BEFORE THE INDEPENDENT HEARING PANEL
APPOINTED BY UPPER HUTT CITY COUNCIL

IN THE MATTER	of the Resource Management Act 1991 (**RMA**)
AND	
IN THE MATTER	of a request by **MAYMORN DEVELOPMENTS LIMITED** for Private Plan Change 55 (Gabites Block) to the Upper Hutt District Plan under Part 2 of Schedule 1 to the RMA

STATEMENT OF EVIDENCE OF ALAN MITCHEL BLYDE

CIVIL ENGINEERING ISSUES

30 SEPTEMBER 2022

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INTRODUCTION

1. My full name is Alan Mitchel Blyde.

Qualifications and experience

2. I am a Director of Envelope Engineering Ltd (**Envelope**), an engineering consultancy practice, with offices in Wellington and Auckland. Prior to becoming a director at Envelope, I was the Technical Director, and Wellington Manager for Harrison Grierson Consultants Limited. I have the following academic qualifications:

(a) I hold a Bachelor of Engineering (Environmental) Hons Degree and a NZ Certificate in Engineering (Civil).

(b) I am a Professional Member of Engineering New Zealand.

3. I have worked for 30 years in the Land Development field of civil engineering. I have worked on numerous large residential land subdivision projects providing clients with technical design and construction expertise on all aspects of residential subdivision development. This particularly includes the design of earthworks and sediment and erosion control on steep sites. I have prepared numerous Environmental and Construction Management Plans for large development sites and have overseen construction works to completion for those sites.

4. I have worked on residential land development projects in Wellington since 2008, including in Upper Hutt as well as the wider Wellington region. I have been involved in reviewing and overseeing all civil engineering design aspects for the PC55 application, including infrastructure services, water supply, wastewater, roading, earthworks and sediment and erosion control, and stormwater and flood hazard management.

Code of Conduct

5. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and confirm that I have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise, except where I have indicated that I am relying on others' opinions. I have not omitted material facts known to me that might alter or detract from my evidence.

SUMMARY OF EVIDENCE

6. This statement of evidence discusses the following:

(a) a summary of how earthworks and erosion and sediment control will be designed, managed and implemented;

(b) the consultation which has occurred with UHCC and Wellington Water on 3-waters servicing and flood risk and how these are proposed to be managed for future development on the site;

(c) the consultation which has occurred with Wellington Electricity and Chorus to confirm that utility services can be provided to the site;

(d) the issues of concern raised by submitters with respect to earthworks, 3-waters and utility services, and flooding; and

(e) my opinion as to why and how the principles and the provisions of PC55 are suitable and some recommended amendments/ additions.

INVOLVEMENT IN PC55

7. I have been involved with the Envelope team carrying out engineering assessments in relation to the Gabites Block site under engagement from Maymorn Developments Ltd.

8. Envelope's scope of works for Maymorn Developments Ltd (**Maymorn**) was to provide input to civil engineering matters including earthworks, erosion and sediment control, stormwater and flood management, wastewater disposal and potable and fire fighting water supply, as well as power and communications utility services. My evidence covers the outcomes of our work with regard to the proposed rezoning of the site.

9. In carrying out my work, I have undertaken a number of site visits and detailed walkovers as well as attended meetings with Council and Wellington Water to discuss infrastructure matters. From an early stage in our investigations, we have identified Wellington Water as a key stakeholder and worked closely with them exchanging technical correspondence back and forth to reach agreement on the appropriate way to manage 3-waters for residential development of the site.

10. I have reviewed and approved for release all civil engineering and earthworks design plans and reports prepared by Envelope in support of this proposed Plan Change.

11. I have worked closely with the project geotechnical engineers from Engeo Ltd and other experts including the project ecologist and stormwater modeller/ engineer.

12. Following preparation of our Infrastructure report[1] and notification of PC55, a number of submissions were received which raised concerns about flooding of downstream properties being exacerbated by development of the site. We therefore arranged for a specialist flood modeller to undertake a floodplain assessment[2] of the site and immediate surrounds and to build a flood model that identified flood extents under the current situation, as well as what flood storage/ attenuation and controls would be required in future, following possible development of the site. The aim was to ensure that no increased flood effects are generated to downstream properties and waterways, and to ensure that future development of the site can occur with appropriate flood protection.

[1] Envelope Engineering (October 2021). Infrastructure Report – Gabites Block, Upper Hutt.
[2] Golovin (September 2022). Floodplain Assessment – Gabites Block, Te Marua, Upper Hutt.

13. I attended a joint meeting on 29th Spetember 2022 with Council's expert witness, Mr David Wilson and other Wellington Water stormwater modelling staff to review the site, with respect to the submitted Floodplain Assessment report.

OVERVIEW OF CONTEXT AND ENVIRONMENT

14. The 'Gabites Block' is a largely undeveloped parcel of land located to the north and east of Maymorn Rd, Upper Hutt. The legal description for the site is Lot 2, DP356697 and Pt Sec 299 SO 10985. In total the site is approximately 74Ha and is currently zoned General Rural Valley and Rural Production. The approximate extent of the site is shown in figure 1 below:

Figure 1. Site Plan

15. Currently the site contains a single farmhouse and several ancillary sheds in the south-west corner. The site rises from flattish paddocks at the west to the steeper vegetated hilly part to the east. The elevations on the lower part of the site are around RL 110 while the upper part of the site reaches around RL 195.

16. The lower flatter parts of the site are in pasture while the hill parts of the site are covered by a variety of vegetation including some areas of mature or regenerating native bush. Ms Annabelle Coates of Babbage Consultants Ltd provides evidence which includes ecological assessments of the site and a more detailed description of existing vegetation and current land use.

17. Engeo have undertaken geotechnical investigations across the site to provide us (the civil/ earthworks designers) with advice and parameters around earthworks issues and constraints and provide recommendations on ground stability. The soils on the hill parts of the site are predominantly highly weathered greywacke. The flatter parts of the site contain silty material close to the surface underlain by river gravels.

Site Considerations

18. The topography of the site and geotechnical ground conditions have influenced earthworks requirements and thinking and this has been a factor in determination of the development area locations shown on the Gabites Block Structure Plan.

19. The flattest land is located along the western side of the site, adjacent to Maymorn Road and this land lends itself to development of smaller lots, from an earthworks perspective. The Northwest; Valley Flats; and Station Flats areas are proposed over this flatter land and these areas will range from having minimum lot sizes of 400m^2; 2,000m^2; and 1,000m^2 respectively.

20. The central portion of the site contains the steepest land on the site, and the Hillside Area proposed will contain the largest lots with a minimum lot size of 10,000m^2, and an average size of 25,000m^2.

21. On the upper parts of the site the topography is not as steep, and so within the Hilltops Area a minimum lot size of 2,000m^2 (and a minimum average of 4,000m^2) is proposed.

22. Within the northeast corner of the site there is a basin containing gently sloping land, and this is proposed as the Hilltop Basin Area with a minimum lot size of 1,000m^2.

ENGINEERING AND INFRASTRUCTURE GOALS AND ASSESSMENT

Earthworks

23. When developed, the Gabites Block will require earthworks to occur mainly to enable road access over the site. From an engineering perspective the future earthworks for the Gabites Block land will be required to achieve the following:

(a) Modify land topography to reduce steepness of the site, sharply incised gullies, and undulations within the hilltops.

(b) Provide lot shapes and/ or platforms at a bulk earthworks stage that will minimise the need for secondary future earthworks during house building stage.

(c) Provide site access through trafficable roads and pedestrian pathways which have an appropriate width and achieve design standards for gradient and geometry.

(d) Earthworks for flood mitigation measures, required to form attenuation ponds, rain gardens, and other measures such as culvert upgrades, that will reduce the risk of flooding to downstream properties.

24. Proposed PC55 includes provisions to control earthworks and also considers the overarching Regional earthworks provisions encompassed within the GWRC Proposed Natural Resources Plan (PNRP), and this is discussed later in my evidence.

25. For Gabites Block a key consideration for future earthworks is protection of Gabites Block Natural Areas (GBNAs) and minimising earthworks within these.

26. Other key considerations for earthworks are:

(a) Achieving a cut and fill balance as far as practicable (i.e. limiting the need for excess material leaving the site and the requirement for additional material to be imported to site).

(b) Controlling gradients and rehabilitation of batter slopes. In accordance with specific geotechnical recommendations outlined by Engeo[3], permanent cuts must be formed at no greater than 1 in 2 slope (26 degrees) when in soil and no greater than 1 in 0.75 slope (55 degrees) when in rock. Any earthworks fill will be completed in accordance with NZS: 4431: 1989 Code of Practice for Earth Fill and Residential Development.

(c) Requiring bulk earthworks proposals to be accompanied by a scheme plan so that all land development works can be considered together.

Erosion and Sediment Control

27. The UHCC District Plan and PC55 recognises that primary responsibility for significant earthworks and sediment and erosion control lies with GWRC. The guideline document which is accepted as the appropriate standard for management of earthworks and, in particular, erosion and sediment control in the Wellington region is the Greater Wellington Regional Council "Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Wellington Region 2021".

28. These guidelines will be utilised to design erosion and sediment control measures on the site which will be included in Resource Consent applications to UHCC and GWRC at the time of earthworks and subdivision. In any grant of consent UHCC and GWRC can impose appropriate conditions of consent at the time of land development.

[3] Engeo. (November 2021). Geotechnical Investigation – Gabites Block, Upper Hutt.

Wastewater

29. There is currently no existing public wastewater drainage within the site, but there is a DN225 public main within Maymorn Road immediately adjacent to the site.

30. I attended meetings with Council's development engineers and Wellington Water staff and the following was made clear to us:

(a) The existing public wastewater reticulation located downstream of the site, has capacity constraints during wet weather.

(b) During dry weather conditions the network has spare capacity and could accommodate additional flows from the site.

(c) Wastewater discharge from the site could not connect to the existing public downstream reticulation without the current wet weather capacity issues being addressed.

31. Understanding that the downstream public wastewater system had capacity constraints, we initially considered if on-site disposal of wastewater was a suitable option for the Gabites Block, however we concluded that this approach would not be suitable on a site-wide scale because:

(a) Geotechnical investigations identified that ground permeability is poor within the hilly parts of the site and this would result in large treatment beds being required which is less feasible on sloping ground.

(b) The lower, flatter part of the site is underlain by gravels which are typically free-draining, however have a relatively high-water table less than 2 metres below the existing ground which complicates the design of the required treatment beds.

