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

I, R.J. Knowles, of CMW Geosciences (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 Developer as the Geotechnical Engineer on Stages 1 and 2A of the Karepiro Drive Development.

2. The extent of preliminary investigations carried out to date are described in Coffey Geotechnics Geotechnical Reports referenced GENZSILV12728, dated 30 March 2010, 13 June 2010 and 27 August 2010. The conclusions and recommendations of those documents have been re-evaluated in the preparation of this report. The results of all tests carried out are also appended.

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

   (a) Apart from the area of uncertified filling on Lot 21 depicted on as-built drawing 60356-1-2A-GCR-203, the earth fills shown on the appended Cut and Fill As-built Plan have been placed in compliance with NZS 4431, the Legacy Rodney District Council Plans and related documents.

   The uncertified fill area on Lot 21 contains organic materials and was not compacted to engineering standards. Any building development within this area will require specific investigation and foundation design prior to building Consent application.

   (b) The completed earthworks give due regard to 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 2.5(h)) or are adjacent to land having such gradients. Accordingly, restrictions incorporating Specific Design Zones (Slope) and Piled Foundation Zones have been applied as depicted on the as-built plans as follows:

   - **Specific Design Zone (Slope) areas** have been applied on Lots 1 to 12, 20, 22 to 29 and 95 to 101 inclusive. No building construction and no earthworks (i.e. cut or fills of any depth) should take place within the designated **Specific Design Zone (Slope) areas** unless endorsed by design of all earthworks, 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, as such operations may, in certain circumstances, have detrimental effects on overall site stability. The geotechnical assessments will need to consider the implications of both global stability conditions and soil creep on the development proposals, including the effects of services and associated trench backfills and control of surface water.

     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.

- **Piled Foundation Zones** have been applied to Lots 1 to 12 and 22 to 29 inclusive above the Specific Design Zone (Slope) areas. Building foundations within the **Piled Foundation Zones** may be piled without the need for specific engineering design based on the following table and with reference to the building restriction zone plans appended:

TABLE 1: FOUNDATION REQUIREMENTS WITHIN PILED FOUNDATION ZONES

Design Case	Applies to Lot Numbers	Downslope Leading Edge Pile Minimum Depth (m)	Depth of Lateral Load to be Applied to Downslope Leading Edge Piles Only (m)	Pile Depth for all Load Bearing Foundations Within Remainder of Piled Foundation Zone (m)
A	11, 12, 29	3	1.0	2
B	1, 8, 9, 10, 22, 23 ,24, 25, 26, 27, 28	4	1.25	2
C	2, 3, 4, 5, 6, 7	5	1.5	2

The following design parameters may be assumed for the design of these piles:

Ø' = 30 degrees

Su = 100 kPa

Geotechnical ultimate end bearing capacity at and beyond 2.0m depth = 450 kPa

Ultimate side adhesion beyond 1.5m depth = 25 kPa. Ignore side adhesion in the top 1.5m.

These Piled Foundation Zone requirements may be amended as part of a specific design by a Chartered Professional Engineer, experienced in geomechanics and familiar with the contents of this report.

The structural engineer should attend to the pile details, including ensuring that the design allows for any differential movement that may occur between piled and un-piled portions of the building.

(c) **No Build / Bush Covenant Zone** areas defined on Lots 1 to 5, 20 to 22 and 95 to 101 inclusive are designated no-build zones on the basis of potential for instability and/ or because of the presence of protected bush.

No building construction and no earthworks may take place in these areas.

(d) **Specific Design Zone (Retaining Walls) areas** have been applied on Lots 1 to 20, 29, 30 and 91 to 101 inclusive for the protection of the function of the retaining walls.

No building construction and no earthworks (i.e. cut or fills of any depth) should take place within the designated **Specific Design Zone (Retaining Walls) areas** unless endorsed by the design of all earthworks, 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, as such operations may have detrimental effects on site stability. The geotechnical assessments will need to consider the implications of the development proposals the stability of the retaining walls.

(e) Lots 16 to 20 inclusive contain a buried (palisade) wall close to the toe of the retaining wall. The top of the wall is buried 500mm below existing ground levels. House designers should ensure that this does not clash with proposed foundations.

(f) The function of the subsoil drains installed beneath Lots 1 to 11, 14, 15, 17 to 19, 23 to 28 inclusive must not be impaired by any building development or landscaping works. Any bored or driven piles must be positioned to avoid damaging the draincoils. 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.

(g) The formed drainage outlets on Lots 1 to 5 and 95 to 100 inclusive must be kept free of debris and otherwise maintained as necessary to ensure there ongoing function.

(h) A geotechnical ultimate bearing capacity of 300 kPa may be assumed for shallow foundation design on the building platforms of Lots 1 to 19, 20 to 30 and 97 to 101 inclusive.

Due to the presence of softer natural subsoils on the building platforms of Lots 19, 91 to 96 inclusive a geotechnical ultimate bearing capacity of 240 kPa may be assumed for shallow foundation design on these lots.

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.

(i) The expansive site Class for all lots has been assessed as AS2870 Class M (Moderate). We recommend that building designers note the need to maintain appropriate moisture levels across building subgrades and in footing excavations (as described in Section 5.12.3 of the Geotechnical Completion Report) on Building Consent drawings for reference by foundation contractors.

(j) The backfilling and compaction of the stormwater and sanitary sewer trenches on this subdivision has been carried out to appropriate standards having regard for the prevailing ground conditions and associated compaction induced pipe loadings.

However, no building development should take place within the 45 degree zone of influence of drain 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 the pipe and trench backfill.

