



To	Panel Appointed for the Waikanae North Development	Date	29 September 2026
From	Jon Williamson	Project No	WWLA1956
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Subject	Waikanae North Development – Hydrogeological Review		

1. Overview of the Assessment

This review evaluates the hydrogeological conceptual model presented in O'Callaghan Design Ltd (OCDL) (2026)¹ alongside the off-site flooding considerations raised in the submission by Nicholas Brown on behalf of neighbours concerned with Hydrology, Stormwater Management, Flooding Impacts and Traffic Impacts.

Whilst several technical inconsistencies were identified and these have the potential to impact post-development groundwater behaviour, it is considered that with appropriate mitigations in the form of appropriate ground levels onsite and drainage controls downgradient, these are unlikely to affect the proposed operation of the development and the downgradient residents.

The technical inconsistencies identified include unverified assumptions regarding groundwater flow, calculation discrepancies in transmissivity, apparent contradictions regarding soil permeability, the omission of existing artificial drainage effects, and a lack of data regarding vertical groundwater gradients.

Given the complexity of the site and the scale of the proposed changes, the review concludes that a three-dimensional groundwater model is necessary for:

- 1) **Stormwater system design:** determine detailed design levels for stormwater infrastructure; and
- 2) **Alleviate downgradient groundwater pressure:** to accurately rationalise the groundwater flow and pressure on the downgradient wetlands, and if necessary, assist in defining maximum water levels to aid the design of surface water control devices.

2. Methodological Limitations and the Need for 3D Groundwater Modelling

The site features a complex hydrogeological setting, encompassing multiple wetlands, a network of modified drains, low-lying areas with variable peat deposits up to 2.6 m thick, and an underlying layer of highly permeable marine sand. The proposed development introduces numerous interacting modifications to this system, including:

- Raising the Ngarara Stream bed invert by 0.3 to 0.4 m.
- Removing 475,000 m³ of peat and replacing it with structural fill of differing permeability.
- Installing a downstream dual box culvert and weir structure to control surface flows.
- Raising ground levels with approximately 300,000 m³ of fill to mitigate flooding.

Given the interplay between surface water, shallow groundwater in the peat, and the deeper transmissive sands, simplified analytical calculations and one-dimensional ratios are insufficient to predict the cumulative effects. To properly rationalise how these combined physical changes will alter the groundwater flow regime, particularly regarding vertical gradients, changes in hydraulic

¹ OCDL, 2026. Appendix-17-Hydrological-Report_Redacted. Consultancy report prepared for Waikanae North Developments Limited, March 2026.

connections, and downstream transmission, a comprehensive three-dimensional (3D) numerical groundwater model is required.

3. Downstream Groundwater Flooding Risks (Paetawa Road)

The hydrological report outlines a proposed design strategy to raise the surface water level in the reconstructed Ngarara Stream by 0.3 to 0.4 m to maximise soil moisture for adjacent wetlands. The proposal also intends to release treated stormwater flows to the Te Harakeke Swamp to support restoration.

However, the report does not assess how elevating the local groundwater table may impact off-site properties to the northwest. According to the submission by Nicholas Brown, empirical evidence suggests a direct correlation between groundwater levels in the Te Harakeke Swamp/Ngarara Stream catchment and flood risk to properties on Paetawa Road, summarised as follows:

- During a documented event between December 2021 and August 2022, blocked culverts in the Ngarara Stream caused surface water levels in Te Harakeke Swamp to rise to 3.45 m NZVD 2016.
- This raised the groundwater gradient towards the sea, elevating groundwater levels in the Paetawa Road area by approximately 0.6 m above normal maximums.
- The resulting groundwater flooding affected an estimated 50 properties, blocked access roads, flooded septic tanks, and led to the loss of mature trees through prolonged waterlogging.

It was accepted by the hydrologists at JWS conferencing that water level control in Te Harakeke Swamp and maintenance of the downgradient drainage network would prevent groundwater related flooding in the properties further to the west. However, it is recommended that Te Harakeke Swamp water level monitoring is initiated, in addition to the 17 groundwater monitoring piezometers that are located exclusively on the development site. This would provide water level information to the various stakeholders that could be used to initiate maintenance or remedial works before water levels approach historical highs such as the 2021/2022 event.

