

**BEFORE THE HEARING PANEL**

**IN THE MATTER**

of the Resource Management Act  
1991

**AND**

**IN THE MATTER**

of Plan Change 8 – Natural  
Hazards of the Rotorua District  
Plan

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**PRIMARY STATEMENT OF EVIDENCE OF ANNA KATE MCKAY  
BAY OF PLENTY REGIONAL COUNCIL TOI MOANA (SUBMITTER 45)  
ENGINEERING**

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## INTRODUCTION

1. My full name is Anna Kate McKay.
2. I am employed by Bay of Plenty Regional Council (**Regional Council**) as a Principal Advisor Environmental Engineering. I have held this role since August 2023.

## QUALIFICATIONS AND EXPERIENCE

3. I hold a Bachelor of Science Degree in Civil Engineering. I obtained this qualification from the University of Alaska Anchorage in 2016.
4. My degree is a Washington Accord accredited qualification equivalent to a New Zealand Bachelor of Engineering, Honours.
5. I have approximately 10 years' experience working as an engineer, including the following relevant practices:
  - i. Hydrologic and hydraulic analysis,
  - ii. Stormwater modelling and design,
  - iii. Flood risk assessment,
  - iv. Strategic asset and catchment management planning,
  - v. Project and design management of stormwater, river management, and coastal infrastructure projects,
  - vi. Engineering review of consent applications and compliance matters
  - vii. Flood hazard policy advice, and
  - viii. Emergency flood response
6. Specific responsibilities of my role at Regional Council related to Plan Change 8 (PC 8) matters include integrated catchment and emergency response planning for Rotorua streams in Regional Council's upper Kaituna Catchment Control Scheme, technical liaison for civil defence, reviewing both district and regional resource consent applications, providing internal advice on flood

hazard policy, and providing external advice to district councils, developers, and members of the public regarding flooding and stormwater matters.

7. I am the project manager for Regional Council's Ngongotahā Flood Mitigation project, am involved in flood risk mitigation planning for the Utuhina catchment, and have worked on numerous resource consents in the Rotorua Lakes District.

## **PLAN CHANGE INVOLVEMENT**

8. I have been involved with PC 8 since the scoping stage in December 2024. I have provided input for Regional Council's response to the options paper and submissions as well as attended numerous meetings between RLC and Regional Council throughout the plan change development, s 32 and s 42A report processes.
9. I have not been involved with the development of or engagement for Lake Ōkāreka flood level information but do wish to comment on the planning response as related to flood hazard management.

## **ASSUMPTIONS AND EVIDENCE CONSIDERED**

10. My expert opinion covers submission points of the Regional Council related to my subject area. For the purposes of my evidence, I have considered the following:
  - i. Planner's Section 32 and 42A Reports.
  - ii. Statement of Evidence Paula Meredith (Flood Hazard Information for Rule Implementation)
  - iii. Statement of Evidence Peter Cochrane (Flood Hazard - Lakes)
  - iv. Statement of Evidence Simon Aiken (Flood Hazard)
  - v. Statement of Evidence of John Brzeski (Geothermal and Land Stability Hazards)
  - vi. Discussions with Rotorua Lakes Council
  - vii. Rotorua Lakes Design Levels Technical Report (BOPRC, 2022)

- viii. Natural hazards evidence prepared by Mark Ivamy (Regional Council)
  - ix. Planning evidence prepared by Nicole Marshall (Regional Council)
  - x. Relevant submissions and further submissions
11. Where I have not expressly stated in this evidence the reasons why I disagree with other experts or submitters in relation to more minor matters, that should not be interpreted as agreement.

### **CODE OF CONDUCT**

12. I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023 and I agree to comply with it. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where I state I am relying on the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from my expressed opinion.

### **SCOPE OF EVIDENCE**

13. My evidence provides technical information supporting Regional Council's submission points regarding:
- i. Land stability effects of land use activities
  - ii. Setbacks from streams for natural hazards management
  - iii. Overland flow path management in rural zones, and
  - iv. Flood level implementation around Lake Ōkāreka
14. My evidence primarily relates to submission numbers:
- i. 45.16 – Land Stability
  - ii. 45.28 – Development adjacent to waterways
  - iii. 45.23 and 45.31 – Overland flow paths
  - iv. 45.22 – Development in flood prone areas

