Kainga Ora – Homes and Communities

6 Teitei Drive, Ohakune

Engineering Services Report

220528_Rev.2
4 July 2023

Kainga Ora – Homes and Communities

6 Teitei Drive, Ohakune

Engineering Services Report

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1. INTRODUCTION

Cheal Consultants Limited (Cheal) has been engaged by Kainga Ora – Homes and Communities (Client) to produce an engineering services report for a proposed residential subdivision which will subdivide an existing parcel of land into a total of 46 residential allotments plus lots for public access and stormwater management (Stage 1) and a balance lot for future development located at 6 Teitei Drive, Ohakune.

The proposed development site is located at the southwest end of Teitei Drive, off Rangataua Road (State Highway 49), approximately 500 metres southeast of the Ohakune town centre.

The site proposed for future residential lots consists of 9.54 ha of land, designated as Lot 2 DP 54909.

This report summarises the findings of service investigations carried out on site and details the constraints and proposed solutions to enable the development to be implemented successfully, as based on Cheal's Scheme Plan 220528-SC002 Rev.D, dated 01/06/23 (see Appendix 1). This will form an integral part of the Assessment of Environmental Effects to be included with the Resource Consent application to Council.

2. SITE DESCRIPTION

The site subject to the proposal is 6 Teitei Drive, Ohakune. The site is identified in Figure 1 below.

Figure 1 – Site Location (Source: Ruapehu District Council Intramaps)

The site consists of gently sloping country from northeast to southwest. The land is all in pasture with no dwellings and/or associated rural outbuildings. There is one road access, from Teitei Drive to the north.

Two drains, one from Turoa Village to the east and one from State Highway 49, traverses through the site from east to west and along the northern and western boundary, respectively, to a tributary to the Mangawhero River. Mangateitei Stream runs west, north of State Highway 49.

The surrounding area is predominantly characterised by residential properties to the east and north, and a rural area to the west and south. The land is located in the residential zone as per the Ruapehu District Council (RDC) District Plan.

3. GEOTECHINICAL CONTEXT OF THE SITE

A specific Geotechnical Investigation Report has been carried out for the proposed subdivision. Please refer to CMW's Geotechnical Interpretative Report, dated 17 February 2023. The Geotechnical Investigation Report is to be included in a separate cover of the Subdivision Consent Application.

This investigation has determined that the site is classified as TC2 according to the MBIE Canterbury Rebuild Guidelines. The site has a minor risk of liquefaction during a ULS case, and these will require specific parameters to be met or engineering design for foundations.

The Slope Stability Assessment has determined that earthworks localised setbacks are required for lots adjacent to drains.

4. EARTHWORKS

4.1. Overall

The proposed earthworks of this subdivision are to provide road corridors, access, building platforms, overland flow paths, stormwater ponds and amenities for 46 new lots.

These works are proposed to be undertaken in accordance with Horizons Regional Council (HRC) One Plan, Rule 13-2 '*Large scale land disturbance, including earthworks*'.

Please refer to Section 9 Foundation Recommendations of the Geotechnical Interpretative Report included in the Subdivision Consent application, for any further analysis and testing required.

It is proposed that this land modification will comprise of topsoil strip and stockpile, bulk earthworks, cut to waste, cut to fill, imported fill and topsoil respread. Refer to drawings 220528–201 to 204 for the overall earthworks to be completed during the 2023/2024 earthworks season. Table 1 provides a summary of the proposed earthworks.

Table1: Earthworks Area and Cut/Fill Volumes

Item	Value
Cut Volume (Adjusted)	1731 m^3
Fill Volume	16218 m^3
Net Volume (Adjusted)	14488m^3
Total Bulk Earthworks Area	38120 m^2

4.2. Topsoil

Topsoil was generally encountered to a depth ranging between approximately 300 mm and 400 mm below the existing ground surface. The majority of this material will be respread back onto the residential sites, road berms and stormwater pond areas. The remaining topsoil will be stockpiled or disposed of offsite on completion of the earthworks.

4.3. Earthworks

As discussed in Section 4.1 of this report, it is proposed to undertake bulk cut and fill earthworks as part of the proposed subdivisional earthworks. Fill depths of up to approximately 2.3 m are proposed within the low-lying parts of the site and cut depths of up to approximately 1.7 m.

4.4. Earthworks Considerations

4.4.1. Site Preparation

Prior to the cut to fill operation commencing, the earthworks areas will be stripped of topsoil material, this topsoil will be stockpiled onsite. Any unsuitable materials will then be removed.

