



**WOODS**

# STORMWATER REPORT

**PROJECT** Middle Road – Fast-track Referral  
Application

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**W-REF** P25-496

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**FOR** CDL Land New Zealand Limited

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**DATE** 30/03/2026

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**STATUS** FINAL

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## Document Control

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<b>Client</b>	CDL Land New Zealand Limited
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## Statement of Qualifications & Experience

The following is a statement of the qualifications and experience of the experts involved in preparing this Report.

### Ricky Kiddle – Graduate Engineer, Wood & Partners Consultants Limited

I am a Graduate Water Engineer at Wood and Partners Consultants Ltd ("Woods"). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since February 2024.

I hold the qualifications of Bachelor of Engineering with Honours from Canterbury University, which I completed in 2023. I am an Engineering NZ emerging professional member. I have 2 years of professional experience in the water engineering field. My experience includes stormwater management, flood management, and stormwater modelling.

I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

### Sakti Gounder – Senior Associate, Wood & Partners Consultants Limited

I am a Senior Associate Engineer in the Water Infrastructure and Planning team at Woods. Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure and surveying. I have been employed at Woods since 2023.

I hold a Bachelor of Engineering degree from the University of Auckland, which I completed in 2010. I am a Chartered Professional Engineer (CPEng) and a member of Engineering New Zealand (CMEngNZ) and Water New Zealand.

I have over 16 years of experience in stormwater design, hydrodynamic modelling, flood risk assessments, water infrastructure and stormwater management for land development. I have been the principal author and lead stormwater engineer for a wide range of stormwater management plans and flood modelling reports to support Woods' land development, urban design and planning teams. I have been involved in and prepared numerous catchment scale flood models, detailed stormwater pipe models and integrated catchment management plans for private clients as well as for district and regional councils.

I confirm that, in my capacity as lead author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

### Andres Roa – Technical Director, Wood & Partners Consultants Limited

I am a General Manager Local Government and Technical Director at Wood & Partners Consultants Ltd (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since 2020.

I hold the qualifications of Bachelor of Engineering from the Pontificia Universidad Javeriana, Colombia, which I completed in 1994. I am a Chartered Professional Engineer and an International Practicing Engineer.



I have 30 years of experience in civil, infrastructure, and environmental engineering in New Zealand and internationally. I have provided technical advisory services to multiple regional and territorial authorities throughout New Zealand. I have also acted as an expert witness on a range of major infrastructure projects, including nationally significant developments such as Transmission Gully (Wellington), SH16 / Western Ring Route, Waterview Tunnel, Wynyard Quarter, State Highway 20 (Puhinui), AMETI (Phases 1 and 2), and the East-West Link motorway.

I confirm that, in my capacity as contributor of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

### **Brian Flood – Principal & Executive Director, Wood & Partners Consultants Limited**

I am a General Manager Major Projects Infrastructure, Principal Engineer and Director at Wood & Partners Consultants Ltd (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since 2003.

I hold the qualifications of Bachelor of Engineering from the University of Ulster, Ireland, which I completed in 1989. I am a Chartered Professional Engineer and a Fellow of the Institute of Professional Engineers New Zealand.

I have 35 years of professional experience in the Land Development and Infrastructure fields. My experience includes design, and coordination of Land Development and Infrastructure projects, typically acting as Engineer to the Contract under NZS3910 during the construction phase. I have been involved in a large range of projects from green field to brown field developments (both commercial and residential) small and large but primarily focused on residential subdivisions similar to this Application.

I confirm that, in my capacity as reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.



## 1.0 Introduction

This Stormwater Report has been prepared by Woods on behalf of CDL Land New Zealand Limited (CDL/the Applicant) in support of a Referral Application for the Middle Road Project under the Fast-track Approvals Act 2024 (FTAA). The project is for residential development at 92, 108, 148 Middle Road and 139 Te Aute Road in Havelock North and is referred to as the 'Middle Road' project.

The Middle Road project will provide for the residential subdivision of the site to enable the development of approximately 300 - 350 lots. The intended subdivision layout will provide for a range of lot sizes to enable conventional residential development along with medium density development opportunities. The indicative concept plan is included with the Referral Application material.

## 1.2 Purpose

This report has been prepared in support of the application by CDL for a Fast Track referral application.

The purpose of this report is to outline options for managing stormwater on site and demonstrate that stormwater can be adequately managed on site without creating effects upstream or downstream of the site.

The overarching objectives are as follows:

- Demonstrate that stormwater and flooding can be managed in accordance with the requirements of Hastings District Council (HDC) and Hawke's Bay Regional Council (HBRC);
- Incorporate a Water Sensitive Design (WSD) approach that manages the impact of land use change from rural to urban;
- Provide stormwater management standards for the proposed development and ensure stormwater runoff is to be conveyed in a safe manner to the receiving environment through the primary and secondary network;
- Provide appropriate treatment of runoff prior to discharge to the receiving environment through WSD practices;
- Identify flood risk areas and ensure development is outside of the 1% AEP floodplain without creating effects upstream or downstream of the site; and
- Understand mana whenua values and incorporate these values into the stormwater management approach for the development.

## 2.0 Description of Application Site

A full description of the site and surrounds is provided in the Planning Overview Report submitted as part of the Referral Application.

The application site is located at 92, 108, 148 Middle Road and 139 Te Aute Road in Havelock North (**site**). The site is held in eight separate titles and consists of a combined area of approximately 30.6 hectares. The site is relatively flat and currently used for rural residential purposes with five existing dwellings. **Figure 1** shows the location of the site within the context of Havelock North.



Figure 1: Site plan

A separate 3ha rural residential landholding at 80 and 84 Middle Road, known as the McKenna Block, is located immediately to the east of the site adjacent to the Herehere Stream (**Figure 1**). This landholding is in separate ownership and does not form part of the application site at the time of lodgement. However, given the McKenna Block's proximity and relationship to the Middle Road site, the landholding has been considered at a high level within this assessment.

## 2.1 Topography

The site has a gradual fall east to west towards Te Aute Road. The northern part of the site adjacent to the Herehere Stream is relatively flat, with little fall towards the western boundary (**Figure 2**).

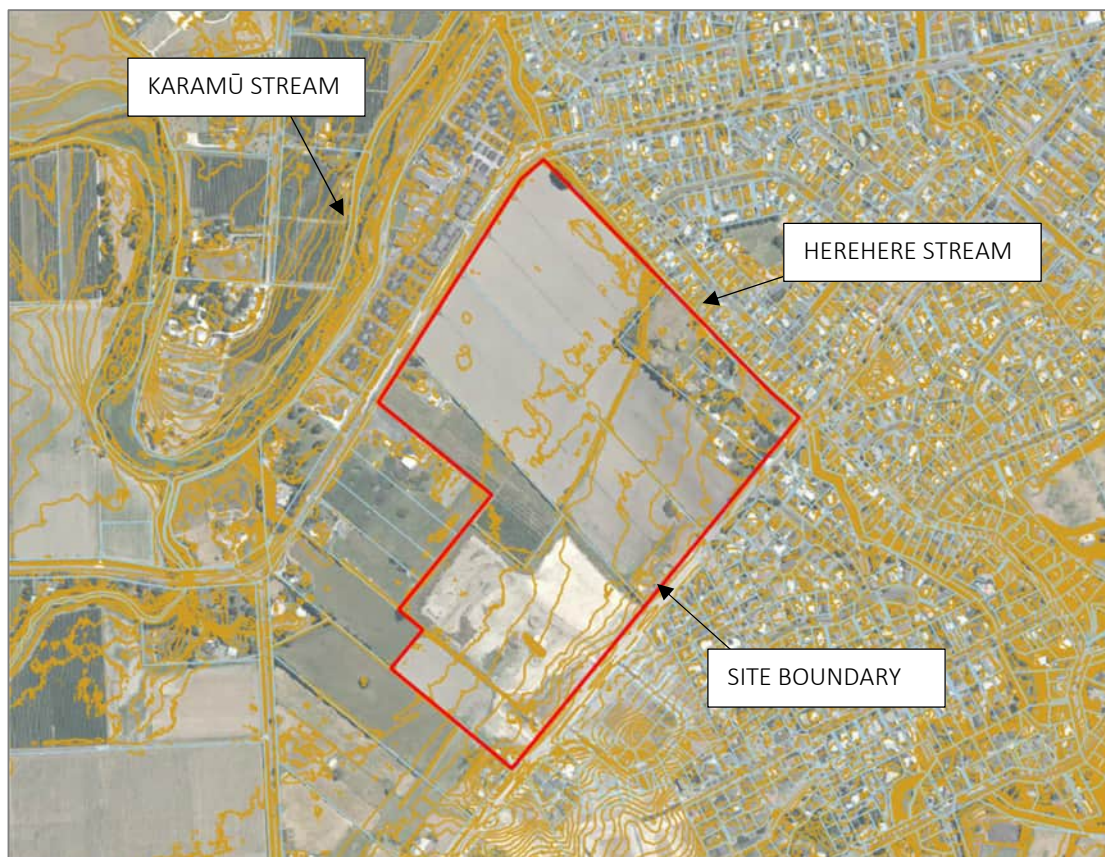


Figure 2: Existing topography (LiDAR 2024)

## 2.2 Geotechnical/Soil Conditions

Published drainage maps of the site obtained from S-maps indicate the site's drainage capacity. The soil underlying the site is poorly to imperfectly drained (**Figure 3**).



Figure 3: Soil drainage (source: S-maps)

A site-specific geotechnical investigation has been undertaken by CMW Geosciences which is appended to the referral application. This assessment has identified that the groundwater table is 1-3m below ground level across the site.

## 2.3 Existing Stormwater Network/Hydrological Features

There are several hydrological features in the vicinity of the site, which are discussed in the following subsections.

### 2.3.1 Land Drains

There are several land drains that run within the site (**Figure 4**), which are owned and maintained by HBRC.

The Pomeroy and Bake drains pass through the site and discharge to the Herehere Stream along the northern property boundary. A portion of the Bake drain alignment passes through the McKenna Block. There is an existing culvert along the Bake drain that discharges to the Herehere Stream

The Gilpin drains receive and convey flows from the following areas:

- The consented Iona basin, within the site boundaries, which services the Iona development south of Middle Road; and
- Existing sites to the south of the development, which include part of 147 Te Aute Road, 167 Te Aute Road and part of 169 Te Aute Road.

The Gilpin drain discharges directly to the Karamū Stream. There is an existing culvert under Te Aute Road prior to discharge to the Karamū Stream.

