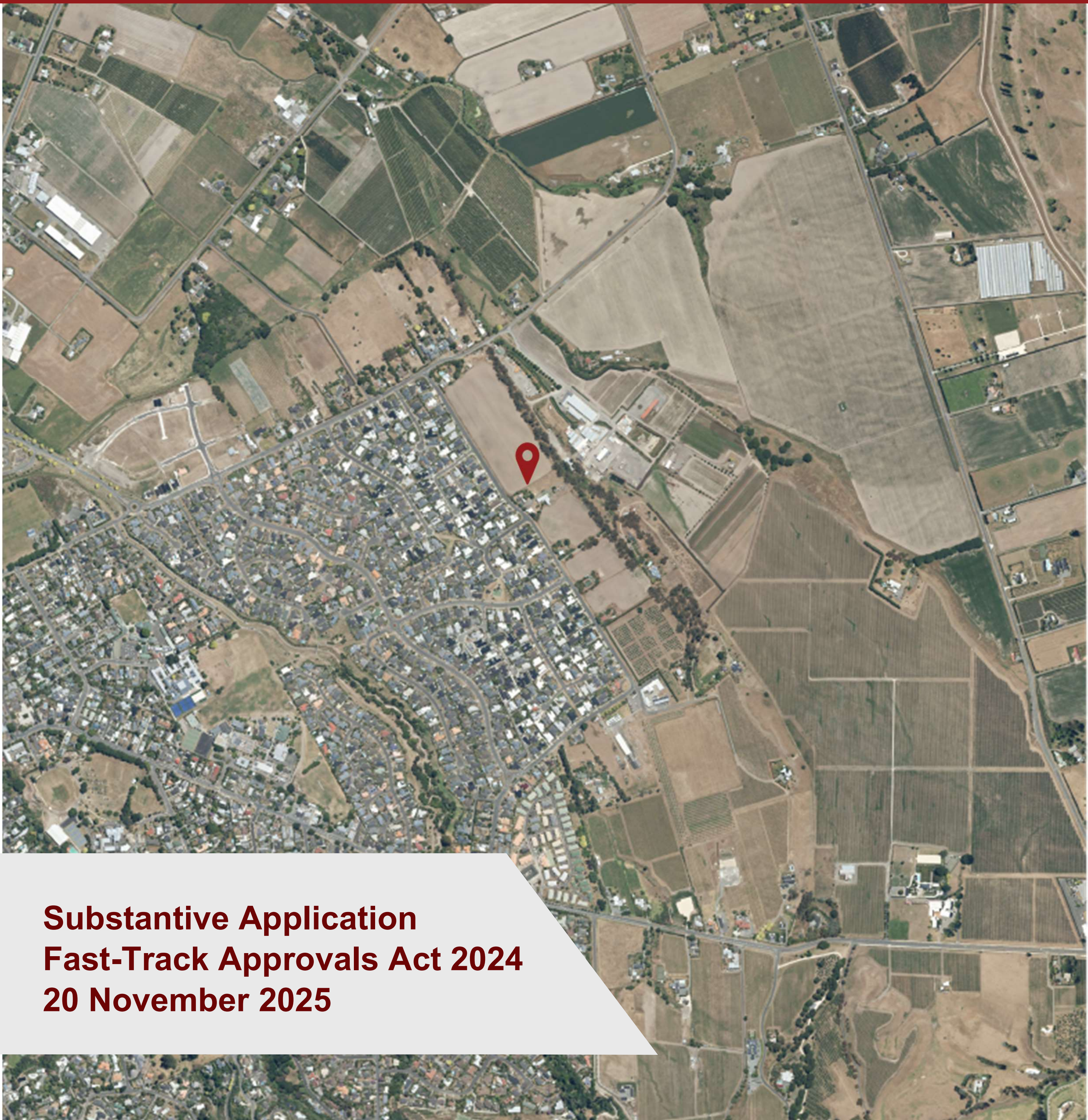
STORMWATER MANAGEMENT PLAN

Arataki Project
CDL Land New Zealand Limited
86, 108 & 122 Arataki Road, Havelock North



Substantive Application
Fast-Track Approvals Act 2024
20 November 2025

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Approval	Pranil Wadan – Technical Director – Water Infrastructure & Planning
Consultant details	Wood & Partners Consultants Limited (**Woods**) PO Box 6752 Victoria St West, Auckland 1142 woods.co.nz
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1.0 Statement of qualifications and experience

Pranil Wadan

I am a Technical Director and the General Manager of Water Infrastructure & Planning at Wood and Partners Consultants Limited ("Woods"). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since 2012.

I hold a Bachelor of Engineering degree from the University of Auckland, which I completed in 2007. I am a Chartered Professional Engineer (CPEng) and a member of Engineering New Zealand (CMEngNZ) and Water New Zealand. In addition, I also hold the following qualifications and affiliations:

- International Professional Engineer (IntPe(NZ))
- Certified Independent Hearing Commissioner
- Certificate in Company Direction & Governance

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 approver 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.

Bidara Pathirage

I am a Senior Associate Engineer in the Water Infrastructure & Planning at Wood and Partners Consultants Limited ("Woods"). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since 2017.

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 14 years of experience in stormwater design, flood risk assessments, water infrastructure and stormwater management.

I have been the principal author and lead stormwater engineer for a wide range of stormwater management plans and flood modelling reports to support various projects.

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.

Boniface Kinnear

I am a Senior Associate Engineer in the Water Infrastructure & Planning at Wood and Partners Consultants Limited ("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 a Bachelor of Science in Environmental Engineering from the University of Southern California, Los Angeles, California which I obtained 2004. I also hold Master of Engineering Studies and a Master of Engineering in Environmental Engineering both from the University of Auckland completed in 2007 and 2008 respectively. I am a Chartered Professional Engineer (CPEng), a chartered member of Engineering New Zealand (CMEngNZ) and an Internation Professional Engineer (IntPE)/APEC Engineer. Additionally, I am a member of the Environment Institute of Australia and New Zealand (EIANZ) as well as a member of the Rivers Group NZ.

I have over 17 years of experience in environmental management, contaminated land, impact assessments, stormwater design and modelling, flood risk assessments, water infrastructure and stormwater management. I have authored several stormwater management plans, flood modelling reports, infrastructure assessment/design reports, earthworks reports and detailed site investigation reports to support numerous projects.

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.

Tony Wang

I am an Associate Engineer in the Water Infrastructure & Planning at Wood and Partners Consultants Limited ("Woods"). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since 2021.

I hold a Bachelor of Engineering degree from the University of Auckland, which I completed in 2010. I also hold a Master of Engineering Studies in Environmental Engineering from the University of Auckland, which I completed in 2011. I am a Chartered Professional Engineer (CPEng) and a member of Engineering New Zealand (CMEngNZ) and Water New Zealand.

I have over 13 years of experience in stormwater management and design, and flood risk assessments. I have authored several stormwater management plans, flood modelling reports, and infrastructure assessment to support numerous projects.

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.

Ricky Kiddle

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 1.5 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.

2.0 Introduction

The Arataki Project will facilitate the subdivision and development of 171 detached dwellings, which will provide additional housing capacity to Havelock North and the Hawkes Bay region. The development will be supported by a local road network, pedestrian accessways, and required infrastructure. A planning design framework is proposed to facilitate residential built form development on the future lots.

The Arataki Project will comprise two phases of development:

- **Phase 1:** The first phase will realise the residential subdivision of the land and will be delivered by CDL. The residential subdivision and bulk earthworks phase create 171 residential lots (average lot size 450m^2), a drainage reserve to vest, 4 roads to vest in 6 sections, 2 accessways to vest, 10 JOALs, bulk earthworks landform modification, infrastructure provision, buffer planting and external boundary fencing.
- **Phase 2:** The second phase of development will deliver the residential built form in accordance with the planning design framework established for the site. This phase of development will be delivered by CDL's build partners and will involve house construction on individual lots and include vehicle access, parking, landscaping and fencing.

The applicant is proposing to lodge a substantive application under the Fast-track Consenting process. This application relates to the development of a contiguous landholding at the eastern end of Arataki Road and south of Brookvale Road. The planning report prepared to support the substantive application under the FTAA provides a full description of the proposal.

2.1. Purpose

This report has been prepared in support of the application by CDL Land New Zealand Limited (CDL) for a substantive application to the Environmental Protection Authority (EPA) under the Fast-Track Approvals Act 2024 (FTAA).

The purpose of this report is to outline the stormwater management plan (SWMP) for the development. It highlights how requirements of Hastings District Council (HDC) and Hawkes Bay Regional Council (HBRC) have been met in the development of the stormwater strategy.

The overarching objectives are as follows:

- Demonstrate that the proposed stormwater management meets the requirements of HDC and HBRC;
- Incorporate a water sensitive design 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 networks;
- Provide appropriate treatment for the receiving environment via stormwater quality treatment guidelines and avoidance of high contaminant yielding roof and cladding materials;
- Identify flood risk areas and provide for development outside the 1% AEP floodplain without creating adverse flooding effects on properties upstream or downstream of the site; and

- Understand mana whenua values and incorporate these values into the stormwater management approach for the development.

3.0 Description of Application Site

The site subject to this substantive application is located at 86, 108, 122 Arataki Road, Havelock North, Hawkes Bay (**site**). Comprising a total area of approximately 11ha, the site is held in three separate titles, all owned by CDL Land New Zealand Limited (CDL). The site is located at the eastern edge of the existing urban area of Havelock North, approximately 2.5 kilometres from the Havelock North Village Centre.

The site is generally bounded by Brookvale Road to the north and Arataki Road to the west (Figure 1). The land to the south is used as an olive orchard, and the land to the east is used for rural and light industrial purposes. Access to the site is provided via five existing crossings along Arataki Road.

There are a scattering of existing buildings including sheds spread out across the site. Vegetation (predominantly exotic species) is largely limited to garden areas around these buildings and a shelter belt alongside the eastern boundary. The site is currently utilised for grazing livestock.

The planning report prepared to support the substantive application under the FTAA provides a full site description. Sections 3.2 to 3.10 below outline site specific features relating to stormwater.

Figure 1: Existing site

3.1. Summary of data sources and dates

A summary of key background information used in the development of the SWMP is provided in Table 1 below.

Table 1: Summary of data

Existing site appraisal item	Source and date of data used
Topography	Hawkes Bay LiDAR 2023, LINZ Data Service Site Survey, Woods
Geotechnical/ soil conditions	S-Map Online, Manaaki Whenua Landcare Research CMW Geosciences, Geotechnical Investigation Report – 15/5/2025, Version C
Existing stormwater network	Hasting District Council Online IntraMaps
Existing hydrological features and waterways	Hawke's Bay Regional Council Map - Drains
Flooding and flow paths	Hasting District Council via Email Dated 27/2/2025 (Correspondence is included in Appendix A)
Ecological/ environmental areas	Boffa Miskell, Ecology Report, 28/5/2025
Contaminated Land	SQN GeoSciences, Supplementary Detailed Site Investigation (DSI), 17/03/2025 SQN GeoSciences, Remediation Action Plan (RAP), 17/03/2025
Cultural and heritage sites	CFG Heritage Ltd, Arataki Extension: archaeological assessment, 2/5/2025

3.2. Topography

The site has a gentle crossfall from south to north (Figure 2) with contours dropping from 32mRL to 14mRL. The site is on a natural terrace and the landform is elevated above the rural property to the east by approximately 6m.

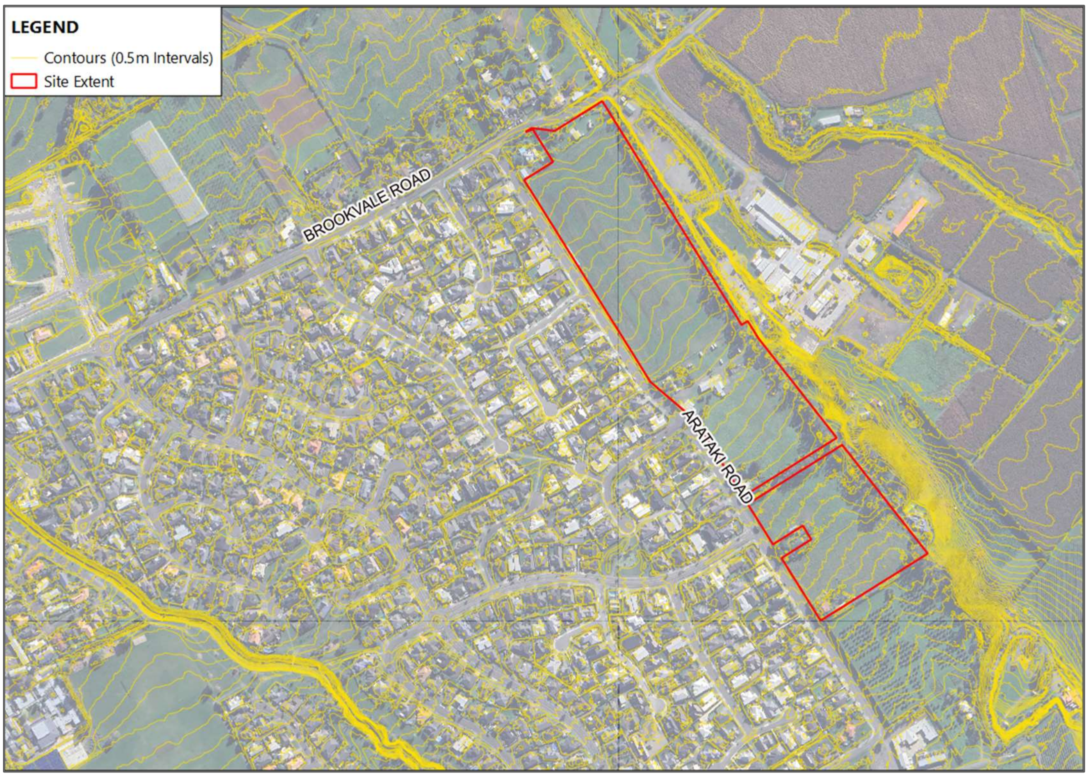


Figure 2: Existing topography

3.3. Geotechnical/ soil conditions

Published drainage maps of the site obtained from the S-map indicate the site area's drainage capacity. The site is contained within well-draining soils, as shown in Figure 3.

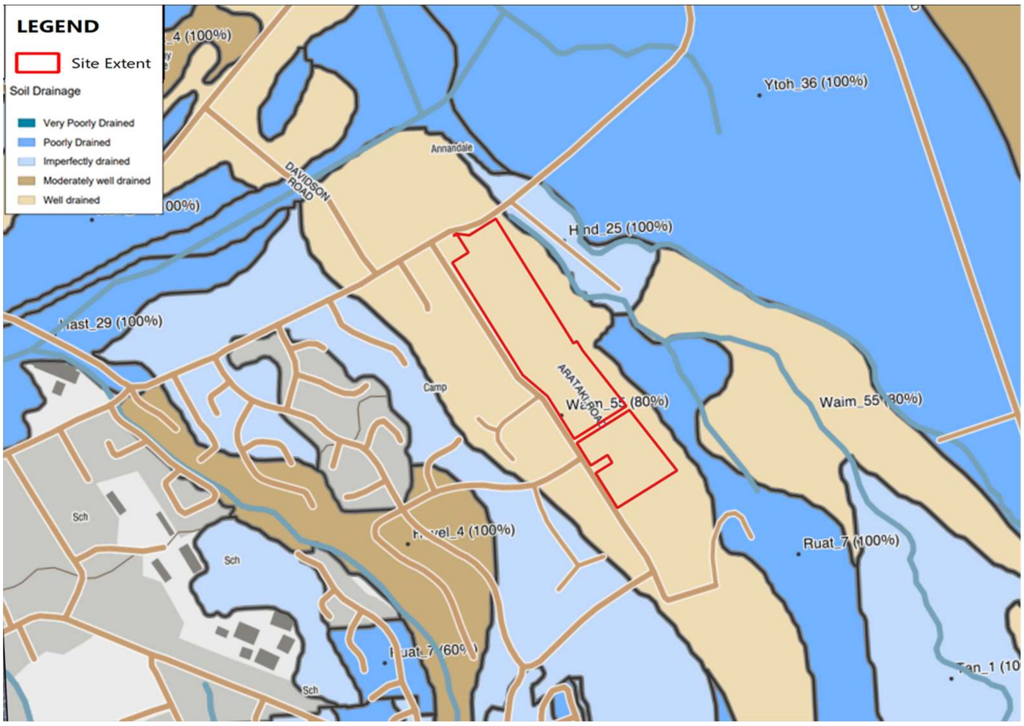


Figure 3: Soil drainage (Source: S-map)

WSP Opus and Initia Ltd previously completed geotechnical investigations for the site, and a site-specific geotechnical report has been undertaken by CMW Geosciences and accompanies this fast-track application. As per the reports, groundwater was not encountered within any of the investigations completed to date across the site and is expected to be at depths greater than 8m below the site (Initia's BH01), which was drilled at the lowest elevation (RL 14m) to a depth of approximately 8m (RL 6.0m).

3.4. Existing stormwater network

The site is located at the eastern extent of the Havelock North urban area. The site is currently undeveloped, with no stormwater infrastructure in place. The nearest stormwater network is at the Arataki Road and Brookvale Road intersection, as shown in Figure 4 below which services the urbanised area to the west of Arataki Road.

It is noted that the section of Arataki Road adjoining the site has been partially urbanised and a roadside swale conveys stormwater to the reticulated network at the intersection of Arataki Road and Brookvale Road. On the western urbanised side of Arataki Road is a kerb and channel. These features are shown in Figure 5.

Figure 4: Existing stormwater network (Source: HDC online maps)

Figure 5: Existing swale

3.5. Existing hydrological features and waterways

There are two watercourses to the east of the site as shown in Figure 6. They flow from south to north, crossing Brookvale Road, via two culverts, and discharge to Crombie and Taco Drains located downstream. The watercourses are mainly grassed downstream of Brookvale Road. Some bank slumping has been observed at the culvert outlet of the far eastern watercourse indicating ongoing erosion.

An ecological assessment has been undertaken by Boffa Miskell Ltd. The assessment concluded that there are no streams or wetlands on the site, and downstream ecosystems comprise modified lowland streams that have low sensitivity to future sediment or stormwater discharges.

It is noted that both Crombie and Taco drains are part of HBRC's drainage schemes for Havelock North that ultimately discharge to the Karamu River as shown in Figure 7.

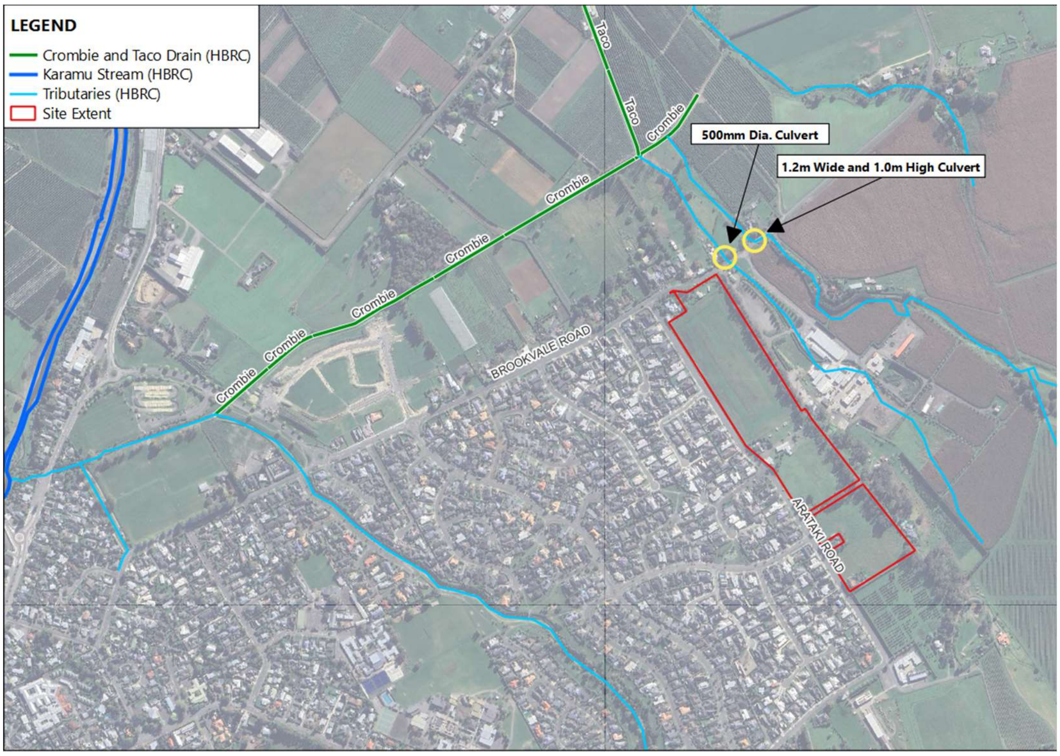


Figure 6: Site adjacent drainage

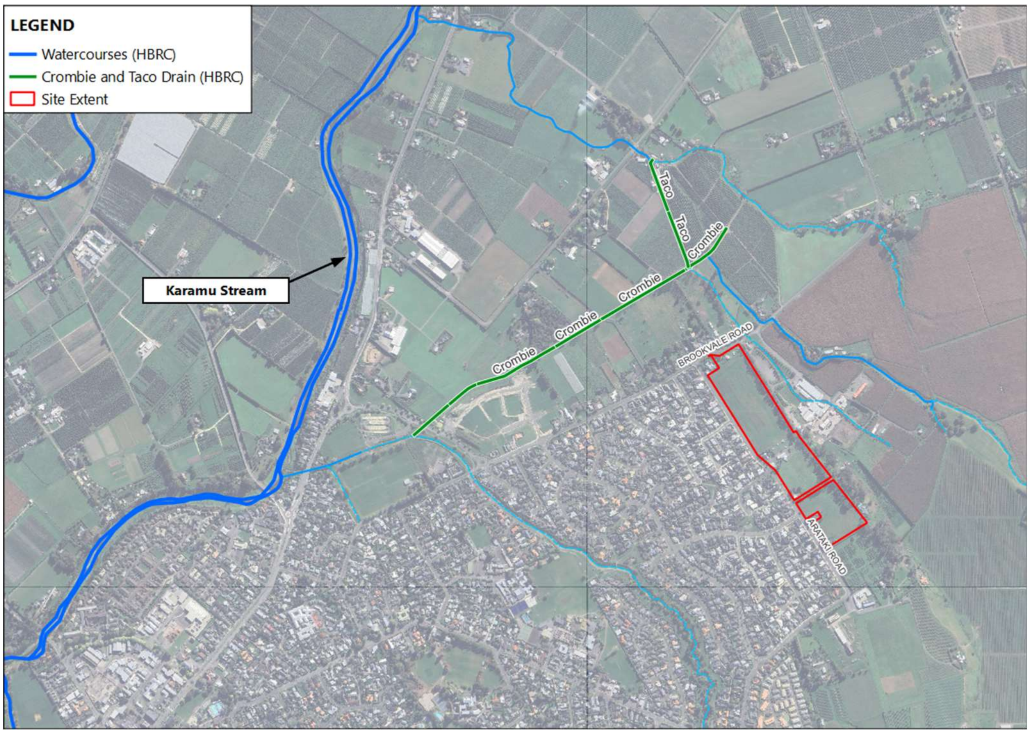


Figure 7: Catchment drainage

3.6. Flooding and flow paths

Overland flows that enter the site from the south drain to both the northwest and the northeast. The existing overland flow paths within the site and Arataki Road are shown in Figure 8.

The catchment is bisected as follows:

- Sub-catchment A (Arataki sub-catchment):
  - Existing catchments from the site that discharge northwest to the intersection of Arataki Road/ Brookvale Road
  - Existing catchment from Arataki Road and adjoining residential development
- Sub-catchment B (Brookvale sub-catchment):
  - Existing catchments from the site that discharge northeast to the watercourse located to the east of the development

Figure 8 indicates the extents of the catchments and outlines the discharge points.

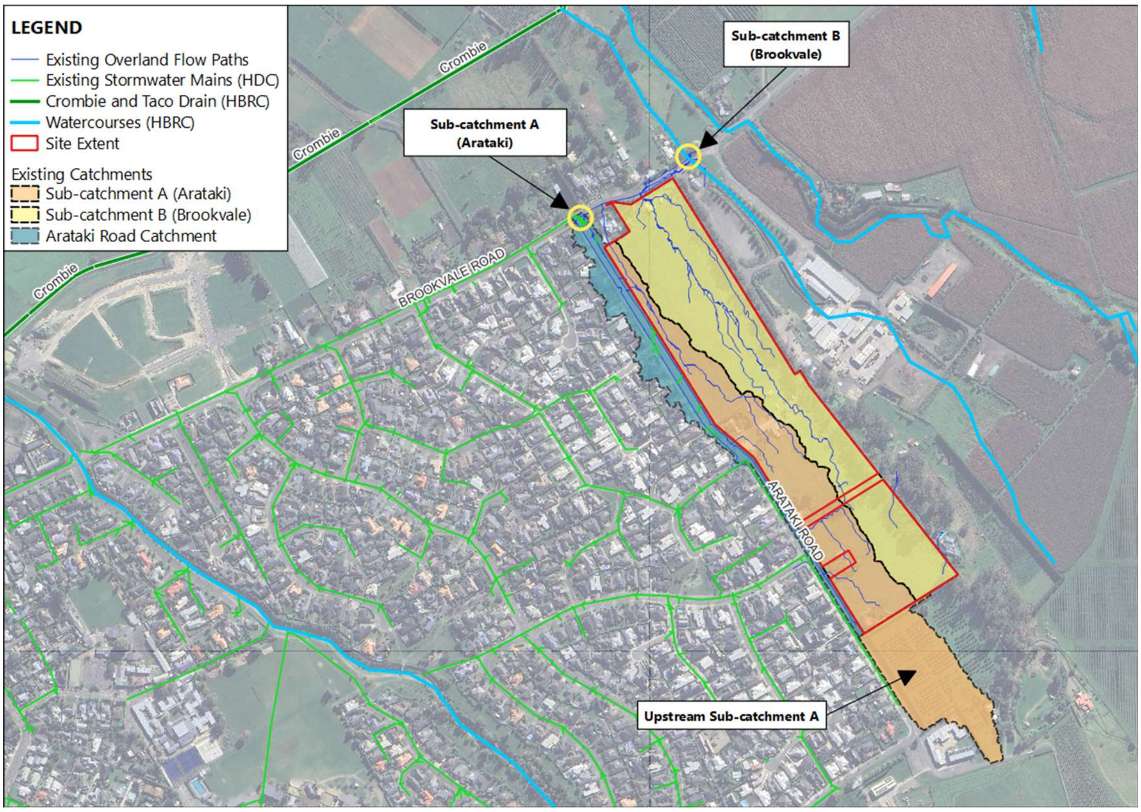


Figure 8: Existing catchments and overland flows

3.7. Ecological / environmental areas

Please refer to the Ecology Report by Boffa Miskell, dated 6 June 2025, and the substantive application material for details.

3.8. Contaminated Land

Please refer to the Supplementary Detailed Site Investigation (DSI) and Remediation Action Plan (RAP) by SQN GeoSciences, dated 17 March 2025, and the substantive application material for details.

3.9. Cultural and heritage sites

Please refer to the archaeological assessment by CFG Heritage Ltd, dated 2 May 2025, and the substantive application material for details.

3.10. Source Protection Zones

A Source Protection Zone has been defined for the Hastings urban water supply by the Hastings District Council. This supply provides drinking water to approximately 65,000 people across the Hasting Urban Area, including Havelock North, Bridge Pā and Pakipaki. Most of the development extent (approximately 80%) is within the source protection zone. The source protection zone extent is shown in Figure 9.

As per HBRC guidelines, for development in this zone, measures should be put in place to prevent potential contamination of drinking water sources. It is noted the northern approximately 80% of the site, north of driveway at #104 Arataki Road, falls within the Hastings Source Protection Zone identified within the TANK Plan Change.

Additional details are contained in Proposed TANK Plan Change 9 2020 (refer to Table 3).

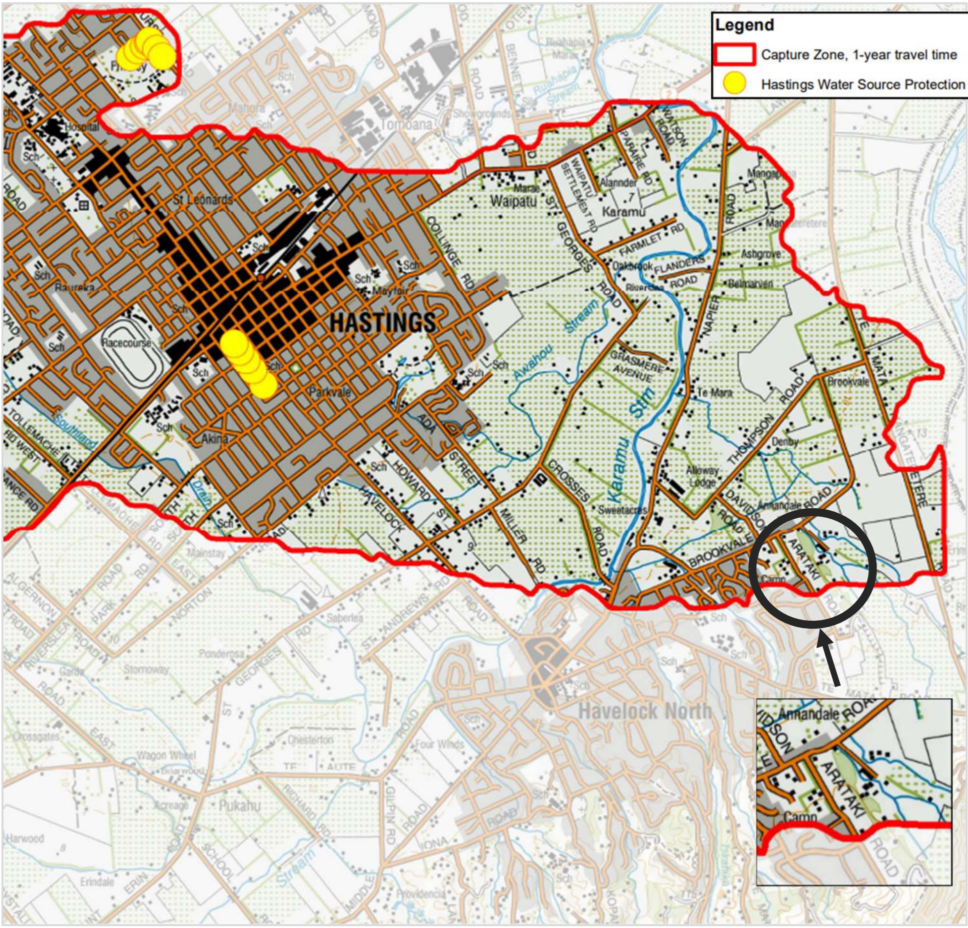


Figure 9: Source Protection Zone (Hastings District Council)

4.0 Development summary and planning context

A review of the relevant stormwater guidelines and policies has been undertaken to determine appropriate stormwater and flooding requirements to be adopted in the SWMP for this area.

The documents reviewed and summary of the relevance is provided in Table 2.

Table 2: 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 guidelines for engineering of subdivision and land development
Hawke's Bay Waterway Guidelines – Stormwater Management - 2009	Provides an outline of HBRC preferred design approach for structural stormwater management devices	Yes – provides guidance on water quality and water quantity devices
National Policy Statement for Freshwater Management 2020 (NPS-FM)	Tool for managing and improving conditions of New Zealand's freshwater and coastal systems	Yes - outlines strategic objectives to be considered
Hawke's Bay Regional Council – TANK Plan Change	Provisions in managing the land and waterways of the Tūtaekurī, Ahuriri, Ngaruroro and Karamū (TANK) catchments	Yes – provides objectives for managing water quality and water quantity within the Karamū catchment

5.0 Stakeholder engagement and consultation

Consultation has been undertaken with various stakeholders and matters relevant to stormwater are summarised in Table 3.

Table 3: Summary of stakeholder engagement

Stakeholders	Date	What engagement has been completed?
Hastings District Council	13/02/2025	• Meeting with 3 Waters at HDC • Initial introduction to the project proposal and discussion around proposed stormwater management • Generally positive feedback received on the stormwater strategy • Ownership of the watercourses located to the east of the development to be checked as that will determine the overall requirements and stormwater proposal
	28/03/2025	• Meeting held with the wider HDC team • Overview of the project and design details provided • Discussion around the applicability of TANK plan change and ownership of the watercourses • Protection of the aquitard – the proposed basin to be lined and therefore no infiltration
	09/04/2025	• Correspondence from HDC and HBRC on the watercourse. The watercourse is within the 'Karamu and Tributaries' HBRC scheme and therefore TANK rule 71 to apply. Email is included in Appendix A.
	06/05/2025	• In person meeting held at HDC with the wider project team • Discussion around planning, engineering and three waters • Details around the stormwater strategy in terms of modelling are undertaken for the communal basin and removal of the swale. • Feedback from mana whenua in terms of water quality treatment and proposal to provide treatment for the discharges from Sub-catchment A • HDC are generally supportive and want to understand: ○ Modelling that has been undertaken and the effects on Arataki Road as a result of the removal of the swale

Stakeholders	Date	What engagement has been completed?
		◦ Any impacts/ effects on downstream properties as a result of discharging to the stream next to the water course ◦ Life cycle cost assessments in relation to water quality treatment on Arataki Road This information has been included in this SWMP.
	12/06/2025	• Draft stormwater reporting provided for feedback to HDC
	17/06/2025	• Feedback provided from HDC in regard to the flood assessment undertaken and the hazards. Further clarification is now provided in this report and accompanying appendices - refer to Section 7.0 and Appendix C.
Hawke's Bay Regional Council	06/03/2025	• Meeting held with the wider HBRC team with an overview of the project, design and stormwater strategy discussed • Discussion around the applicability of TANK plan change and ownership of the watercourses to the east of the development
	09/04/2025	• Correspondence from HDC and HBRC on the watercourse. The watercourse is within the 'Karamu and Tributaries' HBRC scheme and therefore TANK rule 71 to apply. Email is included in Appendix A.
	06/05/2025	• In person meeting held at HBRC with the wider project team • Discussion around earthworks and stormwater discharge • General feedback is that the strategy is adhering to the relevant standards and is therefore satisfactory. • Water quality testing and monitoring briefly discussed with data around wider water quality monitoring to be requested
	12/06/2025	• Draft stormwater reporting provided for feedback
	23/06/2025	• Feedback provided from HBRC in regard to the emergency spillway of the basin. Further clarification on this matter is now provided in this report and accompanying appendices – refer to Section 7.0 and Appendix D.
	02/04/2025	• Hui with Ruahāpia Mārae and Tamatea Pōkai Whenua

<table>
<tr><th>Stakeholders</th><th>Date</th><th>What engagement has been completed?</th></tr>
<tr><td rowspan="2">Mana Whenua Consultation</td><td></td><td>General development proposal presented along with specific stormwater strategy in terms of water quality monitoring and flood management
Primary concerns raised around water quality with this being critical to Ruahāpia due to lack of protection and monitoring of the environment. Concerns also raised around water quality treatment of Sub-catchment A (i.e., Arataki Road), prior to discharging to the network
Ruahāpia are seeking developers to get better overall outcomes and queried regarding testing and monitoring
Post hui, CDL and Woods have provided further feedback to Ruahāpia Mārae and Tamatea Pōkai Whenua in terms of incorporating mana whenua values into the stormwater strategy. Email correspondence is included in Appendix A and is further discussed in Section 7 of this report.</td></tr>
<tr><td>15/07/2025</td><td>Verbal feedback received from Ruahāpia in support of the project</td></tr>
<tr><td>Hastings District Council</td><td>6/11/2025 - Meeting

13/11/2025 – Formal HDC Comments to Panel</td><td>Following lodgement of the substantive application, Hastings District Council and the Applicant have reconsidered the planning framework for the proposal through post-lodgement engagement. A consent notice approach is now proposed.
A meeting was held on 6/11/2025 with HDC to understand why the standard Hastings District Plan stormwater standard could not apply for this development and in the alternative, determine the requirements of the bespoke consent notice that would instead apply to the site. At this meeting and in their formal Panel correspondence, HDC requested an assessment of the stormwater mitigation measures required for lots with impervious surfaces exceeding 60%.
Section 7.3 of this report has been amended to include the requested information.</td></tr>
</table>

Relevant minutes, presentations and consultation are included in Appendix A for reference.