It is recommended that any fill material placed at the site be placed in accordance with the general requirements described in NZS 4431: 1989; Earth Fill for Residential Development and in accordance with the recommended fill specification presented in the Geotechnical Report under separate cover.

4.4.2. Under Fill Drains

It is required that under fill drains be installed where seepage is encountered or as directed by the site engineer. When installed, under fill drains shall discharge to existing watercourses onsite in a controlled manner to prevent any potential erosion.

4.4.3. Compaction Criterion

Fill shall be placed in accordance with the requirements described in NZS 4431:1989, Earth Fill for Residential Development. It is required that the proposed fill placement be certified by a suitably qualified professional engineer to confirm that it has been placed in accordance with the above requirements.

4.4.4. Bulking Factors

A compaction factor of 85 % from solid cut to solid fill, and a bulking increase factor of 30 % from solid cut to loose spoil have been adopted for this design. These factors do not allow for wastage or unsuitable materials.

All of the fill material for the proposed fill earthworks at the site will be borrowed from cut earthworks.

It is recommended that a suitably qualified professional engineer be engaged to inspect any undercutting of recent sediments and topsoil in order to confirm that the subgrade is founded in competent natural ground.

4.4.5. Contaminated Land Requirements

The subject site is contained within the Residential Zone. In determining whether the subject site is a 'piece of land' under the NESCS, a search was undertaken of the property file in accordance with Section 6(2) of the NESCS and sought comment from both the Ruapehu District Council and Horizons Regional Council. Both Councils have advised there is no record of any NESCS activities having been undertaken on the site.

Given the above, it is considered that the site or any specific area is not considered a 'piece of land' under the NESCS and therefore the NESCS does not apply and further assessment or consent under the NESCS is not required. Furthermore, it is considered highly unlikely that there will be a risk to human health as a result of the proposed subdivision.

4.4.6. Earthworks Completion

A Geotechnical Completion report will be undertaken following completion of earthworks within each stage. This will certify that fill placed on building sites complies with appropriate building standards and specify if any specific engineering design will be required for the construction of dwelling within the development.

5. SEDIMENT AND EROSION CONTROLS

5.1. General

Earthworks for the development will include cut and fill operations to form roads and associated rights-of-way and a stormwater management pond.

Sediment and erosion controls will be required for the earthworks to prevent the discharging of sediment laden runoff to the receiving environment. These controls will consist of sediment retention ponds, silt fences (where necessary), compacted earth bunds, dirty water channels and decanting earth bunds as required, all constructed in accordance with Waikato Regional Council Erosion and Sediment Control '*Guidelines for Soil Disturbing Activities*'. An Earthworks consent is required to be obtained from Horizons Regional Council (HRC).

Sediment and erosion control required for the subdivision infrastructure works will be installed and maintained for the duration of the infrastructure activities associated with the development in accordance with the consents.

Landscape planting is proposed throughout the development, and it is intended for these plans to be provided with the engineering approval plans.

5.2. Objectives

The main rationale and objectives for the ESCP are:

- To minimise disturbance to areas where erosion may occur, including any exposed land.
- To minimise the extent and duration of works on the site, including temporary stockpiles, and to ensure revegetation can occur in a staged manner, so as to reduce the risk of silt/sediment running off the site and entering the downstream receiving environment.
- To install perimeter controls such as diversion drains, silt fences and construction entrances to prevent sediment leaving the site.
- To provide sediment removal devices to minimise the amount of sediment laden runoff leaving the site.
- To ensure exposed areas are stabilised as soon as practicable by sowing or mulching to prevent erosion.
- To provide guidance in case of unforeseen events including poor weather.
- To ensure all control measures are inspected and repaired after storm events.
- To ensure that the site is rehabilitated prior to the removal of sediment control measures.
- To mitigate dust emissions from the site during earthworks and clean filling so as not to adversely affect any nearby properties.
- To minimise potential environmental effects.

5.3. Sediment and Erosion Control Measures

The proposed sediment and erosion control measures for the general earthworks are shown on drawings 220528-210 to 212 in Appendix 2.

The site development catchment's primary control measure will be one sediment retention pond and two DEBs, one for the Teitei Drive entrance area and one off the western end of Road B.

5.3.1. Development Catchment

Covering an area of 37,000 m^2, the catchment will be managed by SRP-1 with storage capacity of 1140 m^3 (300m^3/hectare). SRP-1 will be located in the balance land and to be constructed utilising the proposed stormwater pond. A series of clean water and dirty water diversion bunds and silt fences will be placed along the perimeter and within the site. It is proposed for the treated runoff to flow into the existing waterway/drain at the western boundary of the existing lot.

