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memorandum

TO	Tim Carter	FROM	Tom Garden
	Carter Group Limited	DATE	18/11/2025
RE	104 Ryans Road Fast Track Application – Response to ECan Groundwater Comments		

1.0 Introduction

This memorandum is in response to the technical advice given by Environment Canterbury (ECan), in particular Marta Scott, regarding groundwater aspects of the Ryans Road Industrial Development Fast Track application. In particular, the ECan groundwater technical advice identifies areas of contention mostly regarding the potential highest groundwater levels at the site, and the implications of these highest groundwater levels on potential contamination of downgradient groundwater users, particularly domestic water supply bores.

Marta Scott recommended that a more detailed survey of land surface and groundwater levels be conducted to inform a map of highest groundwater levels across the site. In response PDP has conducted such a survey, as detailed in Section 2.0. Potential implications regarding potential for contamination of downgradient drinking water supply bores from soak pits are assessed in Section 3.0.

2.0 Groundwater Level Assessment

The comments from Marta Scott (ECan) indicate a concern that the highest possible groundwater levels at the site could be higher than estimated in the Pattle Delamore Partners (PDP) Assessment of Groundwater Effects, which may have implications regarding potential for contamination of downgradient drinking water supply bores from soak pits that are proposed to be used for infiltration of stormwater. As recommended by ECan, a more detailed assessment of groundwater levels has been undertaken.

There are three ECan groundwater level monitoring bores in the area near the site, and one geotechnical borehole (BH206406) that was drilled in September 2023 adjacent to the site, which recorded a groundwater level of 12.05 m bgl. The locations of these bores are shown on Figure 1, and their details are provided in Table 1. The three monitoring bores have records back to the 1980s, and the groundwater records are provided in terms of depth below ground level (bgl) in Figure 2 and reduced level (RL) in Figure 3. RL's have been estimated from LiDAR data. These groundwater records show that the highest recorded groundwater level in these bores generally occurred in July 2013, with other significant high groundwater level events occurring in September 2022, September 2008 and October 1992, among others. The record also shows that the groundwater level in M35/3614 was approximately 2 m shallower (i.e. closer to the ground surface) than in BH206406 when concurrent measurements were taken (10.27 versus 12.05 mbgl).

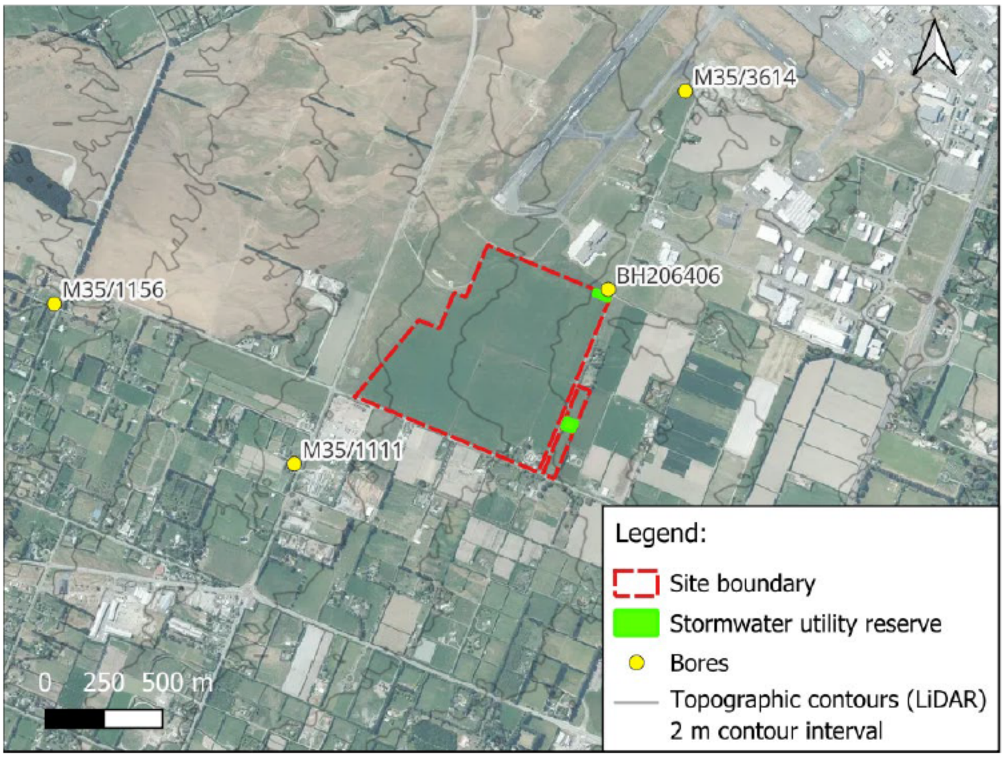

Figure 1: Locations of bores discussed in text.

