Stormwater Assessment

Milldale Stages 14-17 – Fast-track Approvals Act 2024

Fulton Hogan Land Development Ltd
14/08/2026
Issued for Fasttrack approval

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Statements of qualifications and experience

Pranil Wadan (Flowstate Consulting)

I am a Director of Flowstate Consulting LP and act as a Technical Consultant to Wood and Partners Consultants Limited, trading as Woods.

I hold a Bachelor of Engineering from the University of Auckland, completed in 2007. I am a Chartered Professional Engineer and a member of Engineering New Zealand and Water New Zealand. My additional professional qualifications and appointments include International Professional Engineer (IntPE(NZ)), Certified Independent Hearing Commissioner, and a Certificate in Company Direction and Governance.

I have more than 18 years' experience in stormwater design, hydrodynamic modelling, flood risk assessment, water infrastructure, and stormwater management for land development projects. I have acted as principal author and lead stormwater engineer for a wide range of stormwater management plans and flood modelling assessments prepared for projects across New Zealand.

My experience includes the development of catchment-scale flood models, detailed stormwater network models, and integrated catchment management plans for both private sector clients and territorial and regional authorities.

In my role as originator of this report, I confirm that I have read and comply with the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Boniface Kinnear

I am a Principal 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 International 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 18 years of experience in environmental management, contaminated land, impact assessments, stormwater design and modelling, flood risk assessments, stream 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.

Chantelle Potbury

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 November 2024.

I hold the qualifications of Bachelor of Engineering with Honours from the University of Auckland, which I completed in 2024. 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, environmental and water quality 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.

Timothy Rickards

I am a Principal Civil 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 Feb 2013.

I hold the qualifications of Bachelor of Engineering (Technology), which I completed in 2008. I am a Chartered Professional Engineer of Engineering New Zealand.

I have 20 years of professional experience in the Engineering industry. My experience includes the design and construction observation of a range of land development projects, including the design of large-scale stormwater systems, stormwater management devices and overland flowpaths as well as undertaking flood risk assessments and flooding effects assessments.

I have lead the design of the stormwater systems throughout the previous stages of Milldale and have an extensive knowledge of development.

I confirm that, in my capacity as the reviewer/ 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.

Executive summary

This stormwater assessment has been prepared on behalf of Fulton Hogan Land Development Limited to support the substantive application for Milldale Stages 14–17 under the Fast-track Approvals Act 2024.

The Project comprises the comprehensively planned urban development of approximately 231 ha of land centred on Wainui Road, Wainui. It includes residential neighbourhoods, a commercial node, transport and servicing infrastructure, public open space, constructed wetlands, and ecological restoration.

The site drains to the Orewa Awa, Waterloo Creek and their tributaries. The proposed stormwater management system has been developed in alignment with to Version 4 of the Wainui East Stormwater Management Plan and version 7 of the Milldale North and Wainui West SMP and to align with the relevant requirements of:

- The Auckland Unitary Plan (Operative in Part);
- The Regionwide Stormwater Network Discharge Consent;
- The Auckland Council Stormwater Code of Practice; and
- Auckland Council guidance documents GD01 and GD04.

Water-sensitive design principles have been incorporated throughout the proposed system to manage water quality, stream hydrology, stormwater conveyance, flood risk and erosion effects.

Stages 14–17 cover 97 ha of the site and are divided into 11 stormwater catchments. Water Quality Design Volume Runoff from all impervious surfaces will be treated before discharge. Runoff from roads, jointly owned access lots (JOALs) and other hardstand areas will be directed to communal treatment devices. Roof runoff will be managed at source through inert roofing materials and private onsite tanks that provide retention of the first 5 mm of rainfall and detention up to the 37mm event. The flows discharged from the tanks will also pass through the communal treatment devices prior to discharge to the receiving environment.

The communal system comprises:

- six constructed wetlands—Wetlands A–E and H;
- two communal bioretention devices—Devices F and G; and
- three bioretention devices for stream-recharge located at the heads of retained and realigned streams.

The proposed development also includes the creation of Te Korowai o Maraeriki, this is 134 ha of land north of the Orewa Awa and is predominantly proposed to remain as a permeable catchment with replanting of the portions of pasture proposed or currently already being undertaken. There is also wetland and stream rehabilitation proposed in this portion of the site. No further stormwater devices are required to mitigate these works.

Within the Te Korowai o Maraeriki lot it is proposed to construct the potable water and wastewater treatment plants. The combined area of these plants is approximately 2.4 ha of which approximately 50% will be impermeable surface, with the balance being permeable landscaping. A private bioretention device is proposed to provide water quality treatment and stormwater detention of runoff from the impermeable surface prior to release to the Orewa Awa.

Flood risk has been assessed using a catchment-scale hydraulic model comparing pre- and post-development conditions. The model assesses the 2-, 10- and 100-year annual recurrence interval (ARI) events, incorporates a 3.8°C climate-change allowance and accounts for the maximum probable development of the upstream catchment.

The modelling indicates that:

- post-development flooding will generally be contained within road reserves and stream corridors;
- flood extents will generally remain unchanged or reduce relative to the pre-development condition;
- localised increases in flood levels will occur only in locations where no habitable or non-habitable buildings are affected;
- the development will not result in adverse flood effects on third-party land upstream or downstream of the site;
- the proposed primary stormwater network will convey the 10-year ARI event, including climate change; and
- the performance of the assessed culverts and bridges will either accommodate the modelled flows as per the currently operative stormwater code of practice and TP108 or are not materially changed in performance from the predevelopment scenario.

Erosion modelling of the Upper Orewa Awa and lower Waterloo Creek for the 100-year ARI event indicates that post-development erosion potential will not differ significantly from the pre-development condition. The proposed development is therefore not expected to exacerbate erosion within these receiving environments. However, at outlet locations and modified stream banks susceptible to erosion, mitigation measures will be incorporated as part of the detailed design of these outlets.

The proposed stormwater management approach is consistent with the relevant direction of the National Policy Statement for Freshwater Management 2020, the National Policy Statement for Natural Hazards 2025, and the natural-hazard objectives and policies notified through Plan Change 120. No departures from the applicable regulatory requirements or design codes are proposed.

Overall, the assessment demonstrates that Milldale Stages 14–17 can be appropriately serviced by the proposed stormwater management system. Subject to confirmation of the identified detailed-design matters, the proposed approach represents the best practicable option for the site. The residual effects on the receiving environment and flood risk are assessed as being no more than minor.

1.0 Introduction

This report has been prepared in support of the substantive application for the Milldale Stages 14-17 (Milldale North) Project under the Fast-track Approvals Act 2024 (FTAA).

The Project relates to approximately 231ha of land centred around Wainui Road in Wainui, Auckland. The proposal provides for a comprehensively planned urban development including residential neighbourhoods, a supporting commercial node, transport and servicing infrastructure, open space, wetland and ecological restoration, and associated enabling works.

The application seeks approvals necessary to facilitate the staged development of the Project, including a suite of resource consents required under the FTAA framework.

The substantive application is supported by a comprehensive set of technical assessments and plans addressing the environmental, servicing and infrastructure matters associated with the proposal. This report should be read alongside the Planning Report and the appended technical reports and drawings lodged in support of the substantive application.

1.1. Background

The Wainui East Stormwater Management Plan (Version 4, dated 2016, by Woods) was developed for the wider Wainui East Future Urban Zone. It has only been adopted by Healthy Waters for the live-zoned land referred to as the Wainui Precinct / Milldale, in accordance with the requirements of the Auckland regionwide Network Discharge Consent (NDC).

The Milldale North and Wainui West Future Urban Zone Structure Plan, led by Fulton Hogan Land Development Limited (FHLD), covers approximately 244ha of predominantly Future Urban Zoned land at Wainui that integrates with the existing live-zoned Wainui Precinct / Milldale.

The Milldale North and Wainui West SMP was submitted to Healthy Waters as part of the plan-change lodgement in 2023. It was included as a Version 7 update to the Wainui East SMP and is yet to be adopted by the Council. The wider Milldale North area is located immediately north of the existing Wainui Precinct / Milldale, comprises approximately 145ha of predominantly Future Urban Zoned land together with 3.8ha of Special Purpose – Education zoned land. It incorporates the Milldale Stages 14-17 land.

This report addresses Milldale Stages 14-17 of the plan change area only, as well as Te Korowai o Maraeriki, being the land north of the Orewa Awa which sits outside the plan change boundaries. This report supports an application for a private stormwater discharge consent. Once the Version 7 of the Wainui East SMP is adopted by the Council, FHLD intend to fold this application into it in a similar manner as has been done at Drury.

1.2. Purpose and scope

This report addresses matters relating to Stormwater & Flooding associated with the Project proposal. It sets out how stormwater and flooding are proposed to be managed for the development and demonstrates that the relevant requirements of Schedule 4 of the Auckland regionwide stormwater Network Discharge Consent (NDC) and the Auckland Unitary Plan: Operative in Part (AUP) are met. The assessment is based on, and is consistent with, the Milldale North and Wainui West Stormwater Management Plan (SMP) (Version 7, Woods), which sets the catchment-wide stormwater management framework for the wider Wainui East Future Urban Zone. The overarching objectives of this report are to:

- demonstrate that the proposed stormwater management meets the requirements of Schedule 4 of the regionwide NDC;

- incorporate a water sensitive design approach that manages the effects of land-use change from rural to urban;
- retain the stream network and protect and enhance riparian margins;
- provide stormwater management standards that convey runoff safely to the receiving environment through the primary and secondary networks;
- provide appropriate treatment for the receiving environment through stormwater quality treatment and the avoidance of high-contaminant-yielding roof and cladding materials; and
- 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 development, including an assessment of downstream structures such as the Wainui Road, Kowhai and Upper Ōrewa crossings.

This report has been prepared having regard to the relevant statutory and technical framework applicable to the proposal, including:

- Auckland Unitary Plan: Operative in Part – in particular Sections B2, B7 and B10, and Auckland-wide provisions E1 (water quality and integrated management), E8 (diversion and discharge) and E36 (natural hazards and flooding);
- Schedules 2 and 4 of the Auckland Council regionwide stormwater Network Discharge Consent;
- National Policy Statement for Freshwater Management 2020;
- National Policy Statement for Natural Hazards 2025;
- Auckland Council guidance documents GD01 (Stormwater Management Devices in the Auckland Region), GD04 (Water Sensitive Design), TP10 and TR2013/035;
- Auckland Council's Stormwater Code of Practice (SWCOP V4, 2022);
- TP108 for runoff estimation;
- Auckland Transport Transport Design Manual; and
- the adopted Wainui East Stormwater Management Plan (Versions 4) and submitted Milldale North and Wainui West Stormwater Management Plan (Version 7).

Proposed Plan Change 120 (Housing Intensification and Resilience) has also been given regard to, noting that it carries limited weight at this stage.

1.3.Relationship to the Wainui East Stormwater Management Plan

This report relies on, and is consistent with, the Milldale North and Wainui West Stormwater Management Plan (Version 7). The Milldale North and Wainui West SMP sets the catchment-wide stormwater management framework for the live-zoned Milldale area, Milldale North and Wainui West. The Wainui East SMP Version 4 (2016) is the currently adopted SMP and applies to the live-zoned Milldale area only.

The. Milldale North and Wainui West SMP (Version 7) extends the framework over Milldale North (and Wainui West); it was submitted to Healthy Waters as part of the plan-change lodgement (originally Version 5) and was subsequently updated to reflect the responses to a Clause 23 request. Version 7 is currently under review by Healthy Waters and has not yet been adopted.

It is anticipated that, following Healthy Waters approval, Version 4 will be superseded by Version 7 and Version 7 will then be adopted across the wider extent.

The stormwater and flood assessment presented in this report for Milldale Stages 14-17 has been developed in general accordance with the strategy outlined in Version 7 of the Milldale North and Wainui West Stormwater Management Plan.

2.0 Site appraisal

2.1.Site Description

The site comprises approximately 231ha of land located to the north of the existing Milldale development. The site comprises two distinct areas:

- Residential subdivision area to the south of the Ōrewa Awa (shown in red in Figure 1); and
- Te Korowai o Maraeariki to the north of the Ōrewa Awa (shown in orange in Figure 1).

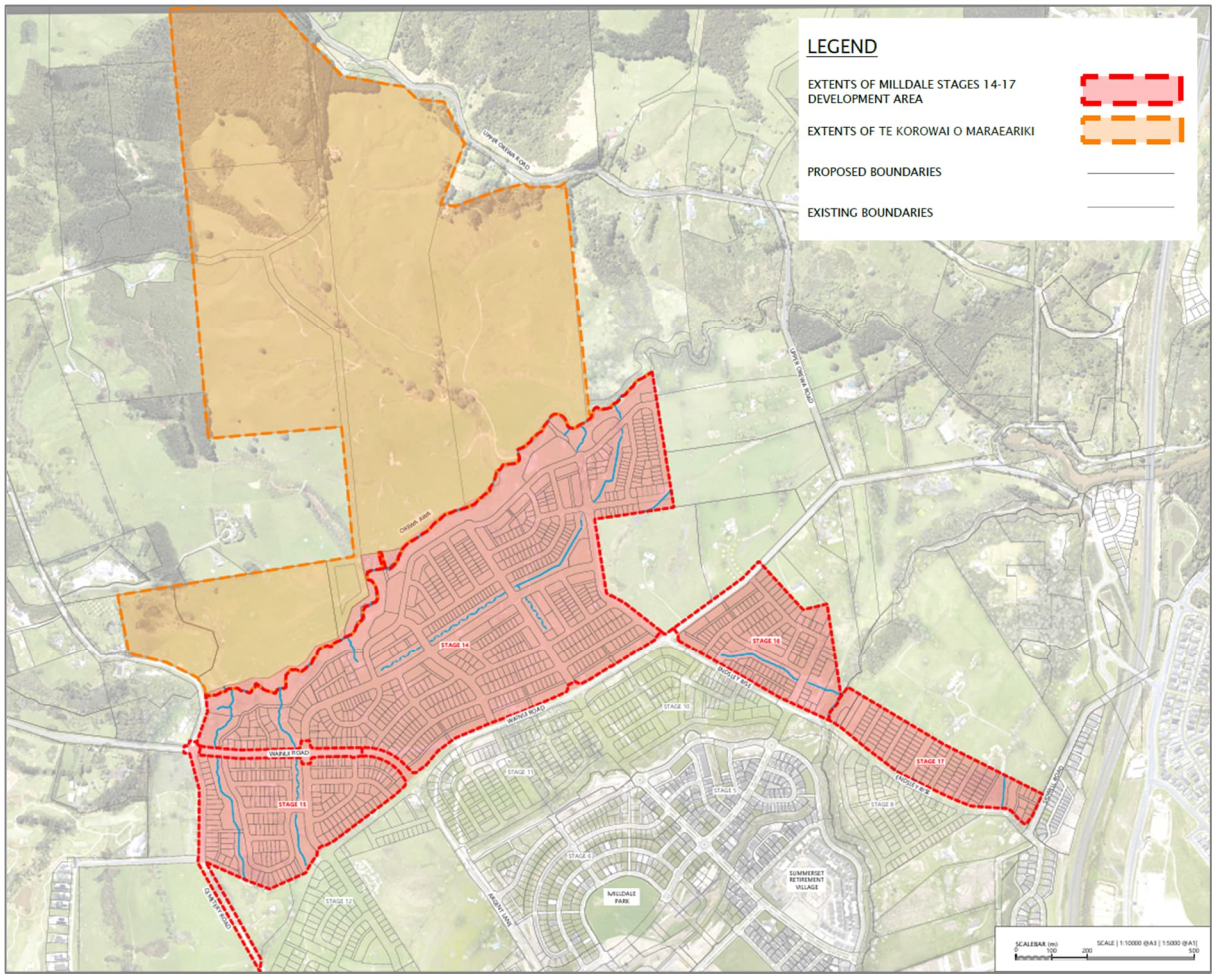

Figure 1: Site Location Plan

The proposed residential subdivision area is located within the Future Urban Zone under the Auckland Unitary Plan (AUP). This part of the site is characterised by gently undulating to rolling pasture, with several streams, natural wetlands, constructed ponds and artificial drains traversing the area.

Te Korowai o Maraeariki is located to the north of the Ōrewa Awa and is zoned Rural Production under the AUP. This area is characterised by more undulating to steep terrain, with a series of ridgelines separated by incised gullies extending from the Ōrewa Awa. The land is predominantly managed pasture interspersed with streams and natural wetlands, together with pine plantations, exotic vegetation and gorse scrub. Relatively large areas of indigenous vegetation are also present, including a Significant Ecological Area – Terrestrial Overlay in the north-western portion of the site.

There is existing water, stormwater and wastewater infrastructure surrounding the site as a result of the extensive development within previous Milldale Stages. However, the site itself is not currently serviced

in terms of supply and infrastructure. The surrounding roading network has been progressively developed in accordance with the staging of the Milldale development.

Further detail regarding the site, surrounding environment and planning framework is provided within the Planning Report and technical reports appended to the application

2.2. The Proposal

The Milldale Stages 14-17 project seeks approvals for an urban development on the site. The proposal provides for up to 1,401 dwellings across a range of housing typologies and densities. A yield of 1,425 dwellings has been conservatively used for infrastructure assessment purposes. In addition, the proposal includes provision for a small commercial area, transport infrastructure, servicing and stormwater infrastructure, subdivision, earthworks, stream works, and neighbourhood parks.

To the north of the Ōrewa Awa within Te Korowai o Maraeariki, the project includes private water and wastewater infrastructure if required, ecological restoration, as well as walking and cycling trails to enhance recreation and amenity.

Development of the Project will require a suite of approvals under the FTAA, including resource consents associated with subdivision, land use activities, bulk earthworks, infrastructure works, stream works, water take, diversion and discharge; along with NES for contamination and freshwater.

The aspects of the proposal relevant to this report are those that generate or convey stormwater runoff, alter catchment hydrology, or interact with the stream network and floodplain. These comprise:

- The change in land use from rural/grazing to urban residential, increasing impervious coverage across the residential subdivision area from approximately 5% to approximately 70% at maximum probable development (MPD);
- Residential subdivision and roading, including the primary piped stormwater network, cesspits and swales, and secondary overland flow paths within the road corridor and conveyance channels;
- Large communal bioretention devices (raingardens) and constructed wetlands located at the downstream end of each sub-catchment, providing water quality treatment and hydrology mitigation for all impervious areas prior to discharge;
- Rainwater re-use tanks on all dwellings providing 5mm retention of roof runoff, with roofs constructed of inert (non-contaminant-generating) materials;
- Bulk earthworks and the associated landform change, and stream works including culvert crossings, stream realignment and riparian restoration;
- The upgrade of the existing culverts under Wainui Road to enable the pass-flows-forward strategy adopted for the catchment;
- New stormwater outfalls and discharges to Waterloo Creek and the Ōrewa Awa; and

A full description of the proposal is provided in the Planning Report and technical reports and drawings appended to the substantive application, and should be read in conjunction with this report.

2.3.Summary of data sources and dates

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

Table 1: Summary of data sources

Existing site appraisal item	Source and date of data used
Topography	Auckland Council LiDAR 2024; topographical survey; as-built and consented design surfaces of the Milldale development
Geotechnical / soil conditions	Preliminary geological assessment by Gibbs Ritchie (2026); geotechnical investigations by Tonkin + Taylor (2016)
Existing stormwater network	Auckland Council Geomaps – underground services (2018); Woods survey
Existing hydrological features	Auckland Council Geomaps; ecological assessment by Virdis (March 2026)
Stream, river, coastal erosion	Auckland Council Geomaps – catchment and hydrology
Flooding and flow paths	Milldale Stages 14–17 Model Build Report (Woods, 2026) (Appendix A), building on Wainui East SMP Version 4 (2016, Woods)
Coastal inundation	Auckland Council Geomaps – coastal inundation (2018)
Ecological / environmental areas	Auckland Council Geomaps – SEA overlays (2016); Virdis ecology assessment
Cultural and heritage sites	Archaeological assessment by Clough and Associates
Contaminated land	Contaminated land assessment by Environmental Management Solutions Ltd

2.4.Geotechnical

A geotechnical investigation for Milldale Stages 14-17 has been undertaken by Gibb Ritchie Geotechnical Engineers and is reported in the Geotechnical Investigation Report (ref. AK26-027AB Rev 1, dated 23 July 2026). The investigation confirms that the site is underlain by Hukerenui Mudstone and transitional (weathered) Hukerenui Mudstone of the Northland Allochthon, overlain by residual soils, with soils over rock generally 1–2m thick and thicker alluvial deposits in the valleys and lower-lying areas.

For the purpose of calculating stormwater runoff using the SCS methodology outlined in TP108, the soils have been classified as Hydrologic Soil Group C, consistent with Auckland Council's soil-type GIS layer.

2.5.Existing drainage features and stormwater infrastructure

There is no existing public stormwater network within Milldale Stages 14-17 other than the stream network and culvert crossings. A full topographical survey of the streams and infrastructure within the area has been undertaken, with additional infrastructure surveyed for the stormwater flood model. Auckland Council GeoMaps records numerous existing stormwater assets along Wainui Road, Gervin Road and near Cemetery Road, predominantly culverts associated with the road drainage network, and the surveyed culvert data is summarised in the Milldale Stages 14–17 Model Build Report (Appendix A). Three existing structures on the receiving watercourses – the Wainui, Kowhai and Upper Orewa bridges - have also been surveyed and are represented in the flood model.

2.6.Receiving environment

Milldale Stages 14-17 predominantly discharges to the Orewa Awa, with a small portion discharging to Waterloo Creek. The Orewa Awa drains to the Orewa Estuary and ultimately to Whangaparaoa Bay to the east.

The Orewa Awa and Waterloo Creek (including its tributary near the eastern boundary) are therefore the freshwater receiving environments for stormwater discharged from Milldale Stages 14-17, with the Orewa Estuary and Whangaparaoa Bay the ultimate coastal receiving environments.

The lower reaches of Waterloo Creek and the Orewa Awa are coastally influenced, and Auckland Council Geomaps and the AUP indicate that parts of the wider site discharging to these reaches are subject to coastal inundation.

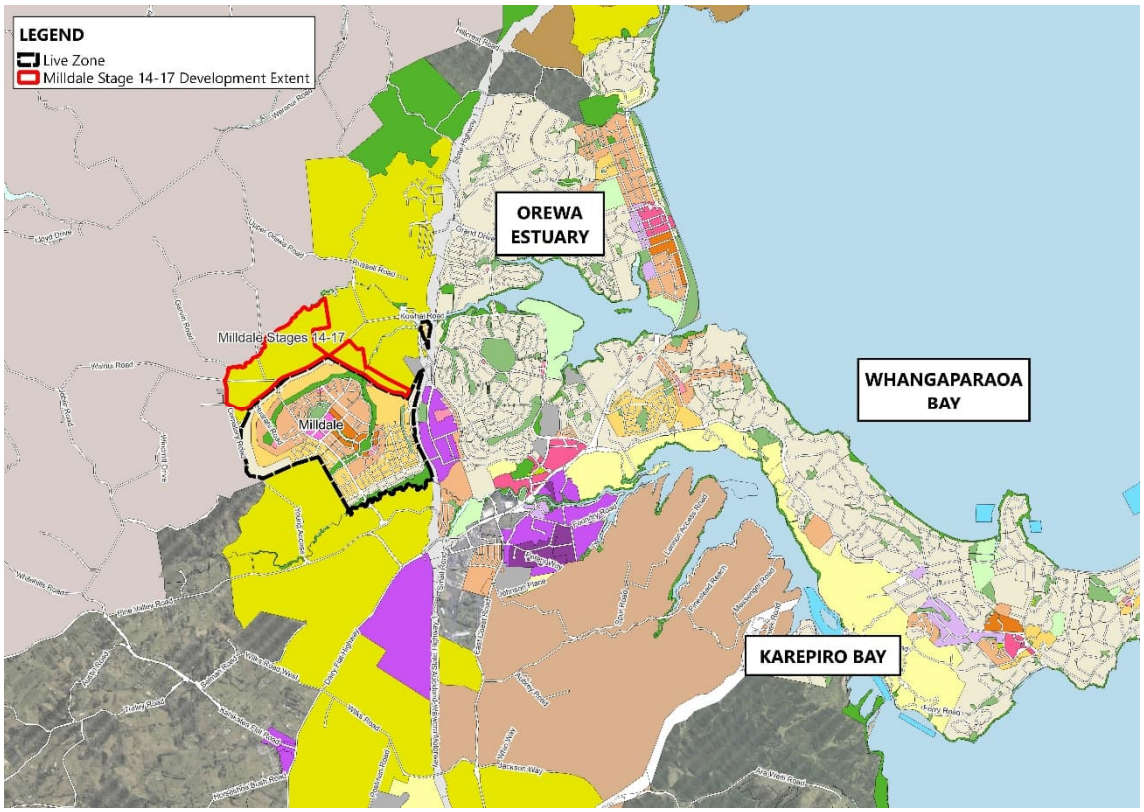

Figure 2: Site location and discharge points

2.7.Existing hydrological features and biodiversity

An ecological assessment has been undertaken by Virdis Environmental Consultants, combining desktop assessment and site visits. Permanent streams identified within and adjacent to Milldale Stages 14-17 include the Orewa Awa (P1), Waterloo Creek (P2) and a Waterloo Creek tributary (P3). Waterloo Creek flows through the Wainui Precinct and the Milldale development before re-entering Milldale Stages 14-17, with a tributary near the eastern boundary; it feeds into the Orewa Awa, a higher-order stream draining to the Orewa Estuary. The Orewa Awa forms the northern boundary of Milldale Stages 14-17.