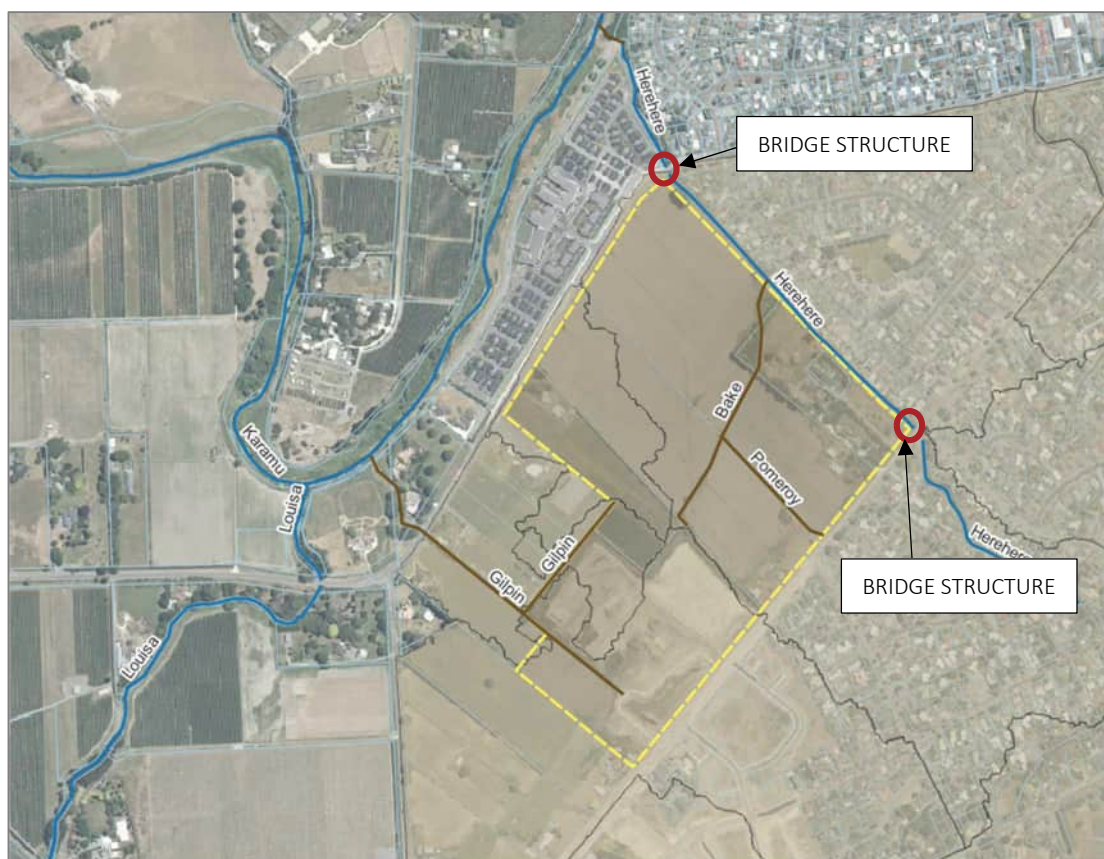


Figure 4: Land drains (brown) and streams (blue) (source: HBRC GIS)

### 2.3.2 Streams

Several streams are positioned in the vicinity of the site. The Herehere Stream (owned and maintained by HDC) runs along the northern boundary of the site, which discharges to the Karamū River to the north. There is an existing bridge under Te Aute Road along the Herehere Stream alignment.

The Karamū Stream runs to the east and is separated from the site by Te Aute Road and other private properties. The section of Herehere Stream to the north of the Te Aute Road bridge, outside of the site boundaries, is managed by HBRC.

It is noted that following erosion that occurred during Cyclone Gabrielle in 2023, HBRC undertook bank stabilisation works in this section of the stream, including the installation of gabion baskets and the application of shotcrete to protect and stabilise the stream banks.

HDC have commissioned a Stream Erosion review for Havelock North, which has identified observed stream erosion risk in the Herehere Stream (Figure 5).



Figure 5: Observed stream erosion risk (Karanema Havelock North Streams Erosion Review 2025; WSP)

The identified areas along the Herehere Stream are localised to upstream of where the Bake drain currently discharges adjacent to the McKenna Block. The erosion risk has been classified as moderate to high.

The HDC published velocity bands for the Herehere Stream show no difference in bands for the 2% and 1% AEP events. These have been pictured in **Figure 6**. The bands show that significant stretches of the Herehere Stream are subject to velocities greater than 2m/s in these events.



Figure 6: Velocity bands for the 2% and 1% AEP storm events (source: HDC landowner tools and guides)

### 2.3.3 Existing Piped Network

The existing pipe network obtained from the HDC Open Data Portal is shown in **Figure 7** below. Although the network was not directly modelled, flows entering the development area via the existing pipe network are represented in the model as a time-series flow hydrograph applied as a point inflow. Further details on this approach are provided in Section 6.2.3.

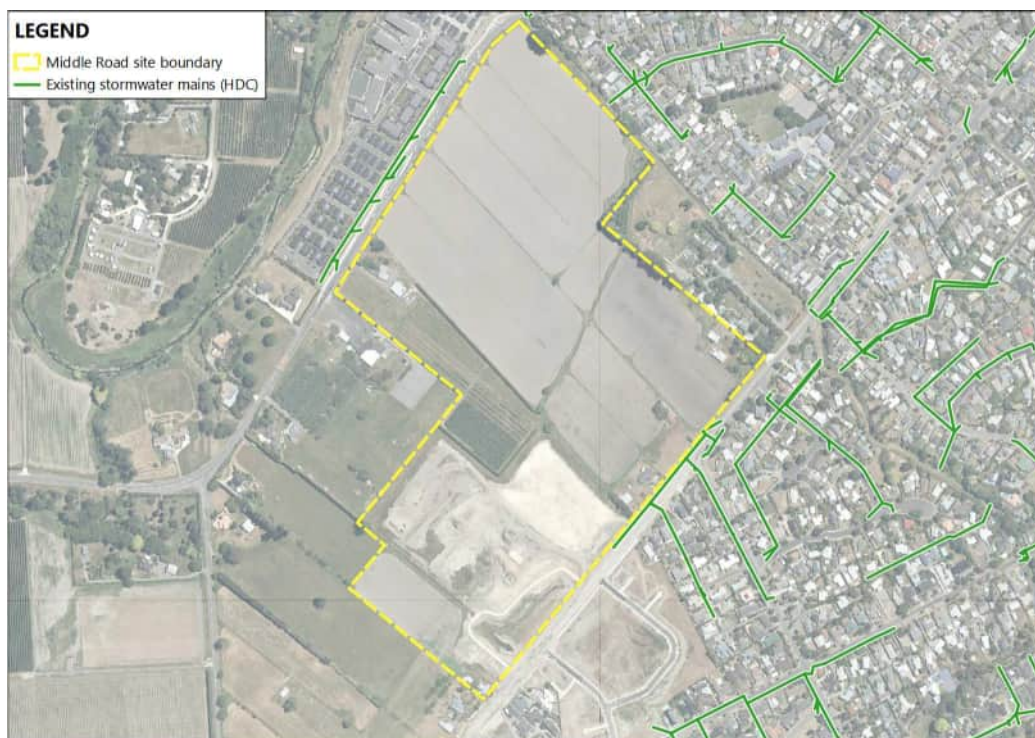


Figure 7. Existing pipe network (HDC, Open Data Portal)

It is understood that HDC currently hold a global discharge consent for the urban stormwater network. The Middle Road development is not covered by this discharge consent, and a new privately held discharge consent will be sought by CDL from HBRC.

### 2.3.4 Floodplains

The HBRC Hazard Portal has published flood risk areas on the Hawke's Bay Hazard Portal. The published maps have corresponding depths across the site, which align with the land drains and streams along the site.

2% AEP flood levels have been quantified as follows:

- Within the Bake and Pomeroy - 8.80mRL;
- Within the Gilpin drains - 8.30mRL;
- Within the Karamū Stream – 6.90mRL.

Flood levels within the Herehere Stream have been quantified at 9.80mRL for an unknown return period.

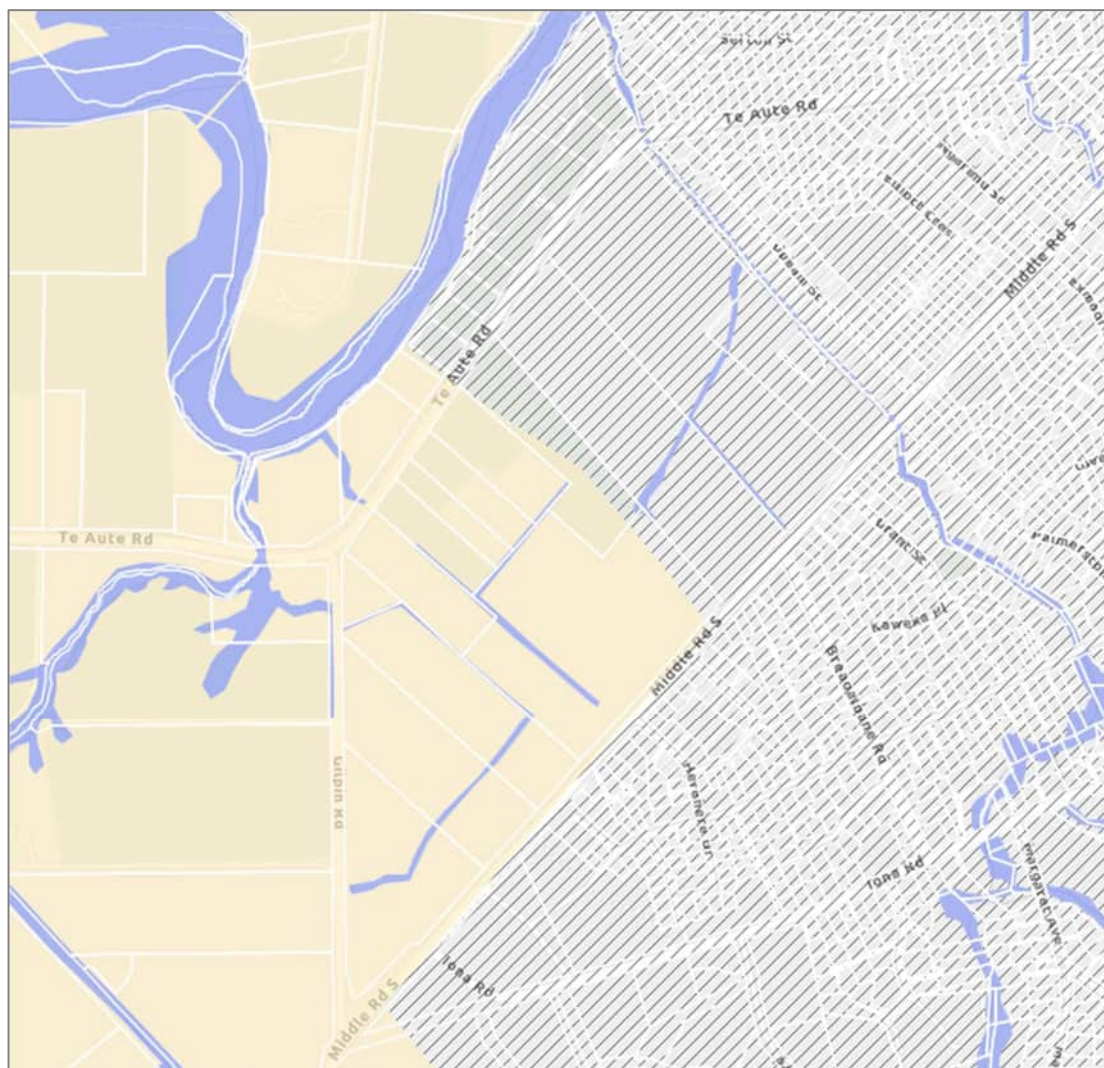


Figure 8: Flooding -2% AEP (source: HBRC Hazards Portal)