## **EXECUTIVE SUMMARY**

15. The key points of my evidence are:

- i. I provide this evidence as background information in support of Regional Council's overall position in the s 42A Report regarding matters within my area of expertise.
- ii. Land use activities have the potential to affect land stability. These effects may not be managed appropriately if proposed land stability policy and performance standards apply only to subdivision. Natural hazards provisions should apply to land use activities where they are not otherwise managed by the Building Act or earthworks performance standards.
- iii. Setbacks from streams serve a critical function in managing natural hazards and should be considered for all streams in the district. Development within a setback distance from streams increases the exposure to flood risk and hinders Council's ability to maintain a stream or construct flood defences.
- iv. Buildings and earthworks in Rural 2 areas have the potential to divert flow paths which can cause or increase flooding on land owned by others and cumulatively impact downstream flood risk. Land zoned Rural 2 should be subject to NH-R5 and the same earthworks performance standard as all other zones.
- v. The original intention of PC 8 as notified to extend NH-R4 to the Lakes A zone is a more robust approach to manage flood risk around Lake Ōkāreka than the bespoke approach introduced in the s 42A Report.

## **LAND STABILITY**

16. With respect to land stability hazard, PC 8 seeks to insert a land stability policy

(NH-P2) applicable to subdivision and to amend earthworks performance standards and exemptions.

17. Regional Council's submission sought for NH-P2 to extend to land use activities in addition to subdivision. The s42A evaluation of this submission stated the policy is not intended to apply to land use activities because there are no equivalent performance standards, and that land stability hazards for land use are assessed under the Building Act and earthworks standards.

18. Land use activities such as landscaping, earthworks, and ancillary structures have the potential to adversely affect land stability through the following mechanisms:

- i. Modified slope geometry from preparatory earthworks within proposed permitted thresholds,
- ii. Changes in hydrological regime and introduction of concentrated stormwater discharges directed into or onto ground near land stability hazard,
- iii. Increased surcharge on or near slopes,
- iv. Vibrational effects during construction, and
- v. Cumulative effects over time.

19. Earthworks for utilities and access tracks are exempt from earthworks standard EW-S1. Structures such as pools, plumbing and drainage structures, platforms, decks, bridges and many others do not require building consent under Schedule 1 of the Building Act 2004. This demonstrates that there are land use activities not covered by the Building Act or earthworks standards that have the potential to adversely impact land stability. These activities are more likely to be identified as part of a land use application.

20. Adverse land stability effects increase the risk of landslide and consequently potential for damage to life, property, and environment. Landslides can:

- i. Entrap people,

- ii. Mobilise, deform, or bury buildings, roads, and infrastructure,
  - iii. Undermine buildings, roads, and infrastructure, and
  - iv. Deposit material into streams and flow paths in the run-out zone, consequently obstructing or diverting flow.
21. It is common to receive standalone land use applications for land that has already been subdivided and does not need further subdivision. If there is a land stability risk present on the site, it is necessary to assess the activity's effects on land stability at the time of land use consent.
22. In my experience, it is also common for subdivision applications to defer site specific slope stability assessment until the time of development or building consent. This practice demonstrates that the land stability risks are not always well defined at subdivision consent stage, so the consent notices or conditions cannot reasonably be expected to anticipate or manage all future potential land use activities that affect land stability.
23. In my opinion, if land stability policy applies only to subdivision then there is a gap in the plan's recognition of the effects of land use activities on land stability. Extending land stability policy to explicitly include land use activities signals to applicants and planners the need to assess stability effects where these activities are included in a land use application and the proposal does not otherwise require building consent or subdivision consent.

## **SETBACKS**

24. PC 8 seeks to strengthen protection of river corridors by inserting an additional matter of discretion under NATC-R3 to consider natural hazards risk for new buildings within 25 metres of a waterbody identified for esplanade reserve acquisition.
25. Setbacks from waterbodies provide a critical natural hazards function by allowing additional space for flooding, uncertainty in flood levels, increases in flood magnitude expected with climate change, and lateral migration or vertical adjustment of the bed of a stream, river, or lake. Setbacks also provide a buffer for residual risk associated with overdesign events, breaches and blockage

scenarios.

