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DELMORE

STORMWATER INFRASTRUCTURE

Vineway Ltd

MCKENZIE & CO.

DOCUMENT CONTROL RECORD

PROJECT: Delmore

CLIENT: Vineway Ltd

PROJECT LOCATION: 53A, 53B & 55 Russell Road and 88, 130 & 132 Upper Ōrewa Road

Revision	Date	Originator	Checker	Approver	Description
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H	22/12/25	[redacted]	[redacted]	[redacted]	Substantive Application

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Engineering drawings attached separately.

1. EXECUTIVE SUMMARY

McKenzie & Co. Consultants has prepared this Stormwater Infrastructure Report to support Vineway Ltd.'s proposed 109-hectare residential development in Ōrewa, comprising approximately 1,213 residential lots. The report focuses on stormwater management, with related topics (e.g., earthworks, road access, water supply) covered in separate documents.

Regulatory & Design Framework

The stormwater network design aligns with relevant legislation and Auckland Council standards, including the Building Act, Auckland Unitary Plan, Stormwater Code of Practice (V4), Auckland Council's Regional Network Discharge Consent (NDC), and guidance documents like GD001, TP108, and TR 2013/018. Climate change projections of 2.1° for the 10% Annual Exceedance Probability (AEP) event, and 3.8° temperature increase 1% AEP event.

Existing Conditions

Currently, no public stormwater infrastructure is available on-site. The area is predominantly pastoral with pine plantation and covenanted bush areas, drained by several natural streams and wetlands. These features will remain protected where possible, with new culverts replacing outdated farm culverts and ensuring ecological connectivity.

Proposed Stormwater Management

Quality, Retention, & Detention: Low contaminant generating building materials, on lot tanks and raingardens, are proposed for lots. Gross pollutant traps (GPTs) & communal raingardens are proposed to treat runoff from roads and Joint Owned Access Lots (JOALS).

Primary & Secondary Systems: Lots fronting streams will discharge direct to the streams. A new primary network of catchpits and pipes will manage flows up to the 10% AEP event, while secondary OLFPs within road reserves will handle 1% AEP events.

Culvert Crossings: Multiple box culverts are designed to be embedded a minimum of 350mm below the streambed. For all culverts, riprap will be installed to reduce erosion and maintain natural flow regimes.

Flood Management & Overland Flow: The design ensures no significant adverse flooding effects upstream or downstream, with proposed Delmore building platforms set above modelled flood levels and climate-change-adjusted flows.

Operations & Maintenance

Maintenance access is integrated into the design for culverts, raingardens, and riprap areas. Periodic checks, especially after major storms, will safeguard infrastructure performance and water quality.

Discharge Consent

A stormwater discharge consent will be required for discharges from the development. In the future if the land becomes zoned from Future Urban Zone to a residential zone, it is anticipated that the area will eventually be adopted into Auckland Councils Regionwide Stormwater Network Discharge Consent (NDC). The infrastructure has been designed with this in mind, with an accompanying draft Stormwater Management Plan that can be adopted in the future, as part of that process.

Conclusion

The proposed stormwater solution balances development needs with environmental protection, adhering to Auckland Council requirements and best-practice engineering. With careful consideration of flood risk, water quality, and climate change, the design will provide a robust and sustainable stormwater network for the new residential community.

All reported flood levels are referenced to NZVD2016 unless stated otherwise.

2. INTRODUCTION

McKenzie & Co. Consultants have been engaged by Vineway Ltd to provide a Stormwater infrastructure report in support of the proposed 109Ha development located at 53A, 53B & 55 Russell Road and 88, 130 & 132 Upper Ōrewa Road, Ōrewa. The development is a residential development for approximately 1213 lots.

This report is prepared in support of Vineway Ltd.'s application for approvals under the Fast-track Approvals Act 2024 by addressing the key stormwater matters that relate to this proposal. It is important to note that this report only covers stormwater, while other infrastructure matters, including earthworks, sediment, and erosion control, roading and access, wastewater, water supply and utility works are addressed in separate Infrastructure reports.

The primary objective of this stormwater infrastructure report is to demonstrate how the proposed system is designed to manage stormwater runoff to minimise flood damage and adverse effects on both the built and natural environments.

To fully comprehend this report, it should be read together with the consent application, plan drawings, and other supporting documents referred to in this report.

3. LEGISLATION, CODES OF PRACTICE, & STANDARDS

The stormwater system has been designed in accordance with the below requirements, and appereports:

- Building Act 2004

- NIWA Climate Projections for Auckland Region, 2020
- Auckland Unitary Plan
    - E1 Water quality and integrated management
    - E8 Stormwater – Discharge and diversion
    - E9 Stormwater quality – High contaminant generating car parks and high use roads
    - E10 Stormwater management area – Flow 1 and Flow 2
    - E36 Natural hazards and flooding
- Stormwater Code of Practice, V4
- Auckland Councils' Regional Network Discharge Consent (NDC)
- TP108 – Guidelines for Stormwater runoff modelling in the Auckland Region
- GD001 – Stormwater management devices in the Auckland region
- TR 2013/018 – Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices
- Auckland Transport TDM
- McKenzie & Co Flood Assessment Report, 2025
- NZS4404:2010
- National Policy Statement for Freshwater Management 2020 (updated 2024)
- New Zealand Coastal Policy Statement 2010
- Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020
- National Adaptation Plan (MfE, 2022)
- Health and Safety at Work Act 2015
- Plan Change 120

4. SITE DESCRIPTION

The proposed development site is legally described as Lot 1 DP 336616, Lot 1 DP 497022 & Lot 2 DP 497022, Lot 2 DP 418770, Lot 1 DP 153477 & Lot 2 DP 153477, as illustrated in Figure 1 below. The site is zoned as Future Urban area.

The development is accessed from Grand Drive in the northeast, and Russell Road and Upper Ōrewa Road from the south.

Currently, the site is used for agricultural purposes with livestock roaming across a significant portion of the site. Some bush areas subject to consent notices that are generally proposed to remain, and a pine tree stand in the northeast corner of the site.

The location of the development is shown below in Figure 1.

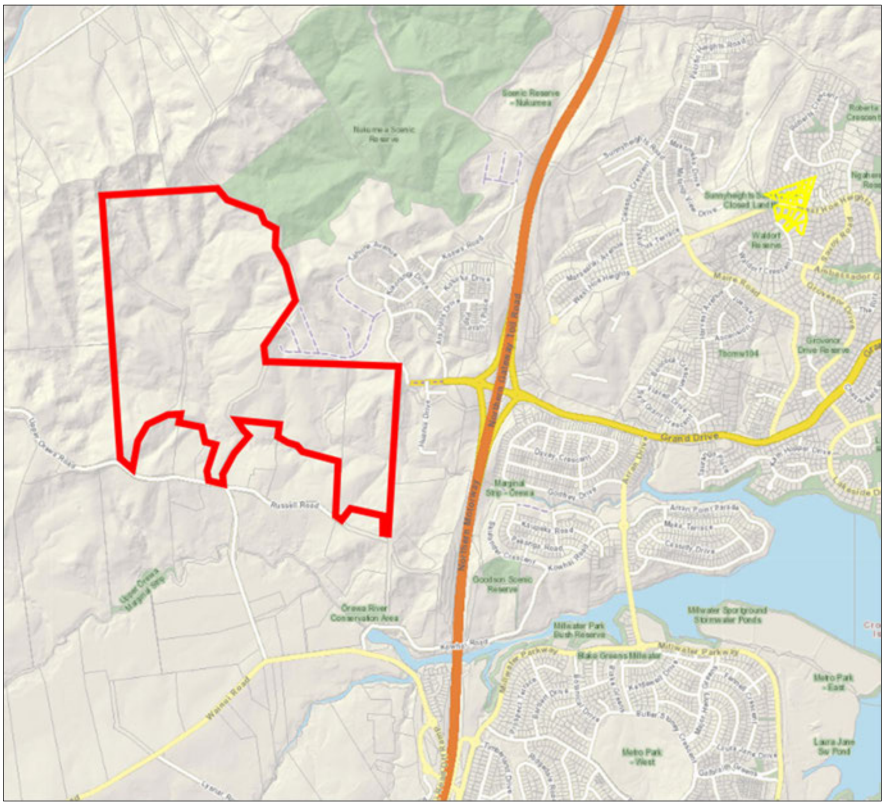


Figure 1 - Site Location – Extent of affected properties

5. EXISTING STORMWATER INFRASTRUCTURE

There is currently no public stormwater infrastructure within the site or available for connection at the boundary.

The development is fully contained within the Ōrewa West catchment, as shown below in Figure 2.

Several smaller sub-catchments within this catchment, contain several streams discharging into a single stream which flows out of the site at a single discharge point. The streams have been mapped and assessed by Viridis[1], and are shown in Figure 3. The sub-catchments are shown in Figure 4 further below.

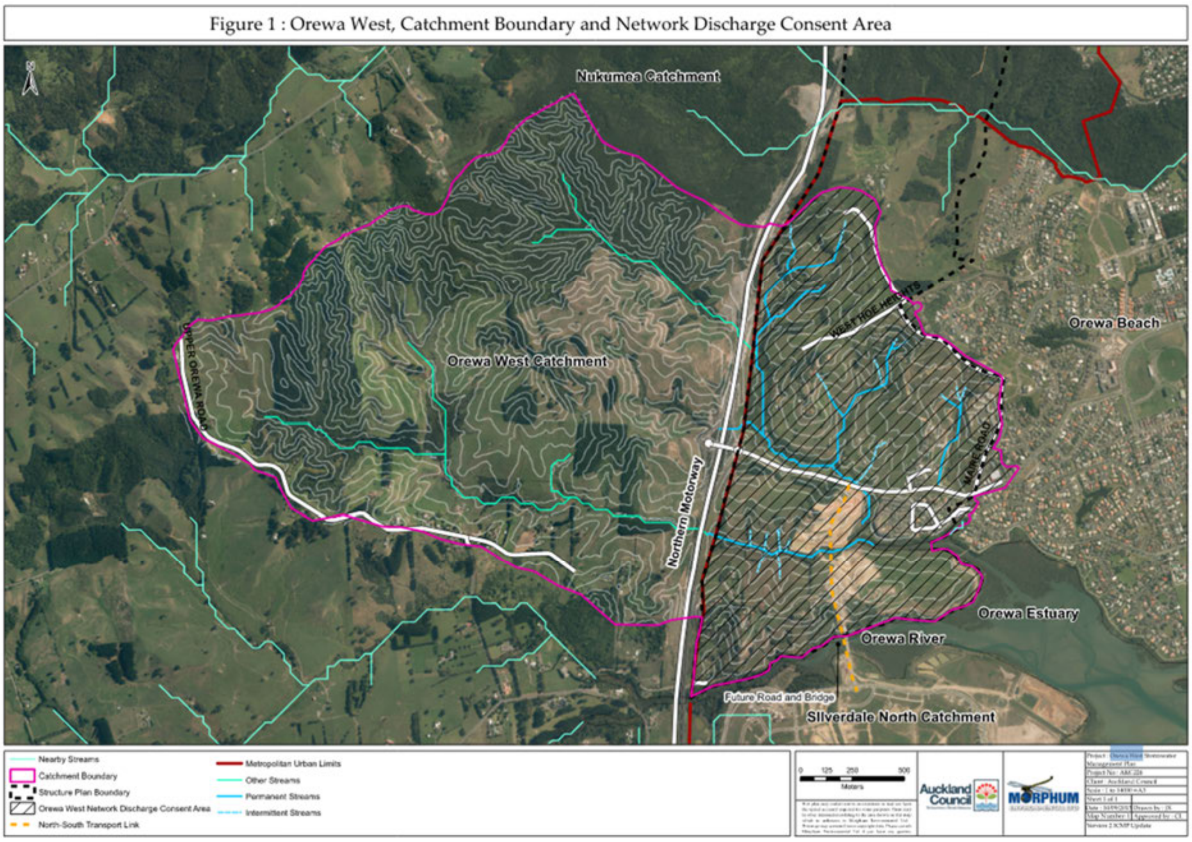


Figure 2 - Ōrewa West Catchment

The streams have existing driveway and farm culvert crossings and associated natural wetlands at various locations throughout the development. They also contain a network of natural wetlands. All wetland features and streams have been mapped, by Viridis consultants.

