s67 – Stormwater Assessment – Downstream Flood Effects

Beachlands South Fast Track Consent

Beachlands South Limited Partnership

Date: 19th October 2026

HG Project no.: A2515591.00

1.0 Executive Summary

This memo has been prepared by Harrison Grierson (HG) on behalf of Beachlands South Limited Partnership and is proposed, as an addendum, to support the Stormwater Management Plan (SMP) submitted as part of the Fast Track Consent (FTC) application for the Beachlands South development (Beachlands South). Specifically, this memo addresses matters raised by Auckland Council associated with downstream flood effects.

The stormwater modelling lodged as part of the SMP, and in support of the FTC application, illustrated potential increases in downstream flooding of up to 30mm in the 1% AEP storm event, including allowances for climate change. In HG's opinion, such increases when considering a hypothetical modelling scenario are within the tolerances of accuracy from which modelling results can be relied upon. HG considered the operation of the stormwater management system, as designed, was effective, as it utilised capacity within the existing waterways (natural and artificial) relying on the existing culvert discharge capacity as a means to control the flow from the site. i.e. utilising the existing culverts capacity to control the quantum of site discharge. While further attenuation controls can be introduced, these carry different risks associated with blockage and additional maintenance. Therefore, on balance, HG felt this was the most practicable way in which to manage stormwater for Beachlands South.

While Council understood this perspective, they requested, through their feedback, that sensitivity testing of the stormwater system be undertaken. Council also requested all existing house finished floor levels (the Boathouses) adjacent to the waterway be assessed.

This memo summarises the impact on the boathouses, in the existing assessment scenario, while also undertaking sensitivity testing to see what impact further management controls has on the flood results.

The assessment of the Boathouses highlighted based on the existing SMP that 4 houses either experience flooding (2 no.) or reduced freeboard (2 no.) (i.e. <500mm) in the 1% AEP storm event.

The sensitivity testing focused on two areas: the culvert in the northeast of the site and an Overland Flow Path discharging midway along Jack Lachlan Drive (JLD).

While the model modifications did show some reduction in the downstream flooding, the range of impact was between 0 – 50mm and therefore not significant when considering the existing flow depth at this location of 4.7m.

The northeast culvert modifications focused on potential changes to the existing pedestrian walkway beneath Jack Lachlan Drive. No change was made to the primary stormwater culvert. The changes

proposed ranged from removing the walkway completely to retaining a range of pipe sizes between 1050 and 2300mm (approximated size of the walkway). The proposed scenarios showed changes in the Boathouse level between -10mm (removed walkway) to 30mm (retained walkway). By removing capacity at this location for discharge the flood levels behind JLD increase.

A secondary investigation was therefore provided to assess how the proposed scenarios impacted the volume and level of water stored behind the JLD embankment. A range of scenarios was run to reduce the level of the permanent water level in the existing golf ponds in conjunction with reduction in size to the pond outlet. While these results showed a reduction in the flood water level is achievable, including freeboard provision to JLD compliant with the code of practice, matching the predevelopment flood level directly adjacent to JLD is not feasible with the current interventions. i.e. we can reduce the overall storage volume across the ponded areas upstream but not the water level immediately adjacent to JLD.

In addition to the northeast culvert, we also investigated the impact on reducing an OFLP from JLD. We had noted from the results given the flood modelling assumption of the pipe network being 100% blocked (no primary pipe network or inletting) that the OFLP from JLD had significantly increased from 1.68m³/s to nearly 6m³/s. We have again conducted further sensitivity modelling to assess the impact of this OFLP. By artificially reducing the post development discharge to predevelopment levels an improvement in the downstream flood depth of up to 15mm was achieved.

We are currently finalising a 2D flood model which will allow us to more accurately assess the impact of the reduced OLFP discharge but also allow this to be considered in conjunction with other changes which may see some further minor improvement. Ultimately this model may show the optimal outcome is to retain the walkway corridor in some form to reduce the upstream attenuation requirements if this can be achieved with an acceptable downstream flood impact.

Having completed the modelling exercises, we consider the next step would be to agree a finalised stormwater management strategy, however, we consider the results and findings from our analysis show a low level of sensitivity to any of the proposed changes.

2.0 Introduction

The purpose of this memo is to address the comments provided from Auckland Council following the submission for a Fast Track Consent application (Application) for the Beachlands Development. Subsequently several 'Requests for Information' (RFIs) were provided relating to the proposed stormwater management of the development, and the impacts to the downstream environment.

In reading this memo, reference should be made to the original Stormwater Management Plan, prepared and submitted by Harrison Grierson (HG) as part of the Application which outlined the overall approach to stormwater management. The RFI's addressed as part of this memo relate to Auckland Council Healthy Waters' (ACHW) observation of increased flood depths within the downstream watercourse in which the development's northern catchments discharge into, illustrated in Figure 1 below.