5.3.2. Teitei Drive Street Entrance Catchment

Covering an area of 1300 and 430 m^2, decanting earth bunds (DEB) of 26 m^3 and 8.6 m^3, should be constructed for the entrance to the proposed development and the western end of Road B respectively, as per calculated considering a site slope less than 10% and a length of less than

200 m, therefore a contributing percentage of 2% is used (20m^3 for each 1000m^2 of contributing catchment). The footprint area will suit the specific site conditions.

A stabilised site entrance, filter sock and silt fences will be required to ensure that any sediment will be minimised leaving the site.

5.3.3. DEB Variations

DEB's covering an earthworks area of 1,500m^2 can be controlled by a DEB with a volume of 45m^3. It will be up to the approval from the contract engineer prior to the construction and placement of any further DEBs apart from the one indicated on drawing 220528-210 and 211.

6. STORMWATER

The proposed subdivision will lead to an increase in stormwater runoff from the land, with the potential to cause effects downstream of the site.

Management of the stormwater runoff within the site will be via a Primary Reticulation System for a 10-yr ARI storm and Secondary Overland Flow for a 200-yr ARI storm as per NZS 4404:2010, RDC and HRC guidelines.

Horizons One Plan Policy 9-2 generally discourages new habitable buildings or extensions to existing habitable buildings in areas that are likely to be inundated during a 0.5% AEP flood event. Where the flood hazard cannot be avoided, Policy 9-2 states that the risk must be mitigated. Flood mitigation for habitable dwellings (including attached garages) includes having a finished floor level that includes reasonable freeboard of 500mm above the 0.5% AEP flood surface and ensuring that there is safe access to and from the property during a flood event. Reasonable freeboard is considered for habitable dwellings to be 500mm as per New Zealand Standard 4404:2010 – Land Development and Subdivision Infrastructure. This freeboard requirement is to account for factors which cannot be included in the model, such as waves and debris effects. If the water flow paths cannot be avoided, then Horizons recommends that the finished floor levels for habitable dwellings to be elevated to 500mm above the 0.5% AEP surface.

Safe egress and access will need to be easily achieved for habitable dwellings and workplaces. Access between habitable structures and an identified safe area, where safe evacuation may be carried out (preferably ground that will not be flooded), must be a safe wading zone in a 0.5% AEP flood event. This would normally be an access way that would not be covered by more than 0.5 m of water in a 0.5% AEP flood event, but the depth of the water will vary depending on the speed of the flood flow.

The finished floor level needs to be based on the original ground level prior to any land disturbance works.

Please note that as per the Standard, reasonable freeboard for a commercial and industrial buildings is a minimum height of 300 mm and reasonable freeboard for non-habitable residential buildings and detached garages is a minimum height of 200mm.

Horizons can provide information on the level of inundation and recommended freeboard based on NZS 4404:2010 and Policy 9-2, however it is Ruapehu District Council as the Building Consent Authority that makes the decision on appropriate freeboard and finished floor levels.

Care will need to be given when elevating the building platforms to mitigate the flood waters as this potentially could exacerbate flooding on neighbouring properties.

6.1. Existing Catchment

The site, which is currently rural pasture, is currently connected to the public stormwater system via open channels which then discharge to the Mangawhero River approximately 4 km to the west.

The existing catchments consist of 17.5 ha and 25.7 ha for the northern and southern catchments respectively, of rural pasture and grass cover on a mixture of heavy clay and medium soakage soil types and therefore has a catchment characteristic (C)of 0.35 as per an average of the NZBC E1/VM1 Table 1 catchment characteristic values.

6.2. Stormwater Conveyance Design

Stormwater conveyance infrastructure design has been completed to a level so that confirmation can be provided that the development can be adequality serviced in accordance with NZS 4404:2010. Stormwater Layout Plans 220528–601 to 603 can be found in Appendix 3.

Stormwater design guidelines from the New Zealand Building Code (NZBC) E1 Surface Water will be utilised where stormwater design criteria are not specified in NZS4404:2010.

6.3. Stormwater Model

The goal of the stormwater calculations and modelling was to limit the discharge from the proposed development to existing stormwater discharges for the 10 yr and 100 yr ARI storm events to comply with NZS 4404:2010 and to maintain hydraulic neutrality for the 200 yr ARI storm event as per the RDC District Plan and HRC's One Plan.

