IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications for resource consent (**APP-2005011178.01** and **APP-2018201909.00**) to Horizons Regional Council associated with the construction of a wetland as part of the proposed upgrades to and ongoing operation of the Eketāhuna Wastewater Treatment Plant
BY	**TARARUA DISTRICT COUNCIL** **Applicant**

STATEMENT OF EVIDENCE OF ELOISE (ELLA) BOAM (GROUNDWATER)
ON BEHALF OF TARARUA DISTRICT COUNCIL

12 November 2018

BUDDLEFINDLAY
Barristers and Solicitors
Wellington

Solicitors Acting: **David Allen / Esther Bennett**
Email: david.allen@buddlefindlay.com / esther.bennett@buddlefindlay.com
Tel 64-4-499 4242 Fax 64-4-499 4141 PO Box 2694 DX SP20201 Wellington 6140

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INTRODUCTION

Background and role

1. My full name is **Eloise Boam**.

2. I am a groundwater scientist and geologist.

3. My evidence is given on behalf of Tararua District Council ("**TDC**") in relation to its application ("the **Wetland Application**") under section 88 of the Resource Management Act 1991 ("**RMA**") for resource consents relating to the construction of a wetland as part of the wider proposed upgrades to, and ongoing operation of, the Eketāhuna Wastewater Treatment Plant ("**EWWTP**").

4. I became involved in the EWWTP resource consent proceedings subsequent to the initial application, when I investigated the presence of a groundwater system at the site.

5. My evidence relates to the potential effects of the proposed EWWTP wetland on groundwater.

6. In light of the limited scope of the Wetland Application and the hearing that will take place on 27 November 2018, I address matters relating to the Wetland Application in Part A. My response to one matter raised that falls outside the scope of the Wetland Application, and 27 November hearing, is addressed as "Other" under Part B.

Qualifications and experience

7. I have the following qualifications and experience relevant to this evidence.

8. I have a Bachelor of Science Degree with a major in Geology. I am a member of the following relevant professional associations:

   (a) New Zealand Hydrological Society; and the

   (b) New Zealand Geotechnical Society.

9. I am employed by WSP Opus as a Groundwater Scientist within the water resources team.

10. Prior to 2018, I was employed by Opus International Consultants as an engineering geologist within the geotechnical, risk and resilience team.

11. For the past 7 years, my professional experience has focused on various aspects of geology, hydrology and geomorphology, including; groundwater dynamics, hydrogeology, landscape evaluation and natural hazards.

Code of conduct

12. I confirm that I have read the 'Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014.

13. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Scope of evidence

14. I have been asked by TDC to provide evidence in relation to the potential effects of the proposed EWWTP wetland on groundwater.

15. The purpose of this evidence is to provide key information relating to:

    (a) Part A: Wetland Application:

        (i) The local geology at the wetland site, and particularly its potential to host a groundwater system;

        (ii) The nature of any groundwater system present at the wetland site and the dynamics of the flow, with respect to the Makakahi River;

        (iii) The potential effects of the proposed wetland on groundwater levels;

        (iv) The potential effect on groundwater levels during high flows of the Makakahi River; and

        (v) Queries raised by the Council Officers' Section 42A Reports as they relate to the Wetland Application, as required.

    (b) Part B: Other:

        (i) Paragraph 40 of Ms Morton's 42A Council Officer's Report.

EXECUTIVE SUMMARY

16. The wetland site is located on the lowest/youngest river terrace of the Makakahi River, as shown in (**Figure 1**) and forms part of the contemporary floodplain.

17. The lowest terrace is adjacent to the Makakahi River and is comprised of 1 - 2 m of alluvial deposits consisting mainly of sand and gravel. These deposits

are underlain by Eketahuna Group mudstone which is exposed in terrace risers (between the terraces), and along the incised channel of the river.

18. It is only the alluvial sediments that can host a groundwater system.

19. Consequently, there is only a limited and rudimentary groundwater system present at the wetland site, and the wider area of the EWWTP. The nature of the geology (ie. the thickness of the alluvial deposits) is such that it does not have the capacity to hold a useable amount of groundwater.

20. Water infiltrating through the surficial alluvial deposits flows along the interface with the underlying impermeable mudstone. The natural direction of any minor groundwater flow mimics the topography, and flows down-gradient towards the wetland and the Makakahi River.

21. The groundwater in the alluvial material overlying the lower terrace is hydraulically connected to the river. The top of the saturated zone and the river level being coincident. Therefore, during periods of high river flow the groundwater is expected to rise. During 'average' flow conditions, the groundwater is approximately 1 m below the surface of the lower terrace.

22. The development of the proposed wetland will not alter the natural path of groundwater to the lower terrace.

23. At the lower terrace, any groundwater will either flow below the wetland base and enter the river (existing situation), or flow laterally into the wetland system before eventually entering the river through the constructed outlet.

