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 – Christopher Paul Bacon
Waimakariri District Council

On behalf of Waimakariri District Council

Summary Statement on Natural Hazards (Flooding) Relating to Private Plan Change Request PPCR31 – 535 Mill Road, Ohoka Plan Change Application

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Dated: 7 August 2023

File Note: DDS-06-05-01-31-04

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 and respond to evidence presented at the hearing from the applicant..
2. My full name is Christopher Paul Bacon and I am the Network Planning Team Leader for the Waimakariri District Council. In this position I am involved with planning for infrastructure growth and flood modelling. I am a Chartered Professional Engineer and hold a Batchelor Degree in Civil Engineering. I have over 20 years of experience in civil engineering.
3. My summary statement has predominantly been based on assessing the information presented in the Applicants Evidence to PC31 prepared by Ben Throssell related to Flooding.
4. I have heard the above experts present their evidence before the hearings panel, and have read their summary statements.
5. I also wish to respond to Mr Walsh (Planning) in relation to flooding in the Kaiapoi FUDA and his comments on flooding generally as a constraint to development.
6. I have prepared this evidence to respond to new evidence, while highlighting some of the key points from my earlier evidence and comment on where I believe these have been addressed through subsequent evidence from the applicant.

UPDATED MODELLING

7. In response to my concerns on the flood modelling provided as part of RCP031 (as set out in my evidence in chief), the applicant has undertaken a revision of the previous modelling exercise and introduced a number of refinements to the model. The key differences with the modelling include:
    i. Updated DEM (2020 LIDAR) applied to the pre-development model;
    ii. More refined post development model including better conveyance of flood flows through the site and better representation of key features such as buildings and stormwater attenuation areas;
    iii. Rainfall has been added to the internal development area, previously only external flows were applied to the upstream boundary; and
    iv. Infiltration has been applied to the model and a conservate assumption has been adopted.
8. I consider the updates undertaken to the model now better represent the proposed development, however I am not satisfied that the above ground stormwater ponds featured in the post development scenario will adequately attenuate post development flows from the development area. This issue is covered in more detail in Mr Roxborough's evidence.
9. The bunding required for the above ground stormwater ponds have the potential to interfere with flood flows if placed anywhere within the red hatched areas identified on Attachment 1 in Mr Throssell's Evidence in Chief. Any interference with flood flow through the site has the potential to affect flood levels on downstream properties.
10. I am satisfied that the effects from bunding for the stormwater ponds in the current post development scenario has been assessed however bunding for any additional ponds has not been assessed.
11. I therefore do not consider the results from the modelled post development scenario are suitable for assessing potential offsite flood effects.

MODEL COMPARISON TO FLOOD FREQUENCY ANALYSIS

12. To help validate the WDC District Flood Model, Mr Throssell has undertaken a comparison between the output from the WDC District Wide Flood Model and a previous flood frequency assessment undertaken by Tonkin and Taylor on the Ohoka Stream in 2017 (**2017 flood frequency analysis)**. I have a number of comments on and concerns with this comparison.
13. The 2017 flood frequency analysis did not provide an assessment of future climate change effects which are incorporated into the WDC District Wide Flood Model. In order to account for this Mr Throssell has estimated these effects using outputs from the WDC District Wide Flood Model. This comparison shows the WDC District Wide Flood Model flows compare favourably in the 100 year ARI event but are between 39% to 80% higher than the derived Tonkin and Taylor figures in the 200 and 500 year ARI events.
14. I note that the WDC District Wide Flood Model predicts a significant spill over from the Cust River catchment further upstream that contributes to the modelled flows in the Ohoka Stream channel. The statistical analysis undertaken by Tonkin and Taylor on the historic flow records from the Ohoka Stream will not account for such spill over from adjacent river systems in more extreme events. In my opinion, it is important to understand the possible spill over from the Cust River Catchment to have confidence in the comparison and the modelling.
15. I consider using the outputs from the WDC District Flood Model to estimate climate change effects to be a reasonable approach in a well defined catchment with little to no interaction between neighbouring catchments. However given the complex nature of the upstream catchment and the interaction seen in the WDC District Flood Model I consider that using an estimate approach for the Ohoka Stream is not appropriate.
16. I therefore consider that without further investigation of possible spill over from the Cust River catchment and the other complex interactions occurring upstream in the Ohoka Stream catchment there is a low degree of confidence in the validation undertaken by Mr Throssell.
17. However, I do consider the WDC District Flood Model to be conservative due to the modelling assumptions used when building this model. I remain of the view that the model results from the WDC District Flood Model are appropriate for assessing the flood effects from the proposed development and any potential impact on habitable floor levels in the surrounding area.