6.3.1. Rainfall Data

Stormwater flows for primary piped systems use a rainfall data from a 10-year storm, and overland flow rates (secondary flow) adopt rainfall data from the 200-year storm events, as specified in the RDC District Plan and HRC's One Plan.

Rainfall tables from HIRDSv4 has been used for present data to determine the existing rainfall runoff.

6.3.2. Climate Change

An increase in precipitation of 16.8 % has been calculated for the area as per the Ministry for the Environments '*Preparing for Climate Change: A guide for Local* Government' 2008.

6.3.3. Proposed Catchments

Detention Basin Catchment
The detention basin(s) catchment will consist of:

- A proposed residential development of 9.54 ha.

The Ruapehu District Council District Plan limits the building area to 35 % of lot area and therefore it is assumed that the amount of imperviousness for the lots will be limited to 50 % of the gross area. Therefore, this will give a C value of 0.55 as per NZBC E1/VM1 Table 1.

6.3.4. Detention Requirements

The calculations in Appendix 4 show that the following detention volumes were required to limit discharge to the existing catchment discharges for the 10- and 200-year storm events.

A detention basin with average dimensions of 50 m long x 20 m wide x 1.5 m deep will be required to limit off site discharge to a predevelopment rate.

Also refer to the Morphum Environmental memorandum dated 17 May 2023 in Appendix 5 regarding the assessment on the presence and status of any wetlands and potential stormwater options to address potential freshwater impacts at the development.

Table 2: Stormwater requirements for detention and discharge

	10 yr ARI storm		200 yr ARI storm	
	Detention m^3	Discharge ls^{-1}	Detention m^3	Discharge ls^{-1}
Subdivision requirement	1040	251	1560	625

6.4. Proposed Primary Flow Piped Infrastructure

It is proposed to construct a stormwater pipe network collecting run-off from roads and lots and convey this stormwater to the stormwater detention basins.

6.4.1. Stormwater Pipes

Stormwater design for pipe gradients will generally adhere to NZS 4404:2010

Pipes of DN300 and DN600 mm are proposed typically at 0.70 % to 1.70 % grade.

6.4.2. Stormwater Manholes

All proposed stormwater manholes in are reinforced concrete DN900 – DN1050 depending on depth and will have scruffy dome lids.

6.4.3. Stormwater Wingwalls

All proposed stormwater wingwalls in are reinforced concrete 300 or 600 series wingwalls.

6.4.4. Stormwater Swales

All swales shall have minimum section slopes of 1V:5H and shall be designed to convey the 1 in 10-year ARI storm event, they shall be suitably grassed/vegetated and stormwater velocities shall be limited to 0.5 ms^{-1} to ensure that erosion does not occur.

Construction details of the swales, vehicle crossings and detention ponds will be provided with Engineering Plans for approval.

6.5. Secondary Overland Flow

Overland flow through the site will primarily be via the proposed roading network. In a 200-year storm event or greater the site will form one catchment with overland flow paths (OLFP) exiting the site via the outlets from the detention basins and primarily from Road D, into the existing central drain.

6.5.1. Flow Calculations

Cheal Consultants Ltd has undertaken a study on the flooding potential as part of this development application. These flow calculations are contained within Appendix 4 of this report.

6.5.2. Onsite Flood Potential

A Hydrology Assessment completed by Cheal Consultants dated 8 March 2023, shows the flooding for critical storm events and can be found in Appendix 6.

Overland flow from the contributing catchments can reach the roading network, via runoff from the lots directly to the roads. This roading network will act as a flow path and divert runoff away from the lots and roadways, generally west towards the existing waterway/drain.

Once the flow has reached the detention basin the flood levels will be controlled by the basin outlet structures. Once the basin/s have obtained maximum levels the roading layout will act as the primary conduit for any further flooding.

6.5.3. Floor Levels

As the residential properties are not subject to flooding or an overland flow path, E1/AS1 of the Building Code outlines acceptable solutions to mitigate surface water. Section 2.0 of the Code sets out the requirements for minimum acceptable floor levels. The building platforms for the lots are proposed to be 500 mm higher than the 1 in 200-year flood levels and will be supplied at engineering plan approval stage.

Horizons Council have provided flood modelling depths within the site (refer to Hydrology Assessment - Appendix 4), and these are primarily the existing open channel drains. Once earthworks and the new stormwater infrastructure has been put in place the 200-year flood level is not seen as an issue with respect to this site.