32. Notwithstanding the above points, there can be isolated parts of the site, on larger lots where on-site wastewater disposal can be viable and would be considered as an option.

33. For the majority of the site, our early discussions with Council and Wellington Water identified that connection to the existing downstream public wastewater network was preferred, subject to peak flow control and discharge to the network occuring outside times of high wet weather flow, when network capacity might be constrained.

34. There are two locations we had identified for new connection to the public wastewater network: one was from the Northwest Area; and the second was to be further along Maymorn Rd from the Valley Flats area (catering for the rest of the site). However the evidence of Mr David Wilson identifies that only a single connection to the existing wastewater network with a telemetered flowmeter will be allowed (by Council/ Wellington Water). This is understood and accepted, in light of Council/ Wellington Water's preferred option for watewater management for the site as discussed below.

35. During earlier discussions, a number of acceptable options for peak flow control were agreed with Wellington Water but, more recently, Council/ Wellington Water have identifed their preferred option and this is also detailed within the evidence of Mr David Wilson for UHCC.

36. All wastewater from the Gabites Block site, which is to discharge to the existing public wastewater network, is to be serviced via a de-centralised, on-lot private pump and storage system, connected to a public low-pressure sewer system. The on-lot pump and storage system will include 'smart controllers' enabling Wellington Water to instigate peak flow control during times of wet weather.

37. The low-pressure sewer system will be designed in accordance with Wellington Water's "Pressure Sewer Design Guide. Version 0. October 2021".

Water Supply

38. There are existing public water mains parallel to the site boundary along Maymorn Rd. One of these, a DN200 mPVC pipe, lies partly within the site and the other, a DN 150 AC pipe, is on the opposite side of the road.

39. I attended meetings with Council's development engineers and Wellington Water staff and the following was made clear to us:

(a) The existing public watersupply network has no capacity available to provide water to the site.

(b) UHCC/ Wellington Water have proposed upgrades to the wider public water supply network, including watermain upgrades and a new reservoir. However they confirm that that there is no set programme for these upgrade works to occur and so this cannot be relied upon for the Gabites Block site.

40. On the basis that there is no capacity within the existing public water supply network, on-lot water supply utilising rainwater collection tanks is the only option available. Each lot will need to have an adequate water supply and water storage for both potable use and firefighting.

41. The UHCC Code of Practice contains guidance on suitable storage requirements. In accordance with the Code, we determined that: assuming 3.5 people/dwelling, 180 litres/p/day and 60 days storage, this would require a storage volume of 37,800 litres for potable water supply.

42. In addition to the potable water storage, additional water storage will be required for firefighting purposes. Provided this can be reserved for firefighting this could be within the same tanked system used for potable water. The firefighting storage should meet the requirements of SNZ PAS 4509:2008. The storage requirement depends on the fire water classification, domestic dwellings are likely to be FW1 if they have sprinkler systems or FW2 without sprinklers. For FW1 the storage requirement will be 7,000 litres, for FW2 this will be 45,000 litres.

43. On the basis that future houses are sprinklered with a domestic sprinkler supply (fed from a rainwater collection tank), then the total water supply storage requirements for a typical dwelling would be 37,800 litres for potable water and 7,000 litres for fire fighting supply, giving a total storage requirement 44,800 litres.

44. The above-mentioned total water storage requirement could be met with the provision of 2x 25,000 litre tanks on each site. These tanks are typically 3.5m diameter x 3.0m high and therefore two of these tanks could readily be accommodated on a lot of 1,000m^2 or larger.

45. The proposed size of the lots for the Northwest Area (average 600m^2, down to a minimum of 400m^2) means it is more difficult to satisfactorily integrate the required storage with any proposed house design. For this reason, we propose that subdivision below 1000m^2 only be carried out when a suitable public water supply is available to serve the Northwest Area.

Stormwater and Flood Management

46. There is an existing stream that bisects the site. This stream is a tributary of the Mangaroa River, the stream travels northwards through the site and joins another tributary just beyond the site before passing underneath Maymorn Road in a culvert and then joining the Mangaroa River.

47. I have prepared a plan showing Proposed Stream Corridors specifically with respect to flooding/ conveyance of stormwater. This is included as Attachment 1 to my evidence. The mapped stream corridors (flooding) are generally aligned with the mapped Waterways included as Figure 14 within the Ecological report[4].

48. I understand Wellington Water have been working on modelling the stormwater catchment containing the site and have identified that parts of the proposed Valley Flats Area may be at risk of flooding during a 1% AEP rain event.

49. To confirm that flood risk is alleviated at the time of subdivision, a Floodplain Assessment was commissioned under Envelope's direction and this has been completed by Dr Steven Joynes of Golovin Ltd. The Floodplain Assessment is included as Attachment 2 to my evidence. The floodplain assessment has been prepared based on a detailed topographical study of the site, including stream banks and culverts. For the rest of the flood catchment area, LIDAR survey data has been used in the model.

[4] Bioresearches. (8 Oct 2021). Ecology Report: Gabites Block, Maymorn.

50. Figure 2 below, taken from the Floodplain Assessment report prepared by Dr Joynes, shows the floodplain catchment (in orange dashed line) in relation to the site (red solid boundary line). The catchment area was determined as 1.18km^2.

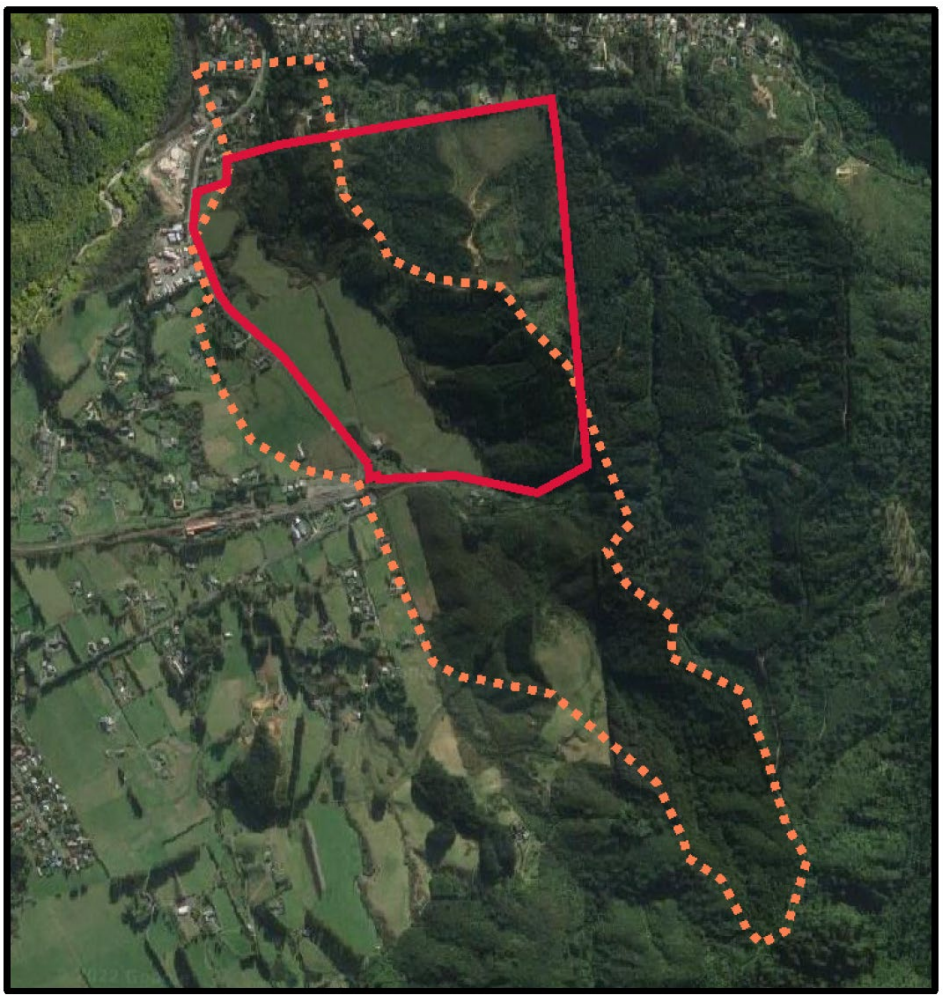


Figure 2. Identified Catchment

51. The Floodplain Assessment report details the **existing** Flood-map for the site which would occur in a 100-yr storm event, also allowing for a 20% increase in storm flows to cater for climate change effects. The Flood-map from the report is shown as Figure 3 below.

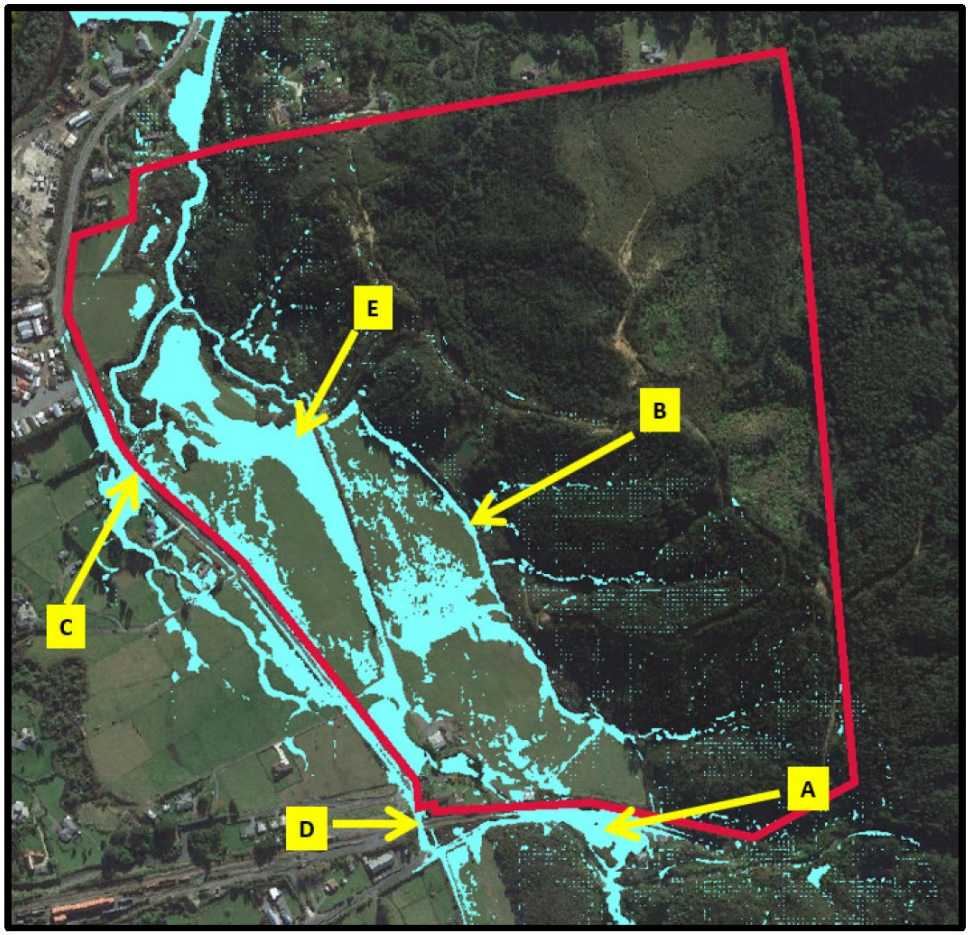


Figure 3. Existing Flood-map for 100-yr event plus 20% climate change

52. It is evident that in a 100-yr storm event and if allowances are made for future climate change effects, the site will theoretically experience flooding over the lower-lying, flat part of the site and within the existing drains and stream channel and across some of the flat paddocks.

