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Infrastructure Report

Milldale Stages 14-17 Fast-track
131 Argent Lane, Upper Orewa
Fulton Hogan Land Development Limited
4/08/2026
For Consent

DOCUMENT CONTROL

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STATEMENT OF QUALIFICATIONS AND EXPERIENCE

Originator: Sam Kirk – Associate Engineer

I, Sam Kirk, am an Associate Engineer at Woods. Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since July 2025, although also previously between January 2019 and September 2022.

I hold the qualifications of a Bachelor of Surveying, which I completed in 2018, and I also hold a Cadastral Surveying License. I am also a Voting Member of S+SNZ.

I have eight years of experience in the Engineering industry. My experience includes the design and construction observation of a range of land development projects, including project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved with the surveying, design and management of previous Milldale projects, dating back to Stage 1A. I have also been involved in managing multiple land development projects in London and Melbourne.

I confirm that, in my capacity as the 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.

Reviewer: Tim Rickards - Principal

I, Tim Rickards, am a Principal at Woods. I have been employed at Woods since February 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 project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved in the design and construction of most of the previous stages of Milldale including the surrounding Milldale Stage 4 development and the development of the secondary superlot developments at Milldale.

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

Approval: Jamie Whyte – Principal

I, Jamie Whyte, am a Principal at Wood & Partners Consultants Ltd. Wood & Partners Consultants Ltd is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since January 2004.

I hold the qualifications of a Bachelor of Surveying from the University of Otago (BSurv), which I completed in 2003. I hold a professional qualification as a Registered Professional Surveyor (RPSurv). I am a Full (voting) Member of Survey and Spatial New Zealand.

I have over 20 years of professional experience in Subdivision Engineering and the Land Development industry. I have extensive knowledge in the design, construction and delivery of large-scale land development projects. My experience includes major roles on some of New Zealand's largest subdivision projects including Stonefields, Long Bay, Millwater and Milldale.

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

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APPENDICES

1. INTRODUCTION

1.1. General Proposal

This Infrastructure Report has been prepared by Woods on behalf of Fulton Hogan Land Development Limited (FHLD) (the Applicant) 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 231 ha of land centred around Wainui Road in Wainui, Auckland. The proposal provides for a comprehensively planned extension of Milldale comprising residential neighbourhoods, a supporting commercial area, transport and servicing infrastructure, open space, ecological restoration and associated enabling works.

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

This report addresses the engineering infrastructure associated with the Project, including earthworks and retaining, transport infrastructure, stormwater management, wastewater servicing, water supply, utility services and Safety in Design.

This report should be read alongside the application planning reports and the technical reports and drawings supporting the substantive application.

1.2. Site Description

1.2.1. Site Location

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

The site comprises two distinct areas:

i. **The Development Area** – approximately 97 ha comprising the proposed residential development and the associated subdivision, earthworks and supporting infrastructure; and

ii. **Te Korowai o Maraeariki** – approximately 134 ha north of the Ōrewa Awa, comprising ecological restoration works, recreational tracks and localised private water and wastewater infrastructure if required.

These areas consist of land covered by the following underlying parcels.

Table 1: Underlying Parcel Information

Proposed Staged Development Area	Lot 1 DP 130515
	Lot 2 DP 130515
	Lot 3 DP 130515
	Lot 1 DP 589819
	Lot 4 DP 353309
	Lot 5 DP 198205
	Lot 8 DP 198205
	Lot 9 DP 198205
	Lot 10 DP 198205
	Lot 11 DP 198205
	Lot 12 DP 198205

Te Korowai o Maraeariki	Allot 210 PSH OF Waiwera
	Allot 216 PSH OF Waiwera
	Part Allot 182 PSH OF Waiwera
	Part Allot 73 PSH OF Waiwera
	Part Allot 74 PSH OF Waiwera
	Part Allot 74 PSH OF Waiwera
	Allot 549 PSH OF Waiwera
	Lot 7 DP 198205
	Lot 14 DP 198205

The Development Area is comprised of two non-contiguous areas. Stages 14 and 15 are located between the Ōrewa Awa to the north and the existing Milldale development to the south. Stages 16 and 17 are located further east, immediately north of Endsley Rise and on either side of Waterloo Creek.

Te Korowai o Maraeariki is located north of the Development Area, between the Ōrewa Awa to the south and Upper Ōrewa Road to the north.

A full description of the site and its surroundings is provided in the application AEE. The site location is shown below in Figure 1.

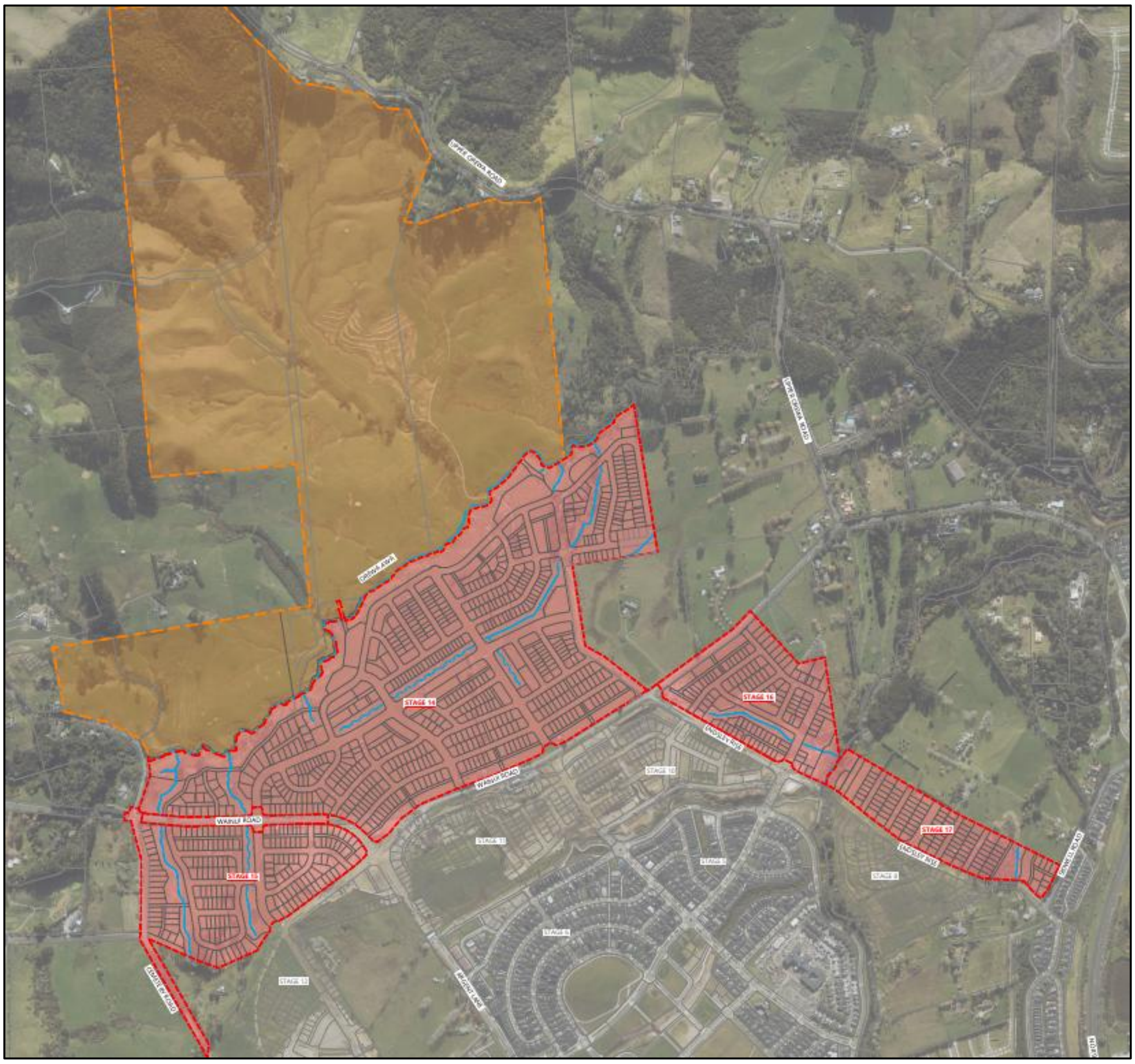


Figure 1: Site Location Overview

1.3. Project Description

FHLD is proposing to develop the site as a medium-density residential extension to the existing Milldale development. The proposal includes residential lots and superlots, one commercial superlot, jointly owned access lots (JOALs), public roads, reserves, landscaping and the supporting infrastructure required to enable and service the development.

Overall, the site covers a total area of approximately 231 ha – 97 ha comprising the Development Area and 134 ha Te Korowai o Maraeariki.

The proposed Stages 14–17 will comprise seventeen residential sub-stages, being: Stages 14A–14J, 15A–15C, 16A–16B and 17A–17B. These will collectively create:

- 926 standalone lots;
- 44 superlots with a dwelling yield of 475 dwellings;
- 1 commercial superlot;
- 9 accessways;
- 2 recreational reserves;
- 6 esplanade reserves; and
- 18 drainage reserves.

All development-wide infrastructure reporting and servicing design has been based on the maximum development potential of 1,425 dwellings. This incorporates an allowance for the commercial superlot and provides a conservative basis for the infrastructure assessment.

The proposal is structured in two phases:

- **Phase 1** – **Bulk Earthworks and Principal Infrastructure:** Comprises all bulk earthworks and substantially all civil and infrastructure works required to form and service the Development Area. It includes the roads, reserves and principal three-waters infrastructure, together with the preparation of all standalone lots for housing construction and each residential superlot for the Phase 2 development (as described below).
- **Phase 2 – Residential Superlot Development:** This is limited to the subsequent subdivision and land-use development of the residential superlots. Each superlot will already have been formed to its proposed finished levels and provided with access to the principal transport and servicing networks, with only localised works required to enable the proposed dwellings.

All development-wide infrastructure has been designed for the maximum development yield, including the anticipated dwellings within the residential superlots and small scale commercial activity on the one commercial site. Unless otherwise identified, the engineering drawings relate to Phase 1.

Each residential superlot is separately supported by a Phase 2 scheme plan and engineering/servicing plan.

The proposed layout has been developed as a coordinated extension of the existing Milldale urban area and implements key outcomes of the Wainui Structure Plan 2023, which was previously prepared by FHLD to inform the wider Milldale North and Wainui West private plan change process.

The project requires bulk earthworks and associated stream and wetland works to form the proposed landform and enable the subdivision. It also includes the construction of road and active-mode networks, stormwater management infrastructure, wastewater and water supply systems, utility services, geotechnical improvement works, retaining structures and associated landscaping.

The application allows for private water and wastewater servicing on either an interim or long-term basis, transition to public servicing when sufficient capacity and approved connections become available, or public servicing from the outset. The infrastructure implemented will depend on the servicing arrangement available at the relevant stage of development.

Within Te Korowai o Maraeariki, the proposal includes ecological restoration works and recreational tracks, together with associated access, ecological offset wetlands and the localised private water supply and wastewater infrastructure if required under the applicable servicing scenario.

The infrastructure and utilities required to accommodate the development will be designed and constructed in accordance with the applicable Auckland Council standards and the requirements of the relevant service providers.

The associated drawing sets in support of this consent application are provided in **Appendix A** (Phase 1) and **Appendix B** (Phase 2).

1.4. Staging of the Development

Due to the scale of the proposed works, bulk earthworks will be undertaken over three non-winter earthworks seasons, with a potential fourth. During this period, no more than 30 ha of bulk earthworks will remain open and active at any one time, with completed areas progressively stabilised before further areas are opened.

A potential fourth earthworks season has been allowed within the proposed civil staging as a contingency. This provides flexibility if unforeseen ground conditions or extended wet-weather periods delay the planned three-season programme.

The time at which works will commence is in part dependant on when/if the public servicing solution becomes available. Civil and subdivision works for each stage will generally follow completion and stabilisation of the corresponding bulk-earthworks area.

The proposed sequencing has been developed to enable the coordinated delivery of multiple subdivision stages while maintaining efficient earthworks operations and the progressive extension of the supporting infrastructure networks. Localised earthworks and infrastructure within Te Korowai o Maraeariki will be undertaken during the relevant earthworks seasons.

The indicative earthworks staging assumes that private water-supply and wastewater infrastructure may be required. If public servicing is available, the associated earthworks areas will reduce accordingly.

The earthworks seasons and civil sub-stages described below relate to the progressive delivery of the Phase 1 works. Development of individual residential superlots will occur separately, following the completion of the underlying civil stages.

The indicative high-level programme is summarised in Table 2. The timing and sequencing may be refined through detailed design and pre-construction planning, while remaining generally consistent with the proposed staging strategy.

Table 2: Stages 14 to 17 High-Level Timeframes

SEASON	EARTHWORKS	PHASE 1 CIVIL / SUBDIVISION WORKS
Season 1	Bulk Earthworks Season 1 Enable earthworks for Season 2 civil works	No Civil Works to be Undertaken
Season 2	Bulk Earthworks Season 2 Enable earthworks for Season 3 civil works	Stages 14A and 14B 148 Standalone Lots and 7 superlots
Season 3	Bulk Earthworks Season 3 Enable earthworks for Season 4 civil works	Stages 14C, 14D, 14E, 14F and 14G 219 Standalone Lots and 22 superlots
Season 4	Potential contingency earthworks season, if required	Stages 14H, 14I, 14J, Wainui Road West Upgrades and 15C 191 Standalone Lots and 8 superlots

Season 5	No Bulk Earthworks remaining	Stages 15A, 15B, 16A and 16B 266 Standalone Lots and 5 superlots
Season 6	No Bulk Earthworks remaining	Stages 17A and 17B 102 Standalone Lots and 2 superlots

Further detail on the proposed staging strategy and earthworks methodology is provided in the accompanying Earthworks Methodology Report (see **Appendix C**).

1.5. Level of Design Provided

A consent-level engineering design has been prepared to support the Milldale Stages 14–17 Fast-track application. The engineering drawings and associated infrastructure reporting provide a sufficient level of design to define the proposed land uses and subdivision activities within the site. The extent of design details confirms the scope of the proposed activities and accurately supports the intended development outcomes.

The engineering design described in this report principally relates to the Phase 1 earthworks, civil and infrastructure package. Where relevant, the report also addresses the localised superlot-specific Phase 2 works, including their servicing requirements and integration with the Phase 1 infrastructure.

Sufficient land areas have been set aside within areas to vest in Council to support transport and stormwater infrastructure. Additionally, private water supply and wastewater servicing solutions have been developed to ensure the proposed development is adequately serviced where public infrastructure with the required capacity is not available.

It is noted that, subject to resource consent approval, Engineering Approvals (EA) will be prepared and applied for that are in general accordance with the resource consent conditions and plans. This is the appropriate time to provide Council with the necessary detailed engineering design, calculations and plans. This is also the most appropriate time for Council to review the detailed design and confirm compliance with the applicable development engineering standards.

Where detailed design is not subject to EA, it will be addressed through the applicable Building Consent, specialist-design, management-plan or pre-construction approval and certification processes.

The following sub-sections detail the specific information that will be provided at the EA stage, unless otherwise stated.

1.5.1. Earthworks & Retaining

Further design for the following Earthworks and Retaining items will not be subject to an EA. Instead, these elements of the consent design will be further detailed, approved or certified prior to construction:

- Detailed design for geotechnical ground improvement features, such as shear keys, undercut areas, subsurface drainage and RE Slopes (pre-construction detailing for earthworks);
- Detailed Design for retaining walls (Building Consent);
- Site specific Sediment and Erosion Control drawings for each respective earthworks season and civil stage (pre-construction condition); and
- Detailed design for stream enhancement (Streamworks Management Plan).

All bulk earthworks and superlot platform formation will be completed under Phase 1. Only localised excavation associated with building foundations, internal services and building construction will remain as part of the subsequent development of the standalone lots and residential superlots.

1.5.2. Roading

- Detailed horizontal geometry;
- Detailed vertical geometry (road long sections);

- Final pavement design based on confirmed subgrade conditions and testing;
- Intersection design (horizontal and vertical geometry);
- Vehicle tracking to support horizontal intersection designs;
- Sight distance assessments;
- Pedestrian Accessway long sections;
- JOAL long sections;
- Parking bay layout;
- Line marking and signage layout;
- Pedestrian and cycling crossing facilities;
- Final traffic calming design layout;
- Streetlight design;
- Detailed structural design and building consent documentation for the proposed bridges; and
- Detailed streetscape and landscape designs (Landscape Approval).

1.5.3. Stormwater

- Final primary stormwater reticulation layout, pipe sizing and long sections;
- Constructed wetland detailed design, including hardware, site access, operation and maintenance, and landscaping;
- Detailed design for overland flow path assessments, including any necessary scour protection for flow paths;
- Communal bioretention device detailed design, including hardware, site access, operation and maintenance, and landscaping;
- Stormwater outlet details;
- Detailed design for culverts;
- JOAL detention design and sizing;
- Detailed design of internal superlot stormwater reticulation, roof-water tanks and connections to the primary network; and
- Landscape design for drainage reserves.

Further details of the consent-level stormwater design are provided in the Milldale Stages 14-17 Stormwater Design Memorandum included in **Appendix E**.

1.5.4. Wastewater

- Final development-wide wastewater reticulation layout, pipe sizing and long sections;
- Detailed design of individual LPS pump systems, valves, flushing points, air-release facilities and associated operational infrastructure;
- Detailed design of individual property connections and internal superlot reticulation, where applicable;
- Detailed design of wastewater pumping and public-network connection arrangements, as applicable; and
- Detailed design of wastewater treatment and discharge infrastructure, where required.

Further details of the wastewater-servicing strategy, LPS network design and hydraulic assessment are provided in the Milldale Stages 14-17 Wastewater Servicing and Low Pressure Sewer Design Memo included in **Appendix F**.

1.5.5. Water Supply

- Final development-wide water-supply reticulation layout and pipe sizing, in accordance with the approved Water Supply Memo;
- Detailed design of individual property connections and internal superlot reticulation, metering and service connections;
- Detailed design of the water-source, treatment, storage and associated pumping infrastructure, where required; and
- Detailed design of public-network connections, metering, backflow prevention and associated network modifications, where applicable.

Further details of the water-supply demand assessment, network design and hydraulic performance are provided in the Milldale Stages 14-17 Water Supply Network Design Memo included in **Appendix G**.

2. EARTHWORKS

2.1. Bulk Earthworks

Bulk earthworks are proposed to be completed over three earthworks seasons. A potential fourth earthworks season has been allowed for as a contingency should unforeseen ground conditions or extended wet-weather periods delay the planned programme.

A detailed description of the proposed earthworks, staging, erosion and sediment controls and construction methodology is provided in the attached Earthworks Methodology Report (see **Appendix C**).

The proposed earthworks comprise the following two broad components:

- Bulk earthworks within the Development Area to form the proposed residential stages and associated roads, reserves and infrastructure; and
- Localised earthworks within Te Korowai o Maraeariki for private water and wastewater treatment infrastructure (if required) and associated access, the surface-water reservoir and stream intake device, wastewater dispersal wetlands (if required) and ecological offset wetlands.

Within the Development Area, the bulk earthworks will shape the pre-development landform into a landform that is suitable for residential development and civil construction.

As well as reshaping the landform, the bulk earthworks will complete the necessary geotechnical improvements, streamworks and bulk retaining features. All bulk earthworks required to form the standalone lots and superlots to their proposed finished levels will be completed under Phase 1. This will prepare the standalone lots for housing construction and each residential superlot for its subsequent Phase 2 development. Localised excavation associated with foundations, internal servicing and building construction may still be required.

Earthworks within Te Korowai o Maraeariki will be limited to the localised footprints required for the proposed infrastructure and wastewater dispersal wetland works. The location and design of these works have been coordinated with the relevant geotechnical, groundwater and ecological assessments prepared for the application.

The ecological offset wetland works within Te Korowai o Maraeariki will be undertaken separately from the bulk earthworks and civil works, in accordance with the relevant consent conditions and ecological design and management documentation.

Following completion of each earthworks season, the earthworks sites will be stabilised and made available for the Phase 1 civil construction and subdivision works.

2.2. Erosion & Sediment Control Methodology

2.2.1. Overview

A best-practice management strategy will be implemented for the proposed earthworks. This will involve the application of best practice from Auckland Council Guidance Document 2016/005 (GD05), Amendment 3.

The adaptive management approach currently applied on adjacent Milldale earthworks sites will also be implemented. This approach assesses the performance of the erosion and sediment control network and enables the methodology to be adapted in response to any non-conforming performance or sediment discharges.

The erosion and sediment control methodology will apply across the bulk earthworks within the Development Area and the localised earthworks within Te Korowai o Maraeariki. The controls for each area will be selected and staged having regard to the scale and nature of the works, the contributing catchment and the relevant receiving environment.

The primary sediment controls will comprise sediment retention ponds (SRPs). Secondary controls will include decanting earth bunds (DEBs) for smaller areas not captured within SRP catchments, together with silt fences and/or super silt fences. There will also be a strong focus on erosion prevention before forecast rainfall events.

During each earthworks season, there will be no more than 30 ha of bulk earthworks area open and active at any given time – excluding open areas associated with civil works stages. Completed areas will be progressively stabilised before further bulk-earthworks areas are opened.

The works will be staged as the Contractor expands the scale of their operation into the height of summer. The methodology is to gradually extend the area open to earthworks, complete the works and progressively stabilise completed areas. Emphasis will be placed on getting areas cut / filled to grade as quickly as possible and then immediately stabilised.

2.2.2. Team Approach

The team approach ensures that adequate resources, commitment, and expertise are provided to support the Erosion and Sediment Control Methodology from start to finish. This team will undertake pre and post storm surveys, discuss Erosion and Sediment Control Methodology at weekly site meetings. At all times the team will utilise a significant resource and "expertise base" to ensure appropriate and technically sound decisions are made. This approach has proved successful with the works completed at Milldale to date. Stakeholders involved in the project will include:

2.2.3. Principal – Fulton Hogan Land Development Ltd

FHLD is committed to development of their landholdings at Milldale, Wainui East in an environmentally responsible manner. The Principal has an environmental policy in which they are committed to protecting the environment from damage and minimising nuisance from its operations and activities through effective planning and site management and controls.

The Principal has an excellent track record in managing environmental effects. They are prepared to invest in additional measures that will enable robust systems to be utilised in the effective management of environmental risks.

2.2.4. Civil Engineering, Planning & Surveying – Woods

Woods have been engaged by FHLD to provide civil engineering, planning and surveying services associated with development in Milldale. Woods will act as the lead consultant on the project and liaise with the Principal, all other members of the project team, and statutory authorities and will supervise the Contractor as Engineer to the Contract (under NZ3910). Woods will review as-built data provided by the Contractor and will undertake and submit compliance documents.

Woods has an excellent track record in managing large residential projects and has a wealth of in-house knowledge to prepare and administer effective sediment and erosion control plans.

Woods will prepare contract documents with a significant allocated budget to allow Contractors to implement sediment and erosion controls and manage the site for the duration of works. Contract allowances will provide sufficient scope for adjusting sediment and erosion control as required in advance of rain events.

2.2.5. Independent Expertise and Oversight – Southern Skies

Southern Skies have been engaged by FHLD to provide technical expertise as specialists in sediment and erosion control and are the author of the Adaptive Management Plan for Milldale (AMP). Southern Skies have been involved with the Milldale project in this capacity for six years, and have a strong understanding of how the site operates during earthworks construction.

As set out in the AMP, Southern Skies monitor water turbidity within key waterways as a marker of the sites performance during rain events. Southern Skies undertake site walkovers following rain fall trigger events, report of the sites performance managing those rain events and provide recommendations under the adaptive management of the site.

These recommendations are then implemented under the contract works.

2.2.6. Earthworks Contractor – TBC

The Principal will appoint a suitably experienced earthmoving Contractor with experience in large earthmoving projects (to date two experienced earthworks contractors have been involved with Milldale). This Contractor will have experience with many of the commonly used erosion and sediment control practices detailed in GD05 as well as a history of implementing other innovative measures to improve erosion control and the quality of stormwater discharges.

The Contractor will be responsible for implementation, management and maintenance of erosion and sediment control measures. The Contractor will liaise with the site engineer, erosion and sediment control consultant and statutory authorities to ensure all erosion and sediment control measures are operating effectively.

Prior to the pre-construction meeting, the Contractor shall produce all pre-construction documentation, including:

- Construction Management Plan (CMP);
- Updated Sediment and Erosion Control Plan (SECP);
- Chemical Treatment Management Plan (CTMP);
- Dust Management Plan (DMP); and
- Any other plans and documentation required to address the pre-construction conditions of resource consent.

The minimum requirements for the Construction Management Plan are provided in **Appendix D**.

As we have experienced in previous stages of bulk earthworks, the Contractor plays a critical role in the successful performance of the sediment and erosion control network. There will be a strong emphasis on the Contractor's sediment and erosion control track record when tendering for the works. Only Contractors with an excellent record will be considered when awarding works that fall under this consent.

2.2.7. Statutory Authorities – Auckland Council (AC)

The Principal, Engineer and Contractor will liaise with representatives of AC to ensure that erosion and sediment control measures are implemented, maintained and monitored in accordance with consents granted. Weekly inspections undertaken with AC's representative will be utilised for discussion of site variables as works progress.

3. ROAD NETWORK AND DESIGN

The proposed road network has been informed by the Wainui Structure Plan 2023 that was prepared by FHLD, and has been developed as a coordinated extension of the existing Milldale transport network. The network generally implements the transport connections identified through the Structure Plan process, while refining the road layout in response to the proposed subdivision design, existing landform, watercourses, infrastructure corridors and surrounding connection points.

The Structure Plan involved consultation with Auckland Transport, and further detailed discussions were held with Auckland Transport as this application was being prepared. The proposed design addresses the feedback received, including in relation to the proposed road hierarchy, cross-sections, active-mode facilities and intersection treatments.

A design philosophy of providing linkages and connectivity with existing and potential future routes and developments has been adopted.

Further detail on the proposed road hierarchy, road typologies, intersections and active-mode facilities is provided in the following subsections.

The proposed roading layout is shown on the provided road typology plans (Sheets 01-2010-RD and 01-2020-RD to 01-2033-RD), included with **Appendix A**.

3.1. Existing Roading Network

The site is connected to the surrounding road network principally through Argent Lane, Wainui Road, Endsley Rise and the collector and local roads constructed through the preceding Milldale stages.

The Development Area is located approximately 1.5 km west of the Millwater Interchange and approximately 3 km north of the Silverdale Interchange. These interchanges provide the principal connections between Milldale, State Highway 1 and the wider Hibiscus Coast and Auckland transport networks.

Argent Lane provides the principal connection from the Development Area through the existing and planned Milldale road network towards the Silverdale Interchange. Wainui Road forms the principal east–west route along the southern edge of the Development Area and provides access eastward to State Highway 1 via the Millwater Interchange. Endsley Rise and Sidwell Road connect the eastern portion of the site with the existing Milldale development.

Roading infrastructure delivered through the preceding Milldale stages, including the progressive upgrading of Wainui Road, will provide the initial network connections for Stages 14–17. The proposed development will connect to and extend this network as the relevant stages are delivered.

Localised works to existing roads and intersections are also proposed to facilitate access to the Development Area. The specific external and wider transport-network upgrades identified through the Integrated Transportation Assessment and associated traffic modelling are addressed separately later in this section.

3.2. Design Standards

The design of all the roads within Stages 14 to 17 are to be designed to the following relevant road design guidelines and standards:

- Auckland Transport's Transport Design Manual (TDM), including the relevant design guidance, Engineering Design Codes and standard engineering details;
- Austroads: Guide to Road Design (Austroads) series; and
- Waka Kotahi NZ Transport Agency - Manual of traffic signs and markings (MOTSAM) series and Traffic Control Devices (TCD) series.

Road gradients have been designed to comply with the applicable TDM criteria where practicable. Local-road gradients do not exceed 12.5%, and collector-road gradients generally do not exceed 8%.

One constrained section of collector road (within Stage 15) exceeds 8% but remains below 12.5%, due to the fixed tie-in levels of the existing roads at either end of the proposed connection.

The detailed geometric design will seek to minimise the extent and gradient of this constrained section and will provide the supporting assessment and justification required through the subsequent EA process.

3.3. Design Speed

A design speed of 50km/h has been used for all collector roads in Milldale. Designated pedestrian crossing points have been placed on raised tables to ensure safe speeds at these conflict points.

A design speed of 40km/h has been used for all local roads in Milldale. A combination of road geometry, intersections and traffic calming is used to ensure this target design speed is achieved.

The detailed road geometry, intersection treatments and traffic-calming measures will be confirmed through the subsequent EA process.

3.4. Geometric Design

The geometric road design completed to date provides an appropriate level of detail to support the resource consent application. Detailed design for the roads, including intersection geometry, vehicle tracking and design calculations, will be provided at the EA stage.

All standard intersections are designed based on the AT residential compound kerb return with a 1 in 20m taper on the entry and exit, and a radius of 4m on the approach curve and 15m on the exit curve.

Custom intersections and vehicle-crossing arrangements that do not use the standard kerb-return geometry will be developed with reference to the tracking requirements of the applicable design vehicles

The site’s topography, existing road connections, watercourses and adjoining land levels have influenced the proposed road geometry, landform and stormwater catchments. The road layout has therefore been developed by balancing the following considerations:

- The transport connections identified through FHLD’s Wainui Structure Plan 2023;
- Quality urban design outcomes;
- Balancing earthworks volumes as much as practicable;
- Existing and future road connection points;
- Respecting levels at neighbouring property boundaries;
- Maintaining an acceptable design gradient and minimise the steep gradient as low as possible;
- Creating buildable lot gradients for future development;
- Overland flow path management;
- Striking a balance between retention and realignment of key streams, and creating a quality urban environment; and
- Culverts – consideration for appropriate number of crossings, which is a balance between connectivity and ecology outcomes.

As noted in Section 3.2, a localised section of one collector road exceeds the preferred maximum gradient of 8% but remains below 12.5%. This road connects between two existing roads, meaning that its start and end levels are substantially fixed. Its alignment and vertical profile have therefore been optimised to minimise the length and severity of the steeper section while maintaining the required network connection and appropriate adjoining landform.

Detailed design will further refine the road geometry and demonstrate compliance with the applicable standards, or provide supporting justification for any necessary localised departures. This work will have regard to the fixed road tie-ins, neighbouring levels, watercourses, earthworks and stormwater catchments identified through the consent design.

3.5. Proposed Road Network

The proposed roading network consists of the following road typologies:

- Local roads;
- Collector roads; and
- Arterial Roads

3.5.1. Local Road Typologies

Local road typologies adopted for this project include:

- Local Road Type 1 (24.00m Road Reserve);
- Local Road Type 2 (16.20m Road Reserve);
- Stream-Edge Road (17.00m Road Reserve);
- Active Mode Corridor (24.00m Road Reserve);
- School Access Road (18.0m Road Reserve); and
- School Fronting Road (16.20m Road Reserve).

The proposed local-road typologies are largely a continuation of those implemented throughout the existing Milldale development. The cross-sections have been developed with regard to Auckland Transport feedback provided during pre-application discussions, and are generally consistent with the applicable AT TDM requirements.

The School Access Road and School Fronting Road typologies have also been coordinated with the Ministry of Education – with whom discussions have been held – to provide suitable pedestrian, cycling and vehicular connections to the proposed future school site east of Stage 14A.

3.5.1.1. Local Road Type 1

This type of Suburban Street is a dual crossfall carriageway, with 3.0m lane widths, 450mm kerb and channel; a 2.95m wide front berm corridor, 2.0m cycle lane, 300mm cycle mountable kerb, 1.8m footpath, and 1.5m back berm on both sides.

This typology is illustrated on application drawing P25-609-01-2023-RD.

3.5.1.2. Local Road Type 2

This type of Suburban Street is a dual crossfall carriageway, with 2.7m lane widths, 450mm kerb and channel, a 2.15m wide front berm corridor, 1.8m footpath, and 1.0m back berm on both sides.

This typology is illustrated on application drawing P25-609-01-2024-RD.

3.5.1.3. Stream Edge Road

The Stream Edge Road is a single crossfall carriageway with 2.7m lane width, and 450mm kerb and channel on the downhill side; and 2.85m lane width, and 300mm kerb and nib on the uphill side. The uphill side has a 2.15m front berm corridor, 1.80m footpath and a 1.0m back berm. The downhill side has a 2.75m front berm and a 3.0m shared path.

This typology is illustrated on application drawing P25-609-01-2025-RD.

3.5.1.4. Active Mode Corridor

This type of Suburban Street is a dual crossfall carriageway, with 2.7m lane widths, and 450mm kerb and channel. The eastern side has a 3.05m wide front berm corridor, 1.8m footpath, and 1.0m back berm. The western side has a 5.05m wide front berm corridor, 4.0m mixed-use path, and 2.8m back berm.

This typology is illustrated on application drawing P25-609-01-2028-RD.

3.5.1.5. School Access Road

The School Access Road is a single crossfall carriageway with 2.7m lane width, and 450mm kerb and channel on the downhill side; and 2.85m lane width, and 300mm kerb and nib on the uphill side. The uphill side has a 0.65m front berm corridor, 3.0m cycle lane, 300mm cycle mountable kerb, 1.80m footpath and a 1.0m back berm. The downhill side has a 2.15m front berm, 1.8m footpath, and 1.0m back berm.

This typology is illustrated on application drawing P25-609-01-2026-RD.

3.5.1.6. School Fronting Road

The School Fronting Road is a dual crossfall carriageway with 2.7m lane width, and 450mm kerb and channel on both sides. The residential side has a 2.15m front berm corridor, 1.80m footpath and a 1.0m back berm. The school-fronting side has a 2.15m front berm and allowance for a 2.80m interface to the external development boundary.

This typology is illustrated on application drawing P25-609-01-2027-RD.

3.5.2. Collector Roads

Collector road typologies adopted for this project include:

- Collector Road (24.00m Road Reserve);
- Stream-Edge Collector Road (24.00m Road Reserve);
- Cemetery Road Upgrade (20.12m Road Reserve);
- Lysnar (Collector) Road Upgrade (24.00m Road Reserve); and
- Wainui Road West Upgrade (24.00m Road Reserve).

The proposed collector-road typologies are largely a continuation of those implemented throughout the existing Milldale development. They have been developed with regard to Auckland Transport feedback and are generally consistent with the applicable AT TDM requirements.

3.5.2.1. Collector Road

The Collector Road typology is a dual crossfall road with 3.2m wide lane widths, 450mm kerb and channel, 3.25m wide front berm corridor, 2.00m cycleway, 300mm cycle kerb type 15, 1.80m footpath and a 1.00m back berm. The front berms will accommodate rain gardens, 2.25m wide fully indented parking bays and street trees where appropriate.

This typology is illustrated on application drawing P25-609-01-2021-RD.

3.5.2.2. Stream-Edge Collector Road

The Stream Edge Collector Road typology will be used on the southern side of Stream 7 and the eastern side of Stream 3, and will connect with the Cemetery Road Link to the south and the Lysnar Road extension to the east.

The Stream Edge Collector Road typology will be a dual crossfall road with 3.2m wide lane widths, and 450mm kerb and channel. The stream edge side is made up of 4.4m wide front berm corridor, 3.0m two-way cycleway, 300mm cycle mountable kerb, and 1.80m footpath. The residential side is made up of 4.4m wide front berm corridor, 1.80m footpath and a 1.0m back berm.

This typology is illustrated on application drawing P25-609-01-2020-RD.

3.5.2.3. Cemetery Road Upgrade

The existing Cemetery Road alignment will be upgraded to a dual-crossfall carriageway. The residential side of the road will have a 2.7m lane width, 450mm kerb and channel, 2.15m front berm corridor, 1.8m footpath, and 1.0m back berm.

The rural edge side will have a 2.7m lane width, 450mm kerb and channel; and 9.02m grassed swale, including for the variable width to tie into existing neighbouring boundaries.

This typology is illustrated on application drawing P25-609-01-2029-RD.

3.5.2.4. Lysnar (Collector) Road Upgrade

The Lysnar Road Collector Road typology is a dual crossfall road with 3.2m wide lane widths, and 450mm kerb and channel. The residential side has 3.25m wide front berm corridor, 2.00m cycleway, 300mm cycle kerb type 15, 1.80m footpath and a 1.00m back berm. The eastern side has 3.25m wide front berm corridor, 2.00m cycleway, and 3.10m interface to the external property boundary. The front berms will accommodate rain gardens, 2.25m wide fully indented parking bays and street trees where appropriate.

The proposed upgrade of the currently unformed Lysnar Road portion is consistent with that previously consented by Council and AT for the eastern remainder of Lysnar Road (fronting proposed Stages 16 and 17), which is now known in its entirety as Endsley Rise.

This typology is illustrated on application drawing P25-609-01-2022-RD.

3.5.2.5. Wainui Road West Upgrade

The Wainui Road West Upgrade will comprise a dual-crossfall carriageway with 3.2 m traffic lanes and 450 mm kerb and channel. The southern side will include a 3.9 m front-berm corridor, 3.0 m two-way cycleway, 300 mm cycle-mountable kerb and 1.8 m footpath. The northern side will include a 3.9 m front-berm corridor, 1.8 m footpath and 1.0 m back berm.

This typology is illustrated on application drawing P25-609-01-2030-RD.

3.5.3. Arterial Roads

3.5.3.1. Wainui Road Upgrade Eastern Extension

The Wainui Road Eastern Extension typology will be a dual carriageway road with a 1.5m central traffic island, with 300mm kerb and nib; and 3.5m wide lane widths, with 450mm kerb and channel. The residential side is made up of 2.85m wide front berm corridor, 3.0m two-way cycleway, 300mm cycle mountable kerb, 1.80m footpath, and 1.0m back berm. The rural boundary side is made up of a 4.05m wide retention swale, and a 1.0m back berm.

This typology is illustrated on application drawing P25-609-01-2031-RD.

The proposed cross-section continues the form of the consented Wainui Road upgrades (BUN60466785) adjoining the preceding Milldale stages and provides for the planned future arterial function of this corridor.

3.5.4. Intersections

Intersection designs have been prepared to a consent level, with detailed geometry and vehicle tracking to be confirmed through the subsequent EA process.

The proposed intersection forms and locations have been selected having regard to:

- The hierarchy and function of the intersecting roads;
- Road gradients and available sight distance;
- Spacing from adjoining intersections;
- Anticipated traffic volumes;
- Pedestrian and cycling movements;

- Traffic-calming requirements; and
- The suitability of each treatment within the surrounding street environment.

Typical concept designs have been prepared where a standard intersection arrangement can be applied. These are shown on Drawings P25-609-01-2040-RD to 2045-RD and include the following:

3.5.4.1. Typical Design Intersections

Typical concept design has been provided for a number of the intersections where a typical arrangement can be considered at consent stage. These typical intersections are shown on drawings P25-609-01-2040-RD to P25-609-01-2045-RD, and includes the following intersections:

- **Local to Local Road Mini Roundabout (Drawing 2044-RD)**

This treatment is proposed for local to local road intersections where longitudinal grades allow (<5%) for a roundabout typology.

- **Local to Collector Road Roundabout (Drawing 2044-RD)**

This treatment is proposed for local to collector road intersections where longitudinal grades allow (<5%) for a roundabout typology.

Exceptions are made in localised locations between shorter blocks, as detailed further below.

- **Local to Stream Edge Road Roundabout (Drawing 2044-RD)**

This treatment is proposed for a local road (type 1) tee onto a stream-edge road, where higher traffic and pedestrian volumes are anticipated. This will support safer movements in these areas, and effective traffic calming.

- **Collector to Collector Road Roundabout (Drawing 2044-RD)**

This treatment is proposed for collector to collector road intersections where longitudinal grades allow (<5%) for a roundabout typology.

Within this proposed development, this will be applicable to all collector to collector road intersections.

- **Local to Collector Road Flush Priority Intersection (Drawing 2045-RD)**

This treatment is proposed for local to collector road intersections where longitudinal grades are too steep (>5%) for a roundabout typology. Flush thresholds will be used to manage pedestrian movements.

This is also considered in locations where blocks are shorter and the use of multiple roundabouts in close proximity is not deemed fit for purpose.

- **Local to Local Road Tee (Drawing 2045-RD)**

This treatment is proposed for local to local road tee. This detail is used throughout the remainder of the Milldale development.

- **Local Road Tee to Collector Road (Drawing 2045-RD)**

This treatment is proposed for a local road tee onto a collector road. This is a standard arrangement used throughout Milldale.

- **Local Road Tee to Arterial - Left-In-Left-Out (Drawing 2045-RD)**

This treatment is proposed for two local road intersections with Wainui Road. This is consistent with the standard arrangement used for recent proposed intersections with Wainui Road, from the existing Milldale development.

3.5.4.2. Concept Design Intersections

Concept design drawings have been provided for two specific intersections, where a typical design intersection could not be applied. These specific design intersections are shown on drawing P25-609-01-2046-RD, and includes the following intersections:

- The Endsley Rise Roundabout, adjoining Stage 17; and
- The Wainui Road / Lysnar Road / Endsley Rise Roundabout

The latter includes interim and ultimate arrangements to respond to the timing and extent of Auckland Transport's acquisition of the adjoining designated land.

These concept intersection design will be further refined at the EA stage.

3.5.5. Car Parking

Both kerbside and fully indented parking bays will be allowed for across Stages 14 to 17. This arrangement is depicted on the road cross section plans provided on drawings P25-609-01-2020 to 2031-RD.

An indicative target of approximately 0.5 on-street parking spaces per dwelling has been adopted. The final number and location of spaces will be coordinated with lot density, vehicle crossings, street trees, streetlights, stormwater devices, pedestrian and cycling facilities, sight-distance requirements and other safety-in-design considerations.

Other off-street parking spaces have also been provided, specifically in higher-density areas containing proposed superlots. In these instances, private carparks within JOALs are proposed.

A detailed car parking layout will be provided with detailed design at EA stage.

3.5.6. Culverts

With several streams being retained and enhanced as part of the development, culvert crossings are necessary to maintain an urban structure with a high degree of connectivity.

Culvert crossing locations have been carefully considered with the roading design, with the design principle of minimising the number of culverts from an ecological perspective, whilst still enabling a high degree of connectivity.

Refer to culvert drawings P25-609-01-3050 to 3070-DR and typical offline and online culvert installation drawings 3075-DR to 3076-DR.

Nine road culverts are proposed across Stages 14–17, all of which provide crossings of retained or realigned watercourses. Their indicative dimensions are summarised below in Table 3. The lengths shown relate to the culvert barrels only and exclude wingwalls and scour protection. An additional 5 m length allowance has been provided for the associated wingwalls and scour protection.

Fish-passage provisions have been incorporated into the consent-level culvert design in accordance with the applicable requirements and ecology recommendations. These include countersinking culvert inverts by 25% of the barrel diameter, providing baffles where required, and generally maintaining pre-development stream grades and widths through the crossings.

Detailed design will confirm the final substrate, baffle, scour-protection and stream-transition details while retaining these fish-passage outcomes.

Table 3: Summary of Culvert Details.

Culvert #	Diameter (m)	Length (m)	Grade (%)
2-1	1.60	29.5	1.54
3-1	1.05	29.75	6.23
3-2	1.20	29.64	4.9
7-1	1.50	29.48	0.79

7-2	1.50	29.87	0.86
7-3	1.80	42.14	0.82
7-4	1.80	29.92	3.94
8-1	1.05	29.66	2.37
10-1	1.50	29.8	2.11

3.6. Lot Access

Vehicle access will generally be provided directly from the adjoining road for standalone lots and front-accessed superlots. Jointly owned access lots (JOALs) are proposed where direct road frontage is unavailable or where direct vehicle access to the adjoining road is restricted.

3.6.1. Standalone Lot Access

Private vehicle access to standalone residential lots will generally be provided by individual vehicle crossings from the adjoining road.

The final location of each crossing will depend on the future dwelling and garage layout and will therefore generally be confirmed and constructed through the relevant building-consent process rather than as part of the Phase 1 civil works. Indicative crossing locations will be coordinated with the streetscape design, including on-street parking, street trees, lighting, stormwater devices and sight-distance requirements.

Standard vehicle-crossing details and tracking curves are shown on the P25-609-01-2070-RD drawing series.

In isolated locations where direct road frontage is unavailable, access to standalone lots will be provided via JOALs.

3.6.2. Front-Accessed Superlots

Front-accessed superlots will obtain vehicle access directly from the adjoining road in a similar manner to standalone lots.

The location of vehicle crossings will be confirmed through the relevant building-consent and associated approval processes, similarly to the standalone lot crossings – rather than being addressed during the Phase 1 and Phase 2 civil works.

3.6.3. Rear-Accessed Lots

Joint Owned Access Lots (JOALs) are proposed for rear private access lots and lots fronting the restricted accessed roads of Argent Lane and Wainui Road.

Five JOAL typologies are proposed, as illustrated on Drawing P25-609-01-2032-RD:

- JOAL – Type 1: 5m wide legal width with 3m wide formation. Serving 2 rear lots only.
- JOAL – Type 2: 7m legal width with a 5.5m wide formation with no footpath. Serving rear vehicle access to superlots where the superlot also has legal road frontage and pedestrian frontage to that road reserve.
- JOAL – Type 3: 7m legal width with a 5.5m wide formation and 1.5m footpath. Serving rear vehicle access to superlots where the superlot also has no legal road frontage.
- JOAL – Type 4: 10m legal width with a 6m wide formation and 1.8m footpath. Serving rear vehicle access to superlots where the superlot also has no legal road frontage.
- JOAL – Type 5: 13.5m legal width with a 6m wide formation and 6m wide perpendicular parking bay. Serving rear vehicle access to superlots where an additional provision for off-street parking is being provided. the superlot also has no legal road frontage.

All JOALs are proposed to be constructed as part of the Phase 1 civil stages, regardless of whether these will service standalone lots, superlot dwellings or a combination of the two.

Full details for the JOALs will be provided with detailed design at the EA stage.

The proposed JOAL approach is also recognised in the ITA, which confirms that different cross-sections are used according to the type and scale of development served.

3.7. Pedestrian and Cycling Network

3.7.1. Overview

The design philosophy for the proposed road cross sections is derived from the Milldale IFA and the Milldale Integrated Transportation Assessment (ITA) prepared by Stantec, with the aim to provide a safe connection route for pedestrians and cyclists through the wider Milldale development.

Table 4 describes how the walking and cycling network for this project has been developed to align with AT policies and guidelines:

Table 4: Proposed Walking and Cycling Network in Accordance with AT Guidelines.

AT Policy / Guideline Document	How the walking and cycling network proposed for this Project aligns with AT guidelines?
Auckland Transport Local Path Design Guide (Rev 1.2)	Aligns with the Local Paths design framework based on the following principles: **Safe:** Conflict points and high speeds have been minimised by providing a consistent level of experience across the collector road corridor, including appropriate speed-management and pedestrian-crossing treatments at intersections. Provides standard pedestrian-only footpaths along most streets, which are not intended for use by cyclists. **Connected:** This Project considers the wider Milldale development and includes provisions for connecting to local destinations such as residential neighbourhoods, schools, Local Centres, and bicycle facilities. These connections shall be designed to be easily navigated through the use of clear and consistent line marking and consistent wayfinding. **Accessible & Comfortable:** Accessible for all users, including children and people with disabilities, including design considerations for increased cycleway width and gentle gradients. **Enabling:** Improve ecological function through planting and kerbside raingardens providing a water sensitive design adjacent to the walking and cycling facilities.
Auckland Transport Engineering Design Code – Cycling Infrastructure Version 1	Aligns with the principles set out in the AT EDC Cycling Infrastructure (version 1): Physical separation between cycleway and carriageway, avoids conflict between vehicles and people on bikes. Physical separation between cycleway and footpath minimises conflict between pedestrians and people on bikes. Wide enough to allow a comfortable environment for all ages and abilities – The bi-directional cycle facility is designed and located to support the land use and anticipated future land use.

The walking and cycling facilities will be designed to comply with the requirements of the AT TDM, as well as through previous consultations with AT as part of the previous stages consent applications.

The proposed design provides for active modes of transport, including physically separated compliant walking and cycling facilities. Separation from the carriageway is achieved via vertically by kerb and channel and horizontally by a buffer zone.

3.7.2. Pedestrian Network

The proposed scheme provides a well-connected pedestrian network throughout Stages 14–17 and with the existing Milldale development.

Footpaths with a typical width of 1.8 m will be provided within the road reserves, while dedicated pedestrian accessways will provide mid-block connections to improve pedestrian connectivity and permeability.

Shared and separated active-mode paths will also be provided along the stream side of the stream-edge roads. These will generally comprise either 3.0 m-wide shared paths or 4.8 m-wide separated pedestrian and cycling facilities along the collector-road corridors.

Pedestrian accessways are proposed at mid-block locations to provide connectivity and permeability to the pedestrian network. Pedestrian accessways will be 8.0m wide and include a 3.0m formed concrete path. Stairs will be required within three of these accessways where accessways are adjacent to reinforced earth slopes. Full details for the stairs will be provided with detailed design at EA stage.

A key active-mode connection will extend the existing route through the centre of Milldale, from Waterloo Reserve through the preceding stages and across Wainui Road into Stage 14 and eventually the Ōrewa Awa corridor. This connection will comprise a 4.0 m-wide shared path and will connect with the wider pedestrian, cycling and recreational track networks.

3.7.3. Cycle Network

The proposed cycle network will extend the existing Milldale active-mode network into Stages 14–17 and provide connections to the future school site, local centres, reserves and Te Korowai o Maraeariki.

Collector roads will generally include either 2.0 m-wide one-way cycleways or 3.0 m-wide two-way cycleways within the road reserve, as shown on Drawings P25-609-01-2020-RD to 2023-RD. The cycleways will be separated from adjoining footpaths by an Auckland Transport Type 15 cycle kerb and from vehicle traffic through kerbs, berms, parking bays or other buffer treatments.

Traffic-calming measures and intersection treatments will be used to manage vehicle speeds and reduce conflicts between vehicles, pedestrians and cyclists. Detailed cycleway transitions, crossing arrangements, markings and signage will be confirmed through the EA process.

3.7.4. Recreational Track Network

A publicly accessible recreational track network is proposed through Te Korowai o Maraeariki, connecting with the active-mode network within Stages 14–17 via the proposed Ōrewa Awa bridge crossings.

The track alignments have been located along existing farm tracks as far as practicable to minimise disturbance. The tracks are proposed to be formed by placing GAP aggregate over the existing track surfaces, without separate earthworks or material land disturbance.

Existing culverts and crossings along the proposed alignments will be inspected during detailed design. Localised upgrades or replacements will be undertaken where necessary, having regard to their condition, hydraulic performance, safety and ecological requirements.

The final track details will be coordinated with the landscape and ecological design for Te Korowai o Maraeariki.

3.7.5. Bridges

There are five bridges proposed within Stages 14-17, including

- Two Ōrewa Awa Bridge Crossings – each provides pedestrian and cycling connectivity to Te Korowai o Maraeariki and service-vehicle access to the private water-supply and wastewater infrastructure, where required under the applicable servicing scenario; and
- Three Pedestrian Bridge Crossings – proposed for pedestrian connectivity between residential blocks otherwise prevented by tributary watercourses.

The Ōrewa Awa crossings are proposed as heavy-duty precast-concrete structures capable of accommodating the required service and maintenance vehicles. They will also accommodate associated water supply and wastewater pipelines beneath the bridge decks and will be designed to maintain appropriate clearance above the 1% AEP flood level.

The three pedestrian bridges will form part of the proposed shared-path network. Where required, they may also accommodate stormwater pipelines beneath the bridge structures.

The designs are currently at resource consent level. Detailed structural, geotechnical, hydraulic, scour-protection, barrier and service-integration requirements will be confirmed through the EA and building consent processes.

The bridge locations are shown on Drawings P25-609-01-2080-RD to 2085-RD.

3.8. Public Transport

The proposed collector-road network has been designed to accommodate future bus services and associated bus-stop infrastructure. The principal east–west collector road north of Wainui Road is anticipated to form the main potential public-transport spine through the Development Area.

Drawing P25-609-01-2060-RD shows the existing and proposed public-transport network, indicative bus routes and existing, proposed and future bus-stop locations. Indicative 400 m walking catchments are also shown around the bus stops.

The proposed bus-stop distribution will place the majority of Stages 14–17 within convenient walking distance of a potential bus stop, with the principal exception being a small cluster of lots in the northeastern part of Stage 14.

The road corridors and bus-stop provisions enable the future extension of public-transport services into the Development Area. The timing, routing and operation of any service will ultimately be determined by AT.

3.9. Pavement Design

The Milldale generic pavement design has been adopted for each road hierarchy, these pavement designs are reliant on ground type and in-situ CBR testing at the earthworks construction stage. Specific modifications to the design parameters may occur under consultation with Auckland Council Engineers.

