Before an Independent Hearings Panel at Waimakariri District Council

under:	the Resource Management Act 1991
in the matter of:	Proposed Private Plan Change Request 31 (PPCR31) to the Waimakariri District Plan

Summary Statement – Colin James Roxburgh
Waimakariri District Council

On behalf of Waimakariri District Council

Summary Statement on Water, Wastewater and Stormwater Relating to Private Plan Change Request PPCR31 – 535 Mill Road, Ohoka Plan Change Application

Dated: 8 August 2023

File Note: DDS

INTRODUCTION

1. The purpose of this summary statement is to set out the key points from my evidence in chief in relation to the Applicant's Evidence on Private Plan Change PC31 – Mill Road, Ohoka, located south of the Ohoka township, as well as to respond to new evidence that has been presented since I prepared by evidence in chief.
2. My full name is Colin James Roxburgh and I am the Project Delivery Manager for the Waimakariri District Council. In this position I have responsibility for the Project Delivery Unit of the Council, which is an internal consultancy responsible for providing professional services relating to infrastructure delivery within the Council, which covers water supply, wastewater and stormwater. I have been in this role since May 2023, and prior to this I was the Council's Water Asset Manager from 2016. Prior to my role as Water Asset Manager I was a senior engineer within the Project Delivery Unit, with design and project management experience in the field of water supply, wastewater and stormwater projects, as well as experience with hydraulic modelling of stormwater infrastructure.
3. Since 2013, I have been recognised as a Chartered Professional Engineer based on the above experience.
4. My summary statement has predominantly been based on assessing the information presented in the Applicants Evidence to PC31 prepared by **Eoghan O'Neill** on Stormwater and Wastewater, **Tim McLeod** on Infrastructure, **Carl Cedric Steffens** on Water Supply, **Victor Mthamo** where his evidence is of relevance to stormwater and water supply, as well as the evidence presented by **Benjamin Smith Wilkins** of the Canterbury Regional Council and **Shane Bishop** of Stantec on 3 Waters Infrastructure.
5. I have heard the above experts (excluding Mr. Bishop) present their evidence before the hearings panel, and have read their summary statements.

EXECUTIVE SUMMARY

6. There are a number of points which I will cover off throughout my summary evidence with respect to water supply, wastewater and stormwater. To begin with, I wish to highlight the most significant points, which I will then go over in more detail:

   i. **Water supply:** As part of my evidence in chief I highlighted uncertainty with the availability of deep groundwater sources. This has now been responded to by the applicant with the suggestion that if there is not enough deep groundwater available, an alterative option would be to establish shallow groundwater sources on the site. The shallow groundwater on the site is high in nitrates, which would present an unacceptable risk to the community in my opinion. The Council has recently completed an approximately 20-year programme of works to move away from groundwater sources such as the old shallow source in Ohoka because of the heightened risk of contamination of the source water by activities on the surface, which can include both microbiological contamination, as well as chemical contamination, such as nitrates. Reverting back to shallow groundwater at this site would make it the worst raw water source on a public supply in the district.

ii. **Wastewater:** Servicing the site for wastewater is challenging due to the high groundwater table. The applicant has suggested this may be able to be overcome by constructing pressure sewer for the entire site, rather than gravity sewer. I would not support this, as this would represent a lower level of service to the community, and I note that this suggestion is not backed by all of life costings on the proposal. The applicant also appears to suggest some form of cost sharing which needs to be agreed with Council, however I note that the wastewater system that is proposed would benefit only the development area, and so there should be no contribution by the Council towards the wastewater infrastructure to service the development. It is important that the expectations for development and funding of this infrastructure are clearly understood now rather than leaving it to a later date.

iii. **Stormwater:** Stormwater is the most challenging of the three waters, due to the very high groundwater table. The applicant has acknowledged earlier concerns raised by ECan about the risk of excavating into the water table, and responded that if necessary stormwater basins would need to be constructed entirely above ground. The key issue with this is that large parts of the development area would not be able to drain into the basins, and unattenuated runoff would be allowed to flow downstream. I have not seen this proposal used before, and believe it would present an unacceptable risk to the downstream community. The key risk with this approach is that increased runoff from the downstream parts of the development that is not able to be held back by stormwater basins, which could lead to increased flood risk for the downstream community.

iv. **Interception of groundwater:** There is a large amount of uncertainty and inconsistency in the evidence of various experts with regard to the interception of groundwater. Despite the evidence of Mr. McLeod stating that groundwater would not be intercepted during construction, I am certain that this would be the case. I am uncertain as to how effective water stops suggested by the applicant as a form of mitigation (Mr. McLeod, paragraph 8) may be. Based on the evidence I have read and heard, it does not appear that any thought has been given by the Applicant to the potential need for a subsoil drainage system to keep the road subbase free of water, which may be an oversight in my opinion. A subsoil drainage system may be required where the water table is high to ensure that the roading subbase can be compacted, as if a flexible pavement becomes saturated it can cause slumping and failure.

7. In conclusion, I am of the view that this site is very challenging to service for all three waters. Where questions have been raised through earlier evidence with respect to these challenges, the proposed alternatives or explanations that have since been offered introduce more reasons for concern, rather than alleviating the earlier concerns. On this basis, I am not satisfied that it has been demonstrated that it is feasible to service this site for three waters. Further detail explaining how I have come to this conclusion is given below.