24. The development of the wetland will have less than minor effects on the groundwater system.

25. In my opinion, the wetland will not have any adverse effects on groundwater during flood events of the Makakahi River.

PART A: WETLAND APPLICATION

Background Information

26. A resource consent application for a wetland associated with the discharges of the EWWTP to the Makakahi River was lodged in October 2018 by TDC.

27. This brief of evidence relies on, and should be read in conjunction with, the following reports:

    (a) Boam, E. & McConchie, J. 2018 Eketāhuna Wastewater Treatment Plant Preliminary Groundwater Investigation. Technical Memorandum prepared by WSP Opus for the Tararua District Council, June 2018. 6p,

attached as Appendix II to the Assessment of Environmental Effects ("**AEE**").

(b) Boam, E. & McConchie, J. 2018: Section 92 Additional Information Request for the Eketāhuna Wastewater Treatment Plant. Technical Memorandum prepared by WSP Opus in response to Horizons Regional Council request for additional information, for application APP-2018201909.00 – land discharge and diversion permits (Eketāhuna Wastewater Treatment Plant). September 2018. 2p, included within TDC's further information response provided to the Panel on 21 September 2018.

(c) Maas, F., Sadeghi, L., Warren, S. & McConchie, J. 2018: Eketāhuna WWTP Hydraulic modelling. Report prepared by WSP Opus for the Tararua District Council. 20p, attached as Appendix IV to the AEE.

Local groundwater system assessment

Nature of geology and groundwater

28. To understand the local groundwater system at the wetland site, I undertook a comprehensive desktop study of published geological and topographical maps, assessed aerial photographs and reviewed available borehole logs. I also visited the site to confirm the published literature and make observations of the geomorphology, geology and groundwater.

29. The wetland site is located on the lowest/youngest river terrace of the Makakahi River (**Figure 1**). The lowest terrace is adjacent to the Makakahi River and forms part of the contemporary floodplain.

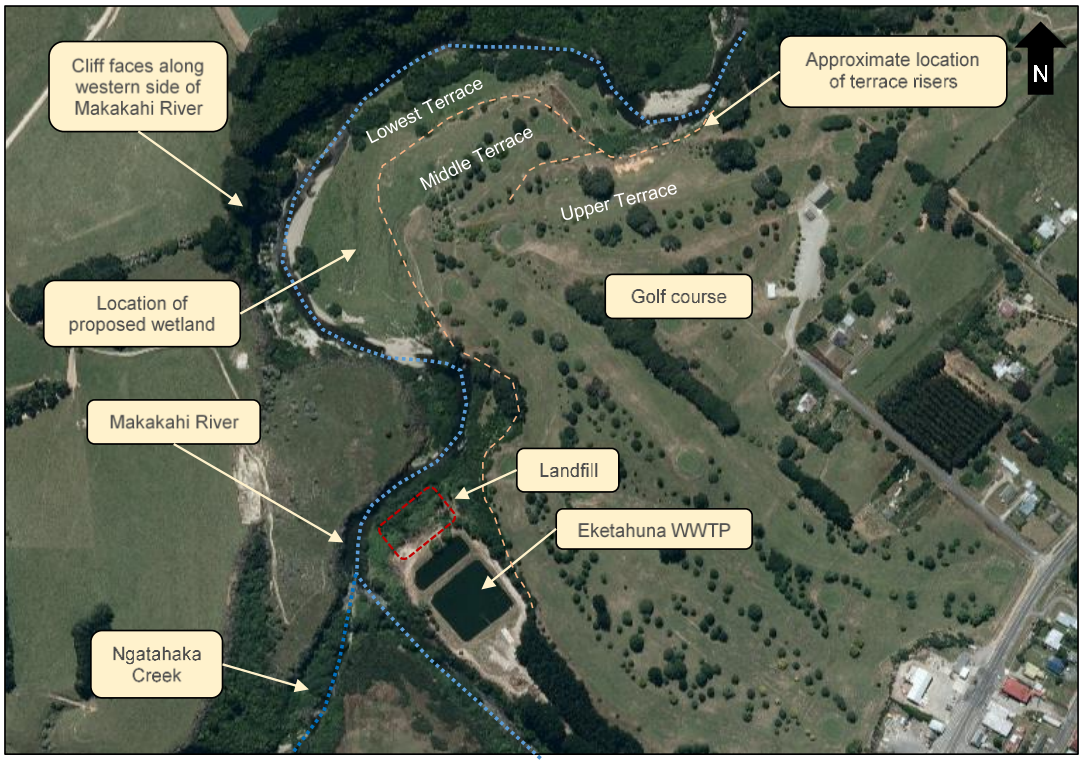

Figure 1: EWWTP, wetland site and surrounding landforms.

