IN THE MATTER	of the Resource Managemnet Act 1991 ("**the Act**")
AND	
IN THE MATTER	of a submission pursuant to Clause 6 of Schedule 1 of the Act in respect of the **PROPOSED WAIKATO DISTRICT PLAN** by Pokeno Village Holdings Limited (submitter no. 368 / further submitter no. 1281)

STATEMENT OF EVIDENCE OF DALE SARAH PAICE ON BEHALF OF POKENO VILLAGE HOLDINGS LIMITED (HEARING 25 – REZONING)

1. INTRODUCTION

1.1 My name is Dale Sarah Paice. I am a Technical Director in Civil Engineering at Beca Limited.

Qualifications and experience

1.2 I have a Bachelor of Engineering in Civil Engineering with First Class Honours from the University of Auckland (2003). I am registered as a Chartered Professional Engineer and International Professional Engineer with Engineering New Zealand.

1.3 I have 18 years' experience in Civil Engineering. I specialise in flood risk and stormwater management aspects of infrastructure and land development.

1.4 Examples of my experience relevant to this statement of evidence are:

(a) Infrastructure masterplanning including stormwater management plan preparation for Kāinga Ora's largescale residential intensification programmes (2016-2020).

(b) Civil lead role for resource consenting, detailed design and construction phases for a number of New Zealand retirement villages, including assessment of stormwater matters for a development contributions appeal (2015-2017).

(c) Preparation of a stormwater management plan to support successful rezoning of approximately 300 hectares of rural land (initially zoned "future urban" under the Auckland Unitary Plan) for residential purposes (2014-2015) at the Paerata Rise development.

(d) Stormwater design and assessment, including preparation of a stormwater management report to support rezoning of approximately 360 hectares of rural land for industrial purposes (2008-2016) at Drury South.

(e) Presentation of evidence on stormwater matters to the Auckland Unitary Plan Independent Hearings Panel on behalf of a number of clients (2014-2015).

Involvement in project

1.5 I was engaged by Pokeno Village Holdings Limited ("PVHL") in June 2020 to provide stormwater advice relating to the potential effects arising from the proposed extension of the urban areas of Pokeno as a result of submissions on the Proposed Waikato District Plan ("PWDP").

1.6 I last visited the site on 18 January 2021.

Purpose and scope of evidence

1.7 The purpose of my evidence is to describe the potential stormwater effects and infrastructure requirements arising from the various submissions on the PWDP seeking urban zoning for land on the outskirts of Pokeno and to make recommendations for addressing those effects and requirements.

1.8 Specifically, my evidence will:

(a) Describe the nature and scale of the stormwater runoff changes that would be generated if all submissions were approved (Section 3);

(b) Outline appropriate measures to cater for those changes (Section 4), by:

(i) Categorising the types of potential stormwater effects arising and identifying infrastructure that would manage those effects, and

(ii) Considering how the location and timing of development within a catchment influences the identified infrastructure requirements.

(c) Assess and comment on the PWDP stormwater management provisions (Section 5).

(d) Provide comment on relevant submissions (Section 6).

(e) Comment on the Council Officer's Report (Section 7).

(f) Provide a brief conclusion (Section 8).

1.9 A summary of my evidence is contained in Section 2.

Expert Witness Code of Conduct

1.10 I have read the Code of Conduct for Expert Witnesses, contained in the Environment Court Consolidated Practice Note (2014) and I agree to comply with it. I can confirm that the issues addressed in this statement are within my area of expertise and that in preparing my evidence I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

2. SUMMARY OF EVIDENCE

2.1 To give an indication of the scale of stormwater changes that the proposed zone changes would cause, I assessed stormwater runoff from the Tanitewhiora catchment. This catchment contains a large proportion of PVHL's development and many of the submissions for zone changes. The catchment extent is shown on the figure below.

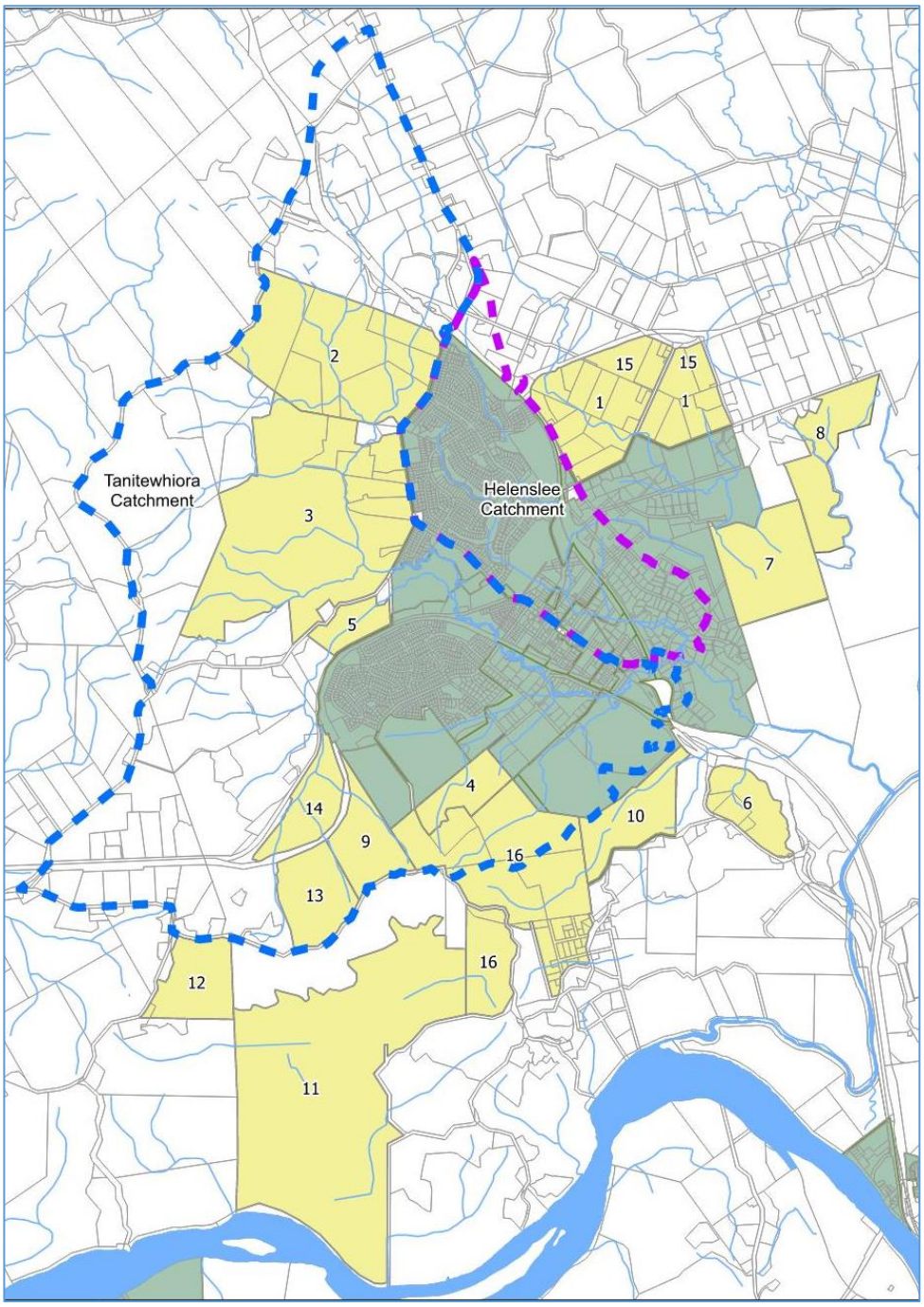

Figure - Tanitewhiora catchment extent and streams overlain on operative and proposed zoning

2.2 I calculated that the proposed zone changes would result in an 88% increase in impervious area and an increase in runoff volumes of 12%-64% (depending on the rainfall event assessed). The magnitude of these changes is significant and similar in scale to those enabled by Plan Change 24 (PC24) The stormwater management implications of PC24 and the associated infrastructure requirements were defined in a catchment management plan prepared by Franklin District Council (the 2010 SMP[1]).

