Technical\Drawings\As-Built Drawings\43252-DR-SU-9300-9301 - SW As-Built

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Cabra Developments Limited
951 Coatesville Riverhead Highway
Riverhead

Enlarged Stormwater
As-Built
Plan

No.	REVISION (DESCRIPTIONS)	NAME	DATE
0	Issued For Completion	K.McPherson	25/11/2022

FOR COMPLETION

	NAME	DATE
SURVEYED	H.Baker	16/11/2022
DESIGNED	-	-
DRAWN	B.Nel	17/11/2022

DATE	ORIGINAL SCALE	ORIGINAL SIZE
17/11/2022	1:500	A3

DRAWING NO.	REVISION
43252-DR-SU-9301	0

Appendix A: Statement of Professional Opinion on Suitability of Land for Building Construction

STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

Development: Coatesville-Riverhead Residential Subdivision
Developer: Cabra Developments Limited
Location: 951 Coatesville-Riverhead Highway, Riverhead, Auckland

I, Andrew Linton, of CMW Geotechnical NZ Limited, Auckland, hereby confirm that:

1. As a Chartered Professional Engineer experienced in the field of geotechnical engineering, I am a Geo-professional as defined in Clause 1.2.2 of NZS 4404:2010 and was retained by the Developer as the geo-professional on the above development.

2. The extent of preliminary investigations carried out to date are described in the CMW Geotechnical Investigation Report referenced AKL2018-0182AA Rev. 0, dated 27 September 2018. The conclusions and recommendations of this document have been re-evaluated in the preparation of this report. The results of all tests carried out are appended.

3. In my professional opinion, not to be construed as a guarantee, I consider that:

   (a) The completed earthworks take into account land slope and foundation stability considerations on the building platform areas, but as shown on the appended building restriction zones plans, areas on all lots have gradients steeper than 1(v) in 4 (h) (and generally up to 1(v) in 2(h)) or are adjacent to land having such gradients.

   No building construction and no earthworks (i.e. cut or fills of any depth) should take place outside the designated building platforms unless endorsed by a Chartered Professional Engineer experienced in geomechanics and familiar with the contents of this report. The endorsement will need to consider the implications of the proposals on both global stability conditions and soil creep on the building, the interaction with service pipes and associated trench backfills, control of surface water, construction sequencing, timing and temporary support requirements construction of all earthworks and foundations and if necessary, comment on what aspects require engineering inspections and certification.

   This limitation also applies to long-term landscaping works, including any proposed minor cuts either on or near batter toes to be retained by new landscaping walls that might not normally require engineering, and to landscaping fills on or immediately above the batter slopes.

   No earthworks in excess of 600mm cut or fill should take place inside the designated building platforms unless endorsed by a Chartered Professional Engineer experienced in geomechanics and familiar with the contents of this report. The endorsement will need to consider the implications of the proposals on both global stability conditions and soil creep on the building, control of surface water, construction sequencing, timing and temporary support requirements construction of all earthworks, foundations and retaining walls and if necessary, comment on what aspects require engineering inspections and certification

   (b) The function of the subsoil drain installed beneath Lot 1, as shown on the as-built plans, must not be impaired by any building development or landscaping works. Any bored or driven piles must be positioned to avoid damaging the draincoil. Where any subsoil drain is intercepted by building works, it must be reinstated under the direction of a Chartered Professional Engineer to ensure the integrity of the subsoil drainage system.

(c) The formed drainage outlet depicted on the as-built plans on Lot 1 inclusive must be kept free of debris and otherwise maintained as necessary to ensure their ongoing function.

(d) A geotechnical ultimate bearing capacity of 300 kPa may be assumed for shallow foundation design on the building platforms of Lots 1, 2 and 4 to 6 inclusive.

If for any reason higher geotechnical bearing capacities are required, further specific site investigation and design of foundations should be carried out prior to Building Consent application.

(e) The site (seismic) subsoil class for each lot has been assessed in accordance with NZS1170.5:2004 Clause 3.1.3 from borelogs that included measurements of geotechnical properties. Our assessment is that all lots are Class C - shallow soil.

(f) The expansive site Class has been assessed as AS2870 Class M (Moderate) for Lots 4 to 6 and Class H2 (Highly) for Lots 1 and 2. We recommend that building designers note on the Building Consent drawings the need to maintain appropriate moisture levels across building subgrades and in footing excavations (as described in Section 4.11.4 of the Geotechnical Completion Report) for reference by foundation contractors.