7. WASTEWATER

NZS 4404:2010 outlines wastewater generation constants which are tabulated below:

Table 3: Wastewater generation constraints

Average dry weather flow per person	250 l/d/p
People per dwelling	3.5
Diurnal peaking factor	2.5
Dilution/infiltration factor	2.0

The development is ultimately to provide residential house lots. The wastewater reticulation system has been laid out such that gravity flow is achieved for all lots and individual pump stations will not be required (see plans attached in Appendix 3).

The sewer line servicing 46 lots will discharge to a proposed pump station. RDC have engaged Mott McDonald to carry out a Static Capacity Assessment of the Ohakune Wastewater Network and this report has been provided to Cheal (Appendix 7), the report has stated that given certain upgrades to some of the existing infrastructure within the network, there is enough capacity in the line to connect these development. In the meeting between Council, Cheal and Kainga Ora, it was confirmed by Council that there is enough capacity for development of Stage 1.

Using the figures above, the 46 lots produced a peak development flow of 2.4 litres per second (refer to wastewater calculations in Appendix 8).

8. ROADING

8.1. Road Layout

8.1.1. Public Roads

Road A, the access off Teitei Drive, will have a road reserve width of 18 m, a footpath either side, a swale on one side for stormwater and a 7.0 m wide carriageway. Roads B, C and D will have a road reserve width of 14 m, a footpath on one side, a swale on one side for stormwater and a 6.0 m carriageway. Road E will have a road reserve width of 12 m, a footpath on one side, a swale on one side for stormwater and a 6.0 m carriageway.

The road carriageways will have single 3% cross fall with flush concrete beams sides.

The proposed typical cross-sections can be found in Isthmus' Concept Master Plan dated 19 May 2023 and the road layout can be seen on the plans attached in Appendix 3.

Connectivity to the adjoining land to the south is provided by the creation and vesting of a lot for Roads A and D.

8.1.2. Street Signs

Street signage and marking will be required as new public roads are being formed. Designs shall satisfy the Land Transport Rule (Traffic Control Devices (2004) and link traffic sign specification, and the NZTA '*Pedestrian planning and design guide*'.

8.2. Pavement Design

From the Geotechnical Investigation Report it was anticipated that the majority of future pavement will be over SILTs and SANDS.

The California Bearing Ratio (CBR) available for the road/ pavement has been correlated using DCP blow counts from five tests performed over the proposed development in the geotechnical investigation. Following the recommendations based on the DCP testing, a preliminary design CBR of 5 has been used.

Sealing will be 25mm thick asphaltic concrete or two chip seal and it is expected that the basecourse will be 100 mm of GAP40/M4 over a 250 mm layer of subbase. Any contaminated soils encountered in the subgrade will likely be either removed or replaced with clean fill or suitably approved granular material. Council will be involved with the treatment methods selected should it be necessary.

For private access and vehicle crossings the basecourse will be 100mm of clean good quality GAP 40/M4 or 125 mm concrete, over a 150 mm layer of GAP60.

In-situ CBR and/ or DCP testing should be undertaken once the foundation subgrade has been exposed to confirm the available CBR across the site. Localised soft or weak spots should be remediated by either excavation and recompacting or replacement with suitably compacted granular material.

9. WATER SUPPLY SERVICING

Assessment of the water reticulation, by RDC, identified that the existing 100 mm diameter watermain was sufficient to ensure firefighting flows and water pressure are maintained through the subdivision and surrounding residential areas. In discussions with Council, it was suggested a 125 mm internal diameter pipe would be required in Road A, connected to the existing 100mm uPVC watermain in Teitei Drive. Refer to Mott MacDonald's '*Technical Memo: Ohakune Township Water Supply Network Model*', dated February 2022 with regards to sufficient capacity being available for the proposed development (in Appendix 9).

For the 46 lots to be serviced, a 125 mm diameter PE pipe will be laid along one side of Road A, within the subdivision. This will provide potable water and firefighting supply and has been recommended as appropriate by RDC. The 125 mm diameter watermain will reduce to 100 mm and 63 mm pipes along the rest of the roading network.

Hydrants are proposed at spacings which comply with the requirements of NZS 4404:2010, section 6.3.15 and SNZ-PAS 4509-2008 Fire Service Code of Practice. Hydrants shall be placed to provide firefighting coverage within 125 m of any fire risk on the lots as required.

The schematic water reticulation layout for this development is shown on the Water Reticulation Layout Plans attached in Appendix 3.

The 150 mm and 100mm diameter main pipes shall be PE100 SDR13.6 PN12.5. All 63 mm diameter rider mains shall be MDPE PE80 PN12.5.