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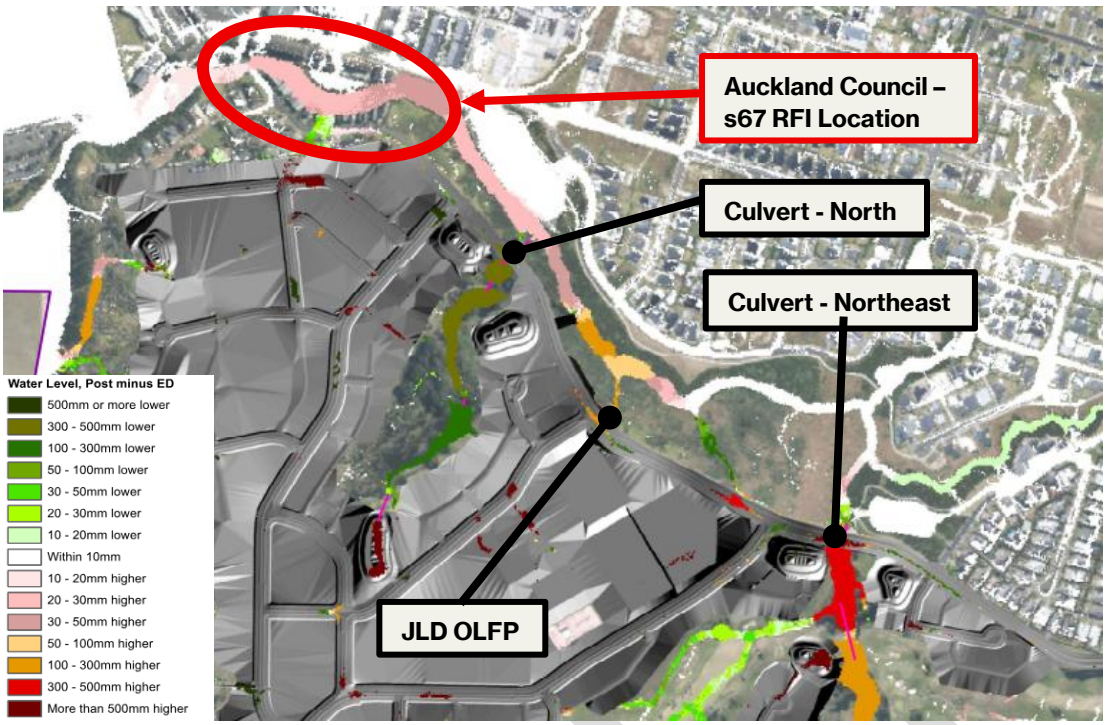


Figure 1 Observed flood increase downstream of proposed Beachlands South development during the 1% AEP + 3.8°C CC scenario *(Source: Harrison Grierson SMP, June 2026)*

Further to this observation, ACHW provided the following RFI comments:

> *"Flooding effects*
>
> *The Stormwater Management Plan (SMP) identifies increases in flood levels downstream of the development across all modelled scenarios. In Section 6.3.5 of the SMP it is concluded that these increases will have an immaterial impact due to the existing high flood levels in the receiving environment and due to minimal changes in flood hazard classification. The SMP further concludes that the finished floor levels of units within the key area of interest (highlighted in Figure 1) are located above the floodplain and therefore an increase flood levels in this area will result in flooding of the existing buildings. It is unclear how these conclusions have been drawn as only one cross section was provided at this location (SMP – Figure 33) with no information provided other than flood depth comparison. No finished floor levels were identified in the reporting relative to the adjacent floodplain levels.*
>
> *Within this area of interest, the flood mapping provided by the Applicant's Engineer shows flooding encroaching around the building footprints with several finished floor levels appearing to be set relatively low in relation to both the existing stream banks and the mapped flood levels (Figure 2). As such, we believe that further information is required to support the assessment and conclusions outlined in the SMP including the finished flood levels of the existing buildings and an assessment of them against the adjacent increased floodplain levels. This should include residential buildings at 167 – 189 Jack Lachlan Drive (along the true left bank) and commercial building at 190 Jack DRAFT Lachlan Drive. In addition, further information is also required on the potential increase in flood hazard risk to the Jack Lachlan Drive bridge crossing and the Pine Harbour Marina Wastewater Pump Station."*

A meeting was held with ACHW 9th September to discuss these comments with subsequent email correspondence with ACHW on 28th September. From this meeting and correspondence, it was agreed that further sensitivity analysis relating to the stormwater effects be provided by HG to Auckland Council, to give a better understanding of the risks associated with the flooding.

This memo seeks to address the concerns raised by Healthy Waters, and provide further context, evidence, and proposed mitigation options to achieve a practical solution in response to these observations.

3.0 Observed Results

As shown in Figure 1, during the 1% AEP storm event, flood levels can be seen to increase by approximately 30mm downstream of the JLD watercourse. The area of concern identified by ACHW, consists of residential properties immediately adjacent to the watercourse embankments. As part of the SMP submission, an assessment of one of these properties was undertaken to show its finished floor level, relative to the post-development flood level. Figure 2 illustrates the assessment undertaken as part of the SMP submission.

