

**GEOTECHNICAL COMPLETION REPORT  
ON BEACHWOOD ESTATE STAGE 1,  
OTANERUA ROAD, HATFIELDS BEACH**

Cabra Developments Limited

GENZOREW12407  
3 October 2008

3 October 2008

Cabra Developments Limited  
PO Box 197  
Orewa

**Attention: Lloyd Barker**

Dear Lloyd

**RE: Geotechnical Completion Report for Cabra Developments Limited at Beachwood Estate  
Stage 1, Otanerua Road, Hatfields Beach**

This report presents all supporting geotechnical data and our Suitability Statement in relation to land development works undertaken at the above location.

It has been prepared in accordance with instructions received from Ian Hutchinson Consultants Limited acting on behalf of Cabra Developments Limited and forms part of the documentation required by Rodney District Council to achieve certification under Section 224(c) of the Resource Management Act.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact the undersigned.

For and on behalf of Coffey Geotechnics (NZ) Limited

  
*RP Richard Knowles*  
**Chris Thompson**

Engineering Geologist

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	Rodney District Council	2 Copies
	Ian Hutchinson Consultants Limited	1 Copy
	Coffey Geotechnics Archives	1 Copy

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## 1 INTRODUCTION AND DESCRIPTION OF SUBDIVISION

This Geotechnical Completion Report has been prepared for Cabra Developments Limited as part of the documentation required to be submitted to the Rodney District Council following residential subdivisional development.

It contains our Suitability Statement, relevant test data and the Ian Hutchinson Consultants Limited as-built plan set relating to Stage 1 of the Beachwood Estate Residential Subdivision as follows:

**TABLE 1: IAN HUTCHINSON CONSULTANTS LIMITED AS-BUILT PLANS**

Title	Reference No.	Date
As-Built Contour Plan	A3-11258AB/03	September 2008
As-Built Cut/ Fill Depth Contour Plan	A3-11258AB/04	September 2008
As-Built Stormwater Plan	A3-11258AB/07	September 2008
As-Built Sanitary Sewer Plan	A3-11258AB/09	September 2008
As-Built Retaining Wall Plan	A3-11258AB/12	September 2008
As-Built Stormwater Wetland Plan	A3-11258AB/14	September 2008
As-Built Stormwater and Sanitary Sewer Consent Notice Plan	A3-11258AB/16	September 2008
As-Built Batter and Retaining Wall Consent Notice Plans (A & B)	A3-11258AB/17 & 18	September 2008
As-Built Counterfort Drainage Consent Notice Plan	A3-1125/8AB/19 & 20	September 2008
As-Built Underfill Drainage Plan	A3-11258AB/21	September 2008
As-Built Overland Flow Path Plan	A3-11258AB/22	September 2008

This report covers the construction period from October 2007 to September 2008. It is intended to be used for certification purposes for 33 proposed lots on lots 1 to 3 DP204357, lots 4 to 8 DP52564 and lot 16 DP65652 as follows:

- 32 residential lots numbered 2 to 33
- 2 new roads named Beachwood Drive and Fendalton Place and numbered as lot 38
- 4 jointly owned access lots numbered 34, 35, 36 and 37
- 1 utility reserve numbered as lot 1 containing a stormwater wetland/ pond

This stage of the subdivision is accessed from Otanerua Road and as can be seen on the fill as-built plan, a total of 19 of the lots have been partly or totally affected by filling, to a maximum depth of approximately 6 metres.

## **2 RELATED REPORTS**

A Geotechnical Investigation Report (GIR) on stages 1 and 2 of the site was prepared by Foundation Engineering Consultants Limited (FECL), reference 12407, dated 14 July 2006. The conclusions and recommendations of that report have been reviewed during the preparation of this document.