53. As discussed previously, it is envisaged that earthworks will occur across the site to enable future development. In addition, the installation of upgraded stormwater culverts, widening of stream channels and formation of attenuation devices such as stormwater ponds will be required for sitewide stormwater management and these works would be designed and detailed as part of a future Resource Consent application.

54. The Floodplain Assessment report includes modelling of a future scenario where the flat lower part of the site is to be fully developed and identifies that with the following upgrades and stormwater management works, flooding can be contained within stormwater management areas and away from development area/ house sites:

(a) Existing stormwater culverts across the site will be upgraded/ upsized to allow better through-flow and prevent backing up and ponding upstream of culvert crossings within streams.

(b) The existing stream on site will be doubled in size to allow a significant increase in attenuation capacity within the site, thereby preventing downstream properties from any increased flood effects which could have otherwise occurred with additional development on the Gabites Block.

(c) Additional pond storage and detention basins will be strategically located within drainage reserve areas to provide additional attenuation volume for flood flow control.

55. The above measures will be finalised with future project specific Resource Consent applications, designed with comprehensive development plans and will involve preparation of a detailed Stormwater Management Plan (**SMP**). The measures will be designed to ensure that peak flow to downstream properties is controlled and remains hydraulically neutral. In addition, the measures will ensure that development areas on Gabites Block can be developed with a suitable freeboard.

56. Figure 4 below, taken from the Floodplain Assessment report details the hypothetical future modified floodplain extents, following implementation of development earthworks and the stormwater management measures described under points 54 a – c above.

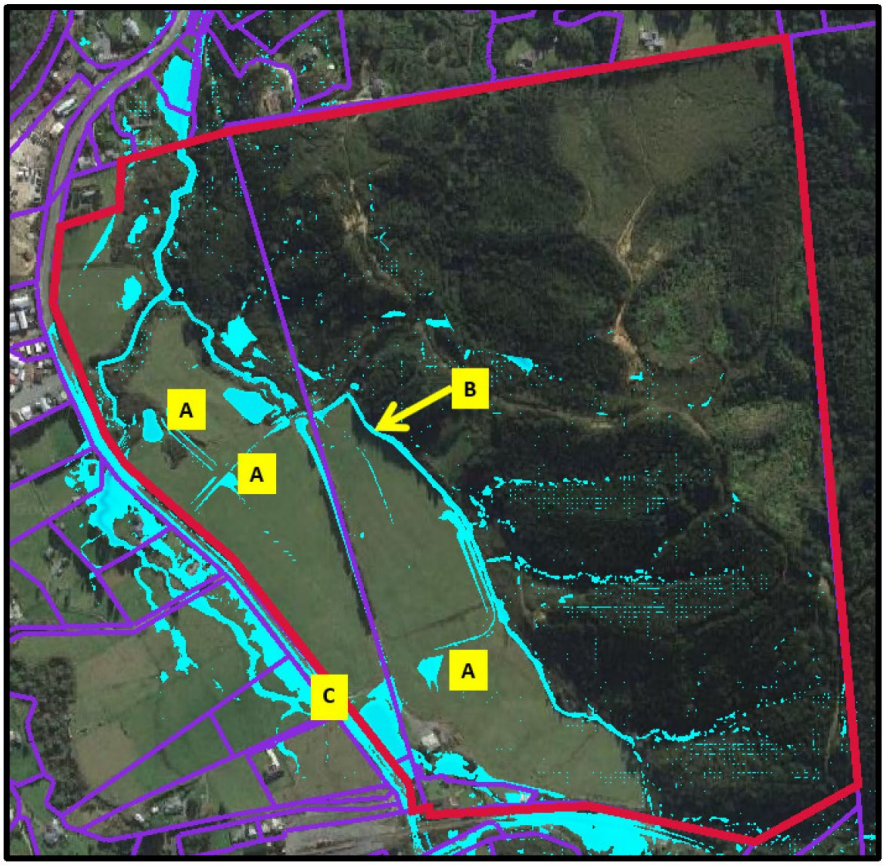


Figure 4. Extents of Floodplain for 100-yr storm with 20% climate change allowance (post development and implementation of hypothetical flood management measures).

57. It should be noted that no subdivision design has been completed for this Plan Change process and any notional sizing or identified flood mitigation and stormwater management measures is conceptual only at this stage and should be resolved during future Resource Consent processes.

58. I am confident that sufficient land space and mitigation/ management options are available to ensure that the rezoning and future development of the site can occur without creating increased flood risk to downstream properties and ensuring that development on-site is free from flood hazard.

Stormwater Management

Road Stormwater

59. Most of the possible future roads across the site are expected to be vested to Council as public roads. Stormwater assets within the road lot would therefore become public assets.

60. On the steeper parts of the site there is a greater need to control the runoff velocity of road-based stormwater and there may be more kerb and channel used. These channels would drain into roadside sumps which are likely to be connected to short, piped networks within the road. These piped networks would discharge to existing gullies. On the lower, flatter parts of the site stormwater runoff from roads is expected to be controlled by roadside swales.

Stormwater Quality

61. Treatment of stormwater runoff from all trafficked areas is to be provided, and we anticipate this would be achieved with either rain gardens or constructed wetlands. Swales may also be used on the flatter parts of the site for pre-treatment. Ultimately the final form of treatment proposed will be detailed within a development specific Stormwater Management Plan provided at the time of future Resource Consent and may take many forms, in compliance with the Wellington Water Water Sensitive Design for Stormwater: Treatment Device Design Guideline (December 2019).

Stormwater Attenuation

62. As discussed earlier, due to the downstream constraints there is a need to provide attenuation of peak runoff rates to ensure hydraulic neutrality. For runoff from the proposed roadway areas, this could be achieved by constructing ponds at or close to the discharge points. A hypothetical concept for stormwater attenuation measures, for flood flow management purposes has been modelled within the Floodplain Assessment report (Attachment 1 to my evidence) and is described in paragraphs 54 to 56 above.

Stormwater Discharge

63. Discharge from stormwater pipes collecting runoff from roadways will be into existing gullies with suitable erosion control. As noted above the discharge will include or be preceded by treatment/attenuation devices.

On-Lot Stormwater

64. Stormwater generated from development on individual lots will be managed on each site and will be required to be designed to achieve hydraulic neutrality. Roof water would be collected to rain tanks adjacent to each house which will serve as the primary source of potable water for the houses. There will be overflow connections from the rain tank passing to the downstream disposal point. The discharge point will vary depending on the location of the house site within the lot, the terrain of the lot, and whether there is a piped system available within the road.

65. Lots below the road would typically discharge to gully areas via a designed outfall structure with energy dissipation and scour protection. Some lots that are close to the road where a piped system is present may discharge to the piped network provided that this has been included in the attenuation calculations at subdivision stage.

66. Some measures available to aid in achieving hydraulic neutrality on individual lots include: raingardens/ tree pits; additional detention tanks (above or below ground); infiltration trenches with storage volume; permeable paving, to name a few. These are all orthodox and effective measures.

Utility Services

Power Supply

67. I have attended meetings and consulted with the power network operator, Wellington Electricity. We have discussed the development plans with them and they have advised that network upgrades would be required for the proposed development to be fully developed. This is not unusual for developments of this scale. Further detailed discussions are ongoing with Wellington Electricity to determine the timing of the upgrade.

68. At least one new power substation will be required within the site. The timing and location for this will be worked through with Wellington Electricity.

69. Based on our investigation and discussions, I see no problem with the ability for power to be supplied to future development on the rezoned site, from Wellington Electricity's network.

Telecommunications

70. Access to the fibre network is available close to the site. Envelope has liaised with Chorus who have confirmed the development can be serviced. Based on our investigations I see no problem with the ability for telecommunications to be supplied to future development on Gabites Block upon rezoning.

ISSUES RAISED IN SUBMISSIONS

71. I have read the submissions received in response to the PC55 application and respond below to the submissions specific to engineering/ infrastructure matters.

72. The main themes raised by submitters in relation to engineering matters included: the inability for existing infrastructure/ horizontal infrastructure to support the potential development; perceived flaws in wastewater disposal and water supply concepts; fire fighting capacity and requirements for large tanks not allowed for; increased stormwater runoff and decreased permeability and effects from stormwater on downstream properties; increased flood risk to downstream properties; a requirement for importation of 'engineered fill'; earthworks effects on ground stability including to neighbouring properties; effects of earthworks on downstream waterways and land; and the perceived existing poor service and capacity of existing power and telecommunications infrastructure.

Ability of infrastructure to support this type of development, wastewater disposal, water supply and stormwater management.

73. A number of submitters have questioned the ability of existing infrastructure or "horizontal infrastructure" to service the increased development. For 3-waters, my evidence has identified how infrastructure will be provided for future development without creating downstream effects.

74. For wastewater, peak flow control will be achieved on-site through individual lot storage tanks with telemetered control, connected to a low-pressure wastewater network. The low-pressure network from the site will connect to Council's existing public network and will only discharge wasetwater during times when the public network is not constrained by wet weather peak flows. Wellington Water (WWL) have confirmed that the existing public network has capacity for this controlled discharge therefore there is no negative downstream effect by future discharge from the site. The Section 42A Report recommends an amendment to SUB-DEV3-S3 to confirm the above agreed solution. I agree with this amendment.

