IN THE MATTER OF the Resource Management Act 1991

AND

IN THE MATTER OF Private Plan Change 95 Pencarrow Estate Pongakawa to the Western Bay of Plenty District Plan

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POST-HEARING REPLY EVIDENCE OF DANIEL HIGHT
(ENGINEERING, FLOODING AND NATURAL HAZARDS)
ON BEHALF OF KEVIN AND ANDREA MARSH

Introduction

1. My full name is Daniel James Hight. I confirm my qualifications and experience as set out in my statement of evidence dated 24 October 2024.

2. I also confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses, as contained in the Environment Court's Practice Note 2023. I confirm that this evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

3. This reply evidence addresses the contents of the following statements of evidence:

   (a) James Abraham's Summary Statement of Evidence;

   (b) Mr Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (dated 22/11/24);

(c) Lucy Holden's Supplementary Statement of Evidence on Behalf of Bay of Plenty Regional Council (dated 22/11/24).

4. The following subjects are discussed below:

(a) The suitability of the site for disposal of stormwater to ground soakage, and the validity of the associated design calculations previously provided.

(b) The design specifics of the wastewater disposal field.

Stormwater Soakage

5. In both Mr Abraham's[1] and Ms Holden's evidence[2], doubt is cast on the appropriateness of the assumed stormwater soakage rates at the site. In Lysaght's Servicing Report[3] an assumed design soakage rate of 100mm/hr was used to demonstrate that a soakage disposal device was appropriate for the private lots within the Plan Change area. That 100mm/hr design soakage rate was adapted from the nearby Penelope Place development and based on advice from CMW that the soakage rate is unlikely to vary considerably between that site and the subject site. Those initial calculations suggested that a 7m² tank would be sufficient to serve a 165m² hardstand catchment, which is to be expected on a 300m² small residential lot. That design soakage rate was challenged by both Mr Abrahams (WBOPDC) and Sue Southerwood (BOPRC) in their Summary Statements. After reviewing those statements, I prepared a new design using a design soakage rate of 7mm/hr, as suggested by Ms Southerwood. That calculation is attached in Appendix A. In my experience, a design soakage rate of 7mm/hr is extremely conservative for

[1] Mr Abraham's Summary Statement of Evidence: Topic 1, Paragraphs 4, 5 and Mr. Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (22/11/24): Paragraphs 9-13.
[2] Lucy Holden's Supplementary Statement of Evidence on Behalf of Bay of Plenty Regional Council (dated 22/11/24): Paragraph 1.
[3] Proposed Private Plan Change – Engineering Servicing Report, Revision 7 (22/08/24).

soils such as those at the site, and the 100mm/hr rate originally adopted is more likely to be appropriate. I have however prepared a calculation using a soakage rate of 7mm/hr to demonstrate that even in that case a soakage device remains feasible (and would occupy 24m²). Mr Abraham's calculations use a design soakage rate of 3.5mm/hr (having applied a 50% reduction factor for even more conservatism). I have repeated my calculation using that rate and attached it in Appendix B. As per that calculation, the same 24m² system remains capable of serving the site, as both soakage rates are so low as to be negligibly different.

6. In their latest statements of evidence, both Mr Abraham and Ms Southerwood continue to dispute my calculations, based on the perceived need for a stormwater soakage system to drain a design storm entirely within 24 hours[4] (as implied by Mr Abraham as being in accordance with the WBOPDC Development Code) or 48 hours[5] (as stated by Ms Southerwood as being in accordance with the BOPRC Stormwater Management Guidelines). I have reviewed the WBOPDC Development Code and have been unable to find where the 24-hour drainage time requirement is stated. Ms Southerwood makes direct reference to section 7.2.1 of the BOPRC Stormwater Management Guidelines, part of section 7.2 entitled 'Stream Channel Erosion'. That section discusses an Auckland scenario as follows:

"An example of this is that storms in Auckland during winter months occur approximately every two days. In that scenario, the retained volume must be drained within 48 hours to ensure that the storage volume is available for the next storm."

