BEFORE A HEARING PANEL
CONSTITUTED BY NELSON CITY COUNCIL

IN THE MATTER	of an application by **CCKV Maitahi Development Co LP** and **Bayview Nelson Limited** for a change to the Nelson Resource Management Plan (Plan Change 28)
IN THE MATTER	of Part 5 and Schedule 1 of the Resource Management Act 1991

STATEMENT OF EVIDENCE OF DAMIAN VELLUPPILLAI

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Section A – Introduction and Scope of Evidence

Name, qualifications and experience

[1] My full name is Damian Nathan Velluppillai.

[2] I am a Water Resources Engineer with 20 years of experience, currently employed by Tonkin & Taylor Ltd (T+T).

[3] I have a Bachelor of Engineering with Honours from the University of Canterbury.

[4] I am a member of Engineering New Zealand, the New Zealand Hydrological Society, and the New Zealand Coastal Society.

[5] I have assessed stormwater and flood risk for many infrastructure and other developments, including subdivisions, mainly in the Nelson/Tasman region but extending throughout New Zealand. I have assisted Councils (notably Nelson City, Tasman District and Greater Wellington) with their flood modelling programmes and provided advice on flood risk as part of their district/regional planning and infrastructure projects. I have undertaken assessment and design of stormwater systems for major transport projects, as well as for council networks and private subdivisions. I have undertaken civil design work on a range of three waters infrastructure, dams and hydro, transport and land development projects.

Expert Code

[6] While this is not an Environment Court hearing I have met the standards in that Court for giving expert evidence.

[7] I have read the Code of Conduct for expert witnesses issued as part of the Environment Court Practice Note 2014 (Part 7). I agree to comply with the Code of Conduct. I am satisfied that the matters addressed in this statement of evidence are within my expertise. I am not aware of any material facts that have either been omitted or might alter or detract from the opinions expressed in this statement of evidence.

Role in Project

[8] T+T was engaged to assess the potential effects of the Proposed Plan Change 28 (PPC28) on flood hazard. I was the technical lead for the flood risk assessment. The purpose of that assessment was firstly to identify existing flood hazard affecting the site, and then to assess potential impacts of the requested land use change on flood hazard and any mitigation likely to be required. The assessment also provided preliminary design parameters (such as indicative flood levels and extents) to assist the design team. I have visited the application site as part of the assessment, and while on site inspected the general catchment terrain and the natural drainage systems.

[9] I am aware of and have read preliminary assessment and reporting on existing and potential flood risk as prepared by T+T as follows (my involvement in the preparation of these documents is noted in brackets):

(a) Infrastructure and Flooding Report, T+T, March 2021 (I reviewed the flooding aspects of this report);

(b) Response to Request for Further Information (RFI), T+T, 20 August 2021 (I reviewed the flooding aspects of this response);

(c) Additional Flood Hazard information – PC28, T+T, 05 May 2022 (I was the primary author);

(d) Stormwater Management Plan, T+T, June 2022 (I was a contributing author).

[10] I have participated in conferencing discussions with other Flood Risk experts for Council and the appellants on 29 April, 06 May and 27 May 2022. Together with those other experts I prepared the Joint Witness Statement dated 25 May 2022, at the conclusion of the conferencing process. Agreement was not reached on various matters which are recorded in the Section 42a report and are addressed in my evidence below.

Scope of Evidence

[11] My evidence relates to:

(a) The existing flood hazard at and adjacent/downstream of the application site;

(b) The potential impacts of the proposed land use change on flood hazard to adjacent and downstream property.

[12] The treatment and conveyance of stormwater and the management of flood hazard within the application site, including any sizing and preliminary design of attenuation devices and channels sizing design, is outside the scope of my evidence and is addressed by others. However, I refer to aspects of these matters where they have the potential to impact on flood hazard to other properties. I note that:

(a) Mr. Maurice Mills discusses in his evidence, the stormwater effects related to the proposed development of the PPC28 area.

(b) Mr Stuart Farrant discusses in his evidence, the water-sensitive design principles in consideration of the PPC28 area.

(c) Mr Josh Markham discusses in his evidence, the potential terrestrial ecological effects in consideration of the PPC28 area.

Section B – Executive Summary

[13] An assessment has been made of the existing flood hazard risk within the application site, arising from runoff from within the Kākā catchment and the Maitahi/Mahitahi River to the south, and from hill slopes in the northern part of the site (Walters Bluff and Brooklands catchments) leading to a number of existing overland flowpaths.