## **3 EARTHWORKS OPERATIONS**

### **3.1 Plant**

The main items of plant used by the Principal Contractor, Mason Contractors Limited and their main sub-contractor Sceats Earthmoving Limited were:

- 1x Hanomag 4x4 compactor
- 1x Cat D6 Bulldozer
- 6x 12 to 20 tonne hydraulic Excavators
- 2x 6 Wheel Trucks
- 2x Track Dumptrucks (Marookas)
- 1x Tractor and discs
- 1x Cat 615C Elevating Scraper
- 1x Cat 613 Elevating Scraper
- 1x Terex TS14 Motorscraper

### **3.2 Construction Programme**

Earthworks for this stage of the subdivision commenced in late October 2007 with the installation of erosion control measures. Observation of the material beneath an existing road within the subdivision was carried out at this time to confirm its suitability. A temporary silt pond within lots 1 and 4 was excavated mid November 2007.

Minor undercuts of unsuitable materials along with the installation of underfill drainage were carried on Beachwood Drive during mid November 2007, with AP150 aggregate placed in the undercuts to drainage outfall level and conventional filling above. Filling operations commenced at this time with material cut from the main ridge in the northern portions and placed along Beachwood Drive. An undercut to support the keystone wall at the head of the existing gully was carried out mid to late November 2007. This undercut was founded on competent identified Waitemata Group transitional soils and was backfilled with AP150 aggregate to the invert of the stormwater pipe extending beneath the keystone wall and extended into lot 28 to remove an area of soft natural ground. Construction of the keystone wall commenced late November 2007 following placement of the stormwater pipe. Further service line installation was undertaken from this time through to July 2008. Compaction checks were carried out to confirm suitability in critical areas.

Underfill drainage was installed within the mucked out gully inverts prior to filling within stage 1 and also within the future stage 2 area. These drains comprised a 160mm diameter highway grade perforated draincoil covered with drainage 40 aggregate and fully wrapped in a non-woven geotextile filtercloth. Unsuitable materials were added to the topsoil stockpiles and respread along with the topsoil at the completion of cut to fill operations. Filling in the vicinity of lots 16 to 19 and future stage 2 commenced late November 2007. Construction of the timber pole wall located within lots 27, 28, 30 and 31 commenced mid December 2007 progressing to the east.

In mid January 2008 an approximately 3 metre deep undercut was excavated for the culvert crossing to access lots 31 and 32. The excavation exposed highly weathered Waitemata Group bedrock and was backfilled with AP150 aggregate to the culvert invert. Preparation of lots 31 and 32 for filling was carried out in mid February 2008 with the removal of topsoil and benching of the underlying ground.

Construction of the timber pole retaining wall within lot 33 was carried out in March 2008 with associated cut to fill above the wall. Lime and cement stabilisation of Beachwood Drive and Fendalton Place was carried out in late March 2008. During March and April 2008 counterfort drains were installed along the cut batter on the southeastern boundary. These drains were up to 3 metres deep, comprised a single 160mm diameter highway grade perforated draincoil covered with drainage 40 aggregate and fully wrapped with a non-woven geotextile filtercloth and were connected to the public stormwater reticulation.

Bulk filling operations continued through to February 2008 with material generally sourced from the main northern ridge. Filling slowed considerably in March 2008 due to the increasing water contents of the main cut area and lime and cement stabilisation was employed to assist with workability. Temporary stockpiles were formed in the future stage 2 area and comprised material won during the formation of the batters and building platforms for the stage 1 area.

In mid May 2008 the construction of the permanent stormwater wetland/ pond commenced with the muck out of the temporary silt pond and filling of the portion of this wetland/ pond within lot 4 and the lot 3 accessway. Filling within this area comprised lime stabilised material with the exception of the pond liner as this was sourced from a remaining area of clay-rich natural ground. Construction for the retaining wall within lot 1 commenced mid June 2008 along with final shaping of the permanent wetland/ pond. Progressive respreading of topsoil was carried out upon completion of works in each area.

## **4 QUALITY ASSURANCE AND CONTROLS**

### **4.1 Construction Observations**

During earthworks construction, observations were undertaken on a near daily basis to assess compliance with NZS 4431:1989 and specific recommendations and specifications included in the GIR for the project. Specific construction observations were required on this stage of the development for:

- gully areas prior to the placement of fill materials to ascertain that all mullock and soft inorganic subsoils had been removed to our satisfaction,
- installation of underfill drains,
- counterfort drain excavations to confirm depths, ground conditions, draincoil placement and backfilling,
- subsoil drain connections to outlets,
- silt traps/ ponds prior to backfilling to ensure that all silt had been removed and that the sides of the excavation were benched where necessary,
- retaining wall pile hole excavations.