Table 1: Bore details

Bore	Depth	Bore Purpose
M35/1156	22.9	Water level observation
M35/1111	21.6	Domestic supply and water level observation
M35/3614	12.93	Water level observation
BH206406	15.6	Geotechnical

The groundwater levels from the three ECan monitoring in July 2013 were contoured to create a piezometric contour map of peak groundwater levels. The contours were extrapolated across the site, assuming the same hydraulic gradient continued beneath the site. The resulting contours are shown in Figure 4. The piezometric contours were used to create a map of estimated depth to peak groundwater levels, by subtracting the piezometric surface elevation from the LiDAR digital elevation model (DEM). The depth to groundwater map is shown in Figure 5.

The depth to groundwater map shows that the estimated highest groundwater levels (based on the July 2013 event) range from approximately 9.2 to 12.9 mbgl, with a mean of 11.0 mbgl. The depth to groundwater at the proposed Northern Stormwater Management Area (SMA) is estimated at 10.18 mbgl, and 11.3 mbgl at the Southern SMA.

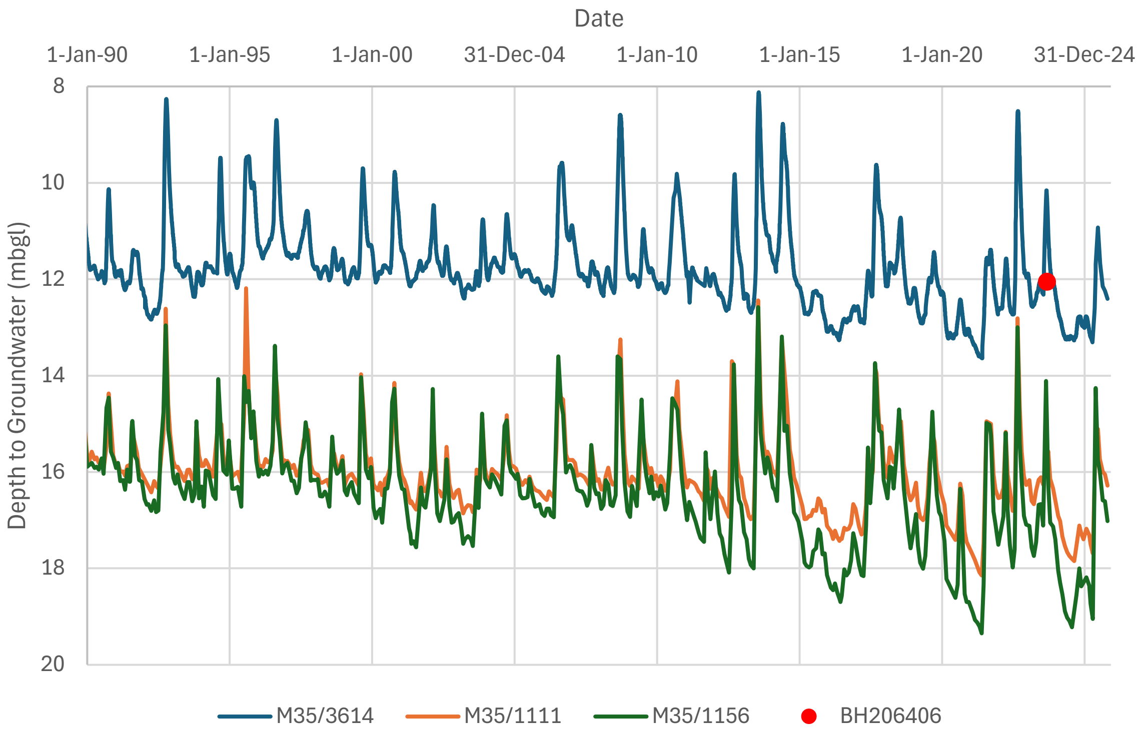

Figure 2: Depth to groundwater measured in nearby bores.

