Before an Independent Hearings Panel

The Proposed Waikato District Plan (Stage 1)

IN THE MATTER OF the Resource Management Act 1991 (**RMA**)

IN THE MATTER OF hearing submissions and further submissions on the Proposed Waikato District Plan (Stage 1):
<u>Topic 25 – Zone Extents</u>

REBUTTAL EVIDENCE OF RYAN JAMES PITKETHLEY
ON BEHALF OF HAVELOCK VILLAGE LIMITED

(Infrastructure and Stormwater)

3 May 2021

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1. SUMMARY OF REBUTTAL EVIDENCE

1.1 My rebuttal evidence responds to the evidence of Mr Campbell McGregor filed on behalf of Hynds Pipe Systems Ltd and the Hynds Foundation and Ms Dale Paice for Pokeno Village Holdings Limited. I also briefly comment on the section 42A Report.

1.2 Mr McGregor has identified some uncompleted works recommended in the 2008 Stormwater Catchment Management Plan ("**SCMP**") and the uncompleted work associated with the Pipeline A and the Hynds and Synlait overland flow path channels both on site and upstream. In my opinion the completion of these works is not necessary to manage stormwater from the HVL land and so these are unrelated to whether the HVL land should be rezoned. They are issues needing resolution separate to and regardless of the rezoning outcome.

1.3 As required by the Waikato District Council Regional Infrastructure Technical Specification ("**WDC RITS**") Section 4.1.8, all stormwater systems shall provide for the management of stormwater runoff from within the land being developed together with any runoff from upstream catchments. Yashili, Hynds and Synlait and Waikato District Council ("**WDC**") are required to manage as a minimum the upstream predevelopment flows entering their site (or public road in the case of WDC), pass it through their site and discharge it downstream. This is currently being achieved in the temporary situation with private accessways, channels, pipes and publicly vested road overland flow without Pipeline A being completed.

1.4 The proposed stormwater strategy for Havelock is to reduce flow rates from the HVL site to 80% of predevelopment flow rates, which would reduce flooding in the downstream land and be accommodated by the existing downstream piped and overland flow network. This means that the current temporary situation as between WDC, Yashili, Hynds and Synlait can accommodate HVL now and until Pipeline A is completed. As explained above in paragraph 1.3, those four parties are required to ensure that the situation is maintained.

1.5 I agree with the suggestion that for appropriate stormwater management, controls should be considered on a catchment wide basis. This will be useful to understand whether the timing and volume of stormwater discharges is managed appropriately, and to confirm that the HVL strategy of over attenuation is benefitting the catchment as intended. However, the timing of when a catchment wide analysis is completed is in my opinion not related to whether the land should be rezoned and developed. I consider that a catchment wide analysis would not alter the proposed stormwater strategy for Havelock and there is no need to wait for this analysis to rezone the Site. I disagree with Mr McGregor and Mrs Paice on this point and consider that these matters can be addressed at the subdivision stage (during the resource consent process) as is usual for this type of development.

1.6 For similar reasons I also disagree with Mr McGregor and Ms Paice that the existing SCMP needs to be updated before Havelock can be rezoned.

1.7 A catchment wide hydrological model is not required to support the rezoning but can be provided as part of the resource consenting process. If development occurring on the upstream land identified in the SCMP as ‘rural’ manages stormwater so as to replicate predevelopment peak flow rates and to control increased runoff volumes (as intended in the HVL strategy), then flooding is not likely to be exacerbated downstream. Therefore, any further catchment modelling or update to the current SCMP is not required prior to rezoning because the upstream development will still be in line with the SCMP assumptions.

1.8 Further clarification, calculations and plans have been provided to show the revised stormwater strategy to complement the revised HVL masterplan. Dry attenuation basins offline to streams and ecological features are to be located adjacent to road sags, or in the case where lots fall away from roads, a conveyance channel running within the drainage reserve adjacent to the backs of the lots, draining (treated water) to a communal dry attenuation basin and then to the stream.

1.9 Storage volumes are to attenuate the 2 and 10 year plus climate change events to predevelopment levels, and the 100 year plus climate change event to 80% of predevelopment levels to assist with and alleviate downstream flooding.

1.10 These steps address Mr McGregor's concerns about the viability of the proposed offline measures on the HVL site.

1.11 Mr McGregor agrees with me that there is a technically feasible design to manage stormwater from the HVL land. The only real area of dispute is whether the detail needs to be provided prior to rezoning or at resource consent stage. In my view the relevant information can be provided at that later stage. That is consistent with the view of Mr Mead the section 42A report writer.

1.12 The issues raised by Mr McGregor and Mrs Paice are in my opinion about how the HVL land should be developed for housing, rather than if the land should be developed. Therefore, I see no reason not to rezone the land as previously submitted.

2. INTRODUCTION

2.1 This rebuttal statement relates to evidence in opposition filed by:

(a) Campbell James McGregor for Hynds Pipe Systems Ltd and the Hynds Foundation.

(b) Dale Sarah Paice for Pokeno Village Holdings Limited.

2.2 This rebuttal statement also addresses matters raised in the Council's section 42A report.

2.3 I confirm that I have the qualifications and expertise previously set out in paragraphs 2.1-2.5 of my primary evidence.

2.4 I repeat the confirmation given in my primary evidence that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014 and that my evidence has been prepared in accordance with that Code.

3. EVIDENCE OF CAMPBELL JAMES MCGREGOR FOR HYNDS PIPE SYSTEMS LIMITED AND THE HYNDS FOUNDATION

3.1 The following is a summary of the evidence being responded to and my position on that evidence which follows as the next paragraph or groups of paragraphs. I address the following issues raised by Mr McGregor:

(a) Uncompleted works recommended as part of Stormwater Catchment Management Plan;

(b) Incomplete stormwater works on Hynds Land;

(c) Requirement for catchment wide stormwater approach prior to rezoning;

(d) Whether the correct soil type is used in my assessments; and

(e) Viability of Offline storage.

Uncompleted works recommended as part of Stormwater Catchment Management Plan

3.2 Paragraphs 3.1-3.9 of Mr McGregor's evidence notes that the Pokeno Plan Change 24 ("**PC24**") SCMP (originally prepared by Harrison Grierson Consultants Limited (September 2008) and subsequently updated by MWH NZ Limited in September 2010):

(a) Considered a 1,500ha catchment draining into what was identified at the time as the Pokeno growth area of PC24 (440ha), and

(b) Recommended several stormwater treatment devices (i.e. wetlands and attenuation ponds) to mitigate the effects of development in the Pokeno growth area and showed the extents of the existing 1% Annual Exceedance Probability ("**AEP**") flood plain.

3.3 Modelling was completed and stormwater management outcomes recommended. Relevant outcomes are specifically noted in Mr McGregor's paragraph 3.7. The McDonald Road bridge has been replaced with a new culvert. However, two infrastructure upgrades have not been completed as follows:

(a) Widen the waterway under the Great South Road Bridge to remove the constriction to flow; and

(b) Upgrade the Tanitewhiora Stream transition entry and exit to the State Highway 1 ("**SH1**") culvert.

3.4 Mr McGregor concludes that the SCMP should be updated, and these works need to be completed prior to the rezoning of Havelock proceeding in order to mitigate flood effects.[1]

Response

3.5 I agree with the strategies and recommendations of the SCMP as being good practice and in line with acceptable standards. I also agree that the SCMP recommendations outlined in 3.2 a) and b) above should be completed as part of the catchment wide solution to alleviate the issues outlined in that report. I understand that this work is in the Long Term Plan and will be completed by WDC in due course but I am unsure of specific timing.

3.6 The report associated with the SCMP explains that both upgrades outlined in 3.3 a) and b) will improve the flood hydraulics in the Tanitewhiora Stream and reduce flooding upstream of those locations. For example, referring to highlighted numbers in Figure 1 (extracted from the SCMP), it notes that with the improvements in 3.3 a) and b) completed, at the upstream entrance to Great South Road bridge (node 13), the 1%AEP plus climate change flood level would reduce from 20.2m RL (predevelopment) to 19.0m RL (post development with the mitigation measures completed). The McDonald Road bridge has already been removed and upgraded with a new box

[1] Paragraphs 4.13 and 6.2.

culvert (completed by Pokeno Village) (node 10). With this and the 3.2 a) and b) upgrades completed, the downstream flood level at this node (adjacent to Hynds site and Pond K) theoretically can be reduced from 20.4m RL to 19.9m RL.

3.7 It should be noted that the lowest part of the Hynds site is in the northern corner (adjacent to the privately owned Pond K crest) at a level of approximately 20m RL. The closest buildings on site are approximately 100m south of this point and their finished floor levels are all above 21m RL, at least a 0.6m freeboard from the predevelopment flood level (building code compliant). The recommended SCMP improvements (in their entirety) would theoretically mean a reduction in flooding of 0.5m (20.4m less 19.9m) and an increase in freeboard to the existing buildings from 0.6m to at least 1.1m. It is therefore in Hynd's best interest that these works are completed to further reduce flood risk to their site.

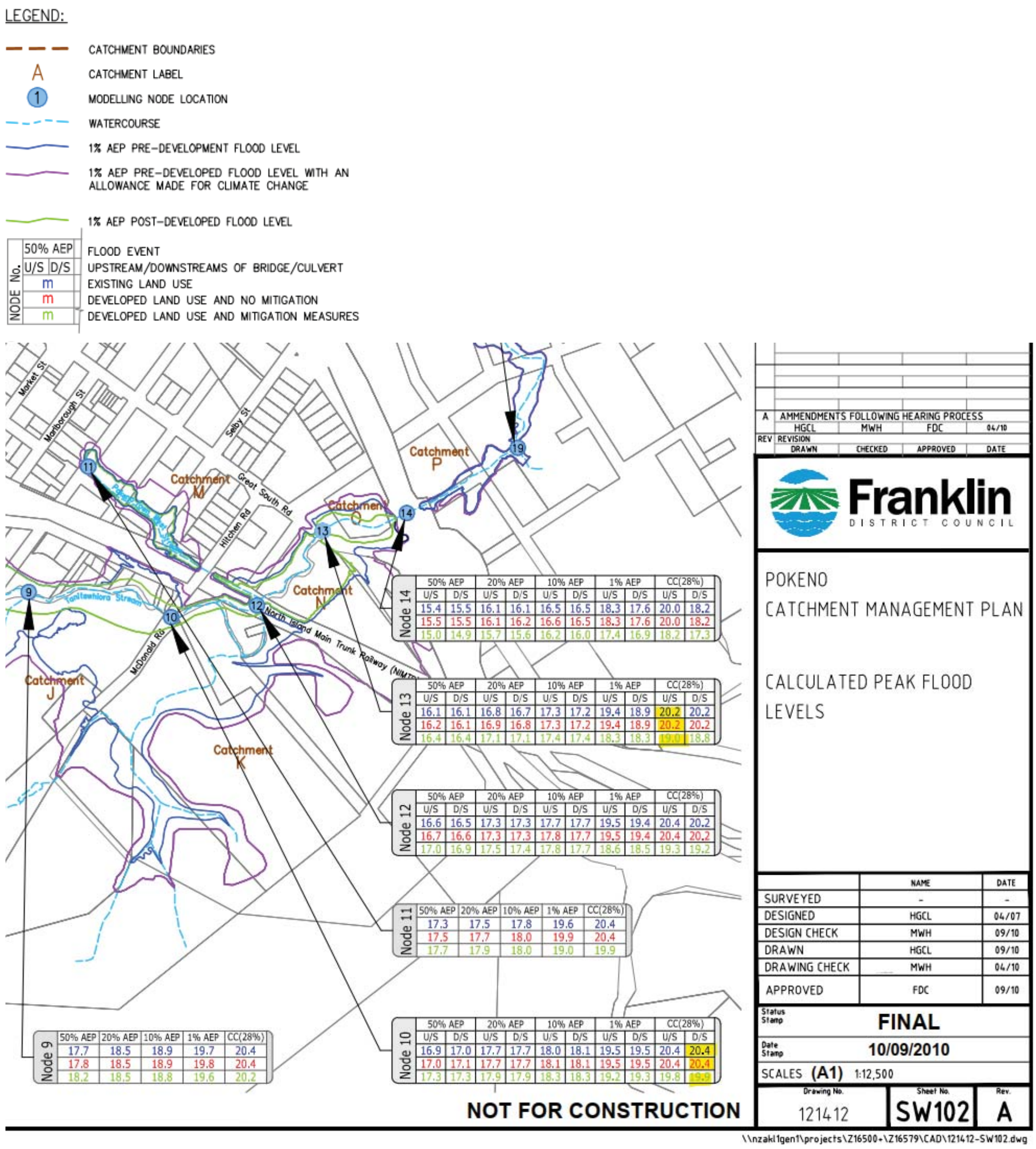


Figure 1 – Peak Flood Levels (from SCMP drawing SW102).

3.8 I note that the modelling and recommendations in the SCMP assumes that the upstream land holdings remain a rural zone – refer to the green shading in Figure 2.

3.9 A catchment wide hydrological model is not required to support the rezoning but can be provided as part of the resource consenting process. If development occurring on the upstream land identified in the SCMP as 'rural' manages stormwater so as to replicate predevelopment peak flow rates and to control increased volumes from development, then flooding is not likely to be exacerbated downstream. Therefore, any further catchment modelling or update to the current SCMP is not required prior to rezoning because the upstream development will still be in line with the SCMP assumptions.

3.10 The rezoning and development of Havelock (and other unrelated upstream land within the wider catchment) provides an opportunity to reduce flow rates to 80% of predevelopment flow rates, which would reduce flooding in the downstream land and be accommodated by the existing downstream piped and overland flow network.

3.11 As I explain in more detail below, this is the main stormwater management strategy to be used for the Havelock Site to manage water quantity and is a usual practice where existing downstream flooding exists (this is also recommended by Ms Dale Paice, refer to paragraph 4.3 below).