The existing farm culverts will be removed during the construction process to enable the streams to be reinstated to their original alignment and cross section.

Streams 31 & 38 comprise the main channel, which flows to the East to the lowest point of the catchment. The streams are shown below in Figure 3. This stream flows from West to East, passes under State Highway 1, and discharges out to the upper reaches of the Ōrewa Harbour.

[1] Viridis Ecological Impact Assessment December 2024, Ref : 10122-002-A .

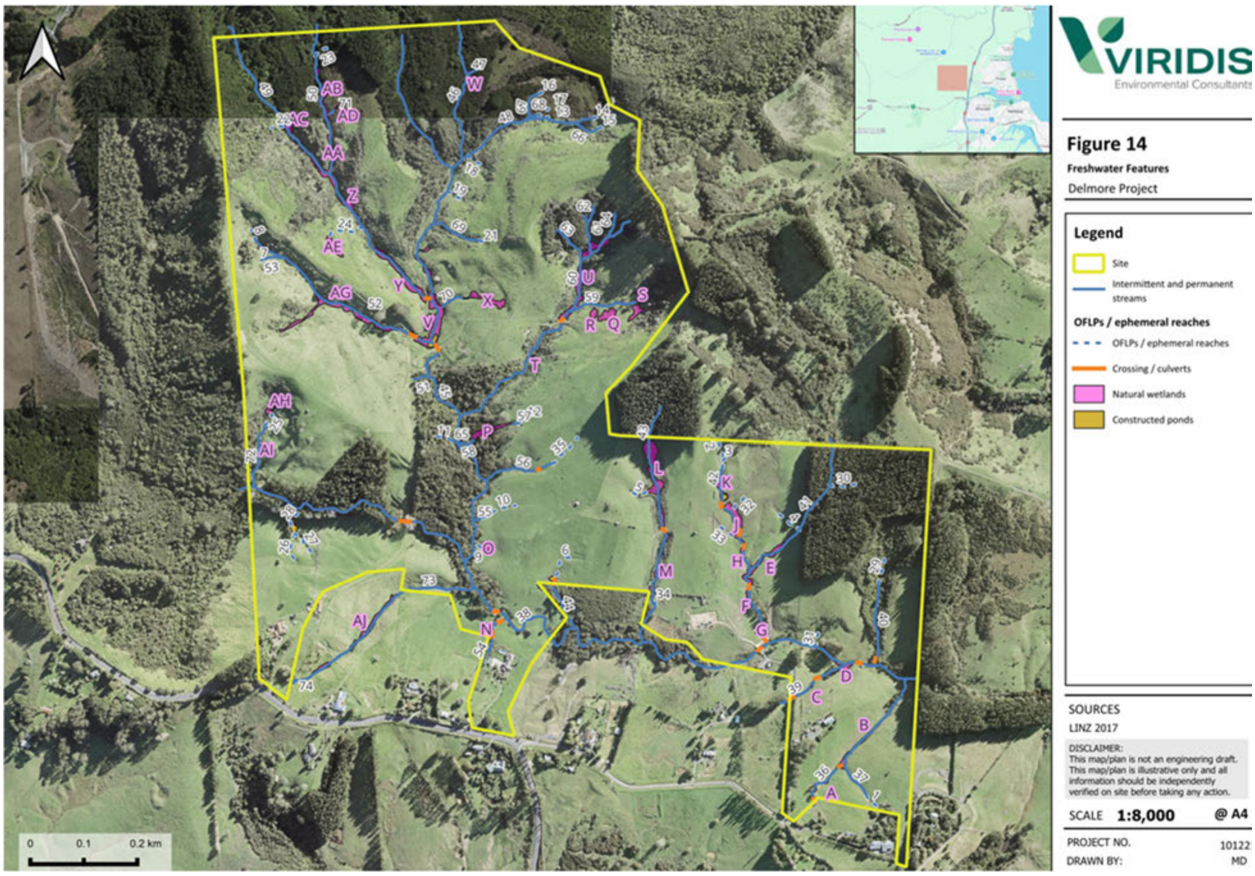
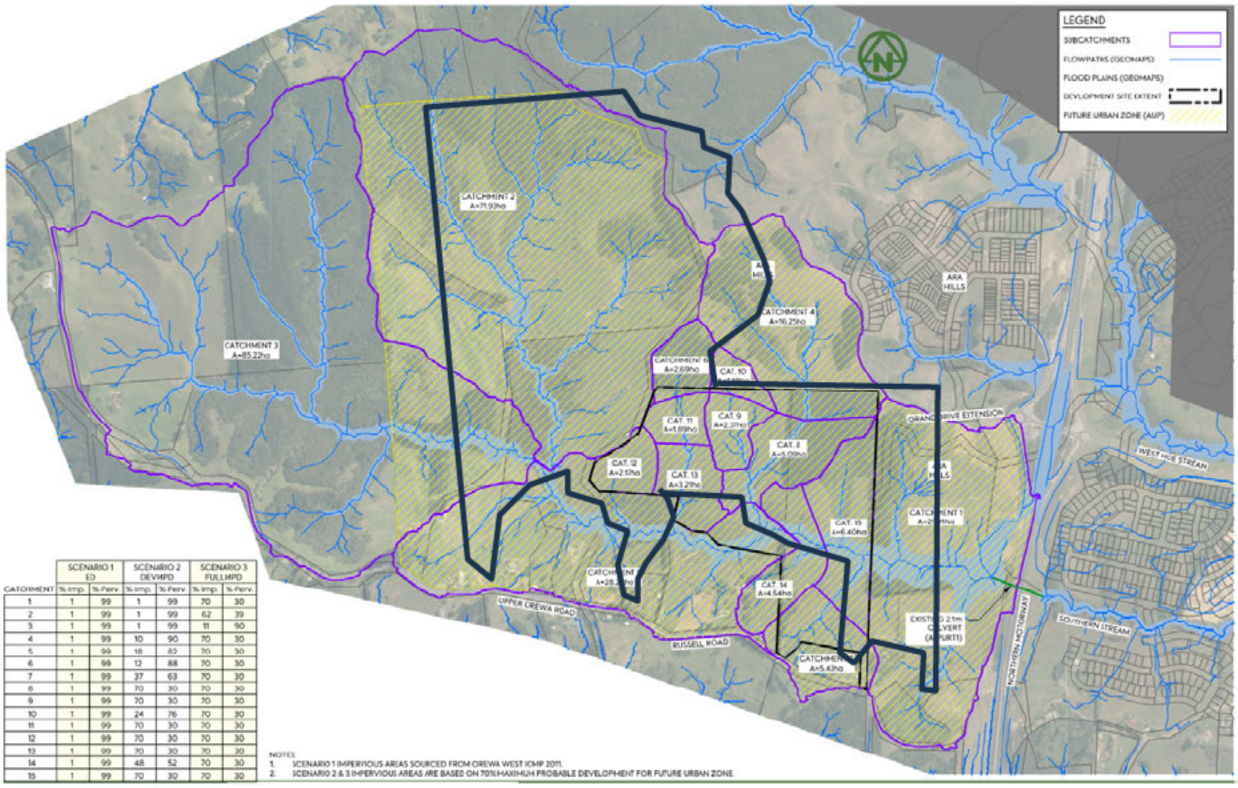


Figure 3 – Streams within the Delmore project site

Refer to Figure 4 shows the contributing sub-catchments which affect the site.

The site is predominantly pasture, with a pine plantation in the northeastern corner. Consent notices issued under s 221 of the Resource Management Act 1991 apply to some areas of the site protecting flora and freshwater features.

Several existing stream crossings that are currently used for farming are shown in Figure 3. Some of these existing crossings may be utilised temporarily during construction works, however will ultimately be removed and replaced with future culverts to enable road crossings over the streams. These are discussed in further detail in Section 10.



	SCENARIO 1 ED		SCENARIO 2 DEVMPD		SCENARIO 3 FULLMPD	
CATCHMENT	% Imp.	% Perv.	% Imp.	% Perv.	% Imp.	% Perv.
1	1	99	1	99	70	30
2	1	99	1	99	62	39
3	1	99	1	99	11	90
4	1	99	10	90	70	30
5	1	99	18	82	70	30
6	1	99	12	88	70	30
7	1	99	37	63	70	30
8	1	99	70	30	70	30
9	1	99	70	30	70	30
10	1	99	24	76	70	30
11	1	99	70	30	70	30
12	1	99	70	30	70	30
13	1	99	70	30	70	30
14	1	99	48	52	70	30
15	1	99	70	30	70	30

Figure 4 – Sub-Catchments and streams within the site

6. STORMWATER MANAGEMENT PLAN

The land is currently zone Future Urban, and as such is not currently included in the scope of Auckland Councils Region Wide Network Discharge Consent (NDC), therefore a site-specific stormwater discharge consent will be required for the public and private stormwater discharges. Ultimately, it is expected that the land will be re-zoned to a residential zone in the future. As such, the stormwater infrastructure has been designed in accordance with a stormwater management plan, so that when the re-zoning occurs, the public infrastructure can come under the NDC. The lots with private discharges will still need to comply with their with the private discharge consent.

A Stormwater Management Plan (SMP) for the site has been prepared by McKenzie and Co to demonstrate how the proposed stormwater management could comply with the with the NDC Green-field requirements.

The SMP identifies the following requirements for the site:

1. Water Quality – GD01 treatment for all impervious areas
2. Stream Hydrology – Equivalent hydrology to pre-development (5mm retention, 95th percentile detention)
3. Flooding - 10% AEP – Demonstrate sufficient capacity in downstream network
4. Flooding - 1% AEP – No effect on existing downstream building floor levels, achieves

SWCoP freeboard requirements.

This stormwater infrastructure report is consistent with the Stormwater Management Plan and shows how the development area can come under Councils NDC in the future.

7. INTEGRATED STORMWATER MANAGEMENT

An integrated stormwater management approach has been applied as far as possible, relying on natural components such as vegetation and soil media to cater for stormwater management as well as enhancing urban environments.

This approach has resulted in on lot devices, raingardens being proposed for stormwater quality, retention, and detention management for road and JOAL surfaces.

Tanks are proposed to provide on-lot mitigation. Lots adjacent to streams, are proposed to discharge via T-bar outlets to mimic pre-development conditions and to maintain flows to streams to support wetland health.

8. CATCHMENT & OFFSITE EFFECTS

8.1. Upstream

The development is located at the upper reaches of the currently zoned FUZ land. To the north, it is bordered by the Nukumea Scenic Reserve, and to the west, an area of vegetation identified as a significant ecological area under the Auckland Unitary Plan (identified as SEA_T_6652).

These natural features limit the potential for further upstream development, and it is expected that the zoning of these neighbouring sites will remain conservation/rural under the AUP. Consequently, the runoff coefficient is proposed to remain unchanged between the pre- and post-development scenarios.

8.2. Downstream

The downstream catchment is currently pasture between the development site and State Highway 1 the point at which a 2.1m diameter culvert discharges flow to the upper reaches of the Ōrewa harbour. The downstream catchment and flows from the 1% AEP, Maximum Probable Development (MPD) with 3.8°C Climate Change, is shown in Figure 5. Development in the downstream portion of the catchment, has been developed outside of the flood plain, in accordance with the Ōrewa West Integrated Catchment Management Plan.

As outlined in the Flood Assessment Report, There are no dwellings or buildings downstream of the development which will be adversely affected by increased impervious area.