WATER SUPPLY

8. Under section 8 of the information provided by Mr. Steffens on 7 July 2023, it is noted that existing irrigation takes would mean that no new allocation is required. Under Rule 8.5.17 of the Canterbury Land and Water Regional Plan – Plan Change 7 Decision Documents, when transferring a water take from one use to another in an over-allocated zone, I understand only 50% of what has actually been used (not 100% of what has been allocated) can be transferred. It is not clear if the actual volume used has been assessed, or simply the volume allocated. Mr. Steffens also notes that regardless there is provision in the LWRP for new allocations in over allocated zones for public water supplies, however, the mechanism by which the allocation will be sourced should be understood.

9. In my evidence in chief, I highlighted the uncertainty associated with groundwater bore performance, and noted that this uncertainty was not explored in the original evidence provided by PDP. There is a statement made by Mr. Steffens (item 33) that "*if aquifer testing shows that one or more of the new bores had a lower long term sustainable yield, then additional bores would be required*". On the surface, this appears a reasonable approach, however there may be a limit to this approach. Figure 6 of the evidence supplied by Mr. Steffens shows 'virtual wells'. This appears to show wells at the site boundary, maximising the full site to achieve the assumed number of wells. It is therefore unclear whether the site could or couldn't accommodate a greater number of wells, if the long-term sustainable yield of the new bores is less than expected.

10. Within his evidence presented on 3 August 2023, Mr. Steffens had considered this matter further and reported that if sufficient deep sources could not be established, shallow sources within the site could be utilised. Mr Steffens was unclear on what further treatment may be required for a shallow source relative to deep groundwater. I can provide additional context with respect to this point.

11. The current Ohoka water supply used to be serviced by a shallow well similar to the irrigation wells within the development area. This well did not meet the previous Drinking Water Standards for New Zealand (DWSNZ), nor would it meet the revised Drinking Water Quality Assurance Rules (DWQAR). The option of treating this source to comply was not considered viable by the Council, and a deeper source was required.

12. While microbiological risks with shallow sources can be addressed through additional treatment barriers, what was not acknowledged by either Mr. Steffens or the subsequent evidence by Mr. O'Neill was the high nitrates within the shallow aquifer which are currently at greater than 50% of the maximum acceptable value (MAV) in the DWSNZ. Nitrates are very difficult and expensive to treat for, with this type of treatment system very rare as a result, and generally avoided at all costs.

13. As part of assessing the risk of increasing nitrate levels in groundwater sources, the Council obtained advice in 2018 about the costs to treat water sources for nitrate. By way of example, it was estimated that the Mandeville water supply would cost in the order of $1.5 - $2.0 million in capital costs, and $30 - $50,000 per year in operating costs. If treatment were needed, the cost for the Plan Change area would be greater than this due to higher flows that would require treatment, and inflation since the 2018 cost estimates were prepared.

14. The Council has embarked on a close to 20-year programme to convert water supplies with shallow sources to deep sources wherever possible, due to risks such as nitrate and heightened microbiological risks associated with shallow sources. Reverting the Ohoka supply to shallow

sources would represent a significant step backwards for the scheme and the Council, and would make the supply the highest risk in terms of nitrate levels within the district's public supplies. This in turn would put the Council and community at increased risk of needing to invest in nitrate treatment if either the nitrate levels increase further, or the drinking water standards with respect to nitrate reduce the MAV over the life of the supply. It is noted that further assessments are underway currently on the health impacts of nitrate, and potential links to colorectal cancer, so it is conceivable that what is considered to be the safe level for nitrate could reduce over the life of this supply.

15. The nitrate risk is in fact acknowledged by the applicant but in a different context within Mr. Mthamo's evidence. Mr Mthamo states in paragraph 17, e) "N leaching would also be higher at this site given the high groundwater levels", as well as in Paragraph 93 of Mr. Mthamo's evidence in chief that says nitrate in shallow groundwater is approximately 7.5 mg/L in Ohoka (66% of MAV), with Mr. Mthamo also noting that nitrate levels in shallow monitoring bores shows an increase over time. This appears to have been overlooked with respect to the water supply assessment and the proposal to use shallow groundwater, despite the presence of nitrate in shallow groundwater being understood and highlighted by other experts.

16. The evidence of Mr. Mthamo also places further doubt on the shallow water supply proposal, as he notes within paragraph 7.3 *"at least one of the consents is subject to minimum flow in the Ohoka stream".* While not assessed by the applicant with the context of the water supply, it appears as though this consenting restriction could also present a risk should one of these shallow sources be utilised for drinking water due to insufficient availability of deep groundwater.

17. The shallow source that was previously used for the supply also required treatment for pH correction, which is something that was considered unlikely by Mr O'Neill in response to questions about what type of treatment may be required for a shallow source over and above a deep source. I would consider it very likely that pH correction would be required based on experiences with the Council's shallow source, that is now a backup only.

18. Paragraph 4.3 of Mr. McLeod's evidence presented on 4 August 2023 talks about an *"improved water supply",* which is inconsistent with the evidence of Mr O'Neill discussed above noting that if sufficient supply is not found within deep sources, that shallow sources shall be utilised. As outlined above, reverting to a water supply utilising a shallow well, with increased nitrate levels at >50% of the MAV, as well as increased microbiological risk would certainly not be an improvement over the current supply.

19. The above points illustrate the risks with utilisation of the shallow sources, and demonstrates the lack of analysis that has sits behind the suggestion that the shallow sources could be used if there is insufficient deep groundwater. Again this illustrates the potential risk posed to Council if this development were to proceed based on the evidence provided.

20. Mr. O'Neill also suggested another possible alternative being an off-site supply. The example was given of Rangiora whose wells are located in Kaiapoi, and a trunk main is installed to bring the water from Kaiapoi to Rangiora. I do not consider that this option has been explored in adequate detail at this stage for me to come to a conclusion either way about its viability. There could be a high cost in terms of establishing a bore field at a separate site, and constructing a delivery main to then deliver the water to the development. The ongoing pumping costs, and depreciation of the new delivery main would need to be determined in order to establish the economic viability of this option.