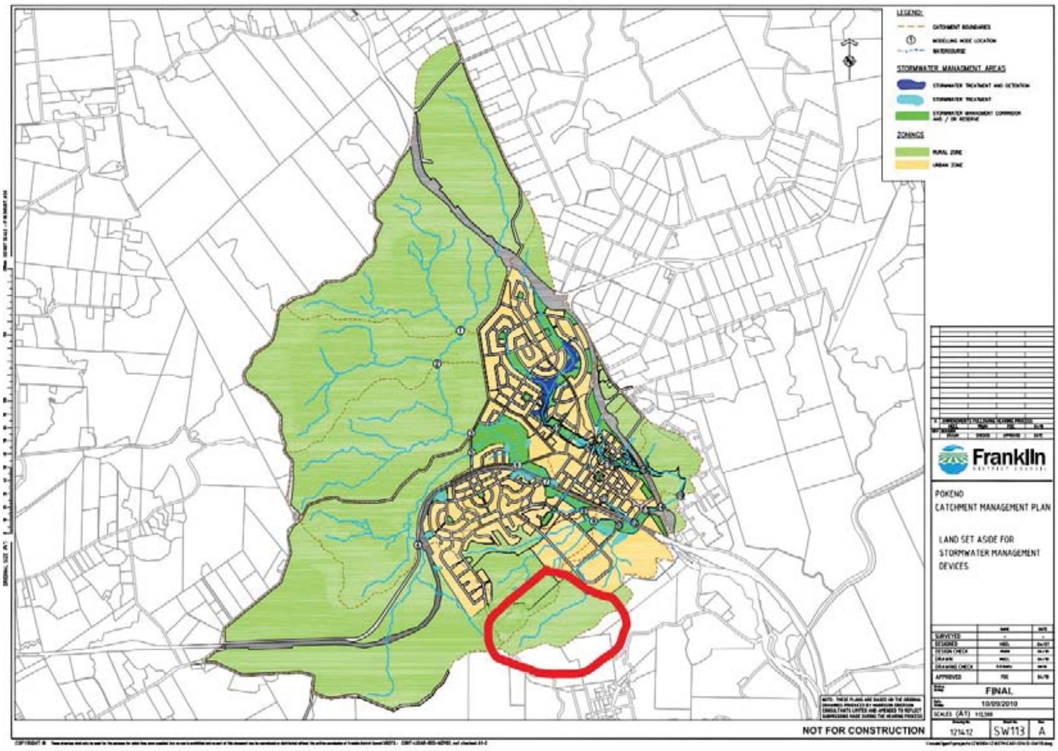


Figure 2 – Assumed land uses (from SCMP drawing SW113). HVL is circled red and is assumed as rural zoning (ie rural runoff rates).

3.12 I consider it is technically and practically feasible to develop the land and manage stormwater within the HVL land holdings so as not to increase peak flow rates at the HVL boundaries or downstream, and be in line with the current SCMP. Mr McGregor also agreed this is technically feasible. Therefore, in my opinion the completion of the SCMP works is unrelated to whether the HVL land should be rezoned as the management of stormwater from Havelock does not rely on completion of the SCMP works.

3.13 The completion of the SCMP works is an issue needing resolution separate to and regardless of the rezoning outcome. I also consider that resource consent processes for development within the HVL land can address the implications (if any) of the failure to complete these works on the management of stormwater from the Havelock Site, including in the absence of a Council-led catchment management plan.

3.14 The section 42A report records the concerns raised by Mr McGregor at paragraph 377. The report writer, Mr Mead, considers that the implications of the incomplete works for development of the HVL site can be assessed at the time of resource consent. This is consistent with my opinion.

Incomplete stormwater works on Hynds Land

3.15 Paragraphs 3.17-3.28 of Mr McGregor's evidence explains additional incomplete works in Hynds and Synlait land and is very similar to his concern about other incomplete stormwater works explained above.

3.16 He notes that certain stormwater works, called Pipeline A, are incomplete and in private (Hynds) ownership due to works ceasing on account of a misunderstanding of how the pipeline cost is to be reimbursed (discussions to establish a Developer's Agreement with WDC are ongoing).

3.17 Mr McGregor considers that:

(a) Pipeline A is required to be extended to service the Synlait and upstream HVL land, to provide connection to both land holdings. This line also requires vesting to WDC.

(b) That the HVL site needs to connect to Pipeline A directly.

(c) Pipeline A is adequately sized to cater for catchments to remain in their current state under the Operative District Plan (which includes 32ha of HVL land currently in pasture).

(d) Further consideration is required regarding to the continued safe conveyance of flows through the Synlait site to McDonald Road and Pipeline A, and

(e) No identification of existing 1 in 100-year flow paths or their ability to cater for existing flooding has been provided, and no 1% AEP flood path is provided for the HVL / Synlait land without Pipeline A being completed.

Response

3.18 I agree with and am of the same opinion of Mr McGregor with regards 3.12 a) – d) above. These are all technical requirements for the successful completion of Pipeline A as originally intended.

3.19 I also agree that discussions to establish a Developer's Agreement with WDC need to be concluded and the works completed so that the system can operate as intended.

3.20 I do not agree with the statement in paragraph 3.17 e) above. The landform, infrastructure, roading and channels currently on site allow for the safe conveyance of 1% AEP overland flows from HVL land through to the Tanitewhiora Stream. This is shown on drawings 2020-08-SK05-1 and 2 in the Appendices and conveyed as follows:

(a) Cut off channels running within Yashili's, Synlait's and Hynd's properties which directs water to McDonald Road, Pipeline A, and then to the Tanitewhiora stream.

(b) Water passing via McDonald Road itself to the sag to the east of the McDonald Road roundabout, which then flows into Pipeline A.

3.21 As required by the WDC RITS Section 4.1.8, all stormwater systems shall provide for the management of stormwater runoff from within the land being developed together with any runoff from upstream catchments. WDC, Yashili, Hynds and Synlait are required to manage as a minimum the upstream predevelopment flows entering their site, pass it through their site and discharge it downstream. This is currently being achieved in the temporary case with private channels and road overland flow without Pipeline A being completed. Figure 3 (drawing 2020-08-SK05-1 in the Appendix) illustrates the current situation. There are also a series of photographs in the Appendix illustrating how overland flow currently passes from HVL land to the Tanitewhiora stream via Synlait Land, publicly vested McDonald Road, and Hynds Land/partially completed Pipeline A. With the preservation of the status quo, this would also be a feasible route if HVL was developed with the proposed stormwater strategy.

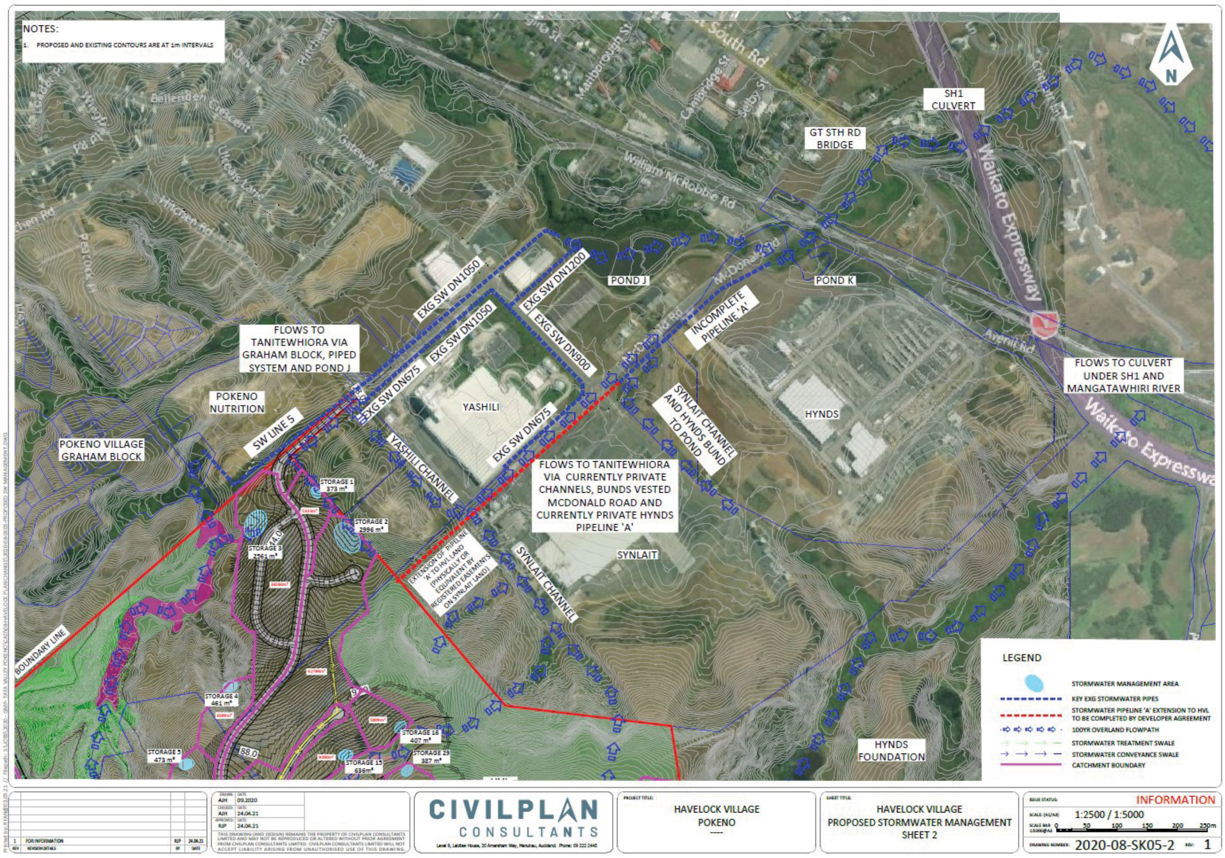


Figure 3 – Overland Flow Paths from 2020-08-SK05-1.

3.22 Predevelopment peak flows discharging into the downstream sites (Yashili, Synlait, Graham Block, Pokeno Nutritional, Hynds) from the HVL land will not change due to the proposed attenuation measures within the HVL land, at the top of the catchment. As noted in Mr McGregor's evidence, undersized culverts currently produce some issues further down the external catchment at SH1, but are not related to HVL in the pre or post development cases. This can be verified with catchment modelling at the resource consent stage and should not prevent the HVL land being rezoned.

3.23 Plans 2020-08-SK05-1 and 2 in the Appendix identify all 1 in 100-year flows paths from the HVL site. The piped networks and flow paths have been sized to cater for the predevelopment run off from HVL as per the WDC RITS requirements. To verify flows down McDonald Road, a calculation in the Appendix has been completed that shows that the catchment above McDonald Road generates 5.5m^3/s of predevelopment run off in the 1 in 100 year plus climate change event.

3.24 In the case where all pipes and inlets are 100% blocked (a common test for secondary overland flow path design), the Synlait western channel would overtop and flow would enter the top of McDonald Road via the Synlait site. McDonald Road is able to pass 5.6m^3/s completely within the public road reserve, without crossing boundaries or the need for privately held ponds and ditches. This occurs from the start of Synlait's gated entrance, flowing east until the McDonald Road sag adjacent to the Hynds land. The private ditches and ponds in Synlait Land provide additional storage for the catchment and would manage Synlait's own flows, but the calculation shows they are not required to pass HVL predevelopment flows.

3.25 At the McDonald Road sag the road flattens to 0.5% either side and this is where Hynds currently takes and expects to take the runoff from the road and into Pipeline A.

3.26 This demonstrates that the existing arrangement of roads, private accessways, channels, ditches and both completed and uncompleted pipes can remain as the status quo regardless of whether HVL is developed without exacerbating flooding downstream. The lack of some completed infrastructure (ie Pipeline A) is not necessary to be in place for the HVL land to be developed, although in my opinion should be in place as soon as possible to honour the original developer's agreement.

3.27 As noted above the reporting officer has commented on this lack of certain infrastructure at paragraph 377 and agrees this issue can be addressed at resource consent stage. This is consistent with my opinion.

Stormwater should be considered on a catchment wide basis prior to rezoning

3.28 In Paragraph 4.10-4.18 Mr McGregor considers that:

(a) Development of the nature proposed by the submitters is technically feasible from a stormwater perspective.

(b) Although it is common to provide a stormwater assessment as part of a particular resource consent, he considers in this case the catchment has specific risks (large scale, significant downstream development and absence of secondary flow path connectivity), so should be considered on a catchment wide basis, and prior to rezoning being given.

Response

3.29 I discuss above at paragraphs 3.8 to 3.14 how the upstream land identified as 'rural zoning' in the SCMP can be developed and still be in line with the current SCMP strategy.

3.30 I agree with the suggestion that for appropriate stormwater management, controls should be considered on a catchment wide basis. This is useful to understand whether the timing and volume of stormwater discharges is managed appropriately, and to confirm that the HVL strategy of over attenuation is benefitting the catchment as intended.

3.31 I also agree that to apply management solutions in a piecemeal nature can exacerbate flooding issues due to the timing and release of stormwater peak flows. This is in line with the WRC TR2020-07 section 2.5 which states that “in addition to any site-specific effects, cumulative effects must also be considered for the maximum probable development scenario within the catchment.”

3.32 The HVL proposal is to over attenuate (i.e., hold back and release stormwater volumes at rates slower than predevelopment, thereby reducing the existing flows) to 80% of predevelopment flows to assist with and alleviate the downstream flooding. Due to the upper geographical location of the HVL land, it is my opinion that a catchment wide study will not likely change the proposed strategy and principles for rezoning or developing the HVL land. Over attenuating flows within the HVL land will ensure that peaks from lower down the catchment will have time to exit and not coincide with the stormwater peaks discharging from HVL.