3.8°C Climate change factor and sea level rise has been considered as part of the assessment of the downstream effects.

This is outlined in more detail in the Flood Risk Assessment report [2]

Figure 5 - Downstream catchment

9. PROPOSED STORMWATER INFRASTRUCTURE

Below is a summary of the key elements of the requirements of the proposed stormwater system.

9.1. Water Quality

Lots

Low contaminant generating building materials shall be required for all lots, to ensure contaminants are not generated on the site.

Driveways shall be treated with a $1m^2$ raingarden.

All roads and JOALs, will have water quality treatment provided by communal raingardens.

9.2. Retention & Detention

The following retention and detention are to be provided for all impervious areas –

- Retention (volume reduction) - 5mm runoff depth
- Detention (temporary storage) and a drain down period of 24 hours for the difference between the pre-development and post-development runoff volumes from the 95th

[2] McKenzie & Co Flood Assessment Report, 2025

percentile, 24-hour rainfall event minus the 5 mm retention volume or any greater retention volume that is achieved.

For this development, the following depths for retention and detention have been calculated in accordance with TP108, using a design rainfall of 38mm (TR35) -

- Retention depth – 5mm
- Detention depth – 19.5mm

Calculations are included in Appendix B further below.

9.3. Lots

Private lots are managed at source through the installation of:

- First flush diversion devices and retention/detention tanks;
- Driveway treatment devices (e.g., GD01-compliant stormfilters or small on-lot raingardens); and
- Consent notices on each title requiring installation and long-term maintenance of these devices.

This dual approach ensures that all impervious surfaces—public and private—achieve full compliance with treatment and hydrology mitigation requirements. The proposed solution reflects the Best Practicable Option (BPO) for the site, balancing performance, feasibility, and ongoing operability.

Quality

Roof materials will be required to be made from low contaminant generating building materials. This mitigation will ensure that contaminants are not introduced at the source.

Discharge from the parking areas will require treatment, in the form of a $1m^2$ raingarden. This size is required to provide sufficient area for plants to survive and provide meaningful treatment.

The communal raingardens have been sized to accommodate runoff from the driveways from these lots.

Retention and Detention

Water from the roof from each lot will be discharged into an on-lot tank, to be designed in accordance with GD01 section C5. This tank will be sized for retention and detention volumes. The retention volume can be used for irrigation and/or recycled water.

Lots that do not have a stream interface, are proposed to discharge to the public pipe network, from the on-lot retention/detention tank.

All lots are to have on-lot tanks to undertake retention and detention. Typical tank sizes for various lot sizes are below, based on 60% site coverage:

Lot area (m^2)	Retention Volume (m^3)	Detention volume (m^3)	Total volume (m^3)
200	0.06	2.34	2.94
250	0.75	2.93	3.68
300	0.90	3.51	4.41

Figure 6 – Tank examples - slimline or underground

A simplified graph for sizing the on-lot tanks is shown below in Figure 7.

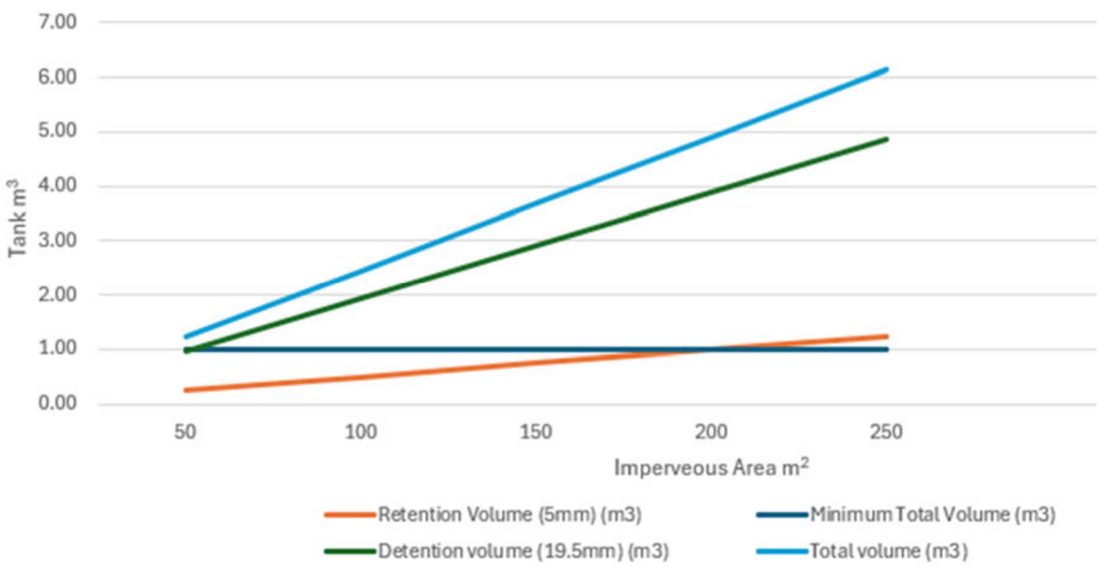


Figure 7 - On Lot tank sizing Chart

Discharge

To maintain stream base flows, it is proposed that lots facing the streams discharge direct to the streams, through a piped discharge or T bar level spreader, as shown below in Figure 8. This detail is also shown on drawing 3725-1-4360. The level spreaders will provide maintenance access for regular checking for blockages, damage and checking for scouring or erosion.

The proposed flow spreader units from private lots are not intended to discharge to the communal raingardens. Where private lot runoff may flow downslope near communal raingardens or access tracks, the following is proposed:

- A swale or shallow channel will be constructed alongside the access track to intercept and redirect any overland flow, preventing uncontrolled inflow into the raingarden;
- Where necessary, subsurface piping may be introduced to convey runoff away from the raingarden, ensuring it is discharged to the streams in a controlled manner, and in accordance with GD01 energy dissipation guidelines; and
- In all cases, these flow paths will be separated from the operational zone of the communal raingardens, with erosion protection and safe flow conveyance addressed through detailed design.

These solutions are intended to minimise hydraulic loading on the communal devices while protecting baseflow for adjacent streams and wetlands. Final design will be developed in coordination with Healthy Waters at the EPA phase, with appropriate erosion control and hydrology management measures confirmed as part of the detailed stormwater design.

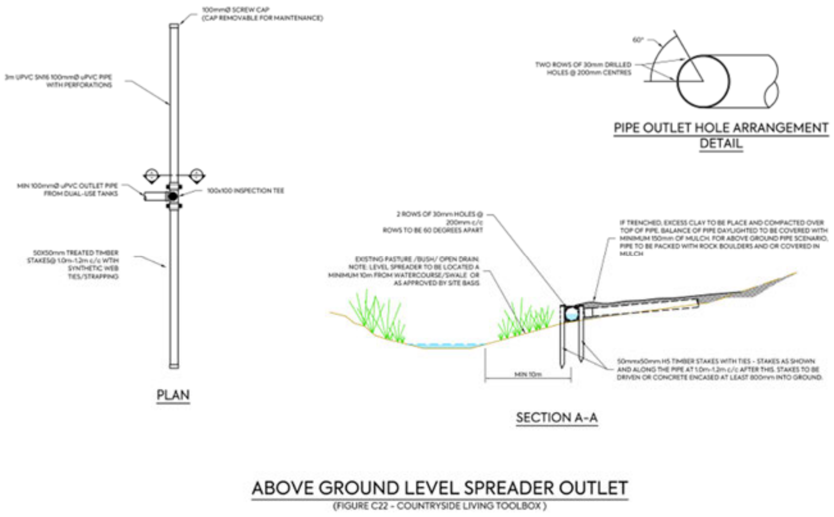


Figure 8 - T-Bar level spreader for private lots discharging to streams

Lots that do not discharge to streams will be required to connect to the public pipe network.

Lots that have retaining walls and steeper batters that 1 in 1 slopes are proposed to be connected to the pipe network, for conveyance to a stabilised discharge point.

9.4. Roads & JOALs

It is proposed that all road and JOAL surfaces will discharge through a catchpit with a sump prior to discharging to the pipe network.

Stormwater will then be piped through a gravity pipe system, to a splitter manhole. This will split low flows for treatment in the raingarden, from high flows which will bypass the raingarden and be discharged directly to the streams. Low flows will first pass through a Gross Pollutant Trap (GPT) prior to being discharged to a GD01 compliant communal raingarden. The raingardens have been sized to undertake appropriate treatment, retention and detention for all roads and JOAL impervious areas. The communal raingardens are each designed and sized in accordance with GD01 requirements.

Treatment catchments and associated impervious surface areas have been confirmed via design drawings 3725-1-4310 and 3725-2-4310, and calculations demonstrating the assumed runoff coefficients and sizing methodology.

Flows exceeding the water quality flow (which would otherwise be directed to the raingarden for treatment) will be diverted directly to the stream outlet. This diversion is designed to protect the raingarden from potential damage caused by high flow volumes and velocities.

9.5. Primary Stormwater System

A catchpit and pipe network will be constructed to convey flows from storms up to the 10% AEP storm events to the treatment devices. The network layout and catchment plans are shown on the 4000 series drawings for each stage.

Pipes and catchpit sizes, types, class, grades and hydraulics, are shown on the 4100 series long sections.

In accordance with SWCOP V4, a 2.1-degree climate change factor has been applied.

9.6. Secondary Stormwater System

Secondary flow paths have been designed within road carriageways for storms up to the 1% AEP storm event. Flows are generally contained within the road carriageway and subsequently discharge to adjacent streams. The 1% AEP road flow discharge channel erosion protection plans are shown on the 4600 series.

In accordance with SWCoP V4, a 3.8°C climate change factor has been applied.

Riprap has been provided at low points to safely convey flows to the stream channels.

9.7. Communal Stormwater Treatment Devices

Catchpits

All catchpits will have a sump to capture gross pollutants and particulate matter.

Gross Pollutant Trap (GPT)

A GPT such as a Cascade Separator from SW360, is proposed as part of the treatment train approach. This will ensure a longer life for the raingarden and reduce the amount of sedimentation. A parking area for maintenance vehicles will be provided within approximately 50m to allow for a sucker truck to clean out the sump regularly.

The Stormwater plans show the locations of the proposed GPTs, which are positioned downstream of the splitter manholes and upstream of the communal raingardens. These GPTs are included to capture gross debris and sediment prior to inflow into the bioretention media, and serve a pretreatment function.

The hydraulic interaction between the splitter box and GPT will be considered in more detail and EPA phase design process:

- The GPT introduces a hydraulic head loss which is beneficial to the system, as it reduces flow velocity entering the raingarden, helping to minimise scour, media disturbance, and erosion at the surface;
- This arrangement ensures both the first flush diversion to the treatment device and pretreatment of coarse material without compromising flow capacity; and
- The outlet pipe downstream of the splitter will be appropriately sized to convey both the detention volume and high-flow bypass scenarios, consistent with GD01 hydraulic modelling principles.

Final confirmation of sizing, head loss allowances, and detention performance will be undertaken as part of the Engineering Plan Approval (EPA) phase, including dynamic hydraulic modelling of the full system.

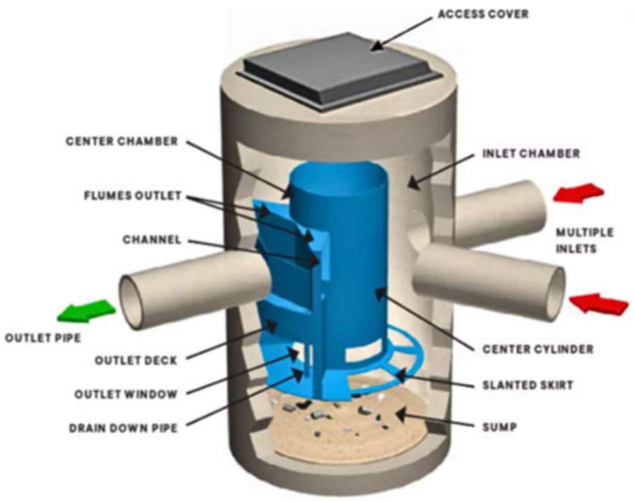


Figure 9 – example GPT

Communal Raingardens

Due to the topography and requirements for retention, it is considered that communal raingardens are the best practical option for the site.