[14] The potential effects on flooding of proposed development within the PPC28 area have been assessed; the primary effects are changes in catchment runoff behaviour due to proposed land use changes, and earthworks within the catchment that will affect flowpaths and/or floodplain storage.

[15] The modelling and assessment demonstrate that there are feasible options available to address potential effects of the proposed development on

flooding, to meet the requirements of the Nelson Tasman Land Development Manual (NTLDM).

Section C – Evidence

Context

[16] My evidence provides information and discussion on the management of flood hazard within the application site, and on the potential effects of the proposed development on flooding in adjacent and downstream areas.

[17] T+T has prepared a Stormwater Management Plan (SMP) that sets out how the flood hazard would be managed for proposed new development within the site, and how stormwater controls would be provided within the site to mitigate any effects on flooding in the receiving environment. The SMP, together with the report titled "Additional Flood Hazard Information" dated 28 May 2022, also presents information on the assessment of potential flood effects to neighbouring and downstream property.

[18] Appendix J of the Section 42a Report refers to the use of Integrated Catchment Management Plans (ICMPs) (e.g. by Hamilton City Council (HCC) as part of its planning framework). HCC's stated purpose of an ICMP is to "integrate land use and three water development so as to promote sustainable management of the City's natural and physical resources…a planning tool…[that] aids decision-making about three waters infrastructure and management in relation to large-scale land use changes…which have the potential to affect adversely the receiving environment or existing infrastructure". I note that NCC does not require an ICMP as a means of fulfilling the requirements of the Resource Management Act, and one has not been prepared in support of this application. However, the SMP that has been prepared by T+T for the applicant was prepared for the same purpose and includes information to demonstrate the feasibility of stormwater and flood management for the proposed PPC28 area. The principles and objectives within the SMP will inform stormwater and flood management for future development within the PPC28 area.

[19] The approximately 2.87 km² application site is partly within the Kākā catchment to the south and east and extends into the Walters Bluff and Brooklands) catchment (referred to in my evidence as the Walters Bluff/Brooklands catchment) to the north and west. The Kākā catchment is currently largely undeveloped, while the Malvern Hill catchment already includes significant existing residential development.

[20] In accordance with the Nelson Tasman Land Development Manual (NTLDM), I have considered events up to the 1% annual exceedance probability (AEP) when assessing flood hazard. These include an assumed increase in rainfall intensities by 2130 in line with the Intergovernmental Panel on Climate Change Representative Concentration Pathway (RCP) 8.5M climate projections, as set out in NIWA's latest (2018) design rainfall data. This allows for consideration of potential effects of climate change on flood hazard over at least the next 100 years, as required by the Inundation Practice Note in the NTLDM.

C1 – Kākā Catchment

[21] Kākā Stream is a tributary of the Maitahi/Mahitahi River, with a catchment of approximately 2.5 km². The floodplain of the Kākā Stream merges with the Maitahi/Mahitahi River floodplain at the confluence of the two watercourses. During normal/low flow, Kākā Stream discharges into the Maitahi/Mahitahi River at Denne's Hole. This point in the River is approximately 12 km downstream of the dam, and 3.5 km upstream of the river mouth into The Haven (estuary).

[22] The Maitahi/Mahitahi River has a catchment of approximately 100 km² and an estimated (present-day climate) 1% AEP flow in Nelson of 365 m³/s (per 2021 NIWA analysis of the "Maitai at Avon Terrace" flow gauge data). T+T has developed a flood model of the Maitahi/Mahitahi River for Nelson City Council (NCC), last updated in 2021. Based on modelling of NIWA's High Intensity Rainfall Design System (HIRDS) v4 regionally representative storm profiles (1 hour, 6 hour, 12 hour, 24 hour and 48 hour events) for NIWA's typical "North of the South Island" rain events, the 12-hour storm was found to be critical in terms of peak flows and flood levels

at the application site. The modelled pre-development Maitahi/Mahitahi River flood extents at the Kākā Stream confluence in a 2130 (RCP8.5M) 1% AEP event are shown in blue on Figure 1 below (PPC28 boundary shown in red). Note that flows in the Maitahi/Mahitahi River channel are not shown in blue – only out-of-channel flooding. i.e. on the floodplain.