75. For potable water supply and fire fighting supply, my evidence has confirmed the proposal is to provide water for these purposes through the collection of rainwater to storage tanks on each individual site. Some submitters have questioned the sizing of raintanks. Paragraphs 42 – 44 of my evidence provide the basis for determining the required tank storage volumes (ie 37,800L for potable water and 7,000L for fire fighting supply with a sprinklered building) in accordance with the UHCC Code of Practice and SNZ PAS 4509:2008 respectively. This volume of storage can be provided through the use of two 25,000L tanks, providing a total storage volume of 50,000L. Tanks of this size are readily accommodated on lots of 1,000m^2 or larger. The Section 42A Report confirms agreement with the above calculations of storage requirements.

76. Submitter 30, Fire and Emergency NZ notes their support of SUB-DEV3-S2 and indicates the preferred method of compliance with the standard in non-reticulated areas is with the installation of sprinklers. I support an amendment to this provision to include wording that specifically references a domestic fire sprinkler system as being required for fire fighting water supply.

77. Submitter 15, RJ (Bob) Anker has stated that water supply concept for the Northwest area is contradictory in light of constraints with water supply capacity as noted in our Infrastructure Report. I take this to refer to the fact that these lots are smaller (average 600m^2) and therefore cannot readily accommodate the required rainwater storage tanks. Our Infrastructure Report and my evidence confirm that it has always been intended that development of smaller lots in the Northwest area can only proceed once Wellington Water have completed their future envisaged water supply network upgrades, to allow this area to be serviced from reticulated public network. SUB-DEV3-S2 requires that lots are either connected to Council's reticulated water supply network, where there is available capacity, or the lots need to be capable of being provided with water supply storage tanks. Therefore if neither is able to be complied with, the Northwest lots cannot meet this standard until Council's network has available capacity.

78. For stormwater infrastructure my evidence has confirmed the intention to achieve hydraulic neutrality on all individual future lots, through the use of a range of management device options including above or below ground detention tanks, permeable paving, raingardens/ treepits, infiltration trenches with storage, etc. The requirement for achieving hydraulic neutrality will ensure that downstream properties and waterways are not affected by increased stormwater runoff from future development of Gabites Block. My evidence has also confirmed the requirement for hydraulic neutrality and peak flow management to be achieved for stormwater runoff from the roadway areas throughout the development through provision of attenuation devices including raingardens, attenuation ponds, designed wetlands and widened/ naturalised drains with additional flood storage area. Peak flow management for runoff from future development on the site will be achieved for the 100-yr storm event (including allowance for increase due to climate change effects).

79. In addition to provisions requiring achieving hydraulic neutrality, I support the inclusion of additional provisions which require development to achieve water sensitive design in accordance with the Wellington Water Water Sensitive Design for Stormwater: Treatment Device Design Guideline 2019.

80. Submitter 40, GWRC also supports a Water Sensitive Urban Design (WSUD) approach to protect waterways. GWRC have also stated that there has not been adequate detail provided to demonstrate how the stormwater network will work. In response to this, I have contributed to and recommended some amendments to the originally proposed provisions of PC55 specifically in relation to stormwater matters and these included:

(a) A new stormwater objective DEV3-SW-01 related to Water Sensitive Design, which is in addition to the previous objective for hydraulic neutrality.

(b) A new policy DEV3-SW-P1 requiring Water Sensitive Design

(c) Minor amendments to policy DEV3-SW-P2 around hydraulic neutrality specifically being a requirement for roadways.

(d) Amend SUB-DEV3-P3 to require roadways to achieve stormwater quantity and quality management

(e) Amend SUB-DEV3-S6 to require stormwater management for roads.

(f) Amend DEV3-P2 to require the management of stormwater quantity and quality in accordance with the stormwater policies for water sensitive design (DEV3-SW-P2) and hydraulic neutrality (DEV3-SW-P1).

(g) Amend DEV3-P2 to require a stormwater management plan as SUB-DEV3-IR-3.

(h) Amend Clause 2 of SUB-DEV3-S4 to require on-site design to meet the WWL Regional Standard for Water Services.

(i) Insert DEV3-S14 to require a minimum building setback from waterbodies.

(j) Other minor changes to rules to refer to the policies and standards

81. The Section 42A Report recommends a requirement for a comprehensive Stormwater Management Plan to be provided as part of the first subdivision for the site and there is inclusion of a new provision SUB-DEV-IR-3 in this regard, which I support.

Flooding

82. Submitters: 8, Lisa and Jonathan Bryant; 21, Fiona and Barry Evans; 26, Janet Pitman; 29 Rob and Sharon Houghton; 40, GWRC; and 44, Lesley Francis have all submitted on concerns with increased stormwater runoff and effects to downstream properties and waterways from increased runoff and flooding.

83. My evidence has discussed that for future development over the Gabites Block, a key objective is achieiving hydraulic neutrality, both on individual lots as well as from public roadways. My evidence identifies the ways this can be achieved within individual lots as well as through communal management measures such as detention ponds, increased flood area within existing drains, to name a few.

84. The hypothetical development area with concept stormwater management measures was modelled in the Floodplain Assessment Report (Attachment 2) and this proved that peak flow stormwater discharge from the site could be controlled to ensure there is no increased downstream peak discharge, post development. This would ensure there are no increased flooding effects from the existing situation.

85. The hypothetical development area and concept stormwater management measures should be designed in detail as part of future development proposals, Resource Consent applications and in accordance with a comprehensive Stormwater Management Plan.

86. The Section 42A Report and evidence of Mr David Wilson has recommended inclusion of a Flood Overlay Map in PC55 and refers to recent flood modelling completed by Wellington Water.

87. The flood modelling undertaken by Wellington Water uses LIDAR contour information across the catchment, while the Floodplain Assessment Report (Attachment 2) has modelled an existing floodmap based on site specific survey across Gabites Block. Therefore, with respect to the site, this floodmap is more accurate then modelling work undertaken by Wellington Water. Notwithstanding that, I do not support the inclusion of the flood map within PC55. A flood map which details existing/ pre-development floodplains across the site is irrelevant in that this does not recognise how floodplains will be modified/ made obsolete as development proposals are implemented (with suitable flood management measures, as identified in a comprehensive Stormwater Management Plan for Gabites Block).

88. In my opinion, flood mapping is more appropriately carried out over the site in conjunction with specific future development proposals and with more detailed design information. The requirements for stormwater management and flood protection/ management measures would all be comprehensively detailed in a Stormwater Management Plan at that time also. The proposed provisions set out in the evidence of Mr Cumming provide suitable mechanisms to achieving appropriate management of flood hazards.

Earthworks

89. Submitters: 15 ,RJ (Bob) Anker; 21, Fiona and Barry Evans; and 29, Rob and Sharon Houghton; all raise concerns around stability of earthworks/ excavations, importation of fill material and sediment effects.

90. Future earthworks design will be carried out in accordance with detailed geotechnical assessments by a suitably qualified engineer. Current UHCC District Plan provisions require this. The geotechnical engineer will specify safe and stable earthworks and excavation/ filling parameters based on site specific investigation and testing.

91. My evidence has discussed that for future development over the Gabites Block, a key objective is achieiving a cut to fill balance as far as practicable to reduce the need for importation of fill material or disposal off-site of cut material. Design of bulk earthworks would also be focussed on reducing the need for secondary earthworks.

92. With respect to erosion and sediment control for proposed earthworks, my evidence has detailed that future development would require Resource Consent for bulk earthworks from GWRC under the PNRP and in obtaining those consents, proposed erosion and sediment control measures will be designed in accordance with Greater Wellington Regional Council "Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Wellington Region 2021".

Utility Services

93. Submitters: 14 , Jaki Sifflett; 17, Debbie Baston; 44, Lesley Francis all raise concerns around capacity of existing power and telecommunication utility services.

94. My evidence details significant consultation and meetings with Wellington Electricity and that capacity/ network upgrades are in hand and can be designed/ implemented as part of future development proposals.

95. My evidence also details consultation with Chorus with respect to telecommunication services and their confirmation that their existing network can provide for future development of the site.

Summary of position on issues raised in submissions

96. In summary, I believe my evidence and the responses above confirm that the concerns raised by submitters with respect to wastewater and water infrastructure, stormwater and flood management, earthworks and sediment control management and utility services can all be appropriately dealt with under future development proposals and and Resource Consent applications which are in accordance with the existing UHCC District Plan, the proposed provisions of PC55, the provisions of the GWRC PNRP, UHCC Code of Practice for Civil Engineering Works and Wellington Water and GWRC standards and guidance documents referred to.

SECTION 42A REPORT

97. The Section 42A report and specifically the evidence of Mr David Wilson states that two areas of information have not been sufficiently covered within the proposed PC55, being:

(a) The stormwater and flood risk effects of future development should the site be rezoned through PC55; and

(b) The proposed stormwater and floodrisk management system to mitigate these effects and whether this is sufficient to mitigate the effects on the receiving environment.

98. Subsequent to the Section 42A Report being prepared, I have arranged for and provided to Mr Wilson the Floodplain Assessment Report (Attachment 2). In my opinion, this report and the assessments within now provide the requested information. Paragraphs 46-66 of my evidence summarise the findings of the Floodplain Assessment and confirm that stormwater and flooding effects of future development can be readily and effectively managed to mitigate downstream effects and also to ensure development on Gabites Block is free of flood hazard.

99. Mr Wilson's evidence also suggests that flood hazard layers should be generated for the site. For the reasons that I have explained earlier, I disagree and my evidence has explained that any flood hazard layers generated would have to be based on the existing situation and these are irrelevant to future development which would modify these, thereby making any flood hazard layer obsolete.

100. Mr Wilson has also requested hydraulic modelling of the existing site should be carried out. This has now been provided to Mr Wilson/ Wellington Water with the Floodplain Assessment Report and at a meeting on 29 September 2022 with Mr Wilson and Mr Alistair Osbourne (WW Flood Modeller). I understand that they have confirmed general acceptance of the flood modelling results and methodology, specific to the site.

101. At the meeting of 29 September 2022, Mr Wilson has requested a further round of modelling to integrate our site-specific model with the wider Wellington Water Northern Upper Hutt Model to determine if the timing of flows creates any downstream issues.

102. In opinion, this is not required to be carried out at this stage. We know there is sufficient land area and options available to fine-tune proposed stormwater management/ mitigation measures such as detention ponds, and this work is more appropriately done with detailed design information as opposed to the hypothetical concept development model we are currently working with.

