

BEFORE THE INDEPENDENT HEARINGS PANEL

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

AND

IN THE MATTER Resource consent applications by Te Puna Industrial
Limited in relation to 297 Te Puna Station Road

**STATEMENT OF EVIDENCE OF ROBERT TAYLOR ON BEHALF OF
TE PUNA INDUSTRIAL LIMITED**

(GEOTECHNICAL)

25 JUNE 2024

1. EXECUTIVE SUMMARY

1.1 My name is Robert Taylor and I am a Principal Geotechnical Engineer at CMW Geosciences.

1.2 I was engaged by TPIL in 2024 to assess the potential geotechnical effects of the Application. I have reviewed the geotechnical report by WSP (dated 2 December 2022) and consider that:

- (a) I agree with the recommendation to add a preload to the Site prior to constructing services or structures in the Site to manage effects from static settlement.
- (b) For typical industrial-type buildings, the expected magnitude of liquefaction from an Ultimate Limit State seismic event is expected to be accommodated within the structural design without building collapse. In liquefaction prone areas, suitable foundations can be adopted.
- (c) The predicted magnitude of liquefaction-induced lateral spreading is expected to be readily accommodated by the foundation solutions identified in respect of liquefaction.
- (d) Given the topography of the Site, the risk of slope instability on the wider development is low. I recommend the steep slope in the south-western corner of the Site (ie intend borrow area) is lowered to 1 (vertical): 2 (horizontal), to account for additional elevated porewater pressures that may occur following extreme rainfall events.
- (e) A suitable construction methodology has been recommended for the widening of Te Puna Station Road at the site entrance which will improve the overall stability of the existing road and mitigate future settlement by preloading.

1.3 I consider that the concerns raised by submitters are appropriately addressed by the Application and conditions proposed.

2. INTRODUCTION

2.1 My name is Robert Taylor. I am a Principal Geotechnical Engineer at CMW Geosciences.

Qualifications and experience

- 2.2 I have had 19 years' experience in the field of Geotechnical Engineering.
- 2.3 I have obtained a Bachelor of Science from the University of Waikato (2005), Bachelor of Engineering from the University of Southern Queensland (2014) and a Masters in Engineering Science from the University of New South Wales (2018).
- 2.4 I am a Chartered Professional Engineer (CPEng) in the field of Geotechnical Engineering and Chartered Member of Engineering New Zealand (CMEngNZ) and a member of the New Zealand Geotechnical Society (NZGS).

Code of conduct

- 2.5 I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving oral evidence before the Hearings Commissioners. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

3. SCOPE OF EVIDENCE

- 3.1 My evidence relates to the resource consent applications by Te Puna Industrial Limited ("**TPIL**") in relation to its site at 297 Te Puna Station Road ("**Site**"). The applications are to authorise the development of the Site for the establishment and operation of yard-based industrial activities, with associated earthworks and discharge to water, within the Site ("**Project**"). The proposed development will give effect to the Te Puna Business Park Structure Plan ("**Structure Plan**") provisions that apply to the Site under the Western Bay of Plenty District Plan. ContainerCo will be the anchor tenant of the Site. ContainerCo intends to store, repair, and lease out/sell shipping containers.
- 3.2 Regional resource consents to enable the Project are required from Bay of Plenty Regional Council ("**BOPRC**") and land use consents are required by Western Bay of Plenty District Council ("**WBOPDC**") (together, the "**Application**"). The specific consent requirements are set out in the planning evidence of Mr Murphy.¹

¹ Statement of Evidence of Vincent Murphy (26 June 2023).