30. The geological units present at the lower terrace / wetland site, and the wider area, are 1 - 2 m of alluvial deposits consisting mainly of sand and gravel. These are underlain by Eketahuna Group mudstone which is exposed in terrace risers (between the terraces), and along the incised channel of the river.

31. The surficial alluvial deposits are permeable and allow the infiltration of water. As such they can host a limited and rudimentary groundwater system. The thickness of these deposits mean that they do not have the capacity to hold a useable amount of groundwater. Any groundwater system cannot be considered an aquifer.

32. The mudstone bedrock is essentially impermeable and cannot host a groundwater system.

33. Given the nature of the alluvial deposits (permeable but of limited thickness) there is only a rudimentary groundwater system present. This system is likely to be both temporally and spatially limited, and exist only during winter, or following periods of prolonged or intense rainfall.

34. Water within the surficial alluvial deposits flows along the interface with the underlying impermeable mudstone. The natural direction of the groundwater flow mimics the topography. Any groundwater flow is down-gradient, towards the wetland and the Makakahi River.

35. On the lower terrace, the soil is waterlogged and the water table is near the ground surface.

36. The groundwater in the lower terrace is hydraulically-connected to the river, with the top of the saturated zone and the river level being coincident. During periods of high river flow, the groundwater is therefore expected to rise. During 'average' flow conditions, the groundwater is approximately 1 m below the surface of the lower terrace.

Effect of the wetland on groundwater

37. The wetland will be constructed on the lower terrace adjacent to the Makakahi River, which forms part of the contemporary floodplain. As previously discussed, groundwater flow on the wetland side of the river mimics the surface topography and flows west towards the Makakahi River.

38. The development of the proposed wetland will not alter the natural path of any groundwater flow to the lower terrace.

39. As groundwater is hydraulically connected to the river at the lower terrace, any groundwater entering the lower terrace / wetland area will either: (a) flow through the alluvial deposits below the wetland and enter the river (ie. same as the existing situation); or (b) become part of the wetland system, with the water eventually also entering the river (ie. through the outlet).

40. Therefore, the development of the proposed wetland will have a less than minor effect on the groundwater system.

41. The groundwater in the vicinity of the wetland is not used for any consumptive purposes. Therefore, the wetland will not affect any existing water users.

Flood events

42. As the groundwater is hydraulically-connected to the Makakahi River across the lower terrace, during floods rising groundwater will exert pressure on the base of the wetland. This pressure will be controlled by the head difference between the groundwater and the wetland, which will be minimal and only occur during high flow events. Such conditions will exist for only a very brief period during any large flood event, in themselves infrequent events.

43. If the river overtops the wetland, the groundwater and river levels will be the same. Any pressure difference through the base of the wetland will cease.

44. In my opinion, the wetland will not have any adverse effects on groundwater during flood events of the Makakahi River.

Matters raised in Council Officers' Section 42A Reports relating to the wetland

Timothy Baker - Groundwater

45. Regarding paragraph 9, the monitoring of nitrate concentrations of the inflow and outflow of the wetland is not considered as a groundwater related issue. As such, no comment is made regarding the proposed monitoring regime. This is addressed in the evidence provided by Dr. Olivier Ausseil.

46. Regarding paragraph 10, the 'receiving environment' is not considered to be the groundwater system. As such, no comment is made regarding the proposed monitoring regime. This is addressed in the evidence provided by Mr Roger MacGibbon and Dr. Olivier Ausseil.

47. I agree with the recommended condition (paragraph 11) stating that the permeability of the wetland liner shall be no greater than 1.4 x 10-7 m/s and that the in-situ permeability of the material should also be confirmed and documented by an appropriately qualified engineer during construction.

Fiona Morton - Planning

48. Regarding paragraphs 35 - 39 of Ms Morton's evidence, she relies on the Section 42A Supplementary Report 2 submitted by Mr Baker, which is addressed in paragraphs 45 – 47 of this evidence. No further comment is required.

PART B: OTHER

Matters raised in Council Officers' Section 42A Report outside the scope of the Wetland Application

Fiona Morton - Planning

49. At paragraph 40 of her report, Ms Morton makes reference to Mr Baker's earlier recommended condition of one up-gradient and two down-gradient monitoring wells, in the event that the treatment ponds are not lined.

50. In my view this is not necessary. Mudstone bedrock was observed at the ground surface near the WWTP. Mudstone is impermeable and therefore cannot host a groundwater system. It is highly likely that the full depth of the ponds are constructed within bedrock. Given this, any seepage from the base of the ponds is extremely unlikely. Since any seepage could not interact with a groundwater system, it cannot affect water quality.

51. To confirm that no leakage is occurring from the ponds, permeability investigations could be undertaken. This could be achieved through water balance calculations and/or geotechnical investigations at the existing ponds.

Eloise Boam

12 November 2018