The Orewa Awa's riparian margins and floodplain include natural inland wetlands. The permanent streams, including Waterloo Creek, are generally degraded, with low-quality riparian vegetation and high sediment loads associated with the existing agricultural land use, and fish barriers that impede native fish migration. Most riparian margins are managed pasture offering limited ecological function. The

freshwater features constrain development and may be retained, realigned or incorporated into open spaces for restoration and enhancement through riparian planting and protection.

2.8.Existing Flooding and flow paths

Existing flood hazards within and in proximity to Milldale Stages 14-17, are mainly limited to the existing stream corridors. The flood model originally developed for Wainui East SMP Version 4 has been updated to represent the Milldale Stages 14–17 landform, catchments and stormwater infrastructure, building on the models prepared for the consented Milldale Stages 10–13 Fast-track application, and is reported in the Milldale Stages 14–17 Model Build Report (Appendix A). Pre-development modelling of the 2-, 10- and 100-year ARI events including 3.8°C climate change confirms that existing flooding is generally contained within the stream corridors, with localised overtopping where existing road culverts are under capacity.

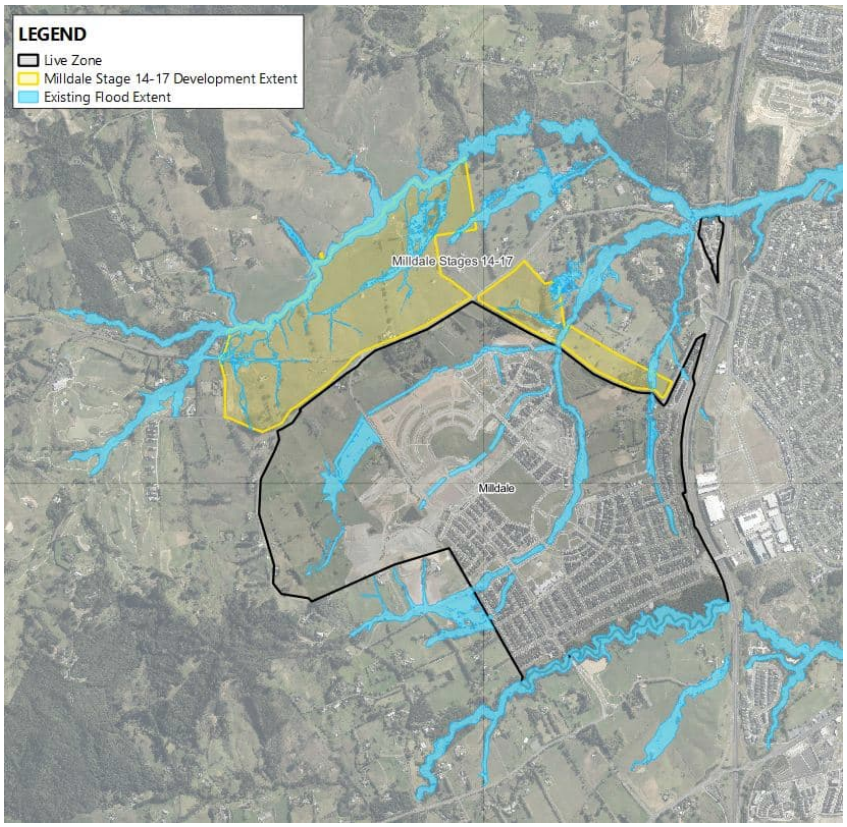

Figure 3: Existing Flood Extent

2.9.Coastal inundation

Auckland Council Geomaps and the AUP indicate that parts of the wider site discharging to streams are influenced by coastal inundation.

The adopted sea level rise assumptions were determined using the MfE publication – Coastal Hazards and Climate Change Guidance (2024). The tidal boundary conditions use a timeframe out to 2130 while applying the medium confidence SSP5-8-5 H+ based relative sea level rise (RSLR) projection. This projection includes the relevant vertical land movement for the local area and approximately 1.6 metre rise in mean sea level. The coastal inundation extents are shown in Figure 4. The representation of the coastal boundary conditions applied in the Flood Model are discussed in Flood Model Build Report (Appendix A).

Figure 4: Tidal boundary extents included in the Milldale development

2.10. Cultural and heritage sites

An Authority to Modify under the Heritage New Zealand Pouhere Taonga Act 2014 has been obtained for Milldale Stages 14-17. This requires the development to be undertaken in accordance with standard accidental discovery protocols.

2.11. Contaminated land

A site investigation has been undertaken by Environmental Management Solutions Ltd, which highlighted potential contamination from past agricultural activities falling under the Hazardous Activities and Industries List (HAIL); the NES for Assessing and Managing Contaminants in Soil therefore applies. Some areas exceed NES and AUP contamination limits and a Site Management Plan and a Remedial Action Plan has been prepared. This is considered typical for rural sites, and development can be managed to ensure site conditions are safe for human health and the environment. Further information is provided in the contamination report submitted with the Assessment of Environmental Effects.

3.0 Development summary and planning context

The development approach for managing stormwater aligns with policy E1.3(10) of the AUP. This section communicates the minimum regulatory, technical and design requirements that the stormwater management for the development must meet.

3.1.Regulatory and design requirements

A summary of the technical guidance documents used in this report is provided in the table below.

Table 3: Guidance summary

Guidance document	Relevance
Regionwide stormwater Network Discharge Consent (NDC)	Schedule 2 and Schedule 4 – greenfield development requirements
Wainui East SMP Version 4	Catchment framework; V4 adopted for live-zoned Milldale,
Milldale North and Wainui West Stormwater Management Plan (Version 7).	Catchment wide SMP submitted as part of the Milldale North and Wainui West Plan Change, Milldale Stages 14-17 are located within this SMP extent.
Auckland Unitary Plan – Operative in Part (AUP)	Policies regarding stormwater and flooding
GD01 – Stormwater management devices in the Auckland Region (2017/001)	Design criteria for stormwater management devices
TP10 (2003), Chapter 5	Legacy device design guidance (superseded by GD01)
TP108 (1999)	Hydrology – rainfall depths and assessment method
TP108 (August 2026)	Updated TP108, currently not operative and been released for industry consultation.
TR2013/035	Contaminant and volume management requirements
Auckland Code of Practice (SWCOP) V4.0 (2022), Chapter 4	Minimum standards for stormwater systems
Auckland Council Stormwater Flood Modelling Specifications (2011)	Flood-model build guidance
GD04 – Water Sensitive Design (2015/004)	WSD approach for the site
NPS-FM 2020	Strategic freshwater objectives
NPS-NH 2025	National direction on natural hazard risk, including flood hazard avoidance and management

Guidance document	Relevance
NPS-UD 2020 / Auckland Plan / NZS4404	Growth, development and subdivision infrastructure guidance
Plan Change 120 (PC120) – Housing Intensification and Resilience (notified 3 November 2025)	Proposed AUP natural hazard provisions; limited weight pending decisions, direction relevant to flood and coastal hazard management

3.2. Auckland Unitary Plan – Operative in Part

The AUP became operative in part on 15 November 2016 and sets out objectives, policies and rules for development. The Regional Policy Statement provisions most relevant to stormwater are Section B2 (Urban Growth and Form), Section B7 (Natural Resources) and Section B10 (Environmental Risk, including natural hazards, climate change and contaminated land).

The Auckland-wide provisions relevant to the management of stormwater and flooding are Section E1 (Water quality and integrated management), Section E8 (Diversion and discharge) and Section E36 (Natural hazards and flooding). Policy E1.3.10 requires an integrated stormwater management approach that has regard to the nature and scale of development, the protection of site features and receiving environments, reducing stormwater flows and contaminants at source, and the use and enhancement of natural hydrological features. Policy E1.3.14 requires the best practicable option (BPO) to be adopted to minimise the adverse effects of stormwater discharges. Section E36 requires that development avoids the 1% AEP (100-year ARI) floodplain and does not increase flood depths or velocities, or otherwise increase flood hazards, for other properties upstream or downstream.

3.3. Regionwide stormwater Network Discharge Consent

The regionwide stormwater NDC is a tool for managing and integrating land use, stormwater discharge and the region's natural water assets to mitigate the impacts of climate change and flooding. Schedule 2 sets the objectives and outcomes for stormwater discharge across the region, including reducing risk to people and property, enhancing waterways and te mauri o te wai, supporting growth through water sensitive design, and avoiding the creation of new flooding of habitable floors.

Schedule 4 outlines the development requirements for greenfield developments. The water-quality requirement is treatment of 100% of impervious areas by a water-quality device designed in accordance with GD01. For discharges to a stream via a public network outside a Stormwater Management Area – Flow (SMAF), equivalent hydrology to the pre-development (grassed) state is required, comprising retention of a minimum of 5mm runoff depth for all impervious areas and detention (24-hour drain down) for the difference between pre- and post-development runoff volumes from the 95th percentile, 24-hour rainfall event. Sufficient downstream network capacity is required in the 10% AEP event, and buildings are to be developed in accordance with SWCOP (V3, 2022) for the 1% AEP event.

Where these requirements cannot be met, an alternative level of mitigation determined through an SMP that applies an integrated stormwater management approach, meets the Schedule 2 objectives and outcomes, and represents the BPO for the project. This stormwater assessment has been prepared to align with the regionwide NDC and the Milldale North and Wainui West SMP (V7) that has been submitted as part of the Milldale North Plan Change, which when adopted would include Milldale Stages 14-17.

3.4. Water Sensitive Design (GD04)

GD04 introduces the principles and objectives for Water Sensitive Design (WSD), including an inter-disciplinary design approach and the use of at-source stormwater management practices that mimic natural systems. The objectives include reducing stormwater runoff volume and peak flow towards pre-development levels, managing stormwater quality to avoid adverse environmental effects, minimising soil disturbance, promoting ecosystem health, delivering best-practice urban design, and maximising the return on investment from stormwater management.

3.5. National Policy Statement for Freshwater Management 2020

The NPS-FM 2020 directs how freshwater is managed under the Resource Management Act 1991. It requires freshwater to be managed in a way that gives effect to Te Mana o te Wai, prioritising the health and wellbeing of water bodies first, the essential needs of people second, and other uses third. It requires the protection of wetlands and streams, avoidance of further loss or degradation, and an integrated approach to managing land use, freshwater and coastal water. The stormwater management approach for Milldale North gives effect to these directions through water quality treatment of all impervious areas, hydrology mitigation, and the retention, protection and enhancement of the stream network and riparian margins.

3.6. National Policy Statement for Natural Hazards 2025

The National Policy Statement for Natural Hazards 2025 (NPS-NH) was gazetted on 18 December 2025 and came into force on 15 January 2026. It provides, for the first time, national direction on how natural hazards are to be addressed in plan-making and in resource consent decision-making, and local authorities are required to give effect to it when making consent decisions. The NPS-NH applies to all environments and zones, including coastal environments, and to the natural hazards it specifies, which include flooding and coastal inundation.

The NPS-NH embeds a risk-based approach, requiring natural hazard risk to be assessed using the best available information and determined from the combination of the likelihood of a hazard event and the consequence of that event, applying the risk matrix set out in the instrument. It does not prescribe exact outcomes other than the avoidance of activities that would result in a 'very high' level of natural hazard risk, recognising that hazard risk management is context specific.

For Milldale Stages 14-17, the relevant natural hazards assessed in this report relate to flooding. This has been quantified through the XP-SWMM 1D/2D flood model, including climate-change scenarios, and the development responds to that assessment by locating development outside the 1% AEP floodplain, providing finished floor levels and freeboard in accordance with SWCOP, and demonstrating no increase in flood depths, velocities or hazard for upstream or downstream properties. The assessment against the direction of the NPS-NH is set out in Section 10.0.

4.0 Mana whenua: Te ao Māori and mātauranga

Engagement correspondence has been sent to 12 iwi groups. Te Kawerau ā Maki and Ngāti Manuhiri have confirmed an interest in being involved, and a Joint Cultural Impact Assessment has been prepared by the Ngāti Manuhiri Settlement Trust and Te Kawerau Iwi Tiaki Trust for the proposed Structure Plan and Plan Change. Ngāti Whanaunga also expressed an interested in the project. Further detail on the cultural impact assessment is included in the wider application documents. Consultation and engagement with mana whenua will continue on an ongoing basis as the application progresses.

5.0 Stakeholder engagement and consultation

Consultation has been undertaken with Auckland Council including Healthy Waters and the Parks team.

A summary of the consultation undertaken with Healthy Waters and Parks is provided below. Consultation and engagement will continue on an ongoing basis as the application progresses.

Extensive consultation was also undertaken during the preparation of the plan change, which informed the stormwater management framework applied to this application.

An existing Stormwater Management Plan (SMP) (Version 4) was adopted in 2016 and catered to the then Milldale live-zoned area; while the extent of the SMP covered a wider area, it was only adopted for the live-zoned Milldale land. The SMP was updated to Version 5 to include the additional areas of Milldale North and Wainui West, to incorporate the requirements of the Auckland regionwide Network Discharge Consent (NDC) (Version 4 having been published prior to adoption of that document), and to address the comments received from Healthy Waters on the Draft Milldale North Structure Plan.

Following lodgement of the plan change, a meeting was held with Healthy Waters in July 2024 to discuss the Clause 23 request. The SMP was subsequently updated to Version 6 to reflect the responses, the main updates being a stream erosion assessment undertaken at the request of Healthy Waters, an implementation strategy for the SMP, and an assessment of large communal raingardens against the use of wetlands.

A further meeting was held with Healthy Waters in March 2025 to discuss the Clause 23(2) request, with subsequent correspondence on implementation of the SMP and infrastructure dependencies. The SMP was updated to Version 7 to reflect those responses.

Table 2: Summary of consultation for Milldale Stages 14 - 17 with Auckland Council

Date	Summary of discussion
21/01/2026	Referral feedback form received from Healthy Waters, ahead of any pre-application meetings or meetings that Woods was party to. The feedback recorded an officially neutral position on the proposed works, and acknowledged the zoning scenario, the proposed ownership and vesting arrangements, and the high-level stormwater management strategies.
16/02/2026	Meeting covering the overall stormwater management approach, the consenting approach (private discharge consent and an SMP or equivalent), the criteria for vesting drainage reserves, and the flood modelling approach. Auckland Council Parks also attended. Initial feedback indicated some opposition to the vesting of drainage reserves that do not provide clear community functions beyond stormwater management, such as public amenity or connectivity. No minutes or written feedback from this meeting are available.
24/04/2026	Open-space meeting held primarily with Auckland Council Parks, with Healthy Waters in attendance, which included specific consideration of the proposed drainage reserve arrangement.

6.0 Proposed development

6.1. Impervious coverage assumptions

The development will increase impervious coverage and consequently the amount of stormwater runoff generated. The percentage of impervious area within Milldale Stages 14-17 is expected to increase from approximately 5% to approximately 70% at maximum probable development (MPD), consistent with the refined impervious-coverage assumptions detailed in the Milldale Stages 14–17 model build report (Appendix A). The applicable underlying zones and MPD impervious coverages are summarised in Table 3.

Table 3: Impervious coverage summary

Zone type	Impervious percentage (%)
Millwater (Single House)	65
Milldale (Single House)	65
Single House	60
Large Lot	10
Milldale Stages 14-17	70*
Road Catchments	80
Mixed Rural	10
Rural Production	10
Countryside Living	10
Heavy Industry	80
Light Industry	80
General Business	80
Town Centre	100
Public Open Space (Conservation/ Community/ Information Recreation)	Lesser of 10% or 5000 m^2

*Future urban coverage based on Wainui East Precinct zoning plan

Areas within the Future Urban Zone (FUZ) have been assessed using refined post-development impervious percentages to provide a more reliable estimate for the catchments. A high-level assessment of the development catchments was undertaken to establish specific impervious rates, with a conservative approach taken by adopting the largest calculated impervious percentage for each storm event.

Catchments outside the development area retain their existing impervious percentages. These parameters are consistent with the approach outlined in the Wainui East Flood Model Build Report V1. The applicable underlying zones and MPD impervious coverages are summarised in Table 3 above, and the AUP zones within the catchment extent are shown in Figure 5.

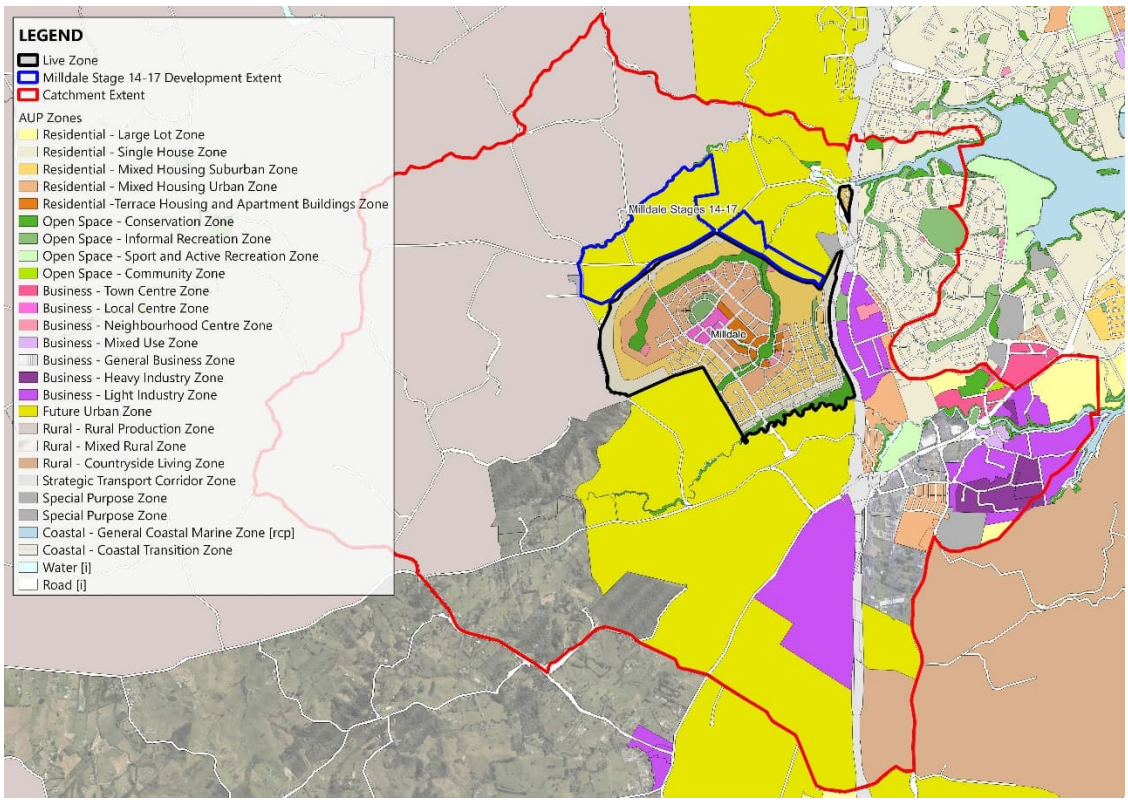

Figure 5: AUP zoning within the Milldale Stages 14-17 catchment

6.2.Design criteria

The design rainfall depths adopted for the Milldale Stages 14–17 stormwater design are based on the currently operative TP108 rainfall depths for the Milldale catchment, adjusted for climate change in accordance with the Stormwater Code of Practice (3.8°C temperature increase). The adopted depths are set out in Table 13 and the corresponding 10-minute peak rainfall intensities in Table 14. Stormwater management devices are designed to the 95th percentile event, defined as a 37mm, 24-hour rainfall event.

Table 13: Milldale design rainfall depths

ARI	Rainfall depth (mm)	With climate-change adjustment – 3.8°C (mm)
1-year	71.8	91.5
2-year	88.0	112.1
5-year	120.0	155.5
10-year	145.0	189.6
100-year	225.0	298.6

7.0 Flood management

7.1. Background and model build

Woods has undertaken flood modelling to assess flooding within and outside of the proposed development. Flood modelling was based on maximum probable development (MPD), and AUP zonings for the 2-year, 10-year, and 100-year storm events with a 3.8°C climate change allowance.

A flood model was developed using XPSWMM (Version 2024.2) by Innovyze to undertake the Milldale Stage 14-17 flood assessment. Details regarding the model build parameters and assumptions are detailed in the Milldale Stage 14-17 Model Build Report which is attached as Appendix A of this report.

7.2. Modelled scenarios

Scenarios 1 to 3 represent pre-development (existing development) conditions for the 2-, 10- and 100-year ARI events, with allowance for a 3.8°C temperature increase by 2110 consistent with SWCOP V4. These scenarios adopt 5% impervious coverage for Future Urban Zone areas, 65% for the live-zoned Wainui/Milldale Precinct and AUP impervious rates for all other zones. They provide the baseline reference against which the effects of the proposed development are compared.

Scenarios 4 to 6 represent post-development (maximum probable development) conditions for the same three events. These adopt 70% impervious coverage for Milldale Stages 14-17, 80% for road-only catchments and 65% for the Wainui/Milldale Precinct, with AUP rates retained for all other zones. The Milldale Stages 14-17 design surface is incorporated into the landform, and the proposed culverts and structures are included in the model. These scenarios assess the flood effects (if any) resulting from the development and the performance of the proposed culverts in accordance with SWCOP V4.

Two additional scenarios have been simulated for the 100-year ARI event. Scenario 7 applies culvert blockage to the proposed structures in accordance with SWCOP V4, to assess infrastructure performance and any overtopping risk or hazard posed to surrounding areas. Scenario 8 applies the revised TP108 rainfall distribution. More information on the revised TP108 rainfall distribution is available in Section 8.5.

Across all scenarios the landform is based on the 2024 LiDAR and topographical survey, with full buildout of the Milldale development area and existing landform retained for 147 Argent Lane and the remainder of the model extent. No primary network is represented within Milldale Stages 14-17. A tidal boundary condition of 3.72 m RL has been applied to all scenarios, derived from the MfE publication Coastal Hazards and Climate Change Guidance (2024) including allowance for sea level rise and vertical land movement.

8.0 Model Results

Flood modelling has been undertaken to assess any flood effects from the proposed Milldale Stages 14-17 development to the upstream or downstream areas. Modelling has been undertaken in line with recommended flood management strategy i.e. pass flow forward. Water levels and flood depth results were extracted from the simulated model scenarios and used to assess flood effects for the 2-year, 10-year and 100-year ARI events with allowance for 3.8°C climate change (as per the SWCP V4).

The assessment also covers an analysis of the minimum freeboard requirements and blockage for culvert structures in accordance with the Stormwater Code of Practice (V4). The culverts' freeboard requirements are covered in more detail in Section 8.3.2 and the culverts blockage scenario in Section 8.3.3.

8.1. Modelled Scenarios

There was a total of eight modelled scenarios and they are summarised in Table 4.

Table 4: Modelled scenarios summary

#	Model Scenario	Rainfall Event	Land Use	Landform	Hydraulic Conveyance	Tidal Boundary Condition	Purpose
1	Pre-Development (ED)	2-Year ARI + 3.8°C future climate change	5% Existing development for Future Urban Zone areas 65% Wainuia/Milldale Precinct Impervious coverage for all other zones as per AUP	Topographical Survey LiDAR 2024 Full buildout for Milldale development area + existing landform for 147 Argent Lane and rest of the model extent	No primary network within the proposed Milldale Stages 14-17 development All consented structures within the Milldale development area + Existing Structures within Milldale Stages 14-17 and remaining model extent	3.72 m RL (MfE publication – Coastal Hazards and Climate Change Guidance (2024) + SLR and VLM)	To provide a baseline reference model which is used to compare the effects from the proposed Milldale Stages 14-17 development
2		10-Year ARI + 3.8°C future climate change					
3		100-Year ARI + 3.8°C future climate change					
	Post-Development (MPD)	2-Year ARI + 3.8°C future climate change	70% impervious for Milldale Stages 14-17	Milldale Stages 14-17 Design Surface	No primary network within the proposed Milldale Stages 14-17	3.72 m RL (MfE publication – Coastal Hazards	To assess flood effects (if any) resulting from the Milldale Stages 14-

			80% Road-Only catchments 65% Wainui/Milldale Precinct Impervious coverage for all other zones as per AUP	Topographical Survey LiDAR 2024 Full buildout for Milldale development area + existing landform for 147 Argent Lane and rest of the model extent	development All consented structures within the Milldale development area + Proposed structures within Milldale Stages 14-17 + Existing structures in the remaining model extent	and Climate Change Guidance (2024) + SLR and VLM)	17 development. To assess the culverts performance as per the SWCOP(V4)
5		10-Year ARI + 3.8°C future climate change					
6		100-Year ARI + 3.8°C future climate change	70% impervious for Milldale Stages 14-17 65% Wainui/Milldale Precinct Impervious coverage for all other zones as per AUP				
Additional Scenarios							
7	Post-Development (MPD) assuming culverts blockage	100-Year ARI + 3.8°C future climate change	70% impervious for Milldale Stages 14-17 65% Wainui/Milldale Precinct Impervious coverage for all other zones as per AUP	Milldale Stages 14-17 Design Surface Topographical Survey LiDAR 2024 Full buildout for Milldale development area + existing landform for 147 Argent Lane and rest of the model extent	No primary network within the proposed Milldale Stages 14-17 development Includes proposed culverts/structures proposed for Milldale Stages 14-17 development and allows for blockage as per SWCOP V4	3.72 m RL (MfE publication – Coastal Hazards and Climate Change Guidance (2024) + SLR and VLM)	To assess the proposed infrastructure performance with allowance for blockage and overtopping risk/hazard that may be posed to the surrounding areas (if any).

