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 **WAIKATO REGIONAL COUNCIL** and **WAIKATO DISTRICT COUNCIL** (ref LUC0488/22) by **GLEESON MANAGED FILL LIMITED** to establish and operate a managed fill disposal activity at 310 Riverview Road, Huntly.

STATEMENT OF EVIDENCE OF PARVIZ NAMJOU

GROUNDWATER ESPECIALIST

Dated 21 November 2022

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1. INTRODUCTION

1.1 My full name is Parviz Namjou. I am a Principal Hydrogeologist at Pattle Delamore Partners Limited, specialists in water resources and environmental engineering.

1.2 This evidence is given in respect of resource consent application LUC0488/22 by Gleeson Managed Fill Limited ("GMF") to Waikato Regional Council ("WRC") and ("Waikato District Council") ("WDC") to establish and operate a managed fill disposal activity at 310 Riverview Road, Huntly ("Site").

Qualifications and experience

1.3 I have a Doctor of Philosophy in Hydrogeology from University of Auckland and member of member of the US National Groundwater Association.

1.4 I have over 20 years' experience in hydrogeology, groundwater allocation, groundwater resource investigation, groundwater supply development, groundwater effects assessment including the effects of quarry operations on the surface water and groundwater environment.

1.5 My project experience relevant to Gleeson Quarry groundwater effects assessment includes:

- Groundwater modelling and assessment of the groundwater and surface water effects caused by quarry expansions and deepening in fractured greywacke, basalt and limestone for Drury, Smythes, Hunua, Whitford, Mt Wellington, Flattop, Wilsonville, Cameron and Beachlands Quarries.
- Effects of cleanfilling and managed fill on the Thorburn Fill (Peach Hill Valley, Drury) on the perched groundwater and the regional groundwater.
- Dewatering analysis and evaluations of the hydraulic properties of groundwater within fractured greywacke and basalt.
- Assessing effects of quarry dewatering on stream flow baseflows within the fractured greywacke rocks at Brookby, Drury, Smythes and Hunua Quarries.
- Preparing and implementing monitoring and augmentation plans for quarries within the same rock types.
- Groundwater resource evaluations in similar geological setting within the North Island.

1.6 **Involvement in the project**

1.7 My relationship with Gleeson Quarry began in 2015 when I carried out a preliminary site investigation to assess the hydraulic properties of the greywacke rocks at the Huntly Quarry. From 2018 to 2020 I have been involved in details site investigation to assess the groundwater and surface water effects assessment for the proposed Gleeson Quarry expansion. These investigations included, drilling, geological logging, aquifer pumping tests, field permeability tests, groundwater level monitoring and stream flow gauging.

1.8 I have an extensive experience and knowledge of the Gleeson Quarry groundwater environment and stream baseflow conditions in the neighbouring catchments. This knowledge is based on my involvement with the quarry groundwater effects assessments for the quarry expansion and water take.

Site visits and background material

1.9 I have visited the quarry site and surrounding catchments numerous times between 2015 to 2020 as part the groundwater and surface water investigations.

1.10 In preparing this evidence I have read and am familiar with the Officer's Report and the supporting documentation, as well as those submissions that are relevant to my area of expertise.

Purpose and scope of evidence

1.11 The purpose of my evidence is to describe the hydrogeology of the site and nature of the regional and perched groundwater in the Fill area.

1.12 My evidence is structured as follows:

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

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

(c) Sets out the key policy matters (Section 5);

(d) Addresses the relevant groundwater issues arising (Section 6);

(e) Comments on issues raised by the Officer's Report relevant to my area of expertise (Section 7);

(f) Comments on issues raised by Submitters relevant to my area of expertise (Section 8);

(g) Comments on the conditions (Section 9);

(h) Provides a brief conclusion (Section 10).

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

1.14 My evidence should be read together with the evidence of:

(a) Mr Andrew Rumsby, Contaminants.

Expert Witness Code of Conduct

1.15 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.

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

2. SUMMARY OF EVIDENCE

2.1 Based on the available hydrogeological data, there is no shallow aquifer (continuous zone pf saturation) below the proposed Fill area and the laterally discontinuous lenses pr pockets of perched groundwater minimise lateral groundwater flow away from the proposed fill areas. This is supported by the logs and ephemeral nature of the tributaries at the site (lack of baseflow) as assessed by the original Ecological Impact Assessment Report from Boffa Miskell[1]. Considering the lenses are discontinuous and are bounded by low permeability sediments, the perched groundwater is considered to be predominantly stagnant. Vertical infiltration from the perched groundwater lenses to the regional groundwater in the greywacke is possible. However, considering these lenses of perched groundwater are underlain by clays and silts (e.g., completely weathered coal measures) with low vertical hydraulic conductivity, the infiltration is likely to be low.

