Takitimu North Link Stage 2
Specimen Hydraulic Design Report
Stormwater Management

Review comments by Graham Macky

9th November 2023, amended 4th January 2023

2.2 Hydrology	Comments	Responses	
P4 2.2.1 3rd para	For clarity: Insert "At least the lower parts of all catchments are in Zone A". Do you mean "three different rainfall intensities have been used ***for each scenario***"?	Yes, three different rainfall intensities have been used for each scenario. We have updated and added text (blue coloured) for clarity which reads as: "Since the headwaters of Te Puna Stream and Waipapa Stream catchments lie in Zone B and Zone C, three different rainfall intensities have been used for each scenario (pre-construction and post construction). At least the lower parts of all catchments are in Zone A."	**Resolved**
P5	Please reference or briefly explain the "alternating block method".	We have added the reference for the alternating block method. Chow, V.T., Maidment, D.R. and Mays, L.W. (1988). *Applied Hydrology.* International Edition, McGraw-Hill, Singapore.	**Resolved**
Fig 2-2 and Fig 2-3	A passing comment that I've made elsewhere: this design hyetograph and this infiltration pattern are together very conservative for	Noted	

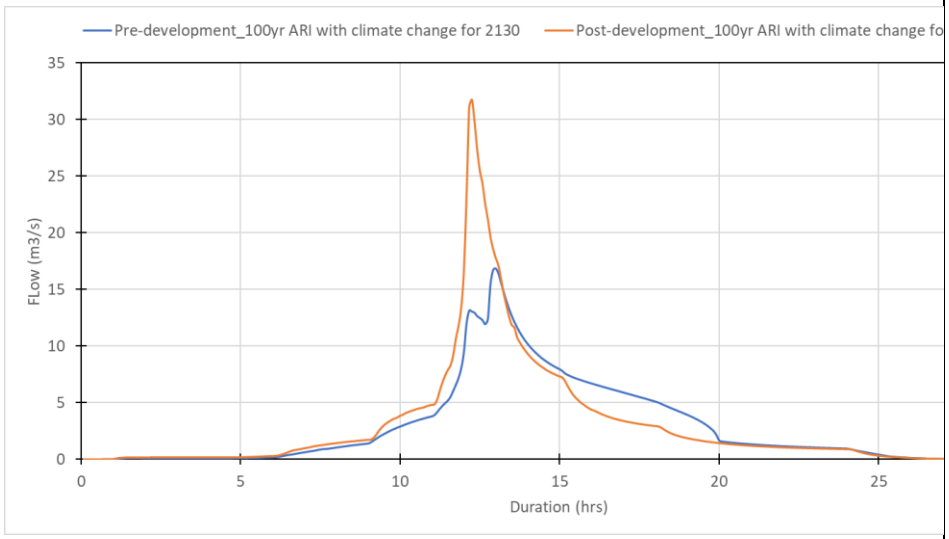
	small catchments, because the catchment is calculated to be saturated before the short-term design events begin. The report says as much on p8.		
P8	It's not stated how the hydrological parameters have been deduced from the soil characteristics and other information. However, the chosen parameter values seem reasonable.	The soil hydrological parameters based on the soil characteristics were taken from EPA SWMM reference Manual and Rawls et al. (1983). We have already stated how we have estimated infiltration parameters in last paragraph of page 7 of the report. However, we have added following text (blue coloured) for clarity: Infiltration was estimated based on typical hydraulic characteristics for typical soil texture classes, that were taken from the EPA SWMM-5 Manual and Rawls et al. (1983). Soil textures from the site were derived from available geotechnical information, NZ Landcare Research S-Map Online, NZ Landcare Research LRIS Soils Portal, NZ National Soils Database and site observation and take into account general soil type, the clay content, and the moisture content.	**Resolved/ good anyway …**
P11	(1st line) I think your meaning would be clearer if "In general," was replaced by "For treatment swales which receive inflow	We have replaced "In general" by "For treatment swales which receive inflow along their length,". The revised text (blue coloured) reads as: For treatment swales which receive inflow along their length, mean hydraulic residence time for the treatment swale was calculated dividing half of the total length of treatment swale by the velocity in the treatment swale for the maximum water	**Comment Resolved**