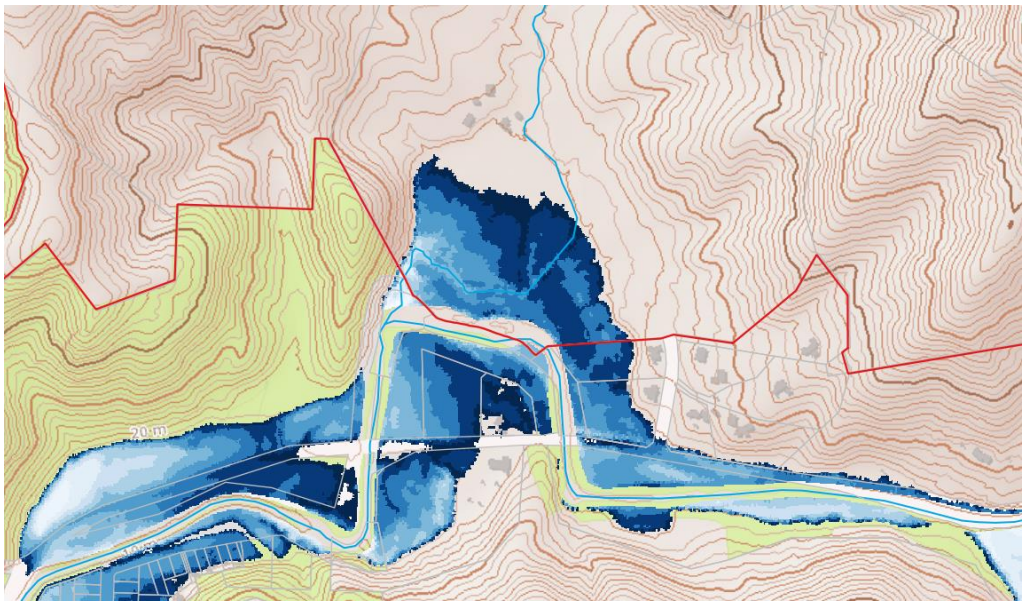

Figure 1: Modelled Maitahi/Mahitahi River flood extents, 2130 RCP8.5M 1% AEP event.

[23] For the purposes of assessing effects of PPC28 on flooding, T+T developed two additional models:

(a) A hydrological (rainfall-runoff) model of the Kākā Stream catchments. This model was created using HEC-HMS v4.9 software, for the purpose of assessing pre and post-development runoff rates, and for providing parameters for preliminary design of attenuation devices within the proposed development;

(b) A computational hydraulic model of the Kākā catchment, using TUFLOW software. This model is a direct-rainfall two-dimensional model of the full pre-development catchment and includes a reach of the Maitahi/Mahitahi River in the vicinity of the confluence. This enables modelling of the flooding in this area due to flows from both the Maitahi/Mahitahi River and local Kākā Stream catchments. Maitahi/Mahitahi River flows are modelled using

NCC's river model and provided as input data to the TUFLOW model for the selected design event.

Figure 2 below shows the mapped flood extents from the TUFLOW model results for the pre-development 2130 (RCP8.5M) 1% AEP 6-hour event. (The 6-hour event was found to be more critical for Kākā Stream flows than either the 1-hour or 12-hour design events. Given that the 12-hour event is more critical for the Maitahi/Mahitahi River at this location, both events should be assessed during any subsequent design stages when considering flood hazard in the confluence floodplain). The figure shows where flood depths exceed 0.1 m.. Figure 2 shows that runoff from the Kākā catchment in this event would be largely contained within a narrow channel or flow corridor through the application area, with peak velocities in the main branch of 3 m/s to 6 m/s. Closer to the confluence floodplain, flows exceed the capacity of the channel and flow out of bank across the floodplain and into the Maitahi/Mahitahi River floodplain. It is proposed to realign and widen the watercourse in the lower reaches, using natural stream channel design principles. This realigned and enlarged channel (covered in the evidence of others) will be designed to contain the full 2130 1% AEP design flow and convey this around the eastern part of the lower floodplain.