The generic pavement designs for Stages 14 to 17 are:

Local Roads:

- 40mm thick of DG10 placed over a bitumen membrane seal;
- 120mm thick TNZ M/4, Basecourse;
- 200mm thick GAP 65, Sub-base; and
- 250mm thick 3% Lime / 3% Cement stabilised. Effective CBR 8%.

Collector Roads:

- 40mm thick of DG10 placed over a bitumen membrane seal;
- 220mm thick TNZ M/4, Basecourse;
- 230mm thick GAP 65 Stabilised with 1.5% Cement, Sub-base; and
- 250mm thick 3% Lime / 3% Cement stabilised. Effective CBR 8%.

Final pavement materials, treatment requirements and layer depths will be confirmed through detailed design following completion of the relevant earthworks and in-situ subgrade testing. The final pavement design will comply with the applicable Auckland Transport requirements and will be submitted through the Engineering Approval process.

Kerb and channel profiles will be selected in accordance with the applicable Auckland Transport standards and the approved road cross-sections.

3.10. Street Lighting

Street lighting will be provided along all public road corridors and identified pedestrian accessways within the Development Area, in accordance with:

- Applicable standards listed within the AT TDM Engineering Design Code – Street Lighting standard;
- AT Road Lighting Column Approved List – AT-LCAL;
- Appendix documents for Street Lighting Engineering Design Code; and
- AS/NZS 1158 Lighting for roads and public spaces.

Lighting shall be provided along the edge of the road on all corridors, with lighting fixtures placed at appropriate intervals so that they do not obstruct walking and cycling paths, while improving night-time safety and visibility for street users.

Separate fittings will be investigated during the EA design process to cater for the different lighting needs for both pedestrians and vehicle traffic.

3.11. External and Wider Road Network Upgrades

3.11.1. Localised External Road Works

Localised works are proposed to connect Stages 14–17 with the surrounding road network. These include upgrades to the development-facing sections of Wainui Road and Cemetery Road, new and modified intersections along Wainui Road, and connections to Endsley Rise and the preceding Milldale stages.

These works will be undertaken as part of the proposed civil works programme and progressively delivered alongside the relevant subdivision stages. The Wainui Road and Cemetery Road works will be sub-staged so that east–west travel can be maintained throughout the construction programme.

The Cemetery Road upgrades will also be divided into separate work areas to retain access to properties served by Grayson Road while construction proceeds. Detailed sequencing, temporary traffic management and property-access arrangements will be confirmed through pre-construction planning.

The proposed road cross-sections and intersection arrangements are described in Sections 3.5.2 and 3.5.3 and shown on the engineering drawings included in **Appendix A**.

3.11.2. Wider Road Network Upgrades:

Traffic modelling has also been undertaken to assess the effects of Stages 14–17 together with anticipated development in Silverdale West and other surrounding areas. The modelling identifies targeted upgrades required as development proceeds.

The relevant development thresholds and wider-network upgrades are summarised below.

Table 5: Proposed Wider-Network Upgrades

Proposed Wider-Network Upgrade	Development threshold
Dairy Flat Highway/Pine Valley Road intersection upgrade	740 dwellings
Signalisation of the Wilks Road/Dairy Flat Highway intersection	960 dwellings
Signalisation of the Wilks Road/East Coast Road intersection	960 dwellings
Silverdale Interchange upgrade, including a western-approach left-turn slip lane, extension of the southbound off-ramp left-turn lane and AM peak queue metering	1,180 dwellings
Double-laning of the Pine Valley Road/Argent Lane roundabout	1,425 dwellings

The thresholds are approximate and indicate when each upgrade should be operational.

As these works are outside the Development Area, they will be delivered separately from the Stages 14–17 civil works and will require their own detailed design, coordination and approvals. Delivery will be secured through the relevant consent conditions or other agreed mechanisms.

Further detail is provided in the Stantec Integrated Transportation Assessment – Milldale Stage 14–17 Fast-track Application and supporting feedback memorandum.

A set of concept design drawings for these proposed external road upgrades is included in Appendix J (bound separately). These drawings include a concept design layout for each of the proposed upgrades, including vehicle tracking to support the concept design arrangement and confirm feasibility within the existing road reserves.

3.12. Streetscape

The proposed streetscape has been developed in coordination with the road typologies and the Landscape Proposal prepared by Barker & Associates. It provides for the integration of street trees, planting, parking bays, rain gardens where proposed, footpaths, cycleways, street lighting and other road-corridor infrastructure.

The final streetscape layout will coordinate these elements with vehicle crossings, utilities, sight-distance requirements, bus stops and pedestrian crossing facilities. Detailed streetscape design will be completed through the EA and Landscape Approval processes.

The proposed streetscape shown in Landscape Proposal, prepared by Barker & Associates and provided separately, indicates the typologies on all corridors. The detailed design will be provided at engineering approval stage.

4. STORMWATER CATCHMENT ANALYSIS & MANAGEMENT

4.1. Existing Stormwater Infrastructure

The site drains through a network of existing watercourses, farm drainage features and stormwater infrastructure associated with the preceding Milldale stages.

The principal receiving environments and infrastructure interfaces comprise:

- Ōrewa Awa – runs generally west to east along the northern side of Stages 14 and 15. Stages 14 and 15, together with Te Korowai o Maraeariki, generally drain to the Ōrewa Awa either directly or through its tributaries.
- Waterloo Creek – runs generally south to north between Stages 16 and 17. A substantial part of the existing Milldale development drains to its upper reaches, either directly or through tributary watercourses.
- Permanent Watercourse P3 – runs generally south to north and intersects the eastern extent of Stage 17. Portions of the earlier Milldale stages drain to the upper reaches of this watercourse.
- Ōrewa Awa Tributaries – several existing intermittent tributaries extend through Stages 14 and 15 and discharge to the Ōrewa Awa. These are generally proposed to be retained or realigned and incorporated into the post-development stormwater and ecological network.
- Other Existing Watercourses and Drainage Features – the site also contains artificial farm drains, ephemeral watercourses, existing culverts and other drainage features. Many of these will be reclaimed or modified as part of the proposed streamworks, as shown on Drawings P25-609-01-1450-EW to 1456-EW.

The principal interfaces with existing and consented public stormwater infrastructure are:

- Endsley Rise – includes public stormwater networks and culvert crossings associated with Waterloo Creek and Permanent Watercourse P3.
- Wainui Road – includes existing and consented stormwater works that alter local catchment boundaries, convey treated flows to intermittent streams within Stage 14 and interface with the primary networks serving consented Stages 10–11.
- Cemetery Road – includes public primary stormwater networks serving consented Stages 12–13. A consented dry basin also discharges to intermittent Stream I3 within Stage 15 under BUN60446761 and has been incorporated into the proposed stormwater design.

These receiving environments and existing network interfaces have been accounted for in the proposed stormwater catchment layout. The stormwater catchments are shown on Drawings P25-609-01-3010-DR to 3013-DR.

4.2. Stormwater Management Strategy and Flood Modelling

Stormwater management for the development is set out in the Stormwater Assessment – Milldale Stages 14–17, prepared by Woods. That assessment applies the updated catchment-wide stormwater-management framework developed through the Wainui East Stormwater Management Plan, Version 7 (Wainui East SMP V7), to Stages 14–17.

The proposed strategy applies an integrated, water-sensitive design approach comprising:

- Water-quality treatment for runoff from all impervious areas;
- Retention at source, principally through dedicated reuse storage within private roof-water tanks;
- Detention within communal wetlands and bioretention devices where required by the applicable stormwater management zone; and

- Safe conveyance of larger storm events through the primary and secondary stormwater networks.

Water-quality treatment will be provided to the applicable GD01/TP10 treatment levels. Runoff from roads, hardstand areas, JOALs and other private impervious areas will be directed through the proposed communal wetlands or bioretention devices before discharge to the receiving environment. Roof runoff will be managed through inert roofing materials and private reuse tanks in accordance with the integrated treatment approach established by the Stormwater Assessment.

The communal devices have been sized at consent level to provide the required water-quality treatment and applicable hydrology mitigation for their contributing catchments. This includes the storage required for detention and, where relevant, retention that cannot otherwise be achieved through infiltration or private reuse.

The site is not currently subject to a Stormwater Management Area Flow overlay under the Auckland Unitary Plan. Nevertheless, the proposed strategy adopts a hydrology-mitigation approach broadly aligned with SMAF principles, including retention of at least 5 mm of rainfall and detention of the 95th-percentile rainfall event, discharged over 24 hours, where detention applies.

Stages 14 and 15 are located within Stormwater Management Zone B, Stage 16 is within Zone A, and Stage 17 extends across Zones A and C, as shown in Figure 2. The applicable water-quality treatment and hydrology-mitigation requirements for each zone have been incorporated into the proposed design.

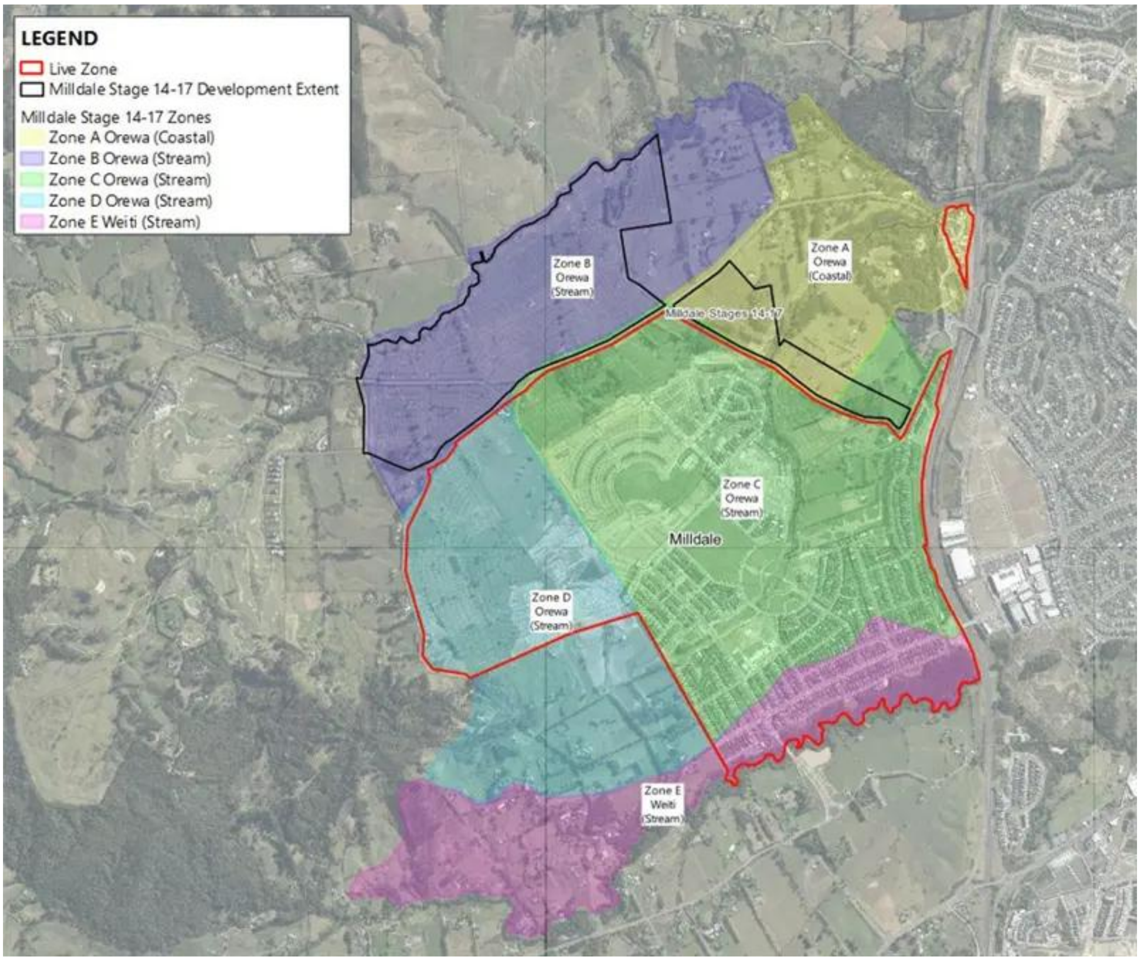


Figure 2: Stormwater Management Zones

Larger storm events will be passed forward without attenuation. Flows exceeding the applicable treatment and hydrology-mitigation thresholds will bypass the communal devices and be safely conveyed through the primary network, overland flow paths and receiving watercourses.

The flood model has been updated to reflect the proposed landform, land use, catchment boundaries and stormwater structures. It assesses the proposed development with allowance for climate change and informs the design of the primary and secondary networks, culverts and overland flow paths. Further detail is provided in the Milldale Stages 14–17 Stormwater Assessment, provided separately.

The Wainui East SMP V7 has been prepared through the wider Milldale North and Wainui West private plan-change process. While it is not currently operative, its updated stormwater-management framework has been applied to the Project through the Stormwater Assessment – Milldale Stages 14–17.

Further consent-level design detail is provided in the Milldale Stages 14–17 Stormwater Design Memorandum included in **Appendix E**.

The detailed stormwater network, water-quality treatment, hydrology-mitigation and flood-management measures are described in the following sections.

4.3. Stormwater Network Overview

The proposed stormwater system comprises primary reticulation, communal treatment devices, stream-recharge systems and overland flow paths. The principal catchments are:

Stage 14:

- Wetland Catchment B – Discharges to the Ōrewa Awa, via Wetland B
- Wetland Catchment C – Discharges to the Ōrewa Awa, via Wetland C
- Part Wetland Catchment D – Discharges to the Ōrewa Awa, via Wetland D
- Part Stream 4 Catchment – Discharges to Stream 4, via the Stream 4 and 7 re-charge device
- Part Stream 7 Catchment – Discharges to Stream 7, via the Stream 4 and 7 re-charge device
- Stream 8 Catchment – Discharges to Stream 8, via the Stream 8 re-charge device

Stage 15:

- Wetland Catchment A – Discharges to the Ōrewa Awa via the upper reaches of Stream 1, Stream 2 and Wetland A
- Part Wetland Catchment D – Discharges to the Ōrewa Awa, via Wetland D
- Part Stream 4 Catchment – Discharges to Stream 4, via the Stream 4 and 7 re-charge device
- Part Stream 7 Catchment – Discharges to Stream 7, via the Stream 4 and 7 re-charge device
- Wainui Road West Upgrade Catchments – These overlap with the Stage 14 and Stage 15 catchments described above

Stage 16:

- Wetland Catchment E – Discharges to the Waterloo Creek, via Wetland E
- Communal Bioretention Device Catchment F – Discharges to the Waterloo Creek, via Communal Bioretention Device F
- Stream 10 Catchment – Discharges to Stream 10, via the Stream 10 re-charge device

Stage 17:

- Communal Bioretention Device Catchment G – Discharges to the Waterloo Creek, via Communal Bioretention Device G
- Wetland Catchment H – Discharges to the Permanent Stream P3, via Wetland H

The communal wetlands and bioretention devices have been sized to provide the water-quality treatment and hydrology mitigation for their contributing catchments. Runoff from roads, JOALs and other public and private hardstand areas has been included in the relevant catchments and device sizing.

The primary network and communal stormwater devices have been designed for the ultimate development catchments, including runoff associated with the anticipated residential superlot dwellings.

The devices will treat smaller and more frequent storm events in accordance with the water-quality criteria established by the Stormwater Assessment and will also provide detention where required. Flows exceeding the applicable treatment or detention threshold will bypass the relevant device components and be safely conveyed through the primary or secondary network, avoiding excessive velocities, scour and reduced treatment performance.

Roof-water tanks will be designed for each residential DUE (standalone and superlot DUEs) at the relevant building consent stage. Each tank will include dedicated reuse storage equivalent to at least 5 mm of runoff from the contributing roof area, being 0.5 m^3 per 100 m^2 of roof area. The retained water will be available for non-potable reuse, such as toilet flushing and gardening.

Detention storage is separate from this retention requirement. Where detention applies, it will manage the difference between the applicable pre- and post-development runoff volumes from the 95th-percentile rainfall event, with discharge occurring over a 24-hour drawdown period.

Each residential superlot dwelling, to be created during the proposed Phase 2 works, will generally discharge through a single loading manhole connected to the Phase 1 primary network. Short localised public stormwater pipelines will be provided within the superlot under the Phase 2 works to collect the future private tank and hardstand connections and convey them to that manhole.

The proposed piped reticulation will convey runoff from storms up to the 10% AEP event in accordance with the applicable Auckland Council engineering standards. These flows will be conveyed to the relevant wetland, bioretention or stream-recharge system before discharging to the receiving watercourse.

Flows from events exceeding the 10% AEP storm will be conveyed via overland flow paths through roads and other designated secondary flow paths to the post-development watercourses. These routes will be designed to safely convey flows without damage to private property or the watercourse channels themselves.

Further detail on the catchments, device sizing, primary network and overland flow paths is provided in the *Milldale Stages 14–17 Stormwater Design Memorandum*, included in **Appendix E**.

Stormwater catchments are shown on Drawings P25-609-01-3010-DR to 3013-DR, the primary network on the P25-609-01-3000-DR series, and the overland flow paths on the P25-609-01-3020-DR series.

All overland flow paths presented in the application drawings are subject to detailed design. It is acknowledged that the alignment of overland flow paths can be further refined and positioned at Engineering Approval stage to ensure the best practical outcomes are achieved prior to construction.

4.3.1. Stormwater Network Watercourse Discharge

Stormwater catchments will discharge to receiving watercourses via controlled outlet structures, including wingwalls and scruffy-dome outlets.

The outlets and associated channels will be designed to safely convey the primary-network flows while minimising scour and erosion within the receiving watercourses. Final outlet types, discharge velocities, energy-dissipation measures, scour protection and stream-transition details will be detailed at the EA stage.

Each outlet structure and channel will be designed to minimise any scouring or erosion within the watercourse, while conveying the 10% AEP flow. Outlets will also be designed in accordance with TP10, Chapter 13. The detailed outlet design will also have regard to the findings of the supporting stream geomorphology assessment.

4.3.2. Stream Re-Charge

Several intermittent tributaries will be retained or realigned and enhanced as part of the proposed development. Stream recharge will be provided by directing an appropriate proportion of treated and mitigated stormwater flows from the primary network to the upper reaches of these watercourses.

The three proposed stream-recharge devices will serve road-reserve catchments and are proposed as Auckland Transport assets.

The principal objective is to maintain suitable baseflows and hydrological support for the retained stream environments. This will be achieved through the gradual discharge of treated and detained flows from the communal wetlands and recharge devices, supplemented by groundwater collected through the proposed underfill drainage network.

Post-development recharge catchments have been assigned to the relevant stream heads, having regard to their pre-development contributing areas and the proposed stream realignments. The assessment focuses on the flows delivered to the retained upper reaches rather than requiring an exact replication of peak flows at every downstream location.

For Stream 7, the recharge assessment is based on the combined contribution to the relevant tributary heads rather than the materially larger flow at their downstream convergence. This better represents the flow available to support the retained upper stream reaches.

The pre-development and post-development recharge catchments are shown on Drawings P25-609-01-3080-DR and P25-609-01-3090-DR, respectively.

4.3.3. Wetland Re-Charge

Several natural and potential wetlands occur within or immediately adjoining the retained stream corridors. In some locations, portions of a drainage feature have been classified as wetland rather than watercourse, while elsewhere wetland vegetation extends around the stream channel and banks, as identified in the freshwater feature mapping prepared by Viridis.

Separate pre-development catchments will not be replicated for each retained wetland. However, earthworks setbacks around the retained wetlands will be applied where practical to help preserve the immediate catchment area.

The proposed stream-recharge system, together with underfill drainage and the gradual discharge of treated and detained stormwater, will assist in maintaining the local hydrological conditions that support the retained wetlands following development.

4.3.4. Stormwater Asset Ownership and Management

The proposed drainage reserves will accommodate the principal communal stormwater-management devices, receiving watercourses, outlet structures and associated maintenance access. The reserves have been configured to provide suitable access for inspection, routine maintenance and any longer-term remedial works.

The drainage reserves are proposed to vest in Auckland Council so that the stormwater assets and receiving environments can be managed as an integrated public system. This will support consistent long-term maintenance, preserve access to the infrastructure and help maintain the intended hydraulic and environmental performance of the stormwater network.

5. WASTEWATER DESIGN

5.1. Existing and Planned Public Wastewater Infrastructure

The existing Milldale trunk sewer is located generally alongside Waterloo Creek and extends through the vicinity of Stage 16. An existing wastewater main is also located within Sidwell Road and could service a small eastern portion of the Development Area under a public servicing arrangement. Wastewater entering these networks is ultimately conveyed to the Army Bay Wastewater Treatment Plant.

Although public wastewater infrastructure is located near the site, sufficient public treatment capacity and an approved connection have not presently been confirmed for Milldale Stages 14–17. The availability of public servicing will depend on the timing and capacity provided by the planned Army Bay upgrades, together with Watercare approval of the proposed connection arrangements.

5.2. Wastewater Servicing Strategy

For wastewater servicing purposes, the infrastructure has conservatively been designed for the maximum development yield for which consent is being sought, 1,425 dwelling unit equivalents (DUEs), providing an allowance for the proposed commercial superlot and any future unforeseen increases to the development yield.

The development-wide wastewater network, together with any private treatment and dispersal infrastructure required under the applicable servicing scenario, will be delivered as part of Phase 1 and has been sized for the ultimate development yield. Service connections will be delivered during the Phase 1 (standalone dwellings) and Phase 2 (superlot dwellings) civil works.

The application provides for the following three wastewater servicing scenarios:

- **Fully Private Servicing** – All stages would be serviced by a development-wide low-pressure sewer (LPS) network discharging to the proposed private wastewater treatment plant and associated discharge infrastructure within Te Korowai o Maraeariki. This arrangement could remain as the long-term wastewater servicing solution if sufficient public wastewater capacity and an approved connection do not become available.
- **Interim Private Servicing and Future Public Connection** – A development-wide LPS network would initially discharge to the private wastewater treatment plant, with treated wastewater conveyed to the associated dispersal infrastructure. Once sufficient public capacity and approved connections become available, the applicable parts of the network would be redirected to the public wastewater system.
- **Immediate Public Servicing** – Where sufficient public capacity and approved connections are available before the relevant civil works commence, the development would connect to the public wastewater network from the outset.

As the application provides for these alternative servicing scenarios, the internal wastewater infrastructure may comprise an LPS network, a gravity network, or a combination of the two. The applicable arrangements are shown on the P25-609-01-4000-WW drawing series and described in the following subsections.

5.3. Private Servicing and Low Pressure Sewer Network Design

5.3.1. Low Pressure Sewer Network Design

Under the fully private and interim private servicing scenarios, wastewater from Stages 14–17 will be collected through a development-wide low-pressure sewer network.

Individual wastewater pump units will discharge to a series of pressure collector mains. The Phase 1 civil works will provide the collector and terminal mains, together with service connections for the standalone lots, all sized for the ultimate development. Localised collector mains and dwelling service connections within the residential superlots will be provided through the Phase 2 civil works, with the private drainage and pump units connected during the subsequent building development.

Collector mains will generally be provided on both sides of roads where development fronts both sides, allowing service connections to be made without routinely crossing beneath the carriageway. The collector mains will combine into a terminal main that crosses the Ōrewa Awa and conveys wastewater to the proposed private wastewater treatment plant within Te Korowai o Maraeariki.

The consent-level LPS network has been designed in accordance with the applicable pressure-sewer requirements of the Watercare Code of Practice. This will facilitate the network's potential future connection to, and vesting within, the public wastewater network (subject to subsequent Watercare approvals).

The hydraulic assessment indicates that the network can satisfy the applicable pressure-sewer design criteria. Isolation valves will be provided at major branch connections, flushing points at the heads of branch mains and dead-end sections, and air-release valves at identified high points.

Detailed design of the LPS reticulation and associated operational infrastructure will be undertaken through the relevant EA applications. Individual dwelling pump units and private drainage connections will be confirmed through the subsequent building-consent process.

Detailed design of the LPS reticulation, individual pump systems and associated operational infrastructure will be undertaken as part of the subsequent Engineering Approval applications.

Further details of the network layout, design methodology and hydraulic assessment are provided in the Milldale Stages 14–17 Fast-track – Wastewater Servicing and Low Pressure Sewer Design Memo, included in **Appendix F**.

5.3.2. Wastewater Treatment Plant and Treatment Process

Wastewater collected by the LPS network will be treated at the proposed private wastewater treatment plant within Te Korowai o Maraeariki, north of the Ōrewa Awa. The treatment plant and associated discharge infrastructure may operate as either the long-term private servicing solution or as an interim system until public servicing becomes available.

Following treatment, all treated wastewater will be conveyed by pumped main to the constructed cascading wastewater dispersal wetland. The treated wastewater will be discharged at the upper part of the wetland and progressively pass through a series of bunded wetland areas, providing further treatment and controlled dispersal.

Following passage through the cascading wetland, treated water will filter through to the adjoining riparian wetland and stream tributary. No direct discharge from the proposed wastewater treatment plant to the Ōrewa Awa or its tributaries are proposed.

The wastewater treatment plant, pumped conveyance infrastructure and cascading wastewater dispersal wetland are shown on the P25-609-02 series drawings, also included in **Appendix A**.

Further detail on the selected treatment process and dispersal arrangement is provided in the supporting reporting prepared by Apex Water for the treatment-plant design and WWLA for the hydrology and dispersal assessment.

5.3.3. Future Conversion of the Low-Pressure Sewer Network to Public Servicing

The proposed LPS network has been designed to Watercare standards to facilitate its potential future connection to, and vesting within, the public wastewater network.

Once sufficient public capacity and approved connection points become available, the applicable terminal sections of the LPS network could be modified so that wastewater is redirected to the public trunk network rather than the private wastewater treatment plant.

The final conversion arrangement will depend on the extent of the LPS network constructed at that time, the confirmed public connection locations and levels, available capacity and the operating conditions of the public network. The affected terminal mains and their hydraulic performance will be reviewed against those confirmed requirements before a connection is made.

5.4. Public Servicing and Gravity Network Design

Under the immediate public servicing scenario, or where public servicing becomes available before the relevant wastewater infrastructure is constructed, the development would be serviced through a predominantly gravity wastewater network connected to the public system.

The development-wide gravity network will be constructed as part of the Phase 1 civil works and sized for the ultimate development. Service connections for the standalone lots will also be provided through those civil works. Localised gravity reticulation and dwelling service connections within the residential superlots will be provided through the Phase 2 civil works.

The existing Milldale Trunk Sewer is located generally alongside Waterloo Creek and ultimately conveys wastewater to the Army Bay Wastewater Treatment Plant. Public servicing of the development will depend on sufficient capacity being available within both the downstream network and the Army Bay treatment system, including capacity arising from the planned Army Bay upgrades, together with Watercare approval of the proposed connections.

Stages 14 and 15 would generally drain by gravity to a proposed wastewater pump station in the north-eastern part of Stage 15. Wastewater would then be pumped across Wainui Road to the Milldale Trunk Sewer alongside Waterloo Creek.

Stages 16 and 17 would be serviced predominantly by gravity connections to the adjoining public trunk network. A small eastern sub-catchment would connect through the existing wastewater main within Sidwell Road, while limited localised LPS reticulation – connected into the gravity lines – may be used where gravity servicing is not practicable.

The gravity reticulation, pump station, rising main and public connection infrastructure will be designed in accordance with Watercare requirements and confirmed through the Engineering Approval process.

6. WATER RETICULATION

6.1. Existing and Planned Public Water Infrastructure

Existing public water supply infrastructure serves the developed portions of Milldale and is located adjacent to parts of Stages 14-17. However, sufficient public network capacity and approved connection arrangements have not yet been confirmed for the proposed development.

Watercare's April 2026 assessments identify that there is currently physical capacity available within the North Harbour 1 Watermain under the operating and demand conditions assessed. Access to this capacity remains subject to Watercare's risk-based planning considerations and project-specific confirmation and approval.

The availability of public servicing will depend on Watercare confirming suitable connection points and the available network pressure, flow and capacity. The application therefore provides for the alternative water-supply servicing scenarios described in Section 6.2.

The North Harbour 1 Watermain: Remaining Headroom and Growth Implications – Technical Assessment Report and associated North Harbour 1 Watermain: Planning Assessment are included in **Appendices H and I** respectively.

6.2. Water Supply Servicing Strategy

For water-supply purposes – as with the wastewater servicing – the infrastructure has conservatively been designed for the maximum development yield for which consent is being sought, 1,425 DUEs, providing additional capacity for the commercial superlot and any future unforeseen increases to the development yield.

The application provides for the following three water-supply servicing scenarios:

- **Fully Private Servicing** – All stages would be supplied through a development-wide water reticulation network connected to the proposed private water treatment plant and associated water-source infrastructure within Te Korowai o Maraeariki. This arrangement could remain as the long-term water-supply solution if sufficient public water-supply capacity and approved connections do not become available.

- **Interim Private Servicing and Future Public Connections** – The development would initially be supplied from the private water supply and treatment plant, before the reticulation network is connected to the public water-supply network once sufficient capacity and approved connections become available.

- **Immediate Public Servicing** – Where sufficient public capacity and approved connections are available from the outset, the proposed reticulation would connect directly to the adjacent public water-supply network.

A common water reticulation layout has been developed for all three scenarios. The network can therefore be supplied from either the proposed private water treatment plant or approved public connections, subject to confirmation of the applicable supply conditions.

Watercare's April 2026 assessments confirm that there is currently physical capacity within the North Harbour 1 Watermain under the operating and demand conditions assessed. Access to that capacity remains subject to Watercare's risk-based planning considerations and confirmation of project-specific connection arrangements.

The proposed arrangements are shown on the relevant water-supply drawings and described in the following subsections.

6.3. Private Water Supply and Reticulation Design

6.3.1. Water Reticulation Network Design

Under the fully private and interim private servicing scenarios, potable water will be supplied from the proposed private water take (groundwater and surface water) and treatment plant to a development-wide network of principal and local watermains.

Watermains will generally be located within road reserves or other accessible areas and configured to provide network connectivity and operational resilience. The same reticulation layout and pipe sizing would also be retained if the development subsequently transitions to public water supply.

The network has been designed with reference to the Watercare Code of Practice for Land Development and Subdivision. The design considers anticipated demands, operating pressures, flow velocities, headloss and firefighting water-supply requirements.

Different demand bases have been adopted for the reticulation network and the private water-source, storage and treatment infrastructure. The reticulation network has been designed to the full Watercare Code of Practice demand criteria for all three servicing scenarios, while the private source, storage and treatment infrastructure has been assessed on the basis of the proposed water-efficiency measures, including dual low-flush toilets.

Designing the network to Watercare requirements will facilitate its potential future connection to, and vesting within, the public water-supply network. Any future connection or vesting will remain subject to Watercare review and approval.

Detailed design of the watermains, service connections, valves, hydrants, metering and associated operational infrastructure will be completed through the EA process. Phase 1 will provide these works for the standalone lots, while localised reticulation and service connections for the proposed superlot dwellings will be provided through the Phase 2 civil works.

The consent-level water reticulation arrangement is shown on the P25-609-01-5000-WR drawing series. Further details of the demand assessment, network sizing and hydraulic performance are provided in the *Milldale Stages 14–17 – Water Supply Network Design Memo*, included in **Appendix G**.

6.3.2. Private Water Sources and Water Supply Treatment Plant

Raw water for the private water supply will be obtained from a combination of groundwater and surface-water sources within Te Korowai o Maraeariki.

Groundwater will be abstracted from a proposed bore located alongside the private water treatment plant and conveyed directly to the plant for treatment.

Surface water will be abstracted from the Ōrewa Awa when river flows exceed the specified abstraction threshold. The intake will include the associated pumping, monitoring and control infrastructure required to manage the abstraction. Raw water will be conveyed by pumped main from the intake to the proposed surface-water reservoir located west of the treatment plant.

The reservoir will provide storage for periods when abstraction from the Ōrewa Awa is constrained or unavailable, including extended dry-weather periods.

Raw water from the groundwater bore and surface-water reservoir will be treated at the proposed private water treatment plant to achieve the applicable drinking-water quality requirements before being pumped into the development-wide reticulation network.

The groundwater bore, Ōrewa Awa intake, surface-water reservoir, treatment plant and associated conveyance infrastructure are shown on the P25-609-02 series drawings, included in **Appendix A**.

The abstraction arrangements, operating controls, monitoring requirements and associated effects are addressed in the supporting WWLA and specialist water-supply reporting.

6.3.3. Future Conversion to Public Water Supply

Under the interim private servicing scenario, the development may subsequently transition to public water supply once sufficient capacity and approved connection points become available.

The proposed reticulation network has been designed with reference to Watercare standards and the adjacent Milldale public water infrastructure so that it can be retained following this transition. Once public servicing becomes available, the network would be connected to one or more approved public connection points and the private water treatment plant and associated private water-source and treatment infrastructure may be decommissioned.

The final conversion arrangement will depend on the approved connection locations, available public network capacity, pressures and flows, and Watercare's operational requirements. The hydraulic performance of the network will be reviewed against the confirmed public supply conditions before the connections are implemented.

Any future vesting of the reticulation infrastructure will remain subject to Watercare approval.

6.4. Public Water Supply Servicing

Under the immediate public servicing scenario, or where public water supply becomes available before the relevant private infrastructure is constructed, the proposed development-wide reticulation network would connect directly to one or more approved connection points within the adjacent public network.

This arrangement will be dependent on Watercare confirming sufficient capacity, pressure and flow to service the development, together with approval of the proposed connection arrangements.

The proposed reticulation layout and sizing would remain substantially the same as under the private servicing scenarios. The network hydraulic performance would, however, be reviewed against the confirmed public connection locations and supply conditions. Any necessary modifications, including connection infrastructure, metering and backflow prevention, would be confirmed through the EA process.

Under this arrangement, the private groundwater bore, Ōrewa Awa intake, surface-water reservoir and water treatment plant would not be required.

7. UTILITY SERVICES

The proposed development will be serviced by extensions to the utility networks established through the preceding stages of Milldale. The final layouts and any required network upgrades will be coordinated with the relevant service providers during detailed design.

7.1. Power Reticulation

Stages 14–17 will be supplied by extending the power-reticulation infrastructure installed as part of the Stages 8, 10, 11 and 12 civil works.

The proposed power network and any upstream extensions or upgrades required to service the development will be confirmed through detailed reticulation design and coordination with Vector.

7.2. Telecommunication

Telecommunications services will be provided by extending the infrastructure installed as part of the Stages 8, 10, 11 and 12 civil works.

The proposed telecommunications network and any extensions or upgrades required to service Stages 14–17 will be confirmed through detailed design and coordination with the selected fibre supplier.

7.3. Natural Gas

Natural gas is not proposed within Stages 14 to 17.

8. SAFETY IN DESIGN

While developing the design, the philosophy has been to integrate hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life cycle of the development.

Safety in Design (SiD) has been considered during the design of Stages 14 to 17. The SiD commentary in this Section should be used to inform further detailed design of the project.

A detailed review of SiD will also be provided as part of the future EA application, which will incorporate further SiD considerations with detailed design.

8.1. Construction Considerations

8.1.1. Site Access

Stabilised site access is to be provided from public roads to each earthworks and civils stage. These site access points should be located in areas of good visibility both to and from the access point. Priority for these locations should be given to public roads with posted speeds of 50 km/hr and must be accompanied by suitable temporary traffic control.

8.1.2. Steep Batter Slopes

Batter interfaces are required where the design model interfaces with the following features:

- Existing ground levels at the extents of the earthworks area (batter slopes typically 1V:5H to maximum 1V:3H);
- Riparian margin either side of the Streams and dry basins (batter slopes typically 1V:3H); and
- Reinforced earth slopes (1V:2H).

Construction mitigation:

- Riparian margin batter slopes modelled to a maximum grade of 1V:3H;
- All batter slopes will be identified with the contractor at the pre-construction meeting; and
- Batter slopes are to be fenced at the top of batter with high-visibility safety mesh fencing or high-visibility line flags at the completion of each stage.

All geotechnical stabilisation works, including reinforced earth slopes, shear keys, buttresses and subsurface drainage, will be undertaken under the supervision of a suitably qualified geotechnical engineer and in accordance with the recommendations of the Geotechnical Investigation Report.

8.1.3. Trenching

The proposed stormwater reticulation network has been designed in accordance with the applicable Auckland Council Stormwater Code of Practice V5, while the wastewater network has been designed with reference to the Watercare Code of Practice.

All trenching operations shall be carried out in accordance with the Approved Code of Practice for Safety in Excavation and Shafts for Foundations, Part One: Trenches and Open Excavations.

Trench depths have been minimised where practicable through coordination with the proposed finished landform and other services. Detailed service levels, clearances and drainage long sections will be confirmed through the Engineering Approval process.

Trenching within soft or firm alluvial soils may require temporary support, safe battering and groundwater control, particularly where excavations extend below the groundwater table. These matters will be addressed through the contractor’s construction methodology and site-specific health and safety planning.

8.1.4. Drainage Networks Layout

The layout of the drainage networks (stormwater and wastewater) will be reviewed with detail design drawings to be submitted with the EA.

At this stage consideration has been given to the network layout including:

- Location of manholes to provide for safe maintenance access;
- Locating manholes out of the future riparian margin to provide safe maintenance access;
- Limiting infrastructure immediately adjoining retained watercourses to necessary stormwater outlets and associated structures; and
- Minimising the number of stormwater pipes crossing future roads, to reduce the amount of possible future maintenance works within the carriageway.

8.1.5. Private Servicing Infrastructure and Bridges

The proposal includes private water and wastewater infrastructure within Te Korowai o Maraeariki, together with associated pipelines, accessways, the surface-water reservoir, Ōrewa Awa intake, wastewater dispersal wetland and bridge crossings.

The detailed design and construction methodology for these works will consider matters including safe construction access, work near waterways, temporary works, large structures and tanks, lifting operations, embankment construction, mechanical and electrical installation, and geotechnical foundation requirements.

The bridge structures and private servicing facilities will be subject to further specialist SiD assessment through their detailed structural, geotechnical and process design.

8.2. Operations Considerations

Stages 14–17 have been designed primarily as a residential subdivision. The design has considered the following operational and maintenance risks.

8.2.1. Safe Access for Maintenance

Manholes are generally located in the road reserve or within 3.0m set back of lot frontage, clear of the carriageway, to provide safe access.

Landscaped batters will generally be no steeper than 1V:3H, providing a practical slope for normal landscape maintenance.

8.2.2. Stormwater Devices (Wetlands, Communal Devices and Stream Re-Charge Devices)

Stormwater devices are designed with surrounding batters being no steeper than 1V:3H to provide a safe working slope to access the device inlet and outlet structures.

The constructed wetlands will have maximum water depths exceeding 1.5 m. To mitigate drowning risk, the following measures will be incorporated, subject to confirmation through detailed design at the EA stage:

- Internal safety benching around the wetland margins to assist a person to regain footing and exit the device following accidental entry;
- External safety fencing, either as an interim measure while perimeter planting becomes established or as a permanent measure where required; and
- Dense perimeter planting to discourage unintended access to the water's edge.

The devices will also incorporate stable batters and formed maintenance access (3.5m wide). Detailed design will consider safe access to operational structures, maintenance-vehicle requirements, sediment and vegetation removal, and appropriate edge treatment.

8.2.3. Retaining Walls and Reinforced Earth Slopes

The retaining walls (no higher than approx. 3.0m in height) will be constructed as part of this consent. All retaining walls will be fenced in accordance with the building code.

Reinforced earth slopes will be completed as part of the Stages and are no steeper than 1V:2H. These will be fenced above the top of the slope to prevent falls. These slopes will also be planted with low maintenance plantings, to avoid the need for access to the slope.

8.2.4. Safe Transport Operations

SiD has been considered for vehicle, pedestrian and cyclist movements.

The proposed road hierarchy provides lower-speed local-road environments connected to the collector-road network.

Walking and cycling facilities are separated from traffic where appropriate, with intersection design, sight distances, crossing facilities, traffic calming and street lighting to be confirmed through the EA process.

8.2.5. Crime Prevention Through Environment Design (CPTED)

CPTED principles have been considered in the proposed road, shared-path and pedestrian-route layouts.

The design provides for:

- Pedestrian-accessway corridors typically 8 m wide, incorporating formed paths within the corridors;
- Passive surveillance from adjoining lots;
- Lots and public frontages oriented toward pedestrian routes and open spaces;
- Suitable lighting of pedestrian and active-mode connections; and
- Clear sightlines and legible routes.

Detailed lighting, landscaping and accessway design will be confirmed through the EA and landscape-approval processes.

8.2.6. Stormwater Overland Flow Paths

Overland flow paths have been designed in accordance with the applicable Auckland Council Stormwater Code of Practice V5. The design model ensures that no private property is located within the 1% AEP flow. Overland flow paths are generally contained within the road reserve, pedestrian accessway, stairway, or riparian reserve and are clear of private property. Refer to Woods' drawing P25-609-01-3020-DR series for the overland flow path plans and sections.

8.2.7. Private Water and Wastewater Infrastructure

The private water and wastewater infrastructure will require controlled operational access and specialist maintenance.

The detailed facility designs will consider:

- Secure access to the treatment facilities and associated infrastructure;
- Safe vehicle access and equipment-delivery areas;
- Access to tanks, pumps, valves and monitoring equipment;
- Electrical and mechanical isolation;
- Confined-space and pressurised-system risks;
- Safe access around the reservoir, intake and wastewater dispersal wetland; and
- Sufficient space for inspection, maintenance and replacement of major equipment.

The relevant operation and maintenance manuals and emergency procedures will be prepared before the private facilities become operational.

9. CONCLUSION

FHLD is seeking consent to develop Milldale Stages 14–17 as a comprehensively planned extension to the existing Milldale urban area.

The proposal provides for 926 standalone residential lots and 44 residential superlots, with an indicative yield of approximately 475 dwellings within the superlots and a maximum development potential of 1,425 dwellings. It also includes a commercial superlot, public roads, JOALs and accessways, reserves and the supporting infrastructure required to enable the development.

The consent package is structured in two phases. Phase 1 comprises the bulk earthworks and principal civil and infrastructure works, including creating standalone lots for housing construction and the residential superlots for their subsequent development. Phase 2 provides for the localised subdivision and servicing of the residential superlots.

This Infrastructure Report demonstrates that the development can be supported by the proposed earthworks, transport and active-mode networks, stormwater-management system, utility services, and water-supply and wastewater infrastructure. The stormwater system applies an integrated, catchment-based approach that provides water-quality treatment, hydrology mitigation, flood management and hydrological support for retained streams and wetlands, with the primary network and communal devices designed for the ultimate development catchments.

The application provides flexibility for water supply and wastewater to be privately serviced on either an interim or long-term basis, transitioned to public servicing when sufficient capacity and approved connections become available, or publicly serviced from the outset. The proposed private infrastructure within Te Korowai o Maraeariki provides a viable servicing solution where public capacity is unavailable, while the development-wide networks have been designed to facilitate future connection to the public systems where applicable.

On this basis, the consent-level design confirms that Milldale Stages 14–17 can be appropriately formed, accessed, drained and serviced through the infrastructure shown on the application drawings and described in this report. Further design detail will be confirmed through the applicable Engineering Approval, building-consent, specialist-design and pre-construction approval processes.

Appendix A – Phase 1 Engineering Plans (Bound Separately)

Appendix B – Phase 2 Engineering Plans (Bound Separately)

Appendix C – Milldale Earthworks 14-17 – Earthworks Methodology Report
(bound separately)

Appendix D – Construction Management Plan Requirements

Milldale Construction Management Plan Requirements (CMP)

Date: 31 July 2026

Status: Draft - Subject to Contractor Construction Methodology

This document provides a preliminary outline of the content expected to be included within Construction Management Plans (CMPs) required as pre-construction conditions for each earthworks season or subdivision works stage within the Milldale Fast-track works.

Following award of each relevant earthworks or subdivision construction contract, the appointed contractor shall prepare a site-specific CMP. Each CMP shall be tailored to the relevant season or stage of works and submitted in accordance with the applicable resource consent conditions.

Each CMP shall include, but not be limited to, the following information:

1. Project Description

Details of the Project Description will be provided for each earthworks construction season and each sub-stage of civil construction.

The Project Description will be contract and stage specific, and include the following details:

a) Site location
b) General scope of works
c) Specific construction elements to be undertaken, i.e. earthworks, drainage works, retaining, landscaping, etc.
d) Project deliverables, i.e. completed subdivision, stage numbers
e) Timeframes for key stages of works

2. Project Management

Details of Project Manager(s) to be provided for each earthworks construction season and each sub-stage of civil construction.

Project Manager(s) will be contract and stage specific. The CMP shall include the following details:

a) Site Supervisor – name and contact information
b) Project Engineer – name and contact information
c) Project Manager - name and contact information
d) Project Director - name and contact information

3. Health and Safety Plan

Health and Safety Plans shall be prepared specifically for each earthworks construction season and each sub-stage of civil construction.

The contractor shall take responsibility for preparing an appropriately detailed Health and Safety Report and implement the Health and Safety Plan for the duration of the works.

The Health and Safety Plan shall include but not be limited to the following information:

a) Site-specific health and safety managers and contact details. Identify roles and responsibilities
b) Site-specific health and safety risks
c) Identification of hazards and risks specific to the project
d) Risk Assessment and management controls
e) Procedures for undertaking High Risk Activities
f) Site layout of Health and Safety inventory on site
g) Sign in procedures for visitor management
h) Emergency management response
i) Health and Wellbeing procedures
j) Incident Reporting and investigation procedures
k) Required Personal Protective Equipment (PPE)
l) Monitoring and review procedures

4. Working Hours

The hours of construction work are to be identified in the plan and are to be in accordance with the approved Resource Consent conditions. The proposed condition in the application is:

All construction works authorised by this consent must only take place between 7.00am and 6.00pm, Monday to Saturday, with no works undertaken at any time on Sundays, or on public holidays.

Machinery and heavy vehicles operated between 7.00am and 7.30am must be located at least 130 m from any occupied building. Vibratory pile driving, mulching, chipping, bored piling and chainsaw work must only take place between 7.30am and 6.00pm, Monday to Saturday. Chipping and mulching must not take place within 60 m of any occupied building

5. Site Access

Details of Site Access will be provided for each earthworks construction season and each sub-stage of civil construction.

Site Access will be contract and stage specific and include the following details:

a) A plan showing the stage of works, including street / road names
b) Site ingress and egress locations
c) Site compound and site office locations.
d) Location of signage and hazard boards.

e) Extent of security fencing
f) Location of wash down facilities at egress locations
g) Location of first aid and health and safety equipment.

6. Construction Traffic Management Plan

Construction Traffic Management Plan (CTMP) shall outline measures to ensure the safe and efficient movement of vehicles, pedestrians, and cyclists in and around the construction site. The plan shall include details around the access to the site to comply with the Code of Practice for Temporary Traffic Management (CoPTTM) and all relevant local and national regulations.

Details of Construction Traffic Management will be provided for each earthworks construction season and each sub-stage of civil construction.

Within Milldale Construction Traffic will be managed in a way to minimise any disruption to residents within the development and to users on the surrounding road network.

Construction Traffic Management will be contract and stage specific and include the following details:

a) Provide a parking management plan for construction traffic.
b) Address the transportation and parking of oversize vehicles (if any).
c) Provide appropriate loading / working areas to minimise disruption to traffic.
d) Provide cleaning facilities within the site to thoroughly clean all vehicles prior to exit to prevent mud or other excavated material from being dropped on the road. In the event that material is dropped on the road, resources should be on hand to clean-up as soon as possible.
e) Provide traffic management plans in compliance with the latest edition of the NZTA "Code of Practice for Temporary Traffic Management" (COPTTM) document.
f) Ensure the site access point shall be clearly signposted.
g) Include measures that are to be adopted to ensure that pedestrian access on the adjacent public footpaths in the vicinity of the site is safe during construction works.
h) Detail how the works will be undertaken to maintain access to properties adjacent to the work site during construction and address the duration time frame for sites with no-vehicle access during the works.
i) Identify proposed numbers and timing of heavy vehicle movements throughout the day.
j) Identify the location of vehicle and construction machinery access during the period of site works.
k) Identify the storage and loading areas for materials and vehicles.
l) For each construction phase, identify the location and duration of any road or lane closures, division of road closures into segments, duration of works in each closure, indication of detour routes for each closure and assessment of the effects on the Auckland Transport Road network of any road closures and a plan to mitigate these effects.
m) Detail how communication with drivers regarding diversion routes will be undertaken, and how this will be monitored to confirm the expected level of diversion is achieved.

n) Identify the relevant Auckland Transport approvals.

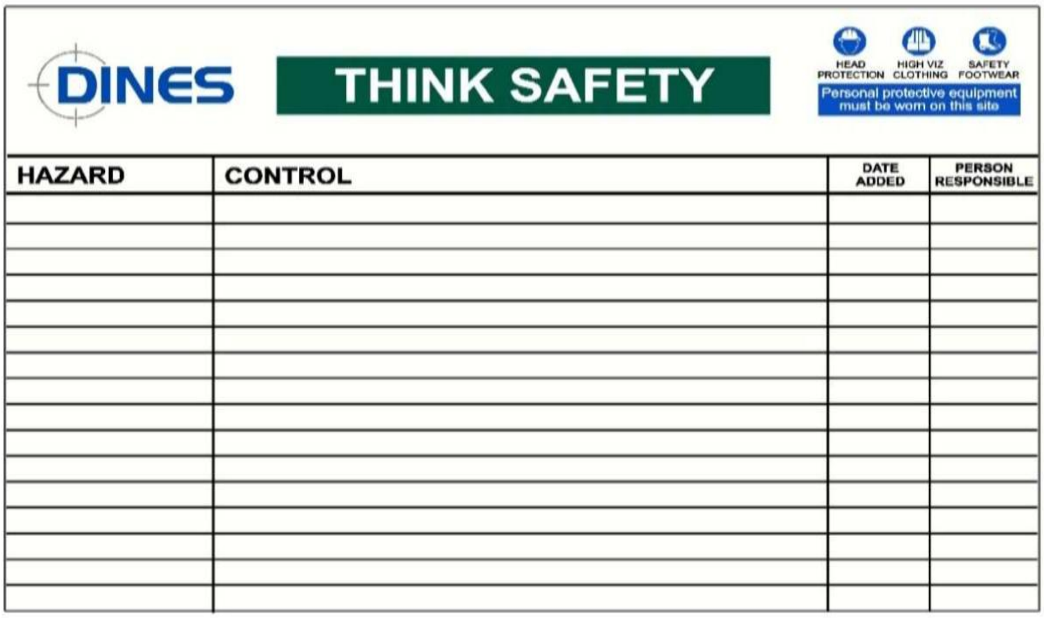
It is the responsibility of the Contractor and/or Applicant to obtain the relevant traffic management approvals from Auckland Transport.

7. Site Notice Board

A large and visible notice board will be located at the site entry points and be clearly visible to any construction traffic prior to entering the site. The notice board will include site hazards along with contact details for the Site Manager. Examples of the site notice boards;

450mm x 600mm

450mm x 600mm



8. Environmental Management

Details of Environmental Management shall be provided for each season of earthworks or stage of subdivision works.

Environment management plans prepared within the CMP shall be in accordance with the requirements of the resource consent conditions.

9. Sediment and Erosion Control Plan

Prior to the commencement of each earthworks construction season and each sub-stage of civil construction on the subject site, finalised Erosion and Sediment Control Plans must be prepared in general accordance with the application documents referenced in condition 1 and in general accordance with Auckland Council Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016, Incorporating Amendment 2 (GD05), and submitted to the Council. No earthworks activity on the subject site must commence until the Council has confirmed that the ESCP(s) satisfactorily meets the requirements of GD05. The plans must contain sufficient details to address the following matters:

a) specific erosion and sediment control measures for the earthworks stages (location, dimensions, capacity) including the location of any sediment retention ponds and decanting earth bunds, super silt fences, clean and dirty water diversion bunds and stabilised construction entrances, in general accordance with GD05;
b) supporting calculations and design drawings as necessary;
c) details of construction methods;
d) monitoring and maintenance requirements;
e) catchment boundaries and contour information as necessary;
f) confirmation of any erosion and sediment control measures associated with construction of pedestrian bridges and culvert installation; and
g) details relating to the management of exposed areas (e.g. grassing, mulching).
h) Outline conformance measures to ensure compliance with the approved Adaptive Management Plan (AMP)
i) Site inspection procedures including timings for regular inspections and specific inspections for rainfall trigger events as detailed in the AMP.
j) Streamworks management and detailed methodologies for in-stream works, such as culvert installation

10. Chemical Treatment Management Plan

Prior to the commencement of earthworks activity on the subject site, a Chemical Treatment Management Plan (ChTMP) must be prepared in general accordance with Auckland Council Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region, June 2016, Incorporating Amendment 2 (GD05), and submitted to the Council. No earthwork activities must commence until confirmation is provided by the Council that the ChTMP meets the requirements of GD05, and the measures referred to in that plan for the sediment retention ponds and / or decanting earth bunds have been put in place. The plan must include as a minimum:

a) Specific design details of a chemical treatment system based on a rainfall activated methodology for the site's sediment retention ponds, decanting earth bunds or any other approved impoundment devices;
b) Monitoring, maintenance (including post storm) and contingency programme (including a record sheet);

c) Details of optimum dosage (including assumptions);

d) Results of initial chemical treatment trial;

e) A spill contingency plan; and

f) Details of the person or bodies that will hold responsibility for long term operation and maintenance of the chemical treatment system and the organisational structure which will support this system.