21. As a result of the above, I maintain my original position that the level of uncertainty with respect to water supply is unacceptable.

WASTEWATER

22. As noted in my evidence in chief, in terms of wastewater there is a viable solution to service the proposed development area, through the construction of a new rising main and pumpstation to pump waste to the Rangiora Wastewater Treatment Plant (WWTP), while noting there are technical matters that will need to be worked through at design stage.

23. Mr. O'Neill has proposed in his evidence that the construction of the wastewater infrastructure could be staged, with the initial 250 lots connecting to the existing pressure main. The proposed new wastewater rising main would then need to be constructed prior to the connection of the remaining lots. I agree that this staged approach is viable, however I note the following:

    i. The rising main does not have 250 lots of spare capacity on a long-term basis, as there is land already zoned for development within the catchment that is earmarked to connect into the rising main to utilise the current spare capacity. However, this further development within the catchment will occur gradually over a period of time, meaning there is some spare capacity in the immediate term that will ultimately be utilised in the long term. Therefore, while the proposed plan change area could use this spare capacity in the short term (i.e. under our assessment there would be capacity for 219 lots in the Ohoka system in 10 years, reducing to 184 connections in 20 years), there is a risk that if the development area only ever developed to 250 lots, a new rising main would still need to be constructed to accommodate the flows from these 250 lots to free up the capacity in the current main over time. This could be achieved through a bonding arrangement requiring the developer to construct the rising main by a certain time, regardless of whether the development has progressed beyond 250 lots or not.

24. Mr. O'Neill also raises the topic of pressure sewer versus gravity sewer in his evidence. In paragraph 38 of his evidence, he concludes that pressure sewer is preferable to gravity sewer due to lower levels of inflow and infiltration, and therefore flow. One point that is not acknowledged is that even with a pressure sewer system, a significant amount of inflow and infiltration can occur within the gravity laterals upstream of the pressure sewer pumpstation, especially where there is high groundwater. Therefore, even with pressure sewer, inflow and infiltration would still be a challenge.

25. What is not covered within Mr. O'Neill's evidence is the relative level of service provided by pressure sewer versus gravity sewer, or the ongoing operation, maintenance and depreciation costs to property owners. The main contributing factor to these additional ongoing operation, maintenance and depreciation costs is the fact that a pressure sewer system for a development of this size would have hundreds of individual pumpstations to be operated and maintained, relative to a gravity sewer network which would have a much smaller number of individual pumpstation/s (likely one) servicing the entire development.

26. It is the Council's Policy that pressure sewer pumpstations are owned and maintained by the property owner, as well as the lateral up to the property boundary. The Council is then responsible for the pressure sewer reticulation network from the property boundary onwards. From a Council point of

view, it is accurate that a pressure sewer system is lower cost to gravity as the pipework is smaller in diameter and shallower, therefore lower cost when it is due for renewal. However, from a property owner's point of view, the level of service provided by pressure sewer relative to gravity is lower, for the following reasons:

i. The pumpstation itself must be accommodated within the residential section, and must be accessible for servicing vehicles etc. This can take away land that could be utilised on each section. On a large rural residential, or rural section, this is relatively negligible, however on a smaller residential zoned section this is more significant.

ii. The individual pumpstations have a greater value and shorter useful life than a gravity sewer lateral, meaning that property owners will have to replace their private pumpstation infrastructure sooner and at higher cost than they would if they were responsible only for a gravity sewer pipe.

iii. In addition to future replacement costs, there are also some ongoing maintenance and operation costs that must be borne by the property owner, which are greater than those associated with a gravity sewer lateral.

27. Given the above, there are pros and cons to both pressure sewer and gravity sewer, with pressure sewer having more on-site costs borne by the property owner, and gravity sewer having greater cost of infrastructure within the road reserve (borne by the Council, but passed on to the property owners via rates).

28. Generally there is a tipping point associated with density of housing, where higher densities (i.e. in residential zoned areas) result in gravity sewer being the preferred system, and lower densities result in pressure sewer being the preferred system. This is because at higher density, if pressure sewer were utilised, the number of pumpstations per unit of area is high increasing the costs, and this is not offset by the marginal savings in cost of gravity pipework relative to pressure pipework.

29. Conversely at lower density, the length of pipe between properties can make gravity sewer cost prohibitive on an all-of-life cost per property basis, and the additional costs of the pressure sewer pumpstations are offset and justified by the savings in gravity pipework, hence why pressure sewer is often preferred for rural-residential zoned developments.

30. It is for the above reasons that both the Council's Engineering Code of Practice, and Wastewater Policy require that gravity sewer is the default type of wastewater system provided, and only allow pressure sewer systems by exception, where it can be demonstrated that a pressure sewer system is preferential, and subject to specific approval from the Council being gained. At this stage, it does not appear that a sufficient case has been made for pressure sewer only over gravity sewer. The applicant has noted that the system could be serviced by either gravity or pressure sewer, and based on the information provided I consider that there has not been a sufficient case made for pressure sewer in the residential areas, and therefore consider that gravity wastewater should be preferred.

31. Within paragraph 12 of Mr. O'Neill's evidence, it is noted that the allocation of costs is to be agreed for wastewater. It should be noted that the wastewater system proposed is solely to service the development area, and therefore there should be no expectation of the wider community part funding / subsidising the costs of servicing the site. There would need to be development contributions paid by the developer for the capacity of the Easter Districts Sewer Scheme that would be consumed by the development as it discharges into the Rangiora WWTP, but all the new reticulation, pumpstation,

and pressure main are solely for the benefit of the development area, and would be required to be funded directly by the developer.