The communal raingardens will be located within public drainage reserves. They are in areas where access for maintenance can be achieved, and where the natural catchment can discharge into.

The rain garden is provided with:

- Storage volume to meet retention and detention requirements.
- Forebay(s) equivalent to 15% of the permanent water area
- Orifice and overflow outlets
- High level overflow
- Emergency overflow
- Sufficient space for maintenance access

A typical raingarden configuration is shown below in Figure 10, showing the bio-media and drainage layers.

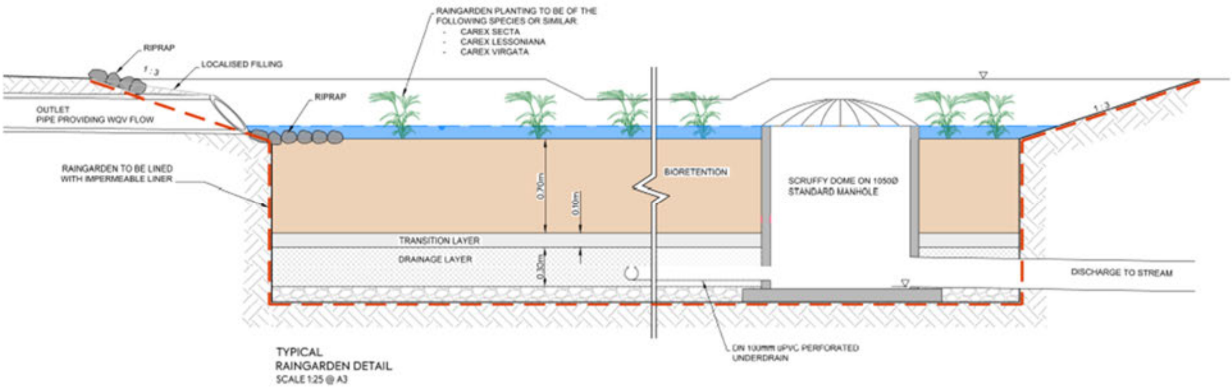


Figure 10 – Raingarden cross section

The communal raingardens have been designed to manage stormwater runoff from defined road and JOAL catchments, with treatment and hydrology mitigation outcomes tailored to the contributing area. Each raingarden is connected to a splitter manhole, which diverts flows up to the water quality volume (WQV)—generally equivalent to the 95th percentile storm—into the bioretention device. Flows beyond this threshold bypass the raingarden to avoid overloading.

The catchment areas for each raingarden are illustrated in plans 3725-1-4340 and 3725-2-4310 (attached as Appendix A). Dynamic hydraulic modelling will be undertaken during the Engineering Plan Approval (EPA) phase to confirm that the splitter manhole configuration, and raingarden devices meet both treatment and conveyance performance expectations.

Although some runoff from private lots may enter the public stormwater system, these flows are already mitigated at source through on-lot retention/detention systems. As such, their contribution to the first flush flow entering the communal devices is minimal, and conservative sizing has been applied to account for this.

High flows – Diversion manhole and OLFP

Flows above the 95^{th} percentile storm event will be diverted to protect the raingardens from high flows, using diversion manholes. In addition, OLFPs will not flow through raingardens but will be diverted around them to avoid damage from scour and erosion. The hydrological sequencing has been determined to demonstrate that the timing and magnitude of tank discharges from private lots are delayed, such that they do not interfere with or dilute the first flush entering the communal raingardens.

Specifically:

- Even with a conservative scenario where private lot catchments are twice the area of road catchments, a 10-minute overlap would result in <1% dilution of the road first flush;
- This overlap is further reduced in reality due to the initial 5mm retention in private tanks, ensuring near-zero early discharge during the critical pollutant-laden initial storm period; and

- This confirms that the communal raingardens are functionally and hydraulically separated from private lot contributions during the first flush window, and are treating high-risk runoff independently and effectively.

We consider this approach to meet or exceed GD01 performance requirements for both treatment and hydrological control. A dynamic hydraulic analysis will be finalised at the EPA stage to confirm the sizing and performance of all devices through full storm events.

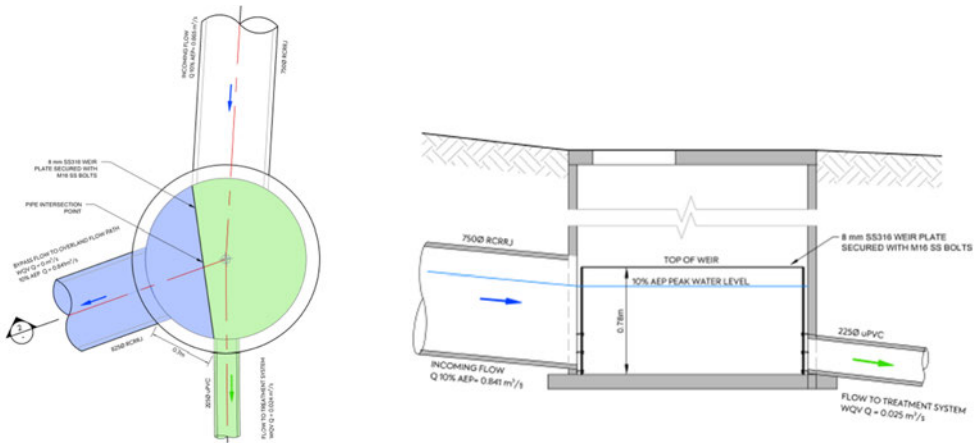


Figure 11 - Typical diversion manhole

Stormwater Reticulation

The development includes a new stormwater reticulation network to service the site. This consists of a new public pipe and manhole network, sized for the 10%AEP event.

The network extension has been designed in accordance with the Auckland Council Code of Practice for Land Development: Chapter 4 Stormwater v4 and sized to accommodate flows from the 10% AEP storm event, plus climate change.

Refer to drawings 3325-0-400 to 403 and 420 to 425.

Outlets to streams

Stream outlets will be designed to minimise scour and erosion, utilising headwalls, bubble up manholes, and rip rap to reduce velocities and provide erosion protection. It is anticipated that most outlets will be into streams.

Outlets will be combined into single outlet locations where possible. Access will be provided to outlet locations for maintenance purposes.

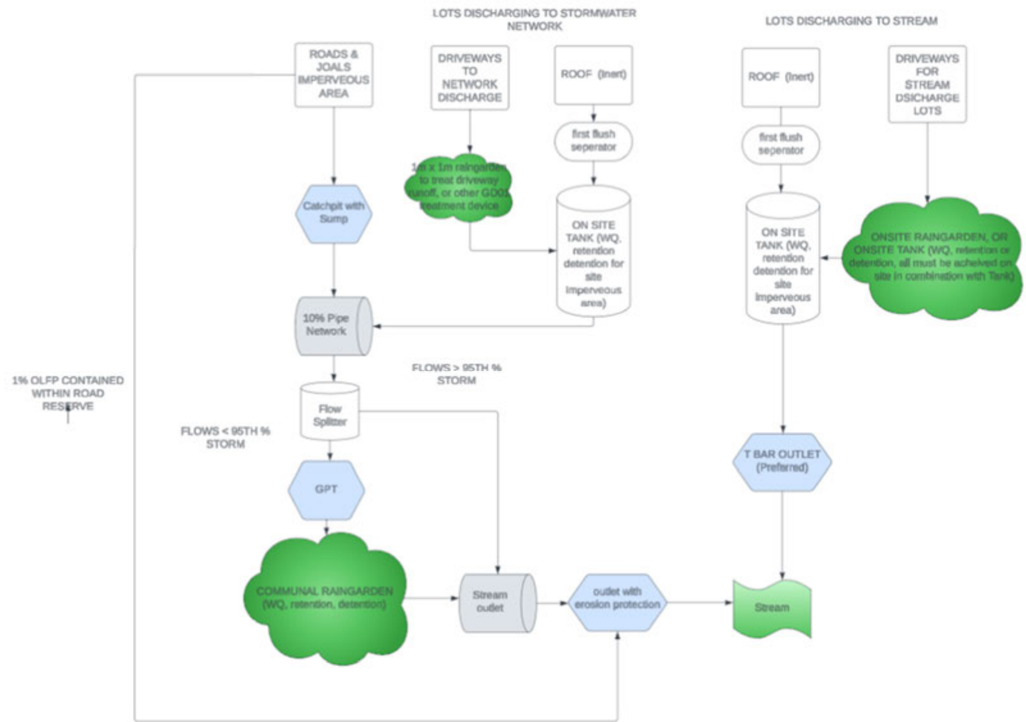


Figure 12: Summary of Stormwater Strategy

Maintenance

All public and private stormwater devices will require regular maintenance to ensure proper functionality and long-term operation. Comprehensive maintenance plans will be developed for both public and private devices, supported by conditions of consent and consent notices to guarantee ongoing upkeep. All raingardens have been designed to have a max 1 in 5 access track, with an area available for drying of wet materials during maintenance. Access for an excavator and truck manoeuvring has been allowed for.

9.8. Flooding and Overland Flow Paths (OLFPs)

Flooding

McKenzie & Co have prepared a flood assessment report[3] to assess the effects of the development on upstream and downstream properties and assess the effects of culverts on flows and flood levels on adjacent properties. It also includes an E36.9 Hazard Risk Assessment.

The report has modelled 17 scenarios for the 2, 5-, 10-, 20- and 50-year storm events, and for the pre- and post-development FUZ scenarios, both with and without the development surface for comparison. It concludes that the effects of the development will not result in adverse effects to properties upstream or downstream properties and therefore are less than minor.

[3] McKenzie & Co Flood Hazard Assessment, 2025

Pre-Development

A predevelopment flood model has been prepared to model the catchment for various scenarios. Refer to Figure 13.

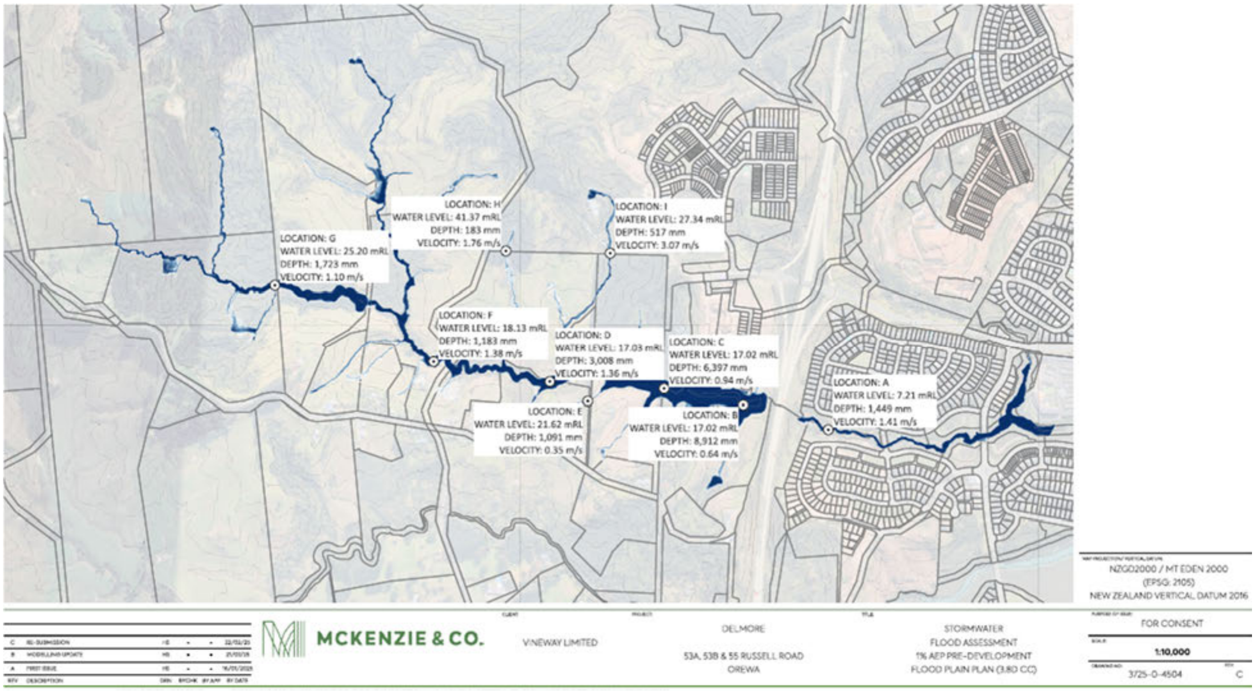


Figure 13. Pre-development 1% AEP MPD with 3.8°C CC - flood depths

Post Development

The design proposes to recontour the site, to provide road formations and flat lots for house construction. Post-development flood model scenarios have also been run. These are outlined in more detail in the Flood Assessment Report.