11. Dust Management Plan

The Contractor will need to prepare a site-specific Dust Management Plan (DMP) for each new season of earthworks and submit this as part of their pre-construction documentation prior to works commencing. This plan will identify appropriate dust mitigation strategies for the site.

The site-specific DMP will have an allowance for a dedicated water cart resource, dust fences and daily management strategies to avoid dust nuisance to neighbouring properties.

While the Contractor's Dust Management Plan will ultimately provide the management regime for dust nuisance mitigation, the following measures will be expected as part of an effective dust mitigation strategy for this site. Allowance will be made in the construction contract for implementation of these dust control measures.

- The Contractor shall prepare a site-specific DMP for each earthworks season in accordance with the relevant resource consent conditions;
- The Contractor is to monitor dust emissions daily and implement appropriate measures as necessary;
- The Contractor shall provide sufficient water carts and/or sprinklers that are capable of ensuring that the exposed areas of the site are appropriately moistened to avoid dust nuisance at neighbouring properties. Particular attention shall be given to sensitive receivers identified in the site-specific DMP;
- On site traffic management, including specific traffic control measures in areas that are sensitive to dust generation;
- The site is to be watered at the end of each working day when it is considered that a dust nuisance may exist following the close of works for that day. (unless there is sufficient rain or showers, falling or forecasted);
- The site is to be watered if strong winds are forecast, and these coincide with dry ground conditions to avoid dust nuisance towards neighbouring properties;
- Adjoining owners will be informed with a pre-construction communication which will include a 24-hour contact telephone number to call the site Contractor for dust and other complaints;
- The Contractor is to promptly implement additional dust control measures when a complaint is received, and they are to note the complaint, outcomes, and actions;
- A record of dust events and complaints is to be recorded in weekly site meetings;
- Earthworks on site are to be staged to allow for progressive stabilisation. Once areas of works are completed to finished ground, progressive revegetation to pasture is to be undertaken over these areas. Monitoring of this revegetation is to be undertaken to ensure good uptake until stabilisation is achieved;
- A 3m high dust fence can be erected along the boundary of a neighbouring property where an actual dust nuisance has arisen;

- Stockpiles to be stabilised if not in use;
- When loading / unloading trucks, materials are to be dropped from as low a height as practicable;
- Removal of sediment or dust generating materials from the access roads, haul roads, and public roads with a suction sweeper; and
- Use of a wheel wash facility capable of washing dust from vehicles.
- Dust monitoring procedures in accordance with the site-specific DMP;
- Complaint response procedures in accordance with the site-specific DMP.

12. Construction Staging Methodology

For each earthworks construction season and each sub-stage of civil construction, a site-specific construction staging methodology will be necessary to enable the site to be constructed in a methodical, safe and timely manner.

A Construction Staging Methodology Plan shall include the following items:

- Site Establishment
- Sediment and Erosion Control implementation
- Spatial staging of works across the site
- Detailed programme of the construction works tasks
    - Earthworks
    - Geotechnical works
    - Streamworks
    - Retaining works
    - Drainage works
    - Roading works
    - Services
    - Landscaping
- Stabilisation of the site
- Removal of Sediment and Erosion Control devices
- Demobilisation and site presentation
- Final walkovers and site certifications

Appendix E – Milldale Stages 14-17 – Stormwater Design Memorandum

To

Auckland Council

From

Woods
Sam Kirk – Associate Engineer

W-REF: P25-609
4 August 2026
Reviewer: Jamie Whyte

Milldale Stages 14-17 – Stormwater Design Memorandum

Statement of Qualifications and Experience

Originator: Sam Kirk – Associate Engineer

I, Sam Kirk, am an Associate Engineer at Woods. Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since July 2025, although also previously between January 2019 and September 2022.

I hold the qualifications of a Bachelor of Surveying, which I completed in 2018, and I also hold a Cadastral Surveying License. I am also a Voting Member of S+SNZ.

I have eight years of experience in the Engineering industry. My experience includes the design and construction observation of a range of land development projects, including project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved with the surveying, design and management of previous Milldale projects, dating back to Stage 1A. I have also been involved in managing multiple land development projects in London and Melbourne.

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

Reviewer: Tim Rickards - Principal

I, Tim Rickards, am a Principal at Woods. I have been employed at Woods since February 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 project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved in the design and construction of most of the previous stages of Milldale including the surrounding Milldale Stage 4 development and the development of the secondary superlot developments at Milldale.

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

Approval: Jamie Whyte – Principal

I, Jamie Whyte, am a Principal at Wood & Partners Consultants Ltd. Wood & Partners Consultants Ltd is a multi-disciplinary consultancy specialising in planning, urban design, civil engineering, water infrastructure and surveying. I have been employed at Wood & Partners Consultants Ltd since January 2004.

I hold the qualifications of a Bachelor of Surveying from the University of Otago (BSurv), which I completed in 2003. I hold a professional qualification as a Register Professional Surveyor (RPSurv). I am a Full (voting) Member of Survey and Spatial New Zealand.

I have 20 years of professional experience in Subdivision Engineering and the Land Development industry. I have extensive knowledge in the design, construction and delivery of large-scale land development projects. My experience includes major roles on some of New Zealand's largest subdivision projects including Stonefields, Long Bay, Millwater and Milldale.

I confirm that, in my capacity as reviewer and 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.

1. Background

This memorandum has been prepared by Woods on behalf of Fulton Hogan Land Development Limited (FHLD) in support of the substantive application for the Milldale Stages 14–17 Project under the Fast-track Approvals Act 2024 (FTAA).

The memorandum presents the consent-level stormwater design for the approximately 231 ha Development Area, with a particular focus on the contributing catchments, primary network interfaces and proposed communal stormwater-management devices. It should be read alongside the Stormwater Assessment – Milldale Stages 14-17, the associated flood modelling results, and the supporting application drawings.

2. Stormwater Design Strategy and Requirements

2.1. Stormwater Management Framework

The Wainui East Stormwater Management Plan, Version 4, dated 2016 and prepared by Woods (the Wainui East SMP V4), was developed for the wider Wainui East Future Urban Zone. However, it has been adopted by Auckland Council Healthy Waters only for the live-zoned Wainui Precinct, comprising the existing Milldale development.

The Milldale Stages 14–17 Development Area remains predominantly zoned Future Urban. It is therefore outside the area for which the Wainui East SMP V4 has been adopted and is not presently covered by the existing regional Network Discharge Consent stormwater-discharge framework.

The Stormwater Assessment – Milldale Stages 14-17 has been prepared in support of the substantive application. That assessment applies the catchment-wide stormwater-management framework, modelling and design approach developed through the Milldale North and Wainui West Stormwater Management Plan, Version 7 to the proposed development. It also supports the project-specific stormwater diversion and discharge permit sought through the application.

This memorandum provides the supporting design detail for the stormwater catchments, communal devices and network interfaces serving Stages 14–17, consistent with the Stormwater Assessment and the technical framework established by the Milldale North and Wainui West SMP V7.

2.2. Design Rainfall and Storm Event Parameters

The rainfall depths adopted for the Milldale Stages 14–17 stormwater design are based on the TP108 rainfall depths for the site, adjusted in accordance with the current Auckland Council Stormwater Code of Practice Version 4 (SWCoP V4) for the 3.8°C increase climate change scenario.

The adopted rainfall depths are summarised below in Table 1.

Milldale Design Rainfall Depth (mm)		
ARI	Rainfall	SWCoP V4 (3.8°C)
1-year	71.8	91.5
2-year	88	112.1
5-year	120	155.5
10-year	145	189.6
100-year	225	298.6

Table 1 – Milldale Design Rainfall Depths

The stormwater management devices are to be designed to the 95th percentile event. This event is defined as a 37mm, 24-hr rainfall event.

2.3. Stormwater Management

The proposed stormwater design applies an integrated, water-sensitive approach comprising:

- Water-quality treatment for runoff from all applicable impervious areas to the relevant GD01/TP10 treatment levels;
- Retention and detention at source, principally through dedicated storage within private roof-water tanks;
- Detention within communal stormwater-management devices where required by the applicable stormwater-management framework;
- Controlled stream recharge to support retained and realigned streams; and
- Safe conveyance of larger storm events through the primary and secondary stormwater networks.

Runoff from roads, JOALs and other public and private hardstand areas will be directed through the applicable communal stormwater-management devices. Roof runoff will be managed using inert roofing materials and private reuse tanks providing at least 5 mm of retention, together with detention storage. The detention component of the private tanks delays the discharge of roof runoff, such that these flows reach the downstream communal devices after the peak of the storm event.

Where detention applies, it will manage the difference between the applicable pre-development and post-development runoff volumes from the 95th-percentile rainfall event, with discharge occurring over a 24-hour drawdown period. Flows exceeding the applicable treatment and detention thresholds will be passed forward through the primary network, overland flow paths and receiving watercourses.

The primary network and communal devices have been sized at consent level for the ultimate development catchments. Final device details, private roof-water tanks and localised superlot reticulation will be confirmed through the applicable Engineering Approval and building-consent processes.

3. Proposed Stormwater Management Strategy

The proposed stormwater strategy builds on the systems implemented through earlier Milldale stages and the wider SMP framework. The Stormwater Assessment applies the updated Milldale North and Wainui West SMP V7 approach to Stages 14–17 and establishes the relevant water-quality, hydrology-mitigation and flood-management requirements.

The proposed treatment strategy comprises:

- Constructed wetlands serving the larger downstream catchments;
- Communal bioretention devices serving isolated or constrained catchments;
- Stream-recharge devices supporting selected retained or realigned streams;
- Private roof-water reuse tanks providing at-source retention and detention; and
- The primary stormwater network conveying flows from events up to the 10% AEP event; and
- The secondary stormwater network conveying excess runoff from larger events up to the 1% AEP event.

Constructed wetlands were the preferred communal device throughout the design-development process. However, their land and sizing requirements meant that communal bioretention devices provided a more practical solution for two isolated catchments while achieving the required stormwater-management outcomes.

The stream-recharge devices consolidate the management of road runoff within larger communal devices at the heads of selected streams. This is consistent with Auckland Transport's preference for integrated devices rather than numerous individual kerbside raingardens.

The detailed catchment allocation, device sizing and discharge arrangements are described in Sections 5 and 7.

4. Stormwater Management Options Assessment

4.1. Constructed Wetlands

Constructed wetlands were the preferred communal device throughout the design-development process and are proposed for the larger downstream catchments. They allow water-quality treatment and hydrology mitigation to be consolidated within devices integrated with the proposed drainage reserves and receiving watercourses.

GD01 Compliance: The wetlands will be designed in accordance with the applicable GD01 requirements for constructed wetland devices.

Treatment: The wetlands will provide water-quality treatment for runoff from roads, JOALs and other public and private hardstand areas. They will also provide detention in accordance with the applicable stormwater-management requirements. Roof runoff will first be managed through private roof-water tanks, with controlled discharges and overflows subsequently conveyed through the downstream stormwater network and wetlands. Larger storm events will bypass or pass through the devices using appropriately designed inlet, outlet and overflow arrangements.

Construction Costs: High – Constructed wetlands require a comparatively large land area, formation of permanent-water and live-storage areas, inlet and outlet structures, planting and maintenance access. Where wetlands can be accommodated within drainage reserves, the impact on developable land is reduced.

Maintenance Costs: Moderate – Routine maintenance will principally involve planting and weed management, removal of litter and sediment, and inspection and maintenance of the inlet and outlet structures. Longer-term sediment removal may require machinery access.

Safety in Design: The permanent water and live-storage areas introduce a potential drowning hazard. Detailed design will incorporate appropriate safety benching, batter slopes, planting, access controls and fencing where required. Safe access to the inlet, outlet and maintenance areas will also be provided.

Summary: Constructed wetlands provide an efficient catchment-scale solution for the larger catchments and offer water-quality, hydrology, landscape and ecological benefits. They are the preferred device where sufficient land and hydraulic head are available.

4.2. Communal Bioretention and Stream Re-Charge Devices

The communal bioretention and stream-recharge devices are consolidated bioretention systems serving combined catchments. This approach provides a practical means of treating and mitigating runoff while avoiding the servicing and maintenance implications associated with numerous individual treatment devices within the road corridor.

The stream-recharge devices are sized for road-reserve catchments and are proposed as Auckland Transport assets. The communal bioretention devices serve isolated catchments where the land and sizing requirements associated with a constructed wetland make a wetland less practical.

GD01 Compliance: The devices will be designed in accordance with GD01 and, where applicable, the Auckland Transport Bioretention Design Guide.

Treatment: The devices will provide water-quality treatment and applicable hydrology mitigation through filtration, temporary storage and evapotranspiration. The stream-recharge devices will also provide controlled discharge to the upper reaches of retained or realigned streams. The design will not rely on infiltration unless suitable ground conditions are confirmed through detailed design.

Construction Costs: Moderate – The construction requirements are generally similar to those for conventional raingardens, including excavation, drainage, filter media, planting and inlet and outlet structures. Consolidating several road catchments into larger communal devices reduces the number of individual devices and associated service conflicts.

Maintenance Costs: Moderate – Maintenance will include litter and sediment removal, weed and planting management, inspection of inlet and outlet structures and periodic replacement of filter media. Although the devices require more maintenance than a detention-only basin, consolidating them into a smaller number of communal assets reduces the servicing, traffic-management and maintenance implications associated with numerous kerbside raingardens.

Safety in Design: The devices are relatively shallow compared with wetlands and conventional drainage structures. Routine inspections and surface maintenance can generally be undertaken without entering confined spaces. Detailed design will address safe maintenance access, batter slopes, maximum ponding depths and temporary traffic-management requirements.

Summary: Communal bioretention and stream-recharge devices provide the treatment performance of raingardens while allowing stormwater management to be delivered across larger, consolidated catchments. They are appropriate for the road-only stream-recharge catchments and for isolated catchments where constructed wetlands are not practical.

4.3. Private Roof-Water Reuse Tanks

Private roof-water reuse tanks are proposed for each residential DUE, including future dwellings within the residential superlots. They provide at-source management of roof runoff and support the integrated treatment approach established by the Milldale North and Wainui West SMP V7 and Stormwater Assessment.

GD01 Compliance: Rainwater reuse systems are consistent with the water-sensitive design principles of GD01, although the detailed design and maintenance requirements for individual tanks are not specifically addressed by GD01.

Treatment: Each tank will provide dedicated reuse storage equivalent to at least 5 mm of runoff from the contributing roof area. The retained water will be available for non-potable uses such as toilet flushing and gardening. Roofs will be constructed using inert materials that do not generate contaminants of concern.

Construction Costs: Moderate – The tanks and associated private reticulation will be installed as part of the building development. The cost is distributed across the individual dwellings rather than requiring a separate communal land area.

Maintenance Costs: Low – Routine maintenance will generally involve inspection and cleaning of the tank, screens, filters, pumps and associated pipework.

Safety in Design: Routine inspection and maintenance should be capable of being undertaken from the surface. The tank design should avoid the need for entry wherever practicable, as any entry would involve confined-space hazards.

Summary: Private roof-water tanks provide the required at-source retention and non-potable reuse without requiring additional communal land. Final tank sizing and design will be confirmed through the relevant building-consent process.

4.4. Other Treatment Devices

A range of stormwater-management devices has been considered against the applicable GD01 requirements and the strategy established through the Milldale North and Wainui West SMP V7 and the Stormwater Assessment – Milldale Stages 14-17. This assessment is summarised below in Table 3.

Treatment Device	Achieve GD01/ SMP Requirements	Shortlisted	Comments
Constructed wetlands	✓	✓	Preferred communal device for the larger downstream catchments. Wetlands provide water-quality treatment and detention where required and are proposed where sufficient land and hydraulic head are available.
Communal bioretention devices	✓	✓	Consolidated bioretention systems serving combined catchments. These are proposed for isolated catchments where the land area or sizing requirements associated with a wetland make a wetland less practical.
Stream-recharge devices	✓	✓	Consolidated bioretention systems serving combined road-reserve catchments. These devices provide treatment, applicable hydrology mitigation and controlled discharge to retained or realigned stream heads. They are proposed as Auckland Transport assets.
Private roof-water reuse tanks	✓	✓	Proposed for residential roof catchments as part of the integrated treatment approach. The tanks provide at-source retention and non-potable reuse, with final design confirmed via the building-consent process.
Individual kerbside raingardens	✓	✗	Capable of providing the required treatment and hydrology mitigation. However, numerous individual devices would create servicing, maintenance and road-corridor constraints. Larger communal devices are preferred, consistent with Auckland Transport's preference for integrated devices.
Individual Offline raingardens	✓	✗	Capable of providing treatment and detention but generally require a similar land area to communal bioretention devices or wetlands. They have not been selected as a separate device type because these func-tions are provided by the proposed communal devices.
Dry basins	✗	✗	Provide detention but not the water-quality treatment required for runoff from all applicable impervious areas. Additional upstream treatment would be required, making them less suitable than the proposed wetlands and bioretention devices.
Underground detention tanks	✗	✗	Can provide detention where land is constrained but do not provide water-quality, ecological or landscape benefits. They also introduce confined-space inspection and maintenance requirements.
Wet ponds	✗	✗	Not preferred due to water-temperature, permanent-water and safety considerations. Constructed wetlands provide a more appropriate treatment solution for the proposed catchments.
Swales	✗	✗	Swales can provide conveyance and some pre-treatment but do not provide the complete treatment and detention functions required without bespoke designs. They may be used as supplementary network elements where appropriate.

Table 3 – Summary of Treatment Devices Considered

5. Stormwater Design Discussion

5.1. Natural Watercourses

Stages 14 to 17 discharges to several watercourses:

Stage 14:

- Stream 4 via piped stormwater reticulation network and stormwater recharge devices.
- Stream 7 via piped stormwater reticulation network and stormwater recharge devices.
- Stream 8 via piped stormwater reticulation network and stormwater recharge devices.
- Orewa Awa via piped stormwater reticulation network and wetlands.

Stage 15:

- Stream 4 via piped stormwater reticulation network and stormwater recharge devices.
- Stream 7 via piped stormwater reticulation network and stormwater recharge devices.
- Orewa Awa via piped stormwater reticulation network and wetlands.

Stage 16:

- Stream 10 via piped stormwater reticulation network and stormwater recharge devices.
- Waterloo Creek via piped stormwater reticulation network, wetlands and communal bioretention devices.

Stage 17:

- Waterloo Creek via piped stormwater reticulation network and communal bioretention devices.
- Watercourse P3 via piped stormwater reticulation network and communal bioretention devices.

5.2. Private Lots

5.2.1. Residential lots

Roof runoff from the residential lots and future residential superlot dwellings will be managed through private roof-water tanks. Each tank will provide dedicated reuse storage equivalent to at least 5 mm of runoff from the contributing roof area and, where required, separate detention storage with controlled discharge over a 24-hour period. Controlled discharges and overflows will connect to the downstream public stormwater network and may pass through the applicable communal stormwater-management device. Final tank sizing and private reticulation will be confirmed through the relevant building-consent process.

Runoff from private hardstand areas and JOALs will be conveyed through the public network to the applicable constructed wetland or communal bioretention device for treatment and hydrology mitigation.

The primary network and communal devices have been sized at consent level to accommodate the anticipated ultimate development of the residential superlots.

5.2.2. Te Korowai o Maraeriki

Te Korowai o Maraeriki is the 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 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.

5.3. Road Reserve, Lot Hardstand and JOAL Detention

Apart from roof runoff which will be treated at source, treatment devices are required to provide detention for the Road Reserve, lot hardstand and JOAL runoff.

Detention requirements will be sized as agreed with Healthy Waters and in line with Section 2.3 above.

5.4. Stormwater Catchments

The stormwater drainage network in Stages 14 to 17 splits the stages into 11 stormwater catchments. Refer to drawings P24-128-00-3010-DR to 3013-DR which is included as part of Appendix A.

5.5. Wetlands

Six constructed wetlands are proposed to provide water-quality treatment and detention for the applicable Stages 14–17 catchments.

The wetlands have been designed as broad, planted devices with a permanent-water depth of up to 1.5 m, a live-storage depth of up to 0.8 m and a minimum freeboard allowance of 400 mm.

Runoff from the upstream piped networks will pass through a gross pollutant trap, forebay or similar inlet treatment feature before entering the principal wetland area. The final inlet arrangement will be confirmed through the Engineering Approval process.

The wetlands will receive runoff from their contributing road, JOAL and private hardstand catchments. Roof runoff will be managed at source through private roof-water tanks, with controlled discharges subsequently conveyed through the public stormwater network and applicable wetland. The detention provided within the tanks delays the arrival of these flows, such that they pass through the wetlands after the peak of the storm event. The wetland treatment and live-storage volumes have been sized for their contributing hardstand catchments, including any offset storage confirmed by the calculations in Appendix B.

As the wetlands are integrated with the stormwater drainage network, the 10% AEP primary-network flows will be safely conveyed through or around each device. Where practicable, a high-flow bypass will be provided to limit the volume and velocity of larger storm flows passing through the principal wetland area. Established planting will also assist in reducing velocities and protecting the wetland surfaces from erosion.

An outlet structure will be constructed within each wetland and will generally comprise a controlled low-flow outlet and an overflow structure. The current consent-level design provides for an orifice outlet and scruffy-dome overflow. Final outlet sizing, overflow arrangements and associated erosion protection will be confirmed through Engineering Approval.

Water stored above the permanent-water level will drain through the controlled outlet. Water velocities are expected to reduce as the wetland drains, while established planting will assist in limiting the movement of debris and sediment towards the outlet structure.

The wetlands are anticipated to be unlined, subject to confirmation through geotechnical assessment and detailed design. They will be heavily planted to support treatment performance and discourage uncontrolled public access. Plant species will be selected to tolerate the anticipated permanent and intermittent wet conditions. The current design allows for a nominal 300 mm depth of suitable topsoil to support the wetland planting, subject to confirmation through detailed landscape and wetland design.

The wetlands will generally be located within or adjacent to drainage reserves and receiving watercourses. The wetland embankments and surrounding ground levels will be designed to prevent external 10% AEP and 1% AEP flood flows from entering the permanent-water and live-storage areas.

Safety measures, including benching, batter slopes, perimeter planting and fencing where required, are addressed in Appendix C.

5.6. Communal Bioretention and Stream Re-Charge Devices

The proposed design includes:

- Three stream-recharge devices serving the Streams 4 and 7 (combined device), Stream 8 and Stream 10 catchments; and
- Two communal bioretention devices, identified as Devices F and G.

These devices are consolidated bioretention systems operating on the same general principles as large raingardens. They provide a practical means of treating and mitigating runoff from larger combined catchments while avoiding the servicing and maintenance implications associated with numerous individual roadside raingardens.

The stream-recharge devices will receive runoff from their contributing road-reserve catchments and are proposed as Auckland Transport assets. They will provide water-quality treatment, applicable hydrology mitigation and controlled discharge to the upper reaches of the relevant retained or realigned streams.

Communal Bioretention Devices F and G will serve the applicable road, JOAL and private hardstand catchments before discharging to Waterloo Creek. These devices are proposed in isolated catchments where the land area and sizing requirements associated with a constructed wetland made a wetland less practical.

Each device will generally 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. The devices will provide the required water-quality treatment and detention volumes identified in Section 5.4 and Appendix B.

The consent-level design does not rely on infiltration into the underlying ground. Any contribution from infiltration will only be relied upon where suitable ground conditions are confirmed through geotechnical assessment and detailed design.

Final device dimensions, media specifications, inlet and outlet arrangements, flow controls, bypass provisions, planting, maintenance access, erosion protection and asset-ownership requirements will be confirmed through the Engineering Approval process. The detailed design will also address safe access and temporary ponding within and around the devices.

6. Operations & Maintenance Requirements

The maintenance of the proposed stormwater systems will need to be considered as a key aspect of the design, ensuring that the design considers the full design life of the system. The below section discusses the expected required maintenance of the key aspects of the stormwater system.

6.1. Pipe Network

The proposed stormwater network will have a 100-year design life in accordance the Auckland Council Stormwater Code of Practice. Very little maintenance is expected to be required to the pipe network during this time.

The stormwater network will utilise sumps on the proposed catchpits and these will require regular cleaning to remove sediment build-up. It is anticipated that this be done twice per year, but may vary.

6.2. Wetlands

Maintenance of the constructed wetlands will include:

- Inspection of inlet, outlet and overflow structures;
- Removal of litter and accumulated sediment from inlet pre-treatment components, including any GPT (gross pollutant trap) and the wetland forebay;
- Management of weeds and wetland planting;
- Inspection of embankments, batters and access arrangements; and
- Repair of erosion, planting or structural defects where required.

Routine planting maintenance and surface inspections will generally be undertaken on foot. However, maintenance access will also allow for machinery where longer-term sediment removal or repair of inlet and outlet structures is required.

Final inspection frequencies, sediment-removal triggers and vegetation-management requirements will be established through the operation and maintenance documentation. Wetland batters will generally be no steeper than 1V:3H where pedestrian maintenance access is required.

6.3. Bioretention Devices

The communal bioretention and stream-recharge devices will require regular maintenance to maintain their hydraulic performance, treatment function and landscape quality.

Maintenance will generally include:

- Removal of litter, debris and accumulated sediment;
- Management of weeds and planting;
- Inspection of inlet, outlet, overflow and underdrain components;
- Inspection and cleaning of any GPTs or other upstream inlet pre-treatment components;
- Monitoring of surface ponding and drawdown performance; and
- Partial or full replacement of filter media where declining hydraulic or treatment performance is identified.

During earthworks and construction, sediment-laden runoff must be prevented from entering the devices. Filter socks or equivalent protection should remain over device inlets until construction within the contributing catchment is complete and the catchment has been stabilised.

The maintenance and asset-ownership arrangements for the stream-recharge devices will be coordinated with Auckland Transport through the Engineering Approval and vesting processes. The operation and maintenance requirements for the communal bioretention devices will similarly be confirmed through Engineering Approval.

6.4. Private Roof-Water Reuse Tanks

The private roof-water reuse tanks will remain privately owned and maintained.

- Routine maintenance will generally include:
- Inspection and cleaning of inlet screens and filters;

- Inspection of pumps and reuse pipework;
- Checking overflow arrangements and connections to the public network; and
- Removal of accumulated sediment where required.

Final operation and maintenance requirements will be established through the relevant building-consent documentation. Tank arrangements should avoid the need for confined-space entry wherever practicable.

7. Proposed Treatment Devices

This section summarises the proposed stormwater-management device for each principal catchment. The contributing areas and required and provided treatment and detention capacities are based on the consent-level design and are supported by the calculations in Appendix B.

Where surplus detention storage within one communal device is relied upon to offset a shortfall in another catchment, this is identified in the relevant device subsection. Final device dimensions, contributing flow splits, outlet controls and storage volumes will be confirmed through the Engineering Approval process.

7.1. Wetland A

Wetland A Catchment

- o Catchment Area – Road and Lots: 84,900 m^2
- o Required water quality treatment volume: 457 m^3
- o Required detention volume: 869 m^3

Wetland A is proposed north of Wainui Road, northeast of its intersection with Gervin Road, and will discharge to the Orewa Awa. The current design provides approximately 538 m^3 of water-quality treatment volume and 1,117 m^3 of detention storage.

The sizing of this device results surplus detention storage which may be used at detailed design through catchment adjustment to optimise the developments stormwater device designs.

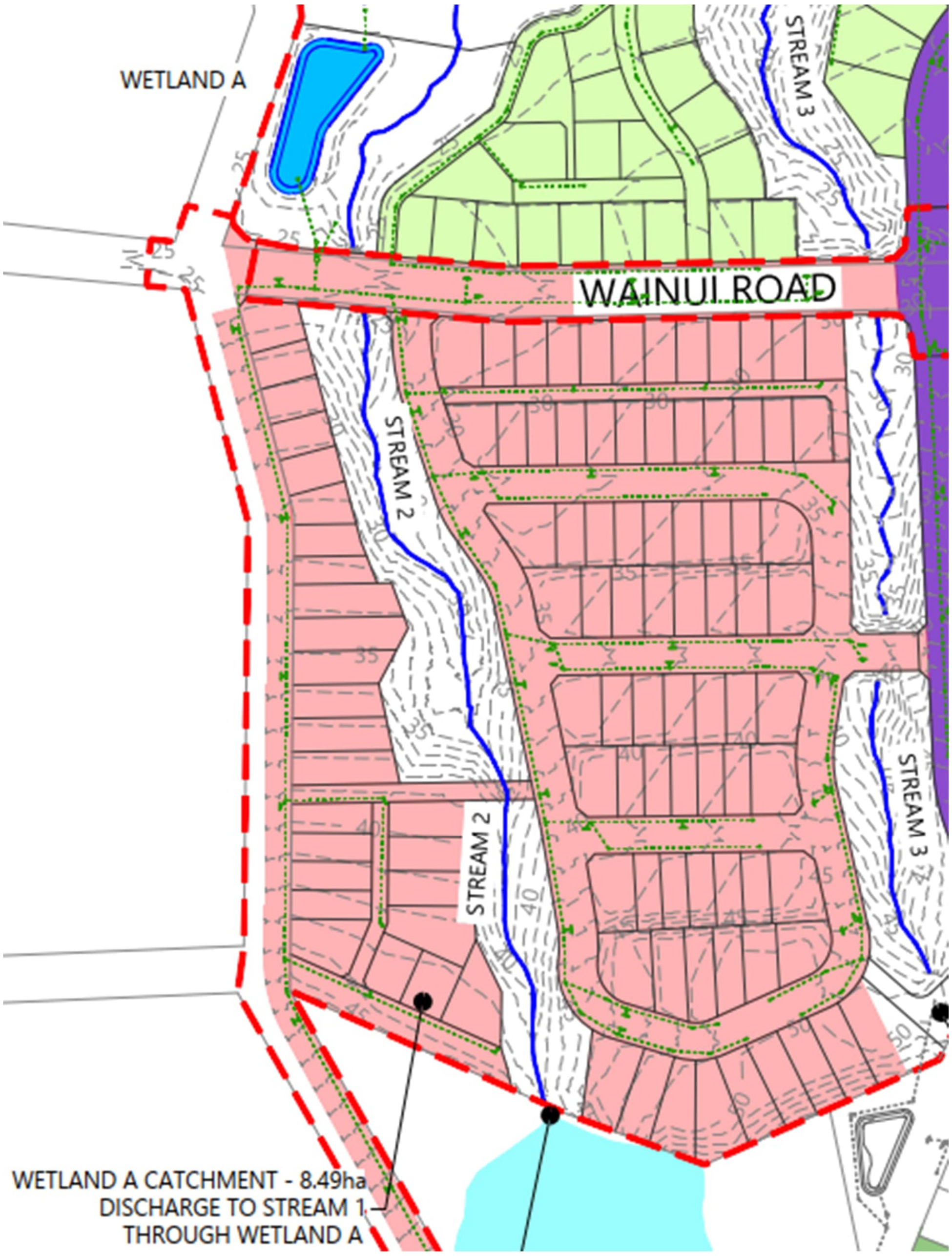


Image 1: Wetland A Catchment - Red

7.2. Wetland B

Wetland B Catchment

- Catchment Area – Road and Lots: 152,200 m^2
- Required water quality treatment volume: 688 m^3
- Required detention volume: 1257 m^3

Wetland B is proposed beside the northern Stream Edge Road, adjacent to the Orewa Awa. The current design provides approximately 700 m³ of water-quality treatment volume and 1,277 m³ of detention storage.

The sizing of this device results surplus detention storage which may be used at detailed design through catchment adjustment to optimise the developments stormwater device designs.

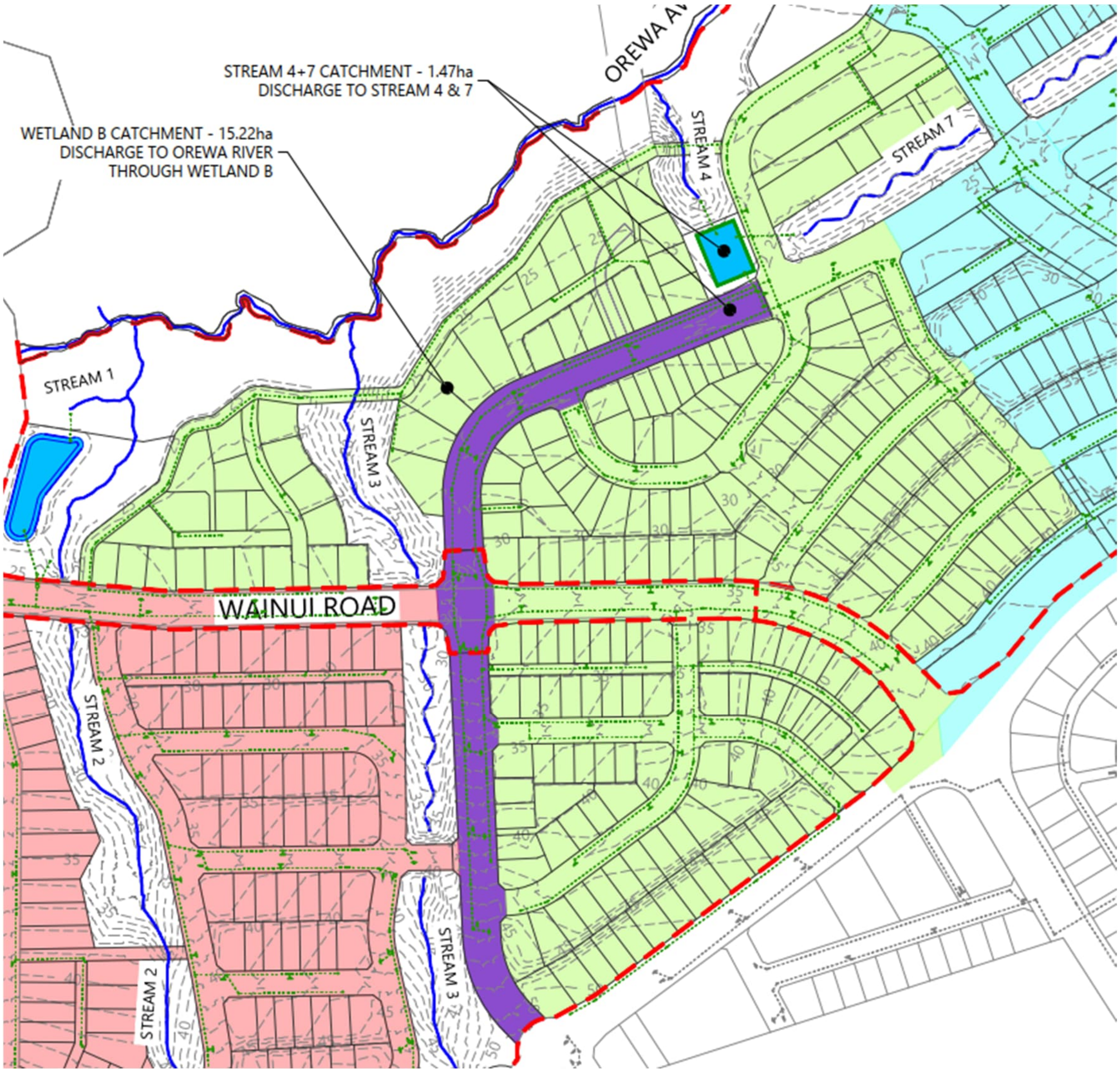


Image 2: Wetland B Catchment - Green

7.3. Streams 4 and 7 recharge bioretention device

Streams 4+7 Catchments (through Stormwater Recharge Device)

- Catchment Area – Roads: 14,700 m^2
- Required detention volume: 282 m^3

A stream-recharge device is proposed beside the Stream Edge Collector Road at the head of Stream 4. The device will provide the required water-quality treatment capacity and approximately 283 m³ of detention storage before discharging to both Streams 4 and 7.

The final distribution of controlled discharge between Streams 4 and 7 will be confirmed through the Engineering Approval process

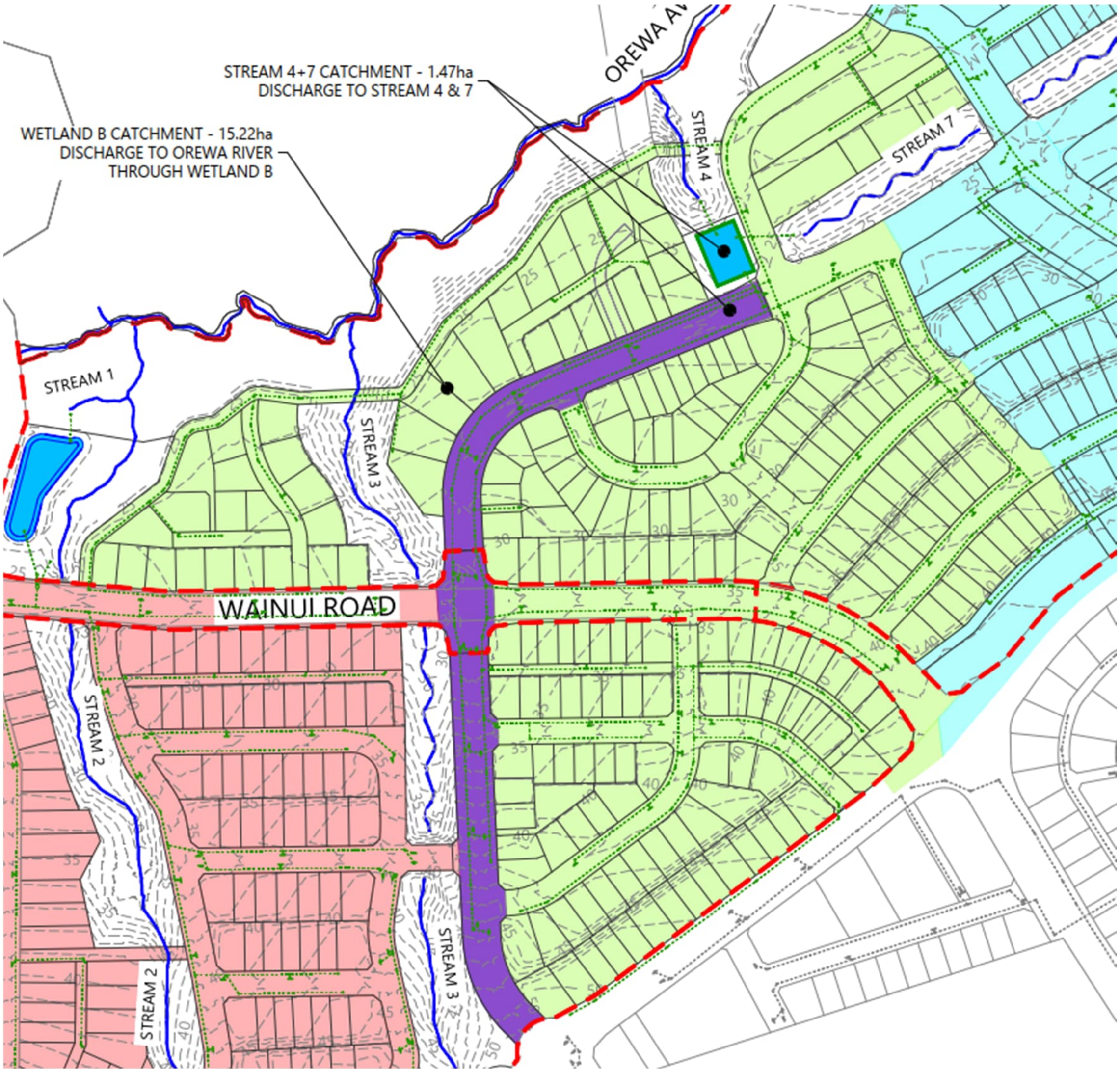


Image 3: Streams 4 & 7 Catchment – Dark Purple

7.4. Wetland C

Wetland C Catchment

- o Catchment Area – Road and Lots: 325,300 m^2
- o Required water quality treatment volume: 1,745 m^3
- o Required detention volume: 3,315 m^3

Wetland C is proposed beside the northern Stream Edge Road, adjacent to the Orewa Awa. The current design provides approximately 1,787 m^3 of water-quality treatment volume and 3,336 m^3 of detention storage.

The wetland is adequately sized for its current catchment.

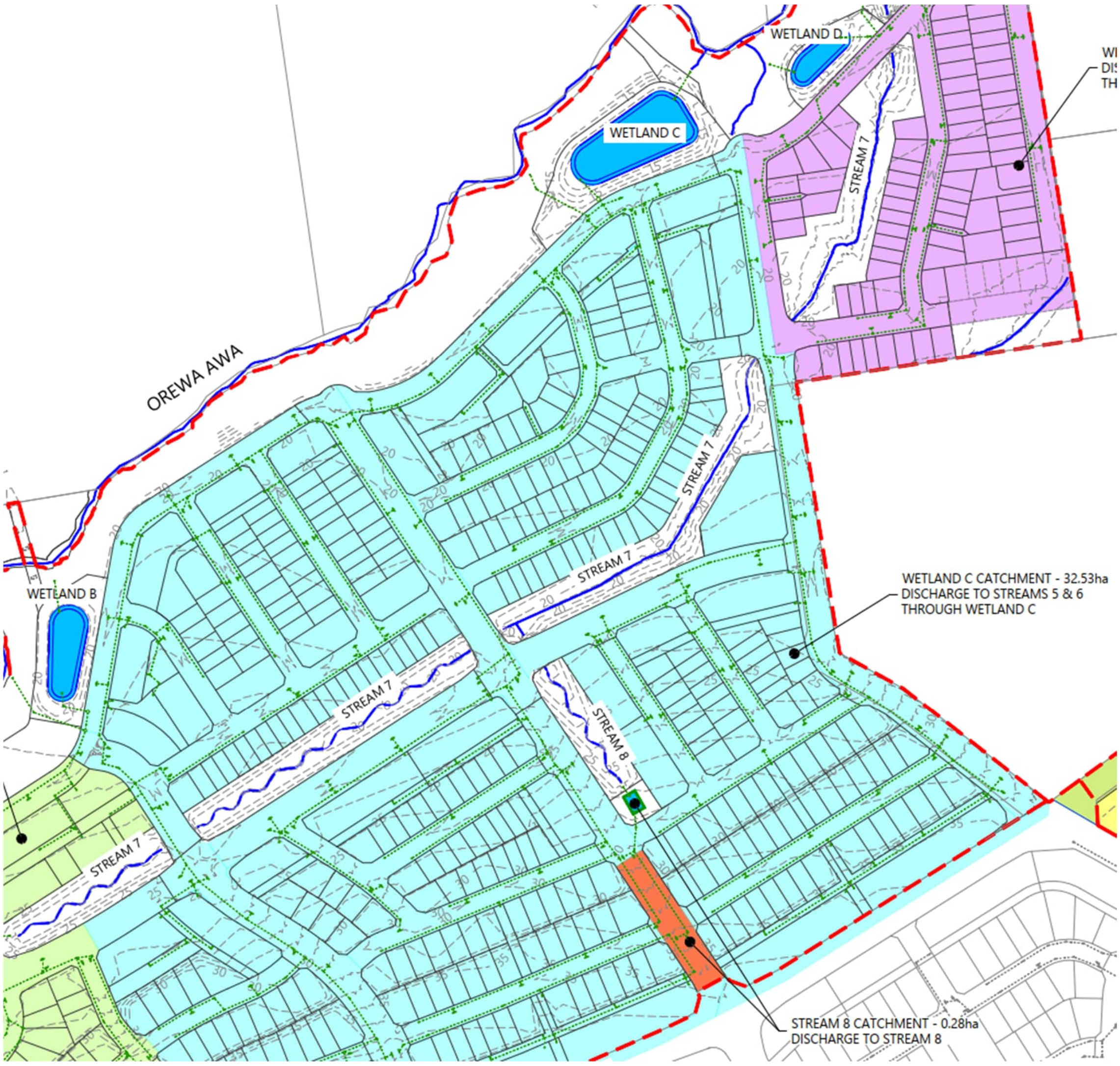


Image 4: Wetland C Catchment – Light Blue

7.5. Stream 8 recharge bioretention device

Stream 8 Catchment (through Stormwater Recharge Device)

- Catchment Area – Roads: 2,800 m^2
- Required detention volume: 53 m^3

A stream-recharge device is proposed beside the Collector Road at the head of Stream 8 – which is adequately sized to provide the required water-quality treatment capacity and detention storage.

Image 5: Stream 8 Catchment - Orange

7.6. Wetland D

Wetland D Catchment

- Catchment Area – Road and Lots: 47,700 m^2
- Required water quality treatment volume: 247 m^3
- Required detention volume: 467 m^3

Wetland D is proposed beside the eastern part of the northern Stream Edge Road, adjacent to the Orewa Awa. The current design provides approximately 316 m³ of water-quality treatment volume and 595 m³ of detention storage.

The sizing of this device results surplus detention storage which may be used at detailed design through catchment adjustment to optimise the developments stormwater device designs.

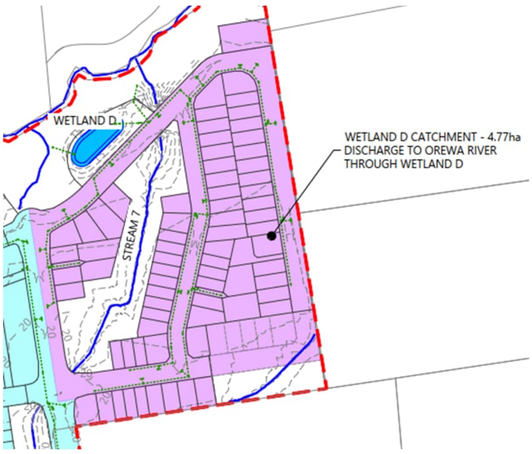


Image 6: Wetland D Catchment – Light Purple

7.7. Wetland E

The Wetland E catchment requires approximately 327.6 m³ of water-quality treatment volume and 603.1 m³ of detention storage.

Wetland E Catchment

- Catchment Area – Road and Lots: 70,200m^2
- Required water quality treatment volume: 328 m^3
- Required detention volume: 603 m^3

Wetland E is proposed along the eastern edge of Stage 16, adjacent to Waterloo Creek. The current design provides approximately 339 m³ of water-quality treatment volume and 622 m³ of detention storage before discharging to Waterloo Creek.

The sizing of this device results surplus detention storage that may be used to offset a shortfall within another contributing catchment.

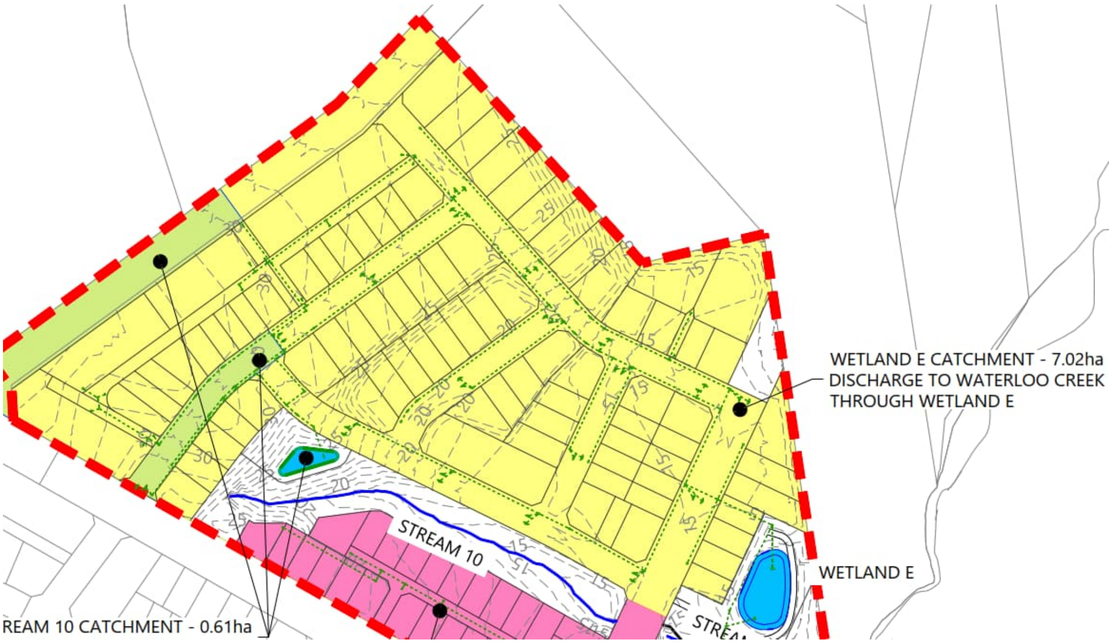


Image 7: Wetland E Catchment - Yellow

7.8. Stream 10 recharge bioretention device

Stream 10 Catchment (through Stormwater Recharge Device)

- Catchment Area – Roads: 6100 m^2
- Required detention volume: 116 m^3

A stream-recharge device is proposed beside the Stage 16 Stream Edge Road at the head of Stream 10. The device will provide the required water-quality treatment capacity and detention storage before discharging to Stream 10.

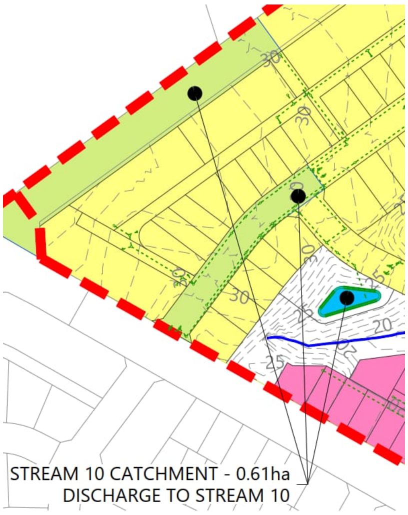


Image 8: Stream 10 Catchment – Lime Green

7.9. Communal Bioretention Device F

Bioretention Device Catchment F

- Catchment Area – Road and Lots: 14,500 m^2
- Required detention volume: 105 m^3

Communal Bioretention Device F is proposed north of Endsley Rise, southwest of the confluence of Stream 10 and Waterloo Creek. The device will provide the required water-quality treatment capacity and detention storage before discharging to Waterloo Creek.

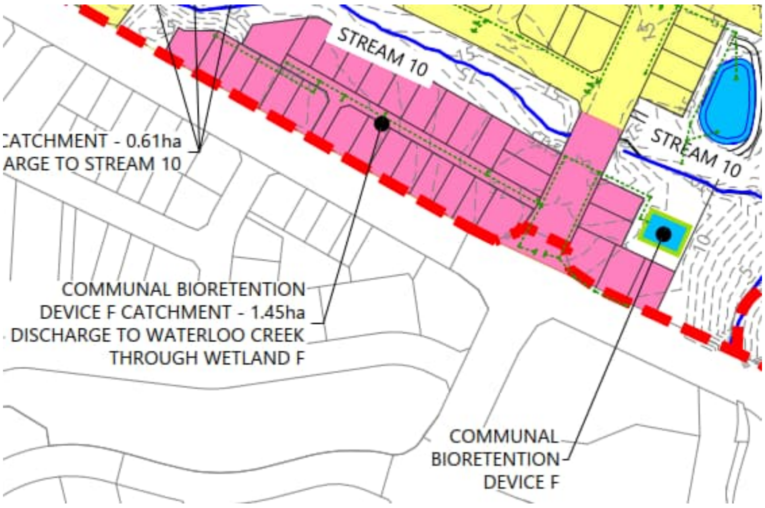


Image 9: Bioretention Device F Catchment – Pink

7.10. Communal Bioretention Device G

Bioretention Device Catchment G

- o Catchment Area – Road and Lots: 23,200 m^2
- o Required detention volume: 175m^3

Communal Bioretention Device G is proposed north of Endsley Rise, east of Waterloo Creek. The device will provide the required water-quality treatment capacity and approximately 193 m^3 of detention storage before discharging to Waterloo Creek.