8	Post-Development (MPD)	100-Year ARI + 3.8°C future climate change. With revised TP108 Rainfall distribution	70% impervious for Milldale Stages 14-17 65% Wainui/Milldale Precinct Impervious coverage for all other zones as per AUP	Milldale Stages 14-17 Design Surface Topographical Survey LiDAR 2024 Full buildout for Milldale development area + existing landform for 147 Argent Lane and rest of the model extent	No primary network within the proposed Milldale Stages 14-17 development Includes proposed culverts/structures proposed for Milldale Stages 14-17 development and allows for blockage as per SWCOP V4	3.72 m RL (MfE publication – Coastal Hazards and Climate Change Guidance (2024) + SLR and VLM)	To assess the resilience of the development under the revised TP108 rainfall distribution (draft guidance, currently out for consultation and not operative)

8.2.Flood model results

8.2.1. Pre Development

The pre-development results indicate that flooding within and adjacent to Milldale Stages 14-17 is largely confined to the existing stream corridors, with localised overtopping where existing conveyance structures – including the culverts under Wainui Road – are under capacity. Flood depth results for predevelopment 2yr, 10yr, and 100yr scenarios are included as Figure 6, Figure 7, and Figure 8, respectively.

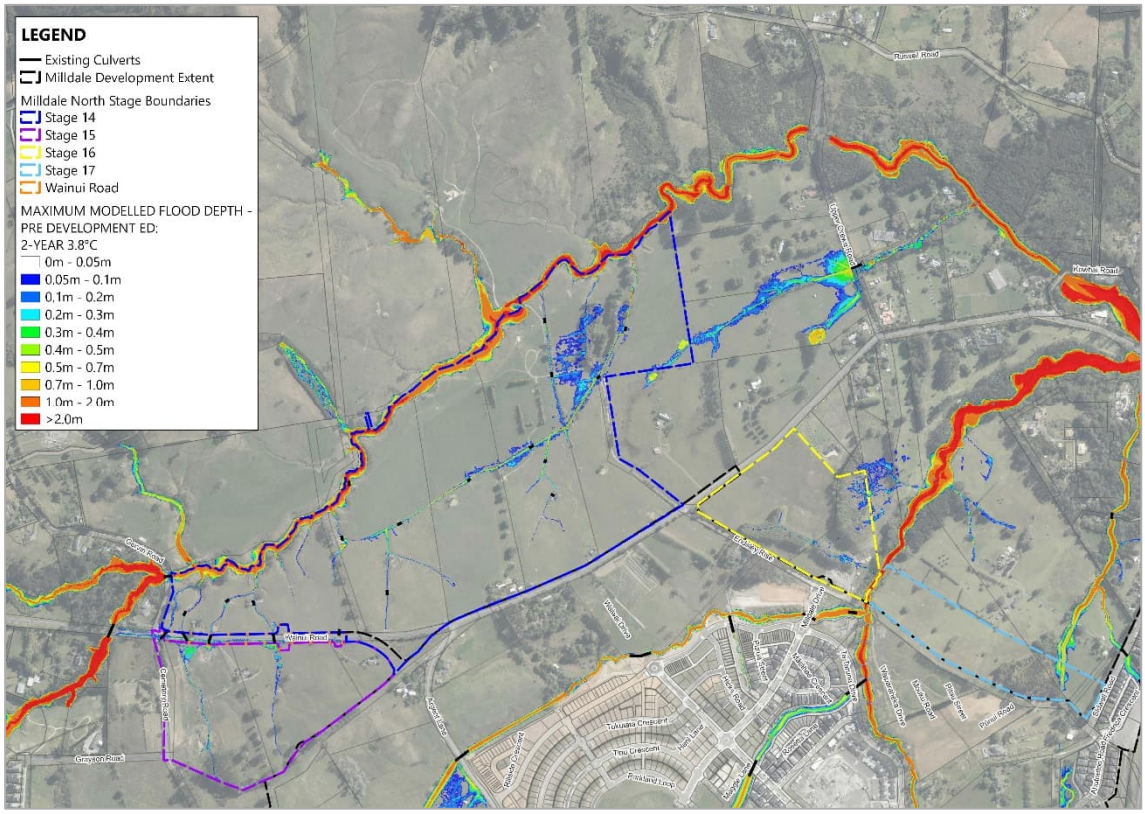

Figure 6: Pre-development scenario model flood depth results (2-year ARI event including 3.8 °C climate change)

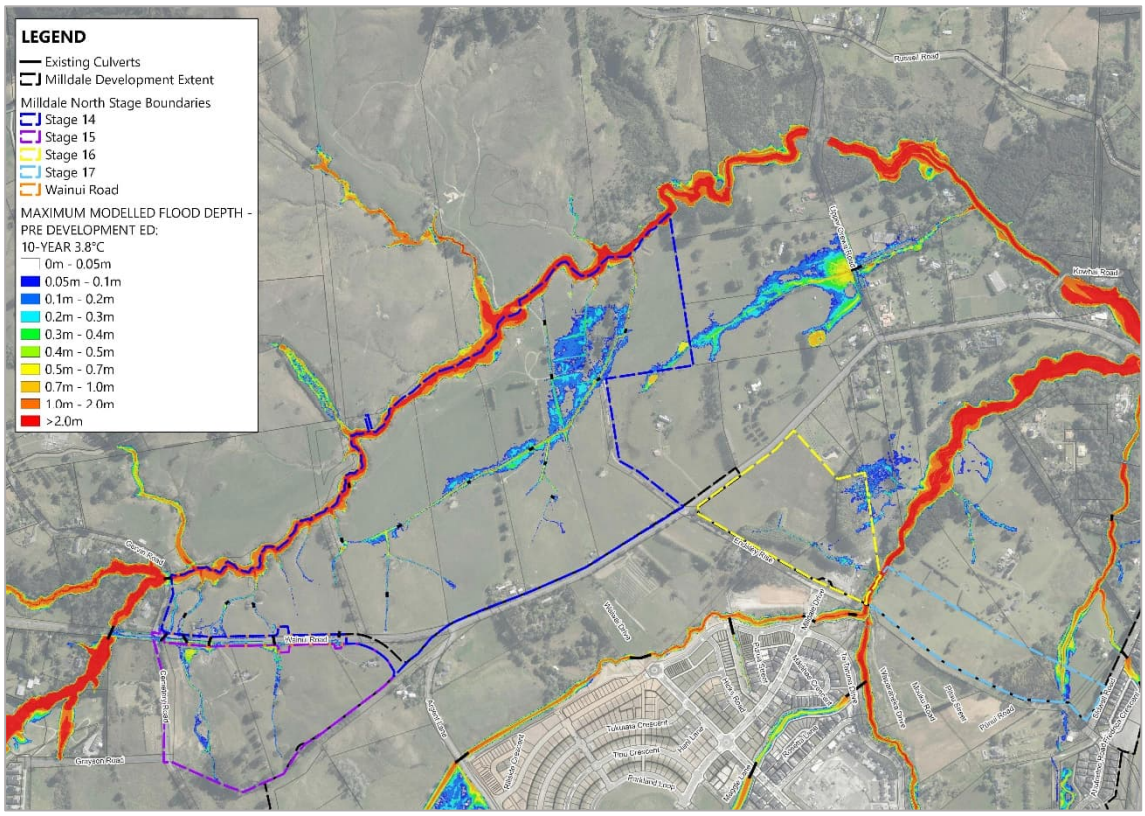

Figure 7: Pre-development scenario model flood depth results (10-year ARI event including 3.8 °C climate change)

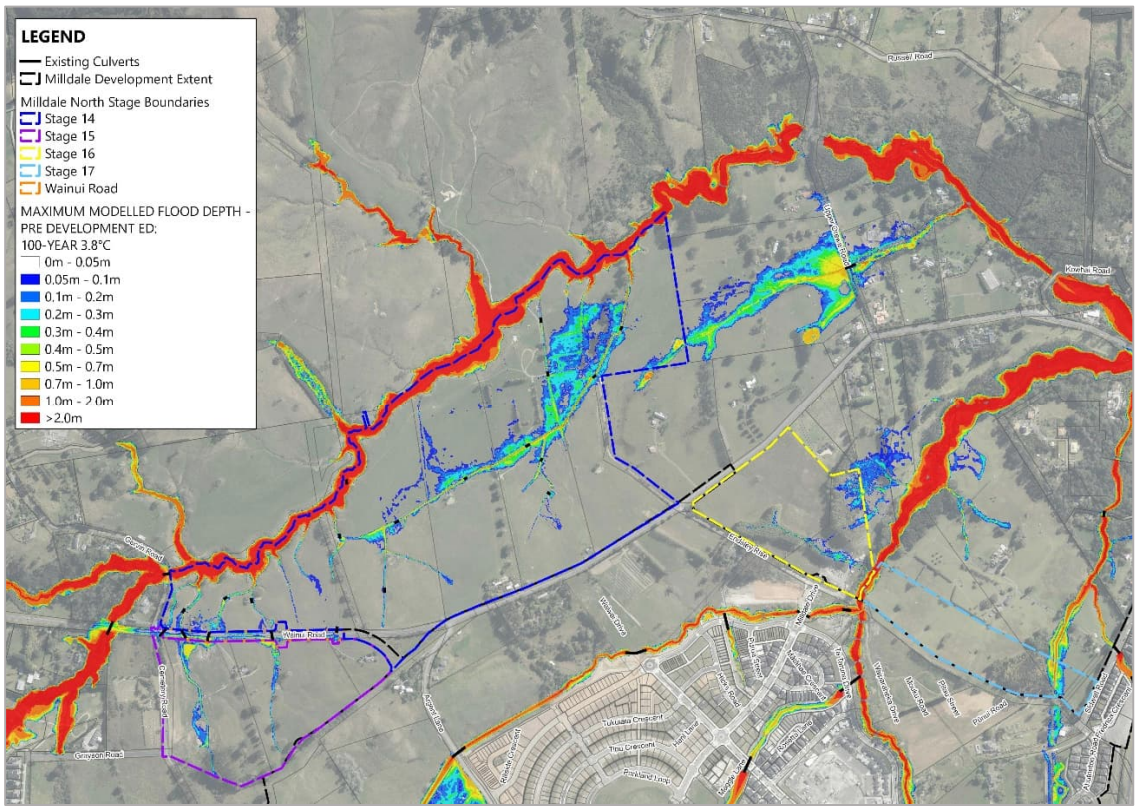

Figure 8: Pre-development scenario model flood depth results (100-year ARI event including 3.8 °C climate change)

8.2.2. Post Development

The post-development (MPD) results show that the proposed landform contains runoff within the stream corridors and that flows are passed forward through the upgraded and proposed conveyance structures. Comparison of maximum water levels and flood extents between the pre- and post-development scenarios for the 2-, 10- and 100-year ARI events including 3.8°C climate change shows that any increases in water level are limited to the stream corridors and are generally contained within the pre-development flood extent, and that post-development flood extents are generally unchanged or reduced – in places reduced as a result of the proposed structure upgrades and the pass-flows-forward approach.

8.2.2.1. Flood Depth Results

Flood depth results for the 2yr, 10yr, and 100yr scenarios are included in Figure 9, Figure 10, and Figure 11, respectively.

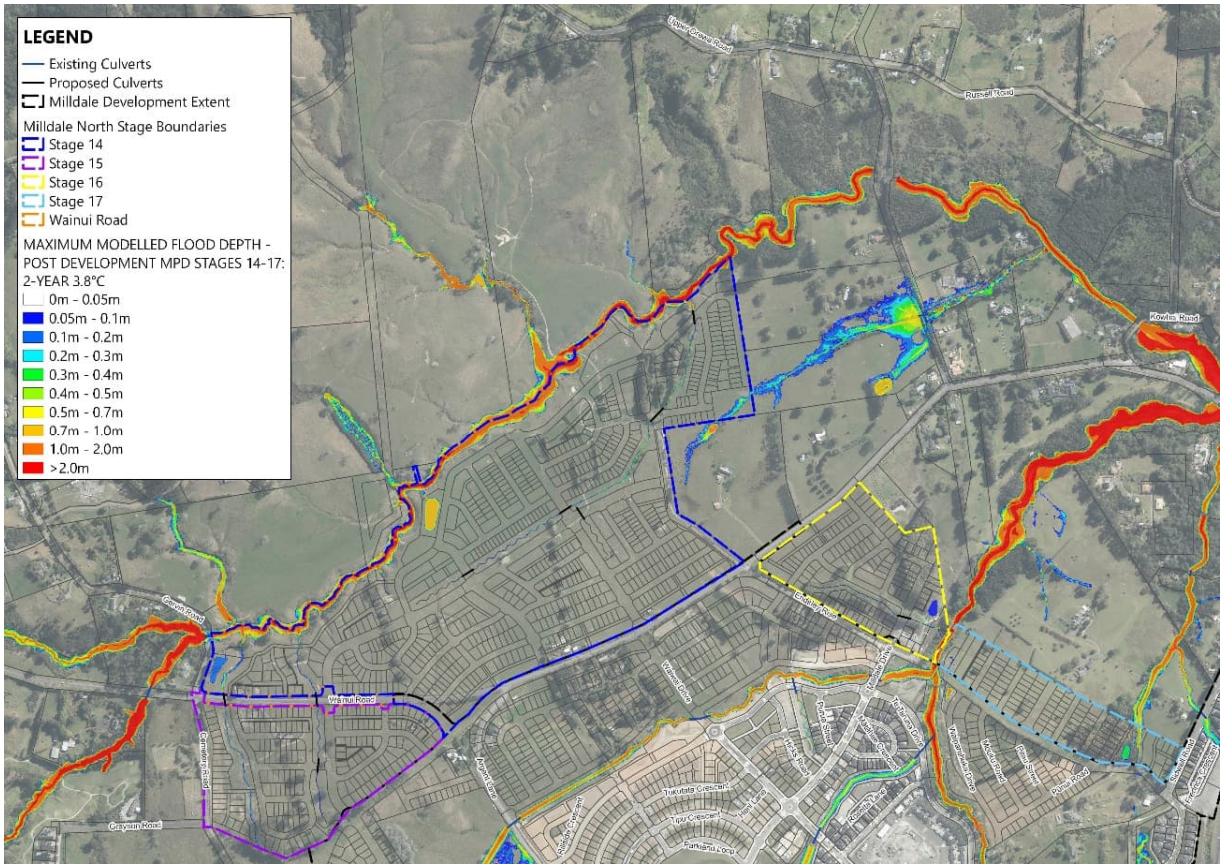

Figure 9: Post-development scenario model flood depth results (2-year ARI event including 3.8 °C climate change)

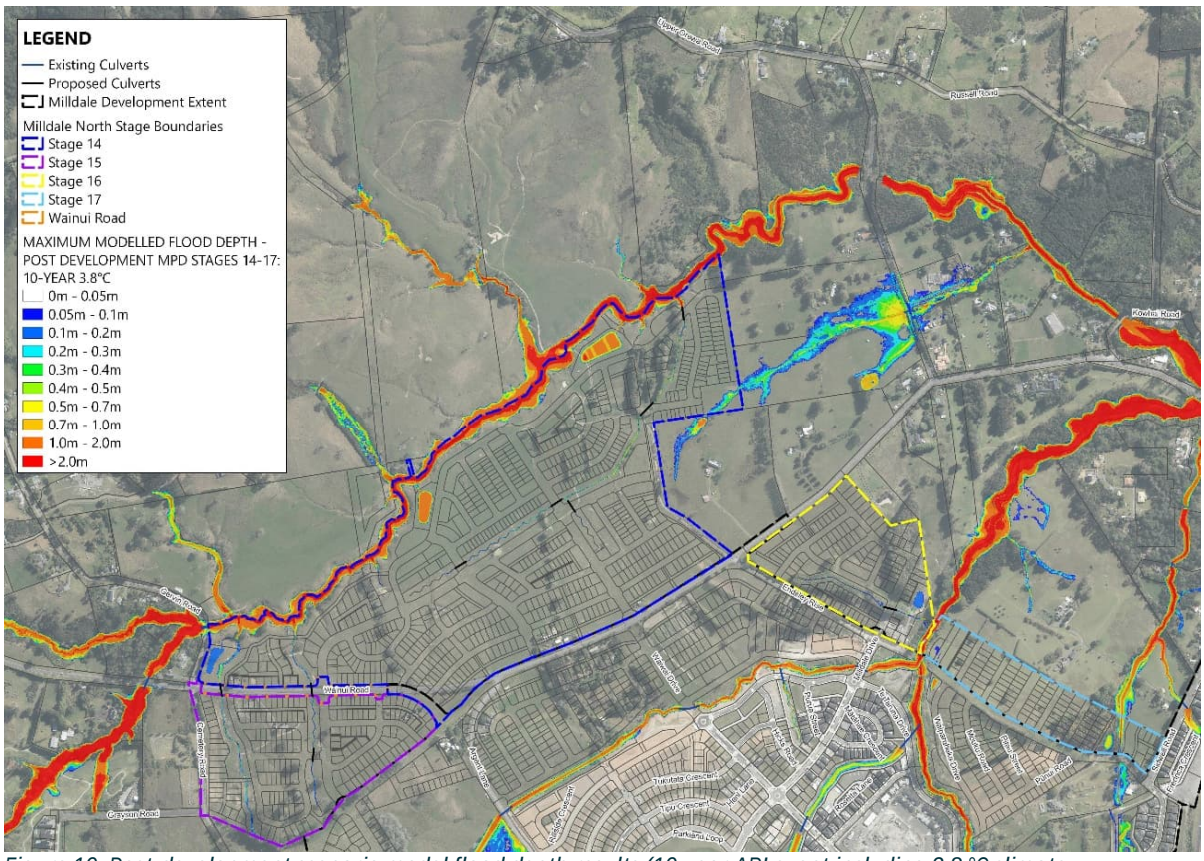

Figure 10: Post-development scenario model flood depth results (10-year ARI event including 3.8 °C climate change)

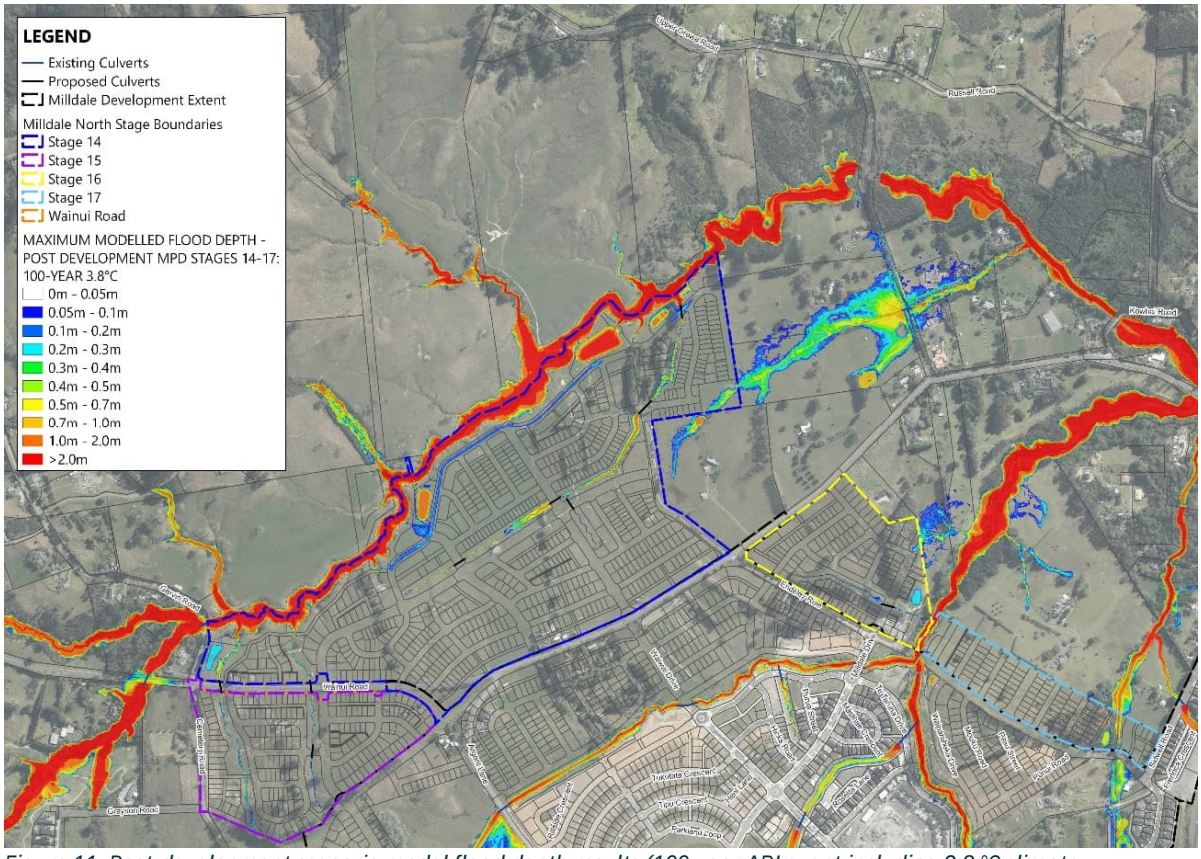

Figure 11: Post-development scenario model flood depth results (100-year ARI event including 3.8 °C climate change)

The results for the post-development scenario results indicate that:

- Flooding within the site is contained within the road reserves and stream corridors
- The proposed roads have capacity to convey flows from runoff generated from the catchments within the development

8.2.2.2. Water Level Difference Results

Water level differences between pre- and post- development scenarios for the 100-year storm event including 3.8° climate change is shown in Figure 12 with closeups shown on Figure 13 to Figure 16 .

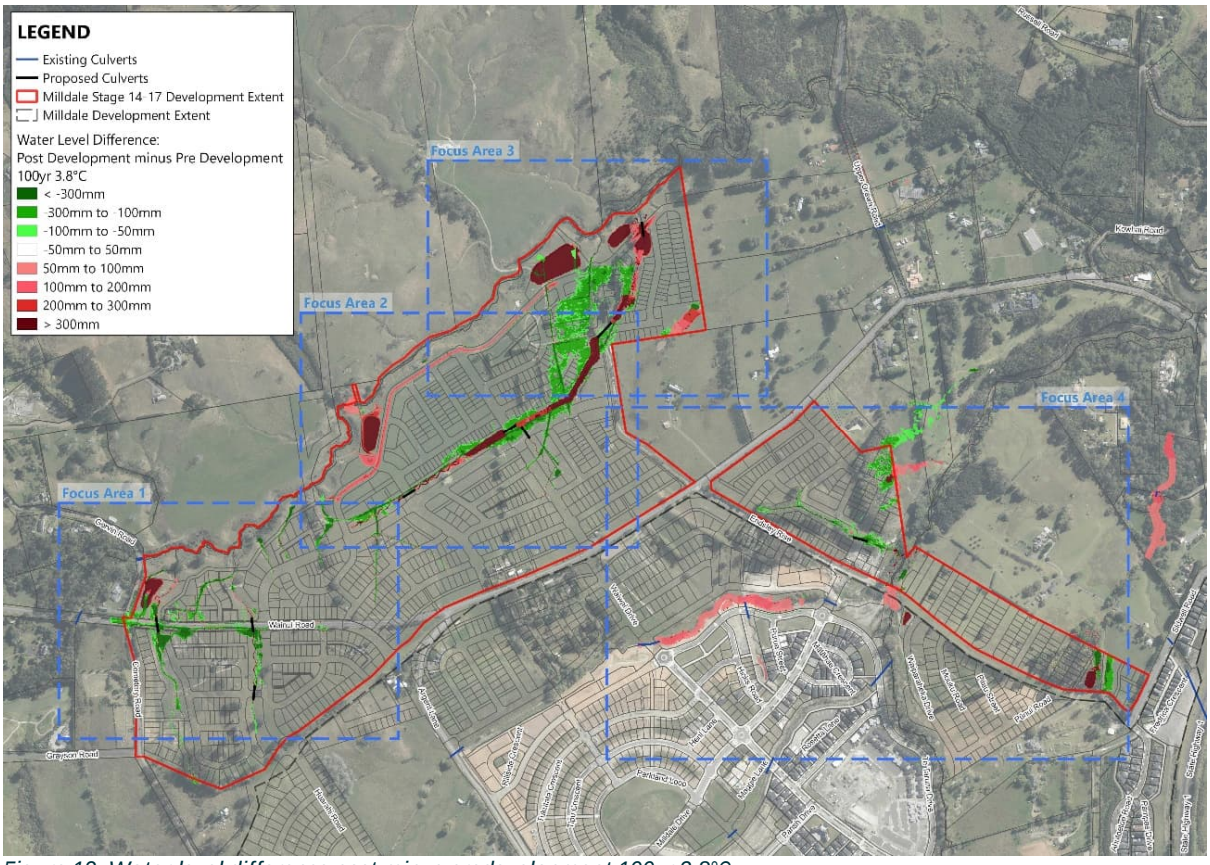

Figure 12: Water level difference post minus predevelopment 100yr 3.8°C

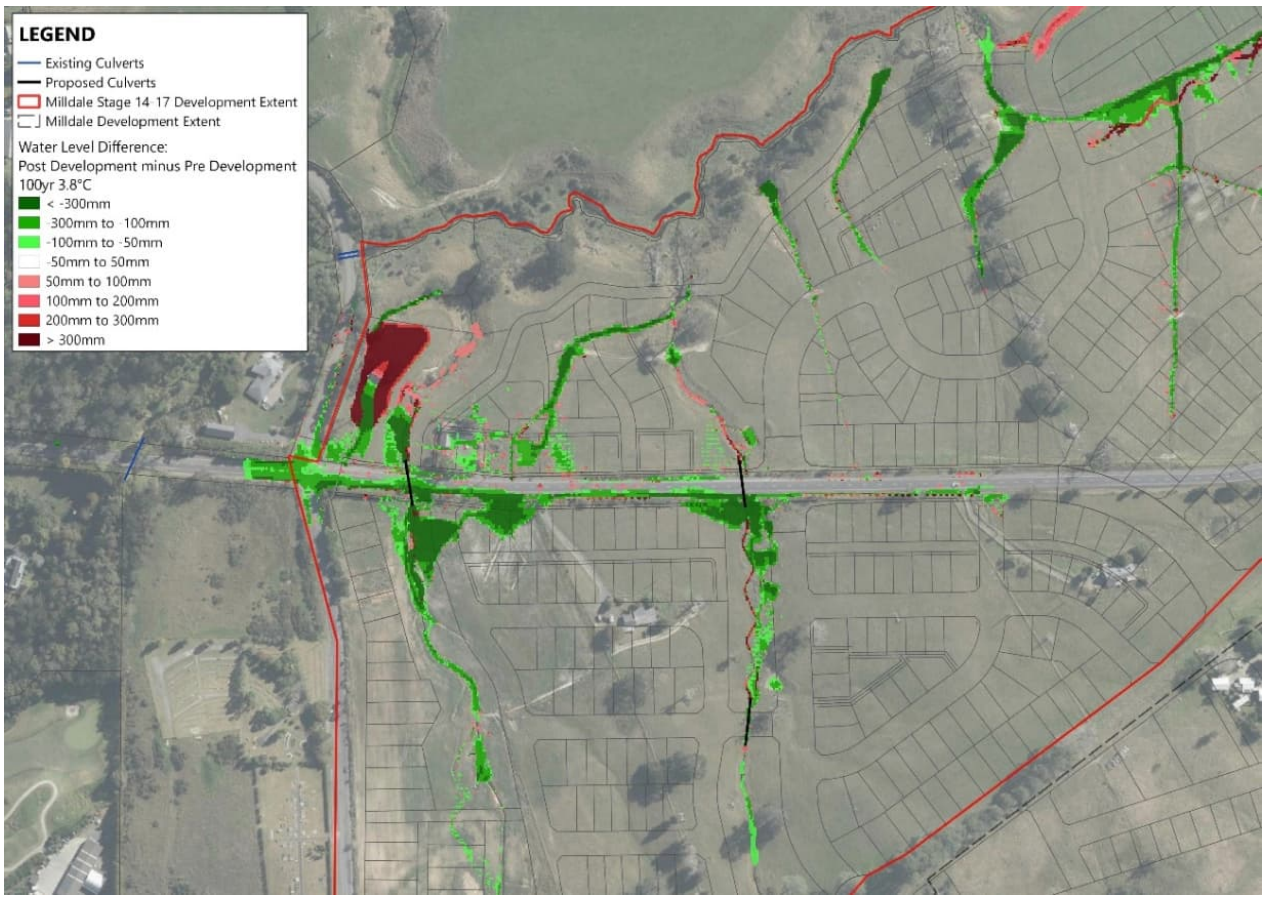

Figure 13*: Water level difference post minus predevelopment 100yr 3.8°C (Focus Area 1)*

