Tonkin+Taylor

Memo

To:	**Mark Iszard and Carmel O'Sullivan (Healthy Waters)**	**Job No:**	**1008200.2000**
From:	**Tim Fisher and Charlotte Peyroux (Tonkin + Taylor)**	**Date:**	**6 April 2020**
cc:	**Andrew McCarthy (Oyster), Nick Roberts (Barkers)**		
Subject:	**Drury East (Oyster Capital) flood modelling - Response to Auckland Council Further Information Request on Stormwater Matters (Version 2)**		

This memo responds to the Auckland Council Further Information Request (FIR) for the Oyster Capital Plan Change Area (also referred to as 116 Waihoehoe Road and surrounds). While the three Drury East Plan Change Areas (Kiwi Property, Fulton Hogan and Oyster Capital) work towards an integrated stormwater management approach, the Oyster Capital development is located within a different catchment to the other developments and therefore a different flood assessment approach is needed because of the different catchment issues, scale of development and availability of modelling tools.

The flood assessment approach adopted below supplements the *Drury East (Kiwi and Fulton Hogan) flood modelling – response to Auckland Council modelling requests* memo prepared by Tonkin + Taylor on 19 February 2020. That memo demonstrated that existing flooding in Drury was not worsened by those developments and that a pass-forward approach was suitable. The same principles apply for the Oyster Plan Change Area, which is similarly located at the bottom of the large adjacent Slippery Creek catchment.

This memo builds on the *Response to Auckland Council Further Information Request on Stormwater Matters for Drury East* memo prepared by Woods and Tonkin + Taylor on 25 March 2020.

The structure of the memo is as follows:

- Background
- Flooding effects
- Stream erosion
- Water quality

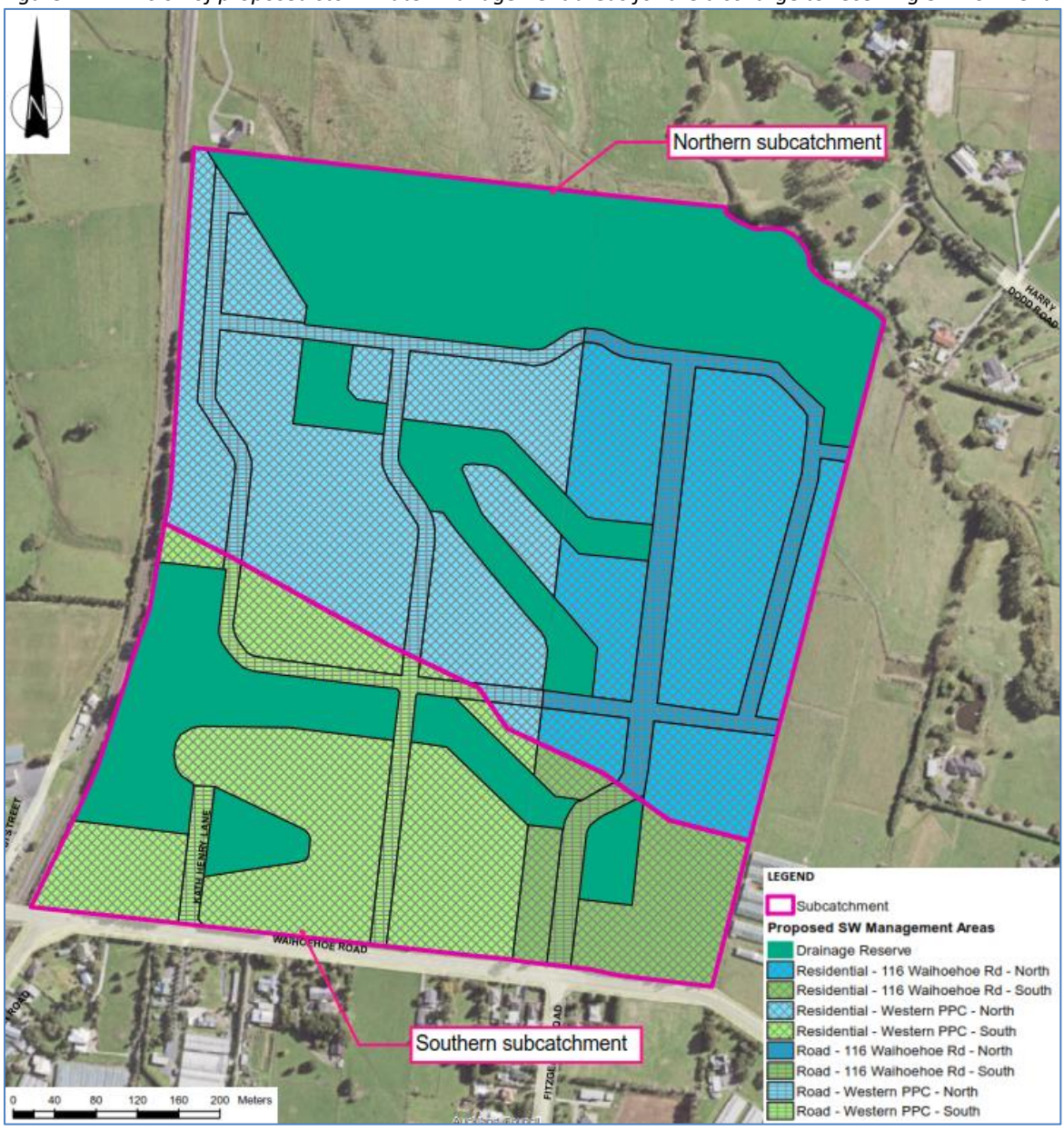
How the response relates to the Auckland Council FIR table is summarised in Appendix A.