- 3.3 I was engaged by TPIL in 2024 to assess the potential geotechnical effects of the Application. For this, I reviewed the WSP Geotechnical Assessment Report, dated 2 December 2022 ("**WSP Report**"), to confirm I agreed with the recommendations and mitigation measures detailed in that report with respect to the development proposed. I also undertook a Site visit in June 2024 to familiarise myself with the development area with respect to the recommendations provided in the WSP Report.
- 3.4 I am familiar with the Site, having previously been involved with it for various interested parties over the past 8 years. During this time, my involvement was primarily providing high-level feasibility advice based on existing information and my experience with other sites and developments in the region. In May 2020 I coordinated a site investigation on this Site which included a desktop review and undertaking a series of Cone Penetrometer Tests (CPTs) across the Site.
- 3.5 The purpose of my evidence is to address the potential geotechnical effects associated with the Application. In this statement of evidence I will:
- (a) describe the existing environment;
 - (b) summarise my review of the WSP Report and my subsequent assessment of the potential geotechnical effects associated with the Application, and my recommendations to mitigate these potential effects;
 - (c) respond to the submissions received on the Application that raise matters relating to potential geotechnical effects;
 - (d) comment on the WBOPDC and BOPRC Section 42A Reports ("**S42A Report**")²; and
 - (e) comment on the relevant proposed conditions of the consent relating to geotechnical matters.

4. EXISTING ENVIRONMENT

- 4.1 The Site is situated within the base of a gully that extends from the foothills of the Minden Hills in the south, to the mouth of the Wairoa River in the north. The western Site boundary is situated near the toe of the moderately steep

² Bay of Plenty Regional Council section 42A Report (17 June 2024) and Western Bay of Plenty District Council section 42A Report (17 June 2024).

gully escarpment with the majority of the Site extending across the low-lying gully invert.

- 4.2 As detailed in Section 7, and depicted in the Cross Sections in Appendix C of the WSP Report, broadly, the Site is underlain by approximately 1m to 2m of existing fill comprising soft to hard clayey silts. The existing fill is underlain by soft and compressible silts and clays associated with the Holocene-aged (<10ka) alluvial fan deposits. The deposits are shown to be thin at the toe of the gully escarpment in the southwest and increasing to approximately 15m to 20m thick in the northeast of the Site. The alluvial deposits are underlain by various thickness of stiff silts and dense sands of the older Pleistocene-aged (~2.18Ma) Matua Subgroup deposits, which also extend under the elevated gully escarpments to the south and west.
- 4.3 Section 7.3 of the WSP Report details that during the field investigations, groundwater levels were recorded at between 0.0m and 2.0m below existing ground level (approximately RL 1.3m to RL 2.2m Moturiki Datum).

5. ASSESSMENT OF GEOTECHNICAL EFFECTS

- 5.1 The main geotechnical effects of the Application along with recommended mitigation measures are detailed in the WSP Report.³ I agree with the assessments in this Report and summarise them below.

Static Settlement

- 5.2 The alluvial deposits that occur across the Site are soft and compressible and as such, will experience significant settlement in response to the proposed structural and fill loads.⁴ To manage this, it is recommended to add preload (placement of a temporary load) to the Site for a period of time prior to constructing services or structures on the Site, to induce additional consolidation settlement which over-consolidates the soil and reduces the long term settlements to acceptable limits (ie <50mm).
- 5.3 Preliminary analyses detailed in Sections 9.1 and 9.5 of the WSP Report suggest a preload height of 2.0m for a period of 12 months may be sufficient. When monitoring of the preload settlement determines a sufficient magnitude of settlement has been achieved, the preload can then be removed. This method of ground improvement has been successfully completed for

³ WSP Geotechnical Analysis Report (2 December 2022) at 8-9.

⁴ WSP Geotechnical Analysis Report (2 December 2022) at Table 2 details expected static settlements for various areas of the Site and loading scenarios of between 90mm and 1450mm.

numerous developments across the Bay of Plenty Region (more specifically, within Tauranga), including the Tauriko Business Estate, Takitimu North Link Project and more specifically the Teihana Residential Development located approximately 500m to the east of the Site. I therefore support these recommendations.

Liquefaction

- 5.4 Section 8.4.3 of the WSP Report details that there is a low probability of liquefaction triggering under a Serviceability Limit State ("**SLS**") seismic event,⁵ with estimated volumetric settlements of between 3mm and 15mm (which are expected to meet SLS design requirements). Under an Ultimate Limit State ("**ULS**") seismic event,⁶ liquefaction-induced settlements of between 16mm and 231mm are predicted. Within the location of the proposed container workshop, ULS settlements of up to 65mm are predicted.
- 5.5 For typical industrial buildings (such as steel portal framed buildings with slab on grade foundations), this magnitude of ULS settlement can readily be accommodated within the structural design without building collapse, therefore satisfying the ULS design requirement. For the consideration of foundation design in liquefaction-prone areas, guidance can also be taken from the MBIE Canterbury Rebuild Guidance Documents where the site falls within a TC2 and a TC2/3 Hybrid site.⁷ These documents provide proprietary solutions for light-weight buildings or suitable design guidance for specific engineer design foundation solutions, that include shallow concrete foundations and/or geogrid reinforced gravel rafts supporting shallow foundations, as recommended in Section 9.5 of the WSP Report. I support these recommendations.