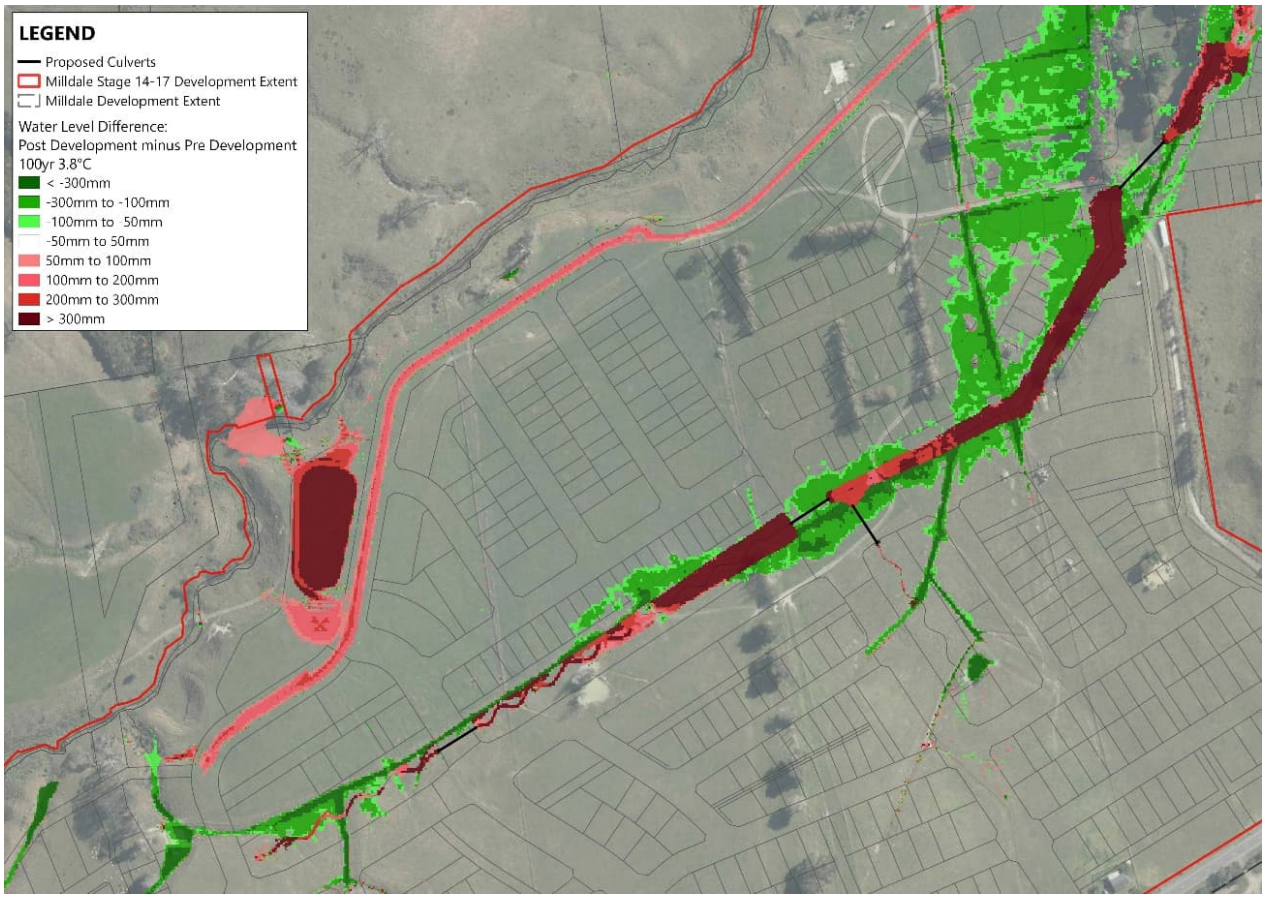

Figure 14*: Water level difference post minus predevelopment 100yr 3.8°C (Focus Area 2)*

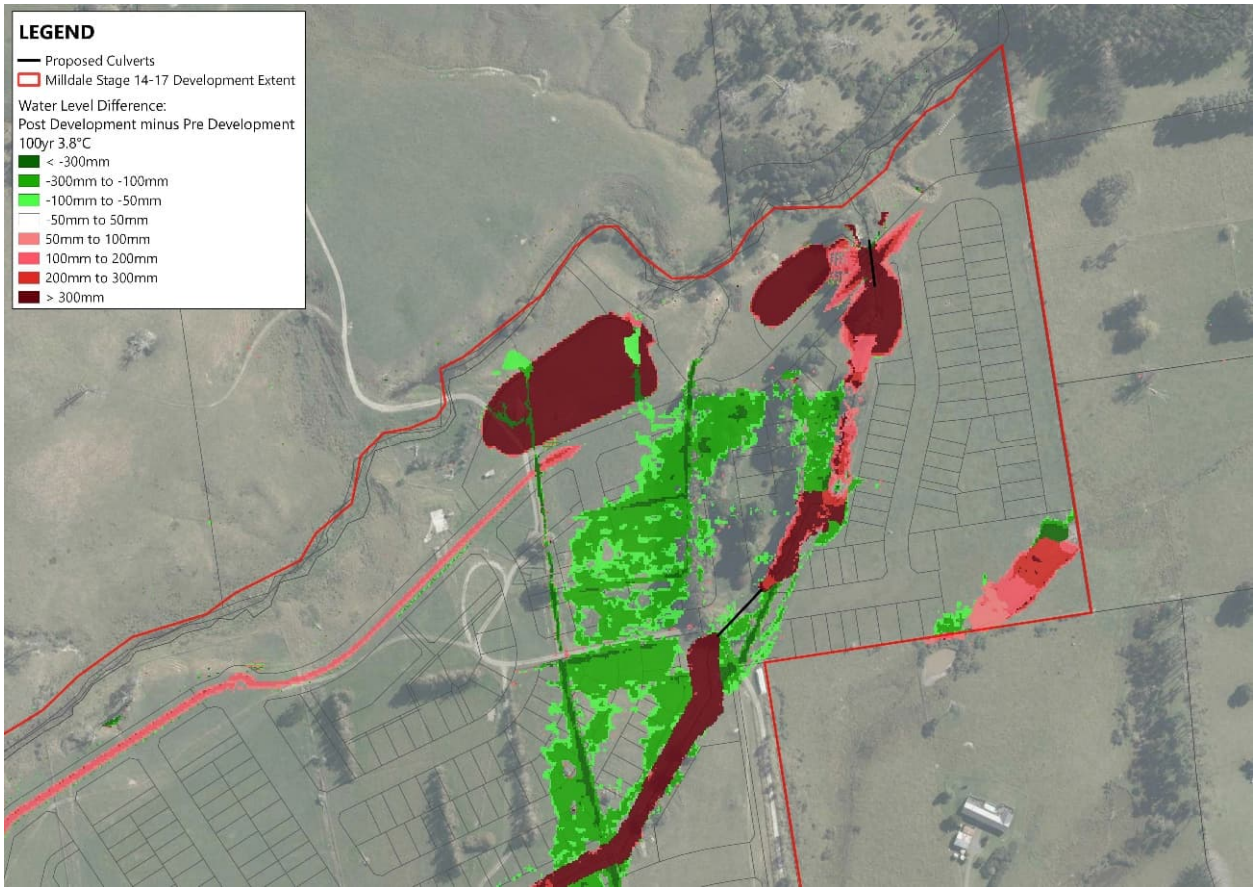

Figure 15: Water level difference post minus predevelopment 100yr 3.8°C (Focus Area 3)

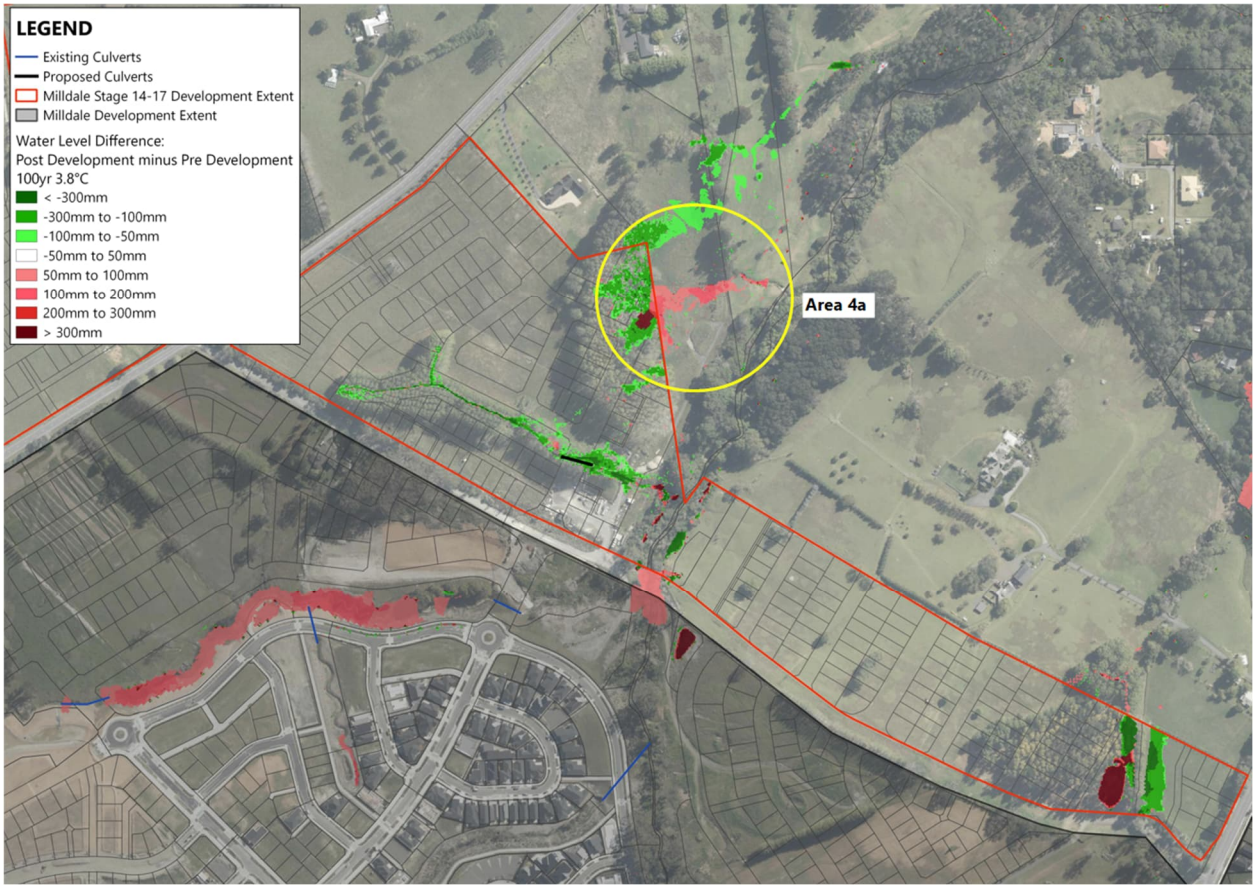

Figure 16: Water level difference post minus predevelopment 100yr 3.8°C (Focus Area 4)

The water level comparison results between the post-development and the pre-development model scenarios indicate that:

- Changes in water levels are generally a function of the modified landform as the site is earthworked to create roading and building platforms
- Increases observed throughout the catchment are associated with areas where new depressions are formed, i.e. the proposed wetlands, as well as along the modified tributaries to the Orewa Awa. These changes are contained within the watercourses and the device footprints themselves.
- Beyond these areas, no habitable or non-habitable buildings are located within the extent of predicted water level increase and therefore any differences are considered less than minor.
- Some minor differences are noted at 419 Wainui Road at the rear of the property (Area 4a, as shown on Figure 16). These differences are within an existing inundation extent/overland flowpaths and are not expected to be a flooding nuisance at this property. It is further noted that within the same extent, there are some minor improvements as a result of the proposed works at Stage 16. The modelled results reported here are considered conservative, and once the proposed primary stormwater network is taken into account the overall position at this property is not anticipated to be any worse than the existing situation.

It is noted that the Milldale live zone is not assessed in this water level comparison and any effects in this area are limited to the stream corridor and have no adverse impacts within the development lots or habitable areas.

It is therefore concluded that the proposed development does not worsen flooding on third-party land upstream or downstream of the development area for events up to the 100-year ARI including 3.8°C climate change. Where changes in water level are predicted, they are minor, localised and contained within the watercourses and the modified landform, and no habitable or non-habitable buildings are affected. Full flood depth and water level difference maps are included in the Milldale Stage 14-17 Fast Track Model Build report in Appendix A.

8.2.2.3. Hazard Assessment (ARR)

A flood hazard assessment has been undertaken to evaluate the effects of the proposed development on flood risk within the development site and adjoining properties. The assessment has been completed in accordance with the principles of Australian Rainfall and Runoff (ARR 2019). Assessment under Auckland Council Plan Change 120 (PC120) is discussed in Section 11.

The Australian Rainfall Runoff (ARR) Flood Hazard classification is a nationally recognised quantitative assessment tool that utilises modelled depths and velocity to identify areas of risk. It classifies flood hazards vulnerability 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 26 and Table 9 respectively, show the flood hazard vulnerability curves and criteria.

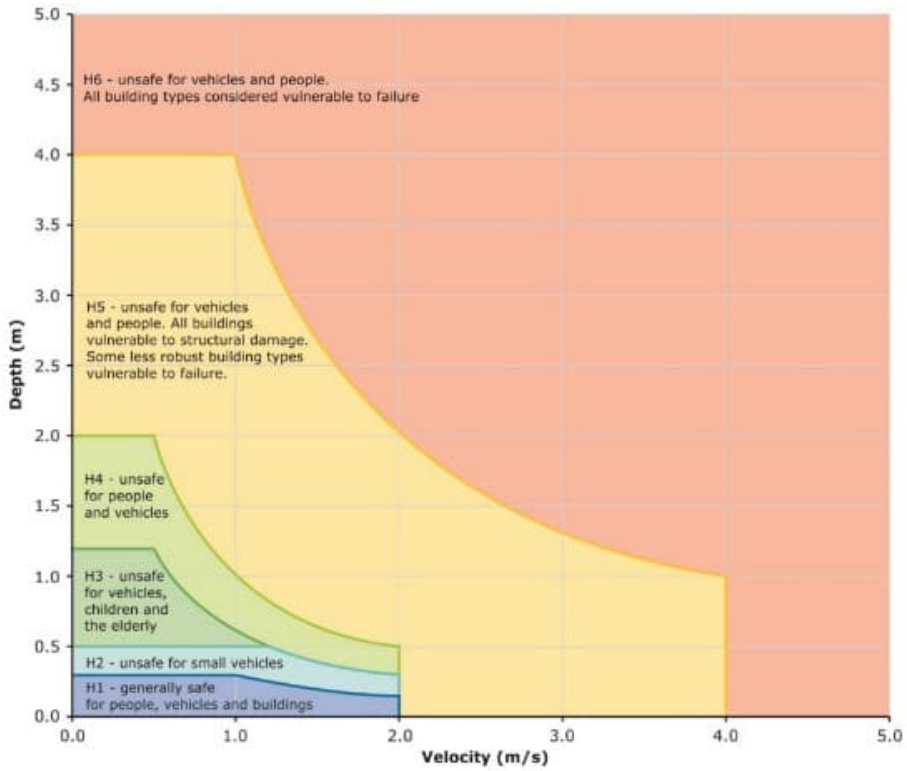

Figure 17: ARR flood hazard vulnerability curves

Table 5: Hazard Curves – vulnerability thresholds classification limits

Hazard Vulnerability Classification	Classification limit (D and V in combination) m^2/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	-	-

Hazard results for the post- development 100-year storm event including 3.8° climate change scenario are shown in Figure 18.

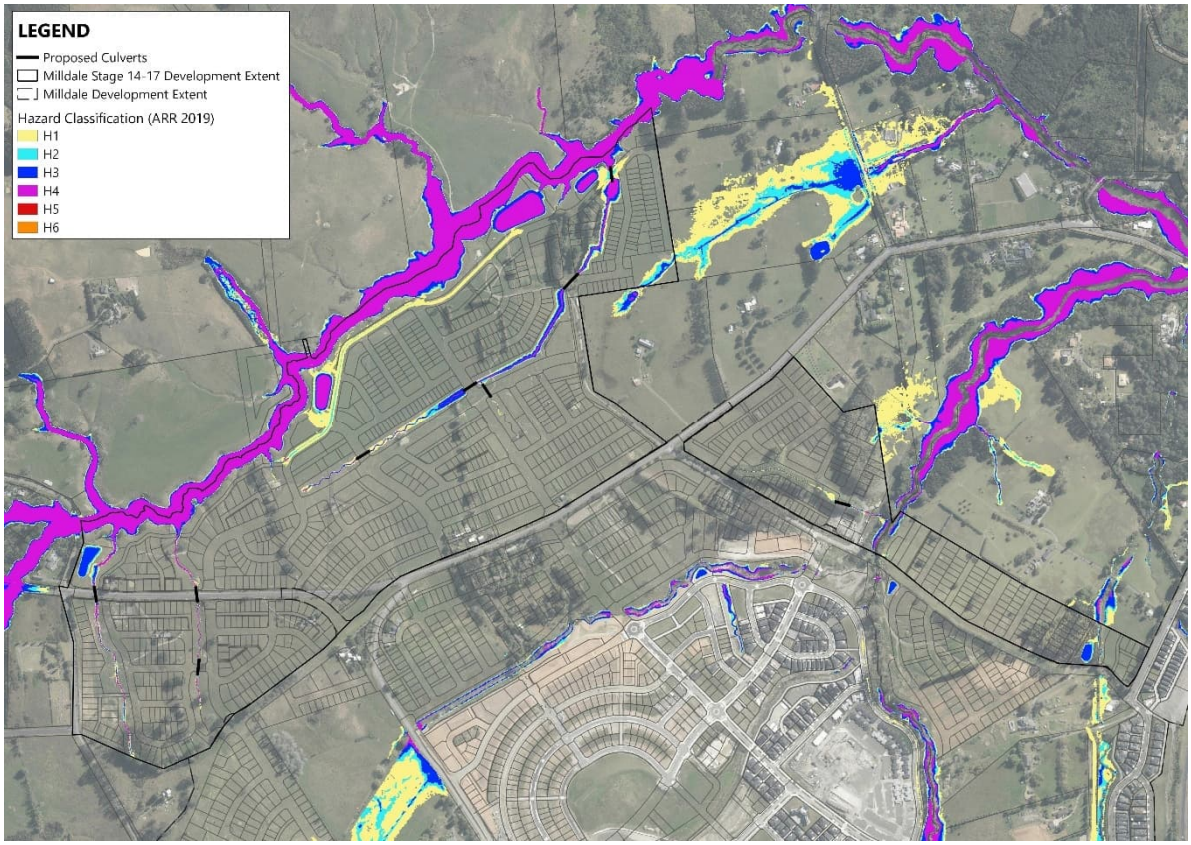

Figure 18: Post Development 100yr 3.8°C Hazard (ARR 2019)

The post-development 100-year 3.8° climate change hazard results indicate that:

- Within the site, the mapped flood hazard is limited to streams and road corridors. Hazards do not encroach on lots, and road hazards are primarily classified as H1.
- Hazards classified as H3 and H4 are limited and localised, occurring primarily along streams and within the designed wetlands.

8.3.Structures assessment

The flood modelling results have been used to assess the performance of proposed Milldale Stages 14-17 development culverts and the capacity of existing bridges downstream of the proposed development.

8.3.1. Bridges Assessment

A freeboard assessment has been undertaken for the following bridges:

- Wainui Bridge
- Kowhai Bridge
- Upper Orewa Bridge

Locations of the bridges are included in Figure 19.

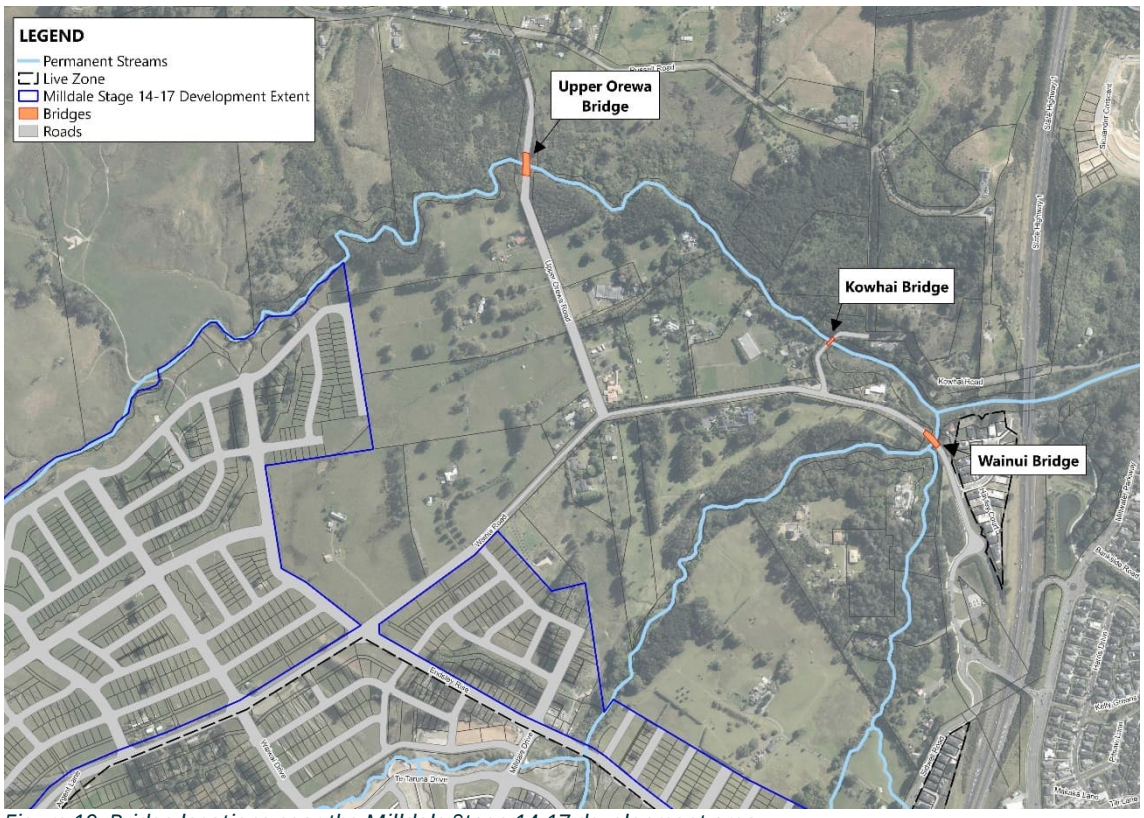

Figure 19: Bridge locations near the Milldale Stage 14-17 development area

8.3.1.1. Wainui Bridge

- The Wainui Road bridge, shown in Figure 20, has a low chord elevation of 4.79m RL (underside of bridge) and the high chord elevation (road level) elevation of 5.44m RL
- The flood modelling predicts that the water level does not exceed the low chord elevation for the post-development scenario in the 10-year ARI plus climate change events (4.60 m RL for 3.8°C climate change)
- Both the pre development and post development 100-year ARI plus climate change event water levels overtop the Wainui Bridge as the maximum water level are more than the high chord elevation (5.48 m RL for pre development, lifting to 5.52 for the post development).

