IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of an application for a Private Plan Change (Private Plan Change 2) to the Hamilton City Operative District Plan: Te Awa Lakes, pursuant to the Act

APPLICANT Perry Group Limited

CONSENT AUTHORITY Hamilton City Council

STATEMENT OF EVIDENCE OF ANN LOUISA WILLIAMS FOR HAMILTON CITY COUNCIL

Dated 27 November 2019

INTRODUCTION

1. My full name is Ann Louisa Williams.

2. I am a Technical Director and the Manager of the national Geotechnical team of Beca Limited ("Beca"), comprising more than 120 people.

3. I participated in Court assisted caucusing on geotechnical matters on 16 September 2019 and contributed to the preparation of a Geotechnical Joint Witness Statement (JWS) on that date.

4. I also participated in an informal caucusing discussion with John Olliver and Kori Lentfer (amongst others) on 17 October 2019. The purpose of the meeting was to address geotechnical issues raised in the geotechnical JWS and the planning JWS of 4 October 2019 to consider planning responses to the issues.

QUALIFICATIONS AND EXPERIENCE

5. My qualifications and experience relevant to the evidence I shall give are set out below:

   (a) I am a graduate of the University of Auckland with the degrees of Bachelor of Science and Master of Science in Geology (Honours), specialising in Engineering Geology. I have completed post-graduate studies in Resource and Environmental Management and in Hydrogeology. I have some 30 years post-graduate experience in engineering geological and hydrogeological investigations and analysis.

   (b) I am a registered Professional Engineering Geologist (PEngGeol) and Fellow of Engineering New Zealand.

   (c) I am a past Chair and Life Member of the New Zealand Geotechnical Society, and past Vice-President representing Australasia on the Executive of the International Association for Engineering Geology and the Environment (IAEG). I am a Fellow of the Geological Society of London (FGS), a member of the International Association of Hydrogeologists (IAH) and a member of the editorial boards of three international journals in the fields of Engineering Geology and Hydrogeology.

(d) I have guided a wide range of projects that have required investigation and analysis of slope stability and the interaction of soils, structures and groundwater as part of engineering design in many parts of the North Island and in parts of the South Island of New Zealand, and have presented expert evidence on a range of projects including Waterview Tunnel, East West Link and McKays to Peka Peka Expressway.

EXPERT CODE OF CONDUCT

6. I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note 2014, and I agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are 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.

PURPOSE AND SCOPE OF EVIDENCE

7. The purpose and scope of my evidence is to respond to the outstanding geotechnical issue identified in the Section 42A report and raised in the opening submission of Mr Nolan at paragraph 5.2 b) (and discussed in paragraphs 5.8 to 5.22 of his submission) around the geotechnical risks associated with zoning the landform dam (Areas Q and R) for residential development.

8. Specifically, the issue is the potential for piping erosion and scour to occur, which could result in wash-out and loss of the landform dam.

RISK OF PIPING EROSION OF THE LANDFORM DAM

9. Piping erosion is the formation of voids within a soil caused by the removal (entrainment) of material (soil grains) by seepage and is a very common cause of earth dam failure.

10. The proposed linear lake will be dammed by a structure at the Southern end of the site (referred to as the Hutchinson Gully Dam in area X).

11. The narrower strip of land between the Waikato River and the linear lake (that would be created) would also be considered a "dam". This area has

been termed "the landform dam" (areas Q and R) because area R and part of area Q is natural ground.

12. The risk to the landform dam is due to the potential differential between the water level in the dammed linear lake (on the landward side) and that in the Waikato River (river side).

13. The risk, under a number of scenarios, is illustrated in **Appendix 1**.

14. Because the water level difference under normal operating conditions will be small (< 2 m, equivalent to a hydraulic gradient of < 2 %[1]), the risk of failure of the landform dam under normal operating conditions is considered to be small. I refer to this small risk as the residual risk in paragraphs 22 to 26 below.

Risk Due to Increased Hydraulic Gradient

15. The 100-year flood level on the Waikato River adopted by the project team is RL 15.9 m compared to a spill level on the proposed Hutchinson Gully dam of RL 14.5 m.

16. If the Waikato River were to flood, it would overtop the Hutchinson Gully dam and fill the linear lake to the same flooded Waikato River level.

17. When the flood recedes, the Hutchinson Gully dam may not allow the flood water to drop at the same rate as the River lowering (the lake is at least one kilometre long with a single exit at Area X).

18. This would increase the hydraulic gradient across the landform dam and could result in a risk to properties built on areas Q and R of loss by scour and piping erosion.

19. The risk from an increased hydraulic gradient could be largely mitigated if the outlet to the river was designed to have sufficient width capacity so that, as the river recedes the lake water level will drop at the same rate (or with a small lag difference of not more than say 500 mm).

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[1] The landform dam is assumed to be about 80 m wide. If it were narrower in part (as some of the illustrative figures submitted show), then the hydraulic gradient at that location would be steeper.