6.0 Proposed development

The development proposes to create 171 residential lots, roads, accessways and reserves. The development will also include the urbanisation of Arataki Road. The work will be largely limited to the western side of Arataki Road to form a pedestrian and/or shared path and associated berm. It is to be noted that the width of the trafficable lane will remain unchanged.

The project will comprise two phases of development. The first phase will be the residential subdivision of the land and will be delivered by CDL. This residential subdivision and bulk earthworks phase will create 171 residential lots (average lot size 450m^2), a drainage reserve, roads, accessways and jointly owned access lots (JOALs) to vest. Additionally, internal infrastructure is to be provided (3 waters, power and telecom) as well as buffer planting and external boundary fencing.

The second phase of development will deliver the residential built form in accordance with the planning design framework established for the site. This phase of development will be delivered by CDL's build partners and will involve house construction on individual lots and include vehicle access, parking, landscaping and fencing.

A schematic of the indicative site layout for the Arataki project is shown in Figure 10 and a full Project description is provided in the application AEE.

Figure 10: Indicative site layout (Source: BM240623_Arataki_landscape_concept_report_20250417)

7.0 Stormwater management

This section discusses the proposed stormwater management for the site. It has been developed to meet the objectives and design requirements of HDC and HBRC guidance documents. It has been designed to ensure that stormwater runoff can be managed and the potential water quality effects of stormwater on the receiving environment are avoided.

The stormwater management strategy has been governed by the discharge locations as further outlined in this section. The overall stormwater management approach seeks to:

- Develop a set of best practicable options (BPO) for stormwater that can be incorporated into the development
- Emphasise a water sensitive design approach that:
  - Manages the impact of land use change from existing (undeveloped) to urban development
  - Minimises or mitigates the adverse effects on water quality, freshwater systems, stream health and ecological values of the receiving environment through the implementation of stormwater management devices
  - Addresses mana whenua values
- Minimise the generation and discharge of contaminants/ sediments into a sensitive receiving environment, including changes in water temperature caused by stormwater discharges.
- Facilitate urban development and protect key infrastructure, people and the environment from significant flooding events.
- Consider the NIWA HIRDS V4 rainfall dataset includes an allowance for climate change based on the Representative Concentration Pathway (RCP) 6.0 scenario for the 2081-2100 period, based on HDC guidelines

As in the existing situation, the development area is split into two sub-catchments, A and B, based on their respective discharge locations. However, the sub-catchment coverage areas have been refined to reflect the proposed landforms in the post-development scenario. The proposed landforms are designed to ensure the site can be properly treated and the peak runoffs from each sub-catchment can be properly managed before discharge to the downstream receiving environments.

The revised post development boundaries are shown in Figure 11 with a summary of how these catchments will be managed shown in Figure 12. Additional details are provided in the subsequent sections of this report.

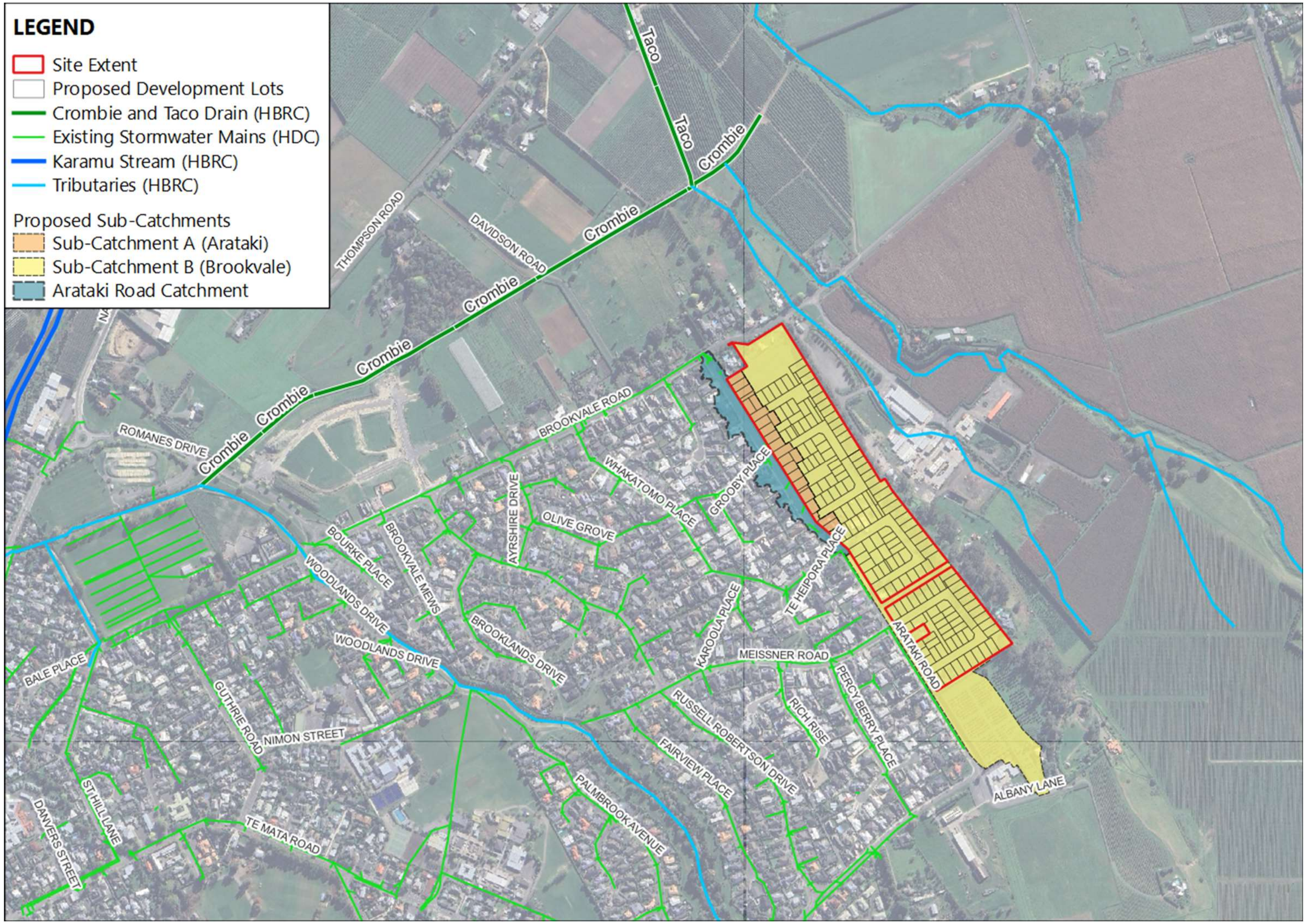


Figure 11. Proposed Stormwater Management Strategy

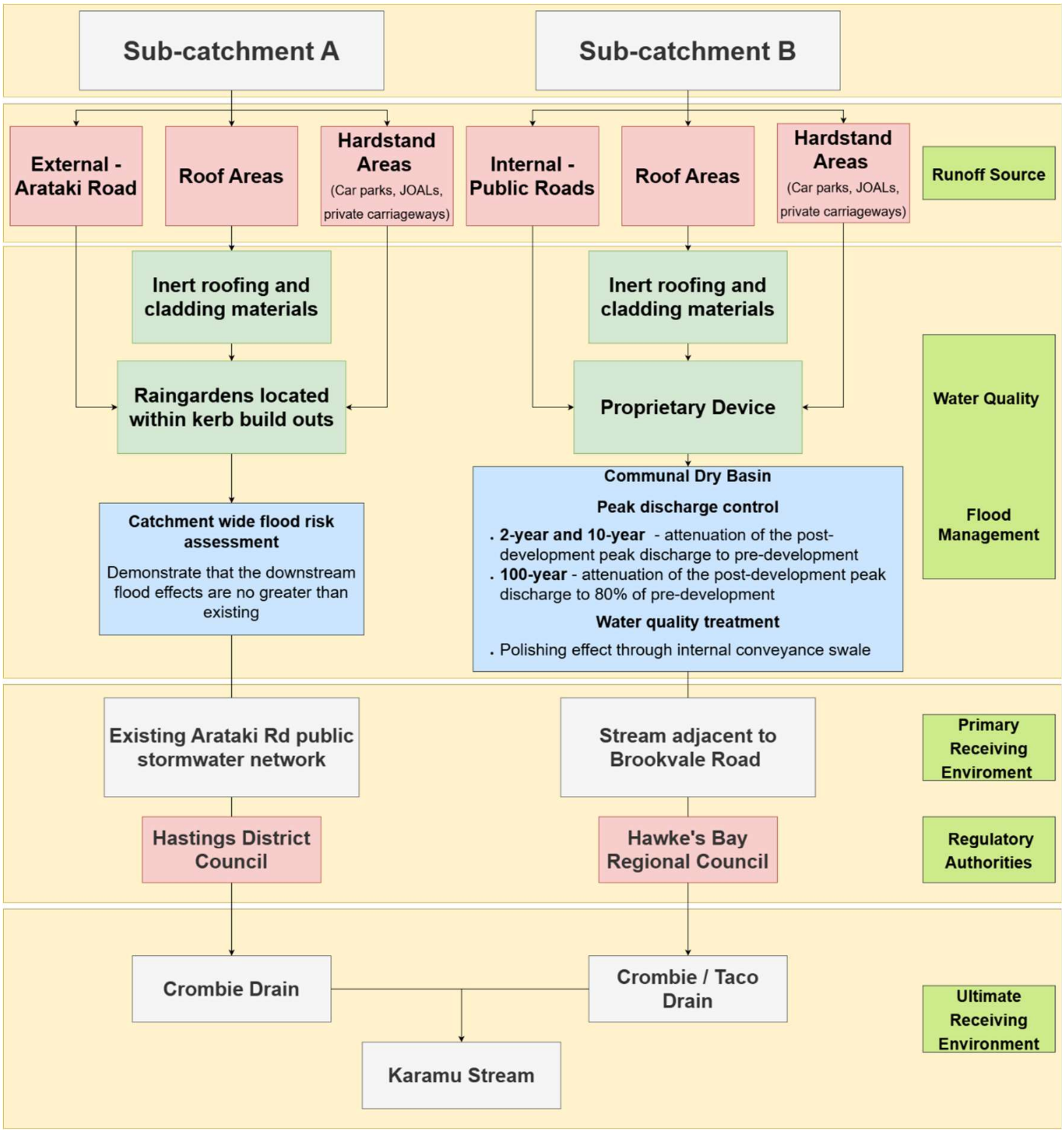


Figure 12: Proposed stormwater management

7.1. Sub-catchment A

Flows from Sub-catchment A discharge to the existing public network along Arataki Road. As this network is covered by HDC's global network discharge consent, stormwater management is to be in accordance with HDC standards.

7.1.1. Water quality management

HDC guidelines currently do not require any water quality treatment to be provided for stormwater runoff being discharged to its network. However, following feedback from mana whenua (as summarised in Table 3), water quality treatment options in the form of raingardens have been considered for areas located within Sub-catchment A.

Four proposed raingardens have been identified for installation within kerb-buildouts along Arataki Road. It is acknowledged that the available area for these raingardens is insufficient to fully treat the corresponding catchment areas in accordance with HBRC's guidelines, given the development constraints. However, they are proposed as the best practicable measure to incorporate mana whenua values and enhance overall water quality outcomes.

The locations of the proposed raingardens are shown in Figure 13, with a summary of the areas provided in Table 4. The associated calculations are included in Appendix B for reference.

Figure 13: Indicative raingarden locations

Table 4: Indicative raingarden areas

Raingarden	Contributing Lots areas (m^2)	Contributing Road areas (m^2)	Proposed Raingarden Areas (m^2)
Raingarden 1	1000	850	10
Raingarden 2	3679	1601	10
Raingarden 3	2491	1479	35
Raingarden 4	2454	2247	15

Through the engagement process, HDC requested a life cycle cost (LCC) estimate be undertaken to understand ongoing costs related to the maintenance of the raingarden devices. This has been undertaken with data sourced from "Report 9, A Total Economic Valuation Approach to Understanding Costs and Benefits of Intervention Scenarios, Auckland Council". A discount rate of 4% has been used for the Net Present Value LCC calculation. It has been undertaken based on the area of the proposed raingardens and is summarised in Table 5.

Table 5: Indicative life cycle cost analysis

Raingarden	Raingarden area (m2)	LCC $/m2/year	Life span(years)	Total LCC ($)
Raingarden 1	10	146.66	50	$80,296.35
Raingarden 2	10	146.66	50	$80,296.35
Raingarden 3	35	56.25	50	$107,419.92
Raingarden 4	15	111	50	$89,873.55

Note: The assessment is based on Arataki Road being partially developed and the excludes the land cost

7.1.2. Water quantity management

7.1.2.1. Development area

An assessment of peak flows based on pre- and post-development conditions has been undertaken for the development. It is noted that a portion of the site, which naturally drains to Sub-catchment A under the pre- development conditions, will be redirected to Sub-catchment B. This redirection will offset increase in Sub-catchment A runoff due to post-development intensification.

The pre-development sub-catchment A area was determined to be approximately 4.47ha and the post-development sub-catchment A area was determined to be approximately 1.13ha. A summary of the flows from the development area only, within Sub-catchment A is summarised below in Table 6.

Table 6: Pre-development and post-development peak discharges from sub-catchment A (site area only)

	2-year ARI	10-year ARI	100-year ARI	80% 100-year ARI
Pre-development (m^3/s)	0.14	0.30	0.59	0.48
Post-development (m^3/s)	0.10	0.18	0.30	

7.1.2.2. Arataki Road

As discussed in Section 3.4, there is an existing swale along Arataki Road that borders the site. The proposed development includes an upgrade of Arataki Road, which will involve removing the existing swale and installing a reticulated piped network.

The removal of the swale leads to a reduction in conveyance along Arataki Road. Therefore, flood modelling has been undertaken to demonstrate effects (if any) as a result of the development.

Details on the flood modelling undertaken are included in Appendix C (Arataki Development Flood Risk Assessment Memorandum), with a summary provided in this section.

The pre-development and post-development flood model results for the 100-year results are shown in Figure 14 and Figure 15.

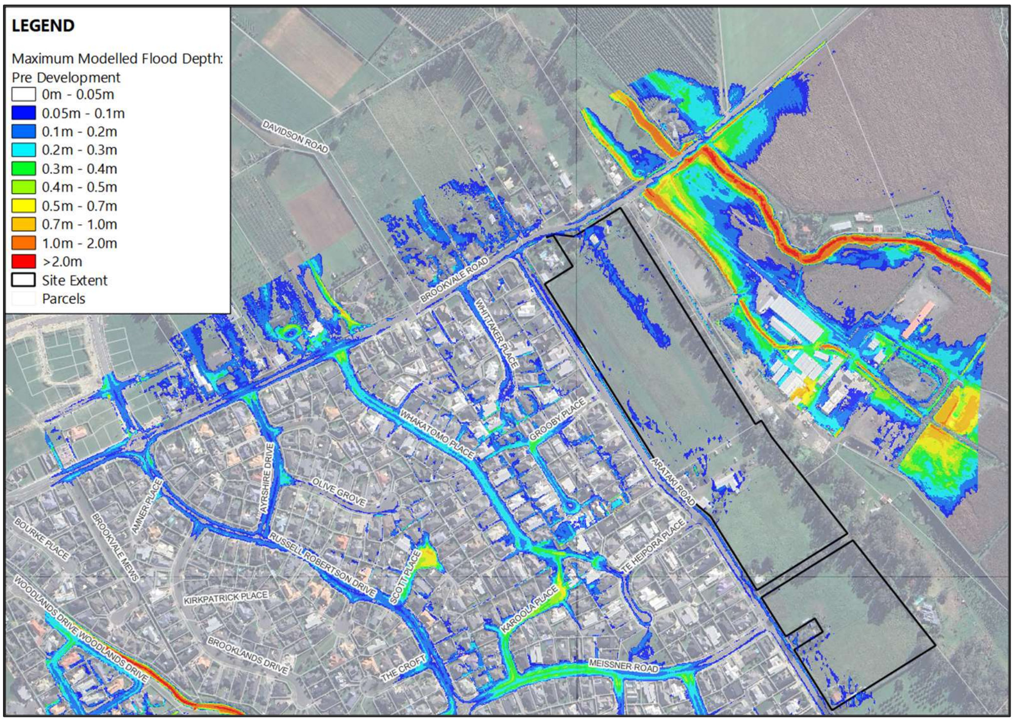


Figure 14: Pre-development flood extent – 100-year + RCP 6.0

Figure 15: Post-development flood extent – 100-year + RCP 6.0

The resulting 100-year water level difference plot is shown in Figure 16.

Figure 16: Water level difference plot - 100-year + RCP 6.0

The flood modelling predicts increases in flood levels along Arataki Road, Meissner Road and Te Heipora Place as shown in Figure 16. The increase in flood level observed in the model are less than 25mm and are deemed negligible and considered less than minor as the overland flows are generally contained within the road reserves and designed conveyance paths.

No third-party effects have been observed as a result of the development. No adverse effects on third-party properties or assets have been identified as a result of the proposed development. The stormwater design ensures that the level of service for surrounding properties is maintained and that any additional overland flow is appropriately managed within public infrastructure.

The complete set of model results is included in Appendix C; however, a selected range of cross sections along Arataki Road and the adjoining roads (Meissner Rd and Te Heipora Pl) is included in Figure 18, Figure 20 and Figure 20.

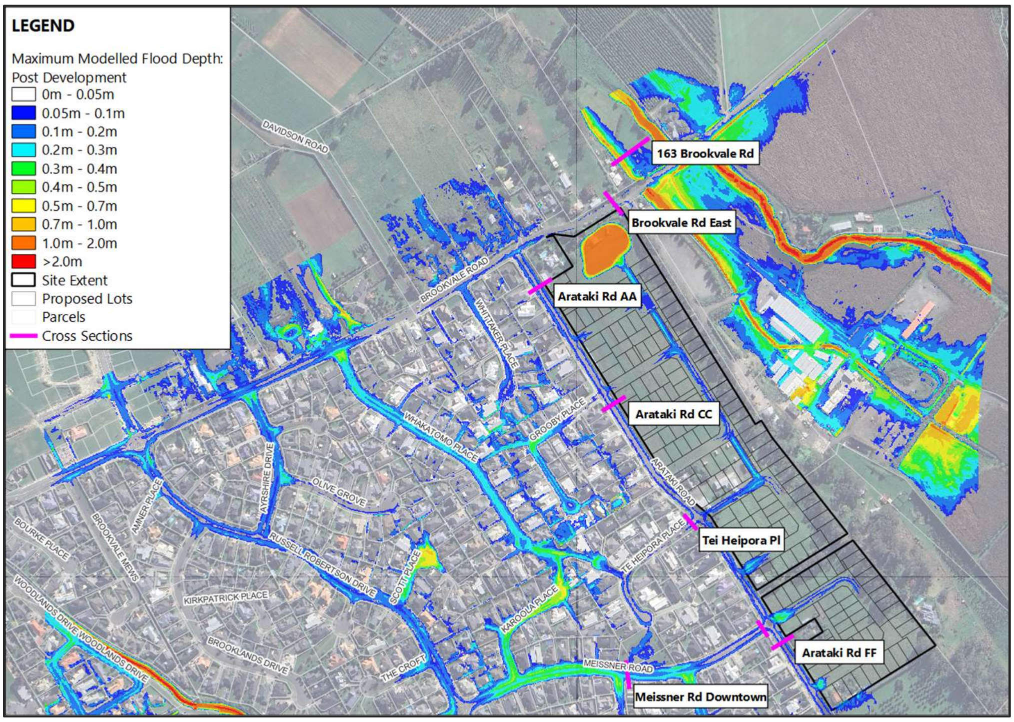


Figure 17: Locations of cross sections

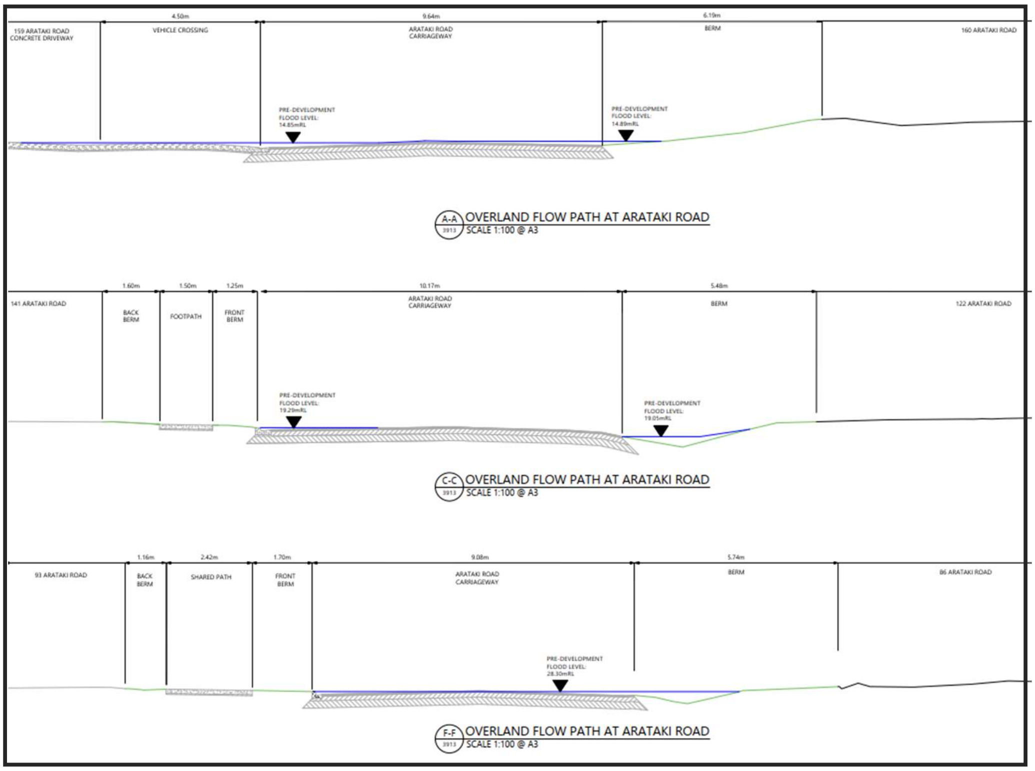


Figure 18: Predevelopment cross sections along Arataki Road

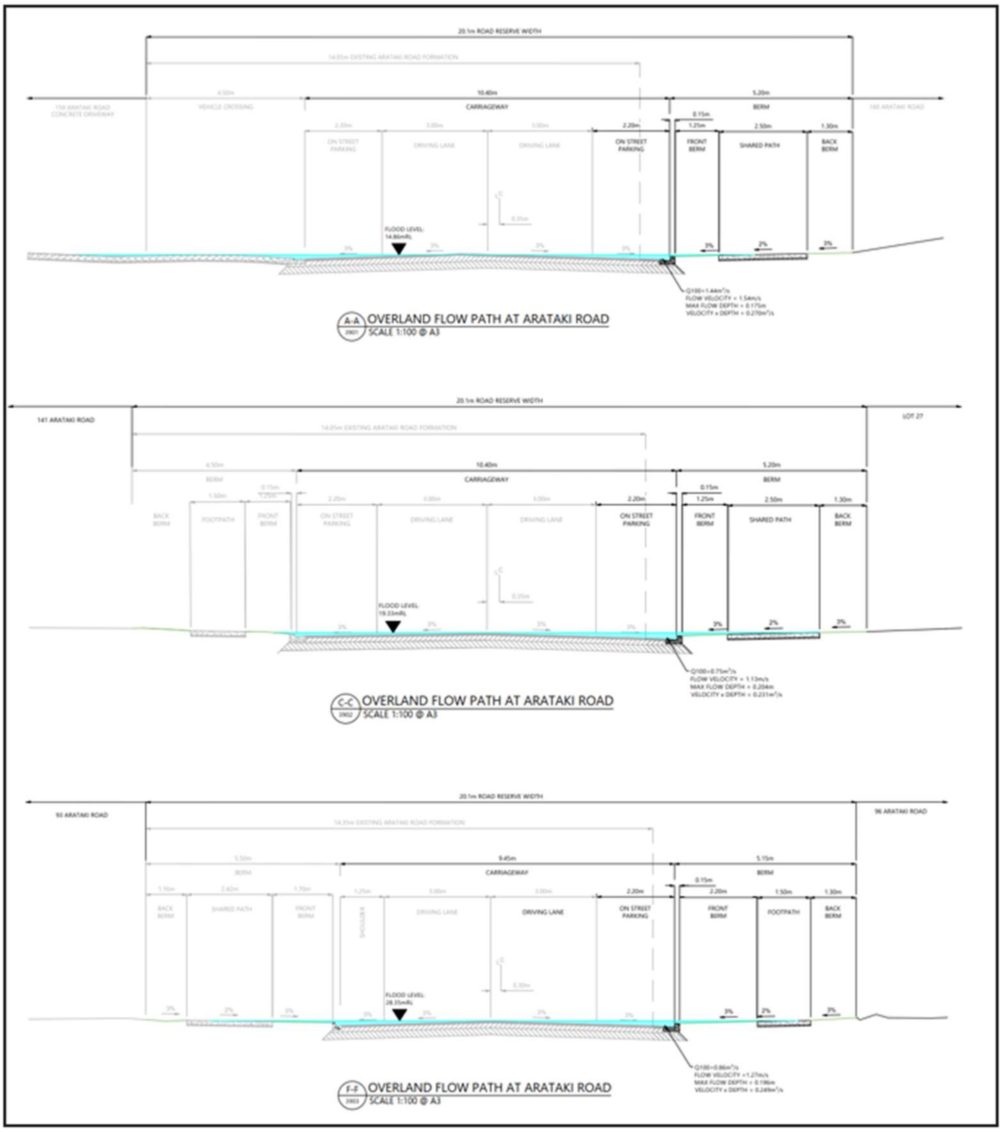


Figure 19: Post development cross sections along Arataki Road

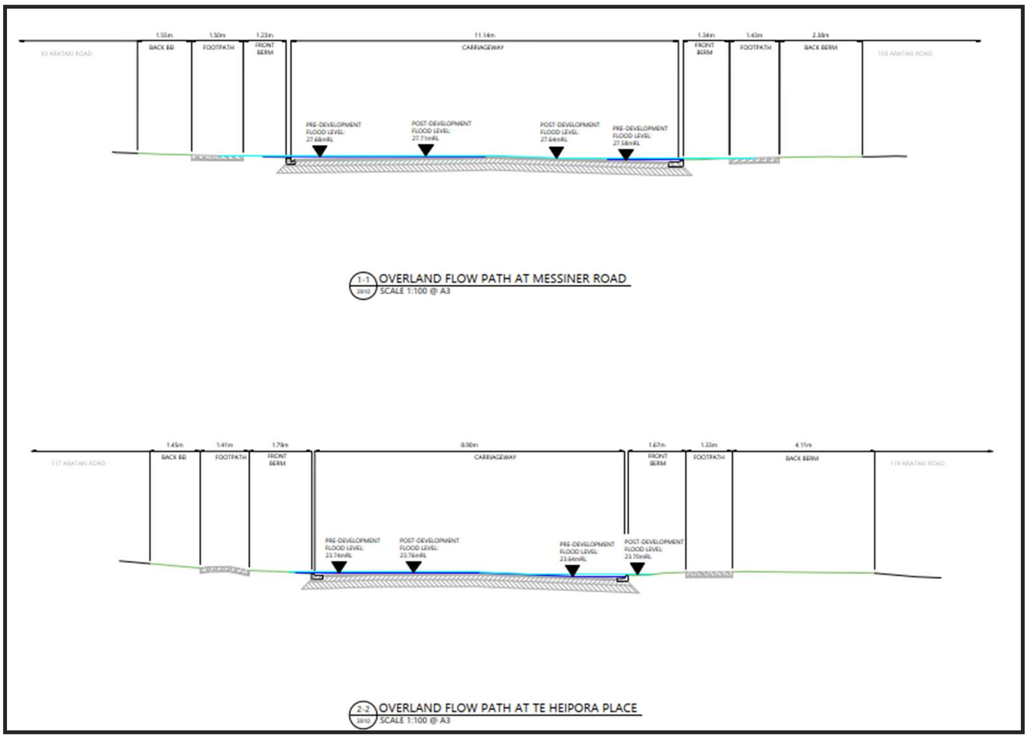


Figure 20: Pre and post development - cross section analysis along Te Heipora Pl and Meissner Rd

7.2. Sub-catchment B

Flows from Sub-catchment B will discharge to the communal dry basin prior to discharging to the stream located to the east of the site. HBRC have confirmed this stream is a modified natural watercourse that flows to the Crombie drain and is within the 'Karamu and Tributaries' scheme area, and therefore Rule 71 of the TANK plan change would apply. Correspondence from HBRC is included in Table 3.

This section summarises the proposed stormwater management for this area. The potential flood risks on Brookvale Road are discussed in Section 7.5.

7.2.1. Water quality management

In accordance with the HBRC guidelines, any stormwater discharging to a HBRC owned and maintained network should be treated to 75% total suspended solids (TSS) removal. For this proposal, a treatment train approach has been adopted where the water quality of runoff from all impervious areas is proposed to be treated via a combination of a proprietary device (baffle box or similar), and the communal dry basin.

The treatment devices proposed will be in series to provide greater water quality benefit than if used individually.

The overall removal of a given contaminant for two or more stormwater management practices in series is defined following the approach specified under Waikato Stormwater Management Guideline, May 2020[1]. The assessment indicates that the overall proposed

[1] The WSMG 2020, has been adopted as it more detailed in determining performance of treatment train approaches while drawing from the same source material (Minton, G., R., Treatment Trains, Don't Get Run Over, Stormwater Journal for Surface Water Quality Professional, July/August Issue, 2006) as the HBRC guidelines thus considered appropriate.

treatment rate exceeds the minimum requirement of 75%. This is a key outcome sort as part of our mana whenua engagement.

Table 7: Treatment train - Waikato Stormwater Management Guideline, May 2020

	TSS removal rate %
Baffle Box Proprietary Device (or similar)	73%
Dry Basin	40%
Overall	84%

As per rule 32 of the Proposed Plan Change 9 for TANK catchments, the proposal involves diversion and discharge of drainage water into water or onto or into land, from a gravity flow system (without pumping). The discharge shall not cause the natural temperature of any receiving water to be changed by more than 3°C from normal seasonal water temperature fluctuations, after reasonable mixing.

A literature review was conducted to understand the performance of the proposed treatment device with respect to temperature management. As documented in Auckland Regional Council Technical Publication 10 (TP10), the extended detention dry pond typically does not provide a temperature increase. Additionally, Auckland Council Guideline Documents 01 (GD01) suggests that the dry pond is effective in controlling temperature. However, as discussed in the HBRC Waterway Guidelines, a dry pond may not be suitable if receiving water is temperature sensitive, as detention ponds do not detain water long enough to reduce temperatures from impervious surfaces. Therefore, based on the literature review undertaken and given that the entire site (including the basin) will be vegetated, with appropriate shading, any potential temperature increase is anticipated to be managed on site appropriately prior to discharge.

It is important to note that the wetland option was also evaluated during the design phase. However, it was not pursued further due to concerns about its performance during dry summer periods.

7.2.2. Water quantity management

In order to meet the water quantity requirements of HBRC, a communal dry basin is proposed at the northern end of the site. It has been designed to undertake the following:

- Provide extended detention volume. That volume is then stored and released over a 24-hour period
- 2-year ARI and 10-year ARI - attenuation of the post-development peak discharge to pre-development
- 100-year ARI - attenuation of the post-development peak discharge to 80% of pre-development

The basin has been modelled using 'Hydrologic Engineering Centre - Hydrologic Modelling System' (HEC-HMS) with information regarding the model build and results included in Appendix D (Arataki Development – Dry Attenuation Basin Design Memorandum). The model has guided in designing the geometry of the basin and confirming the sizing of the outlet structure (Figure 9). The pre-development sub-catchment B area was determined to be approximately 6.98ha.The post-development overall contributing area to the basin was determined to be approximately 11.45ha (slightly smaller, 11.24ha for the 100-year catchment.

The modelling undertaken shows that the basin performs as intended, storing the extended detention volume, and with the attenuated flows below the required flows, as per HBRC guidelines. It also shows the emergency spillway is not activated in the 100-year ARI event. A summary of the results is discussed in the following subsections.

7.2.2.1. Stream hydrology

Given that a stream channel erosion assessment has not been undertaken for the receiving streams, extended detention volume (EDV) is proposed as a measure to address downstream stream erosion. The EDV was calculated by multiplying the water quality volume by 1.2. The EDV is designed to be stored and released over a 24-hour period.

The required EDV will be provided by large communal basin and is detailed in Table 8.

Table 8: Extended Detention Volume

Parameter	Volume
Water quality volume	895m^3
Extended detention volume	1074m^3

7.2.2.2. Basin design

A summary of the total basin geometry, including the discharge control, is presented in Table 9 with details on the structure shown in Figure 21.

The associated calculations are included in Appendix D.

A draft operation and maintenance manual has been prepared and is included in Appendix E for reference.

Table 9: Basin Design summary

Item	Dry Basin
Basin Invert Level	11.7mRL
EDV Orifice Diameter	146mm
Orifice invert	11.7mRL
Vertical slot width	230mm
Vertical slot level	12.91mRL
Maximum rim elevation	14.36mRL
Emergency spillway width	20.0m
Emergency spillway elevation	14.36mRL
Basin embankment level	14.84mRL

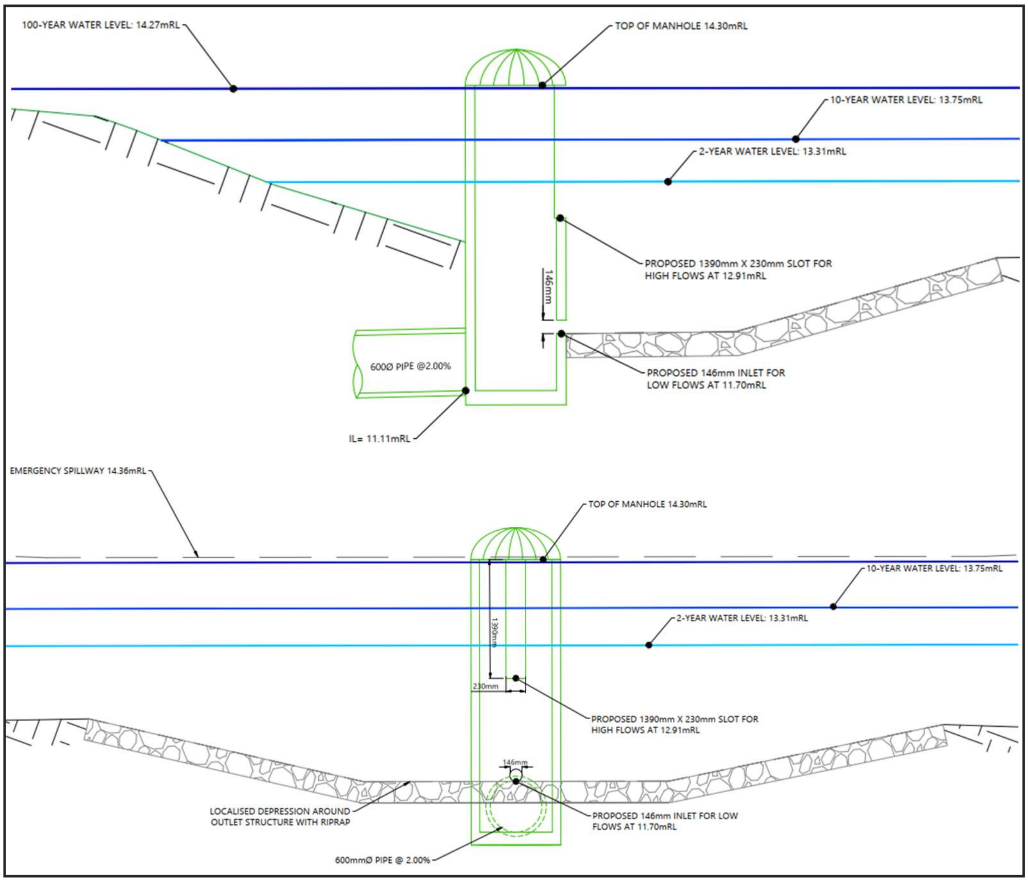


Figure 21: Discharge control design summary

Overall, the dry basin design represents the most appropriate solution for the development, ensuring effective stormwater management and treatment, while appropriately addressing potential upstream and downstream effects. Further details on the design of the basin are included in Appendix D and the Civil Infrastructure Report and associated drawings, prepared by Woods, submitted with this application.