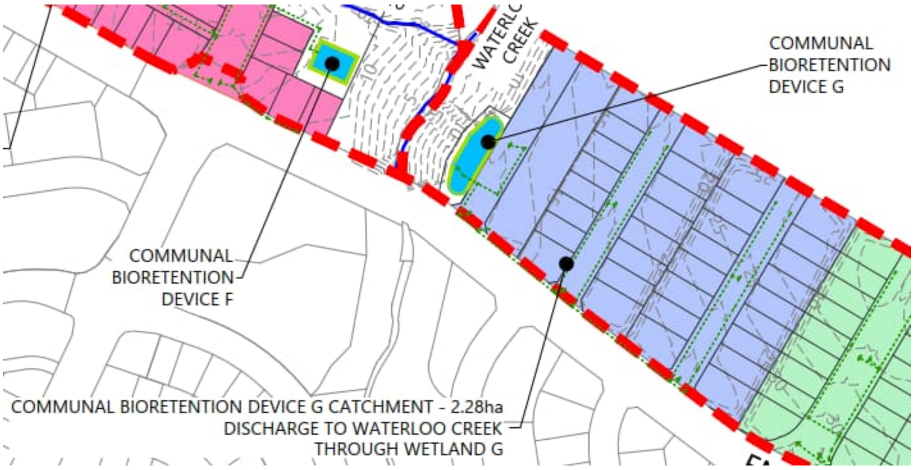


Image 10: Bioretention Device G Catchment – Blue

7.11. Wetland H

Wetland H Catchment

- o Catchment Area – Road and Lots: 40,500m^2
- o Required water quality treatment volume: 164m^3
- o Required detention volume: 290 m^3

Wetland H is proposed north of Endsley Rise, adjacent to Permanent Watercourse P3. The current design provides approximately 173 m^3 of water-quality treatment volume and 368 m^3 of detention storage.

Image 11: Wetland H – Green

8. Conclusion

The proposed stormwater design adopts an integrated, catchment-based approach informed by the stormwater systems implemented through earlier Milldale stages, the wider Wainui East SMP framework and the Stormwater Assessment – Milldale Stages 14-17.

The proposed stormwater-management approach comprises:

- Private roof-water reuse tanks providing at-source retention and non-potable reuse;
- Constructed wetlands providing water-quality treatment and detention for the larger downstream catchments;
- Communal bioretention devices providing treatment and hydrology mitigation for isolated catchments where constructed wetlands are less practical;
- Stream-recharge devices providing treatment, applicable hydrology mitigation and controlled discharge to selected retained or realigned streams;
- The primary stormwater network conveying flows from events up to the 10% AEP event; and
- The secondary stormwater network conveying excess runoff from larger events up to the 1% AEP event.

The consent-level design is consistent with the stormwater-management framework established through the Milldale North and Wainui West SMP V7 and applied to the proposed development through the Stormwater Assessment – Milldale Stages 14-17. The proposed approach provides water-quality treatment for runoff from all applicable impervious areas, retention of roof runoff at source, detention where required and safe discharge to the receiving watercourses.

The communal devices and principal stormwater networks have been sized at consent level for their anticipated ultimate contributing catchments, including the future development of the residential superlots. The supporting catchment calculations demonstrate the required water-quality treatment and detention capacity for each proposed device, subject to the outstanding checks and refinements identified in this memorandum.

Final device dimensions, network alignments, contributing flow splits, outlet controls, bypass arrangements, planting, maintenance access and asset-ownership requirements will be confirmed through the applicable Engineering Approval process. Private roof-water tanks and internal property drainage will be confirmed through the relevant building-consent and building-development processes.

Appendix A: Drawings (bound separately)

Appendix B: Wetland and Bioretention Device Catchment Calculations

Wetland Design Calculations

MDL North Fast Track - Wetland A

Catchment info

Total Road Catchment area	36057	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	28845.6	m^2
Permeable Road Catchment Area (m2)	7211.4	m^2
Total Lot Catchment area	48874	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	7331.1	m^2
Impermeable Lot Roof Catchment Area (m2)	26880.7	m^2
Permeable Lot Catchment Area (m2)	14662.2	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	36176.7	m^2
Total Permeable Catchment Area (m2)	21873.6	m^2
TP-108 parameters		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	
Water Quality Flow Composite Catchment CN	88.96	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.62	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland A

<u>Water Quality Design Storm (90%AEP, 24hr)</u>

Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	801.84	m3
Permeable Catchment Runoff Volume	91.30	m3
Total Water Quality Event Runoff Volume	893.14	m3
Wetland Permanent Water Volume*	446.57	m3

**PWV halved due to provision of live storage*

Required Wetland Area Footprint	893.14	m2
Required Maintenance Area Footprint (10% of PWV)*	44.66	m2

**Assuming 1m height of soil*

<u>Detention Design Storm (95%AEP, 24hr)</u>

Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	868.51	m3

Required Detention Depth above PWV	0.88	m2

Wetland Design Calculations

MDL North Fast Track - Wetland B

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EST.1970

Catchment info

Total Road Catchment area	45430	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	36344	m^2
Permeable Road Catchment Area (m2)	9086	m^2
Total Lot Catchment area	106745	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	16011.75	m^2
Impermeable Lot Roof Catchment Area (m2)	58709.75	m^2
Permeable Lot Catchment Area (m2)	32023.5	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	52355.75	m^2
Total Permeable Catchment Area (m2)	41109.5	m^2
<u>TP-108 parameters</u>		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	
Water Quality Flow Composite Catchment CN	87.44	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.63	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland B

Water Quality Design Storm (90%AEP, 24hr)		
Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	1160.43	m3
Permeable Catchment Runoff Volume	171.59	m3
Total Water Quality Event Runoff Volume	1332.03	m3
Wetland Permanent Water Volume*	666.01	m3
*PWV halved due to provision of live storage		
Required Wetland Area Footprint	1332.03	m2
Required Maintenance Area Footprint (10% of PWV)*	66.60	m2
*Assuming 1m height of soil		
Detention Design Storm (95%AEP, 24hr)		
Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	1256.93	m3
Required Detention Depth above PWV	0.85	m2

Wetland Design Calculations

MDL North Fast Track - Wetland C

Catchment info

Total Road Catchment area	137384	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	109907.2	m^2
Permeable Road Catchment Area (m2)	27476.8	m^2
Total Lot Catchment area	187919	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	28187.85	m^2
Impermeable Lot Roof Catchment Area (m2)	103355.45	m^2
Permeable Lot Catchment Area (m2)	56375.7	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	138095.05	m^2
Total Permeable Catchment Area (m2)	83852.5	m^2
TP-108 parameters		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	(Soil Group C)
Water Quality Flow Composite Catchment CN	88.93	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.62	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland C

Water Quality Design Storm (90%AEP, 24hr)		
Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	3060.80	m3
Permeable Catchment Runoff Volume	350.01	m3
Total Water Quality Event Runoff Volume	3410.80	m3
Wetland Permanent Water Volume*	1705.40	m3
*PWV halved due to provision of live storage		
Required Wetland Area Footprint	3410.80	m2
Required Maintenance Area Footprint (10% of PWV)*	170.54	m2
*Assuming 1m height of soil		
Detention Design Storm (95%AEP, 24hr)		
Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	3315.31	m3
Required Detention Depth above PWV	0.87	m2

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Wetland Design Calculations

MDL North Fast Track - Wetland D

Catchment info

Total Road Catchment area	18900	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	15120	m^2
Permeable Road Catchment Area (m2)	3780	m^2
Total Lot Catchment area	28800	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	4320	m^2
Impermeable Lot Roof Catchment Area (m2)	15840	m^2
Permeable Lot Catchment Area (m2)	8640	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	19440	m^2
Total Permeable Catchment Area (m2)	12420	m^2
TP-108 parameters		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	
Water Quality Flow Composite Catchment CN	88.64	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.62	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland D

Water Quality Design Storm (90%AEP, 24hr)		
Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	430.88	m3
Permeable Catchment Runoff Volume	51.84	m3
Total Water Quality Event Runoff Volume	482.72	m3
Wetland Permanent Water Volume*	241.36	m3
*PWV halved due to provision of live storage		
Required Wetland Area Footprint	482.72	m2
Required Maintenance Area Footprint (10% of PWV)*	24.14	m2
*Assuming 1m height of soil		
Detention Design Storm (95%AEP, 24hr)		
Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	466.71	m3
Required Detention Depth above PWV	0.87	m2

Wetland Design Calculations

MDL North Fast Track - Wetland E

Catchment info

Total Road Catchment area	22449	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	17959.2	m^2
Permeable Road Catchment Area (m2)	4489.8	m^2
Total Lot Catchment area	47743	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	7161.45	m^2
Impermeable Lot Roof Catchment Area (m2)	26258.65	m^2
Permeable Lot Catchment Area (m2)	14322.9	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	25120.65	m^2
Total Permeable Catchment Area (m2)	18812.7	m^2
TP-108 parameters		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	
Water Quality Flow Composite Catchment CN	87.72	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.63	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland E

Water Quality Design Storm (90%AEP, 24hr)		
Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	556.78	m3
Permeable Catchment Runoff Volume	78.53	m3
Total Water Quality Event Runoff Volume	635.31	m3
Wetland Permanent Water Volume*	317.65	m3
*PWV halved due to provision of live storage		
Required Wetland Area Footprint	635.31	m2
Required Maintenance Area Footprint (10% of PWV)*	31.77	m2
*Assuming 1m height of soil		
Detention Design Storm (95%AEP, 24hr)		
Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	603.08	m3
Required Detention Depth above PWV	0.85	m2

Wetland Design Calculations

MDL North Fast Track - Wetland H

Catchment info

Total Road Catchment area	9222	m^2
Impermeable Road Percentage (%)	0.8	
Impermeable Road Catchment Area (m2)	7377.6	m^2
Permeable Road Catchment Area (m2)	1844.4	m^2
Total Lot Catchment area	31263	m^2
Impermeable Lot Hardstand Percentage (%)	0.15	
Impermeable Lot Roof Percentage (%)	0.55	
Impermeable Lot Hardstand Catchment Area (m2)	4689.45	m^2
Impermeable Lot Roof Catchment Area (m2)	17194.65	m^2
Permeable Lot Catchment Area (m2)	9378.9	m^2
Total Impermeable Catchment Area excl. Roofs (m2)	12067.05	m^2
Total Permeable Catchment Area (m2)	11223.3	m^2
TP-108 parameters		
Impermeable Surface CN:	98	
Permeable Surface CN:	74	
Water Quality Flow Composite Catchment CN	86.43	
Catchment Length	2.0	km
Catchment Slope	0.01	m/m
Channelisation, C	0.60	
Tc	0.64	hrs
Impermeable Soil Storage (S)	5.18	
Permeable Soil Storage (S)	89.24	
Impermeable Initial Abstraction (Ia)	0.00	mm
Permeable Initial Abstraction (Ia)	5.00	mm

Wetland Design Calculations

MDL North Fast Track - Wetland H

Water Quality Design Storm (90%AEP, 24hr)		
Rainfall Depth	26.5	mm
Impermeable Catchment Runoff Depth	22.16	mm
Permeable Catchment Runoff Depth	4.17	mm
Impermeable Catchment Runoff Volume	267.46	m3
Permeable Catchment Runoff Volume	46.85	m3
Total Water Quality Event Runoff Volume	314.31	m3
Wetland Permanent Water Volume*	157.15	m3
*PWV halved due to provision of live storage		
Required Wetland Area Footprint	314.31	m2
Required Maintenance Area Footprint (10% of PWV)*	15.72	m2
*Assuming 1m height of soil		
Detention Design Storm (95%AEP, 24hr)		
Rainfall Depth	37	mm
Impermeable Catchment Runoff Depth	32.45	mm
Permeable Catchment Runoff Depth	8.45	mm
Required Detention Storage Depth	24.01	mm
Required Detention Volume	289.70	m3
Required Detention Depth above PWV	0.83	m2

Raingarden Sizing spreadsheet - Milldale

LOCATION	Stream 4&7 Recharge

TP108 Calculations		
95th %ile Rainfall Depth (mm)	37	mm
Pervious Curve Number	74	
Impervious Area (m^2)	11760.0	m^2
Imeprvious Area (%)	80%	
Total Area (m^2)	14700.0	m^2
Impervious Runoff (TP108)		
Storage (mm)	5.2	mm
Runoff depth (mm)	32.45	mm
Impervious Runoff Available (m3)	381.65	m^3
Pervious Runoff (TP108)		
Storage (mm)	89.2	mm
Runoff Depth (mm)	8.45	mm
Pervious runoff available (m3)	24.83	m^3
Hydrology Management Runoff Depth (mm)	24.0	mm
Hydrology Management Volume required (m^3)	282.33	m^3
Detention Volume Achieved (m^3)	**282.33**	m^3
Offset volume Achieved/ Required	0.00	m^3

Rain garden designed to meet SMAF requirements for its catchment

Raingarden Length		
Raingarden Design Length	34.78	m
Available Length	22.50	m

Raingarden Design		
Raingarden Type	Type A	
Type A - Triangular		
Width	26	m
Side slopes	100	%
Media Slope	50	%
Longitudinal fall	2.5	%
Ponding depth	0.2	m
Media depth	0.5	m
Drainage layer (inc transition layer)	0.4	m
Berm crossfall	3	%
Kerb Height	0.15	m
Max Base Width	23.34	m
Raingarden Internal Length	33.10	m
Height change over length	0.83	m
Check Dam height	0.05	m
Maximum drop	0.35	m
Number of check dams	5	

Raingarden Volumes		
Ponding Volume	135.95	m^3
Media Volume	472.30	m^3
Media voids	30	%
Media Storage	141.69	m^3
Drainage Volume	13.40	m^3
Drainage voids	35	%
Drainage Storage	4.69	m^3
Total Raingarden Storage Volume	282.33	m^3

Raingarden Setout		
Checkdam Height	0.14	m
Total Length	34.78	m
1st cutout	0.7	m
1st check dam peak	6.99	m
Checkdam/ Cutout Spacing	6.79	m

Raingarden Sizing spreadsheet - Milldale

LOCATION	Stream 8 Recharge
TP108 Calculations	
95th %ile Rainfall Depth (mm)	37 mm
Pervious Curve Number	74
Impervious Area (m^2)	2225.6 m^2
Imeprvious Area (%)	80%
Total Area (m^2)	2782.0 m^2
Impervious Runoff (TP108)	
Storage (mm)	5.2 mm
Runoff depth (mm)	32.45 mm
Impervious Runoff Available (m3)	72.23 m^3
Pervious Runoff (TP108)	
Storage (mm)	89.2 mm
Runoff Depth (mm)	8.45 mm
Pervious runoff available (m3)	4.70 m^3
Hydrology Management Runoff Depth (mm)	24.0 mm
Hydrology Management Volume required (m^3)	53.43 m^3
Detention Volume Achieved (m^3)	**53.43** m^3
Offset volume Achieved/ Required	0.00 m^3

Rain garden designed to meet SMAF requirements for its catchment

Raingarden Length	
Raingarden Design Length	15.62 m
Available Length	22.50 m

Raingarden Design	
Raingarden Type	Type A
Type A - Triangular	
Width	11 m
Side slopes	100 %
Media Slope	50 %
Longitudinal fall	1 %
Ponding depth	0.2 m
Media depth	0.5 m
Drainage layer (inc transition layer)	0.4 m
Berm crossfall	3 %
Kerb Height	0.15 m
Max Base Width	9.24 m
Raingarden Internal Length	13.94 m
Height change over length	0.14 m
Check Dam height	0.05 m
Maximum drop	0.35 m
Number of check dams	0

Raingarden Volumes	
Ponding Volume	26.80 m^3
Media Volume	82.09 m^3
Media voids	30 %
Media Storage	24.63 m^3
Drainage Volume	5.74 m^3
Drainage voids	35 %
Drainage Storage	2.01 m^3
Total Raingarden Storage Volume	53.43 m^3

Raingarden Setout	
Checkdam Height	0.14 m
Total Length	15.62 m
1st cutout	0.7 m
1st check dam peak	15.42 m
Checkdam/ Cutout Spacing	15.22 m

Raingarden Sizing spreadsheet - Milldale

LOCATION	Stream 10 Recharge
TP108 Calculations	
95th %ile Rainfall Depth (mm)	37 mm
Pervious Curve Number	74
Impervious Area (m^2)	4840.0 m^2
Imeprvious Area (%)	80%
Total Area (m^2)	6050.0 m^2
Impervious Runoff (TP108)	
Storage (mm)	5.2 mm
Runoff depth (mm)	32.45 mm
Impervious Runoff Available (m3)	157.07 m^3
Pervious Runoff (TP108)	
Storage (mm)	89.2 mm
Runoff Depth (mm)	8.45 mm
Pervious runoff available (m3)	10.22 m^3
Hydrology Management Runoff Depth (mm)	24.0 mm
Hydrology Management Volume required (m^3)	116.20 m^3
Detention Volume Achieved (m^3)	**116.20** m^3
Offset volume Achieved/ Required	0.00 m^3

Rain garden designed to meet SMAF requirements for its catchment

Raingarden Length	
Raingarden Design Length	30.69 m
Available Length	22.50 m

Raingarden Design	
Raingarden Type	Type A
Type A - Triangular	
Width	10 m
Side slopes	100 %
Media Slope	50 %
Longitudinal fall	0.1 %
Ponding depth	0.2 m
Media depth	0.8 m
Drainage layer (inc transition layer)	0.4 m
Berm crossfall	3 %
Kerb Height	0.15 m
Max Base Width	8.3 m
Raingarden Internal Length	29.23 m
Height change over length	0.03 m
Check Dam height	0.05 m
Maximum drop	0.35 m
Number of check dams	0

Raingarden Volumes	
Ponding Volume	49.77 m^3
Media Volume	207.58 m^3
Media voids	30 %
Media Storage	62.27 m^3
Drainage Volume	11.85 m^3
Drainage voids	35 %
Drainage Storage	4.15 m^3
Total Raingarden Storage Volume	116.20 m^3

Raingarden Setout	
Checkdam Height	0.03 m
Total Length	30.69 m
1st cutout	0.7 m
1st check dam peak	30.49 m
Checkdam/ Cutout Spacing	30.29 m

Raingarden Sizing spreadsheet - Milldale

LOCATION		
TP108 Calculations		
95th %ile Rainfall Depth (mm)	37	mm
Pervious Curve Number	74	
Impervious Area (m^2)	4375.0	m^2
Impervious Area (%)	30%	
Total Area (m^2)	14485.0	m^2
Impervious Runoff (TP108)		
Storage (mm)	5.2	mm
Runoff depth (mm)	32.45	mm
Impervious Runoff Available (m3)	141.98	m^3
Pervious Runoff (TP108)		
Storage (mm)	89.2	mm
Runoff Depth (mm)	8.45	mm
Pervious runoff available (m3)	85.39	m^3
Water Quality Treatment Volume required (m^3)	105.03	m^3
Water Quality Treatment Volume Achieved (m^3)	**105.03**	m^3
Offset volume Achieved/ Required	0.00	m^3

Bioretention Device F

Rain garden designed to meet SMAF requirements for its catchment

Raingarden Length		
Raingarden Design Length	22.37	m
Available Length	22.50	m

Raingarden Design		
Raingarden Type	Type A	
Type A - Triangular		
Width	17	m
Side slopes	100	%
Media Slope	50	%
Longitudinal fall	2.1	%
Ponding depth	0.2	m
Media depth	0.5	m
Drainage layer (inc transition layer)	0.4	m
Berm crossfall	3	%
Kerb Height	0.15	m
Max Base Width	14.88	m
Raingarden Internal Length	20.68	m
Height change over length	0.43	m
Check Dam height	0.05	m
Maximum drop	0.35	m
Number of check dams	2	

Raingarden Volumes		
Ponding Volume	57.77	m^3
Media Volume	191.99	m^3
Media voids	30	%
Media Storage	57.60	m^3
Drainage Volume	8.43	m^3
Drainage voids	35	%
Drainage Storage	2.95	m^3
Total Raingarden Storage Volume	118.32	m^3

Raingarden Setout		
Checkdam Height	0.14	m
Total Length	22.37	m
1st cutout	0.7	m
1st check dam peak	8.38	m
Checkdam/ Cutout Spacing	8.18	m

Raingarden Sizing spreadsheet - Milldale

LOCATION	Bioretention Device G	
TP108 Calculations		
95th %ile Rainfall Depth (mm)	37	mm
Pervious Curve Number	74	
Impervious Area (m^2)	7289.7	m^2
Impervious Area (%)	31%	
Total Area (m^2)	23239.0	m^2
Impervious Runoff (TP108)		
Storage (mm)	5.2	mm
Runoff depth (mm)	32.45	mm
Impervious Runoff Available (m3)	236.57	m^3
Pervious Runoff (TP108)		
Storage (mm)	89.2	mm
Runoff Depth (mm)	8.45	mm
Pervious runoff available (m3)	134.71	m^3
Water Quality Treatment Volume required (m^3)	175.01	m^3
Water Quality Treatment Volume Achieved (m^3)	**175.01**	m^3
Offset volume Achieved/ Required	0.00	m^3

Rain garden designed to meet SMAF requirements for its catchment

Raingarden Length		
Raingarden Design Length	62.98	m
Available Length	22.50	m

Raingarden Design		
Raingarden Type	Type A	
Type A - Triangular		
Width	10	m
Side slopes	100	%
Media Slope	50	%
Longitudinal fall	2.1	%
Ponding depth	0.2	m
Media depth	0.5	m
Drainage layer (inc transition layer)	0.4	m
Berm crossfall	3	%
Kerb Height	0.15	m
Max Base Width	8.3	m
Raingarden Internal Length	61.29	m
Height change over length	1.29	m
Check Dam height	0.05	m
Maximum drop	0.35	m
Number of check dams	8	

Raingarden Volumes		
Ponding Volume	91.54	m^3
Media Volume	309.13	m^3
Media voids	30	%
Media Storage	92.74	m^3
Drainage Volume	24.68	m^3
Drainage voids	35	%
Drainage Storage	8.64	m^3
Total Raingarden Storage Volume	192.92	m^3

Raingarden Setout		
Checkdam Height	0.14	m
Total Length	62.98	m
1st cutout	0.7	m
1st check dam peak	8.30	m
Checkdam/ Cutout Spacing	8.10	m

Appendix C: Wetland Safety in Design

Safety In Design - Risk Register

WOODS
EST.1970

Name:	**Wetlands and Outlets**	**JOB #**	**P25-609**
Project name:	**Milldale Civil Stages 14 to 17**		
Date:	**20/07/2026**		

Project Description

Communal Stormwater Device risk register to accompany the Operation and Maintenance Manuals

	IDENTIFIED SAFETY RISK						TREATMENT PLAN	RESIDUAL RISK				
Risk ID	Risk Title	Risk description	Status	Pre-Treatment			1. Eliminate, 2. Substitution 3. Isolation 4. Engineering Control 5. Administrative Control 6. Personal Protective Equipment	Post-treatment			Residual controls	Notes
				Likelyhood	Consequence	Risk rating		Likelyhood	Consequence	Risk rating		
1. CONSTRUCTION												
1.01	Falls - Batter Slopes	Rolling construction plant, workers slipping.	Open	Possible	Moderate	**Medium**	Slopes designed at 1:3 maximum to minimise the risk of falls	Unlikely	Minor	**Low**	Construction monitoring, ensuring soil strength is adequate for walls and that it has been accounted for in the design. Ensuring safety education on site for workers near walls and steep slopes. Requiring JSA and SWMS for specific activities	
1.02	Drainage	Manhole and wingwall requiring construction methodologies. Tipping, rolling or breaking during construction	Open	Unlikely	Minor	**Low**	Manholes and wingwalls have been reduced to their minimum possible sizes allowable by standards to reduce requirements for lifting plant or unfamiliar construction methodologies to the workers	Highly Unlikely	Minor	**Low**	Construction monitoring	
1.03	Mucking out Existing Sediment Pond	Incidents invoved with the process of removing silt and sediment that has built up inside the existing sediment retention pond.	Open	Possible	Moderate	**Medium**	Desilting to be done using best construction practises.	Highly Unlikely	Minor	**Low**	Construction monitoring. All wetlands to be maintained during construction works.	
1.04	Work around Streams	Incidents involved with working around an active stream including drowning and slipping due to wet ground.	Open	Possible	Major	**High**	Design to avoid works within stream where possible.. Where unavoidable specific design and risk assessment to be undertaken.	Highly Unlikely	Minor	**Low**	Machinery and staff to stay out of the stream at all times. Stream is to be fenced off for the duration of the works. Contractor H&S Plan. Engineer Site inspections and Audits.	
1.05	Planting near watercourses	Falls into water, drowning, slips, falls	Open	Unlikely	Moderate	**Medium**	Slopes have been reduced to 1:3 maximum or flatter to reduce risk of falling and the damage caused by a fall.	Rare	Hospitalisation	**Medium**	JSA for landscaping activities	
1.06	Planting on steep slopes	Risk of slips and falls	Open	Possible	Minor	**Low**	Slopes have been reduced to 1:3 maximum or flatter to reduce risk of falling and the damage caused by a fall.	Rare	Minor Injury	**Low**	JSA for landscaping activities	
2. OPERATION/MAINTENANCE												
2.01	Falls: Internal slopes	Falls associated with internal slopes	Open	Highly Unlikely	Minor	**Low**	Batter slopes modelled to 1:3 grade; Batter slopes will be landscaped with suitable vegetation to deter access onto slope.	Highly Unlikely	Serious	**Low**	No residual controls	
2.02	Ponding Depth/Flood depth in basin	Drowning due to falling into wetland. Permanent water level in wetland up to 1.5m deep. Depth of water in wetland whilst in operation further increased by up to 800mm.	Open	Unlikely	Catastrophic	**Extreme**	Dense vegetative planting around wetland, planting to deter and restrict access into wetland. Provision of 3m wide safety bench around permanent water areas. Selection of plant species to minimise maintenance and reduce clogging of SW structure	Highly Unlikely	Major	**High**	No residual controls	
2.03	Stormwater Overland Flow Management	Mitigation of stormwater overland flows during large rainfall event	Open	Highly Unlikely	Serious	**Low**	Design in accordance with SWCOP. Design model ensures no private property in 1% AEP flow.	Highly Unlikely	Minor	**Low**	No residual controls	
2.04	Safe access for Maintenance Operations	Safe access for maintenance operations.Consideration for both stormwater operations teams and landscapers	Open	Highly Unlikely	Moderate	**Low**	Vehicle access is provided around and into basin to ensure maintenance can conduct all required operations.	Highly Unlikely	Moderate	**Low**	No residual controls	
2.05	Overland Flow	In major storm events the wetland will be inundated with storm flows.	Open	Unlikely	Moderate	**Medium**	Appropriate riprap is provided in the upstream to prevent erosion during extreme event.	Unlikely	Moderate	**Medium**	No residual controls	
2.06	Maintenance of plants	Poison, minor injuries, cuts, scrapes, infections	Open	Highly Likely	Moderate	**High**	Appropriate planting plan, non-poisonous species, low maintenance plant species.	Highly Unlikely	Moderate	**Low**	No residual controls	
3. DECOMMISSION												
3.01	Decomisioning temporary Basin and outlet	Risks associated during the removal of the temporary basin and the outlet	Open	Possible	Moderate	**Medium**	Outlet location situated where plant can access while staying on the access track.	Highly Unlikely	Moderate	**Low**		
3.02	Decomisioning temporary Swale	Risks associated with the removal of the drainage swale that discharges into the temporary basin such as slipping, fall	Open	Possible	Moderate	**Medium**	Proposed swale to consist of a geotextile liner pined onto ground so decommission work is minimal	Highly Unlikely	Moderate	**Low**		

Appendix F - Milldale Stages 14-17 - Wastewater Servicing and Low Pressure Sewer Design Memo

MEMORANDUM

To	From
Fulton Hogan Land Development Ltd.	Woods Marcel Bear - Principal Water Engineer
	W-REF: P25-609 7/08/2026 Reviewers: Cristian Jara – 3 Waters Engineer, Sam Kirk – Associate Engineer

Milldale Stages 14-17 Fast-track – Wastewater Servicing and Low Pressure Sewer Design Memo

Statement of Qualifications and Experience

Originator: Marcel Bear – Principal Water Engineer

I am a Principal Engineer at Wood & Partners Consultants Limited (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed by Woods since April 2017.

I hold the qualification of Bachelor of Engineering (Honours) in Civil Engineering from the University of Auckland, which I completed in 1990. I am a Chartered Engineer with Engineering New Zealand.

I have 30 years of professional experience in water supply design and planning. My experience includes water supply design, hydraulic modelling and infrastructure master planning, for greenfield and brownfield developments such as; the Unitec site-Auckland, Northcote, Wesley and Waikowhai neighbourhoods and the Sleepyhead Development in Ohinewai.

I confirm that, in my capacity as originator 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.

Reviewer: Cristian Jara – 3 Waters Engineer

I am Water Engineer at Wood & 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 November 2020.

I hold the degree of Professional Civil Engineer from the Pontifical Catholic University of Chile with a Diploma in Hydraulic Engineering, obtained in 2013. I am member of Engineering New Zealand.

I have over 11 years of professional experience in wastewater and water supply modelling. My experience includes building, updating and reviewing water supply and wastewater models. Recent projects include multiple neighbourhoods for Kāinga Ora (Glen Innes, Te Ararata and Middlemore Crescent) and water supply modelling and reporting for multiple stages of the Milldale development.

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

Reviewer: Sam Kirk – Associate Engineer

I, Sam Kirk, am an Associate Engineer at Woods. Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since July 2025, although also previously between January 2019 and September 2022.

I hold the qualifications of a Bachelor of Surveying, which I completed in 2018, and I also hold a Cadastral Surveying License. I am also a Voting Member of S+SNZ.

I have eight years of experience in the Engineering industry. My experience includes the design and construction observation of a range of land development projects, including project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved with the surveying, design and management of previous Milldale projects, dating back to Stage 1A. I have also been involved in managing multiple land development projects in London and Melbourne.

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

1. Summary

This memorandum outlines the wastewater servicing strategy for the proposed Milldale Stages 14-17 Fast-track development (Figure 1) and presents the design and hydraulic assessment of the proposed low-pressure sewer (LPS) network.

The development comprises a mixture of standalone dwellings, residential superlots and a commercial lot, totalling up to 1,425 dwelling unit equivalents (DUE).

Three potential wastewater servicing scenarios are being considered:

- A fully private arrangement, under which all stages would be serviced by a development-wide LPS network discharging to the proposed private wastewater treatment plant (WWTP) and associated dispersal facilities;
- An interim private arrangement, under which the same LPS network would initially discharge to the private treatment facilities before being redirected to the public wastewater network once sufficient capacity and an approved connection become available; and
- Immediate public servicing following upgrades to the Army Bay Wastewater Treatment Plant, under which Stages 14 and 15 would be serviced by gravity reticulation to a proposed pump station, while Stages 16 and 17 could connect directly to the public network using gravity or LPS reticulation, as appropriate.

The development-wide LPS network assessed in this memorandum is directly applicable to the fully private scenario and the interim private phase of the second scenario. The immediate public scenario, with a full gravity network, is also considered – however, this is not the focus of this memorandum.

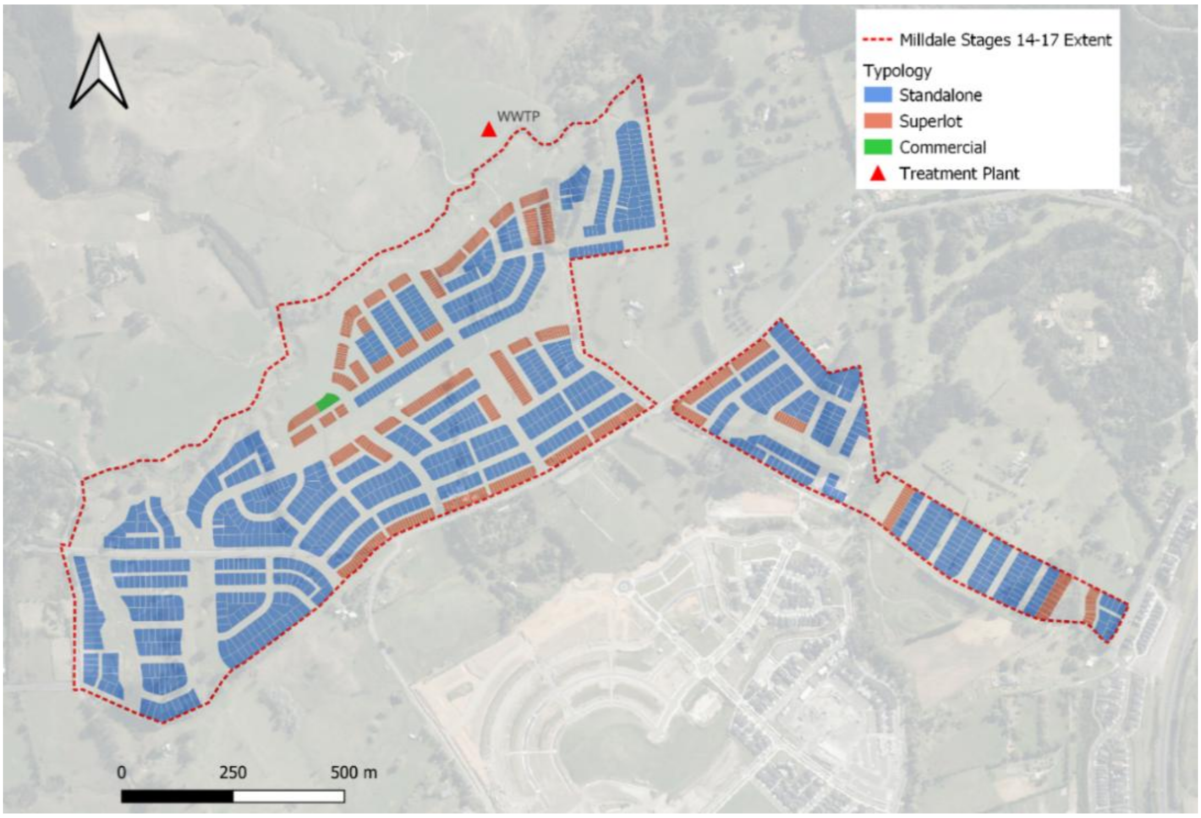


Figure 1: Overview of proposed Milldale Stages 14-17 Fast-track development

The proposed LPS layout and sizing (shown in Figure 2) has been designed with reference to the pressure sewer requirements of the Watercare Code of Practice for Land Development and Subdivision, Version 2.2, November 2019. The design assessment considers pump operating head, network velocity, retention time, flushing and air management.

2. Wastewater Servicing Scenarios

Three potential wastewater servicing scenarios have been developed for Milldale Stages 14–17. These are described below to establish the context for the LPS network design and hydraulic assessment presented in this memorandum.

2.1. Fully Private Servicing

Under the fully private servicing scenario, all of Stages 14–17 would be serviced by the proposed development-wide LPS network. The network would terminate at the proposed private WWTP located north of the residential subdivision area, with treated wastewater discharged through the associated dispersal facilities.

The LPS network, WWTP and dispersal facilities could remain as the long-term wastewater servicing arrangement, without any reliance on a future connection to the public wastewater network.

2.2. Interim Private Servicing and Future Public Connection

Under the interim private servicing scenario, all of Stages 14–17 would initially be serviced by the same development-wide LPS network, discharging to the proposed private WWTP and associated dispersal facilities.

Once sufficient public wastewater capacity and an approved connection become available, a new local pump station would be required near the discharge point of the LPS network, with a rising main directing flows alongside back up Lysnar Road, and across Wainui Road into the trunk line. The LPS network itself can't redirect its flow into the existing trunk line as this would exceed the LPS pumps maximum head due to the elevation and static head requirement of the rising main. Therefore, a new local pumpstation would be required to redirect the flows into a new public connection.

After connection to the public network, the WWTP would no longer required and would be decommissioned in its entirety.

The ultimate servicing arrangement for Stages 16 and 17 would depend on the timing of their development relative to the planned upgrades to the Army Bay WWTP and the availability of public wastewater capacity for the development. Areas developed before public capacity becomes available could be serviced under the interim private arrangement, remaining connected to the development-wide LPS network before subsequently transitioning to public servicing. Areas developed after public servicing becomes available could instead connect directly to the public trunk network via either gravity or LPS reticulation.

2.3. Immediate Public Servicing

Under the immediate public servicing scenario, the development would connect to the public wastewater network from the outset, once upgrades to the Army Bay Wastewater Treatment Plant are completed. This scenario is dependent on sufficient public wastewater capacity being confirmed and made available before development works commence.

Stages 14 and 15 would be serviced by a gravity wastewater network terminating at the proposed wastewater pump station in the north-eastern corner of Stage 15. Wastewater would then be pumped across Wainui Road to the public trunk line running alongside the Waterloo Creek.

Stages 16 and 17 would also be predominantly serviced by gravity reticulation, with flows generally conveyed directly to the public trunk line. A small eastern sub-catchment would also instead be conveyed via an existing Sidwell Road main. Short, localised LPS connections may be required for a limited number of lots where gravity servicing is not practicable.

All wastewater generated by the development would ultimately be conveyed via the public network to the Army Bay WWTP. The private WWTP and associated dispersal facilities would therefore not be required under this scenario. The immediate public servicing scenario is not described in this memorandum.

3. LPS Service Area Topography

All levels are in terms of NZVD2016.

For the development-wide LPS configuration assessed in this memorandum, the service area generally falls from the south-west towards the north-east. Ground levels range from approximately RL 50 m to RL 10 m, before rising to the proposed private wastewater treatment plant platform at approximately RL 20 m, north of the residential subdivision area.

The undulating topography creates local high points and varying operating heads across the network. Air-release valves have therefore been provided at key high points, while pipe diameters have been selected to maintain adequate velocities and support effective flushing, thereby reducing the potential for air accumulation and solids deposition.

4. Network Design

4.1. Design Standards

The design parameters have been taken from Watercare Code of Practice (CoP) Section 5.3.12. These are shown in Table 1.

Table 1: Milldale Stages 14-17 Fast-track – LPS design parameters

Parameter	Unit	Value	
Development yield	DUE[1]		1,425
Occupancy rate	people/DUE		3
Peak flow	l/person/day	1.2 times the ADWF[2]	1.2 x 180
Maximum pump head	m		40
Minimum velocity	m/s		0.8
Maximum velocity	m/s		2.0
Maximum retention time	hours		8
Pipe type			PE100 PN16 SDR 11
Pipe friction	Hazen Williams C		140

[1] Dwelling Unit Equivalent

[2] Average Dry Weather Flow – 180 l/person/day

4.2. Design Methodology

The network has been designed using the probabilistic method, based on the operating characteristics of the E-One pump system. The pumps have a relatively steep pump curve, creating a generally consistent discharge rate across the anticipated range of operating heads.

The zone layout is shown in Appendix B and the resulting system performance is detailed in Appendix C.

4.3. Proposed Network

The proposed LPS network layout and sizing are shown in Figure 2. All pipe diameters in this memorandum are outside diameters shown in millimetres. The design provides a collection main on each side of the road where properties front the carriageway, avoiding the need for private connections to cross the road.

This layout and the hydraulic assessment presented in this memorandum are based on the development-wide LPS network discharging to the proposed private WWTP located (within Te Korowai o Maraeariki). This configuration applies to the fully private servicing scenario and the interim private phase of the second scenario.

If public wastewater servicing subsequently becomes available under the interim private scenario, the terminal arrangement would be modified so that the LPS network servicing Stages 14 and 15 is redirected to the trunk line via a local pumpstation and rising main running back along Lysnar Road, over Wainui Road, and down Endsley Rise.

The affected sections of the network and their hydraulic performance would be reviewed once the pump station connection levels and operating conditions are confirmed.

Isolation valves will be placed at major junctions and upstream of the terminal discharge points to allow for sectional isolation during emergency or maintenance operations. Two air-release valves are proposed at local high points where air accumulation may occur. Flushing points have also been included at the head of each line to facilitate easy network maintenance.

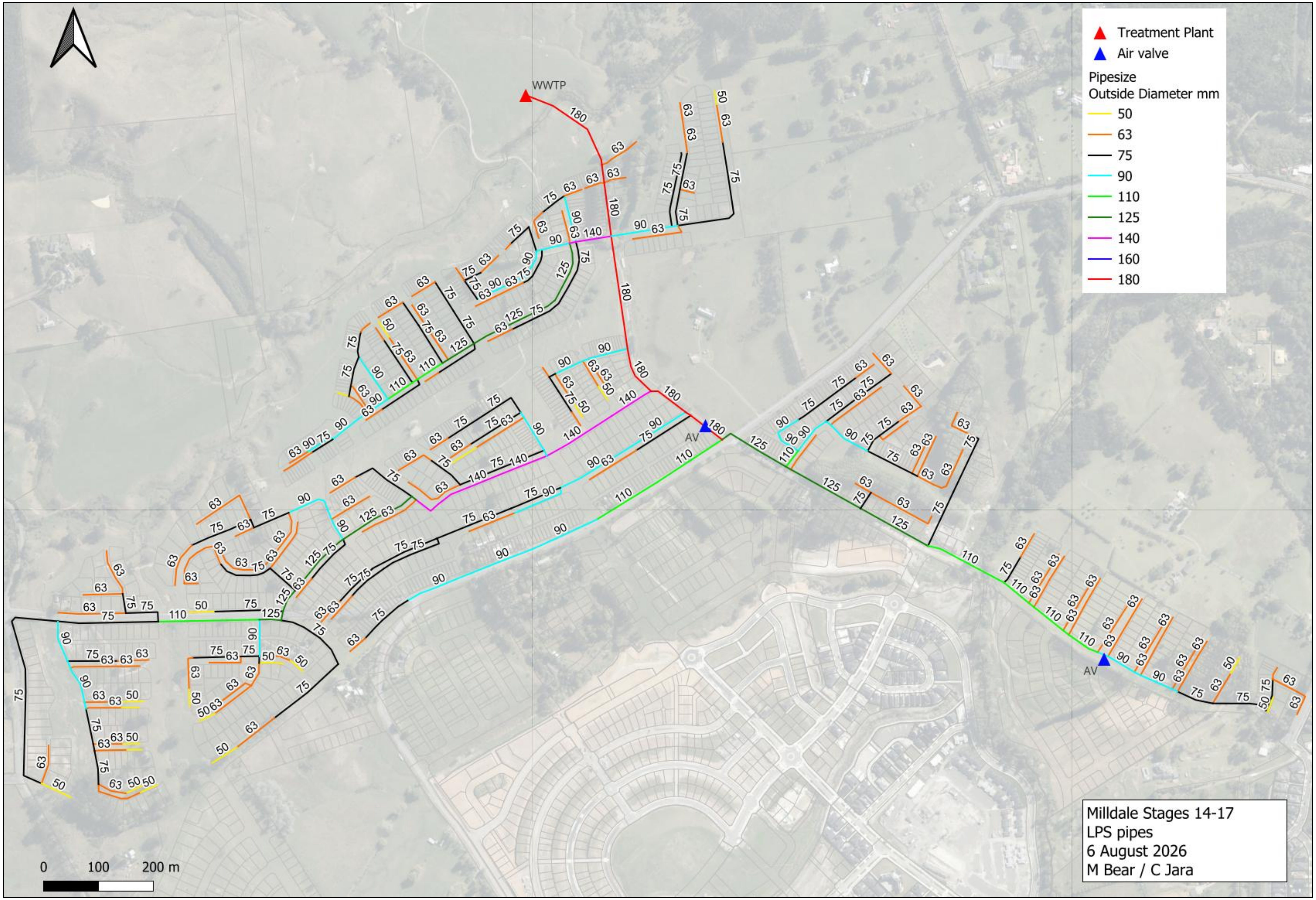


Figure 2: Proposed network layout and sizing for Milldale Stages 14-17 Fast-track

4.4. Network performance

The network performance against the Watercare design criteria is summarised in Table 2 and discussed below. Detailed results for all pipes in the network are shown in Appendix C.

Table 2: Summary of network performance against Watercare COP Criteria

Parameter	Unit	CoP limit	Value	Compliance with CoP
Maximum pump head	m	40	39	Compliant
Minimum velocity	m/s	0.8	0.8	Compliant
Maximum velocity	m/s	2.0	2.0	Compliant
Maximum retention time	hours	8	5.2	Compliant

Pump Operating Heads

The E-One semi-progressive cavity pumps have a steep pump curve, meaning the flow is fairly consistent irrespective of the head required, within the power limits of the pump. The pump curve is shown in Appendix A.

The continuous maximum pump head allowed by the pump manufacturer is 55m, and the CoP limit is 40m. The maximum design pump head is 39m, below the CoP limit and well within the pump capability.

Self-Cleansing Velocities

The velocities within the network range from 0.8 m/s to 2.0 m/s, with all significant collector pipes above 0.9 m/s. The lower velocity sections are at the start of pipes that have a low number of lots connected. Flushing points will be provided at the upstream of all lines, to clear the lines if this becomes necessary.

Retention Times

The retention times range up to 5.2 hours. This is comfortably within the design limit of 8 hours maximum.

Air Management

This design allows for air management by the dendritic (non-looped) layout and air entrainment through achieving adequate velocities. The velocities are achieved by a combination of using small diameter pipe and utilizing the head available from the pumps to deliver the required flow through the small pipes, that would be considered undersized in a gravity system.

Two air valves are proposed at the local high points that pose an air accumulation risk. Suitable valves are the combination air/vacuum valve ARI D20 or similar.

Odour Control

The highest average retention time of sewage within the pressure sewer system is approximately 5.2 hours. This means that the risk of septicity and odour is low.

Maintenance

Isolation valves have been proposed on all branch line intersections, upstream of the tee. These enable each line to be isolated as required for maintenance or connection of additional boundary kits.

Flushing Points

Flushing points will be provided at the head of branch mains and any dead end sections. These will be placed to provide easy access for vacuum loader trucks or tankers.

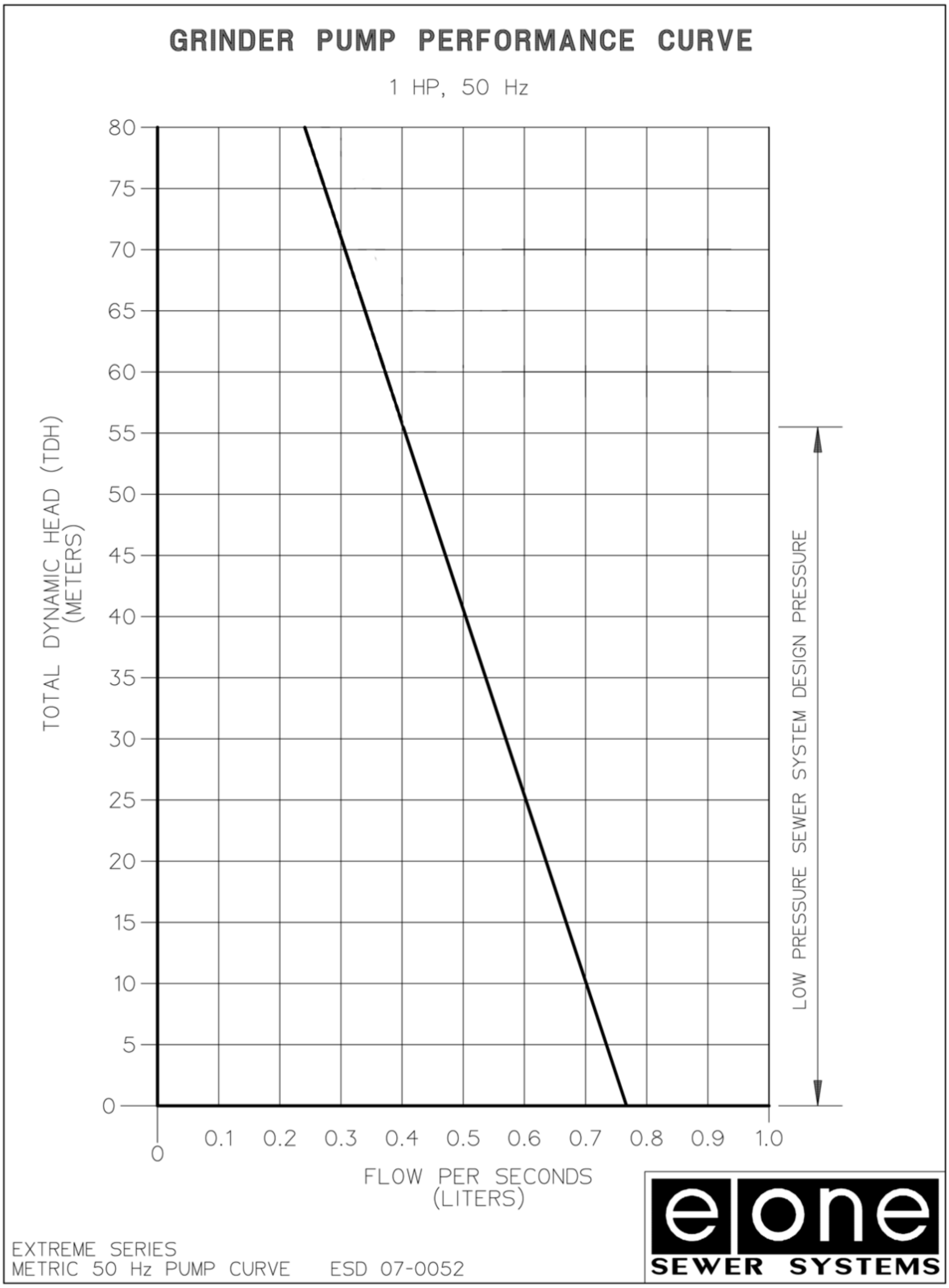
5. Summary and Conclusions

The proposed LPS network is suitable to service the Milldale Stages 14-17 Fast-track development of up to 1,425 DUE under both the fully private servicing scenario and the interim private phase scenario. Under the fully private arrangement, the network would discharge to the proposed private WWTP as the long-term servicing solution. Under the interim private arrangement, the same network would initially discharge to the WWTP before transitioning to the public wastewater network once sufficient capacity and an approved connection become available.

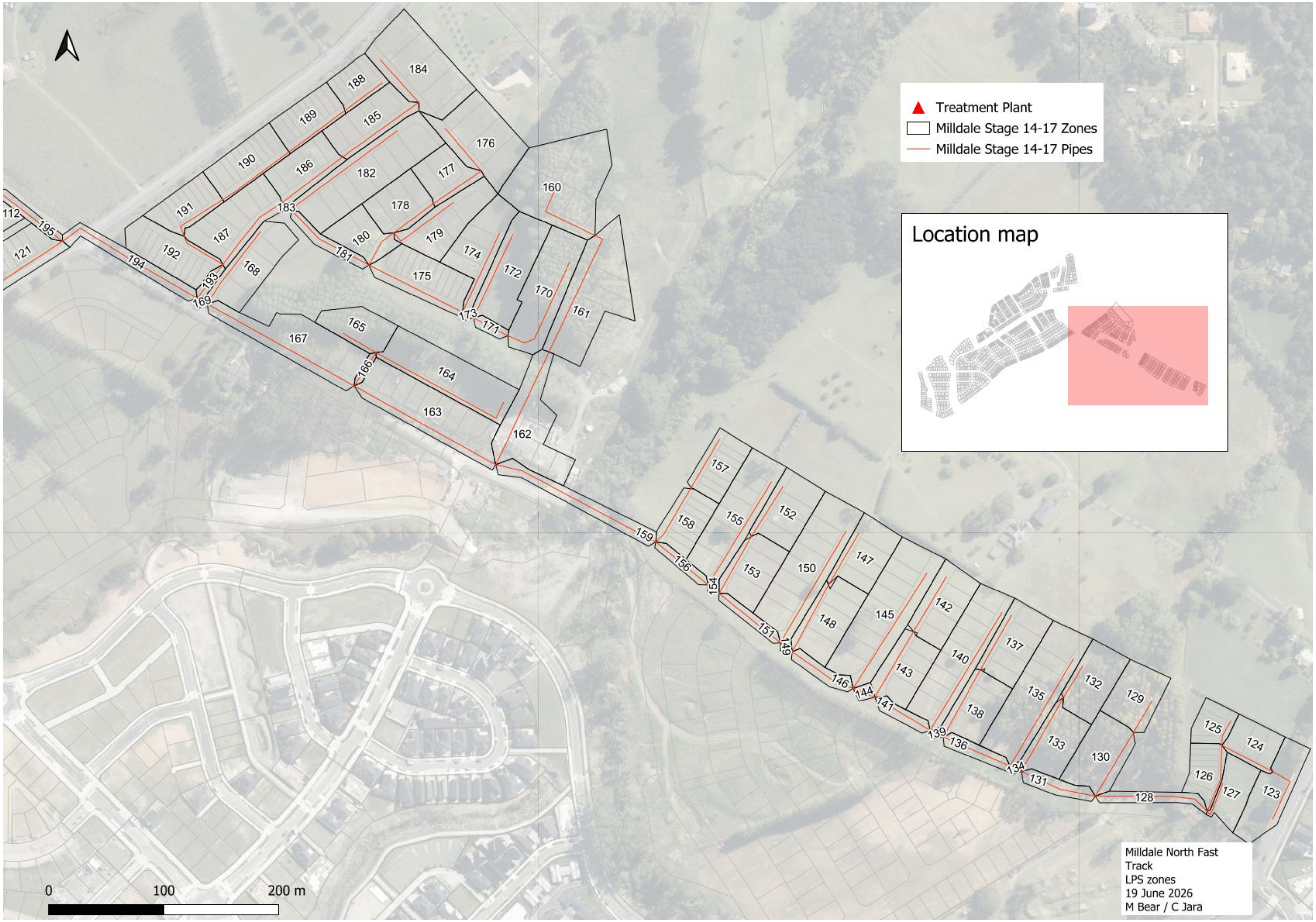
The maximum modelled pump head of 39 m is expected, with velocities generally above 0.9 m/s and below 2.0 m/s. Some areas of lower velocity (all above 0.8 m/s) are expected at the head of lines where there are a small number of lots connected. This will be managed by flushing if necessary. Flushing points will be provided at the head of all lines. The maximum retention time is 5.2 hours.