20. This would likely necessitate two outlets, one at the northern end of the lake (in the vicinity of (22) and (23) on Figure 7 of the Boffa drawing set) and the other over the Hutchinson Gully dam.

21. The outlet at the northern end would need to be at the same elevation as the Hutchinson Gully dam (i.e. RL 14.5 m) and to also be of sufficient width to avoid scour occurring. I recommend the plan provisions reflect this requirement for an additional outlet, and that the hydraulic gradient not exceed 2%.

Residual Risk

22. Scour and piping erosion could also result if water from the linear lake finds a preferential flow path towards the Waikato River, which might be via an existing higher permeability layer or via a combination of a man-made intervention and more permeable layers.

23. The likelihood of piping via an existing permeable layer on its own is very small because the lake will be created by excavation below existing groundwater level, and will therefore not alter the existing groundwater gradient, provided other conditions do not change.

24. Examples of a man-made intervention might be the permeable backfill of a stormwater drain or a basement excavation that might be installed at some time in the future. The types of activities that could indirectly cause or exacerbate this risk are set out in paragraph 28 of the Geotechnical JWS.

25. As part of informal caucusing the Applicant and HCC representatives (including myself) explored controls that might address this residual risk through planning and design measures, but it is apparent that these could be very challenging to manage.

26. This residual risk to the landform dam is considered to be small but of high potential consequence. I recommend that the plan provisions make it a requirement that steps be taken to minimise the potential for preferential flow paths towards the River to develop.

FURTHER COMMENTS

27. Area X contains the proposed Hutchinson Road dam. While I appreciate that Figure 7 or the Boffa drawing set is illustrative only, it is not apparent to me how development of a hotel at (10) on that figure might occur over the dam, bearing in mind that this is a key ingress and egress point for Waikato River floodwater.

28. As indicated at paragraph 12 of the Geotechnical JWS, it is important that the applicant's plans show the extents of the Waikato River and Gully Hazard area and the Waikato River Bank Stability area and that these District Plan requirements for development on this land are considered at Subdivision Consent and Resource Consent stage.

CONCLUSIONS

29. The risk to the landform dam from possible scour and piping erosion is due to the differential between the water level in the dammed linear lake (on the landward side) and that in the Waikato River (river side).

30. This risk is elevated if the floodwater in the lake is not able to recede at the same rate as the floodwater in the Waikato River, because the hydraulic gradient across the landform dam will be increased which could potentially result in scour and piping erosion somewhere along the landform dam, in turn potentially compromising its integrity.

31. The risk from an increased hydraulic gradient could be largely mitigated if the outlet to the river was designed so that, as the river recedes the lake water level will drop at the same rate. This is likely to require two appropriately sized spillway structures at RL14.5 m, one at the north and one the Hutchinson's Road dam. The goal is to ensure the hydraulic gradient does not exceed the 2% identified for normal operating conditions.

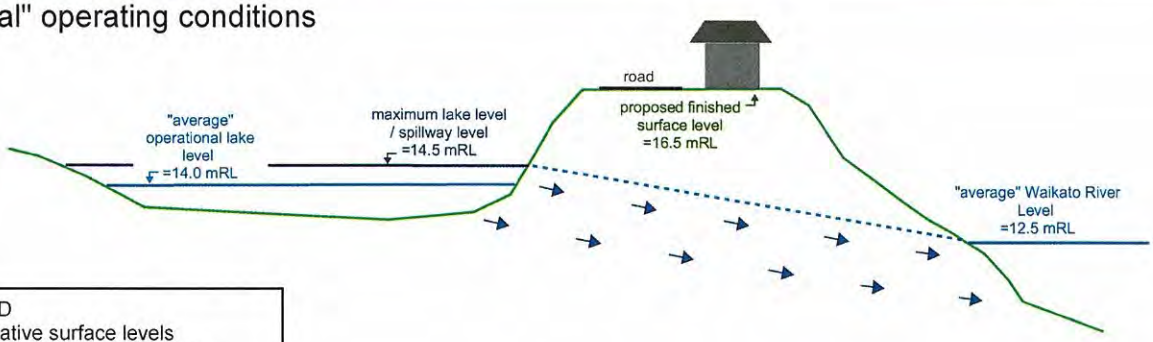
32. There remains a residual risk of piping failure of the landform dam via a preferential flow path towards the Waikato River, which might be via an existing higher permeability layer or develop via a combination of a man-made activities and more permeable layers. This residual risk is small, but steps should be taken at the consenting stage to minimise the possibility of this occurring.