2.3 I considered types of potential stormwater effects likely to arise from the proposed rezoning (being water quality, nuisance flooding and building flooding) and carried out a high-level assessment of the type and scale of infrastructure required to manage those effects in the Tanitewhiora catchment. The scale of infrastructure requirements is significant and likely to be similar in scale to that required in the 2010 SMP.

2.4 My analysis showed that approximately six hectares of land (spread across a number of locations) in the Tanitewhiora catchment may need to be set aside for centralised public attenuation devices (that is, ponds, wetlands or dry basins) to manage the additional runoff generated from the proposed zone changes. The location of attenuation devices within the catchment will be important. If incorrectly located attenuation devices are at best ineffective and, at worse, can actually worsen flooding in other parts of a catchment. This happens because attenuation changes runoff timing and can create coincident peaks. The phenomenon is widely recognised, including by Waikato Regional Council whose guidelines[2] recognise "position in catchment" as a consideration and call for either a catchment study or attenuation to well below pre-development peaks.

2.5 In my review of the submissions and reports, I have not found direction, controls or guidance on where attenuation devices are to be located within the Tanitewhiora catchment (or the other affected catchments). In my opinion this is a gap that could result in:

(a) unnecessary infrastructure being constructed and vested, or

(b) an inefficient number of attenuation devices spread over a greater number of locations than necessary, or

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1 Franklin District Council, September 2010 *"Pokeno Stormwater Catchment Management Plan"*

2 Waikato Regional Council Technical Report 2020/07 Section 7.1.17 "Peak flow control criteria"

(c) (unintended) increased flood risk in the catchment due to peak flows increasing from timing effects.

2.6 Notwithstanding the significant scale of proposed development, the significant scale of the infrastructure required and the need to consider catchment location further, I consider that the proposed growth could be accommodated from a stormwater effects and infrastructure perspective, if stormwater is considered at catchment (not site) scale.

2.7 On that basis, I consider rezoning could be appropriate subject to catchment-scale spatial plans being produced (supported by hydrological modelling) to show:

(a) Where different types of stormwater management devices (especially attenuation devices) are to be applied or avoided,

(b) Floodplain extents and levels and where specific controls on building floor levels are to be applied, and

(c) What new or upgraded public infrastructure is required linked the to the areas of growth it enables.

2.8 In my experience of large-scale rezoning, this sort of catchment-wide study has been completed before land is up-zoned. The exception was the Paerata Rise development which was re-zoned to a "future urban zone" ahead of the catchment study which was then completed before the area was zoned for residential development.

3. MANAGEMENT OF STORMWATER IN POKENO

3.1 In 2008 applications were made to allow a significant amount of growth around Pokeno Village under Plan Change 24 (PC24). The growth area identified at that time was some 400 hectares and located within the 1270 hectare Tanitewhiora stormwater sub-catchment and the 230 hectare Helenslee sub-catchment.