Where pipes are laid in curves the minimum deflection requirements as per NZS 4404 manufacturer guidelines will be met and the pipe joints will be braced against the trench wall. Where minimum deflections will be exceeded, factory fabricated bends will be used, with thrust blocks as per NZS4404 clause 6.3.12.11.1.

All proposed public water reticulation laid within private land will be protected by easements in favour of Council. Easements over mains in ROWs will cover the entire ROW width.

10. POWER AND TELECOM SERVICING

Power and telecommunications will be provided to all lots, laid in a common services trench as shown on the Drawings.

Power and telecommunications designs have not yet been engaged; it is expected that when resource consent is granted the design will be required to providers. However, both companies have confirmed they have capacity to service the subdivision. Design and extension of these services should be no issue with completing the required extensions.

Letters of design have been provided in Appendix 10 and confirmation of capacities and designs will be provided prior to Engineering Approval application.

11. STREET LIGHTING

The street lighting is proposed to continue along the local street. However, we will discuss the specific streetlight type and location to be acceptable by RDC. It is not anticipated that the private accesses will be fitted with street lighting.

Detailed design will be submitted to Council for approval prior to construction and shall be in general accordance with AS/NZS 1158.1.1:2005.

12. DISCLAIMER

This Report has been prepared solely for the use of our client with respect to the particular brief given to Cheal Consultants Limited (Cheal).

No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this Report are the result from the application of accepted industry methods of site investigations.

If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred back to Cheal immediately.

CHEAL CONSULTANTS LIMITED
4 July 2023

Appendix 1

Scheme Plan
220528-SC002 Rev B

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NOTES:

Warning:
This plan has been prepared for the purpose of a resource consent application only. It is not a precise survey plan. As areas and dimensions are likely to vary upon survey it should not be attached to any sale & purchase agreements without an appropriate condition to cover such variations. The information hereon shall not be passed on to any third party without the express written permission of Cheal Consultants Ltd. In the event of this information being passed on to a third party, even with written permission, or the information being used for any other purpose than discussion, Cheal Consultants Ltd take no repsonsibility for its correctness and subsequent use.

Aerial Imagery has been obtained from:
LINZ Data Service and is provided under a Creative Commons Public License. It has been provided as a guide to where the boundaries are positioned, or proposed on the ground, but may not be absolute.

Boundaries are sourced from Landonline.

Areas and dimensions are subject to LT Survey.

Owner: Waimarino District Council
Computer Freehold Register: WN24D/752
Title Area: 9.4536ha

Rev	Date	Amendment	By	Chk	App
D	01/06/23	Area Fixes	AJW	SP	SP
C	29/05/23	Layout Changes	AJW	DS	DS
B	27/04/23	Road Changes	AJW	DS	DS
A	31/03/23	First Issue	AJW	DS	DS

Project Title

Kainga Ora -
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Proposed Subdivision of
Lot 2 DP 54909
Stage One

Surveyed			
Designed			
Drawn	A.White	31/03/23	AJW
Checked	D.Sherrit	31/03/23	DS
Approved	D.Sherrit	31/03/23	DS

Status **RESOURCE CONSENT**

Scale A1
A3 1:1000 | A3

Drawing Number
220528-SC002

Rev
D

C:\Workspace\data\CHEALSVR\220528 - Kainga Ora - Homes and Communities_32287\CAD\12D\Stage 1 Scheme and LT.12dmodel Thu Jun 1 09:52:42 2023