STORMWATER

32. There are a number of challenges with servicing this site for stormwater. To provide some structure, I have broken these down into the following sub-sections:

    i. Excavation of stormwater basin into the water table
    ii. Lack of attenuation for parts of the development
    iii. Basin concept design
    iv. Examples of proposed system
    v. Calculation of basin size
    vi. Rain gardens within water table
    vii. Interception of groundwater during construction
    viii. Evidence presented from July 2023 floods
    ix. Unknown future impacts

<u>Excavation of Basin into Water Table</u>

33. In terms of the provision of stormwater attenuation and treatment, it is accepted that the proposed site is very challenging to service for stormwater due to high groundwater levels, the large upstream rural catchment and relatively flat nature of the site. In the evidence of Mr. O'Neill it is summarised that stormwater attenuation in areas of high groundwater will be addressed through the use of bunding combined with the fall of the land to effectively create above ground storage basins.

34. I also note the concerns raised by Mr. Wilkins regarding the consenting pathway for stormwater infrastructure. Mr. Wilkins concludes the original proposed stormwater solution will likely intercept groundwater, which would then likely reduce the water table, which would then be considered a take and use of groundwater in an over-allocated groundwater allocation zone, which is a prohibited activity with no consent pathway.

35. Within Paragraph 10 of the 3 August 2023 evidence presented by Mr O'Neill, he did acknowledge that even excavation to construct the basins to 0.2m bgl may intercept the water table and that 0.2m was the maximum depth to excavation, rather than target depth of excavation for the basins. He went on to conclude that if required, there would be no excavation whatsoever with the basins potentially constructed above ground with bunding. I note that if the basins were constructed entirely above ground, the water volume stored per m^2 of area would reduce (as the volume that was to be stored below ground would be lost), and as such the land area required to be utilised for stormwater treatment would increase further. It is not clear if this is reflected in the earlier evidence of Mr. O'Neill in calculating the basin areas.

36. While the acknowledgement that excavation even down to 200mm could intersect groundwater has fed into an adapted concept for the stormwater basins, this does not seem to have been considered for the swales. Typically, swales would have a depth of at least 200mm, therefore the swales too

may present a risk of intersecting the groundwater table, thereby providing a consenting barrier. With such a high groundwater table, this is an area that also needs to be worked through.

37. Also of relevance with the swales is that if they intercept the water table, this can generate a maintenance issue as a saturated swale is not mowable, as it can become boggy.

<u>Lack of Attenuation for Downstream Sections of Development</u>

38. There is a more inherent challenge with the approach of constructing above ground basins (in order to avoid the water table) rather than the more conventional approach of construction basins below ground. With the runoff being first treated by below ground rain gardens, then attenuated in above ground basins, some areas of the development would not be able to drain into a basin and therefore would not be attenuated, requiring that some of the runoff be discharged directly into the receiving environment.

39. This is a problem that comes from the unconventional approach to get water to constructed storage basins entirely above ground, while still expecting water to flow by gravity from below ground infrastructure into the basins.

40. This was already a challenge when basins were to be constructed only 200mm below existing ground level, and is more of a challenge if they are to be constructed entirely above ground, and as such even greater areas of the development would have to discharge directly into the receiving environment without attenuation. As noted in the recent July 2023 flood events, the Ohoka area is already susceptible to flooding, and anything that presents a risk of making this worse should be avoided.

41. I have provided Attachment 1 to help illustrate what I have calculated to be the area of the development that will not be able to be attenuated, based on information provided by the applicant. This shows that an area extending approximately 280m upstream of Whites Road would not be able to be both treated by rain gardens and attenuated, and therefore would have to discharge directly into the downstream system. The risk with not attenuating the increased runoff caused by the development is that this could increase flows to the downstream system, and therefore could increase flooding.

42. In paragraph 31 of Mr. O'Neill's evidence it is acknowledged that runoff from some parts of the development will not be able to be attenuated, with it suggested that hydraulic neutrality can be maintained through providing additional compensatory storage elsewhere. The proposal to provide compensatory storage and not to attenuate some areas, is not a typical approach, which introduces risk. This will require careful consideration to ensure that localised flooding issues, immediately downstream of the unattenuated areas, are not created or exacerbated. Based on the indicative ODP layout and existing topography, it is expected that there will be unattenuated areas along Mill Road as well as Whites Road. The applicant has not demonstrated that this approach will not result in any offsite flooding effects in the 50 year event. It is noted that the PDP Stormwater Management report had referred to compensatory storage being used for flows exceeding the 50 year event, which is different to the purpose of the compensatory storage set out in Mr. O'Neill's evidence, which is attenuation of flows in up to a 50 year event. I believe that the PDP Stormwater Management report is incorrect, as there are areas of the development unable to be attenuated for any duration event, not just events exceeding the 50-year event. I consider Mr. O'Neill's evidence is more accurate,

acknowledging that there will be unattenuated flow for more frequent events (less than 50 year) as well.