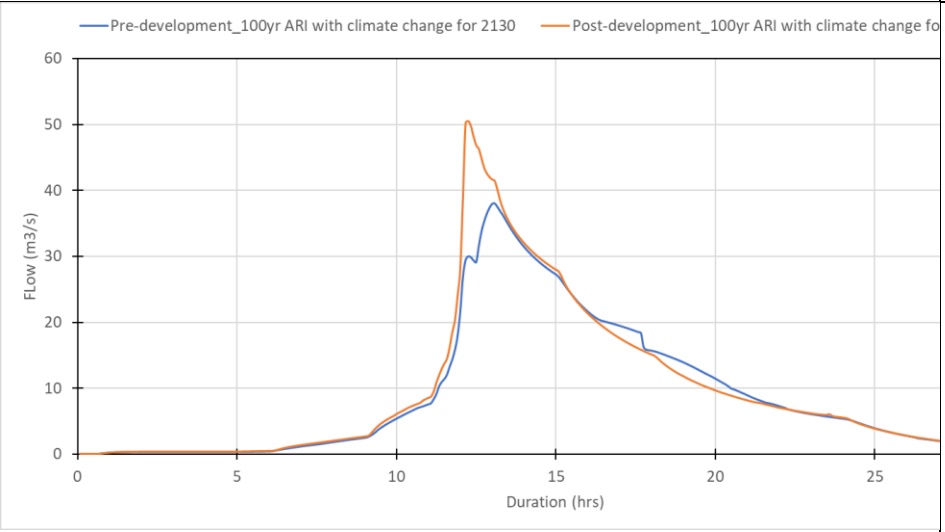
	along their length,".	quality flow. However, if all of the stormwater runoff from sub-catchment ……	
	I read this and wasn't sure whether the hydrological /hydraulic responses of these devices have been determined from residence time or modelled directly. However, it's confirmed on p13 that they are modelled.	Noted	
P13 2.2.5 SWMM model	I agree that failing to include some "main" channels is unlikely to have much effect on the catchment's response.	Noted	
	The choices of Manning's n would be easier understood in a table. I presume that they are somewhat arbitrary choices, but they all sound credible. The main criterion, though, is the	Yes, they are somewhat arbitrary but the choice of Manning's n for the catchment is based on information provided in the EPA-SWMM Reference Manual.	If in your opinion the times of concentration are all credible, that's all good. However, given the inherent approximations in the method, one or two reality checks

	resulting time of concentration of the catchment. If you have done any comparison with the commonly used empirical formulas, I'd be keen to see it.		against empirical formulas or site information would have added confidence. **Comment Resolved**
3 Stormwater Management	You could reference Appendix B here. The text describing the network connections is best read with the plans in the Appendix (the Figures taken from those plans being a bit small). See also my comments below on the symbology of Appendix B.	We have provided refence to Appendix B. The revised text (coloured blue) reads as: Road surface drainage is facilitated through a network of swales, median drains and kerbs that convey the runoff from the on-site catchments to the treatment and attenuation facilities (refer to Appendix B for the plans). The treatment and attenuation…	**Resolved**
P14 3.1 para 2	Are "planted" swales planned rather than grassed? And do they indeed treat stormwater? Grassed swales rely on continuous contact with leaves during the 9-minute	Planted swales are planted with appropriate native vegetation as opposed to grass. Plant selection will be made by a landscape architect.	Suggest "planted **with suitable species** or" **Comment Resolved**