Liquefaction-Induced Lateral Spreading

- 5.6 Following the onset of liquefaction during a severe earthquake event, the decrease in soil shear strength can lead to significant lateral movements across sloping topography or within areas adjacent to a free-face (ie an open drain or pond embankment).
- 5.7 The generally flat Site suggests liquefaction induced lateral spreading is expected to be negligible across the majority of the Site, however, up to 1.1m of lateral spread is estimated in the north of the Site immediately adjacent to the open drain that runs along the northern Site boundary. Within the proposed

⁵ This event is defined in the New Zealand loadings standard NZS 1170.5 as the limit at which the structure is to maintain operational continuity.

⁶ This event is defined in the New Zealand loadings standard NZS 1170.5 as the limit at which the structural system is to avoid collapse.

⁷ Part D: Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region (MBIE, 2012).

building locations, lateral spreading is shown to be significantly reduced due to the flat Site and considerable distance to the open drain (freeface), and the predicted magnitude of lateral spreading is expected to be readily accommodated by the foundation solution identified above (eg proprietary or specific engineer designed shallow foundations and/or geogrid reinforced gravel rafts supporting shallow foundations).

- 5.8 Although the low batter gradients associated with the proposed stormwater ponds are expected to be less susceptible than steeply graded batters, as is normal practice in geotechnical design, the Detailed Design of pond batters and open drains shall demonstrate stability during an ULS seismic event. Rockfill shear keys and / or geogrid reinforcement can readily be incorporated into pond batters to improve seismic performance to meet SLS and ULS design requirements, should there be any issues with stability.

Slope Stability

- 5.9 The majority of the Site is flat to very gently sloping and as such, the risk of slope instability on the wider development area is low.
- 5.10 A steep 10m high slope is present in the south-western corner of the Site below the existing dwelling. Slope stability analyses of this slope have been undertaken with results presented in Appendix G and summarised in Table 4 of the WSP Report, which show requisite factors of safety are not achieved.⁸ However, this elevated area has been identified as a source of fill (borrow area) for the development, at which time the slope can be regraded to a stable profile.
- 5.11 Analyses and results referenced in Section 8.5 of the WSP Report suggest a slope gradient of 1:1.75 (vertical:horizontal) meets the required factors of safety for this slope.⁹ However, based on my experienced on similar projects in the area, I recommend this slope gradient is further lowered to no steeper than 1(v):2(h) to account for additional elevated porewater pressures that may occur following extreme rainfall events. Furthermore, construction of the earthfill embankment across the Site to raise the Site above minimum flood levels will buttress this slope thereby further improving its stability.

Te Puna Station Road Widening

- 5.12 Section 9.4 of the WSP Report provides a detailed construction recommendation for the Te Puna Station Road widening, which includes

⁸ WSP Geotechnical Analysis Report (2 December 2022) at Table 4: Slope Stability Results.

⁹ WSP Geotechnical Analysis Report (2 December 2022) at 8.5.

compacted AP65 rockfill, 3 layers of geogrid reinforcement and preloading to reduce longterm settlements of the road extension.¹⁰ The use of concrete blocks or aggregate filled bags may be utilised as preload to negate the need to encroach into the existing road thereby keeping both lanes open to traffic during preloading. The stability of the road widening adjacent to the new drain alignment will need to be specifically designed at the Detailed Design stage of the Project. It is anticipated that this may involve a cantilever retaining wall (eg timber pole wall), a gravity wall (eg MSE wall or crib wall), or an engineered batter slope. I support these recommendations.

- 5.13 As detailed in Section 9.4 of the WSP Report, even with the above measures carried out, there will likely be some differential settlement of the existing roadway during the preload phase, which could result in cracking to the pavement. The existing road on Te Puna Station Road will therefore need to be maintained by the Applicant during this period.