3.33 This over attenuation strategy is based on NZ and American studies and is widely accepted as an indicative target to compensate for the increased volume of runoff from the Site. The studies indicated that if post development flows are attenuated to 80% of the predevelopment 100-year peak flows, post development run off rates are less than predeveloped for the entire storm. Over attenuation generates an increased time period over which to discharge the Site’s developed stormwater volume. This offers greater opportunity for stormwater from the HVL land and other sites within the catchment (with similar levels of control) to combine downstream in such a way as to produce a total downstream peak that is no greater than the predeveloped peak at that location. Therefore, any cumulative hydrological effects that could increase the peak flow downstream are avoided.

3.34 This is a relatively and common engineering approach to address these issues which would be refined at the design of detailed design for resource consent.

3.35 Section 7.1.1 of the Waikato Regional Council Technical Report TR2020-07 (Waikato stormwater management guideline) (“**TR2020-07**”) also states (highlighting mine):

In the absence of a catchment study that evaluates a potential project in a given location, it is important to err on the side of caution, especially where human safety or structure damage is concerned. As such, in catchments where flooding problems do exist and there is no catchment management plan or catchment wide analysis, it is required that the post-development peak discharge for the 100-year ARI event for a new development be limited to 80% of the pre-development peak discharge.

3.36 TR2020-07 section 7.1.3 “Catchment location” also notes that:

A major consideration regarding the requirement for peak flow control is catchment location. As a general rule, stormwater detention for peak flow control should only be provided for developments located in the top half of a catchment *[as in the HVL development, which is at the top of the catchment]* to ensure that the potential for discharge peaks to coincide does not occur. This is to ensure the discharge peak from the development does not coincide with the discharge peak from the upper catchment.

3.37 TR2020-07 section 7.1.3 continues:

It is noted that this is a simplified approach, as there are other variables that can affect the timing of discharge peaks, including catchment shape, topography, surface type, etc………The optimal approach to determine where peak flow control is required in a catchment is to conduct a comprehensive catchment analysis where potential locations for peak flow control can be considered. In these situations, the study results will determine the need for peak flow control at potential locations within the catchment.

3.38 Based on this guidance and my experience, it is my opinion that as the HVL development is at the top of the catchment, the proposal of providing for over attenuation offline to streams for events up to and including the 100 year plus climate change event is in line with this best practice.

3.39 Based on the above I consider that a catchment wide analysis is not necessary prior to approval of the rezoning and such a catchment wide analysis would not change the stormwater strategy and controls for the HVL land. I disagree therefore with Mr McGregor on this point and consider that these matters can be addressed at the subdivision stage (during the resource consent process). The issues raised by Mr McGregor are in my opinion about how the HVL land should be developed for housing, rather than if the land should be developed.

3.40 I also therefore disagree with Mr McGregor that the existing SCMP needs to be updated before Havelock can be rezoned.

Soil Type

3.41 In paragraph 5.6 Mr McGregor warns of using a soil type curve number that is not representative of geology at HVL. The consequence of this is that devices could be undersized.

Response

3.42 I reiterate that the stated the curve numbers have been used based on previous experience with similar soils in the area and that this will be confirmed by geotechnical investigations.

3.43 However, I have considered Mr McGregor suggestion and calculated the attenuation size requirements based on a (likely conservative) pre-development soil group curve number of 49 and a post development (earthworked) curve number of 69 as shown in Figure 4. I have changed the post development curve number as recommended by the Waikato Regional Council Technical Report TR2020-06 (Waikato stormwater runoff modelling guideline) ("**TR2020-06**") page 11 which states:

> …if soil remediation is not provided for pervious areas that have been earthworked, then the initial abstraction of runoff from the entire site should be retained. In those situations, the pervious areas shall assume a reduction in ground permeability from the pre-development permeability. <u>The soil group classification should be reduced by one classification </u>(for example Group A to B, Group B to C and Group C to D).
>
> [emphasis added]

3.44 The basin size calculations are shown in the Appendices, which has increased in size, and therefore has potential to reduce the lot yield (subject to detailed design). The stormwater catchment plan is now shown in more detail and also a more detailed footprint for the basins is included in the plan. Refer to drawing 2020-08-SK05-1 in the Appendices.

3.45 This shows that in my opinion, by using a worst-case soil type the land can still be developed and rezoned.

Table 5-2: Runoff curve numbers for most urban and rural lands[18]

Cover description					
Cover type and hydrologic condition	**Hydrologic condition**	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, reserves, etc.)					
Condition (grass cover < 50%)	Poor	68	79	86	89
Fair condition (grass cover 50%-75%)	Fair	49	69	79	84
Good condition (grass cover >75%)	Good	39	61	74	80
Impervious areas					
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads*					
Paved; kerbing and catchpits (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Pasture, grassland, or range – continuous forage for grazing	Poor Fair Good	68 49 39	79 69 61	86 79 74	89 84 80

Figure 4 – Selected Curve Numbers in Revised Calculations.

Viability of Offline storage

3.46 In Paragraph 5.13-5.16 Mr McGregor considers that the original submission proposal of tanks raised several concerns:

(a) Providing sufficient inletting capacity and preventing inlet bypass;

(b) The location/size of the tanks;

(c) Access to the Tanks and maintenance; and

(d) Lack of an emergency or back-up system should the tank system become blocked.

Response

3.47 The proposal has progressed since the original submission documentation which proposed tanks. The current masterplan shown on drawing 2020-08-SK05-1 lends itself to the following strategy which answers the concerns raised above.

3.48 The drawing and calculations in the Appendix detail communal dry attenuation basins offline to streams and ecological features to be located adjacent to road sags, or in the case where lots fall away from roads, a conveyance channel running within the drainage reserve adjacent to the backs of the lots, draining to the basin and then to the stream. Refer to drawing 2020-08-SK05-1 in the Appendix.

3.49 The stormwater management area volumes shown in the calculations and drawings are indicative detention volumes estimated based on 70m³ per 1000m² catchment (lots and roads, pervious and impervious). The largest (worst case) catchment and basin (Catchment/Basin 28) have been modelled in HEC HMS[2] to prove its size, shape and location are all feasible, and this is shown in plan, section and perspective on drawings 2020-08-SK07-1, 2, 3 in the Appendix. The other storage volumes shown on drawing 2020-08-SK05-1 have been based on prorated volumes from that example catchment 28, and will be subject to detailed design at resource consent stage.

3.50 This illustrates that in principle accepted engineering approaches to stormwater management can be established, and therefore the land can be developed for residential purposes. Clearly at the time of resource consent the final design would be provided.

3.51 The stormwater strategy for flood control is for storage volumes to attenuate the 2 and 10 year plus climate change events to predevelopment levels, and the 100 year plus climate change event to 80% of predevelopment levels to assist with and alleviate downstream flooding.

3.52 This strategy has been selected for the following reasons and to answer Mr McGregor's concerns:

(a) Inletting into a dry basin in a road sag or via a channel can give certainty to capture of the 1 in 100 year plus climate change event without bypassing, as

[2] The US Army Corps of Engineers "Hydrologic Engineering Center Hydrologic Modelling System" (HEC-HMS) is designed to simulate the complete hydrologic processes of dendritic watershed systems. The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing.

entrance into the basin is via overland flow and is not restricted by grating or pipe inlets etc.

(b) Communal dry basins and channels are easy to maintain and are a preference for councils to be in public land (not held privately on lot) so that maintenance and inspections can be controlled by Council.

(c) Access to the devices is easy to achieve and maintenance of the typical manhole and orifice control structures are well known within Council.

(d) Emergency spillways can be incorporated for events larger than the 1 in 100 year plus climate change event, or in the event of blockage.

(e) To attenuate the 100 year plus climate change event to 80% of predevelopment is in an effort to alleviate existing flooding downstream.

Online storage

3.53 This evidence in paragraphs 5.17-5.27 is no longer relevant as it is not the option to be pursued by HVL in the current masterplan.

Comments on my primary evidence

3.54 In section 8 of his evidence Mr McGregor comments specifically about my primary evidence. In response, I consider that the level of detail within my primary evidence supplemented by this document and its Appendices is sufficient not to require any further assessment prior to the rezoning of the land.

3.55 A catchment wide hydrological model is not required to support the rezoning but can be provided as part of the resource consenting process. If development occurring on the upstream land identified in the SCMP as ‘rural’ (including Havelock) manages stormwater so as to replicate predevelopment peak flow rates and to control increased volumes from development (which is the strategy for Havelock), then flooding is not likely to be exacerbated downstream. Therefore, any further catchment modelling or update to the current SCMP is not required prior to rezoning Havelock because the upstream development will still be in line with the SCMP assumptions.

3.56 The rezoning and development of Havelock (and other unrelated upstream land within the wider catchment) provides an opportunity to reduce flow rates to 80% of predevelopment flow rates, which would reduce flooding in the downstream land and be accommodated by the existing downstream piped and overland flow network.

4. EVIDENCE OF DALE SARAH PAICE FOR POKENO VILLAGE HOLDINGS LIMITED

4.1 In the same vein as Mr McGregor, Mrs Paice's evidence notes that the location of attenuation devices within a catchment (at a catchment wide scale) is important to avoid coincident peaks. She recommends that rezoning could be appropriate subject to catchment spatial plans being produced (with hydrological modelling) to show device locations and floodplain extents to inform building floor levels.

4.2 She recommends that attenuation be avoided in the lower third of the catchment and encouraged in the upper third. The proposed stormwater strategy and design is consistent with this approach.

4.3 Ms Paice refers to TR2020-07 section 7.1.7 "Peak Flow Control Criteria" where it states (highlighting mine):

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.

4.4 Overall, Mrs Paice recommends a catchment-wide study be completed prior to rezoning.

Response to Mrs Paice's evidence

4.5 As explained above, the strategy for HVL is consistent with Mrs Paice's approach and TR2020-07. I have highlighted the most relevant aspects that are implemented in the HVL strategy: Storage volumes are to attenuate the 2 and 10 year plus climate change events to predevelopment levels, and the 100 year plus climate change event to 80% of predevelopment levels to assist with and alleviate downstream flooding.

4.6 I agree with the suggestion that for appropriate stormwater management controls must be considered on a catchment wide basis. I also agree that to apply management solutions in a piecemeal nature can exacerbate flooding issues due to the timing and release of stormwater peak flows.

4.7 However, the timing of when a catchment wide analysis is completed is in my opinion not related to whether the land should be rezoned and developed. I disagree with Mr McGregor and Mrs Paice on this point and consider that these matters can be addressed at the subdivision stage (during the resource consent process). I also consider that developing a catchment wide approach would not significantly alter the proposed strategy for the Havelock land and so there is no need to wait for such an approach prior to approving the rezoning.

4.8 This is consistent with the opinion of Mr Mead who notes in paragraph 377 that these matters are about how the HVL land should be developed, not if the land should be developed.

5. RESPONSE TO SECTION 42A REPORT

5.1 The Section 42a report has the following sections of relevance to this rebuttal:

> **376.** **There are infrastructure issues to resolve, in particular extension of wastewater networks. The submission state that discussions with Watercare have confirmed that Watercare's current and future upgrade plan for the Pukekohe WWTP allows for residential growth expected by WDC in Pokeno. Extension of wastewater networks can be accommodated through the subdivision and development process.**
>
> **377.** **Hynds' evidence (Campbell McGregor) has raised concerns about stormwater management for the land that drains to the east (that is, towards the Hynds site). The evidence identifies a number of existing problems in the vicinity of the Hynds site; works not yet undertaken to deal with these existing problems and the measures that need to be put in place to mitigate additional effects on downhill properties, from the HVL development. These measures are identified in Hynds' evidence as not being 'show stoppers', but Mr McGregor considers that they should be addressed before rezoning occurs, in particular the method to attenuate 1% AEP flows. I consider that these matters can be addressed at the subdivision stage, as the issues raised are essentially about how the HVL land should be developed for housing, rather than if the land should be developed.**

395. The main statutory issue is whether sufficient steps have been taken to avoid reverse sensitivity effects, and address effects associated with stormwater and transport. As outlined in the previous section, I consider that additional methods are required to manage reverse sensitivity effects, including controls on building design and layout along the eastern edge of the new development. Methods can be included in the PWDP to manage transport issues, while stormwater issues can be managed through current plan provisions and processes. Provided these measures are included, my opinion is that the proposed rezoning is appropriate in terms of the objectives and policies of the NPS-UD, WRPS and the PWDP.

5.2 I agree with Paragraph 376 in relation to the Pukekohe WWTP ability to provide for residential growth and network extensions can be accommodated throughout the development process.

5.3 I agree with paragraph 377 that states that the issues raised does not preclude the land being rezoned. The evidence above has explained in more detail the stormwater strategy and has answered Mr McGregor's concerns, in particular regarding the method to attenuate 1%AEP flows, and identifying the overland flow paths and capacities themselves. Part of the solution is to attenuate these flows to 80% of the predevelopment flows to assist with the known downstream flooding issues, thereby improving the status quo for all in the catchment.

5.4 I agree with the statement in paragraph 395 noting that "stormwater issues can be managed through current plan provisions and processes."

6. CONCLUSION

6.1 I have read the evidence of Mr McGregor and Mrs Paice and replied to each of their concerns that gives clarity and more detail regarding the HVL proposal with regards to stormwater.

6.2 I agree that the existing SCMP (2008) recommendations outlined in 3.2 a) and b) above should be completed as part of the catchment wide solution to alleviate the issues outlined in that report. In my opinion the completion of these works is not necessary to manage stormwater from the HVL land and so this is unrelated to whether the HVL land should be rezoned. It is an issue needing resolution separate to and regardless of the rezoning outcome.

6.3 Regarding the uncompleted work associated with the Pipeline A and the Hynds and Synlait overland flow path channels both on site and upstream, I agree that discussions to establish a Developer's Agreement with WDC need to be concluded and the works completed so that the system can operate as intended. In my opinion this is unrelated to whether the HVL land should be rezoned and is an issue needing resolution separate to and regardless of the rezoning outcome.