43. In Mr. O'Neill's evidence, he refers to Attachment 2 for the detention pond locations, which was later corrected to be Attachment 3 of his updated evidence. It is noted that some of the basins do not appear to be positioned to minimise the amount of compensatory storage required, which could mean that there is an even greater proportion of the site where attenuation is not provided than I had calculated in Attachment 1. This is a concern because the more unattenuated flow from the development, the greater the risk of downstream impacts

Basin Concept Design

44. Attachment 1 of Mr O'Neill's 3 August 2023 evidence shows proposed detention basin designs. While I acknowledge these are indicative only, there are some points to note:

   i. This is a highly unconventional basin design, requiring elongated shapes to make the most of the fall to achieve storage volume given they are entirely above ground. This shape is inefficient in terms of the volume of storage created per m^2 of land consumed. This is because there would be relatively large areas required for bunding compared to more conventional basin designs within sites suited for below ground basins. This may impact on the amount of the site able to be utilised for housing, and the overall yield of the development.
   ii. The illustrations do not accurately represent the full area that would be required as the batter slopes as shown are not mowable / maintainable. To achieve adequate batters, the bunding would need to be significantly wider than shown, consuming more land for stormwater attenuation.

Examples of Proposed System

45. As part of questioning when presenting his evidence, Mr O'Neill was asked to provide examples of the type of stormwater system proposed being used elsewhere. Some photos were presented of rain gardens within Christchurch. It is well accepted that rain gardens for treatment and basins to achieve stormwater attenuation can achieve the required outcomes in certain circumstances. What these examples did not address was whether they have ever been used in these specific circumstances; specifically with an exceptionally high water table, leading to completely above ground storage basins, and with rain gardens constructed within the water table but being entirely water tight. Some examples of these systems in the same circumstances, not just in general, would have been far more reassuring that the significant challenges presented by this site can be overcome by what is proposed. I am not aware of these types of systems being used in these circumstances, and question whether they are feasible.

Calculation of Basin Area

46. Putting aside the above concerns regarding groundwater data and unattenuated runoff from the development potentially creating a downstream flooding risk, the basin area set aside for stormwater attenuation also appears to be incorrect in the evidence of Mr. O'Neil. The PDP Stormwater Management Report, within the Stormwater Treatment section (Table 6) states that 55,950m^3 of

attenuation volume is required, while Mr. O'Neil states a volume of 21,990m^3. Using the 55,950m^3 figure, and assuming an average water depth of 0.5m and a 5-10m buffer around the basin for the bunding and maintenance access, a total area of approximately 150,000m^2 would be required for stormwater attenuation. This is about three times larger than the figure stated by Mr. O'Neil and equates to approximately 10% of the overall development site. It is noted that this area is in addition to any land to be set aside for the conveyance of the 50-year flood flow from the upstream rural catchment through the site, which based on the post-development flooding modelling information would be in the order of another 150,000m^2.

47. Therefore, the total area required for stormwater management at this site, is approximately 20% of the overall development site. This figure is higher than what is required for other developments, due to the high groundwater levels, the large upstream rural catchment and relatively flat nature of the site. The Outline Development Plan presented in the Application does not adequately represent the extent of area required for stormwater management at this site.

48. In terms of the 55,950m^3 attenuation volume figure, this is stated in the PDP Stormwater Management report to be related to the 12-hour duration event. However, there has been no information submitted that demonstrates the critical duration for storage is not longer than 12 hours. The conventional approach when determining the critical duration for an event is to assess various durations and determine which is the peak. In this case, only the 6-hour and 12-hour event have been assessed, therefore it is not clear if an 18-hour duration event, for example, may have given a greater volume than the 12-hour duration event that has been assumed to be critical by the applicant. While PDP have indicated that the critical duration of 6 – 12 hours has been based on the DHI Kaiapoi Flood Modelling report, it would be more robust to verify this by also calculating the volume that would result from a longer duration event, which would then either verify that the 12-hour event is critical, or indicate that a longer duration event is in fact critical in terms of the volume of attenuation required. The effect of this is that I do not believe it has been demonstrated that the full design volume of the basins is adequate, and if the basins have been undersized, the result would be that the basins would be over-whelmed and there would be an increase in the level of flooding downstream.

49. This is particularly important given the large upstream rural catchment, hence the potential for the outflow to be restricted by backwater effects, and the proposal to provide compensatory storage to over attenuate some catchments. It is however noted that issues with the backwater effects would be offset to an extent by the proposal to bund the attenuation areas above ground level and also locate the basins outside of the 50-year flow path from the upstream catchment.

<u>Rain Gardens within Water Table</u>

50. In terms of the treatment solution proposed, it is noted that it is unconventional to have roadside rain gardens and infiltration pits constructed within the water table. The treatment objectives would not be achieved if groundwater enters the rain garden chambers, and it is therefore critical that these chambers remain watertight. This appears to have been acknowledged by the applicant as it is proposed in the evidence of Mr. O'Neill that these chambers be lined, presumably to overcome this issue. This proposal does introduce a layer of complexity, as it is technically challenging to construct below ground chambers within the water table that will remain watertight, not just at the time of commissioning but throughout their design life. Council does not currently have assets like this in its

stormwater network, and is not aware of any being installed like this elsewhere. It is considered that there is a high level of risk that these types of assets would fail and that groundwater would start to seep in over time. This is another reason I have concerns about the suitability of the proposed stormwater treatment options at this site.

51. It is important to note not only would the sealed chambers need to be entirely watertight, but so too would the downstream gravity pipework that takes stormwater from the chambers to the basins. It is acknowledged with respect to wastewater by Mr. O'Neill that gravity systems can be susceptible to infiltration when constructed within the water table, and the same goes for the gravity stormwater system, where it is critical that groundwater does not enter the downstream pipe network and flow back into the below ground chambers. In my experience, I have not seen a raingarden and its associated downstream pipework constructed within the water table that was successfully built to a watertight standard for its entire design life. While I cannot conclude that this is impossible, in my view it is very uncertain and introduces an unacceptable level of risk to the successful performance of the system.