Appendix 2

Sediment & Erosion
Control Plans
220528-210 to 212
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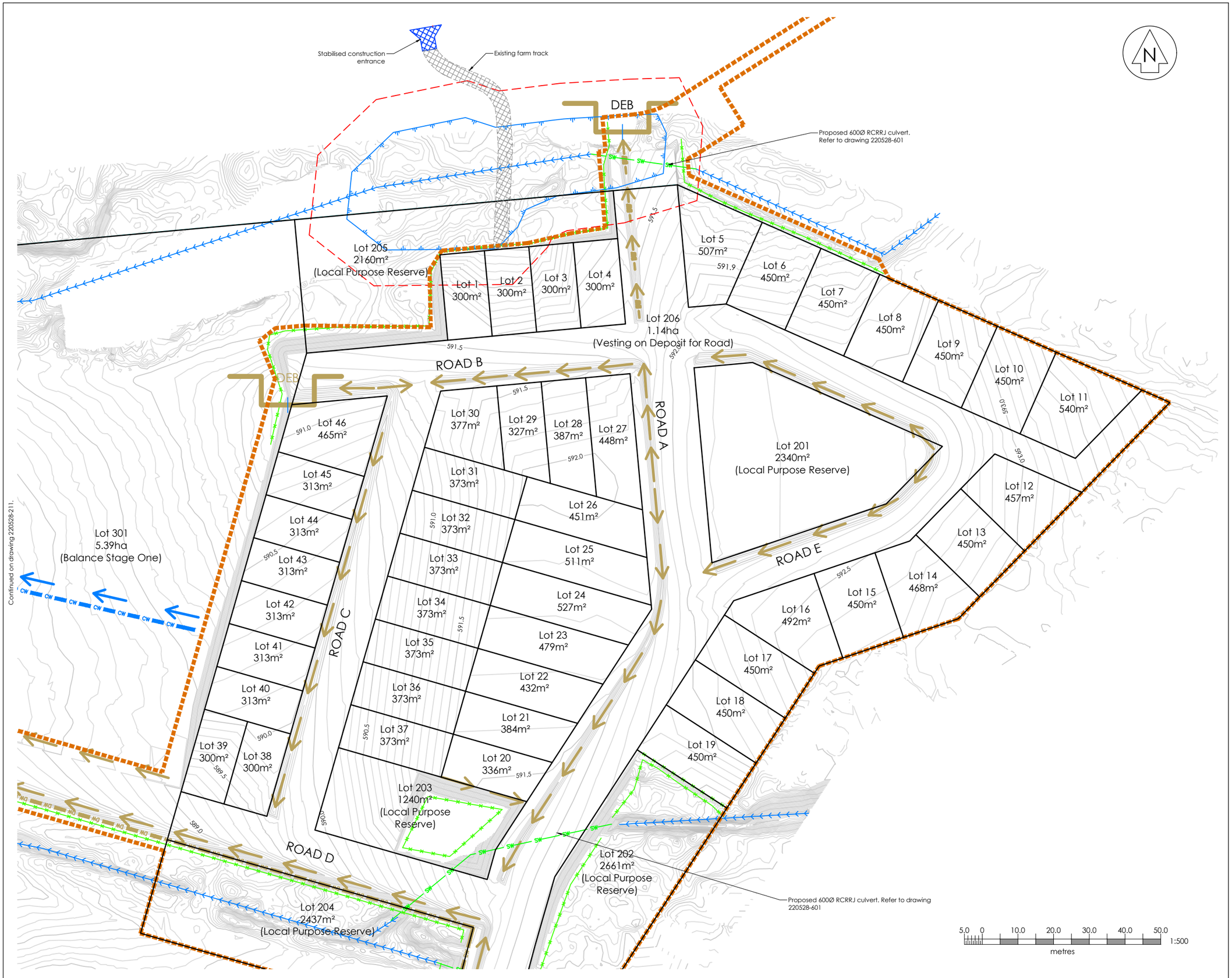

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NOTES:

1. All work shall be done in accordance with the Ruapehu District Council Code of Practice.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Waikato Regional Council Erosion and Sediment Control - "Guidelines for soil disturbing activities".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Stage 1 (Extent of Works)
- Clean water flow
- Clean water diversion bund
- Dirty water flow
- Dirty water diversion bund
- Silt fence/ Super silt fence
- Decanting earth bund
- Proposed stormwater culvert
- Existing stormwater drain
- Extent of assessed wetalnd
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