## 4.2 Quality Control Criteria

### 4.2.1 General

Two representative soil samples were recovered from the main borrow area prior to the commencement of earthworks. When tested in the IANZ (International Accreditation New Zealand) endorsed laboratory these samples produced standard compaction control data as appended.

The results of these tests were referred to for comparison purposes, however, due to the varying soil types being used as filling, the compaction control criteria of minimum allowable shear strength and maximum allowable air voids were mainly used for quality assurance purposes.

Specification details were as follows:

**TABLE 2: COMPACTION CONTROL CRITERIA**

<u>Minimum Shear Strength and Maximum Air Voids Method</u>	
(a)	<u>Air Voids Percentage</u>
	(As defined in NZS 4402)
	General Fill
	Average value less than <span style="float: right;">10%</span>
	Maximum single value <span style="float: right;">12%</span>
	Pond Liner Fill
	Maximum single value <span style="float: right;">6%</span>
(b)	<u>Undrained Shear Strength</u>
	(Measured by Pilcon shear vane - calibrated using NZGS 2001 method)
	General fill
	Average value not less than <span style="float: right;">140 kPa</span>
	Minimum single value <span style="float: right;">110 kPa</span>
	Pond Liner Fill
	Maximum single value <span style="float: right;">100 kPa</span>
	Minimum single value <span style="float: right;">70 kPa</span>

### 4.2.2 Pond Liner Permeability

The clayey soils utilised for the pond liner construction were sourced from the first 1 to 1.5 metres of cut within the main cut area and were set aside and not disturbed prior to excavation for placement. A reduced minimum and limited maximum shear strength along with a reduced maximum air voids percentage were also used, as described above, to maintain the fill in optimum condition for use as a pond liner.

## 4.3 Quality Assurance Testing

Regular insitu density, strength and water content tests were carried out on all areas of the filling at or in excess of the frequency recommended by NZS 4431.



Control tests carried out on the filling showed that on some occasions the required compaction standards were not being achieved. Results of the test failures were relayed to the site foreman and/or his staff, and to the best of our knowledge the affected areas of fill were re-worked as necessary. In each case, further testing was carried out until compliance with the standards was achieved as shown in the appended field density test summary sheets.

## **5 PROJECT EVALUATION**

### **5.1 Building Foundations**

Following the completion of earthworks operations, we returned to the site and drilled a series of hand auger boreholes at appropriate natural ground locations in order to determine representative finished ground conditions and hence evaluate likely foundation options for future building development. Our resulting bearing capacity recommendations are presented in the appended Suitability Statement.

At current subgrade levels all areas of filling and the majority of the lots underlain by undisturbed natural ground have a geotechnical ultimate bearing capacity of 300 kPa within the influence of conventional shallow residential building foundation loads.

However, due to the presence of soft to firm natural subsoils on some lots, reduced geotechnical ultimate bearing capacities of 240, 210 and 180 kPa have been recommended.

At these bearing pressures differential settlements due to building loads should be within code limits.

Restrictions on cut and fill depths are presented in the Suitability Statement.

It should be noted that NZS 3604 only allows a maximum backfill depth of 600mm over the building platform of a dwelling unless an Engineering design solution is proposed, on account of the risk of induced consolidation of the subsoils caused by the weight of the backfill.

### **5.2 Expansive Soils**

Two sets of Expansive soil tests were carried out on samples selected from the site within the zone of likely influence of shallow building foundations.

These shrink-swell tests were carried out in accordance with AS 1289, "Methods of Testing Soils for Engineering Purposes" test method 7.1.1 and were primarily intended to assess the Expansive Classes of the site materials as defined in AS 2870, "Residential Slabs and Footings – Construction".

Test results are IANZ (International Accreditation New Zealand) endorsed and full details are appended.

On the basis of our results and visual tactile assessment of the on-site subsoils, the AS 2870 Site Class for this subdivision is assessed to be S (slight). Specific design alternatives for this Site Class are presented in the Suitability Statement.