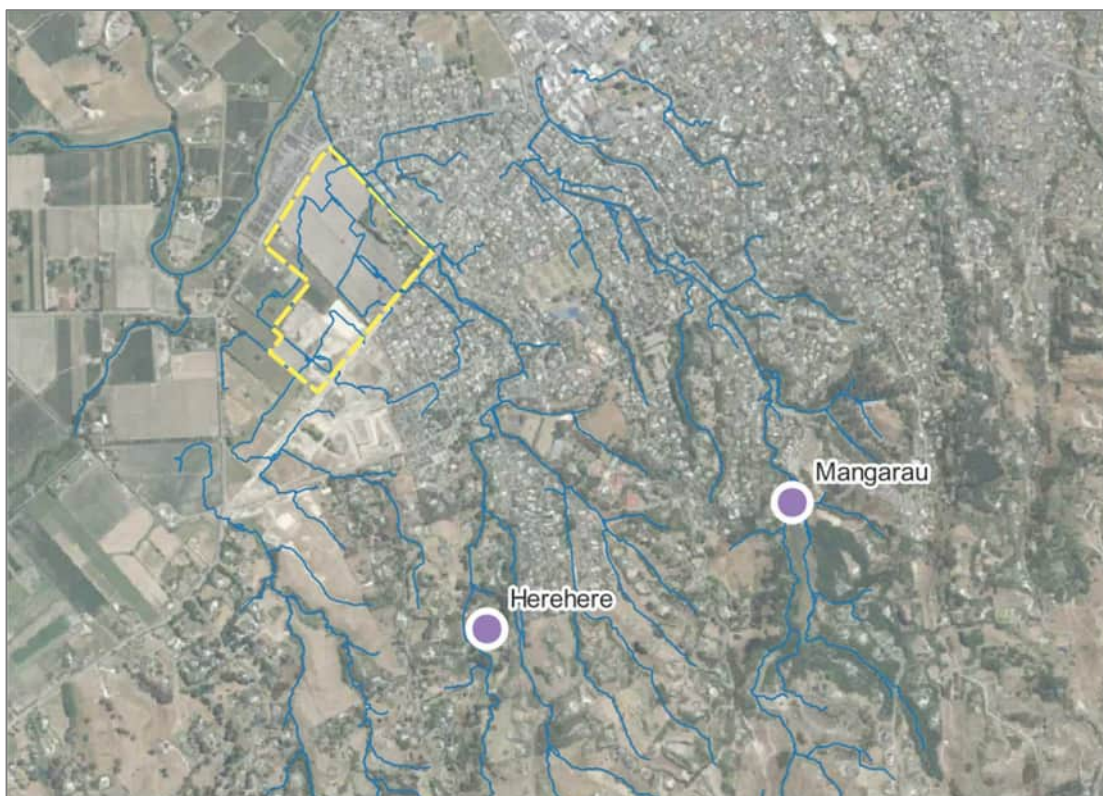
It is noted that part of the site draining to the Pomeroy and Bake drains have been identified as not being within a flood risk study area and part of the site draining to the Gilpin drains are within a low-risk area.

Outside of the site, HDC have noted that flooding on Upham Street is a known issue and can be attributed to the Herehere Stream. Further, it is HDC's understanding that the Bake drain is affected by tailwater conditions in the Herehere Stream and is a source of erosion in smaller storm events. HDC further noted that the tailwater conditions abated closer to the Te Aute bridge and suggested this might be a more appropriate location for a future discharge point rather than the existing outlet via the Bake drain.

Woods have undertaken flood modelling to quantify flood risk at the site, which is discussed in Section 6.

### 2.3.5 Dams

Two dams have been identified upstream of the site, which may impact the development (Figure 9).



**Figure 9: Dam locations**

The HBRC Hazard Portal shows the ponding areas and hazard zones for both dams (**Figure 10**).

**Figure 10** shows zones at risk of damage from water that might cascade down in the event of a dam failure. These failures have been modelled by HBRC and show that the site is not at risk of inundation in the event of a dam failure. Flows from the Herehere dam are contained within the portion of the Herehere Stream that runs along the northern boundary.

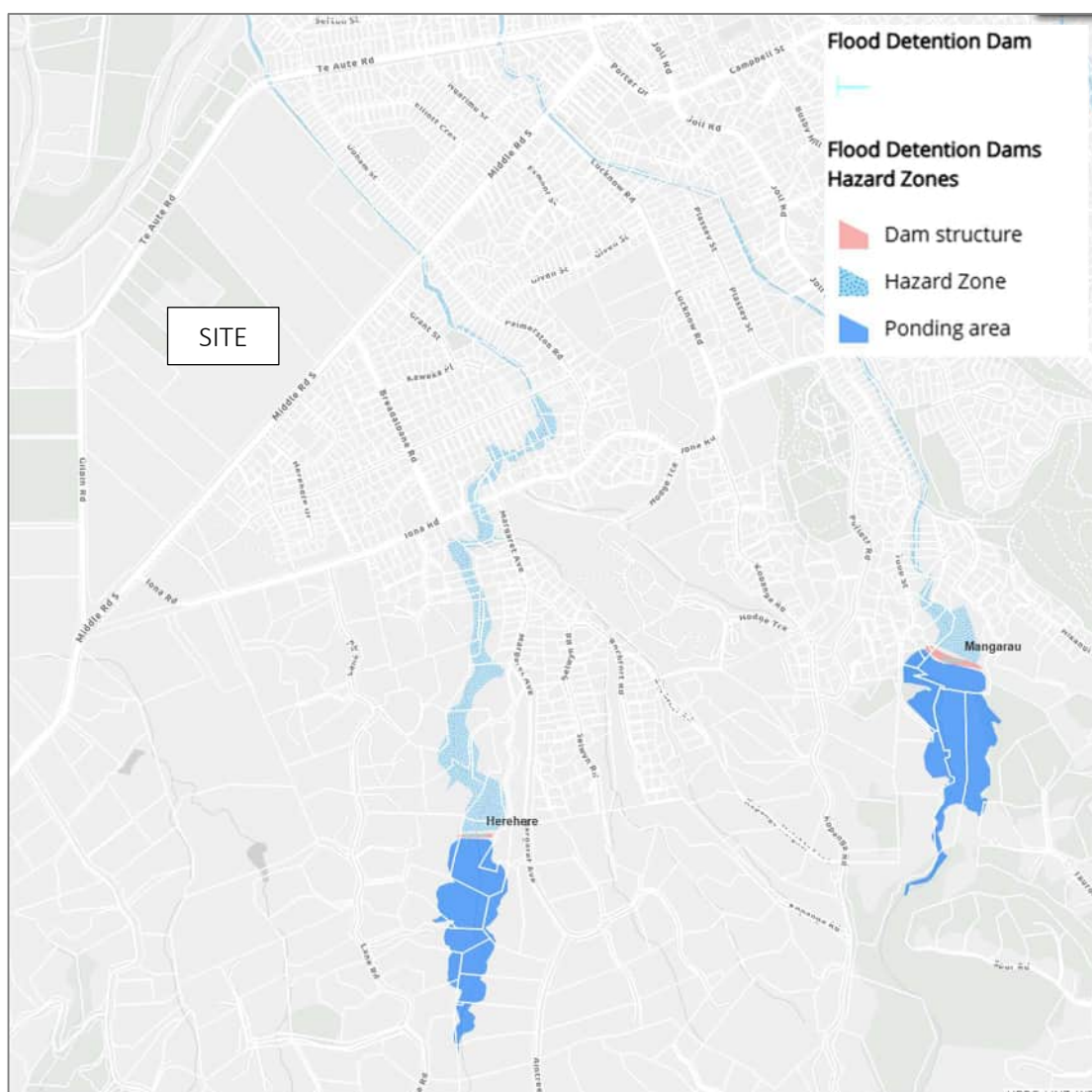


Figure 10: Dam ponding areas and hazard zones

### 2.3.6 Upstream Development

CDL have consented for development to occur upstream of the site as part of the Iona Structure Plan. A stormwater management device, which services the upstream development, is located within the site extent (**Figure 11**) and discharges to the Gilpin drain. This device provides attenuation for Stages 1A, 1B and Stapleford Park in the Iona Development.

The device has been consented for and constructed within the site (consent reference RMA20220188). Design drawings have been provided by CDL for the spillway from the device.



Figure 11: Iona pond

The intention is that both service outlet and emergency flows from the Iona pond will be conveyed through the development to discharge to the Gilpin drain as per the consented arrangements.

### 3.0 Development Summary and Planning Context

A review of the relevant stormwater guidelines and policies has been undertaken to formulate the stormwater management strategy for the site. These are summarised in **Table 1**.

Table 1: Guidance summary

Guidance Document	Summary	Relevance
Hastings District Council – Engineering Code of Practice (2020)	Sets out HDC expectations for developers to ensure RMA and District Plan requirements are met.	Yes – provides guidance for subdivision and land development.
Hastings District Council – IntraMaps HDC	Provides information on stormwater infrastructure, including pipe network and land drains within the district.	Yes – provides information on infrastructure.
Hawke’s Bay Regional Council – Waterway Guidelines Stormwater Management (2009)	Provides an outline of HBRC’s approach to stormwater management at a catchment scale and the design of stormwater management devices.	Yes – provides guidance on water quality and quantity devices.



Guidance Document	Summary	Relevance
<b>Hawke’s Bay Regional Council – Waterway Guidelines Low Impact Design (2009)</b>	Provides an alternative approach to site design and development for stormwater management.	Yes – provides guidance on mitigating effects of developments to avoid, remedy or mitigate environmental effects.
<b>Hawke’s Bay Regional Council – TANK Plan Change</b>	Provisions in managing the land and waterways of the Tūtaekuri, Ahuriri, Ngaruroro and Karamū (TANK) catchments	Yes – provides objectives for managing water quality and quantity within the Karamū catchment.
<b>Hawke’s Bay Regional Council – Hazard Portal</b>	Provides information on flood hazard risks associated with rainfall events or dam break scenarios.	Yes – provides an understanding on the level of risk
<b>National Policy Statement for Freshwater Management 2020 (amended 2025) (NPS-FM)</b>	Tool for managing and improving conditions of New Zealand’s freshwater and coastal systems.	Yes – outlines strategic objectives to be considered.
<b>National Environmental Standards – Freshwater 2020 (amended 2025)</b>	Provides a set of regulations under the RMA to control activities that could harm freshwater and freshwater ecosystems in New Zealand.	Yes – outlines standards that the development must meet prior to discharge into rivers, streams and wetlands.
<b>National Policy Statement – Natural Hazards 2025</b>	Provides national direction under the RMA for assessing and managing natural hazard risk in land use, subdivision and development.	Yes – outlines how development will manage natural hazard risks, including the effects of climate change.

## 4.0 Proposed Development

The Middle Road project will provide for the residential subdivision of the site to enable the development of approximately 300 to 350 lots. The intended subdivision layout will provide for a range of lot sizes to enable conventional residential development along with medium density development opportunities.