<u>Interception of Groundwater During Construction</u>

52. In paragraph 8 of the evidence presented by Mr McLeod, he talks about avoiding the interception of groundwater during construction activities, and reinforced that any groundwater interception will be avoided when asked about this by commissioners. With stated excavations of up to 1.2m deep (which would be greater still for gravity wastewater reticulation) this statement is entirely inconsistent with the groundwater data provided by other experts, where the water table has been shown to be within 0.14m of the surface, not to mention the springs where the water table intersects the surface already. The evidence of Mr McLeod that the water table will be avoided during construction appears impossible based on other evidence provided by the applicant and my knowledge of the area and experience.

53. The excavation depth in the range of 0.6m to 1.2m during construction is also of relevance to the roading design. Mr. McLeod noted that the excavation depth for pavement would be in the order of 0.6m, noting that this would not intercept the water table. As set out above, and as referenced by numerous other experts, there is clear evidence there is groundwater within 0.6m of the ground level. It is common for roading designs where there is a high groundwater table to include drainage of the roading sub-base, however there is no mention of consideration of such a drainage system for this site. If the roading sub-base contains excessive water (i.e. caused by a high water table without adequate drainage), the road can be at risk of slumping or a reduced life.

<u>Evidence Presented from July 2023 Flood Events</u>

54. Attachment 1, Photo 1 from Mr McLeod's Summary of evidence shows a roadside swale on Wilson Drive that is not performing as intended and led to flooding of the road. This roadside swale is an example of the type of stormwater conveyance system that is proposed by the applicant. My understanding was that it was presented as an example of a substandard system. However, I have not heard any evidence from the applicant about this proposal will improve the system.

55. Wilson Drive (where the photo is taken) is in fact a typical, but all too common, example of a development put forward by a developer and consultants that ultimately does not perform as intended. In the case of Wilson Drive, there have been numerous flooding issues experienced in this development, leading to levels of service not being met, and now it is the existing community that is required to fund improvements via their rates to address the inadequate original design. Investigations are currently underway to address the deficiencies with the original system design from the original development. There are many other examples throughout the district I can provide of developments that have not performed as expected, where the Council has had to subsequently come in and address the issues that are causing problem for landowners and Council assets.

56. To supplement the photo already provided by Mr. McLeod, I have attached other photos from the recent rain event as well as a different event from 2022 (refer Attachment 2). These photos highlight the challenges with providing a workable stormwater system in areas with high groundwater and high tailwater levels in the receiving environment.

57. In my opinion, ther is a particularly high risk of design issues where there is a high groundwater table, such as the Plan Change 31 site, and caution should be used with respect to the issues raised with respect to the high water table, as if not adequately considered and addressed, the Council will be at risk of being left to operate and remediate a substandard system.

58. Specifically, within the Mandeville area, there are numerous other examples of the risks and issues the Council has inherited from developments where the high groundwater levels within the area have not been adequately considered or addressed. This includes large parts of the area that are subject to flooding and groundwater issues. The types of issues experienced are springs appearing in the road carriageway for extended periods of time, significant flood flow paths through sites appearing via what have been designed as soak-pits which then act in reverse as groundwater levels rise above what had previously been expected, and pumped sewer systems becoming inundated and overwhelmed with inflow and infiltration into the pump chambers in private property during times of high groundwater.

<u>Unknown Future Impacts</u>

59. Within the wider evidence that has been presented over recent days, there has been several instances of ongoing monitoring being required to determine long term maintenance requirements. In general, I see the reliance on monitoring as an indication of impacts of the development not yet being fully understood, which introduces uncertainty as to what the future burden to the Council may be.

60. An example of this is within paragraph 35 of the evidence of Mr. Veendrick, where the new ODP text (shown in red) notes the requirement for an Ecological Management Plan including ongoing maintenance and monitoring requirements that are to be implemented, including groundwater level, spring water level and spring flow monitoring. This is putting a burden on the Council as the additional monitoring may identify unforeseen issues that need to be resolved. It appears that the consequence of any decrease in water levels as a result of subdivision and development is unknown and not appropriately understood, and any adverse impacts (in particular) would only be understood potentially many years after the development had been undertaken. By then, in the ordinary course,

Council would be left with having to address the adverse impacts. Rate payers would end up having to fund changes or improvements. Monitoring that needs to be undertaken pre and post development and is of little value unless there are triggers, actions and remediation measures that the developer is required to undertake if the monitoring shows different impacts than those anticipated.

61. This approach of reliance on future monitoring to determine further maintenance or mitigations is similar to the situation that has evolved with the Pegasus Lake. When this was developed, the ongoing monitoring and management requirements were unknown due to the potential effects being unknown. In that case, the impacts have been severe with the lake subject to algal blooms, and public health alerts having to be put out frequently with no long term solution yet determined.

62. While the specifics of the Pegasus Lake example are not directly relevant, the similarity is the suggestion of unknown consequences being addressed through future monitoring and maintenance. The reality is that often once the issues are identified and understood, the impacts cannot be undone.

63. The evidence of Ms. Laura Drummond (paragraph 11) also supports ecological monitoring as mitigation to measure any negative impacts of possible changes to spring flows within the site, due to possible interception of groundwater within service trenches or road construction. This again highlights the uncertain outcome of the proposal, and planning to simply monitor the impact does not give sufficient confidence of how any negative consequences that are identified through monitoring will then actually be resolved.