7.2.2.3. Emergency spillway analysis

As discussed earlier, the emergency spillway is not activated under normal operating conditions. The design memo included in Appendix C discusses an assessment that has been undertaken where the primary outlet is completely blocked in the 100-year event. The assessment concludes that in this scenario, the 20m spillway will discharge flows out of the basin. It is designed as a precautionary safety feature with the likelihood of the basin embankment failing to be extremely low. Even in the very rare event that the spillway is activated, it has been engineered to safely convey flows in a controlled manner, without creating flooding or risk to downstream properties. Given the high level of design safety and minimal residual risk, a further assessment for Probable Maximum Flood (PMF) (extremely rare storm events) is not required.

Further details on this assessment is included in Appendix C.

7.2.2.4. Peak flow attenuation

A summary of the peak flows for the pre-development and post-development design scenarios are shown in Table 10. The assessment showed that 2-year and 10-year attenuation of the post-development peak discharge to pre-development and 100-year attenuation of the post-development peak discharge to 80% of pre-development can be achieved.

Supporting calculations are included in Appendix D along with the design memo.

Table 10: Pre-development and post-development peak discharges from sub-catchment B

<table>
<tr><th></th><th>2-year ARI</th><th>10-year ARI</th><th>100-year ARI</th><th>80% 100-year ARI</th></tr>
<tr><td>Pre-development (m^3/s)</td><td>0.2</td><td>0.45</td><td>0.90</td><td>0.72</td></tr>
<tr><td>Post-development (m^3/s)
(with attenuation)</td><td>0.16</td><td>0.38</td><td colspan="2">0.72</td></tr>
</table>

7.3. On-lot management (Impervious > 60%)

A bespoke stormwater management approach is required for the Arataki development because the Hastings District Plan (HDP) stormwater standards are not suited to the way this site has been designed. The subdivision has been specifically engineered to accommodate up to 60% impervious area per lot, supported by oversized communal stormwater infrastructure. The HDP applies a lower impervious threshold and does not account for this additional storage capacity. It is therefore important that future development can utilise the full 60% allowance. Where a lot exceeds this threshold, a clear process is required to determine and implement appropriate on lot mitigation to ensure stormwater effects remain appropriately managed.

7.3.1. Overall strategy

As outlined in Sections 7.1.2.1 and 7.2.2.4, on-site flows are effectively managed to 80% of the pre-development flow rate. This outcome is based on an imperviousness allowance of 60% for lots. Should imperviousness exceed 60%, additional stormwater mitigation measures will be required as shown in Figure 22.

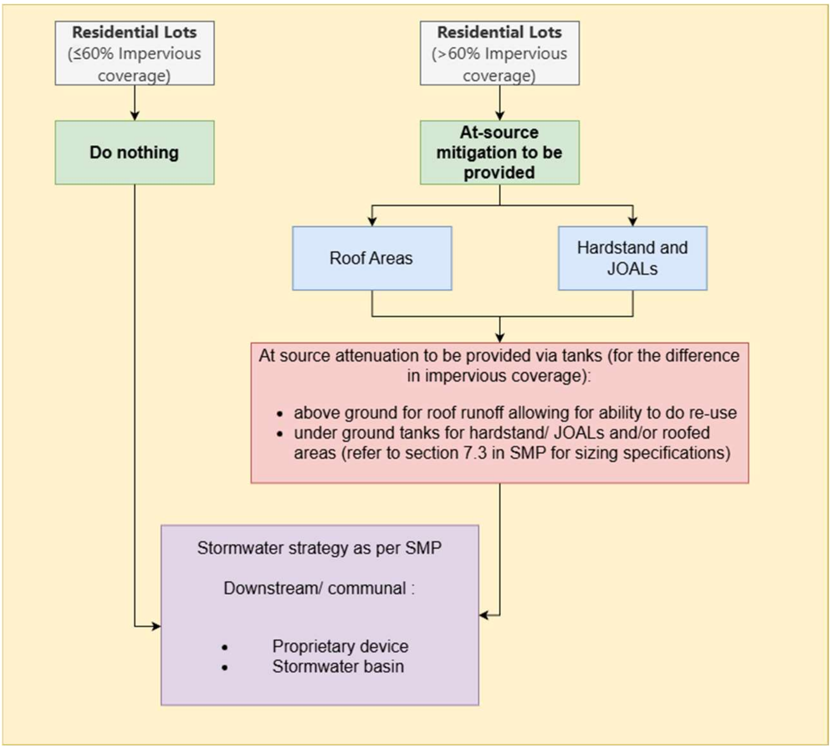


Figure 22: On-lot management strategy

7.3.2. On-lot mitigation measures

The development's stormwater system has been designed to accommodate up to 60% impervious area per lot. If a future lot owner proposes development that results in more than 60% impervious area, additional on-lot attenuation will be required.

Mitigation is to be provided through stormwater tanks, which may be installed either above ground (collecting roof runoff and enabling optional water re-use) or below ground, as shown in Figure 22.

Table 11 sets out tank volumes for additional impervious allowances beyond the 60% threshold for guidance purposes. A detailed assessment of the sizing methodology is provided in Section 7.3.2.1.

While development exceeding 60% impervious area is expected to be uncommon, Table 11 provides a clear and prescriptive pathway for determining the on-lot stormwater mitigation required where an exceedance occurs.

Table 11: Indicative on-lot tank storage requirements

Lot imperviousness (%)	Required tank storage volume (m³)	Comments
≤60%	N/A	No on-lot mitigation required
Exceedance above 60% Lot Impervious	**Required tank storage volume (m³) – Guidance only (subject to detailed design)**	**Comments**
0 – 25m²	0 - 2.2	Sizes are for guidance purposes, based on a generic underground off-shelf modular tank. Specific designs will be required for optimising tank sizes during detail design.
25 – 50m²	2.2 - 4.4	
50 – 75m²	4.4 - 6.6	
> 75m²	6.6 - 8.8+	

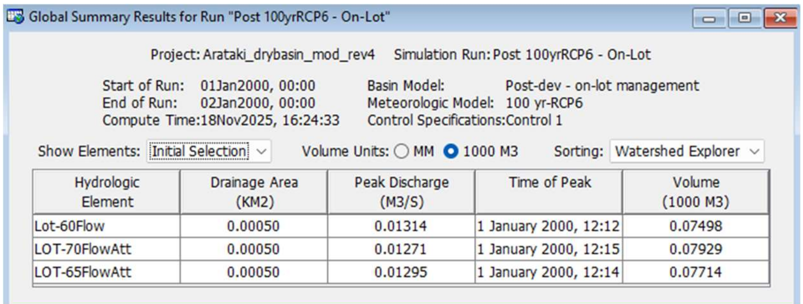
7.3.2.1. Detailed analysis

For an increase of imperviousness of 25m² per lot, on average, approximately 2.2m³ of volume (achieved via the use of attenuation tanks) will be required to manage the difference with an allowance of 10-20% for adequate tank functionality.

For an indicative lot size of 500m² at 60% imperviousness the allowable flow for the 100-year ARI event from the lot to meet the design criteria of the basin has been determined to be 13.1L/s (allowable flow from a 500m² lot at 60%). Increasing the imperviousness to 65% and 70% will result in the lots generating 13.5L/s and 13.8L/s (Figure 23) respectively which will need to be throttled/managed down to 13.1L/s or lower.

Using a generic underground off-shelf modular tank it was calculated that a tank measuring 3.6mL x 0.8mW x 0.9mH (approximately 2.46m³) with a 100mm orifice set at the base of the tank will be sufficient to manage the 60 to 65% increase for the 500m² lot (Figure 24). For the 70% imperviousness a 4.3m³ tank is adequate to achieve the allowable or lower (Figure 25).

Specific designs will be required for optimising the size of tank, location (underground versus above ground) and control structures.



Global Summary Results for Run "Post 100yrRCP6 - On-Lot"

Project: Arataki_drybasin_mod_rev4 Simulation Run: Post 100yrRCP6 - On-Lot

Start of Run: 01Jan2000, 00:00 Basin Model: Post-dev - on-lot management
End of Run: 02Jan2000, 00:00 Meteorologic Model: 100 yr-RCP6
Compute Time: 18Nov2025, 16:24:33 Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Lot-60Flow	0.00050	0.01314	1 January 2000, 12:12	0.07498
LOT-70FlowAtt	0.00050	0.01271	1 January 2000, 12:15	0.07929
LOT-65FlowAtt	0.00050	0.01295	1 January 2000, 12:14	0.07714

Figure 23: Indicative flow characteristics for a 500m² lot

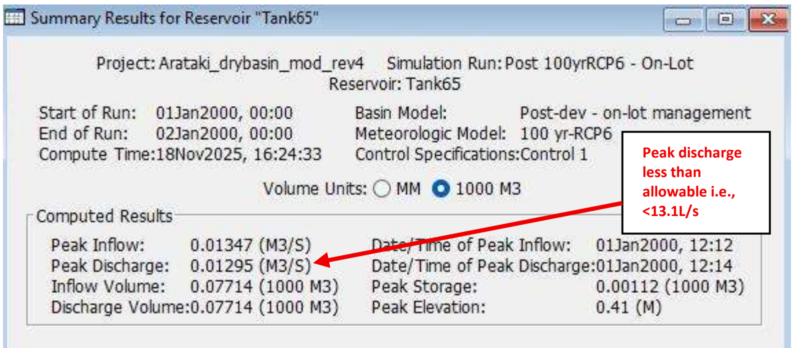


Figure 24: Indicative tank performance for 65% imperviousness for a 500m² lot

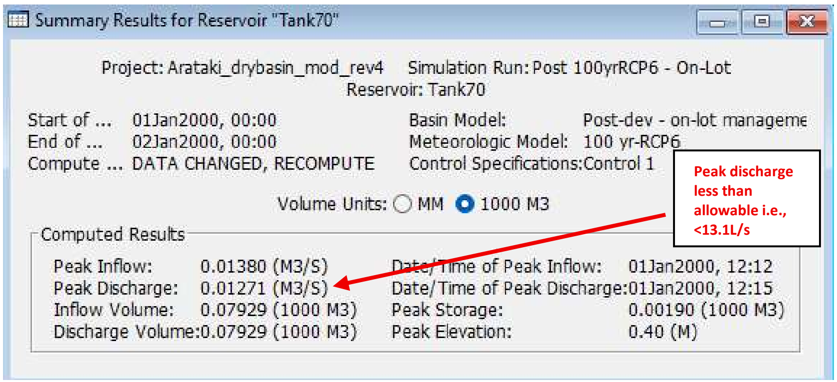


Figure 25: Indicative tank performance for 70% imperviousness for a 500m² lot

7.4. Primary network

The proposed piped reticulation is detailed in the Civil Infrastructure Report and associated drawings, prepared by Woods, that is submitted with this application.

The network is sized in accordance with HDC and HBRC standards and is summarised below:

- The network that discharges to the existing stormwater network on Arataki Road (Sub-catchment A) is designed to the 5-year ARI, in accordance with HDC guidelines
- The network that discharges to the communal basin (Sub-catchment B) is designed to the 10-year ARI, in accordance with HBRC guidelines
- The network that discharges from the communal basin to the stream is designed for the 100-year ARI

7.5. Secondary network - internal overland flow paths

The impacts of the proposed development in the catchment have been assessed to determine the flood risk within the development. This is detailed in the flood assessment memo included in Appendix C, with a summary provided in this section.

Overland flows from Sub-catchment B, for events greater than the 10-year ARI storm event, will be conveyed along road corridors as overland flow paths. Multiple representative cross-sections of the road carriageway have been analysed (Figure 26). These show that flow is contained within the road corridor, as shown in Figure 27. It is thus considered that the flood risk is acceptable.

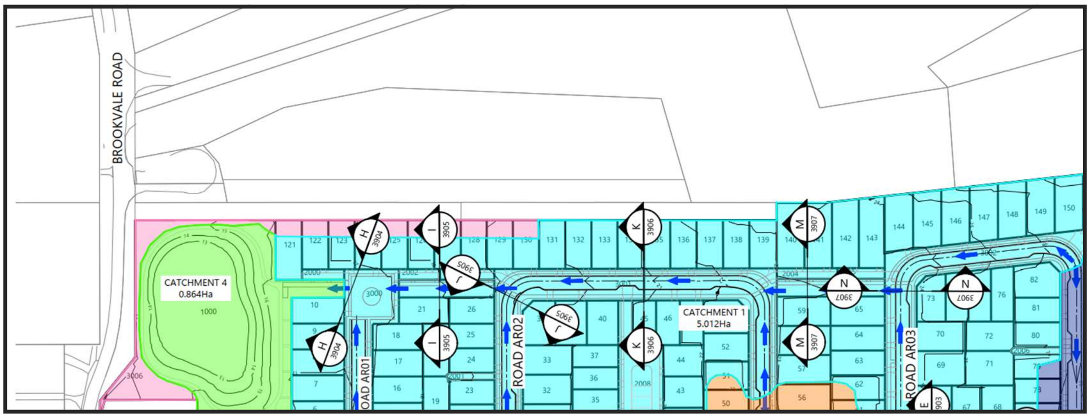


Figure 26: Select internal cross sections

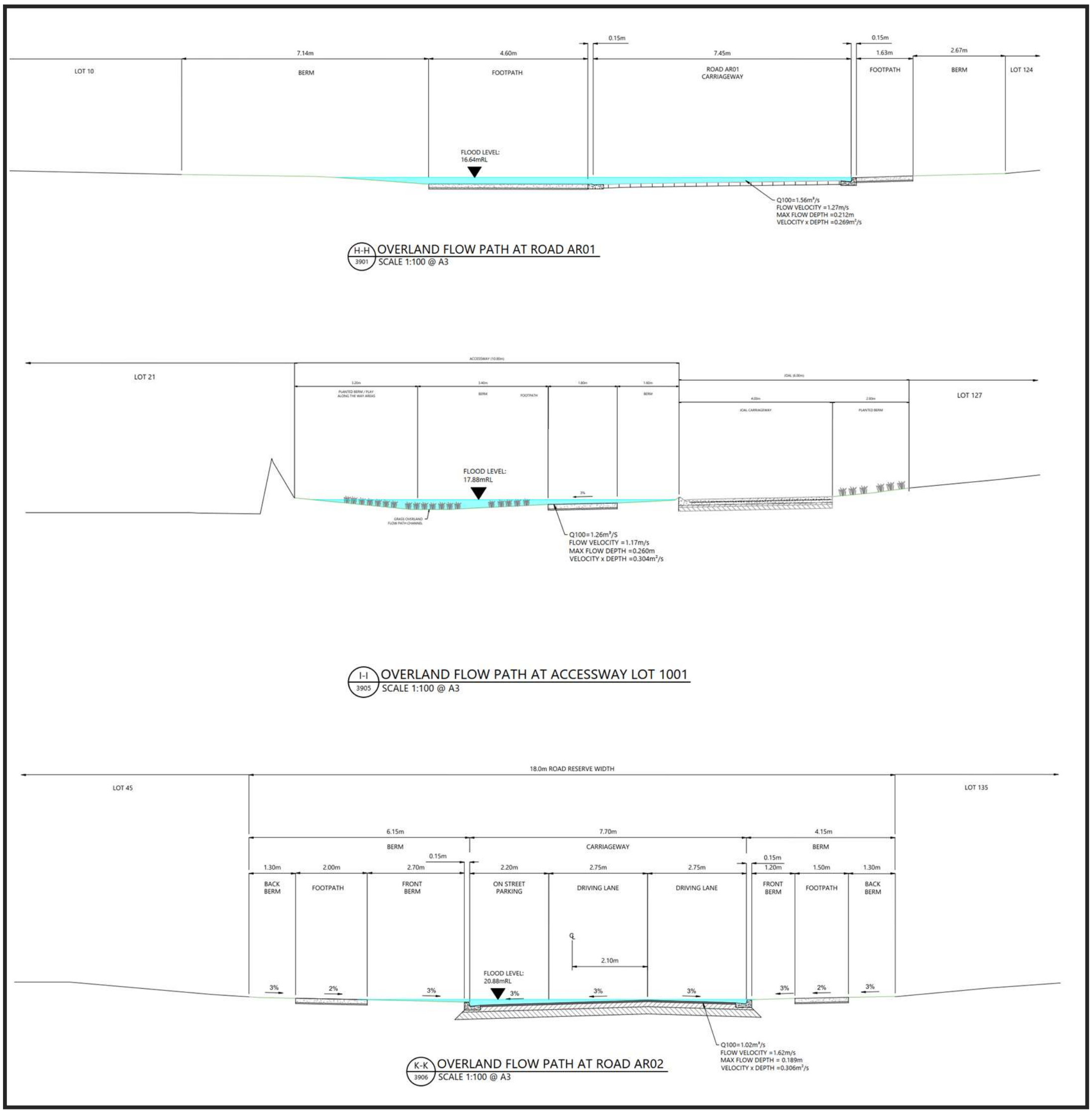


Figure 27: Cross-section K-K, Cross-Section I-I and Cross-section H-H

7.5.1. Required Finished Floor Levels

As per the HBRC Waterway Guidelines for Stormwater Management, habitable building floor levels are required to include a contingency freeboard above the 1% AEP flood level. In accordance with NZS 4404:2010, a minimum freeboard of 0.5 metres above the computed top water level for the 1% AEP design stormwater event is required for habitable dwellings, including attached garages.

7.6. Brookvale Road

Flows from Sub-catchment B are proposed to discharge to the watercourse to the east of the site as discussed in earlier sections of this report. The discharge structure is proposed to be a scruffy dome outlet with a small drain down outlet. The outlet structure is designed with appropriate erosion/scour matters to ensure that no additional degradation occurs in alignment with good engineering practice. It is not expected that the presence of the outfall structure will create negative effects at the neighbouring properties.

The outlet has been designed in accordance with HBRC guidelines and is further detailed in the Civil Infrastructure Report and associated drawings, prepared by Woods, submitted with this application.

Flood modelling undertaken shows flows from the site, flowing towards the discharge location to the stream are contained within Brookvale Road.

Cross section surface elevations taken from the model are shown in Figures 29 and 30 with the locations of the cross sections shown in Figure 28.

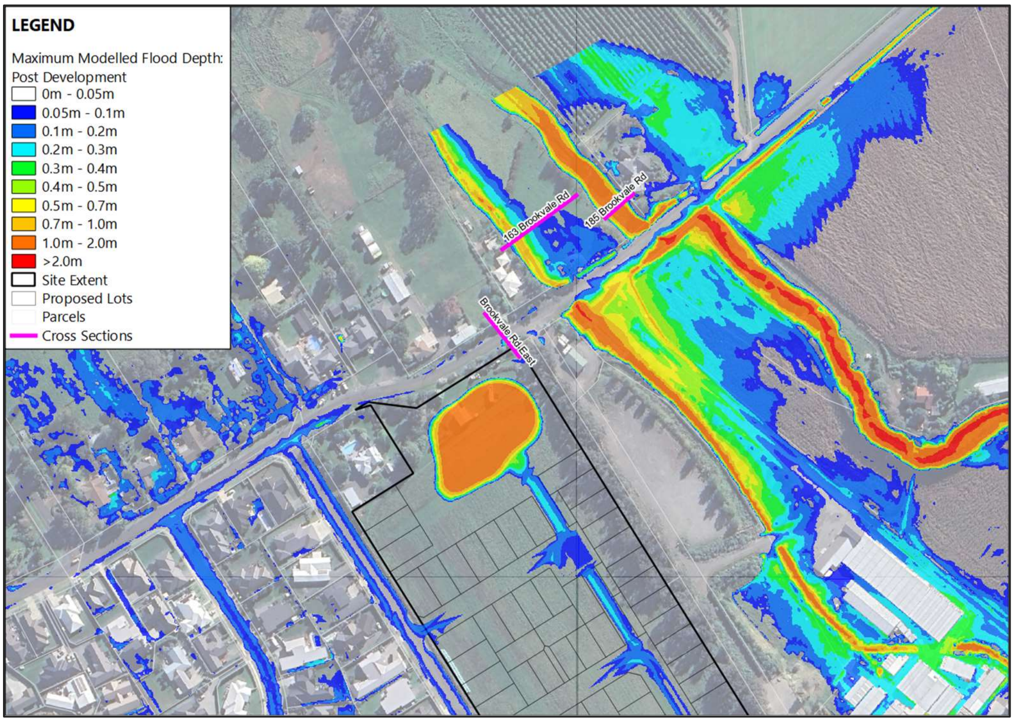


Figure 28: Cross sections along Brookvale Road and streams

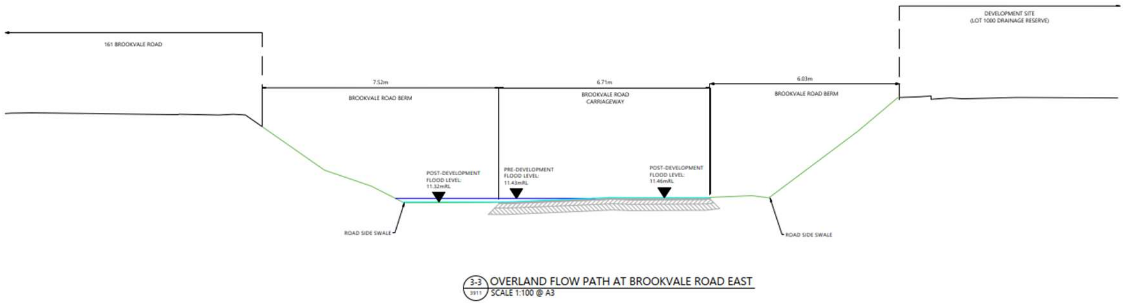


Figure 29: Water surface elevation - Cross sections along Brookvale Road

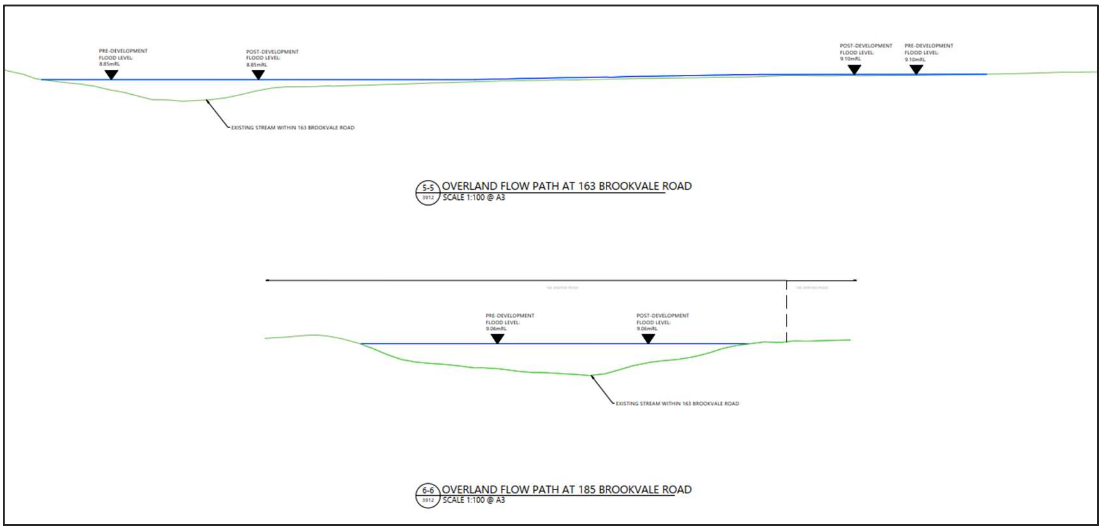


Figure 30: Water surface elevation - Cross sections along Brookvale Road – 163 and 185 Brookvale Road

7.7. Water quality monitoring

As summarised in Table 3, water quality is critical to mana whenua values. It was mentioned during the Hui (02/04/2025) that adequacy, efficiency and operations of stormwater management devices are crucial to performance of devices. As such it is important for devices to be monitored so that treatment performance can be better acquainted and understood.

Following the hui, Woods undertook further investigations into the matters that were raised, and the Project now proposes to carry out water quality testing both upstream and downstream of the development. This is intended to address mana whenua requests and to demonstrate that:

- the development will not result in adverse effects, and
- the proposed stormwater management devices will operate as intended

This work is proposed to include baseline testing to understand the existing state of the stream as well as testing post-development (up to year 3) to understand adequacy and efficiency of the devices. Baseline sampling will be conducted monthly for the first three months, followed by quarterly sampling for the remainder of the year.

A project update has been provided back to Ruahāpia Mārae and Tamatea Pōkai Whenua in terms of incorporating mana whenua values into the stormwater strategy and is included in Appendix A for reference.

To set up the baseline, the following parameters are to be tested at various locations either by field testing or laboratory analysis. A summary of the main contaminants being tested is summarised below. It is noted additional contaminants maybe tested as required.

- Total suspended solids
- Total petroleum hydrocarbons
- Heavy metals
- Total nitrogen and other nitrogen species
- Total phosphorus and other phosphorus species
- Total hardness
- E coli

The water quality sampling location plan can be found in Figure 31. Water Quality Sampling Locations below.

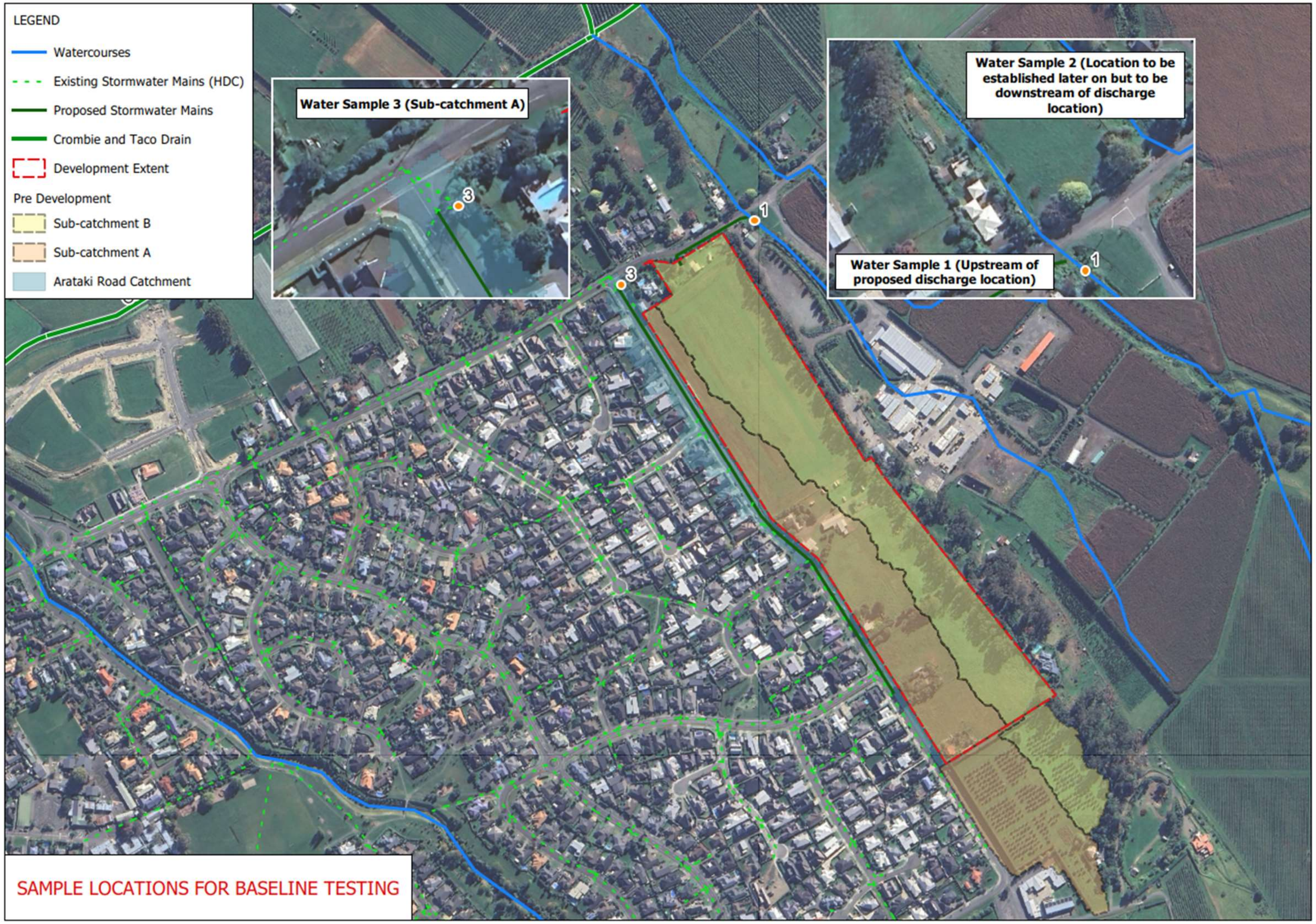


Figure 31. Water Quality Sampling Locations

8.0 Recommended Conditions

The stormwater specific recommended conditions to support the delivery of the Arataki Project through this substantive application are summarised below.

- Water quality monitoring strategy is recommended as detailed in this report to ensure:
    - the development will not result in adverse effects, and
    - the proposed stormwater management devices will operate as intended
- Stormwater management and maintenance plans are recommended for the Dry Basin, Raingardens and the Proprietary Device to ensure they are managed, operated and performs as intended.

9.0 Conclusion

Woods has been engaged to prepare a stormwater management plan (SWMP) and to support a substantive application under the Fast-track Consenting process to facilitate the development of 171 detached dwellings on the site.

The SWMP has been prepared to meet the requirements of the HDC and HBRC guidelines and standards for a Greenfield site. The proposed stormwater management strategies are:

- Provide extended detention volume. That volume is then stored and released over a 24-hour period
- 2-year and 10-year attenuation of the post-development peak discharge to pre-development, as a minimum. It is noted the proposal actual provides greater attenuation than the requirement.
- 100-year attenuation of the post-development peak discharge to 80% of pre-development
- Provide minimum of 75% total suspended solids (TSS) removal for the sub-catchment B runoff
- Stormwater management has considered temperature and device selection to mitigate temperature prior to discharge by no more than 3°C from normal seasonal water temperature fluctuations, after reasonable mixing
- Provide the best practical stormwater treatment practice for the sub-catchment A runoff
- Monitor water quality post development to ensure the effectiveness of treatment devices

Flood modelling has been undertaken for the site and surrounding areas. Model results and Water level difference plots indicate there are small, localised increases (up to 25mm). However, these are considered less than minor as the increases are minimal with flooding contained within the road reserve.

The results also indicate there are no third-party properties effected as a result of the development. The stormwater design ensures that the level of service for surrounding properties is maintained and that any additional overland flow is appropriately managed within public infrastructure.

Mana whenua engagement has highlighted the importance of water quality as a key cultural value, particularly given that water from the site will ultimately discharge to the local awa. In response, the proposal incorporates a range of water quality treatment measures, including raingardens, proprietary devices, and a dry basin. In addition, the applicant proposes to undertake post-development water quality monitoring to confirm the ongoing effectiveness of the treatment measures.

Overall, the proposed stormwater management approach ensures that runoff from the development is appropriately attenuated, treated, and conveyed, with less than minor effects on the receiving environment, upstream and downstream properties

Appendix A

(Refer to Substantive Application Consultation Report)

Appendix B

Raingarden Calculations – Indicative Calculations

WOODS
Engineers. Surveyors. Planners.

Raingarden

PROJECT NUMBER: P24-244
ADDRESS: Arataki Road
BY: TW
DATE: 22/05/2025

	RG1	
WQV	22.4	m3
Drg	0.85	m
k	0.75	m/d
h	0.15	m
trg	1.5	day
Live storage	9.0	m3
Arg	16.9	m2
Arg (Due to live storage)	29.9	m2
Proposed RG Area (m2)	10	m2

	RG2	
WQV	61.04	m3
Drg	0.85	m
k	0.75	m/d
h	0.15	m
trg	1.5	day
Live storage	24.4	m3
Arg	46.12	m2
Arg (Due to live storage)	81.39	m2
Proposed RG Area (m2)	10	m2

	RG3	
WQV	46.86	m3
Drg	0.85	m
k	0.75	m/d
h	0.15	m
trg	1.5	day
Live storage	18.74	m3
Arg	35.41	m2
Arg (Due to live storage)	62.482	m2
Proposed RG Area (m2)	35	m2

	RG4	
WQV	57.23	m3
Drg	0.85	m
k	0.75	m/d
h	0.15	m
trg	1.5	day
Live storage	22.89	m3
Arg	43.24	m2
Arg (Due to live storage)	76.3	m2
Proposed RG Area (m2)	15	m2

Raingarden Depth	Raingarden 1-3	Raingarden 4
Ponding depth (m)	0.3	0.3
Soil depth (m)	0.85	0.65
Transition layer (m)	0.25	0.25
Total depth (m)	**1.4**	**1.2**

WOODS
Engineers. Surveyors. Planners.

Raingarden WQV

PROJECT NUMBER:	P24-244
ADDRESS:	Arataki Road
BY:	TW
DATE:	22/05/2025

1/2 Arataki Road Width	10	m
Road Impervious %	80%	
Lot Impervious %	60%	
90th Percentile Rainfall Depth	17.5	mm

Raingarden	Arataki Rd interval (m)	Aratai Road (m2)	Local Road (m2)	Total Road (m2)	Total Road Imp (m2)
1	85	850	0	850	680
2	141	1410	191	1601	1281
3	85	850	629	1479	1183
4	143	1430	817	2247	1798

Raingarden	Lot Area (m2)	Lot Imp Area (m2)
1	1000	600
2	3679	2207.4
3	2491	1494.6
4	2454	1472.4

Raingarden	Area
1	1850
2	5280
3	3970
4	4701

Raingarden	Total Impervious(m2)	WQV (m3)
1	1280	22
2	3488	61
3	2678	47
4	3270	57


Raingarden 4
Raingarden 3
Raingarden 2
Raingarden 1

Appendix C

Arataki Development - Flood Risk Assessment Memorandum

To	From
Hastings District Council, Hawke's Bay Regional Council, and Environmental Protection Authority	*Woods* *Tony Wang (Associate Engineer), Boniface Kinnear (Senior Associate Engineer) Ricky Kiddle (Graduate Engineer)* *Reviewer: Bidara Pathirage- Senior Associate Engineer* *W-REF: P24-181* *18 July 2025*

Arataki Development – Flood Risk Assessment Memorandum

1. Introduction and Background

This memorandum has been prepared by Woods for CDL Land New Zealand to assess the impacts of the proposed development in the catchment and determine the flood risk within the development. CDL Land New Zealand (CDL) proposes a 171-dwelling development at 86, 108 and 122 Arataki Road Havelock North. As part of the development, it is proposed for Arataki Road to be upgraded to cater for increased vehicular and pedestrian traffic. An existing roadside swale along the eastern side of Arataki Road will be removed. This assessment aims to ensure that post development overland flows do not create any adverse effects at downstream roads and properties. Figure 1 shows the location of the proposed development.

Figure 1: Development Site

2. Modelling

2.1. Catchment Analysis

Using a digital terrain model (DEM) from LINZ and applying QGIS and SAGA tools, a catchment analysis was undertaken to determine the sizes of the subcatchments around the development and the flows they generate in the pre and post development scenarios. In the predevelopment scenario the site survey was merged with the DEM while for the post the proposed design surface was used. The catchment analysis extent is shown on Figure 2.