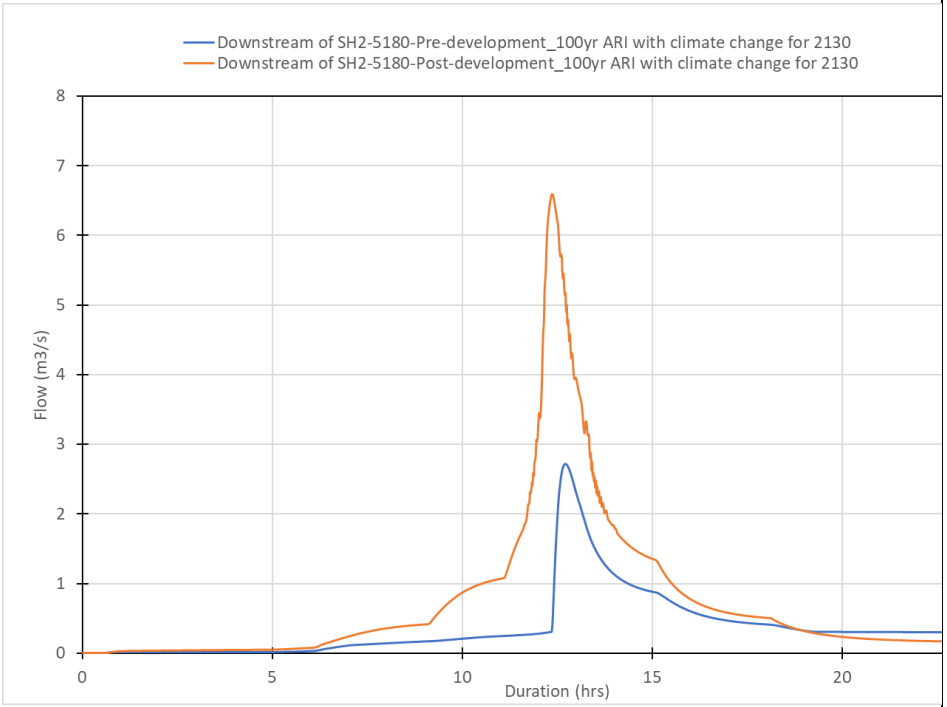
	residence time. The BoP Guidelines are ambivalent – mentioning oioi favourably but elsewhere saying "it should be grass"		
P14 3.2 para 2 and Fig 3-1 (p15)	I found the text and map took a while to understand. Could you mark on Fig3-1 either the swale direction of flow or the sub-catchment boundary (all areas draining via the pipe and swale to Waipapa Stream)?	Swale flow arrows have been added to report figures and appendix figures.	**Resolved**
	Could the pipe and swale to Waipapa Stream be shown and identified in Fig 3-1?	Pipe has been called out.	**Not sure** **Comment Resolved**
P15	I agree that no attenuation is needed before discharge into Waipapa Stream.	Noted	
	I also agree that the cut slope part of RO1B does not need attenuation. If its	Noted	

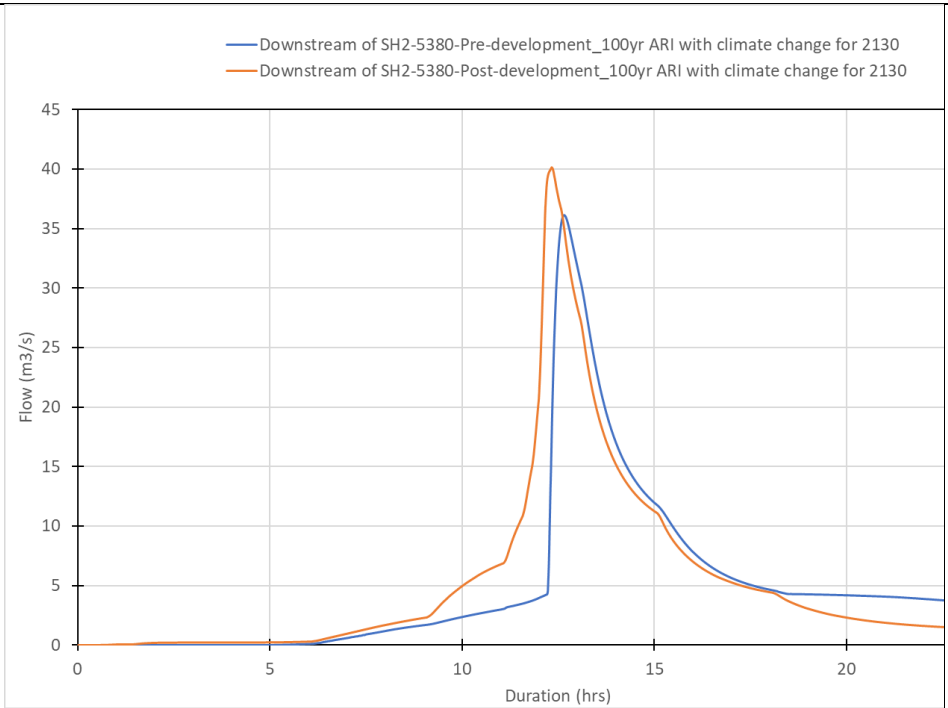
	vegetation includes grass or other ground cover, its runoff won't need treatment either.		
	But has RO1B been labelled RO1A in Fig 3-1?	No RO1B was missing. We have added RO1B in Fig 3-1.	**Comment Resolved**
P16 RO2B-E	This all looks satisfactory. But what rainfall event equals the capacity of the catchpits? If it's less than the 100-year event, does the excess runoff actually reach the pond?	The catchpits capacity is not equated to any rainfall event rather the catchpits will be spaced so that they meet the flow spread requirements for both 10yr and 100yr ARI storm events as per P46 Stormwater Specification by Waka Kotahi NZTA (2016). The total flow at the catchpit is the sum of the runoff from the sub-catchment and the bypass flow from the previous catchpit, except for the most upstream catchpit. More catchpits need to be added in case the spread of the flow is larger than the allowable spread. Further, additional catchpit will be provided at lowest point on the main traffic lane alignment so that the total flow is captured and conveyed. The catchpit spacing needs to be completed by design/construct team and hence, more in line with a review to ensure that a detailed design is compliant with consent conditions.	**Good, but we should say "all runoff from up to the 100-year ARI event"** **Comment Resolved**
P16 3.3 RO3E-K	The arrangements described sound fine but are difficult to visualise from the text. Can you reference the plans in	We have added refence to the plans in the Appendix B. The additional text (coloured blue) reads as: The stormwater runoff from sub-catchments RO3E, RO3F, RO3G, RO3H, RO3I, RO3J and RO3K will drain into the tidally influenced area of Mangawhai Bay via existing Stream 1 tributaries and stream realignments SR3A and SR3B (Figure	**Resolved**