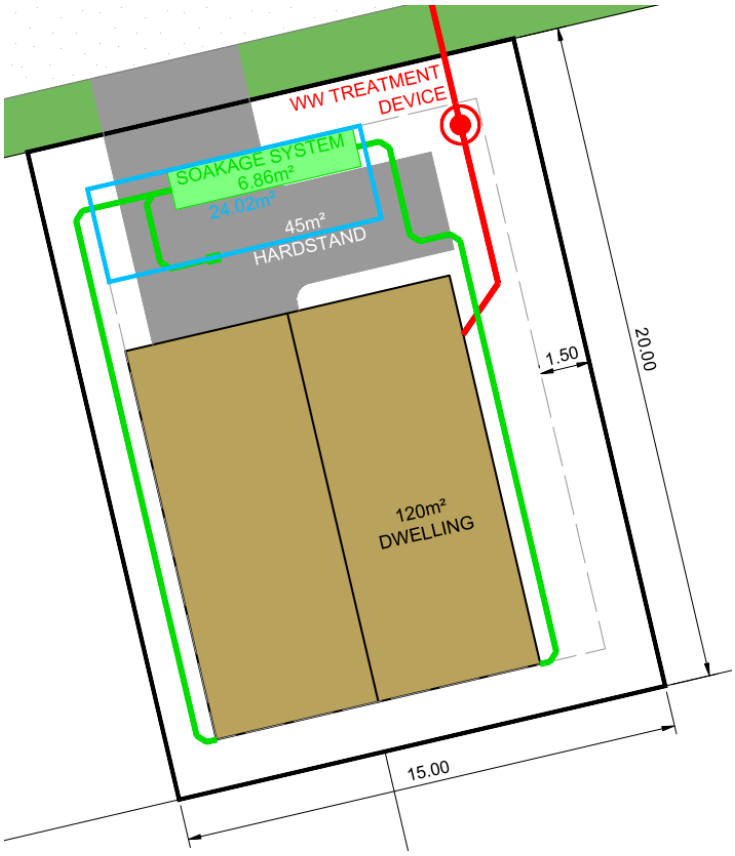
7. It's not clear to me that that statement (part of a chapter regarding stream channel erosion) conclusively requires a soakage system in the Bay of Plenty to drain within 48 hours. Later in chapter 7.2 of the BOPRC Stormwater

[4] Mr Abraham's Summary Statement of Evidence: Paragraph 4 and Mr Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (22/11/24): Paragraph 6.
[5] Ms Holden's Supplementary Statement of Evidence on Behalf of Bay of Plenty Regional Council: Paragraphs 1, 2.

Guidelines alternative criterion for preventing stream channel erosion are discussed, which centre generally around the need to provide extended detention (the slow release of water quality storms, or approximately 2-year storms) within stormwater retention devices. Notably, the pond design presented in section 5.4 of the Lysaght servicing report includes an extended detention outlet already, designed in accordance with the BOPRC Stormwater Guidelines.

8. Further, Ms Southerwood's statement of evidence states that a 10-year 48-hour storm must be drained entirely within 48 hours, which I believe to be an incorrect summation of the requirements of the BOPRC Stormwater Guidelines. Despite being unclear on how the rules/guidelines being quoted relate to this principle, I understand that the intention is to ensure that the soakage device could receive two design storms in quick succession, ie. a first design storm would drain entirely from the device within 24 or 48 hours, and the device would then be ready to receive another.