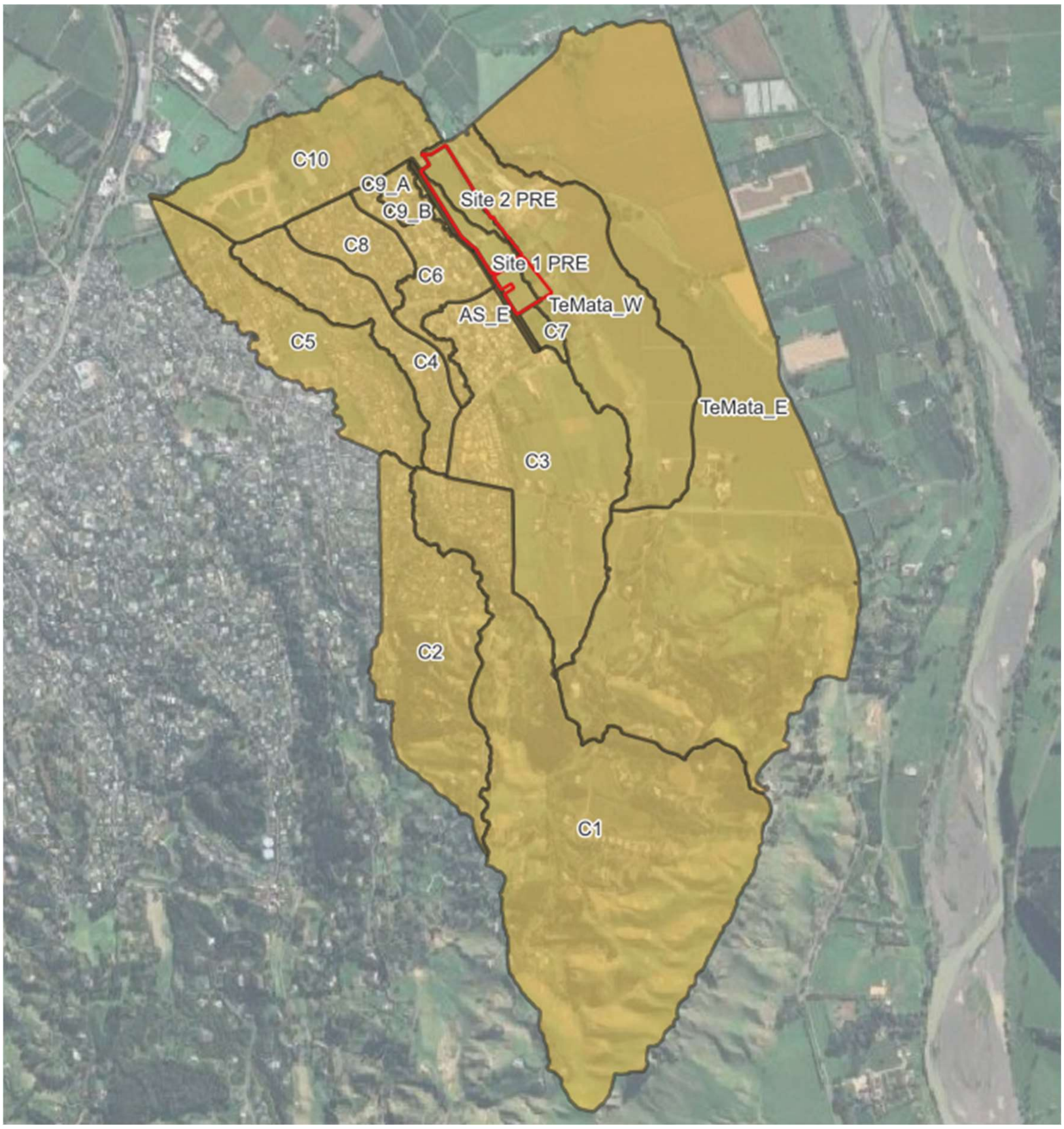


Figure 2: Catchment Extent

2.2. Hydrology Model

2.2.1. Modelling Parameters

The SCS methodology, as outlined in TP108 document (published by Auckland Regional Council, 1999) was adopted to calculate the flows generated by the various subcatchments (subbasins) as noted in the preceding section. This approach was discussed and agreed upon within the Hastings District Council. Table 1 summarises the hydrological parameters used in the HEC-HMS model. The various catchment impervious/pervious coverages were determined using data from LINZ and approximations from aerial photography while the times of concentration were calculated using the equal area method based on the DEM. Table 2 summarises these parameters.

Table 1. HEC-HMS Parameters

Parameter	Method/Value
Loss Method	TP108
Transform Method	SCS Unit hydrograph
Curve Numbers	Pervious: 61 Impervious: 98
Initial Abstraction	Pervious: 5mm Impervious: 0mm
Slope Method	Equal area slope method
Time of Concentration (ToC)	Calculated as per TP108
Lag Time (min)	2/3 of ToC

Table 2. Modelled Sub-basin Areas

Catchment	Total (ha)	Pervious (ha)	Impervious (ha)	ToC (min)
Site C1 Pre	5.84	5.54	0.29	20.5
Site C2 Pre	4.56	4.33	0.23	18.6
C1	163.12	127.66	35.46	36.8
C2	48.58	29.22	19.36	29.6
C3	68.83	49.96	18.87	34.5
C4	23.75	13.54	10.21	34.5
C5	40.96	26.70	14.26	38.2
C6	15.21	8.57	6.64	32.1
C7	2.14	1.71	0.43	13.3
C8	12.45	6.84	5.60	23.5
C9A	3.55	1.95	1.60	10
C9B	0.71	0.39	0.32	17
C10	41.55	26.90	14.65	13.3
AN_W (Arataki Road North-west)	0.46	0.25	0.20	16
AN_E (Arataki Road North-east)	0.51	0.33	0.18	16.7
AS_W (Arataki Road south-west)	0.51	0.28	0.23	17
AS_E (Arataki Road south-east)	0.60	0.42	0.18	17.6
Te_Mata_W	60.83	44.10	16.73	45.1
Te_Mata_E	224.72	171.35	53.37	51.9
Post Development (Site only)				
BV1	1.49	0.45	1.04	10
BV2	0.85	0.25	0.59	10
BV3	0.23	0.07	0.16	10
BV4	1.15	0.34	0.80	10
BV5	1.52	0.46	1.06	10
Basin_Area	1.00	1.00	0.00	10
LotE2	1.43	0.43	1.00	10
LotNE1a	0.69	0.21	0.48	10
LotNE1b	1.77	0.53	1.24	10

2.2.2. Rainfall Data

Modelled rainfall depths were obtained from the NIWA HIRDS v4 dataset for the 100-year ARI storm event and include an allowance for climate change based on the RCP6.0 scenario for the 2081-2100 period. The climate change scenario was discussed and agreed upon within the Hastings District Council. Table 3 summarises this rainfall data.

Table 3. Modelled Rainfall Depth

Storm event	Rainfall depth
24-hour 100-year ARI Rainfall Depth (accounting for **RCP6.0** climate change factor)	190

2.3. Hydraulic Model

To build the terrain model, 2023 LiDAR for the area was used together with site survey (pre-development) and design surface (post-development). To perform the analysis and determine flow behaviour, USACE Hydrologic Engineering Center-River Analysis System (HEC-RAS) version 6.6 was used. It was resolved to utilise a 2D method and a study area was developed within a trimmed terrain model. The study area was set up in a 5m x 5m grid format with 2m x 2m used for refinement in some areas (Figure 3). A global Manning's 'n' value of 0.05 was used, while for the roads, buildings, and open spaces values of 0.02, 0.1 and 0.045 were adopted. Existing culverts on Brookvale Road (east of the development) were incorporated into the model. Additionally, for the post development model, the basin was also included with a smaller outlet pipe (450mm) than the proposed outlet pipe (600mm) to regulate the flows out of the basin and mimic the outlet design. The pipe discharges adjacent to 163 Brookvale Road where the existing buildings on this property are noted to be significantly higher than the stream.

Hydrographs generated from the HEC-HMS model for the 100-year ARI event were used as inflows for the various subcatchments in the study area. A downstream boundary was set as a normal depth.

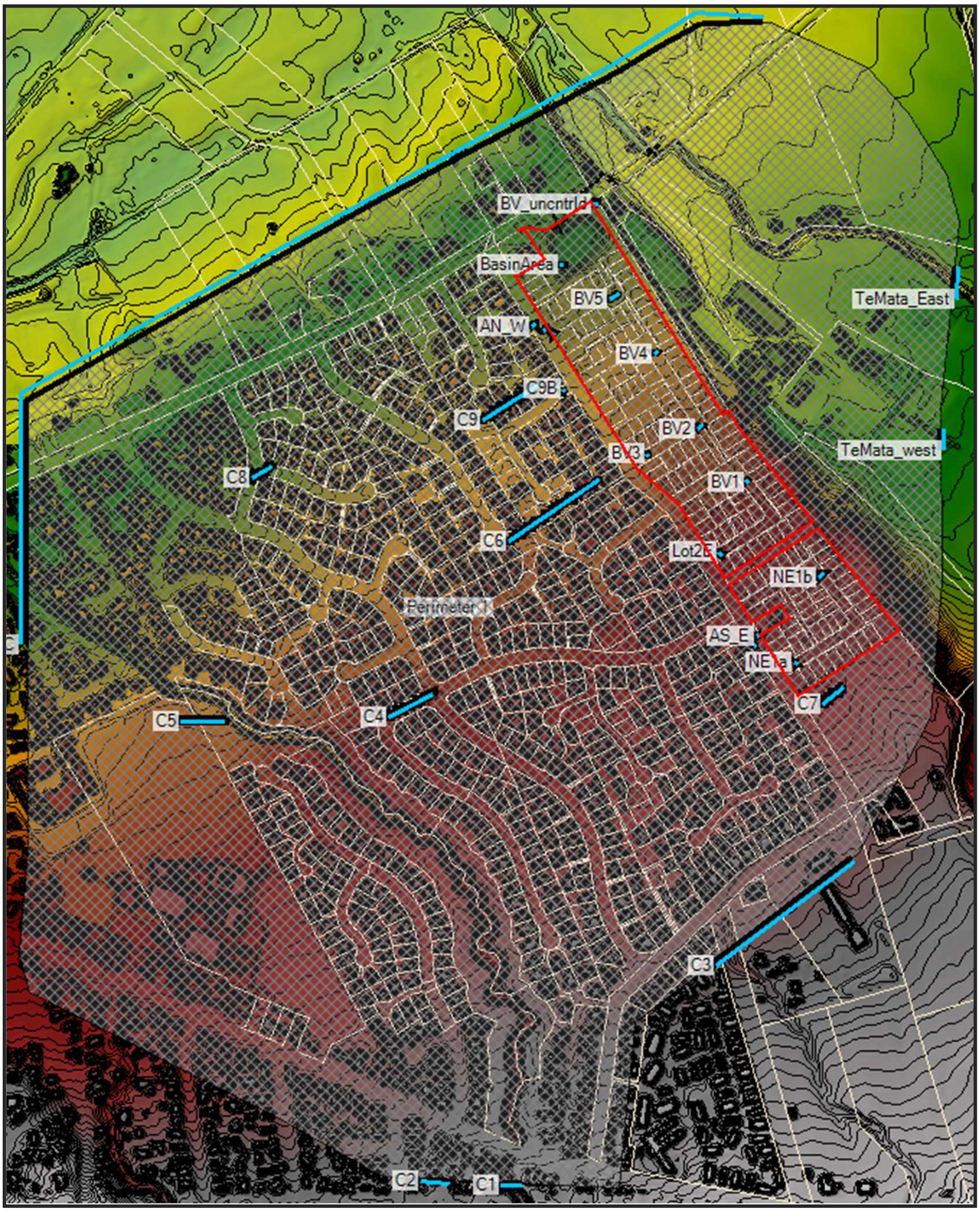


Figure 3. Model Extents (shows post development internal catchment)

3. Model Results

3.1. Overall

The model was run for a 24-hour period at computational intervals of 1s and output at the 10-minute interval using shallow water equations. Modelling results indicate that overland flows will be contained within the road corridors. Figure 4 and Figure 5 indicate the flooding extents in the predevelopment and post development scenarios (also in Attachment 1). Runoff generated onsite flows to both Arataki Road and Brookvale Road in the predevelopment scenario. In the post development, given the changes in the landform (including the incorporation of the basin) the runoff will continue to flow to both Arataki Road and Brookvale Road however to varying quantities and with differing effects. This is discussed in detail in the next section.

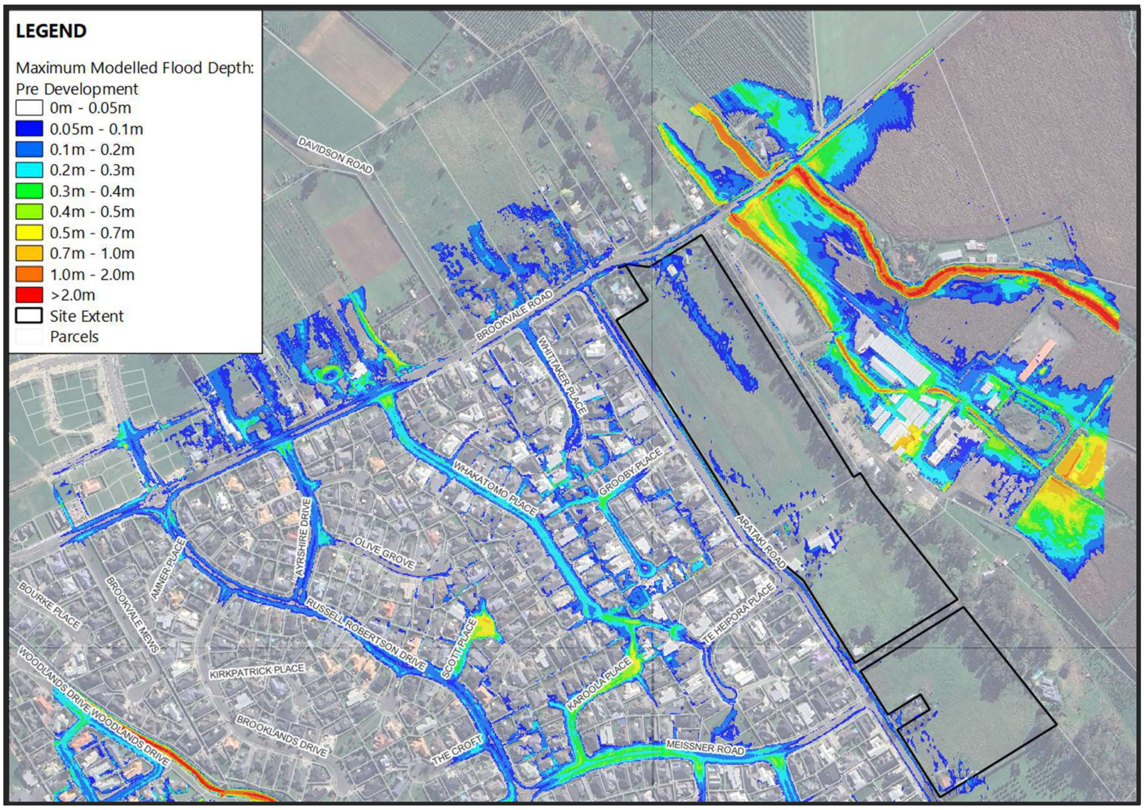


Figure 4: Predevelopment flood extent

Figure 5: Post development flood extent

3.2. Offsite

To evaluate the differences in flood levels between the predevelopment and post development scenarios, a water level difference plot was generated (Figure 6). The results indicate that the only noticeable change is along Arataki Road where the existing swale is to be removed. There are also some localised increases along some of the roads adjacent to the development [Meissner Road and Te Heipora Place], however these are considered to be less than minor i.e., less than 25mm. Several cross sections were also extracted at various downstream locations (Figure 7) along Arataki Road and Brookvale Road as well as Meissner Road and Te Heipora Place to further evaluate the differences (Figure 8, Figure 9, Figure 10, and Figure 11). The results further reinforce the observation that noticeable effects are contained within the road corridors and that no third-party properties are adversely affected. It has been noted that along Brookvale Road, the post development depths are less than in the predevelopment stage (given that the proposed basin attenuates the runoff from the development - Figure 11). Cross sections were extracted along the stream corridor (Figure 12) indicating no observable difference between the predevelopment and post development scenarios. At the discharge location to the stream east of 163 Brookvale Road, no adverse effects have been observed (note that the direct discharge to the stream is negligible in comparison to the stream flow and as per good engineering practice, erosion and scour protection will be provided at the discharge location). Overall, the effects are considered insignificant.

The integrated stormwater management approach adopted in this design combines landform modifications, engineered upgrades to the Arataki Road corridor, and the incorporation of a hydraulically engineered dry basin. Collectively, these measures provide a robust and effective framework for managing post-development runoff. The design ensures that flow rates and volumes are appropriately attenuated and controlled prior to discharge, thereby mitigating potential adverse effects on the receiving catchment. This approach aligns with best practice stormwater management principles and is considered sufficient to maintain the hydraulic neutrality of the site within the wider catchment.

Figure 6: Water level difference (pre vs post)

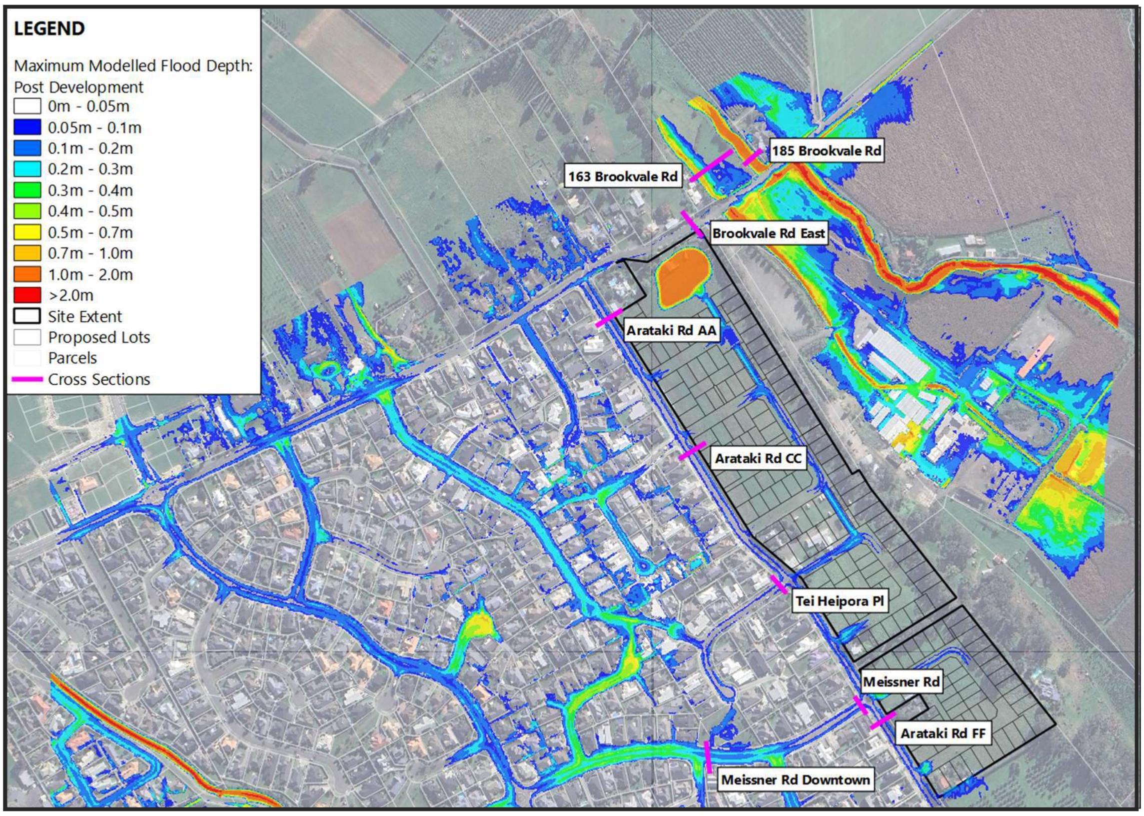


Figure 7: Cross section locations

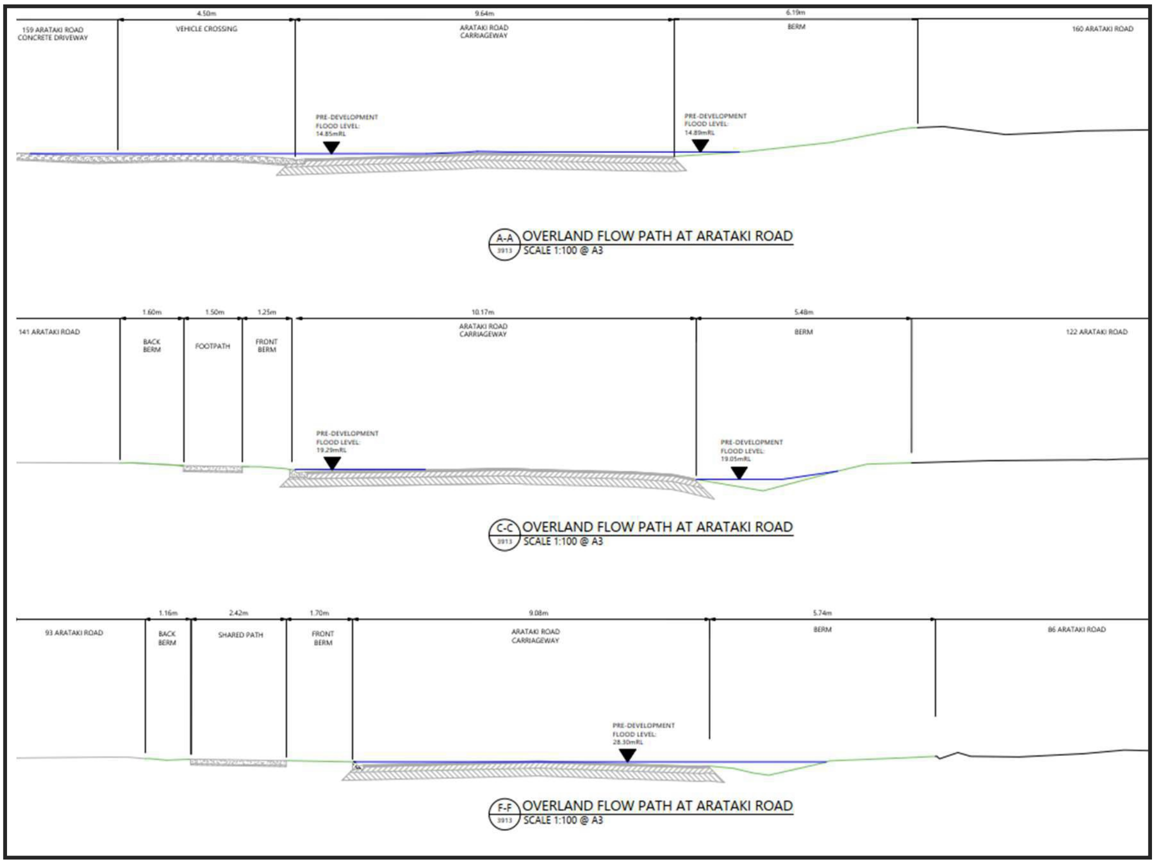


Figure 8: Predevelopment cross sections (Arataki Road)

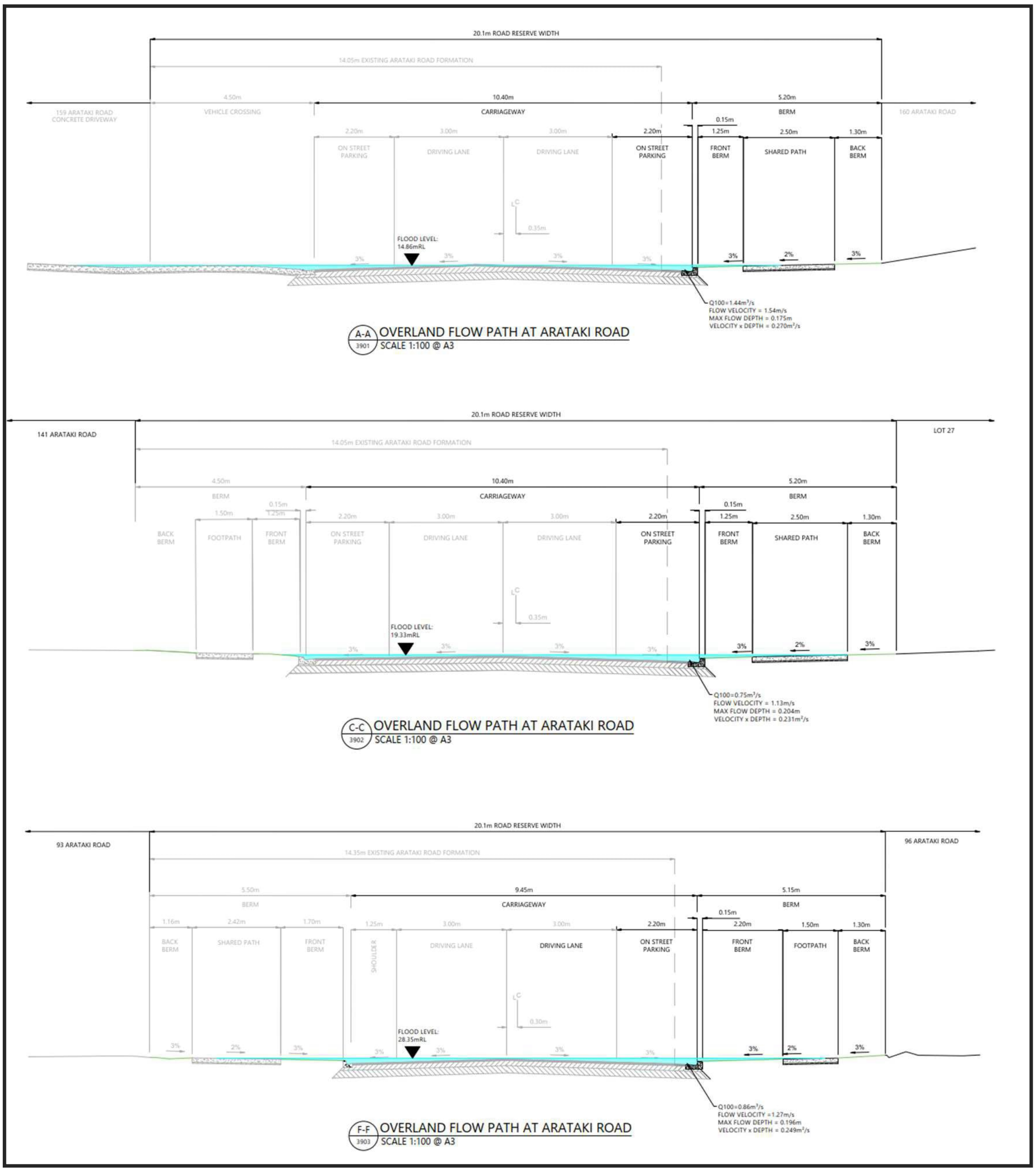


Figure 9: Post development cross sections (Arataki Road)

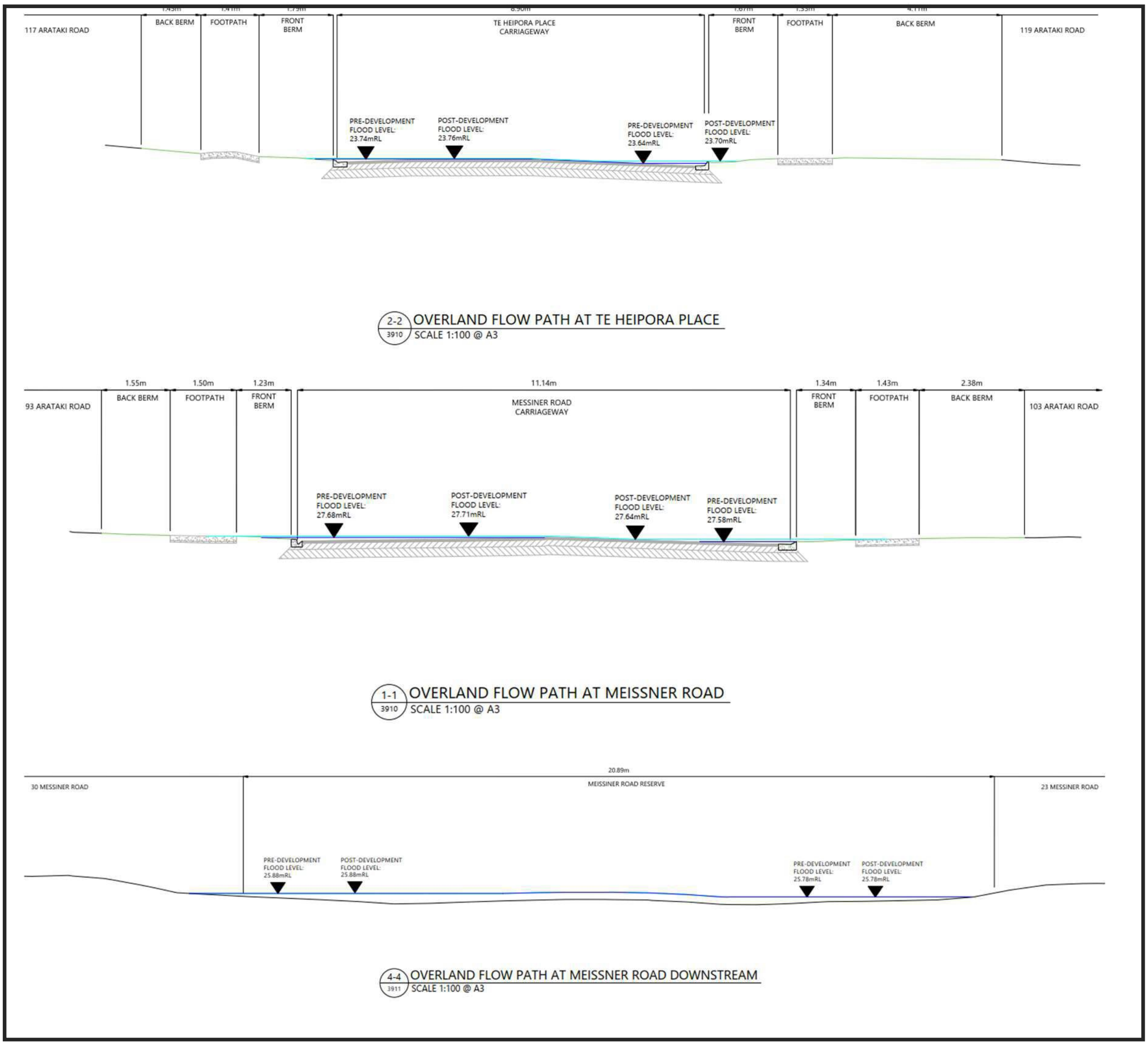


Figure 10: Select cross section comparisons (Side roads – Meissner Rd and Te Heipora Pl)

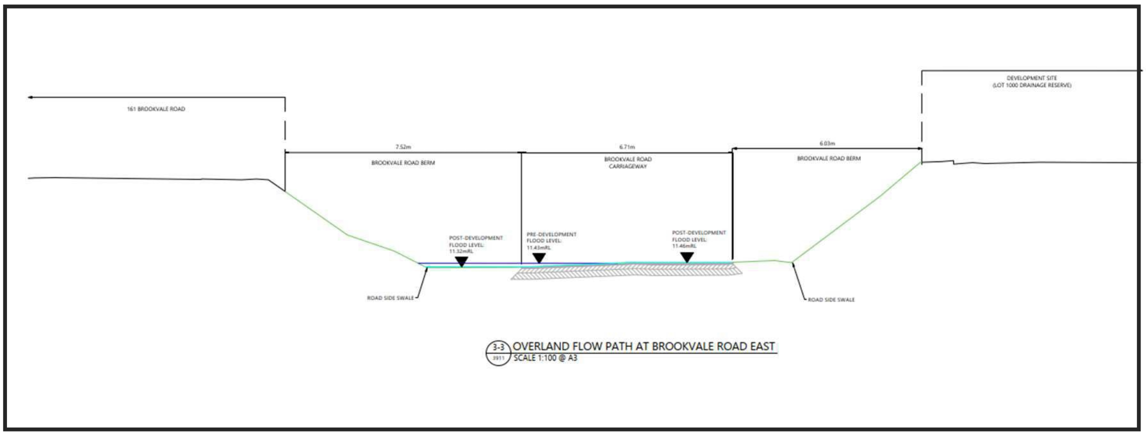


Figure 11: Brookvale Road cross section

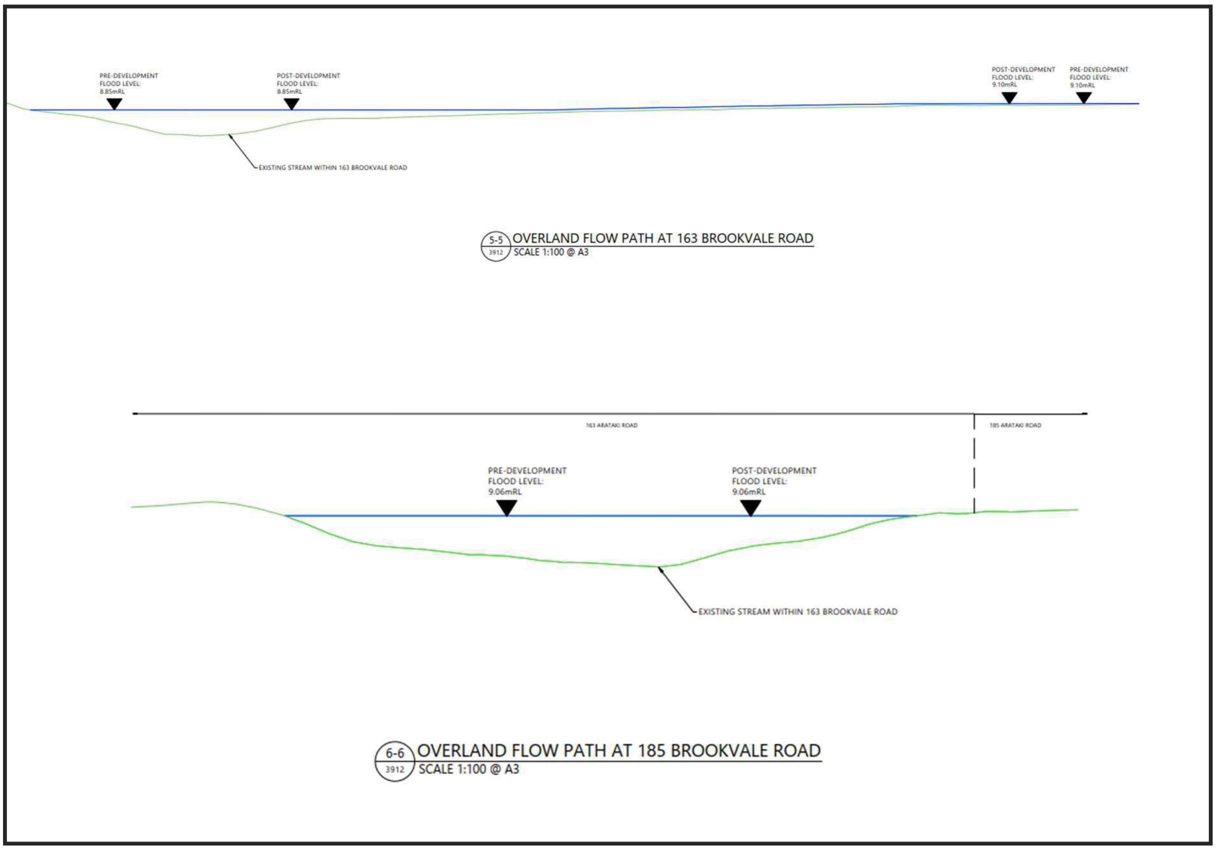


Figure 12: Stream cross sections

3.3. Internal Flooding

Based on the information/results from the post development model, the flood hazards on the proposed roads were quantified. A quantitative assessment using modelled depth and velocity based on the Australian Rainfall-Runoff 2016 manual (ARR) chart was applied to the model results to identify areas of risks. ARR defines Flood hazards vulnerability is defined into six categories as follows

- H1: Generally safe for vehicles, people and buildings
- H2: Unsafe for small vehicles.
- H3: Unsafe for vehicles, children and the elderly.
- H4: Unsafe for vehicles and people.
- H5: Unsafe for vehicles and people. All building types vulnerable to structural damage. Some less robust building types vulnerable to failure.
- H6: Unsafe for vehicles and people. All building types considered vulnerable to failure.

Figure 13 and Table 4, respectively, show the flood hazard vulnerability curves and criteria.