1 Background

The Oyster Capital development comprises two sub-catchments (refer Figure 1.1), which lie at the downstream end of the Slippery Creek catchment and within the Slippery Creek flood plain. These two sub-catchments have different catchment opportunities and constraints and therefore require separate stormwater and flood management approaches. The proposed approaches outlined in the 116 Waihoehoe Road and surrounds Stormwater Management Plan (SMP) prepared by Tonkin + Taylor in August 2019 are:

- The northern sub-catchment will allow for quick conveyance of flows into Wahoihoi Stream to pass flows forward before flows of upper catchments reaches the area.
- The southern sub-catchment will detain flows of up to 100 year Annual Recurrence Interval (ARI) storms within the sub-catchment to mitigate flooding within the western part of the plan change area and further downstream.

Figure 1.1: Division of proposed stormwater management areas for the discharge to receiving environment



2 Flooding effects

We understand that Auckland Council want additional assessment for the potential flooding caused by a 'development only flood scenario' in accordance with Item 5 of the *Further Information Request (FIR) - Drury East Plan Changes* included in the *Healthy Waters Review of Adequacy of Information for a Private Plan Change (PPC) Request – Drury East - Fulton Hogan and Kiwi Property* memo from Auckland Council on 2 February 2020. The purpose of this assessment is to ascertain whether the development with its additional runoff causes a new flooding mechanism and effects and to confirm the suitability of the flood management approaches.

2.1 Northern sub-catchment - Proposed methodology

The *Response to Auckland Council Further Information Request on Stormwater Matters for Drury East* memo prepared by Woods and Tonkin + Taylor on 25 March 2020 demonstrates that the "pass flows forward" solution works for the Fulton Hogan and Kiwi Property developments. As the Oyster Capital development is smaller in size, albeit in the adjacent catchment, we anticipate that the peak flows generated on the northern sub-catchment as a result of the development will be negligible in comparison to the peak flows generated by the upstream catchment. Additionally, it is expected that the peak flows from the development will occur earlier than the peak of the upstream catchment, which is why it is preferable to discharge the stormwater in advance of the catchment flood peak.

This memo seeks to test this "pass flows forward" solution with the following simple approach:

- Build a HEC-HMS[1] model (hydrology model rather than full flood model) for the pre- and post-development 2, 10 and 100 year ARI rainfall events and generate development only flows.
  - Estimate 24 hour rainfall depths for 2, 10 and 100 years from the TP108 isopleths and use those totals to prepare hyetographs using TP108 temporal distribution.
- Compare post-development flows to:
  - a Pre-development flows from the site.
  - b Slippery Creek model flows at the Slippery and Waihoihoi culvert crossings under the railway to show the much smaller size of the development flows compared to the catchment flows.
  - c Compare the increase in flood volume (and timing) to size/volume of the receiving flood plain to demonstrate that the development causes negligible differences in the flood levels.