  This is a known constraint identified as part of previous investigations and the proposed additional development has a negligible increased effect on flooding encountered at the bridge.

Figure 20: Wainui Bridge cross-section view

8.3.1.2. Kowhai Bridge

- The Kowhai Road bridge, shown in Figure 21, has a low chord elevation of 7.95m RL (underside of bridge) and the high chord elevation (road level) elevation of 9.98m RL
- The maximum water level under the bridge for 100- year ARI storm event with allowance for 3.8°C future climate change is 6.84m RL which results in a freeboard of 1.11m to the underside of the bridge
- Kowhai Bridge is deemed to be able to convey runoff in all post-development modelled scenarios with adequate freeboard

Figure 21: Kowhai Bridge downstream view

8.3.1.3. Upper Orewa Bridge

- The Upper Orewa bridge has a low chord elevation of 12.25m RL (underside of bridge) and the high chord elevation (road level) elevation of 12.75m RL
- The maximum water level under the bridge for 100-year ARI storm event with allowance for 3.8°C future climate change is 10.79m RL which results in a freeboard of 1.46m to the underside of the bridge
- Upper Orewa Bridge is deemed to be able to convey runoff in all modelled scenarios with adequate freeboard

Figure 22: Upper Orewa Bridge side view

8.3.1.4. Summary

The flood assessment of the bridge structures concludes that the the proposed development will not have an adverse effect on the downstream structures. The 100-year ARI post-development scenarios doesn't reach the Kowhai or upper Orewa bridges, and the Wainui Bridge overtops in the predevelopment scenario and the post development flood level is only marginally higher.

Table 6 shows the maximum water level for the bridges in a 10-year and 100-year ARI storm events with allowance 3.8°C future climate change.

Table 6: Bridge summary for 100-year ARI storm event

Structure	Chord Levels		Post Development 10-year 3.8°C			Pre Development 100-year 3.8°C			Post Development 100-year 3.8°C		
	Lower (m RL)	Upper (m RL)	Peak flow (m3/s)	Max Water Elevation (m RL)	Overtopping status	Peak flow (m3/s)	Max Water Elevation (m RL)	Overtopping Status	Peak flow (m3/s)	Max Water Elevation (m RL)	Overtopping Status
Wainui Bridge	4.79	5.44	79.68	4.60	Not Overtopping	129.57	5.48	Overtopping	131.31	5.52	Overtopping
Kowhai Bridge	7.95	9.98	81.26	5.61	Not Overtopping	159.80	6.86	Not Overtopping	158.16	6.84	Not Overtopping
Upper Orewa Bridge	12.25	12.75	78.66	9.49	Not Overtopping	156.15	10.81	Not Overtopping	154.32	10.79	Not Overtopping

8.3.2. Culverts Assessment

The proposed Milldale Stages 14-17 development includes a total of 9 culvert structures as shown in Figure 23 and Figure 24.

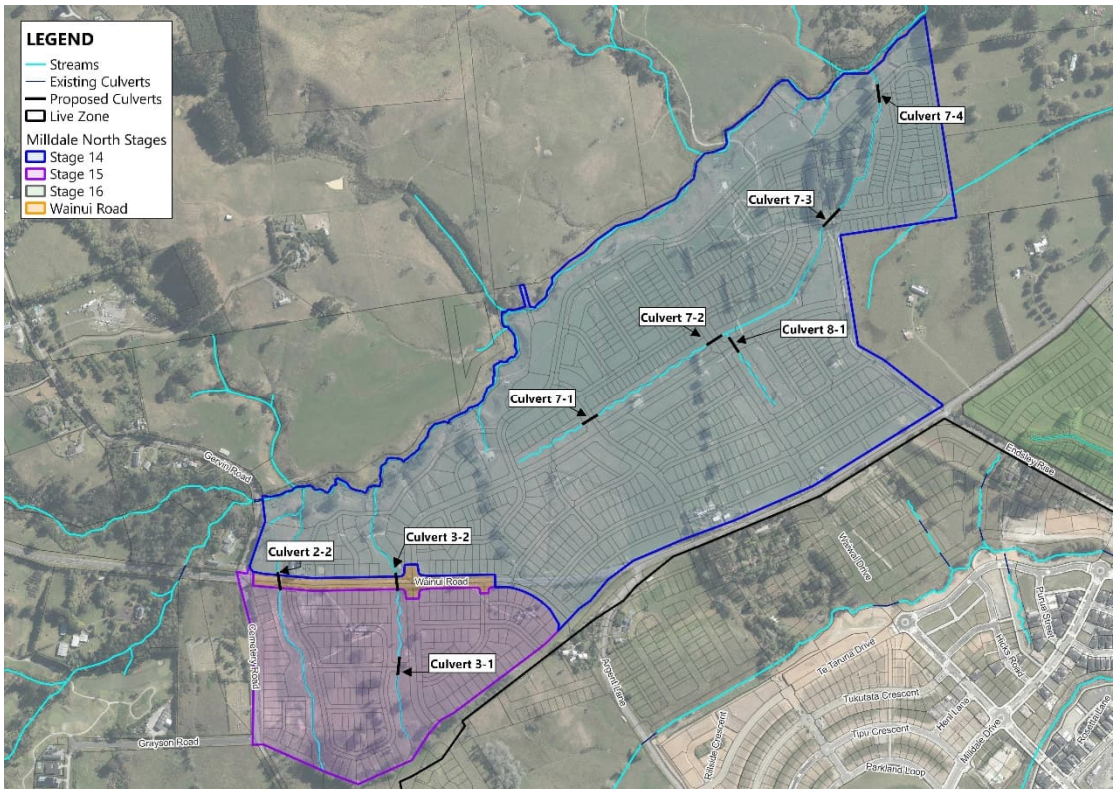

Figure 23: Culvert structures included in Milldale North Stages 14 & 15

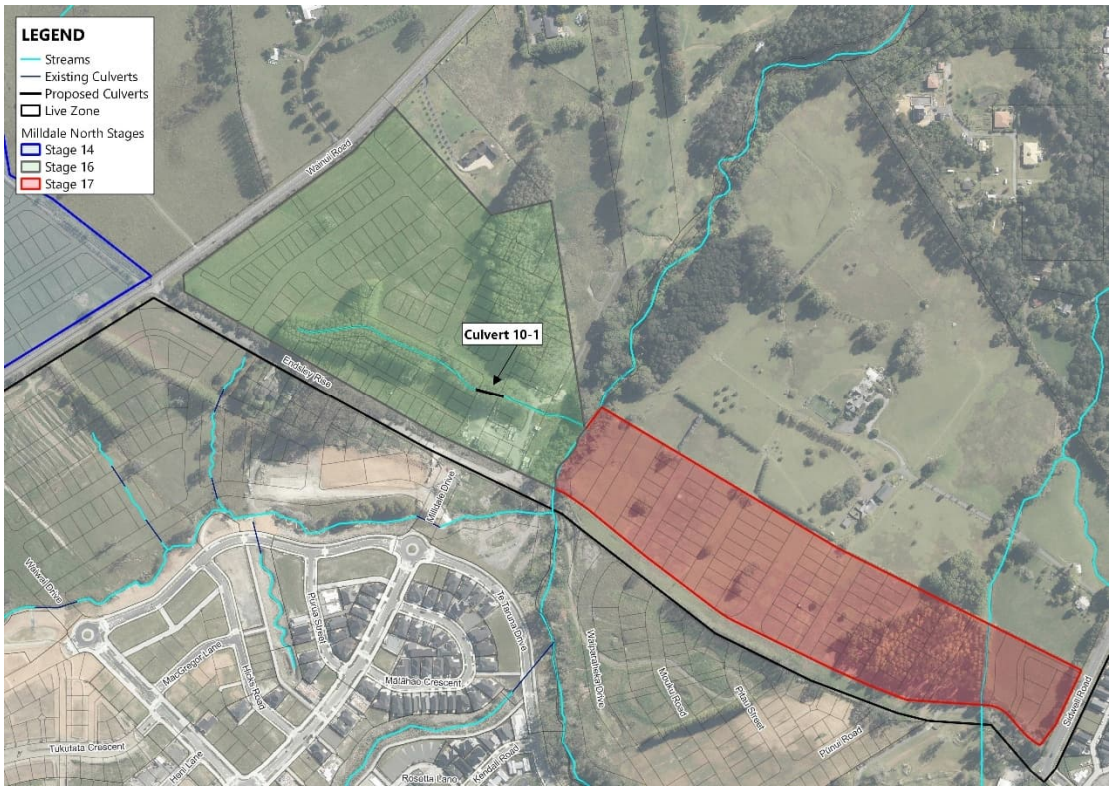

Figure 24: Proposed culverts within Stages 16 & 17

The post-development model results also show that all culvert structures comply with the freeboard requirements stated in the Stormwater Code of Practice (V4) for both 10 and 100-year ARI storm events (inclusive of 3.8°C future climate change) as:

The maximum water level in the culvert does not exceed the soffit level of the pipe during a 10- year ARI storm event (inclusive of 3.8°C future climate change).

The maximum headwater level has a freeboard of 500mm to the top of the edge of seal and maximum headwater depth less than 3m during a 100-year ARI storm event (inclusive of 3.8°C future climate change).

Table 7 and Table 8 provide a summary showing that all proposed culverts within the proposed Milldale Stages 14-17 development at the time of writing are compliant with the freeboard requirements stated in the Stormwater Code of Practice (V4) for both 10- and 100-year ARI storm events (inclusive of 3.8°C future climate change). For those culverts whose approach velocities exceed 2m/s (2-2 and 3-1), the velocity head multiplied by 1.5 (SW CoP 4.3.9.8 c) is less than the freeboard hence the design is compliant. It is further noted that each of the culverts have a cross-sectional area less than 3.4m^2 (the largest 1.95m dia.: area = 3m^2) thus assessment under NZTA Bridge Manual (SP/M/022) has not been considered.

Final engineering design for all proposed structures within the proposed Milldale Stages 14-17 development will be completed during the detailed design phase.

Table 7: 10-year ARI (3.8°C climate change) SWCOP v4 culvert compliance summary

Milldale Stages 14-17				
Culvert #	Diameter (mm)	Soffit level (m RL)	Headwater level (m RL)	Compliance Status
Culvert 2-2	1600	23.92	23.20	Compliant
Culvert 3-1	1050	37.54	36.88	Compliant
Culvert 3-2	1200	28.49	27.55	Compliant
Culvert 7-1	1500	22.49	21.47	Compliant
Culvert 7-2	1500	20.66	19.80	Compliant
Culvert 8-1	1050	20.80	19.90	Compliant
Culvert 7-3	1950	19.22	18.12	Compliant
Culvert 7-4	1950	13.67	13.41	Compliant
Culvert 10-1	1500	14.05	12.82	Compliant

Table 8: 100-year ARI (3.8°C) SWCOP v4 culvert compliance summary

	Milldale Stages 14-17						
Culvert #	Diameter (mm)	Headwater level (m RL)	Headwater depth (m)	Top of embankment (m RL)	Freeboard (m)	Velocity Head*1.5 < Freeboard	Compliance Status
Culvert 2-2	1600	23.99	1.67	26.6	2.62	Yes	Compliant
Culvert 3-1	1050	36.86	0.37	40.3	3.41	Yes	Compliant
Culvert 3-2	1200	28.00	0.71	30.3	2.30	Yes	Compliant
Culvert 7-1	1500	22.27	1.28	24.3	2.04	Yes	Compliant
Culvert 7-2	1500	21.21	2.05	22.3	1.08	Yes	Compliant
Culvert 8-1	1050	20.44	0.69	22.8	2.38	Yes	Compliant
Culvert 7-3	1950	19.73	2.46	21.2	1.48	Yes	Compliant
Culvert 7-4	1950	14.88	3.16	17.3	2.46	Yes	Compliant
Culvert 10-1	1500	12.97	0.39	40.9	2.99	Yes	Compliant

8.3.3. Culvert Blockage Assessment

Culverts proposed as part of Milldale Stages 14-17 development are required to be assessed assuming blockage as per the Stormwater Code of Practice (V4). The culverts blockage assessment criteria are as follow:

- For culverts less than DN1500 diameter, there should be a blockage allowance of 100%

- For culverts greater than or equal to DN1500, there should be a blockage allowance of 50%.

The post-development culvert blockage model scenario flood depth results for 100-year ARI (with allowance for 3.8°C future climate change) is shown in Figure 25. It is noted that the flood depth model results are filtered by 50 mm (consistent with the Wainui East SMP, Woods, 2016).

The post-development culvert blockage model scenario assumed all the proposed culverts within the proposed Milldale Stages 14-17 development to be fully or partially blocked.

The culvert blockage assessment aims to demonstrate resilience for proposed infrastructure in an event of blockage. This is not considered to be suitable for assessing flood effects (if any) on areas upstream, downstream and within the Site.

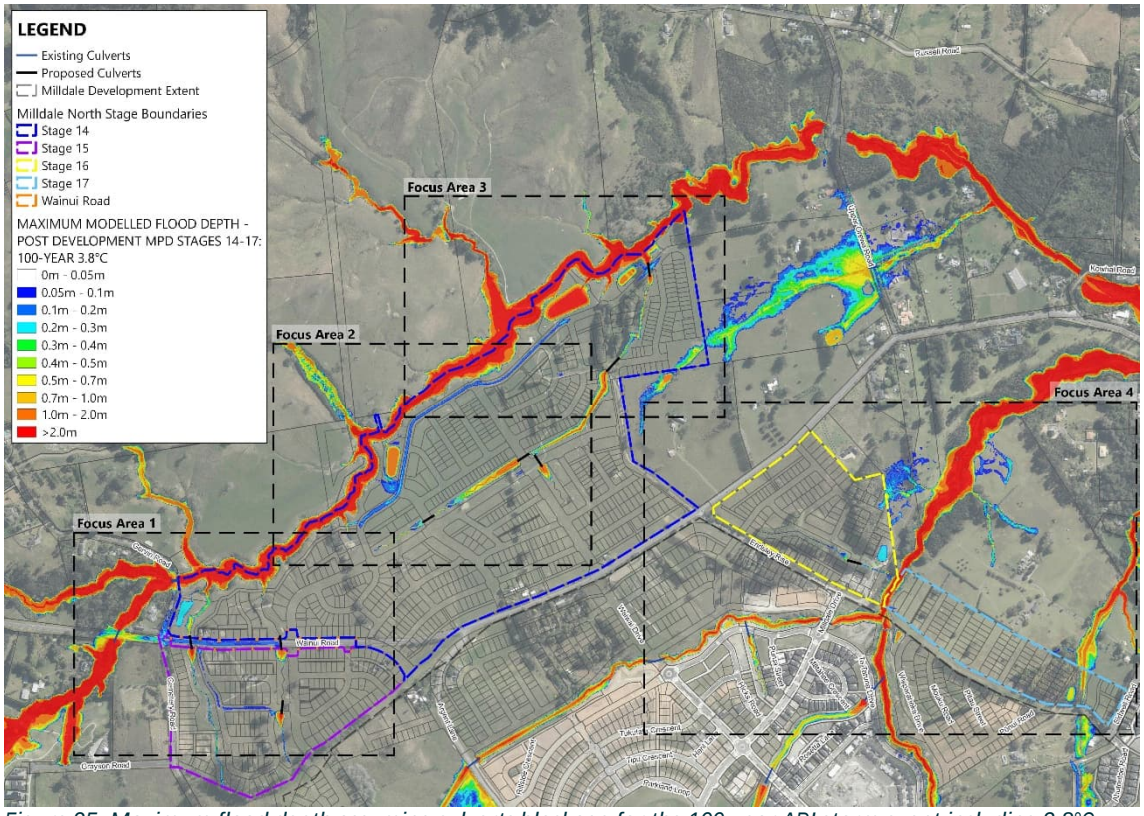

Figure 25: Maximum flood depth assuming culverts blockage for the 100-year ARI storm event including 3.8°C climate change

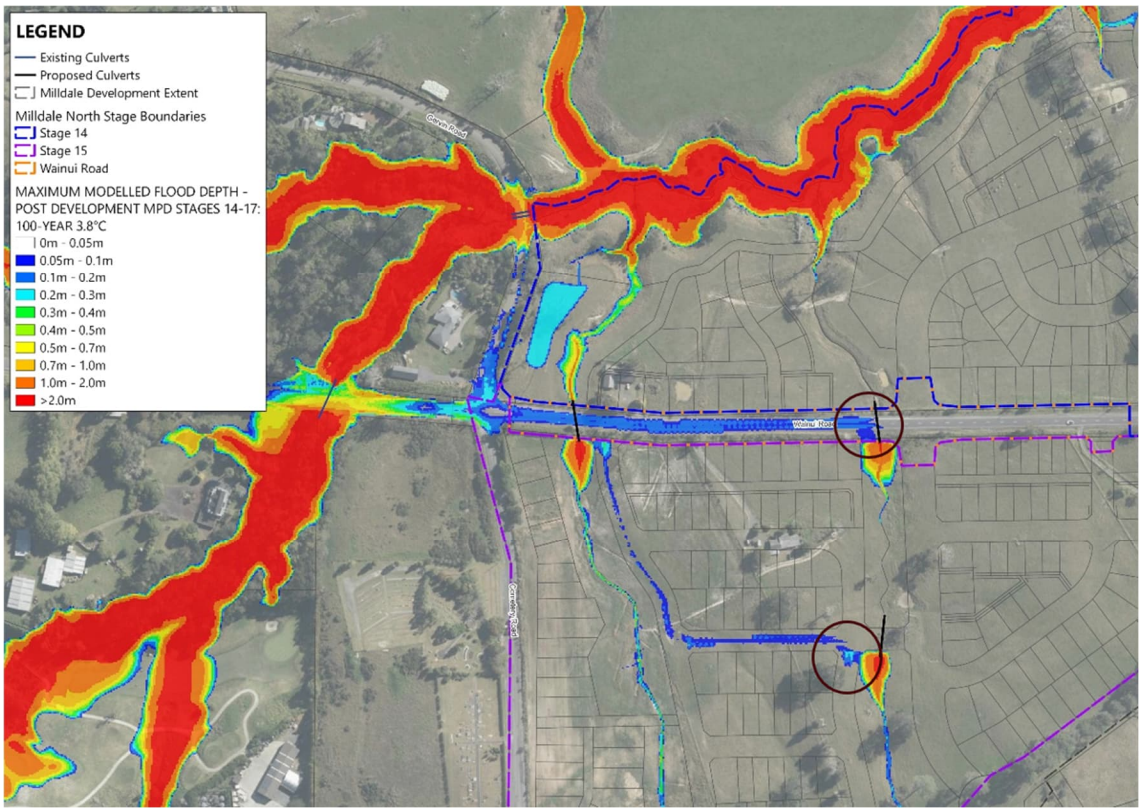

Figure 26: Maximum flood depth assuming culverts blockage for the 100-year ARI storm event including 3.8°C climate change (Focus Area 1)

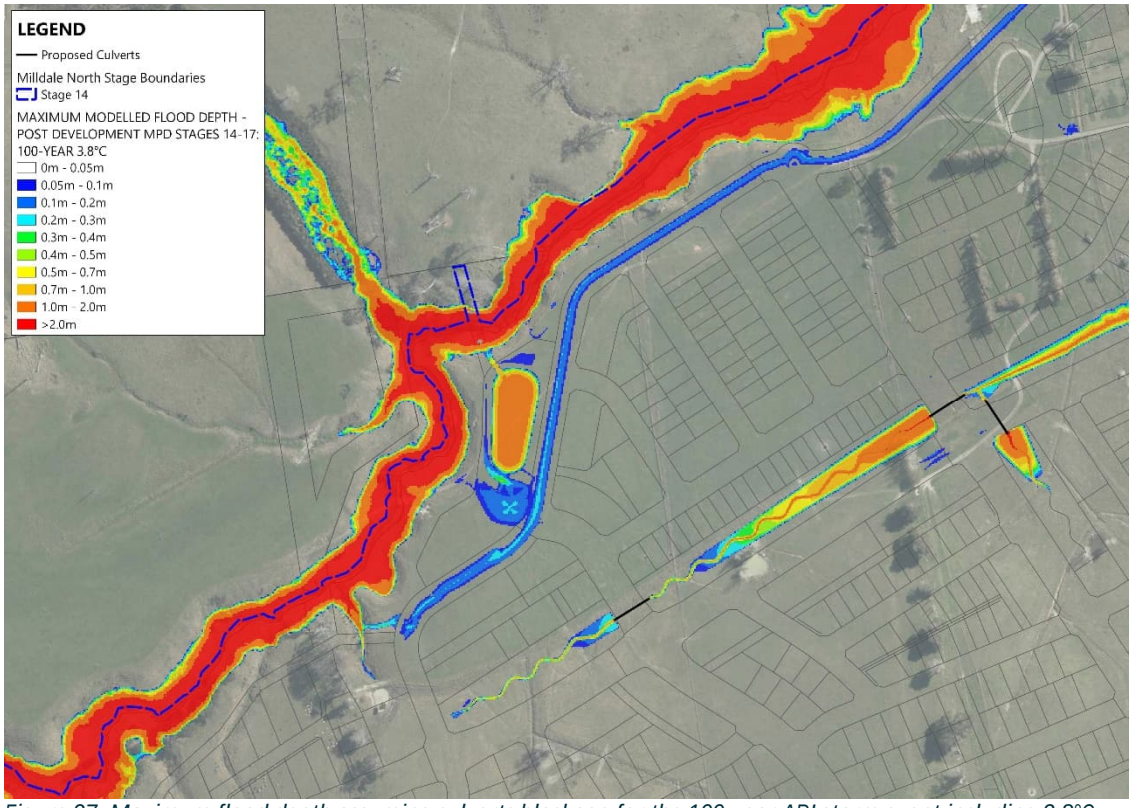

Figure 27: Maximum flood depth assuming culverts blockage for the 100-year ARI storm event including 3.8°C climate change (Focus Area 2)

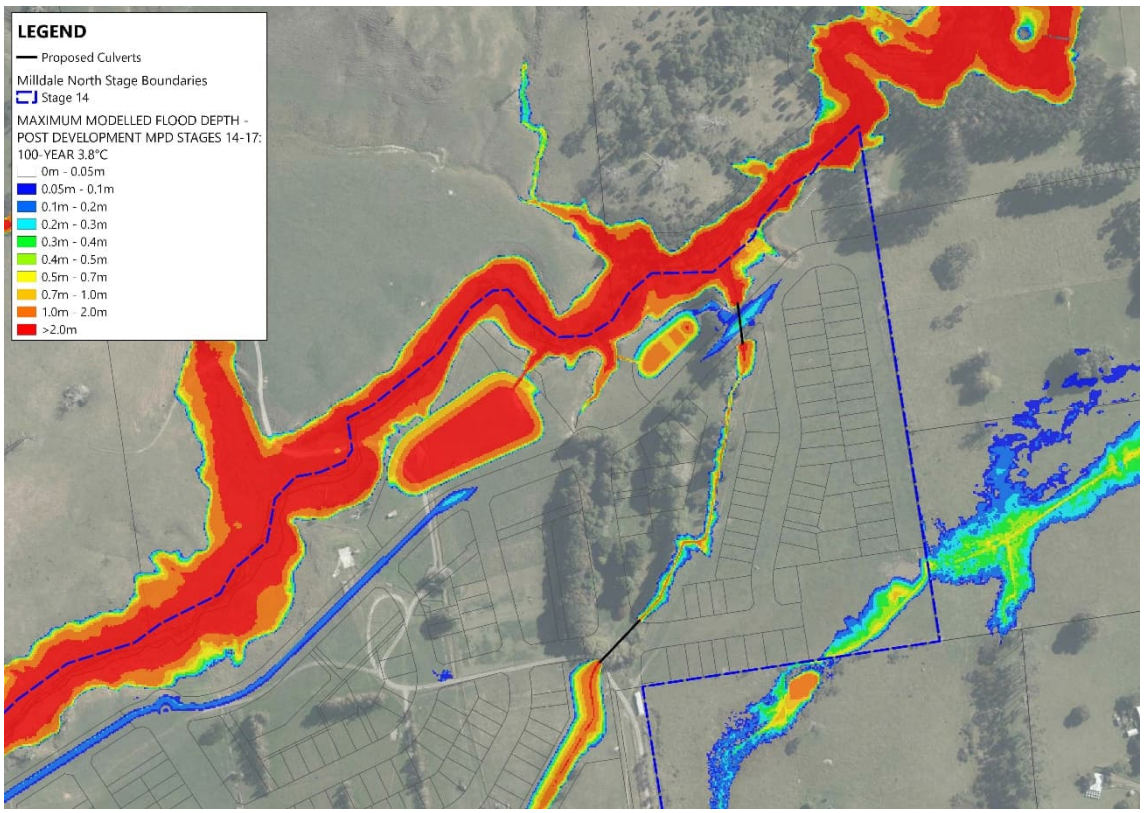

Figure 28: Maximum flood depth assuming culverts blockage for the 100-year ARI storm event including 3.8°C climate change (Focus Area 3)