Dated this 27th day of November 2019

Ann Louisa Williams

APPENDIX 1

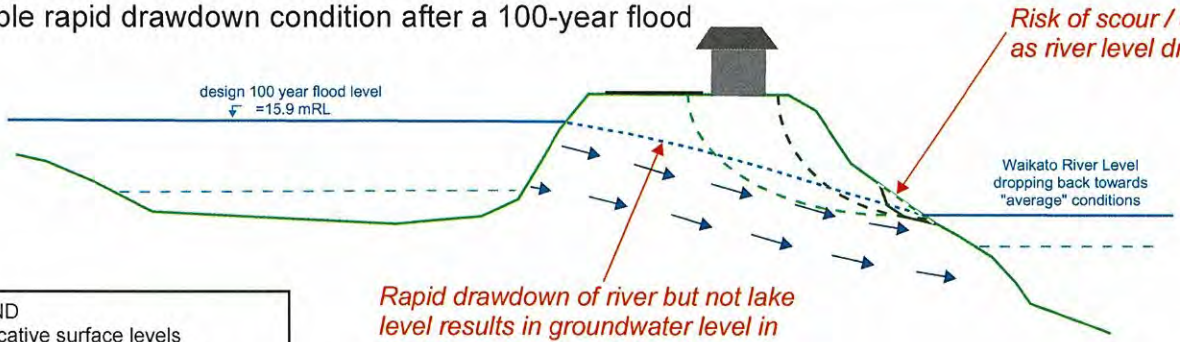
"Normal" operating conditions



LEGEND
- Indicative surface levels
- Design surface water levels
- Interpolated groundwater levels
- Scaled flow vectors

Not To Scale

Possible rapid drawdown condition after a 100-year flood

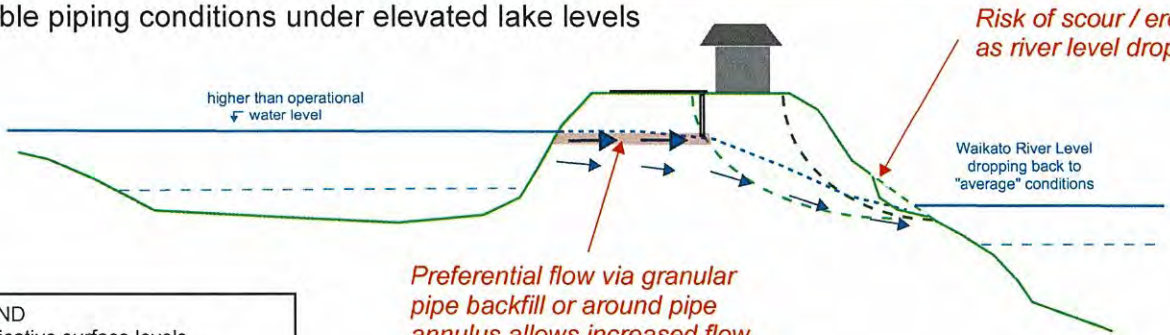


Rapid drawdown of river but not lake level results in groundwater level in land-form dam remaining elevated, increasing pore pressure on the slope and reducing slope stability

LEGEND
- Indicative surface levels
- Design surface water levels
- Interpolated groundwater levels
- Scaled flow vectors

Not To Scale

Possible piping conditions under elevated lake levels

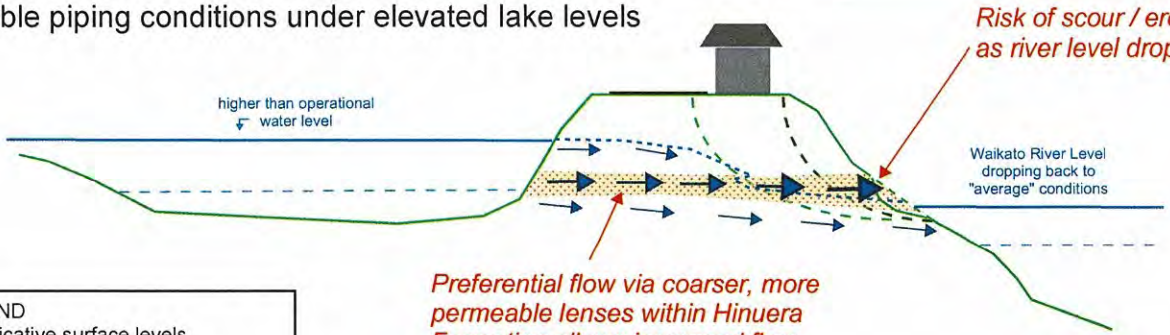


Preferential flow via granular pipe backfill or around pipe annulus allows increased flow velocities and steeper hydraulic gradients resulting in entrainment and piping

LEGEND
- Indicative surface levels
- Design surface water levels
- Interpolated groundwater levels
- Scaled flow vectors

Not To Scale

Possible piping conditions under elevated lake levels



Preferential flow via coarser, more permeable lenses within Hinuera Formation allows increased flow velocities resulting in entrainment and piping

LEGEND
- Indicative surface levels
- Design surface water levels
- Interpolated groundwater levels
- Scaled flow vectors

Not To Scale

Project Name: Te Awa Lakes Plan Change
Project Number: 3208222/300
Date: 20/11/2019
Originator: SYF / ALW

PDF ONLY
NO DWG FILE

Beca