2.2 Northern sub-catchment - Results

Figure 2.1 shows the northern sub-catchment development only hydrographs generated in HEC HMS and Table 1 shows the peak flow rates for the pre- and post-development 2, 10 and 100 year ARI rainfall events.

[1] Hydrologic Engineering Center – Hydrologic Modelling System software designed to simulate the complete hydrologic processes of dendritic watershed systems.

Figure 2.1 - Northern sub-catchment 'development only' hydrographs

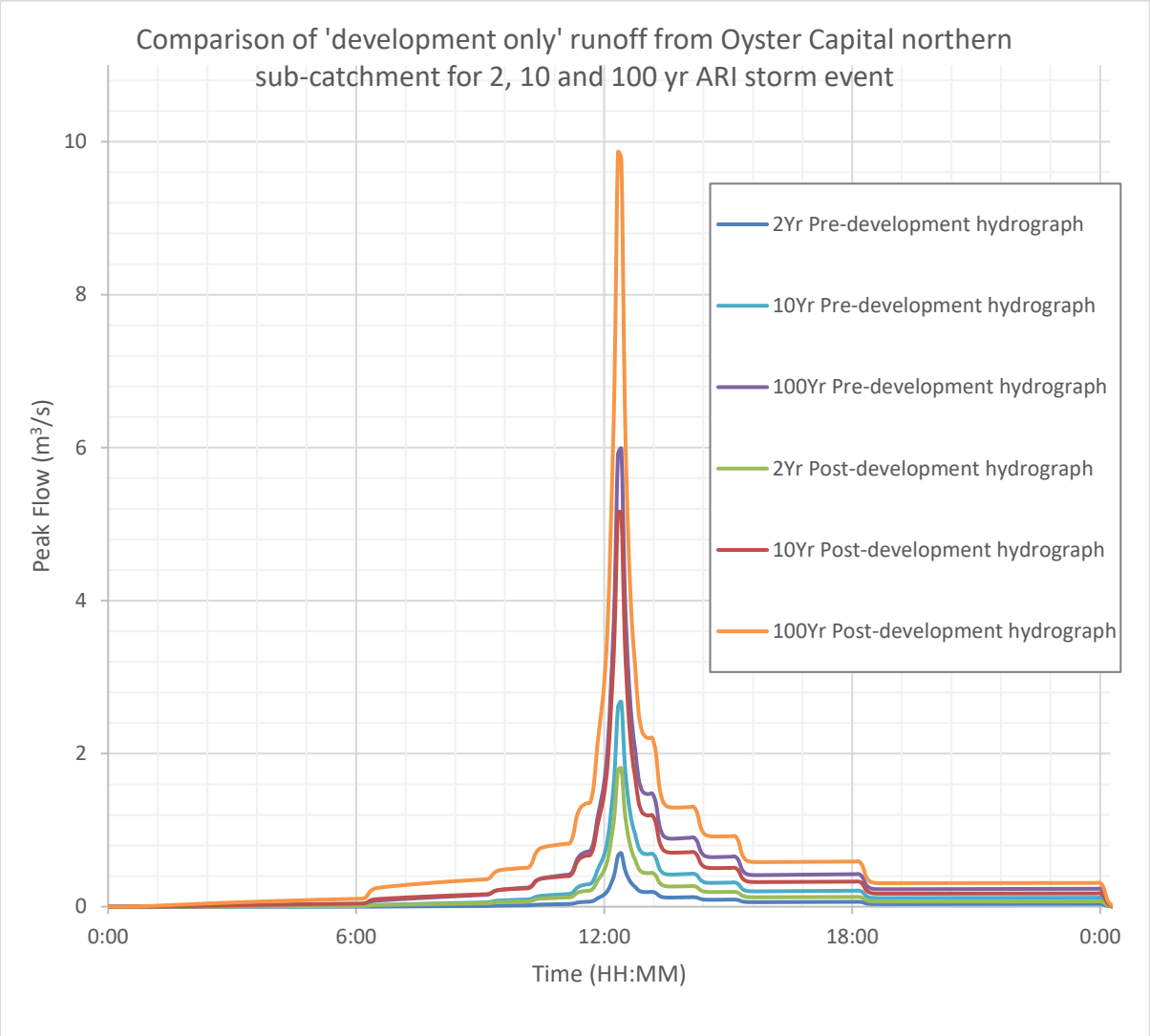


Table 1 – Peak development only flow rates from the Northern sub-catchment for the pre- and post-development 2, 10 and 100 year ARI rainfall events.