2.2 Following rainfall some minor discharge from the perched groundwater lenses to the watercourses is possible if any of these perched groundwater lenses intercept the ground surface. However, considering widespread occurrence of clay and silt at shallow depths, these ephemeral tributaries predominantly act as run-off watercourses and surface water drainage system rather than a discharge zone for groundwater.

3. SITE DESCRIPTION AND LOCALITY

3.1 Fill Areas 2, 3 and 4 are generally underlain by three geological units:

(a) Existing Fill (only within Fill Area 3): These sediments are sourced from nearby coal mine stripping operation and based on the site investigation (Gaia 2021) predominantly consists of silty clay and mudstone remnants occasionally minor sands or gravel lenses have been logged. However, based on the test pit data these lenses are not forming any continues layer. The exact thickness of this unit is

[1] Ecological Impact Assessment (EcIA) (Boffa Miskell, 2019) Appendix 12.1 to AEE

unknown but based on the topography of the surrounding catchments may be about 20m.

(b) Waikato Coal Measures (WMC) which is part of the Te Kuiti Group consists of up to 6m of weathered sediments consist of silt and clay and minor fine sand which overlie mudstones and fine grain sandstones. No coal or carbonaceous sediments was observed in this units at this site[2].

(c) Newcastle Greywacke: WMC is underlain by the highly weathered greywacke (silt and clay) and moderately to fresh greywacke. The thickness of highly weathered greywacke is estimated to be up to 14 to 30m[3].

4. DESCRIPTION OF PROPOSAL

4.1 GMF proposes to infill three gullies (Fill Areas 2-4) with 2,000,000 m^3 of managed fill. Managed Fill consists of clean fill and contaminated clay, soil, rock, and other inert materials that may have contaminants that exceed background concentrations.

5. KEY POLICY MATTERS

5.1 This evidence prepared only to describe the conceptual groundwater in the proposed fill areas. The policies related to the groundwater contamination assessment is presented by Andrew Rumsby in his evidence.

6. GROUNDWATER ISSUES

6.1 Groundwater level measurements and pumping tests undertaken by PDP in 2020[4] indicated two groundwater systems beneath the Fill Areas:

(a) A perched/shallow groundwater layer (with discontinuous zones of saturation); and

(b) Regional groundwater aquifer (with continuous zone of saturation).

6.2 The perched/shallow groundwater occurs within the Existing Fill, Tauranga Group (including Taupo Pumice Ash), Te Kuiti Group (coal measures) and

[2] Gaia (2021) Huntly Quarry Disposal Sites – Geotechnical Assessment (Draft), prepared for Gleeson Quarries Ltd November 2019.
[3] Stevens M and Fulton G (2006) Stevenson Geological and Resource Assessment of Huntly Quarry, Prepared for Stevenson Resources Ltd, July 2006.
[4] Pattle Delamore Partners (2020) Huntly Quarry Expansion 2020 Groundwater and Surface Water Effects Assessment, Prepared for Gleeson Quarries Huntly Limited, December 2020.

the greywacke at shallow depths and are characterised by discontinuous zones of saturation, which respond and behave according to rainfall patterns.

6.3 The regional groundwater is defined as the zone of continuous saturation that extends to full depth within the greywacke across the region. The regional groundwater is likely to occur within the fractured greywacke and discharges predominantly to the Waikato River or lower reaches of the permanent streams in the area. The regional groundwater level elevation ranges between RL8m (next to the Waikato River) to RL20m (below the proposed Fill areas) (PDP 2020) and is confined in some areas by highly weathered greywacke, or clay layers within the coal measures and Tauranga Group.

6.4 The watercourses in the fill area are sourced at elevations above RL90m, well above the regional groundwater at elevations below RL20m. These watercourses may contain local and discontinuous perched groundwater. The local shallow/perched groundwater within the Waikato Coal Measures and Taupo Pumice flows along the contact surface between the weathered greywacke and the overburden materials and may discharges to the local streams following rainfall events.

6.5 It is likely that the perched groundwater has been developed in local high permeability pockets (lenses) especially within the Existing Fill over low permeability clays. Lenses of mudstone gravels and boulders (Gaia 2021) have been identified in the Existing Fill (Fill Area 3). Based on the borehole logs drilled in 2006 for rock resource evaluation (Stevens and Fulton 2006) fragmented coal and sandstone gravels have been also identified locally in the coal measures which can potentially form pockets of perched groundwater.