The development will be supported by integrated three-waters and transport infrastructure and an open space network. A planning framework is proposed to guide future residential development. A full description of the Middle Road Project is provided in the Planning Overview Report submitted as part of the Referral Application.

An indicative concept plan has been prepared to inform the referral application and is provided as **Figure 12**. The assessment has considered the potential extension of the Middle Road development across the adjoining McKenna Block (McKenna Block Extension shown as opaque area on **Figure 12**), however the focus of the assessment has been on enabling development on CDL landholdings.



Figure 12. Indicative Concept Plan (including McKenna Block), 19/03/2026 (Urban Acumen)



With respect to matters relating to stormwater management, further aspects of the stormwater strategy for the Middle Road development are provided in the following sections of this Report:

- Stormwater Management – 5.0
- Flood Modelling – 6.0

These sections are to be read in conjunction with the supporting technical assessments including the Infrastructure Report appended to the Planning Overview Report.

## 5.0 Proposed Stormwater Management

This section discusses the intended stormwater management strategy for the site based on the indicative concept plan. The strategy has been developed to meet the objectives and design requirements of HDC and HBRC and seeks to:

- Manage and mitigate existing flood risk on the site.
- Develop a set of best practicable options (BPO) for stormwater that can be incorporated into the development.
- Prioritise a water sensitive design approach that:
  - Manages the impact of land use changes.
  - Retains natural landform and hydrological processes, as much as practicable, to reduce stormwater quantity related impacts upstream and downstream of the development site.
  - Minimizes or mitigates adverse effects on water quality, stream health and ecological values of the receiving environment through stormwater management devices.
  - Avoids exacerbating existing erosion/changes to stream geomorphology in the Herehere Stream.
  - Addresses mana whenua values.
- Minimise the generation and discharge of contaminants/sediments into a sensitive receiving environment, including changes in temperature.
- Facilitate urban development and protect key infrastructure, people and the environment.
- Consider climate change in the design of stormwater infrastructure and management devices per HDC guidelines.

The Middle Road Project is proposed to be split into two catchment areas based on the discharge locations of the land drains within the site. These areas have been split into Zone 1 (discharge to the Herehere Stream) and Zone 2 (discharge to the Karamū Stream via the Gilpin Drains). The McKenna Block extension has not been included within the Zone 1 catchment for the purposes of this assessment; however, the conclusions of this report remain applicable regardless of whether this landholding forms part of the future development area.

A preliminary surface has been generated to reflect the concept plan, which changes the post development catchment configuration in comparison to the existing scenario. The revised post development boundaries are shown in **Figure 13**. Additional details are in subsequent sections of this report.



It is important to note that the stormwater management approach described in this report is indicative only and based on the current conceptual masterplan. Detailed stormwater design, including the final configuration and sizing of stormwater devices, will be undertaken as part of the future substantive application. The assessments and descriptions provided in the following sections therefore represent a conceptual servicing approach intended to demonstrate that the site can be appropriately serviced for stormwater management and that suitable stormwater management solutions are available to support the proposed development.

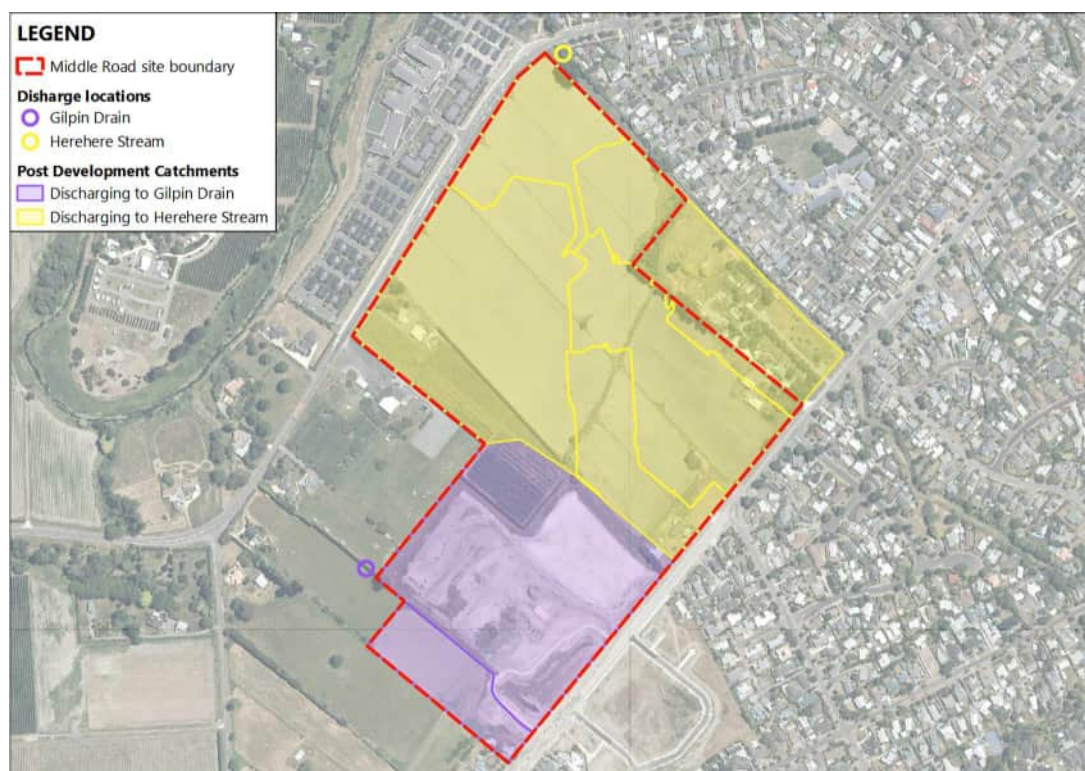


Figure 13. Revised proposed development catchment boundaries

## 5.2 Water Quality Management

HDC guidelines currently do not require any water quality treatment to be provided for stormwater runoff being discharged to its network. We understand from early engagement with Mana Whenua that the stream network is a sensitive environment and water quality treatment is intended to be provided through water sensitive devices or through proprietary treatment devices.

The indicative water quality approach is that devices will be selected to provide 75% TSS removal through nature-based devices (NbS) (where practical) using a treatment train approach, in addition to the proposed dry passive detention basin which will address water quantity management (refer Section 5.3 below). The water quality treatment devices will be further identified as part of a substantive application and will be selected based on treating contaminants of concern.

Consultation with HBRC raised the issue of temperature as a contaminant of concern for the Herehere Stream catchment. Temperature effects will be mitigated using green



infrastructure/NbS devices, which will encourage cooling of runoff through drainage into vegetated media.

Wetlands have not been specifically pursued as an option at this stage on the basis that summer months in the region are dry and the elements contributing to basin performance (planting and standing water) could possibly be compromised between storm events. However, other NbS devices such as swales, filter strips and/or raingardens will be considered as part of the substantive design.

### 5.3 Water Quantity Management

Stormwater for the development can be managed in dry basins that are designed for the following:

- Extended detention to address stream erosion risk in the Herehere Stream;
- Attenuation to pre-development peak flow rates for the 2- and 10-year storm events; and
- Maintaining the floodplain storage offered by the sites bounded by Te Aute, Middle and Gilpin Road to avoid effects on properties outside of the development boundaries.

Stormwater within the northern part of the site currently discharges to the Herehere Stream via the Bake and Pomeroy drains. Stormwater within the southern part of the site discharges to the Karamū Stream via the Gilpin Drains.

The following landform modifications are proposed within the development boundaries:

- The removal of most of the Bake drain (except for the portion that runs within the McKenna Block) and the Pomeroy drain;
- Stormwater will be conveyed through the (primary) network to discharge to stormwater management basins prior to discharge to the Herehere Stream; and
- The flood management strategy for the referral has explored an outlet into the Herehere closer to the Te Aute Road bridge where tailwater conditions in the Herehere Stream are unlikely to create any backwater effects and is located away from existing erosion hotspots.
- The tributary of the Gilpin Drain within the development boundaries will be removed and a section of the Gilpin drain that conveys flows between Middle Road to Te Aute Road will be modified to convey runoff from the Iona pond to its existing discharge point. No changes to the Gilpin drain are proposed outside of the development extent.

All basins within the development are designed to temporarily store runoff, attenuate peak flows and control discharge to the receiving environment. The basins have been sized so that post development peak flow rates do not create effects on third party land. This has been demonstrated through flood modelling.

## 6.0 Flood Modelling

Preliminary flood modelling has been undertaken using the XPSWMM version 2024.2 software.



The flood modelling has been carried out with Hawkes Bay 2000 projection and makes use of New Zealand Vertical Datum 2016 (NZVD16).

## 6.1 Hydrological Model

**Table 2**

Table 2 states the input parameters used to model the hydrological aspects of the flood models.

Table 2. Input parameters

Attribute	Value
CN (Pervious)	61
CN (Impervious)	98
Ia (Pervious)	5 mm
Ia (Impervious)	0 mm
Slope calculation	Equal-Area Method
Tc method	TP108 method (minimum of 10 minutes)

The sub catchment delineation for the pre- and post-development model scenario differs around the development site areas because of the proposed design. The sub catchment delineation outside the Middle Road development extent has remained unchanged.

**Figure 14** and **Figure 15** show the sub catchments delineation around the site area for pre- and post-development model scenarios.