	the Appendix.	3-3 and drawing number 144702-00-2212 and 144702-00-2214 of Appendix B). Hence, attenuation….. We have also added swale flows arrow to Figure 3-3.	
P17 swales (also 3.4 p18)	"In general" might suggest at least one swale does not meet the 9-minute residence time. Perhaps refer to the table 3-1, which shows that all swales are fine	We have removed the word "in general" from the text.	**Resolved**
P17 peak flows	The Stream 1 channel downstream, including the inter-tidal channel through the mangroves, is only 300m long, but BoPRC might prefer that its peak flows be kept to natural levels. That may well occur anyway with the proposed works, because the road runoff will peak quicker than the rest of the catchment. Could you please extract a hydrograph for Stream 1, ideally	 The peak flow for Stream 1 is higher in post-development condition as compared to pre-development condition which is	It would be helpful to include this hydrograph in a report, but should that be this report or "Downstream Effects"? If the postdevelopment hydrograph is likely to be close to pre-1950s, this could be noted. **Comment Resolved**

	compared with the predevelopment equivalent?	primarily due to replacing of the existing culvert at Stream 1 with a new bridge named SH2-530. The existing culvert at Stream 1 is significantly undersized. Modelling of the pre-development condition for Stream 1 indicates that there is significant informal attenuation in the form of upstream flooding associated with the existing culverts. In addition, the existing culverts would be considered barriers to fish passage under the NPS/NES regulations. Replacing the undersized existing culvert with a new bridge will improve the upstream flooding, restore the streams to a more natural form, significantly improving stream ecology. For details, please refer to Specimen Hydraulic Design Report Culverts, Bridges and Streams.	
P18 3.4 peak flows	Same remarks as p17 above, though with some reservation as Stream 2 now appears to be a ditch.	 The peak flow for Stream 2 is higher in post-development	This hydrograph also should be reported. The increase in peak flow rate is quite modest. **Comment Resolved**

		condition as compared to pre-development condition which is primarily due to replacing of the existing culvert at Stream 2 with a new bridge named SH2-990. The existing culvert at Stream 2 is significantly undersized. Modelling of the pre-development condition for Stream 2 indicates that there is significant informal attenuation in the form of upstream flooding associated with the existing culverts. In addition, the existing culvert would be considered barriers to fish passage under the NPS/NES regulations. Replacing the undersized existing culvert with a new bridge will improve the upstream flooding, restore the streams to a more natural form, significantly improving stream ecology. For details, please refer to Specimen Hydraulic Design Report Culverts, Bridges and Streams.	
P20 SR5B	This realigned stream discharges into Te Puna tributary 3, which traverses the edge of an intertidal wetland, yet it isn't given any flow mitigation. Does SR5B need to continue to meet the tidal Te Puna Stram, or will the hydrographs show that its peak flow is	This is not a stormwater management issue rather an overland flow path issue. This comment has been transferred to the response to the Specimen Hydraulic Design Report Culverts, Bridges and Streams.	**Comment Resolved**