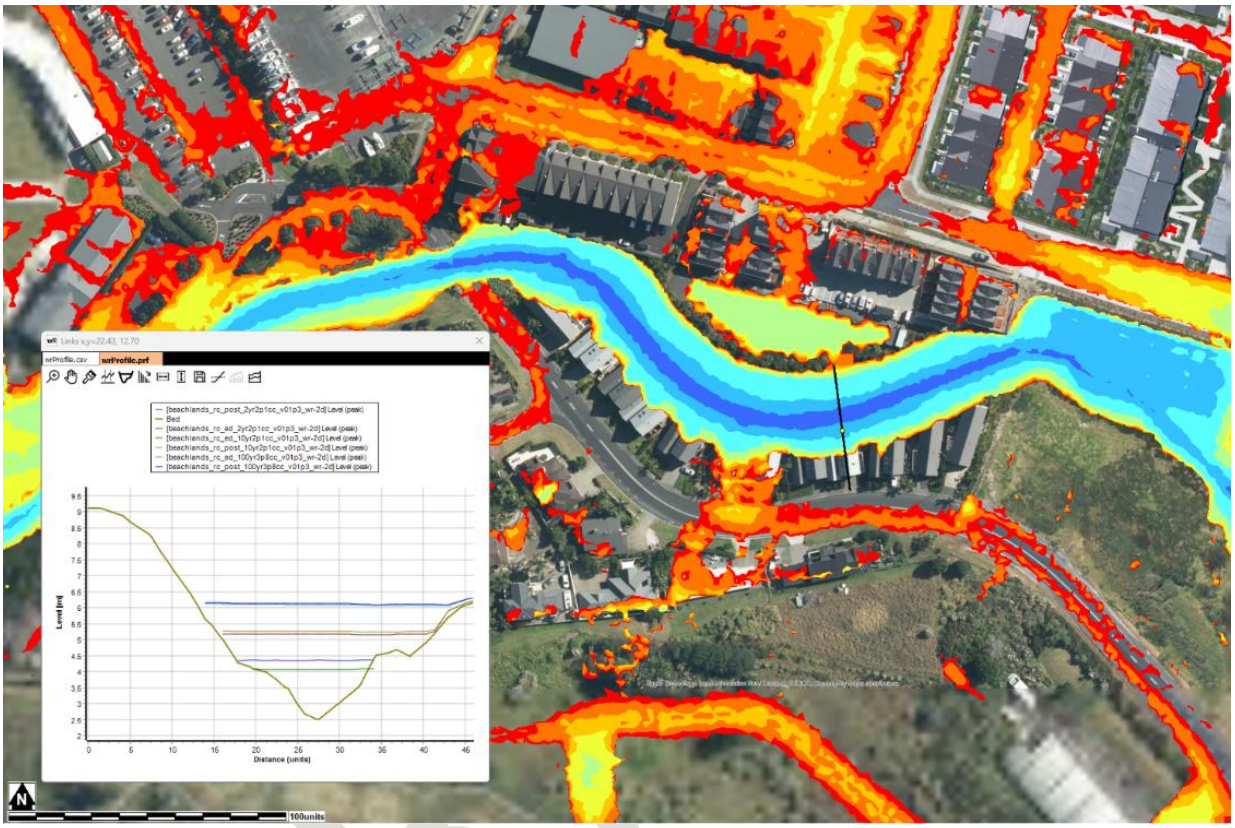


Figure 2 Comparison of flood depths across all storm events within downstream watercourse (Plan illustration during 1% AEP ED scenario) (Source: HG ICM model, October 2026)

The result of this assessment demonstrated there was likely suitable freeboard above the post-development freeboard to the finished floor level (FFL) of the associated property. However, at the time of the assessment, no FFLs were acquired, and ACHW sought confirmation that this conclusion was applicable across all properties within this area.

It should be noted that the relative increase in these flood depths is 30mm within an already 6.5m deep watercourse, and therefore the Beachlands South development appears to only increase these flood levels by approximately 0.5% in the post-development scenario.

The total discharge produced by the development is approximately 20m³/s, which is approximately one-third of the total 60m³/s discharge at this location. Therefore, whilst a notable contribution, the majority of flow contributing to this location originates from outside the development, and therefore outside of the developments influence. An illustration of the flow rate at this location is presented in Figure 3 below.

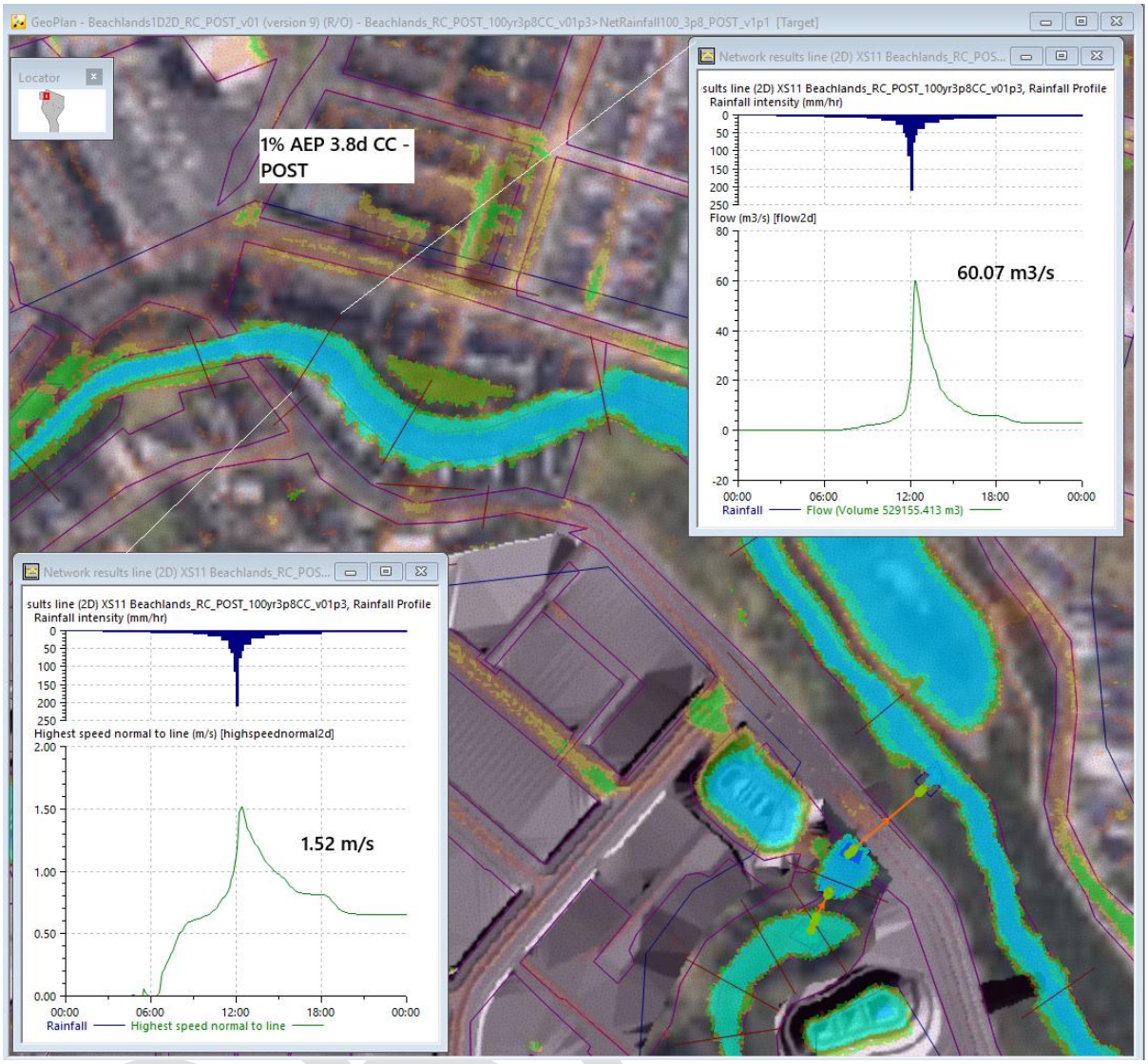


Figure 3 Post-development discharge rate and velocity assessment at downstream residential area during 1% AEP storm event (+3.8°C CC) (Source: HG ICM Model, October 2026)

The post-development flow rate represents a 1% increase compared to the pre-development discharge, which was calculated to be 58.80m³/s during the same 1% AEP storm event (+3.8°C CC).