6.4 As required by the WDC RITS Section 4.1.8, all stormwater systems shall provide for the management of stormwater runoff from within the land being developed together with any runoff from upstream catchments. WDC, Yashili, Hynds and Synlait are required to manage as a minimum the upstream predevelopment flows entering their site, pass it through their site and discharge it downstream. This is currently being achieved in the temporary case with private accessways, channels and public road flow without Pipeline A being completed.

6.5 I have clarified the overland flow paths exiting the HVL site and how they pass through the catchment to the Tanitewhiora Stream. I have verified that McDonald Road has capacity to pass the upstream predevelopment flows from HVL, without the assistance of privately owned ditches which are upstream of the road sag.

6.6 I agree with the suggestion that for appropriate stormwater management controls should be considered on a catchment wide basis. I also agree that to apply management solutions in a piecemeal nature can exacerbate flooding issues due to the timing and release of stormwater peak flows.

6.7 However, the timing of when a catchment wide analysis is completed is in my opinion not related to whether the land should be rezoned and developed. I disagree with Mr McGregor and Mrs Paice on this point and consider that these matters can be addressed at the subdivision stage (during the resource consent process). I do not consider that a catchment wide analysis would alter the proposed stormwater strategy for Havelock and there is no need to wait for this analysis to rezone the Site.

6.8 Further clarification, calculations and plans have been provided to show the revised stormwater strategy to complement the revised masterplan. Dry attenuation basins offline to streams and ecological features are to be located adjacent to road sags, or in the case where lots fall away from roads, a conveyance channel running within the drainage reserve adjacent to the backs of the lots, draining (treated water) to a communal dry attenuation basin and then to the stream.

6.9 Storage volumes are to attenuate the 2 and 10 year plus climate change events to predevelopment levels, and the 100 year plus climate change event to 80% of predevelopment levels to assist with and alleviate downstream flooding.

6.10 The largest catchment and basin (Catchment/Basin 28) have been modelled in HEC HMS to prove its size, shape and location are all feasible on HVL land.

6.11 The issues raised by Mr McGregor and Mrs Paice are in my opinion about how the HVL land should be developed for housing, rather than if the land should be developed. Therefore, I see no reason not to rezone the land as previously submitted.

Ryan James Pitkethley

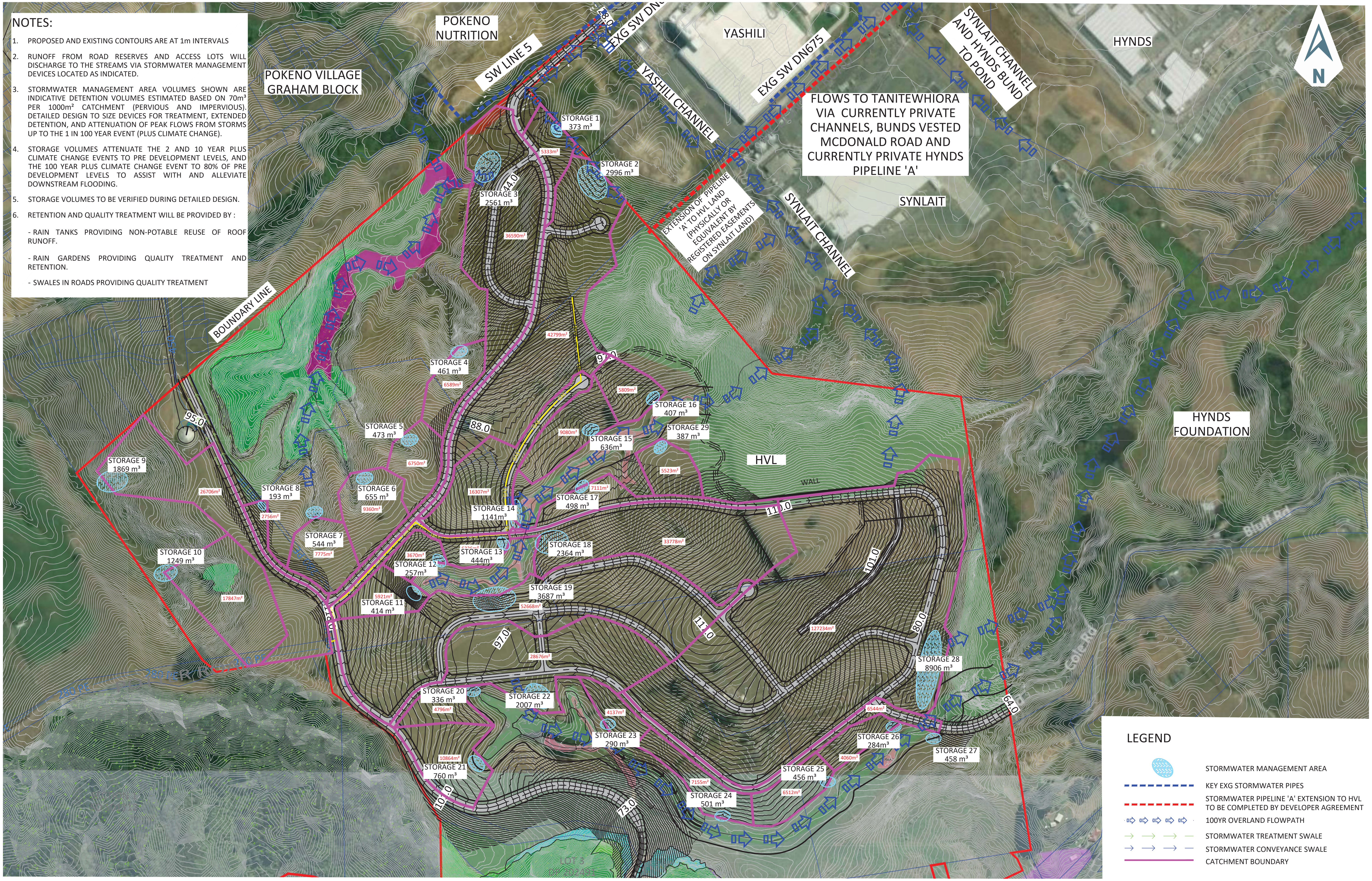
3 May 2021

APPENDICES

1. Drawing 2020-08-SK05-1 – HVL proposed stormwater management sheet 1
2. Drawing 2020-08-SK05-1 – HVL proposed stormwater management sheet 1
3. McDonald Road overland flowpath capacity calculation
4. Overland flowpath site photos from HVL to Tanitewhiora Stream - 2 May 2021
5. HVL on site Basin 28 TP108 calculations
6. HVL on site Basin 28 HEC HMS calculations
7. HVL site basin sizing estimates
8. Drawing 2020-08-SK07-1 – HVL proposed stormwater basin 28 detail sheet 1 (plan)
9. Drawing 2020-08-SK07-2 – HVL proposed stormwater basin 28 detail sheet 2 (cross sections)
10. Drawing 2020-08-SK07-3 – HVL proposed stormwater basin 28 detail sheet 3 (perspective)

NOTES:

1. PROPOSED AND EXISTING CONTOURS ARE AT 1m INTERVALS
2. RUNOFF FROM ROAD RESERVES AND ACCESS LOTS WILL DISCHARGE TO THE STREAMS VIA STORMWATER MANAGEMENT DEVICES LOCATED AS INDICATED.
3. STORMWATER MANAGEMENT AREA VOLUMES SHOWN ARE INDICATIVE DETENTION VOLUMES ESTIMATED BASED ON 70m³ PER 1000m² CATCHMENT (PERVIOUS AND IMPERVIOUS). DETAILED DESIGN TO SIZE DEVICES FOR TREATMENT, EXTENDED DETENTION, AND ATTENUATION OF PEAK FLOWS FROM STORMS UP TO THE 1 IN 100 YEAR EVENT (PLUS CLIMATE CHANGE).
4. STORAGE VOLUMES ATTENUATE THE 2 AND 10 YEAR PLUS CLIMATE CHANGE EVENTS TO PRE DEVELOPMENT LEVELS, AND THE 100 YEAR PLUS CLIMATE CHANGE EVENT TO 80% OF PRE DEVELOPMENT LEVELS TO ASSIST WITH AND ALLEVIATE DOWNSTREAM FLOODING.
5. STORAGE VOLUMES TO BE VERIFIED DURING DETAILED DESIGN.
6. RETENTION AND QUALITY TREATMENT WILL BE PROVIDED BY :
   - RAIN TANKS PROVIDING NON-POTABLE REUSE OF ROOF RUNOFF.
   - RAIN GARDENS PROVIDING QUALITY TREATMENT AND RETENTION.
   - SWALES IN ROADS PROVIDING QUALITY TREATMENT



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REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	24.04.21

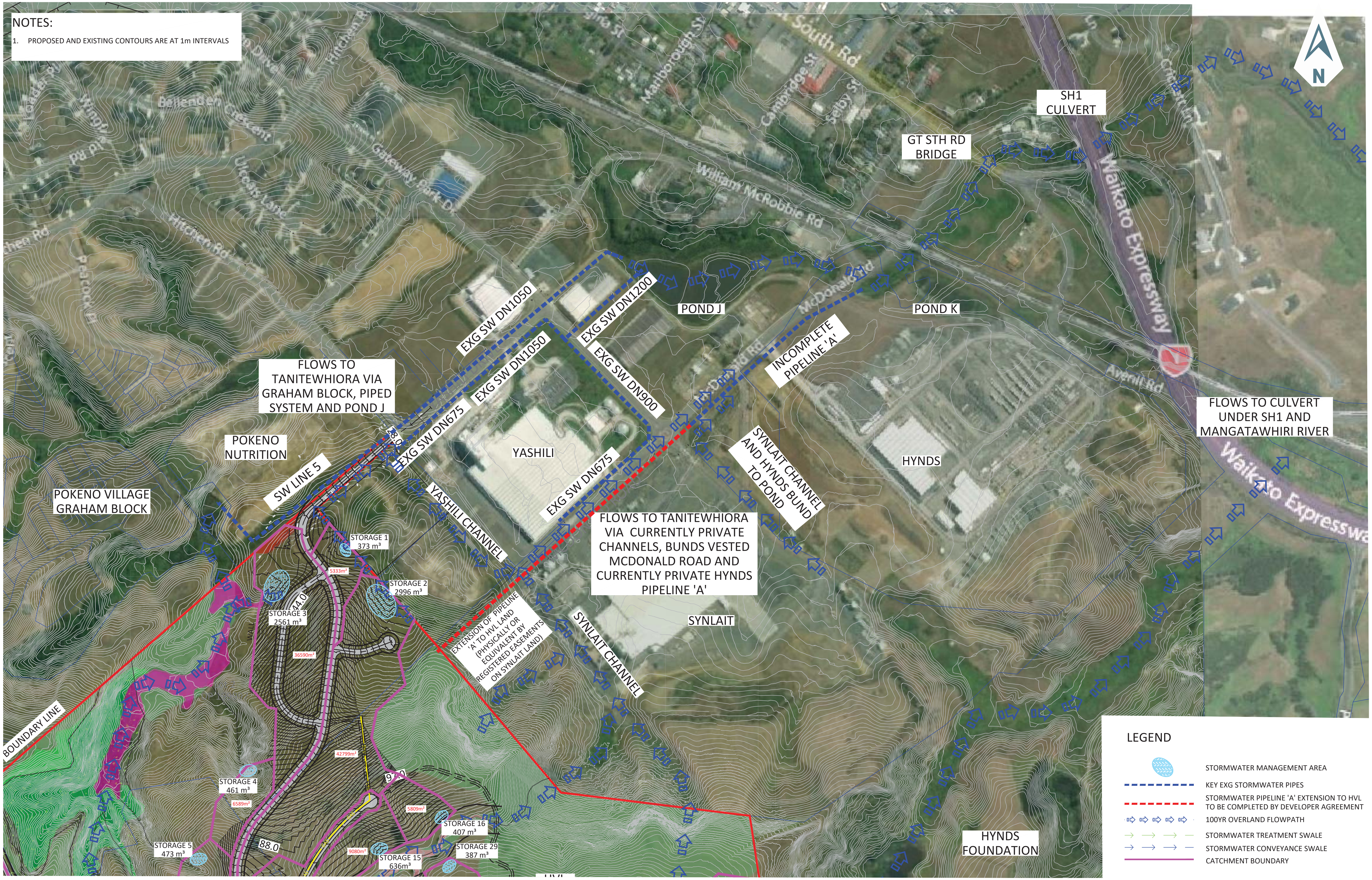
DRAWN: AJH	DATE: 09.2020	
CHECKED: AJH	DATE: 24.04.21	
APPROVED: RJP	DATE: 24.04.21	

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER MANAGEMENT
SHEET 1

ISSUE STATUS: INFORMATION
SCALE: (A1/A3) 1:2500 / 1:5000
SCALE BAR 1:5000@A3 0 50 100 150 200 250m
DRAWING NUMBER: 2020-08-SK05-1 REV: 1



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1	FOR INFORMATION	RJP	24.04.21

DRAWN: AJH	DATE: 09.2020	
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CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER MANAGEMENT
SHEET 2

ISSUE STATUS: INFORMATION
SCALE: (A1/A3) 1:2500 / 1:5000
SCALE BAR 1:5000@A3 0 50 100 150 200 250m
DRAWING NUMBER: 2020-08-SK05-2 REV: 1

CIVILPLAN CONSULTANTS

McDONALD RD OLFP CAPACITY CALCULATION (MANNINGS FLOW)