ARI rainfall event	**2 Year**	**10 Year**	**100 Year**
Pre-development *(m³/s)*	0.73	2.83	6.36
Post-development *(m³/s)*	1.92	5.50	10.46
Difference (m³/s)	**1.19**	**2.67**	**4.10**

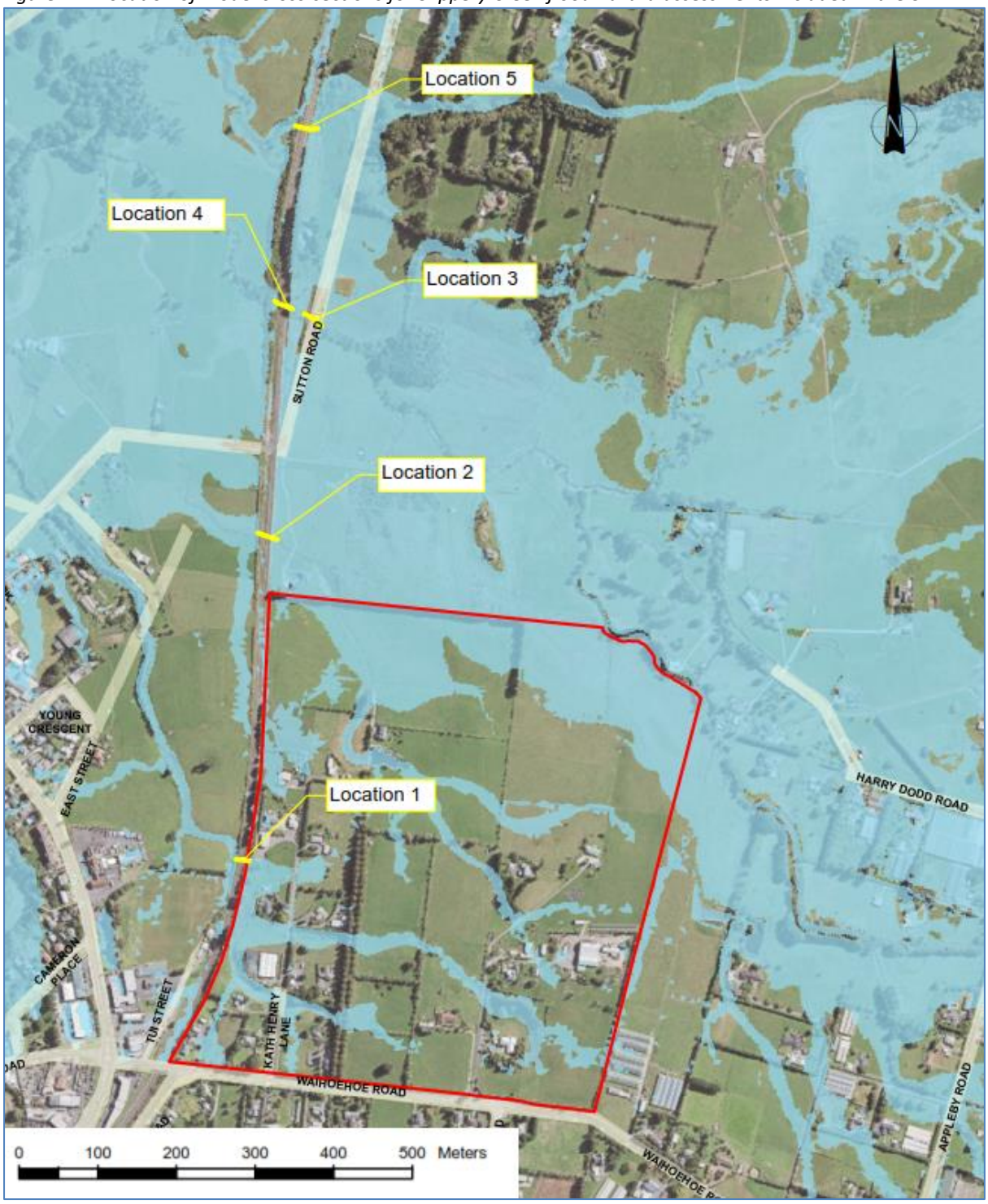
The results show that in all design rainfall events the post-development flows are almost twice that of pre-development flows.