26. Setbacks further benefit natural hazards management by reducing the population and number of structures exposed to residual flood risk, allowing space for the construction of flood defences, and providing access for stream maintenance activities such as vegetation management and blockage clearance.
27. As referenced in Paula Meredith's evidence point 29, the significance of flood hazard is classified based on depth and velocity. The greater the depth, velocity, or combination of both, the greater the risk is to structures and people. Flood depth and velocity are most often highest in and near the stream and consequently within the setback distance of a stream.
28. Development within a setback distance increases the exposure of people and structures to flooding. Flooding poses a risk of injury or fatality if a person is swept away or submerged. Flooding can damage structures and vehicles through hydrostatic pressure or hydrodynamic (shear) force, dislocation through uplift, scour and erosion of foundations, debris impact, material or foundation degradation through saturation (becoming waterlogged) and contamination.
29. The flood mechanics described above are applicable to all natural waterbodies. It is best practice in flood hazard management to avoid development within a setback distance from the bank of all rivers and streams, not only those identified for esplanade reserve acquisition.
30. This is of particular concern for existing urban areas that are expected to intensify near streams not identified for esplanade reserve acquisition such as around Otamatea Stream, unnamed streams through Lynmore and Ōwhata Waingaehe Stream (upstream of Te Ngae Road), and Waiōhewa Stream.
31. Two local examples of increased flood risk associated with buildings within 25 metres of the streambank are:
  - i. Design investigations for the Ngongotahā Flood Mitigation Project concluded there is insufficient space in the stream esplanade to construct stopbanks due to the proximity of buildings to the streambank. This has precluded Regional Council from extending the flood protection scheme.

Approximately 20 properties along Brookdale Drive are exposed to flooding in a 1% Annual Exceedance Probability (AEP) stream flood due to the inability to retroactively construct flood defences in this location.

- ii. Evacuation planning is currently under development for approximately 14 properties adjacent to Otamatea Stream along Sunset Road and Pandora Avenue. These properties all include buildings within 25 metres of the streambank. The ability to provide advanced evacuation warning to these residents is difficult due to limited gauges and upstream telemetry.
- iii. The number of properties identified in i. and ii. are based on current climate estimates.

32. This risk is expected to increase with the effects of climate change and urban intensification unless otherwise managed through the district plan

### **OVERLAND FLOW PATHS IN RURAL ZONES**

33. PC 8 introduces an earthworks performance standard to limit potential effects on overland flow paths. The performance standard requires permitted earthworks to maintain the entry and exit points, contributing catchment size and carrying capacity of an overland flow path on a site. This standard only applies to Residential zones, City Centre Zones, Commercial Zones, Industrial Zones, Business and Innovation Zones. The standard is not proposed to apply in rural zones and the s 42A report outlines concerns that the standard would be overly restrictive for rural land uses.

34. PC 8 also introduces a restricted discretionary activity under Rule NH-R5 for any building or structure that changes the entry or exit point, or capacity, of an overland flow path. This rule also does not apply to any rural zones.

35. I agree with the s 42A evaluation that the wording of the performance standard should preclude both a change in catchment size and reduction in carrying capacity since the standard is intended to capture earthworks that divert water from one overland flow path to another.

36. Overland flow paths through rural areas are often associated with larger contributing catchments because of the topography. In steeper hill country,

which is typical upstream of the rural zones, overland flow paths are confined and concentrated by the terrain. These flow paths can also have a higher velocity due to greater ground slope and volume of flow. As terrain begins to flatten out closer to Lake Rotorua, these overland flow paths become more susceptible to diversion because there are less topographical features to confine them.

37. The topographical relationship described above suggests that rural land use activities, and building platforms, have the potential to divert overland flow paths with larger catchments compared to urban areas due to the concentration of these features and the greater permitted earthworks volumes.
38. Diverting overland flow paths on flatter terrain can modify the entire downstream flow path from that point. This has potential to direct flow across land where water did not previously flow, to increase the quantity of flow in other existing flows paths, or on a cumulative catchment-wide scale these changes can increase peak flow and timing for downstream overland flow paths through developed areas.
39. Diversion of overland flow paths is of particular concern where larger catchments areas are permitted to be diverted, on flatter terrain where downstream trajectory can change more easily, and where developed land and infrastructure are located downstream that may flood as a result of upstream overland flow path diversion. Land zoned as Rural 2 in areas such as Ngongotahā, Hamurana, and Tikitere demonstrate all of these attributes.
40. PC 8 also seeks to introduce a definition of overland flow path to those with a contributing catchment of 4000 m<sup>2</sup> or more. I consider this addresses concern about over-restriction in rural zones by limiting the applicability of the performance standard to only flow paths that meet this definition. Rural earthworks would still be able to modify flow paths smaller than the definition if the performance standard is extended to the Rural 2 zone.
41. The proposed wording of the performance standard explicitly states the “entry or exit point on a site”. This inherently applies the performance standard only to flow path modifications that directly affect land potentially owned by others while still permitting earthworks within the site. This further addresses concern about over-restriction in rural zones.