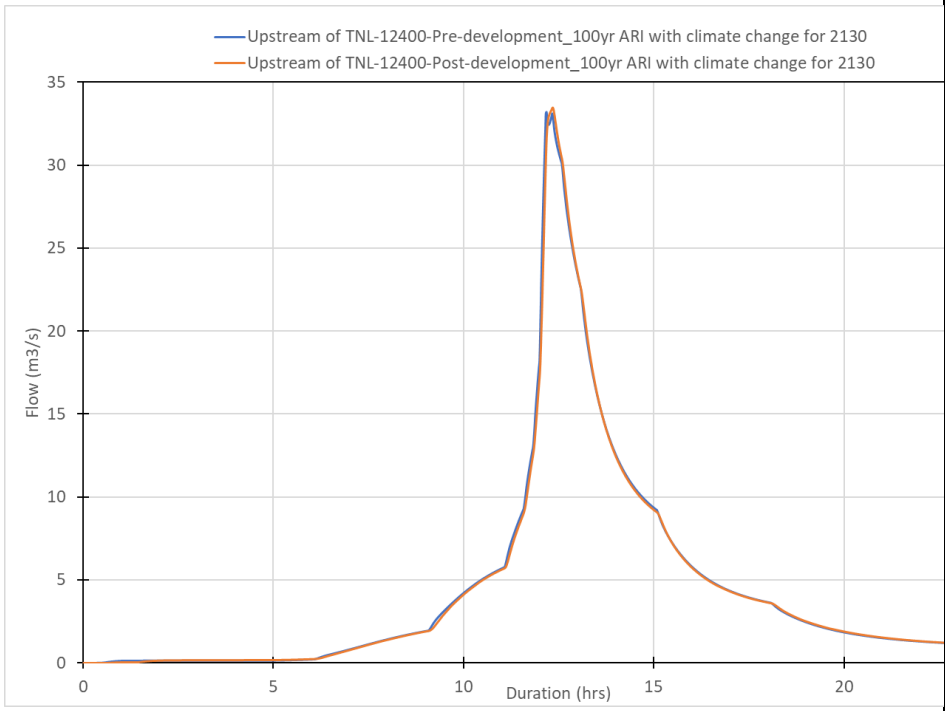
	no more than before?		
P22 R08	This all sounds satisfactory. To confirm, could you please extract before and after hydrographs downstream of culverts SH2-5180 and SH2-5380?		SH2-5180 will be passing a much greater volume and peak flow to the Oturu Creek tributary than it does now. Does this reflect an increased catchment? SH2-5380 pre- and post- flows are close enough to equal. Both hydrographs would be helpful in one of the reports. The increased flow downstream of SH2-5180 should be noted but may well have only minor effects. **Comment Resolved**