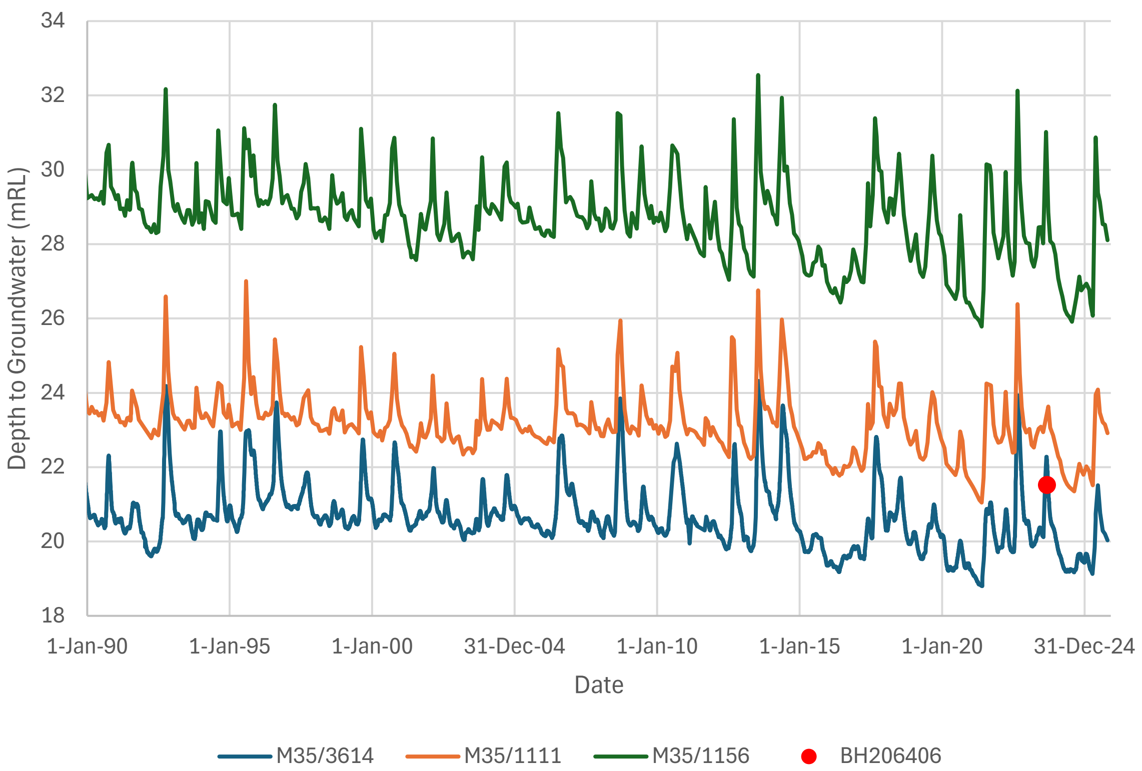

Figure 3: Groundwater levels (in terms of RL) in nearby bores.

Figure 4: Groundwater level measurements and associated piezometric contours (extrapolated across the site) from July 2013 high groundwater level event.