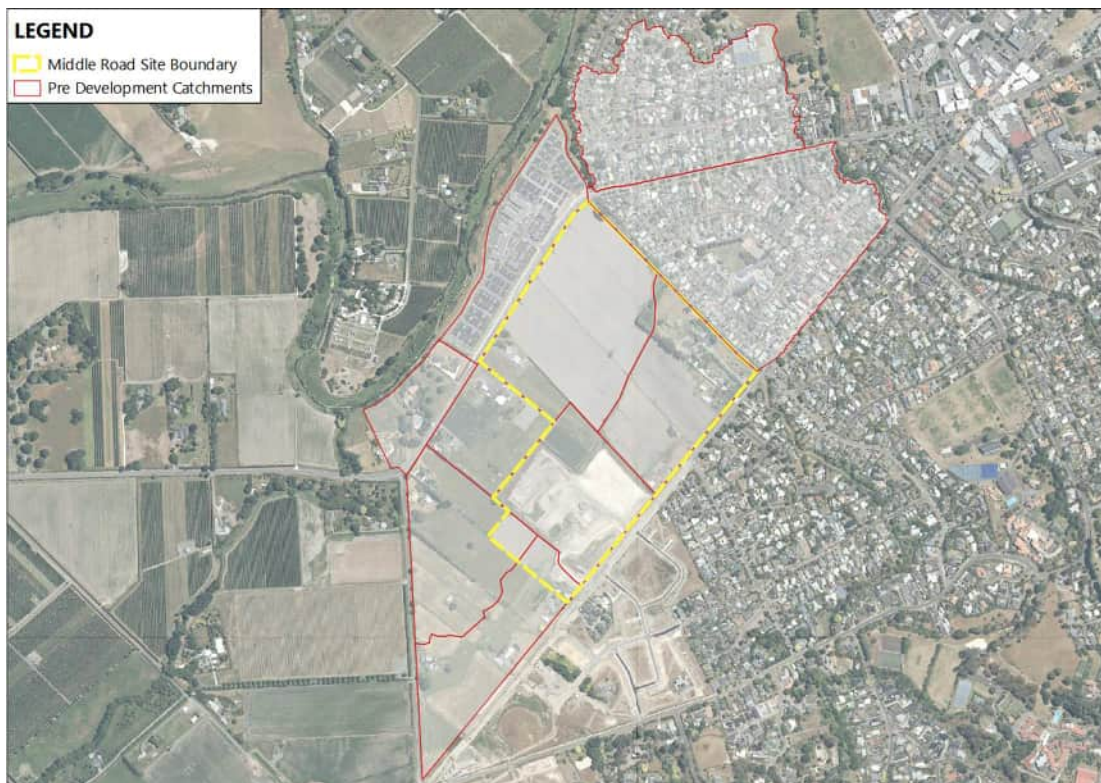


Figure 14. Pre-development catchment delineation

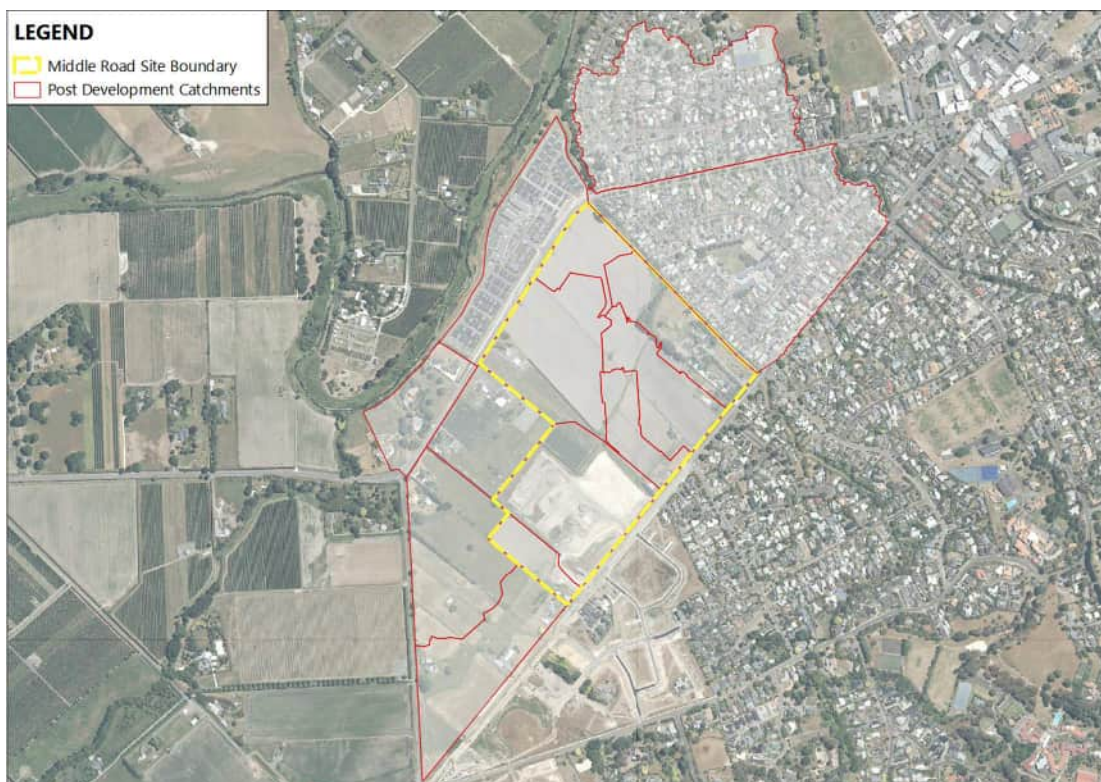


Figure 15. Post development catchment delineation



## 6.1.2 Land use

Impervious coverages within the development extent are as shown in **Table 3**. These coverages are indicative for referral only. The lots have been conservatively assumed to be 70% in the model to allow for resilient design of the basins.

Table 3. Impervious coverage by land use

Land use	Impervious coverage
Basin	100%
Roads	90%
Lots	70%
McKenna Block	13% (calculated based on existing coverage)
Reserve Area	0%

## 6.2 Hydraulic Model

This section describes the 1D and 2D model parameters used in the flood model.

### 6.2.1 1D Elements

The pre- and post-development models include three existing stormwater culverts which are currently in place along Gilpin Road and Te Aute Road, near the development area. **Figure 16** shows the culvert locations as well as their respective dimensions.

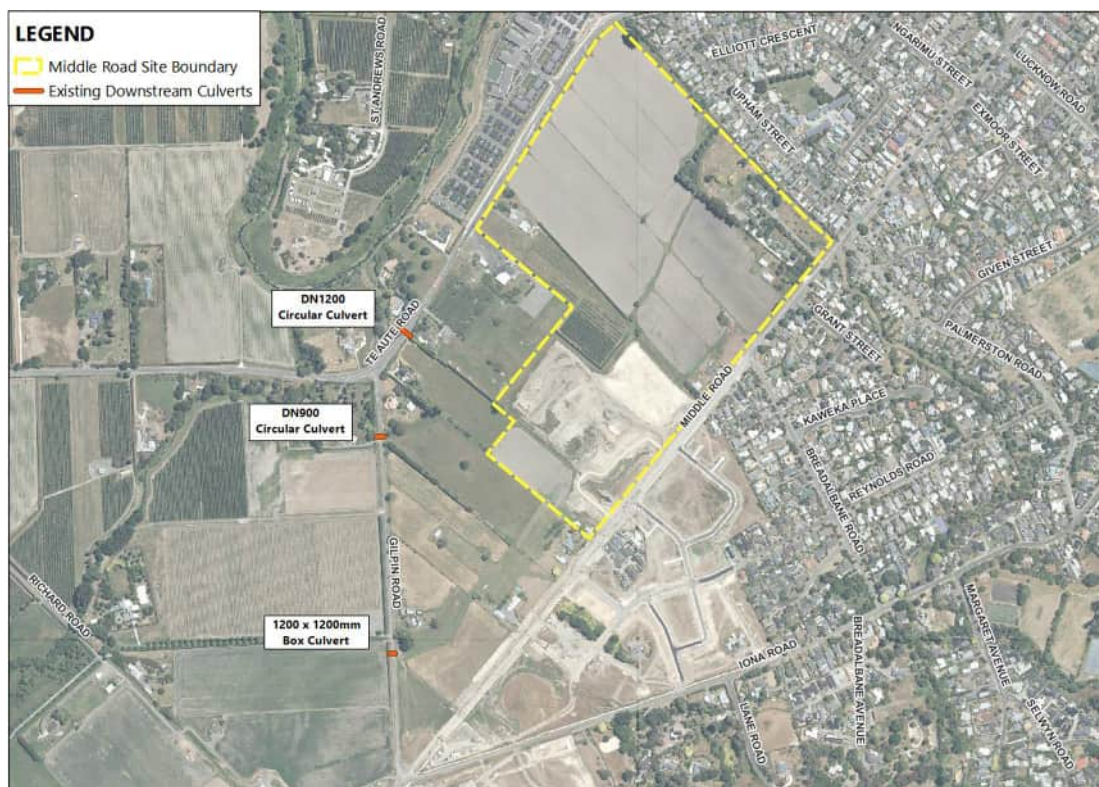


Figure 16. Modelled existing downstream culverts

The 1D parameters for the modelled culverts incorporate energy and friction losses. These are mentioned below:

- Entrance loss coefficient of 0.3
- Exit loss coefficient of 0.5
- Friction losses (manning's 'n' value) of 0.014

## 6.2.2 2D Elements

The pre-development model scenario includes a surface developed using topo survey data collected by Woods and LiDAR 2024 to represent the existing topographical conditions. The post development model scenario further includes the proposed landform design for the Middle Road development. **Figure 17** shows the different topography datasets extents used to create the flood model surface.

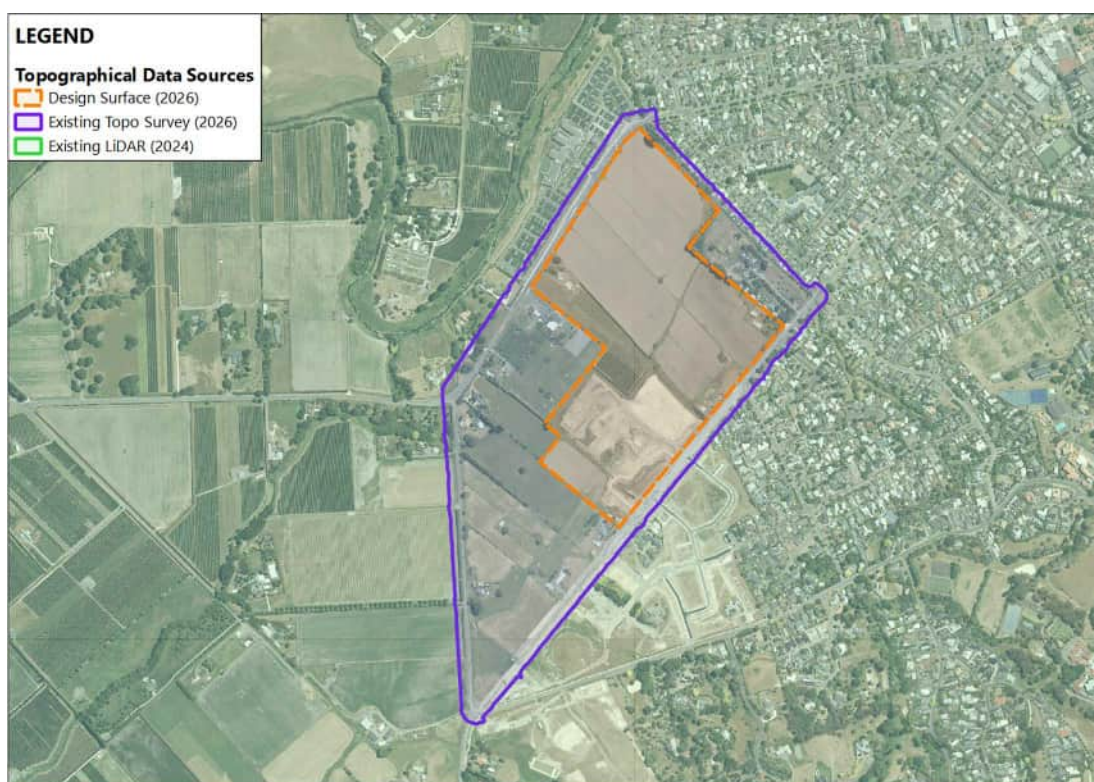


Figure 17. Topo survey extents

### 6.2.2.2 2D model losses

2D model parameters for the losses as an effect of runoff traversing overland are as follows:

- A manning's 'n' value of 0.02 has been used to represent losses from roads and lots.
- A value of 0.03 has been used to represent losses through the Karamū stream bed
- A value of 0.06 has been used to represent losses through the Karamū stream banks
- A value of 0.08 has been used to represent losses for all remaining modelled areas.

