BEFORE A HEARING PANEL
CONSTITUTED BY HORIZONS REGIONAL COUNCIL

IN THE MATTER OF	an application dated 21 December 2020 for regional consents by Grenadier Limited to develop the Douglas Link Golf Course at 765 Muhunoa West Road, Ohau
IN THE MATTER OF	Part 6 of the Resource Management Act 1991

STATEMENT OF EVIDENCE OF ALEXANDRA CLARE JOHANSEN

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Section A – Introduction

Name, qualifications and experience

[1] My full name is Alexandra Clare Johansen. I hold a Bachelor of Science with Honours (Geology) from Victoria University of Wellington.

[2] I am a geologist with twenty-five years of experience predominantly in petroleum geology in New Zealand, including ten years of experience as a hydrogeologist and six years as Director of Bay Geological Services Limited. I currently specialise in hydrogeology in the Hawkes Bay and Gisborne regions, which involves pre-drill investigations, including seismic surveys, well logging, aquifer pump testing, data analysis and interpretation.

Expert Code

[3] While this is not an Environment Court hearing, I have met the standards in that Court for giving expert evidence.

[4] I have read the Code of Conduct for expert witnesses issued as part of the Environment Court Practice Note 2014 (Part 7). I agree to comply with the Code of Conduct. I am satisfied that the matters addressed in this statement of evidence are within my expertise. I am not aware of any material facts that have been omitted or might alter or detract from the opinions expressed in this statement of evidence.

Role in Project

[5] I am the project Hydrogeologist.

[6] I assisted in developing the current bore that was drilled on site by Neville Webb and Sons (Philip Webb). I understand that Mr Webb's company has drilled and tested a substantial number of wells in the region. I monitored the bore construction through close contract with the well driller. Once we had agreed that a suitable aquifer had been found, Mr Webb and I collaborated on an appropriate testing programme for the well. I checked

that the aquifer testing programme for the well was in line with the Regional Council's guidelines for the purposes of preparing a technical report to support the assessment of any actual and potential adverse effects on the environment as a result of groundwater abstraction. My company's technical report is attached to the application documents and is dated June 2021.

[7] During the course of processing the application, I have also assisted the Applicant and Horizons through responses to further information requests in my area of expertise. That includes a letter I wrote dated 2 December 2021 regarding hydraulic gradients at the site. My input on groundwater has also assisted the various ecologists and coastal scientists that have been assessing the proposed activities.

Scope and purpose of Evidence

[8] My evidence will address the following matters:

- The hydrogeological setting of the Douglas Links groundwater well;
- A summary of the potential effects that may result from the proposed water abstraction;
- Comment on any relevant submissions made concerning hydrogeological matters;
- The section 42A reports prepared by the Regional Council, including Dr Tom Garden's evidence dated 6 April 2022; and
- A summary and recommendations on the proposed conditions of resource consent.

Section B – Executive Summary

[9] The surface geology at the coast is mapped as a series of Quaternary sand deposits formed adjacent to the coastline (Begg and Johnston 2000, Morgenstern et al 2019).

[10] In low permeability strata, surface water run-off typically drains in directions aligned with the topographic gradient. The Ohau drainage pattern is NE-SW, aligned with the tectonic structure of the area, with flow toward the coast (northwest). The groundwater bores located across the sand dunes adjacent to the coastline and NNE of the Pumped Well record water levels ranging from 14.40 to 16.30 m above mean sea level (amsl), which suggest a largely consistent set of water levels through the sand dune material. Due to the lack of multiple data points, a definitive hydraulic gradient from triangulation cannot be identified; however, a potentiometric slope likely exists toward the northwest, away from the salt marsh.

[11] To the south of the project area and on the true left bank of the Ohau River, the available water level data exhibits artesian aquifer conditions in confined shallow to deep bores. Due to the groundwater being trapped in artesian aquifers beneath low permeability strata, the data points do not provide information on hydraulic gradient contouring, and there is no clear evidence of a dominant potentiometric slope across this area.

[12] The Douglas Links Well was drilled to 104.60 m below top of casing (toc), and screened from 96.91 – 102.91 toc (6 m) across a sandy gravel aquifer with an initial static water level (SWL) of -11.22 m toc. The Pump Test data analysis indicates a 'leaky' confined aquifer, where the cone of depression is predicted to be less due to the vertical contribution. No other deep gravel bores are recorded within 2 km of the pumped Well, and the depth of the gravel aquifer and shallow SWL infers a large water column within bores screened across the same deep gravel interval.

Section C – Evidence

[13] The Grenadier Developments Limited property lies centrally within the Horowhenua lowlands, across NNE-SSW-trending marine deposits elevated some 5 to 40 m above sea level, formed sub-parallel to the western coastline north of Paekakariki. The Holocene marine and marginal marine terraces mantle the project area, adjacent to alluvium deposited by the Ohau

River that drains westward to the coast approximately 250 m south of the Applicant's groundwater Well. The surface geology at the coast is mapped as a series of Quaternary sand deposits form adjacent to the coastline (Begg and Johnston 2000, Morgenstern et al. 2019).

[14] The 150 mm diameter well was drilled to 104.60 m toc, and is screened from 96.91 – 102.91 toc across a sandy gravel aquifer with an initial SWL of -11.22 m toc. The bore log records a series of sand units above the gravel aquifer, with upper confinement provided by low permeability silty sand fining to clay, with traces of shell (79.10 – 93.00 m toc); clay, peat and wood (48.70-49.10 m toc), and occasional clay beds, with predominantly fine to medium sand with occasional clay layers that extend to the surface.