4.0 Finished Floor Level Assessment

As requested, a more comprehensive assessment was undertaken to compare the pre- and post-development flood levels with the FFLs of the existing residential developments downstream of the Beachlands South development.

The developer of these properties was contacted (Jalcon Homes), and the FFLs for these units was provided, based on the Resource Consent approved plans. On discussion with Council on 9th September it was deemed acceptable and appropriate that this information could be relied upon for the purposes of conducting this assessment. The information provided is present in Figure 4 below.



Figure 4 Design FFLs for existing residential properties downstream of Beachlands South development (Source: Jalcon Homes, September 2026)

The flood assessment compared the pre- and post-development flood levels with the existing FFLs at this location.

A summary of this assessment is provided in Table 1 below.

Table 1 FFL flood assessment (Pre and Post development). 50%, 10% and 1% AEP scenarios

ID	Address (Jack Lachlan Drive)	FFL (mRL NZVD2016)	ED 50% AEP 2.1° C CC	ED 10% AEP 2.1°C CC	ED 1% AEP 3.8°C CC	POST 50% AEP 2.1°C CC	POST 10% AEP 2.1°C CC	POST 1% AEP 3.8°C CC	POST minus ED 50% AEP	POST minus ED 10% AEP	POST minus ED 1% AEP	Freeboard 10%	Freeboard 1%
1	**167**	6.96	4.227	5.271	6.182	4.497	5.356	6.212	0.270	0.085	0.031	1.604	**0.748**
2	**169**	**6.14**	4.177	5.243	**6.169**	4.440	5.330	**6.200**	0.263	0.087	**0.031**	0.810	**- 0.060**
3	**171**	8.48	4.152	5.235	6.168	4.421	5.323	6.199	0.270	0.088	0.031	3.157	**2.281**
4	**173 & 175**	7.41	4.062	5.150	6.089	4.329	5.238	6.118	0.266	0.088	0.030	2.172	**1.292**
5	**177 & 179**	6.42	4.015	5.100	6.031	4.284	5.186	6.060	0.269	0.087	0.029	1.234	**0.360**
6	**181**	7.06	3.986	5.069	5.992	4.257	5.156	6.022	0.271	0.086	0.029	1.904	**1.038**

7	**183 & 185**	7.66	3.979	5.058	5.977	4.248	5.144	6.007	0.269	0.086	0.029	2.516	**1.653**
8	**187**	7.33	3.941	5.002	5.906	4.207	5.087	5.935	0.266	0.085	0.029	2.243	**1.395**
9	**189**	**5.62**	3.894	4.944	**5.830**	4.160	5.028	**5.858**	0.266	0.084	**0.028**	0.592	**-0.238**

Whilst the assessment confirmed an average increase of 30mm throughout this area, the assessment concluded that, for 8 of the 12 properties, the nominal increase in flood depths had minimal impact on the existing freeboard (i.e. significantly more than 500mm freeboard is provided).

Two of the properties (177 & 179 Jack Lachlan Drive) have reduced freeboard, however, this was already beneath the required 0.5m freeboard in compliance with standard residential freeboard requirements stated in the Auckland Council Stormwater Code of Practice.

Two. properties (169 and 189 Jack Lachlan Drive) have FFL's below the flood level in a 1% AEP storm event during the pre-development scenario, and therefore, the increase in flood depths naturally has made the level of flooding nominally 30mm worse.

Nonetheless, following further discussion with Auckland Council and Healthy Waters, several assessments have been undertaken to assess the sensitivity of the flood impact and then to consider possible mitigation options to reduce this flood depth increase, and see how this impact might be mitigated.

5.0 Mitigation Proposals

Existing culverts that discharge from the site beneath Jack Lachlan Drive were not proposed to be augmented within the original SMP following the flood risk assessment. The negligible downstream flood depth increases, and the avoidance of future maintenance complications associated with additional control structures, was considered a practical solution to the development's stormwater management approach.

In response to Auckland Council's request to assess the relative impact of the development on the flood levels downstream and the additional 30mm of flooding generated by the development in the post-development scenario, possible mitigation options were analysed to provide further context and justification to the proposed stormwater solution.

Augmentation of the Culvert-North was deemed to make a negligible impact given the reduction in contributing catchment area in the post-development scenario. As a result, the cost and maintenance implications of adjusting/controlling this feature was not considered to make a difference to the overall flood depth contribution at the downstream residential area.

Therefore, more focus has been afforded to the upstream Culvert-Northeast which is shown to attenuate more volume and generate a larger final discharge during the 1% AEP storm event post-development scenario.

5.1 Culvert Northeast – Pedestrian Walkway

Subsequent to the submission of the SMP, the existing pedestrian walkway was included within the stormwater modelling during the pre-development and post-development scenarios. As part of the SMP we had conservatively assumed this did not exist in either pre or post development scenarios.

The geometry was retrieved from the survey undertaken by Harrison Grierson which confirmed the upstream and downstream invert levels and an internal diameter of the walkway of approximately 2.3m diameter.

To simplify the modelling associated with the walkway, it was assumed the walkway is circular in diameter, as opposed to a flat base at the invert. This is considered a conservative assumption as the walkway would otherwise discharge a larger quantity at the base in earlier storms, prior to full flow discharge.

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A diameter of 2.3m was conservatively assumed for the walkway within the ICM model, and additional variations to this diameter was considered to assess the impact of the walkway to the downstream flood levels.

Variations of the pedestrian walkway included, 'Walkway Existing' (2.3m dia.), 1.8m dia., 1.5m dia., 1.2m dia., 1.05m dia. and 'No Walkway'.

5.1.1 Volume Assessment

Constriction of this walkway would inevitably generate additional attenuation behind the JLD embankment, upstream of Culvert-Northeast. For all scenarios, the change in generated volume has been assessed within each of the cascading ponds that contribute to the attenuation volume. The baseline pre-development scenario has been volumetrically illustrated in Figure 5 to provide a baseline to this assessment.