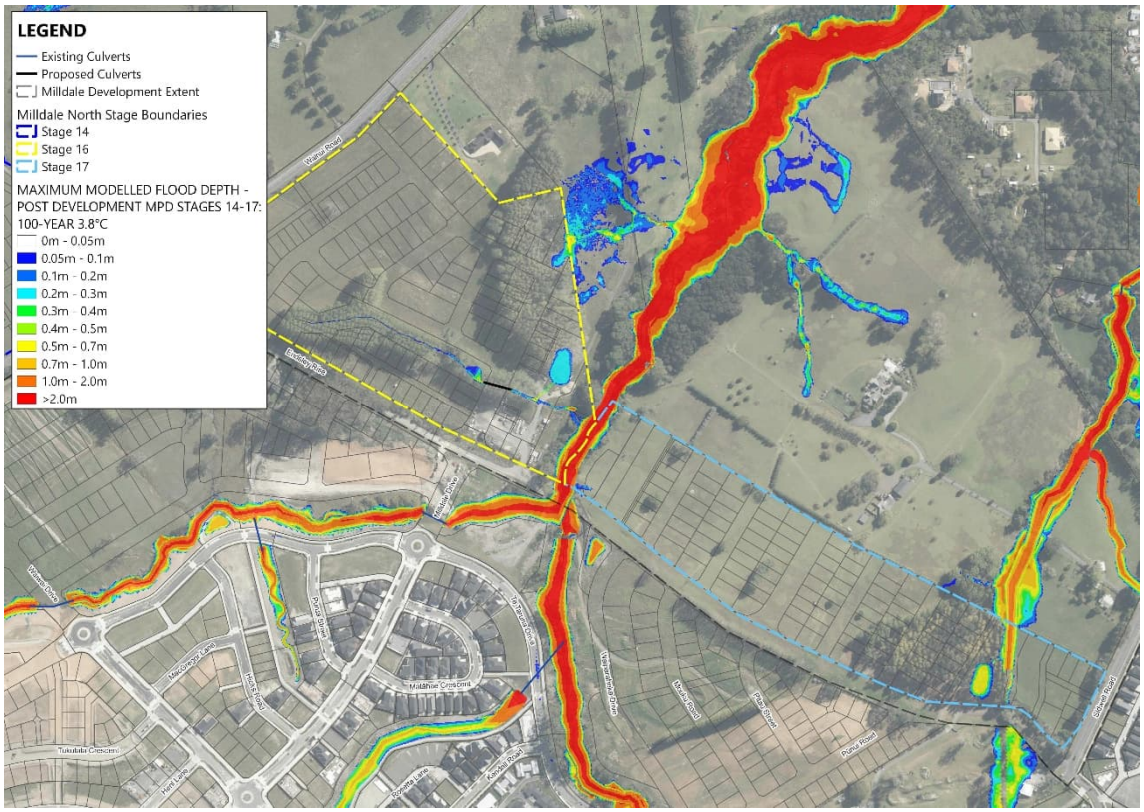

Figure 29: Maximum flood depth assuming culverts blockage for the 100-year ARI storm event including 3.8°C climate change (Focus Area 4)

The culvert blockage assessment shows that:

- There is road overtopping at Culverts 3-1 and 3-2 along Stream 3 (Figure 26) onto a proposed road and Wainui Road respectively. Total blockage of the culverts has been assumed in the modelling which results in the overtopping onto the road corridor. It is noted that the flows remain contained within the road corridors prior to tipping into streams without entering private lots.
- There is no flooding entering the boundaries of the lots within the Milldale Stage 14-17 development during a 100-year ARI storm event including 3.8°C climate change scenario where proposed culverts are assumed to be blocked as per SWCOP (V4).
- No flooding of lots, dwellings or other private property, either upstream or downstream of the Milldale Stages 14-17, has been observed as a function of fully or partially blocked culverts. Under the blockage scenario, the resulting flood extents remain contained within the stream corridors and the road corridors, where they are conveyed as overland flow before discharging back into the streams.

8.4.Dam / Culvert Embankment Review

The SW CoP V4, Section 4.3.9.8 (a) requires for culvert embankments to be reviewed under the context of the Building Act 2004 or the Building (Dam Safety) regulations 2022, to determine whether they might be considered as dam. The Building Act 2004, defines a dam as an

a. artificial barrier, and its appurtenant structures that
    i. Is constructed to hold back water or other fluid under constant pressure so as to form a reservoir and
    ii. Is used for storage, control, or diversion of water or other fluid
b. Includes
    i. A flood control dam; and
    ii. A natural feature that has been significantly modified to function as a dam; and
    iii. A canal
c. Does not include a stopbank designed to control floodwaters

Further to the purposes of the Act, a classifiable dam means a dam that has a height of 4 or more meters and stores 20,000 or cubic meters of water or other fluid.

Based on the initial design, the embankments for Culverts 2-2 and 7-4 exceed the 4m threshold for dam classification. In the unlikely scenario where either of these culverts are fully blocked, the upstream pools that form are significantly less than the 20,000m^3 threshold for dam classification (1200m^3 for Culvert 2-2 and 2200m^3 for Culvert 7-4).

Given that these culverts are not intently designed for storage/to hold back water (if storage formed would be << 20,000m^3) and will not technically function as dams, the legislative definitions are not applicable i.e., do not meet the criteria for such a characterisation thus this assessment is not considered necessary.

8.5.Revised TP108 Sensitivity Assessment

An additional scenario was modelled with the revised TP108 rainfall distribution. As this revised distribution is currently a draft guidance out for public consultation and has not been adopted as Auckland Council policy, it was not an operative requirement for this application at the time of preparation. The design of the development is based on the currently operative Stormwater Code of Practice (V4) and TP108. Scenario 8 has therefore been undertaken purely from a resilience perspective,

to demonstrate that the development and its proposed infrastructure remain resilient should the revised rainfall temporal pattern subsequently be adopted.

The revised TP108 rainfall depth for the Milldale Stage 14-17 site is summarised in Table 9.

Table 9: Revised TP108 rainfall for the 100yr ARI event

Scenario	Rainfall Depth (mm)	Rainfall Depth + Climate Change Allowance (mm)
100-year Currently Operative TP108	225	298.58
100-year Revised TP108	260	345.02

Maximum flood depth results for the revised TP108 post development 100-year 3.8°C scenario are included in Figure 30.

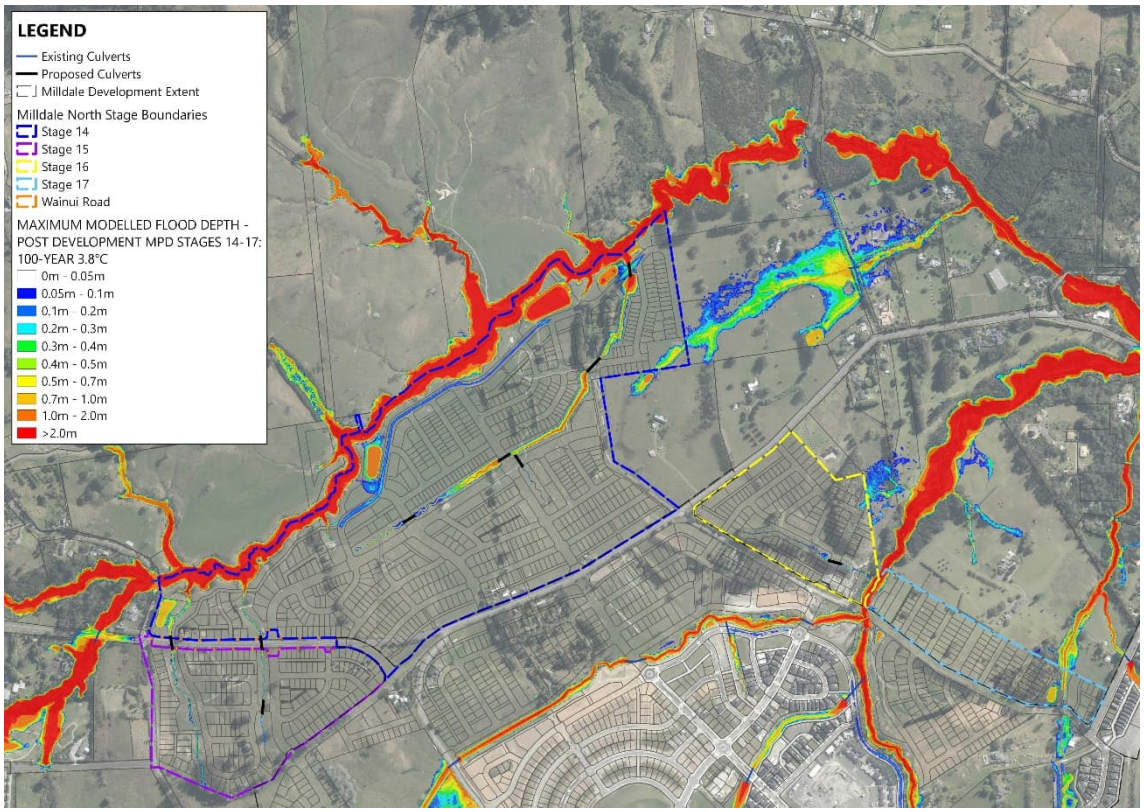

Figure 30: Post-development scenario model flood depth results (Revised TP108 100-year ARI event including 3.8°C climate change)

The results for the revised TP018 post-development 100-year 3.8°C scenario result indicate that:

- Flooding within the site is contained within the road reserves and stream corridors
- The proposed roads have capacity to convey flows from runoff generated from the catchments within the development

9.0 Stormwater management

This section presents the proposed stormwater management approach for Milldale Stages 14-17, developed to align with the Milldale North and Wainui West SMP (V7) and meet the objectives and design requirements of the regionwide NDC Schedule 4 and the AUP. It covers the proposed stormwater discharge, water-quality and hydrological-mitigation requirements; flood management is covered in Section 7.0.

9.1. Principles of stormwater management

The integrated stormwater management approach is consistent with the guidance and planning context in Section 4 and the AUP policies on integrated stormwater management and the regionwide NDC. The objective is to implement the best practicable option for stormwater management, including enabling well-functioning urban environments; improving and maintaining the health of water bodies and freshwater ecosystems; maintaining the extent of natural inland wetlands; minimising the generation and discharge of contaminants; minimising or mitigating changes in hydrology including loss of infiltration; providing for the management of gross stormwater pollutants; and ensuring upstream and downstream flood effects are no more than minor.

9.2. Water quality

Water quality treatment is proposed for all impervious areas (with a BPO applied for roof areas) to GD01/TP10 treatment levels. This is an increase on the currently adopted SMP (Version 4), under which treatment was only required for high-use roads (>5,000 vehicles per day) and high-contaminant-generating areas. At-source raingardens on public roads were considered but are not feasible, as Auckland Transport has been averse to accepting numerous small raingardens with high maintenance and low performance. Large communal raingarden/bioretention devices and wetlands have been identified as the most appropriate means of meeting the treatment requirement, as there is sufficient space within the Structure Plan to incorporate them at the downstream end of each sub-catchment, and an acceptable number of units can cater for the development.

All new roof areas are proposed to be constructed of low contaminant roofing materials (i.e. materials that do not leach contaminants such as copper, zinc or treated timber). In accordance with TR2013/035, the contaminants of concern for roofs are metals and temperature; with inert roofing materials and re-use tanks providing retention (which removes first flush content from system). This represents a best practicable option (BPO) that meets Schedule 2 objectives and outcomes and applies an integrated stormwater management approach. It is noted that as a requirement for hydrology mitigation (to be discussed in the next section), the lot tanks will also provide a detention function prior to the runoff entering the network and flowing out to communal treatment devices.

Treatment for hardstands, JOALs and some of the public roads will be achieved either by communal wetlands or communal bioretention devices (sizing strategy discussed below). Given that the overflow from the lot tanks is conveyed by the primary network, these downstream communal devices provide the added benefit of further treatment. System function strategy and performance are discussed below.

Treatment volumes for the wetlands are sized based on the 90th percentile rainfall event – a 26.5mm, 24-hour event – applied to the contributing impervious areas (excluding the roofs). Given that hydrology mitigation is to be provided within the same devices, the water-quality volume has been halved for design purposes in accordance with GD01, on the basis that the extended residence time associated with the detention volume provides the settling time necessary to achieve treatment.

The public pipe network upstream of each device includes a flow diversion chamber sized to divert the equivalent of the water-quality volume and the detention volume generated by the road and hardstand areas, to the device. Flows that exceed this threshold i.e., those generated by larger events, will bypass the device and discharge directly to the stream.

A long-term continuous simulation (1-year run) for this arrangement was undertaken using a HEC-HMS model. The model showed that approximately two-thirds of annual catchment runoff gets diverted to the device. This translates to first flush flows (which carry the greatest contaminant load) from the catchment being conveyed to the devices and allowing for treatment to be provided. A detailed summary of this strategy is provided in Section 9.4.

It is noted that a small number of roads will be treated via bioretention devices. These devices will only receive runoff from specific roads via dedicated networks i.e., no runoff from lots will be routed through these devices (in contrast to the wetlands which use common networks). Bypass scruffy dome manholes for larger events (greater than detention requirements) will be located within the devices. As shall be discussed below, some of the devices will have an allowance for stream recharge.

9.3. Stream hydrology

Milldale Stages 14-17 is not located within a Stormwater Management Area – Flow (SMAF) overlay. However, hydrology mitigation is proposed for all impervious areas, consistent with the Milldale North and Wainui West SMP (Version 7), to mitigate the increased runoff associated with the development. The development will provide detention of the 95th percentile rainfall event – a 37mm, 24-hour rainfall event – discharged over 24 hours coupled with retention of at least 5mm of rainfall depth (roofs only) as outlined below.

For private hardstands/driveway areas and most of the public roads, hydrology mitigation will be provided by the wetlands. It is noted that wetlands do not perform a significant retention function as water loss in them is relatively insignificant thus as per GD01, retention considerations are not included and the retention volume has been included in the detention requirements. Preliminary modelling of the design event indicates that live storage within the wetland returns to permanent water level over a period exceeding 24 hours, satisfying the drawdown requirement for hydrology mitigation and providing a residence time favourable to treatment. This is discussed in more detail in Section 9.4.

Other public roads not managed by wetlands will be routed through bioretention devices. Where geotechnical conditions are suitable, i.e., minimum infiltration rates of 2mm/hr, the retention portion will be achieved in this manner otherwise the retention volume will be included in the detention volume and released over 24-hours. Site-specific infiltration testing has not been undertaken at this stage given the size of the area; the neighbouring Milldale live zone has demonstrated that infiltration rates do not support infiltration. Specific infiltration testing will be conducted as part of the detailed design phase to confirm if designing for retention is possible.

It is noted that at specific areas (starting locations to Streams 4, 7, 8 and 10) specialised bioretention devices will be installed. As previously mentioned, these devices will have allowance stream recharge i.e., provide baseflows to the respective streams in addition to SMAF mitigation of the connected roads.

A flowchart showing the management is given on Figure 31.

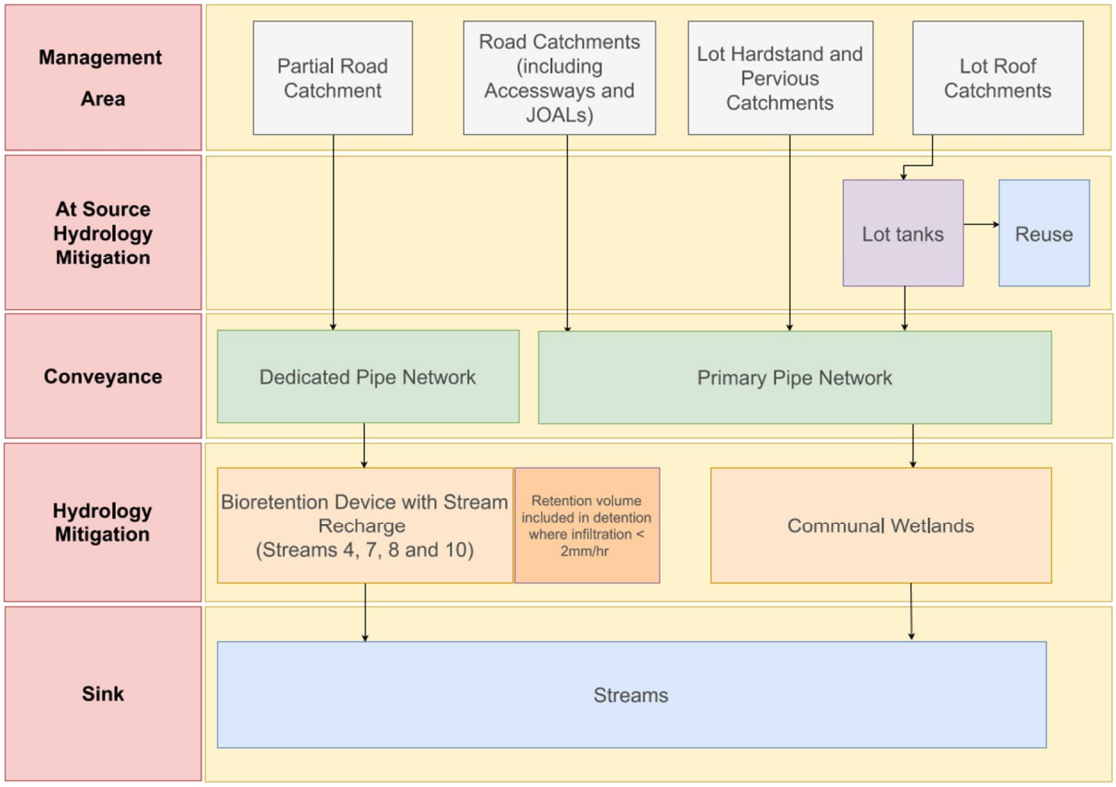

Figure 31: Management flowchart

9.4.Stormwater management devices

9.4.1. Device selection and design background

A range of stormwater-management devices was assessed against the applicable GD01 requirements and the stormwater-management framework for the site. Constructed wetlands, communal bioretention devices, stream-recharge devices and private roof-water re-use tanks were shortlisted.

Individual kerbside and offline raingardens are capable of providing the required treatment and detention but were not preferred, as they would require a large number of small devices with a correspondingly high maintenance burden. Dry basins, underground detention tanks, wet ponds and swales were not shortlisted, as they do not provide the required water-quality treatment or are not preferred on water-temperature, land-availability or maintenance grounds. Constructed wetlands remained the preferred communal device throughout design development, with communal bioretention devices adopted where the land area or topography required for a wetland is constrained.

The wetlands are designed as broad, planted devices with a permanent water depth of up to 1.5m, a live-storage depth of up to 0.8m and a minimum freeboard of 400mm. Inlet treatment is provided by a gross pollutant trap, forebay or similar feature, and the outlet comprises a controlled low-flow orifice together with an overflow structure. The wetlands are anticipated to be unlined, subject to geotechnical confirmation, and allow for a nominal 300mm depth of topsoil to support planting; embankments and surrounding ground levels are designed to prevent external 1% AEP flood flows from entering the permanent-water and live-storage areas. The communal bioretention and stream-recharge devices comprise an inlet arrangement, temporary surface storage, bioretention filter media, underdrainage, a controlled outlet and provision for larger flows to bypass or overflow the treatment area, and do not rely on infiltration unless suitable ground conditions are confirmed at detailed design.

A Stormwater Design Memorandum detailing the strategies adopted is provided in Appendix B.

9.4.2. Device location and preliminary sizing

The consent-level design divides Stages 14–17 into 11 stormwater catchments served by six constructed wetlands (Wetlands A to E and H), two communal bioretention devices (Devices F and G) serving isolated catchments where a constructed wetland is less practical, and three specialised bioretention devices (with stream-recharge) serving the combined Streams 4 and 7, Stream 8 and Stream 10 road catchments. The stream-recharge devices consolidate road-reserve runoff into larger devices at the heads of the retained or realigned streams, consistent with Auckland Transport's preference for integrated devices over numerous kerbside raingardens and are proposed as Auckland Transport assets. Figure 33 and Figure 34 shows the locations of the devices and the preliminary sizing details are summarised in Table 10 (additional details provided in the Stormwater Design Memorandum in Appendix B)

Figure 32: Wetland Locations (Stage 14 &15)

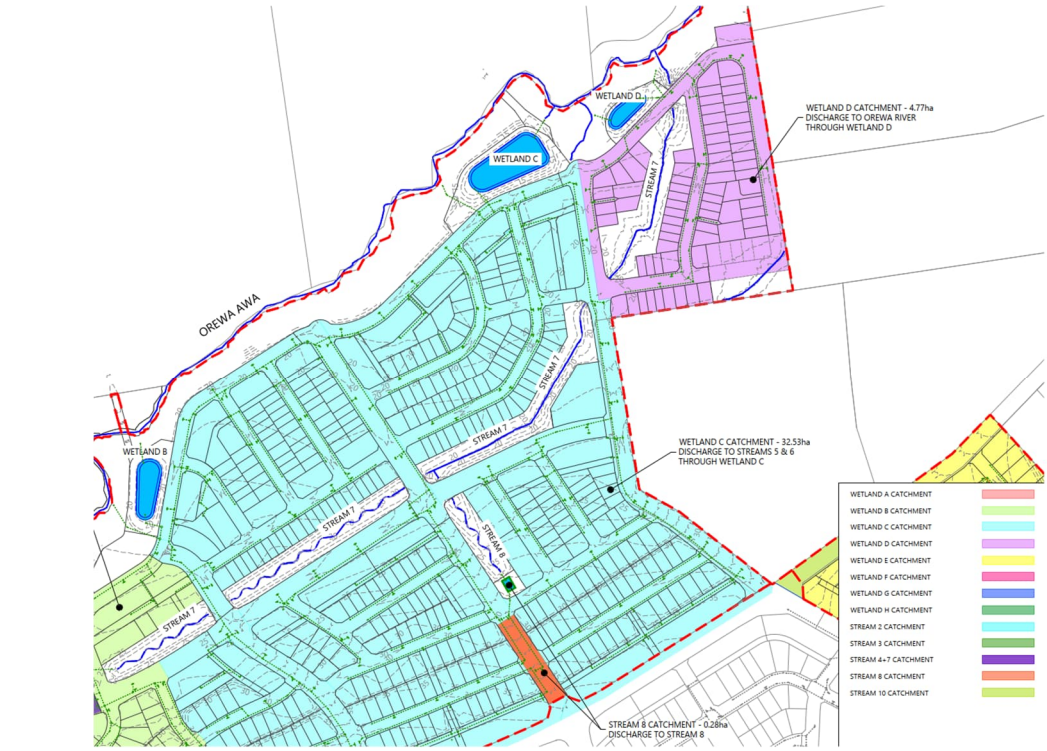

Figure 33: Wetland Locations (Stage 14 &15)

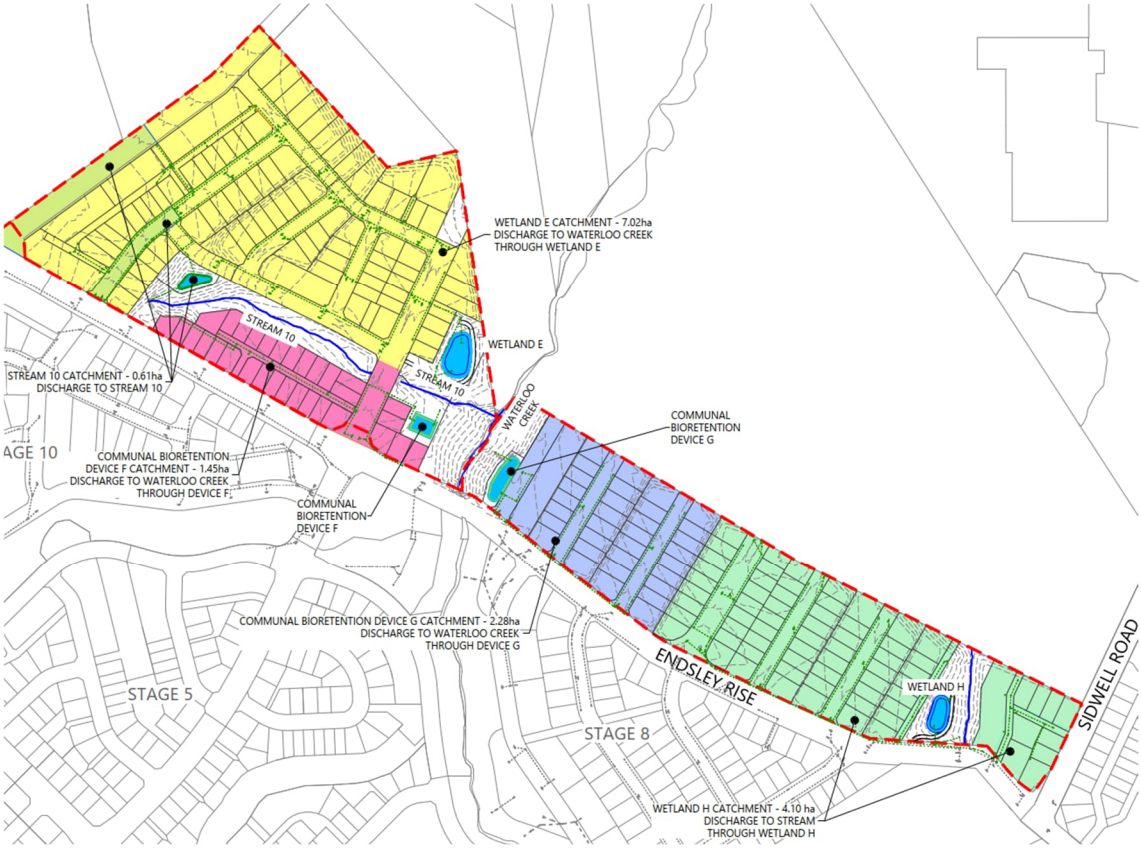

Figure 34:Wetland Locations (Stage 16 &17)

Table 10: Stormwater device sizing Summary – Milldale Stages 14–17

Device / catchment	Contributing area (ha)	Impervious Area (ha)		Required water-quality volume (m³)	Required detention volume (m³)	Receiving environment
		Total	Managed by device			
Wetland A	8.49	6.31	3.61	457	869	Orewa Awa
Wetland B	15.22	11.11	5.24	688	1,257	Orewa Awa
Bio-retention Device (Streams 4 & 7) (Road – Stream Recharge)	1.47	1.18	1.18		282	Streams 4 and 7
Wetland C	32.53	24.15	13.81	1,745	3,315	Orewa Awa
Bio-retention Device (Stream 8) (Road – Stream Recharge)	0.28	0.22			53	Stream 8
Wetland D	4.77	3.53	1.94	247	467	Orewa Awa
Wetland E	7.02	5.14	2.51	328	603	Waterloo Creek
Bio-retention Device (Stream 10) (Road – Stream Recharge)	0.61	0.48	0.48		116	Stream 10
Communal Bioretention Device F	1.45	1.05	0.44		105	Waterloo Creek
Communal Bioretention Device G	2.32	1.69	0.73		175	Waterloo Creek
Wetland H	4.05	2.93	1.21	164	290	Watercourse P3

9.4.3. Treatment plant private bioretention device

Within the Te Korowai o Maraeriki lot it is proposed to construct the potable water and wastewater treatment plants. The combined area of these plants is approximately 2.4 ha of which approximately 50% will be impermeable surface, with the balance being permeable landscaping.