ASSESSMENT OF DOWNSTREAM EFFECTS

18. I note that the applicant has accepted Council recommendations regarding freeboard for the proposed development.
19. I agree with the approach Mr Thossell has used to identify all buildings subject to a more than minor increase in flooding using an increase in flood depth of 20mm in the PDP post development model. This is consistent with the Council's current approach to assessing flood effects. However, without further assessment of the applicant's stormwater solution I don't consider the model suitable for assessing these effects.
20. I agree with Mr Throssell that the predominate issue associated with this modelling work is the conveyance of the existing flood flows through the site, rather than consideration of impervious areas and associated onsite attenuation.

21. I therefore consider it important that any additional above ground earthworks such as those required for additional stormwater management areas are incorporated into the model and their effects are considered.

FLOOD FREQUENCY ANALYSIS

22. In response to queries from various submitters regarding recent flooding in the Ohoka area Mr Throssell has undertaken an assessment of the return period of two recent flood events, June 2014 and July 2022. Using flow records from the Cust Main Drain gauge at Threlkelds Road, Mr Throssell has estimated that the June 2014 event had a return period of approximately 20 years and the July 2022 event a return period of approximately 10 to 20 years.
23. These conclusions are consistent with previous analysis undertaken by Environment Canterbury following the 2014 event that estimated the river flow to be a 1 in 20 year event in the Cust Main Drain. However, the same analysis undertaken by Environment Canterbury also stated that flooding in the Ohoka and Flaxton swamp areas was the greatest experienced since 1974, with similar levels to the 1974 event, and the flows recorded in the Cust Main Drain were the highest ever recorded. I therefore agree that the event in the Cust Main Drain was probably in the order of a 1 in 20 year event however I consider that the same flood event that affected the Ohoka and Flaxton Swamp areas was likely greater than that.
24. I agree with Mr Throssell that any events up to a 50 year Annual Recurrence Interval (ARI) return period should be mitigated by attenuation ponds designed to attenuate the critical 50 year ARI rainfall event. However, I note the concerns raised by Mr Roxburgh and Mr Wilkins in their evidence that the stormwater solution proposed by the applicant is not feasible.
25. I consider it important to note that even if the additional effects from flood events are able to be mitigated by the developer it is unlikely the development will alleviate the **existing** flood risk to surrounding properties.

FLOODING AS A CONSTRAINT TO DEVELOPMENT

26. I disagree with Mr Walsh on paragraph 37 of his evidence which states that the required hazard mitigation for the Kaiapoi New Development Areas (NDA) would not meet the policy objectives under Policy 11.3.1 of the CRPS for development in high hazard areas and that the area therefore has a significant constraint on development. I am not a planner but I have many years of experience in developing servicing strategies for growth areas within the Waimakariri District including the Kaiapoi NDA.
27. Recent works undertaken by the Council as part of the Government's Shovel Ready programme has provided mitigation for flood displacement effects for the Kaiapoi NDA. This has been achieved through the construction of the McIntosh Drain and Beach Road Pumpstations, construction of a new culvert under Beach Road and other upgrades to the McIntosh Drain.
28. The Council commissioned DHI to undertake modelling of these upgrades in 2020[1]. The modelling confirmed that the proposed McIntosh Drain pumpstation in conjunction with other associated works

[1] McIntosh-Feldwick Drain Options Modelling, DHI, October 2020, TRIM 201008134174

would be sufficient to mitigate flood displacement effects in the McIntosh Drain catchment with no additional adverse effects downstream.