## 6.2.3 Boundary Conditions

Inflow boundary conditions supplied by HDC were incorporated into the model as flow hydrograph time series to represent upstream contributions to the site. The hydrographs

were generated by HDC using rainfall depths for the 100-year RCP6 storm events previously provided by Woods.

The inflows were applied as point loadings and line loadings. Two-point inflows representing the upstream 1D pipe network were applied directly using the hydrographs supplied by HDC. The 2D overland flows entering from the Middle Road corridor were represented as line loadings.

HDC initially provided 2D inflows at 17 locations along Middle Road. For modelling, these were consolidated into six 2D inflow lines aligned with the primary overland flow paths entering the site.

Inflows from northern properties adjacent to the Herehere Stream were not clearly identifiable in the information provided. Therefore, Woods delineated and modelled upstream catchments in this area to represent these flows for the 100-year event. **Figure 18** shows the locations of the boundary conditions included in the model.



**Figure 18. Modelled inflow boundary condition locations – point and line loadings (Proposed development)**

Boundary conditions for the Karamū Stream were applied to represent existing water levels and allow flow conveyance through the model domain. An initial water level (IWL) of 7.9mRL (NZVD2016) was adopted for the 1% AEP event, interpolated from the 50-year water level identified in the Hawke's Bay Hazard Portal.

Free outfall boundary conditions were applied at the upstream and downstream extents of the model grid along the Karamū Stream. This approach is considered conservative and has been adopted in the absence of any published 1% AEP flood levels from HBRC's flood modelling. **Figure 19** shows the locations of the 2D head boundaries included in the model.

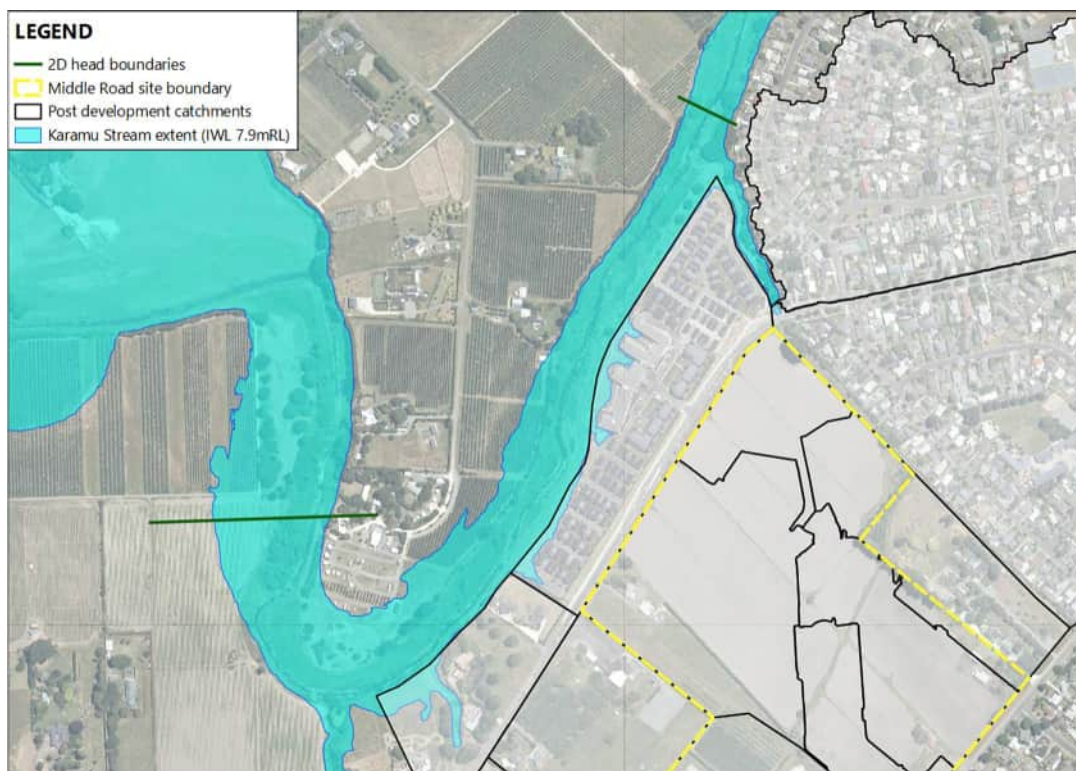


Figure 19. 2D head boundary extent

### 6.3 Modelled Scenarios

The pre-development model scenario reflects the existing conditions. The model scenario has been developed to provide a baseline guide which is used to assess if the proposed development will result in adverse flood effects outside the site.

The post development model scenario represents the changes proposed within the Middle Road development extent. The model results of the post development scenario have been used to evaluate the proposed design and assess if there are any flood effects that may result from proposed development. **Table 4** provides a brief description of the assumptions and the parameters used to develop the model scenarios.

Table 4. Model scenarios

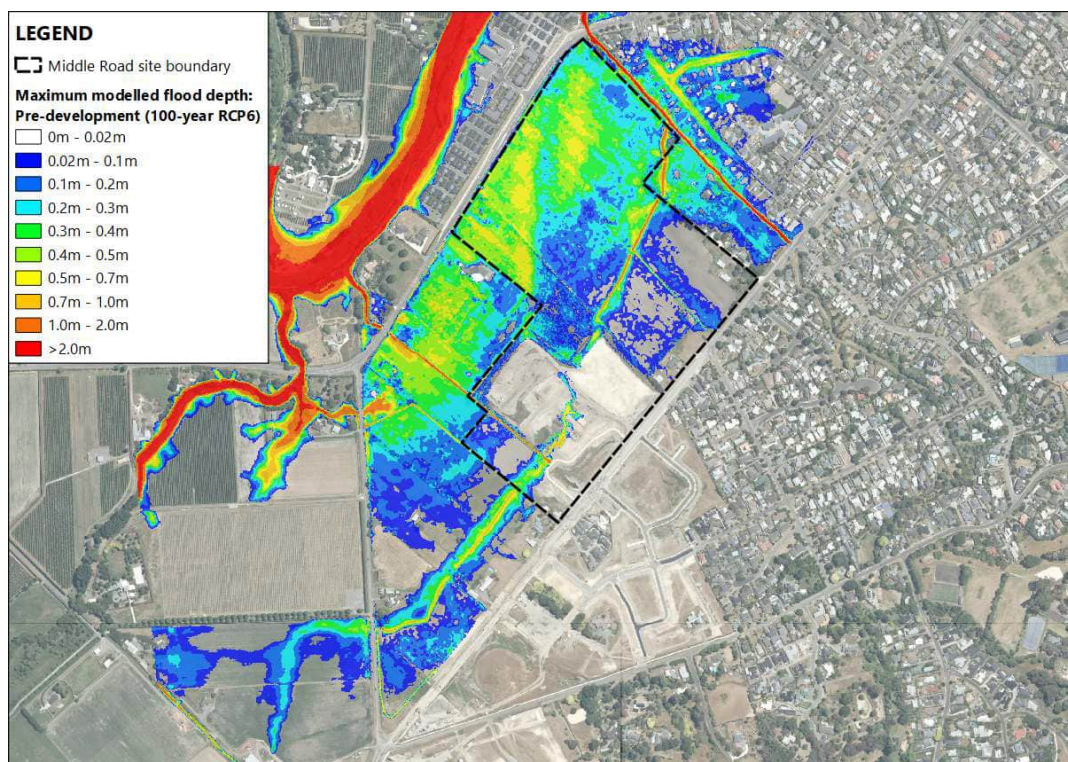
Scenario	Landform	Storm event	Climate change
Pre-development	Existing surface (2024 LiDAR + 2026 Topo survey)	100-year	RCP6 (2081-2100)
Post development	Design surface within development extent + existing surface (2024 LiDAR + 2026 Topo survey)	100-year	RCP6 (2081-2100)

## 6.4 Model Results

Maximum model results were extracted from the flood models. The extracted models have been further processed to create difference plots (afflux plots) to investigate any flooding effects resulting from the proposed development.

### 6.4.1 Pre-Development Model Scenario

**Figure 20** shows the maximum modelled flood depth for the pre-development model scenario during a 100-year ARI storm event (with allowance for RCP6 future climate change). These depths have been filtered for depths less than 20mm, which is within modelling tolerances.



**Figure 20.** Pre-development 100-year ARI RCP6 Max Depth

The model results in **Figure 20** show the existing flood plain extents within and in the vicinity of the development. Of note is the flooding to the north of Herehere Stream, localised to Upham Street and private properties to the south of the development, bound by Middle Road, Te Aute Road and Gilpin Road.

Plans showing the pre-development depths and water level extents are included in **Appendix 1**.

### 6.4.2 Post Development Model Scenario

**Figure 21** shows the maximum modelled flood depth for the post development model scenario during a 100-year storm event (with allowance for RCP6 future climate change). These depths have been filtered for depths less than 20mm, which is within modelling tolerances.

Plans showing the post development depths and water level extents are included in **Appendix 1**.

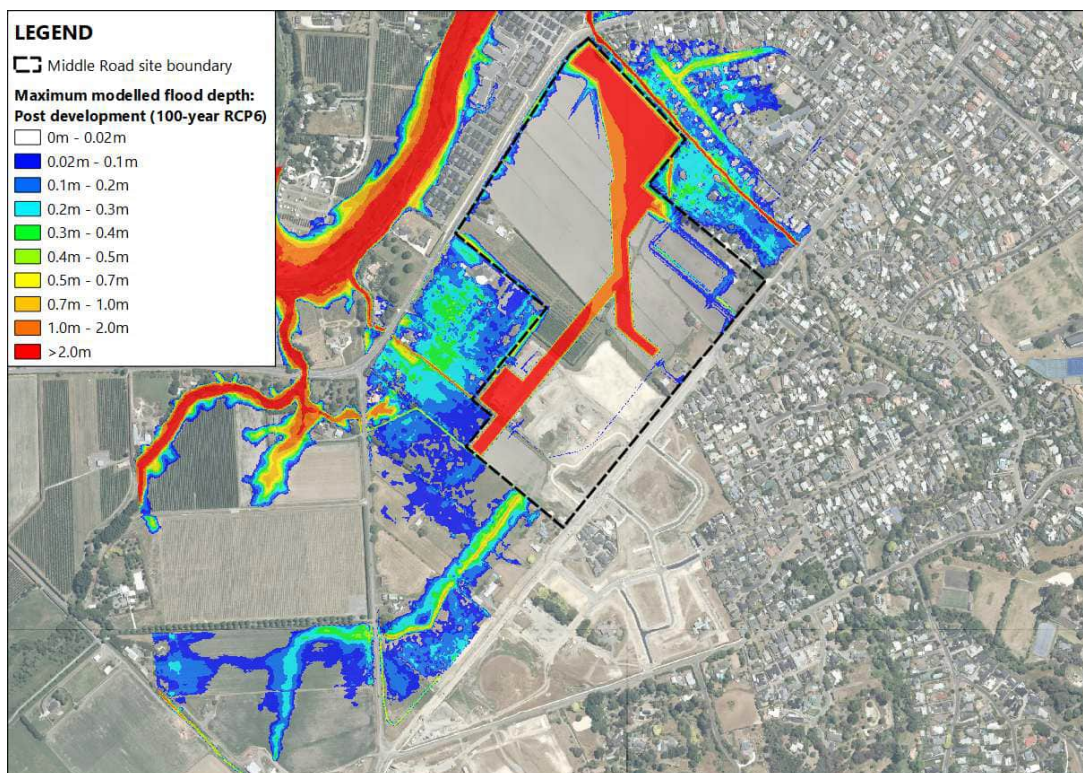


Figure 21. Post development 100-year ARI RCP6 Max Depth

### 6.4.3 Flood Effects Assessment

Figure 22 shows the maximum modelled flood depth difference between the pre-development and post development model scenarios i.e. post-development flood levels minus pre-development flood levels, with negative values indicating a net reduction (and positive values showing a net increase) in post-development flood depths relative to pre-development flood depth conditions.