CLIENT:	GMP		
PROJECT:	Havelock Village		
JOB NO:	2020		
DESIGNER:	RJP		
DATE:	01.05.21		
REVISION:	1		
DESIGN RAINFALL (assumes 10 minute time of concentration)			
Climate Change Allowance:	Waikato TR2018/02		
Design Storm:	100	yr ARI	
10 min peak rainfall:	149	mm/hr	
Climate Change:	16.8%		
10min Peak Rain + CC	174.03	mm/hr	
Peak rainfall intensity (I)	0.000048	m/s	
CATCHMENT INFORMATION:			
Runoff Coefficient (C)	0.3		(average 'C')
Area (A)	377,100	m^2	Upstream rural
Expected Flow (Q=CIA)	5.5	m^3/s	assumes pipes blocked
FLOWPATH DIMENSIONS:			
Depth (d)	0.10	m	on footpath
Cross Sectional Area (A)	2.711	m^2	
Wetted Perimeter (P)	22.248	m	
Hydraulic radius R=A/P	0.122	m	
Slope (S)	0.023	m/m	
			GRASS LAWN = 0.027
Roughness (n)	0.018		ROAD ASPHALT = 0.020
			CONCRETE = 0.015

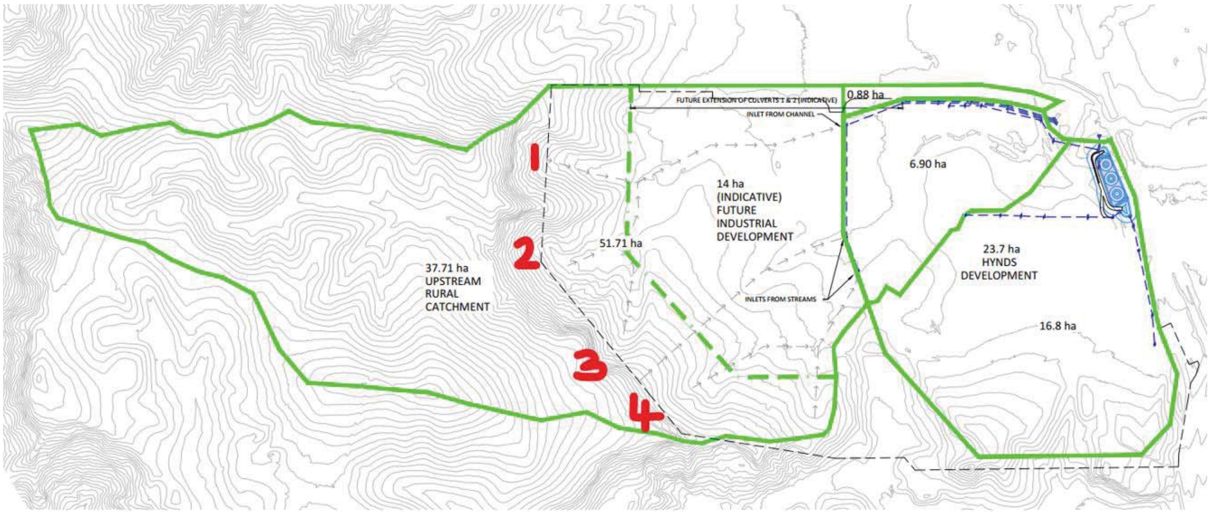
CAPACITY OF FLOWPATH USING MANNINGS EQUATION:

$$Q = \frac{AR^{2/3}S^{1/2}}{n}$$

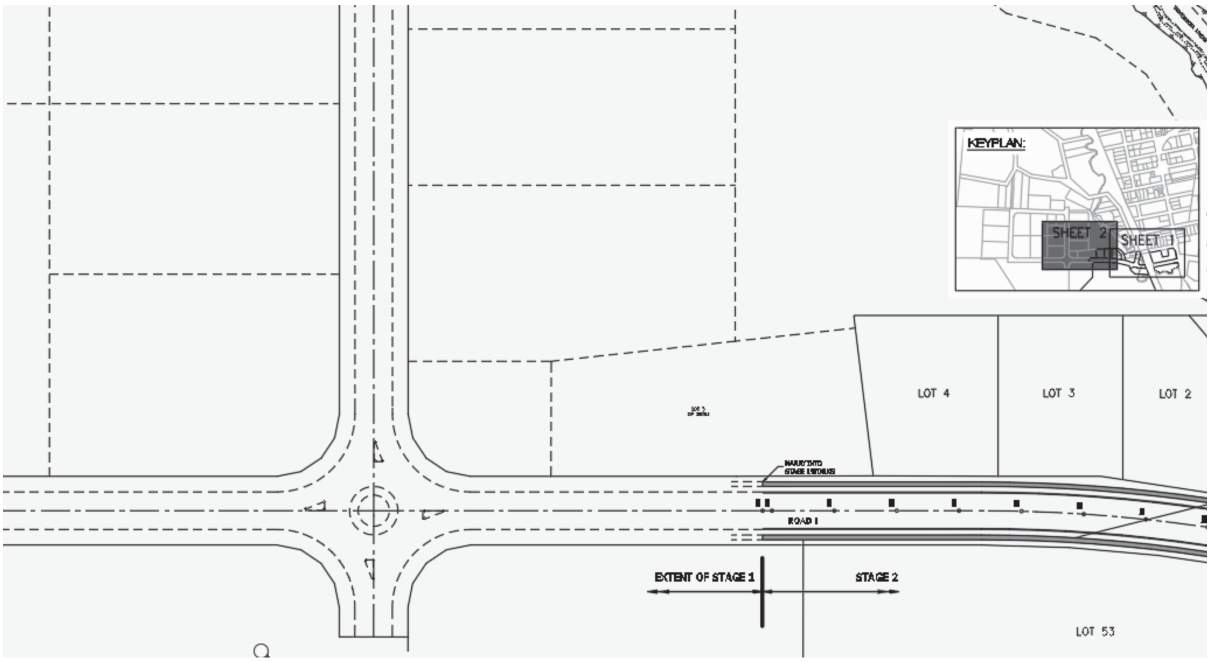
=	5.6	m^3/s
% of required capacity	103%	
Capacity	ADEQUATE	
Velocity Check V=Q/A =	2.07	
V*d	0.21	m/s
Pedestrian Safety Check V*d<0.4 =	OK	
Vehicle Safety Check V*d<0.6 =	OK	

McDonald Road Overland Flowpath Calculation

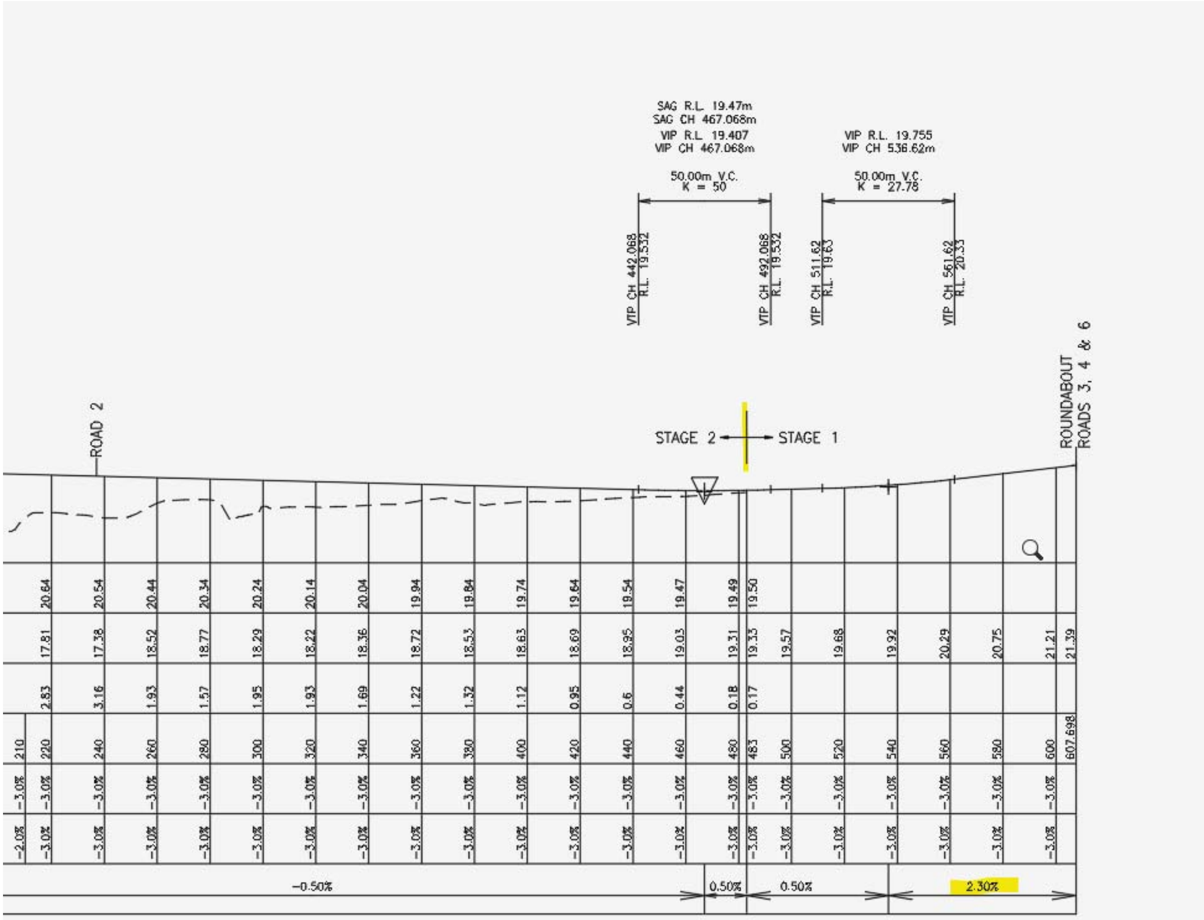
Upstream catchment = 37.71ha, pasture (C=0.3)



McDonald Road adjacent to Synalit (west of roundabout) is Road 1 Stage 1

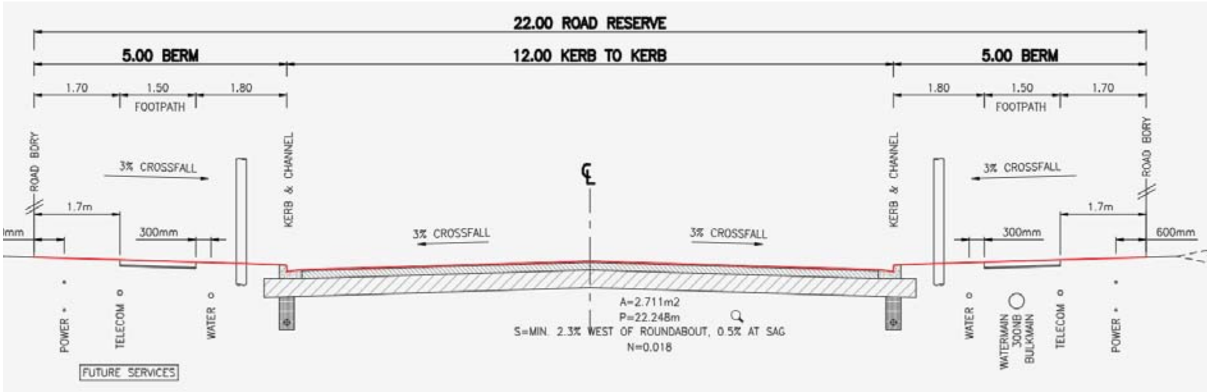


Gradient is minimum of 2.3%. Approaching sag at Stage 1/2 boundary is 0.5%, and spills into Hynds land where Pipeline A picks up flow from McDonald road.



LONGITUDINAL SECTION: ROAD 1

Road cross section for calculation:



Overland flowpath site photos from HVL to Tanitewhiora Stream - 2 May 2021

Photo 1 – Looking south. Synlait Channel to inlet piped under Synlait site to ditch in Synlait site parallel to McDonald Road. HVL to the right.

Photo 2 – Photo taken looking east to McDonald Road. In the case of all pipes and inlets blocked, the Synlait channel in Photo 1 would overtop and overland flow would travel in direction of arrow on Synlait site.

Photo 3 - overland flow would travel in direction of arrows on Synlait site, entering McDonald Road or in events larger than Q100 (or for flows from Synlait land itself), into the ditch on Synlait land.

Photo 4 - overland flow would travel in direction of arrows on Synlait site, entering McDonald Road or in events larger than Q100 (or for flows from Synlait land itself), into the ditch on Synlait land.

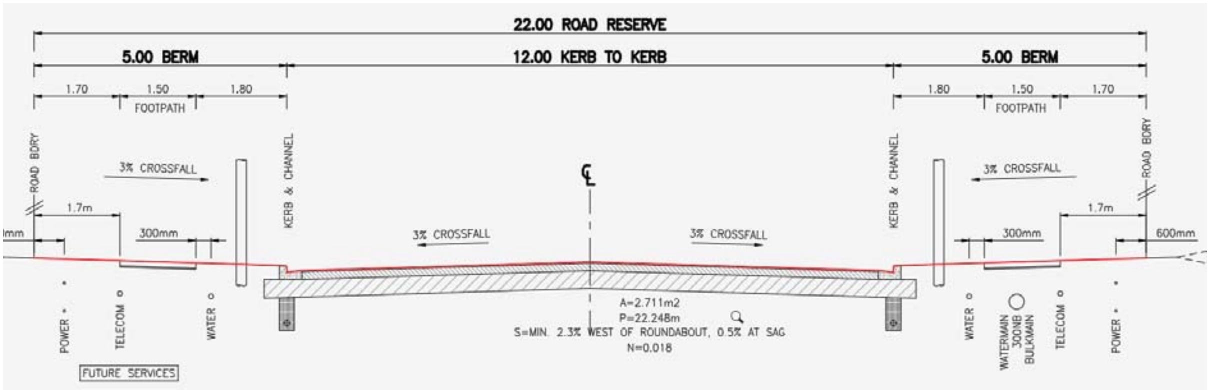


Photo 5 - overland flow down McDonald Road. Road cross section is shown, with a Q capacity of 5.6m3/s (without considering ponds or ditches). Q100 from HVL land is 5.5m3/s so all flow can pass down road without the need for ditches and ponds. The ditches and ponds provide additional storage for the catchment but are not required to pass HVL pre development flows.