(g) No building development should take place within the 45 degree zone of influence of stormwater inverts unless endorsed by specific design and by construction inspections undertaken by a Chartered Professional Engineer experienced in geomechanics to ensure that lateral stability and differential settlement issues are addressed and that building loads are transferred beyond the influence of pipes and trench backfills.

(h) On the basis of the earth fill certification and subject to the geotechnical limitations, restrictions and recommendations contained in clauses 4(a), 4(b), 4(c), 4(d), 4(e), 4(f) and 4(g) above:

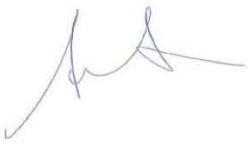
(i) The filled and natural ground is generally suitable for residential buildings constructed in accordance with NZS 3604 and the requirements of AS2870 for the appropriate expansive soil class.

(ii) Where shallow foundations are appropriate, design may be carried out in accordance with AS 2870 (Class M for Lots 3 to 6 and Class H2 for Lots 1 and 2) or alternately, a specific foundation and structural design may be undertaken by a Chartered Professional Engineer.

4. The ROW subgrade has been formed with appropriate regard for slope stability and settlement risks.

The following table summarises the conditions on each of the residential lots.

For and on behalf of CMW Geosciences



Andrew Linton

Principal Geotechnical Engineer CMEngNZ, CPEng

Table 2: GCR Summary Table					
Condition	**Designated Building Platform**	**Subsoil Drain Present**	**Geotechnical Ultimate Bearing Capacity (kPa)**	**AS2870 Expansive Class**	**Indicative Topsoil Depth (mm)**
GCR SOPO Clause	**3(a)**	**3(b)**	**3(d)**	**3(f)**	
Lot number					
1	●	●	300	H2	200
2	●		300	H2	300
3	Not included in this GCR				
4	●		300	M	250
5	●		300	M	200
6	●		300	M	150

Appendix B: Statement of Suitability of Engineered Fill for Lightweight Structures

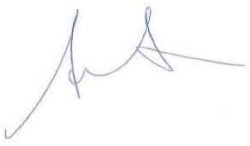
STATEMENT OF SUITABILITY OF ENGINEERED FILLS FOR LIGHTWEIGHT STRUCTURES

To:	Auckland Council
Development:	951 Coatesville-Riverhead Highway
Land Title(s):	Lot 1 DP535483
Location:	951 Coatesville-Riverhead Highway, Riverhead
Resource Consent Nos:	BUN60382053
Developer:	Cabra Developments Limited
Geotechnical Designer:	Andrew Linton of CMW Geotechnical NZ Limited
Certifier:	Andrew Linton of CMW Geotechnical NZ Limited

This Statement of Suitability is provided as an appendix to the CMW Geosciences Geotechnical Completion Report referenced in the page footer below, that also contains all as-built plans, inspection and test plan, geotechnical works specification, test results and test inspection records relevant to the work completed.

1. I, Andrew Linton, confirm that I am qualified as a certifier as defined in NZS4431:2022.
2. During this work, I was retained as certifier and I, or my certifier's representative, undertook inspections and testing as documented in the Geotechnical Completion Report.
3. I am satisfied that the engineered fill shown in the attached as-built survey was placed, compacted and tested in accordance with the attached specification and that all variations and non-compliances have been documented in the Geotechnical Completion Report.
4. Based on the information available, I certify that, to the best of my knowledge, the intent of the geotechnical designer (as presented in the design, drawings and Geotechnical Works Specification) has been achieved.
5. The fill areas shown on the Cato Bolam Consultants Ltd as-built cut and fill plan(s) attached are considered suitable for development as per NZS 3604, subject to any other restrictions described in the Geotechnical Completion Report by the Geotechnical Designer.
6. This certification does not remove the necessity for normal inspection and design of foundations as would be made in natural ground.

For and on behalf of CMW Geosciences



Andrew Linton

Principal Geotechnical Engineer CMEngNZ, CPEng

Appendix C: Field Test Data

LF11 Rev.15 Soil Field Density NDM Direct Transmission with VSS Report (Cohesive Soils)

Auckland Laboratory
CMW Geotechnical NZ Limited
11/63, Arrenway Drive, Rosedale, NZ 0632
PO Box 300206, Albany, Auckland, NZ 0752
Phone: +64 (09) 4144 632

Project:	951 Coatesville-Riverhead Highway
Project No:	AKL2018-0182
Location:	Riverhead
Report No:	AKL2018-0182LAA Rev.0
Report Date:	16/11/2022
Client:	Cabra
Client Address:	19 Tamariki Ave Orewa, Auckland, New Zealand

Test Methods:
NZS 4407 2015 Test 3.1 ◊
NZS 4407 2015 Test 4.2
NZGS:August 2001

Notes:

Solid Density:	Assumed
Solid Density Data Source:	N/A
Testing Locations Selected By:	CMW Field Staff

◊ Only samples <2.0mm will be considered for endorsed testing

① Blade size of 19mm used.