Auckland Council has a Slippery Creek rapid flood hazard assessment model, which includes effective rainfall and major inflows from Slippery Creek, Hingaia Creek, Waihoihoi Stream, Symonds Creek, Whangapouri Creek, Ngakaroa Creek and Oira Creek, and associated tributaries complied in Infoworks ICM[2] .

[2] Infoworks Integrated all source Catchment Modelling software

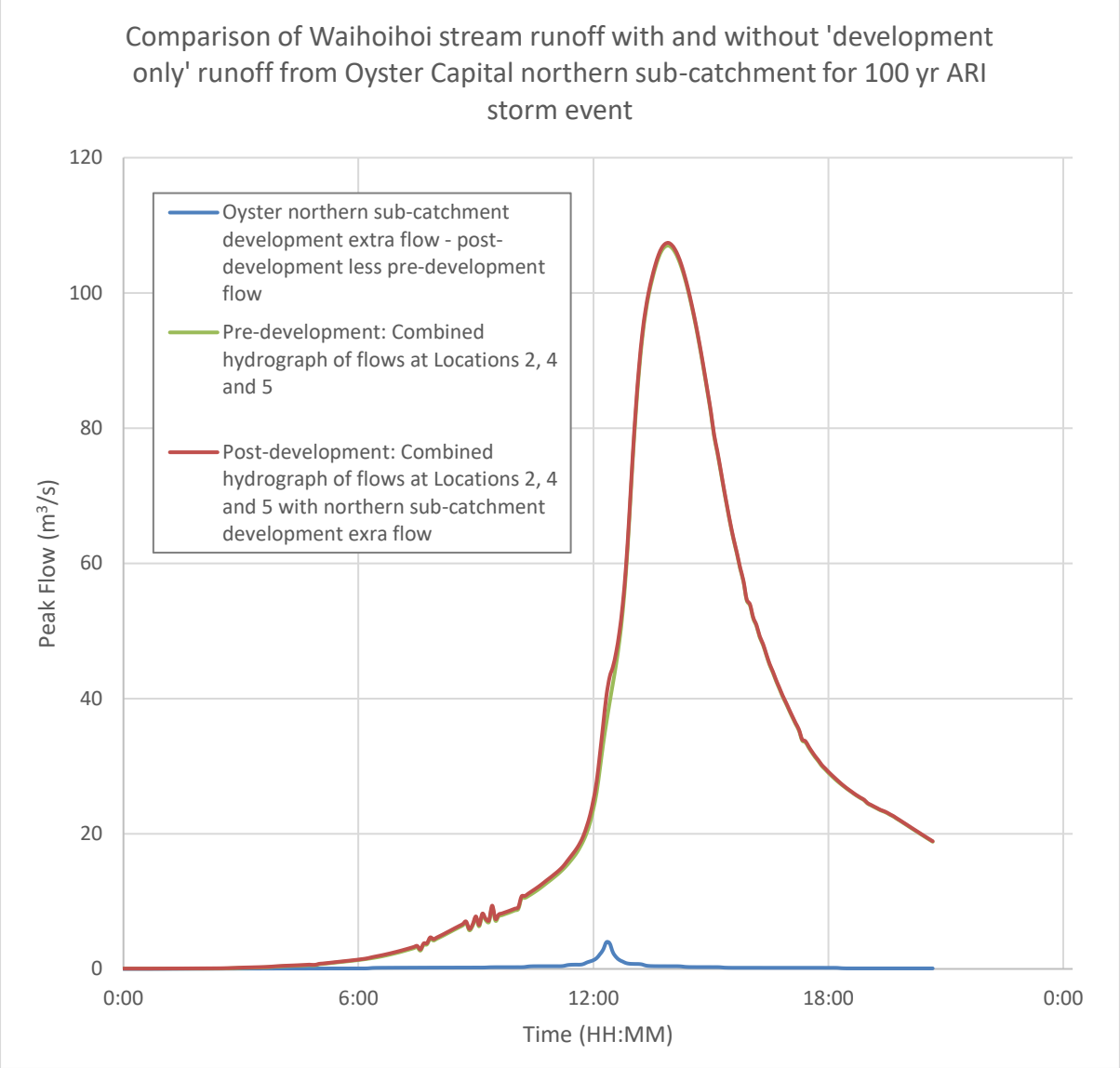
A number of design scenarios and locations were assessed using this model during the Slippery Creek flood hazard assessments to support the SMP (refer Section 5 of the SMP). The baseline scenario for this assessment is the 100 year ARI existing development condition (no future development modelled within the upstream Future Urban Zone, no climate change) as this is what is there now. Downstream of the site the Southern Railway Line crosses the floodplain and this a good location to compare flows. For the Oyster northern sub-catchment, the receiving flood plan is large and wide and in the 100 year event the wider catchment drains through three railway structures at Locations 2, 4 and 5 shown in Figure 2.2 below.