3.2 The post- PC24 operative urban areas and the relevant catchments are shown on Figure 1.

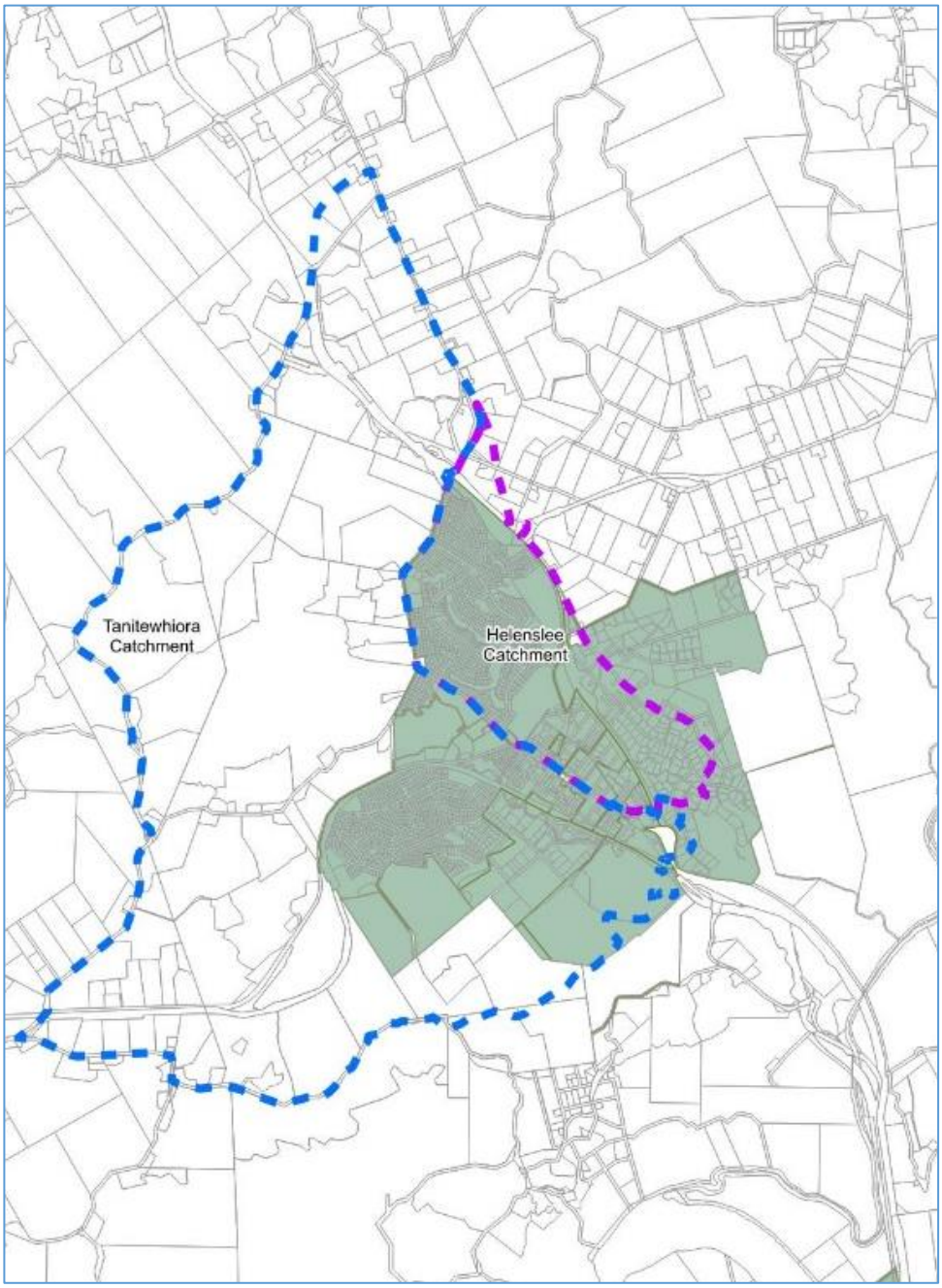


Figure 1 – Tanitewhiora catchment extent overlain on operative zoning

3.3 Plan Change 24 was supported by a stormwater catchment management plan which was prepared by the former Franklin District Council initially in 2008 and subsequently updated in 2010[3] (the 2010 SMP). That plan assessed pre-existing stormwater issues as well as the potential impacts of growth in the Tanitewhiora and Helenslee sub-catchments and made recommendations including:

(a) Floodplain extents (that is, areas subject to flooding issues and areas to avoid for development),

(b) Infrastructure upgrades (for example, culvert upgrades including an upgrade to the Great South Road bridge to open up the waterway),

(c) New infrastructure to manage increased runoff (for example, some 13 ponds), and

(d) Areas where specific constraints or opportunities apply (for example, areas within the original Pokeno Village where on-site stormwater management would apply and areas near the industrial zones where floodplain filling would be possible).

3.4 The 2010 SMP recommendations are shown on the plan included as Figure 2 below. I have been informed that the recommended works have not all yet been completed. I have not reviewed the completeness of those works myself.

[3] Franklin District Council, September 2010 *"Pokeno Stormwater Catchment Management Plan".*

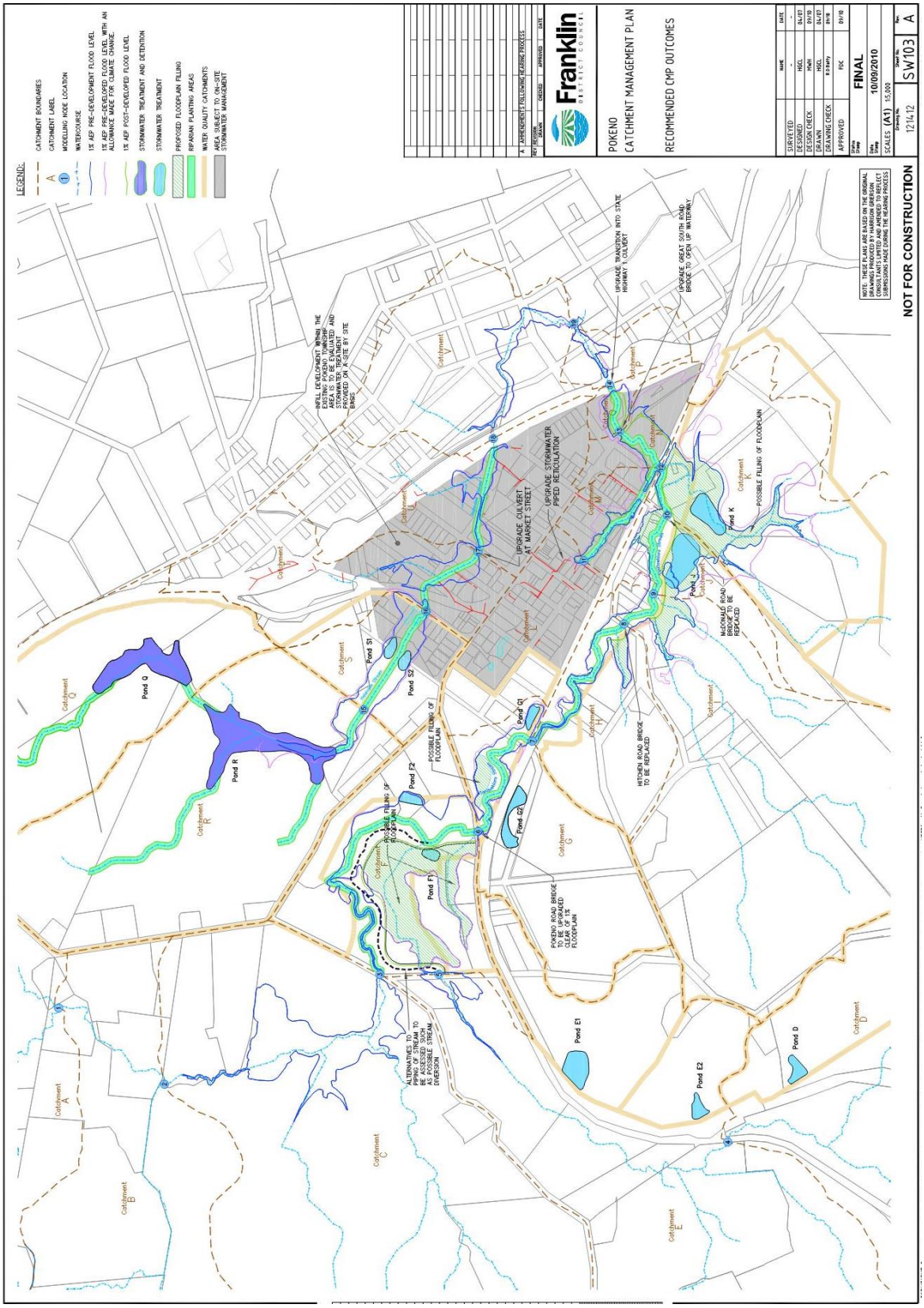


Figure 2 – 2010 SMP Recommended CMP Outcomes

4. SUBMISSIONS ON THE PWDP

4.1 Submissions on the PWDP together seek to re-zone a total of near 1000 hectares of land around Pokeno. Approximately half of this land is within the Tanitewhiora catchment. The remainder is outside the catchments covered by the 2010 SMP to the east and to the south. The location of the potential development area proposed through submissions is shown on Figure 3.

5. NATURE AND SCALE OF STORMWATER CHANGES

5.1 To give an indication of the scale of stormwater changes that approval of the rezoning submissions would cause, I have assessed stormwater runoff from the Tanitewhiora catchment for pre and post development scenarios. I have selected this catchment as it contains a large proportion of PVHL's development and many of the submissions for zone changes.