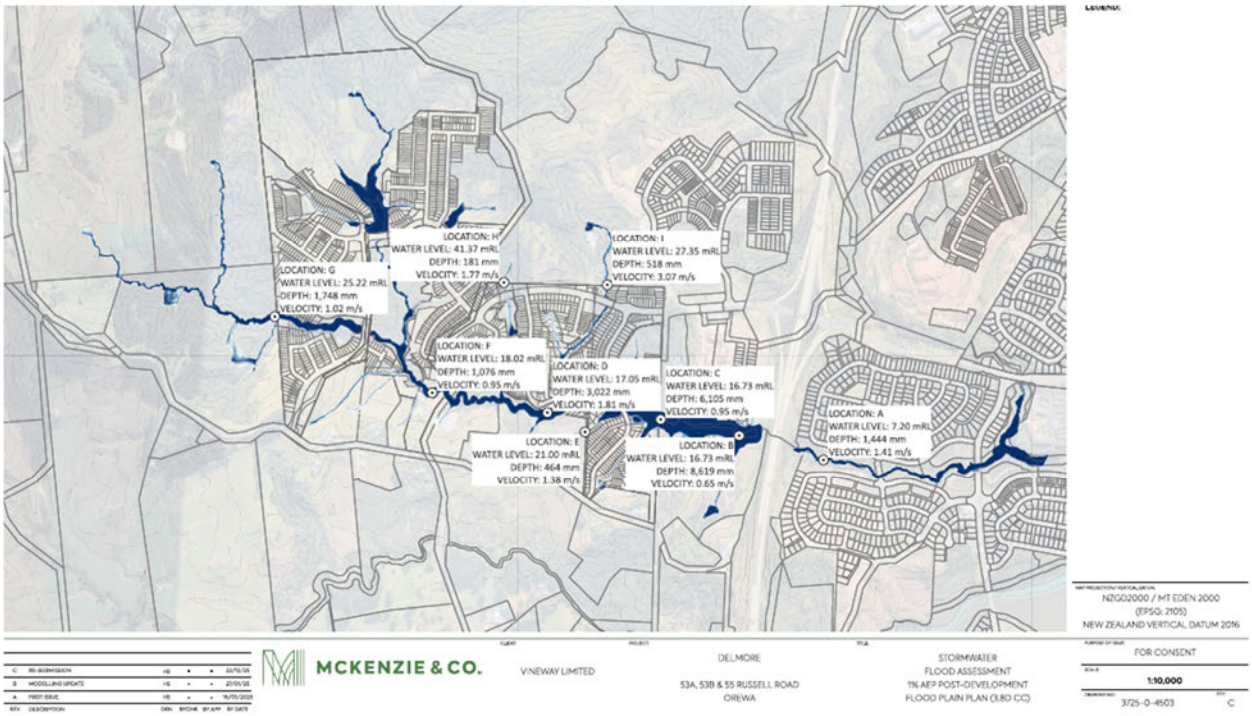


Figure 14 – Post development 1% AEP MPD with 3.8°C CC – flood depths

Due to the site topography, the proposed dwellings are set well above the flood plain contained within the streams. OLFPs are contained within the road reserves. The flood risk to the proposed and existing dwellings is low, as all lots will be set above the flood plain.

Floor levels for habitable dwellings will be set above the 1% AEP Flood plain (3.8°C Climate Change, and Maximum Probable Development) in accordance with requirements of Auckland Unitary Plan Operative in Part, Stormwater Code of Practice, and New Zealand Building Code. In setting minimum floor levels, the 100% blocked scenario for the NZTA motorway culvert has been used, to ensure even under the most extreme scenario, houses will be resilient to flood risk.

Development downstream is setback from the streams, to allow for the flood waters to safely pass through. Therefore no peak flow attenuation has been allowed for flood events, beyond what is provided for upstream of the proposed culverts.

This is consistent with the Ōrewa West ICMP.

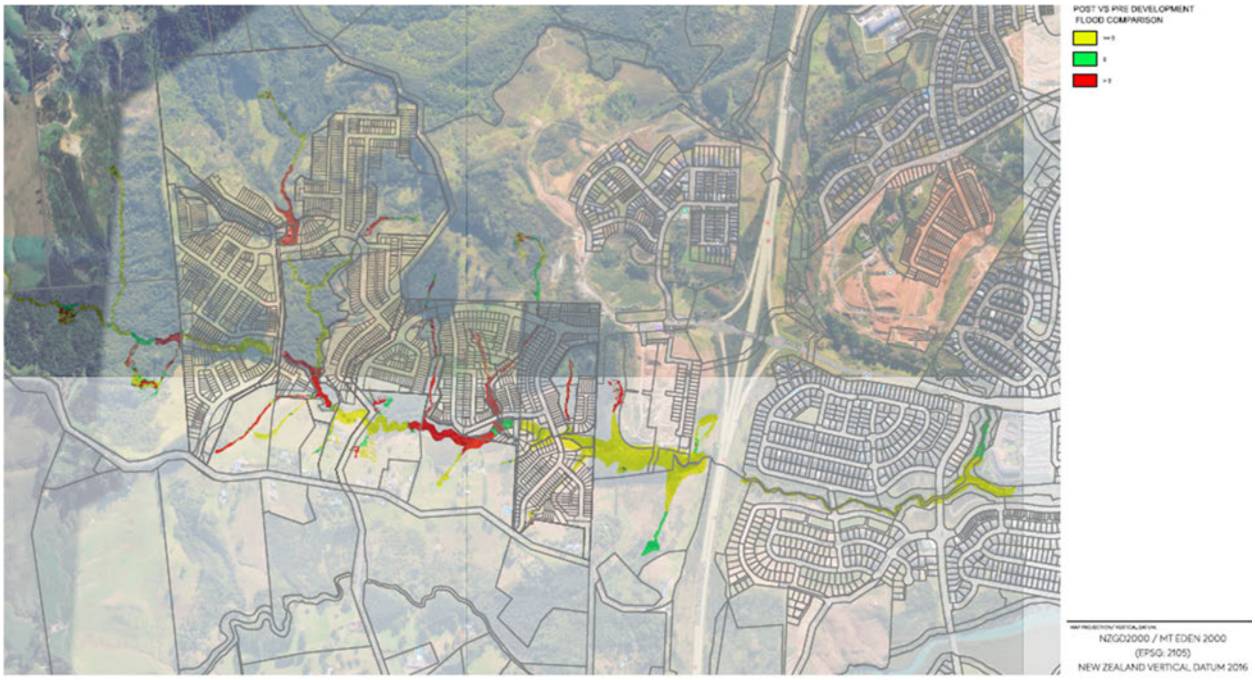


Figure 15 - Difference between the pre- and post-development scenarios for the 1% MPD 3.8°C climate change scenario.

Overland Flow Paths

OLFP's have also been modelled for the road network. The catchments and flowpaths for OLFPs are shown on drawings 3325-0-460 and 461.

OLFP's are contained within the road reserve, where they will discharge to the stream network through discharge points stabilised with riprap or other means to dissipate energy to reduce the risk of erosion.

9.9. Geomorphology and Erosion

A Geomorphology Risk Assessment has been undertaken by Morphum Environmental (refer to Appendix C).

Key findings relating to the stormwater network, are summarised below:

• 10 m riparian setback is generally appropriate from a geomorphic perspective.

• Stormwater inputs will influence erosion, and concentrated discharges should be avoided to minimise hydrograph alteration and associated geomorphic impacts. From a geomorphic perspective, T-Spreader Bars will reduce changes to the hydrograph. On-going maintenance should be carried out to ensure they do not cause scouring or concentrated discharges.

• A stormwater management plan will be put in place to monitor to for changes in the stream, particularly in relation to knickpoint migration to wetlands, erosion around culverts and erosion due to stormwater discharge.

• No bed or bank lining is assumed, as these works would alter natural adjustment processes and fall outside the geomorphic scope.

• Furthermore, no development is proposed in areas identified as having active landslips or creep, and all structures are set back in accordance with geotechnical advice. We consider the risk of gully destabilisation or public safety hazard to be low under the proposed conditions.

In summary, the geomorphic assessment confirms that the proposed stormwater management strategy will not adversely affect the geormorphologic risk in the catchment, and can be managed through appropriate detailed design and monitoring.

10. CULVERT CROSSINGS

13 culvert crossings are proposed as part of the establishment of the development. The culvert layout, long sections, and elevation view can be seen on plans 4800-4813.

All culverts, except for culverts 7, 9, and 10, have been designed to comply with the permitted activity requirements outlined in the NES-FW. Culverts 7, 9, and 10 do not meet these requirements due to the wetland's impractically wide shape, which exceeds the culvert width requirement of being at least 1.3 times the width of the stream.

All culverts have been designed to comply with the SWCOP v4.

All culverts are proposed to be embedded 25% into the existing stream bed and infilled with rock and soil to re-establish a stream bed. Riprap protection at the inlet and outlet is also provided to protect the upstream/downstream environment and the structure from high velocity flows.

A summary table of the culverts is shown below in Table 1.

All culverts are less than 30m in length.

Table 1 - Culvert summary

Culvert Number	Culvert Type	Dimensions (mm)	Catchment Area (ha)	10% AEP flow (m^3)	1% AEP flow (m^3)
01	Box	4000W x 2000H	5.4	**1.6**	**2.7**
02	Circular	1950 dia	3.6	**1.0**	**1.8**
03	Box	5000W x 4000H	225.1	**39.5**	**71.0**
04	Box	5000W x 4000H	220.3	**39.5**	**70.9**

05	Box	4000W x 1000H	25.8	**6.8**	**11.5**
06	Box	4000W x 2000H	16.3	**4.6**	**7.9**
07	Box	6000W x 2000H	2.9	**0.8**	**1.4**
08	Box	2000W x 1000H	9.6	**2.8**	**4.7**
09	Circular	900 dia	41.4	**9.5**	**18.0**
10	Circular	1900 dia	7.6	**1.8**	**3.0**
11	Box	4000W x 1700H	83.1	**21.0**	**37.7**
12	Circular	900	1.6	**0.47**	**0.8**

Access for maintenance has been provided to the inlet and outlet for each culvert, with a 3m wide access track provided for clearing of debris and maintenance of riprap and structure. This will be protected with an easement where the access track does not lie within the drainage reserve area.

11.MODEL DESIGN INPUTS

11.1. Design Rainfall

The following rainfall has been modelled, which includes climate change allowances.

Table 2 - Rainfall data

	Historical Rainfall Depth (mm)	% Increase for Climate Change (SWCOP V4)	Design Rainfall Depth (mm)
10% AEP	155	17% (2.1° increase)	181.4
1% AEP	233	32.7 (3.8° increase)	309.2

11.2. Site coverage

The below site coverage factors have been modelled.