### **5.3 Lot Gradients**

Stability conditions in some parts of the site have been enhanced by the installation of sub-soil drainage and retaining walls as described in section 3.2.

The appended Asbuilt Batter and Retaining Wall Consent Notice Plans show specific design zones due to land gradients or proximity to retaining walls. Land gradient specific design zones include areas having gradients steeper than 1 in 4 or being immediately adjacent to land having such gradients. The extent of these areas has been determined by site gradients and our final site walkover, but there may be localised areas having such gradients that have not been shown on the plans. Specific design zone extents due to the presence of retaining walls have been determined by the height of the adjacent walls.

Details of resulting building and earthworks restrictions within the vicinity of these areas are presented in the Suitability Statement.

The stability of critical areas, including the steep batters, have been assessed for potential circular failure under worst case scenario groundwater conditions. The soil parameters selected were based on assumed realistic conditions and factors of safety normally acceptable to Council were produced.

We consider that these results are satisfactory and are therefore satisfied that these areas are not subject to the hazards described in section 71(3) of the Building Act.

#### **5.4 Fill Induced Settlement**

As a result of our pre-fill construction observations, the installation of subsoil drainage, quality control testing and the elapsed time since the placement of the majority of the filling, we are of the opinion that induced differential settlements beneath or within the certified filling due to its imposed weight should be insignificant with respect to conventional NZS 3604 residential building development.

#### **5.5 Vegetation Cover**

Wherever practical on sloping land beyond building platform areas any existing bush and grass cover should be maintained and supplemented with new plantings. Any vegetation cleared beyond the immediate area of building platforms for temporary construction purposes should be replanted as soon as possible.

The contribution of appropriate vegetation cover to overall site stability and erosion control should not be underestimated.

#### **5.6 Stormwater Controls**

It is important on all sloping lots that due care is paid to the design and construction of appropriate stormwater disposal systems. These systems should serve to collect all runoff from roofs, decks and paved areas, together with discharges from retaining wall drains and other subsoil drains and should connect directly into the public stormwater drainage network.

Uncontrolled stormwater discharges onto the ground surface or into soakage pits can cause erosion, scour and/or instability on sloping land and should not be permitted under any circumstances where stability could be compromised.

As per the Resource Consent lots 32 and 33 will discharge to detention tanks and then into the adjacent stream via specifically designed outfall structures.

#### **5.7 Service Trenches**

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 appended Asbuilt Stormwater and

Sanitary Sewer Consent Notice Plan should be referred to for consent notice areas relating to these services.

## **5.8 Land Drainage**

The appended Asbuilt Underfill Drainage Plan shows the positions of both underfill (subsoil) drains and counterfort drains. Specific comments follow.

### **5.8.1 Underfill Drains**

Underfill drains were placed in mucked out gully inverts prior to filling to tap groundwater seepages and also in cut benches formed prior to filling, particularly when land gradients were greater than 1 in 4, as required by NZS 4431.

These drains were intended to intercept localised groundwater seepages and springs during earthworks and to help provide general control over groundwater levels. They were installed as a precautionary measure and they need no specific maintenance.

Due to the depth of these drains below finished ground levels we consider that the consequences of damage to the drains from any future site excavation or piling operations (albeit extremely unlikely) would be insignificant. Accordingly, no future building restrictions will be required on their account.

Further, to the best of our knowledge, 110mm diameter draincoils were installed in the bedding of all stormwater lines with gradients in excess of 1 in 5 or adjacent to any batter as recommended in the FECL Geotechnical Investigation Report.

### **5.8.2 Counterfort Drains**

During earthworks construction, a series of counterfort drains were constructed to help control groundwater levels in critical areas and are linked into the stormwater disposal system. Invert levels are shown on the appended Asbuilt Underfill Drainage Plan. Trench excavation depths for the counterfort drains were typically up to 3 metres.

Details of resulting building restrictions are presented in the Suitability Statement.

## **5.9 Road Subgrades**

All road subgrades were lime and cement stabilised to achieve appropriate standards and to allow a reduction in sub-base metal depths.