5.2 Figure 3 shows the catchment extent overlain with operative and proposed zoning.

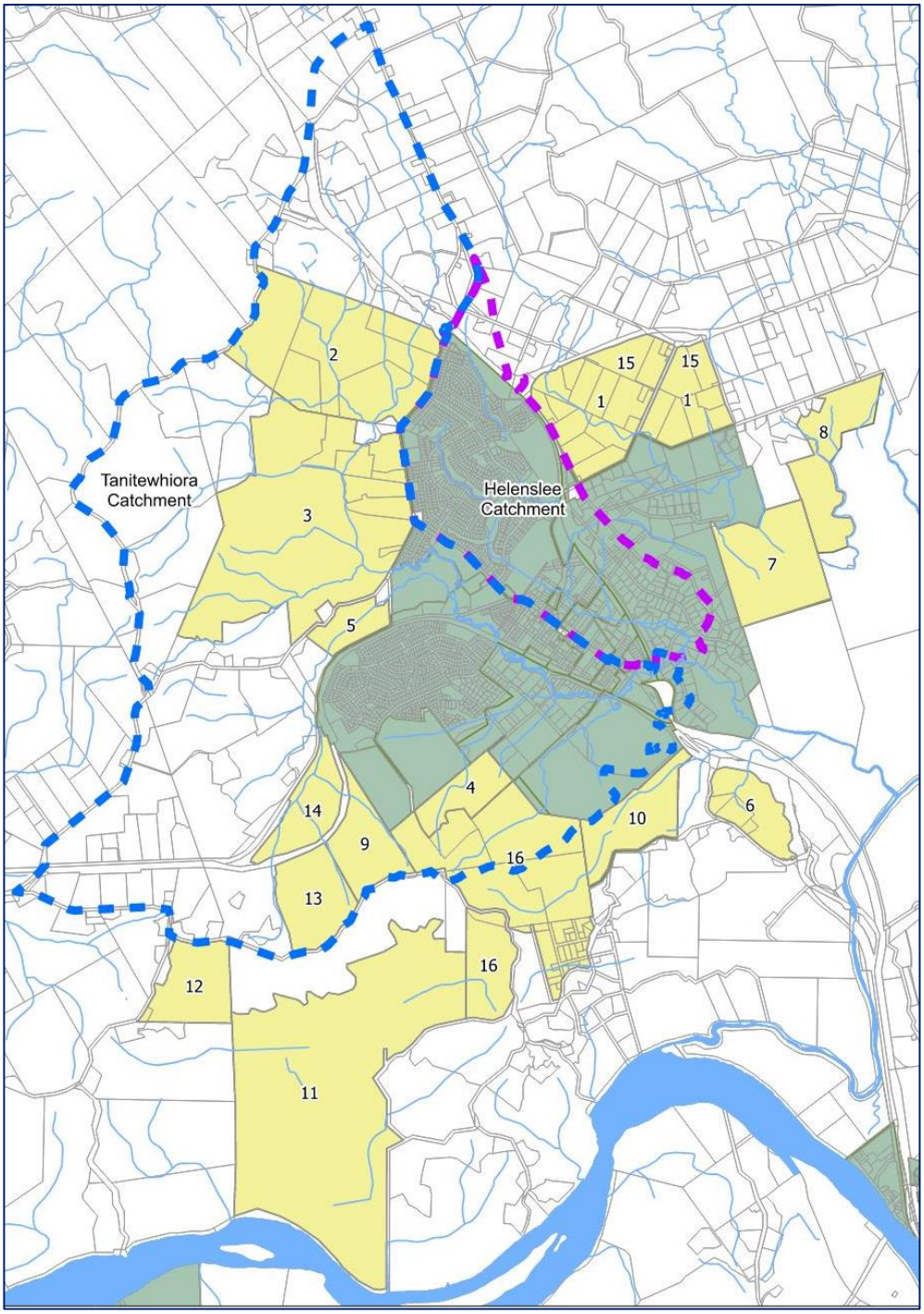


Figure 3 – Tanitewhiora catchment extent overlain on operative and proposed zoning

5.3 I have considered three development scenarios, being:

(a) **2007**: Zoning and impervious coverage as per the "pre-development" scenario assessed in the 2010 SMP.

(b) **Operative**: Zoning and impervious coverage as per the 2010 SMP.

(c) **Proposed**: Zoning and assumed impervious coverage as per submissions to the Waikato District Plan.

5.4 Table 1 summarises the impervious area for each scenario assessed.

Table 1 – Impervious area in the Tanitewhiora catchment

	2007	Operative	Proposed
Catchment area (hectares)	1,259	1,259	1,259
Impervious area (hectares)	81	211	396
Impervious coverage (%)	6.5%	16.8%	31.5%
Increase wrt previous scenario (hectares)	-	130 (160%)	185 (88%)

5.5 If all were approved, the proposed zone changes would increase impervious area in the catchment from 211 to 396 hectares; an increase in impervious coverage from 16.8% to 31.5%. This in a similar magnitude (albeit slightly smaller) of growth as that enabled by PC24 and the 2010 SMP.

5.6 Increases in impervious area lead to increases in stormwater runoff volumes as less rainfall can be absorbed into soils. The increase in runoff volume is influenced by local conditions such rainfall depth (that is, storm size) and soil types. I have calculated the runoff volumes that would occur in the Tanitewhiora catchment for each of the three development scenarios given above, applying the calculation method (SCS), rainfall depths and soil parameters used in the 2010 SMP.

5.7 I have considered three different rainfall events in this assessment, based on key stormwater management practices being:

(a) **Water quality event** (20mm, 24 hour rainfall depth): Events up to approximately this size are captured and passed through water quality treatment devices to remove contaminants and / or held and released slowly to reduce "flashiness" in receiving streams.

(b) **10 year ARI**[4] (152mm, 24 hour rainfall depth): Events up to this size are conveyed through a stormwater network to avoid nuisance and property flooding.

(c) **100 year ARI** (252mm, 24 hour rainfall depth): Events up to this size are conveyed overland or in floodplains or ponding areas and are used to set minimum floor levels, to protect bridges and major road crossings.

5.8 Table 2, Table 3 and Table 4 summarise stormwater runoff volumes calculated for each scenario and rainfall event assessed.

Table 2 – Stormwater runoff volumes in the Tanitewhiora catchment for 20mm rainfall

	2007	Operative	Proposed
Runoff volume (m^3)	23,615	43,043	70,769
Increase wrt previous scenario (m^3)	-	19,427 (82%)	27,726 (64%)

Table 3 – Stormwater runoff volumes in the Tanitewhiora catchment – 10 year ARI

	2007	Operative	Proposed
Runoff volume (m^3)	787,126	904,276	1,071,470
Increase wrt previous scenario (m^3)	-	117,149 (15%)	167,194 (18%)

Table 4 – Stormwater runoff volumes in the Tanitewhiora catchment – 100 year ARI

	2007	Operative	Proposed
Runoff volume (m^3)	1,596,339	1,749,081	1,967,073
Increase wrt previous scenario (m^3)	-	152,743 (10%)	217,992 (12%)

5.9 The volume of runoff is predicted to increase by 64% in the small water quality event, 20% in the 10-year ARI and 12% in the 100-year ARI. It is often the case that the impact of increased impervious area is greater on

[4] ARI: "Average Recurrence Interval".

smaller rainfall events than larger rainfall events. This is because soils can get swamped in a larger, extended rainfall event and stop absorbing rainfall.

5.10 The predicted increase in runoff volume is a similar magnitude (albeit slightly smaller) to the volume increase that was enabled by PC24 and the 2010 SMP.