Photo 6 – overland flow enters Hynds site at the road sag.

Photo 7 – overland flow from McDonald Road enters the partially complete DN1350 Pipeline A at the road sag/low point

Photo 8 – overland flow discharges to the Tanitewhiora Stream. Completed McDonald Road culvert to the right.

CIVILPLAN CONSULTANTS

STORMWATER PEAK FLOW RATE, RUNOFF DEPTH, AND RUNOFF VOLUME

CALCULATED ACCORDING TO WAIKATO REGIONAL COUNCIL TR2020/06

CLIENT:	GMP
PROJECT:	Havelock Village - Basin 28 Sizing Example
JOB NO:	2020
DESIGNER:	AJH
DATE:	29-Apr-21
REVISION:	2

SUMMARY OF RESULTS

INPUT

DESCRIPTION: Basin 28

	WQV	50% AEP	20% AEP	10% AEP	1% AEP
ARI (yr)	1/3 2yr	2yr	5yr	10yr	100yr
Design Rainfall (mm)		71.0	92.2	109.7	188.7
Climate Change per 1°C		4.3%	5.4%	6.3%	8.0%
Climate Change at 2.1°C		9.0%	11.3%	13.2%	16.8%
Design Rainfall + CC (mm)	25.8	77.4	102.7	124.2	220.4

OUTPUT

Catchment Area (ha)	Pre-Development	Post-Development piped	Post-Development overland flow	
Pervious	12.7	3.2	3.2	ha
Impervious	0.0	9.5	9.5	ha
Total	12.7	12.7	12.7	ha

WQV (m^3)	2122	
EDV factor	1.2	i.e. downstream channel assumed unstable
Detention EDV (m^3)	2547	but we will route an EDV storm in HEC-HMS

		50% AEP	20% AEP	10% AEP	1% AEP
Pre Development	Peak flow rate (m^3/s):	0.23	0.41	0.59	1.67
	Runoff volume (m^3):	1319	2312	3282	8908
Post Development	Peak flow rate (m^3/s):	1.38	1.89	2.33	4.35
	Runoff volume (m^3):	7779	10717	13274	24983
Difference	Peak flow rate Difference (m^3/s):	1.15	1.47	1.73	2.68
	Runoff volume Difference (m^3):	6460	8405	9992	16075

STORMWATER PEAK FLOW RATE, RUNOFF DEPTH, AND RUNOFF VOLUME (WAIKATO REGIONAL COUNCIL TR2020/06)

CLIENT:	GMP
PROJECT:	Havelock Village - Basin 28 Sizing Example
JOB NO:	2020
DESIGNER:	AJH
DATE:	29-Apr-21
REVISION:	2
DESCRIPTION:	Basin 28
TOTAL CATCHMENT AREA (Ha):	12.723 Ha
SCENARIO:	PRE DEVELOPMENT

NOTE: This spreadsheet calculates stormwater peak flow rates using WRC TR2020/06 Graphical Method.

PERVIOUS CATCHMENT
Runoff Curve Number (CN) and Initial Abstraction (Ia):

Soil Type	Soil Classification	Cover Description (cover type, treatment, hydrological cond.)	Curve No. CN	Area Ha	CN * Area
Weathered Tuff Clay	A	Pasture	49	12.723	623.447
					0.000
					0.000
					0.000
			Total Pervious=	12.723	623.447
CN (weighted) =			Total product / Total Area =	49.0	

Time of Concentration:

Catchment Length (measured along drainage path)	L=	100 m		
Rise from bottom to top of catchment = "Equal area" height (calculation below)	H =	10.0 m		
Time of Concentration from Equation 7-4, minimum 10 minutes	tc = 0.0195 (L^3 / H)$^{0.385}$ =	10.0 min	0.17	hours
SCS lag for HEC-HMS =	tp = 2/3*tc=	6.7 min	0.11	hours

Graphical Peak Flow Rate:

Soil Storage Parameter S =	((1000/CN)-10)*25.4=	264.4 mm		
Ia (weighted) =	0.05*S =	13.2 mm	1681.825751	m^3

				50% AEP	20% AEP	10% AEP	1% AEP
Av. recurrence interval		ARI=		2yr	5yr	10yr	100yr
24hr rainfall depth (mm)	(From HIRDS)	P24=		71.0	92.2	109.7	188.7
c* =	(P24-2Ia)/(P24-2Ia+2S)	c*=		0.08	0.11	0.14	0.23
Specific Peak Flow Rate	(Figure 8-1)	q*=	0.000	0.025	0.035	0.042	0.070
Peak Flow Rate (m^3/s)	A*P24*q*/100	qp=		0.23	0.41	0.59	1.67
Runoff Depth (mm)	(P24-Ia)^2/(P24-Ia+S)	Q24=		10.4	18.2	25.8	70.0
Runoff Volume (m^3)	1000*Q24*A/100	V24=		1319	2312	3282	8908

IMPERVIOUS CATCHMENT
Runoff Curve Number (CN) and Initial Abstraction (Ia):

Soil Type	Soil Classification	Cover Description (cover type, treatment, hydrological cond.)	Curve No. CN	Area Ha	CN * Area
-	-	-	98	0.000	0.000
					0.000
					0.000
			Total Impervious=	0.000	0.000
CN (weighted) =			Total product / Total Area =	98.0	

Time of Concentration:

Catchment Length (measured along drainage path)	L=	100 m		
Rise from bottom to top of catchment = "Equal area" height (calculation below)	H =	10.0 m		
Time of Concentration from Equation 7-4, minimum 10 minutes	tc = 0.0195 (L^3 / H)$^{0.385}$ =	10.0 min	0.17	hours
SCS lag for HEC-HMS =	tp = 2/3*tc=	6.7 min	0.11	hours

Graphical Peak Flow Rate:

Storage S =	((1000/CN)-10)*25.4=	5.2 mm
Ia (weighted) =	0.05*S =	0.3 mm

				50% AEP	20% AEP	10% AEP	1% AEP
Av. recurrence interval		ARI=		2yr	5yr	10yr	100yr
24hr rainfall depth (mm)	(From HIRDS)	P24=		71.0	92.2	109.7	188.7
c* =	(P24-2Ia)/(P24-2Ia+2S)	c*=		0.87	0.90	0.91	0.95
Specific Peak Flow Rate	(Figure 8-1)	q*=	0.000	0.164	0.165	0.165	0.166
Peak Flow Rate (m^3/s)	A*P24*q*/100	qp=		0.00	0.00	0.00	0.00
Runoff Depth (mm)	(P24-Ia)^2/(P24-Ia+S)	Q24=		65.9	87.0	104.5	183.4
Runoff Volume (m^3)	1000*Q24*A/100	V24=		0	0	0	0

TOTALS:

	0	50% AEP	20% AEP	10% AEP	1% AEP
Peak flow rate (m^3/s):	0.00	0.23	0.41	0.59	1.67
Runoff volume (m^3):	0	1319	2312	3282	8908

AVERAGE SLOPE BY EQUAL AREA METHOD					
Elevation (m)	h (m)	x (m)	delta x (m)	average h (m)	delta A (m^2)
31.0	0.0	0.0			
32.0	1.0	13.0	13.0	0.5	6.5
33.0	2.0	22.0	9.0	1.5	13.5
34.0	3.0	29.0	7.0	2.5	17.5
35.0	4.0	38.0	9.0	3.5	31.5
36.0	5.0	48.0	10.0	4.5	45.0
37.0	6.0	62.0	14.0	5.5	77.0
38.0	7.0	77.0	15.0	6.5	97.5
39.0	8.0	95.0	18.0	7.5	135.0
40.0	9.0	111.0	16.0	8.5	136.0
41.0	10.0	138.0	27.0	9.5	256.5

Average Slope Sc = 2*∑ΔA/L² =	0.086	Total Length L =	138.0	∑ΔA =	816.0
Equal Area height h = Sc/L =	11.826				

STORMWATER PEAK FLOW RATE, RUNOFF DEPTH, AND RUNOFF VOLUME (WAIKATO REGIONAL COUNCIL TR2020/06)

CLIENT: GMP
PROJECT: Havelock Village - Basin 28 Sizing Example
JOB NO: 2020
DESIGNER: AJH

DATE: 29-Apr-21
REVISION: 2

DESCRIPTION: Basin 28

TOTAL CATCHMENT AREA (Ha): 12.723 Ha

SCENARIO: POST DEVELOPMENT

NOTE: This spreadsheet calculates stormwater peak flow rates using WRC TR2020/06 Graphical Method.

PERVIOUS CATCHMENT
Runoff Curve Number (CN) and Initial Abstraction (Ia):

Soil Type	Soil Classification	Cover Description (cover type, treatment, hydrological cond.)	Curve No. CN	Area Ha	CN * Area
Compacted Weathered Tuff Clay	B	Grass berm/lawn	69	3.181	219.479
					0.000
					0.000
					0.000
			Total Pervious=	3.181	219.479
CN (weighted) =			Total product / Total Area =	69.0	

Time of Concentration:

Catchment Length (measured along drainage path)	L=	100	m	
Rise from bottom to top of catchment = "Equal area" height (calculation below)	H =	10.0	m	
Time of Concentration from Equation 7-4, minimum 10 minutes	$tc = 0.0195\ (L^3 / H)^{0.385}$ =	10.0	min	0.17 hours
SCS lag for HEC-HMS =	tp = 2/3*tc=	6.7	min	0.11 hours

Graphical Peak Flow Rate:

Soil Storage Parameter S =	((1000/CN)-10)*25.4=	114.1	mm
Ia (weighted) =	0.05*S =	5.7	mm

			WQV	50% AEP	20% AEP	10% AEP	1% AEP	EDV
Av. recurrence interval		ARI=	1/3 2yr	2yr	5yr	10yr	100yr	
24hr rainfall depth+CC (mm)	(Table 4.3)	P24=	25.8	77.4	102.7	124.2	220.4	30.96452
c* =	(P24-2Ia)/(P24-2Ia+2S)	c*=	0.06	0.22	0.29	0.33	0.48	
Specific Peak Flow Rate	(Figure 8-1)	q*=	0.020	0.067	0.082	0.092	0.122	
Peak Flow Rate (m³/s)	A*P24*q*/100	qp=	0.02	0.16	0.27	0.37	0.86	
Runoff Depth (mm)	(P24-Ia)^2/(P24-Ia+S)	Q24=	3.0	27.7	44.5	60.4	140.2	
Runoff Volume (m³)	1000*Q24*A/100	V24=	96	880	1417	1920	4459	

IMPERVIOUS CATCHMENT
Runoff Curve Number (CN) and Initial Abstraction (Ia):

Soil Type	Soil Classification	Cover Description (cover type, treatment, hydrological cond.)	Curve No. CN	Area Ha	CN * Area
-	-	-	98	9.543	935.170
					0.000
					0.000
			Total Impervious=	9.543	935.170
CN (weighted) =			Total product / Total Area =	98.0	

Time of Concentration:

Catchment Length (measured along drainage path)	L=	100	m	
Rise from bottom to top of catchment = "Equal area" height (calculation below)	H =	10.0	m	
Time of Concentration from Equation 7-4, minimum 10 minutes	$tc = 0.0195\ (L^3 / H)^{0.385}$ =	10.0	min	0.17 hours
SCS lag for HEC-HMS =	tp = 2/3*tc=	6.7	min	0.11 hours

Graphical Peak Flow Rate:

Storage S =	((1000/CN)-10)*25.4=	5.2	mm
Ia (weighted) =	0.05*S =	0.3	mm

			WQV	50% AEP	20% AEP	10% AEP	1% AEP
Av. recurrence interval		ARI=	1/3 2yr	2yr	5yr	10yr	100yr
24hr rainfall depth+CC (mm)	(Table 4.3)	P24=	25.8	77.4	102.7	124.2	220.4
c* =	(P24-2Ia)/(P24-2Ia+2S)	c*=	0.71	0.88	0.91	0.92	0.95
Specific Peak Flow Rate	(Figure 8-1)	q*=	0.154	0.164	0.165	0.165	0.166
Peak Flow Rate (m³/s)	A*P24*q*/100	qp=	0.38	1.21	1.62	1.96	3.50
Runoff Depth (mm)	(P24-Ia)^2/(P24-Ia+S)	Q24=	21.2	72.3	97.5	119.0	215.1
Runoff Volume (m³)	1000*Q24*A/100	V24=	2026	6899	9300	11354	20524

TOTALS:

	WQV	50% AEP	20% AEP	10% AEP	1% AEP
Peak flow rate (m³/s):	0.40	1.38	1.89	2.33	4.35
Runoff volume (m³):	2122	7779	10717	13274	24983

AVERAGE SLOPE BY EQUAL AREA METHOD					
Elevation (m)	**h (m)**	**x (m)**	**delta x (m)**	**average h (m)**	**delta A (m²)**
31.0	0.0	0.0			
32.0	1.0	13.0	13.0	0.5	6.5
33.0	2.0	22.0	9.0	1.5	13.5
34.0	3.0	29.0	7.0	2.5	17.5
35.0	4.0	38.0	9.0	3.5	31.5
36.0	5.0	48.0	10.0	4.5	45.0
37.0	6.0	62.0	14.0	5.5	77.0
38.0	7.0	77.0	15.0	6.5	97.5
39.0	8.0	95.0	18.0	7.5	135.0
40.0	9.0	111.0	16.0	8.5	136.0
41.0	10.0	138.0	27.0	9.5	256.5
Average Slope Sc = 2*∑ΔA/L² =	0.086	Total Length L =	138.0	∑ΔA =	816.0
Equal Area height h = Sc/L =	11.826				

