IN THE MATTER:	of the Resource Management Act 1991 (**RMA**)
AND	
IN THE MATTER:	Proposed Plan Change 2: Pukehangi Heights to the Rotorua District Plan under Part 5, Sub-Part 5 – Streamlined Planning Process and Schedule 1 Part 5 of the RMA

SUMMARY OF EVIDENCE OF PHILIP WALLACE ON BEHALF OF BAY OF PLENTY REGIONAL COUNCIL – HYDRAULIC MODELLING AND FLOOD IMPACTS

21 September 2020

Qualifications and Experience

1. My full name is Philip Lawrence Wallace. I am a director of River Edge Consulting Ltd. I have the qualifications and experience as outlined in paragraphs 3 and 4 of my Statement of Evidence dated 18 September 2020.

Scope of Evidence

2. My evidence covers the following:

- Background to the hydraulic model built for BOPRC;
- Performance of current flood protection assets in lower Utuhina;
- Overview of the hydraulic modelling approach undertaken to assess the effects of the Proposed Plan Change; and
- Results of the assessment of Plan Change effects

Hydraulic Model Background

3. DHI was engaged by the Bay of Plenty Regional Council (**Regional Council**) in 2018 to update and extend an existing hydraulic model of the Utuhina Stream and floodplain. The objectives of the project were to assess the flood hazard posed by the Utuhina Stream and its tributaries and to have a model that could be used to help assess flood mitigation options. (Hereinafter, the hydraulic model is referred to as the **Model**.)

4. The Model incorporates the three main stream channels (Utuhina, Otamatea and Mangakakahi) and the adjacent floodplain as well as short lengths of tributary channels and culverts. Other than those culverts, the model does not explicitly include the city stormwater pipe network.

5. Inflows to the Model were derived from the Non-Linear Reservoir (NLR) hydrological model of the Utuhina catchment that Mr. West of Blue Duck Design Ltd. describes in his evidence.

6. Together, the hydraulic model (Model) and the NLR hydrological model are referred to as the Greater Utuhina Catchment Model (GUCM).

7. The Model has been calibrated against data from five flood events that occurred between 2011 and 2018. Calibration of the Model has been an iterative process run in conjunction with the hydrological model calibration.

Current Level of Flood Protection

8. The Regional Council maintains flood protection assets in the lower Utuhina catchment, the design standard of which is a 1% AEP (annual exceedance probability) flood event, downstream of Old Taupo Road. Model results shows that this standard is not being met. Floodwaters are predicted to spill out of the stream channels or overtop flood defences and flow onto the floodplain into residential and industrial areas.

9. There are a number of practical difficulties and obstacles to achieving the design standard and any additional runoff from the Pukehangi Plan Change area could not be readily accommodated. If there was such additional runoff, it would lead to earlier and additional spillage to the floodplain, exacerbating the flood risk to those residential and industrial areas.

Assessment of Proposed Plan Change

Modelling approach undertaken to assess effects

10. The Model can be used to test the downstream impact of the proposed Plan Change developments on flood extent, flood depth, duration of flooding and flood velocity.

11. Runoff from the Plan Change site and contributing catchments, for both the existing situation in the Plan Change area ("Pre-development") and for the "post-development" land use has been supplied by WSP to Mr. West. He in turn has incorporated that information into the NLR model. Outputs from the NLR model have then been supplied to be used as inputs into the Model.

12. The Model has been run for a range of flood scenarios and for both the existing situation in the Plan Change area ("Pre-development") and for the "post-development" land use.

13. These flood scenarios cover a range of design storms, from 10% AEP to 0.2% AEP, as well as climate change assumptions (current climate and 2130 climate under RCP 8.5). Two variations of downstream urban development were also considered: existing land use and the maximum development allowed under the District Plan

14. Iterations of the "post-development" situation, involving refinements of mitigation measures and site outflows as supplied by WSP, have been tested over recent months. The most recently tested is the "Scenario 15" referred to in the WSP "*Stormwater Report"* dated 14 September 2020. My evidence presents results from Scenario 15.

15. In its stormwater report, WSP also refers to "Scenario 16" that it has considered. Discharge information from Scenario 16 has not yet been supplied by WSP and Scenario 16 has not been run through the GUCM to assess the downstream impacts.

Modelling results

16. Results for all flood scenarios modelled indicate that the effect of the Proposed PC2, with Scenario 15 of the mitigation measures, is generally to decrease peak water levels in the stream channels. Exceptions are localised and of no consequence.

17. Likewise, the effect of the proposal is generally to cause slightly lower peak flood depths on the floodplain.

18. Peak velocities in the stream channels and on the floodplain under Scenario 15 are also predicted to be slightly lowered in general. Again, any increases are insignificant.

19. The use of detention ponds to avoid increased water levels and velocities downstream results in an increase in flood duration downstream however. The duration impacts in the lower floodplain area appear to be relatively small. Further upstream, adjacent to the Otamatea and Mangakakahi Streams, a longer duration is predicted. Further analysis with the RLC stormwater models for Catchments 14 and 15 (Section 3.2.2.1 of the WSP report) would be required to determine if stormwater levels in the pipe network remained elevated and if that would cause any additional flood losses.

Conclusions

20. A calibrated model (the "GUCM") has been developed on behalf of BOPRC, which is a suitable tool to assess the downstream hydraulic impacts of the Proposed Plan Change.

21. The Model predicts that the design standard for flood protection (1% AEP) is not met in the lower Utuhina Stream catchment.

22. There are difficulties in achieving the design standard of flood protection lower Utuhina catchment. There is no room to accommodate additional runoff and increased peak discharges that could result from the Proposed Plan Change.

23. The Model indicates that, with mitigation options as assumed in Scenario 15 presented by WSP, there is a general decrease in peak runoff and in peak flood levels and velocities downstream of the Proposed Plan Change area. Results for all design flood events simulated, ranging from 10% AEP to 0.2% AEP, show similar spatial patterns for the reduced levels and velocities. There is some increase in duration in some locations, which may require further analysis to confirm that there are no adverse effects from that.

24. Results presented are specific to Scenario 15 provided. Scenario 16 has not been tested with the GUCM and if that or any future variation to the mitigation option is to be progressed, the downstream effects would need to be assessed with the aid of the GUCM.

DATE 21 September 2020

Philip Wallace