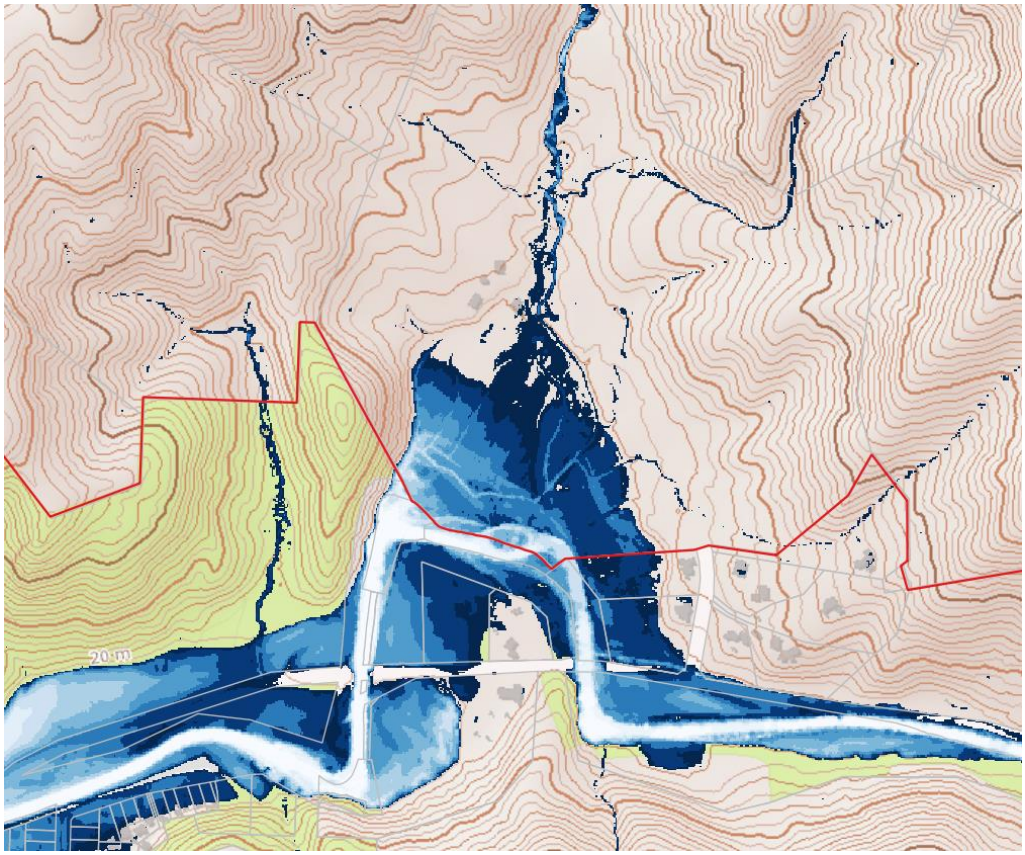

Figure 2: Modelled Kākā Stream and Maitahi/Mahitahi River flood extents, 2130 RCP8.5M 1% AEP 6-hour event. (PPC28 boundary in red).

[24] I present the main impacts on flooding of any development within the catchment in Table 1 below. The table also includes the proposed approaches to mitigating these effects where significant, and commentary on the assessed effectiveness of these. The T+T SMP presents further details of the assessment supporting the commentary below.

Table 1: Potential flooding effects and proposed mitigation

Potential effect	Proposed mitigation	Assessment comments
Changes in runoff due to changes in land use. For example, areas that are converted from pasture to roads and residential dwellings will result in higher runoff rates and total runoff volumes, while areas that are converted from pasture to bush are likely to yield lower runoff rates and volumes. This can impact the timing of peak flows from the catchment.	Flood detention dams designed to NTLDM standards, including attenuation of 10% and 1% AEP storms, and extended detention to mitigate changes in outflow duration.	Preliminary modelling based on the proposed Structure Plan shows that without detention, there would be a net increase in site runoff peaks/volumes as a result of the proposed land use changes. Modelling of a concept design option indicates that approximately 10,000 m^3 of total storage across five ponds would be required to mitigate the effects of development and ensure that post-development flows would be no greater than pre-development flows in the design events. The critical event was found to have a 6-hour duration.

Potential effect	Proposed mitigation	Assessment comments
		Modelling also shows that with these detention devices in place, the timing of the peak outflow from the Kākā catchment would be delayed by approximately ten minutes. The flows in the receiving Maitahi/Mahitahi River in an extreme event of 6-hour duration are expected to remain elevated for much longer (within 10% of peak for approximately 1.5 hours) and therefore that the change in timing of the peak will not have significant downstream effects. Modelling of the post-development hydrographs also shows that the increased runoff volume does not have adverse effects downstream in the Maitahi/Mahitahi system and/or in the lower floodplain.
Development will include stormwater infrastructure that typically concentrates runoff at discharge locations. If unmitigated, this could cause increased erosion at outlets and within watercourses.	Addressed in the evidence of Mr Maurice Mills and Mr Stu Farrant.	
Alteration of flowpaths, flood extents, levels and velocities due to encroachment of existing floodplains by earthworks, affecting existing development on the property, or to adjacent/downstream property.	Earthworks footprints to be designed iteratively with flood modelling to determine effects, and off-site effects avoided.	Several iterations of the earthworks footprint within the existing Maitahi/Mahitahi River floodplain were modelled until a footprint was found that limited any changes in modelled flood depths outside the application site to within the confidence limits of the model (50 mm). A resulting compliant earthworks footprint is presented in the SMP.
Development within the existing floodplain exposes the new development to flood risk.	All new development to meet the requirements of the NTLDM and the NZ Building Act in terms of flood hazard. For the development area within the existing floodplain, the applicant proposes to adopt a minimum ground level for new lots of 0.5 m above the 2130 1% AEP flood level.	For more details refer to the SMP and the evidence of Mr Maurice Mills.