6. RESPONSE TO ISSUES RAISED IN SUBMISSIONS

- 6.1 I have reviewed relevant submissions on the Application that raise matters relating to geotechnical matters.
- 6.2 I note that the submissions filed by 50 of the submitters on this Application are identical in form and substance.¹¹ I acknowledge that these submissions were made by individual submitters, however for ease of reference and given the likeness of these submissions, I will refer to these submitters as "Submitter Group 1", rather than referring to their individual submitter number.
- 6.3 The submissions that are within my expertise raise concerns with: the appropriateness of the filling area;¹² how the compression of underground waterways flowing through the Site will obstruct the natural flow,¹³ and how the soft earth conditions of the area will affect the road widening.¹⁴

Appropriateness of the filling area

- 6.4 In response to the appropriateness of the filling area, Section 8.2 of the WSP Report details that the Site will be susceptible to fill induced settlements.

¹⁰ WSP Geotechnical Analysis Report (2 December 2022) at 9.4.

¹¹ Submitters #3, #4, #6, #8, #9, #10, #11, #12, #14, #15, #16, #17, #19, #20, #21, #22, #23, #24, #27, #28, #29, #31, #32, #33, #37, #40, #41, #42, #45, #47, #48, #51, #52, #57, #58, #61, #62, #63, #64, #66, #71, #72, #100, #105, #111, #112, #127, #187, #194 and #195.

¹² Submitter #92.

¹³ Submitter #73, #82, #92, #93 and #110.

¹⁴ Submitter #46, #92, #93, #110, #244, #254 and Submitter Group 1.

Therefore, ground improvement in the form of preloading has been recommended to reduce the post-construction settlements to tolerable limits for the development proposed. This is achieved by overfilling the fill area to construct a temporary surcharge (preload) that consolidates the underlying soft soils.

- 6.5 As set out above, it is recommended that the preload can be removed and the Site formed to a design level when survey of the preload settlements confirms an appropriate level of settlement has been achieved.

Effect of preload ground improvement on the flow of groundwater

- 6.6 In response to the effect of preload ground improvement on the flow of groundwater through the Site, the preload is not expected to have an adverse effect on the flow of groundwater beneath the Site. Although preloading will consolidate / compress the underlying soft clays to some degree, the level of compression (consolidation) is not at a magnitude that would evidently reduce the permeability of the 15m to 20m thick alluvial soils.
- 6.7 Preloading is only proposed for the future road and lot areas within this Site, such that it does not extend across the width of the Site (such as within the overland flow path and proposed stormwater ponds). Furthermore, a 300mm thick drainage layer comprising of granular sand is to be placed beneath the structural fill, as detailed in Section 9.1 of the WSP Report. This layer will allow groundwater to flow beneath the fill, thereby not creating a dam effect.
- 6.8 As referenced in Section 7.1 of the WSP Report, the published geology for the valley floor alluvium comprises a mixture of poorly consolidated gravel, sand and clay. Although the CPT traces in Appendix D of the WSP Report suggest that the majority of the alluvium is soft clay, the abrupt deviation of the CPT cone resistance (q_c) and decrease in dynamic pore pressure (u) at several depths within the alluvium indicate the presence of sandy layers. These sand layers will contain a much higher hydraulic conductivity (more permeable), therefore the flow of groundwater beneath the Site is likely to be heavily concentrated to these layers which are typically associated with springs or preferential groundwater flow paths. The granular nature of these sand layers suggest they are not susceptible to consolidation compared to the soft clay soils and, as such the flow of groundwater within these layers is not expected to be adversely affected by the preload ground improvement.