Figure 2.2: Location of model cross-sections for Slippery Creek flood hazard assessments included in the SMP



A combined hydrograph of flows at those three locations is shown at “Pre-development” in Figure 2.3. The “Post-development” flow is based on the “extra flow” from the Oyster northern sub-catchment development (represented by the post-development less the pre-development flows from the site) added “Pre-development” hydrograph. Only “extra flow” from the development is added because the “Pre-development” case already accounts for the greenfield runoff from the Oyster Plan Change Area.

Figure 3.3 – Waihoihoi stream hydrographs with and without ‘development only’ flows.



The “Pre-development” and “Post-development” hydrographs almost look identical, except for a very negligible change in flow at approximately 12:20pm, which corresponds with the developments peak flows. This change occurs prior to the catchment peak flow at 1:50pm.

The pass forward flows approach is best as otherwise the additional runoff adds to the flood peak. The volume of additional flow from the development is 21,100m^3 and surface area of the Waihoehoe 100 year flood plain between the development and the Slippery Creek confluence is approximately 984,000m^2. This suggests that the maximum change that the Oyster northern sub-catchment development extra flow could have on the 100 year flood level is 21 mm if the peaks coincided, which is best mitigated if the proposed pass forward flow approach is adopted.

The minimal change shown on the hydrographs in Figure 2.3 confirms that the northern sub-catchment development "extra flows" are negligible and occur earlier in comparison to the peak flows generated by the upstream catchment. This confirms that the development should adopt a "passing flows forward" approach. Flows from the site will be discharged directly into Waihoihoi Stream and Slippery Creek as quickly as possible in order to pass them through before the peak flows from the upper reaches of the catchment reach the area.

2.3 Southern sub-catchment

For the southern sub-catchment, multiple attenuation basins are proposed to achieve staged attenuation to ensure post-development flow match pre-development flows for the 1 in 100 year ARI storm event, as well as for more frequent events such as the 1 in 2 and 1 in 10 year ARI storms. The controlled release of stormwater discharge will match pre-development conditions, thereby minimising the impact of increased peak flow from the development on the downstream environments. The attenuation devices will be designed at Resource Consent.

3 Stream Erosion

Auckland Council has provided an Erosion Stream Risk Tool as a mechanism to analyse stream erosion risk resulting from the development. It requires an understanding of the stream cross section, bed slope and critical shear stress, inter alia, as inputs to the assessment. The Auckland Council Infoworks model uses a bathymetric surface (3D terrain model based on LiDAR) with structures. It does not include a channel survey and therefore we do not have stream cross sections from the model to use in the erosion assessment.

We are also working through a number of other challenges with the Erosion Stream Risk Tool (i.e. assumptions for the critical shear stress of the channel in the absence of site-specific testing) and concerns with the effectiveness of the model at predicting erosion potential. These are documented in the Response to Auckland Council Further Information *Request on Stormwater Matters for Drury East – Stream Erosion Risk Assessment for Hingaia Catchment* memo prepared by Tonkin + Taylor and Woods on 3 April 2020.

We recommend that Oyster refers to the Stream Erosion Assessment for the Hingaia catchment and waits for feedback on that before progressing with this assessment. We can say that SMAF 1 hydrological mitigation will be the minimum. Any additional mitigation for stream erosion can be developed as the SMP progresses based on site observations of erosion and/or improved erosion modelling when the data is available and the methodology is improved.