9. In my revised calculations (refer Appendices A and B) I have sized the device such that it can store entire two design storms (the 10-year 60-minute storm, as per the New Zealand Building Code, which these private systems would be designed and consented under), but not necessarily drain within 24 or 48 hours. Such a system can receive two design storms consecutively without surcharging, which I understand meets the intent of the design principle raised by Mr Abraham and Ms Southerwood. I consider this to be an appropriate approach when designing soakage systems in slow soakage soils (which it should be noted this site may not be, but the calculation very conservatively assumes a slow soakage rate). Using this approach, a soakage device with a 24m² footprint is required (much less than the large devices proposed by Mr Abraham and Ms Southerwood), which can be located within the site as per the blue polygon in the image below.



10. I would reiterate and confirm however that CMW geotechnical engineers have advised me that the types of soil at the PC95 site, based on their expertise, are expected to be similar to those of the land that was developed at Penelope Place. CMW geotechnical engineers were the consulting geotechnical engineers in respect of that subdivision. Against this knowledge, the rate of 100mm/hr has been derived (200mm/hr soakage achieved at Penelope Place, 50% factor of safety as per the WBOPDC Development Code). Therefore notwithstanding the preceding assessment offering a larger soakage system, the use of 3.5mm/hr or 7mm/hr soakage rates opined by Mr Abraham and Ms Southerwood is considered to be disproportionately and extremely conservative. Any soakage system designed for within the PC95 site should be designed in accordance with actual soakage test data gathered in subsequent design phases, which would in all likelihood allow a system much smaller than the theoretical systems discussed here. Those theoretical systems are presented only to demonstrate that even in extremely slow soakage soils a suitable system can be accommodated within the proposed lots.

11. Mr Abraham's evidence[6] and Ms Southerwood's evidence[7] expresses concerns with the groundwater levels beneath the site. I believe this has been adequately addressed in my previous statements. For ease of reference, Lysaght's servicing report states that the measured groundwater level is at approximately RL 2.6m, and that the likely ground levels within the developed lots will be above RL 6m. Therefore, there is considerable vertical space in which to locate a soakage system. The calculations attached use soakage crates founded only 1.36m beneath the ground (at RL 4.64m for a lot with a ground level at RL 6m), meaning that they will be approximately 2m above the groundwater level. I note test pits undertaken in summer and winter across two years at the site (it is acknowledged this was in the lower wastewater field area rather than the location of planned development at higher ground level) revealed little seasonal variation in groundwater levels. Approximately 2m clearance is viable from known groundwater levels to the base of proposed soakage systems. Collectively the risk of groundwater affecting the operation of these systems is considered to be suitably low.

12. In Mr Abraham's reply evidence, he suggests[8] that the responsibility for the maintenance of private soakage systems lies with WBOPDC, by referring to clause 3.3 of the WBOPDC Stormwater Bylaw 2020. I disagree with that statement. These systems will be privately owned and maintained, with WBOPDC having the right to require the owner to fix or upgrade the systems at the owner's cost. Soakage systems are a commonly and successfully used solution for stormwater disposal throughout WBOPDC. Consent notices similar to those discussed by Ms Holden in respect of riparian buffers could also be utilised to ensure awareness of future owners of maintenance obligations (and are commonly utilised by consenting authorities).

[6] Mr Abraham's Summary Statement of Evidence: Paragraph 6.
[7] Ms Southerwood's Statement of Evidence: Paragraph 15, spoken to in evidence presented at hearing on 14th November.
[8] Mr Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (22/11/24): Paragraph 7.

13. To conclude my opinion on the suitability of the site for soakage systems to be located within the private lots:

(a) I believe that the likely soakage rates of the site soils are much higher than the rates (7mm/hr) suggested by Ms Southerwood and adopted by Mr Abraham. Despite that, I have adopted the extremely slow and conservative suggested soakage rate of 7mm/hr in the appended calculations to demonstrate that a viable soakage device can still be installed.

(b) Both Mr Abraham and Ms Southerwood state that a soakage system must be able to soak an entire design storm within 24 or 48 hours. I disagree that the compliance documents quoted actually state that. However, in the appended calculations I have demonstrated that the same level of service can still be provided for (ie. a system can dispose of two consecutive design storms without surcharging) within a feasibly sized system.