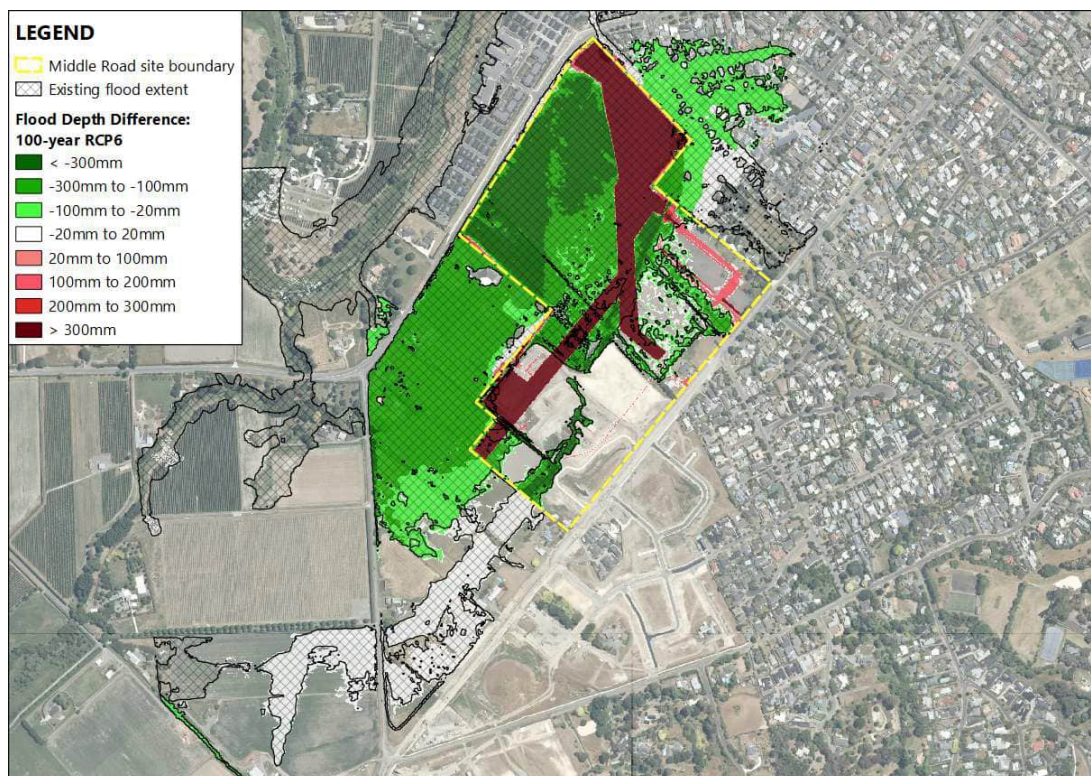


Figure 22. Post development minus pre-development flood levels (100-year RCP6)

The flood depth difference plot shows the following:

- A reduction in flood depths within the development as a result of runoff being directed to the basins;
- Reductions in flood depths outside the development boundaries as a result of runoff being directed to the dry basins;
- Minor increases less than 20mm outside of the development extent directly adjacent to Zone 2. These increases are localised to within the pre-development floodplain extents and can be designed out as part of the substantive application; and
- No changes to flooding on properties north of the Herehere Stream (Upham Street).

The quantified changes in water levels outside the development is considered minor and within modelling tolerances.

## 7.0 Opportunities/Recommendations

There is an opportunity for the development to find synergy with HDC's management strategy for the Herehere Stream. There is bed and bank erosion noted along the stream, with mitigation works having been undertaken north of the Te Aute Road bridge (outside the site boundary) following Cyclone Gabrielle.

The current flood modelling has assumed an outlet closer to the Te Aute Road bridge, which aligns with HDC's understanding of water levels in the Herehere Stream. Stream management responses aligning with stormwater management outcomes can be explored at the substantive application stage and could include the following:



- Channel widening to reduce erosive flow velocity;
- Revised location for the discharge outlet;
- Planting that aligns with the recommendations in HDC's Stream Bank Remediation Guide and Stream Planting Guide; and
- Nature based solutions where possible to avoid reliance on hard infrastructure within the development itself and on the true left bank of the stream.

In addition to the matters outlined above, several key principles and recommendations have been identified in this report to guide the detailed stormwater design at the substantive application stage. These matters will assist in refining the final design response and ensuring appropriate outcomes for water quantity, water quality and the receiving environment. The following principles will be considered as part of the future detailed design process:

- Confirm the final stormwater management layout and device sizing through detailed design.
- Consider a treatment train approach using nature based solutions where practicable to achieve 75% TSS removal prior to discharge.
- Undertake an erosion assessment on the Herehere Stream and provide extended detention to manage stream velocity and erosion risk.
- Confirm impervious surface assumptions as part of detailed design.
- Attenuate flows to pre-development peak flows for the 2- and 10-year events.
- Ensure development does not create unacceptable flood effects beyond the site.
- Nature-based stream management responses.

Overall, the above recommendations provide a framework to guide the detailed stormwater design at the substantive application stage. When implemented through the future design process, these measures will ensure that stormwater from the Middle Road development can be appropriately managed while supporting positive outcomes for the site and receiving environments.

## 8.0 Conclusion

This report has been drafted to inform a Fast-track Referral application for CDL's landholdings at Middle Road. The stormwater management strategy outlined in this report follows a water sensitive design philosophy which uses nature-based solutions to manage stormwater and is aligned with National Policy Statements and Standards, as well as guidance documents from HBRC and HDC.

Water quality treatment for contaminants generated by residential developments will be provided within the development. Contaminants of concern includes hydrocarbons and increases in runoff temperature resulting from intensification.

Consultation with HDC has identified that the Herehere Stream is at risk of erosion. It is noted that following Cyclone Gabrielle, bank stabilisation works were undertaken at the Te Aute Road bridge outside of the site boundary.

An erosion assessment will be undertaken of the Herehere Stream as part of the substantive application to quantify, through modelling, what the existing velocity profile is during smaller storm events. This modelling will inform appropriate extended detention and other interventions to prevent erosion in the Herehere stream.




The modelling undertaken to inform the Fast-track Referral has demonstrated that the 1% AEP (+ climate change) runoff and flooding associated with the Middle Road development can be appropriately managed on site in a manner that is consistent with the requirements and objectives of HDC and HBRC. The flood depth difference plot shows no effects outside of the development extent.

Overall, while the site is subject to known flood constraints, these can be effectively managed through the proposed integrated stormwater approach. The strategy avoids off site adverse effects and supports the suitability of the site for urban development, with ongoing collaboration with stakeholders to refine outcomes through detailed design at the substantive stage.












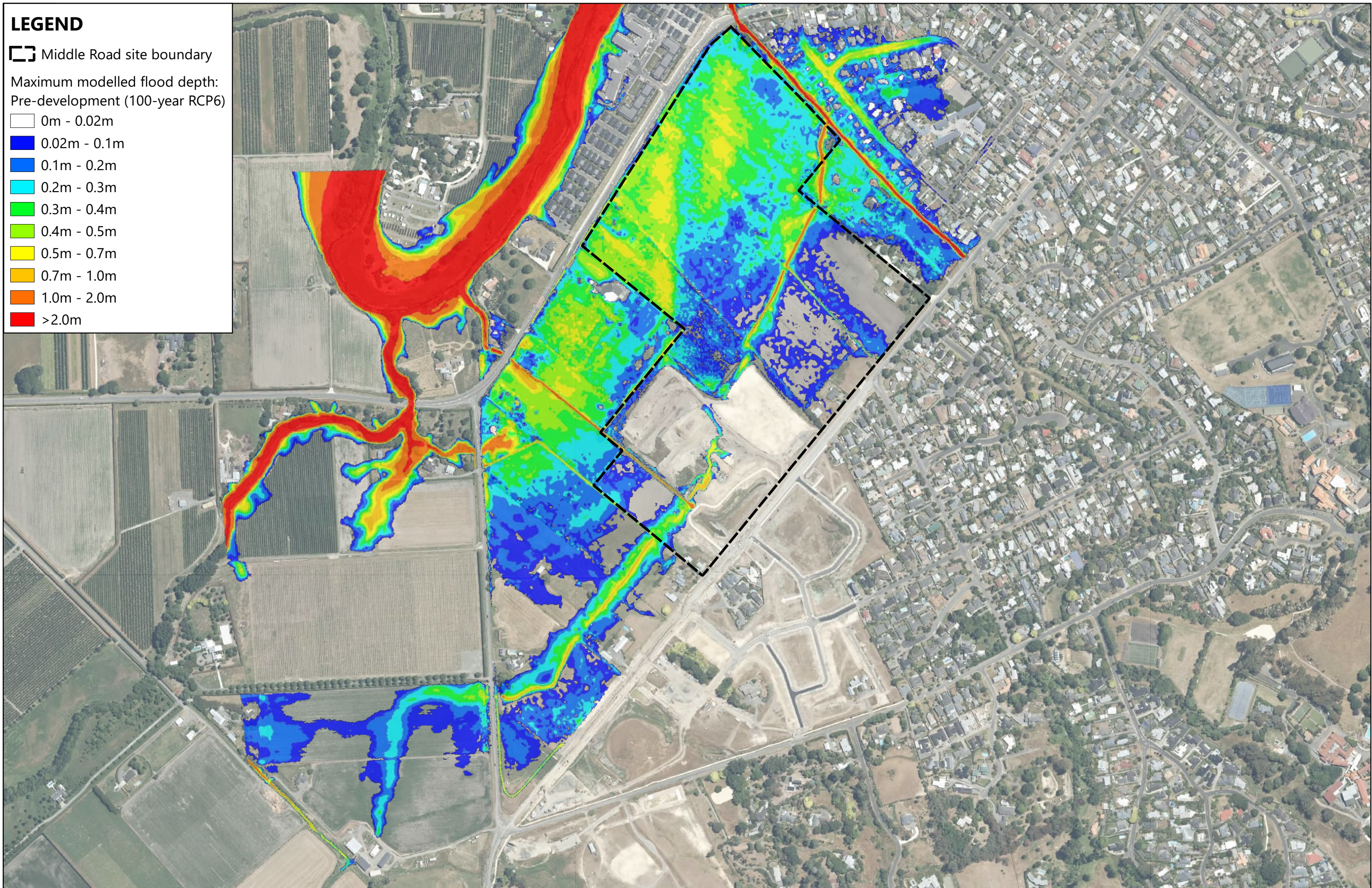
# APPENDIX 1: FLOOD MAPS

# LEGEND

 Middle Road site boundary

Maximum modelled flood depth:  
Pre-development (100-year RCP6)