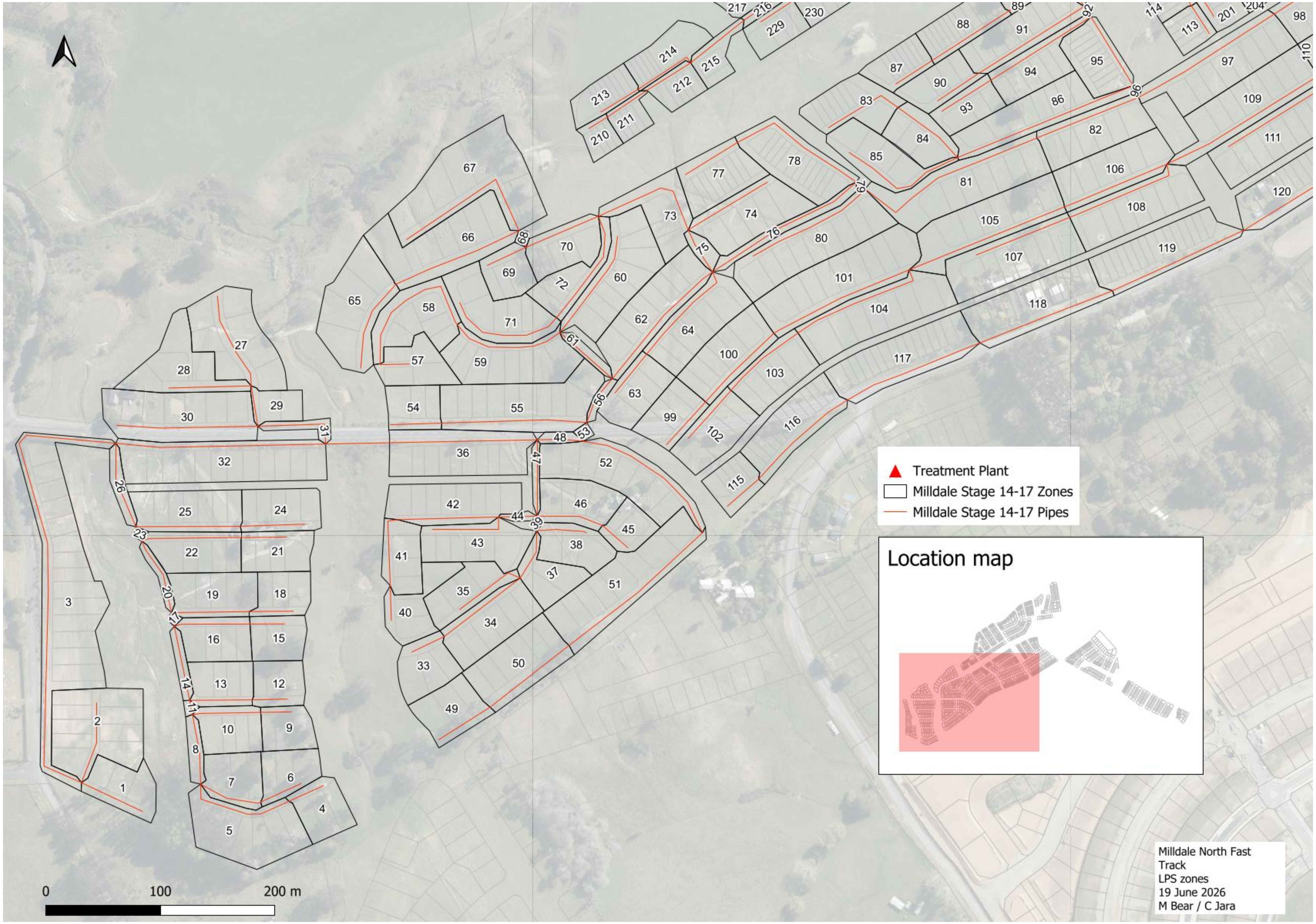
The proposed network is therefore complies with the relevant pressure sewer requirements of the CoP, including pipe isolation and air-management provisions. If the interim arrangement subsequently transitions to public servicing, the affected terminal sections of the LPS network will be reviewed once the relevant connection levels and operating conditions are confirmed.

Appendix A – Pump curve

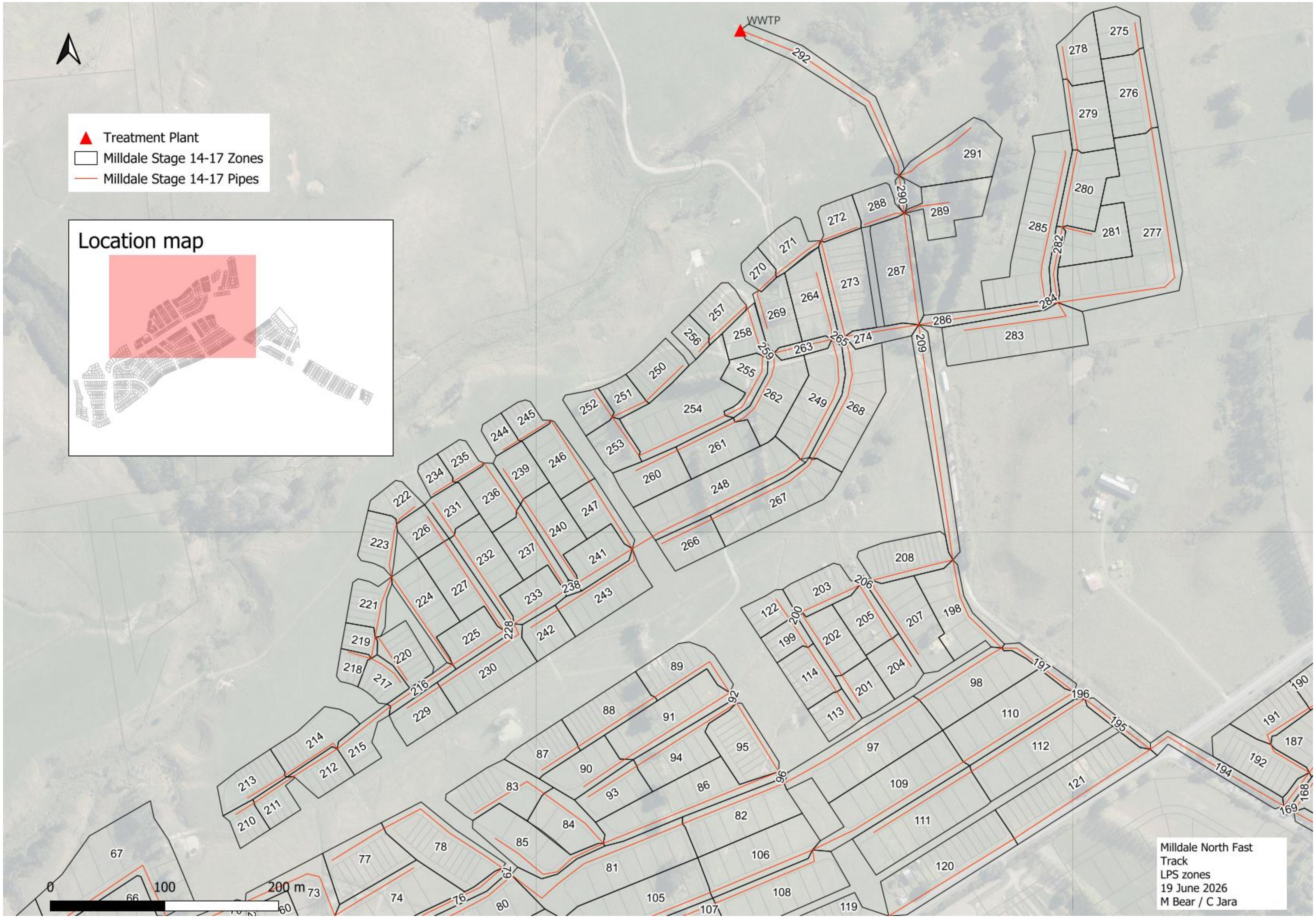


Appendix B – Zone Layout





Treatment Plant
Milldale Stage 14-17 Zones
Milldale Stage 14-17 Pipes
Location map
0
100
200 m
Milldale North Fast Track
LPS zones
19 June 2026
M Bear / C Jara



WWTP
Treatment Plant
Milldale Stage 14-17 Zones
Milldale Stage 14-17 Pipes
Location map
0
100
200 m
Milldale North Fast Track
LPS zones
19 June 2026
M Bear / C Jara

Appendix C – System Performance

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:

Milldale Stage 14-17 Fast Track August 2026

M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100										Friction loss calculations were based on a Constant for inside roughness "C" of:						140	
1.00	3.00	3	3	648	.76	2	1.53	50.00	1.22	59.00	4.48	2.64	46.06	20.00	44.00	-24.00	22.06
2.00	3.00	9	9	648	.74	3	2.23	63.00	1.09	72.00	2.78	2.00	45.42	20.00	41.00	-21.00	24.42
3.00	36.00	14	26	648	.70	5	3.60	75.00	1.23	409.00	2.82	11.51	43.42	20.00	33.00	-13.00	30.42
4.00	5.00	3	3	648	.82	2	1.65	50.00	1.31	33.00	5.16	1.70	44.88	20.00	50.00	-30.00	14.88
5.00	8.00	6	9	648	.83	3	2.48	63.00	1.22	94.00	3.38	3.18	43.18	20.00	49.00	-29.00	14.18
6.00	7.00	3	3	648	.82	2	1.65	50.00	1.31	39.00	5.16	2.01	43.89	20.00	49.00	-29.00	14.89
7.00	8.00	3	6	648	.82	3	2.47	63.00	1.21	56.00	3.35	1.88	41.88	20.00	47.00	-27.00	14.88
8.00	11.00	0	15	648	.81	4	3.30	75.00	1.13	61.00	2.40	1.46	40.00	20.00	43.00	-23.00	17.00
9.00	10.00	3	3	648	.80	2	1.60	50.00	1.27	27.00	4.89	1.32	41.75	20.00	44.00	-24.00	17.75
10.00	11.00	4	7	648	.79	3	2.39	63.00	1.17	60.00	3.15	1.89	40.43	20.00	42.00	-22.00	18.43
11.00	14.00	0	22	648	.79	5	4.08	75.00	1.40	13.00	3.55	0.46	38.54	20.00	40.00	-20.00	18.54
12.00	13.00	3	3	648	.79	2	1.58	50.00	1.25	31.00	4.75	1.47	41.26	20.00	42.00	-22.00	19.26
13.00	14.00	4	7	648	.79	3	2.37	63.00	1.16	55.00	3.10	1.71	39.79	20.00	41.00	-21.00	18.79
14.00	17.00	0	29	648	.78	5	4.05	75.00	1.39	66.00	3.50	2.31	38.08	20.00	38.00	-18.00	20.08
15.00	16.00	3	3	648	.63	2	1.26	50.00	1.00	31.00	3.14	0.97	38.46	20.00	20.00	0.00	38.46
16.00	17.00	4	7	648	.79	3	2.16	63.00	1.06	66.00	2.61	1.72	37.49	20.00	38.00	-18.00	19.49
17.00	20.00	0	36	648	.78	6	4.75	90.00	1.14	12.00	1.97	0.24	35.77	20.00	36.00	-16.00	19.77
18.00	19.00	3	3	648	.77	2	1.54	50.00	1.23	38.00	4.56	1.73	39.29	20.00	38.00	-18.00	21.29
19.00	20.00	5	8	648	.78	3	2.32	63.00	1.14	68.00	2.99	2.03	37.56	20.00	37.00	-17.00	20.56
20.00	23.00	0	44	648	.77	6	4.74	90.00	1.13	69.00	1.95	1.35	35.53	20.00	34.00	-14.00	21.53
21.00	22.00	4	4	648	.74	3	2.23	63.00	1.09	40.00	2.77	1.11	37.70	20.00	33.00	-13.00	24.70
22.00	23.00	5	9	648	.74	3	2.23	63.00	1.09	87.00	2.77	2.41	36.59	20.00	32.00	-12.00	24.59
23.00	26.00	0	53	648	.76	7	5.47	90.00	1.31	14.00	2.55	0.36	34.18	20.00	31.00	-11.00	23.18
24.00	25.00	5	5	648	.75	3	2.24	63.00	1.10	57.00	2.79	1.59	37.24	20.00	33.00	-13.00	24.24
25.00	26.00	7	12	648	.75	4	3.00	75.00	1.03	91.00	2.01	1.83	35.65	20.00	32.00	-12.00	23.65
26.00	36.00	0	65	648	.73	7	5.43	90.00	1.30	76.00	2.51	1.91	33.82	20.00	27.00	-7.00	26.82
27.00	29.00	7	7	648	.70	3	2.10	63.00	1.03	86.00	2.49	2.14	36.73	20.00	27.00	-7.00	29.73
28.00	29.00	4	4	648	.70	3	2.09	63.00	1.02	72.00	2.46	1.77	36.36	20.00	26.00	-6.00	30.36
29.00	31.00	2	13	648	.73	4	2.82	75.00	0.96	36.00	1.79	0.64	34.59	20.00	28.00	-8.00	26.59
30.00	31.00	7	7	648	.70	3	2.10	63.00	1.03	123.00	2.48	3.05	37.00	20.00	27.00	-7.00	30.00
31.00	36.00	0	20	648	.74	5	3.51	75.00	1.20	76.00	2.69	2.04	33.95	20.00	29.00	-9.00	24.95
32.00	36.00	12	12	648	.73	4	2.92	75.00	1.00	184.00	1.90	3.50	35.41	20.00	29.00	-9.00	26.41
33.00	34.00	3	3	648	.82	2	1.64	50.00	1.31	31.00	5.14	1.59	37.98	20.00	43.00	-23.00	14.98
34.00	37.00	6	9	648	.83	3	2.48	63.00	1.21	84.00	3.37	2.83	36.39	20.00	42.00	-22.00	14.39
35.00	37.00	4	4	648	.82	3	2.47	63.00	1.21	65.00	3.36	2.18	35.74	20.00	41.00	-21.00	14.74

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Milldale Stage 14-17 Fast Track August 2026

Prepared By:

M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100										Friction loss calculations were based on a Constant for inside roughness "C" of:						140	
36.00	48.00	9	132	648	.79	9	6.75	110.00	1.09	185.00	1.44	2.66	31.91	20.00	33.00	-13.00	18.91
37.00	39.00	2	15	648	.84	4	3.31	63.00	1.62	45.00	5.76	2.59	33.56	20.00	41.00	-21.00	12.56
38.00	39.00	3	3	648	.84	2	1.69	50.00	1.34	44.00	5.39	2.37	33.34	20.00	41.00	-21.00	12.34
39.00	47.00	0	18	648	.84	4	3.32	75.00	1.14	13.00	2.42	0.32	30.97	20.00	38.00	-18.00	12.97
40.00	41.00	3	3	648	.80	2	1.61	50.00	1.28	30.00	4.92	1.48	37.32	20.00	40.00	-20.00	17.32
41.00	42.00	3	6	648	.79	3	2.39	63.00	1.17	65.00	3.15	2.05	35.84	20.00	37.00	-17.00	18.84
42.00	44.00	8	14	648	.80	4	3.19	75.00	1.09	88.00	2.25	1.98	33.79	20.00	36.00	-16.00	17.79
43.00	44.00	6	6	648	.81	3	2.42	63.00	1.18	69.00	3.22	2.22	34.03	20.00	37.00	-17.00	17.03
44.00	47.00	0	20	648	.83	5	4.00	75.00	1.37	34.00	3.42	1.16	31.81	20.00	38.00	-18.00	13.81
45.00	46.00	2	2	648	.86	2	1.72	50.00	1.37	30.00	5.59	1.68	34.37	20.00	44.00	-24.00	10.37
46.00	47.00	5	7	648	.84	3	2.54	63.00	1.24	58.00	3.52	2.04	32.69	20.00	40.00	-20.00	12.69
47.00	48.00	0	45	648	.82	6	4.92	90.00	1.17	67.00	2.09	1.40	30.65	20.00	35.00	-15.00	15.65
48.00	53.00	0	177	648	.83	10	7.68	125.00	0.96	40.00	0.98	0.39	29.25	20.00	35.00	-15.00	14.25
49.00	50.00	3	3	648	.84	2	1.68	50.00	1.34	53.00	5.35	2.84	43.83	20.00	51.00	-31.00	12.83
50.00	51.00	6	9	648	.85	3	2.53	63.00	1.24	88.00	3.51	3.09	40.99	20.00	49.00	-29.00	11.99
51.00	52.00	7	16	648	.86	4	3.40	75.00	1.16	153.00	2.53	3.87	37.90	20.00	47.00	-27.00	10.90
52.00	53.00	8	24	648	.82	5	4.20	75.00	1.44	138.00	3.75	5.17	34.03	20.00	39.00	-19.00	15.03
53.00	56.00	0	201	648	.83	11	8.54	125.00	1.07	17.00	1.20	0.20	28.86	20.00	35.00	-15.00	13.86
54.00	55.00	3	3	648	.76	2	1.52	50.00	1.21	45.00	4.45	2.00	33.48	20.00	31.00	-11.00	22.48
55.00	56.00	10	13	648	.80	4	3.17	75.00	1.08	127.00	2.22	2.82	31.48	20.00	34.00	-14.00	17.48
56.00	62.00	0	214	648	.83	12	9.33	125.00	1.16	45.00	1.41	0.64	28.66	20.00	35.00	-15.00	13.66
57.00	58.00	4	4	648	.72	3	2.17	63.00	1.06	26.00	2.64	0.69	35.98	20.00	29.00	-9.00	26.98
58.00	59.00	5	9	648	.72	3	2.17	63.00	1.06	133.00	2.63	3.50	35.29	20.00	28.00	-8.00	27.29
59.00	61.00	8	17	648	.76	4	2.96	75.00	1.01	100.00	1.96	1.96	31.79	20.00	29.00	-9.00	22.79
60.00	61.00	8	8	648	.74	3	2.23	63.00	1.09	100.00	2.77	2.77	32.60	20.00	28.00	-8.00	24.60
61.00	62.00	0	25	648	.79	5	3.70	75.00	1.27	61.00	2.97	1.81	29.83	20.00	31.00	-11.00	18.83
62.00	76.00	8	247	648	.81	13	10.07	125.00	1.26	128.00	1.63	2.08	28.02	20.00	32.00	-12.00	16.02
63.00	64.00	4	4	648	.82	3	2.45	63.00	1.20	44.00	3.30	1.45	29.68	20.00	34.00	-14.00	15.68
64.00	76.00	6	10	648	.81	4	3.26	75.00	1.11	98.00	2.34	2.29	28.23	20.00	32.00	-12.00	16.23
65.00	66.00	4	4	648	.71	3	2.14	63.00	1.05	83.00	2.57	2.13	35.22	20.00	27.00	-7.00	28.22
66.00	68.00	6	10	648	.73	4	2.90	75.00	0.99	117.00	1.88	2.20	33.09	20.00	27.00	-7.00	26.09
67.00	68.00	9	9	648	.70	3	2.11	63.00	1.03	143.00	2.50	3.58	34.47	20.00	25.00	-5.00	29.47
68.00	70.00	0	19	648	.74	5	3.57	75.00	1.22	16.00	2.78	0.44	30.89	20.00	26.00	-6.00	24.89
69.00	70.00	4	4	648	.74	3	2.23	63.00	1.09	37.00	2.78	1.03	31.48	20.00	27.00	-7.00	24.48
70.00	73.00	5	28	648	.75	5	3.63	75.00	1.24	69.00	2.86	1.97	30.45	20.00	27.00	-7.00	23.45

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Milldale Stage 14-17 Fast Track August 2026

Prepared By:
M Bear / C Jara

August 6, 2026

This spreadsheet was calculated using pipe diameters for: SDR11PE100 | Friction loss calculations were based on a Constant for inside roughness "C" of: 140

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
71.00	72.00	5	5	648	.73	3	2.19	63.00	1.07	103.00	2.69	2.77	34.11	20.00	28.00	-8.00	26.11
72.00	73.00	3	8	648	.75	3	2.22	63.00	1.09	104.00	2.75	2.86	31.34	20.00	28.00	-8.00	23.34
73.00	75.00	3	39	648	.77	6	4.39	90.00	1.05	107.00	1.70	1.82	28.48	20.00	27.00	-7.00	21.48
74.00	75.00	5	5	648	.79	3	2.36	63.00	1.16	81.00	3.09	2.50	29.16	20.00	30.00	-10.00	19.16
75.00	76.00	0	44	648	.81	6	4.43	90.00	1.06	42.00	1.73	0.72	26.66	20.00	30.00	-10.00	16.66
76.00	79.00	0	301	648	.82	14	10.79	125.00	1.35	149.00	1.85	2.76	25.94	20.00	31.00	-11.00	14.94
77.00	78.00	9	9	648	.76	3	2.28	63.00	1.11	53.00	2.88	1.53	28.61	20.00	26.00	-6.00	22.61
78.00	79.00	12	21	648	.76	5	3.81	75.00	1.30	125.00	3.12	3.90	27.08	20.00	25.00	-5.00	22.08
79.00	81.00	0	322	648	.82	15	11.55	125.00	1.44	10.00	2.10	0.21	23.18	20.00	28.00	-8.00	15.18
80.00	81.00	9	9	648	.81	3	2.44	63.00	1.20	115.00	3.29	3.78	26.75	20.00	31.00	-11.00	15.75
81.00	82.00	7	338	648	.85	15	11.59	140.00	1.14	175.00	1.17	2.05	22.97	20.00	31.00	-11.00	11.97
82.00	97.00	6	344	648	.85	15	11.62	140.00	1.14	96.00	1.18	1.13	20.92	20.00	30.00	-10.00	10.92
83.00	84.00	8	8	648	.75	3	2.24	63.00	1.10	72.00	2.80	2.01	29.00	20.00	25.00	-5.00	24.00
84.00	86.00	3	11	648	.79	4	3.03	75.00	1.04	68.00	2.05	1.39	26.99	20.00	28.00	-8.00	18.99
85.00	86.00	4	4	648	.78	3	2.34	63.00	1.15	113.00	3.03	3.42	29.02	20.00	29.00	-9.00	20.02
86.00	96.00	8	23	648	.82	5	3.91	75.00	1.34	166.00	3.28	5.45	25.60	20.00	30.00	-10.00	15.60
87.00	88.00	8	8	648	.74	3	2.23	63.00	1.09	38.00	2.78	1.06	28.30	20.00	24.00	-4.00	24.30
88.00	89.00	13	21	648	.75	5	3.73	75.00	1.27	80.00	3.00	2.40	27.24	20.00	23.00	-3.00	24.24
89.00	92.00	8	29	648	.77	5	3.75	75.00	1.28	89.00	3.04	2.71	24.84	20.00	23.00	-3.00	21.84
90.00	91.00	4	4	648	.78	3	2.35	63.00	1.15	43.00	3.04	1.31	25.81	20.00	26.00	-6.00	19.81
91.00	92.00	8	12	648	.78	4	3.13	75.00	1.07	109.00	2.18	2.37	24.50	20.00	25.00	-5.00	19.50
92.00	95.00	0	41	648	.80	6	4.56	90.00	1.09	11.00	1.82	0.20	22.13	20.00	25.00	-5.00	17.13
93.00	94.00	3	3	648	.78	2	1.55	50.00	1.24	51.00	4.62	2.36	27.44	20.00	27.00	-7.00	20.44
94.00	95.00	6	9	648	.79	3	2.35	63.00	1.15	103.00	3.06	3.15	25.08	20.00	26.00	-6.00	19.08
95.00	96.00	10	60	648	.83	7	5.43	90.00	1.30	71.00	2.51	1.78	21.93	20.00	28.00	-8.00	13.93
96.00	97.00	0	83	648	.86	8	6.22	90.00	1.49	11.00	3.23	0.36	20.15	20.00	30.00	-10.00	10.15
97.00	98.00	8	435	648	.85	18	13.97	140.00	1.37	139.00	1.66	2.30	19.79	20.00	28.00	-8.00	11.79
98.00	198.00	6	441	648	.86	18	13.99	140.00	1.37	85.00	1.66	1.41	17.49	20.00	27.00	-7.00	10.49
99.00	100.00	4	4	648	.82	3	2.45	63.00	1.20	51.00	3.29	1.68	34.77	20.00	39.00	-19.00	15.77
100.00	101.00	6	10	648	.82	4	3.27	75.00	1.12	85.00	2.36	2.01	33.09	20.00	38.00	-18.00	15.09
101.00	108.00	9	19	648	.83	5	4.12	75.00	1.41	131.00	3.61	4.73	31.08	20.00	37.00	-17.00	14.08
102.00	103.00	5	5	648	.78	3	2.35	63.00	1.15	56.00	3.06	1.72	38.50	20.00	39.00	-19.00	19.50
103.00	104.00	5	10	648	.79	4	3.15	75.00	1.08	78.00	2.20	1.72	36.78	20.00	38.00	-18.00	18.78
104.00	105.00	7	17	648	.80	4	3.17	75.00	1.08	121.00	2.22	2.68	35.06	20.00	37.00	-17.00	18.06
105.00	106.00	7	24	648	.80	5	3.97	75.00	1.36	146.00	3.38	4.93	32.38	20.00	35.00	-15.00	17.38

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:

Milldale Stage 14-17 Fast Track August 2026

M Bear / C Jara

August 6, 2026

This spreadsheet was calculated using pipe diameters for: SDR11PE100 Friction loss calculations were based on a Constant for inside roughness "C" of: 140

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
106.00	109.00	6	30	648	.83	5	4.01	75.00	1.37	97.00	3.44	3.34	27.45	20.00	34.00	-14.00	13.45
107.00	108.00	7	7	648	.83	3	2.50	63.00	1.23	88.00	3.43	3.02	29.37	20.00	36.00	-16.00	13.37
108.00	109.00	7	33	648	.85	6	4.99	90.00	1.19	104.00	2.15	2.24	26.35	20.00	35.00	-15.00	11.35
109.00	110.00	8	71	648	.85	7	5.75	90.00	1.37	153.00	2.80	4.28	24.11	20.00	33.00	-13.00	11.11
110.00	197.00	7	78	648	.88	7	5.79	90.00	1.38	115.00	2.83	3.26	19.83	20.00	32.00	-12.00	7.83
111.00	112.00	8	8	648	.87	3	2.60	63.00	1.27	101.00	3.68	3.72	23.48	20.00	34.00	-14.00	9.48
112.00	196.00	7	15	648	.88	4	3.49	75.00	1.20	118.00	2.66	3.14	19.76	20.00	32.00	-12.00	7.76
113.00	114.00	5	5	648	.83	3	2.50	63.00	1.23	29.00	3.43	1.00	21.39	20.00	28.00	-8.00	13.39
114.00	199.00	7	12	648	.83	4	3.32	75.00	1.14	46.00	2.42	1.11	20.39	20.00	26.00	-6.00	14.39
115.00	116.00	5	5	648	.85	3	2.55	63.00	1.25	36.00	3.56	1.28	34.36	20.00	43.00	-23.00	11.36
116.00	117.00	13	18	648	.85	4	3.41	75.00	1.17	104.00	2.55	2.65	33.08	20.00	42.00	-22.00	11.08
117.00	118.00	15	33	648	.87	6	5.16	90.00	1.23	126.00	2.29	2.88	30.43	20.00	41.00	-21.00	9.43
118.00	119.00	14	47	648	.87	6	5.18	90.00	1.24	124.00	2.31	2.86	27.55	20.00	39.00	-19.00	8.55
119.00	120.00	15	62	648	.89	7	6.09	90.00	1.46	126.00	3.11	3.92	24.69	20.00	38.00	-18.00	6.69
120.00	121.00	15	77	648	.91	7	6.15	110.00	0.99	129.00	1.21	1.56	20.77	20.00	37.00	-17.00	3.77
121.00	195.00	17	94	648	.92	8	7.09	110.00	1.14	143.00	1.57	2.25	19.21	20.00	36.00	-16.00	3.21
122.00	200.00	4	4	648	.82	3	2.46	63.00	1.20	20.00	3.32	0.66	19.21	20.00	24.00	-4.00	15.21
123.00	124.00	4	4	648	.63	3	1.90	63.00	0.93	53.00	2.06	1.09	36.89	20.00	19.00	1.00	37.89
124.00	126.00	3	7	648	.63	3	1.90	63.00	0.93	50.00	2.07	1.03	35.80	20.00	18.00	2.00	37.80
125.00	126.00	5	5	648	.65	3	1.94	63.00	0.95	23.00	2.14	0.49	35.26	20.00	19.00	1.00	36.26
126.00	128.00	7	19	648	.65	5	3.22	75.00	1.10	60.00	2.29	1.37	34.77	20.00	19.00	1.00	35.77
127.00	128.00	2	2	648	.65	2	1.31	50.00	1.04	33.00	3.36	1.11	34.51	20.00	19.00	1.00	35.51
128.00	131.00	0	21	648	.66	5	3.22	75.00	1.10	102.00	2.30	2.34	33.40	20.00	19.00	1.00	34.40
129.00	130.00	3	3	648	.66	2	1.32	50.00	1.05	31.00	3.43	1.06	33.65	20.00	19.00	1.00	34.65
130.00	131.00	5	8	648	.69	3	2.04	63.00	1.00	65.00	2.36	1.53	32.59	20.00	22.00	-2.00	30.59
131.00	134.00	0	29	648	.73	5	3.27	75.00	1.12	68.00	2.36	1.61	31.06	20.00	25.00	-5.00	26.06
132.00	133.00	4	4	648	.72	3	2.16	63.00	1.06	32.00	2.62	0.84	32.29	20.00	25.00	-5.00	27.29
133.00	134.00	4	8	648	.74	3	2.20	63.00	1.08	74.00	2.70	2.00	31.45	20.00	27.00	-7.00	24.45
134.00	136.00	0	37	648	.77	6	4.03	90.00	0.96	11.00	1.45	0.16	29.45	20.00	28.00	-8.00	21.45
135.00	136.00	8	8	648	.74	3	2.21	63.00	1.08	108.00	2.73	2.95	32.24	20.00	27.00	-7.00	25.24
136.00	139.00	0	45	648	.79	6	4.10	90.00	0.98	63.00	1.50	0.94	29.29	20.00	30.00	-10.00	19.29
137.00	138.00	5	5	648	.78	3	2.34	63.00	1.15	55.00	3.03	1.67	32.06	20.00	32.00	-12.00	20.06
138.00	139.00	4	9	648	.79	3	2.35	63.00	1.15	67.00	3.05	2.04	30.39	20.00	31.00	-11.00	19.39
139.00	141.00	0	54	648	.80	7	4.90	90.00	1.17	13.00	2.08	0.27	28.35	20.00	31.00	-11.00	17.35
140.00	141.00	9	9	648	.78	3	2.35	63.00	1.15	120.00	3.05	3.66	31.74	20.00	32.00	-12.00	19.74

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

Milldale Stage 14-17 Fast Track August 2026

Prepared By:
M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100											Friction loss calculations were based on a Constant for inside roughness "C" of: 140						
141.00	144.00	0	63	648	.81	7	4.98	90.00	1.19	56.00	2.14	1.20	28.08	20.00	31.00	-11.00	17.08
142.00	143.00	5	5	648	.81	3	2.43	63.00	1.19	56.00	3.25	1.82	30.45	20.00	34.00	-14.00	16.45
143.00	144.00	4	9	648	.62	3	2.18	63.00	1.06	66.00	2.65	1.75	28.63	20.00	9.00	11.00	39.63
144.00	146.00	0	72	648	.81	7	4.99	90.00	1.19	20.00	2.15	0.43	26.88	20.00	30.00	-10.00	16.88
145.00	146.00	9	9	648	.80	3	2.41	63.00	1.18	119.00	3.20	3.80	30.25	20.00	33.00	-13.00	17.25
146.00	149.00	0	81	648	.78	8	5.79	110.00	0.93	62.00	1.08	0.67	26.45	20.00	26.00	-6.00	20.45
147.00	148.00	4	4	648	.75	3	2.26	63.00	1.11	50.00	2.85	1.43	29.11	20.00	26.00	-6.00	23.11
148.00	149.00	5	9	648	.75	3	2.26	63.00	1.10	67.00	2.83	1.90	27.68	20.00	24.00	-4.00	23.68
149.00	151.00	0	90	648	.76	8	5.81	110.00	0.93	13.00	1.09	0.14	25.78	20.00	23.00	-3.00	22.78
150.00	151.00	8	8	648	.74	3	2.22	63.00	1.09	113.00	2.76	3.12	28.76	20.00	24.00	-4.00	24.76
151.00	154.00	0	98	648	.74	8	5.82	110.00	0.94	68.00	1.09	0.74	25.64	20.00	20.00	0.00	25.64
152.00	153.00	4	4	648	.71	3	2.13	63.00	1.04	51.00	2.54	1.30	27.66	20.00	19.00	1.00	28.66
153.00	154.00	4	8	648	.71	3	2.13	63.00	1.04	57.00	2.55	1.46	26.36	20.00	18.00	2.00	28.36
154.00	156.00	0	106	648	.72	8	5.81	110.00	0.93	12.00	1.09	0.13	24.90	20.00	17.00	3.00	27.90
155.00	156.00	8	8	648	.70	3	2.09	63.00	1.02	105.00	2.46	2.58	27.35	20.00	17.00	3.00	30.35
156.00	159.00	0	114	648	.69	9	6.52	110.00	1.05	59.00	1.34	0.79	24.77	20.00	14.00	6.00	30.77
157.00	158.00	8	8	648	.67	3	2.02	63.00	0.99	49.00	2.32	1.13	26.04	20.00	13.00	7.00	33.04
158.00	159.00	8	16	648	.68	4	2.70	75.00	0.92	56.00	1.65	0.93	24.91	20.00	12.00	8.00	32.91
159.00	163.00	0	130	648	.67	9	6.46	110.00	1.04	155.00	1.32	2.05	23.98	20.00	10.00	10.00	33.98
160.00	161.00	6	6	648	.65	3	1.94	63.00	0.95	74.00	2.15	1.59	27.19	20.00	11.00	9.00	36.19
161.00	162.00	7	13	648	.69	4	2.67	75.00	0.91	116.00	1.62	1.88	25.60	20.00	14.00	6.00	31.60
162.00	163.00	5	18	648	.69	4	2.69	75.00	0.92	109.00	1.64	1.79	23.72	20.00	12.00	8.00	31.72
163.00	167.00	8	156	648	.74	10	7.14	125.00	0.89	141.00	0.86	1.21	21.93	20.00	17.00	3.00	24.93
164.00	166.00	8	8	648	.71	3	2.13	63.00	1.04	134.00	2.54	3.40	24.78	20.00	16.00	4.00	28.78
165.00	166.00	4	4	648	.75	3	2.26	63.00	1.11	33.00	2.85	0.94	22.32	20.00	19.00	1.00	23.32
166.00	167.00	0	12	648	.77	4	2.89	75.00	0.99	35.00	1.88	0.66	21.38	20.00	20.00	0.00	21.38
167.00	169.00	6	174	648	.80	10	7.18	125.00	0.90	146.00	0.87	1.27	20.72	20.00	23.00	-3.00	17.72
168.00	169.00	5	5	648	.85	3	2.56	63.00	1.25	78.00	3.58	2.79	22.24	20.00	31.00	-11.00	11.24
169.00	194.00	0	179	648	.85	10	7.21	125.00	0.90	10.00	0.88	0.09	19.45	20.00	28.00	-8.00	11.45
170.00	171.00	6	6	648	.67	3	2.00	63.00	0.98	98.00	2.26	2.22	28.89	20.00	15.00	5.00	33.89
171.00	173.00	0	6	648	.69	3	2.00	63.00	0.98	34.00	2.26	0.77	26.67	20.00	16.00	4.00	30.67
172.00	173.00	7	7	648	.68	3	2.05	63.00	1.00	80.00	2.37	1.90	27.80	20.00	16.00	4.00	31.80
173.00	175.00	0	13	648	.70	4	2.70	75.00	0.92	11.00	1.65	0.18	25.90	20.00	16.00	4.00	29.90
174.00	175.00	4	4	648	.69	3	2.08	63.00	1.02	76.00	2.44	1.85	27.57	20.00	17.00	3.00	30.57
175.00	181.00	11	28	648	.71	5	3.46	75.00	1.18	91.00	2.61	2.37	25.72	20.00	17.00	3.00	28.72

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Milldale Stage 14-17 Fast Track August 2026

Prepared By:
M Bear / C Jara

August 6, 2026

This spreadsheet was calculated using pipe diameters for: SDR11PE100 — Friction loss calculations were based on a Constant for inside roughness "C" of: 140

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
176.00	177.00	4	4	648	.74	3	2.22	63.00	1.09	49.00	2.75	1.35	27.78	20.00	23.00	-3.00	24.78
177.00	178.00	2	6	648	.78	3	2.26	63.00	1.11	51.00	2.84	1.45	26.43	20.00	26.00	-6.00	20.43
178.00	180.00	4	10	648	.78	4	3.06	75.00	1.05	42.00	2.08	0.87	24.98	20.00	25.00	-5.00	19.98
179.00	180.00	4	4	648	.77	3	2.31	63.00	1.13	66.00	2.97	1.96	26.07	20.00	25.00	-5.00	21.07
180.00	181.00	2	16	648	.79	4	3.07	75.00	1.05	36.00	2.10	0.76	24.11	20.00	25.00	-5.00	19.11
181.00	183.00	0	44	648	.80	6	4.32	90.00	1.03	83.00	1.64	1.36	23.35	20.00	26.00	-6.00	17.35
182.00	183.00	8	8	648	.79	3	2.38	63.00	1.16	115.00	3.12	3.58	25.57	20.00	27.00	-7.00	18.57
183.00	187.00	0	52	648	.85	7	5.11	90.00	1.22	11.00	2.25	0.25	21.99	20.00	30.00	-10.00	11.99
184.00	185.00	5	5	648	.78	3	2.35	63.00	1.15	50.00	3.06	1.53	26.56	20.00	27.00	-7.00	19.56
185.00	186.00	5	10	648	.80	4	3.16	75.00	1.08	81.00	2.21	1.79	25.03	20.00	27.00	-7.00	18.03
186.00	187.00	4	14	648	.83	4	3.20	75.00	1.10	66.00	2.27	1.50	23.24	20.00	29.00	-9.00	14.24
187.00	193.00	7	73	648	.86	7	5.30	90.00	1.27	75.00	2.40	1.80	21.74	20.00	32.00	-12.00	9.74
188.00	189.00	6	6	648	.79	3	2.36	63.00	1.16	40.00	3.08	1.23	27.13	20.00	28.00	-8.00	19.13
189.00	190.00	9	15	648	.81	4	3.19	75.00	1.09	60.00	2.25	1.35	25.90	20.00	29.00	-9.00	16.90
190.00	191.00	10	25	648	.84	5	4.08	75.00	1.40	71.00	3.55	2.52	24.55	20.00	32.00	-12.00	12.55
191.00	192.00	9	34	648	.87	6	4.98	90.00	1.19	53.00	2.14	1.14	22.03	20.00	33.00	-13.00	9.03
192.00	193.00	11	45	648	.88	6	5.05	90.00	1.21	43.00	2.20	0.95	20.89	20.00	33.00	-13.00	7.89
193.00	194.00	0	118	648	.85	9	7.10	110.00	1.14	37.00	1.58	0.58	19.94	20.00	28.00	-8.00	11.94
194.00	195.00	0	297	648	.89	14	10.48	125.00	1.31	137.00	1.75	2.40	19.36	20.00	33.00	-13.00	6.36
195.00	196.00	0	391	648	.92	17	13.29	180.00	0.80	72.00	0.47	0.34	16.96	20.00	34.00	-14.00	2.96
196.00	197.00	0	406	648	.90	17	13.34	180.00	0.81	11.00	0.47	0.05	16.62	20.00	31.00	-11.00	5.62
197.00	198.00	0	484	648	.88	20	15.83	180.00	0.96	76.00	0.65	0.49	16.57	20.00	29.00	-9.00	7.57
198.00	209.00	6	931	648	.85	33	25.92	180.00	1.57	92.00	1.61	1.48	16.08	20.00	24.00	-4.00	12.08
199.00	200.00	4	16	648	.83	4	3.32	75.00	1.13	30.00	2.42	0.73	19.28	20.00	25.00	-5.00	14.28
200.00	203.00	0	20	648	.83	5	4.14	75.00	1.42	13.00	3.64	0.47	18.55	20.00	24.00	-4.00	14.55
201.00	202.00	3	3	648	.82	2	1.65	50.00	1.31	28.00	5.16	1.44	21.72	20.00	27.00	-7.00	14.72
202.00	203.00	5	8	648	.82	3	2.46	63.00	1.21	66.00	3.33	2.20	20.28	20.00	25.00	-5.00	15.28
203.00	206.00	7	35	648	.82	6	4.95	90.00	1.18	55.00	2.12	1.16	18.08	20.00	23.00	-3.00	15.08
204.00	205.00	3	3	648	.83	2	1.65	50.00	1.32	29.00	5.20	1.51	20.30	20.00	26.00	-6.00	14.30
205.00	206.00	5	8	648	.83	3	2.49	63.00	1.22	55.00	3.40	1.87	18.79	20.00	25.00	-5.00	13.79
206.00	208.00	0	43	648	.83	6	4.95	90.00	1.18	12.00	2.12	0.25	16.92	20.00	23.00	-3.00	13.92
207.00	208.00	7	7	648	.83	3	2.48	63.00	1.22	77.00	3.39	2.61	19.28	20.00	25.00	-5.00	14.28
208.00	209.00	13	63	648	.83	7	5.79	90.00	1.38	73.00	2.84	2.07	16.67	20.00	23.00	-3.00	13.67
209.00	287.00	0	994	648	.83	35	27.58	180.00	1.67	208.00	1.81	3.76	14.60	20.00	21.00	-1.00	13.60
210.00	211.00	4	4	648	.79	3	2.36	63.00	1.16	19.00	3.08	0.58	23.34	20.00	24.00	-4.00	19.34

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By: Milldale Stage 14-17 Fast Track August 2026

M Bear / C Jara August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100										Friction loss calculations were based on a Constant for inside roughness "C" of:						140	
211.00	212.00	5	9	648	.79	3	2.37	63.00	1.16	42.00	3.10	1.30	22.76	20.00	24.00	-4.00	18.76
212.00	215.00	5	14	648	.80	4	3.18	75.00	1.09	45.00	2.23	1.00	21.46	20.00	24.00	-4.00	17.46
213.00	214.00	8	8	648	.78	3	2.35	63.00	1.15	38.00	3.05	1.16	22.74	20.00	23.00	-3.00	19.74
214.00	215.00	24	32	648	.79	6	4.74	90.00	1.13	57.00	1.96	1.12	21.58	20.00	23.00	-3.00	18.58
215.00	216.00	3	49	648	.81	6	4.76	90.00	1.14	60.00	1.97	1.18	20.46	20.00	24.00	-4.00	16.46
216.00	225.00	0	49	648	.81	6	4.76	90.00	1.14	65.00	1.97	1.28	19.28	20.00	23.00	-3.00	16.28
217.00	219.00	5	5	648	.78	3	2.34	63.00	1.15	34.00	3.04	1.03	23.05	20.00	23.00	-3.00	20.05
218.00	219.00	3	3	648	.77	2	1.55	50.00	1.23	21.00	4.59	0.96	22.98	20.00	22.00	-2.00	20.98
219.00	221.00	3	11	648	.78	4	3.12	75.00	1.07	19.00	2.15	0.41	22.02	20.00	22.00	-2.00	20.02
220.00	221.00	8	8	648	.78	3	2.34	63.00	1.15	48.00	3.04	1.46	23.07	20.00	23.00	-3.00	20.07
221.00	224.00	6	25	648	.78	5	3.90	75.00	1.34	55.00	3.27	1.80	21.61	20.00	22.00	-2.00	19.61
222.00	223.00	4	4	648	.78	3	2.33	63.00	1.14	23.00	3.01	0.69	21.52	20.00	21.00	-1.00	20.52
223.00	224.00	8	12	648	.78	4	3.12	75.00	1.07	47.00	2.16	1.02	20.83	20.00	21.00	-1.00	19.83
224.00	225.00	5	42	648	.80	6	4.70	90.00	1.12	94.00	1.92	1.81	19.81	20.00	22.00	-2.00	17.81
225.00	228.00	6	97	648	.82	8	6.32	110.00	1.02	54.00	1.27	0.69	18.00	20.00	23.00	-3.00	15.00
226.00	227.00	5	5	648	.79	3	2.36	63.00	1.16	26.00	3.08	0.80	20.21	20.00	21.00	-1.00	19.21
227.00	228.00	5	10	648	.80	4	3.18	75.00	1.09	94.00	2.24	2.10	19.41	20.00	22.00	-2.00	17.41
228.00	233.00	0	107	648	.83	8	6.33	110.00	1.02	11.00	1.27	0.14	17.31	20.00	23.00	-3.00	14.31
229.00	230.00	4	4	648	.80	3	2.41	63.00	1.18	34.00	3.19	1.09	20.41	20.00	23.00	-3.00	17.41
230.00	233.00	8	12	648	.81	4	3.23	75.00	1.11	93.00	2.31	2.15	19.32	20.00	23.00	-3.00	16.32
231.00	232.00	3	3	648	.78	2	1.55	50.00	1.24	34.00	4.62	1.57	21.63	20.00	21.00	-1.00	20.63
232.00	233.00	6	9	648	.80	3	2.37	63.00	1.16	93.00	3.10	2.89	20.06	20.00	22.00	-2.00	18.06
233.00	238.00	6	134	648	.82	9	7.14	110.00	1.15	55.00	1.59	0.88	17.17	20.00	22.00	-2.00	15.17
234.00	235.00	4	4	648	.78	3	2.35	63.00	1.15	20.00	3.05	0.61	20.80	20.00	21.00	-1.00	19.80
235.00	236.00	5	9	648	.78	3	2.34	63.00	1.15	32.00	3.04	0.97	20.19	20.00	20.00	0.00	20.19
236.00	237.00	5	14	648	.80	4	3.15	75.00	1.08	51.00	2.19	1.12	19.22	20.00	21.00	-1.00	18.22
237.00	238.00	4	18	648	.80	4	3.16	75.00	1.08	82.00	2.21	1.81	18.10	20.00	21.00	-1.00	17.10
238.00	241.00	0	152	648	.82	10	7.93	125.00	0.99	12.00	1.05	0.13	16.29	20.00	21.00	-1.00	15.29
239.00	240.00	4	4	648	.78	3	2.35	63.00	1.15	32.00	3.05	0.98	19.85	20.00	20.00	0.00	19.85
240.00	241.00	5	9	648	.80	3	2.37	63.00	1.16	87.00	3.11	2.71	18.87	20.00	21.00	-1.00	17.87
241.00	248.00	6	167	648	.83	10	7.94	125.00	0.99	56.00	1.05	0.59	16.16	20.00	22.00	-2.00	14.16
242.00	243.00	4	4	648	.81	3	2.43	63.00	1.19	29.00	3.24	0.94	18.61	20.00	22.00	-2.00	16.61
243.00	248.00	7	11	648	.82	4	3.25	75.00	1.11	90.00	2.34	2.10	17.67	20.00	22.00	-2.00	15.67
244.00	245.00	4	4	648	.78	3	2.34	63.00	1.15	16.00	3.04	0.49	20.04	20.00	20.00	0.00	20.04
245.00	246.00	5	9	648	.78	3	2.35	63.00	1.15	34.00	3.05	1.04	19.55	20.00	20.00	0.00	19.55

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - PIPE SIZING AND BRANCH ANALYSIS

Prepared By:
M Bear / C Jara

Milldale Stage 14-17 Fast Track August 2026

August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100										Friction loss calculations were based on a Constant for inside roughness "C" of:						140	
246.00	247.00	5	14	648	.79	4	3.15	75.00	1.08	63.00	2.19	1.38	18.51	20.00	20.00	0.00	18.51
247.00	248.00	4	18	648	.81	4	3.17	75.00	1.08	70.00	2.22	1.56	17.13	20.00	21.00	-1.00	16.13
248.00	249.00	11	207	648	.83	11	8.77	125.00	1.09	167.00	1.26	2.10	15.57	20.00	21.00	-1.00	14.57
249.00	265.00	7	214	648	.83	12	9.58	125.00	1.20	114.00	1.48	1.69	13.47	20.00	20.00	0.00	13.47
250.00	251.00	8	8	648	.78	3	2.33	63.00	1.14	45.00	2.99	1.35	19.71	20.00	19.00	1.00	20.71
251.00	253.00	5	13	648	.79	4	3.12	75.00	1.07	33.00	2.16	0.71	18.36	20.00	19.00	1.00	19.36
252.00	253.00	5	5	648	.79	3	2.38	63.00	1.16	27.00	3.13	0.84	18.49	20.00	20.00	0.00	18.49
253.00	254.00	5	23	648	.80	5	3.93	75.00	1.35	41.00	3.32	1.36	17.65	20.00	20.00	0.00	17.65
254.00	255.00	9	32	648	.80	6	4.75	90.00	1.13	83.00	1.96	1.63	16.29	20.00	19.00	1.00	17.29
255.00	259.00	2	34	648	.82	6	4.76	90.00	1.14	66.00	1.97	1.30	14.66	20.00	19.00	1.00	15.66
256.00	257.00	4	4	648	.80	3	2.40	63.00	1.17	13.00	3.16	0.41	15.84	20.00	18.00	2.00	17.84
257.00	258.00	8	12	648	.80	4	3.20	75.00	1.10	45.00	2.27	1.02	15.43	20.00	18.00	2.00	17.43
258.00	259.00	2	14	648	.81	4	3.21	75.00	1.10	46.00	2.27	1.05	14.41	20.00	18.00	2.00	16.41
259.00	263.00	0	48	648	.83	6	4.77	90.00	1.14	10.00	1.98	0.20	13.36	20.00	19.00	1.00	14.36
260.00	261.00	4	4	648	.80	3	2.39	63.00	1.17	40.00	3.16	1.26	17.93	20.00	20.00	0.00	17.93
261.00	262.00	5	9	648	.81	3	2.41	63.00	1.18	56.00	3.20	1.79	16.67	20.00	20.00	0.00	16.67
262.00	263.00	5	14	648	.82	4	3.24	75.00	1.11	74.00	2.32	1.72	14.88	20.00	20.00	0.00	14.88
263.00	265.00	0	62	648	.83	7	5.59	90.00	1.34	52.00	2.66	1.38	13.16	20.00	19.00	1.00	14.16
264.00	265.00	5	5	648	.82	3	2.47	63.00	1.21	60.00	3.35	2.01	13.79	20.00	19.00	1.00	14.79
265.00	274.00	0	281	648	.85	14	11.18	140.00	1.10	12.00	1.10	0.13	11.78	20.00	20.00	0.00	11.78
266.00	267.00	4	4	648	.80	3	2.40	63.00	1.18	49.00	3.18	1.56	19.64	20.00	22.00	-2.00	17.64
267.00	268.00	10	14	648	.80	4	3.21	75.00	1.10	103.00	2.28	2.35	18.08	20.00	21.00	-1.00	17.08
268.00	274.00	9	23	648	.82	5	4.04	75.00	1.38	117.00	3.49	4.08	15.73	20.00	20.00	0.00	15.73
269.00	270.00	4	4	648	.80	3	2.41	63.00	1.18	35.00	3.19	1.12	16.36	20.00	19.00	1.00	17.36
270.00	271.00	4	8	648	.80	3	2.41	63.00	1.18	20.00	3.20	0.64	15.24	20.00	18.00	2.00	17.24
271.00	273.00	7	15	648	.81	4	3.22	75.00	1.10	50.00	2.29	1.15	14.60	20.00	18.00	2.00	16.60
272.00	273.00	6	6	648	.81	3	2.43	63.00	1.19	34.00	3.24	1.10	14.55	20.00	18.00	2.00	16.55
273.00	274.00	12	33	648	.83	6	4.88	90.00	1.17	87.00	2.07	1.80	13.45	20.00	19.00	1.00	14.45
274.00	287.00	0	337	648	.85	15	12.01	140.00	1.18	65.00	1.25	0.81	11.65	20.00	20.00	0.00	11.65
275.00	276.00	3	3	648	.73	2	1.46	50.00	1.17	23.00	4.15	0.95	24.02	20.00	18.00	2.00	26.02
276.00	277.00	6	9	648	.74	3	2.21	63.00	1.08	70.00	2.73	1.91	23.07	20.00	18.00	2.00	25.07
277.00	284.00	15	24	648	.76	5	3.74	75.00	1.28	239.00	3.03	7.23	21.16	20.00	18.00	2.00	23.16
278.00	279.00	4	4	648	.75	3	2.26	63.00	1.11	29.00	2.85	0.83	20.22	20.00	17.00	3.00	23.22
279.00	280.00	5	9	648	.77	3	2.29	63.00	1.12	63.00	2.91	1.83	19.39	20.00	18.00	2.00	21.39
280.00	282.00	6	15	648	.78	4	3.09	75.00	1.06	69.00	2.12	1.46	17.56	20.00	18.00	2.00	19.56

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

Prepared By:
M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Number of Pumps in Zone	Accum Pumps in Zone	Liters/Day per Pump	Max Flow Per Pump (lps)	Max Sim Ops	Max Flow (LPS)	Pipe Size (mm)	Max Velocity (MPS)	Length of Main this Zone	Friction Loss Factor (m/100m)	Friction Loss This Zone	Accum Fric Loss (meters)	Max Main Elevation	Minimum Pump Elevation	Static Head (meters)	Total Dynamic Head (m)
This spreadsheet was calculated using pipe diameters for: SDR11PE100										Friction loss calculations were based on a Constant for inside roughness "C" of:						140	
281.00	282.00	4	4	648	.80	3	2.39	63.00	1.17	27.00	3.16	0.85	16.95	20.00	19.00	1.00	17.95
282.00	284.00	0	19	648	.80	5	3.89	75.00	1.33	67.00	3.24	2.17	16.10	20.00	19.00	1.00	17.10
283.00	284.00	9	9	648	.80	3	2.41	63.00	1.18	104.00	3.20	3.33	17.26	20.00	20.00	0.00	17.26
284.00	286.00	0	52	648	.82	7	5.38	90.00	1.29	11.00	2.47	0.27	13.93	20.00	19.00	1.00	14.93
285.00	286.00	15	15	648	.80	4	3.20	75.00	1.09	137.00	2.26	3.10	16.76	20.00	19.00	1.00	17.76
286.00	287.00	0	67	648	.83	7	5.43	90.00	1.30	112.00	2.51	2.82	13.66	20.00	20.00	0.00	13.66
287.00	290.00	12	1,410	648	.86	48	37.97	180.00	2.30	98.00	3.27	3.21	10.84	20.00	20.00	0.00	10.84
288.00	290.00	6	6	648	.86	3	2.59	63.00	1.27	37.00	3.65	1.35	8.98	20.00	19.00	1.00	9.98
289.00	290.00	5	5	648	.86	3	2.59	63.00	1.27	41.00	3.64	1.49	9.12	20.00	19.00	1.00	10.12
290.00	292.00	0	1,421	648	.87	48	38.00	180.00	2.30	33.00	3.28	1.08	7.63	20.00	19.00	1.00	8.63
291.00	292.00	4	4	648	.85	3	2.56	63.00	1.25	76.00	3.57	2.71	9.26	20.00	18.00	2.00	11.26
292.00	292.00	0	1,425	648	.87	48	38.00	180.00	2.30	200.00	3.28	6.55	6.55	20.00	18.00	2.00	8.55

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One.