(c) Both Mr Abraham and Ms Southerwood state that there remain risks as to groundwater depth in relation to the soakage systems. In my view, the Lysaght servicing report has adequately confirmed that that risk is suitably low.

Wastewater Disposal Field

14. The following issues have been raised in Mr Abraham's evidence, with regard to the wastewater disposal field:

(a) Overland Flow Path 3 is shown passing through the wastewater disposal field, and no clear solution has been presented for how to deal with that.[9]

[9] Mr Abraham's Summary Statement of Evidence: Paragraphs 10.1 and 11.1.

(b) The wastewater treatment plant isn't shown on the structure plan, and therefore the space occupied by it hasn't been factored into sizing the wastewater disposal field.[10]

(c) The details of the disposal method (ie. shallow dripper field, mounds, etc.) haven't been clearly set out by the applicant, nor has how the field is to be used once installed (ie. grassed, vegetated, grazed).[11]

(d) A buffer zone should be provided between the disposal field and the developable residential area.[12]

(e) 13% of the disposal field is shown as being floodable on WBOPDC's flood maps.[13]

(f) If lifting of the disposal area is to be undertaken to relieve it of flood hazard, the effect of that ground level lift on flood hazards elsewhere hasn't been considered.[14]

15. Mr Abraham states that the combined effect of each of those issues is that the wastewater disposal field shown in the structure plan may be undersized. I believe each of those issues can be addressed during detailed design, and that a suitably sized disposal field can be provided in the general location specified.

16. Specifically, the location of Overland Flow Path 3 and the wastewater treatment plant can be determined during detailed design, with limited impact on the total disposal field area. Similarly, the actual treatment technology and sizing would be determined during detailed design. The design area presented

[10] Mr Abraham's Summary Statement of Evidence: Paragraph 10.3.
[11] Mr Abraham's Summary Statement of Evidence: Paragraphs 10.5 and 11.3.
[12] Mr Abraham's Summary Statement of Evidence: Paragraph 10.4 and Mr Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (22/11/24): Paragraphs 17-18 and 24.
[13] Mr Abraham's Summary Statement of Evidence: Paragraphs 10.6 and 11.2 and Mr Abraham's Statement of Evidence in Response to Questions from Hearing Commissioners (22/11/24): Paragraph 20.
[14] Mr Abraham's Summary Statement of Evidence: Paragraph 11.3.

(as derived in Kirsten Brown's evidence) demonstrates that a feasible solution is available.

17. With regard to the need for a buffer zone between the disposal field and the residential lots, I note that a minimum setback of 1.5m from property boundaries is required under NZS 1547:2012 ("On-site Domestic Wastewater Management", Table R1). That table contains an accompanying note stating that that is subject to local regulatory rules. Specifically, that note states that the separation between the disposal field and an upslope boundary (which is the case here, the developable lot area will be elevated above the disposal field) can be reduced to 0.5m. BOPRC's On-site Effluent Treatment Regional Plan makes no specific reference to setbacks from property boundaries.

18. With regard to Mr Abraham's comment that 13% of the disposal field is within a predicted floodable area, I note that that floodable area is as predicted during a 100-year storm, and BOPRC's On-site Effluent Treatment Regional Plan states that the disposal field must be clear of the 20-year flood water. No modelling exists of flooding in the 20-year storm, but it is a safe assumption that the flood extent will be less than that modelled in the 100-year storm.

19. It is possible that lifting the ground level within the disposal field could be undertaken to remove the flood hazard from within it. Mr Abraham states that the effects of doing so on the wider flood plain haven't been considered. While not explicitly stated in the Lysaght servicing report or my previous evidence, I don't believe the effect of such a minor operation would be perceivable in the wider floodplain. As per the Lysaght servicing report, the flood plain is almost infinite in area (given that it is contiguous with the ocean), and therefore the effect of fill displacement within the flood plain is negligible and imperceptible.