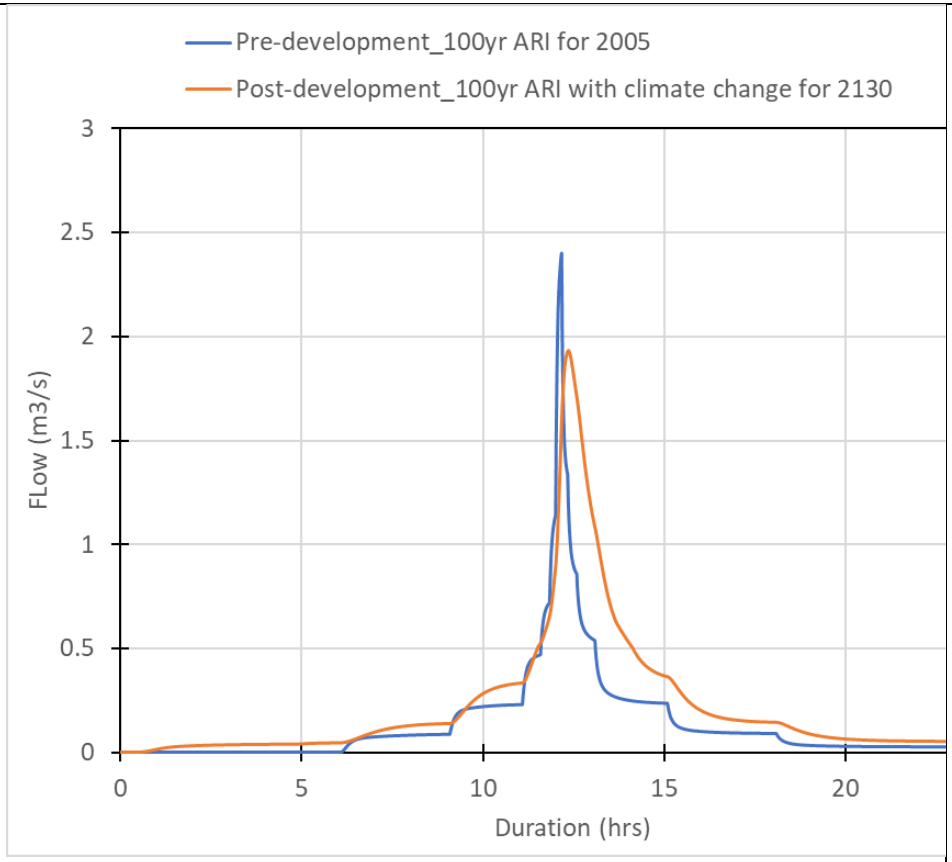
The peak flows downstream of culvert SH2-5180 and bridge SH2-5380 are higher in post-development condition as compared to pre-development condition which is primarily due to replacing of the existing culvert at Oturu Creek Tributary with a new culvert named SH2-5180 and replacing of the existing culvert at Oturu Creek with a new bridge named SH2-5380.

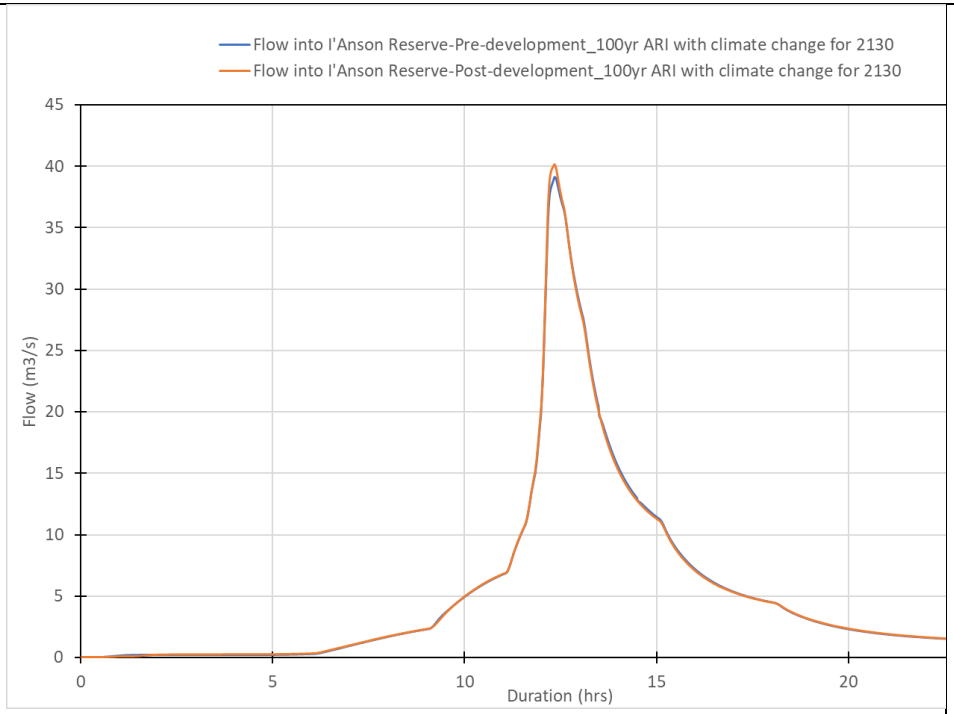
The existing culverts are significantly undersized. Modelling of the pre-development condition for Oturu Creek and Tributary indicates that there is significant informal attenuation in the form of upstream flooding associated with the existing culverts. In addition, the existing culverts would be considered barriers to fish passage under the NPS/NES