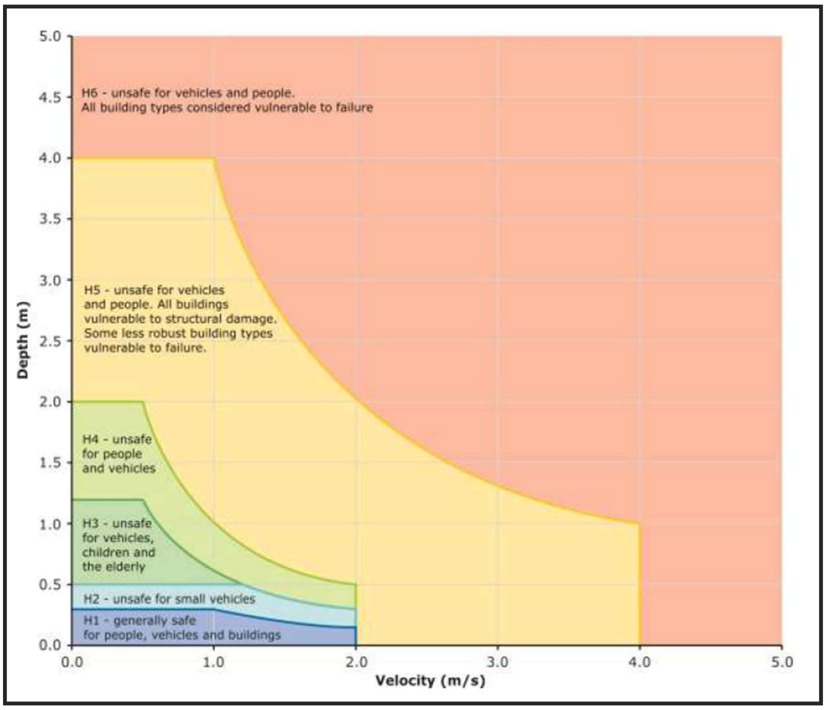


Figure 13: General flood hazard vulnerability curves.

Table 4: Hazard Curves – vulnerability thresholds classification limits

Hazard Vulnerability Classification	Classification limit (D and V in combination) m2/s	Limiting Still Water Depth (D) m	Limiting Velocity (V) m/s
H1	D*V≤0.3	0.3	2.0
H2	D*V≤0.6	0.5	2.0
H3	D*V≤0.6	1.2	2.0
H4	D*V≤1.0	2.0	2.0
H5	D*V≤4.0	4.0	4.0
H6	D*V>04.0	-	-

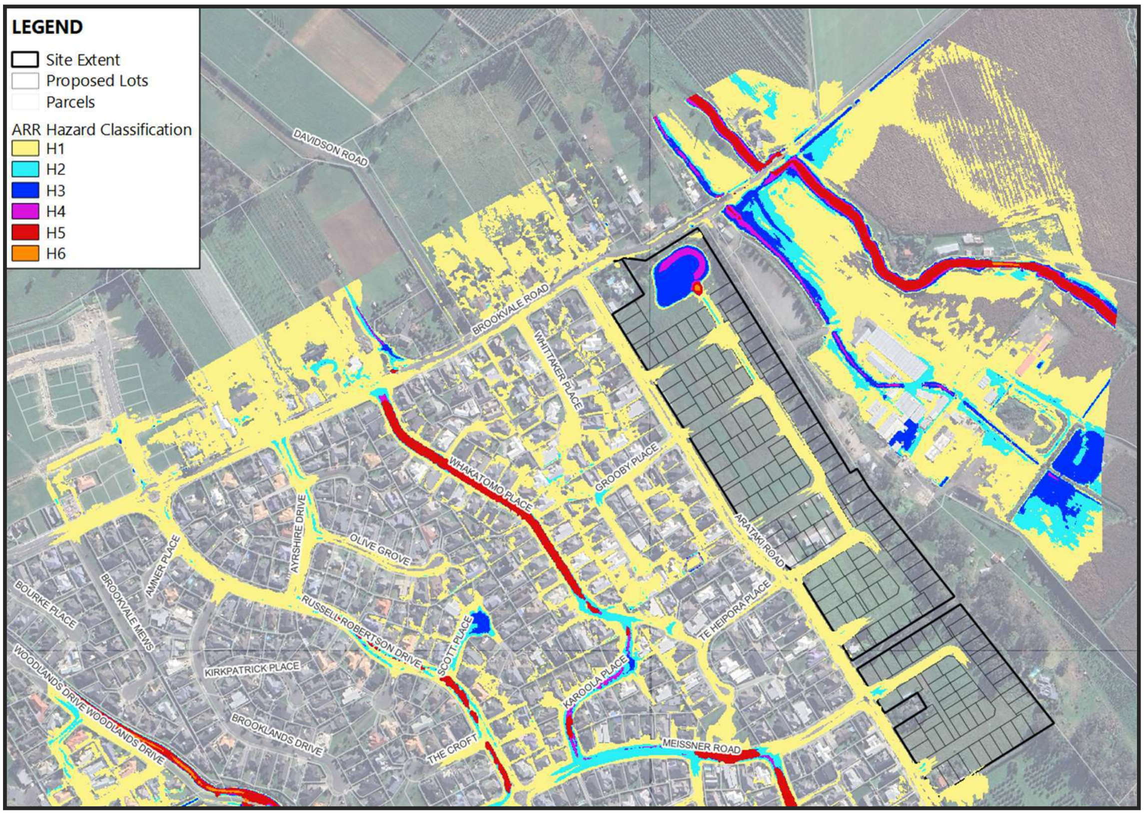


Figure 14: Modelled flood hazards

As per Figure 14 it is noted that the flood hazards on the roads within the development fall within category H1 with a very small portion of the roadway falling within H2. While category H2 indicates a mild hazard, the roads are considered trafficable during extreme events (except for small vehicles) and emergency vehicles will still have access as the hazard is isolated to a small area. The duration of this H2 threshold exceedance is approximately 10 minutes within the 24-hour design storm and does not compromise the usage of the road. The flood risk is thus considered minor. It is noted that this assessment was undertaken with the assumption that under the 100-year ARI event, the pipe network is blocked thus it can be inferred that under 50-year ARI event, the risk will be lower still.

In addition to the hazard assessment, some internal cross sections were extracted from the model (Figure 15 and Figure 16). These show that flow is contained within the road corridor.

It is thus considered that the internal hazard is acceptable as it generally safe as per the categorisation.

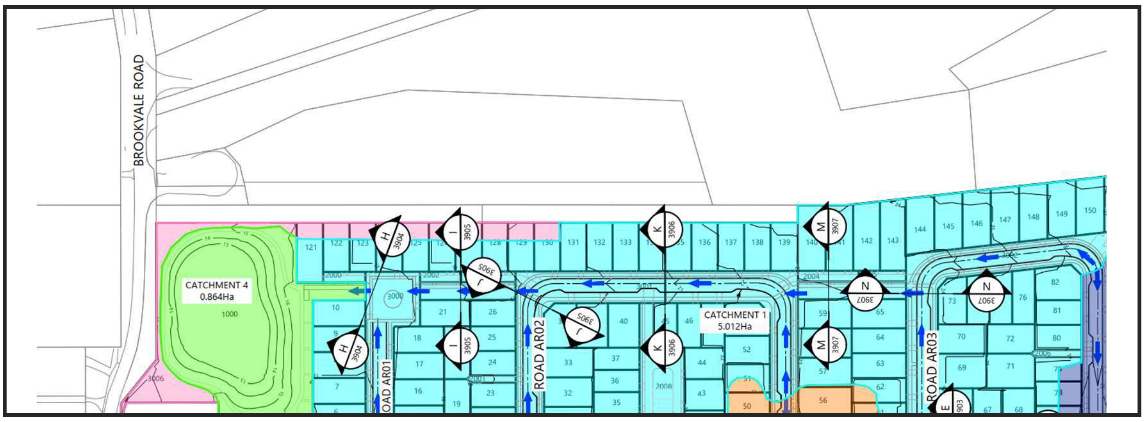


Figure 15: Select internal cross sections

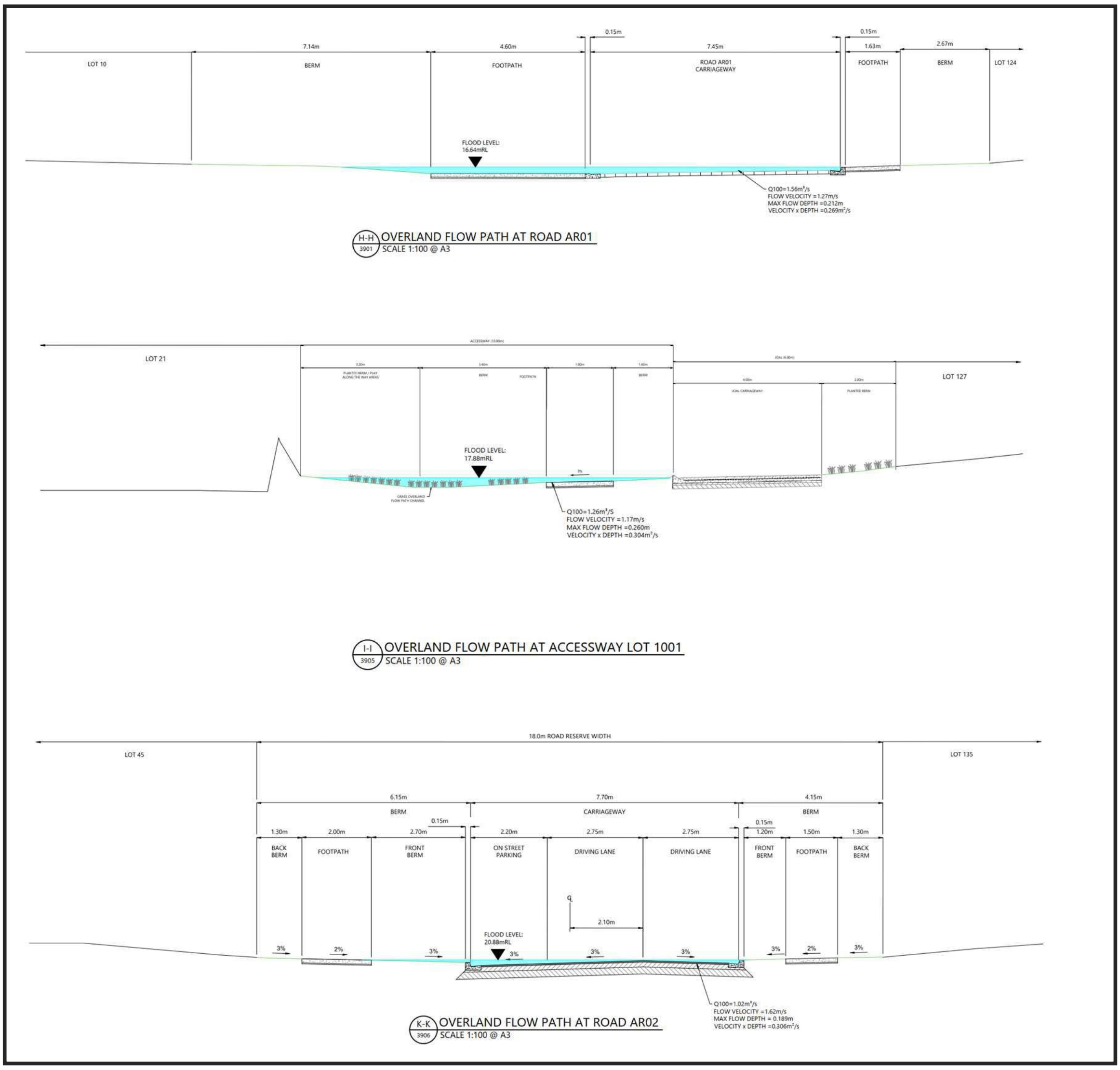


Figure 16: Cross-section K-K, Cross-Section I-I and Cross-section H-H

4. Conclusion

To understand potential impacts in the catchment due to the proposed development, a hydrodynamic model was developed. Using GIS tools, a catchment analysis was undertaken establish the extent of the contributing subcatchment areas and how runoff is conveyed within the catchment under predevelopment and post development scenarios. Information from LINZ was used to build the digital elevation model which was merged with the site survey data for the predevelopment and the proposed design surface for the post development. This included the removal of an existing roadside swale along Arataki Road and the introduction of a dry detention basin within the site.

In the predevelopment model the development site was divided into two subcatchments, A (Arataki) and B (Brookvale). In the post development, the site was further divided into smaller subcatchments to capture the landform modifications. The areal extent of Subcatchment A was reduced in the post development scenario as landform changes diverts runoff to Subcatchment B. The external subcatchments were kept the same in both scenarios. Using HEC-HMS hydrological model, runoff from the various subcatchments in the pre- and post-development scenarios was calculated for the 100-year ARI event with allowance for climate change. Hydrographs generated from the hydrological model were used as inputs to the hydraulic model (HEC-RAS 2D) to allow for the routing of runoff through the catchment and determine offsite and onsite effects.

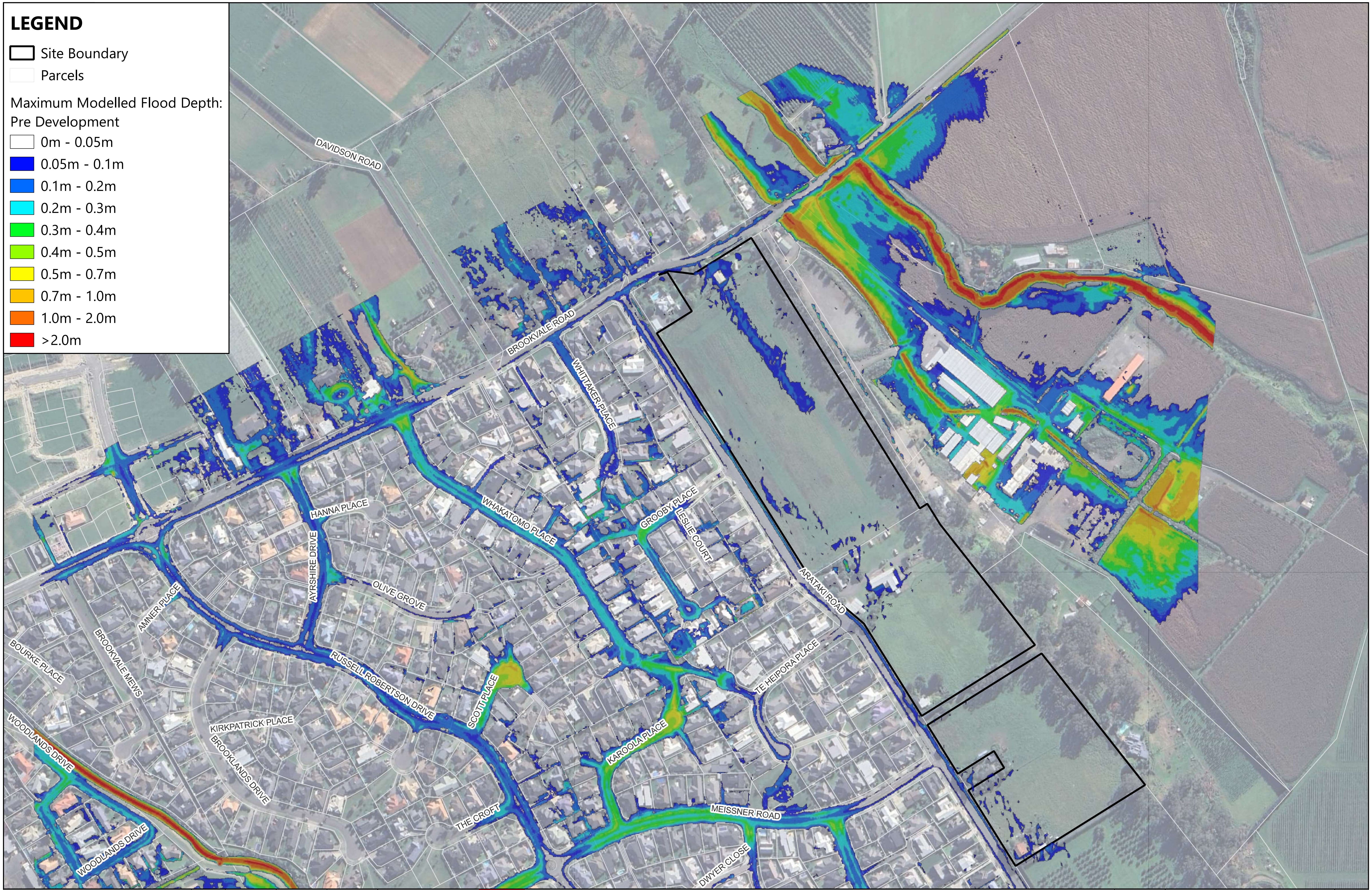
The results (mapping and cross section extracts) indicate that between the pre- and post-development scenarios, there will be a minor increase in flood depths along Arataki Road as well as Te Heipora Place and Meissner Road. The removal of the roadside swale did not affect the conveyance capacity of the road noting that a portion of the predevelopment catchment was diverted to Subcatchment B. No adverse effects were observed to third-party properties west of Arataki Road.

To the north of the development site, a reduction of flood depths was observed on Brookvale Road. This was due to the post development flows being attenuated onsite by the dry basin and released slowly to the stream located northeast of the development site. Even accounting for the increase in post development flows and volumes the no changes in depths were observed in the stream. No adverse effects were observed to third-party properties north of Brookvale Road.

An internal quantitative hazard assessment was undertaken using ARR guidelines to identify areas of risk within the development site. It was determined that runoff will be mainly contained within the proposed road corridors. The hazard was considered to be negligible.

Attachment 1

Model Results (Flood maps and cross sections)



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-	-	-	-	DRAWN	RK				COUNCIL	AUCKLAND COUNCIL	
-	-	-	-	CHECKED	-				SHEET	SHEET 1 OF 1	
				APPROVED	-	WOODS.CO.NZ					

REVISION DETAILS		INT	DATE		
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-	-	-	-	DESIGNED	-
-	-	-	-	DRAWN	RK
				CHECKED	-
				APPROVED	-

8 NUGENT STREET,
GRAFTON,
AUCKLAND

WOODS.CO.NZ

WOODS Est.1970

P22-244 - ARATAKI
MAXIMUM MODELLED FLOOD DEPTH:
POST DEVELOPMENT
100-YEAR WITH ALLOWANCE FOR RCP 6.0

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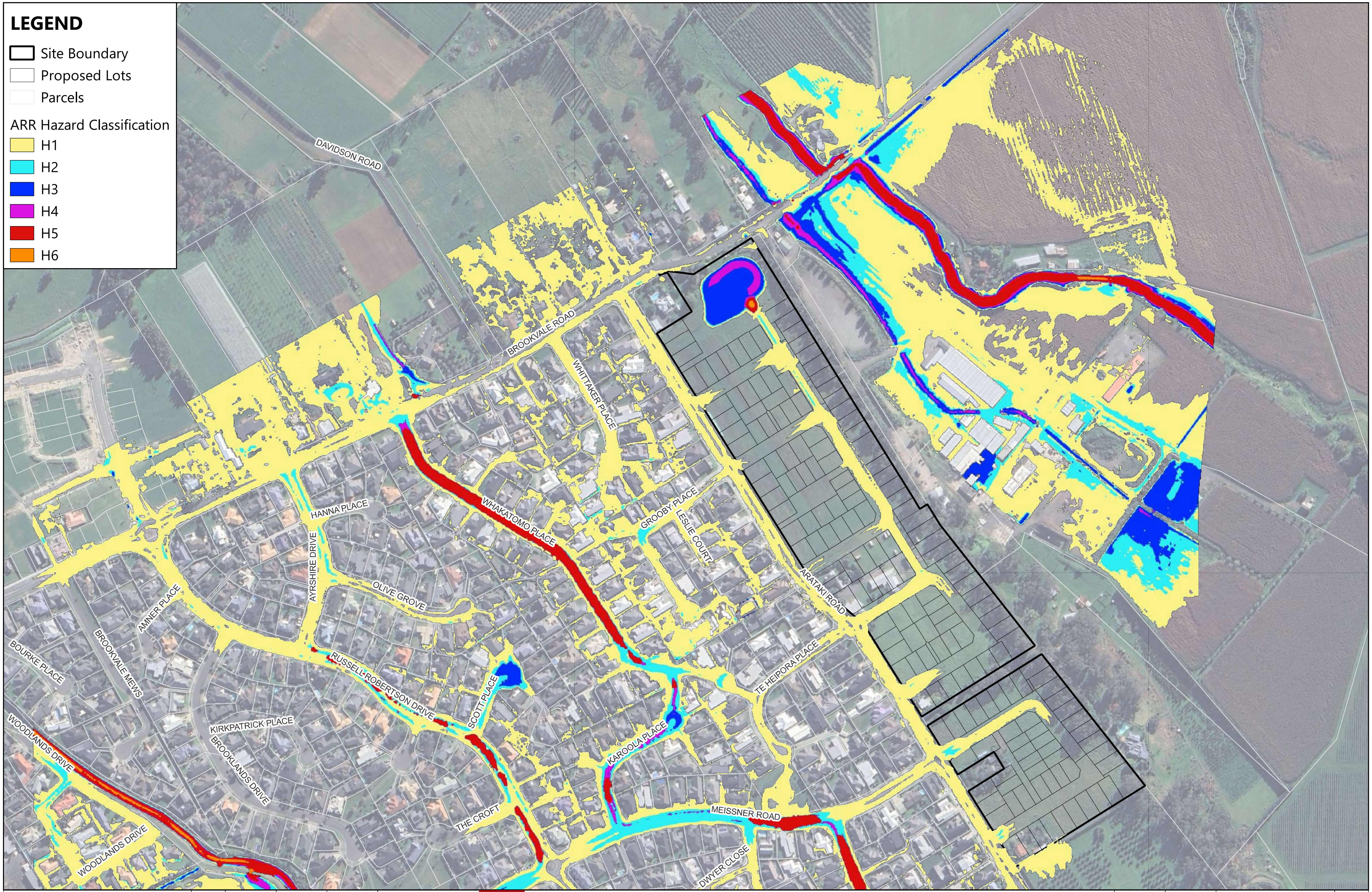
COUNCIL	AUCKLAND COUNCIL	
SHEET	SHEET 1 OF 1	



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8 NUGENT STREET,
GRAFTON,
AUCKLAND

WOODS.CO.NZ

WOODS Est.1970

P22-244 - ARATAKI
ARR HAZARD CLASSIFICATION:
POST DEVELOPMENT
100-YEAR WITH ALLOWANCE FOR RCP 6.0

STATUS	ISSUED FOR INFORMATION	REV
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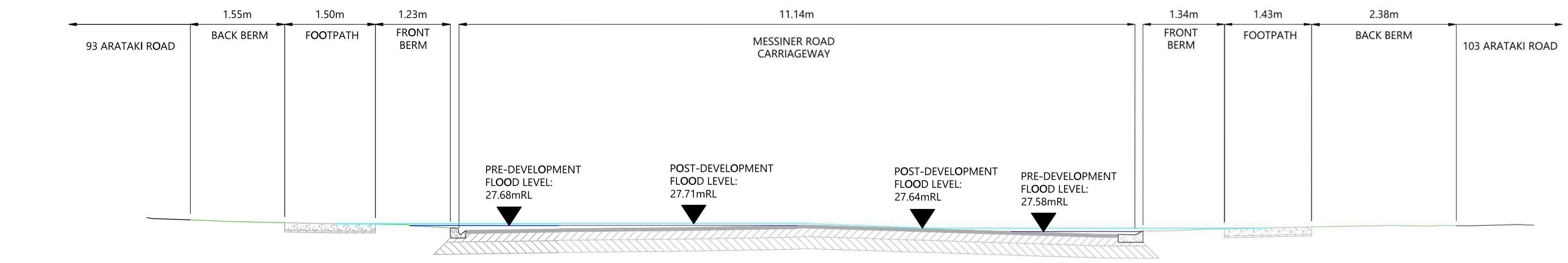
COUNCIL	AUCKLAND COUNCIL	
SHEET	SHEET 1 OF 1	



1-1 / 3910 OVERLAND FLOW PATH AT MEISSNER ROAD
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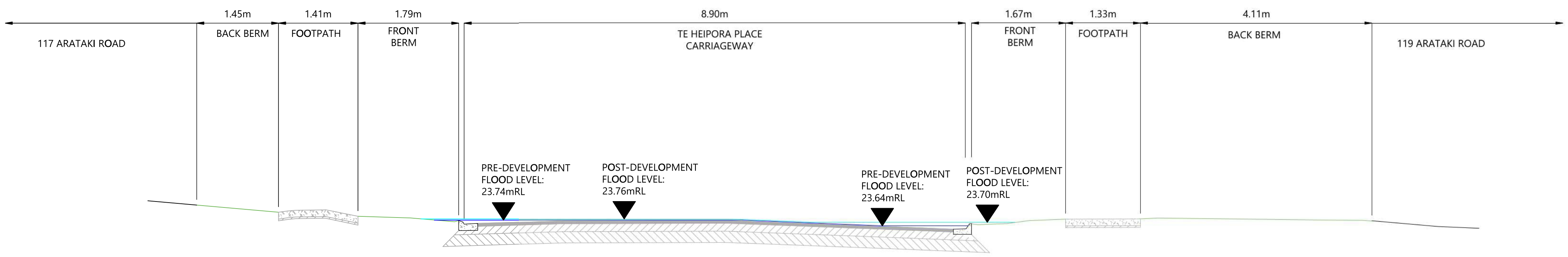

2-2 / 3910 OVERLAND FLOW PATH AT TE HEIPORA PLACE
SCALE 1:100 @ A3

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				DRAWN	AS
				CHECKED	BLO
				APPROVED	BF

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ARATAKI DEVELOPMENT - HAVELOCK NORTH

OVERLAND FLOW SECTIONS

STATUS	FOR INFORMATION	REV
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WOODS Est.1970

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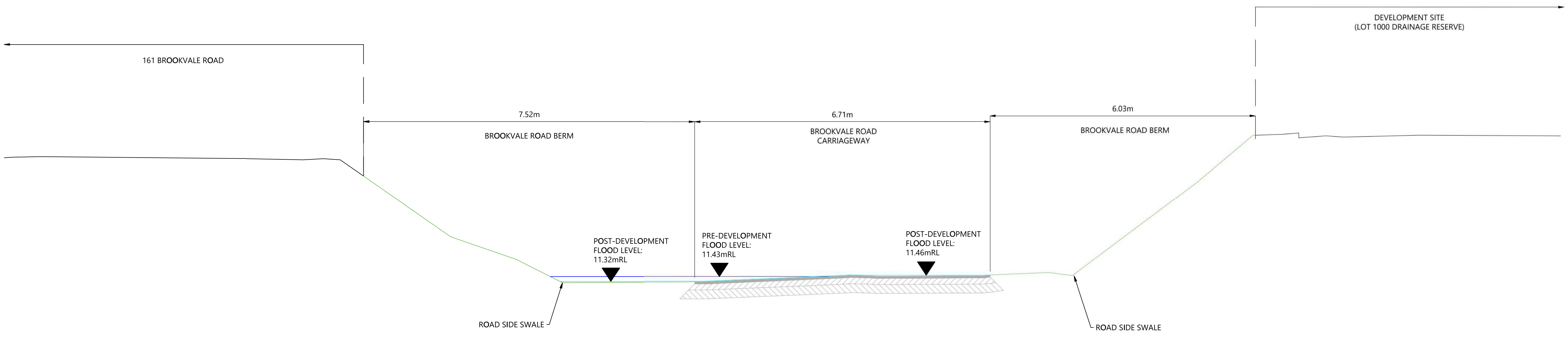
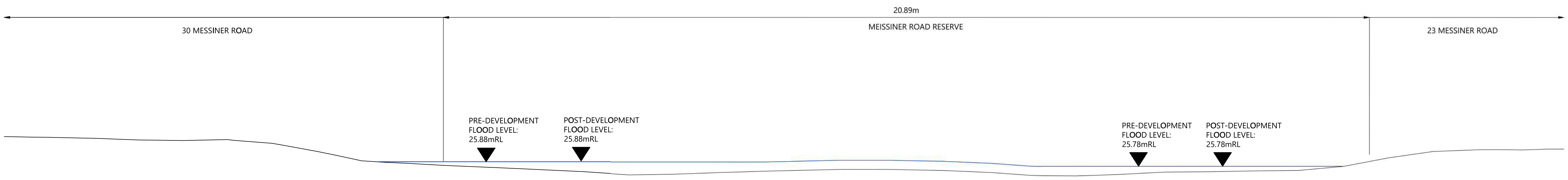


3-3 / 3911 OVERLAND FLOW PATH AT BROOKVALE ROAD EAST
SCALE 1:100 @ A3



4-4 / 3911 OVERLAND FLOW PATH AT MEISSNER ROAD DOWNSTREAM
SCALE 1:100 @ A3

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REVISION DETAILS		INT	DATE	SURVEYED	WOODS
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				CHECKED	BLO
				APPROVED	BF

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8 NUGENT ST, GRAFTON,
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+64 9 308 9229
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ARATAKI DEVELOPMENT - HAVELOCK NORTH

OVERLAND FLOW SECTIONS

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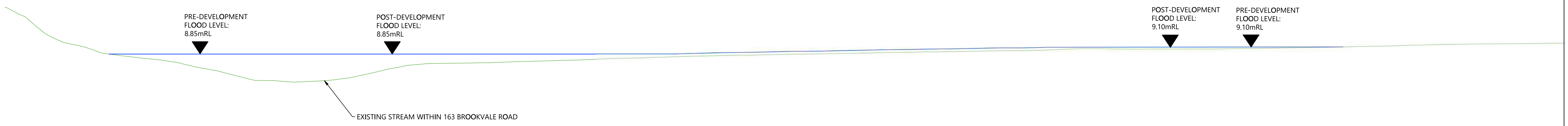
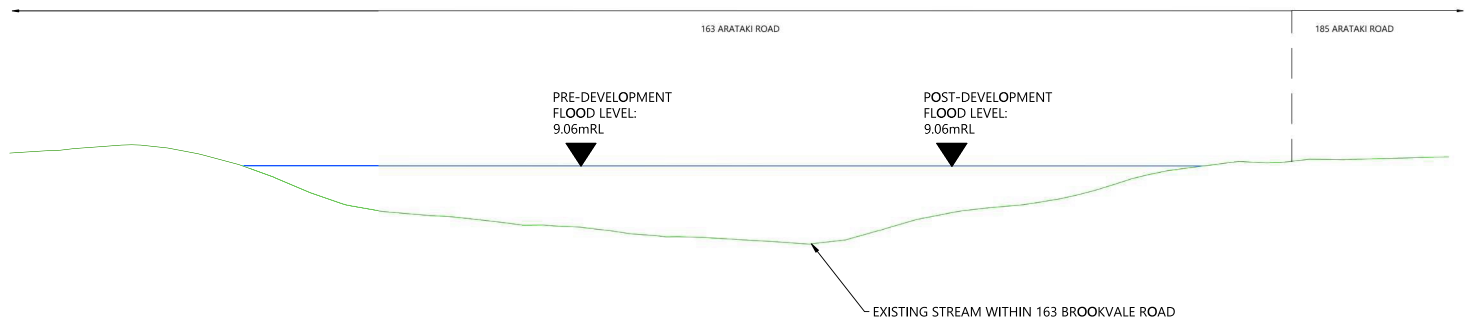


5-5 / 3912 OVERLAND FLOW PATH AT 163 BROOKVALE ROAD
SCALE 1:100 @ A3



6-6 / 3912 OVERLAND FLOW PATH AT 185 BROOKVALE ROAD
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				CHECKED	BLO
				APPROVED	BF

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AUCKLAND 1023
+64 9 308 9229
WOODS.CO.NZ

CDL LAND NEW ZEALAND LTD

ARATAKI DEVELOPMENT - HAVELOCK NORTH

OVERLAND FLOW SECTIONS

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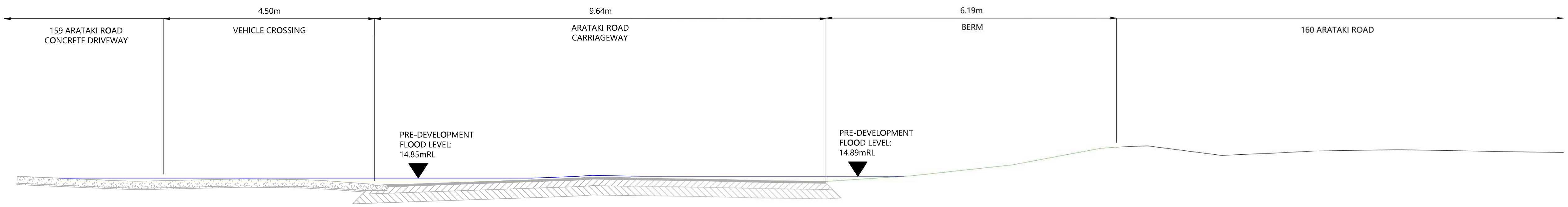
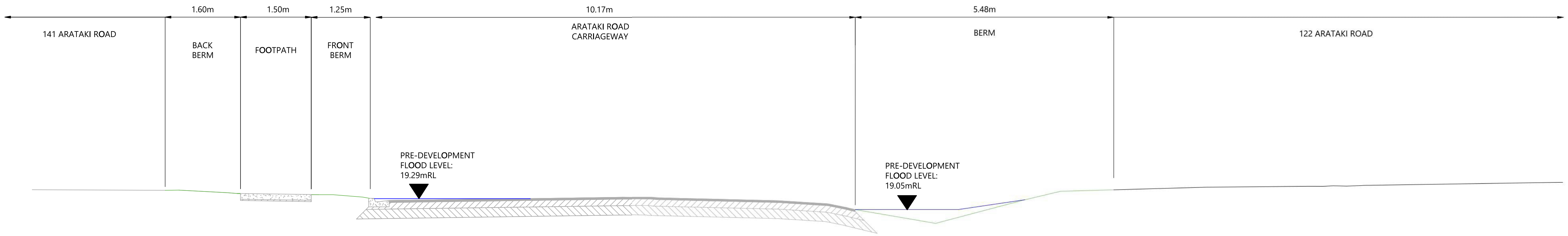


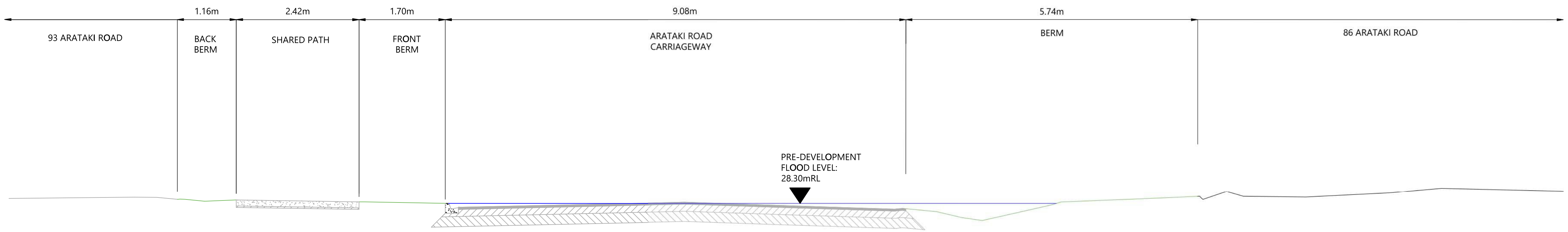
A-A 3913 OVERLAND FLOW PATH AT ARATAKI ROAD

SCALE 1:100 @ A3



C-C 3913 OVERLAND FLOW PATH AT ARATAKI ROAD

SCALE 1:100 @ A3



F-F 3913 OVERLAND FLOW PATH AT ARATAKI ROAD

SCALE 1:100 @ A3

SCALEBAR (m) 0 1 2 5

SCALE | 1:100 @A3 | 1:50 @A1|

REVISION DETAILS		INT	DATE	SURVEYED	WOODS
1	FOR INFORMATION	AS	JUN 2025	DESIGNED	AS
				DRAWN	AS
				CHECKED	BLO
				APPROVED	BF

BUILDING B, LEVEL 1
8 NUGENT ST, GRAFTON,
AUCKLAND 1023
+64 9 308 9229
WOODS.CO.NZ

CDL LAND NEW ZEALAND LTD

ARATAKI DEVELOPMENT - HAVELOCK NORTH

OVERLAND FLOW SECTIONS

STATUS	FOR INFORMATION	REV
SCALE	1:100 @ A3	1
COUNCIL	HASTINGS DISTRICT COUNCIL	
DWG NO	P24-244-00-3913-DR	

Plot Date: 1:45:41 pm,11 June 2025, APRILS
File: C:\USERS\APRILS\DOWNLOADS\ARATAKI\P24-244-00-3900-DR_OLFP FOR BONNY.DWG

Appendix D

Arataki Development – Dry Attenuation Basin Design Memorandum

To

Hastings District Council, Hawke's Bay Regional Council, and Environmental Protection Authority

From

Woods
Ricky Kiddle (Graduate 3 Waters Engineer)
Boniface Kinnear (Senior Associate – 3 Waters Engineer)
Reviewer: Tony Wang (Associate – 3 Waters Engineer)

W-REF: P24-244
18 July 2025

Arataki Development – Dry Attenuation Basin Design Memorandum

1. Introduction

Woods have been engaged by CDL Land New Zealand Limited (CDL) to provide a design for a dry detention/ attenuation basin for a portion of the development as part of a Fast-track substantive application for a 171-lot residential subdivision and development comprising 86, 108 and 122 Arataki Road measuring approximately 11.45ha (Figure 1). The purpose of the basin is to:

- provide management of the extended detention volume generated by the developed site[1]
- attenuation of peak post development flows for 2-year and 10-year annual recurrence interval (ARI) events generated by the developed site to 80% of the predevelopment
- attenuation for the peak post development flow for the 100-year ARI to 80% of the predevelopment level.