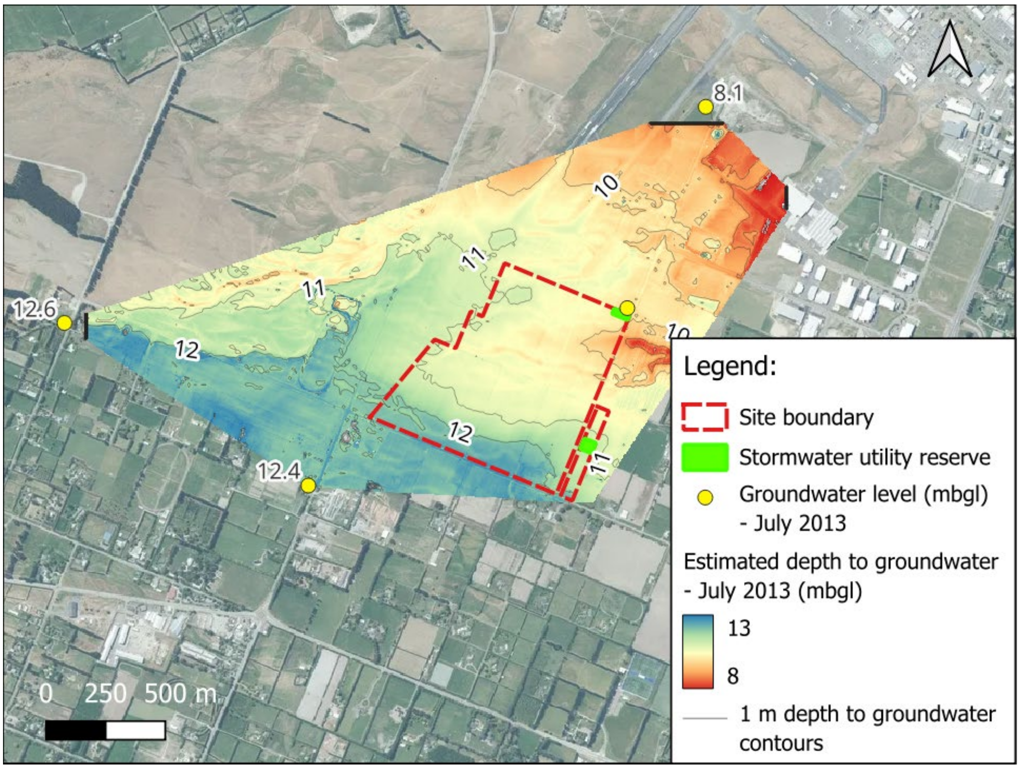

Figure 5: Estimated depth to groundwater across the site at the time of the July 2013 high groundwater level event.

3.0 Revised Mounding Assessment

The mounding assessment was updated to reflect the appropriate soak pit sizing at each SMA associated with the updated Bioscape biofiltration system. The mounding assessment has also been updated to reflect the updated separation distance from the SMAs to the centre of the overall site/individual lots. The northern SMA is approximately 400 m from the centre of the site while the southern SMA is approximately 300 m from the centre of the site. The previous assessment assumed that the location of maximum mounding from individual lots coincides with the maximum mounding from the soak pits, whereas this is not expected to occur in reality due to the locations of the SMAs at the edges of the site.

The estimated groundwater levels during the July 2013 event can be used in conjunction with the updated mounding estimates to provide a more detailed assessment of the unsaturated zone beneath the soak pits, as provided in Table 2. This assessment assumes that soakpits will be no deeper than 7 m depth which is consistent with the proposed consent conditions.

It should be noted that these estimates assume that a 2% AEP 24-hour rainfall event exactly coincides with the highest groundwater levels that have historically occurred. This is very unlikely in reality, and if there was to be a large rain event during a time of high groundwater levels there would be expected to be somewhat of a lag between when the rainfall occurs and when groundwater levels peak.

Shallow groundwater events such as the July 2013 event are also uncommon, for example the highest groundwater level in M35/3614 is 8.12 mbgl, however groundwater levels shallower than 9 m have only occurred six times in the previous 35 years. Only 1.3% of groundwater measurements were shallower than 9 mbgl and only 5% shallower than 10 mbgl.

The results show that under this conservative scenario, and using a highly conservative transmissivity value of 500 m^2/day, there could be less than 2 m unsaturated zone, with an unsaturated zone of close to 1 m in the worst-case scenario. However, a transmissivity of 1,200 or 3,500 m^2/day is considered more realistic, and in these scenarios a 2 m unsaturated zone is maintained beneath the soak pits. Therefore, while it is theoretically possible that there could be a less than 2 m unsaturated zone beneath the soak pits, it is considered extremely unlikely.

Table 2: Estimated depth of unsaturated zone beneath soak pits

SMA	Estimated shallowest GW level (mbgl)	Max depth of soak pit (mbgl)	Maximum mounding for 24-hour 2% AEP event (m)			Unsaturated zone beneath soak pit for 24-hour 2% AEP event (m)[1]		
			T = 500 m^2/day	T = 1,200 m^2/day	T = 3,500 m^2/day	T = 500 m^2/day	T = 1,200 m^2/day	T = 3,500 m^2/day
Northern SMA	10.18	7	2.37	1.34	0.77	0.81	1.84	2.41
Southern SMA	11.3	7	3.37	1.85	0.99	0.93	2.45	3.31

Notes:

1. *Calculated as estimated shallowest groundwater level minus maximum depth of soak pit, minus maximum mounding estimates.*

4.0 Assessment of Contamination Risk

The ECan review indicated that there is concern regarding potential contamination of downgradient drinking water supplies due to contamination from stormwater, with *E. coli* and Norovirus potential contaminants of concern modelled using the Microbial Risk Assessment (MRA) tool developed by ESR.