5.11 Increases in stormwater runoff volume lead to increases to stormwater peak flows which then translate to increases in flood level. Peak flows are unique to each location in a catchment network and require a detailed analysis to assess; I have not done so here. To give an indication of the scale of potential peak flow changes, however, I have estimated the 10-year ARI flow rates at one indicative location low in the Tanitewhiora catchment. The results of that assessment are shown on hydrographs in Figure 4 and indicate a peak flow increase of 26% from the operative scenario to the proposed is possible.

5.12 I note that this analysis was coarse and did not allow for attenuation of flows traveling down the catchment. This means the peak flow increase shown on Figure 6 may be exaggerated. The purpose of this assessment is to indicate how peak flow changes when volume increases (that is, the peak increases and moves early in time) rather than to give an absolute assessment of the size of the increase.

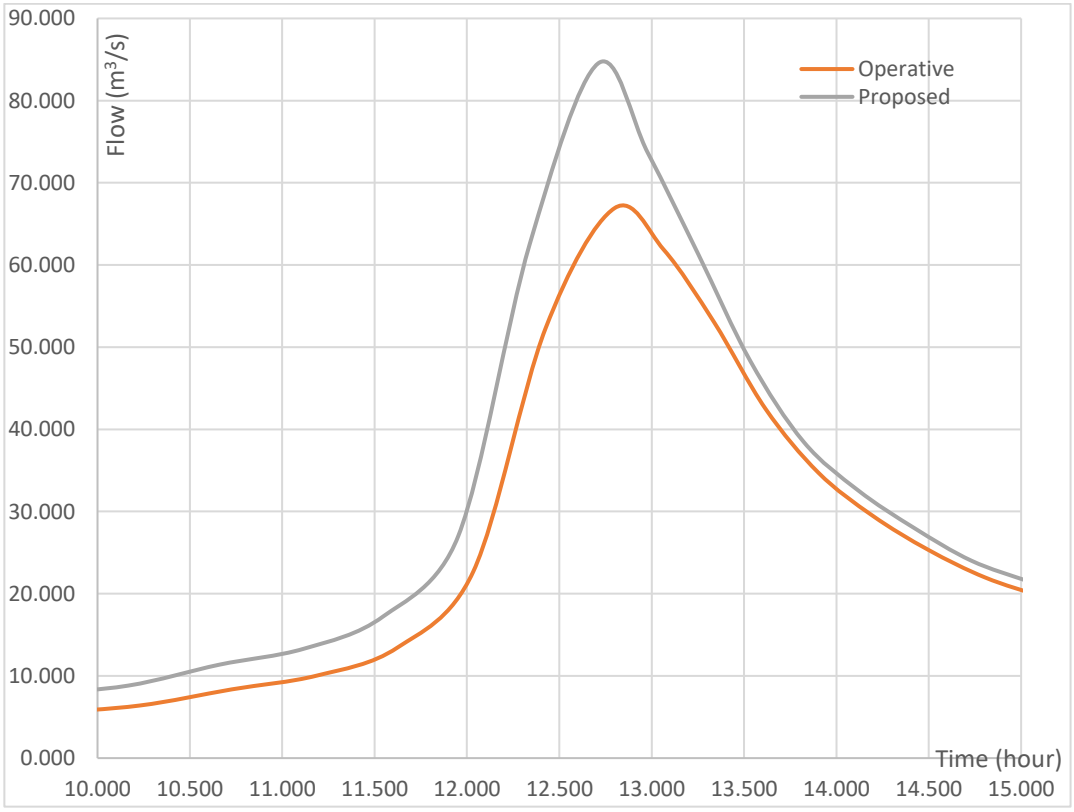


Figure 4 – Indicative hydrographs showing potential peak flow changes at a nominal location low in the Tanitewhiora catchment.

5.13 While the stormwater runoff changes (that is, 88% increase in impervious area, 12-64% increase in runoff volume and increases in peak flow) are significant, it is feasible that the effects of those changes can be adequately managed. The following section sets out appropriate management measures.

6. STORMWATER MANAGEMENT MEASURES

6.1 I have categorised the types of potential stormwater effects likely to arise in the Tanitewhiora catchment and identified infrastructure that would manage those effects.

6.2 The three rainfall events I assessed (summarised in Section 5.7 above) correspond to three different categories of stormwater effect: water quality, nuisance flooding and building and critical asset flooding. Table 5 summarises the nature of the potential effect and what methods are applied to manage those effects.

6.3 Table 6 summarises the type of infrastructure required to manage effects and indicates, for the Tanitewhiora catchment, the area of land that may be required for that infrastructure.

Table 5 – Categorisation of potential stormwater effects.

	Water quality (20mm rainfall)	**10 year ARI (152mm rainfall)**	**100 year ARI (252 rainfall)**
Nature of effect	a. Contamination of streams (e.g. from road runoff). b. Increased stream erosion from increased flashiness.	Nuisance flooding, land inundation, pipe capacity.	Building flooding, critical asset (e.g. State Highway) flooding.

	Water quality (20mm rainfall)	10 year ARI (152mm rainfall)	100 year ARI (252 rainfall)
Method of managing effect.	a. Devices to remove most (75%) contaminants generated from new impervious area. b. Devices to retain or detain flow for slow release.	Construct conveyance network. In appropriate locations, attenuate runoff to match pre-development peak flows.	Create overland conveyance network. Set minimum building floor levels. In appropriate locations, attenuate runoff to match pre-development peak flows.

Table 6 – Stormwater infrastructure requirements for the proposed growth in the Tanitewhiora catchment including estimates of land area required.

	Water quality (20mm rainfall)	10 year ARI (152mm rainfall)	100 year ARI (252 rainfall)
Flow conveyance requirements (public network)	-	Swales or pipes.	Overland flow paths.
Runoff management devices (on-lot / private assets)	Raintank, raingarden, swale, filterstrip, pervious paving, proprietary filters.	n/a [(1)]	n/a [(1)]

	Water quality (20mm rainfall)	10 year ARI (152mm rainfall)	100 year ARI (252 rainfall)
Typical size	2-10% of impervious area	n/a	n/a
Runoff management devices (public assets)	Raingardens, swales, ponds, wetlands	Attenuation in tanks, ponds, wetlands or dry basins.	Attenuation in ponds, wetlands or dry basins.
Typical size	2-10% of impervious area	2-3% of impervious area(2)	2-3% of impervious area(2)
Total device footprint to cater for proposed impervious increases in Tanitewhiora catchment.	3.7 – 18.5 hectares	3.7 – 5.6 hectares	3.7 – 5.6 hectares

Notes: (1) Attenuation is not practicable for residential scale lots but may be practicable for commercial and industrial lots. (2) This size estimate will be small in terms of overall device size as things like access setbacks and batters will need to be provided for.

6.4 My analysis of infrastructure requirements shows that approximately 6 hectares of land in the Tanitewhiora catchment may need to be set aside for centralised public attenuation devices (that is, ponds, wetlands or dry basins) with further areas allowed throughout for water quality management devices.

6.5 I have considered how the location of development and attenuation measures within a catchment influences the infrastructure requirements. Table 7 summarise these considerations and highlights that attenuation measures are sensitive to location in catchment.