The corresponding predevelopment portion of the site used to set the allowable predevelopment flows is the eastern side of the development and referred to '**Subcatchment B**' (alternatively Brookvale subcatchment) measuring approximately 7ha and with runoff conveyed to Brookvale Road to the east (discussed in detail in the subsequent section). The runoff is collected to an unnamed stream located on the eastern side of 163 Brookvale Road which in turn discharges to Crombie and Taco Drains to the north. The western side of the development (**Subcatchment A** or Arataki Subcatchment ~4.5ha) discharges to Arataki Road/Brookvale Road intersection where a primary stormwater network exists along Brookvale Road.

This memo is to be read in the context of the overall Stormwater Management Plan (SMP) which provides the overall framework and additional details for the management of discharges from the development as per the requirements of Hastings District Council and Hawke's Bay Regional Council.

[1] Channel erosion assessment has not been undertaken

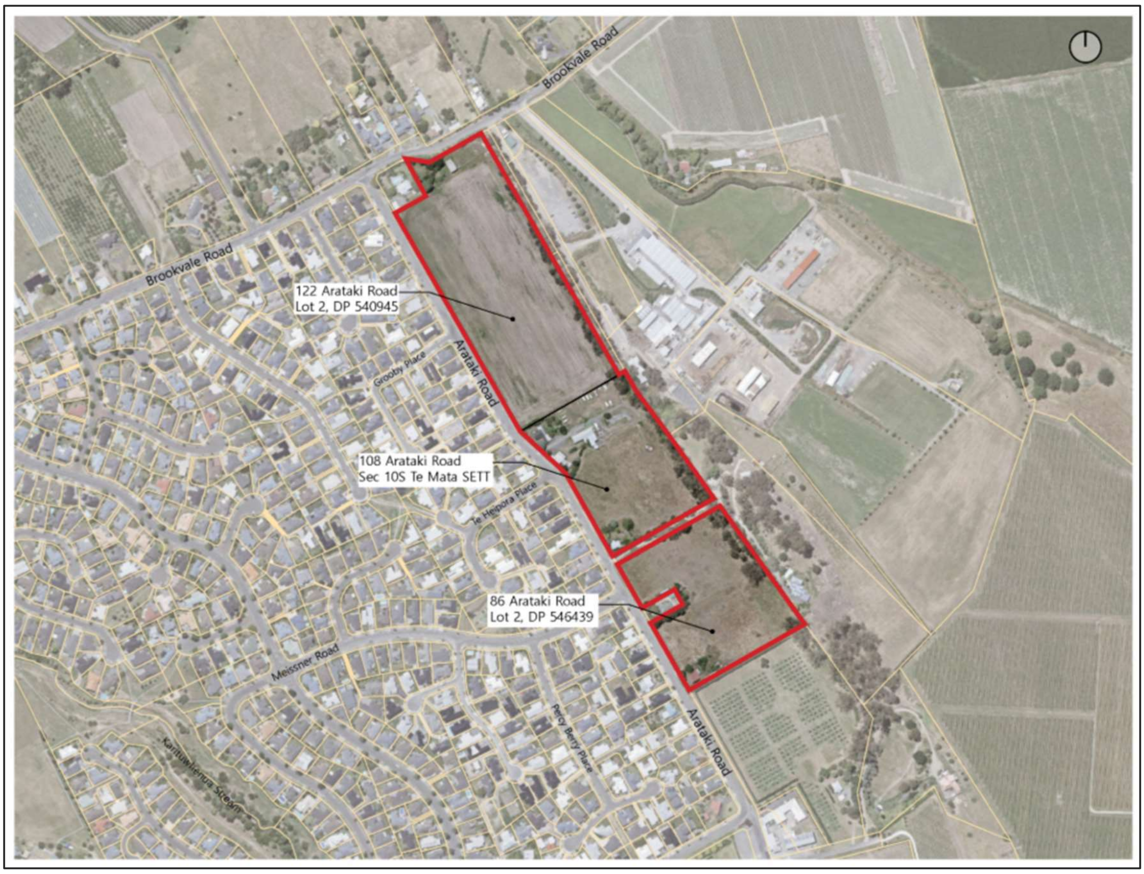


Figure 1: Arataki Development Site Location

2. Modelling

2.1. Catchment Analysis

A catchment analysis was undertaken to determine the existing flow regime and establish allowable flows for the design of the basin. As mentioned previously, the portion of the site used to set the predevelopment levels (i.e. allowable flow rate out of the basin) has been denoted as 'Subcatchment B' as shown on Figure 2. The western side (Subcatchment A) is not utilised in the calculations.

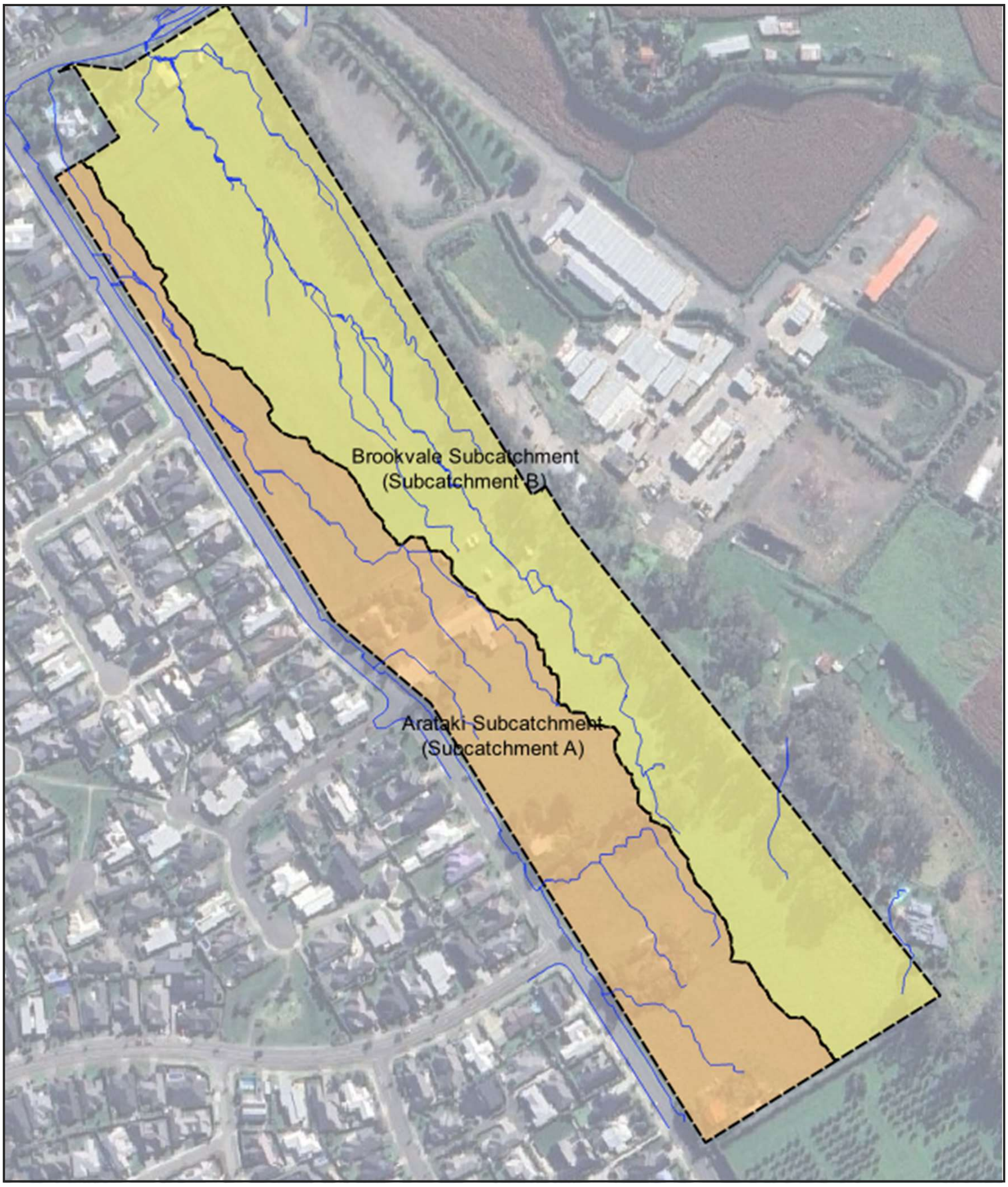


Figure 2: Sub catchment delineation for predevelopment model scenario

In the post development scenario, the development site was divided into smaller sections based on the proposed landform modifications (Figure 3). Further to this, a portion of the runoff from the immediate upstream catchment (south of the development) and Arataki Road are expected to be conveyed into the development site and routed to the basin. A smaller portion of the site to the northwest will discharge to Arataki Road via the proposed reticulated network (details in the infrastructure report) and will not be routed through the basin.

The total contributing catchment area to the basin via the reticulated network has been determined to be approximately 11.45ha. For the 100-year event, the contributing area is slightly reduced to 11.24ha, as one of the smaller sub-catchments, while piped to the basin, will direct some overland flows towards Arataki Road due to the proposed landform design.

Details for these internal catchments are provided in the next section.

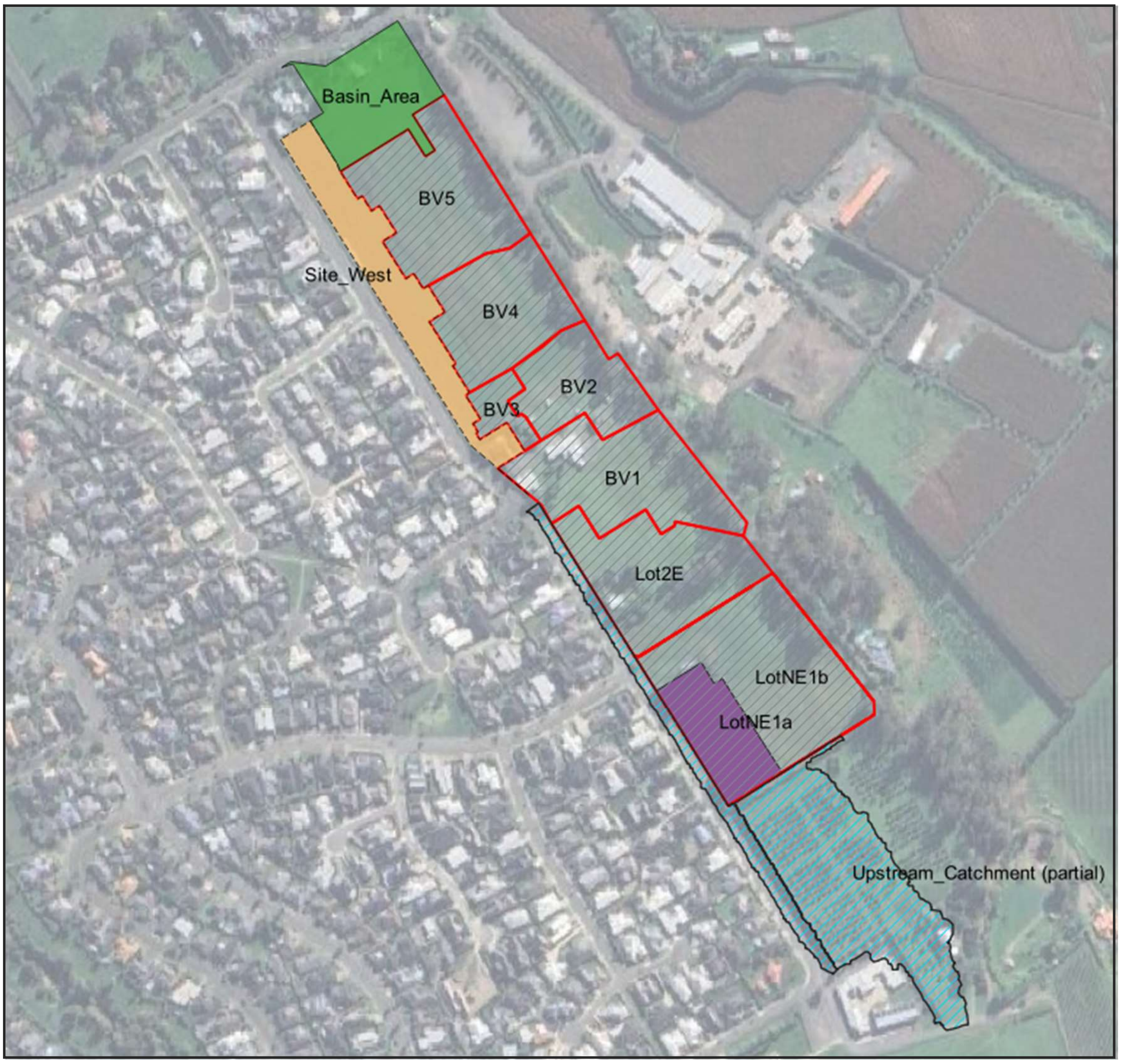


Figure 3: Subcatchment delineation for post-development model scenario

2.2. Hydrology

2.2.1. Rainfall

Rainfall depths were extracted from the NIWA HIRDS V4 dataset for the 2-, 10- and 100-year ARI storm event and include an allowance for climate change based on the RCP6.0 scenario for the 2081-2100 period. The 24-hour rainfall depth used in the modelling, incorporating the climate uplift, is given in Table 1.

Table 1. Modelled rainfall depth

Storm event	Rainfall depth (mm)
2-year ARI	77.6
10-year ARI	123
100-year ARI	190

Note: 24-hour Rainfall Depth (accounting for RCP6.0 climate change factor)[1]

With respect to the determination of the extended detention volume (EDV) for aquatic resource protection, the rainfall depth is based on water quality volume (WQV) depth which is based on the 90th percentile rainfall. Based on the Hawke's Bay Waterways Guidelines for Stormwater Management Figure 6.5 (Figure 4) this was noted to be 17.5mm/24hr. The resulting WQV generated by the contributing area is multiplied by 1.2 to get the EDV as outlined in Section 3.1.

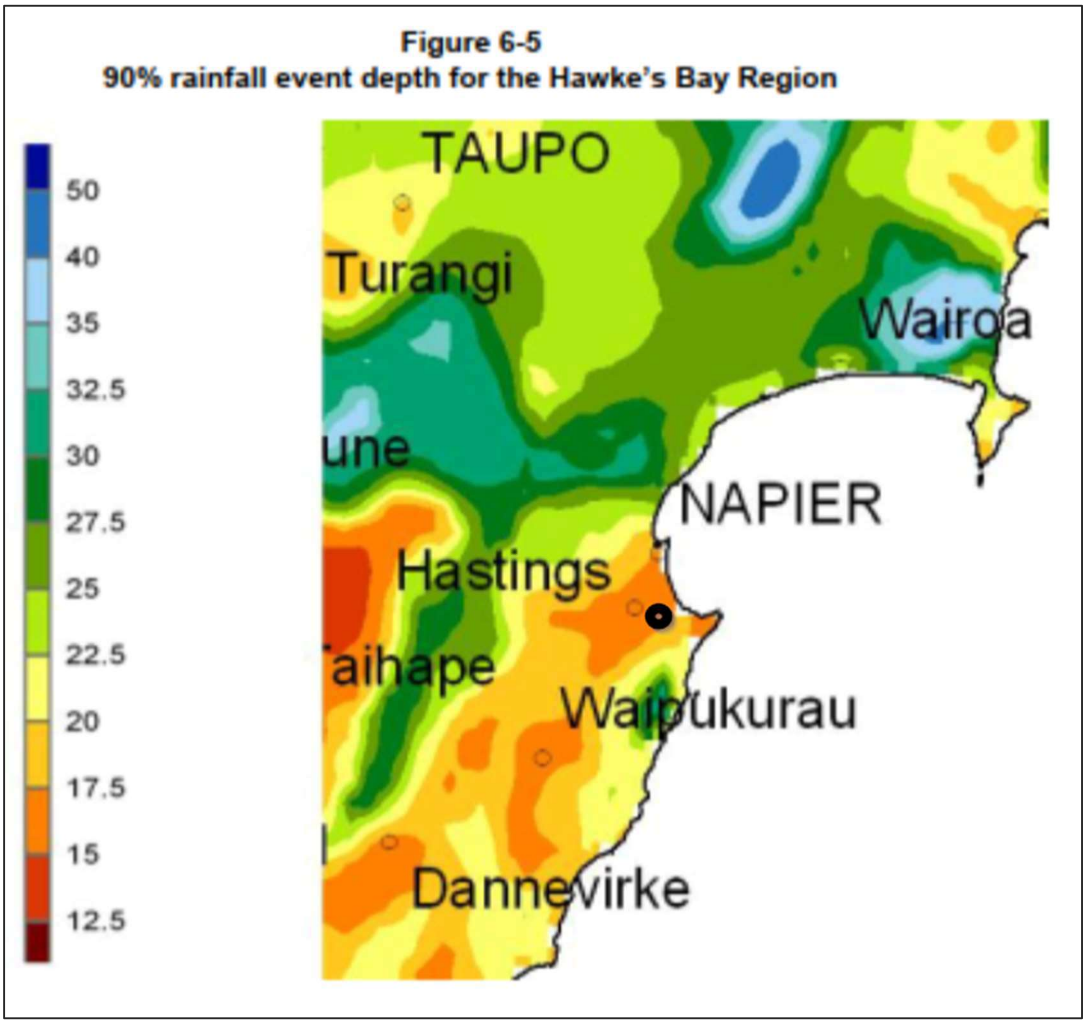


Figure 4: Hawke's Bay Region 90th percentile rainfall event depth

2.2.2. Runoff

Using TP108 methodologies and USACE Hydrologic Engineering Center-Hydrologic Modelling System (HEC-HMS) runoffs from the subcatchments were calculated based on the hydrological parameters in Table 2. Table 3 provides a summary of the modelled subbasin areas and times of concentration used for pre- and post-development model scenarios.

Table 2. HEC-HMS Hydraulic Parameters

Parameter	Method/Value
Loss Method	TP108
Transform Method	SCS Unit hydrograph
Curve Numbers	Pervious: 61* Impervious: 98
Initial abstraction	Pervious: 5mm Impervious: 0
Slope method	Equal area slope method
Time of concentration (ToC)	Calculated as per TP108
Lag time (min)	2/3 of ToC

Notes:
* Hydrological Soil Group B with very low water logging vulnerability (NZ S-Maps)

Table 3. Modelled subbasin areas

Catchment	Total (ha)	Pervious (ha)	Impervious (ha)	ToC (min)
Subcatchment B (Brookvale Subcatchment)	6.98	6.84	0.14	28
Post Development (Site only)				
BV1	1.49	0.45	1.04	10
BV2	0.85	0.25	0.59	10
[1]BV3	0.23	0.07	0.16	10
BV4	1.15	0.34	0.80	10
BV5	1.52	0.46	1.06	10
Basin_Area	1.00	1.00	0.00	10
LotE2	1.43	0.43	1.00	10
LotNE1a	0.69	0.21	0.48	10
LotNE1b	1.77	0.53	1.24	10
Upstream (partial)				
Upstream catchments (road and parcel)	1.37	0.38	0.99	13.3

Notes:
1: BV3 is excluded from the 100-year ARI catchment model (overland flows) as it drains towards Arataki Road.
2: Based on the landform, a portion of the upstream catchment comprising the road a parcel to the south will enter the proposed development.
3: Post-development ToCs were assumed to be 10 minutes

2.2.3. Basin Models

Pre- and post-development basin models were created for the different scenarios. These are summarised in Figure 5 and Figure 6.

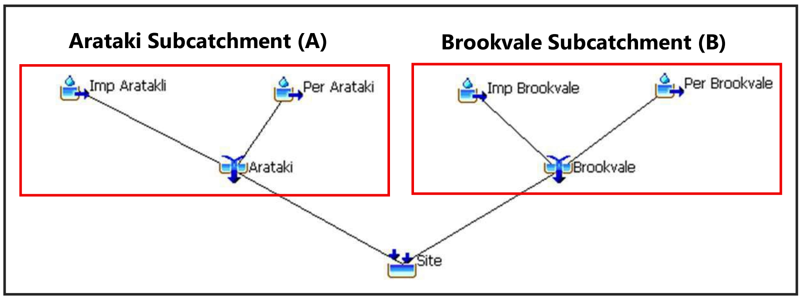


Figure 5: HEC-HMS basin model pre-development (all events)

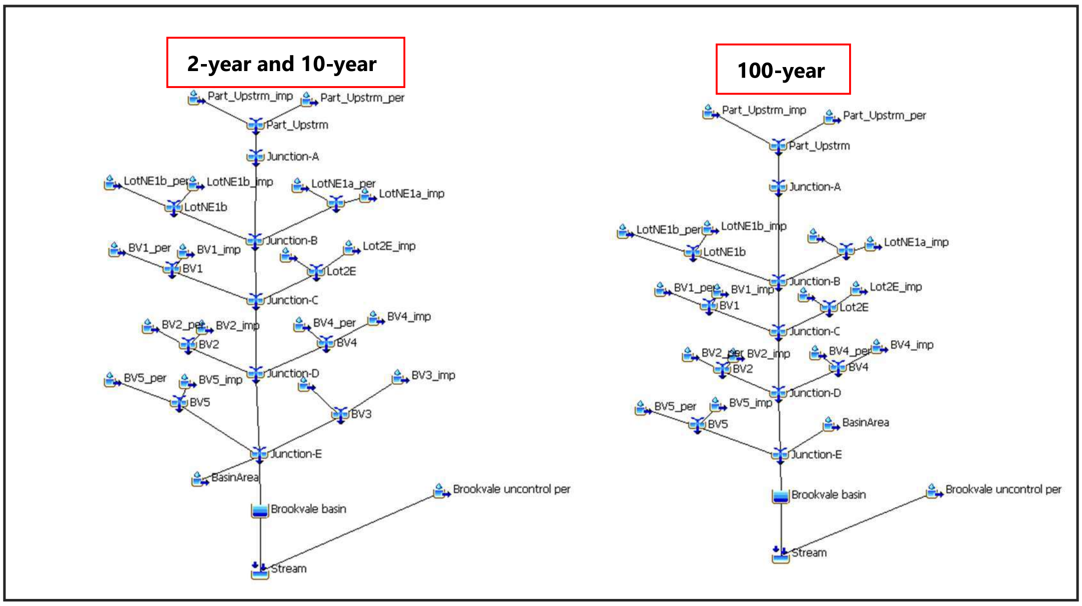


Figure 6: HEC-HMS basin model post development

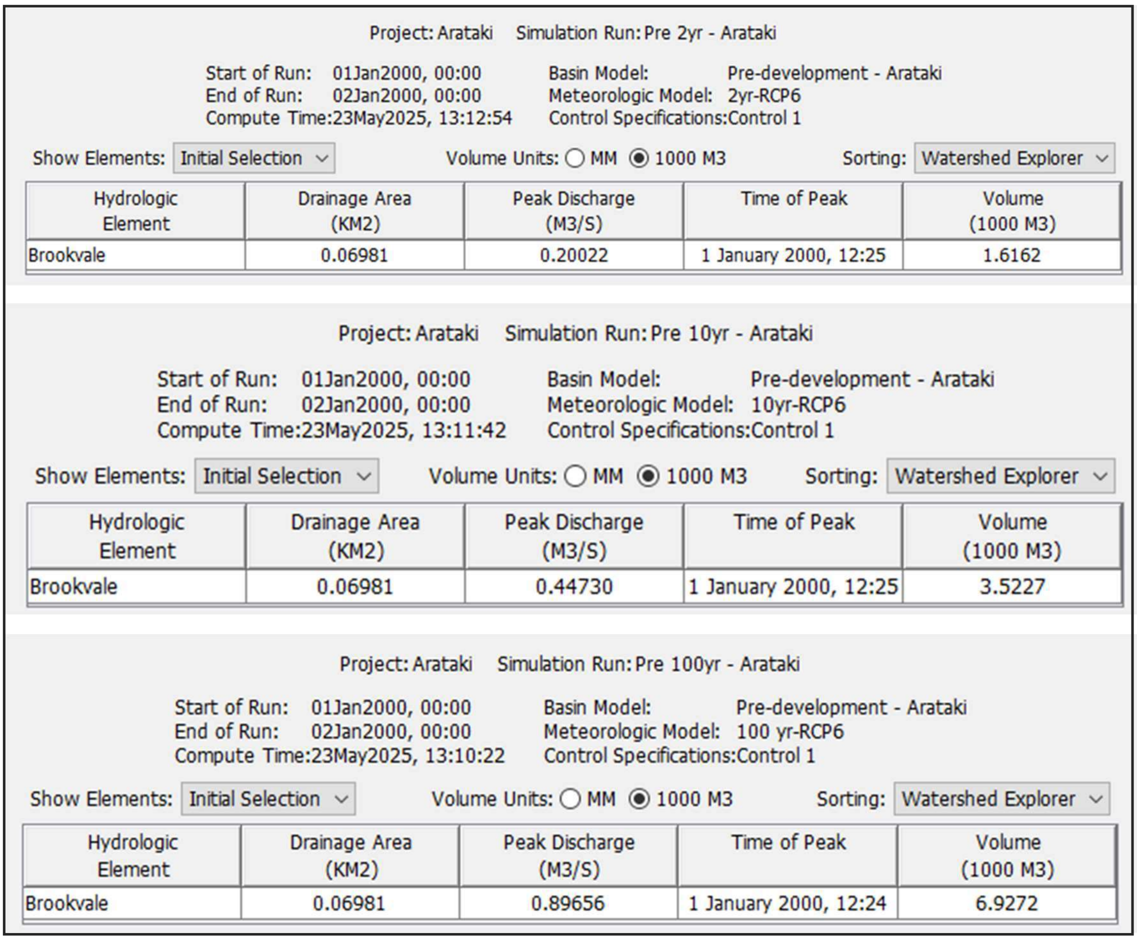
3. Results

3.1. Extended Detention Volume

As mentioned in Section 2.2, extended detention volume is required to be collected. The volume is to be detained and released over 24-hours whose intent is to minimise the initiation or aggravation of existing stream channel erosion. The area requiring mitigation i.e., discharging to the basin measures approximately 10.1ha (excludes partial upstream catchment) at 65% imperviousness. The volume generated was calculated to be 895m^3 and as per the Hawke's Bay Waterway Guidelines the revised volume i.e. multiplied by 1.2 was determined to be 1074m^3 (Attachment 1). It was determined that a 146mm orifice is adequate to release the volume over 24hrs. Details of the overall basin design is discussed in section 3.3.

3.2. Pre-development models

Predevelopment flow rates were calculated for the various storms and are summarised in Figure 7 and Table 4.



Project: Arataki Simulation Run: Pre 2yr - Arataki

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 23May2025, 13:12:54

Basin Model: Pre-development - Arataki
Meteorologic Model: 2yr-RCP6
Control Specifications: Control 1

Show Elements: Initial Selection | Volume Units: MM, 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Brookvale	0.06981	0.20022	1 January 2000, 12:25	1.6162

Project: Arataki Simulation Run: Pre 10yr - Arataki

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 23May2025, 13:11:42

Basin Model: Pre-development - Arataki
Meteorologic Model: 10yr-RCP6
Control Specifications: Control 1

Show Elements: Initial Selection | Volume Units: MM, 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Brookvale	0.06981	0.44730	1 January 2000, 12:25	3.5227

Project: Arataki Simulation Run: Pre 100yr - Arataki

Start of Run: 01Jan2000, 00:00
End of Run: 02Jan2000, 00:00
Compute Time: 23May2025, 13:10:22

Basin Model: Pre-development - Arataki
Meteorologic Model: 100 yr-RCP6
Control Specifications: Control 1

Show Elements: Initial Selection | Volume Units: MM, 1000 M3 | Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Brookvale	0.06981	0.89656	1 January 2000, 12:24	6.9272

Figure 7: Predevelopment model outputs

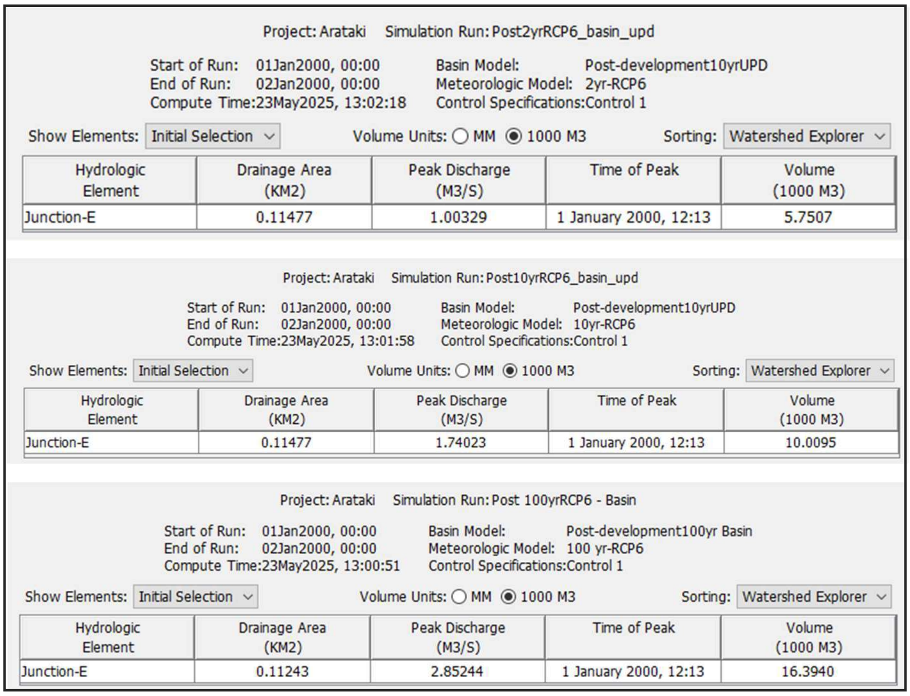
Table 4: Predevelopment model results (allowable flows from basin)

	2yr (m3/s)	10yr(m3/s)	100yr(m3/s)	80% of 100yr(m3/s)
Sub-catchment B Brookvale	0.20	0.45	0.90	0.72

3.3. Post-development models and basin design summary

3.3.1. Post development model

For the post development scenario, the proposed dry basin was introduced into the model to allow for the routing and attenuation of the flows to the allowable levels. For the 2-year and 10-year ARI events, the post development managed by the basin is to be equal to or less than the predevelopment while for the 100-year ARI event this allowed discharge in 80% of the pre- development flow. The post development model outputs are shown on Figure 8. Through adequately sized orifice and weirs, these flows are to be throttled down to the levels as outlined in Table 4.



Project: Arataki Simulation Run: Post2yrRCP6_basin_upd

Start of Run: 01Jan2000, 00:00 Basin Model: Post-development10yrUPD
End of Run: 02Jan2000, 00:00 Meteorologic Model: 2yr-RCP6
Compute Time: 23May2025, 13:02:18 Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Junction-E	0.11477	1.00329	1 January 2000, 12:13	5.7507

Project: Arataki Simulation Run: Post10yrRCP6_basin_upd

Start of Run: 01Jan2000, 00:00 Basin Model: Post-development10yrUPD
End of Run: 02Jan2000, 00:00 Meteorologic Model: 10yr-RCP6
Compute Time: 23May2025, 13:01:58 Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Junction-E	0.11477	1.74023	1 January 2000, 12:13	10.0095

Project: Arataki Simulation Run: Post 100yrRCP6 - Basin

Start of Run: 01Jan2000, 00:00 Basin Model: Post-development100yr Basin
End of Run: 02Jan2000, 00:00 Meteorologic Model: 100 yr-RCP6
Compute Time: 23May2025, 13:00:51 Control Specifications: Control 1

Show Elements: Initial Selection Volume Units: MM 1000 M3 Sorting: Watershed Explorer

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (1000 M3)
Junction-E	0.11243	2.85244	1 January 2000, 12:13	16.3940

Figure 8: Post development flows (unattenuated)

3.3.2. Pond Design

A stage-storage table for volume of basin at specific intervals (maximum 7982m^3 at 14.84mRL summarised at per graph shown in Figure 9 and the layout shown in Figure 10) was extracted from the 12D model and used in the HEC-HMS model. Following an iterative process with the design team, a 1050mm diameter manhole was selected as an appropriate outflow control structure. At the base of the outflow structure, a 146mm orifice was introduced to control and release the extended detention volume over 24 hours. A vertical slot (modelled as a weir) will be cut on the side of the manhole for controlling the 2-, 10- and 100-year events. The structure discharges to a 600mm pipeline which flows out to the unnamed stream as previously discussed through an energy dissipation structure i.e., scruffy dome outlet with surrounding riprap. The energy dissipation structure details are discussed in the Infrastructure Report. A 20m emergency spillway is also incorporated into the pond to allow for conveyance of events greater than the service outlet's capacity as well as in the unlikely scenario of complete blockage.

The design parameters summarised as on Table 5 were plugged into the model.

Table 5: Outlet Design Summary

Item	Dry Basin
Basin Invert Level (mRL)	11.70
EDV Orifice Diameter (mm)	146
Orifice invert (mRL)	11.70
Vertical slot width (mm)	230
Vertical slot level (mRL)	12.91
Maximum rim elevation	14.36
Emergency spillway width (m)	20.00
Emergency spillway elevation (mRL)	14.30
Basin embankment level (mRL)	14.84

Notes:
The area around the discharge structure will be lowered to allow for the orifice level to be achieved.