Soft ground conditions beneath Te Puna Station Road

- 6.9 As detailed in [5.12] above, Section 9.4 of the WSP Report provides a suitable construction methodology for the widening of Te Puna Station Road over these soft ground conditions, and involves the placement of compacted rockfill, geogrid reinforcement and preload. These improvements will buttress the existing road embankment at the Site entrance, thereby improving the overall road embankment stability and future performance compared to the current road embankment. These works may also provide an opportunity to improve the current road pavement at the Site entrance and along the length of road widening.
- 6.10 The mentioned kauri logs beneath Te Puna Station Road were likely used as a sacrificial working platform during construction of the original road embankment. These logs would have been displaced into the underlying alluvium during construction and subsequent settlement of the embankment, and therefore will now be located beyond the foundation of the current road embankment. Te Puna Station Road has been in place for at least the past 80 years and during this time has been subject to heavy vehicle loads that already service the properties along the road, such as the heavy machinery site at 288 Te Puna Station Rd.
- 6.11 It is expected that an increase in volume of heavy (truck) traffic may increase the rate of pavement degradation (including subgrade) where the existing pavement is not designed to support this level of traffic. As such, the requirement for road maintenance, as is the case for all roads, will continue to exist. As mentioned above, the proposed road upgrade works will provide an opportunity to improve the current road pavement at the Site entrance and along the length of road widening, thereby likely to reduce the frequency for future road maintenance.
- 6.12 Vehicles are not a permanent sustained load and as such, an increase in heavy traffic volume will not increase the risk of settlement of the existing road embankment, which would require a load to remain in place for a considerable period of time (ie weeks to years, such as a building or earthworks). Also, as mentioned above, the recommended road widening works will also improve the stability of the existing road embankment. On this basis, the proposed upgrade works are expected to provide a significant improvement to the overall performance of Te Puna Station Road.

7. RESPONSE TO MATTERS RAISED IN THE SECTION 42A REPORTS

7.1 I have reviewed the S42A Reports and recommendations dated 17 June 2024 and matters relating to geotechnical effects.

BOPRC Report

7.2 Section 7.16 of BOPRC S42A Report recommends that conditions of consent require the provision of details on the final landform and maximum cut heights, preparation of which has overseen by a qualified Chartered Geotechnical Engineer.¹⁵ I am supportive of this recommendation.

7.3 Section 7.17 of the BOPRC S42A Report also recommends conditions that require that the stormwater treatment pond is constructed under the supervision of a suitably qualified Geotechnical Engineer to ensure the integrity and stability of the pond.¹⁶ I am also supportive of this recommendation.

WBOPDC Report

7.4 The WBOPDC S42A Report dated 17 June 2024 recommends that maintenance conditions are necessary for the internal roading at the Site, given that the internal roadway is accessible to the public.¹⁷ I am supportive of this recommendation.

7.5 The WBOPDC s42A Report comments that the recommendations regarding slope stability of the borrow area in the south-western corner of the Site near the dwelling have not been reviewed by an expert geotechnical engineer on behalf of the WBOPDC and the reporting planner is therefore unable to draw conclusions on geotechnical effects.¹⁸

7.6 I have reviewed the slope stability assessment of the borrow area and have addressed this above at [5.9] – [5.11] of my evidence. In summary, I consider that a slope gradient of 1(v):2(h) is appropriate. Furthermore, construction of the earthfill embankment across the Site to raise the Site above minimum flood levels will buttress this slope thereby further improving its stability.

¹⁵ Bay of Plenty Regional Council Section 42A Report (17 June 2024) at [7.16].

¹⁶ Bay of Plenty Regional Council Section 42A Report (17 June 2024) at [7.17].

¹⁷ Western Bay of Plenty District Council Section 42A Report (17 June 2024) at [224].

¹⁸ Western Bay of Plenty District Council Section 42A Report (17 June 2024) at [225]-[227].

8. COMMENTS ON PROPOSED CONDITIONS

- 8.1 I have reviewed the BOPRC recommended consent conditions relating to geotechnical matters and confirm I am supportive of these recommended conditions.
- 8.2 No recommended consent conditions relating to geotechnical matters were provided by WBOPDC within its S42A Report dated 17 June 2024.
- 8.3 Subject to the consent conditions proposed by BOPRC being imposed, I consider the risks of adverse geotechnical effects can be suitably managed so as to be acceptable and enable the proposed development of the Site to proceed.

9. CONCLUSION

- 9.1 I consider that the geotechnical hazards to the Site can be adequately mitigated such that the risk to the development and surrounding areas is low and that the concerns raised by submitters are appropriately addressed by the Application and conditions proposed. I am supportive of the recommended consent conditions relating to geotechnical matters appended to the BOPRC and WBOPDC S42A Reports.

Robert Taylor
25 June 2024