Table 7 – Location and timing considerations for development and stormwater attenuation in the Tanitewhiora catchment.

	Water quality (20mm rainfall)	10 year ARI (152mm rainfall)	100 year ARI (252 rainfall)
Location	Generally applied throughout catchment.	Attenuation not applicable in all parts of catchment.	Attenuation not applicable in all parts of catchment. Minimum floor levels vary by location.
Timing	Generally constructed in at same time as development.	Timing dependent on construction of other devices and developments in catchment.	Timing dependent on construction of other devices and developments in catchment.

6.6 The location of attenuation devices within the Tanitewhiora catchment will be important. If incorrectly located attenuation devices are at best ineffective and, at worse, can actually worsen flooding in other parts of a catchment. This happens because attenuation changes runoff timing and can create coincident peaks. This effect is shown indicatively on Figure 6. The phenomenon is widely recognised. A well known industry rule of thumb for this is that attenuation should be avoided in the lower third of the catchment and encouraged in the upper third but in most cases, specific catchment assessments are necessary.

6.7 I note that the Waikato Regional Council recognises this concern. Their guidelines[5] call for the position in catchment to be considered when applying attenuation.

[5] Waikato Regional Council Technical Report 2020/07 Section 7.1.17 "Peak flow control criteria".

7.1.7 Peak flow control criteria

There are five requirements related to peak flow control criteria:

1. Rainfall data used for all rainfall events shall have 24-hour rainfall distribution.
2. The rainfall data for the 2, 10 and 100-year ARI events should be increased for the post-development scenario to allow for predicted climate change in accordance with Section 7.1.6.
3. Where there are existing downstream flooding issues, depending on the site's position in the catchment (refer to Section 7.1.3), it is recommended that the post-development peak discharge for the 100-year ARI rainfall event for a new development be limited to 80% of the pre-development peak discharge (unless there is a catchment study that demonstrates that this is not required).
4. In terms of intermediate storm control, depending on the site's position in the catchment (refer to Section 7.1.3), the 2 and 10-year ARI post-development peak discharges shall not exceed the 2 and 10-year ARI pre-development peak discharges.
5. As discussed in Section 7.1.3, peak flow control is generally only recommended for projects located in the top half of catchments so as to avoid concerns over coincidence of peaks aggravating downstream flooding concerns. It is expected that stormwater design will be undertaken by experienced stormwater practitioners who will be able to determine whether peak flow control is required. If there is confusion regarding whether peak flow control is required, Waikato Regional Council staff can be contacted to discuss further.

Figure 5 – Waikato Regional Guidance on peak flow control criteria

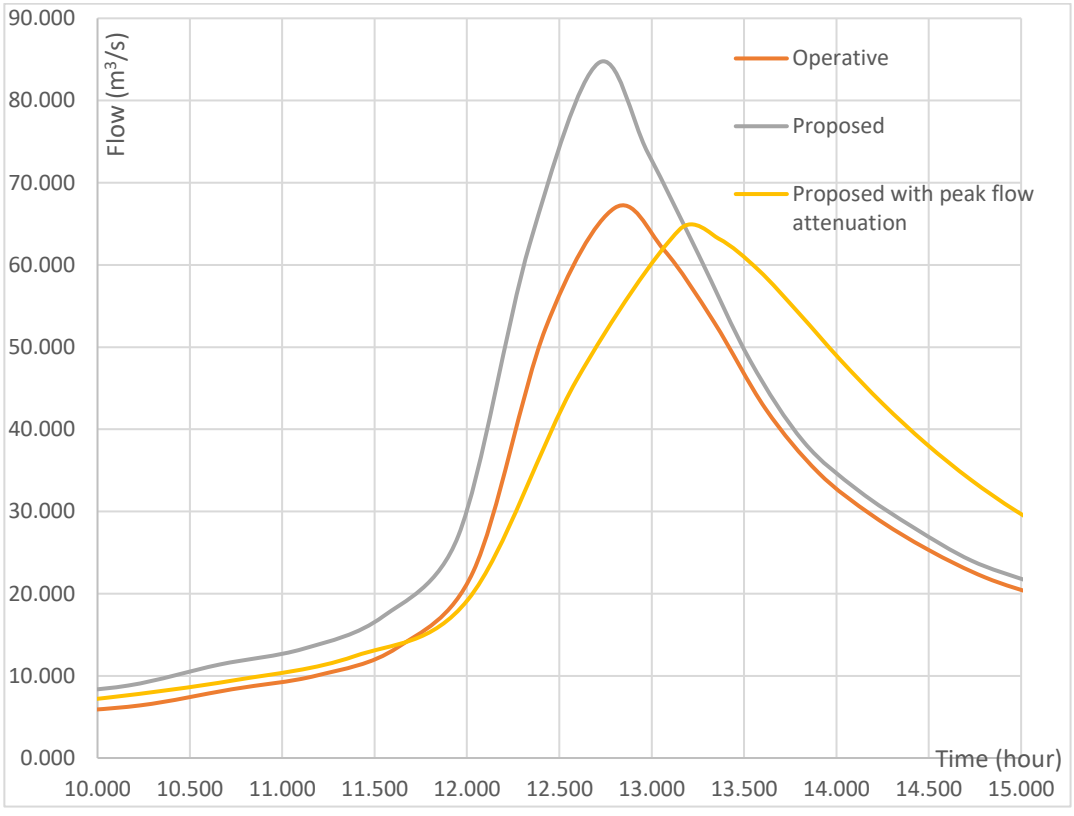


Figure 6 – Indicative hydrographs showing potential peak flow changes at a nominal location low in the Tanitewhiora catchment and the effect of attenuation on peak flow timing.

7. REVIEW OF PROPOSED STORMWATER MANAGEMENT APPROACH AND RECOMMENDATIONS

7.1 In my review of the PWDP and the section 42A reports, I have not found direction, controls or guidance on where stormwater management (particularly attenuation devices) are to be located within the Tanitewhiora catchment (or other affected catchments) to cater for growth.

7.2 It appears site-by-site approaches have been proposed through individual submissions and that no catchment-wide studies have been undertaken yet. As examples, the proposed Pokeno West development (Pokeno West Ltd/ Annie Chen Shui's submission) and proposed development at 179 and 205 Helenslee Road (proposed by CSL Trust and Top End Properties Limited) and the proposed Havelock Village development all describe approaches where ponds or tanks are used to attenuate peak flows to match pre-development flow at the boundary of each site or at the outlet pond or tank itself. The individual submissions do not consider the growth or attenuation proposed by the others and have not therefore assessed how runoff from each of these growth areas might interact to increase peak flows at critical downstream locations.

7.3 In my opinion this is a gap that could result in either unnecessary infrastructure being constructed, vested and maintained or increased flood risk in the catchment.