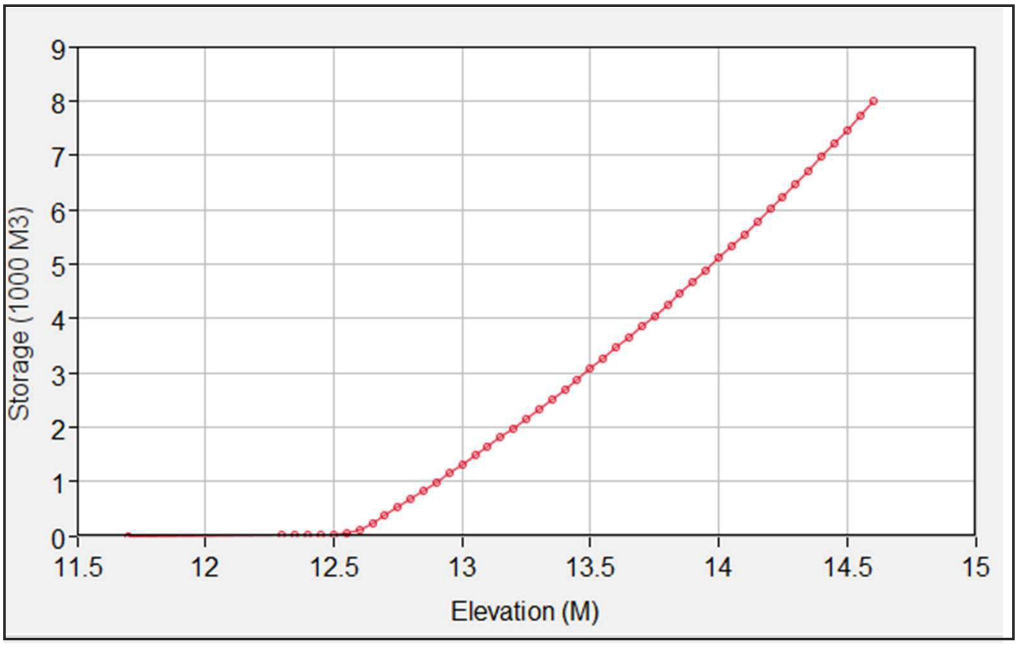


Figure 9. Dry basin stage storage

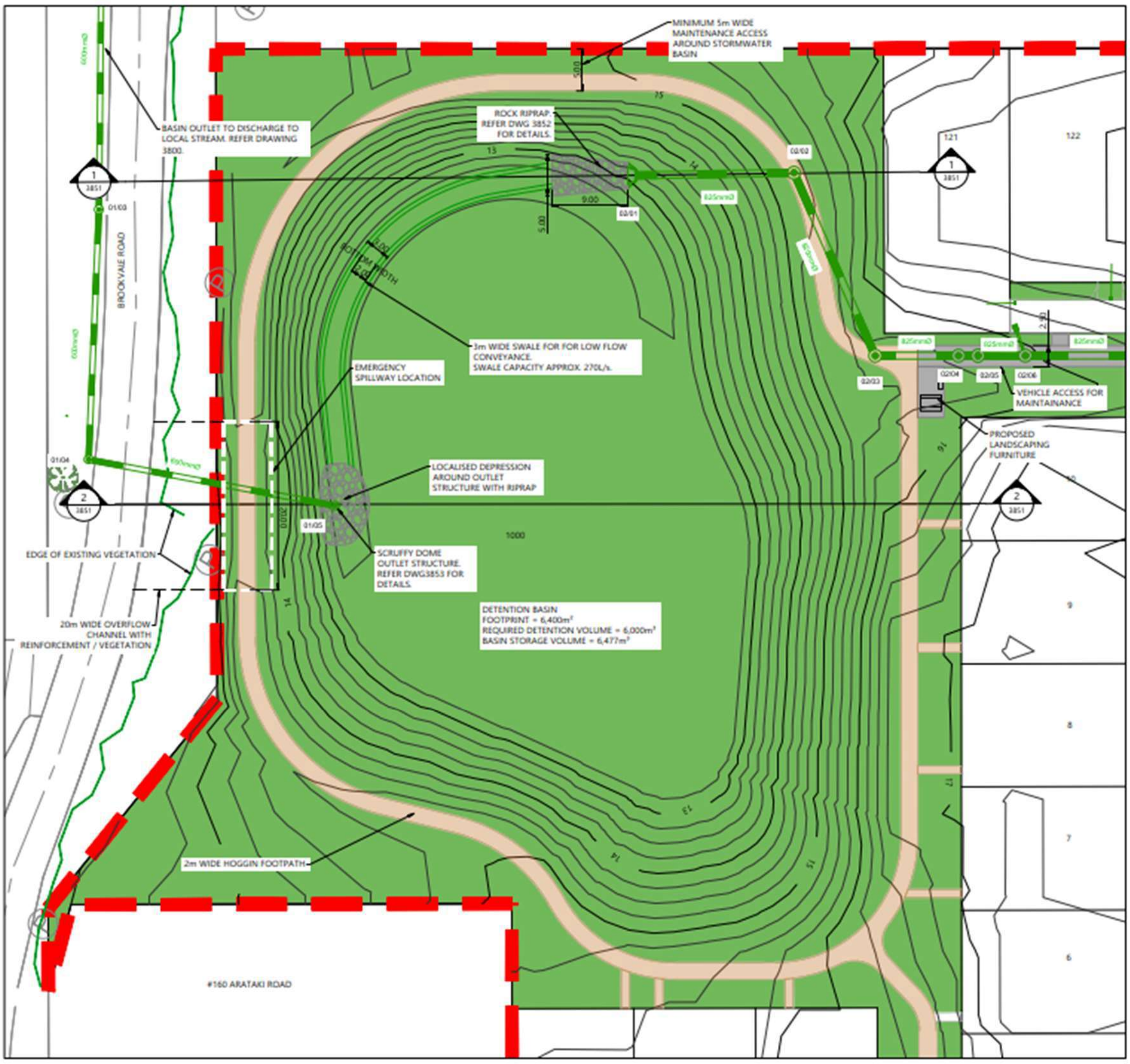


Figure 10: Pond layout

Using the parameters as outlined above, the attenuated flows and performance of the pond are summarised on Table 6 as well as on Figure 11. The results indicate that the basin performs as intended where the attenuated flows for the three key events are all below the allowable discharge levels with the emergency spillway not being activated in the 100-year ARI event. The emergency spillway will be activated only in the unlikely event that all outlet structures (service outlet) become blocked during a 100-year ARI event or during greater events. In the event where this occurs, the runoff will be conveyed to Brookvale Road as is the case under the existing conveyance regime and flow to the stream on the eastern side of 163 Brookvale Road. Figure 12 shows a markup of the outlet structure and performance levels. Figure 13 shows the cross section of the basin with the inlet and discharge control manhole shown. An analysis of the functionality of the emergency spillway is provided in Section 3.3.3 below.

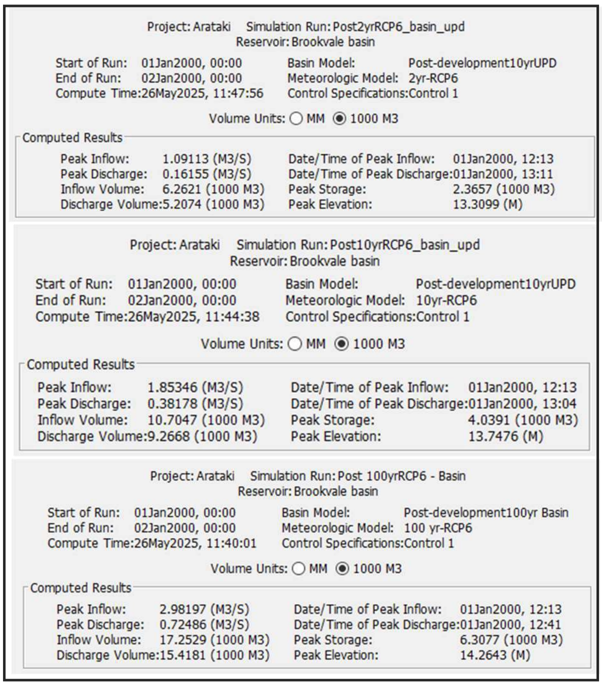


Figure 11: Basin performance summary (HEC-HMS model outputs)

Table 6: Pond Summary

Dry Basin Discharge							
	Pre-development		Post-development				
Catchment Area (ha)	7		11.5				
Strom event	Flow (m^3/s)	Volume Discharged by catchment (m^3)	Catchment Flow (m^3/s)	Volume Discharged by catchment (m^3)	Attenuated flow (m^3/s)	Peak storage in basin (m^3)	Peak level (mRL)
2-year	0.20	1616	1.09	6262	0.16	2366	13.31
10-year	0.45	3523	1.85	10705	0.38	4039	13.75
100-year	0.72 (80% of 900)	6972	2.98	17253	0.72	6308	14.26

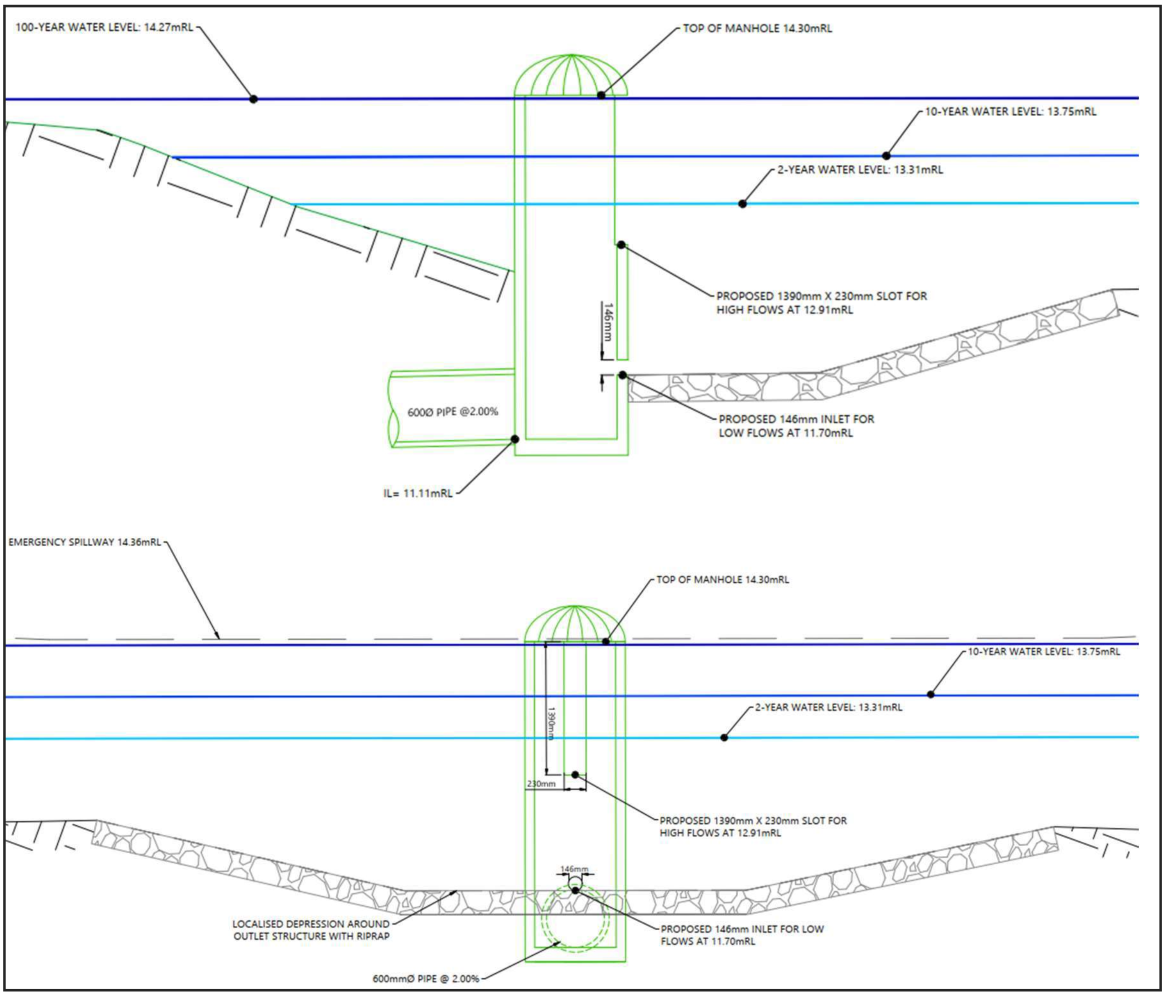


Figure 12: Outlet structure design

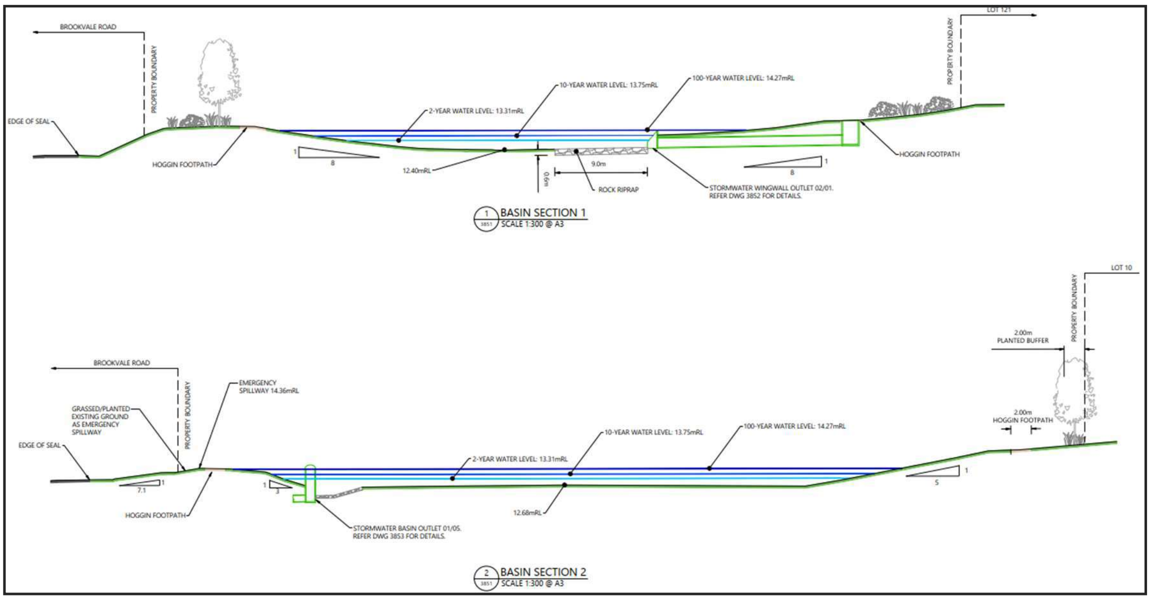


Figure 13: Basin cross sections

3.3.3. Emergency Spillway Analysis

As discussed in the preceding section, the emergency spillway is not activated under normal operational conditions. An assessment was undertaken where the primary/service outlet is completely blocked for the 100-year ARI event. It was determined that in this situation, the 20m spillway will discharge flows out of the basin and peaking at 14.54mRL (Figure 14). The embankment level, as noted previously is 14.84mRL (Figure 15) thus a 300mm freeboard is achieved in accordance with the HBRC Stormwater Guidelines.

The basin will be constructed on natural ground, however, to achieve the required design and embankment levels, some compacted fill material will be placed. On the downstream bank of the emergency spillway an overflow channel 200mm deep leading to Brookvale Road is to be installed with a design slope of approximately 14%. Using Hydraflow Express, the velocity in the channel when the service outlet is completely blocked was determined to be 1.84m/s (Figure 16). The channel will be reinforced with suitable materials and/or vegetation to prevent erosion and maintain stability.

The emergency spillway is designed as a precautionary safety feature and as mentioned before is not expected to operate during normal conditions. The likelihood of the basin embankment failing is extremely low. Even in the very rare event that the spillway is activated, it has been engineered to safely convey flows in a controlled manner, without creating flooding or risk to downstream properties. Given the high level of design safety and minimal residual risk, a further assessment for Probable Maximum Flood (PMF) (extremely rare storm events) is not required.

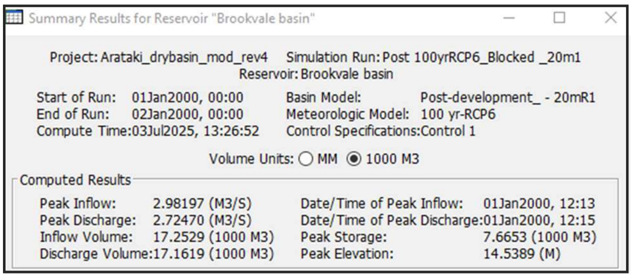


Figure 14: Emergency spillway operation

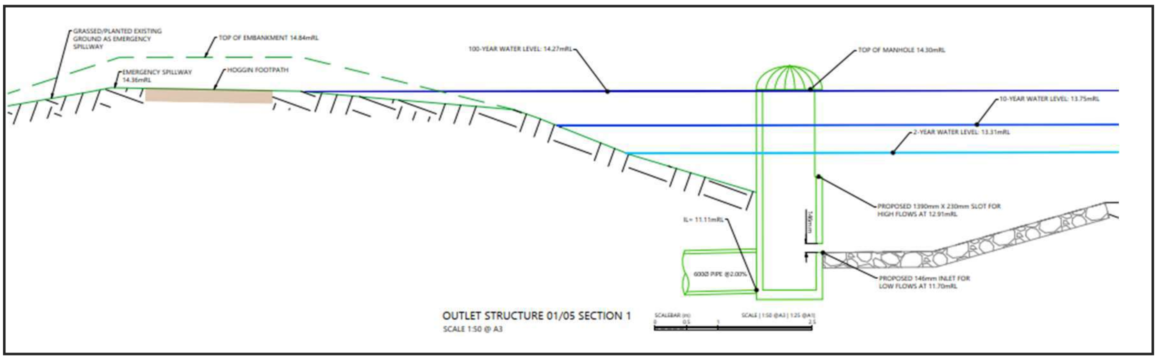


Figure 15: Emergency spillway design

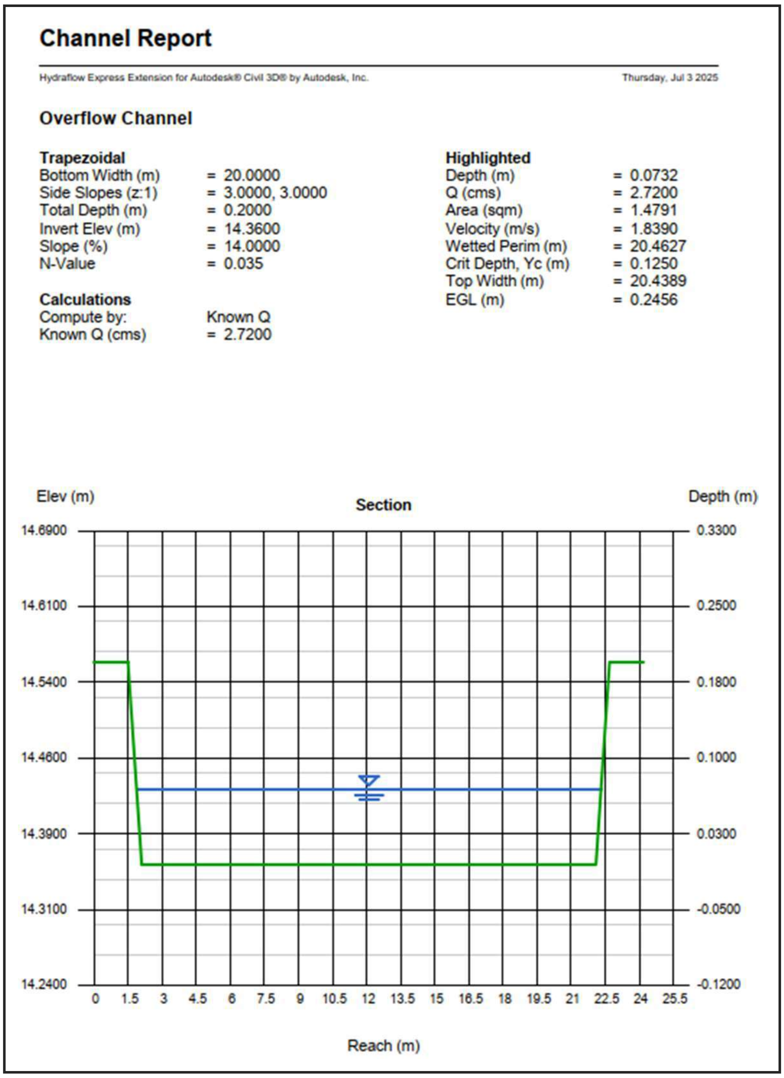


Figure 16: Overflow channel

3.3.4. Stream Outlet

From the discharge control manhole, a 600mm pipe (Figure 12) will be installed to convey the managed flows from the basin to the stream. At the stream interface, a scruffy dome outlet structure will be installed with the appropriate erosion/scour protection to prevent degradation of the stream (Figure 17 and Figure 18). A low flow drainpipe is provided at the base of the structure to empty it out at the end of storm events (additional detail contained in the Infrastructure Report).

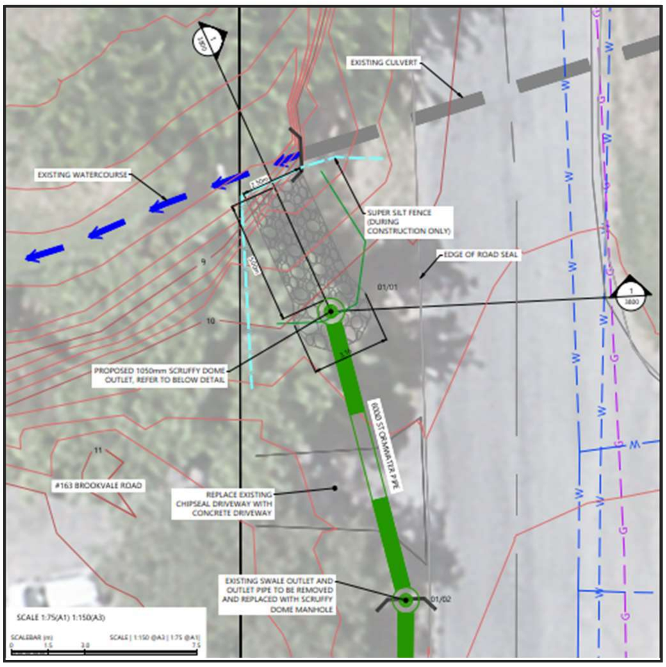


Figure 17: Location of outlet structure to stream

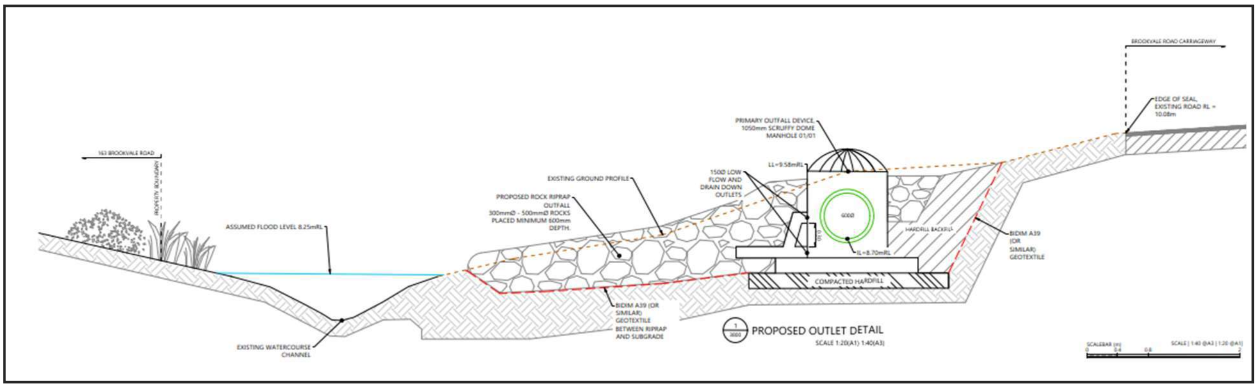


Figure 18: outlet structure details

4. Conclusion

The proposed stormwater detention basin represents a best-practice approach designed to achieve hydrologically neutral discharge conditions post-development. The basin provides extended detention volume control to minimise the initiation and aggravation of stream erosion. Through iterative modelling and analysis, the basin has also been appropriately sized to ensure that peak outflow rates for the 2-year and 10-year ARI events do not exceed predevelopment levels, while the 100-year ARI event is reduced to 80% of predevelopment flows, thus complying with HBRC and HDC stormwater management standards. An emergency spillway has been incorporated into the design to allow for compliant conveyance out of the basin where the primary/service outlet is completely blocked. Adequate scour protection is to be provided on the bank.

The design prioritises site-specific factors, including, catchment hydrology and downstream erosion potential with a stabilised scruffy dome outlet structure engineered to mitigate stream degradation in addition to extended detention volume control. HEC-HMS routing model validates that the system performs as intended, balancing attenuation efficiency with properly managed discharge i.e., achieving hydraulic neutrality.

Stormwater discharge considered a critical component of this project has been optimised to ensure no adverse effects on the receiving stream, aligning with regional policy and sustainable development objectives. This design sets a benchmark for responsible stormwater management, demonstrating that growth and environmental protection can be adequately designed for.

APPENDIX 1 – Extended Detention Volume Calculation

WOODS
Engineers. Surveyors. Planners.

EDV

PROJECT NUMBER:	P24-244
ADDRESS:	Arataki Road
BY:	TW/BK
DATE:	22/05/2025

RUNOFF DEPTH CALCULATIONS

SMAF	1	
Impervious Area	1	m^2
95th Percentile Rainfall Depth	17.5	mm

	CN	S (mm)	Ia (mm)	c*	q*	Q (mm)
Permeable	61	162.39	5	0.02	0.03	0.89
Impermeable	98	5.18	0	0.63	0.15	13.50

Brookvale controlled	M2	WQV	
Impervious	63808	861.4654	m^3
Pervious	37301	33.32476	m^3
Total		894.7902	m^3

EDV (WQV*1.2)	**1073.748**	m^3	Excludes upstream catchment
Qp edv	**24.85528**	l/s	

Appendix E1

Dry Basin - Operation and Maintenance Manual (Draft)

WOODS

Dry Basin
Operations & Maintenance Manual (Draft)

Arataki Project
CDL Land New Zealand Limited
86, 108 & 122 Arataki Road, Havelock North

Substantive Application
Fast-Track Approvals Act 2024
18 July 2025

Document Control

Project Number	P24-244
Project Name	Arataki Project
Client	CDL Land New Zealand Limited (**CDL**)
Date	18/07/2025
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Originator	Ricky Kiddle - Graduate Engineer
Reviewer	Tony Wang - Associate Engineer
Approval	Boniface Kinnear – Senior Associate Engineer
Consultant details	Wood & Partners Consultants Limited (**Woods**) PO Box 6752 Victoria St West, Auckland 1142 woods.co.nz
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1.0 Introduction

This operations and maintenance (O&M) manual details the proposed basin design for the Arataki development by CDL Land New Zealand Limited (CDL). The basin location is shown in Figure 1.

Figure 1: Dry basin location

It is intended that this O&M manual provides:

- Background information on the stormwater treatment and detention facilities at the Basin;
- Basic background information on the contributing stormwater catchment;
- Design details for the stormwater treatment and detention system; and
- O&M details.

This manual excludes information on the stormwater reticulation system within the contributing catchment area.

This manual is to be updated following consent and construction, with final O&M to be provided with CCC.

1.1. Contact Information

A summary of the contact information relating to the ownership, maintenance manager and designer for the basin is included in Table 1.

Table 1. Contact Information

<table>
<tr><th>Asset ID</th><th></th><th>Resource Consent Number</th><th></th></tr>
<tr><td>Location:</td><td></td><td>Development Name / Legal Description:</td><td></td></tr>
<tr><td colspan="4">Asset Owner Details:</td></tr>
<tr><td>Name:

Telephone Number:</td><td></td><td colspan="2" rowspan="2">Address

Private Bag 92300,

Auckland 1142</td></tr>
<tr><td>Email:</td><td></td></tr>
<tr><td colspan="4">Maintenance Manager Emergency Contact Details:</td></tr>
<tr><td>Name:</td><td></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>Telephone Number:

(Daytime)</td><td></td></tr>
</table>

Telephone Number: (Out of Hours) Email:		
Designer Details:		
Name: Telephone Number: Email:		
Applicant Details:		
Name: Telephone Number Email:		
Landowner Details:		
Name: Telephone number: Email:		
Notes / Restrictions / Access		

2.0 System Description

2.1. Catchment Description

The Basin provides stormwater treatment and detention for an approximate 10.1 ha stormwater catchment, as detailed in Table 2.

Table 2. Catchments contributing to Dry Basin

	Total impervious area (ha)	Total pervious area (ha)	Total contributing catchment area (ha)
Catchment Contributing to the Basin	6.4	3.7	10.1

2.2. Design Philosophy

The purpose of the proposed basin is to provide stormwater treatment and detention for the contributing catchments. The basin was designed to improve water quality through reducing contaminants such as Total Suspended Solids (TSS) before entering the receiving environments. Planting around the basin promotes biodiversity and improves public perception of the stormwater device.

2.2.1. Key Features

The basin was designed to meet the following design requirements.

Water Quality:

- Provide water quality treatment.

Hydrology Mitigation:

- Detention – Provide extended detention volume and a drain-down period of 24 hours.
- Attenuation – Provide attenuation of peak post development flows for 2-year and 10-year annual recurrence interval (ARI) events generated by the developed site to 80% of the predevelopment.
- Attenuation – Provide attenuation for the peak post-development flow for the 100-year ARI to 80% of the predevelopment level.

2.2.2. Timeline

Construction is not yet completed. This section will be completed after the Basin is constructed and vested.

2.2.3. Critical Levels as per approved Design and As-built Data

The design has not yet been approved. This section will be completed once the design of the Basin has been approved.

2.2.4. Dam Information

The basin is not a classifiable dam according to the Building (Dam Safety) Regulations 2022. This is because it does not fulfil one of the criteria of:

- having a dam height greater than 4 m and impounding a volume greater than 20,000m³. Or
- having a dam height greater than 1 m and impounding a volume greater than 40,000m³. Therefore, the basin does not require a Potential Impact Classification (PIC) assessment.

2.3. As-Built Information

To be provided following consent and construction.

2.4. Design Standards and Assumptions

The proposed basin is designed to provide management of the extended detention volume and attenuate peak post development flows for 2-, 10- and 100-year ARI generated on site to 80% of the predevelopment flows.

2.5. Ground Conditions

The basin shall be constructed as per the recommendations of the geotechnical report.

2.6. Consent Information

To be provided following consent approval.

3.0 System Components

3.1. Inlet Structure Details

The basin has a single inlet. The inlet details can be summarised in Table 3 below. Refer to drawing P24-244-00-3850-DR for further details.

Table 3. Dry Basin Inlets

	Dry Basin
Inlet structure	DN825

3.1.1. Routine Maintenance

Key routine maintenance actions identified for the basin inlets are summarised in Table 4 below.

Table 4. Basin inlet maintenance actions

Component	Recommended Action
Basin Inlets and Energy Dissipation / Erosion Protection Structures	Inspect for clogging and buildup of debris and rubbish. Debris should not block or threaten to obstruct any stormwater inflow points.
	The area around the inlet and energy dissipation (e.g. rip rap) structures should also be inspected for erosion and cracks in the structure. Remove debris and litter and fix cracks and erosion as necessary.

3.1.2. Health and Safety Risks Associated with Dry Basin Inlet Structure Maintenance

There are a number of health and safety risks associated with working inlet structures. Some of these potential risks are highlighted in Table 5 below.

Table 5. Health and safety risks associated with working around inlet structures

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Flow through inlet making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast
Confined space within inlet pipe	Do not enter the confined space.
Deep manholes	Do not enter the confined space. Take extra care when opening manholes.

3.2. Outlet Structure Details

The basin outlet structure details can be found in Table 6. To be updated following the as-built survey. Refer to drawing P24-244-00-3850-DR for further details.

Table 6. Outlet details

	Dry Basin
Orifice	146 mm
Outflow control manhole	1050mm
Vertical Slot	230 mm
Outlet pipe	DN600

3.2.1. Routine Maintenance

Key routine maintenance actions identified for the basin outlet structure is summarised in Table 7 below.

Table 7. Basin outlet maintenance actions

Component	Recommended Action
Basin outlets	Inspect basin outlets for blockages caused by heavy sedimentation, floating debris, and rubbish. The areas around the outlet control structure should be free of blockages and dense vegetation to maintain an unobstructed flow path for stormwater.
	Inspect for evidence of leaky joints or soil seeping around outflow pipe barrel.
	Inspect outfall and water discharge areas for erosion (presence and severity within 30 m of discharge point).
	Restore eroded areas and stabilise as necessary.
	Erosion (washout, scouring) around outflow pipes can be caused by water flowing from the basin and out along the outside of pipe, which can lead to embankment failure.
Erosion Protection	Inspect areas of erosion protection (rip rap, reno mattress, gabions) to identify any damage or loss of material. Identify any preferential flow paths forming through erosion protection that could be affecting function. Repairs should be carried out as required.
Debris Screens	The debris screens should be inspected for the build-up of pollutants, leaves, sticks, branches, litter, and other debris.

	Accumulated debris can hinder stormwater flows and cause localised flooding, and these should be removed and properly disposed of at an appropriate disposal facility. Visually inspect the debris screens for signs of corrosion, repair or replace if necessary. Check lock and chain for any rust or damage.

3.2.2. Stream Outfall Maintenance Access Requirements

The basin outlet is incorporated into a scruffy dome structure. Plan P24-244-00-3852-DR highlights this. A maintenance vehicle could park on the access track or maintenance track and personnel access the outfall by foot, by walking over the emergency spillway.

Where mechanical equipment such as excavators or vacuum trucks are required to remove larger debris and sediment buildup from the outfall, a sucker truck could park on the access track or maintenance track of the basin, and the suction hose carried down manually to the riprap. For vehicular access in closer proximity to the outfall for other maintenance activities, off-road vehicles such as 4WD or excavators, equipped with suitable traction and suspension systems to navigate the outfall access track is recommended. These can park on the access platform above the outfall structure.

Use of vehicles requires careful coordination to minimise environmental impacts.

3.2.3. Health and Safety Risks Associated with Dry Basin Outlet Structure Maintenance

There are a number of health and safety risks associated with working around waterbodies and outlet structures. Some of these potential risks are highlighted in Table 8 below.

Table 8. Health and safety risks associated with working around Dry Basin outlet structures

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Removing blockage may generate high flow velocities	Lower water level before removing blockage.
Flow through basin making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Confined space within outlet structure	Do not enter the outlet structure.
Fall Hazard	Avoid accessing close to steep drop offs, ensure safe site access

3.3. Emergency Spillway

The basin emergency spillway details are shown in Table 9 below. To be updated following the as-built survey.

Table 9. Spillway details

	Dry Basin
Invert of Emergency spillway	14.36mRL

3.3.1. Routine Maintenance

Key routine maintenance actions identified for basin spillway structures are summarised in Table 10 below.

Table 10. Maintenance actions

Component	Recommended Action
Emergency Spillway	Inspect and maintain grass cover at 100 mm height. Ensure spillway is clear of trees and shrubs (only grass present). Inspect earth embankment for erosion, scour, slumping and any loss of soil. Cavities, erosion and scour should be repaired with engineered fill compacted to the earthwork's specifications (see glossary) Check embarkments for settlement, erosion, scouring, cracking, sloughing, separation, seepage, tomos, etc.

3.3.2. Health and Safety Risks Associated with Emergency Spillway Maintenance

There are a number of health and safety risks associated with working around the spillway. Some of these potential risks are highlighted in Table 11 below.

Table 11. Health and safety risks associated with working around spillway

Risk	Mitigation
Deep water (i.e. deeper than knee depth)	Do not enter the water, have rescue rope and second person available.
Steep and slippery banks	Take care and avoid wet soil conditions.
Erosion, scouring of spillway	Do not access unstable spillway. Stay away from edge of erosion/failure.
Drop offs	Do not mow close to drop off at downstream shoulder of spillway.

3.4. Landscaping

The proposed basin has large areas of riparian vegetation surrounding them. This area is susceptible to weed growth, as well as the loss of desirable native plant species.

Pest plants can affect the basin's vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Hawke's Bay Regional Council Pests and Weeds Hub Database (Hawke's Bay Regional Council, n.d.) and the Hawke's Bay Regional Pest Management Plan 2018-2038 (Hawke's Bay Regional Council, 2018).

3.4.1. Routine Maintenance

Key routine maintenance actions are summarised in Table 12 below.

Table 12: Maintenance actions

Component	Recommended Action
Riparian Vegetation/Landscaping	Vegetation maintenance works including staking, trimming, lawn mowing, weed control, and replacement planting (only during planting season). Inspect riparian plant health and any build-up of dead plant material. Remove debris as necessary. Replace unhealthy or dead planting and undergo ongoing maintenance until established. When new planting is being carried out, exposed soil should be protected with mulch or organic matting such as coconut fibre to prevent soil erosion. Maintenance intervals will vary with growth rates and seasons. Identify weeds. Hawke's Bay Regional Council Pests and Weeds Hub Database (Hawke's Bay Regional Council, n.d.). Notify the Hawke's Bay Regional Council Biosecurity Team if pest species present 0800 108 838). Using appropriate control methods for the weed present, undertake weed control around the basin and in the wider property using a combination of mechanical control, manual removal and herbicide. Specialist to be contacted if further weed inspection and removal is required. Where soil erosion is observed, repair as necessary. Soil can be eroded from basin banks particularly after heavy rainfall and/or where vegetation cover is poor.

3.4.2. Health and Safety Risks Associated with Landscaping

There are a number of health and safety risks associated with working around riparian vegetation. Some of these risks are highlighted in the Table 13 below.

Table 13. Health and safety risks associated with working around riparian vegetation

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

3.5. Wildlife

The proposed Dry Basin will provide habitat for a large number of terrestrial and aquatic wildlife.

Mosquitos, pest animals such as rabbits, and stinging insects such as wasps can create health and safety hazards, which can negatively affect maintenance activities. For example, rabbit burrows can create a trip hazard for maintenance workers, or wasps can sting maintenance workers.