4. Altered Vertical Transmission Pathways and Downstream Transfer

The proposal involves removing approximately 475,000 m³ of native peat and replacing it with compacted sand and silt. As noted in the submission, this removal reduces the natural water storage capacity of the area.

This reduction in storage capacity is notable when considered alongside the absence of vertical groundwater gradient analysis. By removing the peat layer and replacing it with more permeable sand based fill, the development may create a stronger hydraulic connection between the surface water systems and the underlying, more transmissive marine sands.

If the lower-permeability peat currently acts to retain water near the surface, replacing it could allow the elevated groundwater (influenced by the raised stream bed and directed stormwater) to drain more readily into the deeper sands. These deeper sands could then act as a transmission pathway, transferring the groundwater discharges further west and potentially increasing groundwater levels in the lower-lying Paetawa Road area. The current conceptual model does not incorporate this vertical transmission pathway.

5. Implicit Assumptions in Gradient Calculations (Darcy's Law)

In Section 5, the OCDL report attempts to calculate the change in horizontal groundwater gradient resulting from peat removal. The report calculates the new gradient by taking a ratio of pre-development and post-development transmissivities. According to standard hydrogeological principles (Darcy's Law), solving for a change in gradient based solely on a transmissivity ratio

would only have validity with an implicit assumption that the volumetric groundwater flow rate remains constant, which as alluded to above is unlikely to be the case.

The report does not detail or justify this steady-state assumption, which appears inconsistent with the dynamic inputs of directed stormwater and stream-bed raising proposed for the site.

6. Implications and Conclusions

The conceptual model presented in the Hydrological Report has several limitations when used to assess environmental effects. It relies on an extremely basic one-dimensional hydrogeological analysis, which also has mathematical discrepancies (e.g. the calculated transmissivity values), unverified physical assumptions (e.g. flat hydraulic gradient attributed to peat rather than the existing drainage network), and apparent contradictions regarding permeability (e.g. higher transmissivity in peat than sand). The analysis also omits vertical groundwater dynamics and the existing influence or role of artificial drainage.

Furthermore, the proposal aims to elevate local groundwater and stream levels without assessing the downstream consequences. As indicated by recent historical events, elevating water levels in this system poses a potential groundwater flooding risk to Paetawa Road properties.

By removing native peat storage and potentially creating a stronger vertical connection to more transmissive deeper sands, the development could route elevated groundwater into off-site residential areas. Due to the complexity of the site and the scale of the proposed works, a 3D groundwater model is necessary to provide a robust assessment of these potential off-site effects.

6.1 Agreement Reached in the Joint Witness Statements

To resolve residual uncertainty, agreements were reached during the Stormwater and Hydrology expert conferencing, as follows:

- **Commitment to Groundwater Modelling:**
 - The applicant agreed to develop a groundwater model to inform the detailed stormwater design and establish design seasonally high groundwater levels.
 - Whilst not specifically stated in the JWS, this should include the implication on vertical groundwater transfer and seasonal groundwater pressures downgradient in the Te Harakeke Swamp and residential landholdings further to the west.
 - The experts agreed this model will be calibrated to the pre-development situation and will be subject to a peer review by a Greater Wellington Regional Council (GWRC) subject matter expert.
- **Baseline Data Collection:**
 - The applicant confirmed they currently have two winters of groundwater recording data. The applicant expects to have three years of monitoring data available before commencing detailed design.
- **Design Constraints and Water Levels:**
 - It was agreed that all stormwater management devices must be situated above the highest groundwater level, which will in turn drive the minimum ground levels across the site.
- **Reporting and Certification Requirements:**
 - A dedicated Groundwater Monitoring Report (or a combined Hydrological Monitoring Report) must be produced and formally certified.
 - This report will be separate from the Ecological Restoration Management Plan (ERMP) but will directly inform both the ERMP and the final earthworks design.
- **Adaptive Management:**

- The design of the stormwater system will incorporate adaptive management measures, with the potential need to recalibrate the groundwater model over time to reflect site changes and actual groundwater behaviour.

Yours sincerely,



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