HEC-HMS Report - Basin Model

MODEL DETAILS

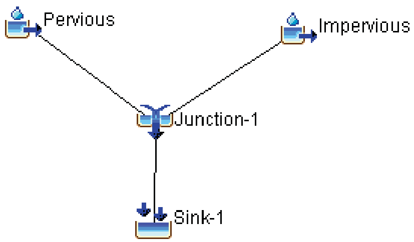
BASIN MODEL: Pre Development
DESCRIPTION: Havelock Village Detention Basin 28
HEC-HMS VERSION: 4.4.1
UNITS: Metric

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Description	Area (m²)	Loss method	Initial abstraction (mm)	CN	Transform method	SCS lag (min)
Pervious	Pervious	127,234	SCS	13.2	49	SCS	9.24
Impervious	Impervious	0	SCS	0	98	SCS	6.8



HEC-HMS Report - Basin Model

MODEL DETAILS

BASIN MODEL: Post Development Mitigated
DESCRIPTION: Havelock Village Detention Basin 28
HEC-HMS VERSION: 4.4.1
UNITS: Metric

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

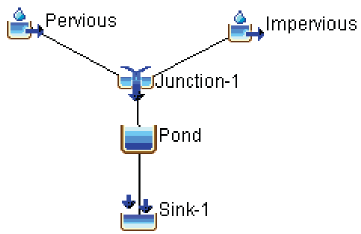
Name	Description	Area (m²)	Loss method	Initial abstraction (mm)	CN	Transform method	SCS lag (min)
Impervious	Impervious	95,426	SCS	0	98	SCS	6.8
Pervious	Pervious	31,809	SCS	5.7	69	SCS	6.8

RESERVOIR TABLE

Name	Description	Tailwater Level (m)	Initial Storage (m³)	Initial Elevation (m)
Pond	Basin	None	0.0	NaN

ORIFICE TABLE

Reservoir Name	Number of Orifices	Orifice Diameter (mm)	Orifice Elevation (m RL)	Orifice Coefficient
Pond	1	95	73.210	0.62
Pond	1	250	74.840	0.62
Pond	1	437	76.100	0.62
Pond	1	440	76.760	0.62



HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : EDV
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Post Development Mitigated
METEOROLOGIC MODEL : EDV
CONTROL SPECIFICATION : 48 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 02Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 21:11:40

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Impervious	95,426	31.0	4.4	26.6	0.342	12:13	2,530	0.86
Pervious	31,809	31.0	26.4	4.6	0.012	12:14	146	0.15

JUNCTION TABLE

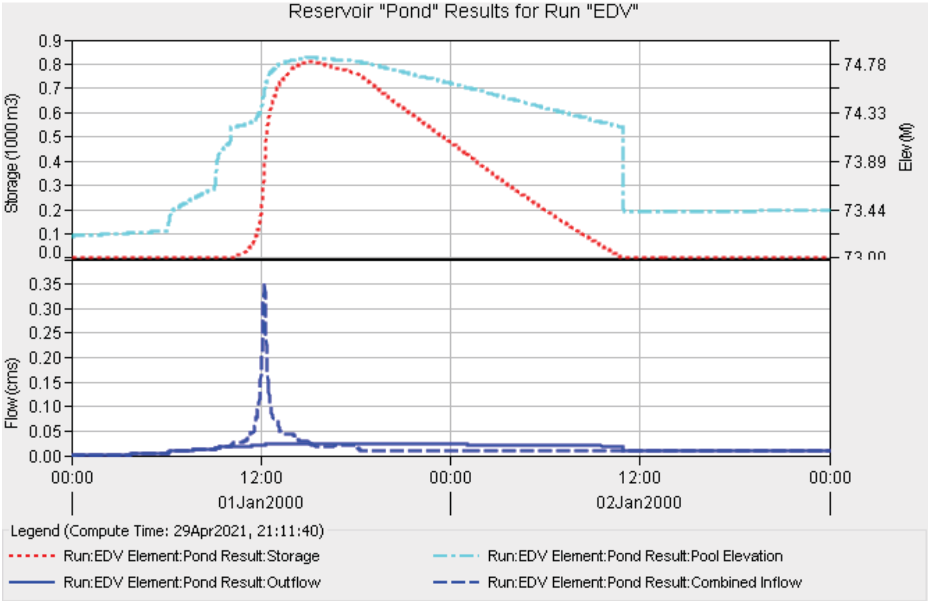
Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	0.354	12:13	2,676

RESERVOIR TABLE

Name	Catchment Area (m²)	Peak Inflow (m³/s)	Time of Peak IN	Inflow Volume (m³)	Peak Outflow (m³/s)	Time of Peak OUT	Outflow Volume (m³)	Peak WL (m RL)	Peak Storage (m³)	Reduction Coeff.
Pond	127,234	0.354	12:13	2,676	0.025	15:09	2,675	74.84	812	0.07

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	0.025	15:09	2,675



CIVILPLAN
CONSULTANTS

HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Pre Dev 2yr
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Pre Development
METEOROLOGIC MODEL : 2yr
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 19:59:28

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Pervious	127,234	71.0	60.6	10.4	0.205	12:16	1,310	0.15
Impervious	0	71.0	4.8	66.2	0.000	12:12	0	0.93

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	0.205	12:16	1,310

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	0.205	12:16	1,310

HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Post Dev Mit 2yr+cc
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Post Development Mitigated
METEOROLOGIC MODEL : 2yr+cc
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 21:11:45

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Impervious	95,426	77.4	4.9	72.5	1.242	12:12	6,904	0.94
Pervious	31,809	77.4	49.7	27.7	0.166	12:13	876	0.36

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	1.407	12:13	7,781

RESERVOIR TABLE

Name	Catchment Area (m²)	Peak Inflow (m³/s)	Time of Peak IN	Inflow Volume (m³)	Peak Outflow (m³/s)	Time of Peak OUT	Outflow Volume (m³)	Peak WL (m RL)	Peak Storage (m³)	Reduction Coeff.
Pond	127,234	1.407	12:13	7,781	0.206	13:10	6,886	76.1	3,340	0.15

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	0.206	13:10	6,886

CIVILPLAN CONSULTANTS

HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Pre Dev 10yr
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Pre Development
METEOROLOGIC MODEL : 10yr
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 19:59:25

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Pervious	127,234	109.7	83.9	25.8	0.541	12:15	3,262	0.24
Impervious	0	109.7	5.0	104.8	0.000	12:12	0	0.95

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	0.541	12:15	3,262

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	0.541	12:15	3,262

HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Post Dev Mit 10yr+cc
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Post Development Mitigated
METEOROLOGIC MODEL : 10yr+cc
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 21:11:42

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Impervious	95,426	124.2	5.0	119.2	2.010	12:12	11,348	0.96
Pervious	31,809	124.2	63.8	60.4	0.369	12:13	1,913	0.49

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	2.377	12:13	13,261

RESERVOIR TABLE

Name	Catchment Area (m²)	Peak Inflow (m³/s)	Time of Peak IN	Inflow Volume (m³)	Peak Outflow (m³/s)	Time of Peak OUT	Outflow Volume (m³)	Peak WL (m RL)	Peak Storage (m³)	Reduction Coeff.
Pond	127,234	2.377	12:13	13,261	0.542	12:42	11,884	76.71	5,018	0.23

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	0.542	12:42	11,884

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HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Pre Dev 100yr
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Pre Development
METEOROLOGIC MODEL : 100yr
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 19:59:26

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Pervious	127,234	188.7	118.7	70.0	1.531	12:15	8,859	0.37
Impervious	0	188.7	5.0	183.7	0.000	12:12	0	0.97

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	1.531	12:15	8,859

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	1.531	12:15	8,859

HEC-HMS Report - Simulation Run

SIMULATION DETAILS

SIMULATION RUN : Post Dev Mit 100yr+cc
DESCRIPTION : Havelock Village Detention Basin 28
BASIN MODEL : Post Development Mitigated
METEOROLOGIC MODEL : 100yr+cc
CONTROL SPECIFICATION : 24 Hr
SIMULATION START : 31Dec1999, 24:00
SIMULATION END : 01Jan2000, 24:00
COMPUTE TIME : 29Apr2021, 21:11:44

TOTAL CATCHMENT AREA

127,234 m²

SUBBASIN TABLE

Name	Catchment Area (m²)	Precipitation (mm)	Loss (mm)	Excess (mm)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)	Derived Runoff coeff.
Impervious	95,426	220.4	5.1	215.3	3.583	12:12	20,498	0.98
Pervious	31,809	220.4	80.2	140.2	0.865	12:13	4,444	0.64

JUNCTION TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Junction-1	127,234	4.443	12:13	24,942

RESERVOIR TABLE

Name	Catchment Area (m²)	Peak Inflow (m³/s)	Time of Peak IN	Inflow Volume (m³)	Peak Outflow (m³/s)	Time of Peak OUT	Outflow Volume (m³)	Peak WL (m RL)	Peak Storage (m³)	Reduction Coeff.
Pond	127,234	4.443	12:13	24,942	1.219	12:37	22,550	77.76	8,701	0.27

OUTLET TABLE

Name	Catchment Area (m²)	Peak Discharge (m³/s)	Time of Peak	Discharge Volume (m³)
Sink-1	127,234	1.219	12:37	22,550

CIVILPLAN CONSULTANTS

ROAD RESERVE & LOTS ATTENUATION BASIN SIZE ESTIMATE

CLIENT:	GMP
PROJECT:	Havelock Village
JOB NO:	2020
DESIGNER:	AJH
DATE:	03.05.2021
REVISION:	3

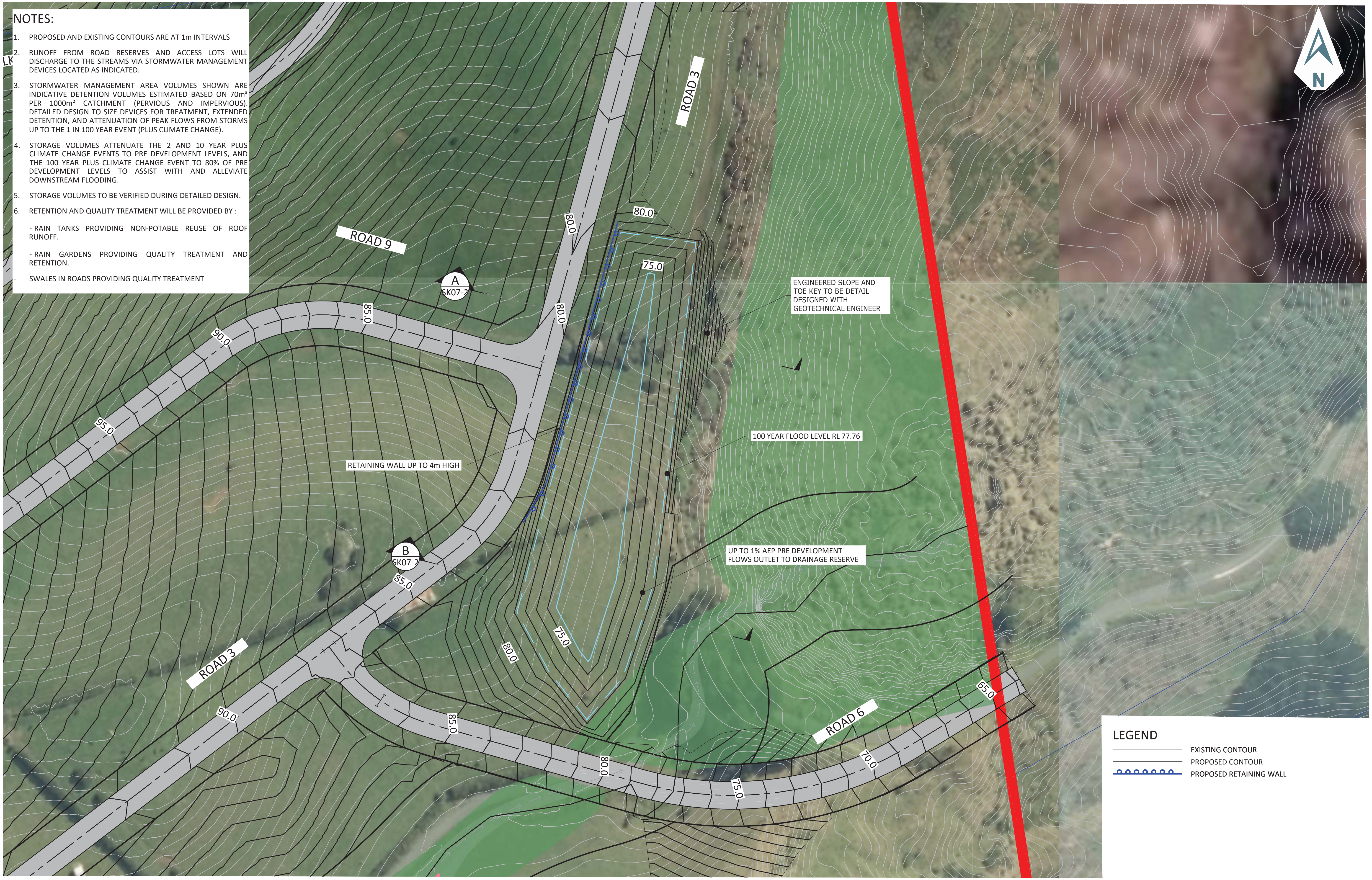
DETENTION BASIN SIZING ESTIMATE

70 m^3 assumed storage required per $1000m^2$ of catchment based on HEC-HMS modelling of basin 28 (which showed $68m^3$ storage was used per $1000m^2$, to provide 24hr extended detention, attenuation of 2 and 10 year storms to 100% of predevelopment, and attenuation of 100 year storm to 80% of predevelopment).

Post-development HEC-HMS calculations allow for climate change and pre-development do not.