Test results indicated as not accredited are outside the scope of the laboratory's accreditation

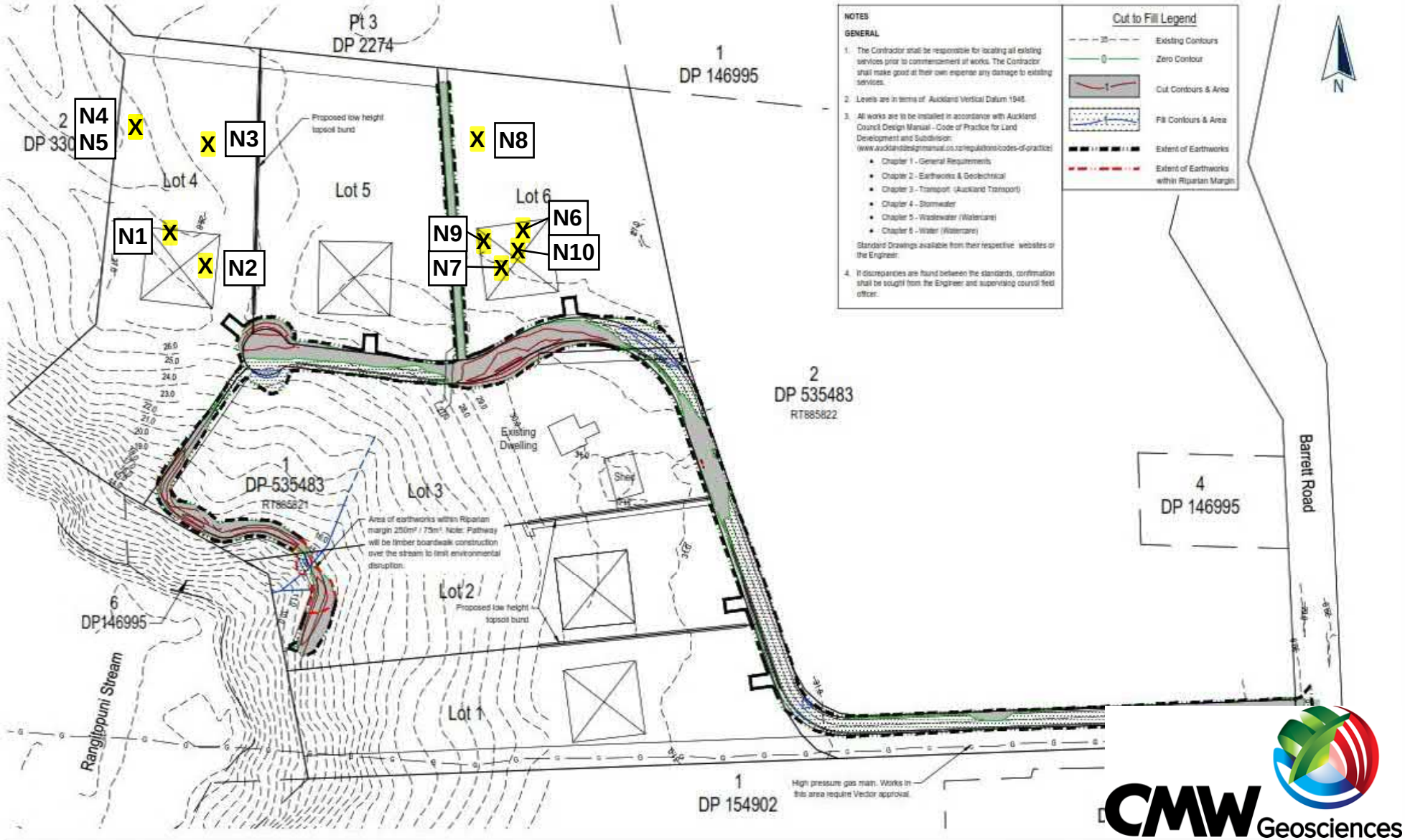
Measurements marked * are not accredited and are outside the scope of the laboratories accreditation