Penetration resistance tests were undertaken at regular intervals on the road subgrades after stabilisation and the results were forwarded to Ian Hutchinson Consultants Limited for pavement design purposes.

## **5.10 Stormwater Detention Wetland/ Pond**

A stormwater detention wetland/ pond has been constructed within Lot 1. Earlier investigations highlighted the presence of sandy and silty soils in the proposed wetland/ pond location and accordingly, it was necessary to provide a low permeability liner.

A 600mm thick clay-rich compacted liner was constructed and a compaction specification was developed following confirmation of the material suitability.

Wetland/ pond design incorporated stability analyses and required seepage collars on inlet and outlet pipes. In addition, careful compaction and backfilling around all pipes and in the pipe trenches helped to eliminate the possibility of future piping erosion.

Specific pond details including aspects pertaining to the operation and maintenance of the wetland/ pond are contained in the Ian Hutchinson Consultants Limited Stormwater Wetland Operation and Maintenance Manual, ref. number LK11258aa, dated September 2008 and a copy of their As-Built Stormwater Wetland Plan is appended.

### **5.11 Retaining Walls**

Some areas of the site have been stabilised by the construction of boundary timber pole retaining walls in the locations shown on the Asbuilt Batter and Retaining Wall Consent Notice Plans. These walls reach a maximum height of approximately 2.5 metres and were designed by Ian Hutchinson Consultants Limited. The ground conditions were confirmed by this Consultancy. A copy of our Producer Statement - Construction Review for the ground conditions is appended.

Details of resulting building and earthworks restrictions within the vicinity of these walls are presented in the Suitability Statement.

### **5.12 Covenant Areas**

The appended Overland Flow Paths plan shows portions of lots 27, 30, 31, 32 and 33 that contain the existing stream. Significant portions of each of these lots are covenanted within the riparian margin as shown on that plan and these areas are defined on site by fencing and/ or retaining walls. No building is permitted within these areas as highlighted in the appended Suitability Statement.

### **5.13 Topsoil**

Topsoil depths in likely building platform areas were checked by the drilling of a borehole in the approximate centre of each lot. Our findings, which are indicative only and subject to variation at other locations, show that likely topsoil depths are between 50mm and 300mm.

Site specific findings are presented in the Suitability Statement Summary.

### **5.14 Contractor's Work**

We have relied on the Contractor's work practices and assume that the works have been carried out in accordance with:

- (i) The approved Contract drawings and design details,
- (ii) The approved Contract specifications,
- (iii) Authorised Variations to (i) and (ii) during the execution of the works,
- (iv) The conditions of Resource, Earthworks and Building Consents where applicable,
- (v) The relevant FECL and Coffey Geotechnics reports, recommendations and site instructions,

and that all as-built information and other details provided to the Client and/or Coffey Geotechnics are accurate and correct in all respects.

## 6 STATEMENT OF PROFESSIONAL OPINION AS TO THE SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

I, R.W. Melville-Smith, of Coffey Geotechnics (NZ) Limited, Auckland, hereby confirm that:

1. I am a Chartered Professional Engineer experienced in the field of geotechnical engineering as defined in section 1.2.3 of NZS 4404 and was retained by the Owner/Developer as the Geotechnical Engineer on Stage 1 of the Beachwood Estate residential subdivision.
2. The extent of preliminary investigations carried out to date are described in the FECL Geotechnical Investigation Report number 12407, dated 24 July 2006, and the conclusions and recommendations of that 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 earth fills shown on the appended fill as-built plan have been placed in compliance with NZS 4431, Rodney District Council's Standards for Engineering Design and Construction (and the provisions of the RDC District Plan) and related documents.
  - (b) The completed earthworks give due regard to land slope and foundation stability considerations within the residential lots, but as shown on the appended Asbuilt Batter and Retaining Wall Consent Notice Plans, Specific Design Zones on lots 2 to 15, 20 to 26 and 29 to 33 have gradients steeper than 1V in 4H or are adjacent to land having such gradients.