SUMMARY AND CONCLUSIONS REGARDING PC55

103. The section 32 technical report which deals with Infrastructure identifies how earthworks, erosion and sediment control, 3-waters, flooding and utility services will be provided for and managed, and my evidence further summarises that and confirms how future development can occur while ensuring engineering and infrastructure matters are managed and downstream effects are mitigated.

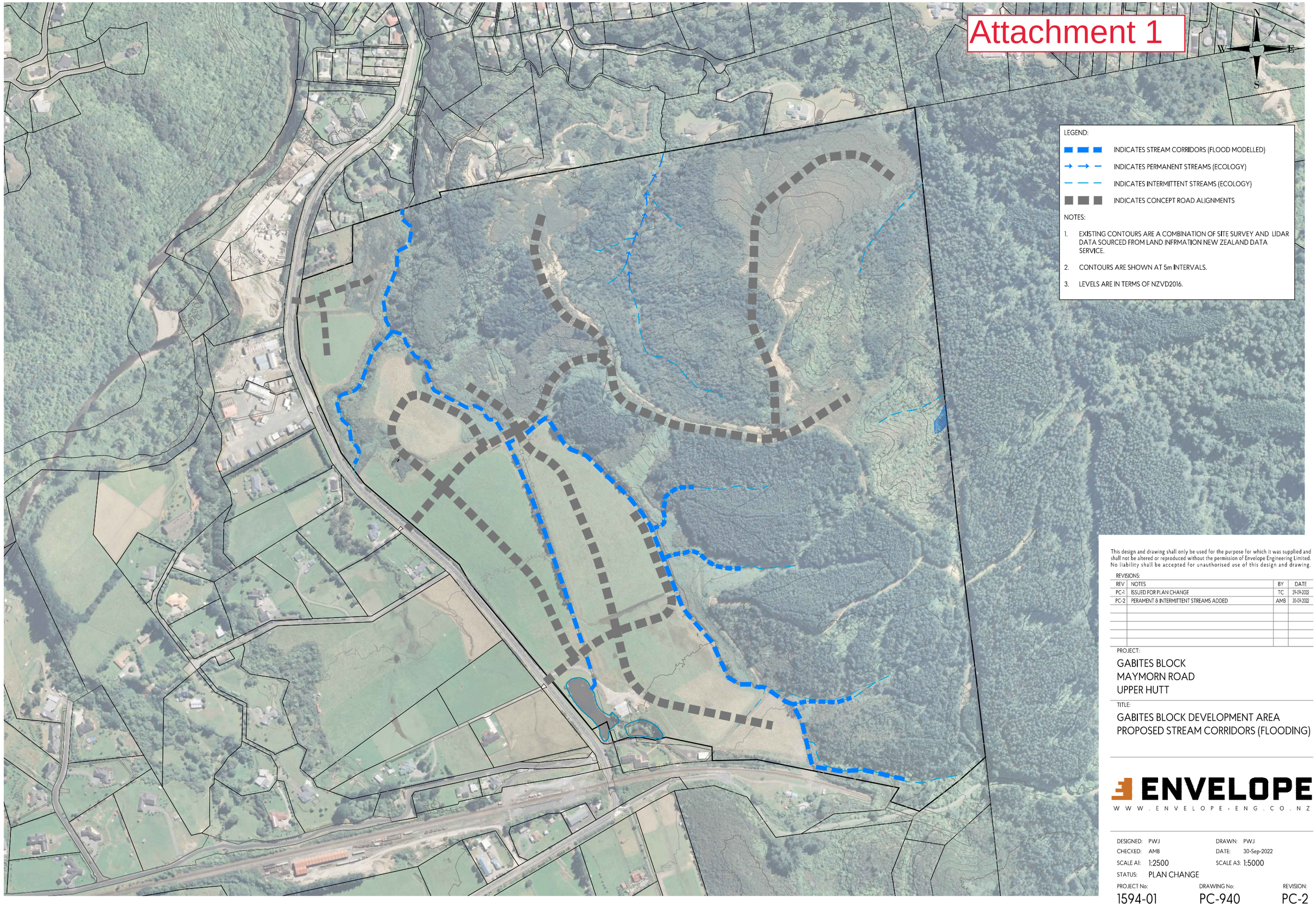
104. The provisions contained within the PC55 are appropriate to ensure that future development of the site when rezoned will be able to be suitably controlled and environmental effects will be minimised.

105. The provisions of PC55 could benefit from some additional provisions around Water Sensitive Design and Stormwater Management which I have recommended in my evidence, along with a number of minor amendments and consequential changes.

DATED this 30th day of September 2022

Alan Blyde

Attachment 1



LEGEND:

- INDICATES STREAM CORRIDORS (FLOOD MODELLED)
- INDICATES PERMANENT STREAMS (ECOLOGY)
- INDICATES INTERMITTENT STREAMS (ECOLOGY)
- INDICATES CONCEPT ROAD ALIGNMENTS

NOTES:

1. EXISTING CONTOURS ARE A COMBINATION OF SITE SURVEY AND LIDAR DATA SOURCED FROM LAND INFRMATION NEW ZEALAND DATA SERVICE.
2. CONTOURS ARE SHOWN AT 5m INTERVALS.
3. LEVELS ARE IN TERMS OF NZVD2016.

REVISIONS:

REV	NOTES	BY	DATE
PC-1	ISSUED FOR PLAN CHANGE	TC	29-09-2022
PC-2	PERAMENT & INTERMITTENT STREAMS ADDED	AMB	30-09-2022

PROJECT:

GABITES BLOCK
MAYMORN ROAD
UPPER HUTT

TITLE:

GABITES BLOCK DEVELOPMENT AREA
PROPOSED STREAM CORRIDORS (FLOODING)

ENVELOPE
WWW.ENVELOPE-ENG.CO.NZ

DESIGNED: PWJ
DRAWN: PWJ
CHECKED: AMB
DATE: 30-Sep-2022
SCALE A1: 1:2500
SCALE A3: 1:5000
STATUS: PLAN CHANGE

PROJECT No: 1594-01
DRAWING No: PC-940
REVISION: PC-2

Attachment 2

GOLOVIN

FLOODPLAIN ASSESSMENT

Gabites Block, Te Marua, Upper Hutt

September 2022

Envelope Engineering Ltd

ENVELOPE ENGINEERING
LAND
STRUCTURE
MANAGE

Prepared by Dr Steven Joynes

FLOODPLAIN ASSESSMENT

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Person assigned to manage the Project & Report

Name Dr Steven Joynes

Organisation **GOLOVIN**

Distribution List

Name	**Project Designation**	**Organisation**
Dr Steven Joynes	Hydraulic Modeller / Civil Engineer	Golovin
Matt Aitchison	Project Manager	Envelope Engineering Ltd

Prepared by

Dr Steven Joynes

1 INTRODUCTION

1.1 Statement of issues

Envelope Engineering are undertaking a Plan Change for a major subdivision in Te Marua on behalf of their client. The site is on 1135 Maymorn Road and the legal description is Lot 2 DP 356697 and Pt Sec 299 Hutt DISTRICT

Figure 1.1 shows the site boundary.

The objective of this report is to determine the extent of flooding of the site and any channel upgrade requirements. This is done for the 100-year storm event only.

Figure 1.1 – Property location

1.2 Present flood hazard information

A review of the Wellington Region flood hazards portal and the Upper Hutt Council GIS identifies no flood hazard. Figure 1.2 shows only a flood hazard to the adjacent Mangaroa River to the west. We understand that that some flood hazard work has been undertaken by Wellington Water Limited on behalf of Upper Hutt City however results have not been published yet.

Figure 1.2 – Flood hazard map

1.3 Proposed strategy

A 2D model was built using LiDAR terrain data to New Zealand Vertical datum based on the LINZ DEM. HEC-HMS was used to create rainfall excess hyetograph

The perimeter of the grid will be determined by initial testing to understand the full extent of water enter and influencing the site.

1.4 Sources of data

Table 1.1 – Source of Data

Attribute	**Organisation**
Catchment Plans	Previous reports
Contours	LINZ DEM 1m GRID
Ground spot heights	Envelope Engineering
Flow & WL data	None
Flood level evidence	None
Development plans	Envelope Engineering
Culvert dimension	Envelope Engineering

1.5 Target audience

The quality, quantity and tenure of the report should consider the following audience.

a) Envelope Engineering staff,
b) Upper Hutt City Council engineering staff,
c) Wellington Water staff.

1.6 Reference technical documents

- Reference Guide for Design Storm Hydrology, Wellington Water Ltd, 2019,
- Waikato stormwater run-off modelling guideline, TR2020/06, Waikato Regional Council,

2 HYDROLOGY

2.1 Rain-on-grid

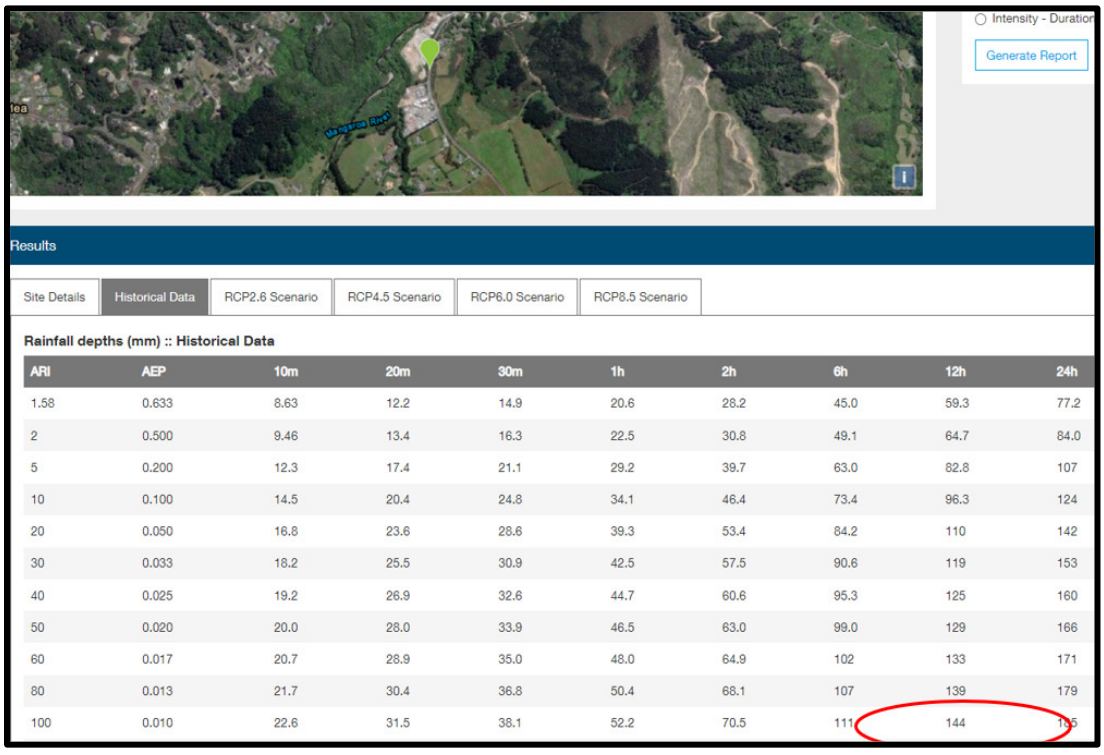
The catchment area does not matter because it is an excess rain analysis. The steps were;

1. Use standard parameters,
2. Create a rainfall distribution based on HIRDS data,
3. Build a HEC-HMS model,
4. Extract the rainfall hyetograph.