29. It is noted that further work to raise the land in the Kaiapoi NDA would still be required but this should be achievable as evidenced by the recent works in the Kaiapoi area, notably the Beach Grove, Silverstream and Waimak Junction developments. Examples showing the effects of raising the land in the Silverstream and Waimak Junction developments are presented in **Attachment 1**. These clearly show that after land raising the sites have gone from high flood hazard to no or much reduced flood hazard.

EXCLUSION OF NEW STORMWATER RETENTION AND TREATEMENT AREAS

30. In this section of my evidence, I provide responses to the applicant's evidence relevant to the exclusion of new stormwater retention and treatment areas and density calculations.

31. I disagree with Mr Walsh on paragraph 36 in Attachment A of his evidence which states that the land required for stormwater management in the ODPs may not reflect the full extent of land required as they will need to service existing, developed areas of the urban environment in addition to the new areas of development. There are no existing upstream urban catchments that need to be accommodated within the stormwater facilities for any of the current ODP areas within the Waimakariri District. This means any new Stormwater Management Areas (SMAs) built for the new development areas will not need additional land to service existing urban environments.

32. I disagree with the statement made by Mr McLeod on paragraph 38 in Attachment A of Mr Walsh's evidence that an average land requirement of 12.5% should be allowed for new SMAs. In the Waimakariri District SMAs typically account for between 5% to 10% of a development area. This can reduce down to 3% in areas of high infiltration. I note that the applicant's own latest plans for Ohoka PC31 show SMAs taking up only 6% of the total urban area in a location noted for an extremely high ground water table.

33. I therefore consider the total lot yields calculated for the NDAs within the Waimakariri District to be correct and it is not necessary to reduce these figures due to stormwater management requirements.

SUMMARY

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

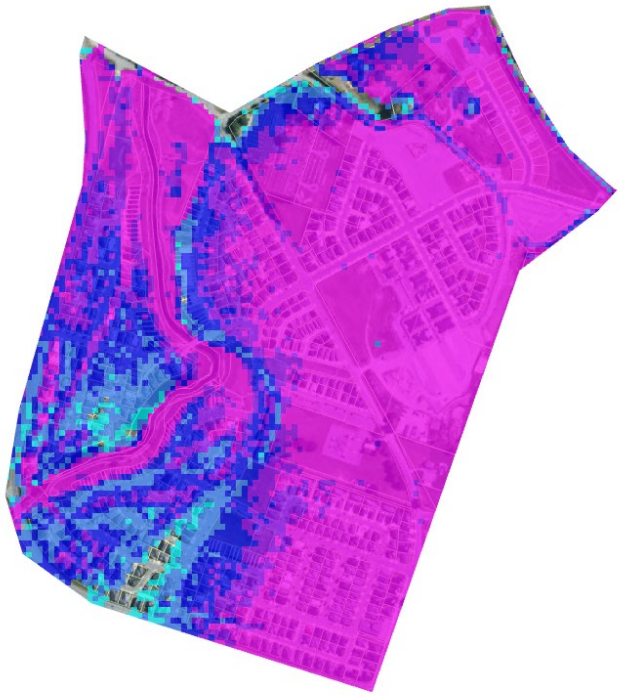
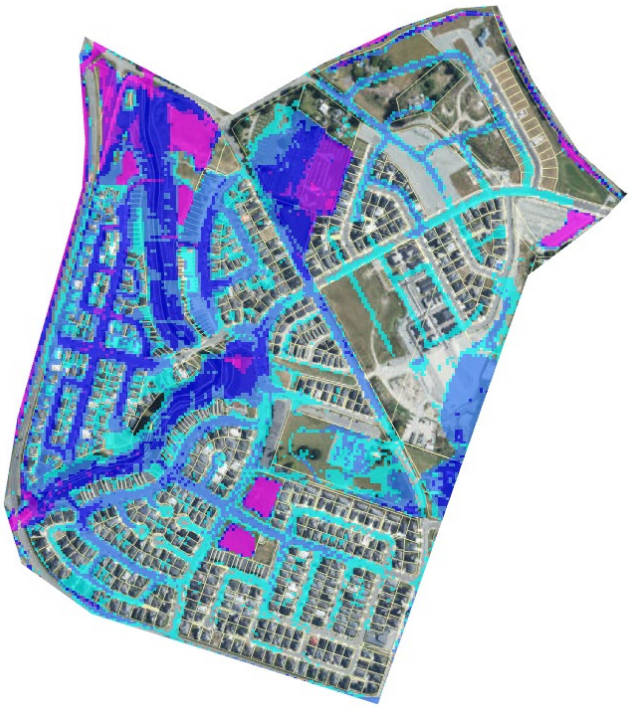
    i. The Applicant has undertaken additional flood modelling that now better represents the proposed development.