-  0m - 0.02m
-  0.02m - 0.1m
-  0.1m - 0.2m
-  0.2m - 0.3m
-  0.3m - 0.4m
-  0.4m - 0.5m
-  0.5m - 0.7m
-  0.7m - 1.0m
-  1.0m - 2.0m
-  >2.0m



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	26/03/2026	DESIGNED	-
-	-	-	-	DRAWN	RK
-	-	-	-	CHECKED	SG
-	-	-	-	APPROVED	SG

8 NUGENT STREET,  
GRAFTON,  
AUCKLAND














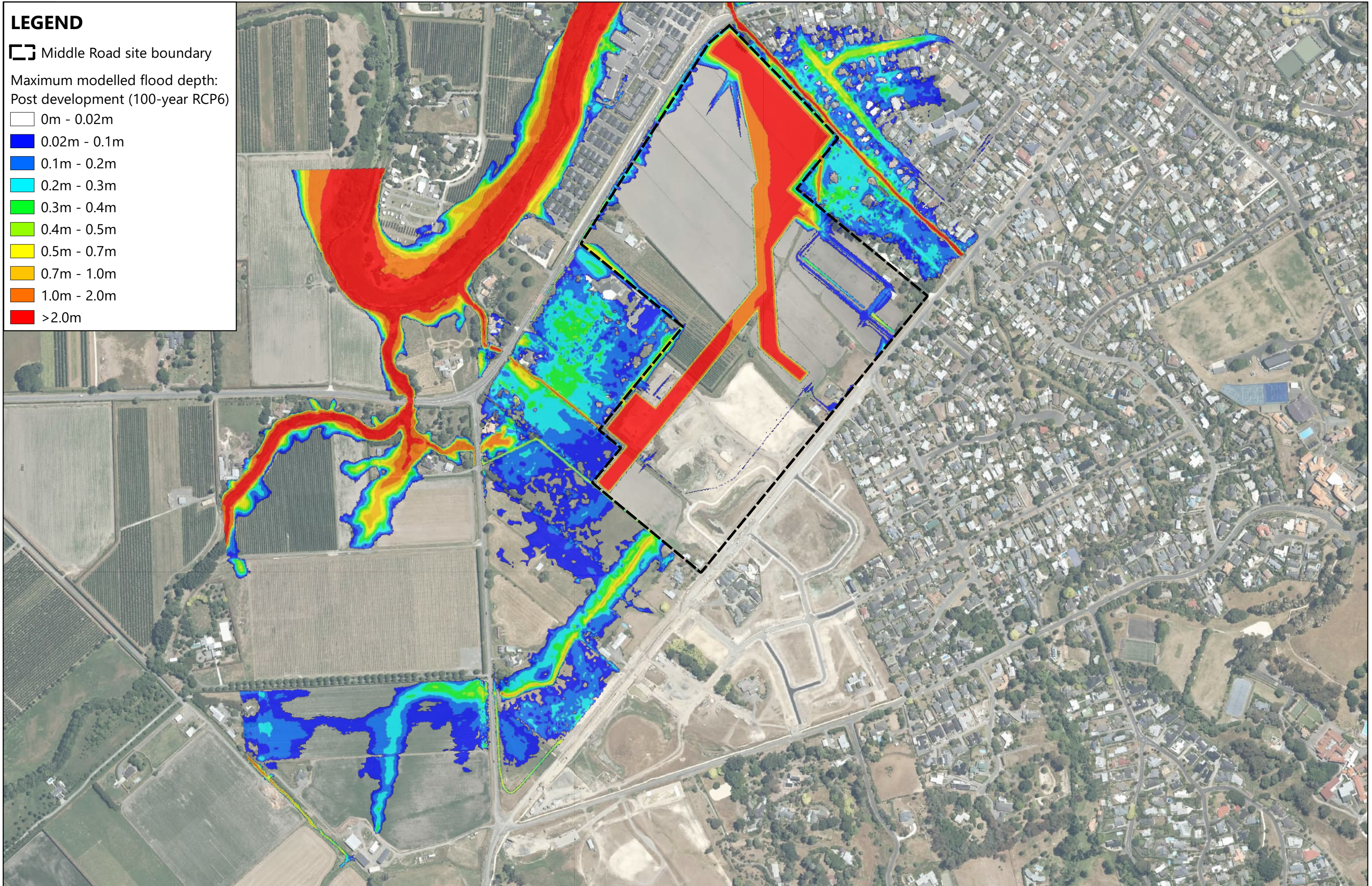
P25-496 - MIDDLE RD  
MAXIMUM MODELLED FLOOD DEPTH:  
PRE DEVELOPMENT  
100-YEAR WITH ALLOWANCE FOR RCP 6.0



STATUS	ISSUED FOR INFORMATION	REV
SCALE	NTS	2.0
COUNCIL	HDC	
SHEET	SHEET 1 OF 3	

# LEGEND

-  Middle Road site boundary
- Maximum modelled flood depth:  
Post development (100-year RCP6)
-  0m - 0.02m
-  0.02m - 0.1m
-  0.1m - 0.2m
-  0.2m - 0.3m
-  0.3m - 0.4m
-  0.4m - 0.5m
-  0.5m - 0.7m
-  0.7m - 1.0m
-  1.0m - 2.0m
-  >2.0m



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	26/03/2026	DESIGNED	-
-	-	-	-	DRAWN	RK
-	-	-	-	CHECKED	SG
-	-	-	-	APPROVED	SG

8 NUGENT STREET,  
GRAFTON,  
AUCKLAND





P25-496 - MIDDLE RD  
MAXIMUM MODELLED FLOOD DEPTH:  
POST DEVELOPMENT  
100-YEAR WITH ALLOWANCE FOR RCP 6.0



STATUS	ISSUED FOR INFORMATION	REV
SCALE	NTS	2.0
COUNCIL	HDC	
SHEET	SHEET 2 OF 3	

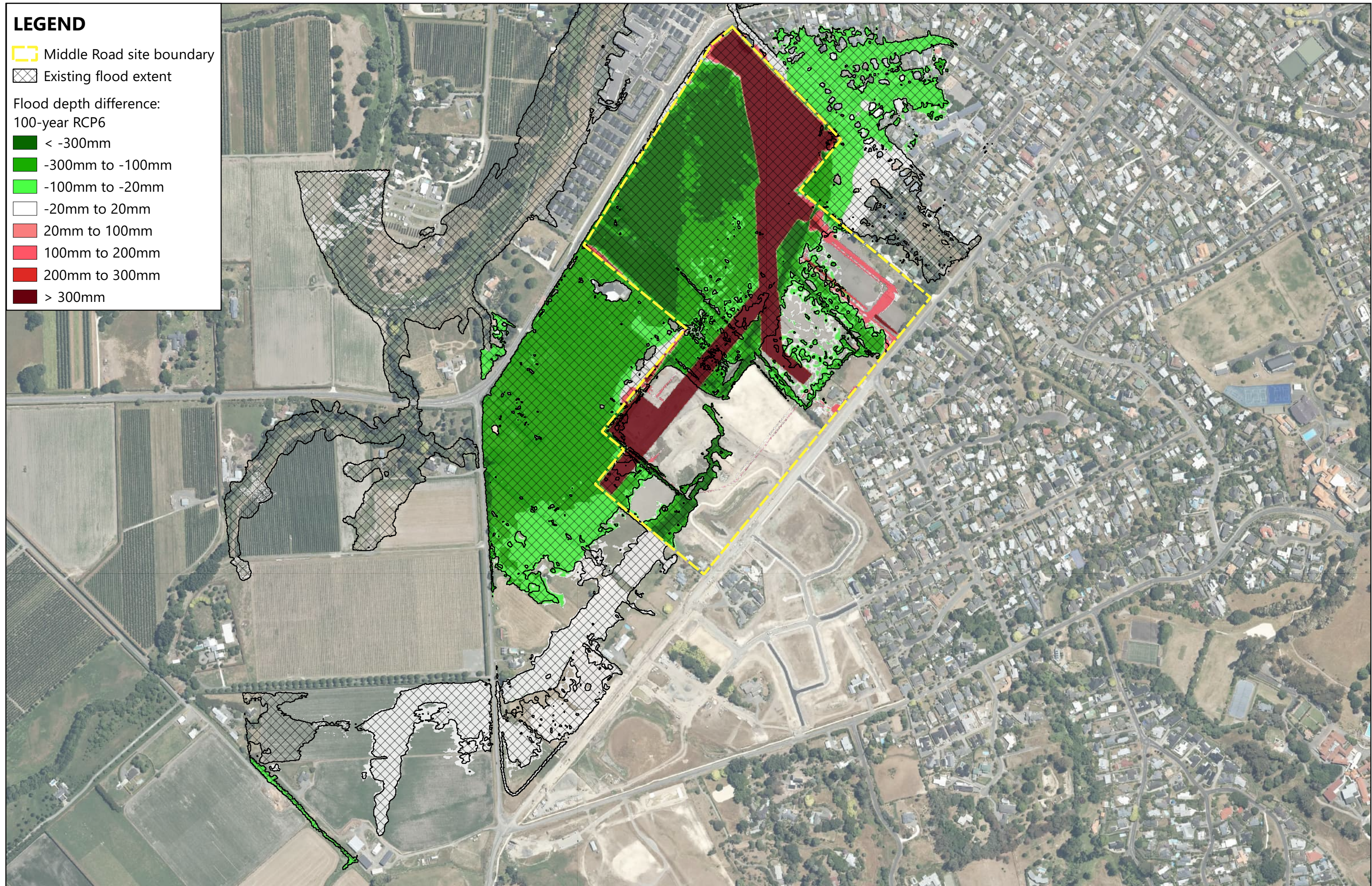
# LEGEND

 Middle Road site boundary

 Existing flood extent

Flood depth difference:  
100-year RCP6

-  < -300mm
-  -300mm to -100mm
-  -100mm to -20mm
-  -20mm to 20mm
-  20mm to 100mm
-  100mm to 200mm
-  200mm to 300mm
-  > 300mm



REVISION DETAILS		INT	DATE	SURVEYED	-
1.0	For Information	-	26/03/2026	DESIGNED	-
-	-	-	-	DRAWN	RK
-	-	-	-	CHECKED	SG
-	-	-	-	APPROVED	SG

8 NUGENT STREET,  
GRAFTON,  
AUCKLAND  
WOODS.CO.NZ



P25-496 - MIDDLE RD  
MAXIMUM FLOOD DEPTH DIFFERENCE:  
POST DEV minus PRE DEV  
100-YEAR WITH ALLOWANCE FOR RCP 6.0



STATUS	ISSUED FOR INFORMATION	REV
SCALE	NTS	2.0
COUNCIL	HDC	
SHEET	SHEET 3 OF 3	