6.6 Mudstone gravels are reported to be bounded by a matrix of completely weathered coal measures silt. Considering the predominant lithology (clay and silt) surrounding these gravels and their laterally discontinuous nature, the groundwater within these perched layers is likely to be predominantly stagnant. The discontinuous nature of such perched groundwater minimises the horizontal movement of groundwater away from the managed Fill areas.

6.7 The ephemeral nature of the tributaries in the vicinity of the proposed Fill areas demonstrates that these pockets of saturation or lenses are not laterally continuous, limited in their extent and not likely to form an aquifer in the area.

6.8 The likely stagnant perched groundwater is supported by the test pit data (Gaia 2021). No water table has been encountered in test pits within the coal measures down to 5.5m depth (TP308 and TP311, TP312 and TP313). The water table has been detected in test pits within the Existing Fill at various depths generally above RL60m and between 1m to 5mbgl (TP301, TP303, TP305 and TP308). But no water table is encountered in TP314 within the same unit (Existing Fill) down to 12m depth. TP314 is located only about 3m from TP301 with recorded water table at 5mbgl. This clearly demonstrated the discontinuous nature of these pockets of saturation developed in localised and isolated perched groundwater.

6.9 The regional groundwater below the fill areas, surrounding streams and the quarry discharges to the Waikato River. The river forms a strong groundwater sink for the regional groundwater. The regional groundwater is recharged from direct rainfall infiltration or through local stagnated perched groundwater within the greywacke overlying shallow sediments. However, considering the silt and clay layers that underlies the above perched groundwater, the recharge contribution from the above lenses to the main aquifer (regional groundwater) will be minimal. Based on the lithology (silty clay and remnant of mudstones), the permeability of the sediments underlying the perched layers is likely to be very low (< 10 x 10-8 m/s) and similar to weathered WMC, minimising the infiltration. Recharge to the regional groundwater predominantly occurs in areas when the greywacke is close to the ground surface.

6.10 Based on the logs (Gaia 2021), the above lenses of perched groundwater are also overlain by silt and clay at the surface (i.e., low permeability sediments). This minimises rainfall infiltration and recharge to perched groundwater lenses and increases the run-off (quick flows) following the rainfalls. This is supported by well-developed natural surface drainage system in the proposed Fill area.

6.11 The above pockets of saturation at the proposed Fill is above the low permeability clays layers within the highly weathered greywacke and coal measures. This limits hydraulic interactions between the regional groundwater and the above pockets of saturation. Therefore, the regional groundwater dewatering at the quarry and its subsequent recovery is not likely to have any effects on the above pockets of perched groundwater.

6.12 The regional groundwater flow beneath the site is expected to be easterly towards the Waikato River, which runs in a northerly direction.

7. ISSUES RAISED BY COUNCIL OFFICER'S REPORT

7.1 I have read the report prepared by Ms Emma Cowan the Council's reporting planner.

7.2 On page 33, Ms Cowan quotes WRC Groundwater Expert Mr Baker, who states that: *I have now reviewed the s92 response letter and Appendix F. From a groundwater perspective they have responded to all my questions.*

7.3 *The new information does help conceptualise the site in more detail and demonstrates a clear differentiation between the deeper groundwater system and the shallower, perched units. This is the basis for them not recommending any groundwater monitoring. I'd like to consider this some more, but conceptually I'm probably ok with that, so long as there is a shallow surface water monitoring programme in place, and perhaps a framework that would require the consideration of installing deeper groundwater bores, if contamination of the shallow perched groundwater/surface flow is observed. Happy to discuss this further.*

7.4 Mr Baker accepts the low risk to groundwater contamination as a result of the fill operation and is open to further discussion around risk-based solutions and outcomes.

7.5 It is preferable to avoid rather than mitigate adverse effects on groundwater. Therefore, in my view, considering the site groundwater conditions and there are no sensitive groundwater receptor, any ongoing groundwater monitoring won't be warranted.

7.6 In addition, the fact that the watercourses in the area are classified as ephemeral is indicative of absence of baseflow or aquifer to be monitored. This means lack of lateral hydraulic continuity of any perched lenses.

To address Mr Baker concern I have proposed a targeted site investigation programme and contingency measure rather than any ongoing monitoring programme during the filling operation as any refinement of the fill construction should be addressed before placement of the fill. Should a shallow aquifer or continuous zone of saturation identified following the proposed site investigation, a deep drainage system at FA2 to be installed (as in FA3) to divert and discharge this water before filling commences.