Table 3 - Site coverage

	Impervious area %
Lots	60
Roads	70
JOALs	90

11.3. Catchment Areas

Catchment areas are shown on plans 4400 for the 10% AEP storm events, and 4600 for the 1% Storm events.

11.4. Roughness Coefficients

Roughness coefficient applied in accordance with Table 4, SWCOP.

12. PLAN CHANGE 120

As of 3 November 2025, new rules under Plan Change 120 apply to the way flood hazards are assessed.. Figure 16 below illustrates the PC120 flood hazard risk applicable to the site. A detailed flood model has been developed—outlined in the accompanying Flood Assessment Report—which describes how this risk has been evaluated and managed.

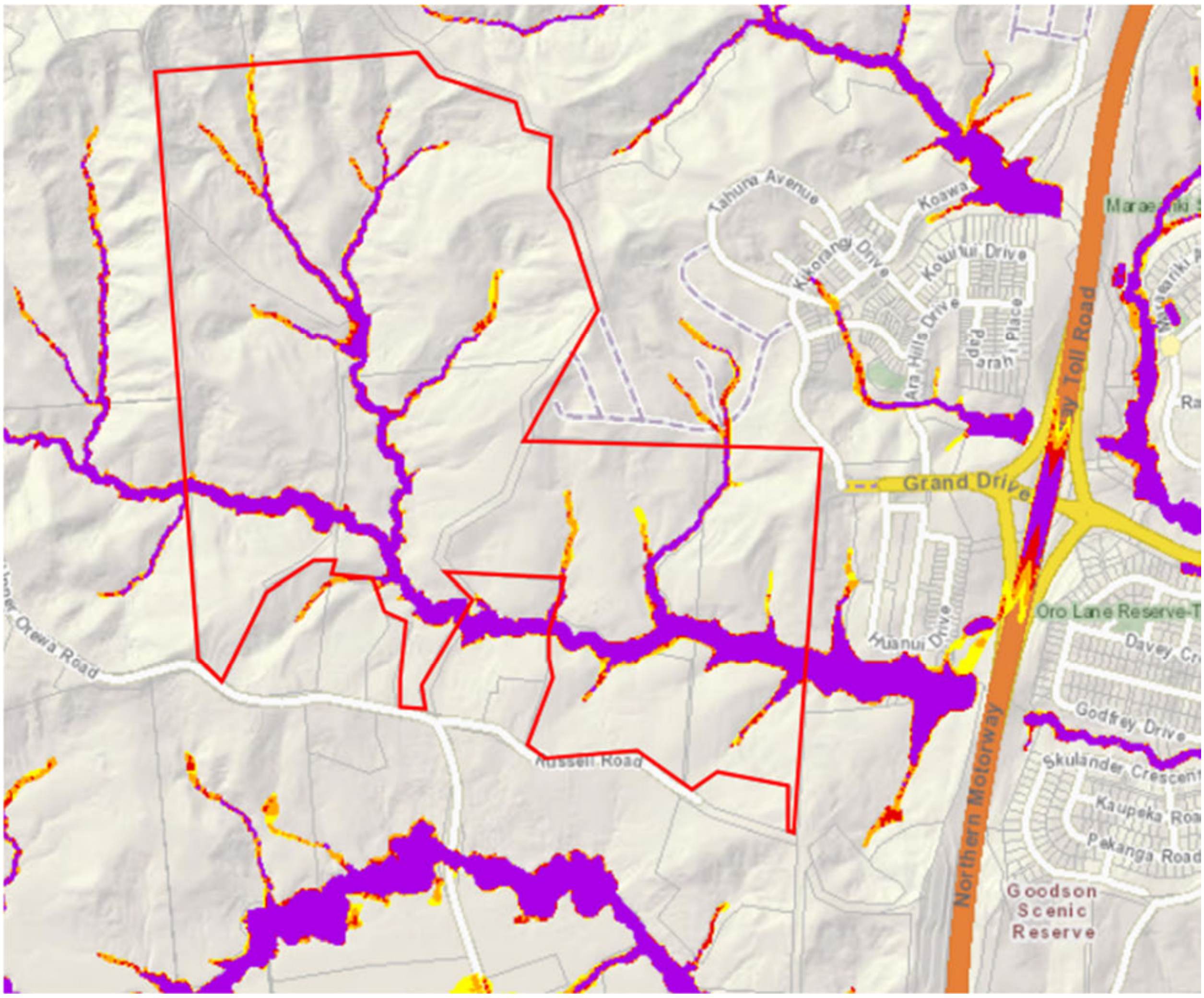


Figure 16 - PC120 Flood Hazard Maps

12.1. Downstream Properties

The flood report / assessment outlines that there were no increases in flood levels downstream of the proposed development.

12.1. Parks, Vehicle Crossings, Private Lots, & Private Roads

A flood hazard assessment across the site was completed and it was shown that there were no flood hazard issues across any of the proposed parks, vehicle crossings, or private lots in this development.

Isolated areas within the private roads showed a pedestrian safety hazard, but they were isolated to a single side of the JOAL and did not prevent pedestrian travel along the JOAL.

The drawings showing the flood hazard assessment can be found in Appendix A (plan sets 3725-1-4610 to 4620 & 3725-2-4610 to 4621).

13. NZTA CULVERT

An existing 2100mm culvert is located at the bottom of the catchment that this development is located in. Consultation with NZTA has been undertaken for this culvert, confirming that no upgrades to this culvert are proposed, unless erosion and damage occur during construction, this is proposed to be conditioned in the resource consent.

The inlet with flood levels shown relative to the inlet and top of embankment for pre and post development flows are shown in Figure 17. All lots are set above the 100% blocked, MPD with climate change scenario, to protect from inundation.

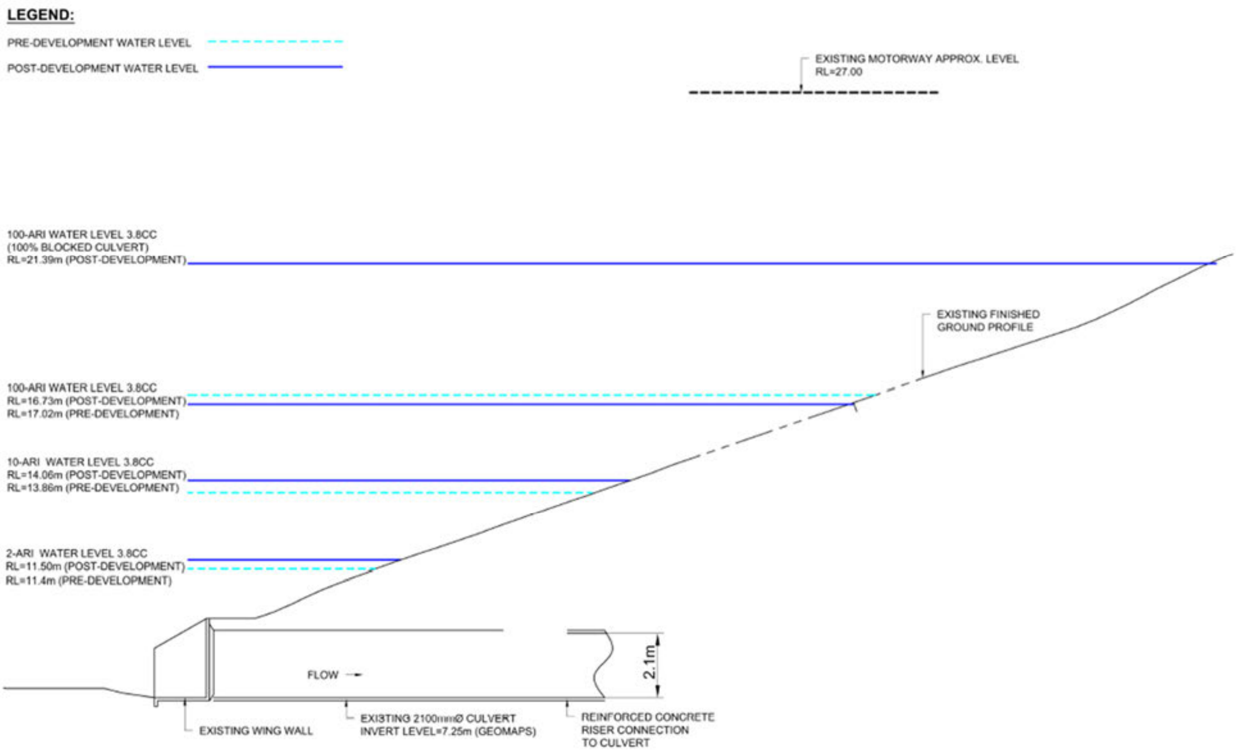


Figure 17 - NZTA culver inlet, with flood levels annotated

14. OPERATIONS & MAINTENANCE

Primary network

All manholes are located outside of road carriageways.

Secondary network

Riprap at outlet locations have been designed where discharge to streams can be maintained. Riprap will need to be checked periodically for damage, particularly after storm events.

Raingardens

All raingardens have been designed with maintenance access adjacent to the raingarden (minimum 3.5m wide and 1 in 8 grade). This will facilitate an excavator and/or truck for repair of outlets and replacement of raingarden media. Tracking is shown on all raingarden plans to show how trucks may manoeuvre around the site. A 5 ton excavator (which can be transported on the back of a six wheel truck) is also shown to demonstrate how it may reach most of the raingarden media from the site.

Culverts

Access to the inlets and outlets of the culverts have been designed for checking for debris, and replacement of riprap, if required.

15. MAINTENANCE

Ponds and other treatment devices are required to have maintenance manuals when vested. These assets are entered into Council's stormwater pond database and the asset is added to the maintenance programme.

For stormwater the maintenance contract covers the technical requirements associated with the stormwater assets.

16. CONSULTATION

The following consultation and correspondence have occurred with Auckland Council on stormwater matters. Records are included in Appendix D.

16.1. Flood model request

McKenzie & Co have requested flood modelling and SMP information for the catchment. Correspondence to and from Auckland Council is included. This information was reviewed, the Orewa West ICMP regarding downstream flood effects.

16.2. Request to review model parameters prior to undertaking modelling

McKenzie & Co submitted a memo detailing the technical parameters of the model to Health Waters. Due to Healthy Water's review process requirements, the related materials could only be formally reviewed after the pre-application meeting. According to Healthy Water's requirements, all technical documentation will be further reviewed and processed after the pre-application meeting is completed. The specific parameters and detailed contents of the model are provided in the Flood Assessment Report, which includes the model's technical parameters and other relevant data for Health Water's review.

16.3. Pre-application meeting – January 2025.

On January 29, 2025, we held a pre-application meeting with Health Waters regarding the stormwater strategy for the site. The key issues raised by healthy Waters were –

a) Due to the land being un-zoned currently, the site can not fall under the NDC and would require a private discharge consent.

b) Healthy Waters prefer Wetlands and dry ponds, rather than raingardens for device selection.

c) The ability for raingardens to achieve retention in engineered fill was questioned.

d) HW has preference for land intended to be vested to be stated as 'land in lieu of reserve'.

For further details, please refer to the attached meeting minutes.

In response to each item –

a) It is acknowledged that a private discharge consent will be required until such time as the land is re-zoned. The stormwater strategy has been developed with a supporting Draft Stormwater Management Plan that can be used to transfer the public network to the NDC at that time.

b) We have reviewed the device selection strategy following the pre-application meeting, and the rationale for selection of raingardens instead of Wetlands or dry ponds is as follows;

Summary of Stormwater Device Selection for the Delmore Development
The stormwater management approach for the Delmore development must provide water quality treatment, retention, and detention, but does not require flood flow attenuation.

The Delmore site is highly undulating, with a series of wetlands throughout the development that need water supply to ensure that they do not dry out. Given these two factors, most of the catchments requiring treatment are small in nature, due to this topography. The size of the devices has been balanced to ensure that water flow is maintained to support the wetlands.