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:
M Bear / C Jara

Milldale Stage 14-17 Fast Track August 2026

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
1.00	3.00	3	50.00	125.66	59.00	74.14	1,944	26.22	0.92	4.23
2.00	3.00	9	63.00	204.28	72.00	147.08	5,832	39.65	0.61	3.92
3.00	36.00	26	75.00	292.25	409.00	1,195.29	16,848	14.10	1.70	3.32
4.00	5.00	3	50.00	125.66	33.00	41.47	1,944	46.88	0.51	4.18
5.00	8.00	9	63.00	204.28	94.00	192.03	5,832	30.37	0.79	3.67
6.00	7.00	3	50.00	125.66	39.00	49.01	1,944	39.67	0.61	4.19
7.00	8.00	6	63.00	204.28	56.00	114.40	3,888	33.99	0.71	3.59
8.00	11.00	15	75.00	292.25	61.00	178.27	9,720	54.52	0.44	2.88
9.00	10.00	3	50.00	125.66	27.00	33.93	1,944	57.30	0.42	3.51
10.00	11.00	7	63.00	204.28	60.00	122.57	4,536	37.01	0.65	3.09
11.00	14.00	22	75.00	292.25	13.00	37.99	14,256	375.24	0.06	2.44
12.00	13.00	3	50.00	125.66	31.00	38.96	1,944	49.90	0.48	3.45
13.00	14.00	7	63.00	204.28	55.00	112.36	4,536	40.37	0.59	2.97
14.00	17.00	29	75.00	292.25	66.00	192.88	18,792	97.43	0.25	2.38
15.00	16.00	3	50.00	125.66	31.00	38.96	1,944	49.90	0.48	3.32
16.00	17.00	7	63.00	204.28	66.00	134.83	4,536	33.64	0.71	2.84
17.00	20.00	36	90.00	418.54	12.00	50.22	23,328	464.47	0.05	2.13
18.00	19.00	3	50.00	125.66	38.00	47.75	1,944	40.71	0.59	3.31
19.00	20.00	8	63.00	204.28	68.00	138.91	5,184	37.32	0.64	2.72
20.00	23.00	44	90.00	418.54	69.00	288.79	28,512	98.73	0.24	2.08
21.00	22.00	4	63.00	204.28	40.00	81.71	2,592	31.72	0.76	3.32
22.00	23.00	9	63.00	204.28	87.00	177.73	5,832	32.81	0.73	2.57
23.00	26.00	53	90.00	418.54	14.00	58.60	34,344	586.12	0.04	1.84
24.00	25.00	5	63.00	204.28	57.00	116.44	3,240	27.83	0.86	3.48
25.00	26.00	12	75.00	292.25	91.00	265.94	7,776	29.24	0.82	2.62
26.00	36.00	65	90.00	418.54	76.00	318.09	42,120	132.42	0.18	1.79
27.00	29.00	7	63.00	204.28	86.00	175.68	4,536	25.82	0.93	3.25
28.00	29.00	4	63.00	204.28	72.00	147.08	2,592	17.62	1.36	3.69
29.00	31.00	13	75.00	292.25	36.00	105.21	8,424	80.07	0.30	2.32
30.00	31.00	7	63.00	204.28	123.00	251.27	4,536	18.05	1.33	3.35
31.00	36.00	20	75.00	292.25	76.00	222.11	12,960	58.35	0.41	2.02
32.00	36.00	12	75.00	292.25	184.00	537.73	7,776	14.46	1.66	3.27
33.00	34.00	3	50.00	125.66	31.00	38.96	1,944	49.90	0.48	3.01
34.00	37.00	9	63.00	204.28	84.00	171.60	5,832	33.99	0.71	2.53
35.00	37.00	4	63.00	204.28	65.00	132.78	2,592	19.52	1.23	3.06

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Milldale Stage 14-17 Fast Track August 2026

Prepared By:
M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
36.00	48.00	132	110.00	622.11	185.00	1,150.91	85,536	74.32	0.32	1.61
37.00	39.00	15	63.00	204.28	45.00	91.93	9,720	105.74	0.23	1.83
38.00	39.00	3	50.00	125.66	44.00	55.29	1,944	35.16	0.68	2.28
39.00	47.00	18	75.00	292.25	13.00	37.99	11,664	307.01	0.08	1.60
40.00	41.00	3	50.00	125.66	30.00	37.70	1,944	51.57	0.47	3.67
41.00	42.00	6	63.00	204.28	65.00	132.78	3,888	29.28	0.82	3.21
42.00	44.00	14	75.00	292.25	88.00	257.18	9,072	35.28	0.68	2.39
43.00	44.00	6	63.00	204.28	69.00	140.95	3,888	27.58	0.87	2.58
44.00	47.00	20	75.00	292.25	34.00	99.36	12,960	130.43	0.18	1.71
45.00	46.00	2	50.00	125.66	30.00	37.70	1,296	34.38	0.70	2.85
46.00	47.00	7	63.00	204.28	58.00	118.48	4,536	38.28	0.63	2.15
47.00	48.00	45	90.00	418.54	67.00	280.42	29,160	103.99	0.23	1.52
48.00	53.00	177	125.00	801.18	40.00	320.47	114,696	357.90	0.07	1.29
49.00	50.00	3	50.00	125.66	53.00	66.60	1,944	29.19	0.82	4.44
50.00	51.00	9	63.00	204.28	88.00	179.77	5,832	32.44	0.74	3.62
51.00	52.00	16	75.00	292.25	153.00	447.14	10,368	23.19	1.04	2.88
52.00	53.00	24	75.00	292.25	138.00	403.30	15,552	38.56	0.62	1.85
53.00	56.00	201	125.00	801.18	17.00	136.20	130,248	956.29	0.03	1.22
54.00	55.00	3	50.00	125.66	45.00	56.55	1,944	34.38	0.70	2.95
55.00	56.00	13	75.00	292.25	127.00	371.15	8,424	22.70	1.06	2.26
56.00	62.00	214	125.00	801.18	45.00	360.53	138,672	384.63	0.06	1.20
57.00	58.00	4	63.00	204.28	26.00	53.11	2,592	48.80	0.49	3.65
58.00	59.00	9	63.00	204.28	133.00	271.70	5,832	21.47	1.12	3.15
59.00	61.00	17	75.00	292.25	100.00	292.25	11,016	37.69	0.64	2.04
60.00	61.00	8	63.00	204.28	100.00	204.28	5,184	25.38	0.95	2.35
61.00	62.00	25	75.00	292.25	61.00	178.27	16,200	90.87	0.26	1.40
62.00	76.00	247	125.00	801.18	128.00	1,025.52	160,056	156.07	0.15	1.14
63.00	64.00	4	63.00	204.28	44.00	89.88	2,592	28.84	0.83	2.87
64.00	76.00	10	75.00	292.25	98.00	286.40	6,480	22.63	1.06	2.04
65.00	66.00	4	63.00	204.28	83.00	169.55	2,592	15.29	1.57	4.75
66.00	68.00	10	75.00	292.25	117.00	341.93	6,480	18.95	1.27	3.18
67.00	68.00	9	63.00	204.28	143.00	292.12	5,832	19.96	1.20	3.12
68.00	70.00	19	75.00	292.25	16.00	46.76	12,312	263.31	0.09	1.91
69.00	70.00	4	63.00	204.28	37.00	75.58	2,592	34.29	0.70	2.52
70.00	73.00	28	75.00	292.25	69.00	201.65	18,144	89.98	0.27	1.82

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Milldale Stage 14-17 Fast Track August 2026

Prepared By:
M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
71.00	72.00	5	63.00	204.28	103.00	210.41	3,240	15.40	1.56	4.10
72.00	73.00	8	63.00	204.28	104.00	212.45	5,184	24.40	0.98	2.54
73.00	75.00	39	90.00	418.54	107.00	447.84	25,272	56.43	0.43	1.56
74.00	75.00	5	63.00	204.28	81.00	165.47	3,240	19.58	1.23	2.36
75.00	76.00	44	90.00	418.54	42.00	175.79	28,512	162.20	0.15	1.13
76.00	79.00	301	125.00	801.18	149.00	1,193.77	195,048	163.39	0.15	0.98
77.00	78.00	9	63.00	204.28	53.00	108.27	5,832	53.87	0.45	1.92
78.00	79.00	21	75.00	292.25	125.00	365.31	13,608	37.25	0.64	1.48
79.00	81.00	322	125.00	801.18	10.00	80.12	208,656	2,604.34	0.01	0.84
80.00	81.00	9	63.00	204.28	115.00	234.92	5,832	24.83	0.97	1.79
81.00	82.00	338	140.00	1,020.70	175.00	1,786.23	219,024	122.62	0.20	0.83
82.00	97.00	344	140.00	1,020.70	96.00	979.88	222,912	227.49	0.11	0.63
83.00	84.00	8	63.00	204.28	72.00	147.08	5,184	35.25	0.68	2.68
84.00	86.00	11	75.00	292.25	68.00	198.73	7,128	35.87	0.67	2.00
85.00	86.00	4	63.00	204.28	113.00	230.84	2,592	11.23	2.14	3.46
86.00	96.00	23	75.00	292.25	166.00	485.13	14,904	30.72	0.78	1.33
87.00	88.00	8	63.00	204.28	38.00	77.63	5,184	66.78	0.36	1.87
88.00	89.00	21	75.00	292.25	80.00	233.80	13,608	58.20	0.41	1.51
89.00	92.00	29	75.00	292.25	89.00	260.10	18,792	72.25	0.33	1.10
90.00	91.00	4	63.00	204.28	43.00	87.84	2,592	29.51	0.81	2.57
91.00	92.00	12	75.00	292.25	109.00	318.55	7,776	24.41	0.98	1.75
92.00	95.00	41	90.00	418.54	11.00	46.04	26,568	577.07	0.04	0.77
93.00	94.00	3	50.00	125.66	51.00	64.09	1,944	30.33	0.79	2.39
94.00	95.00	9	63.00	204.28	103.00	210.41	5,832	27.72	0.87	1.59
95.00	96.00	60	90.00	418.54	71.00	297.16	38,880	130.84	0.18	0.73
96.00	97.00	83	90.00	418.54	11.00	46.04	53,784	1,168.22	0.02	0.55
97.00	98.00	435	140.00	1,020.70	139.00	1,418.78	281,880	198.68	0.12	0.52
98.00	198.00	441	140.00	1,020.70	85.00	867.60	285,768	329.38	0.07	0.40
99.00	100.00	4	63.00	204.28	51.00	104.18	2,592	24.88	0.96	4.11
100.00	101.00	10	75.00	292.25	85.00	248.41	6,480	26.09	0.92	3.14
101.00	108.00	19	75.00	292.25	131.00	382.84	12,312	32.16	0.75	2.22
102.00	103.00	5	63.00	204.28	56.00	114.40	3,240	28.32	0.85	4.46
103.00	104.00	10	75.00	292.25	78.00	227.95	6,480	28.43	0.84	3.61
104.00	105.00	17	75.00	292.25	121.00	353.62	11,016	31.15	0.77	2.77
105.00	106.00	24	75.00	292.25	146.00	426.68	15,552	36.45	0.66	2.00

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:
M Bear / C Jara

Milldale Stage 14-17 Fast Track August 2026

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100							Liters per Day per Dwelling			648
106.00	109.00	30	75.00	292.25	97.00	283.48	19,440	68.58	0.35	1.34
107.00	108.00	7	63.00	204.28	88.00	179.77	4,536	25.23	0.95	2.43
108.00	109.00	33	90.00	418.54	104.00	435.28	21,384	49.13	0.49	1.48
109.00	110.00	71	90.00	418.54	153.00	640.36	46,008	71.85	0.33	0.99
110.00	197.00	78	90.00	418.54	115.00	481.32	50,544	105.01	0.23	0.66
111.00	112.00	8	63.00	204.28	101.00	206.32	5,184	25.13	0.96	2.25
112.00	196.00	15	75.00	292.25	118.00	344.85	9,720	28.19	0.85	1.30
113.00	114.00	5	63.00	204.28	29.00	59.24	3,240	54.69	0.44	1.86
114.00	199.00	12	75.00	292.25	46.00	134.43	7,776	57.84	0.41	1.43
115.00	116.00	5	63.00	204.28	36.00	73.54	3,240	44.06	0.54	3.78
116.00	117.00	18	75.00	292.25	104.00	303.94	11,664	38.38	0.63	3.23
117.00	118.00	33	90.00	418.54	126.00	527.36	21,384	40.55	0.59	2.61
118.00	119.00	47	90.00	418.54	124.00	518.99	30,456	58.68	0.41	2.02
119.00	120.00	62	90.00	418.54	126.00	527.36	40,176	76.18	0.32	1.61
120.00	121.00	77	110.00	622.11	129.00	802.53	49,896	62.17	0.39	1.29
121.00	195.00	94	110.00	622.11	143.00	889.62	60,912	68.47	0.35	0.91
122.00	200.00	4	63.00	204.28	20.00	40.86	2,592	63.44	0.38	1.19
123.00	124.00	4	63.00	204.28	53.00	108.27	2,592	23.94	1.00	5.16
124.00	126.00	7	63.00	204.28	50.00	102.14	4,536	44.41	0.54	4.16
125.00	126.00	5	63.00	204.28	23.00	46.98	3,240	68.96	0.35	3.97
126.00	128.00	19	75.00	292.25	60.00	175.35	12,312	70.21	0.34	3.62
127.00	128.00	2	50.00	125.66	33.00	41.47	1,296	31.25	0.77	4.05
128.00	131.00	21	75.00	292.25	102.00	298.09	13,608	45.65	0.53	3.28
129.00	130.00	3	50.00	125.66	31.00	38.96	1,944	49.90	0.48	3.85
130.00	131.00	8	63.00	204.28	65.00	132.78	5,184	39.04	0.61	3.37
131.00	134.00	29	75.00	292.25	68.00	198.73	18,792	94.56	0.25	2.75
132.00	133.00	4	63.00	204.28	32.00	65.37	2,592	39.65	0.61	3.80
133.00	134.00	8	63.00	204.28	74.00	151.17	5,184	34.29	0.70	3.20
134.00	136.00	37	90.00	418.54	11.00	46.04	23,976	520.77	0.05	2.50
135.00	136.00	8	63.00	204.28	108.00	220.62	5,184	23.50	1.02	3.47
136.00	139.00	45	90.00	418.54	63.00	263.68	29,160	110.59	0.22	2.45
137.00	138.00	5	63.00	204.28	55.00	112.36	3,240	28.84	0.83	3.63
138.00	139.00	9	63.00	204.28	67.00	136.87	5,832	42.61	0.56	2.80
139.00	141.00	54	90.00	418.54	13.00	54.41	34,992	643.12	0.04	2.23
140.00	141.00	9	63.00	204.28	120.00	245.14	5,832	23.79	1.01	3.21

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:

Milldale Stage 14-17 Fast Track August 2026

M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
141.00	144.00	63	90.00	418.54	56.00	234.38	40,824	174.18	0.14	2.20
142.00	143.00	5	63.00	204.28	56.00	114.40	3,240	28.32	0.85	3.46
143.00	144.00	9	63.00	204.28	66.00	134.83	5,832	43.26	0.55	2.61
144.00	146.00	72	90.00	418.54	20.00	83.71	46,656	557.37	0.04	2.06
145.00	146.00	9	63.00	204.28	119.00	243.10	5,832	23.99	1.00	3.02
146.00	149.00	81	110.00	622.11	62.00	385.71	52,488	136.08	0.18	2.02
147.00	148.00	4	63.00	204.28	50.00	102.14	2,592	25.38	0.95	3.35
148.00	149.00	9	63.00	204.28	67.00	136.87	5,832	42.61	0.56	2.40
149.00	151.00	90	110.00	622.11	13.00	80.87	58,320	721.11	0.03	1.84
150.00	151.00	8	63.00	204.28	113.00	230.84	5,184	22.46	1.07	2.88
151.00	154.00	98	110.00	622.11	68.00	423.04	63,504	150.11	0.16	1.81
152.00	153.00	4	63.00	204.28	51.00	104.18	2,592	24.88	0.96	3.15
153.00	154.00	8	63.00	204.28	57.00	116.44	5,184	44.52	0.54	2.19
154.00	156.00	106	110.00	622.11	12.00	74.65	68,688	920.09	0.03	1.65
155.00	156.00	8	63.00	204.28	105.00	214.50	5,184	24.17	0.99	2.61
156.00	159.00	114	110.00	622.11	59.00	367.05	73,872	201.26	0.12	1.62
157.00	158.00	8	63.00	204.28	49.00	100.10	5,184	51.79	0.46	2.34
158.00	159.00	16	75.00	292.25	56.00	163.66	10,368	63.35	0.38	1.88
159.00	163.00	130	110.00	622.11	155.00	964.28	84,240	87.36	0.27	1.50
160.00	161.00	6	63.00	204.28	74.00	151.17	3,888	25.72	0.93	3.78
161.00	162.00	13	75.00	292.25	116.00	339.01	8,424	24.85	0.97	2.85
162.00	163.00	18	75.00	292.25	109.00	318.55	11,664	36.62	0.66	1.88
163.00	167.00	156	125.00	801.18	141.00	1,129.67	101,088	89.48	0.27	1.23
164.00	166.00	8	63.00	204.28	134.00	273.74	5,184	18.94	1.27	2.54
165.00	166.00	4	63.00	204.28	33.00	67.41	2,592	38.45	0.62	1.90
166.00	167.00	12	75.00	292.25	35.00	102.29	7,776	76.02	0.32	1.27
167.00	169.00	174	125.00	801.18	146.00	1,169.73	112,752	96.39	0.25	0.96
168.00	169.00	5	63.00	204.28	78.00	159.34	3,240	20.33	1.18	1.89
169.00	194.00	179	125.00	801.18	10.00	80.12	115,992	1,447.76	0.02	0.71
170.00	171.00	6	63.00	204.28	98.00	200.20	3,888	19.42	1.24	3.36
171.00	173.00	6	63.00	204.28	34.00	69.46	3,888	55.98	0.43	2.12
172.00	173.00	7	63.00	204.28	80.00	163.43	4,536	27.76	0.86	2.56
173.00	175.00	13	75.00	292.25	11.00	32.15	8,424	262.05	0.09	1.69
174.00	175.00	4	63.00	204.28	76.00	155.25	2,592	16.70	1.44	3.04
175.00	181.00	28	75.00	292.25	91.00	265.94	18,144	68.22	0.35	1.60

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By: Milldale Stage 14-17 Fast Track August 2026

M Bear / C Jara August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
176.00	177.00	4	63.00	204.28	49.00	100.10	2,592	25.89	0.93	3.52
177.00	178.00	6	63.00	204.28	51.00	104.18	3,888	37.32	0.64	2.59
178.00	180.00	10	75.00	292.25	42.00	122.74	6,480	52.79	0.45	1.95
179.00	180.00	4	63.00	204.28	66.00	134.83	2,592	19.22	1.25	2.74
180.00	181.00	16	75.00	292.25	36.00	105.21	10,368	98.55	0.24	1.49
181.00	183.00	44	90.00	418.54	83.00	347.39	28,512	82.08	0.29	1.25
182.00	183.00	8	63.00	204.28	115.00	234.92	5,184	22.07	1.09	2.04
183.00	187.00	52	90.00	418.54	11.00	46.04	33,696	731.90	0.03	0.96
184.00	185.00	5	63.00	204.28	50.00	102.14	3,240	31.72	0.76	3.07
185.00	186.00	10	75.00	292.25	81.00	236.72	6,480	27.37	0.88	2.31
186.00	187.00	14	75.00	292.25	66.00	192.88	9,072	47.03	0.51	1.43
187.00	193.00	73	90.00	418.54	75.00	313.90	47,304	150.70	0.16	0.92
188.00	189.00	6	63.00	204.28	40.00	81.71	3,888	47.58	0.50	2.40
189.00	190.00	15	75.00	292.25	60.00	175.35	9,720	55.43	0.43	1.90
190.00	191.00	25	75.00	292.25	71.00	207.50	16,200	78.07	0.31	1.46
191.00	192.00	34	90.00	418.54	53.00	221.83	22,032	99.32	0.24	1.16
192.00	193.00	45	90.00	418.54	43.00	179.97	29,160	162.03	0.15	0.91
193.00	194.00	118	110.00	622.11	37.00	230.18	76,464	332.19	0.07	0.77
194.00	195.00	297	125.00	801.18	137.00	1,097.62	192,456	175.34	0.14	0.69
195.00	196.00	391	180.00	1,651.30	72.00	1,188.94	253,368	213.10	0.11	0.56
196.00	197.00	406	180.00	1,651.30	11.00	181.64	263,088	1,448.38	0.02	0.44
197.00	198.00	484	180.00	1,651.30	76.00	1,254.99	313,632	249.91	0.10	0.43
198.00	209.00	931	180.00	1,651.30	92.00	1,519.20	603,288	397.11	0.06	0.33
199.00	200.00	16	75.00	292.25	30.00	87.67	10,368	118.26	0.20	1.01
200.00	203.00	20	75.00	292.25	13.00	37.99	12,960	341.12	0.07	0.81
201.00	202.00	3	50.00	125.66	28.00	35.19	1,944	55.25	0.43	1.80
202.00	203.00	8	63.00	204.28	66.00	134.83	5,184	38.45	0.62	1.36
203.00	206.00	35	90.00	418.54	55.00	230.20	22,680	98.52	0.24	0.74
204.00	205.00	3	50.00	125.66	29.00	36.44	1,944	53.34	0.45	1.46
205.00	206.00	8	63.00	204.28	55.00	112.36	5,184	46.14	0.52	1.01
206.00	208.00	43	90.00	418.54	12.00	50.22	27,864	554.79	0.04	0.49
207.00	208.00	7	63.00	204.28	77.00	157.30	4,536	28.84	0.83	1.28
208.00	209.00	63	90.00	418.54	73.00	305.53	40,824	133.62	0.18	0.45
209.00	287.00	994	180.00	1,651.30	208.00	3,434.70	644,112	187.53	0.13	0.27
210.00	211.00	4	63.00	204.28	19.00	38.81	2,592	66.78	0.36	2.45

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:
M Bear / C Jara

Milldale Stage 14-17 Fast Track August 2026

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
211.00	212.00	9	63.00	204.28	42.00	85.80	5,832	67.97	0.35	2.09
212.00	215.00	14	75.00	292.25	45.00	131.51	9,072	68.98	0.35	1.74
213.00	214.00	8	63.00	204.28	38.00	77.63	5,184	66.78	0.36	2.03
214.00	215.00	32	90.00	418.54	57.00	238.57	20,736	86.92	0.28	1.67
215.00	216.00	49	90.00	418.54	60.00	251.12	31,752	126.44	0.19	1.39
216.00	225.00	49	90.00	418.54	65.00	272.05	31,752	116.71	0.21	1.20
217.00	219.00	5	63.00	204.28	34.00	69.46	3,240	46.65	0.51	2.29
218.00	219.00	3	50.00	125.66	21.00	26.39	1,944	73.67	0.33	2.10
219.00	221.00	11	75.00	292.25	19.00	55.53	7,128	128.37	0.19	1.77
220.00	221.00	8	63.00	204.28	48.00	98.06	5,184	52.87	0.45	2.04
221.00	224.00	25	75.00	292.25	55.00	160.74	16,200	100.79	0.24	1.58
222.00	223.00	4	63.00	204.28	23.00	46.98	2,592	55.17	0.44	2.20
223.00	224.00	12	75.00	292.25	47.00	137.36	7,776	56.61	0.42	1.77
224.00	225.00	42	90.00	418.54	94.00	393.43	27,216	69.18	0.35	1.35
225.00	228.00	97	110.00	622.11	54.00	335.94	62,856	187.10	0.13	1.00
226.00	227.00	5	63.00	204.28	26.00	53.11	3,240	61.00	0.39	2.28
227.00	228.00	10	75.00	292.25	94.00	274.71	6,480	23.59	1.02	1.89
228.00	233.00	107	110.00	622.11	11.00	68.43	69,336	1,013.20	0.02	0.87
229.00	230.00	4	63.00	204.28	34.00	69.46	2,592	37.32	0.64	2.33
230.00	233.00	12	75.00	292.25	93.00	271.79	7,776	28.61	0.84	1.69
231.00	232.00	3	50.00	125.66	34.00	42.73	1,944	45.50	0.53	2.16
232.00	233.00	9	63.00	204.28	93.00	189.98	5,832	30.70	0.78	1.63
233.00	238.00	134	110.00	622.11	55.00	342.16	86,832	253.77	0.09	0.85
234.00	235.00	4	63.00	204.28	20.00	40.86	2,592	63.44	0.38	2.29
235.00	236.00	9	63.00	204.28	32.00	65.37	5,832	89.21	0.27	1.91
236.00	237.00	14	75.00	292.25	51.00	149.05	9,072	60.87	0.39	1.64
237.00	238.00	18	75.00	292.25	82.00	239.64	11,664	48.67	0.49	1.25
238.00	241.00	152	125.00	801.18	12.00	96.14	98,496	1,024.48	0.02	0.75
239.00	240.00	4	63.00	204.28	32.00	65.37	2,592	39.65	0.61	2.07
240.00	241.00	9	63.00	204.28	87.00	177.73	5,832	32.81	0.73	1.46
241.00	248.00	167	125.00	801.18	56.00	448.66	108,216	241.20	0.10	0.73
242.00	243.00	4	63.00	204.28	29.00	59.24	2,592	43.75	0.55	2.06
243.00	248.00	11	75.00	292.25	90.00	263.02	7,128	27.10	0.89	1.51
244.00	245.00	4	63.00	204.28	16.00	32.69	2,592	79.30	0.30	2.13
245.00	246.00	9	63.00	204.28	34.00	69.46	5,832	83.97	0.29	1.82

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

Prepared By:
M Bear / C Jara

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
246.00	247.00	14	75.00	292.25	63.00	184.12	9,072	49.27	0.49	1.54
247.00	248.00	18	75.00	292.25	70.00	204.57	11,664	57.02	0.42	1.05
248.00	249.00	207	125.00	801.18	167.00	1,337.98	134,136	100.25	0.24	0.63
249.00	265.00	214	125.00	801.18	114.00	913.35	138,672	151.83	0.16	0.39
250.00	251.00	8	63.00	204.28	45.00	91.93	5,184	56.39	0.43	1.99
251.00	253.00	13	75.00	292.25	33.00	96.44	8,424	87.35	0.27	1.56
252.00	253.00	5	63.00	204.28	27.00	55.16	3,240	58.74	0.41	1.70
253.00	254.00	23	75.00	292.25	41.00	119.82	14,904	124.39	0.19	1.29
254.00	255.00	32	90.00	418.54	83.00	347.39	20,736	59.69	0.40	1.10
255.00	259.00	34	90.00	418.54	66.00	276.24	22,032	79.76	0.30	0.69
256.00	257.00	4	63.00	204.28	13.00	26.56	2,592	97.60	0.25	1.40
257.00	258.00	12	75.00	292.25	45.00	131.51	7,776	59.13	0.41	1.16
258.00	259.00	14	75.00	292.25	46.00	134.43	9,072	67.48	0.36	0.75
259.00	263.00	48	90.00	418.54	10.00	41.85	31,104	743.16	0.03	0.39
260.00	261.00	4	63.00	204.28	40.00	81.71	2,592	31.72	0.76	2.16
261.00	262.00	9	63.00	204.28	56.00	114.40	5,832	50.98	0.47	1.40
262.00	263.00	14	75.00	292.25	74.00	216.26	9,072	41.95	0.57	0.93
263.00	265.00	62	90.00	418.54	52.00	217.64	40,176	184.60	0.13	0.36
264.00	265.00	5	63.00	204.28	60.00	122.57	3,240	26.43	0.91	1.14
265.00	274.00	281	140.00	1,020.70	12.00	122.48	182,088	1,486.62	0.02	0.23
266.00	267.00	4	63.00	204.28	49.00	100.10	2,592	25.89	0.93	2.49
267.00	268.00	14	75.00	292.25	103.00	301.01	9,072	30.14	0.80	1.56
268.00	274.00	23	75.00	292.25	117.00	341.93	14,904	43.59	0.55	0.77
269.00	270.00	4	63.00	204.28	35.00	71.50	2,592	36.25	0.66	1.84
270.00	271.00	8	63.00	204.28	20.00	40.86	5,184	126.88	0.19	1.17
271.00	273.00	15	75.00	292.25	50.00	146.12	9,720	66.52	0.36	0.98
272.00	273.00	6	63.00	204.28	34.00	69.46	3,888	55.98	0.43	1.05
273.00	274.00	33	90.00	418.54	87.00	364.13	21,384	58.73	0.41	0.62
274.00	287.00	337	140.00	1,020.70	65.00	663.46	218,376	329.15	0.07	0.22
275.00	276.00	3	50.00	125.66	23.00	28.90	1,944	67.26	0.36	2.46
276.00	277.00	9	63.00	204.28	70.00	143.00	5,832	40.78	0.59	2.10
277.00	284.00	24	75.00	292.25	239.00	698.47	15,552	22.27	1.08	1.51
278.00	279.00	4	63.00	204.28	29.00	59.24	2,592	43.75	0.55	2.39
279.00	280.00	9	63.00	204.28	63.00	128.70	5,832	45.32	0.53	1.84
280.00	282.00	15	75.00	292.25	69.00	201.65	9,720	48.20	0.50	1.31

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

PRELIMINARY PRESSURE SEWER - ACCUMULATED RETENTION TIME (HR)

Prepared By:
M Bear / C Jara

Milldale Stage 14-17 Fast Track August 2026

August 6, 2026

Zone Number	Connects to Zone	Accumulated Total of Pumps this Zone	Pipe Size (mm)	Liters per 100 lineal meters	Length of Zone	Capacity of Zone	Average Daily Flow	Average Fluid Changes per Day	Average Retention Time (Hr)	Accumulated Retention Time (Hr)
This spreadsheet was calculated using pipe diameters for: SDR11PE100								Liters per Day per Dwelling		648
281.00	282.00	4	63.00	204.28	27.00	55.16	2,592	46.99	0.51	1.33
282.00	284.00	19	75.00	292.25	67.00	195.81	12,312	62.88	0.38	0.82
283.00	284.00	9	63.00	204.28	104.00	212.45	5,832	27.45	0.87	1.31
284.00	286.00	52	90.00	418.54	11.00	46.04	33,696	731.90	0.03	0.43
285.00	286.00	15	75.00	292.25	137.00	400.38	9,720	24.28	0.99	1.39
286.00	287.00	67	90.00	418.54	112.00	468.76	43,416	92.62	0.26	0.40
287.00	290.00	1,410	180.00	1,651.30	98.00	1,618.27	913,680	564.60	0.04	0.14
288.00	290.00	6	63.00	204.28	37.00	75.58	3,888	51.44	0.47	0.57
289.00	290.00	5	63.00	204.28	41.00	83.76	3,240	38.68	0.62	0.72
290.00	292.00	1,421	180.00	1,651.30	33.00	544.93	920,808	1,689.78	0.01	0.10
291.00	292.00	4	63.00	204.28	76.00	155.25	2,592	16.70	1.44	1.52
292.00	292.00	1,425	180.00	1,651.30	200.00	3,302.60	923,400	279.60	0.09	0.09

Note: This analysis is valid only with the use of progressive cavity type grinder pumps as manufactured by Environment One

Appendix G – Milldale Stages 14-17 Water Supply Network Design Memo

MEMORANDUM

To	From
Fulton Hogan Land Development Ltd.	Woods Cristian Jara – Water Engineer
	W-REF: P25-609 7/08/2026 Reviewer: Marcel Bear, Sam Kirk

Milldale Stages 14-17 – Water Supply Network Design

Statement of Qualifications and Experience

Originator: Cristian Jara – 3 Waters Engineer

I am Water Engineer at Wood & 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 November 2020.

I hold the degree of Professional Civil Engineer from the Pontifical Catholic University of Chile with a Diploma in Hydraulic Engineering, obtained in 2013. I am member of Engineering New Zealand.

I have over 11 years of professional experience in wastewater and water supply modelling. My experience includes building, updating and reviewing water supply and wastewater models. Recent projects include multiple neighbourhoods for Kāinga Ora (Glen Innes, Te Ararata and Middlemore Crescent) and water supply modelling and reporting to support resource consent applications for multiple stages of the Milldale development.

I confirm that, in my capacity as originator 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.

Reviewer: Marcel Bear – Principal Water Engineer

I am a Principal Engineer at Wood & Partners Consultants Limited (Woods). Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed by Woods since April 2017.

I hold the qualification of Bachelor of Engineering (Honours) in Civil Engineering from the University of Auckland, which I completed in 1990. I am a Chartered Engineer with Engineering New Zealand.

I have 30 years of professional experience in water supply design and planning. My experience includes water supply design, hydraulic modelling and infrastructure master planning, for greenfield and brownfield developments such as; the Unitec site- Auckland, Northcote, Wesley and Waikowhai neighbourhoods and the Sleepyhead Development in Ohinewai.

I confirm that, in my capacity as originator 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.

Reviewer: Sam Kirk – Associate Engineer

I, Sam Kirk, am an Associate Engineer at Woods. Woods is a multi-disciplinary consultancy specialising in planning, urban design, engineering, water infrastructure, and surveying. I have been employed at Woods since July 2025, although also previously between January 2019 and September 2022.

I hold the qualifications of a Bachelor of Surveying, which I completed in 2018, and I also hold a Cadastral Surveying License. I am also a Voting Member of S+SNZ.

I have eight years of experience in the Engineering industry. My experience includes the design and construction observation of a range of land development projects, including project management and the procurement of earthworks, roading, services and other infrastructure. I have been involved with the surveying, design and management of previous Milldale projects, dating back to Stage 1A. I have also been involved in managing multiple land development projects in London and Melbourne.

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

1. Summary

This water supply memorandum presents the calculated demands and network design to service Milldale Stages 14- 17 development, comprising up to 1,425 DUEs. The development is a mixture of standalone dwellings, superlots and a commercial lot, shown in Figure 1. The proposed reticulation has been developed as a common network capable of supporting the following three servicing scenarios:

- Fully private servicing, where all stages would be serviced by a network that supplies water privately, provided by the proposed groundwater bore and surface water reservoir, via a private water treatment plant (WTP);
- Interim private servicing and future public connection, under which the same reticulation network as above is constructed and initially connected to the private water supply facilities – until such time that a public water supply becomes available. At that point the private WTP would be decommissioned, and the reticulation would be connected to the public network;
- Immediate public servicing, a scenario in which the same proposed network as above is constructed but is instead connected directly to the public network from the outset.

A common network layout and pipe sizing has been designed that services all three scenarios, with minor differences at the connection points to the sources. The pipe layout and sizing can service the development at the level of service required by the Watercare Code of Practice for Land development and Subdivision (CoP) in terms of pressures, velocities, headloss and firefighting water supply.

A separate demand basis has been adopted for the private water source, storage and treatment infrastructure, while the reticulation network reported herein has been designed to full Watercare Code of Practice demands for all servicing scenarios, to allow for potential future public connection and vesting.

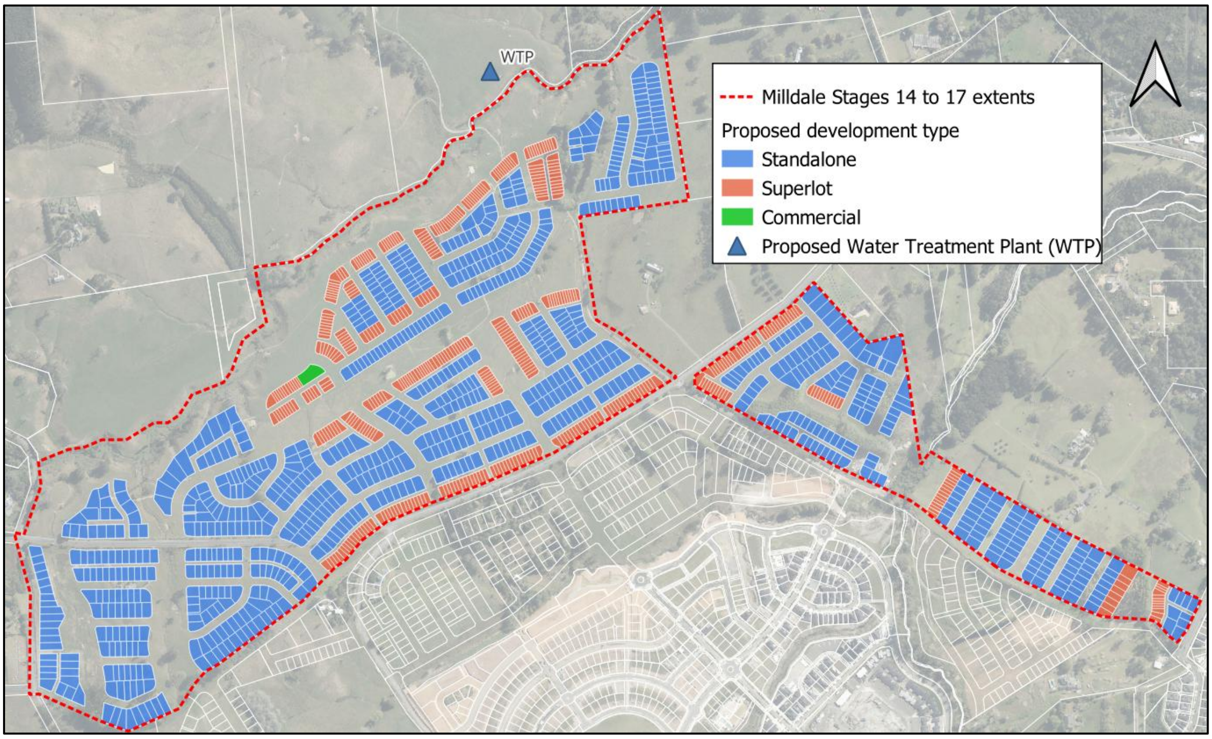


Figure 1: Overview of proposed Milldale Stages 14-17 Fast-track development

2. Water Supply Servicing Scenarios

Three potential water supply servicing scenarios have been considered for Milldale Stages 14–17, each using the same adaptable reticulation network.

The proposed reticulation layout and pipe sizing are common to all three servicing scenarios and have been developed with reference to the performance requirements of the Watercare Code of Practice for Land Development and Subdivision.

The hydraulic assessment presented in this memorandum is based on supply from the proposed WTP. Where public servicing is provided, either from the outset or following an initial period of private supply, the connection locations and available pressure and flow will be confirmed with Watercare during subsequent design stages. Metering, backflow prevention and any associated local network modifications will also be confirmed at that time.

The hydraulic performance of the network will be reviewed against the approved public supply conditions before the relevant public connections are implemented.

2.1. Fully Private Servicing

Under the fully private servicing scenario, the development would be supplied from the proposed private WTP, which would treat raw water sourced from a combination of the proposed groundwater bore and an offline surface-water reservoir that draws from a local stream.

The WTP and associated private water supply infrastructure would remain as the long-term water supply arrangement for the development, without reliance on a future connection to the public water supply.

2.2. Interim Private Serving and Future Public Connection

Under the interim private servicing scenario, the development would initially be supplied from the proposed WTP. Once sufficient public water supply capacity and approved connections become available, the reticulation would be connected to the adjacent Milldale public network and the private water infrastructure (being the WTP, bore and reservoir) would be decommissioned.

The timing of this transition may vary between development stages, depending on the availability of public servicing. The network has therefore been configured and sized to remain suitable for use following connection to the public water supply network.

2.3. Immediate Public Servicing

Under the immediate public servicing scenario, the proposed reticulation would connect to one or more approved connection points within the adjacent Milldale public water supply network from the outset. The proposed WTP and associated private water supply infrastructure would not be required under this scenario.

This arrangement would be dependent on sufficient public network capacity, pressure and flow being confirmed and made available before the development civil works commence.

3. Network

3.1. Demand Basis

Different demand criteria have been adopted for the design of the reticulation network and the private water source, storage and treatment infrastructure[1]. This reflects the different functions of these components and the requirement for the reticulation network to remain suitable for future connection to, and potential vesting in, the public water supply network.

3.2. Reticulation Network Design Demands

The water supply demands for the development reticulation network were calculated based on the Watercare Code of Practice v2.4 June 2021 (CoP) parameters.

The Watercare CoP demand criteria have been used to establish the peak-hour network loads to use for assessing operating pressures and firefighting water supply requirements. These criteria have been retained for all three servicing scenarios, including the interim private servicing arrangement, to provide a conservative network design that remains compatible with a future connection to the public water supply network and vesting, subject to Watercare approval. The adopted network design demands are summarised in Table 1.

Table 1: Milldale Stages 14 to 17 – Reticulation Network Design Demands

Parameter	Value	Total
Development yield	1,425 DUE	
Occupancy rate	3 persons/DUE	
Average day demand (ADD)	220 L/person/day (660 L/DUE/day)	941 m^3/day 10.9 L/s
Peak day factor	1.5	
Peak Day Demand (PDD) (1.5 × ADD)	990 L/DUE/day	1,411 m^3/day 16.3 L/s
Peak Hour Demand (PHD) (2.5 × PDD)	2,475 L/DUE/day	40.8 L/s

3.3. Private Water Source and Treatment Demands

For the private servicing scenarios, a separate demand basis has been adopted for the raw-water sources, storage and WTP treatment capacity. sensitivity study was undertaken to analyse the possible reduction of water demand, which concluded that the use of dual flush toilets provided a meaningful reduction in demand. This is considered a practical and readily achievable water-efficiency measure and has been adopted for this basis, yielding an Annual Average Demand of 836 m^3/day.

The corresponding demand values have been adopted by the relevant specialist consultants in assessing and designing the private water supply, storage and treatment infrastructure. Further detail is provided in the respective water-take, storage and WTP reports supporting the application[1].

[1] Water and Wastewater Treatment for Consenting-Preliminary Design Report prepared for Fulton Hogan Land Development by Apex Water. Revision 1 July 2026. Section 6.1

This separate demand basis does not alter the Watercare Code of Practice criteria used herein for the design and hydraulic assessment of the reticulation network, including peak-hour and firefighting requirements.

3.4. Proposed Network

The proposed network layout is shown in Figure 2. Only principal mains greater than 100 mm internal diameter are modelled at this servicing feasibility stage. Rider mains of reduced diameter are included in the applicable consent set drawings.

The proposed network layout and pipe sizing are common to each of the three potential servicing scenarios and may be extended to service adjacent areas. The proposed network is future proofed and takes into account the size of the nearby existing Milldale network and servicing adjacent potential future development areas.

All elevations are in terms of the NZVD2016 Vertical Datum.

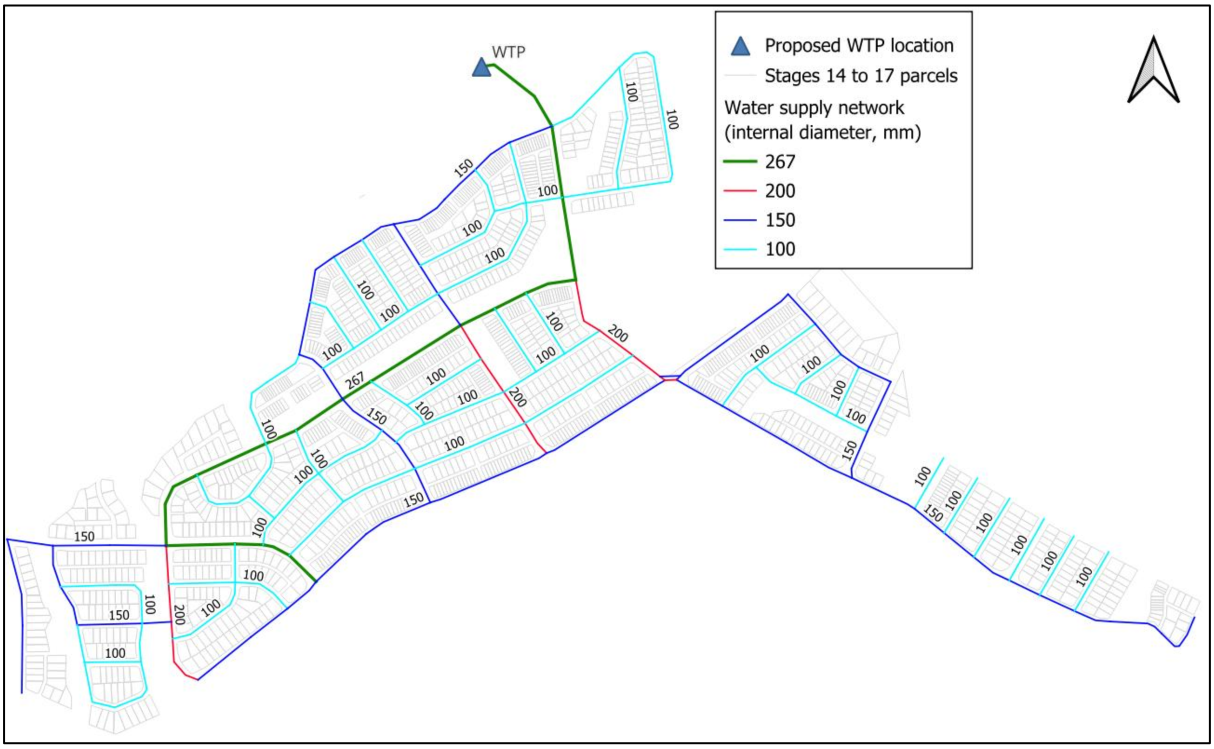


Figure 2: Proposed network layout and sizing for Milldale Stages 14 to 17

3.5. Network Requirements and Performance

The network has been modelled during the peak day scenario with a demand pattern representing peak hour demands in the network, as summarised in Table 1.

Table 2 summarises the network performance results and WTP requirements. Details for the different analysed parameter are presented further below.

The proposed pipe sizing has also been checked for compatibility with public water supply servicing. The pressures and flows within the network under a public supply arrangement will depend on the approved connection locations and available pressure and flow. Further hydraulic checks will therefore be undertaken once these matters are confirmed.

Table 2: Summary of network performance and required pressure at WTP outlet

Parameter	Value	Compliance with CoP
Pressure required at WTP outlet (Full private servicing)	58 m (77 m head)	-
Minimum pressure in the network Over 20 m required	25.8 m	Compliant
Maximum pressure in the network Less than 80 m required	65.8 m	Compliant
Maximum velocity Less than 2 m/s required	0.7 m/s	Compliant
Maximum headloss Less than 5 m/km for pipes DN≤150 Less than 3 m/km for pipes DN>150	1.6 m/km	Compliant
Available Fireflow at 10m residual pressure Residential: FW2 (25 L/s) Commercial[2]: FW3 (50 L/s)	>31 L/s overall 93 L/s at commercial lot	Compliant

Minimum pressure and required WTP outlet pressure

The required pressure at the proposed WTP is defined by the most disadvantaged location in the network, which in this case is at the highest elevation (50.4mRL, highlighted in Figure 3). The required pressure at the WTP outlet into the network is 58m (77 m head).

The resulting minimum pressures in the network are shown in Figure 3, which shows the minimum pressure would be 25.8 m, located at the highest elevation point.