SUMMARY

64. From my evidence, I offer the following summarising statements:

Water

i. There is still a degree of uncertainty as to the availability of deep groundwater at this site, and what the implications would be if the aquifer parameters differ from those assumed, as this has not been sufficiently explored by the applicant in my opinion.

ii. What is more concerning is that an alternative option proposed to address this uncertainty that has been put forward more recently (the use of shallow groundwater if deep groundwater system is not viable) has significant issues that have not been identified by the applicant. In particular, it is well known by the Council as well as other experts acting for the applicant that the shallow groundwater on the site is subject to high nitrates, which are very difficult to treat for. The Council made significant investments to replace its shallow groundwater source for the existing Ohoka water supply (and across the District), and the proposal to potentially revert back to shallow groundwater for this area would be a significant step backwards. In my opinion it woud make this supply the worst in terms of raw water quality of any public supply in the district. This would present what I consider is an unacceptable risk to the Council in taking the water supply over as well as to the wider community who will use the water supply.

Wastewater

iii. The wastewater servicing solution appears to be feasible, however this conclusion is subject to the following comments:

   a. The staged approach appears feasible, but as a short term solution only. There would need to be a mechanism put in place to ensure that the proposed rising main will ultimately get constructed by the developer even if the full extents of the development are never progressed.
   b. There is further analysis to be done on the type of wastewater system, as at this stage there is not sufficient evidence provided as to why a pressure system should be favoured over a gravity system for the residential areas, where gravity would typically be the default system. At this point in time, my position is that a gravity system should be preferred for the residential areas of the development, for the reasons noted already.
   c. Very careful design and construction of the system would be required to avoid excessive inflow and infiltration entering the system, due to the high groundwater levels within the site. This is the case for both a pumped system, and gravity, as both can be susceptible to high levels of inflow and infiltration if not designed and constructed adequately.

<u>Stormwater</u>

iv. The evidence provided for stormwater provides a high level of uncertainty and risk. In particular:

   a. There is uncertainty regarding the depth to groundwater in the site, with the evidence of Mr. Wilkins introducing particular concern, as it is stated that the basins will likely be constructed within the water table, and that there is not a consenting pathway available if groundwater is intercepted by the basins.
   b. More recent evidence from the applicant acknowledges the consenting risk, and has put forward an adapted proposal of completely above ground stormwater basins if required to avoid the interception of groundwater. This however would reduce the basin volume able to be achieved therefore increasing basin size over and above earlier calculations and would increase amounts of site where attenuation would simply not be possible due to inherent limitations with this concept. In my experience this is a highly unusual concept that I have not witnessed being utilised before.
   c. There is a high degree of uncertainty regarding the storage volume required to be attenuated. The evidence provided by Mr. O'Neill in terms of the volume to be attenuated differs significantly from the figures presented in the PDP Stormwater Management Report. There is further uncertainty around whether the critical storm duration and therefore volume has been calculated with a sufficient degree of certainty. This matter is also fundamental to the viability of the proposed solution.
   d. It is acknowledged that the concept for how the storage volume will be achieved (by creating above ground bunding) introduces challenges, with some areas of the site proposed to not be attenuated and to discharge directly into the downstream

environment. This is highly unconventional, and could have localised negative impacts which do not appear to have been assessed. This is of particular significance for an area where the downstream stormwater network is highly sensitive to any increase in flows, as the system can already be overwhelmed during high rainfall events. Part of the reason that the downstream system is so overwhelmed is due to past developments that have been approved, which with the benefit of hindsight can be seen to have not adequately assessed or considered the impact that the shallow groundwater system would have on their proposed designs, such as the Wilson Drive development as discussed previously.

e. The concept of constructing rain gardens within the water table, but relying on the system remaining water tight, is unconventional and introduces a level of risk in terms of the viability of this system that I do not consider is acceptable. This again is an example of an application of this type of system that I have not seen in use before.

v. Based on the above factors, I do not consider the stormwater solution proposed by the applicant is feasible and/or appropriate.