4 Water quality

Refer to response in *Auckland Council Further Information Request on Stormwater Matters for Drury East* memo prepared by Woods and Tonkin + Taylor on 25 March 2020.

Appendix A:

Assessment category		Comments /requests	Reason for comments/requests	Responses
No	**Category**			
01	Stormwater Planning	Please provide an assessment of how the proposed plan changes meet the outcomes of the NPS-FM and the related matters in the AUP Regional Policy Statement. How does the s32 report acknowledge and address methods to meet regional policy statement objectives that are relevant to the plan change areas, including B7.3 E1.3.8 and E1.310? Please update if necessary.	The policy framework acknowledged in the s32 reports primarily addresses matters relating to urban development and the provision of land for urban growth. While there is some acknowledgement of the NPS-FM, this appears to be limited to how streams and other natural hydrological features are recognized in the proposed plan changes. NPS-FM Objectives and Policies relating to water quality, and Regional Policy Statement objectives and policies for water quality and integrated stormwater management, do not appear to be addressed. The process and outcome of urbanising land has significant environmental effects both immediately and into the future. There appears to be little acknowledgement of these effects on the receiving environment (which the NPS and RPS objectives and policies refer to) or adequate demonstration of how these effects will be mitigated through the proposed precinct plan provisions and proposed stormwater management plan.	Refer to Planning and Ecology Response
02	Stormwater quality	Please clarify how objectives in the AUP for water quality will be met. The Planning report (pg46) emphasises that high contaminant generating roads and carparks will be treated (treatment of these roads is covered by region wide rules in Chapter E9 AUP). However, it is unclear how many roads are anticipated to meet the thresholds to trigger E9 rules and if additional roads should be treated to meet the proposed objective. There is also reference in the Drury East – Fulton Hogan request (page 46) to a treatment train approach and secondary treatment but it is unclear if this is part of the approach to treat high contaminant generating roads or is an additional response applied to all roads to meet objectives E1.3.8 and E1.3.8 and meet Schedule 4 NDC requirements greenfield developments. A matrix showing what tools will be used in what proposed land use zone to avoid any adverse effects on water quality should be included in the SMPs as part of identifying how adverse effects will be mitigated and how these achieve AUP policies for water quality.	AUP E1.3.8 directs to avoid as far as practicable the adverse effects of development on water quality. AUP Objective E1.2.3 and Policies 1.3.2 and 1.3.3 directly implements the NPS-FM 2017. Avoiding adverse effects on water quality should be demonstrated in the planning report and SMP. The creation of adverse effects on water quality due to contaminants in runoff from impervious surfaces is an effect of urban land use. Therefore, this should be part of the S32 report and AEE. Reliance on region wide rules in the AUP may not be sufficient to meet AUP policies for this plan change area and for the associated receiving environment which is a Significant Ecological Area; some of which (such as Drury Creek Islands) have further restoration and enhancement underway. Additional detail on the methods for treating stormwater to avoid adverse effects may also be sought prior to notification of this plan change as part of the SMP in support of stormwater discharge authorisation.	Refer to Section 1: Stormwater management of Auckland Council. Further Information Request on Stormwater Matters for Drury East memo prepared by Woods and Tonkin + Taylor on 25 March 2020.
03	Water quality	Please more fully describe how the water quality policies in E1 will be achieved, and what options have been considered to meet the policies.	The current descriptions in the SMPs are confusing and appear to rely solely on the region-wide rules. Given the AUP policy directives for greenfield development and the sensitivity of the receiving environment, additional treatment (such as a treatment train approach) may be justified.	Refer to Planning and Ecology Response
04	Hydrology Mitigation	Please provide an assessment of the degree to which SMAF1 avoids or remedies changes in hydrology which will result from the urban land uses proposed in the plan changes. A Regional Erosion Threshold Metric risk assessment identifies areas at risk of erosion and provides some quantification of the amount of erosion caused, however it does not address how effects will be avoided, remedied or mitigated. Identification of measures to avoid effects and mitigate should also be made and the BSTEM model is appropriate for this task. More detail on this tool is being supplied to the applicants.	The AUP states that for greenfield areas adverse effects of development shall be avoided as far as practicable or otherwise remedied or mitigated and this includes changes in hydrology (Policy E1.3.8). No SMAF controls were applied to greenfield areas in the AUP as it was expected that an assessment on what hydrological mitigation is required would be undertaken as part of plan change process. The Drury-Opaheke Structure Plan SMP also identified that hydrological mitigation and erosion assessments should be completed at the scale of the plan changes so that the particular effects of proposed land uses would be identified, and mitigation measures would be determined, at scale proportionate to the proposed activities and effects.	We recommend that Oyster refers to the Drury East (Oyster Capital) flood modelling - Response to Auckland Council Further Information Request on Stormwater Matters (Version 2) Stream Erosion Assessment for the Hingaia catchment and waits for feedback on that before progressing with this assessment
05	Flooding	Please address the matters identified and discussed in the memo to Healthy Waters from Tonkin + Taylor dated 19 February 2020. We note that all applicants need to explain what the effect cumulatively across developments will be on the Drury township flooding and parts of the catchment that interact with the Slippery Creek floodplain.	Flooding in the Hingaia catchment is complex and needs to be considered in conjunction with other plan changes proposed for the area; acknowledge any interactions with other catchments and the cumulative impact of potential development in the surrounding areas and the point of discharge downstream. Understanding the impact of development on the flood plain within the plan change sites and impacts downstream is necessary to evaluate the plan change proposal and ensure any potential flood effects are avoided or mitigated.	Refer to Section 2 of this memo