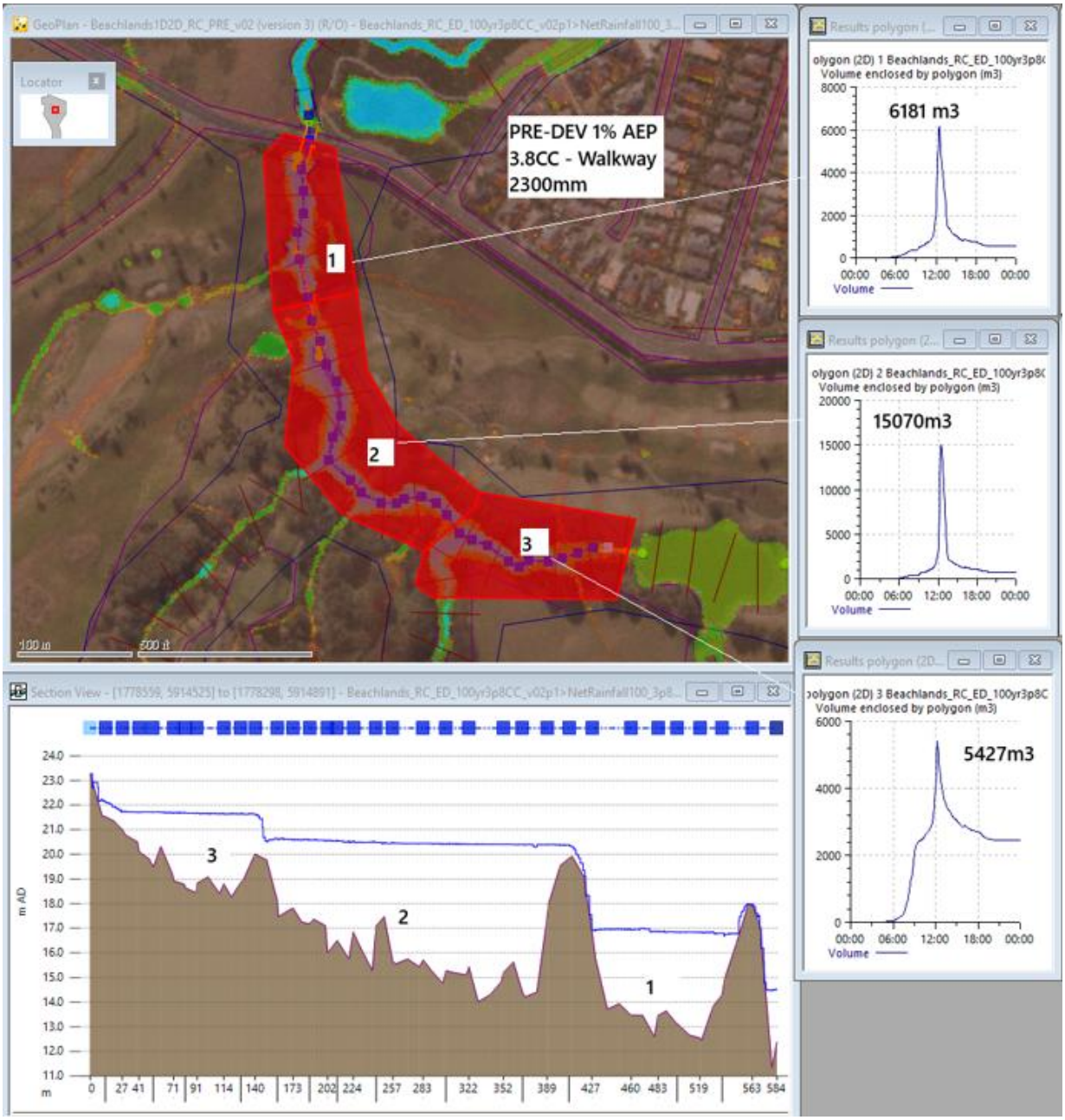


Figure 5 Volumetric assessment upstream of Culvert-Northeast within cascading stream basins during the 1% AEP Storm Event (+3.8°C CC) (Source: HG ICM Model, October 2026)

A summary of the volumes associated with each pedestrian walkway scenario has been provided in Table 2 below.

Table 2 Summary of volumetric analysis upstream of Culvert-Northeast during 1% AEP Storm Event (+3.8°C CC) *(Source: HG ICM Model, October 2026)*

Metric	PRE Walkway 2300mm	POST No Walkway	POST Walkway 2300mm	POST Walkway 1800mm	POST Walkway 1500mm	POST Walkway 1200mm	POST Walkway 1050mm
Flood level upstream of 2 m culvert (m RL)	16.840	18.377	17.160	17.344	17.544	17.845	18.030
Freeboard relative to road crest at 18.35 m RL; pre-development uses 17.8 m RL (m)	0.960	**-0.027**	1.190	1.006	0.806	0.505	0.320
Volume enclosed in Area 1 - d/s (m^3)	**6,181**	11,280	6,933	7,532	8,183	9,147	9,873
Volume enclosed in Area 2 - mid (m^3)	**15,071**	16,476	16,103	16,127	16,151	16,218	16,286
Volume enclosed in Area 3 - u/s (m^3)	**5,428**	5,752	5,752	5,752	5,752	5,752	5,752
Difference from pre-development (Walkway 2300 mm) - Area 1 (m^3)	-	5,099	751	1,351	2,002	2,965	3,692
Difference from pre-development (Walkway 2300 mm) - Area 2 (m^3)	-	1,405	1,033	1,057	1,080	1,147	1,215
Difference from pre-development (Walkway 2300 mm) - Area 3 (m^3)	-	324	324	324	324	324	324
Total Difference (m^3)	-	**6828**	**2108**	**2731**	**3405**	**4437**	**5231**

The assessment demonstrates that the additional volume present behind the Culvert-Northeast, following the Beachlands South development, is approximately 2100m^3 when the walkway is retained. During the highest impact scenario, i.e. total removal of the pedestrian walkway, this volume increases to approximately 6800m^3.

Therefore, to achieve flood level neutrality at this location, the proposed Beachlands South development would need to provide an additional 6800m^3 of attenuation storage upstream of the Culvert-Northeast to achieve pre-development flood levels.