8. ISSUES RAISED BY SUBMITTERS

8.1 A total of 42 submissions have been received. The topics raised in submissions that I can comment are as follows:

(a) Hydrology.[5]

Hydrology

8.2 The Department of Conservation submission (point 4) states that the fill operation has the potential to adversely affect conservation values through changes to hydrology.

8.3 The Te Kauri Marae submission raises concerns with the shared water table being a source of drinking water, with six marae and a residential area in proximity. The submission states that the water table covered by the development is connected.

8.4 Based on the available hydrogeological data, there is no shallow aquifer (continuous zone pf saturation) below the proposed Fill area and the laterally discontinuous lenses or pockets of perched groundwater is likely to prevent lateral groundwater flow away from the site.

8.5 This is supported by the logs and ephemeral nature of the tributaries at the site (lack of baseflow). Considering the lenses are discontinuous and are bounded by low permeability sediments, the perched groundwater is considered to be predominantly stagnant. Vertical infiltration from the perched groundwater lenses to the regional groundwater in the greywacke is possible. However, considering these lenses of perched groundwater are underlain by clays and silts (e.g., completely weathered coal measures) with low vertical hydraulic conductivity, the infiltration is likely to be low.

8.6 Following rainfall some minor discharge from the perched groundwater lenses to the watercourses is possible if any of these perched groundwater lenses intercept the ground surface. However, considering widespread occurrence of clay and silt at shallow depths, these ephemeral tributaries predominantly act as run-off watercourses and surface water drainage systems rather than a discharge zone for any aquifer with shallow groundwater.

9. COMMENT ON CONDITIONS

9.1 Ms Cowan has recommended a condition requiring a groundwater investigation (to determine more accurately the localised hydraulic setting and conductivity), and monitoring bores if contamination of surface flow is observed not attributable to overland runoff.

5 Submission of Department of Conservation, Te Kauri Maarae Trust.

9.2 As I mentioned above the long-term monitoring of discontinuous perched groundwater especially in no base flow conditions is not supported. There is no sensitive groundwater receptor to warrant any ongoing groundwater monitoring. In addition, the fact that the watercourses in the area are classified as ephemeral is indicative of absence of baseflow or aquifer. This means lack of lateral hydraulic continuity of any perched lenses in the area.

9.3 Ephemeral nature of the streams also means there are no groundwater fed baseflow (viable stream) to be monitored.

9.4 As a precautionary measure, it is proposed that further investigations are conducted to determine the depth, extent, and volume of any perched groundwater lenses in FA2 and if necessary, deep drainage utilised to divert the groundwater from the fill site. The conditions drafted by Ms Cowan have been edited as follows:

Condition 40: The consent holder shall engage a groundwater specialist to develop a framework for groundwater investigation. This will include allowance for drilling three boreholes within and downstream of the FA2 and to test groundwater level continuity during the baseflow conditions. The framework shall be incorporated into the Sampling and Analysis Plan required by APP144475.04.01 and subject to WRC review and certification.

Condition 41: Additional to condition 40 above, should a shallow aquifer or continuous zone of saturation identified during construction of FA2 which is vulnerable to leachate from the imported fill, a deep drainage be installed (as in FA3) to divert and discharge this water before filling commences.

10. **CONCLUSIONS**

10.1 Based on the available hydrogeological data, there is no shallow aquifer (continuous zone pf saturation) below the proposed Fill area and the laterally discontinuous lenses pr pockets of perched groundwater minimise lateral groundwater flow away from the proposed fill areas. This is supported by the logs and ephemeral nature of the tributaries at the site (lack of baseflow).

10.2 Considering the lenses are discontinuous and are bounded by low permeability sediments, the perched groundwater is considered to be predominantly stagnant. Vertical infiltration from the perched groundwater lenses to the regional groundwater in the greywacke is possible. However, considering these lenses of perched groundwater are underlain by clays and silts (e.g., completely weathered coal measures) with low vertical hydraulic conductivity, the infiltration is likely to be low.

10.3 Following rainfall, some minor discharge from the perched groundwater lenses to the watercourses is possible if any of these perched groundwater lenses intercept the ground surface. However, considering the widespread occurrence of clay and silt at shallow depths, these ephemeral tributaries predominantly act as run-off watercourses and surface water drainage systems rather than a discharge zone for groundwater.

10.4 As a precautionary measure, it is proposed that further investigations are conducted to determine the depth and extent of any perched groundwater lenses in FA2 and if necessary, deep drainage utilised to divert the groundwater from the fill site.

Parviz Namjou
Pattle Delamore Partners Limited
21 November 2022