34 m^2 of basin required per $1000m^2$ of catchment based on basin 28 model which was 3.8 m deep measured from the embankment crest

Basin	Catchment (m^2)	Estimated Storage (m^3)	Estimated Detention Basin Area (m^2)
1	5333	**373**	**181**
2	42799	**2996**	**1455**
3	36590	**2561**	**1244**
4	6589	**461**	**224**
5	6750	**473**	**230**
6	9360	**655**	**318**
7	7775	**544**	**264**
8	2756	**193**	**94**
9	26706	**1869**	**908**
10	17847	**1249**	**607**
11	5921	**414**	**201**
12	3670	**257**	**125**
13	6336	**444**	**215**
14	16307	**1141**	**554**
15	9080	**636**	**309**
16	5809	**407**	**198**
17	7111	**498**	**242**
18	33778	**2364**	**1148**
19	52668	**3687**	**1791**
20	4796	**336**	**163**
21	10864	**760**	**369**
22	28676	**2007**	**975**
23	4137	**290**	**141**
24	7155	**501**	**243**
25	6512	**456**	**221**
26	4060	**284**	**138**
27	6544	**458**	**222**
28	127234	**8906**	**4326**
29	5523	**387**	**188**
Total	**508686**	**35608**	**17295**



NOTES:

1. PROPOSED AND EXISTING CONTOURS ARE AT 1m INTERVALS
2. RUNOFF FROM ROAD RESERVES AND ACCESS LOTS WILL DISCHARGE TO THE STREAMS VIA STORMWATER MANAGEMENT DEVICES LOCATED AS INDICATED.
3. STORMWATER MANAGEMENT AREA VOLUMES SHOWN ARE INDICATIVE DETENTION VOLUMES ESTIMATED BASED ON 70m³ PER 1000m² CATCHMENT (PERVIOUS AND IMPERVIOUS). DETAILED DESIGN TO SIZE DEVICES FOR TREATMENT, EXTENDED DETENTION, AND ATTENUATION OF PEAK FLOWS FROM STORMS UP TO THE 1 IN 100 YEAR EVENT (PLUS CLIMATE CHANGE).
4. STORAGE VOLUMES ATTENUATE THE 2 AND 10 YEAR PLUS CLIMATE CHANGE EVENTS TO PRE DEVELOPMENT LEVELS, AND THE 100 YEAR PLUS CLIMATE CHANGE EVENT TO 80% OF PRE DEVELOPMENT LEVELS TO ASSIST WITH AND ALLEVIATE DOWNSTREAM FLOODING.
5. STORAGE VOLUMES TO BE VERIFIED DURING DETAILED DESIGN.
6. RETENTION AND QUALITY TREATMENT WILL BE PROVIDED BY :

   - RAIN TANKS PROVIDING NON-POTABLE REUSE OF ROOF RUNOFF.

   - RAIN GARDENS PROVIDING QUALITY TREATMENT AND RETENTION.

- SWALES IN ROADS PROVIDING QUALITY TREATMENT

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REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	30.04.21

DRAWN: AJH	DATE: 09.2020
CHECKED: AJH	DATE: 24.04.21
APPROVED: RJP	DATE: 24.04.21

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER BASIN 28
DETAIL SHEET 1

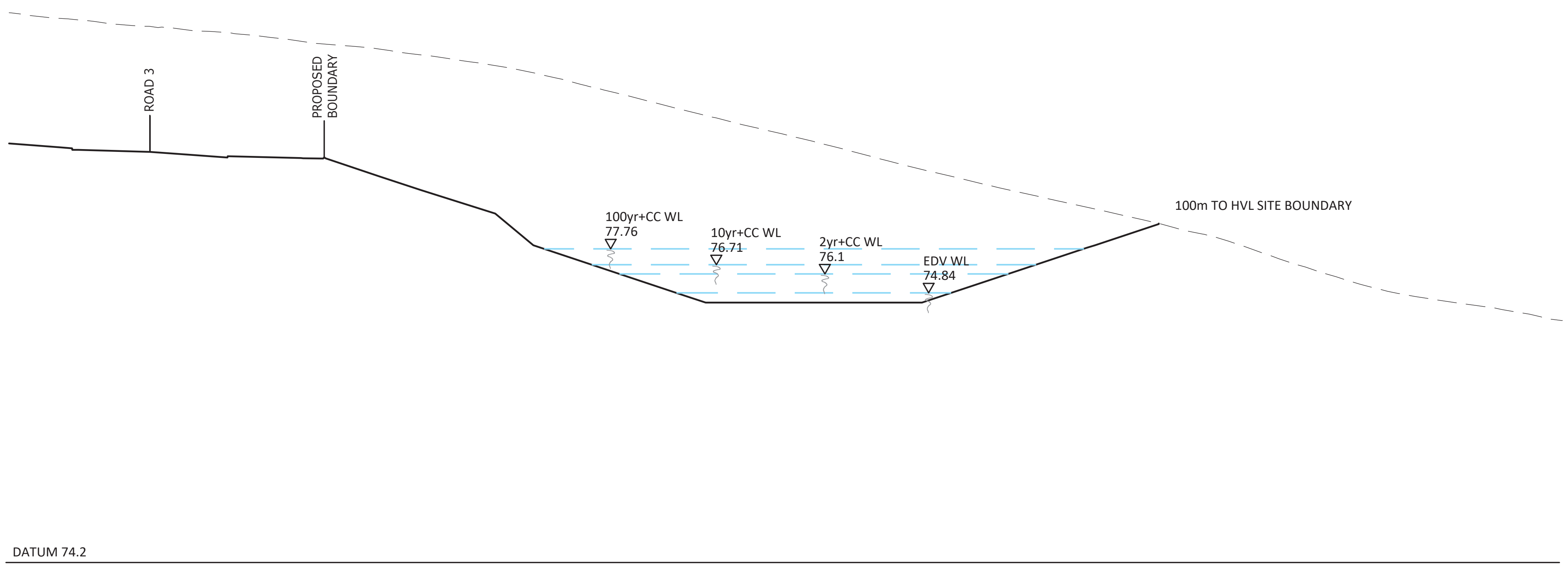
ISSUE STATUS: INFORMATION
SCALE: (A1/A3) 1:500 / 1:1000
SCALE BAR 1:1000@A3 0 10 20 30 40 50m
DRAWING NUMBER: 2020-08-SK07-1 REV: 1

LEGEND

- EXISTING GROUND LINE (dashed)
- PROPOSED GROUND LINE (solid)

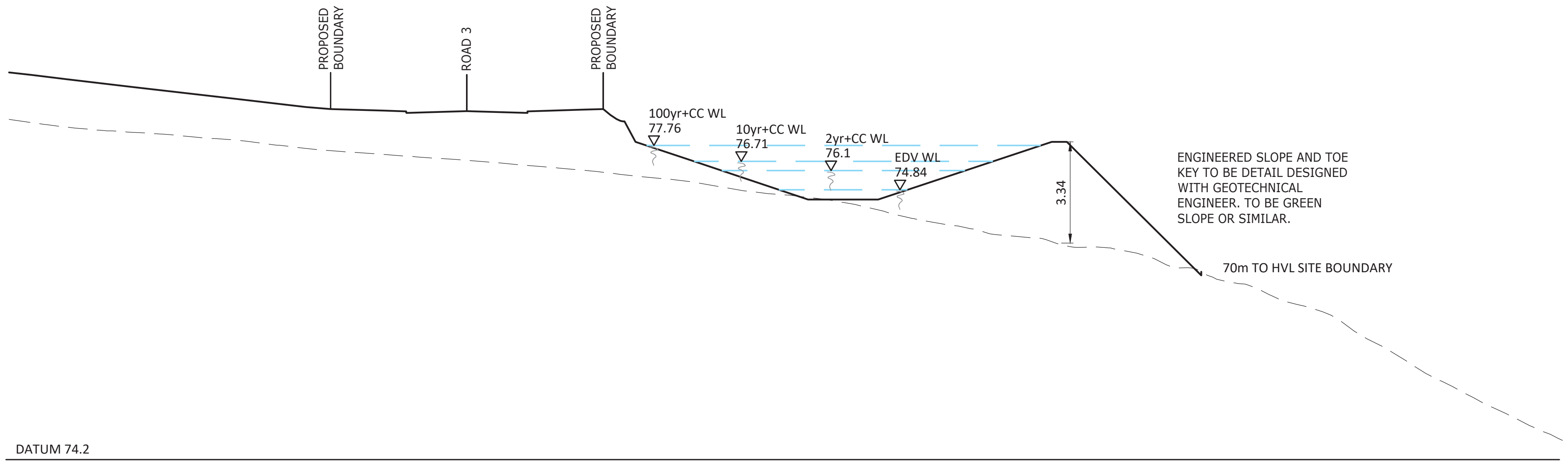
NOTES:

1. REFER TO DRAWING 2020-08-SK07-1 FOR SECTION MARKER LOCATIONS



CROSS SECTION B

SCALE: (A1/A3) 1:1000H 1:500V / 1:2000H 1:1000V



CROSS SECTION A

SCALE: (A1/A3) 1:1000H 1:500V / 1:2000H 1:1000V

REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	30.04.21

DRAWN: AJH	DATE: 09.2020
CHECKED: AJH	DATE: 24.04.21
APPROVED: RJP	DATE: 24.04.21

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

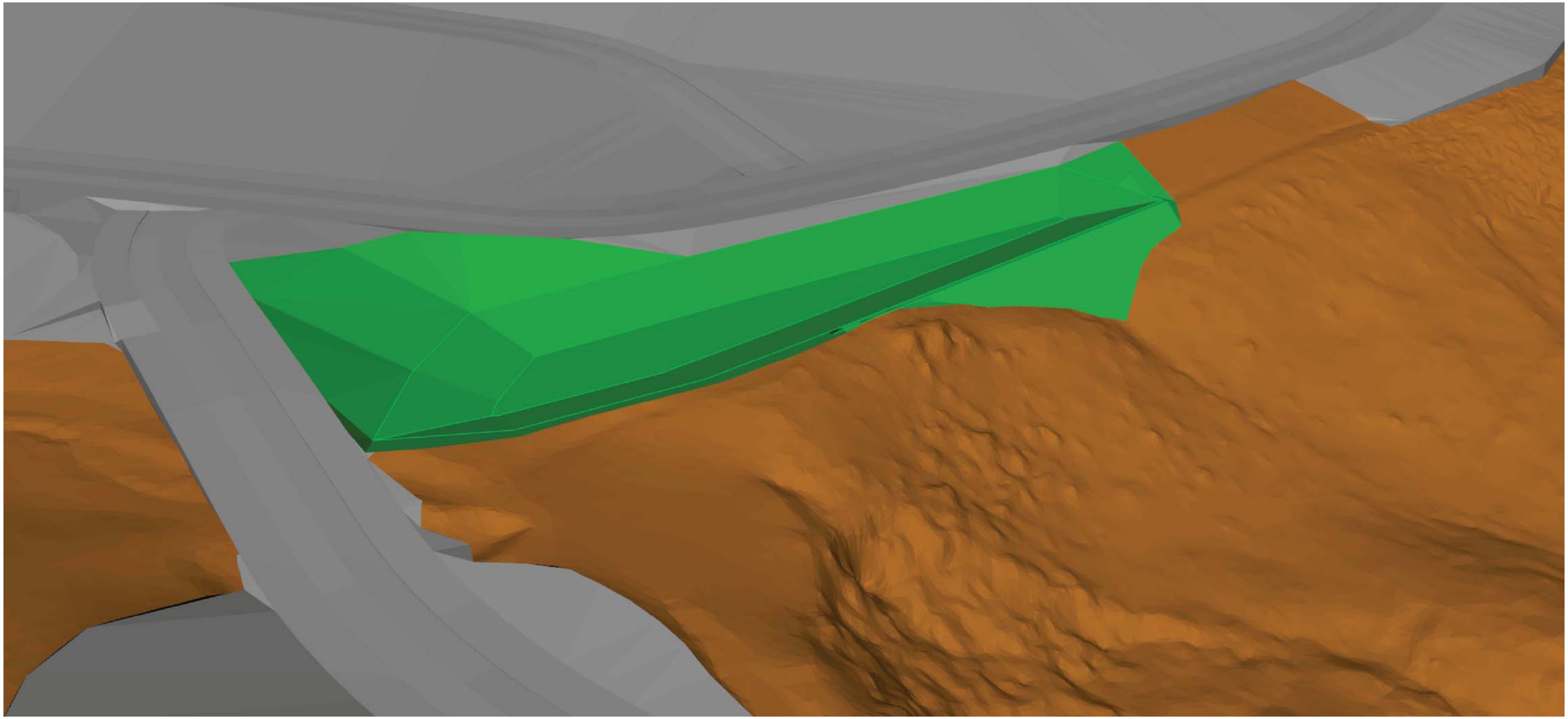
SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER BASIN 28
DETAIL SHEET 2

ISSUE STATUS: INFORMATION

SCALE: (A1/A3) 1:200 / 1:400

SCALE BAR 1:400@A3 0 4 8 12 16 20m

DRAWING NUMBER: 2020-08-SK07-2 REV: 1



PERSPECTIVE VIEW

SCALE: (A1/A3) N.T.S.

REV	REVISION DETAILS	BY	DATE
1	FOR INFORMATION	RJP	30.04.21

DRAWN: AJH	DATE: 09.2020
CHECKED: AJH	DATE: 24.04.21
APPROVED: RJP	DATE: 24.04.21

CIVILPLAN CONSULTANTS
Level 9, Laidlaw House, 20 Amersham Way, Manukau, Auckland. Phone: 09 222 2445

PROJECT TITLE:
HAVELOCK VILLAGE
POKENO

SHEET TITLE:
HAVELOCK VILLAGE
PROPOSED STORMWATER BASIN 28
DETAIL SHEET 3

ISSUE STATUS: INFORMATION

SCALE: (A1/A3) NOT TO SCALE

SCALE BAR N.T.S.

DRAWING NUMBER: 2020-08-SK07-3 REV: 1