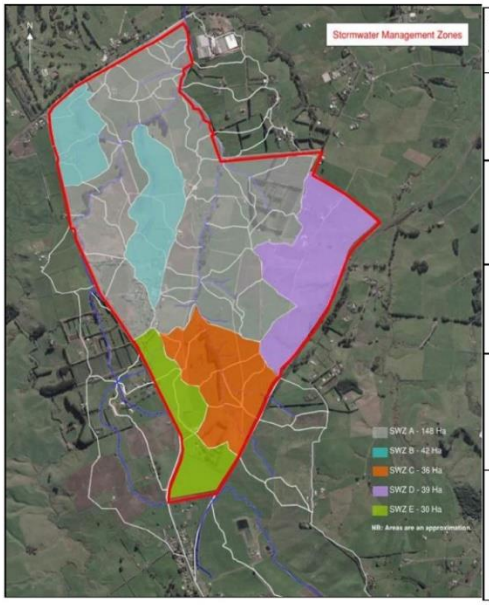
7.4 Some specific areas of risk that I have identified for Pokeno are:

(a) Maintaining adequate flood protection to the floor levels of existing buildings alongside the Tanitewhiora stream (including residential buildings recently constructed within the PVHL developments).

(b) Avoiding increases to floodplain extents and flood levels associated with the Tanitewhiora stream and low-lying tributaries between McDonald's Road through to downstream of Te Ara Aukati Terrace. The 2010 SMP indicates that floodplain extents in this area can be sensitive to increases in peak flows.

(c) Maintaining or achieving adequate flood level protection at structures (that is, bridges and culverts) crossing the stream including the North Island Main Trunk railway, State Highway 1 and Great South Road where freeboard may be reduced.

7.5 I consider that a good way to mitigate the risks identified above is through the development of a catchment-wide study that identifies where specific stormwater management measures will be applied or should be avoided. The findings could be used to set controls for the proposed areas of development that are appropriate to the location. An example of this from my previous work is the Wesley College plan change, where stormwater zones were used to show where attenuation should be applied and where it should not (more than half of the total development).



Stormwater Zone	Approx Area (ha)	Objective	General approach
SWZ A	148	Main catchment out of sensitive head water areas. No flood attenuation.	Water re-use for retention Retention and detention at source No flood attenuation
SWZ B	42	Main catchment with sensitive headwater areas and opportunity to create wetlands. No flood attenuation.	No water re-use Retention at source Detention in constructed wetlands or at source Water quality of HUR and carparks at source No flood attenuation
SWZ C	36	Main catchment with sensitive head water areas and to maintain baseflow. No flood attenuation.	No water re-use Retention and detention at source No flood attenuation
SWZ D	39	Out of main catchment with sensitive head water areas and opportunity to enhance wetlands. With flood attenuation.	No water re-use Retention at source Detention in constructed wetlands or at source Water quality of HUR and carparks at source Flood attenuation to Q_{100} in wetlands or dry storage
SWZ E	30	Out of main catchment with non-sensitive head water areas and opportunity to create wetlands. With flood attenuation.	Water re-use for retention Retention and Detention in constructed wetlands or at source Flood attenuation to Q_{100} in wetlands or dry storage

Figure 7 – Wesley College stormwater management plan overview.

8. RESPONSE TO SUBMISSIONS

8.1 In this section I provide specific comments about the evidence on stormwater matters prepared by submitters on the PWDP:

Pokeno West Ltd/Annie Chen Shiu

8.2 This submission relates "Pokeno West" land that is proposed to be zoned residential as shown on Figure 8.

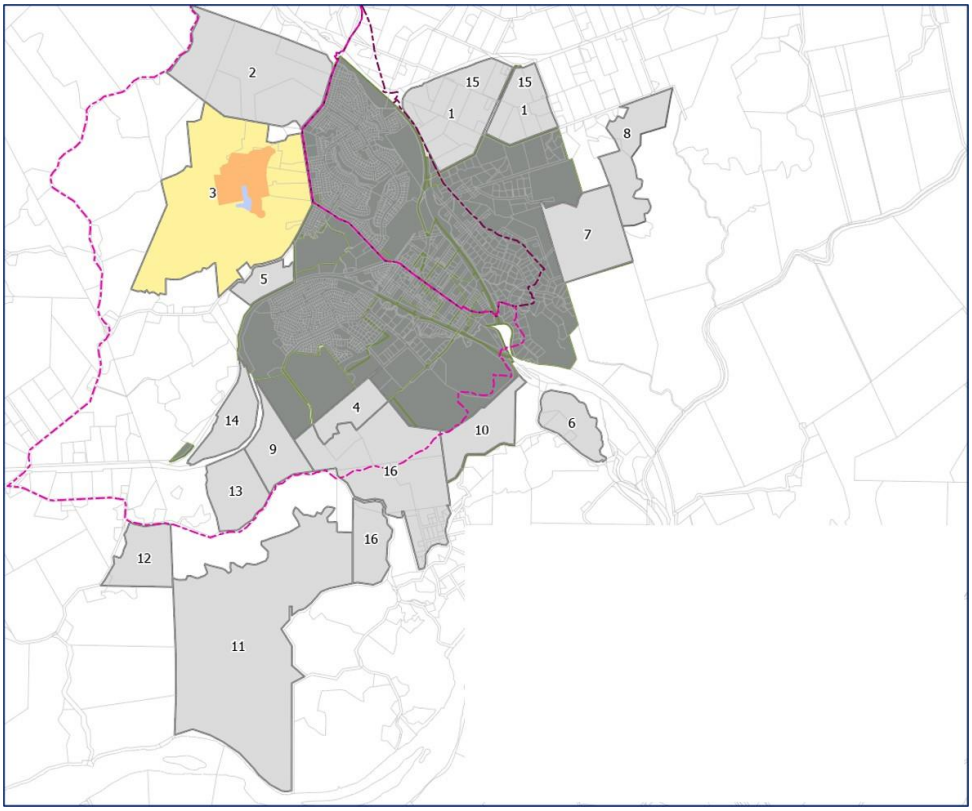


Figure 8 – Proposed zoning highlighting Pokeno West development

8.3 I have reviewed the evidence of Mr William Moore prepared in relation to the proposed Pokeno West development (as well as the proposed CSL and Top End Properties submission adjacent). In addition, I have reviewed an engineering report and drawings produced in 2018 by Maven and Associates for a proposed residential development at Pokeno West.

8.4 The engineering report and drawings show a development layout and proposed stormwater management infrastructure within Pokeno West that could manage stormwater runoff adequately for the proposed works. Location and concept sizes have been provided for "wetland attenuation ponds" and a concept layout for stormwater pipe and overland flow networks have been provided. In my opinion, the general scale and layout of stormwater infrastructure proposed for Pokeno West is likely to be adequate. I consider that the level of detail provided is good and the assessment provided is generally sound.

8.5 I do recommend, however, that the Pokeno West development be considered in the context of the wider catchment.

8.6 Mr Moore (in para 7.6 of his evidence), explains that the wetland ponds proposed will:

> *"provide stormwater attenuation to limit post-development peak discharges for the 10% AEP and 10% AEP storm events to their pre-development peak discharge release rates."*

8.7 Neither Mr Moore's evidence nor the engineering reports and drawings produced for the Pokeno West development specifically consider the position of the development and proposed attenuation ponds within the catchment and how that relates to other areas of development or proposed assets. For the reasons set out in my evidence above, I consider that position in catchment must be considered in order to demonstrate that potential flood risk effects to others can be assessed.