[25] In my opinion, the assessment summarised in Table 1 above (and outlined in more detail in the SMP) demonstrates that there are feasible options available to meet NTLDM requirements for mitigation of the potential

effects on flooding of any future development within the PPC28 area within the Kākā catchment.

C2 – Walters Bluff/Brooklands Catchment

[26] I have read the evidence of Mr Maurice Mills in relation to the management of flood risk in the Walters Bluff/Brooklands catchment. I concur that the effects of development on flooding in this catchment are most appropriately managed through the use of detention devices that include an extended detention volume and are designed in accordance with the NTLDM. Given the existing downstream development and known capacity issues within the existing stormwater networks in this catchment, any future development would need to demonstrate no increase in peak flows as a result of that development. These devices may be on-site (per-lot) or communal (vested to Council), or a combination. I note that the proposed Structure Plan includes the opportunity to offset the effects of new development through enhancing the vegetation cover beyond what is currently found within the existing catchment. In my opinion, realising this opportunity would assist to partially offset the effects of any future development on runoff rates and volumes.

[27] In my opinion, the provision of detention devices in this catchment that are designed in accordance with the NTLDM would mitigate the potential effects of the development on flooding to adjacent and downstream properties.

Comments on Section 42A reports

[28] I have reviewed the Section 42A report, including Appendix J on Stormwater and Flood Risk dated 28 May 2022 and address the flood risk aspects of the report below.

[29] The issues raised in the Stormwater and Flood Risk report, with respect to flooding matters are presented in Table 2 below. Other matters raised in the Section 42a Report relating to stormwater management within the site, as well as on the Kākā Stream realignment and Maitai River bank erosion are addressed by other experts (Mr. Maurice Mills, Mr. Stu Farrant).

Table 2: Section 42a matters related to flooding (refer Appendix J)

Section 42A Report Appendix J Item reference[1]	Item Content	Applicant Response	Amended Plan change reference (where applicable)
Para 24(a)	Cumulative effects of staged development	Addressed through the T+T SMP, dated June 2022.	
Para 24(b) & (d)	Changes to peak flows and volumes	Addressed through the T+T SMP, dated June 2022. Post-development runoff rates assessed, and indicative pond sizing and locations shown.	
Para 24(e)	Filling within Maitai River floodplain	Addressed through the T+T SMP, dated June 2022 and T+T letter dated 05 May 2022. Modelling shows no off-site effects associated with proposed earthworks footprint	
Para 24(f)	Effect of floodplain cut	Not proposed. Refer T+T SMP.	
Para 24(j)	Possible new development within the existing overland flow paths	Addressed through the T+T SMP, dated June 2022.	
Para 24(k)	Flood detention effects on flooding, including dambreak risk	Addressed through the T+T SMP, dated June 2022. All dams to be designed in accordance with NTLDM and NZSOLD guidelines. Development to be designed with reference to post-development flood levels (including dam storage areas)	
Para 24(l)	Cumulative effects and lack of SMP	Addressed through the T+T SMP, dated June 2022.	
Para 25	Cumulative effects and lack of SMP	Addressed through the T+T SMP, dated June 2022.	
Para 26	Lack of development-wide options, or feasibility assessment	Addressed through the T+T SMP, dated June 2022.	
Para 27	Lack of SMP	Addressed through the T+T SMP, dated June 2022.	
Para 29(b), 31 & 33	Lack of detail on proposed detention.	Addressed through the T+T SMP, dated June 2022.	
Para 34(a)-(d)	General lack of detail for post-development runoff	Addressed through the T+T SMP, dated June 2022 and evidence above. Post-development flows have been assessed detention sized and timing of peaks assessed as reported in the SMP.	
Paras 35-57 and 77-88	Lack of SMP, and description of detail it should include.	Addressed through the T+T SMP, dated June 2022.	

[1] Rev 4, dated 28 May 2022

Dated 13 June 2022

Damian Velluppillai – Water Resources Engineer