			Several discussions between Healthy Waters and the applicant's planners have occurred on the best way to approach flood modelling and the memo from T+T dated 19 February 2020 reflects our agreement with regard to flooding matters.	
06	Riparian Margins	Please explain why a 10m wide riparian margin is proposed when the Drury-Opaheke Structure Plan Stormwater Management Plan identified a 20m riparian margin as being appropriate. No evaluation of these two options is provided including their consistency with the objectives and policies of the AUP.	A 20m wide riparian margin was consulted on as part of the Drury-Opaheke Structure Plan 'Blue Green Network' and associated the Stormwater Management Plan. The purpose of the wide margin is to provide an ecological corridor and provide a buffer for the stream noting that stream meander may occur due to erosion. These benefits support achievement of AUP objectives and policies. A rationale for a lesser width margin is not provided in the s32 report.	Refer to Planning and Ecology Response
07	Ecological corridors and Blue Green network.	Please clarify what the ecological corridors are and how they contribute to meeting objectives and policies of the AUP. They are mentioned briefly but there is no description on how these align to the Blue Green network identified in the Drury-Opaheke Structure Plan, nor are the streams or corridors noted specifically in the precinct plan or stormwater management plan. Planning provisions to enable the ecological corridor are not provided in the precinct plan nor is an assessment given in s32 assessment reports.	A blue green network utilising the natural hydrological features of existing streams was identified as part of Auckland Council's Drury-Opaheke Structure Plan. If and how streams are used in this way has implications in relation to: Identifying the impact of urban development on streams (if they are intended to be retained or not). Keeping flood conveyance channels available as part of the 'pass-it-forward' approach outlined in the Drury-Opaheke Structure Plan. Mitigation of effects anticipated by urban development, including hydrology mitigation. The precinct plan and stormwater management plan lack information on the ecological corridors making their purpose for achieving AUP objectives and policies or as part of effects mitigation unclear. We note public access such as walkways/cycle network need to be located outside riparian setbacks and the minimum width required to accommodate water sensitive devices.	Refer to Planning and Ecology Response
08	Development staging	Please explain if and how the precinct plan is to manage flood risks (such as staging of development in conjunction with flood mitigation measures). Flood attenuation is proposed in the SMP but there are no precinct plan provisions to ensure that flood attenuation is provided or when it would be appropriate to not have flood attenuation.	The plan change areas are areas of significant flood hazard and developing the plan change areas could increase the flooding downstream in the existing Drury township. Fulton Hogan, in their SMP page 6 propose as part of their flood management approach for Zone A to provide: *Temporary flood attenuation to pre-develop flow – to enable development in advance of culvert upgrades* There is no indication in their SMP or precinct plan of when this would be provided or when it will not be provided. The attenuation relates to current culvert capacity at Great South Rd and Flannagan Rd. These culverts will likely need upgrading in the future when road upgrades are done but this requirement is not linked to transport infrastructure upgrades or backed up by analysis of culvert capacity.	Not applicable to this development