		regulations. Replacing the undersized existing culverts with a new culvert/bridge will improve the upstream flooding, restore the streams to a more natural form, significantly improving stream ecology. For details, please refer to Specimen Hydraulic Design Report Culverts, Bridges and Streams. The catchment wide analysis of downstream effect has been discussed in Downstream Flood Effects Investigation Report.	
P23 RO9	TW-RO9 is labelled ATW-RO9 in Fig 3.7. I'd like to see a sentence or two making clear to the uninitiated what is meant by extended detention vs attenuation and saying why one is needed here but not the other. Again, "before" and "after" hydrographs for the design events would be helpful and might show that peak flows will not be increased anyway.	We have updated the label in Fig 3.7. The main purpose of extended detention is to prevent initiation or aggravation of stream channel erosion. The extended detention volume (EDV) is released over a 24-hr period. Extended detention used in conjunction with wetland the permanently stored volume calculated for water quality control can be reduced by 50% due to water quality credit provided by the extended detention. That means the land requirement for wetland with extended detention is lesser than for the wetland without extended detention. For this project one of the requirements is to reduce the land acquisition as indicated in section 3.1 of the report. Hence in area where there is a need for minimizing required effects on adjacent landowners due to land acquisition wetland with extended detention is proposed. We have updated text (blue coloured) for clarity which reads as: TW-RO9 is also designed to provide extended detention to satisfy both the stormwater runoff treatment requirement and the need for minimizing effects on adjacent landowners due	**Resolved** I hadn't realised that the pre-development state here is post-TML1, with the undersized SH2 culverts removed.

		to land acquisition. TW-RO9 devised is not intended for attenuation. The catchment wide analysis of downstream effect has been discussed in Downstream Flood Effects Investigation Report. The pre-development and post-development hydrograph upstream of culvert TNL-12400 for the 100yr ARI storm event is provided below:  	
P24 Snodgrass	I presume that the sub-catchments that are SH2 lengths will discharge the same flows as they do now.	Yes, the sub-catchments that are SH2 lengths will discharge the same flow was they do now. The location of SH2-4070 can be seen in Figure 3-6.	**Comment Resolved**

	But I'm not sure where culvert SH2-4070 is anyway. As noted above, hydrographs downstream of culvert SH2-5180 would be useful.	For comparison of hydrograph downstream of culvert SH2-5180 please refer to response to comment on P22 R08.	
P25 Munro E and Ainsworth Roads	I have only skim-read this section, on the assumption that the runoff will remain the same and that any treatment of that runoff will be a bonus.	Noted.	
P27 3.12	I'm not sure from your wording that you actually got ATW-RO8 to provide that 80% of predevelopment peak flow. Regardless, comparative hydrographs would again be helpful	As per BOPRC Stormwater management guidelines, in catchments where flooding problems do exist, it is recommended that the post-development peak discharge for the 100-year storm for a new development be limited to 80% of the pre-development peak discharge. The comparative hydrograph is provided below:	Please check that the graph is in the report **Comment Resolved**

			
P27 3.12	The increases in l'Anson Reserve water levels do sound negligible. However, an equally important metric is I think the peak flow rate, so again a comparison of hydrographs would	The pre-development and post-development hydrograph for the 100yr ARI storm event is provided below:	

	be helpful.		
3.12 Swale Design	Confirmation of the design method and result would help BoPRC. The text should state the design source, the BoP Guidelines I presume. I think it's also worth a short section – or appendix – stating the method again and extending Table	This is a specimen design, being submitted as part of consent application. Detailed design will be completed by design/construct team. While we have assumed grades and flows based on specimen design, it is most likely that the road geometry will be significantly changed in the detail design. The specimen design is used as the basis for developing consent conditions and principal's requirements that the design/construct team will have to meet. So, the information requested will need to be provided as part of detailed design to confirm consent compliance.	**Not resolved**: I take your point about not providing BoPRC with detailed design at this stage. However, (1) you could at this stage reiterate the process that's to be followed and (2) to confirm that the swales are practicable in this