2.2 Rainfall data

The 100-year historical rainfall depth for a 12-hour storm is 144mm as shown in Figure 2.1. Adding a further 20% for climate change the design rainfall is 173mm.

Figure 2.1 – HIRDS – historical 24-hour rainfall, 100-year



ARI	AEP	10m	20m	30m	1h	2h	6h	12h	24h
1.58	0.633	8.63	12.2	14.9	20.6	28.2	45.0	59.3	77.2
2	0.500	9.46	13.4	16.3	22.5	30.8	49.1	64.7	84.0
5	0.200	12.3	17.4	21.1	29.2	39.7	63.0	82.8	107
10	0.100	14.5	20.4	24.8	34.1	46.4	73.4	96.3	124
20	0.050	16.8	23.6	28.6	39.3	53.4	84.2	110	142
30	0.033	18.2	25.5	30.9	42.5	57.5	90.6	119	153
40	0.025	19.2	26.9	32.6	44.7	60.6	95.3	125	160
50	0.020	20.0	28.0	33.9	46.5	63.0	99.0	129	166
60	0.017	20.7	28.9	35.0	48.0	64.9	102	133	171
80	0.013	21.7	30.4	36.8	50.4	68.1	107	139	179
100	0.010	22.6	31.5	38.1	52.2	70.5	111	144	185

2.3 Catchment size

The catchment was identified by initial model runs that demonstrated where the main channels were. Figure 2.2 show the boundary in relation to the site boundary. The catchment area is 1.18km^2. The north-east of the site is not considered in the 2D flood model. The north-east area is hydrologically separate and is considered later in the report.

Figure 2.2 – Identified catchment

2.4 Time of concentration

The Ramser-Kirpich and Bransby-Wiliams methods were calculated and averaged for the time of concentration and then the time to peak was used in HEC-HMS. Figure 2.3 shows the values calculated. 33 minutes was adopted.

Figure 2.3 – Time of concentration

Ramser-Kirpich			
Drop	(m)	450	
L	(m)	3300	
Sa	(m/m)	0.091364	
Tc	25	minutes	
Bransby-Williams			
F		92.7	
L	km	3.3	
A	ha	174	
S	(m/km)	91.364	
Tc	74	minutes	
Average		**50**	**minutes**
Time to peak		**33**	**minutes**

2.5 Curve number and initial abstraction

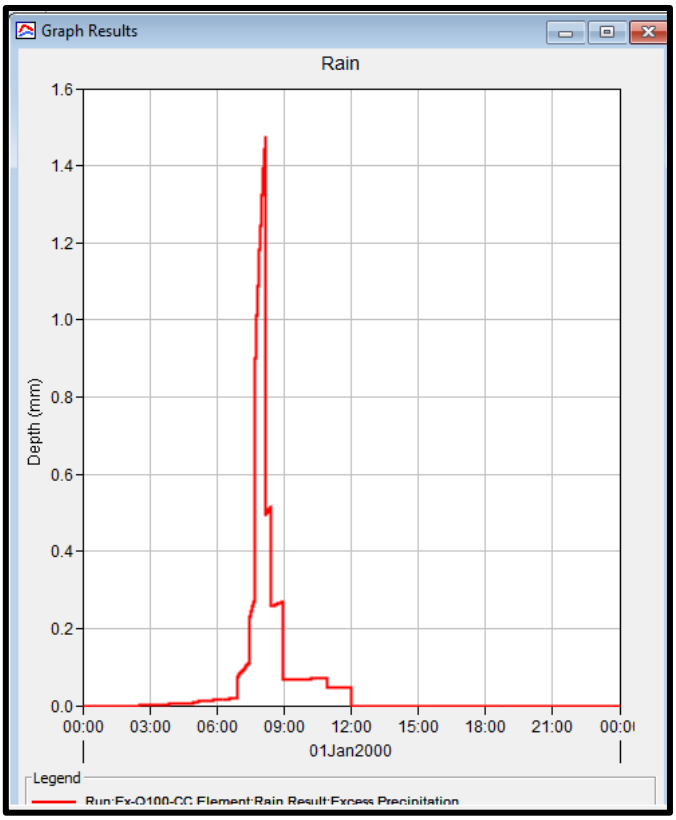
The hydrology guide provides curve numbers in Appendix B. The adopted curve number is 55. The corresponding initial abstraction is 10.4mm based on the Waikato Regional Council TR2020/06 guide, table 5-1.

For a 172.8mm rainfall the equivalent C-factor is 0.41. This is higher than the Document E1 value for predominantly bush areas in good soils of 0.25.

2.6 HEC-HMS model

The data was then transferred to HEC-HMS. Figure 2.4 shows the rainfall hyetograph. The peak flow is 16.5m^3/s. This hyetograph can now be applied to the HEC-RAS 2D terrain model.

Figure 2.4 – Rainfall excess, 100-year, climate change



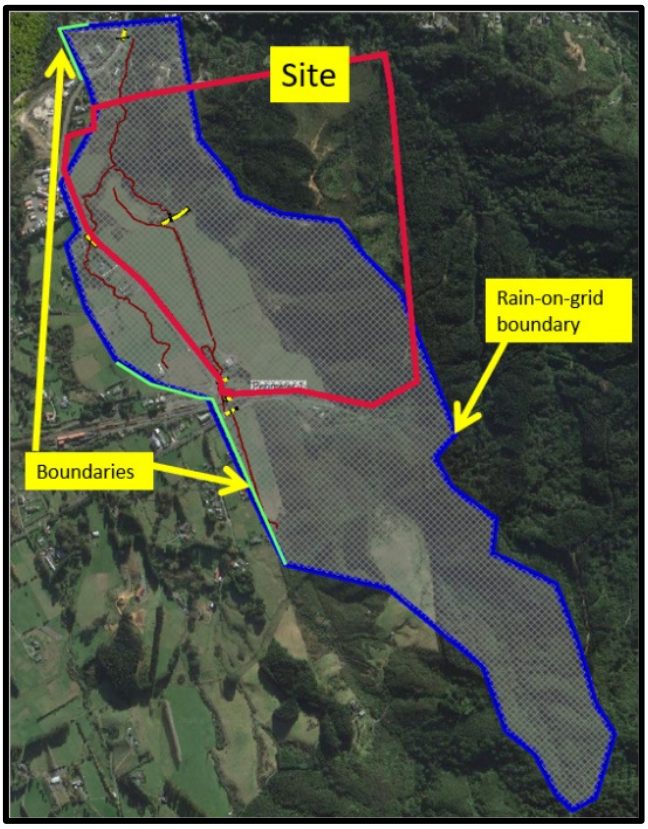
3 HYDRAULIC ANALYSIS

3.1 Model layout

HEC-RAS software was used to generate water levels in the vicinity of the site and general catchment area. A 2D grid was developed from the LiDAR terrain data extracted from the LINZ 1m DEM.

Figure 3.1 shows the general 6m x 6m rain-on-grid perimeter. There are 2 outflow boundaries. To the south-east this is a lateral outflow as flow leaves the general catchment. To the north is the downstream boundary that is set to RL99m, below the influence of the main channel. This value was chosen based on interpretation of the floodplain of the Mangaroa from the Council's GIS. This would be quite conservative because the time of concentration of the Mangaroa is about 3 hours compared to this catchment of 50 minutes. When the stream peaks the Mangaroa is only about 50% peak flow. Therefore, the water level might only be RL97m, hence a conservative assumption.

Figure 3.1 – HEC-RAS model set up



The time step used was 2 seconds. The general bed roughness is n = 0.1 which is a little rougher than the standard grass / bush value of 0.08. The roads have an n = 0.02. The red break-lines along main channel flows allow for more precision. The cell sizes are 2m. Several culverts were installed as per the survey supplied.

3.2 General flood-map

Figure 3.1 shows the floodplain for the climate adjusted 100-year storm. Only depths greater than 0.1m are shown.

At location A the railway line floods as flows move towards Maymorn Road. Typical depths are 0.5m and peak flow about 7.5m^3/s.