[2]Commercial fireflow requirements to be confirmed once type and size of activity is known

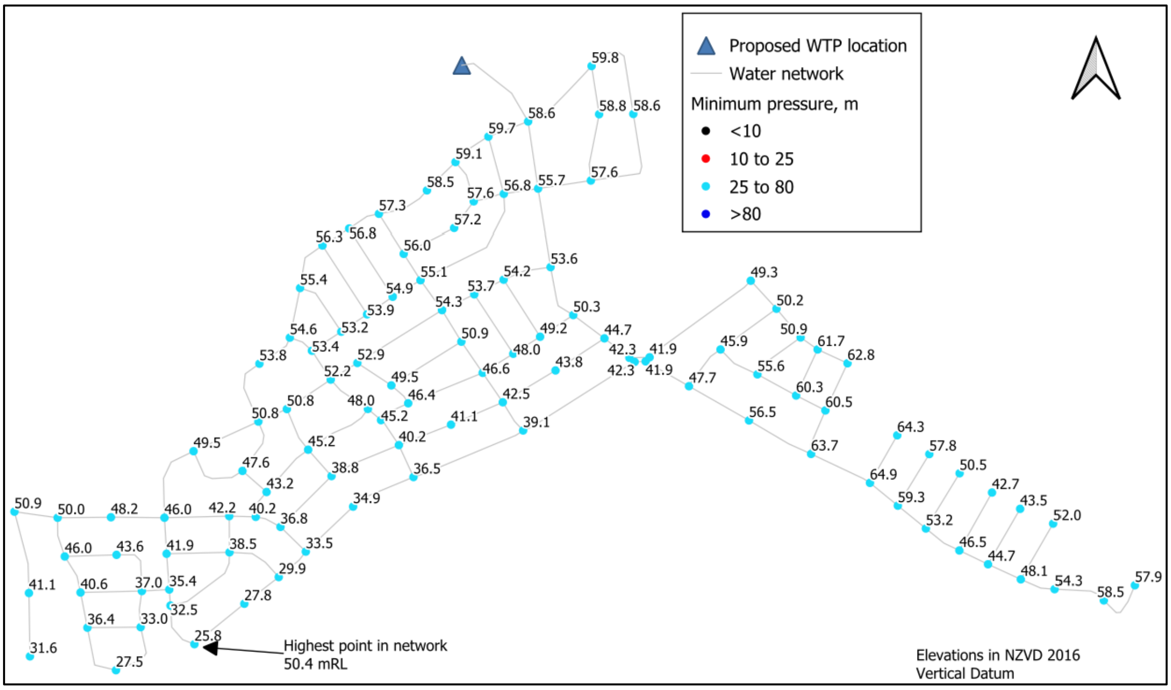


Figure 3: Minimum pressures

Maximum Pressure

Due to the pipe sizes and well-connected network, the maximum pressures do not significantly vary from the minimum pressures. The maximum pressure is 65.8 m, occurring at the lowest point in the network as shown in Figure 4

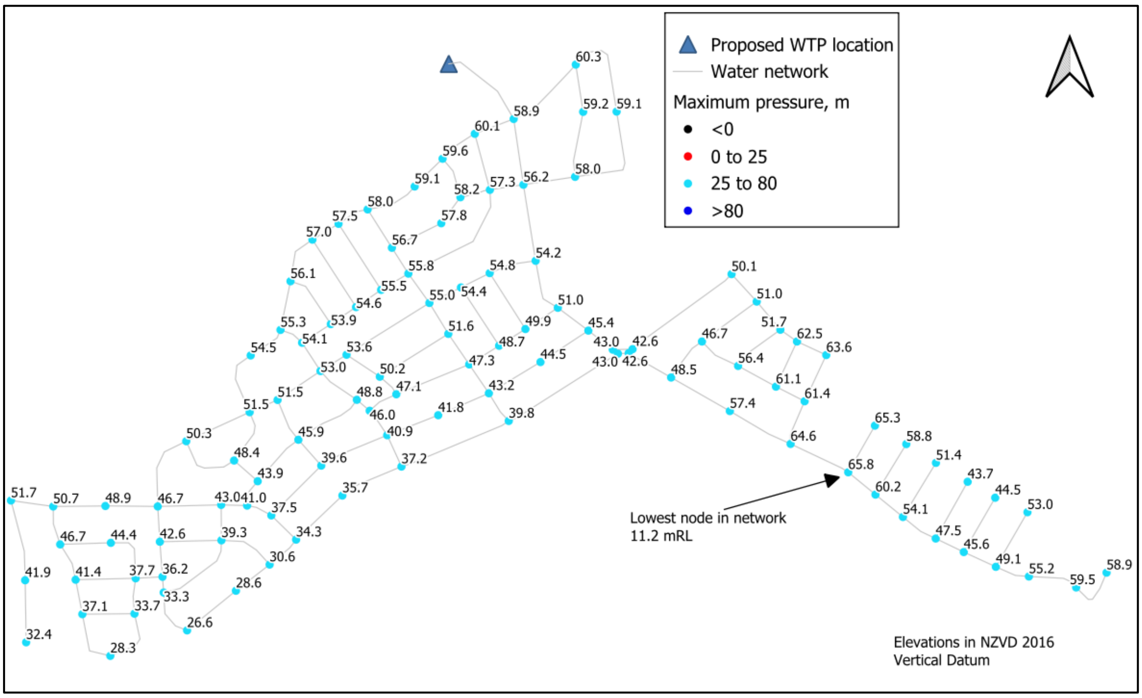


Figure 4: Maximum pressures

Maximum Velocity

The maximum velocities during the peak day would not exceed 0.7 m/s, which is below the 2 m/s limit indicated in the CoP. The maximum velocities are shown in Figure 5.

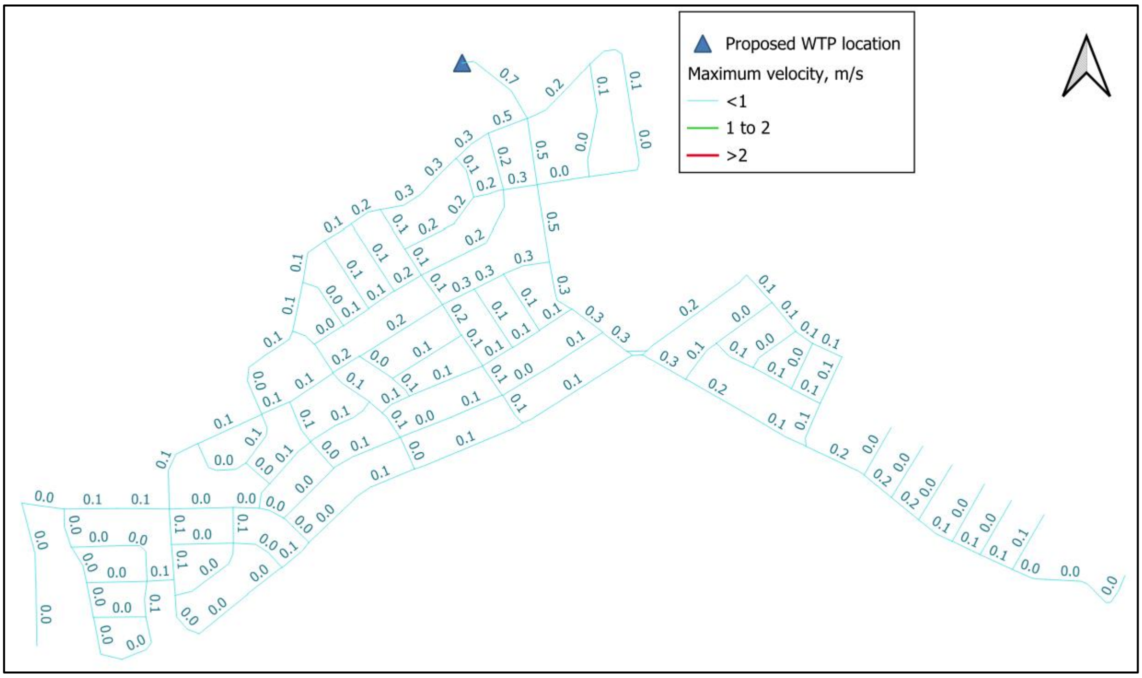


Figure 5: Maximum velocity

Maximum Headloss

Maximum headloss per unit distance in the network would be 1.6 m/km on the pipe connecting the WTP to the development. This complies with the CoP limit of 3 m/km maximum headloss. Figure 6 shows the maximum headloss in the network.

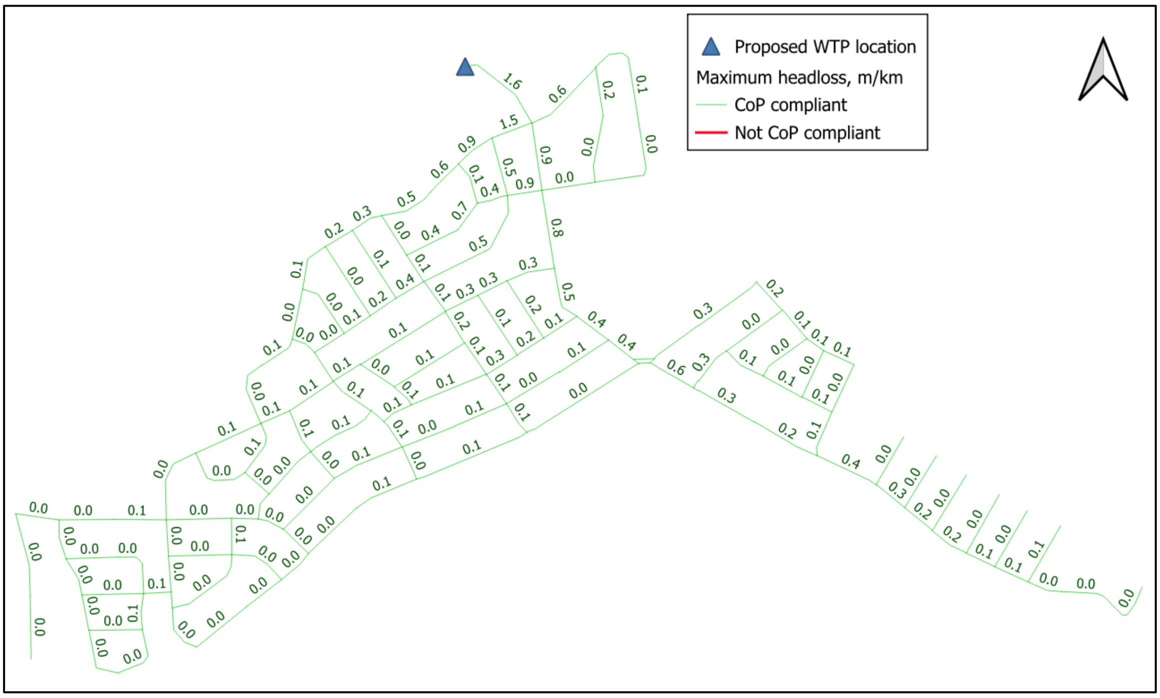


Figure 6: Maximum headloss, compliance with Code of Practice

Firefighting Water Supply

The available fireflow in the network nodes is shown in Figure 7, assuming a supply pressure of 58m and no restriction of flow. Residential FW2 flow requirements (25 L/s) would be achievable throughout the network and FW3 (50 L/s) at the commercial lot.

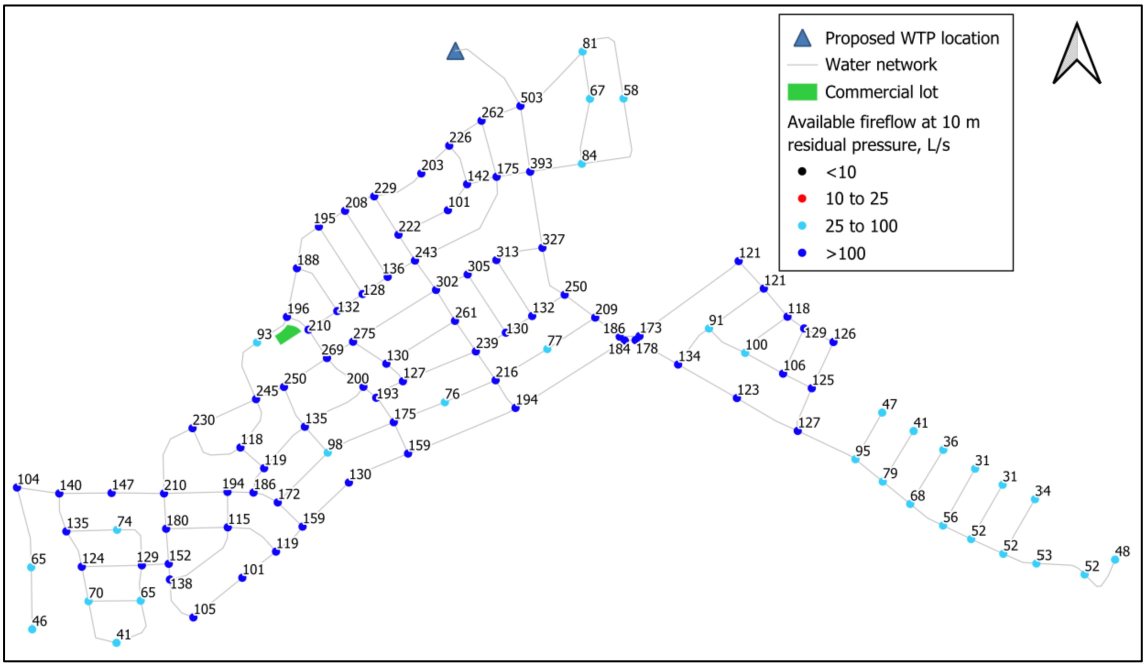


Figure 7: Available fireflow at 10m residual pressure

3.6. Private Supply Water Treatment Plant Pumping Requirements

The pump duties required from the proposed WTP, considering three demand conditions, have been assessed. The corresponding flow and pressure requirements are detailed in Table 3. These flows and pressures will need to be provided by the outlet pumpset of the proposed WTP.

Table 3: WTP outlet pumping duties

Demand condition	Total flow	Required pressure (head)
Peak demand PHD	40.8 L/s	58 m (77 m head)
Fireflow (FW2) 2/3 PHD + 25 L/s	52.2 L/s (27.2+25)	50 m (69 m head)
Fireflow (FW3) at commercial site 2/3 PHD + 50 L/s	77.2 L/s (27.2+50)	47 m (66 m head)

4. Conclusions

The proposed water network is capable of servicing the Milldale Stages 14–17 development of up to 1,425 DUEs under the fully private, interim private and immediate public servicing scenarios. The reticulation has been designed and hydraulically assessed against the performance requirements of the Watercare Code of Practice and is suitable for supply from either the proposed private WTP or approved connections to the public water supply network.

A separate demand basis has been adopted for the private water source, storage and treatment infrastructure. This does not alter the Watercare Code of Practice basis adopted for the reticulation network design herein. The hydraulic assessment presented in this memorandum is based on supply from the proposed WTP. The critical point in the network is the highest elevation node in the network (50.4 mRL). This node defines the pressure that needs to be supplied at the proposed WTP outlet (58 m pressure, 77 m head) in order to comply with the Code of Practice minimum pressure requirement (25 m) during the normal operation. The maximum pressures, maximum velocities, maximum headloss and available firefighting water supply flows all meet the Code of Practice design standard.

Where the proposed WTP is used, the outlet pumps will be selected to provide the flow and pressure requirements for the three operating scenarios identified in Section 3.6. Where public servicing is provided, either from the outset or following an initial period of private supply, the hydraulic performance of the network will be reviewed against the approved connection locations and confirmed public supply conditions.

Appendix H – North Harbour 1 Watermain – Remaining Headroom and Growth Implications – Technical Assessment Report

North Harbour 1 Watermain

Remaining Headroom and Growth Implications

Technical Assessment Report

Amendments						
Revision No.	Details	Originator	Peer Review 1	Peer Review 2	Approved	Date
E	Draft for Peer Review	E Verseput	-	-	-	18/02/2026
0	Final	E Verseput	M Dunstone	B Davies	T Scheirlinck	17/04/2026

CONTENTS

1. EXECUTIVE SUMMARY

1.1 Purpose of the Report

The report assesses the operational performance of the existing North Harbour 1 watermain (NH1), a critical transmission asset supplying water to West Auckland, the Upper North Shore, and the Hibiscus Coast. The purpose of this report is to determine and quantify the remaining capacity headroom that the NH1 can accommodate under peak demand conditions, and to evaluate the implications of accelerated or out of sequence growth on network resilience and service levels. The outcome of the report is summarized in a graph setting the lower and upper limits of capacity headroom and projected growth scenarios.

1.2 Key Findings

- NH1 is operating near its headroom limits with constrained resilience and cannot reliably support uncontrolled additional out-of-sequence development without compromising levels of service.
- NH1's performance is highly sensitive to transmission system operational modes, particularly the configuration of the Pleasant Road and Hobsonville Road transmission pump stations. Operating Pleasant Road Pump Station is considered the primary / optimal system operating mode and operating Hobsonville Road Pump Station is the secondary / assist operating mode.
- The allowable maximum modelled serviceable capacity of the NH1 is calculated to be 91.7 MLD, based on the hydraulic limitations of the watermain and to ensure supply and recovery to the Albany reservoir levels while meeting level of Service (LoS) pressure requirements to the bulk supply points feeding into the local network (***Figure 2***). This was calculated using a hydraulic model under the Primary / optimal system operating mode.
- Peak water demand reached 86 MLD during the 2020 drought, and an average demand of 78.4 MLD based on 3 highest peak summer conditions experienced in 2019, 2022 & 2025 (***Figure 2***).
- This remaining capacity headroom already supports live-zoned and earlier sequenced growth areas under the Auckland Future Development Strategy (FDS) marked as 2025+, such as Whenuapai Business and Albany Village.
- The proposed North Harbour 2 Watermain (NH2) is a pre-requisite for enabling long-term growth in Future Urban Zones (FUZ).
- The remaining available capacity headroom of the NH1 is subject to Watercare's risk-based planning considerations. These considerations will be referenced in a covering letter accompanying this report which will be updated periodically to reflect changes in operational conditions, infrastructure status and planning priorities.

1.3 Implications for Out-of-Sequence Growth

NH1 is operating near its headroom limits with constrained resilience and cannot reliably support uncontrolled additional out-of-sequence development without compromising levels of service.

Further investigations on the remaining capacity headroom have been undertaken to determine the effects of medium and high growth rates for the area. Access to the remaining capacity headroom is subject to Watercare's risk-based planning considerations described in a covering letter to this report.

1.3.1 Supply considering North Harbour 1 only

The remaining capacity headroom is sufficient to support live-zoned and earlier sequenced growth areas under the Auckland Future Development Strategy (FDS) as mentioned in the previous section. Further details on the anticipated growth are provided in the body of the report.

1.3.2 North Harbour 2 Watermains Impact

The NH2 is maintained as a prerequisite for enabling growth in the Whenuapai, Redhills, Silverdale, and Dairy Flat FUZ areas beyond 2035+. Its delivery will provide full redundancy to the current NH1 supply areas and will ensure that sufficient water is delivered to the Albany Reservoirs and onwards. This will in turn free up the capacity of the existing NH1 to service the Northwestern Development areas for the foreseeable future.

Approving plan changes ahead of NH2 commissioning would risk:

- Further exacerbating customer impact during a resilience event.
- Reduced pressure and firefighting capacity.
- Increased vulnerability during peak demand and drought periods.
- Delays to development in live-zoned areas already sequenced for growth.

1.4 Conclusion

The following key considerations apply to the findings:

- Growth Limits
    - Lower limit defined by AGS23v1.1 Medium Growth:
        - For the effect of in sequence growth.
    - Upper limit defined by StatsNZ High Growth:
        - For the effect of in and out of sequence growth occurring concurrently.
    - PC120 impacts not considered.
- Demand Limits
    - Upper limit relating to existing demand <u>allowing a larger number of DUE's to be serviced</u> defined by recent and recurring summer peak demands of March 2019, February 2022 and March 2025.
    - Lower limit relating to existing demand <u>allowing a lesser number of DUE's to be serviced</u> defined by Drought experienced in February 2020.
- Optimal Transmission System Operational Mode Consideration
    - Defined as Pleasant Road pump station acting as main support to the Northwest development areas pumping water from the Huia 2 watermain via the Waitakere 1 & 2 watermains.
    - Hobsonville pump station providing secondary support / assist to the Northwest development areas via the North Harbour 1 Watermain and Waitakere 2 Watermain.

The investigations concluded that the NH1's remaining capacity headroom can be summarised by the ***Figure 1*** below (See ***Figure 11*** for a larger version). This shows the considered lower (AGS23v1.1, Medium) and Upper (StatsNZ, High) growth limits as well as the lower (February 2020) and upper (Summer 2019, 2022 and 2025) remaining capacity headroom limits available under the primary and preferred system operation conditions.

The NH1 can support a total population of between ±378,000 and ±401,000 people, for the lower and upper remaining capacity headroom conditions respectfully. The current population serviced by the NH1, based on demand, is calculated to be ±360,000 people.

The lower capacity headroom limit is triggered by growth either in 2028 (StatsNZ High) or 2033 (AGS23v1.1 Medium) and the upper headroom limit being triggered by growth in either 2032 (StatsNZ High) or 2047 (AGS23v1.1 Medium).

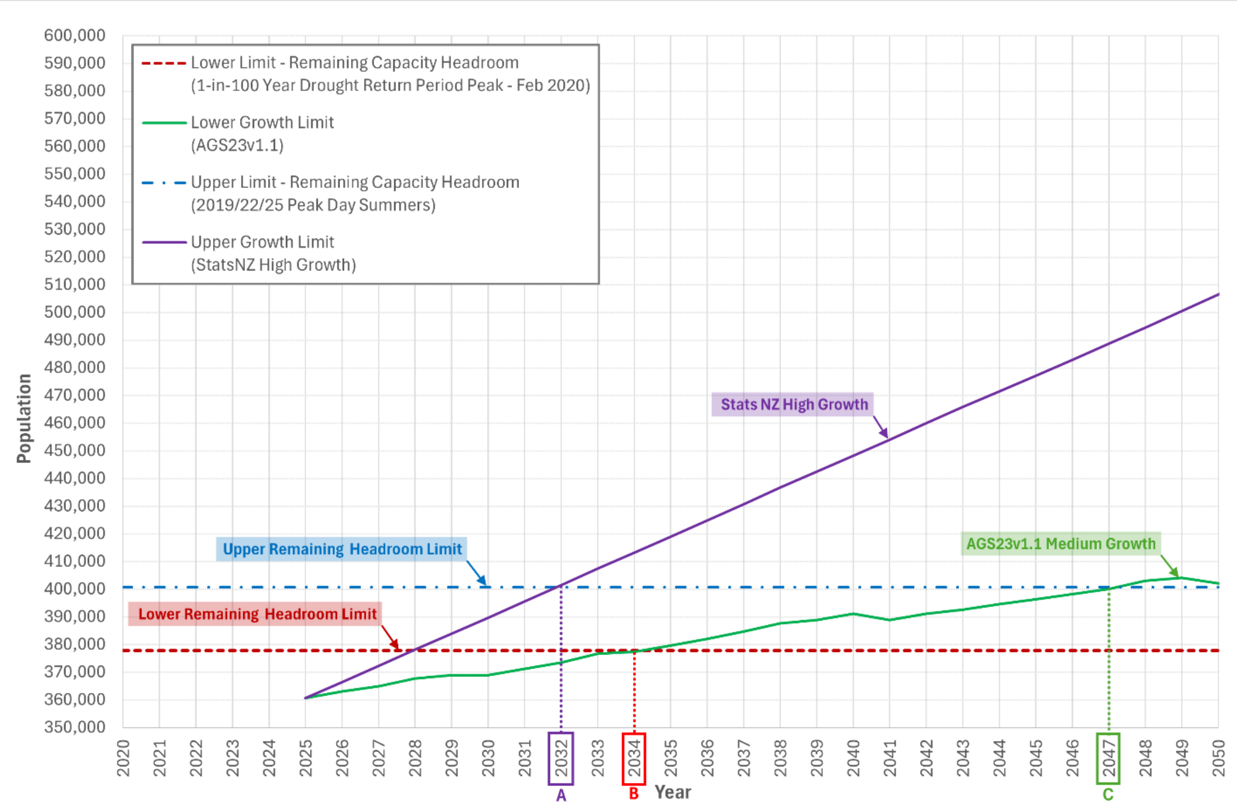


Figure 1 – North Harbour 1 Watermain | Capacity Headroom & Growth Limits

2. TECHNICAL

2.1 Scope and Objectives

This section outlines the technical investigation and modelling approach used in the assessment of the NH1 watermain. It focuses on evaluating NH1's operational performance under known peak demand conditions, different operational scenarios for the transmission system and determining the estimated remaining capacity headroom in the context of Auckland's sequenced growth strategy.

The objectives of this assessment are to:

- Quantify historical and modelled peak flows through NH1.
- Evaluate NH1’s remaining capacity headroom capacity considering various operational scenarios.
    - Assess the impact of pump station configurations on the NH1.
    - Compare remaining capacity headroom against different projected growth scenarios.
- Identify infrastructure dependencies, particularly the role of NH2 in supporting future urban development.
- Support Watercare’s risk-based planning considerations by identifying constraints and risks associated with out-of-sequence growth.

2.2 Background

The NH1 is a strategic and critical transmission asset that stretches for 30km serving the northwestern corridor of Auckland, the Upper North Shore as well as the Hibiscus Coast areas. It originates in Titirangi via a connection to the Huia 2 watermain and extends northward through Waitakere, and the Upper North Shore, terminating at the Albany reservoir complex.

Constructed in stages between 1976 and 1988, NH1 comprises a 910mm diameter concrete lined steel pipe in the southern section and an 810mm diameter pipe in the northern section. Its alignment includes key infrastructure assets such as bulk supply points (BSPs), pump stations, and reservoirs that support both local distribution and regional resilience (see ***Figure 2***).

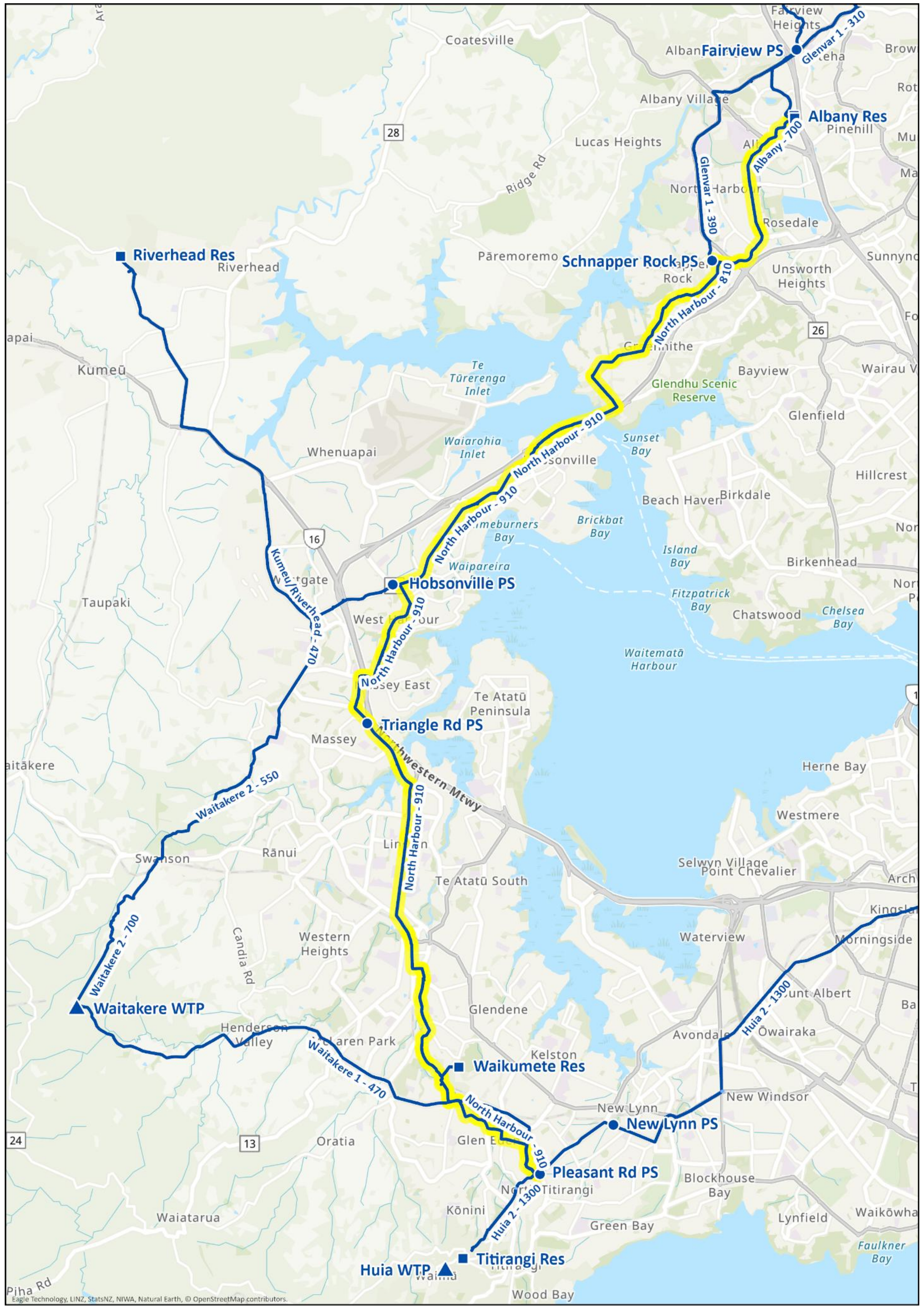
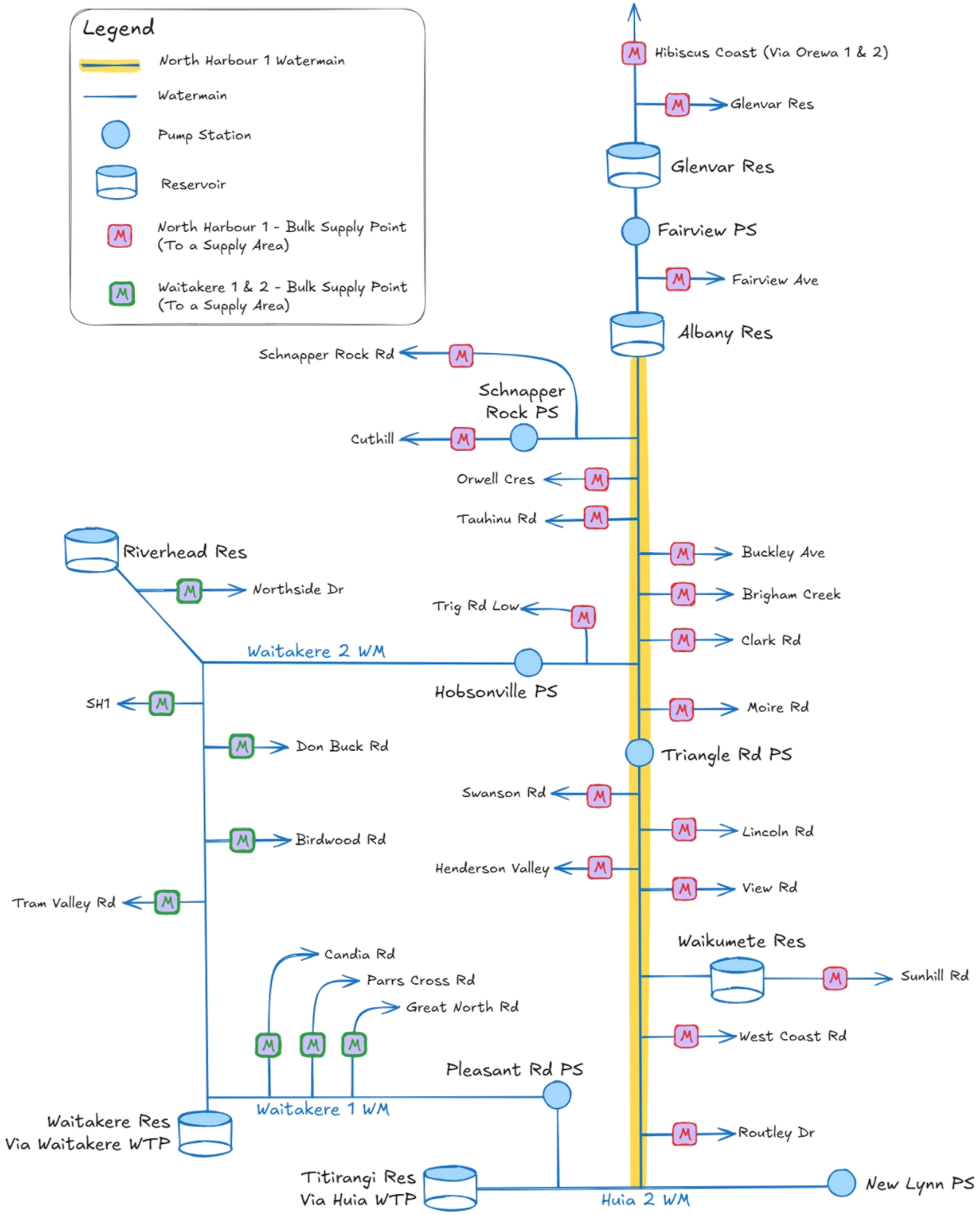


Figure 2 – North Harbour 1 Watermain Extent and Bulk Supply Point Offtakes (NH1 highlighted in yellow)



2.2.1 Existing North Harbour 1 Watermain Operation

The NH1 operates at a hydraulic grade line (the operating pressure) of approximately 115m which is determined by either the top water level in the Titirangi Reservoir (Supplied by the Huia Water Treatment Plant) and/or the New Lynn Pump Station (Supplied predominantly from the Ardmore and Waikato Water Treatment Plants). This driving / operating pressure supplies water north through the North Harbour 1 watermain into the Albany Reservoir site at its termination (with a Reservoir top water level of 87m).

The hydraulic grade line determines what pressure / flow would be available along the length of the watermain depending on the different demands from the relevant offtakes. There are a number of offtakes (bulk supply points (BSP's) / pump stations / reservoirs) along the route between Titirangi and Albany as shown in ***Figure 2*** and listed below:

- 14x Bulk Supply Points (BSP's)
  - Local network offtakes that are directly supplied from the watermain.
- Two reservoirs:
  - Waikumete Reservoir (Enroute)
    - Feeding into the local network.
  - Albany Reservoirs (End point)
    - Feeding to upper North Shore and Hibiscus Coast with emergency supply capability for the lower North Shore areas via Pinehill Reservoir.
- Three pump stations:
  - Triangle Road (Boosts capacity supply along the watermain).
  - Hobsonville (Supply support to Northwest, Waitakere Network)
  - Schnapper Rock (Offtake supply to Cuthill reservoir / upper North Shore).

Additional information on the thee pump stations listed below:

2.2.1.1 Triangle Road pump Station

This pump station was installed in 2013 along the NH1 as an inline booster pump station designed to increase capacity under high demand conditions (summer periods) by maintaining supply to the Albany Reservoir complex to ensure that it remains full and able to supply the Hibiscus Coast areas.

2.2.1.2 Hobsonville pump station

This pump station is the offtake supply point from the NH1 feeding into the Waitakere transmission network via the Waitakere 2 watermain. The goal of this is to support additional direct demand requirements above the Waitakere water treatment plant (WTP) production output while also supporting in maintaining the Waitakere WTP Reservoir level during peak hour times within the day.

The originally purpose of this pump station was to be a backup / assist supply to the Waitakere Transmission Network with the existing Pleasant Road pump station being the preferred mode of operation of supply by pumping from the Huia 2 watermain in the south.

However, due to failures along the Nihotupu 1 watermain during the 2023 Auckland Anniversary Floods the Pleasant Road pump station was reconfigured to support local Bulk Supply Points and has been unable to support the Waitakere Transmission system since. In response to this the Hobsonville Road pump station changed its function from backup / support to full Waitakere Transmission System supply and is still running in this configuration, which is not the optimal operational configuration.

2.2.1.3 Schnapper pump station

The Schnapper Rock pump station is an offtake supply point prior to the Albany reservoir site from the NH1 feeding into the central North Shore transmission network via the Cuthill watermain. This station lifts water to the strategic Cuthill reservoir site transferring approximately 10MLD. The pumps draw water directly from the NH1 watermain with potential to impact the hydraulic grade of the watermain.

2.2.2 NH1 Transfer System Performance Criteria

There are several key levels of service (LoS) and performance metrics that Watercare must meet regarding water supply for the overarching transmission system, and specifically for the NH1 Transfer System as well. If the criteria elements set out below are not met the NH1 would have exceeded its acceptable operational risk and performance metrics. Underpinning these is Watercare's duty to comply with the drinking water standards.

2.2.2.1 Pipe Performance

- Pipe Velocity – Should not exceed **3m/s** (as per Watercare Transmission Standards).

2.2.2.2 Reservoir Performance

- Operational Water Volumes – Reservoir preferred water levels to be always maintained between 80% to 100% during typical day demand scenarios.
- Emergency Storage Volumes – Water levels below the 80% to 100% operational levels are maintained to provide buffer against failures or supply disruptions, ensuring Watercare has **adequate time (minimum 24 hours)** for planned or unplanned isolation, repair, and restore service continuity without immediate risk to downstream supply.
- Ensuring that reservoirs water levels recover and replenish during a **24-hour period**, while operating within operational volume levels and while maintaining reservoir emergency storage volumes. i.e. The reservoir inflow is higher than its outflow over any given 24-hour period.

2.2.2.3 Pump Station Operation

- Pump station run time limited to **16 hours per day** (But with specific reference to the Triangle Road pump station acting as a inline booster) to ensure the system has sufficient **storage recovery time**, maintain **asset longevity**, and provide **operational resilience**. Running pumps continuously reduces the ability to respond to peak demand events, increases mechanical wear, and heightens the risk of overheating or premature failure. The 16-hour limit also ensures reservoirs can refill during off-peak periods, maintaining minimum service levels and providing buffer capacity for outages, fire flow, or emergency events. This operational window balances supply reliability, energy efficiency, and long-term asset protection.
- Pump stations retain a **Standby Pump** operation to allow cycle between duty and standby pumps. Not all the pumps in a pump station should be required to run to meet any given demand. The Standby Pump operation allows Watercare to maintain system reliability and extend asset life. Alternating operation ensures that no single pump carries the full operational load, which reduces wear, balances run hours, and lowers the risk of unexpected failure. Cycling also confirms that the standby pump remains functional, providing operational resilience and ensuring continuity of service if the duty pump trips or requires maintenance.

2.2.2.4 Bulk Supply Points (supply offtakes to the local network and customers)

- Ensure existing Bulk Supply Points located along the NH1 watermain (Figure 2) maintain required **Pressures (Grade)** to enable it to continue to provide adequate **Levels of Service** to the relevant local networks and customers. Increased demand can lower the hydraulic grade / operating pressure of the watermain leading to this requirement not being met. This is being actively managed by Watercare with existing challenges experienced in high lying areas surrounding the Waikumete Reservoir.

2.2.2.5 Additional Acceptable Resilience Risk Consideration

- NH1 has a role to provide additional support outside normal operational conditions during resilience scenarios for both planned and unplanned outages. This support includes supplementary capacity through:
    - Albany Pump Station operational
        - Emergency supply pumped from Albany Reservoir feeding into the adjacent Upper North Shore transmission system, which supplies the East Coast Bays supply zones.
        - This is required in the event of losing the supply across the Waitemata Harbour via the watermains underneath the Harbour Bridge.
    - Hobsonville pump station
        - Secondary operational mode (Detail in Section 4.2) supporting the Waitakere system
        - This is required in the event of losing supply from the Pleasant Rd pump station or Waitakere WTP.

2.2.3 Watercare General LoS Metrics

The following general Level of Service metrics are shown to provide a baseline frame of reference of the Watercare system to support the complex nature and various other considerations that need to be taken into consideration when performing investigations.

2.2.3.1 Local Network LoS Metrics

Non-quality levels of service for the local network include:

- Less than 10 unplanned interruptions per 1,000 connections,
- A maximum of 140 litres per connection of water lost from our network,
- No more than five hours to resolve an urgent outage and six days to resolve a non-urgent outage,
- Provide a residual 100 kilopascal (kPa) water pressure in the network for firefighting purposes,
- Provide a minimum of 200 kPa water pressure at each water meter, and
- Provide a minimum flow of 25 litres per minute to a connection.

These local network metrics are directly linked to the pressures and flows delivered by the Transmission watermains through the relevant Bulk Supply Points.

2.2.3.2 Drought Conditions

Defined in the Auckland Drought Management Plan[1] and are detailed below.

1. Levels of Service 1 – Drought Standard: Unrestricted demand is to be met while maintaining total system storage above 15%. This standard is designed to withstand a severe drought event with a 1% probability of occurrence in any given year.
2. Levels of Service 2 – Demand Restrictions: There should be no more than a 5% chance of implementing water use restrictions in any given year, equating to no more than once every 20 years. This level of service addresses peak summer demands driven by hot and dry weather conditions.

The general level of service requirements listed above and the NH1's remaining capacity headroom are in many cases linked to and in certain events affected by each other. Oversubscribing demand to the NH1, before the NH2 is completed, poses a high risk of Watercare not being able to meet some of the metrics listed above.

2.2.4 Existing North Harbour 1 Watermain Demand

To better understand the current peak demands passing through the NH1 the last 10 years (***Figure 3)*** have been monitored and assessed with two relevant peak day demand periods commented on.

1. 1-in-100 Year Drought Demand Peak – Experienced in February 2020.
2. Recent & recurring Summer Demand Peaks – Experienced in March 2019, February 2022 & March 2025

2.2.4.1 1-in-100 Year Drought

In December 2020 Watercare performed an analysis 2020 Drought to support various drought intervention initiatives. This included a frequency analysis of daily rainfall data from NIWA's Auckland Airport climate station between 1963 and 2020 with the goal of determining the drought return period of the 2020 Drought.

The 2020 January-February rainfall was found to be the lowest total on record at this site, with an approximate return period greater than 100 years.

This confirms that the 2020 drought was a significant exceedance of Watercare's intended service standard and represents a major hydrological outlier within the modern climate record.

2.2.4.2 1-in-100 Year Drought - Demand Peak

The February 2020 summer demand period marks the highest recorded peak on the Watercare network, with system-wide demand reaching 560 megalitres per day (MLD). The peak day from this period was selected as the upper demand limit for the NH1, as shown in ***Figure 3*** by the **maroon** dashed line.

During this scenario the maximum flow in the NH1 reached approximately **86.0 MLD** when considering the first 910mm pipe section.

[1] https://www.watercare.co.nz/home/projects-and-updates/water-restrictions

Note: During this period the system was running in the optimal supply configuration mode where Pleasant Road pump station was operational and the Hobsonville pump station was required to provide support if needed. If the system was running without the Pleasant Road pump station and only relying on the Hobsonville pump station for Waitakere support, the capacity in the NH1 may have been reached.

2.2.4.3 Recent & Recurring Summer - Demand Peaks

To include a less severe peak summer day demand for the lower demand limit, more recent, typical summer months were identified by using the information presented on ***Figure 3***. The three highest peak demand periods were March 2019 (at 76.9 MLD), February 2022 (78.5 MLD) and March 2025 (at 79.9 MLD) providing an average of **78.4 MLD**, shown by the **blue** dot and dashed line.

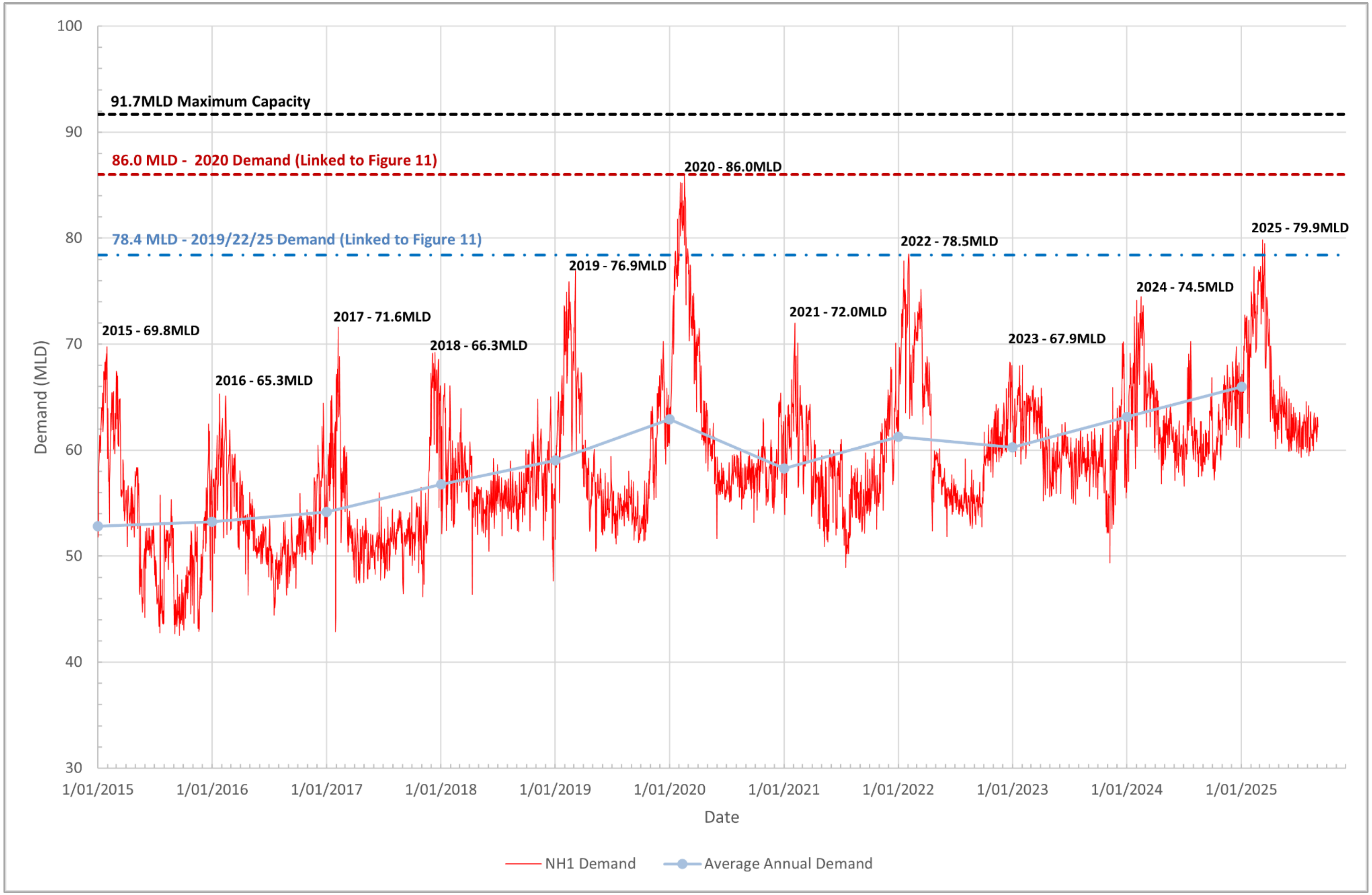


Figure 3 – Historic North Harbour 1 Watermain Supply Demands

Demand Assumptions: *The data for this section has taken from historical SCADA data.*
Some of the data sets did have errors, such as meter failures, therefore some demand at some BSP's were interpolated from before or after trends and data from available hydraulic models where manual monitoring had previously occurred. However, in most cases the data was considered adequate for this assessment.

2.2.5 Future North Harbour 2 Watermain

Watercare has proposed a second North Harbour Watermain (NH2) which when installed, will provide additional capacity to the northwest and Hibiscus Coast areas while providing greater resilience to the current serviced area in general. As of writing this report the project is in detailed design stage with the intention is that it will operate similarly to the existing NH1 with a connection to Huia 2 watermain, downstream of the Titirangi Reservoir, with same hydraulic supply grade / operating pressure feeding north then northeast before terminating at the Albany Reservoirs. The NH2 watermain is proposed to be larger in diameter than NH1 (with a 1200mm diameter section, 26km in length and a 900mm diameter section 9km in length), along with a number of cross connections into the NH1 providing resilience and operational flexibility. The introduction of NH2 is anticipated to provide sufficient capacity to meet estimated 50-year demand projections including the demand anticipated from the growth areas identified in the Future Development Strategy. ***Figure 4*** illustrates the current NH2 proposed pipeline alignment which is subject to minor changes and refinements as the detailed design process progresses.

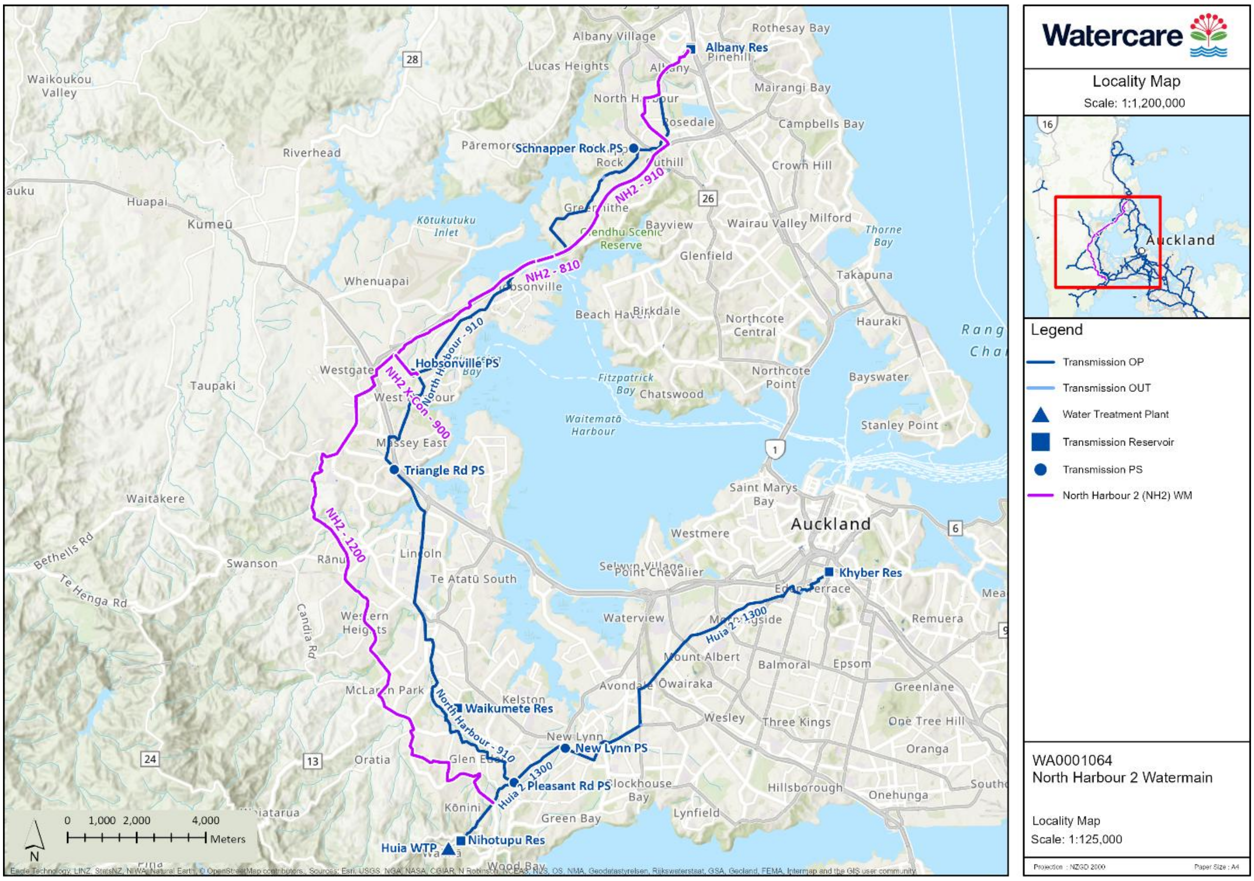


Figure 4 – North Harbour 2 Watermain Proposed Alignment

3. GROWTH

Population projections can be sourced from various providers (e.g. Infometrics, StatsNZ, academic research, etc.). For this report Watercare considered the official growth projection provided by Auckland Council, as well as a high growth scenario from StatsNZ.

The following section summarises the data sources utilised, and provides projected growth for the northwestern area, linked to the latest population projection data for live and future urban zoned areas.

To project the population growth along the North Harbour 1's area of influence, the following datasets and assumptions were utilised:

3.1.1 Projected Growth (AGS23v1.1)

- **DATA SOURCE** – Auckland Council's latest growth scenario, AGS23v1.1 was officially released and made publicly available in October 2024[2].
- The AGS23v1.1 projection is a medium growth scenario that is derived from StatsNZ's medium population growth projection for the Auckland region.
- Population growth projected in the water supply zone, is based on AGS23v1.1. This reflects Auckland Council's latest Long-term Plan 2024 - 2034 directions, and in line with the Future Development Strategy's development sequencing.
- Does not consider the Council's Development Contribution full build-out scenario.

3.1.2 Stats New Zealand High Growth Rate

In addition to the AGS23v1.1, the report has incorporated Statistics New Zealand's (StatsNZ) 2018 census based subregional high population growth scenario providing an expected upper range for potential population and water demand (not limited by infrastructure and planning constraints).

The StatsNZ High figures were used to assess two aspects of the expected growth, namely:

- What the impact of higher density developments would be if the developments were to stay inline with the FDS timing
- What the impact would be if the buildout density remained at a medium growth level and inline with the FDS timing but also adding additional out of sequence development areas. The additional out of sequence development would then contribute to increasing the overall number of DUE's to the high growth level when added to NH1's area of influence.

The StatsNZ High growth rate figures were issued by the Watercare Strategic Planning team for use. Shown in ***Figure 5*** is the split between the NH1 and Waitakere service areas shown in green and orange respectively.