No earthworks which increase the slope angle or surcharge loading of these zones involving cuts or fills (including subfloor hardfill) in excess of 600mm height should take place in these areas or elsewhere if similar gradients exist unless endorsed by a Chartered Professional Engineer experienced in geomechanics, as such operations may, in certain circumstances, have detrimental effects on overall site stability. Any cuts into existing batters should be supported by engineer designed retaining walls with designs incorporating site specific stability analyses.

For building construction in accordance with the provisions of NZS 3604 within Specific Design Zones where a batter slope steeper than 1V in 4H is located below the proposed building, the leading (downslope) edge foundations will need to be piled to a typical minimum depth of approximately 2 metres. The Suitability Statement Summary should be referred to for lot specific piling depth recommendations. It is anticipated that a geotechnical ultimate bearing capacity of 300 kPa will be available for the specific design of piles in end bearing. No building development that falls outside the scope of NZS 3604 should take place in these areas or elsewhere if similar gradients exist unless endorsed by specific design of all foundations and retaining walls and by construction inspections undertaken by a Chartered Professional Engineer experienced in geomechanics and familiar with the contents of this report.

- (c) The function of the counterfort drains installed on lots 1, 2, 3, 7, 9, 20 to 26, 30 and 31 inclusive and all underfill drains should not be impaired by any building development or

landscaping works. In particular, any bored or driven piles must be positioned to avoid damaging the counterfort drains.

They have been installed in accordance with good engineering practice and should require no specific maintenance. However the compaction of the surficial backfill soils above the counterfort drains may not be to certifiable standards. Therefore all buildings having foundations within 45 degree zone of influence of a counterfort drain will require Engineering design.

Outfall structures for stormwater discharge within lots 32 and 33 should be designed by a Chartered Professional Engineer at the time of Building Consent.

- (d) A geotechnical ultimate bearing capacity of 300 kPa may be assumed for foundation design on lots 2, 3, 4, 5, 11, 13 to 21 and 26 to 33 inclusive.

Due to the presence of soft to firm subsoils within the likely zone of influence of future shallow foundations on lots 6, 7, 12, 22, 23, 24 and 25, the geotechnical ultimate bearing pressure here should be limited to 240 kPa.

Our hand auger boreholes in lots 8, 9 and 10 identified soft natural ground and on this basis the geotechnical ultimate bearing pressure for shallow foundations within lots 8 and 9 should be limited to 180 kPa and limited to 210 kPa for lot 10 unless higher values can be demonstrated by specific site investigations, foundation designs and by construction inspections by a Chartered Professional Engineer experienced in geomechanics.

On all other lots, any proposed building platform excavations in excess of 1 metre should be similarly checked.

Where a geotechnical bearing capacity greater than 300 kPa is required, (i.e. outside the limits of NZS 3604, such as when piling is undertaken), further specific site investigation and design of foundations should be carried out prior to building consent application.

- (e) As recommended in the FECL Geotechnical Investigation Report, the backfilling and compaction of the stormwater and sanitary sewer trenches where the final gradient is greater than 1 in 5 or adjacent to any batter has to the best of our knowledge been carried out to the highest attainable standards.

Nevertheless, no building development should take place within the 45 degree zone of influence of drain inverts unless endorsed by specific site investigations, foundation designs 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 the pipe and beyond the extent of the trench backfill.

- (f) No building construction, including the construction of additional retaining walls and no earthworks should take place within a zone defined as 1.5 times the face height of the cantilever pole retaining walls and keystone wall on lots 2, 3, 27, 28, 29, 30, 31 and 32 unless endorsed by specific designs and by construction inspections undertaken by a Chartered Professional Engineer experienced in geomechanics to ensure that no additional loads are applied to the walls.