Attachment 1 – Stormwater basin diagrams

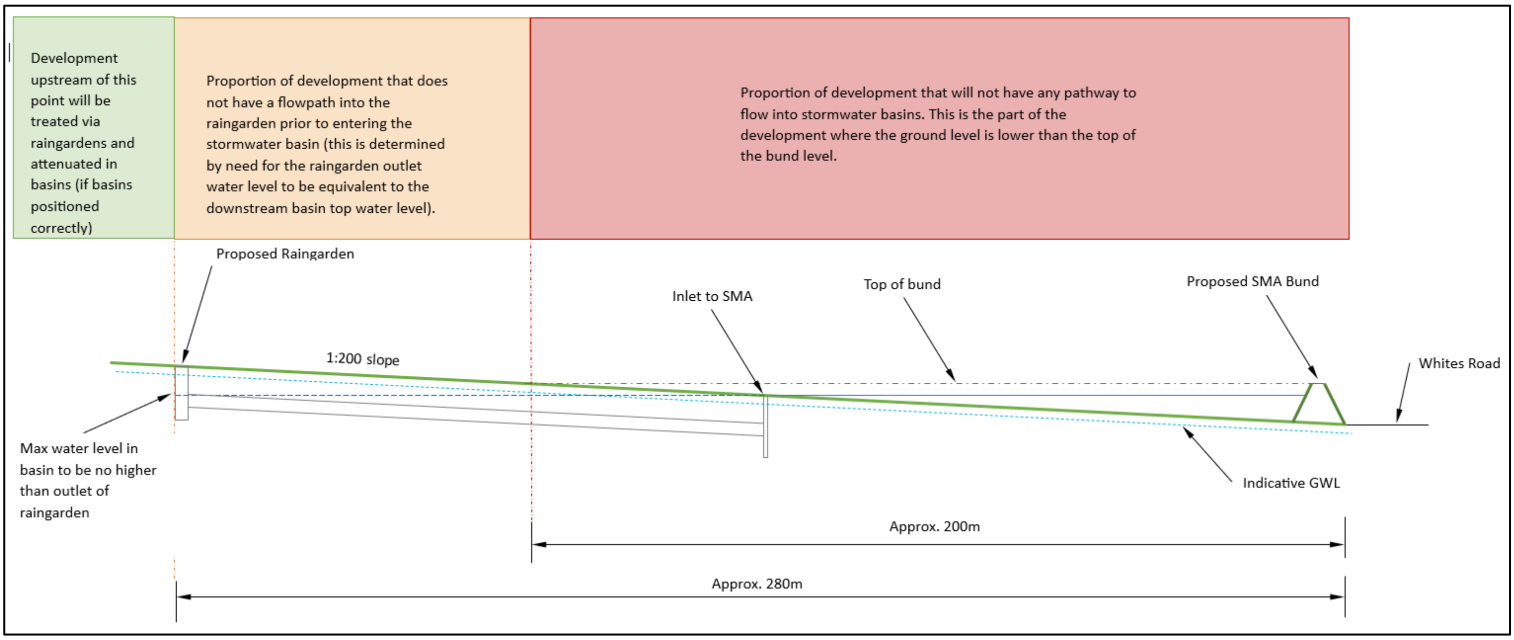

Figure 1: Schematic of stormwater basin proposal

Figure 2: Overlay of area that will not be able to be attenuated into stormwater basin over site area

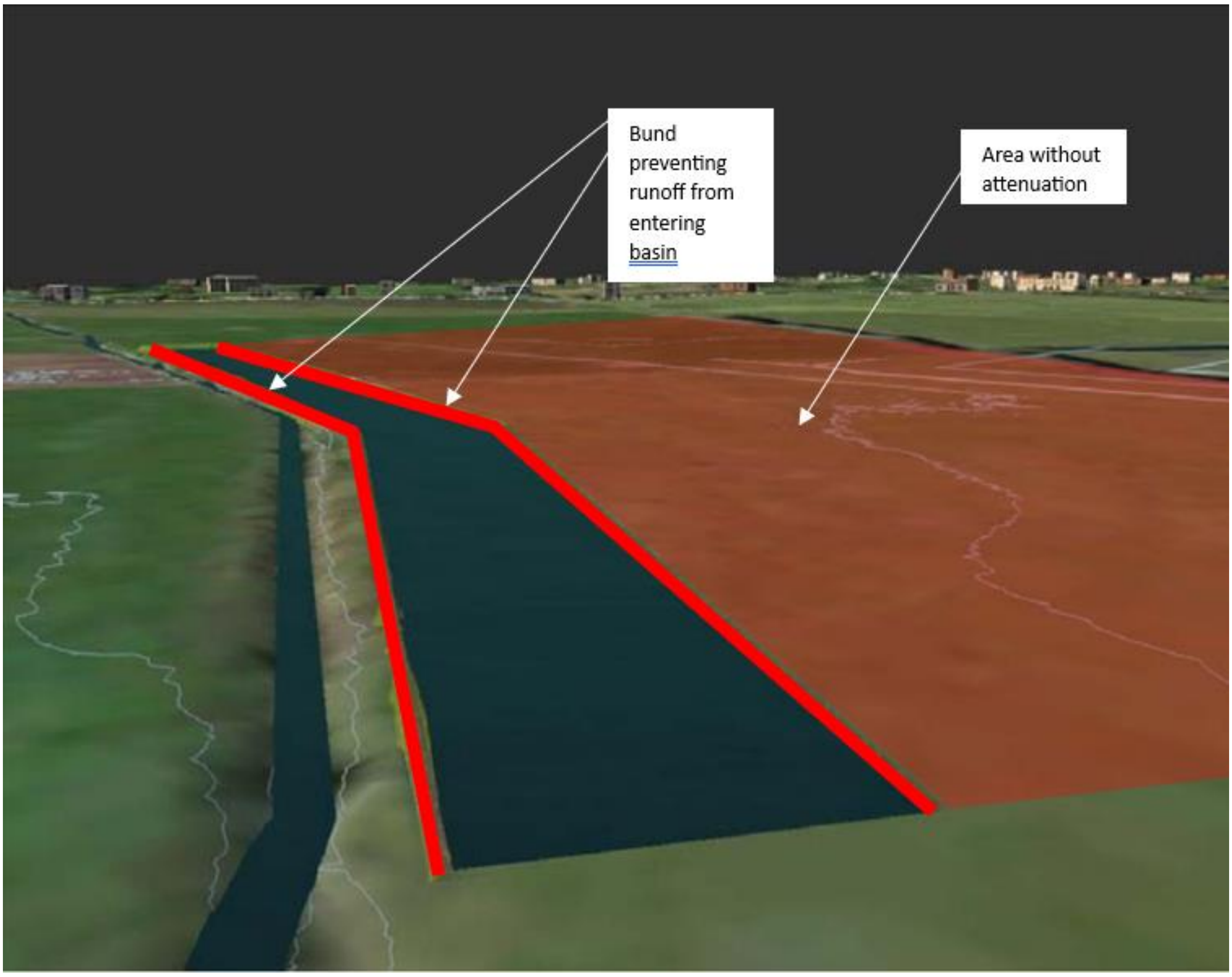

Figure 3: Overlay of unattenuated area over view of detention basin provided by applicant

Attachment 2 – Wilson Drive Flood Photos

Figure 4: Wilson Drive July 2022

Figure 5: Wilson Drive July 2023