Based on the "Microbial Risk Assessment Tool for Discharges Near Drinking Water Wells – Documentation Report" (ESR & GNS Science, 2023)[1], the norovirus component of the MRA tool is unsuitable for assessing risks from stormwater discharge in new subdivisions with separated systems. This report states that "norovirus was chosen as the most suitable viral pathogen for the MRA tool with regards to the human-related land-use scenarios", "*E. coli* was included for all land-use scenarios as an indicator of faecal contamination and because of its use in regulatory standards" (Section 1.3, p. 12). The focus of the norovirus component is specifically for human related land use scenarios i.e. scenarios where human pathogens are likely to be discharged to the environment (e.g. onsite wastewater systems), and therefore is not considered suitable for consideration with respect to stormwater inputs.

The ESR report further notes that, for stormwater, "the tool assumes combined sources of sewage, septage, runoff and animal faeces" and that "the overall quality of stormwater in terms of microbial contaminants, particularly pathogens, is poorly understood" (p. 43). These assumptions are inconsistent with a newly constructed separated system where stormwater is isolated from sewage inputs; hence, the norovirus risk modelling does not represent likely contaminant sources or potential transport pathways affecting downgradient bores. The focus of the tool is, appropriately, on worst case public health risk. Therefore, the stormwater inputs are assumed, by the MRA tool creators, to be more typical of older stormwater systems with constructed overflows between the stormwater and wastewater system.

With respect to the *E. coli* component of the tool, the use of the tool for *E. coli* is somewhat more appropriate than for norovirus, but still very limited for new separated stormwater systems. The inputs to the tool have been selected to be consistent with "weak sewage" (Section 3.4.3). The *E. coli* component can therefore be considered to be useful as a conservative screening tool, but not well-calibrated for separated stormwater systems where human wastewater is excluded. Results should therefore be interpreted as extremely conservative and not as a realistic prediction of public health risk to downgradient bores.

The *E. coli* contamination risk was re- modelled using the MRA tool and the actual distance from the southern SMA and primary soak pit (which is closest to a domestic supply bore) and a revised vadose zone depth of 1 m (the tool allows only whole numbers for vadose zone depth), based on the results in Table 2. Based on the site layout shown in Figure 6, a downgradient distance of 90 m and a cross-gradient distance of 30 m was used to the nearest supply bore M35/9627. All other parameters were kept the same as the previous PDP assessment. The result indicates a probability of exceeding the maximum acceptable concentration of 0%.

If the vadose zone is decreased to zero, then the tool estimates a probability of exceeding the maximum acceptable concentration of 11%. Considering the highly conservative nature of the assessment, and the very low chance that maximum mounding during a 2% 50-year event would occur concurrently with highest historical groundwater levels, it is considered that this risk is acceptable, and in reality the risk of *E. coli* contamination to downgradient water supplies is considered negligible.

[1] https://www.envirolink.govt.nz/assets/Envirolink/2314-NLRC234-Microbial-Risk-Assessment-tool-for-discharges-near-drinking-water-wells-Documentation-Report.pdf