Date Sampled	Sample No.	Test Location*	Soil Description*	Solid Density (t/m³) *	Vane ID		In-situ Vane Shear Strengths					Field and Laboratory Testing Data								Comments
					Head #	Blade # ①	Test 1 (kPa)	Test 2 (kPa)	Test 3 (kPa)	Test 4 (kPa)	Ave.	Gauge Wet Density (t/m³) **	Gauge Dry Density (t/m³)	Gauge Water Content (%)	Gauge Air Voids (%)	Gauge Probe Depth (mm)	Oven Water Content (%)	Oven Dry Density (t/m³)	Oven Calculated Air Voids (%) *	
4/05/2022	N1	Lot 4	CLAY	2.70	1824	1824	235	235	235	235	235	1.94	1.49	30.2	0	300	27.9	1.51	2	
9/05/2022	N2	Lot 4/5	CLAY	2.70	1824	1824	235	235	235	235	235	2.01	1.59	26.9	-1	300	28.4	1.57	-3	
	N3	Lot 4/5	CLAY	2.70	1824	1824	235	235	235	235	235	1.90	1.47	29.4	2	300	22.1	1.56	8	
12/05/2022	N4	Lot 4	CLAY	2.70	1824	1824	203	219	180	142	186	1.98	1.61	23.4	3	300	29.1	1.54	-2	
	N5	Lot 4	CLAY	2.70	1824	1824	235	235	235	235	235	1.88	1.49	26.5	6	300	24.8	1.51	7	
21/10/2022	N6	Lot 6	ENG FILL	2.70	1195	1195	131	131	145	131	135	1.95	1.47	32.4	-2	250	33.9	1.45	-3	
	N7	Lot 6	ENG FILL	2.70	1195	1195	145	160	139	145	147	1.91	1.43	34.2	-2	250	34.2	1.43	-2	
	N8	Lot 6	ENG FILL	2.70	1195	1195	203+	145	160	203+	178+	1.82	1.44	25.9	9	250	26.1	1.44	9	
31/10/2022	N9	Lot 6	CLAY ENG FILL	2.70	1195	1195	203	174	168	174	180	1.84	1.47	25.1	9	300	23.4	1.49	10	
	N10	Lot 6	CLAY ENG FILL	2.70	1195	1195	162	180	174	145	165	1.85	1.46	27.0	7	300	29.3	1.43	5	

This report should only be reproduced in full.

** Gauge Wet Densities outside of the calibrated range of 1.754 to 2.611 t/m³ are not accredited and are outside the laboratories scope of accreditation.

Created By: LC Date: 9/05/2022
Checked By: RS Date: 16/11/2022
Authorised Signatory: JLM Date: 17/11/2022



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CABRA
Land & Property Development

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Cabra Developments Ltd
951 Coatesville-Riverhead Highway
Riverhead

Proposed
Cut to Fill
Plan

No.	REVISION/DESCRIPTIONS	NAME	DATE
A	Issued for Resource Consent	DL	03/07/2020
B	Issued for Resource Consent	EG	29/06/2021
C	Amended for S92	KJW	18/10/2021
D	Issue for Tender	AB	22/12/2021

FOR TENDER

		NAME	DATE
SURVEYED			
DESIGNED		DL	29/06/2020
DRAWN		KJW	30/06/2020
DATE	ORIGINAL SCALE	ORIGINAL SIZE	
30/06/2020	1:1500	A3	
DRAWING NO.		REVISION	
43252-DR-C-2100		D	

CMW Geosciences

Appendix D: Laboratory Test Data

ROADTEST LTD

Revision: 1

DETERMINATION OF THE WATER CONTENT, CONE PENETRATION LIMIT & LINEAR SHRINKAGE
TEST METHOD NZS 4402 : 1986 TEST 2.1, 2.5 & 2.6

Project Name :	**951 Coatesville-Riverhead Highway**		
		Project No :	22 0001 90
Client :	CMW Geosciences	Page :	1 of 1
Address :	PO Box 300206 Albany, Auckland 0754	Date of Order :	25.11.22
		Sample Method :	Hand auger
Attention :	Matt Illingworth	Sample Date :	22.11.22
		Sampled By :	CMW Geosciences

Test Details :

Test performed on :	Whole Sample
History :	Natural

Sample No.	Location	Depth (m)	Cone Penetration (CPL)	Linear Shrinkage (LS)	Natural Water Content (%)
289O	Lot 6	0.4 to 0.8	51	15	31.8
290O	Lot 4	0.4 to 0.8	45	13	21.7
291O	Lot 1	0.4 to 0.8	86	22	47.1

Comments :

Tested By:	RS	Date :	09.12.22
Calculated By :	KH	Date :	13.12.22
Checked By :	ZH	Date :	13.12.22