3.5.1. Routine Maintenance

Key routine maintenance actions identified for the basin wildlife are summarised in Table 14 below.

Table 14. Maintenance actions

Component	Recommended Action
Wildlife	Regular inspection is required to ensure that desirable species are not threatened, and pest species are controlled. Areas for mosquito controlling organisms (e.g. minnows) should be maintained. Infestation of rabbits or rodents should be dealt with by a suitably qualified professional. Avoid contact with insects, such as wasps. If nests are on site, seek a suitably qualified professional to remove nests.

3.5.2. Health and Safety

There are a number of health and safety risks associated with working around ecology. These risks are highlighted in the Table 15 below.

Table 15. Safety risks associated with working around ecology

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

3.6. Access and Security

The Basin is located at the Northern end of the development. A concrete access track off Creek Road provides vehicular access to the basin. The access track for the basin is shown in Figure 2, and can be referred to in drawings P24-244-00-3850/54-DR.

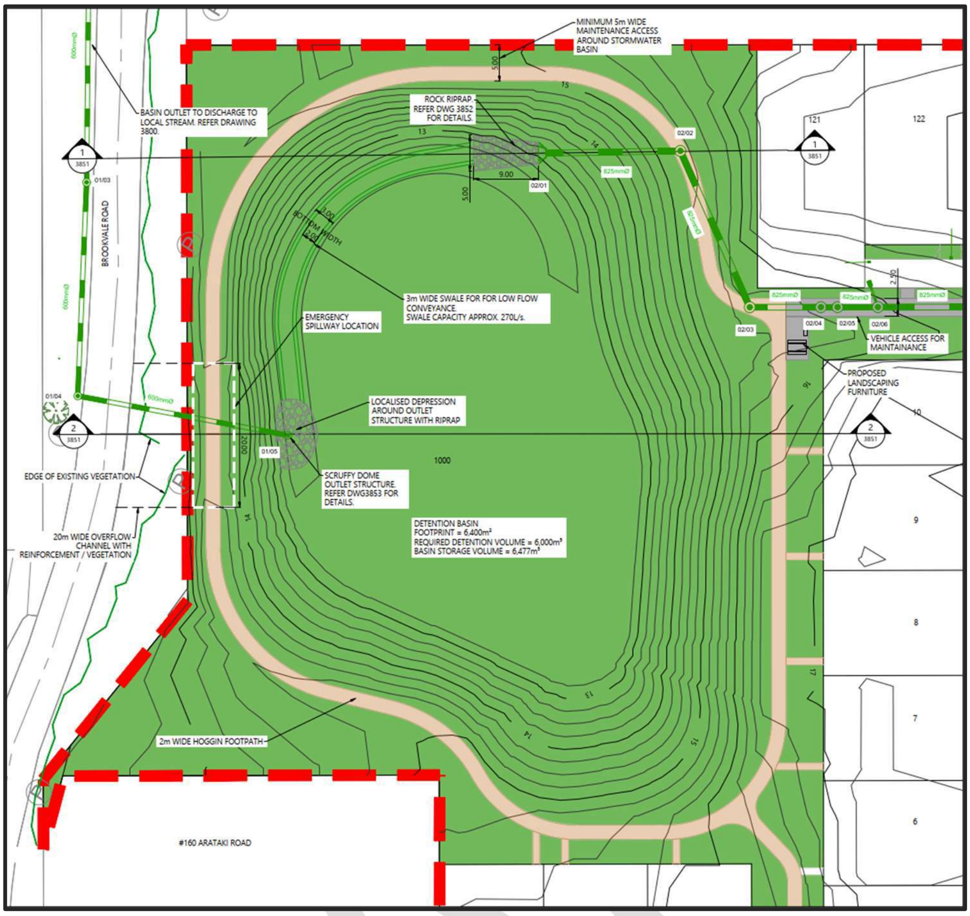

Figure 2. Dry Basin Layout Plan

Maintenance track around the dry basin

- The maintenance track around the perimeter of the basin is proposed to be 4m wide and constructed of durable and permeable materials such as gravel. This minimises soil compaction and erosion around the basin and allows for ease of maintenance of the track itself. A ute or excavator can comfortably track around the maintenance track. The access points to the maintenance track (off the access track) have been designed to allow for tracking of an 8.3m AT Truck design vehicle.

Internal access

- Access to the internal parts of the basin can be made by foot along the middle island. This is 1m wide at 1% crossfall and could be used for maintenance access.

Basin outlet structure / scruff dome

- Access to the scruffy dome outlet can be made by foot from the maintenance track, walking over the shallow marsh, where the outlet has been placed at the edge of the outlet pool for ease of access.
- It is important that the access and maintenance track are regularly inspected and maintained for signs of erosion, damage, or excessive wear.

Emergency spillway

- Access can be made by parking a vehicle on the maintenance track at the entry point of the emergency spillway, and inspections made by foot along the spillway. Note that outflow channel from the emergency spillway is at a 14% grade.

GPT/Proprietary Device

- Drawing P24-244-00-3850 indicates where a vehicle can drive up to the GPT for maintenance activities. Alternatively, a vacuum truck could park on the maintenance track (location indicated on the drawing) and the suction pipe carried to the GPT for clearing out of the GPT. The distance to reach the GPT off the maintenance track is approximately 5.5m and easily reachable by foot. This method of accessing the GPT would be encouraged to minimise environmental impacts.

Outfall structure

- This is discussed in Section 3.

3.6.1. Routine Maintenance

Key routine maintenance actions identified for the basin maintenance access are summarised in Table 16 below.

Table 16. Maintenance actions

Component	Recommended Action
Maintenance Accessway	Vehicular access to basin, structural integrity, width sufficient for plant and machinery access. Check presence of weeds. Remove if present.
Fences/Handrails	Check condition of perimeter/safety fences and handrails.
Signage	Check signage for graffiti or damage

3.6.2. Health and Safety Risks

There are a number of health and safety risks associated with working around a waterbody. Some of these potential risks are highlighted in the Table 17 below

Table 17. Health and safety risks associated with working around access areas

Risk	Mitigation
Steep and slippery banks	Take care and avoid wet soil conditions.
Unstable banks	Avoid standing on unstable banks.
Public	Have a plan if an unwanted encounter occurs.

4.0 Dry Basin Operation & Maintenance Requirements

4.1. Inspection and Maintenance Activities

The following checklists are designed to be used for all maintenance inspections; The checklists are included in Appendix A. It is recommended that all tables are printed/filled out during all inspections (although only the annual inspection requires every item).

Appendix A:

Maintenance Checklist

Effective long-term operation of the basin requires dedicated and routine maintenance tasks performed to a consistent timetable:

Maintenance Activity	Monthly	6 Monthly	12 Monthly	5 Yearly
Remove weeds and replace dead plants. Eradicate noxious/pest weeds and undesirable growth. This shall be completed by competent workmen who have landscape experience. A hoe and weed knife will be required and other weed removal equipment.	✓			
Litter removal. Litter removal will require low skilled workman. Equipment includes a pickup tool claw, rubbish bags and other equipment suitable for the removal of litter.	✓			
Inflow, overflow/outlets – check overflow for clogging. Remove accumulated sediment. Check overflow spillway. This will require specialist materials and competent labour.	✓			
Summer-monitor and water vegetation in extended dry periods. Low skilled labour and watering tools will be required.	✓			
Visually check for damage or missing components of devices Replace/fix as required. Workmen who are competent at identifying broken equipment will be required as well as a site checklist, and other equipment deemed appropriate.	✓			
Pruning or thinning. Low skilled labour and pruning tools are required and other equipment deemed appropriate.		✓		
Inspect trees and shrubs and replace any dead or severely diseased vegetation. A shovel, weed knife, hoe and other equipment deemed appropriate may be required to carry out work.		✓		
Scour/erosion evident: check for erosion signs. Check dams/capping system areas and correct as required. Labourers who are competent in checking for erosion are required and other equipment that are deemed appropriate for job may be required.		✓		
Outlet manholes – check and remove silt from manhole sumps. Competent Labourers and a sucker truck. Equipment that is deemed appropriate maybe required.		✓		

Pre-treatment, inspection and silt removal as required. Low skilled labour is required and a sucker truck required. Equipment that is deemed appropriate maybe required.		✓		
Check for restrictions/clogging/failures in pipes. Competent workers and pipe work tools are required.			✓	

Appendix B:
As-Built Drawings

No as-built data available yet. This will be included once the construction is completed and the as-built drawings are made.

Appendix E2

Raingarden - Operation and Maintenance Manual (Draft)

Raingarden
Operations & Maintenance Manual (Draft)

Arataki Project
CDL Land New Zealand Limited
86, 108 & 122 Arataki Road, Havelock North

Substantive Application
Fast-Track Approvals Act 2024
18 July 2025

Document Control

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Client	CDL Land New Zealand Limited (**CDL**)
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Consultant details	Wood & Partners Consultants Limited (**Woods**) PO Box 6752 Victoria St West, Auckland 1142 woods.co.nz
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1.0 Introduction

This operations and maintenance (O&M) manual details the proposed raingarden design for the Arataki development by CDL Land New Zealand Limited (CDL). The raingarden locations are shown in Figure 1.

Figure 1: Proposed raingarden locations

It is intended that this O&M manual provides:

- Background information on the stormwater treatment and detention facilities at the raingardens;
- Basic background information on the contributing stormwater catchment;
- Design details for the stormwater treatment and detention system; and
- O&M details

This manual excludes information on the stormwater reticulation system within the contributing catchment area.

This manual is to be updated following consent and construction with final O&M to be provided with CCC.

1.1. Contact Information

A summary of the contact information relating to the ownership, maintenance manager and designer for the raingarden are included in Table 1. This is yet to be confirmed.

Table 1. Contact Information

Asset ID		Resource Consent Number	
Location:		Development Name / Legal Description:	
Asset Owner Details:			
Name: Telephone Number:		Address Private Bag 92300, Auckland 1142	
Email:			
Maintenance Manager Emergency Contact Details:			
Name:			
Telephone Number: (Daytime)			

Telephone Number: (Out of Hours) Email:		
Designer Details:		
Name: Telephone Number: Email:		
Applicant Details:		
Name: Telephone Number Email:		
Landowner Details:		
Name: Telephone number: Email:		
Notes / Restrictions / Access		

2.0 System Description

2.1. Design Philosophy

The purpose of the proposed raingardens is to provide stormwater treatment and detention for the contributing catchments. The raingarden was designed to improve urban waterways by controlling and treating stormwater runoff during rain events by reducing pollutants. Stormwater runoff is diverted to these devices, detained and treated before entering the stormwater piped network.

2.1.1. Key Features

The raingardens have been designed to meet the following design requirements.

Water Quality:

- The raingardens are designed to treat the first flush of low storm events. High flows through a raingarden device can cause scour, undermining media and damaging planting.

2.1.2. Timeline

Construction is not yet completed. This section will be completed after the raingardens are constructed and vested.

2.1.3. Critical Levels as per approved Design and As-built Data

The design has not yet been approved. This section will be completed once the design of the raingardens has been approved.

2.2. As-Built Information

To be provided following consent and construction

2.3. Design Standards and Assumptions

The proposed raingarden is designed to provide water quality treatment

2.4. Ground Conditions

The raingarden shall be constructed as per the recommendations of the geotechnical report.

2.5. Consent Information

To be provided following consent approval.

3.0 System Components

The mechanical components within the raingarden devices are scour protection, end boards, liners, pipe work and overflow pits in some cases. Each time the gardens are inspected these components should be checked for damage and fixed/replaced as necessary. Pipe work within the raingarden devices is designed to be accessible by CCTV if required. All pipe work replaced must be to Council standards.

3.1. Raingarden Devices Operation & Maintenance Activity Schedule

Raingardens require regular maintenance to ensure they continue to function as effective stormwater management devices and as attractive landscape features.

With the maintenance of the raingardens, it is important that special care is taken around the trees onsite in order to prevent damage and unnecessary removal of trees. This care is particularly important in the removal of top layer of the soils, silt removal and general maintenance.

A barrier should be placed around the trees when working near them, it is recommended that when operating machinery in or around trees, exhaust is to be directed away from trees and shrubs. Machinery is not to be placed under the dripline of trees and all excavation work.

3.2. Inlet Structure Details

The raingardens have a single inlet. The inlet details can be summarised in Table 2 below. Refer to drawings P24-244-00-3950-DR and P24-244-00-3951 for further details.

Table 2. Inlet details

	Raingarden
Inlet structure (2 x kerb cutout) - Roadside	600 mm
Inlet structure (concrete runoff) - Footpath	-

3.2.1. Routine Maintenance

Key routine maintenance actions identified for the raingarden outlet structure is summarised in Table 3 below.

Table 3. Raingarden inlet maintenance actions

Component	Recommended Action
Raingarden Inlets and Energy Dissipation / Erosion Protection Structures	Runoff flowing into raingardens may carry litter and debris with it. Rubbish and debris should be removed regularly both to ensure that inlets do not become blocked and to keep the area from becoming unsightly. Inspect raingardens after rainstorms to ensure drainage paths are free from blockages.
	The area around the inlet and energy dissipation (e.g. rip rap) structures should also be inspected for erosion and cracks in the structure. Remove debris and litter and fix cracks and erosion as necessary.

3.2.2. Health and Safety Risks Associated with Raingarden Inlet Structure Maintenance

There are a number of health and safety risks associated with working inlet structures. Some of these potential risks are highlighted in Table 4 below.

Table 4. Health and safety risks associated with working around inlet structures

Risk	Mitigation
Flow through inlet making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and non in forecast

3.3. Outlet Structure Details

The raingarden outlet structure details can be found in Table 5. To be updated following the as-built survey. Refer to drawings P24-244-00-3950-DR and P24-244-00-3951 for further details.

Table 5. Outlet details

	Raingarden
Underdrain (Nova Coil Pipe)	DN150

3.3.1. Routine Maintenance

Key routine maintenance actions identified for the raingarden outlet structure is summarised in Table 6 below.

Table 6. Raingarden outlet maintenance actions

Component	Recommended Action
Raingarden outlets	Inspect raingarden outlets for blockages caused by heavy sedimentation.
Erosion Protection	Inspect areas of erosion protection (reno mattress) to identify any damage or loss of material. Identify any preferential flow paths forming through erosion protection that could be affecting function. Repairs should be carried out as required.

3.3.2. Health and Safety Risks Associated with Raingarden Outlet Structure Maintenance

There are a number of health and safety risks associated with working around waterbodies and outlet structures. Some of these potential risks are highlighted in Table 7 below.

Table 7. Health and safety risks associated with working around raingarden outlet structures

Risk	Mitigation
Flow through raingarden making work unsafe (i.e. >0.5 m/s)	Ensure no rainfall has occurred in the last 24 hours and none is forecast.
Fall Hazard	Use caution and maintain stable footing to prevent slips or falls when carrying out maintenance on the raingarden

3.4. Landscaping

The proposed raingardens will be planted with native vegetation. However, these areas are susceptible to weed invasion and the potential loss of desirable native species

Pest plants can affect raingarden vegetation by outcompeting desirable native species. Due to the large number of pest plant species, refer to the Hawke's Bay Regional Council Pests and Weeds Hub Database (Hawke's Bay Regional Council, n.d.) and the Hawke's Bay Regional Pest Management Plan 2018-2038 (Hawke's Bay Regional Council, 2018).

3.4.1. Routine Maintenance

Key routine maintenance actions are summarised in Table 8 below.

Table 8. Maintenance actions

Component	Recommended Action
Vegetation/Landscaping	Vegetation maintenance works including staking, trimming, lawn mowing, weed control, and replacement planting (only during planting season). Inspect riparian plant health and any build-up of dead plant material. Remove debris as necessary. Replace unhealthy or dead planting and undergo ongoing maintenance until established. When new planting is being carried out, exposed soil should be protected with mulch or organic matting such as coconut fibre to prevent soil erosion. Maintenance intervals will vary with growth rates and seasons. Identify weeds. Hawke's Bay Regional Council Pests and Weeds Hub Database (Hawke's Bay Regional Council, n.d.). Notify the Hawke's Bay Regional Council Biosecurity Team if pest species present 0800 108 838). Using appropriate control methods for the weed present, undertake weed control around the raingarden and in the wider property using a combination of mechanical control, manual removal and herbicide. Specialist to be contacted if further weed inspection and removal is required. Where soil erosion is observed, repair as necessary. Soil can be eroded from raingarden banks particularly after heavy rainfall and/or where vegetation cover is poor.

3.4.2. Health and Safety Risks Associated with Landscaping

There are a number of health and safety risks associated with working around riparian vegetation. Some of these risks are highlighted in the Table 9 below.

Table 9. Health and safety risks associated with working around vegetation

Risk	Mitigation
Steep and slippery slopes/banks	Take care and avoid wet soil conditions.
Unstable slopes/banks	Avoid standing on unstable banks
Stinging insects	Wear long sleeved clothing and take care during summer months.
Pollen/Dust	Wear respirator while mowing during summer.

3.5. Access and Security

The raingardens are located adjacent to Arataki Road.

A traffic management plan will need to be submitted if the work will prevent:

- Normal use of a vehicle driving or parking lane
- Normal pedestrian access along a path.

A suitable traffic management plan for maintenance will be provided by traffic contractors at the time of maintenance.

4.0 Raingarden Operation & Maintenance Requirements

4.1. Inspection and Maintenance Activities

The following checklists are designed to be used for all maintenance inspections, . The checklist is included in Appendix A. It is recommended that all tables are printed/filled out during all inspections (although only the annual inspection requires every item).

Appendix A:
Maintenance Checklist

Effective long-term operation of the raingardens requires dedicated and routine maintenance tasks performed to a consistent timetable:

Maintenance Activity	Monthly	6 Monthly	12 Monthly	5 Yearly
Remove weeds and replace dead plants. Eradicate noxious/pest weeds and undesirable growth. This shall be completed by competent workmen who have landscape experience. A hoe and weed knife will be required and other weed removal equipment.	✓			
Litter removal. Litter removal will require low skilled workman. Equipment includes a pickup tool claw, rubbish bags and other equipment suitable for the removal of litter.	✓			
Inflow, overflow/outlets – check overflow for clogging. Remove accumulated sediment. Check overflow spillway. This will require specialist materials and competent labour.	✓			
Summer-monitor and water vegetation in extended dry periods. Low skilled labour and watering tools will be required.	✓			
Visually check for damage or missing components of devices such as inspection chamber caps, edge beams and scour protection. Replace/fix as required. Workmen who are competent at identifying broken equipment will be required as well as a site checklist, and other equipment deemed appropriate.	✓			
Pruning or thinning. Low skilled labour and pruning tools are required and other equipment deemed appropriate.		✓		
Compost/Mulch replenishment (first 3 growing seasons). Low skilled labour and safety gear is required, and other equipment deemed appropriate.		✓		
Remove accumulated sediments. Reinstate plants, soil and mulch. Check for ponding/clogging and blockage of filter media. Workers who are competent at unblocking filter media are required, and equipment deemed appropriate is required.		✓		
Inspect trees and shrubs and replace any dead or severely diseased vegetation. A shovel, weed knife, hoe and other equipment deemed appropriate may be required to carry out work.		✓		

Scour/erosion evident: check for erosion signs. Check dams/capping system areas and correct as required. Labourers who are competent in checking for erosion are required and other equipment that are deemed appropriate for job may be required.		✓		
Sump-accumulated sediments not more than 50% full. Labour who are competent in identifying sump accumulation of sediments are required and other tools that are deemed appropriate may be required.		✓		
Check for restrictions/clogging/failures in pipes. Competent workers and pipe work tools are required.			✓	
Scrape off top 100mm of soil and mulch, dispose to landfill, replace. Competent workers are required, and the appropriate gardening tools are required.				✓
Replace the transition layer if warranted. Competent workers are required; small digger and the appropriate gardening tools are required.				✓

Appendix B:

As-Built Drawings

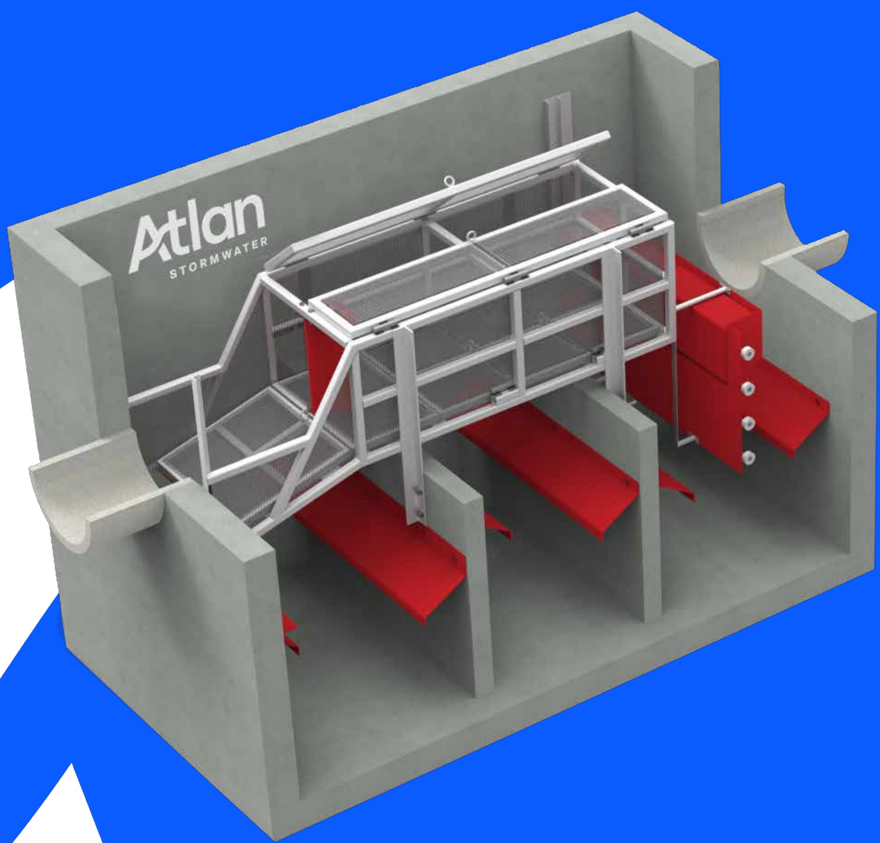
No as-built data available yet. This will be included once the construction is completed and the as-built drawings are made.

Appendix E3

Bafflebox - Operation and Maintenance Manual (Draft)

OPERATION & MAINTENANCE MANUAL

Atlan BaffleBox



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CONTENTS

READ THE FOLLOWING INFORMATION, WARNINGS AND INSTRUCTIONS BEFORE INSPECTING, PERFORMING MAINTENANCE OR CLEANING THIS STORMWATER TREATMENT DEVICE.

OVERVIEW	03
INSPECTION	04
SERVICE	07

This manual is attended to explain the specifics of the Atlan BaffleBox and to review the common aspects of the existing regulations and safety procedures.

It is the responsibility of all personnel to familiarise themselves with, understand, and comply with all applicable local, state and federal laws, BEFORE attempting to inspect or service this unit.

All precautions and procedures in this manual are current at the time of printing if this manual and are subject to change based on new processes and procedures.

Atlan Stormwater assumes no responsibility and will be held harmless for any injuries, fines, penalties or losses that occur involving any procedure in this manual or other non-addressed actions taken.

The Atlan BaffleBox performance is based on the procedures being followed in this manual. Non-Compliance with these measures will be the responsibility of the owner.

OVERVIEW

The Atlan BaffleBox is a precast concrete structure containing a series of sediment settling chambers separated by baffles.

The primary function of Atlan BaffleBoxes is to provide primary treatment, and remove sediment, suspended particles, plastics, debris and associated pollutants from stormwater.

Atlan Stormwater recommends inspections be conducted twice a year for optimal pollutant removal efficiency.

Tested Treatment Efficiencies*

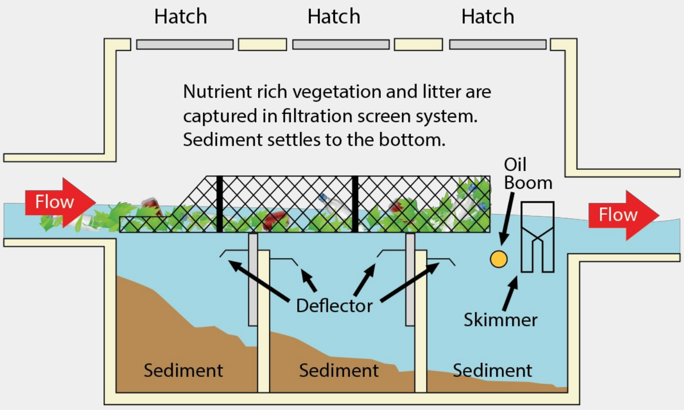
POLLUTANT	EFFICIENCY
Total Suspended Solids (TSS)	73%
Total Phosphorus (TP)	59%
Total Nitrogen (TN)	39%
Gross Pollutants (GP)	99%
Microplastics	66%

*Contact Atlan to confirm approved performance for the project LGA

FUNCTIONAL DESCRIPTION

During the storm event

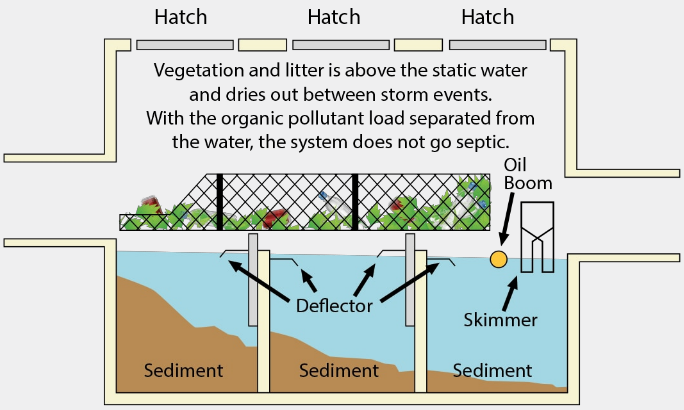
The inflow pipe is the same size as the outflow. Turbulence defectors prevent captured sediment from re-suspending. Hydrocarbons collect in front of skimmer and are absorbed by Storm Boom.



1.1 Bottom of concrete structure is only 1.2m below pipe.

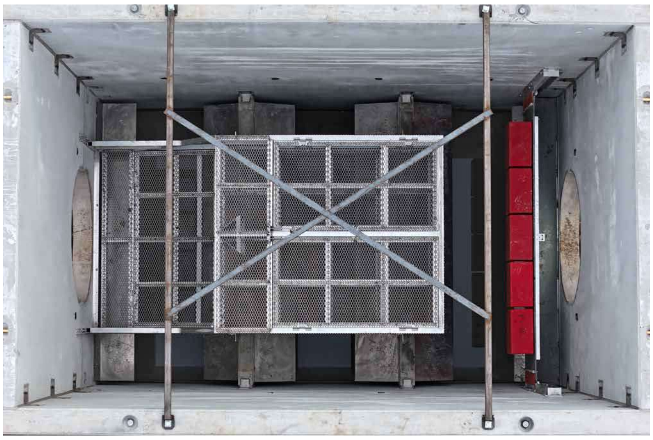
AFTER the storm event

Nutrient pollutant load is not lost to static water and flushed out at the next storm event. Separating organic matter from the static water prevents bacterial build-up.



1.2 During servicing, the screen system hinges off to the side give easy access to the sediment collected in the lower chambers.

INSPECTION



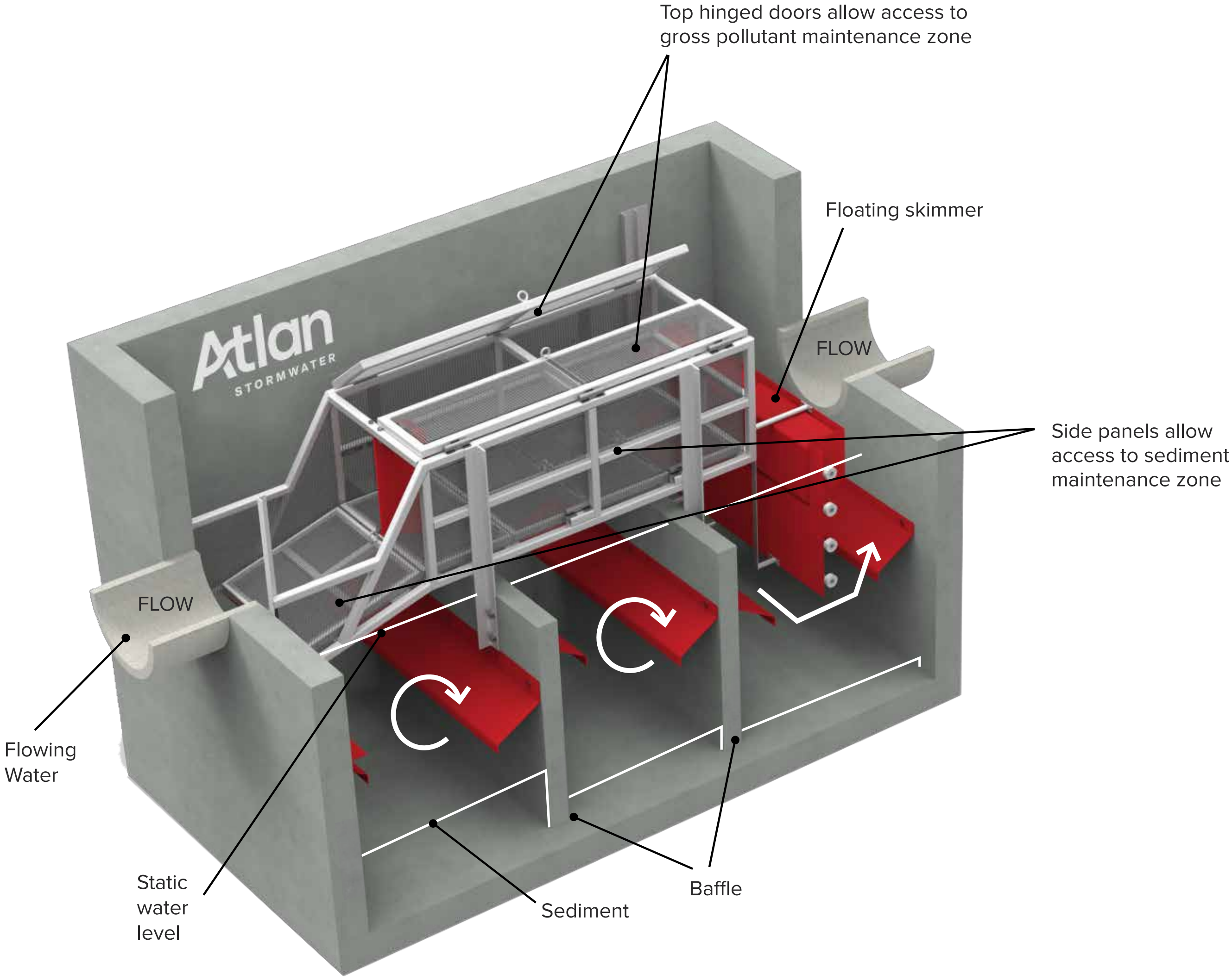
Atlan Stormwater recommends the following inspection guidelines. After installation and the site has stabilised inspections should be conducted after every runoff event for the first thirty (30) days to ensure that the Atlan BaffleBox obtains optimal pollutant removal efficiencies.

Subsequent inspections of sediment accumulation should be conducted a minimum of twice a per year. In the event the sediment accumulation equals or exceeds 50% of the Minimum Sediment Storage Volume (fig 2.1) then all accumulated sediment must be removed. All inspections must be documented (page 6).

TYPICAL INSPECTION PROCEDURES:

1. Visually inspect the unit from the surface for broken or missing hinges or handles.
2. Open access points (ie manhole covers or hatches) and secure properly.
3. A visual inspection should be made of the basket screen system to determine the capacity of debris, cracks or damages.
4. A visual inspection should be made of the stormboom. Check for missing or broken parts.
5. A visual inspection should be done of the sediment chambers. This may require opening the bottom doors of the screen system (if possible).
6. A visual inspection should be made of the overall condition of the vault. Typically joint areas as well as inflow and outflow pipe grout areas.

DRAWING


Top hinged doors allow access to gross pollutant maintenance zone
Floating skimmer
Atlan
STORMWATER
FLOW
FLOW
Side panels allow access to sediment maintenance zone
Flowing Water
Static water level
Sediment
Baffle

INSPECTION CHECKLIST

Location ________________________________

Owner name ________________________________

Address ________________________________

Phone ________________ Date ____________ Time ____________

Site conditions ________________________________

Inspection Items	**Condition**	**Notes**
1. Access Openings		
2. Screen System		
3. Rear Skimmer and Storm Boom		
4. Sediment Chambers		
5. Vault Condition		

☐ Visually inspect accessibility into the Atlan BaffleBox.

☐ Visually inspect screen system for volume of debris and broken or missing parts.

☐ Visually inspect skimmer for missing or broken parts and storm boom for discolouration.

☐ Visually inspect sediment chambers for estimated quantity.

☐ Visually inspect general condition of vault for any clogged areas.

Maintenance Items	**Approximate Volume Collected**	**Date**	**Notes**
1. Screen System			
2. Sediment Chambers			
3. Skimmer Storm Boom	Replaced Y / N		

☐ After opening access vacuum out screen system—estimate volume collected.

☐ After cleaning screen system—open bottom doors and vacuum out sediment chambers—estimate volume collected.

☐ Replace storm boom if completely blackened.

Notes

SERVICE

CAUTION! ANY SERVICE WORK CONDUCTED IN TRAFFIC AREAS MUST MEET ALL RELEVANT GUIDELINES FOR ROADWAY WORK AND ADDITIONAL SAFETY PROCEDURES WILL BE NECESSARY.

Maintenance activities including the removal of captured sediment and debris. Maintenance can be performed from outside the Atlan BaffleBox through access points such as manhole covers or hatches installed in the vault surface above the sediment chambers.

During maintenance, the screen system may have either Sliding Top Doors or Hinged Doors. These top doors open to gain access to the debris captured by the screen system.

The screen system also has bottom doors that open to give access to the sediment collected in the settling chambers. A vacuum truck is required for debris removal.

Although not every circumstance can be covered in this manual a situation may arise when the structure needs to be entered.

MINIMUM EQUIPMENT REQUIREMENTS

A vacuum truck is required for the servicing of the Atlan BaffleBox. Safety equipment will be determined by local, state and federal guidelines.

STRUCTURAL COMPONENTS

The structural components are designed to have a life span of several decades. Structural inspections are not required unless stipulated in guidelines set by local council or state agencies.

REPLACEMENT PARTS

All interior components are designed and sized to be unassembled and removed from the nutrient.

SEPARATING BAFFLE

Box for servicing or replacement. For replacement parts and instructions please contact us.

CAUTION! All OH&S confined space requirements should be met while servicing Atlan BaffleBox structures.

TYPICAL SERVICE PROCEDURES

Step 1
Open the access openings on top of the Atlan BaffleBox. These access openings are typically manhole covers, hatches or grates.

Step 2
Vacuum the debris captured by the screen system to expose the sediment collection chambers.

Step 3
Open the bottom doors to the basket system to expose the sediment collection chambers. These doors are provided with eye bolts to attach a hook to lift open the doors which will hinge off to the side (fig 3.1).

Step 4
Vacuum each of the lower sediment chambers until they are empty.

Step 5
After cleaning the sediment chambers close the bottom screen doors of the screen system. Lower or slide the top doors and assure they lock correctly.

Step 6
Visually inspect the Storm Boom in the skimmer system for oil accumulation. Change Storm Boom if it is significantly discoloured or if it is close to one (1) year of service.
The Storm Boom has ropes attached to each end which are fastened to eyelets adjacent to the access cover. These ropes act as a leash to prevent the bottom from washing away, and to allow the bottom to be easily pulled out of the containment bracket system on the face of the skimmer. Attach a rope on the end of the new boom to a rope on the end of the old boom.

As the old boom is pulled out it will pull the new boom into position. The booms will trade places. Attach the rope ends of the new boom to the eyelets adjacent to the access cover (fig 3.2).

Step 7
When all maintenance work is completed, close the access covers.

Joy in water

‘We believe clean waterways are a right not a privilege and we work to ensure a Joy in Water experience for you, with your children and grandchildren.’

Andy Hornbuckle

Atlan
STORMWATER

P 02 8705 0255
sales@atlan.com.au
100 Silverwater Rd,
Silverwater NSW 2128
atlan.com.au