[15] Following well development, aquifer pump testing was conducted at a constant rate of 16.07 l/s. The well maintained the flow rate over the 4-day duration test period, with a maximum drawdown of 18.92 m. Manual and electronic datalogger monitoring of the pumped well and four relatively shallow neighbouring bores was completed before, during and post (Recovery) pumping period; however, no measurable well interference effects were recorded in the Monitoring bores. Manual calculations of Recovery data determined values ranging from T = 103.85 to 105.00 m^2/day. The aquifer response displays a 'leaky' component with vertical contribution, potentially reducing the predicted well interference response in neighbouring wells. No nearby deep bores are recorded within the near vicinity of the pumped Well, and therefore, adverse effects on nearby bores are not expected.

[16] A Monitoring Bore was installed to 2.6 m depth toc between the pumped well and close to the Ohau River to monitor any indirect surface water level fall resulting from pumping the Applicant's Well. However, the water level rose approximately 0.420 m over the pumping duration, likely due to persistent rainfall.

[17] An approximate potentiometric slope direction toward the northwest is determined from SWL data recorded in shallow groundwater bores drilled across the alluvial terrace to the east of the dune system. The Horizons

bore data infers groundwater levels lowering by approximately 0.5 m over about 1 km toward the coast.

[18] To the south of the project area and on the true left bank of the Ohau River, the Horizons bore data records artesian aquifer conditions in confined shallow to deep bores. Due to the groundwater being trapped in artesian aquifers beneath low permeability strata, the data points do not provide information on hydraulic gradient contouring. There is no clear evidence of a dominant potentiometric slope across this area.

[19] Given the results of the pump testing programme, I concluded that the aquifer encountered by Neville Webb and Sons drillers provides a sustainable groundwater resource. The aquifer test data analysis and modelling provide sufficient evidence to conclude that both the abstraction rate and volume for which consent is sought will not result in significant adverse effects on the hydrogeological setting, any existing bores in the vicinity of the proposed golf course, or any surface water features in the area (including the salt marsh and Ohau River).

Section D – Submissions received

[20] I understand a number of submissions have been received on the project as part of the notification process. I do not comment on the 17 positive submissions because they relate to economics, ecological matters, and general support for the golf course activities. Those areas are not within my expertise.

[21] There is a submission from Te Iwi o Ngāti Tukorehe (including the Tahamata Corporation land north and south of the Ohau River) that opposes the applications and makes reference to the groundwater abstraction. I do not comment on the groundwater abstraction activities as it relates to cultural values. However, in terms of science, I can confirm for the submitter, and Mr Garden for the Council agrees, that the adverse effects of the proposed groundwater abstraction will be less than minor. I can also confirm that the modelled well interference does not adversely affect the Tahamata well south of the river.

Section E – Section 42A Report by Dr Garden

[22] Dr Tom Garden has provided evidence about my company's work on behalf of the Applicant. In paragraphs 47 through 52, Dr Garden provides conclusions that are the same as mine, that the adverse effects resulting from the proposed groundwater abstraction will be less than minor. I concur with those conclusions.

[23] However, Dr Garden does note in paragraph 32 that he has some concerns about the lack of justification or explanation within the reports about the potential effects on surface water bodies from stream depletion. In my opinion, the effects on surface water bodies are likely to be less than minor due to the high level of confinement provided by the low permeability sediments logged during drilling. It is noted that the streambed conductance parameter used in the stream depletion assessment that Dr Garden queried, is adopted from stream depletion parameters used in the nearby Tahamata Irrigation Well No.361063 assessment as discussed and remodelled in the Lattey (2020) feasibility report, as stated in my report. In any case, Dr Garden's concerns are more ecologically based, and Dr Keesing and Mr Dahm for the Applicant address those matters.

Summary and Recommendations

[24] Overall, I agree with Dr Garden's conclusions that the adverse effects on groundwater resources will be less than minor due to the proposed golf course groundwater take. I also recommend that consent conditions are an effective way to ensure that conclusion results going forward. My only suggested changes to the conditions are:

(a) Condition 11. The Electrical Conductivity (EC) values as proposed appear very low. The pumped aquifer groundwater sample analysed an EC of 561 uS/cm, which does not provide a lot of scope for error.

(b) It is suggested that the EC limits proposed in Condition 11 (a, b and c) are amended to 1000, 1500 and 2000 uS/cm, respectively. A similar coastal water take with consent granted by Hawkes Bay

Regional Council (HBRC), stipulates an EC limit of 1500 uS/cm as a condition (EC values above which would require a reduction of 32% of the daily volume) and a limit of 2000 uS/cm as a condition to cease pumping.

(c) Condition 19: The screened aquifer water quality test analysis included in my report, records an initial EC of 561 uS/cm. Therefore, the EC limit proposed in Condition 19 is too restrictive. It is suggested that the EC value limit is removed, leaving Condition 19 to moderate EC using a limit of 50% increase. This would then be similar to an example consent granted by HBRC.

(d) Condition 19 *d. have laboratory analysis undertaken for the ionic balance of the sampled water;*

It is recommended that Condition 19 (d) be deleted as many variables in and out of the laboratory's control (suspended solids, sample filtration, inorganics, iron concentration, EC and sample containers) can affect ionic balance.

(e) Condition 19 Advice Note: *The ionic balance of the sampled water should not have a discrepancy of greater than 5%.*

It is recommended that the Advice Note be deleted as many variables in and out of the laboratory's control (suspended solids, sample filtration, inorganics, iron concentration, EC and sample containers) can affect the ionic balance.

Dated 12 April 2022

Alexandra Clare Johansen