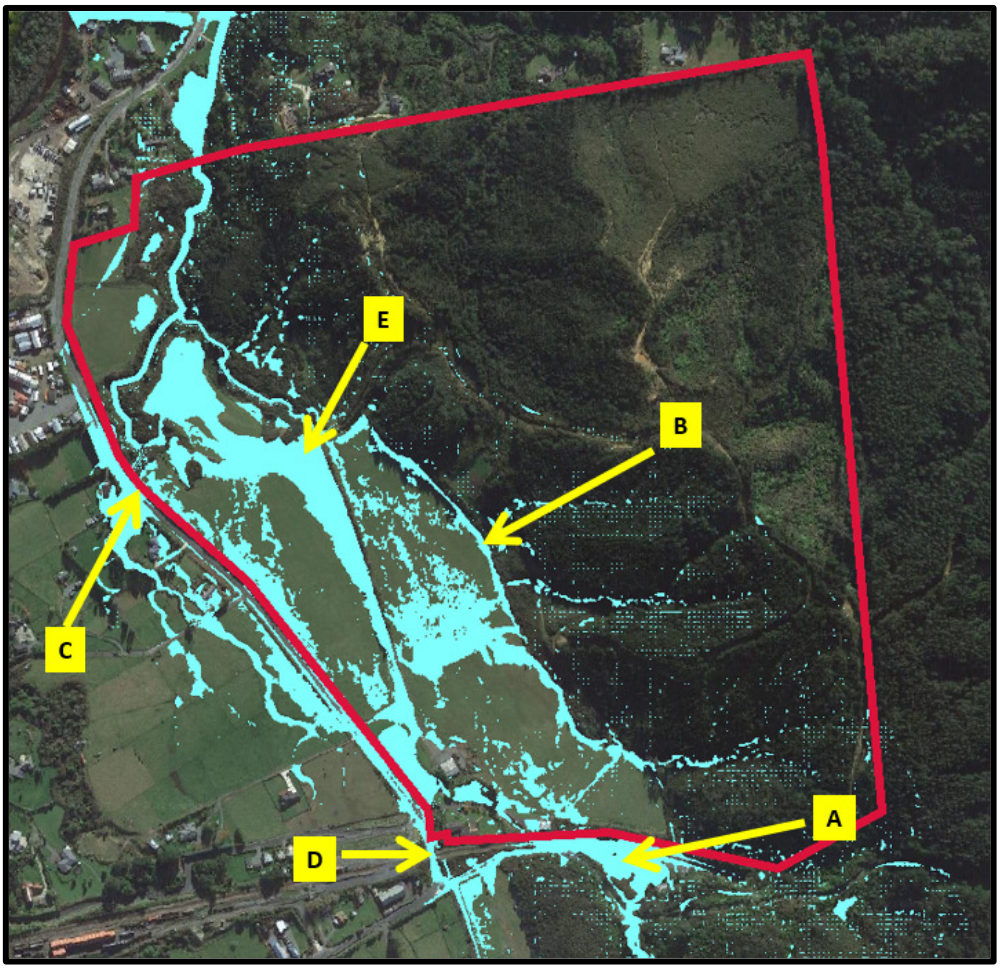
At location B there is a flow channel that collects flow from the 3 hill gullies. The peak flow is about 1m^3/s.

At location C Maymorn Road overflows from the western channel into the site. The depth on the road gets up to 0.5m and the overflow is perhaps 0.4m^3/s.

At location D the road under the railway line gets flooded by 0.4m with a flow of 5m^3/s.

At location E the main stream/drain is about 1m deep with the flow being deflected westwards due to poor culvert capacity. About 6m^3/s arrives and about 4.5m^3/s gets deflected.

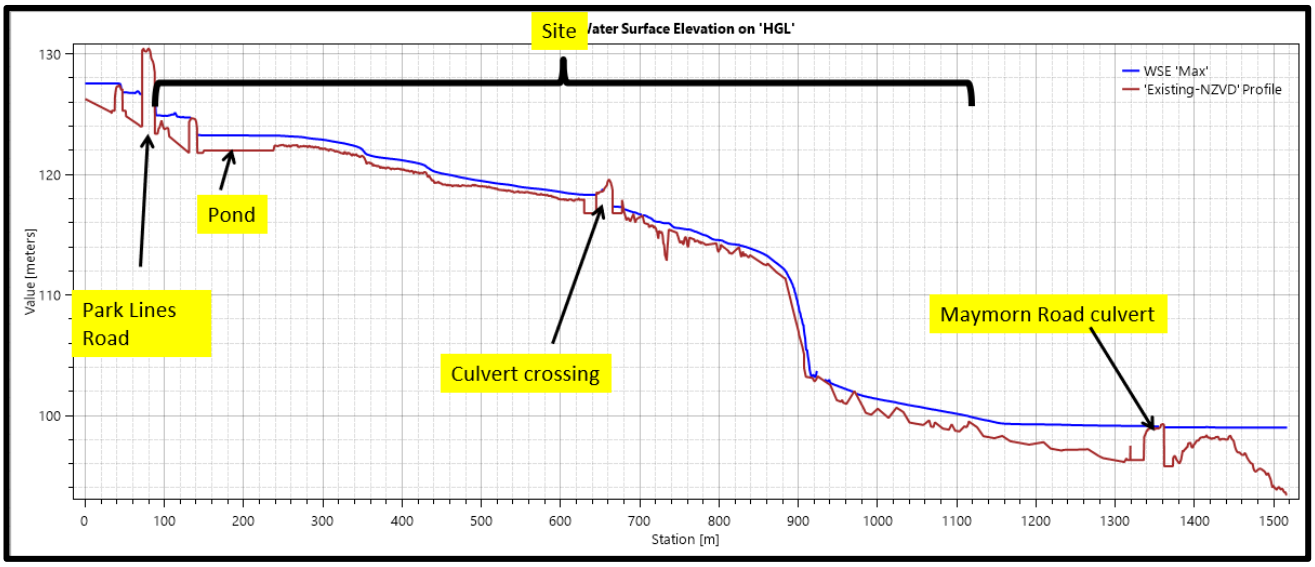
Figure 3.2 – Flood-map for 100-year and climate change



3.3 Hydraulic grade line

Figure 3.3 shows the HGL through the site and beyond. There are the obvious restrictions at culverts. The assumption of the downstream boundary should not affect the site flood levels as the pond forms just down stream of the site boundary.

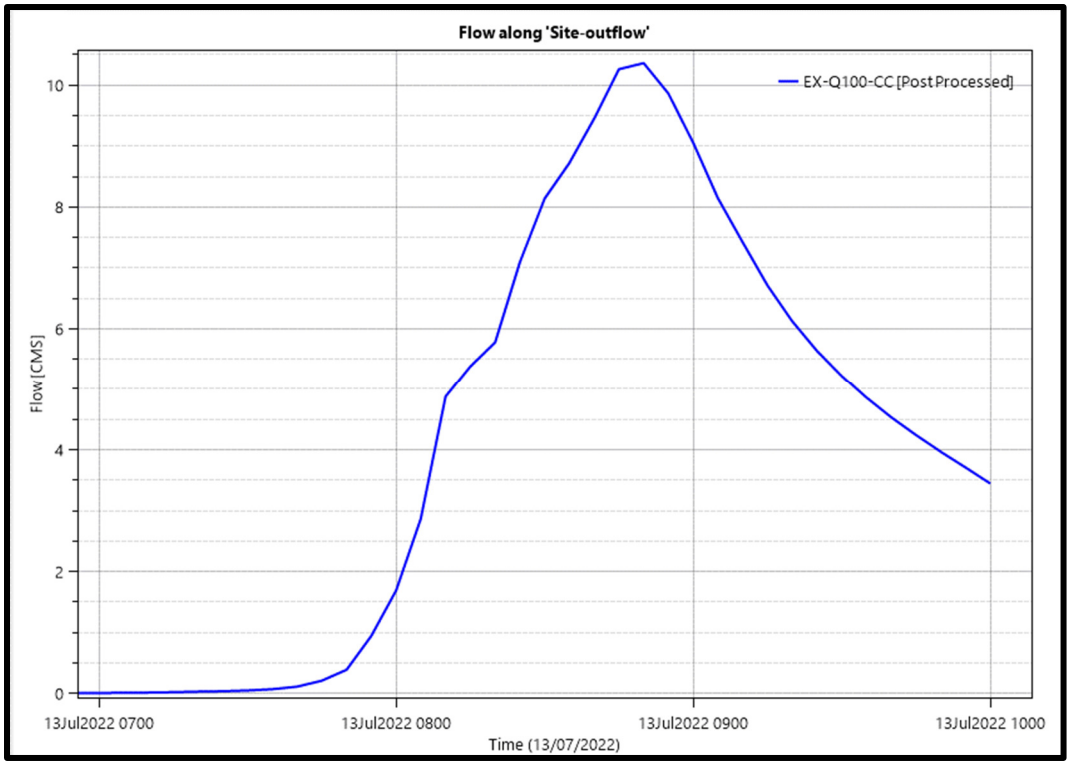
Figure 3.3 – HGL 100-year, climate change



3.4 Downstream flow hydrograph

Figure 3.4 show the flows hydrograph in the reserve at the site outlet. It's a reasonably smooth rise, peaking at 10.3m^3/s, 50 minutes after the rainfall peak.

Figure 3.4 – Flow hydrograph at site outlet, 100-year, climate change



4 IMPACT OF EARTHWORKS

4.1 New terrain

A new terrain was provided. It was meddled together with the existing terrain. Figure 4.1 shows the boundary.

Figure 4.1 – Outline of new earthworks in relation to lot boundaries

4.2 System upgrade

The model was tested until the solution ensured no neighbouring properties has increased

flood levels. This scenario assumes each Lot and the roads have on-site stormwater mitigation. Mitigation for the increased runoff from roads is proposed to be provided in the form of stormwater attenuation ponds. On lot mitigation will be required at the time of house construction on each
lot.

Figure 4.2 shows the 3 key modelled elements. The new culvert to the south needs to be 8m wide and 1.2m deep. The channel widening needs to be 4m wide at the base, side slopes of 1 in 3 so the top width is 20m. This allows for houses to be built near ground level for the required 500mm freeboard. The capacity of this channel is doubled. Alternative channel profiles are possible if they provide the same increase in channel capacity. For example, it is possible to retain the existing stream channel with a widening of the banks above the water level. Finally, the northern culvert upgrade needs to replace the existing with an 8m wide by 1m high box culvert.