    ii. I consider that the stormwater solution modelled by the applicant requires further work and this may result in additional above ground bunding in areas identified as having an effect on flood levels on downstream properties.

    iii. I therefore do not consider the revised modelling suitable for assessing potential offsite flood effects.

    iv. Potential offsite flood effects from events less than 50 years ARI can be adequately mitigated by construction of 50 year attenuation ponds but further work is required to confirm the feasibility of the 50 year pond solution presented by the applicant.

v. I consider that the model validation work and the flood frequency analysis undertaken by the applicant to have a low degree of confidence.
vi. I do not consider that the revised modelling demonstrates there is a viable subdivision layout that can successfully mitigate flood effects on neighbouring properties.
vii. In my opinion, the proposed development will not alleviate any **existing** flood risk to neighbouring properties.
viii. I consider that future development of the land under the Kaiapoi NDA is feasible due to the recent flood mitigation works undertaken for this area by the Council and any flood risk can be avoided through land raising.
ix. I consider the total lot yields calculated for the NDAs within the Waimakariri District to be to be correct and it is not necessary to reduce these figures due to stormwater management requirements.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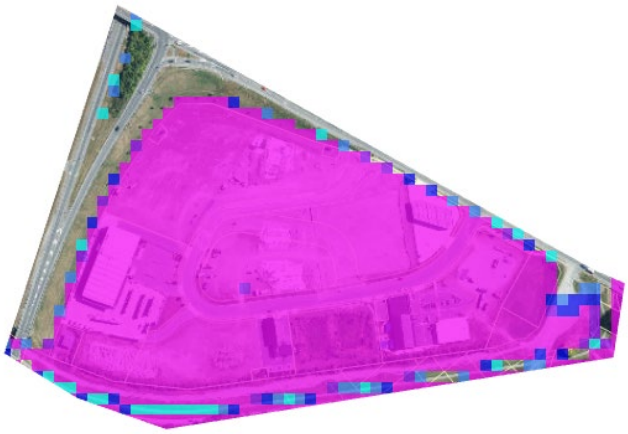	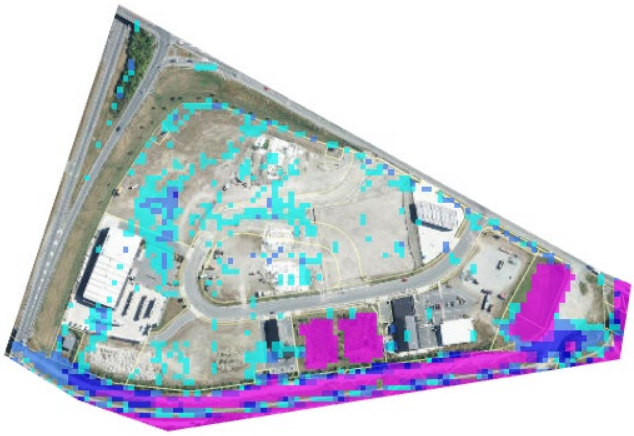
Waimak Junction – 200 Year Flood Depth 2013 Model	Waimak Junction – 200 Year Flood Depth 2020 Model

Attachment 1 - Flood Modelling output showing the effects of raising land in previously high hazard areas in the Kaiapoi Area