A private bioretention device is proposed to provide water quality treatment and stormwater detention to the flows from this impervious area prior to release to the Orewa Awa. Allowance for this device has been made on the treatment plant site layout plans. The sizing and details of the device will be confirmed as part of the detailed design phase of the treatment plants.

9.4.4. Wetland Device function and performance

The performance of the wetland device has been confirmed by conceptual HEC-HMS modelling.

The model adopts:

- a 10-minute time of concentration,
- SCS curve numbers of 74 (pervious) and 98 (impervious),
- initial abstraction of 5mm (pervious) and 0mm (impervious),
- and the 37mm, 24-hour design storm.

As individual lot layouts are not yet available, the models are simplified:

- all roof areas within a sub-catchment are amalgamated into a single representative sub-basin routed through a single rectangular tank, with an auxiliary outlet at the base of the tank representing use of the retention volume on the lot. The roof tanks will have a bypass pipe and detention drawdown orifice that connects to the public drainage network via the lot connection.
- Lot hardstand runoff and runoff from pervious areas is assumed to discharge directly to the public network via the lot connection.
- The public roading, reserves and private JOALs are also collected into the public drainage network.
- All flows are then taken to a bypass manhole where the low flow is directed to the wetland, while excess flow in larger events bypass the wetland and are discharged directly to the stream.

This design approach is illustrated by Sub catchment A as discussed below.

Sub catchment A

Total impervious area of sub catchment A measures 6.31ha (roofs = 2.7ha and roads & hardstands = 3.62ha).

For roofs the retention and detention volumes are 134m³ and 511m³ respectively which are to be managed at source. For the roads and hardstands, the water quality volume and detention volume are 447 m^3 and 869 m^3 respectively which are to be managed by the wetland.

As previously mentioned, the stormwater network will receive flows from these management areas in addition to overflow and detention drawdown from the roof tanks. In designing the network, the bypass manholes will be designed to ensure as a minimum the WQV plus the detention volume.

Iterative modelling has been undertaken to understand the performance of this system in a range of storm events and the full year 2023 rainfall data has been used as test data. This modelling established that a diversion outlet on the bypass manhole sized to direct the 50% AEP rainfall event to the wetland would be a suitable balance point between protecting the wetland from overloading in large events, and treating the maximum possible volume of water. In this design event the wetland receives approximately 80% of the annual catchment runoff, with the balance being discharged directly to the stream.

At the wetland, sizing of the outflow structure is based on achieving discharge of the WQV over a minimum of 24hrs. The live storage thus drains out over a period exceeding 24 hours (i.e., return to the permanent water level occurs after 48 hours) as shown on Figure 35: Wetland A performance. This also exceeds the 24-hour drawdown time required for hydrology mitigation. The longer residence time of the water column within the wetland body is ideal for achieving treatment. This approach is adopted for all wetlands unless otherwise specified.

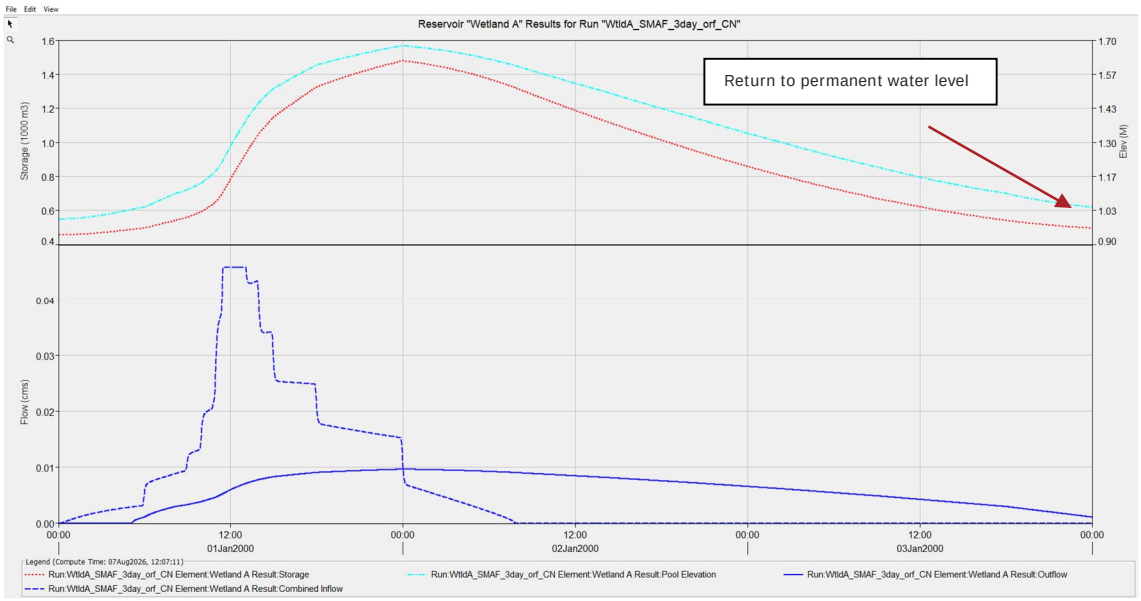

Figure 35: Wetland A performance

9.5.Stream erosion assessment

A stream erosion screening assessment was undertaken to determine whether the proposed development changes erosion behaviour in the receiving streams, whether the proposed riparian setbacks remain adequate, and where bank stabilisation or outlet protection is required to manage any localised increase. This assessment was undertaken for the Orewa Awa (focusing on the Upper Orewa Awa reach) and lower Waterloo Creek. As part of this exercise, walkovers were conducted and erosion modelling completed for the pre and post development scenarios. For this substantive application, the modelling focused on the 100-year ARI event while smaller events will be reviewed as part of the detailed design given that the smaller events are more relevant with respect to design of outlet structures (generally designed for up to 10-year ARI events).

The assessment indicated that under the 100-year predevelopment condition, Orewa Awa will be subject to varying degrees of active erosion mainly along the stream centre with small pockets of rapid erosion at some isolated locations along reach (Figure 36). The most prominent rapid erosion hotspot is noted at the Upper Orewa Road bridge (downstream of the development area) which is consistent with site observations.

In the post development scenario (Figure 38 to Figure 41), it has been observed that the modelled excess shear remains within the same band as the existing situation which implies that the proposed development does not exacerbate erosion within Orewa Awa. Relative to the overall Upper Orewa Awa catchment, the proposed development accounts for small contributions into stream i.e., less than 5%, which does not create detectable changes in depth (refer Figure 12) which in turn does not affect/drive up erosion potential. It has been observed that some erosion is likely along the downstream portion of modified Stream 7 (Figure 41 – focus area 3). Suitable erosion mitigation measures will be provided at this location, designed in accordance with Auckland Council TR2013/018 or other relevant design standards such as HEC14. A suite of potential devices/measures is provided in the attached Stream Erosion Assessment memo (Appendix C).

With respect to the preliminary pipe network outlets along Orewa Awa, the proposed locations have been noted to be areas/spots of low erosion potential (Figure 39 to Figure 41). At the time of detailed design, the pipe network will be modelled which will provide velocity and erosion potential data which will be utilised to design site specific erosion mitigation measures in accordance with Auckland Council

TR2013/018 or other relevant design standards e.g., HEC14. Generally, for pipe outlets, either wing walls or stilling basins/scruffy domes with riprap aprons are utilised.

For Waterloo Creek (main reach), under predevelopment conditions (Figure 36 and Figure 37), the modelling indicates active erosion along the stream adjacent to the development area and extending approximately 250m downstream. Some zones of rapid erosion have also been identified. As part of the development, the portion of Waterloo Creek between Stages 16 and 17 will be modified, where the banks will be reshaped. This results in some slight increases in the erosion potential along this section of the creek in the post development scenario. While this is the case, as part of the construction of these banks, armouring will be provided which will reduce the potential for erosion.

Along the Waterloo Creek tributary to the east, active erosion is observed in both the pre and post development scenarios. Similar to the proposed works along the main reach, the banks of the tributary adjacent to the development site will also be modified and as part of the modification earthworks, armouring will be provided. For all the outlets to Waterloo Creek and its tributary (Figure 42), erosion protection measures (designed in accordance with TR018 or HEC14) will be installed and design details will be provided as part of the detailed design stage.

It should be noted that as part of the stormwater management strategy as described in the preceding section, 95th percentile events for both catchment discharging directly to Orewa Awa (and its tributaries) and Waterloo Creek (and its tributary) will be managed onsite or by communal devices. This strategy ensures that frequent events, which are likely to drive most of the erosion, will be controlled via slow release to the receiving environment.

Overall, the screening assessment concludes that the proposed development does not materially increase erosion potential in the Upper Orewa Awa, where the development contributes less than 5% of catchment flow and modelled excess shear is comparable to existing conditions. Localised increases are predicted along the reshaped banks of Waterloo Creek between Stages 16 and 17 and along the downstream portion of modified Stream 7. In both cases bank armouring and outlet erosion protection designed in accordance with TR2013/018 or HEC14 will be provided, and the proposed riparian setbacks are sufficient to accommodate the predicted erosion behaviour. Residual erosion risk is therefore assessed as low, with the specific measures identified in the Stream Erosion Assessment memo (Appendix C) to be confirmed at detailed design.