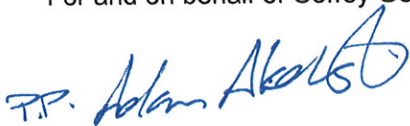
- (g) No building and no earthworks are permitted within the covenant areas on lots 27, 30, 31, 32 and 33.
  - (h) The assessed AS 2870 expansive site Class for all lots is S (slight).
  - (i) Subject to the geotechnical limitations, restrictions, recommendations and expansive soil assessments associated with 3(b), 3(c), 3(d), 3(e), 3(f), 3(g) and 3(h) above:
    - (i) The filled and undisturbed original ground within residential lot boundaries is generally suitable for residential buildings constructed in accordance with NZS 3604 and related documents.
    - (ii) On all lots foundation design may be carried out in accordance with AS 2870 (Class S) or in accordance with NZS 3604 provided that in this latter case the minimum foundation depth below cleared ground level following topsoil removal and benching of building platform areas is 450mm.
4. Road subgrades have been formed having due regard for slope stability and settlement, although CBR values do vary between natural and filled ground as is to be expected. It is likely that subgrade CBR's will be significantly lower than 7 within any areas of non-stabilised natural ground.
5. Geotechnical aspects of slope stability and pond permeability within reserve lot 1 have been appropriately addressed and in these respects the wetland/ pond is suitable for its intended use, although restrictions apply adjacent to retaining walls and land having gradients steeper than 1 in 4 as for the residential lots described above.

The professional opinion contained within this report is furnished to the Rodney District Council and Cabra Developments Limited for their purposes alone on the express condition that it will not be relied upon by any other person. Prospective purchasers should still satisfy themselves as to any specific conditions pertaining to their particular land interest.

It does not remove the necessity for the normal inspection of site conditions and the design of foundations as would be made under all normal circumstances.

The appended table summarises the status of each residential lot covered by this Suitability Statement.

For and on behalf of Coffey Geotechnics (NZ) Limited



**Chris Thompson**

Engineering Geologist



**Rod Melville-Smith**

Principal Geotechnical Engineer FIPENZ CPEng

**TABLE 3: SUITABILITY STATEMENT SUMMARY (refer to Project Evaluation and Suitability Statement for details)**

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
2	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions, proximity to cantilever pole wall and counterfort drainage. Maximum depth of leading edge piling approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
3	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions, proximity to cantilever pole wall, service lines and counterfort drainage. Maximum depth of leading edge piling approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S
4	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
5	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	300	S
6	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	240	S
7	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	240	S



Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
8	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	180	S
9	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	180	S
10	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	210	S
11	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plan due to 1 in 4 gradient restrictions. Maximum depth of leading edge piling approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
12	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	240	S
13	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
14	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	300	S

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
15	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plan due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	300	S
16	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plan due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
17	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plan due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	150	300	S
18	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plan due to proximity to service lines. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S
19	AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
20	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to counterfort drainage and to service lines. Maximum depth of leading edge piling approximately 3 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	50	300	S
21	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Maximum depth of leading edge piling approximately 2.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	300	S
22	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Maximum depth of leading edge piling approximately 2.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	240	S

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
23	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Maximum depth of leading edge piling approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	240	S
24	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to counterfort drainage. Maximum depth of leading edge piling approximately 2 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	100	240	S
25	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	240	S
26	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines and counterfort drainage. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
27	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to cantilever pole wall and service lines. Covenanted no build areas. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S
28	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to proximity to keystone and cantilever pole wall and service lines. Maximum depth of leading edge piling approximately 1.5 metres. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S
29	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to keystone wall. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S

Lot No.	Comments	Topsoil Depth (mm)	Ultimate Bearing (kPa)	AS2870 :1996 Class
30	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions, proximity to cantilever pole wall, service lines and counterfort drainage. Covenanted no build areas. Maximum depth of leading edge piling approximately 1 metre. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	300	300	S
31	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions, proximity to cantilever pole wall, service lines and counterfort drainage. Covenanted no build areas. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm.	200	300	S
32	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to service lines. Maximum depth of leading edge piling approximately 3 metres. Covenanted no build areas. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm. Design of stormwater outfall at time of Building Consent.	200	300	S
33	Specific site investigation, foundation design and construction inspections required in areas shown hatched on consent notice plans due to 1 in 4 gradient restrictions and proximity to cantilever pole wall. Maximum depth of leading edge piling approximately 2 metres. Covenanted no build areas. Elsewhere, AS 2870 foundation design or NZS 3604 with minimum footing depth 450mm. Design of stormwater outfall at time of Building Consent.	300	300	S