However, it should be noted that controlled discharge of the pedestrian walkway using a 1200mm diameter augmentation, would achieve sufficient freeboard to the JLD road embankment, in accordance with the Auckland Council Stormwater Code of Practice, which requires 500mm freeboard for appropriate flood mitigation during the 1% AEP storm event (+3.8°C CC).

5.1.2 Golf Pond Mitigation

As previously mentioned, to achieve the pre-development storage volume behind the Culvert-Northeast, provision of additional upstream storage has been investigated.

The two large existing Golf Ponds immediately upstream of Basin 3, partially illustrated in Figure 5, were considered to achieve the necessary volume required. The pre and post development models both show that the primary outlets capacity are exceeded in the 1% AEP with controlled overtopping occurring during in both events.

In conducting further review of the model, it was observed that the golf ponds existing outlets were submerged beneath the permanent water level (PWL had been taken from LIDAR data of the ponds). As a result, the ICM modelling pond level was reduced by 466mm to reduce the water level to match

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the corresponding outlet levels within both golf ponds, reflecting the realistic permanent water level assuming both outlets are fully operational.

To provide the additional flood storage volume, the outlet level and therefore the permanent water level (which has also be referred to as the pond 'bed level'), was reduced by 200mm. Whilst this would have little to no impact during the smaller storm events (50% and 10% AEP storms), the reduced outlet level provides an additional volume during the 1% AEP storm event prior to the overtopping and downstream discharge.

The results of this assessment are summarised in Table 3 below.

Table 3 Volume Analysis following Golf Pond Mitigation Option *(Source: HG ICM Model, October 2026)*

	Pre-development	[2] Revised Pre-development	[3] Revised Post-Development
Pipe flow (m^3/s)	4.43	4.45	4.57
Overtopping flow (m^3/s)	5.32	4.89	4.14
Pipe volume (m^3)	63,025	66,303	74,686
Overtopping volume (m^3)	20,367	16,518	11,288
Total flow (m^3/s)	9.75	9.34	8.71
Total volume (m^3)	83,392	82,821	85,974
Post minus Pre (volume contributing downstream) (m^3)			**3,153**

Notes:

[1] All scenarios included the 2300mm pedestrian walkway was fully operational

[2] Pond Bed Level Reduced by 466mm to match outlet level

[3] Pond Outlet/Bed Reduced by an additional 200mm below the revised pre-development level

As demonstrated, under the current 'Post-Development' design as part of the submitted SMP, 4,779m^3 of additional volume is discharged from the golf ponds during the post-development 1% AEP storm event (+3.8°C CC). The 200mm reduction within these ponds, as per the 'Revised Post-Development' scenario, reduces the quantity of volume discharged from these ponds to 3,153m^3.

Further assessment was undertaken to assess the potential arrangement required to achieve flood level neutrality behind the central-north in order to achieve an acceptable freeboard provision to Jack Lachlan Drive, as per existing conditions. The following scenarios were modelled without the pedestrian walkway:

- **S1:** POST No Walkway – 200 mm drop in inlet level
- **S2:** POST No Walkway – additional 300 mm drop in inlet level (total drop of 0.5 m)
- **S3:** POST No Walkway – total 0.5 m drop in inlet level, inlet/pipe size reduced from 900 mm to 750 mm
- **S4:** POST No Walkway – total 0.5 m drop in inlet level, inlet/pipe size reduced to 600 mm
- **S5:** POST No Walkway – total 1.0 m drop in inlet level, inlet/pipe size reduced to 600 mm

Further to Table 2, the results of these simulations have been summarised in Table 4 below.

Table 4 Summary of volumetric analysis upstream of Culvert-Northeast during 1% AEP Storm Event (+3.8°C CC) - Pedestrian Walkway Removed *(Source: HG ICM Model, October 2026)*

	PRE Walkway 2300mm	S1	S2	S3	S4	S5
Flood level upstream of 2 m culvert (m RL)	16.840	18.223	17.923	17.786	17.776	17.131
Freeboard relative to road crest at 18.35 m RL; pre-development uses 17.8 m RL (m)	0.960	0.127	0.427	0.564	0.574	1.219

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Volume enclosed in Area 1 - d/s (m^3)	6,181	10,705	9,486	8,938	8,916	6,832
Volume enclosed in Area 2 - mid (m^3)	15,071	15,796	15,002	14,561	14,641	12,532
Volume enclosed in Area 3 - u/s (m^3)	5,428	5,534	5,352	5,223	5,194	4,931
Difference from pre-development (Walkway 2300 mm) - Area 1 (m^3)		4,692.81	3,474.03	2,926.29	2,904.14	820.16
Difference from pre-development (Walkway 2300 mm) - Area 2 (m^3)		398.60	163.38	-277.81	-197.94	-2,306.45
Difference from pre-development (Walkway 2300 mm) - Area 3 (m^3)		0.19	-34.73	-163.02	-192.34	-454.95
Total Difference (m^3)		**5,092**	**3,603**	**2,485**	**2,514**	**-1,941**

The results of this assessment demonstrate that the provision of additional attenuation storage upstream of the culvert, have a positive impact on the downstream attenuation levels behind the Central-North culvert. By increasing the attenuation available within the golf ponds, and augmenting the associated outlet structures, total attenuation volume can be significantly reduced and fully mitigated if desired when compared to the existing pre-development scenario.

'Scenario 3' presents a greatly reduced attenuation volume, and a freeboard provision in compliance with the expectations of the Auckland Council Stormwater Code of Practice, i.e. >0.5m freeboard.

However, with the recent release of the revised TP108 rainfall data, and the acknowledgement of the notable increase in 1% AEP rainfall depth, it may be prudent to consider the increased level of mitigation provided by 'Scenario 5' to allow for an increased level of future resilience.

5.2 OLFP Throttling on Jack Lachlan Drive

An identified OLFP discharging off JLD was observed to exhibit increased discharge runoff in the post-development compared to pre-development conditions, denoted as the 'JLD OLFP' in Figure 1.