8.8 Mr Moore states (para 7.4) that the proposed design approach will focus on *"reducing or eliminating stormwater runoff generation"* and that the proposed stormwater management approach *"will maintain pre-development flood flows from future land change (ie. no change from pre to post development, ensuing* [sp] *the development is stormwater neutral"* (paragraph 7.10).

8.9 In my experience it is never practical to "eliminate" stormwater runoff generation. Also, given that the volume and timing of stormwater runoff inevitably changes with development (even with attenuation ponds), I consider that describing the development as "stormwater neutral" can be misleading. It should be recognised that stormwater runoff volumes will increase with development and hence effects further downstream in the catchment are possible.

8.10 I recommend specific consideration be given to potential flood effects at the following locations which could potentially be affected by the Pokeno West development either on its own or interacting with other development in the catchment. These are:

(a) The floor levels of existing buildings alongside the Tanitewhiora stream, including those recently constructed in the PVHL developments.

(b) Floodplain extents and levels associated with the Tanitewhiora stream and low-lying tributaries between McDonald's Road through to downstream of Te Ara Aukati Terrace. The 2010 SMP indicates that floodplain extents in this area can be sensitive to increases in peak flows.

(c) Flood level protection at structures (that is, bridges and culverts) crossing the stream including the North Island Main Trunk railway,

State Highway 1 and Great South Road where freeboard may be reduced.

8.11 Mr Moore (paragraph 7.1) recognises that a catchment-wide approach is necessary, stating that:

> *A new Stormwater Management Plan ('SMP') will be required to facilitate future development of the area which will determine stormwater management requirements".*

8.12 I agree with Mr Moore on this point.

CSL Trust and Top End Properties

8.13 This submission seeks residential zoning of land to the north of the Pokeno West development that is that is the subject of Pokeno West Ltd/Annie Chen Shui's submission which I have addressed above. This land is shown on Figure 9.

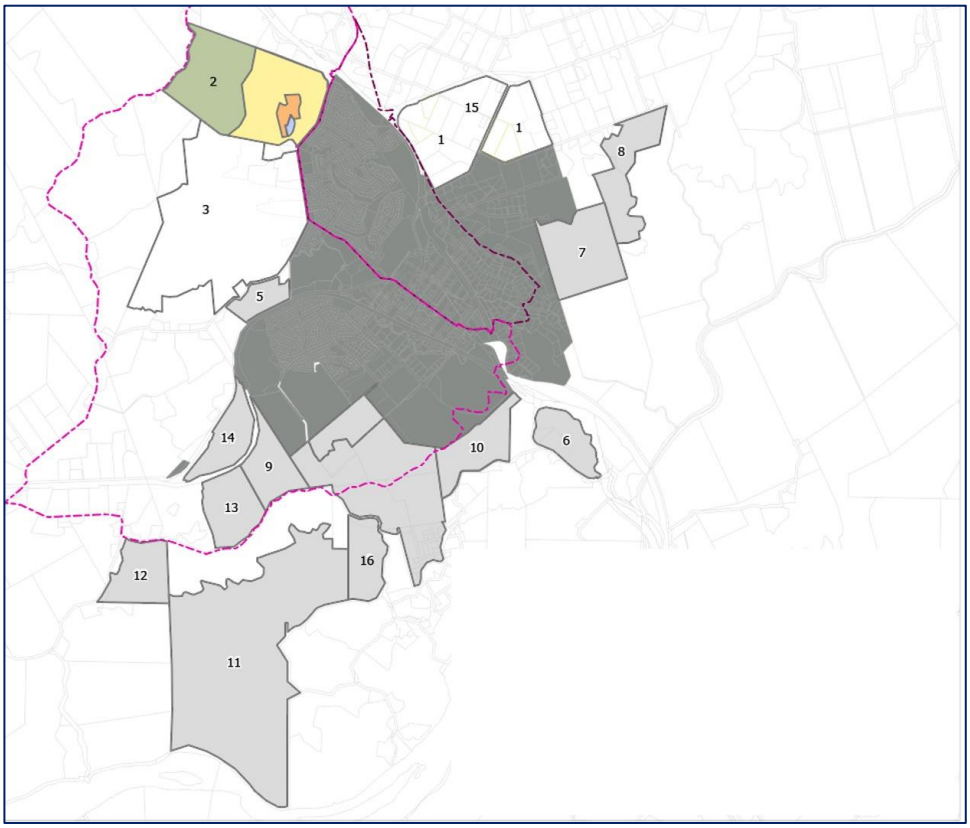


Figure 9 – Proposed zoning highlighting CSL Trust and Top End Properties land.

8.14 I have reviewed the evidence of Mr William Moore prepared in relation to the proposed CSL Trust and Top End Properties submission noting that his evidence also covers the Pokeno West development which I have addressed above.

8.15 I have not reviewed engineering plans and reports related to the development of this land so cannot comment on the adequacy of any stormwater management measures proposed.

8.16 My comments on the evidence proposed as set out in Sections 8.6 to 8.12 of my evidence above apply.

9. RESPONSE TO COUNCIL OFFICER'S REPORT

9.1 I have reviewed parts of the Section 42a "Zone Extents" Framework Report. I have noted that the document makes reference to the Waikato Regional Policy Statement implementation method 6.1.8 g) *"how stormwater will be managed having regard to a total catchment management approach and low impact design methods".*

9.2 A catchment management plan has not been produced that covers the scale and extent of development proposed through submissions or the full extent of catchments affected.

9.3 The 2010 SMP did provide a total catchment management approach for the level of development anticipated in Pokeno at that time, however, I do not consider it adequate for the scale and extent of development now being considered.

10. CONCLUSIONS

10.1 The zone changes proposed through submissions would result in an 88% increase in impervious area and an increase in runoff volumes of 12%-64% (depending on the rainfall event assessed). The magnitude of these changes is significant and is similar in scale to those enabled by PC24 and assessed in the 2010 SMP.

10.2 I considered types of potential stormwater effects likely to arise from the increase in stormwater runoff (being water quality, nuisance flooding and building or critical asset flooding) and carried out a high-level assessment of the type and scale of infrastructure required to manage those effects in the Tanitewhiora catchment. The scale of infrastructure requirements is significant and likely to be similar in scale (and additional to) that identified in the 2010 SMP.

10.3 It appears site-by-site approaches to stormwater management have been proposed through individual submissions and that no catchment-wide studies have been undertaken yet.

10.4 Notwithstanding the significant scale of proposed development, the significant scale of the infrastructure required and the need to consider the wider affected catchments further, I consider that the proposed growth could be accommodated from a stormwater effects and infrastructure perspective, subject to stormwater management plans being produced (supported by hydrological modelling) to show:

(a) Where different types of stormwater management devices (especially attenuation devices) are to be applied or avoided;

(b) Floodplain extents and levels and where specific controls on building floor levels are to be applied; and

(c) What new or upgraded public infrastructure is required linked to the areas of growth it enables.

10.5 I recommend this stormwater management plan is prepared prior to rezoning.

Dale Paice

10 March 2021