	3-1 to include: • Gradient • Length • Length of grass (which is then a maintenance parameter) • Flow rates water quality event and 100-year event (if it is to be carried) • Inflow at upstream end or all along the swale And then the design results: • Dimensions (width at base, presuming side slopes are fixed) • Residence time • Water depths for specific flow rates • Velocity in the highest flow. The BoPRC		instance, I'd have appreciated the calculations that you've applied which have allowed you to comment on residence time. On the plus side, I note that you've referenced the Waka Kotahi guidelines re Water Quality Volume. **Comment Resolved**

	guidelines specify a limit for the 10-year ARI event, but I think your swales will be taking the 100-year flow (for which maybe one would tolerate a higher limit). You may like to include an example design, or maybe the above table pretty well covers it all.		
3.12 Wetland Design	Again, confirmation of the design method and result would help BoPRC, and the text should state the design source. There's just 3 treatment wetland and one attenuation pond, and there are many variations on how these can be designed and built. So I think BoPRC will appreciate a fairly	These are not detailed design documents, and the eventual designer will have to demonstrate compliance with the consent conditions by supplying that information.	**Not resolved**: Again, I take your point about not providing BoPRC with detailed design at this stage. However, I'd have appreciated seeing what went into your model, to confirm that the approach can work. Without that, a reviewer can't say anything of

	thorough description of each device's design details and resulting function. These could well go in an appendix, retaining your present text in the report proper.		substance. A specific point, and (my apologies) one I ought to have asked for, is the attenuation provided by ATW-RO5B. With 8ha of upstream catchment, it is not obvious whether from the geography that attenuating the road runoff is helpful. Flow hydrographs would make that clear to readers. These remarks might possibly also apply to ATW-RO8. **Comment Resolved**
	The description of each design could include: • Catchment area • Water Quality	This is beyond the level of detail for a consent application and more in line with a review to ensure that a detailed design is compliant with consent conditions. This is especially true as, as the project is currently intended for design-construct delivery.	**Comment Resolved**

	Volume • Area and depth for water quality treatment and for peak flow attenuation • Physical description of the outlet • Description of the computational model of the outlet. • In broad terms, proposed vegetation and any bathymetric variations (forebay, shallower and deeper regions for varying vegetation). But it might be a bit early for these details to be known. Then the design results should		

	include: • Outflow hydrographs compared to inflow • Residence time Water level hydrographs		
Pipe design	Just to be sure, will the pipe network be designed for the 100-year ARI event? That's quite unusual, but would remove any worry about overland flow paths.	We cannot have any uncontrolled discharges of stormwater and all outfalls must be consented. Therefore, the combination of pipe network and flow along the kerb and channel will have to be adequate for the 100-year storm. While the network will be sized for the 10-year per Regional, District, and Waka Kotahi requirements, it will need to be increased to ensure that the spread of flow within the road is compliant with Waka Kotahi requirements and the Kerb does not overtop. This will be part of the detailed design.	Please make this point clearer in the report. **Comment Resolved**
Appendix B	In general, these plans are really helpful and (for me) explain the network layout better than any text could. However, a few points have led to my temporary confusion: • Sub-catchment boundaries aren't very clear. The legend	We have edited the drawings to address all comments. Due to flow arrows for swale and change in wetland hatch the pipe network colour now stands out reasonably and no longer needs to have a different colour.	**Resolved**

	indicates a thick red line for their boundaries, which would be better than the thin line actually used. • I had to read everything carefully to know which way the swales and pipes drained. Can some arrows be added? • Could pipes be a different colour from the swales and ponds? • Some stream realignments including SR5A and SR5B seem to be shown but not labelled.		
4 Reticulation	Just a passing thought about kerbing: will it contain the high	This is answered in the response to the comment on pipe design.	**Comment Resolved**

	flows (100-year ARI?) that the reset of the system is designed for? If not, does it matter (i.e. does the excess flow go somewhere unexpected)?		
6 Conclusions	Just to reiterate: I've been effectively asking about mitigation of runoff peak flow within or just above the inter-tidal zone. I'm not sure what BoPRC's position will be, but they may well want mitigation of those flows where there is good-quality wetland. But I suspect that the timing of the road runoff will mean that it doesn't contribute to peak flow much or at all.	The management of outfalls through wetland areas is addressed more in relation to stream design, which can be found in the report covering bridges, streams and culverts. Wetland design requirements are defined in the ecology report. The wetland areas that we are releasing into have low ecological value and will be restored as part of the project. The stream and wetland designs will have to be designed to accommodate the flows discharged into them. We have avoided releases directly into high value wetlands.	**Comment Resolved**