Whilst the location of discharge was present during the pre-development scenario, and therefore retained during the post-development scenario, the runoff rate increased from approximately $2m^3/s$ to $6m^3/s$ during the 1% AEP storm event, inclusive of 3.8°C CC.

Given the scale of increase to this discharge, it was considered that reducing the OLFP discharge to pre-development rates may have a notable impact on the downstream flood depths further downstream.

As a result, this OLFP was throttled in the post-development scenario and the relative flood levels downstream were reassessed.

It should be noted, to achieve the $2m^3/s$ pre-development rate in the post-development scenario, the ICM Rain-on-Grid model required a further reduction to $1.68m^3/s$ to account for the additional runoff generated by the pervious area immediately beyond JLD. For clarity, this has been illustrated in Figure 6 below.

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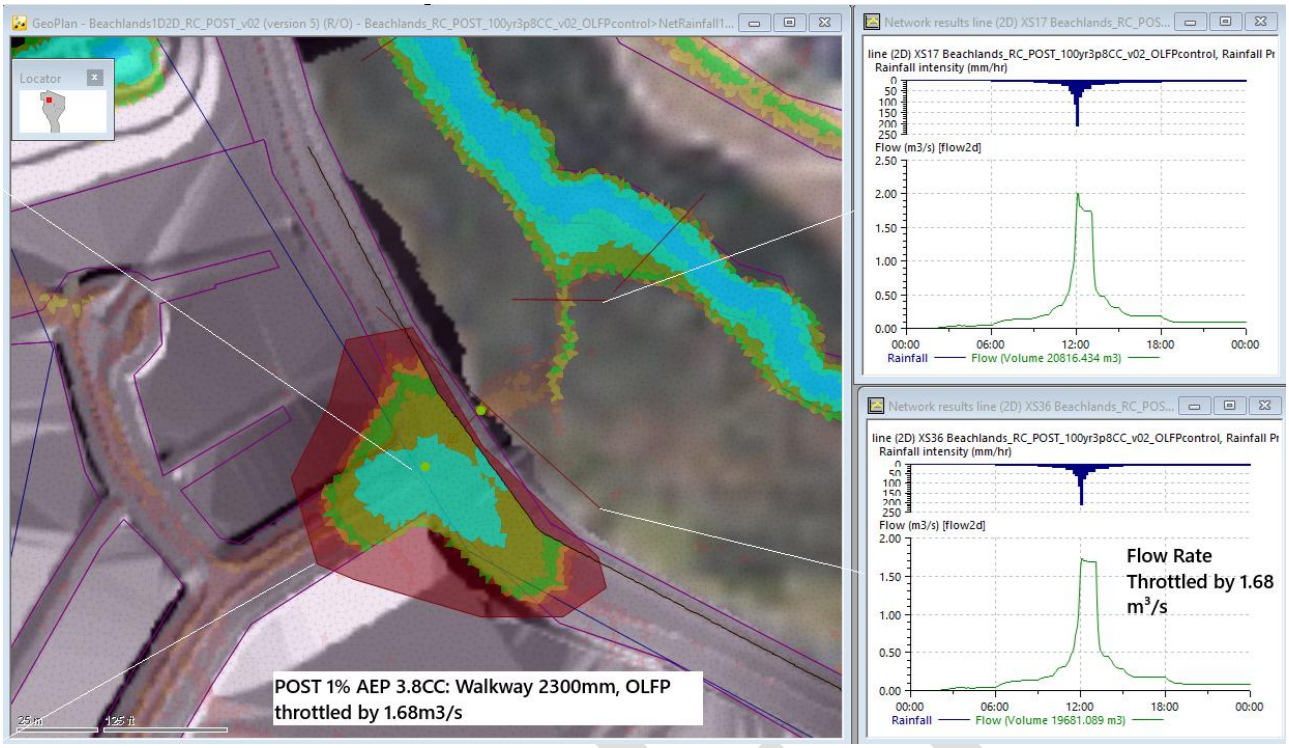


Figure 6 Simulated throttling of OLFP at JLD to achieve pre-development runoff rates *(Source: HG ICM Model, October 2026)*

An additional scenario was simulated throttling OLFP discharge to 1m³/s, to provide a betterment over the existing conditions, and is shown in Figure 7.