[2] webpage link: https://www.knowledgeauckland.org.nz/publications/auckland-growth-scenario-2023-version-11-ags23v11-data/)

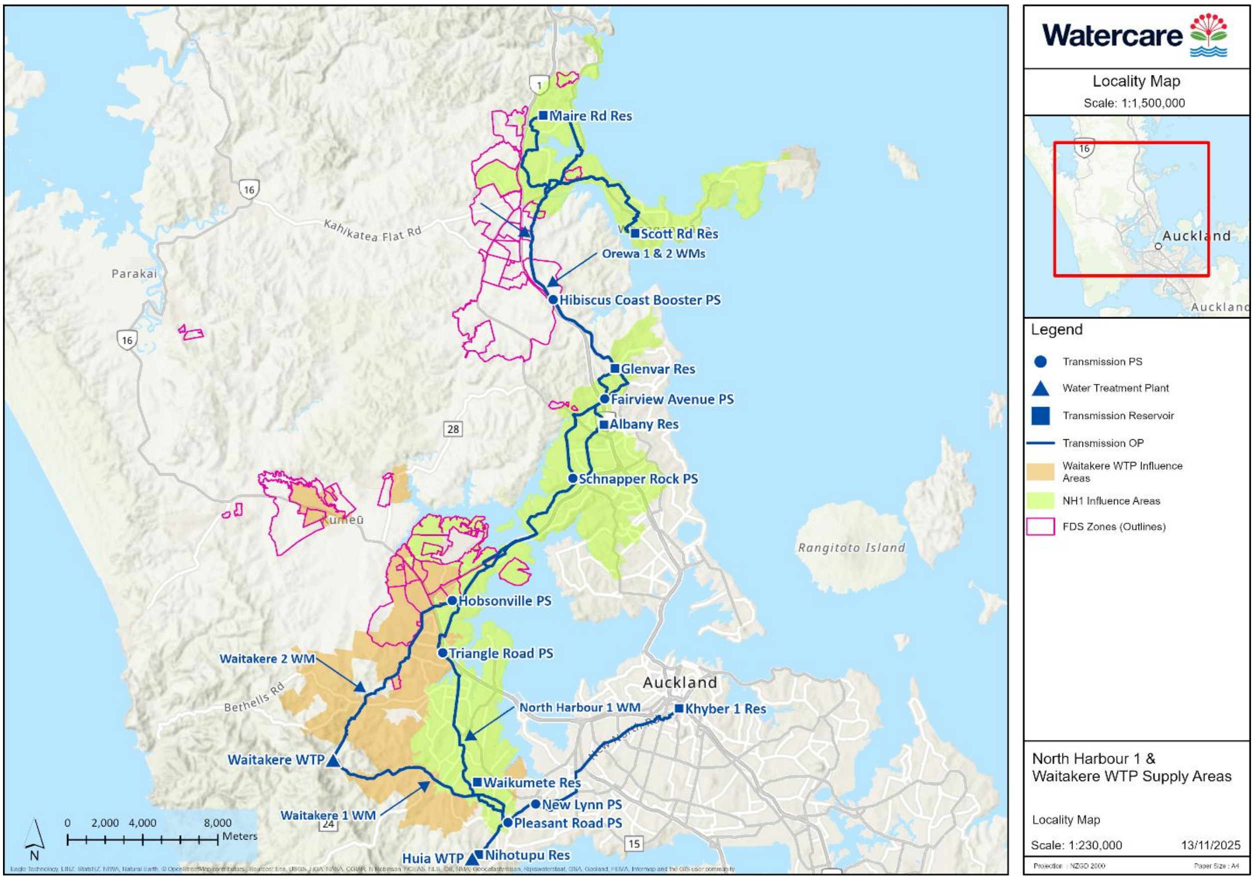


Figure 5 – Supply Areas along the North Harbour 1 and Waitakere 1 & 2 WM's including FUZ Areas

3.1.3 In Sequence Growth for North Harbour 1

The growth, as outlined in the AGS23v1.1 growth figures develop by Auckland Council and indicates that the current demand supplied to the existing areas by NH1 is approximately, 120,219 DUE / 360,660 population equivalents.

The are a number of large live zoned area within the area of influence that are currently under development. These include Redhills and Wainui, which collectively will add an estimated 13,800 DUE to the area, up to 2050.

The Waitakere Supply area (5,850 DUE up to 2050) is also considered when assessing NH1 capacity, as it relies on the NH1 for support water supply. The level of support required from the NH1 is lower when the Pleasant Road pump station is supporting the Waitakere system, and higher when it is not.

3.1.4 Out of Sequence Growth for North Harbour 1

Within the area of influence of NH1 there are two large FUZ areas, totalling 55,860 ha and 18,620 DUE. These have been flagged in the Future Development Strategy as ready for development before or after 2050. In order to evaluate the impact of the out of sequence growth areas the StatsNZ High growth population figures were used and applied them to the existing live zoned areas. The two figures below show the areas, their proposed FDS timings along with current proposed plan changes (August 2025) that if approved would enable additional out of sequence development of these areas:

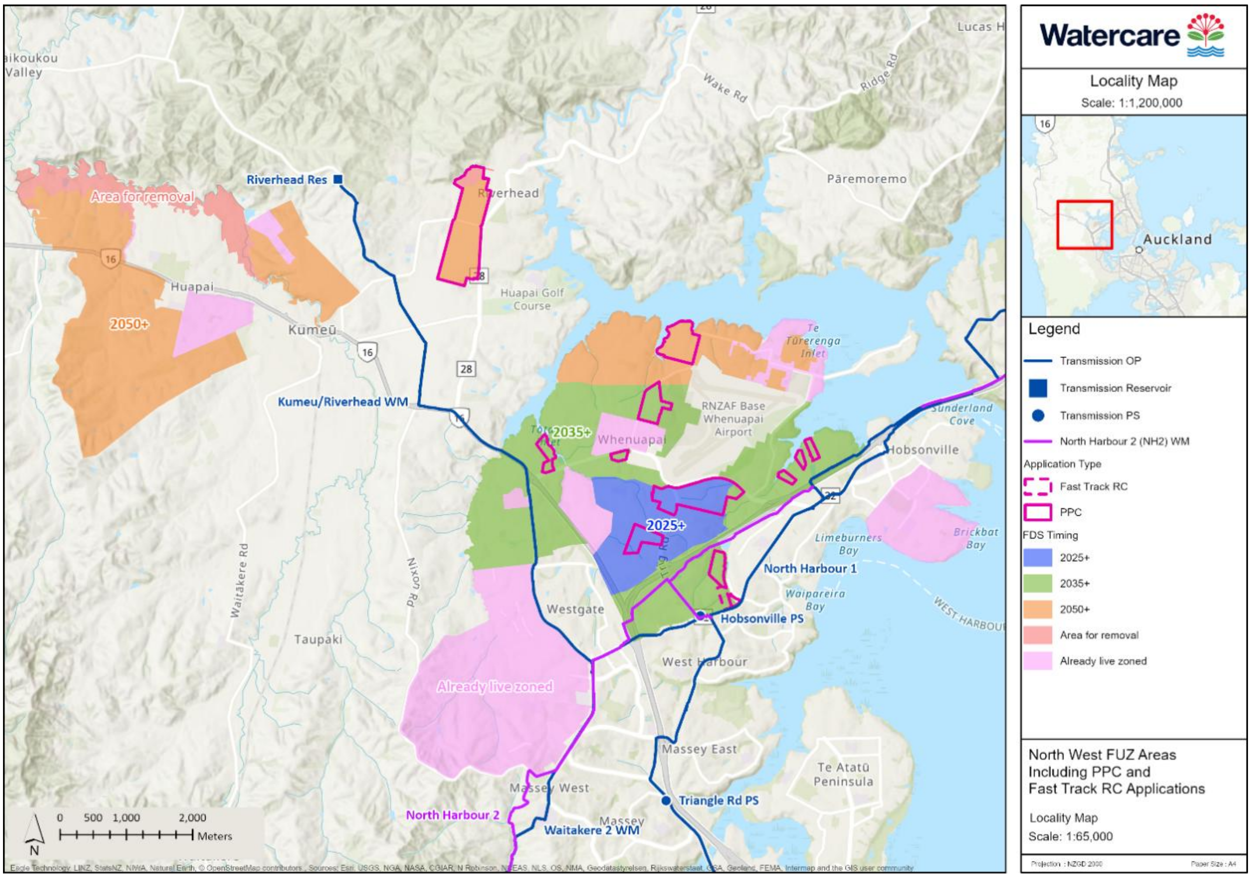


Figure 6 – Western FUZ areas with proposed development timing & Plan Changes as of Aug 2025

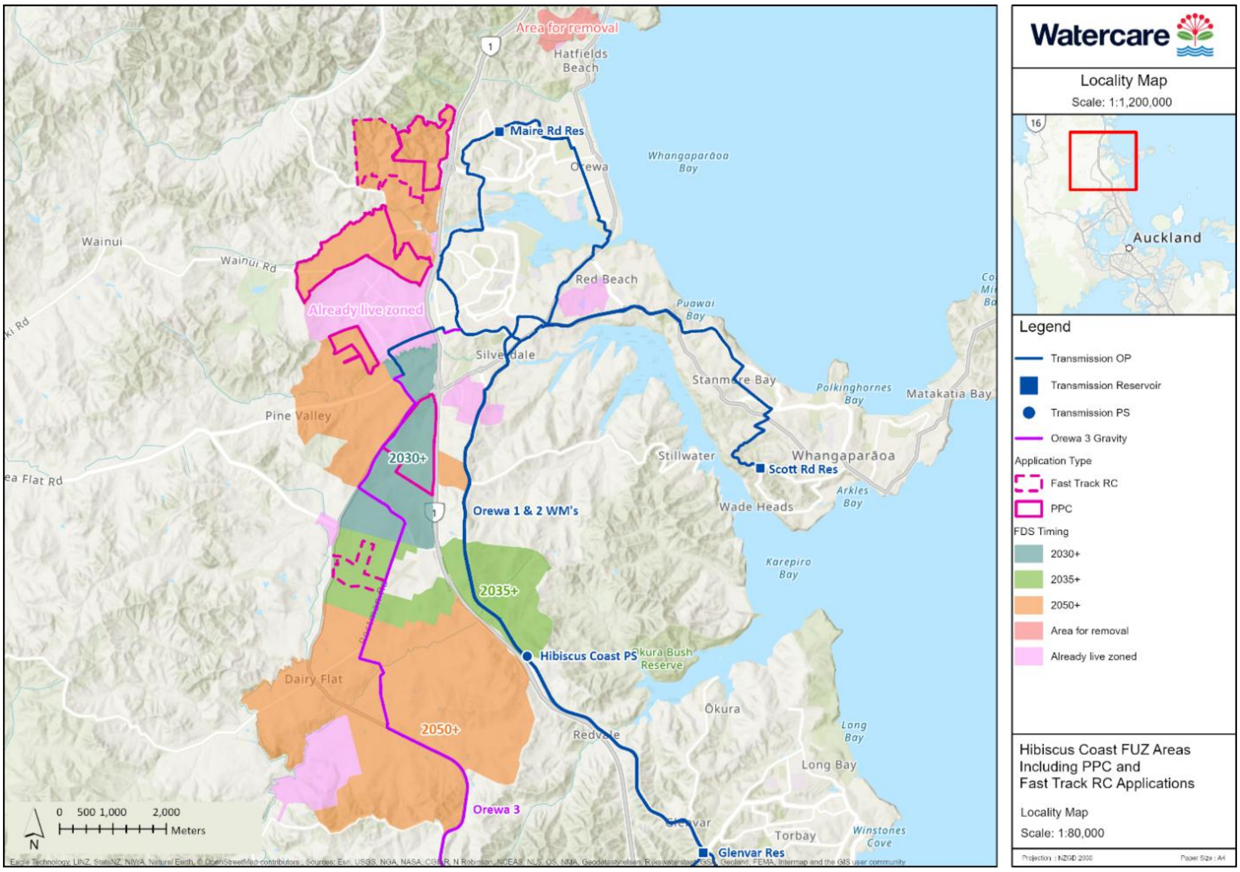


Figure 7 – Northern FUZ areas with proposed development timing & Plan Changes as of Aug 2025

4. NORTH HARBOUR 1 WATERMAIN PERFORMANCE

To understand current and future pipe performance, calculations (manual spreadsheet) and hydraulic model simulations (Infoworks WS Pro) were undertaken.

4.1 NH1 Maximum Capacity within Acceptable Risk Parameters

The following section discusses the theoretical remaining pipe capacity of the NH1 watermain, which when linked to the current peak demands, can determine the potential remaining available headroom for additional growth, whilst considering Watercare's risk tolerance to the overall Transmission system and considerations set in Section 2.2.2. This can then be converted to an estimated population (EP) value and compared with growth population projections.

The NH1 watermain is a significant asset, extending approximately 30 km with varying diameters (910 mm to 810 mm) and distributed demand along its route before terminating at the Albany Reservoirs (with flow continuing on to Upper North Shore and Hibiscus Coast). The remaining single-pipe capacity of the NH1 is highly dependent on where additional demand is introduced, especially in relation to the Hobsonville Pump Station. Demand placed upstream versus downstream of the pump station impacts capacity differently, making it challenging to provide a simple estimate of the remaining serviceable headroom.

For this assessment it has been assumed that the available remaining capacity headroom within the NH1 will be the difference between the upper and lower observed peak demands and the watermains maximum acceptable risk capacity as listed in the Table 1:

Table 1: Upper and Lower Limits (Check Caption Heading)

Current Demand & Acceptable Risk Capacity Limits	Description	Demand (MLD)
Upper	2019/22/25 Peak Day Summers	78.4
Lower	1-in-100 Year Drought Return Period (Feb 2020)	86.0
Maximum	Watermains hydraulic characteristics and limits	91.7

To determine the NH1's maximum acceptable risk capacity the available Infoworks WS Pro Transmission model was utilised (2020 Validation - Waikato 20200616-20200617, Version 2025.5). Additional demand was placed at the Albany Reservoir (considered worse case) and increased during multiple model simulations until a point that operational constraints begin to occur and Risk profile was considered too great. ***Figure 8*** illustrates a snapshot of the model extents and simulation results under the developed maximum headroom scenario including:

- Flow Volume of 91.7MLD experienced in the NH1 watermain to the starting location in the south after the Huia 2 connection.
- Triangle Road pump station supplying 47.4MLD with additional flow via gravity and operating for 16 hours per day on the third day.
- The Albany reservoir receives 33.6MLD to support required flow to the Upper North Shore and Hibiscus Coast with the reservoir receiving flow across 21 hours a day.

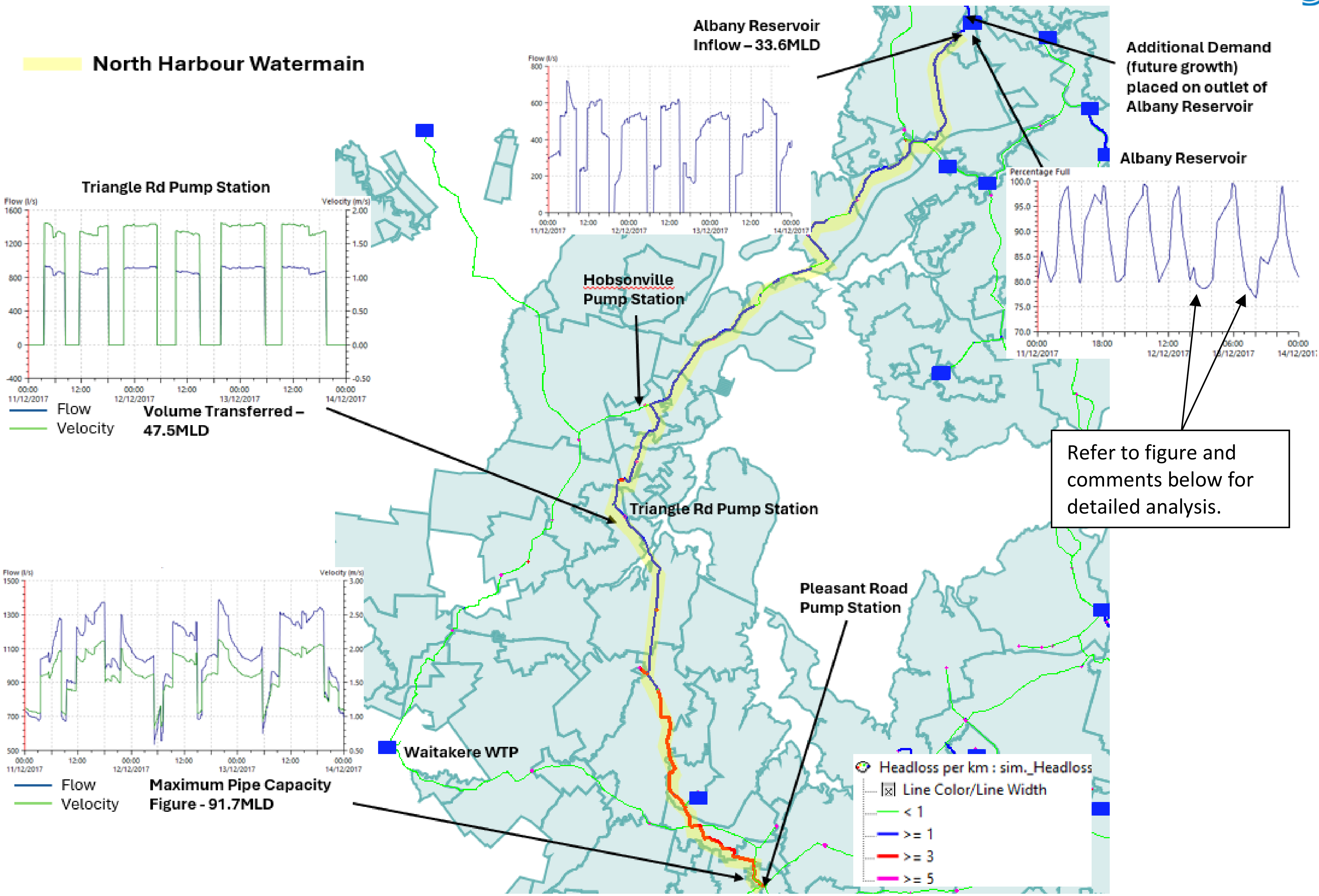


Figure 8 – Infoworks WS Pro Model Setup to determine

Illustrated in ***Figure 9*** some key constraints and risks arise with the network at a pipe flow of 91.7MLD, key being the operating time of the Triangle Road pump station required to maintain supply to the Albany reservoir while keeping the Reservoir levels within the set operational limits. Under this scenario the hydraulic model results showed the following key findings:

- The Albany reservoir is to operate between 80-100%, however at times across the 3-day scenario the reservoir level **falls outside this limit** as it is unable to recover even with the Triangle Road pump station is operation. This results with the water level falling into the emergency storage volume of the reservoir. This operation control is not desirable, outside of the performance criteria as set in Section 2.2.2 and demonstrates the reservoir recovery would be problematic.
- The Triangle Road PS is operating **up to 16 hours a day** with the applied additional growth. This demonstrates that the PS would have reached the performance criteria set in Section 2.2.2 while still making runtime allowance for planned or unplanned operation of the Albany or Hobsonville PS for extended periods. The remaining 8 available hours within a 24 hour period also allows for replenishment of the network reservoir during other emergency periods as well as being able to accommodate other resilience supply configurations available in the Transmission system.
- With the additional demands applied the emergency storage volume at Albany reservoir has been eroded from a previously 1.3-1.8 days storage to **below the minimum 1-day requirement**.
- Filling capacity into Albany reservoir is being impacted by Triangle Road PS, Schnapper Rock PS and peak time BSP demands meaning flow capacity continually changes throughout the day due to upstream factors. The reservoir inflow results demonstrates that the reservoir is filling up to **21 hours** (almost continually open) meaning the water level recovery is now directly linked to the pumped flow from Triangle Road pump station. The result of this is that any planned and unplanned outage to the Triangle Road pump station would have a significant impact to the reservoir time to empty when only considering gravity inflow.

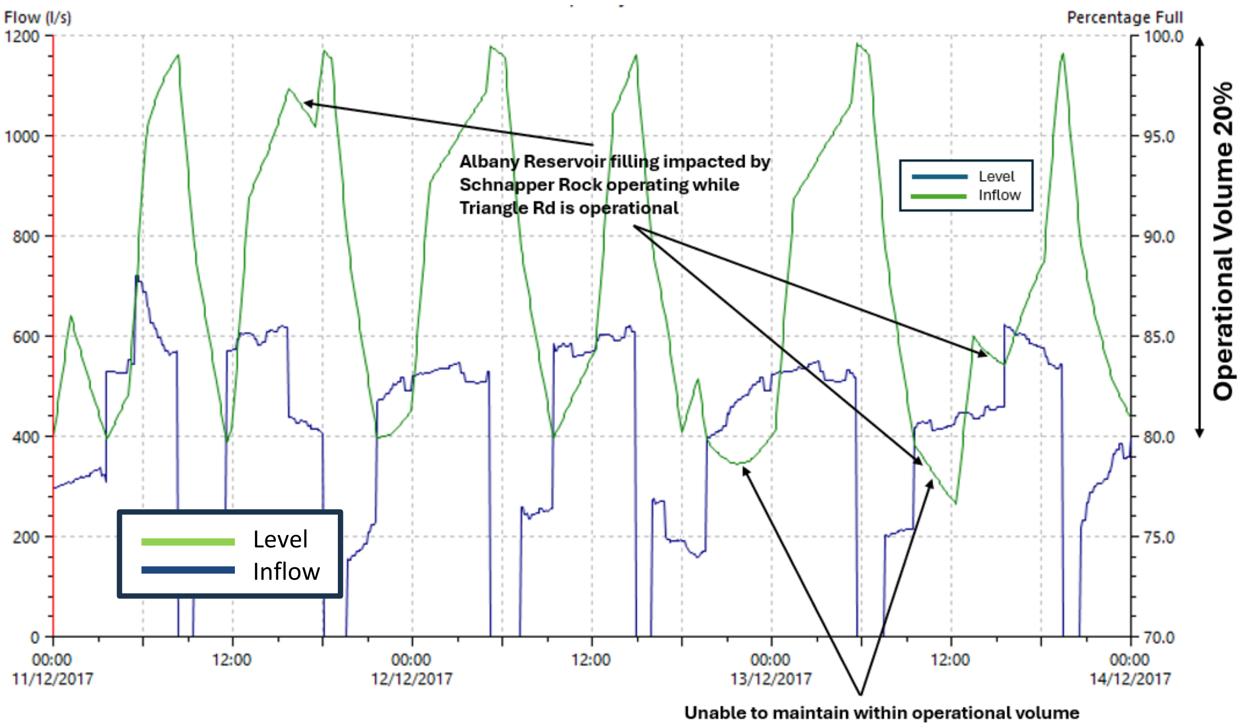


Figure 9 – Albany Reservoir Level and Inflow under theoretical maximum demand

These results demonstrate that at 91.7MLD this is considered as the maximum acceptable risk capacity for the NH1 transfer system.

4.2 Operational Modes

The NH1 can supply water to the Waitakere transmission network via the Pleasant Road (Primary Mode) or Hobsonville (Secondary Mode) pump stations, see **Figure 10**, highlighted in green. Both stations can support the Waitakere system independently or together, controlled by the Waitakere WTP and its reservoir level. Pump operation is triggered when the reservoir level drops below set trigger level, typically during peak demand or when source water from Waitakere WTP is insufficient. For the assessment the primary mode was adopted as a best case.

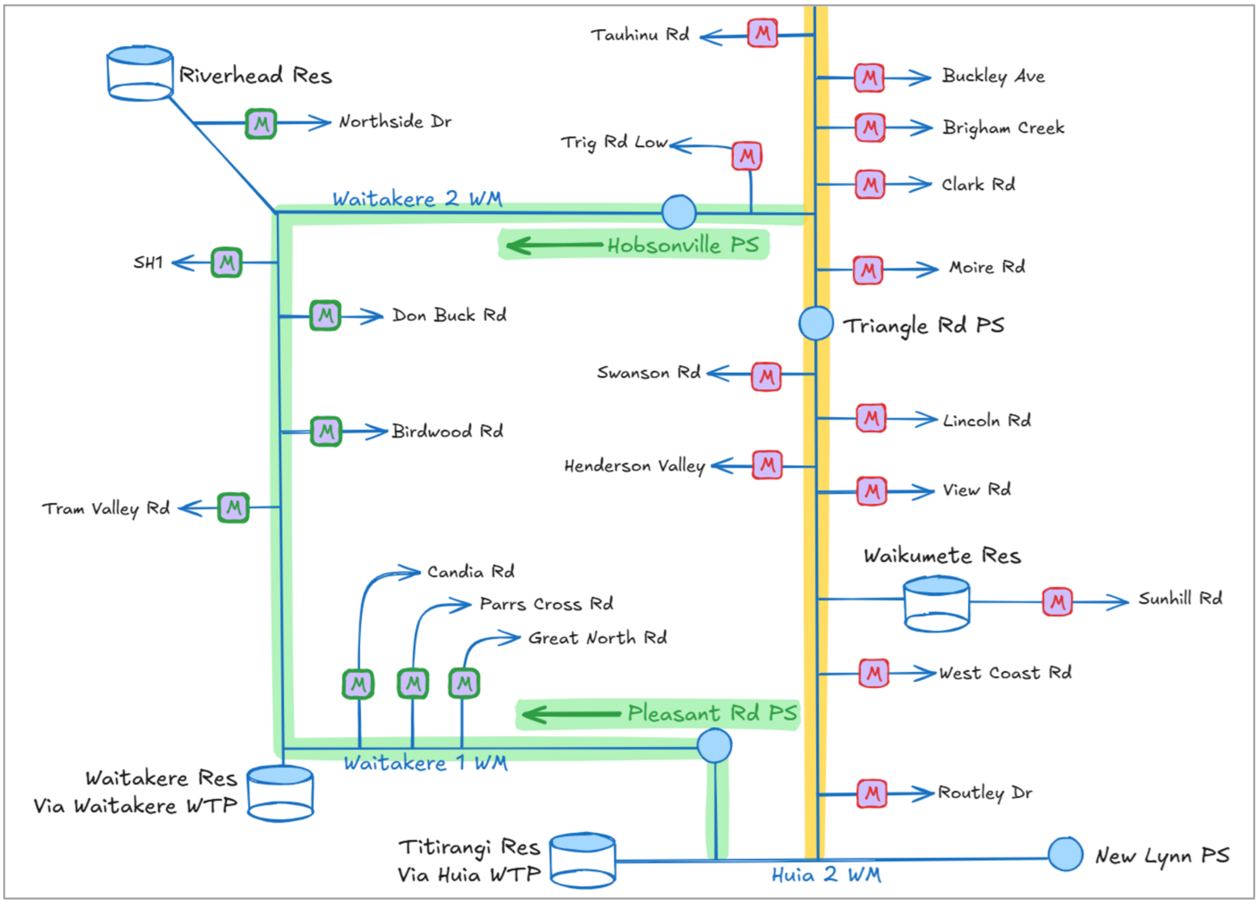


Figure 10 – NH1 supply into Waitakere system from either Pleasant Road or Hobsonville pump stations (Highlighted in Green).

4.2.1 Operational Modes Capacity Implication

The two different Operation Modes were assessed to understand the potential impact of the Hobsonville pump station operating compared to Pleasant Road pump station.

Table 1 describes an actual peak demand day on 9 March 2025. On this day the network demand in the Waitakere supply area was 19 MLD. This exceeded the Waitakere WTP's production output of 12 MLD leaving a demand shortfall of 7 MLD as summarised in **Table 2**.

Table 2 - SCADA Flow Data for 9 March 2025 Peak Summer Day

Description	Flow
Waitakere Supply Area	
Network Demand	19 MLD
Waitakere WTP Production	12 MLD
Shortfall	**-7 MLD**

Meeting the shortfall for this specific day, and any other day the Waitakere supply area's demand exceeds 12 MLD, can be done by pumping at either the Pleasant Road (Primary Mode) or Hobsonville (Secondary Mode) pump stations. The implications of each are addressed in the following two sections.

4.2.1.1 Primary Operational Mode - Pleasant Road Pump Station

In this operational mode the Pleasant Road pump station pumps water from Huia 2 Watermain into the Waitakere 1 Watermain to support the Waitakere WTP and its reservoir. The Huia 2 Watermain is supplied with water primarily from the Huia WTP with the NH1 and Pleasant Road PS being the first two offtake points. The Huia 2 watermain has a diameter of 1300mm diameter and is able to support the NH1 and Pleasant Road pump station offtakes simultaneously without affecting its hydraulic performance and supply to the downstream BSP's and Khyber Reservoirs.

During this operational mode the Pleasant Road pump station supports the Waitakere supply area with up to 10 MLD, over and above the Waitakere WTP's production output of 12 MLD. If the total demand of the Waitakere supply area was to exceed 22 MLD the Hobsonville pump station will act as "assist" to the Pleasant Road pump station which would draw from the NH1's remaining capacity headroom.

This operational mode is considered to be the Primary and preferred mode as it is hydraulicly capable to supply the initial 10 MLD Waitakere supply area support from Huia 2 Watermain, the NH1 normal demand and any additional Waitakere supply area support above that also from the NH1. Unfortunately, this operational mode was not available on 9 March 2025 to cater for this peak summer demand day.

4.2.1.2 Secondary Operational Mode - Hobsonville Pump Station

In this operational mode the Hobsonville pump station pumps water from the NH1 into the Waitakere 2 Watermain. The NH1 watermain is supplied with water from the Huia WTP and would need to support the BSP's along the route, the Hobsonville pump station for Waitakere supply area support as well as the North Shore and Hibiscus Coast demands.

On 9 March 2025 the Hobsonville pump station was required to support the Waitakere Service Area demand as the secondary operational mode due to the Pleasant Road pump station not being available. The 7 MLD shortfall as shown in

Table 2 was pumped from the NH1 into the Waitakere 2 watermain. This operational mode effectively reduced the NH1 remaining capacity headroom by 7 MLD and as it increases would affect the NH1 ability to supply into the Albany reservoirs.

4.2.2 Operational Mode Summary

NH1 remaining capacity headroom is influenced by its operational mode, as described above. The differences between the two modes are summarised below.

- **Primary Mode – Pleasant Road Pump Station**
  - Pumps from Huia 2 Watermain into Waitakere 1 Watermain to support Waitakere WTP and reservoir.
  - Huia 2 Watermain (1300 mm diameter) can supply Pleasant Road pump station and NH1 simultaneously without hydraulic issues.
  - Provides up to 10 MLD additional support to Waitakere supply area beyond the WTP's 12 MLD output up to a combined demand total of 22 MLD.
  - If demand exceeds 22 MLD, Hobsonville pump station assists by drawing from NH1's remaining serviceable capacity.
  - Preferred mode because it maintains NH1 remaining capacity headroom and optimally supports Waitakere supply area demand.

- **Secondary Mode – Hobsonville Pump Station**
  - Pumps from NH1 into Waitakere 2 Watermain, located ~15 km north along NH1 after other BSP offtakes.
  - On 9 March 2025, supplied 7 MLD shortfall from NH1 to Waitakere supply area.
  - Reduces NH1's remaining capacity headroom, which would ultimately impact supply to Albany reservoirs and North Shore/Hibiscus Coast.
  - Used only when Pleasant Road PS is unavailable; less preferred due to impacts to NH1 remaining capacity headroom.

Currently, the system is operating in the secondary configuration due to external limitations and failures, rather than its preferred primary mode. Interventions to restore the primary operational mode are underway.

4.3 NH1 Remaining Capacity Headroom

This section combines the outcomes of the sections above and presents a comparison between NH1's remaining capacity headroom (For the Primary and Secondary operational modes) against population projected growth

4.3.1 Remaining Serviceable Capacity Limits

The lower, upper demand limits, shown in MLD are described in Section 4.1 of the report. In order to plot these against the anticipated population growth the MLD demands were converted into Estimated Population (EP). The process of determining these are described below:

Description	Lower Demand (MLD)	Upper Demand (MLD)
2019/22/25 Peak Day Summers	78.4	
1-in-100 Year Drought Return Period Peak (Feb 2020)		86.0
Maximum Service Capacity	91.7	91.7
Remaining Demand	**13.3**	**5.7**

The remaining lower and upper demands can be converted to EP by using the following formula:

$$Remaining\ Demand\ (EP) = \frac{Remaning\ Demand\ (MLD)\ \times\ 1{,}000{,}000}{220\ (l/p/d)\ \times\ 1.5\ (Peak\ Fator)}$$

Using

- Watercare code of practice demand per capita of 220 litres / person / day.
- Peak Factor of 1.5.

Limit	Demand (MLD)	Remaining Demand (MLD)	Remaining Demand (EP)
Lower	86.0	5.7	**17,300**
Upper	78.4	13.3	**40,300**

The 2025 population figure for the relevant areas supported by the NH1, as per the AGS23v1.1, is 360,700 EP.

Therefore, the lower and upper capacity limits, expressed as EP can be calculated by the following formula and expressed in the table below:

$$Remaining\ Servicable\ Capacity\ (EP) = 2025\ AGS23v1.1\ Population\ (EP) + Remaining\ Demand\ (EP)$$

Limit	2025 AGS23v1.1 Population (EP)	Remaining Demand (EP)	Remaining Capacity Limits (EP)
Lower	360,700	17,300	**378,000**
Upper		40,300	**401,000**

4.3.2 Growth Limits

The lower and upper growth limits were identified by drawing on AGS23v1.1 for Medium Growth and StatsNZ's High Growth projections respectively.

The key difference between the two growth scenarios and why we use them is that:

1. The AGS is Council's scenario that assumes medium growth that follows Councils FDS and AUP.
2. The StatsNZ High figures were used to assess two aspects of the worst case expected growth, namely:
    a) What the impact of higher density developments would be if the developments were to stay inline with the FDS timing
    b) What the impact would be if the buildout density remained at a medium growth level and inline with the FDS timing but also adding additional out of sequence development areas. The additional out of sequence development would then contribute to increasing the overall number of DUE's to the high growth level when added to NH1's area of influence.
    c)

4.3.3 Remaining Capacity Headroom

The graph shown in ***Figure 11*** illustrates NH1's remaining capacity headroom under the primary system operational mode (detailed in section 4.2) against projected growth scenarios, highlighting the remaining capacity headroom. This graph feeds into Watercare's Risk Based Planning Assessment for the impact of out of sequence growth that will accompany this report. Four (4) key outcomes can be derived from the graphed information, listed from A to D and described below.

A) High Growth / Upper Remaining Demand Limit (Marked in **Purple**)
- This scenario shows that if the Stats NZ High growth rate (For combined in and out of sequence developments) is realised the NH1's remaining capacity headroom limit will be reached in 2032 before the NH2 is completion of 2034.
- The likelihood of the Stats NZ high growth being realised is low even when considering simultaneous in and out of sequence development.
- This therefore makes an appropriate upper limit Watercare is aiming to control and manage.

B) NH 2 Completion (Marked in **Red**)
- This scenario shows that if the NH2 is completed in 2034 and 1-in-100 year drought return period is experienced the same year that the NH1 would reach the lower remaining serviceable capacity limit.
- The likelihood / probability of another 1-in-100 year drought return period being experienced in the next 8 years is considered low and feeds into the risk-based planning assessment considerations.

C) Medium Growth / Upper Remaining Demand Limit (Marked in **Green**)
- This scenario shows that if the FDS timing for growth is followed the NH1 would reach its remaining capacity headroom in 2047.
- Considering this scenario an opportunity is presented to develop a risk-based planning assessment on what level of growth, outside of the AGS23v1.1 and FDS timing the NH1 could safely tolerate.

5. CONCLUSION

The assessment for the North Harbour 1 Watermain (NH1) has identified it is operating close to its level of service limits when considering capacity and risk during typical and emergency operation, with remaining headroom capacity influenced by the transmission systems operational configuration and FDS growth timing.

Under optimal conditions the NH1’s maximum acceptable risk capacity should be limited to 91.7 MLD, leaving a remaining capacity headroom of 5.7–13.3 MLD depending on observed peak demand scenarios.

The developed graph illustrates how these limits intersect with projected growth under AGS23v1.1 (medium) and StatsNZ (high) scenarios.

Key insights include:

- Under high growth and simultaneous in and out of sequence development assumptions, NH1 would reach its remaining capacity by 2032, ahead of the planned commissioning of NH2 in 2034.
- Medium, in sequence growth aligned with the Future Development Strategy extends NH1’s viability to approximately 2047 before the remaining capacity headroom is reached.

These findings underscore the importance of Watercare’s risk-based planning assessment to manage development timing and mitigate exposure to supply resilience risks. Approving out-of-sequence growth without considering these constraints could compromise Level of Service requirements, particularly for Triangle Road pump station operation, Albany Reservoir recovery and downstream supply. Timely delivery of NH2 remains critical to unlock long-term growth and maintain system reliability.

The outcome of this report does not allocate development capacity, does not override growth sequencing in the Auckland Future Development Strategy (FDS), and does not approve additional out of sequence connections. What it does do is set upper and lower limits for project growth and demand for the NH1’s area of influence, enabling Watercare to effectively assess the risk and impact of out of sequence developments on the NH1 as well as the project schedule timeframes of the NH2.

More direction on what level of out of sequence developments Watercare could tolerate is described in the accompanying Risk Based Planning Assessment covering letter that will be updated from time to time.

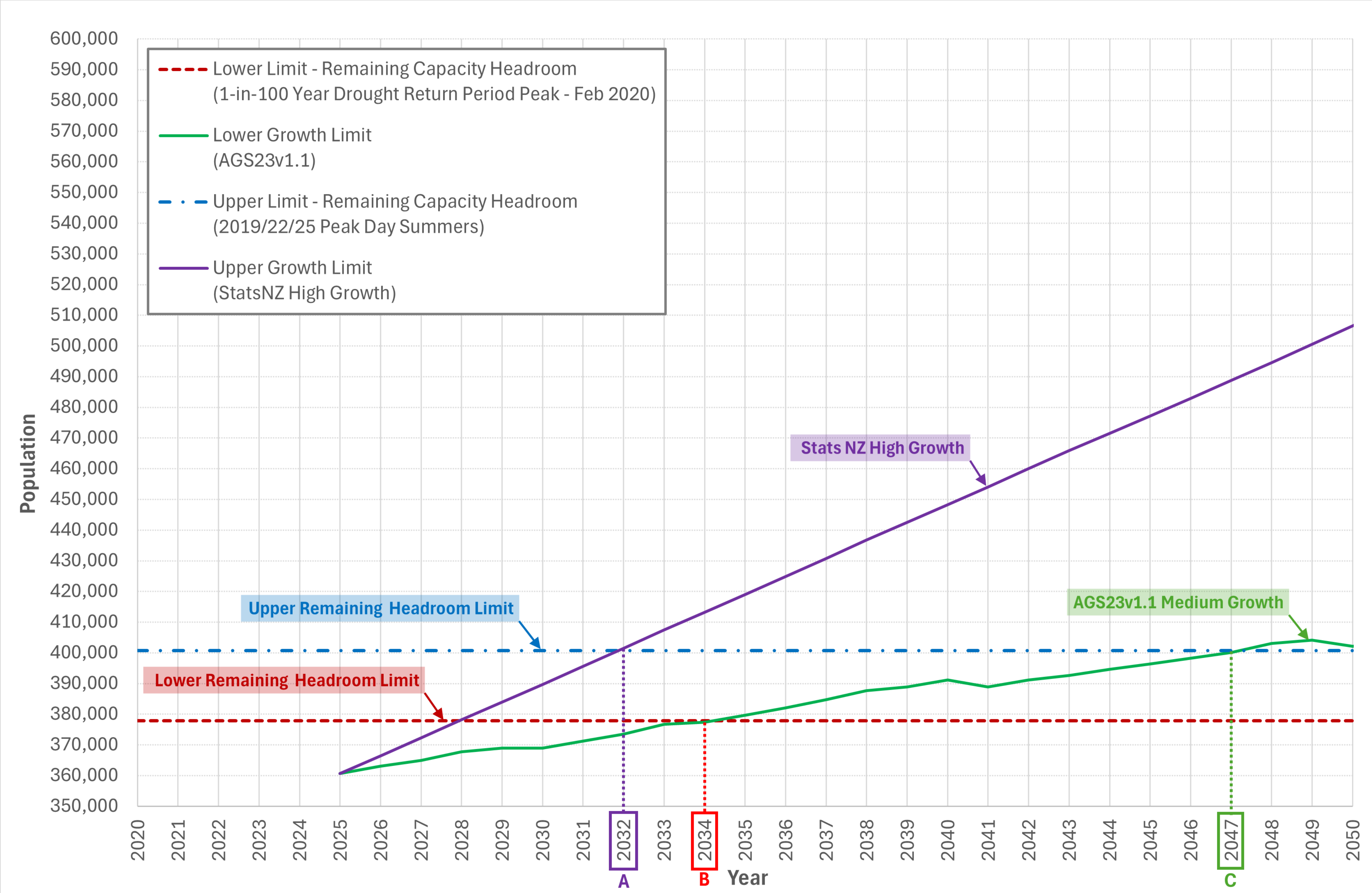


Figure 11 – North Harbour 1 Watermain | Capacity Headroom & Growth Limits

Appendix I – North Harbour 1 Watermain – Planning Assessment

17/04/2026

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To Whom it May Concern

NORTH HARBOUR 1 WATERMAIN | PLANNING ASSESSMENT

This letter considers the outcomes of the "*North Harbour 1 Watermain: Remaining Headroom and Growth Implications - Technical Assessment Report, Rev 0*" (Technical Report) and describes the planning considerations (in a spatial planning and growth projection context) used to understand how system risk escalates if growth occurs earlier or faster than anticipated in the North of Auckland.

The purpose of this letter is not to allocate water servicing capacity, and therefore it does not override growth sequencing in the Auckland Future Development Strategy (FDS). This letter references the technical conclusions of the Technical Report, but does not amend them.

The Technical Report identified lower and upper limits for the remaining capacity of the North Harbour 1 Watermain (NH1), as well as lower and upper growth scenarios for the areas serviced (***Figure 1***). This graph presents a range of options to consider in terms of the ability of the watermain to provide services during peak water use and drought situations.

For example, as described in point C) of the following section, by assuming a projected growth rate in accordance with the latest Auckland Growth Scenario (AGS23v1.1) 'Medium' growth forecast, and in line with FDS timing, the Upper Remaining Capacity Headroom limit for NH1 (servicing peak conditions) could be reached in 2047 (marked in **Green** on ***Figure 1***), while the Lower Remaining Headroom limit for NH1 (servicing drought conditions) could be reached in 2034.

This Technical Report has presented an opportunity to use scenarios to examine the implications and risk associated with growth occurring earlier than anticipated by the FDS and Auckland Growth Scenario. Watercare can then consider whether the NH1 could tolerate changes in growth patterns while still providing supply security to the existing supply zones as well as the future urban zones.

<u>Technical Assessment Report – Graph Conclusions</u>

Figure 1 identifies four key dates, marked A to D on the horizontal axis, and used below to explore the scenarios (coloured lines):

A) High Growth / Upper Remaining Demand Limit (Marked in **Purple**)
- This scenario estimates that if the StatsNZ High Growth rate is realised, the NH1's remaining upper capacity headroom limit will be reached in 2032 before the NH2 completion date of 2034.
- The likelihood of the StatsNZ high growth being realised is low and Watercare is aiming to control and manage through this risk-based planning assessment.

B) NH2 Completion (Marked in **Red**)

- This scenario estimates that if the NH2 is completed in 2034 and a 1-in-100 year drought is experienced the same year that the NH1 would reach the lower capacity headroom limit.
- The likelihood / probability of a 1-in-100 year drought return period being experienced in the next 8 years is considered low but not impossible which feeds into the risk-based planning assessment considerations.

C) Medium Growth / Upper Remaining Demand Limit (Marked in **Green**)

- This scenario shows that if the FDS timing for growth (medium growth projection) is followed, the NH1 would reach its upper remaining capacity headroom (peak flows) in 2047.
- The outcome of this scenario therefore provides opportunity to develop this risk-based planning assessment as described in section D) below.

D) Watercare Risk Based Planning Assessment (Marked in **Orange**)

- Following the determination of the lower and upper remaining capacity headroom and growth limits as described above an opportunity was identified to consider a risk-based planning assessment for tolerance of growth that is out-of-sequence with the AGS23v1.1 and FDS timing.
- The risk-based approach assumes:
    - Increased population growth in the North-West, North Shore and Hibiscus Coast development areas due to either out-of-sequence growth / higher development densities than what was planned for.
    - A three-year delay in the NH2 completion and commissioning date shifting the anticipated completion date from 2034 to 2037.
    - A 1-in-100-year drought is not experienced.
    - Average summer peak demand is experienced.
- Although the risk-based planning line is shown against the upper remaining capacity headroom limit for consistency with the Technical Report, the planning concern is not the current availability of capacity but that out-of-sequence growth materially accelerates the rate at which remaining capacity headroom is consumed. In particular, it brings forward exposure to the lower remaining capacity headroom limit and requires accepting greater operational fragility and diminished resilience while growth may continue ahead of aligned infrastructure delivery, while NH1 remains the sole transmission main.
- In the development of the Orange line Watercare has taken into consideration transmission system operational modes such that all legislated water levels of service can be maintained, including the drought management standard.
- Watercare will not allow demand to exceed the safe available capacity for provision of water.

Anticipated & Risk Based Assessment Growth

By considering the Risk Based Planning Assessment, as described in section D) above, the growth in line with the AGS23v1.1 and FDS timing in 2037 is calculated as shown in ***Table 1*** below:

Table 1: Medium Growth Projection 2037 based on AGS23v1.1 Growth

Description	2025 Existing Population	2037 Projected Population	Projected Additional (EP)	Projected Additional DUE
Anticipated 2037 AGS Growth	360,500	384,500	**24,000**	**8,000**

The additional, out of sequence / higher than planned density growth used to test system tolerance was determined by evaluating the graph, specifically the Orange, April 2026, Risk Assessment line and where it intersects the upper remaining capacity headroom line, shown in ***Figure 1***, summarized in ***Table 2*** below.

Table 2: April 2026 Risk Based Additional Demand Assessment

Description	Upper Remaining Capacity Headroom Limit	Growth Projected AGS23v1.1	Risk Based Additional Population (EP)	Risk Based Additional (DUE)
Apr 2026 Risk Assessment Line	401,000	384,500	**16,500**	**5,500**

Risk Based Assessment | Additional Growth Tolerance

From the outcomes of this risk-based planning assessment, the figures indicate that the system may be able to accommodate demand in the order of 13,500 DUEs by 2037 under the assumptions tested. This figure is derived from the sum of 8,000 DUEs arising from in-sequence growth and an assumed 5,500 DUEs used to test out-of-sequence / higher than planned density growth as shown in ***Table 3*** below. These figures represent a future risk reference point and do not represent available capacity, serviceability or support for enabling additional out-of-sequence development.

Table 3: Additional Growth Tolerance

Description	FDS Sequence Consideration	Anticipated / Additional Population (EP)	Anticipated / Additional DUE's
Anticipated 2037 AGS Growth	In-Sequence	24,000	8,000
Apr 2026 Risk Assessment Line	Out-of-Sequence	16,500	5,500
Totals		**40,500**	**13,500**

The Technical Report findings create a water planning tension that is particularly significant where multiple out-of-sequence proposals are under consideration:

- There is notional headroom at this point in time. The risk-based assessment identifies 5,500 DUEs of headroom measured to the upper limit.
- But using it is problematic. Allocating this headroom to out-of-sequence development would materially reduce the operating margin to the lower operational limit, and bring forward the timeframe of reduced margin.
- The probability is low but not negligible. The likelihood of lower limit conditions remains low, but the circumstances that would trigger them have recently occurred and are therefore not theoretical.
- The 'snapshot' is time-bound. The 5,500 figure is accurate as of April 2026 under the assumptions tested, but is susceptible to changes in (for example) weather / drought conditions, infrastructure timing, or cumulative growth from multiple out-of-sequence approvals.

Access to these 13,500 DUEs will be governed by the policy positions and approvals set by Watercare and Auckland Council, ensuring alignment with established requirements and procedures. The 13,500 DUE figure is referenced here solely as a risk-based sensitivity outcome rather than an indication of available or unconditional serviceable capacity.

<u>Future Considerations</u>

This risk assessment will be reviewed from time to time after the date of issue and if needed be republished, replacing all/any preceding published letters. The review will, amongst others, consider the following aspects:

- Actual demand and population increase in the NH1 areas of influence.
- Private Plan Changes and Fast Track (and other) Resource Consents that have been approved since the issuing of the letter.
- Changes to the NH2 WM Project's delivery timeframes.
- Short to medium term weather and rainfall forecasts that could signal approaching drought conditions.

<u>Conclusion</u>

The analysis in the Technical Report identifies a number of concerns from a water network planning perspective:

- Measured headroom of 5,500 DUEs to the upper headroom limit, but this headroom would be consumed by out-of-sequence development and increased development densities beyond the levels planned for, materially reducing the operating margin to the lower operational limit and bringing forward the timeframe during which the system operates with constrained margin.
- While the probability of lower limit conditions remains low, the real-world circumstances that would trigger such conditions have recently occurred and are not negligible. Allocating headroom to out-of-sequence development would be a planning choice that increases exposure to these conditions in the near term and narrows the tolerance window.
- Multiple out-of-sequence approvals would consume this headroom cumulatively, with compounding effects on system tolerance and operating flexibility.

There is therefore risk in approving any out-of-sequence development. Watercare reserves the right to revisit and amend this risk-based assessment in response to emerging or immediate constraint conditions in the Watercare Water Supply System. Nothing in this letter should be interpreted as confirming the availability, serviceability or appropriateness of enabling additional development ahead of the delivery of the NH2.

Unless updated earlier, this letter expires 12 months after publishing and should not be relied on after that without an update being sought from Watercare.

Nga mihi

Tim Scheirlinck

Head of Water Planning
Watercare Services Limited

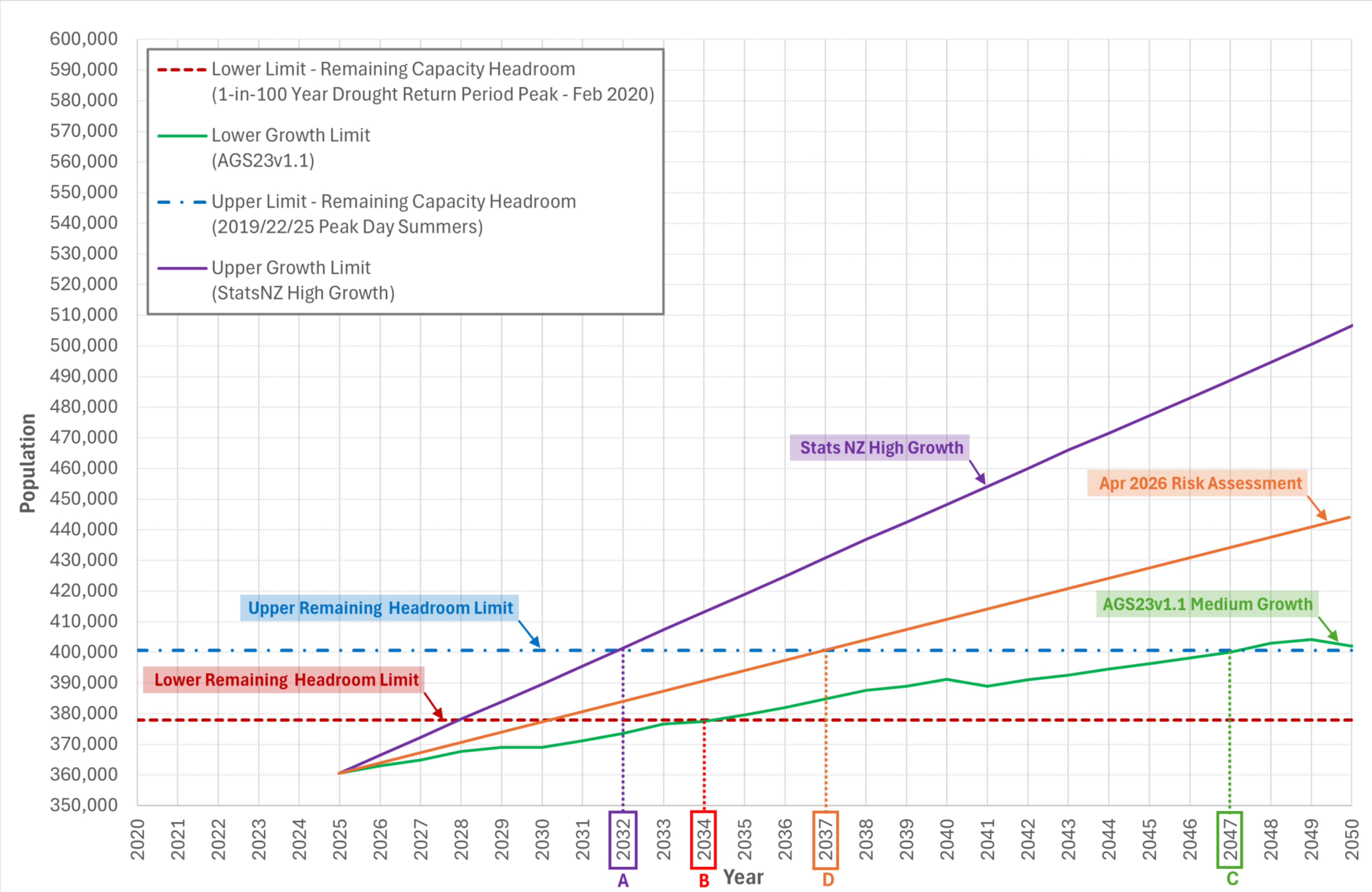

Figure 1 – North Harbour 1 Watermain | Capacity Headroom & Growth Limits

Appendix J – External Road Upgrade Plans

(bound separately)