20. Generally speaking, the disposal field is shown on the Structure Plan as a uniform rectangle, when in reality it will need to be designed to address multiple constraints, such as those set out by Mr Abraham, whilst also using

contemporary technology available at the time of proceeding with development. However, for the reasons set out above, it is my opinion that it is feasible to locate the field in the general location shown. This will be subject to detailed design and further BOPRC OSET, and WBOPDC subdivision consenting where this detail would be considered further (and in greater detail as is common to resource consents). I don't believe the need to refine the exact shape and specifics of the disposal field during detailed design should be unexpected, or prevent the approval of the Plan Change given the location indicated is expected to be feasible.

Daniel Hight
27 November 2024

Appendix A

DETAILED SOAKAGE SYSTEM DESIGN - CRATE SYSTEM - RAINSMART MODULAR TANK

Project No: 225216
Client: Momentum Planning & Design
Site: 1491 State Highway 2, Pongakawa
Date: 25/11/2024

System Details

Catchment Area	165	m^2	
Volumetric Runoff Coefficient	0.9		Impervious Area Runoff Factor
Soil K_h	7	mm/hr	As recommended by Ms Southerwood
Crate Width	0.4	m	
Crate Height	0.86	m	per Manufacturers specs
Crate Length	0.715	m	
No. Crates Wide	21		
No. Crates Long	4		
Width of Infiltration Area	8.4	m	
Length of Infiltration Area	2.86	m	
Depth of Storage	0.86	m	
Porosity/Void Ratio	0.95		Use 0.95 for crate system
Base Area Included In Calc	Yes		
Side Area Included In Calc	No		
Permeable Side Area	0%		Utilise this factor where part of trench side wall not permeable i.e. use 20% if only 20% of trench in permeable soil strata

System Calcs

Base Area	24.02	m^2
Side Area	0.00	m^2
Total Infiltration Area	24.02	m^2
Effective Storage Volume	19.63	m^3

Storm Duration	Storm Mean Intensity (10yr)	Volume in (m^3)	Volume Soaked (m^3)	Additional Storage Required (m^3)	Percentage of Storage provided (%)	Time to Drain (hrs)	Drains within 24hrs?	
10	150.10	3.7	0.0	3.7	532%	21.9		
20	99.00	4.9	0.1	4.8	405%	28.8		
30	91.90	6.8	0.1	6.7	291%	40.1		
60	66.80	9.9	0.2	9.8	201%	58.0	No	(200% storage provided, sufficient to drain two such design storms)
120	44.90	13.3	0.3	13.0	151%	77.3		
360	24.30	21.7	1.0	20.6	95%	122.7		
720	15.90	28.3	2.0	26.3	75%	156.5		
1440	10.40	37.1	4.0	33.0	59%	196.4		
2880	6.40	45.6	8.1	37.5	52%	223.3		

Appendix B

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No. Crates Long	4		
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Base Area Included In Calc	Yes		
Side Area Included In Calc	No		
Permeable Side Area	0%		Utilise this factor where part of trench side wall not permeable i.e. use 20% if only 20% of trench in permeable soil strata

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10	150.10	3.7	0.0	3.7	530%	44.0		
20	99.00	4.9	0.0	4.9	403%	57.9		
30	91.90	6.8	0.0	6.8	289%	80.7		
60	66.80	9.9	0.1	9.8	200%	117.0	No	(200% storage provided, sufficient to drain two such design storms)
120	44.90	13.3	0.2	13.2	149%	156.6		
360	24.30	21.7	0.5	21.1	93%	251.5		
720	15.90	28.3	1.0	27.3	72%	325.0		
1440	10.40	37.1	2.0	35.0	56%	416.8		
2880	6.40	45.6	4.0	41.6	47%	494.5		