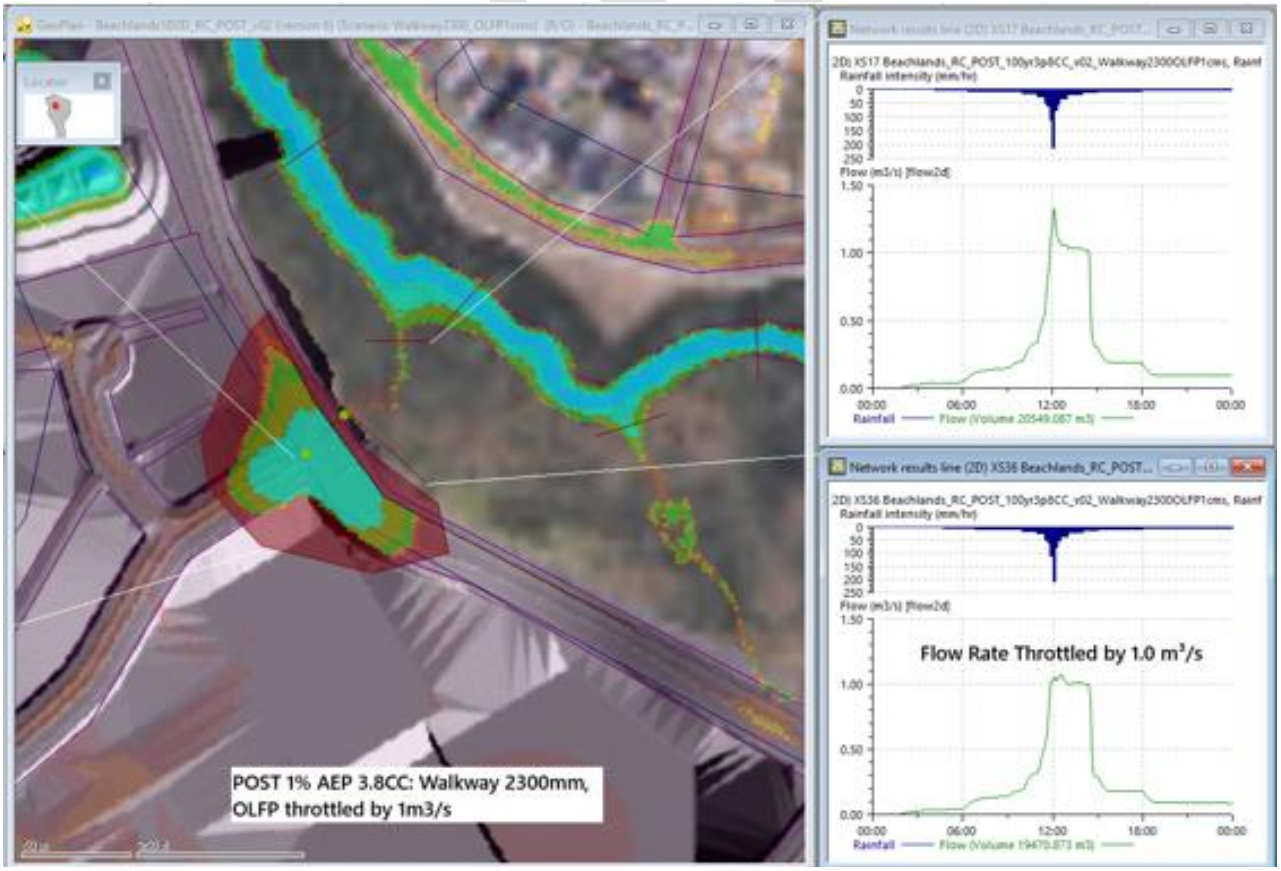


Figure 7 Simulated throttling of OLFP at JLD to 1m³/s *(Source: HG ICM Model, October 2026)*

The implications of throttling this OLFP inevitably created additional attenuation within JLD and the Beachlands development. The additional volume required for attenuation, following the proposed throttling is as per the following:

- OLFP Throttling to 1.68 m^3/s = 2193 m^3
- OLFP Throttling to 1.00 m^3/s = 3500 m^3

Note: *This assessment did not include the practical mitigation of the required attenuation volume to achieve the discharge reduction and was exclusively to focus on the relative impact to the downstream flood levels. Further assessment will be undertaken, should this approach be pursued, to appropriately attenuate this volume as far as practicably possible, as to not adversely impact the flood risk/hazard at this location or surrounding environments.*

5.3 Results

The results of the various mitigation proposals have all been assessed against the relative impact to the downstream flood levels within the residential area highlighted as part of Auckland Council's original s67 comments.

A summary of these results, as per the proposals and methodologies presented in this memo, has been provided in Table 5.

Table 5 Relative Impact to Downstream Flood Levels *(Source: HG ICM Model, October 2026)*

	Average Change to Downstream Flood Levels		
Proposed Post-development Augmentation	**Pedestrian Walkway**	**JLD OLFP Throttled to 1.68 m^3/s**	**Golf Pond Level Reduction**
Pedestrian Walkway Retained (2300mm Dia.)	+ 30 mm	+ 6 mm	+ 28 mm
1800mm Dia. Pedestrian Walkway	+ 26 mm	+ 2 mm	-
1500mm Dia. Pedestrian Walkway	+ 22 mm	- 3 mm	-
1200mm Dia. Pedestrian Walkway	+ 17 mm	- 9 mm	-
1050mm Dia. Pedestrian Walkway	+ 12 mm	- 13 mm	-
Pedestrian Walkway Removed	- 10 mm	-	-
Pedestrian Walkway Retained (2300mm Dia.)	+ 30 mm	- 7 mm *	-
Pedestrian Walkway Removed – Golf Pond - Scenario 1	-	-	- 10 mm
Pedestrian Walkway Removed – Golf Pond - Scenario 2	-	-	- 10 mm
Pedestrian Walkway Removed – Golf Pond - Scenario 3	-	-	- 13 mm
Pedestrian Walkway Removed – Golf Pond - Scenario 4	-	-	- 19 mm
Pedestrian Walkway Removed – Golf Pond - Scenario 5	-	-	- 20 mm

Note:
***** Simulation reflecting the throttled overland discharge off JLD to 1m^3/s creating a betterment compared to existing conditions.

6.0 Summary

Removing the pedestrian walkway in the post-development scenario achieved the largest reduction in flood levels, however, as per Table 3, this also generates the largest additional volume required for attenuation without increasing risks associated with the JLD embankment.

It could be concluded that the most optimal solution is to retain the existing 2300mm pedestrian walkway at Culvert-Northeast and restrict flows at the JLD OLFP location to pre-development levels. This would provide an effective reduction to the downstream flood levels where Auckland Council have expressed concern during the 1% AEP storm event, whilst avoiding any further infrastructure work required at the existing culvert. In doing so, maintenance requirements are minimised at the high-risk location within the stream basin.

The JLD OLFP throttling proved to achieve the largest reduction in downstream flood levels, from 30mm to 6mm, when reduced to pre-development rates.

This would be further improved by reducing this discharge point to $1m^3/s$, which would provide a betterment to existing conditions at the OLFP discharge, as well as a 7mm reduction to downstream flood levels.

Augmentation of the existing Golf Ponds upstream of Culvert-Northeast offered a potential solution to both downstream flood depths at the existing boathouses, and a volumetric solution when removing the pedestrian walkway, in order to achieve this overall positive result. As per 'Scenario 5' of Table 5, it was considered prudent to provide an additional volume of storage within the existing gold pond, by reducing levels 1m, and restricting the pond outlets to a DN600 pipe to reduce the attenuated volume of stormwater upstream of the Culvert-Northeast.

This provided an increased level of freeboard to the proposed JLD levels, which provides future resilience when considering the future increases to the 1% AEP rainfall depth data following the recent TP108 updates.

7.0 Limitations

7.1 General

This report is for the use by Auckland Council Healthy Waters only and should not be used or relied upon by any other person or entity or for any other project.

This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.

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