**IN THE MATTER** of the Resource Management Act 1991 ("RMA" or "the Act")

**AND**

**IN THE MATTER** of an application under section 88 of the Act to **NAPIER CITY COUNCIL** (ref RMA19006) by **DURHAM PROPERTY INVESTMENTS LIMITED** to subdivide and develop the Main Residential Zone at 16 and 38 Willowbank Avenue, Te Awa, Napier.

**STATEMENT OF EVIDENCE OF CAMERON ANDREW WYLIE**

**GEOTECHNICAL ENGINEER**

## 1. INTRODUCTION

1.1 My full name is Cameron Andrew Wylie. I am a consulting geotechnical engineer and director of the consulting engineering practice at Resource Development Consultants Ltd (RDCL).

1.2 This evidence is given in respect of resource consent application RMA19006 ("Application") by Durham Property Investments Limited ("Applicant") to Napier City Council ("Council") for the development of 162 dwellings and a staged subdivision to form 181 residential lots, at 16 and 38 Willowbank Avenue, Napier ("Site").

### Qualifications and experience

1.3 I have a Masters of Science (Geology) degree from the University of Auckland (1989) and am registered as a Chartered Member of Engineering New Zealand (CMEngNZ) and as a Chartered Professional Engineer (CPEng) practicing in the field of geotechnical engineering.

1.4 I have been involved in geotechnical engineering for the past 32 years.

1.5 Of particular relevance to the Application is my experience providing geotechnical engineering support for many residential subdivisions and commercial developments on the Heretaunga Plains over the last 14 years.

1.6 Some of the more recent projects I have been involved with that include:

(a) Bupa Care Services Retirement Village, Ulyatt Road, Napier – comprising the construction of 118 retirement units and a care home;

(b) Awatoto Industrial Development – 14 lot industrial subdivision;

(c) Brookvale and Romanes Drive, Havelock North - ~106 residential subdivision;

(d) Kainga Ora residential developments; 6 x tranches in Hastings – multiple, multi-residential developments within Hastings;

(e) Duck Creek Residential Development, Whitby – ~100 lot residential subdivision.

1.7 All of the projects listed are in similar geotechnical environments as the proposed development with similar geotechnical issues arising concerning house foundations, lateral spread and protection of infrastructure.

1.8 My involvement in all of these projects has been to undertake technical assessments and provide geotechnical engineering solutions.

**Involvement in the project**

1.9 I became involved in the project in September 2018. RDCL was engaged to provide geotechnical services including ground investigation, assessment, and recommendations for development. I am the signing engineer (CPEng) for the resulting initial geotechnical report completed by RDCL "(2018) Liquefaction Potential Assessment, Willowbank Subdivision, Te Awa unpublished report to Durham Property Investments Ltd".

1.10 RDCL updated the Liquefaction Potential Assessment on 4 November 2020 ("RDCL Report") to consider changes to both the design and applied earthquake conditions as follows:

(a) Design change is to allow for a 2.0 m deep open drain which is required for flood control; and

(b) Applied earthquake conditions have been updated in line with GNS (2019) recommendations.

**Site visits and background material**

1.11 I have visited the site and its surrounds many times but particularly in November 2018 and latterly October 2020 associated with geotechnical investigations. I am also a resident in Hawkes Bay and pass the area often.

1.12 In preparing this evidence I have read and am familiar with the Officer's Report and the supporting documentation.

**Purpose and scope of evidence**

1.13 The purpose of my evidence is to provide an outline of the geotechnical issues at the site particularly as they relate to the potential for lateral spread, mitigations for house foundations and potential mitigation for infrastructure if it is required.

1.14 I am not currently aware of the detailed infrastructure plans or the finalised drain design, so consider mitigation works theoretical at this stage. However, I consider that any potential risk can be mitigated by way of design at the engineering approval stage.

1.15 My evidence is structured as follows:

(a) Briefly describe the site (Section 3);

(b) Briefly describe the proposal (Section 4);

(c) Addresses the relevant geotechnical issues arising (Section 5);

(d) Comment on issues raised by the Officer's Report relevant to my area of expertise (Section 6);

(e) Comment on issues raised by submitters relevant to my area of expertise (Section 7);

(f) Comment on conditions (Section 8); and

(g) Provide a brief conclusion (Section 9).

1.16 A summary of my evidence is contained in Section 2.

1.17 My evidence should be read together with the:

(a) Planning evidence, prepared by Matthew Holder (Development Nous Limited);

(b) Engineering / Servicing evidence, prepared by Russell Nettlingham (Strata Group Consulting Engineers Limited).

**Expert Witness Code of Conduct**

1.18 I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's 2014 Practice Note. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

1.19 I understand and accept that it is my overriding duty to assist the Independent Commissioner in matters which are within my expertise as a geotechnical engineer.

## 2. SUMMARY OF EVIDENCE

2.1 From a geotechnical perspective, the residential aspect of the proposal is straightforward. The proposal is made more complicated with the proposed drainage swale due to the risk for lateral spread.

2.2 The site also is susceptible to seismic induced liquefaction.

2.3 Despite the identified liquefaction and lateral spread risks, it is my opinion that the site is suitable for development from a geotechnical perspective. My opinion is premised on the following:

(a) Liquefaction can be addressed by engineered mitigation measures.