Given that most catchments are less than 1 hectare (Ha), with only one catchment exceeding 2 Ha, the selected stormwater device must be suitable for small, distributed catchments. Based on GD01 guidelines, raingardens are the most appropriate choice as they provide water quality treatment, retention (if infiltration is feasible), and detention, while being adaptable to small catchment areas and slopes.

The undulating and steep topography of the site makes it impractical to combine multiple small catchments into larger ones that would be suitable for wetlands or dry basins. Due to the fragmented drainage paths and slope constraints, stormwater must be managed locally rather than being centralized into large treatment devices. Additionally, the steepness of the terrain limits the feasibility of large stormwater management devices, as they require significant grading, large footprint areas, and may pose slope stability risks.

An additional critical factor is the presence of wetlands that must be protected. The use of slightly more distributed raingardens ensures that stormwater is discharged back into natural flow paths at multiple locations, better mimicking the site's pre-development hydrology. By contrast, larger centralized devices such as wetlands or dry basins would consolidate runoff into fewer discharge points, increasing the volume of flow reaching the lower portions of the catchment and potentially impacting the wetlands.

Wetlands require a large contributing catchment, making them impractical given the fragmented catchments. Dry basins, while useful for peak flow attenuation, do not meet GD01's retention and treatment objectives and would be difficult to construct on steep terrain. Instead, raingardens allow for effective treatment at the source, ensuring compliance with GD01 while minimizing land take and infrastructure costs.

The table below summarizes the applicability of each stormwater device to the site:

Stormwater Device	Suitability for small <3Ha Catchments	Retention (Volume Reduction)	Detention (Peak Flow Control)	Water Quality Treatment	Topography Suitability
Raingardens	Suitable	May be suitable (if infiltration possible)	Suitable	Suitable	Suitable for steep and undulating terrain
Constructed Wetlands	Not Suitable	Not Suitable	Suitable	Suitable	Requires large flat areas, not suitable for steep sites
Dry Basins	Not Suitable	Not Suitable	Suitable	Not Suitable	Challenging to construct on steep terrain

Summary of options considered –

Raingardens – Ideal for small, distributed catchments. Provides treatment, retention (if infiltration possible), and detention.

Wetlands – Require large catchments. Not feasible due to small, fragmented catchments and steep topography. Provides water quality, and detention but not retention.

Dry Basins – Do not provide retention or treatment. Steep terrain limits feasibility and increases construction challenges. Not suitable for this site.

By utilizing raingardens, the development will achieve compliance with GD01 and Auckland Council stormwater management requirements, while ensuring that stormwater is managed efficiently across small, localized catchments. This approach also ensures protection of natural wetlands by avoiding excessive centralized discharges that could alter the existing hydrological balance. If additional refinement is needed, other decentralized devices such as tree pits or permeable paving could be considered for specific areas, complementing the raingarden network.

c) Where possible, raingardens will be installed in non-engineered ground. Where this is not possible, the infiltration rate of the soils will be tested at each raingarden location, and if the infiltration rate cannot be achieved, then the raingarden will be lined and the retention volume added to the detention volume.

d) The request for 'land in lieu of reserve' has been incorporated into the scheme plans.

16.4. 27/11/2025 Pre Application Meeting

A pre- application meeting for the proposed second lodgement was held on November 2025. The key feedback provided by Healthy Waters and NZTA, with confirmation they have been addressed in the substantive application are –

1) Clarify proposed Stormwater management approach
2) Clarify operational and maintenance plans for each raingarden.
3) A note that some raingardens are located within the flood plain.
4) Overland flow paths were discussed
5) The NZTA culvert was discussed, and HW had questions on how this would be modelled. Further consultation with HW modelling team was requested.
6) Spill points for culverts are to be aligned with the culverts.
7) Geomorphic discussion, with some additional questions around flows and velocities through the culverts to be included on the plans and assessed.
8) PC120 land instability/landslide hazard assessment to be provided with reporting.

Correspondence is included in Appendix D.

16.5. Response to Pre-Application Meeting

Responses to all the queries raised / provided on 27/11/2025 by Auckland Council have been included in Appendix D.

17. CONCLUSION

The proposed development of Delmore has been designed to provide the required infrastructure necessary for use and enjoyment of the developed lots and follows the AUP and various Council standards.

The design has taken into consideration the possible impact of the proposed development and has minimised impacts to the receiving environment using accepted engineering practices.

APPENDIX A – Drawings

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APPENDIX B – Calculations

CULVERT CHECKLIST
RAINGARDEN SIZING
EROSION PROTECTION

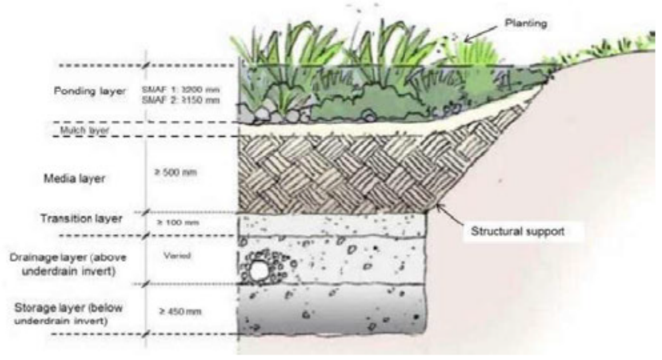
HY-8	Culvert Parameters			1% AEP					OUTLET - TR 2013-018			
									Equation 20	Equation 21		Equation 23
	Span (mm)	Rise (mm)	Embedment (mm)	HEC-RAS 1% AEP flow (m^3/s)	Headwater above embedment (m)	HEC-RAS Inlet velocity (m/s)	Outlet depth (m)	HEC-RAS Outlet velocity (m/s)	Froude No	Riprap size D50	Riprap size (m)	Apron Length (m)
Culvert 1	4000	2000	350	3.01	0.71	1.155	1.65	1.616	0.40	0.17	0.20	2.1
Culvert 2	1950	1950	650	2.83	1.12	0.435	1.3	1.389	0.39	0.13	0.15	1.4
Culvert 3	5000	4000	350	39.83	6.62	1.082	3.65	1.457	0.24	0.22	0.25	-8.9
Culvert 4	5000	4000	350	44.86	5.76	1.132	3.65	1.525	0.25	0.23	0.25	-7.7
Culvert 5	4000	1000	350	6.52	5.13	1.401	0.65	0.41	0.16	0.03	0.15	-3.6
Culvert 6	4000	2000	350	6.76	1.21	0.605	1.65	0.825	0.21	0.08	0.15	-6.2
Culvert 7	6000	2000	350	1.31	0.3	0.814	1.65	0.904	0.22	0.09	0.15	-5.0
Culvert 8	2000	1000	600	3.06	8.1	0.64	0.4	0.641	0.32	0.03	0.15	-0.2
Culvert 9	900	900	150	2.82	5.85	0.256	0.75	0.708	0.26	0.05	0.15	-1.5
Culvert 10	2100	2100	700	0.63	3.53	0.728	1.4	0.428	0.12	0.04	0.15	-11.2
Culvert 11	4000	1700	350	25.72	5.58	0.901	1.35	1.185	0.33	0.11	0.15	-0.4
Culvert 12	900	900	300	1.26	10.91		0.6	0.249	0.10	0.02	0.15	-5.3

Where apron length is < the width of the pipe, the pipe width will be set as the apron length.

SMAF RAIN GARDEN SIZING – PRELIMINARY FOR RESOURCE CONSENT

PROJECT NAME DELMORE DEVELOPMENTS - STAGE 1
PROJECT Nos: 3725

Created By PO | Date 20/11/2025
Checked By JK | Date



Rain Garden	Construction	Material	Depth (m)	Void Ratio
1	Retention	Rock	0.45	35%
2	Drainage Layer	Rock	0.3	35%
3	Transition	Coarse Sand	0.1	30%
4	Detention	Bio Media	0.60	30%
5	Live Storage	None	0.3	100%
	Total		**1.75**	

CATCHMENT INFORMATION

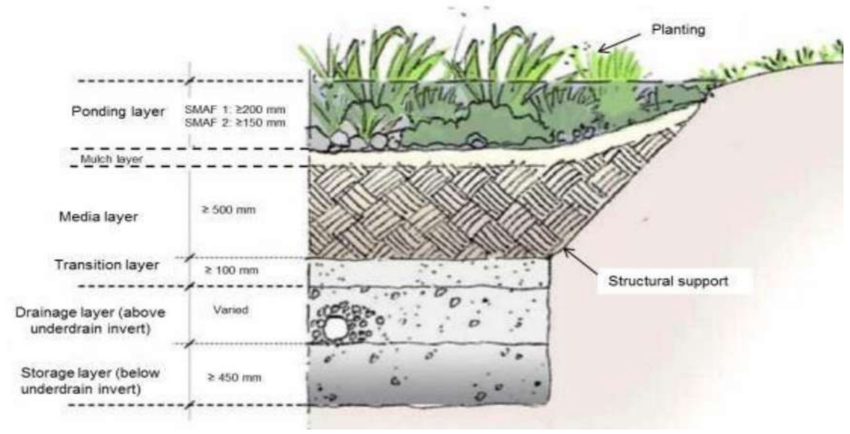
DEVICE NAME	CATCHMENT (road reserve) m2	% impervious	CATCHMENT (JOALs) m2	% impervious	TOTAL CATCHMENT m2	TOTAL % imperviousness	Minimum Raingarden size Required for treatment (2%) m^2	Design Area m^2	Design Area m^2	Comments
RG1	2781	0.7	606.5	0.9	3387.53	0.74	49.85	132.00	132.00	50% Oversized
RG2	15832	0.7	4773.0	0.9	20605.00	0.75	307.56	329.00	329.00	50% Oversized
RG3	1111	0.7	668.0	0.9	1779.00	0.78	27.58	61.00	169.00	50% Oversized
RG5	1504	0.7	158.0	0.9	1662.00	0.72	23.90	57.00		50% Oversized
RG6	13156	0.7	5232.0	0.9	18388.00	0.76	278.36	380.00	263.00	2% Treatment, hydrological offset retention / detention due to space requirements.
RG7	2455	0.7	1691.6	0.9	4146.60	0.78	64.82	114.00	114.00	10% oversized
RG8	8829	0.7	513.0	0.9	9342.00	0.71	132.84	233.00	233.00	10% oversized
RG11	22915	0.7	4514.0	0.9	27429.00	0.73	402.06	845.00	845.00	10% oversized
Totals										

RAINGARDEN SIZING

DEVICE NAME	1 Treatment area check, is design area > treatment area	Retention Volume Required 5mm	Detention 2 Drainage Layer	3 Detention Volume Required 16.3mm	4 Retention Volume Available (m^3)	Drainage Layer m3	Transition Layer Volume (m^3)	Detention Volume Bio Media (m^3)	Live Storage Volume	Total Detention Volume (m^3)	Retention Volume Check	Detention Volume Check
RG1	OK	12.46		48.68	20.79	13.86	3.96	23.76	39.60	81.18	ok	ok
RG2	OK	76.89		300.34	51.82	34.55	9.87	59.22	98.70	202.34	Offset elsewhere	offset elsewhere
RG3	OK	6.89		26.93	9.61	6.41	1.83	10.98	18.30	37.52	ok	ok
RG5	OK	5.98		23.34	8.98	5.99	1.71	10.26	17.10	35.06	ok	ok
RG6	OK	69.59		271.82	59.85	39.90	11.40	68.40	114.00	233.70	Offset elsewhere	offset elsewhere
RG7	OK	16.20		63.30	17.96	11.97	3.42	20.52	34.20	70.11	ok	ok
RG8	OK	33.21		129.72	36.70	24.47	6.99	41.94	69.90	143.30	ok	ok
RG11	OK	100.52		392.62	133.09	88.73	25.35	152.10	253.50	519.68	ok	ok
Totals		**321.74**		**1256.73**	**338.78**					**1322.87**		
		m3 required		m3 required	17.04	m3 Surplus Retention				66.13	m3 Surplus Detention	