Figure 4.2 – Three major design elements

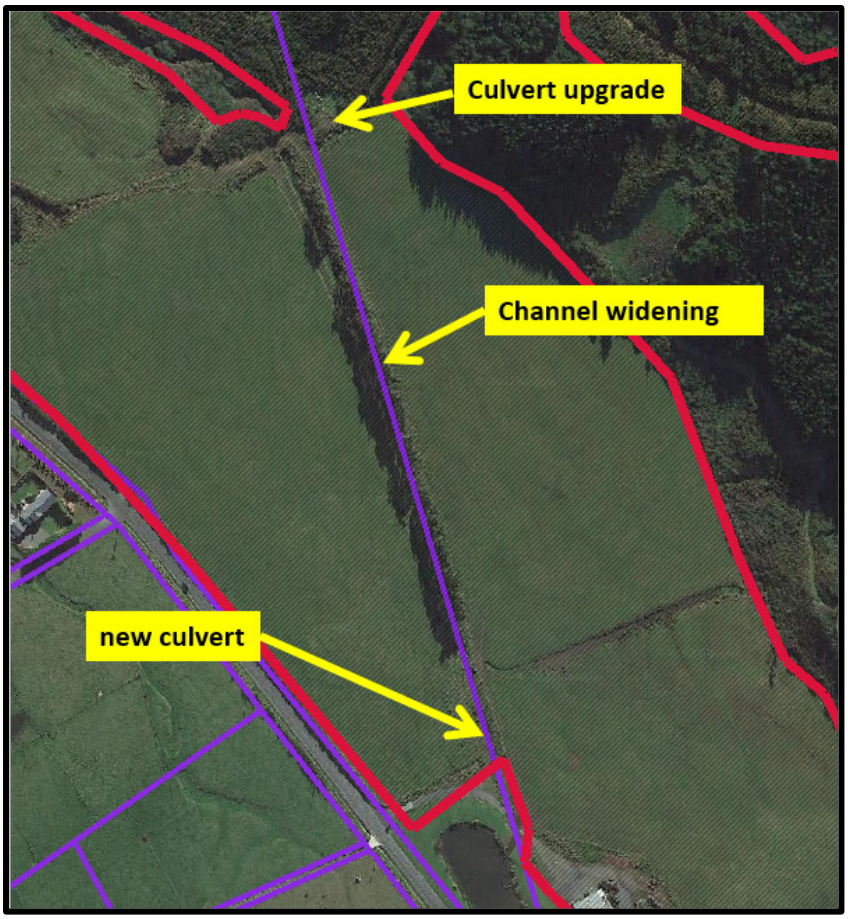


Figure 4.3 shows the floodplain for the new development. There are number of issues to resolve.

Locations labelled A: Flooding area because of the road low points. OLFPs may be required,

Location B: Overland flow channel engineered at the rear of Lots,

Location C: A new road should slope to new culverts because it's adding extra volume to Maymorn Road.

Figure 4.3 – New floodplain – 100yr climate change

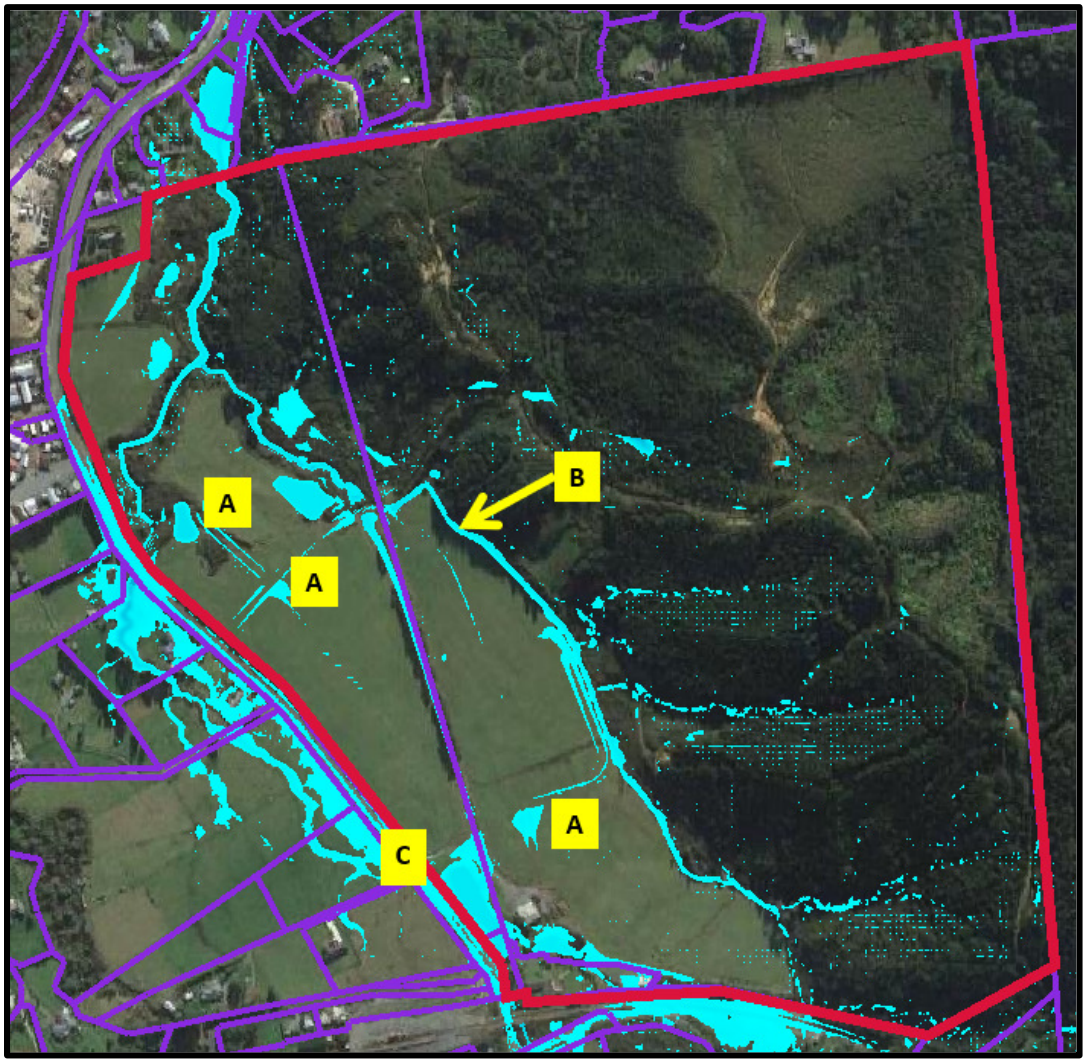
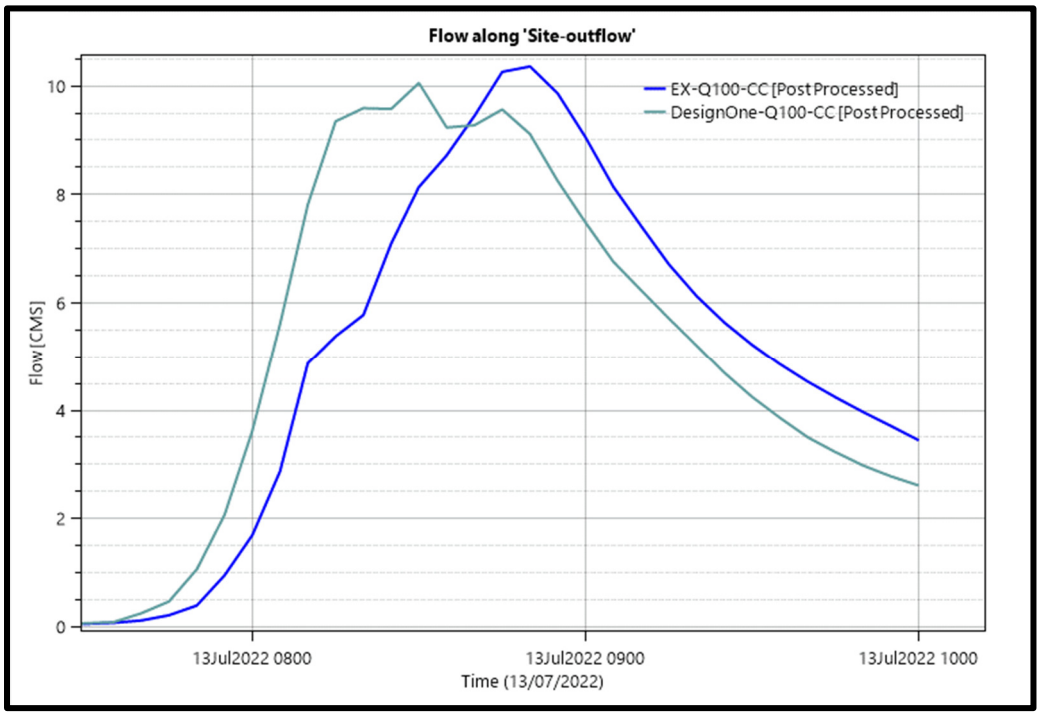


Figure 4.4 shows the flow hydrographs at the site outlet. The peak flows are very similar.

This means the new smoother surfaces have reduced the peak time by perhaps 20 minutes but the new storage in the system attenuates the flow.

Figure 4.4 – Flow hydrograph at the site outlet – 100yr climate change



5 POND DESIGN

A crude first cut analysis has been done to determine a pond size for the road and pavement areas.

Figure 5.1 gives the data. The 100-year storm was used as per the floodplain analysis. HEC-HMs was used, and ponds were used to mitigate the peak flows. A 300mm orifice was put at the base and a broad-crested weir 0.95m above the base.

Figure 5.1 – Catchment areas

North-east catchment		
Sealed	2969	m2
Kerb	266	m2
Footpath	1493	m2
Impermeable	4728	m2
Main catchment		
Sealed	19193	m2
Kerb	594	m2
Footpath	1722	m2
Impermeable	21509	m2

The north-east catchment requires a pond 30m long, 30m wide and 0.4m deep or a volume of about 331m^3.

The main catchment requires a pond 42m long, 42m wide and 1.1m deep or a volume of about 1900m^3.

This will mitigate the peak flow generated by the new surfaces.

6 SUMMARY

A floodplain analysis has been undertaken to determine the 100-year floodplain for Gabites Block in Maymorn Road, Marua.

The catchment has not been identified as a flood-prone area.

A terrain was extracted from the LINZ LiDAR data.

HEC-HMS was used to generate a rain-on-grid hyetograph for the defined catchment area. The rainfall was a 12-hour distribution with climate change enhancement.

HEC-RAS was used with a 6m x 6m grid to calculate flood levels. The channels were better defined using 2m break-lines.

As expected, flooding was identified in several locations with existing culverts too small to convey the 100-year flow.

A new terrain was input based on an indicative development layout with roads for overland flows.

Three upgrades were identified

- New culvert for a new road crossing, 8m wide by 1.2m high.
- The main channel in the centre of the subdivision to have double its existing capacity. It is 4m at the base and 20m at the top width with 1 in 3 side slopes. This ensure adjacent house can have the required freeboard on the proposed ground levels.
- Upgrade of culverts under the existing farm track but for a new road. This is 8m wide by 1m high.

With these upgrades the outlet flow from the site does not change and thus no neighbours downstream of the site are impacted.

Other issues identified were in terms of ponding at road junctions and because of high ground around lots. These can easily be mitigated.

Pond sizes has been estimated to mitigate the impacts of the roads and pavements, not the houses. The north-east requires a volume of 331m^3 while the main catchment needs 1900m3. The final size and depth will be determined by location.