**Before the Independent Commissioners appointed by the Waimakariri District Council**

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| In the matter of | the Resource Management Act 1991 (**the Act**) |
| and | |
| In the matter of | Proposed Waimakariri District Plan: Ohoka Rezonings (Hearing Stream 12D) |
| and | |
| In the matter of | Further submission by the Oxford Ohoka Community Board [submitter 62] to the Rolleston Industrial Developments Limited [submitter 160] and Carter Group Property Ltd [submitter 237] submission to Rezone land at Ohoka |

**Supplementary Brief of evidence of Nick Keenan on behalf of Ohoka Community Board (as Further Submitter) – Stormwater Management.**

Dated: 18 October 2024

AJS-434615-182-104-V1-e

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**Evidence of Nick Keenan:**

**Introduction**

1. My full name is Nicholas John Keenan. I prepared expert evidence in respect of stormwater management for the Oxford Ohoka Community Board as a further submitter dated 13 June 2024, a summary brief of evidence dated 2 July 2024, and participated in the Hearing Stream 12D Stormwater Expert Witness Conferencing (producing a Transport Joint Witness Statement "JWS" 23 August 2024). My qualifications and experience as a stormwater engineer were set out in my evidence in chief.

2. In the time since the HS12D hearing I have had the opportunity to consult with residents of Ohoka including a meeting and site walk over in July 2024, further photos and anecdotal information reviewed in October 2024. A meeting of 12C/12D experts occurred 4 September 2024 to consider stormwater and groundwater cumulative effects.

**Comments on the Disagreements section, JWS 6 August 2024, Stream 12D**

*Groundwater resurgence within the site still carries some risk which has not been fully addressed by the proposal.*

3. These risks were mainly to below-ground infrastructure like pipes, chambers, road integrity, ingress to wastewater pipes, planting and surface damp areas. House floor levels should include a freeboard clearance from overland flow paths and ground levels. Development design will provide secondary flowpath clearances and buoyancy mitigations. The engineering is common.

*Groundwater resurgence can be unpredictable and is not well understood, both in terms of where the resurgence may occur, and at what flowrate. It is also hard to predict how changes to a site may change groundwater resurgence both within and around the site.*

4. Acknowledgement that groundwater movement is unseen and due to soil properties in the ground layers and historical flowpaths based on old river deposits and permeabilities in the ground. New subdivision earthworks levels may encourage surface expressions of groundwater to move to a new "outlet of least resistance" depending on surface levels and soil permeabilities – and this may be unpredictable given a

low understanding of subtle, below-ground, soil properties. Within a development, this will likely be captured by below-ground trenches and outlets to streams. Outside the subdivision area, groundwater surface expressions would be captured by existing infrastructure or existing surface levels which would be an effect.

*Because of this unpredictable nature, if systems are not designed to accommodate it, this can then lead to surface ponding.*

5. This is a statement that groundwater should be factored into further designs. As long as the existing main-stream channels that cross the site are maintained in terms of invert levels and locations then site-wide groundwater changes within and from development can be minimised. Local street/block drainage and trenching within a subdivision will then be able to fall to the main channels. This is similar to Christchurch as a whole.

6. Stormwater surface modelling does not normally have groundwater resurgence flows inputted – this would need some defined basis to determine locations and magnitude of flows. To lend credibility and acceptance to any results that include groundwater resurgent flows, some data from field investigations and Council agreement to the flows would be required. The most likely effects of resurgence inputs to a stormwater design would not be in terms of discharge but in terms of more ponding and storage volumes and higher associated water levels.

**Comments from Stream 12C/12D, 4 September 2024 – stormwater cumulative effects**

*Can groundwater resurgence be managed on-site in a manner that is not going to result in cumulative effects "downstream?*

7. Same comments as above.

*If it is identified that there would be adverse cumulative effects, what might the triggers be for upgrades or new infrastructure to be provided, how could these be reflected in district plan provisions for each rezoning request*

8. The concept of mitigating post-development discharge rates to 80% of pre-development discharge rates was considered as a means of developments including over-attenuation and extra storage volumes to demonstrate minimising stormwater effects within the footprint that

they control. This would provide some hedge against unforeseen effects or secondary effects such as groundwater contributions to stormwater discharge.

**Other comments:**

9. It became clear that another subdivision development that has groundwater and stormwater problems in Manderville is actually using a different stormwater management concept to Ohoka, that is, ground soakage for stormwater disposal. The Ohoka subdivision area is based on open channel drainage into existing streams including Ohoka Stream. Therefore care is needed whenever the two subdivisions are compared

Date: 18 October 2024

**Nick Keenan**