SMAF RAIN GARDEN SIZING - PRELIMINARY FOR RESOURCE CONSENT

PROJECT NA	DELMORE DEVELOPMENTS - STAGE 2	Created By	NC	Date	20/11/2025
PROJECT No	3725	Checked By	JK	Date	20/11/2025



Rain Garden Construction		**Material**	**Depth (m)**	**Void Ratio**
1	Retention	Rock	0.45	35%
2	Drainage Layer	Rock	0.3	35%
3	Transition	Coarse Sand	0.1	30%
4	Detention	Bio Media	0.60	30%
5	Live Storage	None	0.3	100%
	Total		**1.75**	

RAINGARDEN SIZING

	CATCHMENT INFORMATION								1		2	3	4					
										Detention								
DEVICE NAME	**CATCHMENT (road reserve) m2**	**% impervious**	**CATCHMENT (JOALs) m2**	**% impervious**	**TOTAL CATCHMENT m2**	**TOTAL % imperviousness**	**Minimum Raingarden Size for Treatment (2%) m2**	**Design Area m² @3.5%**	**Actual Design Size**	**Retention Volume Required 5mm**	**Drainage Layer**	**Detention Volume Required 19.5mm**	**Retention Volume Available (m³)**	**Drainage Layer m3**	**Transition Layer Volume (m³)**	**Detention Volume Bio Media (m³)**	**Live Storage Volume**	**Total Detention Volume (m³)**
RG20	23463	0.7	3097	0.9	26560	0.72	384.23	672.40		96.06		375.20	105.90	70.60	20.17	121.03	201.72	413.53
RG21	31950	0.7	2498	0.9	14424	1.71	492.26	861.46	848.00	123.07		480.70	135.68	90.45	25.84	155.06	258.44	529.80
RG22	2537	0.7	2257	0.9	4794	0.79	76.14	133.25		19.04		74.35	20.99	13.99	4.00	23.99	39.98	81.95
RG23	2194	0.7	1204	0.9	3398	0.77	52.39	91.68		13.10		51.16	14.44	9.63	2.75	16.50	27.50	56.38
RG24	24124	0.7	1966	0.9	26090	0.72	373.12	652.97		93.28		364.36	102.84	68.56	19.59	117.53	195.89	401.57
RG25	1704	0.7	0	0.9	1704	0.70	23.86	41.75	42.00	5.96		23.30	6.58	4.38	1.25	7.51	12.52	25.68
RG11	Refer to stage 1 Raingarden calculations									350.50		1369.06	386.43					1508.91

APPENDIX C – Geomorphic Risk Assessment

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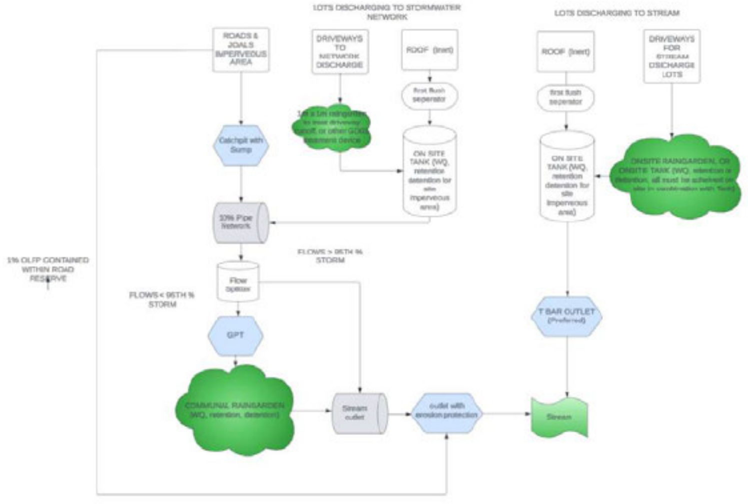
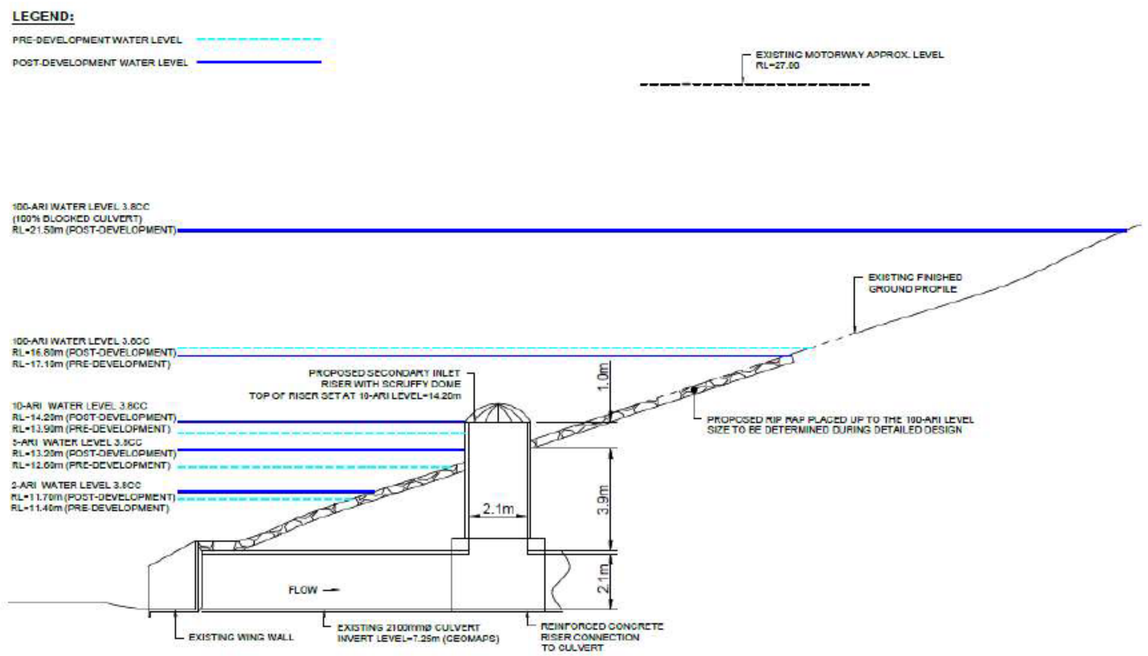
APPENDIX D – Correspondence with Healthy Waters

<table>
<tr><td>Delamore - Healthy Waters Pre App Actions</td><td></td></tr>
<tr><td>Meeting date 27/11/25</td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Stormwater Management</td><td>Applicant Response</td></tr>
<tr><td>Update reporting to clearly outline the proposed stormwater management approach, specifically at-source management for lots, with communal raingardens receiving only JOAL and road runoff.</td><td>Stormwater Management plan and Stormwater Infrastructure report have both been reviewed to ensure clarity on strowmater management approach.

Refer to Figure 14 in Section 6.2.1 of the SMP


and Section 9.7 of the Stormwater Infrastructure Report.
"The communal raingardens have been designed to manage stormwater runoff from defined road and JOAL catchments, with treatment and hydrology mitigation outcomes tailored to the contributing area. "</td></tr>
<tr><td>Operation and maintenance matters were generally addressed. McKenzie will review access track requirements. Small digger preferred over long reach diggers. Full track and halftrack options to be provided.</td><td>A small digger has now been shown on all of the raingarden plans, showing how a truck can deliver a small excavator to all of the raingardens for maintenance purposes.</td></tr>
<tr><td>Healthy Waters confirmed they are comfortable with the proposed consolidation of devices.</td><td>No action required.</td></tr>
<tr><td>It was noted that most raingardens are located above the 1% AEP. There are, however, 2 to 3 devices that sit within the 1% AEP but above the 10% AEP.</td><td>No action required.</td></tr>
<tr><td>Consistency between calculations and reporting highlighted.</td><td>Reports review to confirm consistency.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Overland Flow Path</td><td></td></tr>
<tr><td>AT is satisfied with the revised information provided.</td><td>Noted</td></tr>
<tr><td>McKenzie will circulate proposed plans showing XS locations. Sean will review and advise if any additional XS locations are required.</td><td>Cross sections are shown on the OLFP 's at critical locations. Additional cross sections can be drawn if requested from AT.</td></tr>
<tr><td>It was noted that the roads have been designed to comply with the SW COP and AT COP requirements.</td><td>Noted</td></tr>
<tr><td></td><td></td></tr>
<tr><td>NZTA Culvert</td><td></td></tr>
<tr><td>A secondary inlet is now to be provided. This will need further discussion with NZTA.</td><td>Subsequent correspondence between Pranil Wadan and NZTA have concluded that secondary inlet now not proposed, and lots are above the 100% blocked scenario.</td></tr>
<tr><td>Blockage risk and relevant design parameters were discussed.</td><td>the NZTA culvert has been assessed with 100% blockeage, and no lots will be affected in this extreme scenario.</td></tr>
<tr><td>Healthy Waters commented on how the secondary inlet should be represented in the flood model.</td><td>This is no longer proposed.</td></tr>
</table>

The applicant team outlined the blockage assessments undertaken for various scenarios. Reporting will be updated to include these assessments and demonstrate the resilience of lots under such conditions. Tabulated head water levels under blockage scenarios required as well as where are there localised increases upstream of the culvert.	The 100% blockage scenario has been shown on the culvert cross section, and this is shown at RL=21.5m. See Figure 17 in Section 13 of the Stormwater Infrastructure Report. 
The levels are results as per CoP – for all events 2yr , 10yr, 100yr	Confirming flood model covers these events.
Spill points to be aligned with the culvert under primary network blockage scenarios.	All spill points are aligned with the culverts, with the exception of Culvert 1. In the 100% blocked scenario, 3m3/s will spill down Road 8 and then subsequently down Road 1. This scenario has been checked and no lots will be affected.
[redacted] can be consulted on modelling the culvert in HEC-RAS. Modelling to include secondary flows from the contributing catchment under blockage scenario as well.	A meeting request has been sent however it is not possibsle to meet Larry in 2025. A meeting is pencilled in for January 2026.
Flood Management	
Discussion focused primarily on the NZTA culvert.	No action.
2D model preferred for internal OLFP configuration rather than a 12D analysis.	A 1D 12d model has been prepared, with cross sections at relevant portions. This analysis is a dynamic analysis using TP108 hydrograph.
Healthy Waters queried the downstream effects of providing a secondary inlet, as this may increase flood flows.	Secondary inlet is now not proposed.
McKenzie will incorporate the supplementary culvert into the flood model.	As above.
Since the modelling is being undertaken in HEC RAS, it is recommended that the approach to representing the supplementary culvert is discussed and agreed with Healthy Waters (Larry) in advance.	As above. A meeting with Larry has been reqeuested, however this is not available until January 2026.
Healthy Waters will issue a response to the flood comments and provide a response to parks.	No action.
Other matters	
Culverts in wetlands discussed, namely the incision of existing wetlands and wetlands being established inside the culverts. Contrary to geotech/geomorphic reporting	No action
Hydrology reporting to be provided for the wetlands – McKenzie to provide flows / velocity etc	The culvert drawings including this information can be found in drawings series 3725-1-4800.
PC120 land instability/landslide hazard assessment to be provided with reporting.	PC120 assesment is provided as part of the stormwater report. Refer Section 12 of the stormwater infrastructure report. "The flood report / assessment outlines that there were no increases in flood levels downstream of the proposed development. A flood hazard assessment across the site was completed and it was shown that there were no flood hazard issues across any of the proposed parks, vehicle crossings, or private lots in this development. Isolated areas within the private roads showed a pedestrian safety hazard, but they were isolated to a single side of the JOAL and did not prevent pedestrian travel along the JOAL."