42. I agree with the evidence of Paula Meredith that overland flow paths can be identified from readily available information. Overland flow paths in rural zones can easily be identified to support implementation of the earthworks performance standard and Rule NH-R5 in Rural 2 and Rural 3 zones.

### **FLOOD LEVEL IMPLEMENTATION AROUND LAKE ŌKĀREKA**

43. The original notified version of PC 8 proposed to extend NH-R4 (Buildings in areas susceptible to flooding) to the Lakes A zone, including the Lake Ōkāreka community. The s42A report introduces a bespoke overlay, policy, and rule framework for an area defined by 355.33m Moturiki Datum, based on the 2022 Rotorua Lakes Design Levels Technical Report.

44. I agree with Peter Cochrane's evidence regarding lake flood hazard, specifically the conclusions that the design lake level based on the 2022 report provides a reasonable basis to inform relevant planning rules set out in PC 8 (as notified) and that there are complexities and uncertainties in lake response to climate change and management regime.

45. I agree with the s 42A evaluations on various matters that support the retention of hazard mapping outside the District Plan. Removing static flood level information allows flexibility for new information to be implemented as it becomes available. I consider the reasons provided to support this matter are also relevant to flood level implementation around Lake Ōkāreka.

46. Regional Council is scheduled to undertake a review of design lake levels around 2030 (10 year review cycle). The design flood level for Lake Ōkāreka is expected to be updated after 2030 considering an extended gauge record, updated climate change predictions, outlet considerations, and potential change in methodology (i.e. water balance model versus statistical analysis of annual maxima).

47. Accounting for climate change is a continually evolving science; standard practice is frequently and substantially changing every few years as more information becomes available.

48. The sensitivity of lake levels to climate change methodology and manual lake outlet management reinforces the need for a dynamic flood level around Lake

Ōkāreka rather than a static level included in the district plan. The static level could become outdated when climate change predictions or lake level management protocol changes.

49. The bespoke rule framework introduced in the s42A report enables additions, alterations, and replacements for existing buildings as a permitted activity as long as the floor level is above 355.33 m Moturiki Datum and building importance level does not increase. This increases flood risk compared to original notified approach because:

- i. Floor levels will be based on 355.33 m Moturiki Datum even after the design lake level is updated. If design lake levels increase, then these activities will be set below known 1% AEP flood levels at the time of development.
- ii. New Zealand Vertical Datum is the standard datum for construction and setting minimum floor levels. The conversion factor from Moturiki Vertical Datum to New Zealand Vertical Datum varies spatially which could result in different minimum floor levels being applied within the High Lake Level Resilience Area.
- iii. The level does not allow for updates in response to advances in accounting for climate change.
- iv. The approach does not require flood risk assessment or consideration of residual risk for developments in the High Lake Level Resilience Area.
- v. It enables activities which increase the asset value and potentially the population exposed to flood risk (through means of additional bedrooms and floor area).
- vi. It perpetuates existing flood risks of established land uses, through enabling replacement buildings, where these would have otherwise been reduced under the original notified approach after the asset life cycle.

50. In my opinion, NH-R4 as originally notified under PC 8 provides a more robust framework to manage flood hazard around Lake Ōkāreka for the following reasons:

- i. The 1% AEP basis is consistent with the rest of the district plan as well as regional, national, and international best practice.
- ii. Activities subject to NH-R4 (as notified) will be implemented based on dynamic 1% AEP flood levels located outside the district plan and updated as new information becomes available.
- iii. It allows for consideration of site-specific flood risk assessment, residual risk, climate change effects, and reduction in natural hazard risk on existing land uses which is consistent with proposed SDNH-P1 and NH-O2

## CONCLUSION

51. In summary, the main points I wish to bring to the Panel's attention are that in my opinion:

- (i) Land use activities have potential to worsen stability hazard, and not all of these activities are assessed at the time of subdivision consent, under the Building Act, or against the earthworks performance standard. Land stability policy in the district plan should apply to both subdivision and land use.
- (ii) Setbacks from streams provide a critical function for natural hazards management and should apply to all streams in the district, not only those identified for esplanade acquisition.
- (iii) Overland flow paths in the Rural 2 zone should be subject to the same earthworks performance standards as all other zones because they have the potential to worsen flood risk on land owned by others.
- (iv) NH-R4 as originally notified provides a more robust framework to manage flood risk around Lake Ōkāreka. The bespoke approach introduced in the s42A report unnecessarily increases flood risk and plan inconsistency given the suitability of design lake level information.

Anna McKay

2 April 2026