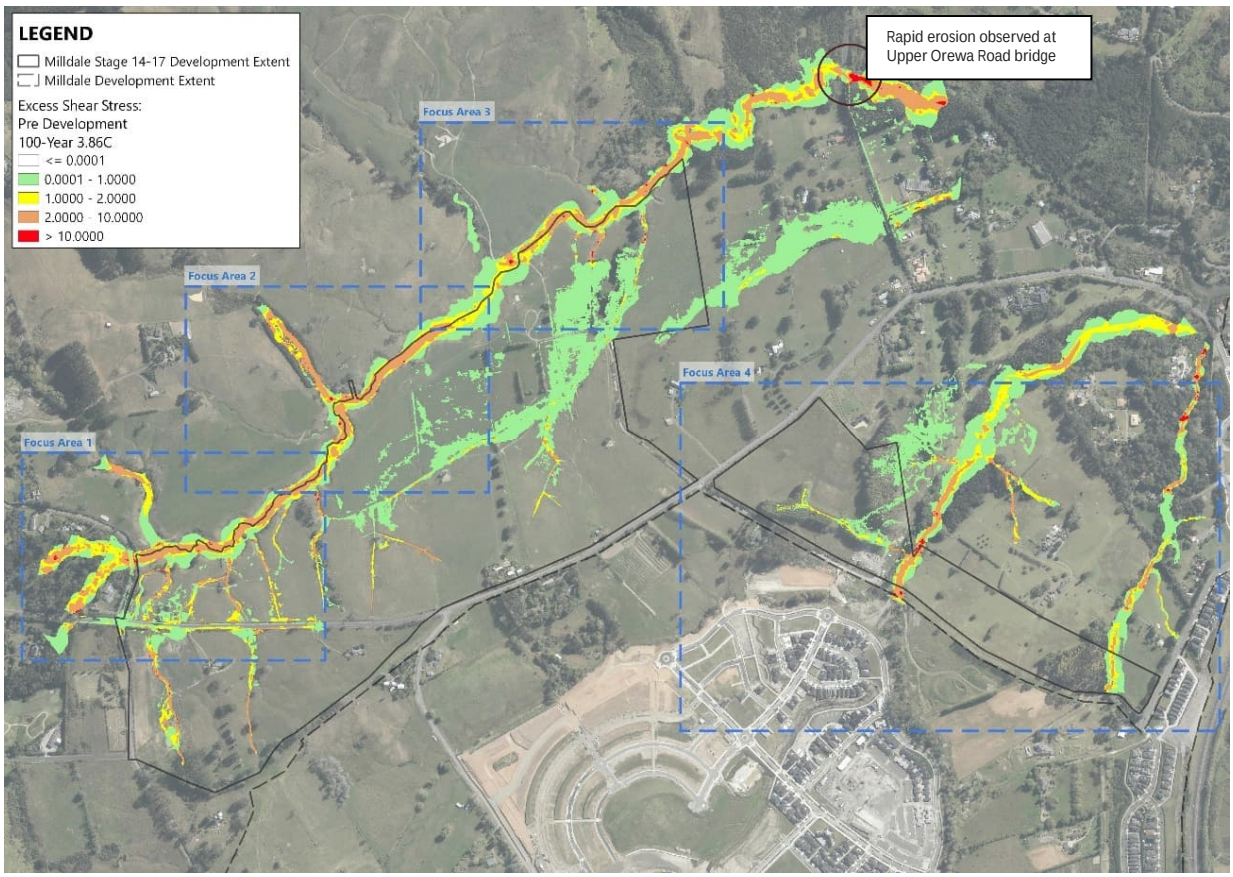

Figure 36: 100-year ARI predevelopment excess shear

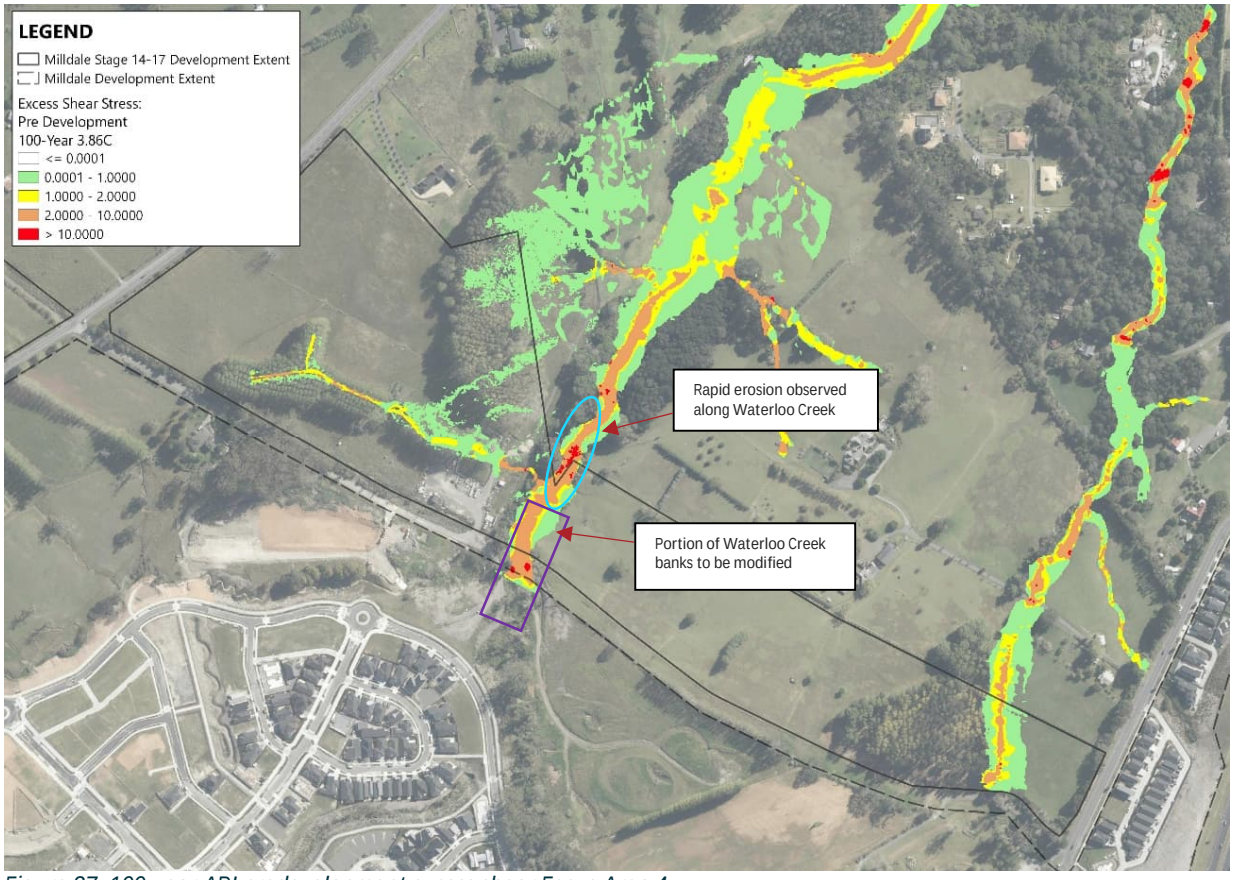

Figure 37: 100-year ARI predevelopment excess shear Focus Area 4

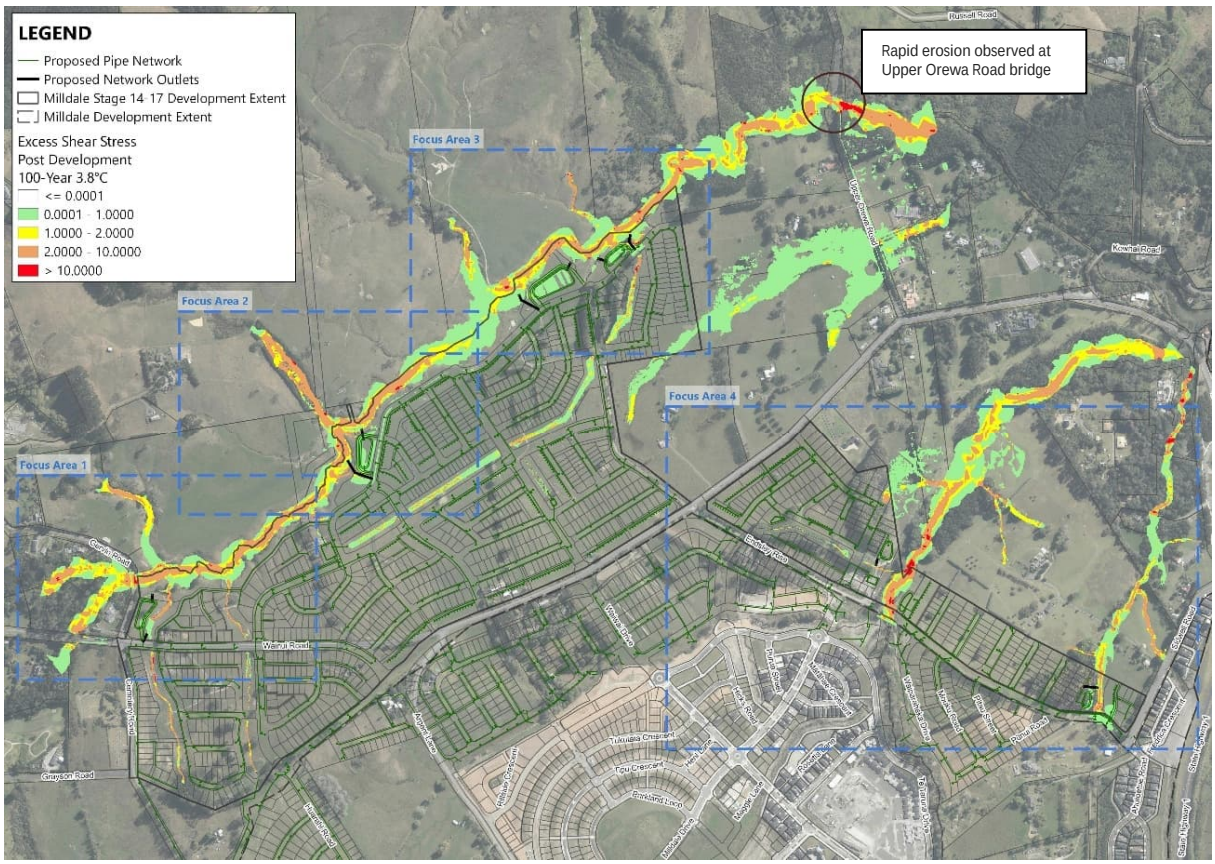

Figure 38: 100-year ARI post development excess shear

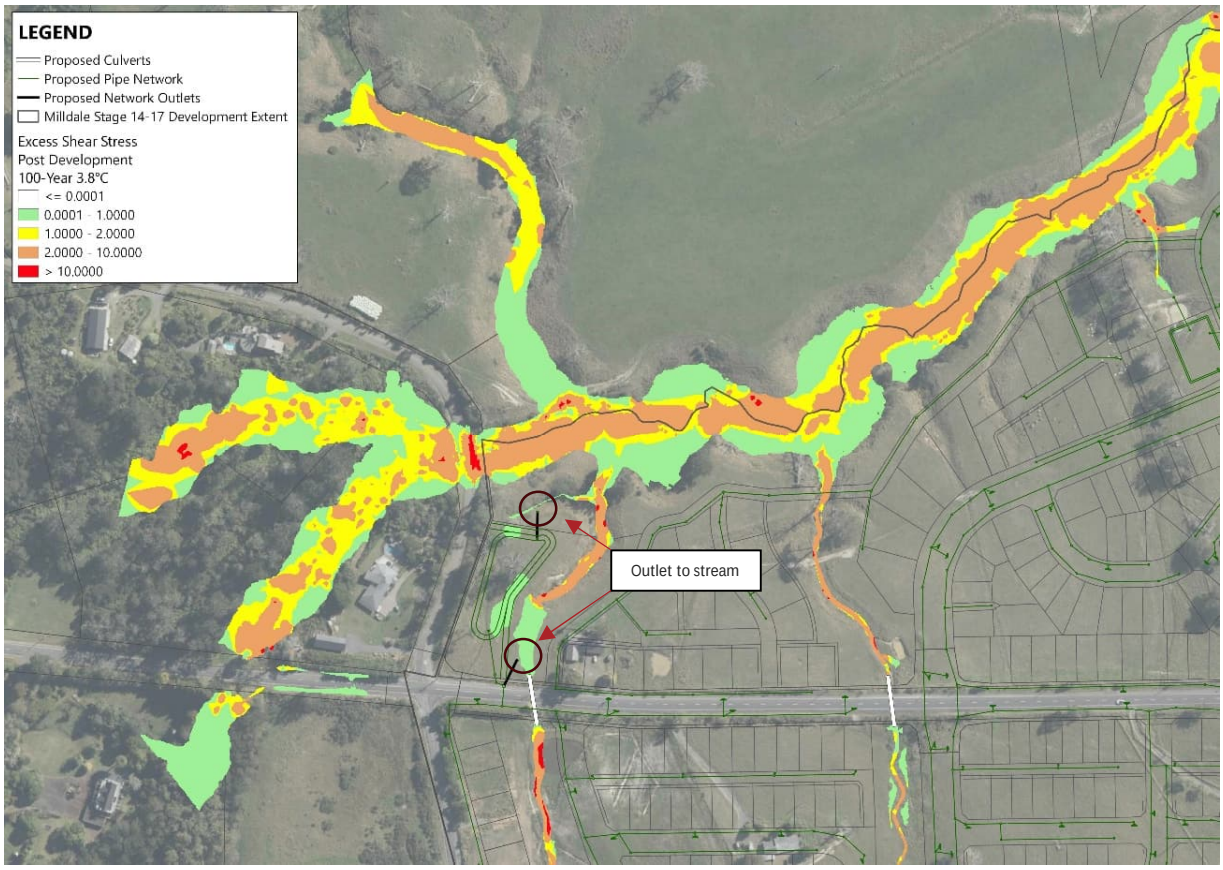

Figure 39: 100-year ARI post development excess shear Focus Area 1

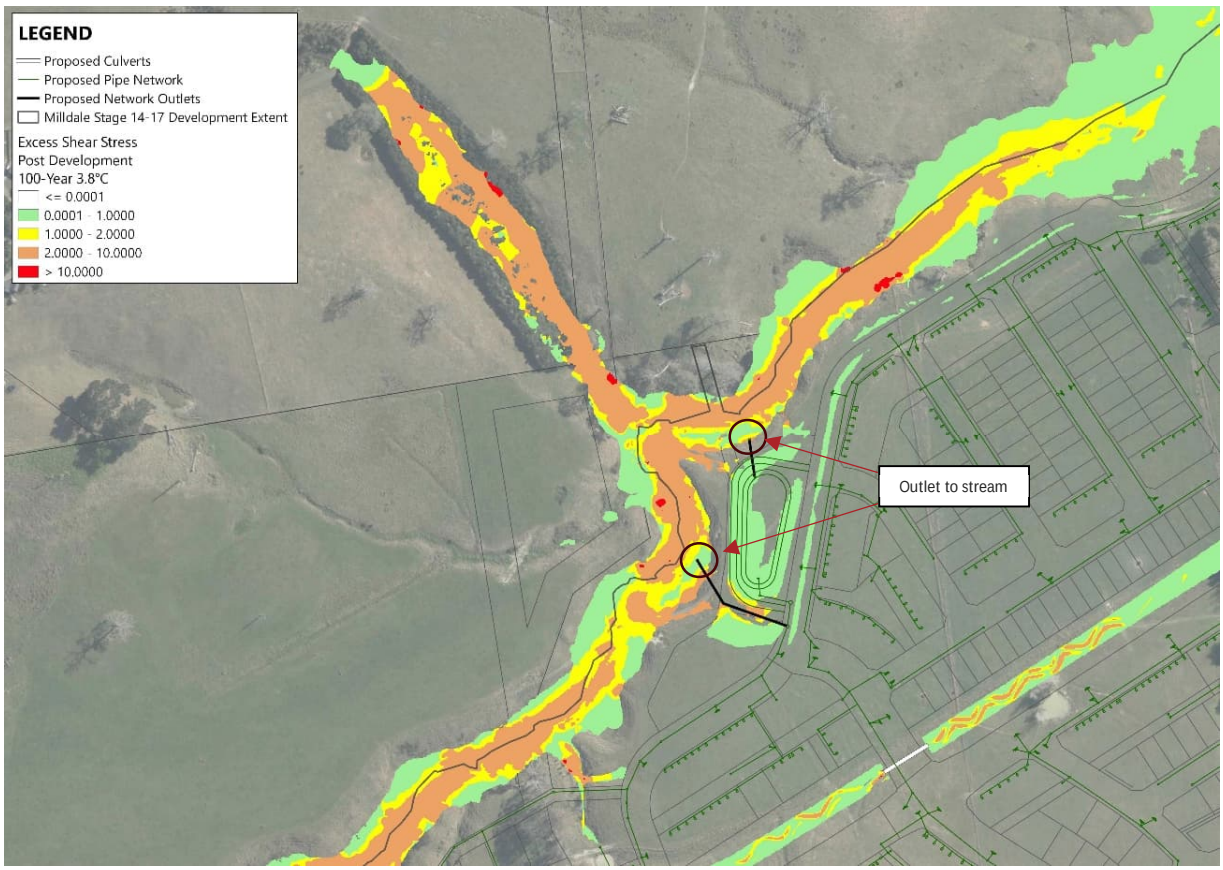

Figure 40: 100-year ARI post development excess shear Focus Area 2

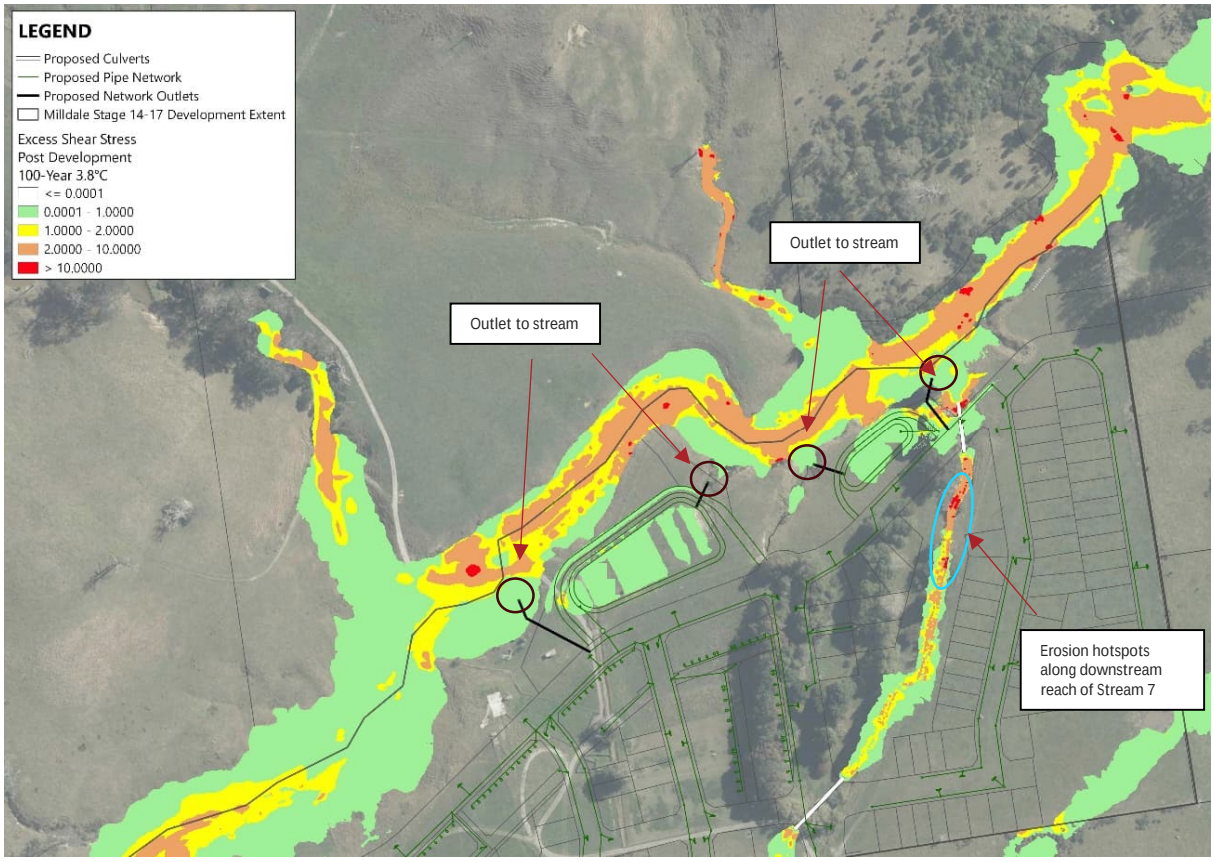

Figure 41: 100-year ARI post development excess shear Focus Area 3

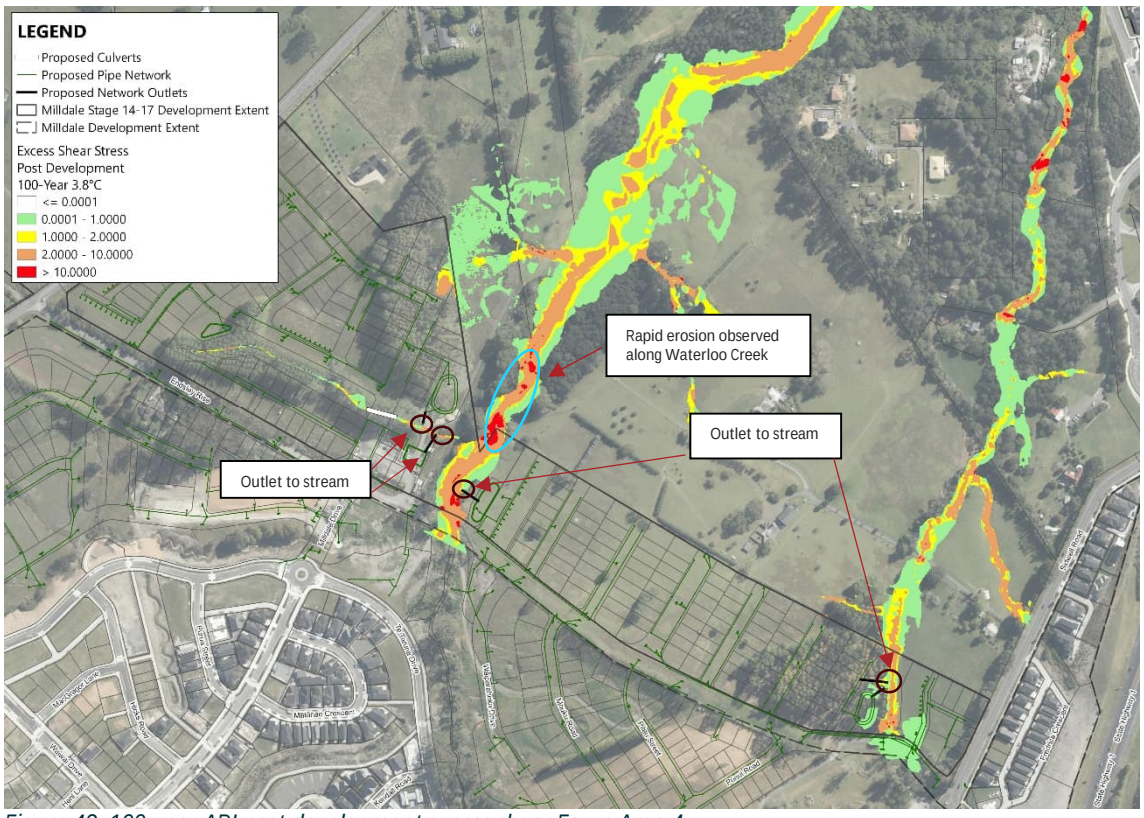

Figure 42: 100-year ARI post development excess shear Focus Area 4

9.6.Flooding 10% AEP event (network capacity)

Primary networks are designed to convey the 10-year ARI event including climate change, in accordance with SWCOP. The primary network within the development comprises a piped network with cesspits for collection and swales (planted or standard).

9.7.Flooding 1% AEP event (habitable floors)

Flooding and habitable floors are to be developed in accordance with SWCOP V4, with adequate freeboard provided. Finished floor levels for the proposed future dwelling will be determined at the dwellings resource-consent stage and subject to freeboard requirement checks at that time.

9.8.Overland flow path and floodplain management

Secondary flows – events greater than a 10-year ARI and up to a 100-year ARI – will be conveyed along the road corridor and conveyance channels as overland flow paths, maintaining existing discharge locations where possible. Overland flow paths will be designed with sufficient capacity for the 100-year ARI event for MPD including 3.8°C climate change, will be unobstructed with safe velocities and depths per the AT TDM and Healthy Waters guidelines, and will meet the design criteria in SWCOP V4.

9.9.Hydraulic connectivity

Primary stormwater runoff is conveyed through the stormwater network, with secondary runoff conveyed through the road corridor and conveyance channels. All impervious areas are routed through stormwater management devices before discharge to the stream receiving environments; secondary runoff and flows in excess of the water-quality storm bypass the devices and discharge directly.

9.10. Asset ownership

The proposed asset ownership is summarised below; the location of devices and confirmation of vesting to Auckland Council or Auckland Transport is to be confirmed.

Table 11: Asset ownership

Management device	Private	Public / communal
Wetlands	-	Auckland Council – Healthy Waters
Communal bioretention device	–	Auckland Council - Healthy Waters/ Auckland Transport
Re-use tanks	Lot owner	–
Private stormwater network	Lot owner	–
Public stormwater network	–	Auckland Council - Healthy Waters/ Auckland Transport

9.11. Ongoing maintenance requirements

Maintenance and operation manuals for the proposed devices are to be provided to Auckland Council for approval as part of the engineering approval application. Publicly vested infrastructure is expected to be maintained by Auckland Council, while maintenance of private treatment devices is the responsibility of future lot owners. Devices are to be maintained in accordance with the maintenance and operation manuals, with the proper maintenance and operation of private devices enforceable under the Stormwater Bylaw 2015.

10.0 National Policy Statement for Natural Hazards 2025

The National Policy Statement for Natural Hazards 2025 (NPS-NH) came into force on 15 January 2026 and applies to this application. It requires natural hazard risks associated with subdivision, use and development to be managed using a risk-based and proportionate approach.

The natural hazards relevant to this stormwater assessment are flooding and coastal inundation. Other natural hazards are addressed elsewhere in the application.

10.1. Relevant policy direction

The objective of the NPS-NH is to ensure that risks to people and property are managed in proportion to the likelihood and consequences of a natural hazard event. Appendix 1 classifies risk as low, medium, high or very high, with medium to very high risk identified as significant natural hazard risk.

In summary, the NPS-NH requires:

- flood risk to be assessed using the prescribed risk matrix (Figure 43);
- management measures to be proportionate to the assessed risk;
- very high risk to be avoided;
- significant risk created or increased on other sites to be avoided or appropriately mitigated;
- decisions to be based on the best available information, including where uncertainty remains; and
- the effects of climate change over a period of at least 100 years to be considered.

The assessment must also account for existing and proposed mitigation measures, residual risk where design thresholds are exceeded, and the location and design of development relative to floodplains and overland flow paths.

Consequence Level	Likelihood Level						
	Almost Certain	Very Likely	Likely	Possible	Unlikely	Rare	Very Rare
ARI (years)	up to 10	10-20	20-50	50-100	100-500	500-5000	> 5000
AEP	10% or more	10% to 5%	5% to 2%	2% to 1%	1% to 0.2%	0.2% to 0.02%	< 0.02%
Catastrophic	Very High	Very High	Very High	High	Medium	Medium	Medium
Major	Very High	Very High	High	High	Medium	Medium	Medium
Moderate	High	High	High	Medium	Medium	Low	Low
Minor	Medium	Medium	Medium	Medium	Low	Low	Low
Negligible	Low	Low	Low	Low	Low	Low	Low

Figure 43: NPS-NH Risk Matrix Framework

10.2. Assessment

Flood risk for Milldale Stages 14–17 has been assessed using a site-specific XP-SWMM 1D/2D model. Eight scenarios were assessed, including pre- and post-development conditions for the 2-, 10- and 100-year ARI events, together with sensitivity testing for culvert blockage and the revised TP108 rainfall distribution. The modelling establishes the frequency, extent, depth and velocity of flooding required to assess the likelihood and consequences of flood events.

The development layout provides the primary means of managing flood risk. Habitable development is located outside the modelled 1% AEP floodplain, with finished floor levels and freeboard provided in

accordance with SWCOP V4. Consequently, the assessed risk to life and property does not reach the very high classification that must be avoided under the NPS-NH.

Residual risk from events exceeding the primary drainage-system capacity is managed through the secondary flow-path network. Roads and dedicated conveyance channels are designed to safely accommodate flows exceeding the 10-year ARI event and up to the 100-year ARI maximum probable development event, including climate-change allowances. The resulting depths and velocities are within the applicable safety criteria in the Auckland Transport Transport Design Manual, Healthy Waters guidance and SWCOP V4.

A pass-flows-forward approach is proposed. Pre- and post-development modelling indicates that predicted changes in flood level beyond the development area are localised and small. Increases are confined to areas where the landform has been modified - the new wetland depressions and the modified tributaries to the Orewa Awa. No habitable or non-habitable buildings are located within the areas of predicted increase, and no flooding is created on land that is not already subject to inundation, so the consequence for third-party land upstream and downstream is minor and the associated risk is assessed as low. Culvert-blockage testing also indicates that the proposed structures will not transfer overtopping risk to surrounding land. Existing floodplains, overland flow paths and discharge locations are retained within the development layout where practicable.

The assessment uses the best available information, including 2024 LiDAR and topographical survey data, Auckland Council flood-model and catchment information, SWCOP V4, and the Ministry for the Environment's 2024 coastal hazards and climate-change guidance. Uncertainty associated with rainfall information and the revised TP108 rainfall distribution has been addressed through sensitivity testing.

Climate-change effects have been incorporated into the modelling using a 3.8°C temperature increase to 2110 and a tidal boundary level of 3.72 m RL, including allowances for sea-level rise and vertical land movement. The assessment therefore considers future changes in both rainfall intensity and coastal water levels over the applicable design horizon.

The proposed stormwater and flood-management approach is consistent with the objective and relevant policies of the NPS-NH. Flood risk has been assessed using site-specific information at a level appropriate to the scale of the development. Habitable development is located outside the 1% AEP floodplain, residual risk is managed through the secondary flow-path network, and climate-change effects have been incorporated. Overall, the residual flood risk to the development and to surrounding land following development is assessed as low, and the proposal will not create or increase significant flood risk on other sites.

11.0 Plan Change 120

Plan Change 120 (PC120) - Housing Intensification and Resilience is a proposed plan change to the Auckland Unitary Plan Operative in Part, publicly notified by Auckland Council on 3 November 2025.

PC120 remains subject to change. Following the Resource Management (Auckland Housing) Amendment Act enacted in April 2026, Auckland Council has approved amendments to PC120 for a further round of public submissions. Submissions will be considered by an Independent Hearings Panel and final decisions are not expected until mid-2027. The provisions therefore carry limited weight at this stage. The direction of the natural hazard provisions is nevertheless relevant, and the stormwater and flood management approach adopted for Milldale Stages 14-17 has been tested against it.

11.1. Relevant objectives and policies

The objectives of Chapter E36 (as amended by PC120) most relevant to stormwater and flooding for this development are:

- Objective E36.2(3B) – new subdivision, use and development avoids significant risk and only occurs when the risk from natural hazards to people, property, infrastructure and the environment is assessed as being tolerable or acceptable;
- Objective E36.2(3C) – subdivision, use and development is managed in a way that avoids creating or exacerbating natural hazard risks on other properties, infrastructure and the environment;
- Objective E36.2(5) – the flood storage and conveyance functions of floodplains and overland flow paths are maintained, and enhanced where practicable, and the creation of new flood prone areas is avoided;
- Objective E36.2(6) – natural features and buffers are used where practicable and nature-based solutions are used in preference to hard protection structures to manage risk from natural hazards;
- Objective E36.2(7) – all natural hazard risk assessments and management measures take into account the potential long-term effects of climate change; and
- Objective E36.2(8) – a precautionary approach is adopted where information is uncertain or incomplete.

Policy E36.3(1B) gives effect to these objectives by requiring land that may be exposed to flooding and coastal inundation to be identified, a site-specific assessment to be undertaken to determine the extent and nature of the hazard.

11.2. Assessment against the PC120 objectives

Milldale Stages 14-17 lies outside an existing urbanised area, so the default risk settings in Table E36.3.1B.2 would apply. Under that table, activities that are sensitive to natural hazards default to a significant risk classification where they are located within a very high, high, medium or low flood hazard area. Based on the site-specific flood modelling, the Site falls within a low flood hazard area. Residential development is an activity sensitive to natural hazards; however, the development has been laid out so that dwellings are located outside the 1% AEP (100-year ARI) floodplain, including the allowance for a 3.8°C temperature increase to 2110. The default significant classification is therefore not engaged for the sensitive activities proposed, and the residual risk to people and property is assessed as acceptable. This is consistent with Objective E36.2(3B).

Flood hazard has been identified and quantified through a site-specific assessment using the XP-SWMM 1D/2D flood model, as required by Policy E36.3(1B) (a). Eight scenarios have been simulated covering pre-

and post-development land use for the 2-, 10- and 100-year ARI events, together with sensitivity runs for culvert blockage and for the revised TP108 rainfall distribution (Section 7.2). The assessment addresses the matters listed in Policy E36.3(3), including hazard scale and frequency, the performance of the development in events more frequent than the 1% AEP event, the proposed mitigation measures, and the residual flood risk.

A pass-flows-forward flood management approach has been adopted, and the modelling demonstrates that the development generally does not increase flood depths, velocities or flood hazard for properties upstream or downstream, and does not create flood risk where none previously existed. The culvert blockage scenario confirms that the proposed structures do not transfer overtopping risk to surrounding land. On this basis the development avoids creating or exacerbating natural hazard risks on other properties, infrastructure and the environment, consistent with Objective E36.2(3C).

The floodplain and existing overland flow paths are retained within the development layout. Secondary flows for events greater than the 10-year ARI and up to the 100-year ARI are conveyed along the road corridor and conveyance channels, maintaining existing discharge locations where possible, with capacity for the 100-year ARI MPD event including 3.8°C climate change, unobstructed alignments, and depths and velocities within the safety limits of the AT Transport Design Manual, Healthy Waters guidance and SWCOP V4. Flood storage and conveyance functions are therefore maintained, and no new flood prone areas are created, consistent with Objective E36.2(5).

Stormwater management relies on wetlands, communal bioretention devices and riparian planting rather than hard protection structures, with treatment and hydrology mitigation provided ahead of discharge to the receiving environment. This use of nature-based solutions and retained natural buffers is consistent with Objective E36.2(6).

All modelled scenarios incorporate a 3.8°C temperature increase to 2110 in accordance with SWCOP V4, and a tidal boundary condition of 3.72 m RL derived from the MfE Coastal Hazards and Climate Change Guidance (2024) including allowances for sea level rise and vertical land movement. The long-term effects of climate change are therefore taken into account in both the risk assessment and the design of the management measures, consistent with Objective E36.2(7).

A conservative approach has been adopted throughout, including maximum probable development impervious coverage, the highest calculated impervious percentage for each catchment, allowance for culvert blockage in accordance with SWCOP V4.

A sensitivity assessment has also been undertaken using the revised TP108 rainfall distribution. That distribution is not operative and was not required for this application; it remains draft guidance currently out for consultation, and the assessment has been undertaken purely from a resilience perspective rather than as an assessment of effects. This precautionary treatment of the areas where information remains subject to change is consistent with Objective E36.2(8).

Overall, the stormwater and flood management approach proposed for Milldale Stages 14-17 is consistent with the direction of the natural hazard objectives and policies introduced by PC120. Should the notified provisions be amended through the submissions and hearings process, the flood assessment set out in this report provides the site-specific information necessary to confirm the risk classification and management response under the framework as finally adopted.

12.0 Departures from regulatory or design codes

The development is to be designed in accordance with Auckland Council and Auckland Transport requirements and meets the relevant regulatory and design-code standards. No departures from the regulatory or design codes are proposed.

13.0 Conclusion

A stormwater assessment has been completed for Milldale Stages 14–17 on behalf of Fulton Hogan Land Development Limited to support the substantive application under the Fast-track Approvals Act 2024.

The assessment demonstrates that the proposed development can be appropriately serviced by the proposed stormwater management system. The system has been developed to give effect to the Wainui East Stormwater Management Plan and to align with the relevant requirements of the Auckland Unitary Plan (Operative in Part) and the Regionwide Stormwater Network Discharge Consent. The residual effects on the receiving environment and flood risk are assessed as being no more than minor.

The principal conclusions are as follows:

- Water quality: Runoff from all impervious surfaces will be treated before discharge. Roof runoff will be managed at source through inert roofing materials and private reuse tanks, while runoff from roads, jointly owned access lots (JOALs) and other hardstand areas will be conveyed to communal treatment devices. The development is divided into 11 stormwater catchments serviced by six constructed wetlands (Wetlands A–E and H), two communal bioretention devices (Devices F and G) and three stream-recharge devices. The proposed treatment approach is consistent with GD01 and the treatment requirements of Schedule 4 of the Network Discharge Consent.
- Stream hydrology: Hydrological mitigation includes retention of the first 5 mm of rainfall from roof areas through reuse tanks across Zones A, B and C. Detention will also be provided within the communal devices serving Zones B and C. Detention is not required in Zone A because it discharges to the tidally influenced reaches of Waterloo Creek and the Orewa Awa.
- Device capacity: The six wetlands, together with the two communal bioretention devices and the three stream-recharge bioretention devices, provide the required water-quality treatment and detention volumes, with surplus storage available in several devices.
- Flood management: Hydraulic modelling of the 2-, 10- and 100-year annual recurrence interval events, incorporating the effects of a 3.8°C climate-change scenario, indicates that post-development flooding will generally be contained within road reserves and stream corridors. Flood extents are generally unchanged or reduced. Where localised increases in predicted flood levels occur, no habitable or non-habitable buildings are affected. The development is not predicted to result in adverse flood effects on third-party land upstream or downstream of the site.
- Stormwater conveyance: The proposed primary stormwater network has been designed to convey the 10-year annual recurrence interval event, including climate change. Assessment of the existing and proposed culverts and bridges indicates that the modelled flows can be accommodated without changing the performance of the structures, subject to the assessment being reviewed against the final rainfall data when available.
- Stream erosion: Erosion modelling undertaken for the Upper Orewa Awa and lower Waterloo Creek during the 100-year annual recurrence interval event indicates that the proposed development does not result in material increase in erosion in Orewa Awa and Waterloo Creek. Where erosion hotspots have been identified within the development extents, appropriately designed mitigation measures will be put in place. With respect to outlets to stream, a detailed analysis will be undertaken as part of the detailed design and the appropriate erosion control measures installed.
- Regulatory alignment: The proposed stormwater management approach is consistent with the relevant direction of the National Policy Statement for Freshwater Management 2020, the National Policy Statement for Natural Hazards 2025 and the natural-hazard objectives and policies notified through Plan Change 120. No departures from the applicable regulatory requirements or design codes are proposed.

Overall, the proposed stormwater and flood-management approach represents the best practicable option for Milldale Stages 14–17.

APPENDIX A – Model Build Report

APPENDIX B – Stormwater Design Memorandum

APPENDIX C – Milldale Stage 14 - 17 Stream Erosion Assessment