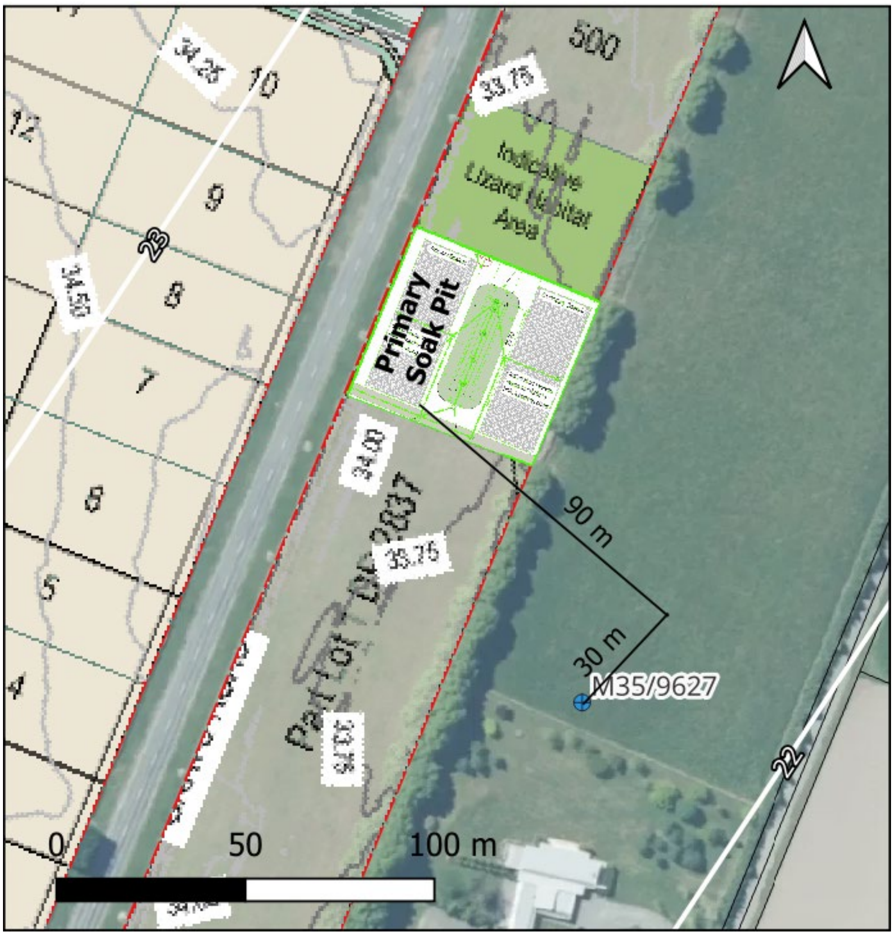

Figure 6: Layout of south-eastern side of site, showing location of southern SMA and soak pits and nearest domestic supply bore M35/9627.

5.0 Conclusion

A detailed assessment of historical and site-specific groundwater levels has been undertaken to address ECan's concerns regarding the potential for shallow groundwater beneath the proposed soak pits. Groundwater records from nearby monitoring bores and a recent geotechnical bore indicate that the highest groundwater levels historically occur infrequently, with depths at the site generally greater than 10 m bgl. Piezometric mapping and conservative mounding calculations for a 2% AEP (50-Year return period) 24-hour rainfall event indicate that, even under highly conservative assumptions and low transmissivity conditions, the unsaturated zone beneath the soak pits is expected to remain at or above 2 m in most scenarios. The likelihood of the maximum mounding coinciding with the highest historical groundwater levels is considered extremely low, confirming that the proposed soak pit design provides an adequate separation to the water table.

A review of the Microbial Risk Assessment Tool – Documentation Report indicates that that the norovirus component is not appropriate for separated stormwater systems, while the *E. coli* is more appropriate as a conservative screening measure. Re-modelling with a revised vadose zone depth of 1 m indicates a probability of exceeding the maximum acceptable *E. coli* concentration of 0%, which, or 11% with a vadose zone depth of 0 m which, given the highly conservative assumptions, represents a very low risk.

Overall, the results indicate that the proposed stormwater soak pit system is unlikely to pose a significant contamination risk to downgradient drinking water supply bores, and the design and placement of soak pits are considered appropriate and protective of groundwater quality.

6.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Rolleston Industrial Developments Ltd and others (not directly contracted by PDP for the work), including Environment Canterbury. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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Eoghan O'Neill

Technical Director – Water Infrastructure

Tom Garden

Tom is a geologist Senior Hydrogeologist Pattle Delamore Partners Ltd with experience in both hydrogeology and engineering geology in New Zealand and Australia. Tom has over seven years of experience as a consulting geologist in both geotechnical and hydrogeological context. He has extensive experience across a range of areas, from groundwater sampling to geological modelling to 3D contaminant transport modelling. He has conducted pump test analysis and environmental impacts assessment both in support of resource consent applications and as a technical reviewer for Hawkes Bay Regional Council, Environment Canterbury, and Horizons Regional Council. He also has significant numerical groundwater modelling experience using MODFLOW and FEFLOW, and 3D geological modelling experience using Leapfrog. He has written numerous technical reports, as well as academic research papers in international journals. His field experience includes drilling supervision, borehole logging, monitoring well installation and conducting pumping tests.

Eoghan O'Neill

Eoghan is a Technical Director with Pattle Delamore Partners Ltd and has been employed in that capacity since October 2012. He is a Chartered Professional Engineer with approximately 25 years' experience in the planning and design of wastewater, water supply and stormwater infrastructure. He holds Bachelor of Engineering and Master of Engineering Science degrees awarded by University College Dublin. Much of his experience is related to the planning of infrastructure to facilitate development in New Zealand. He has prepared and presented evidence to Plan Change Hearings, Resource Consent Hearings and the Environment Court on numerous occasions.