(g) Subject to the geotechnical limitations, restrictions and recommendations contained in clauses 3(a), 3(b), 3(c), 3(d), 3(e) 3(f), 3(g), 3(h), 3(i) and 3(j) 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) or alternately, a specific foundation and structural design may be undertaken by a Chartered Professional Engineer. In this latter case, the minimum foundation depth following topsoil removal and forming of building platform areas is 600mm for NZS 3604 type shallow strip and pad foundations.

4. Road subgrades have been formed with appropriate regard for slope stability and settlement risks.

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

For and on behalf of
CMW Geosciences (NZ) Ltd

Richard Knowles

Principal Geotechnical Engineer, CPEng

CMW Geosciences (NZ) Ltd
Chapman Morton Woodward

GCR Summary Table

Restriction	Bush Covenant / No Build Zone	Specific Design Zone (slope)	Specific Design Zone (retaining)	Specific Design Zone (uncertified fills)	Piled Foundation Zone / Design Case		Subsoil Drains Present	Service Lines Restrictions	On-site Drainage Outlet Present	Palisade Wall Present	Indicative Topsoil Depth (mm)	AS2870 Expansive Class	NZS3604 Minimum Foundation Depth (mm) for Engineering Design	Geotechnical Ultimate Bearing Capacity (kPa)	Comments
GCR SOPO Clause	3(c)	3(b)	3(d)	3(a)	3(b)		3(f)	3(j)	3(g)	3(e)		3(i)	3(g)	3(h)	
Lot Number															
1	☑	☑	☑	☐	☑	B	☑	☑	☑	☐	100	M	600	300	
2	☑	☑	☑	☐	☑	C	☑	☑	☑	☐	250	M	600	300	
3	☑	☑	☑	☐	☑	C	☑	☑	☑	☐	100	M	600	300	
4	☑	☑	☑	☐	☑	C	☑	☑	☑	☐	50	M	600	300	
5	☑	☑	☑	☐	☑	C	☑	☑	☑	☐	100	M	600	300	
6	☐	☑	☑	☐	☑	C	☑	☑	☐	☐	50	M	600	300	
7	☐	☑	☑	☐	☑	C	☑	☑	☐	☐	100	M	600	300	
8	☐	☑	☑	☐	☑	B	☑	☑	☐	☐	100	M	600	300	
9	☐	☑	☑	☐	☑	B	☑	☑	☐	☐	50	M	600	300	
10	☐	☑	☑	☐	☑	B	☑	☑	☐	☐	150	M	600	300	
11	☐	☑	☑	☐	☑	A	☑	☑	☐	☐	100	M	600	300	
12	☐	☑	☑	☐	☑	A	☐	☑	☐	☐	300	M	600	300	
13	☐	☐	☑	☐	☐		☐	☑	☐	☐	150	M	600	300	
14	☐	☐	☑	☐	☐		☑	☑	☐	☐	100	M	600	300	
15	☐	☐	☑	☐	☐		☑	☑	☐	☐	200	M	600	300	
16	☐	☐	☑	☐	☐		☐	☑	☐	☑	200	M	600	300	
17	☐	☐	☑	☐	☐		☑	☑	☐	☑	250	M	600	300	
18	☐	☐	☑	☐	☐		☑	☑	☐	☑	200	M	600	300	
19	☐	☐	☑	☐	☐		☑	☑	☐	☑	50	M	600	240	
20	☑	☑	☑	☐	☐		☐	☑	☐	☑	100	M	600	300	
21	☑	☐	☐	☑	☐		☐	☐	☐	☐	50	M	600	300	
22	☑	☑	☐	☐	☑	B	☐	☐	☐	☐	50	M	600	300	
23	☐	☑	☐	☐	☑	B	☑	☐	☐	☐	250	M	600	300	
24	☐	☑	☐	☐	☑	B	☑	☑	☐	☐	250	M	600	300	
25	☐	☑	☐	☐	☑	B	☑	☑	☐	☐	300	M	600	300	
26	☐	☑	☐	☐	☑	B	☑	☑	☐	☐	250	M	600	300	
27	☐	☑	☐	☐	☑	B	☑	☑	☐	☐	200	M	600	300	
28	☐	☑	☐	☐	☑	B	☑	☑	☐	☐	250	M	600	300	
29	☐	☑	☑	☐	☑	A	☐	☑	☐	☐	150	M	600	300	
30	☐	☐	☑	☐	☐		☐	☑	☐	☐	200	M	600	300	
91	☐	☐	☑	☐	☐		☐	☑	☐	☐	150	M	600	240	
92	☐	☐	☑	☐	☐		☐	☑	☐	☐	50	M	600	240	
93	☐	☐	☑	☐	☐		☐	☑	☐	☐	50	M	600	240	
94	☐	☐	☑	☐	☐		☐	☑	☐	☐	50	M	600	240	
95	☑	☑	☑	☐	☐		☐	☑	☑	☐	100	M	600	240	
96	☑	☑	☑	☐	☐		☐	☑	☑	☐	150	M	600	240	
97	☑	☑	☑	☐	☐		☐	☑	☑	☐	150	M	600	300	
98	☑	☑	☑	☐	☐		☐	☑	☑	☐	150	M	600	300	
99	☑	☑	☑	☐	☐		☐	☑	☑	☐	200	M	600	300	
100	☑	☑	☑	☐	☐		☐	☑	☑	☐	200	M	600	300	
101	☑	☑	☑	☐	☐		☐	☑	☐	☐	150	M	600	300	