(b) Any liquefaction or lateral spread risk to houses can be addressed by requiring house foundations to be constructed to a TC3 category for houses within 35m of the swale drain being constructed, and to a TC2 category for houses further than 35m from the swale drain.

(c) Specific mitigation for liquefaction and lateral spread risk to infrastructure can be put in place once infrastructure plans are finalised.

2.4 I conclude that residential development can proceed provided that accepted, commonly used foundation designs are available for houses for the deformation expected in the event of the design earthquake. I am also confident that protection works can be developed for infrastructure if required.

## 3. SITE DESCRIPTION AND EXISTING ENVIRONMENT

3.1 From a geotechnical perspective, the site is flat in its current condition with no significant change in elevation.

3.2 The land is mapped by GNS as being underlain by Holocene estuarine deposits comprising unconsolidated mud, sand and peat. These materials have a high risk of liquefaction due to the young age of the deposits, material composition and generally elevated groundwater levels often found on the Heretaunga Plains.

3.3 The site is free of known Active Faults.

## 4. DESCRIPTION OF PROPOSAL

4.1 Geotechnically, the proposal is straightforward, being for the development of 181 residential lots with an associated internal access network and additional lots for the required infrastructure. Houses will be single level, residential structures located on a flat site.

4.2 The proposed drainage swale parallel to Willowbank Avenue adds complication to the site as it opens the potential for lateral spread as a result of the free face created, however these issues can be addressed as detailed in Section 5 below.

## 5. GEOTECHNICAL ISSUES

5.1 The purpose of this section is to address the relevant geotechnical issues arising as a result of the RDCL Report.

### Liquefaction risk

5.2 It is considered the site is likely to undergo seismic induced liquefaction under Serviceability and Ultimate Limit state conditions at varying levels of risk. This leads to vertical settlement occurring.

5.3 This was based on a reasonable density of initial testing undertaken which was suitable for a preliminary, resource consent level investigation. I am satisfied that the testing is suitable and fit for purpose but suggest that site specific additional testing be undertaken at the time final detailed design plans are prepared.

5.4 It is my experience that site specific additional testing often results in a less severe assessment of liquefaction potential. This is generally because of the effect of layering in the sediment pile which can reduce the amount of liquefaction expected. This has occurred in other similar projects I have been involved in around the region.

5.5 I consider the liquefaction risk identified can be appropriately addressed by engineered mitigation measures.

### Potential for lateral spread

5.6 We asked to consider the effect on the development of the proposed drainage swale which would run along the western and southern boundaries of the site.

5.7 In that case sensitivity analyses indicates that lateral spread (in addition to the vertical settlement) is likely within a nominal distance of 35m of the drain. The amount of lateral spread combined with the vertical deformation places houses:

(a) Within 35m of the drain - in the Technical Category 3 ("TC3") category in accordance with MBIE (2012);

(b) Outside the 35m zone - in the Technical Category 2 ("TC2") as the amount of lateral spread decreases significantly so that house foundations in this category are considered appropriate (as they can be determined based on vertical settlement alone).

5.8 I consider that lateral spread risk can be appropriately addressed by engineered mitigation measures.

**Mitigation for house foundations**

5.9 Based on the assessment undertaken, it is considered that any liquefaction or lateral spread risk can be appropriately addressed by requiring house foundations within 35m of the drain being constructed to a TC3 category and house foundations further than 35m from the drain being constructed to a TC2 category.

5.10 Further geotechnical testing could be undertaken at the time the plans are finalised to confirm this.

5.11 Finally, mitigation measures to protect against the assessed magnitude of vertical and lateral spread such as those proposed are well developed for house foundations and very commonly deployed in Hawkes Bay.

5.12 **Mitigation for infrastructure**

5.13 I consider that specific mitigation for the infrastructure can be put in place once the infrastructure plans are finalised and at the relevant engineering approvals stage. I see no reason based on the liquefaction and lateral spread risk identified that this could not occur.

5.14 Further geotechnical testing could be undertaken at the time the plans are finalised to confirm this.

## 6. ISSUES RAISED BY COUNCIL OFFICER'S REPORT

6.1 The Officer's Report considers that the risk associated with liquefaction and lateral spread can be appropriately addressed by requiring a combination of TC3 foundations (within 35m of the drain) and TC2 foundations (further than 35m from the drain) unless further site-specific geotechnical investigation demonstrates an alternative is suitable. I agree with this.

6.2 The Officer's Report refers to the HBRC submission and raises issues regarding the risk of material damage to the Drainage Reserve Lots 302 – 308, Recreation Reserve 301 and associated infrastructure and that this would require ground re-instatement post a seismic event (at pages 18 and 19). I consider that ground improvement to mitigate this risk could be developed once the drain and infrastructure details are confirmed. Options include an inground wall to densify the ground adjacent to the drain and reduce potential for lateral spread. The dimension and design of any option requires that the drain depth in particular is known.

## 7. CONCLUSIONS

7.1 I consider that the liquefaction and lateral spread risks can be appropriately addressed and mitigated through specific design (as proposed), further site-specific investigations and through the preparation of final detailed design plans.

7.2 In summary, I consider the proposal is feasible from a geotechnical perspective and that any risk can be addressed by way of conventional engineering measures.

**C A Wylie**
**Resource Development Consultants Ltd**

**14 May 2021**