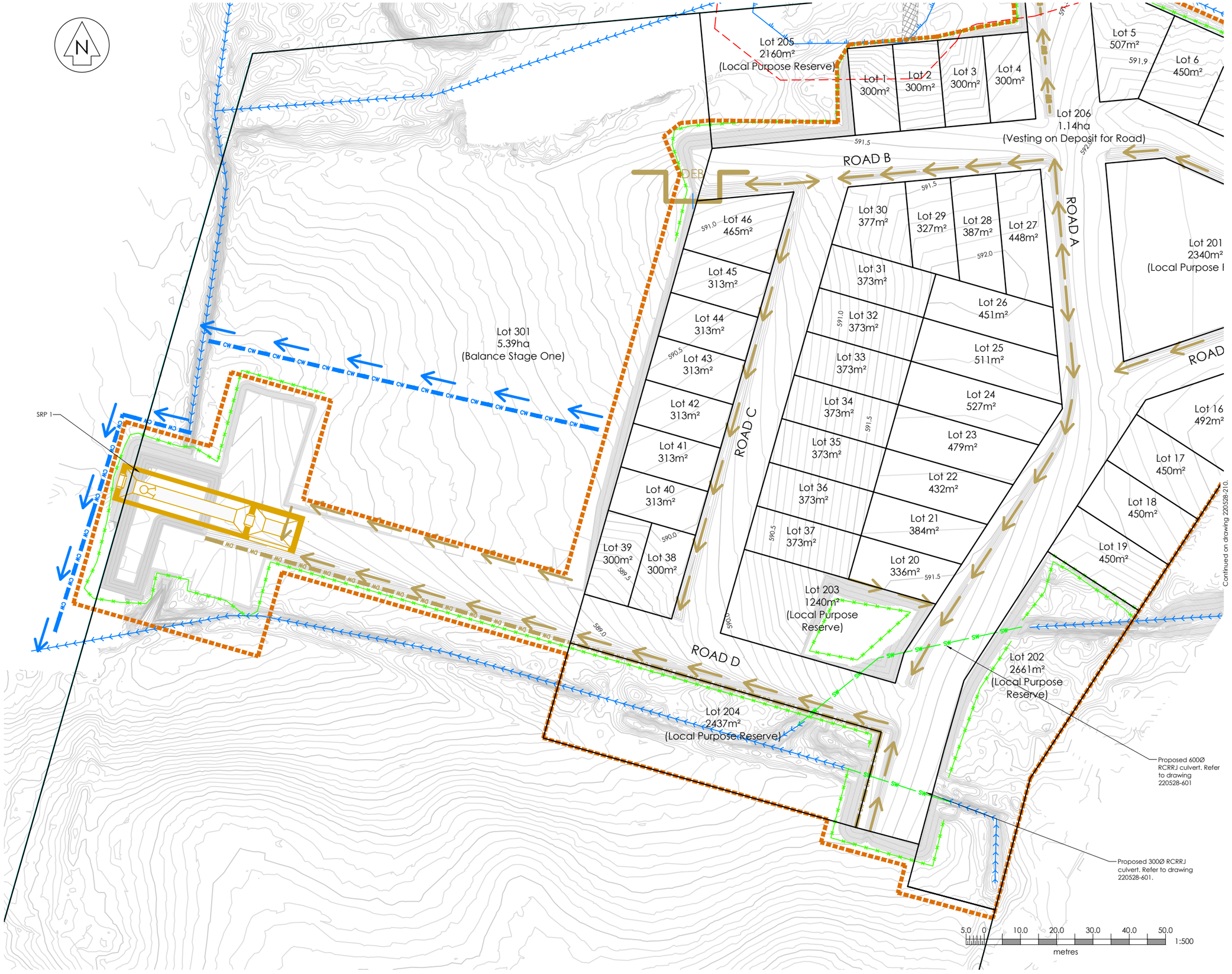
Stage 1 Earthworks
Proposed Sediment & Erosion
Control Plan - Sheet 1 of 2

Surveyed	G. Ripoli	02/11/23	GR
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kilgour	18/05/23	RK
Approved	S.Prasad	22/05/23	RK

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-210 | Rev C



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NOTES:

1. All work shall be done in accordance with the Ruapehu District Council Code of Practice.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
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5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Earthworks Legend: (EW)

- Stage 1 (Extent of Works)
- CW — Clean water flow
- CW CW — Clean water diversion bund
- DW — Dirty water flow
- DW DW — Dirty water diversion bund
- Silt fence/ Super silt fence
- DEB — Decanting earth bund
- SW — Proposed stormwater culvert
- Existing stormwater drain
- Extent of assessed wetalnd
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Proposed Sediment & Erosion
Control Plan - Sheet 2 of 2

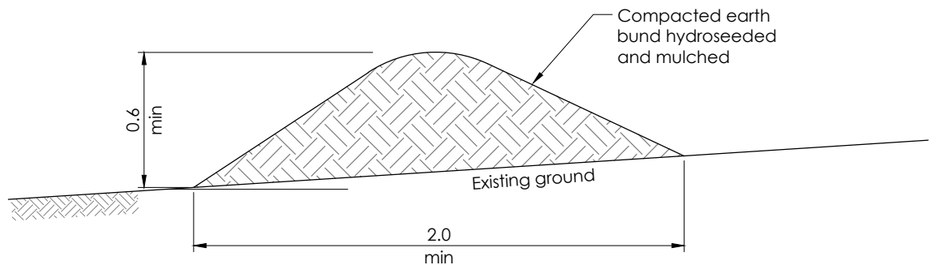
Surveyed	G. Ripoli	02/11/23	GR
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kigour	18/05/23	RK
Approved	S.Prasad	22/05/23	RK

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

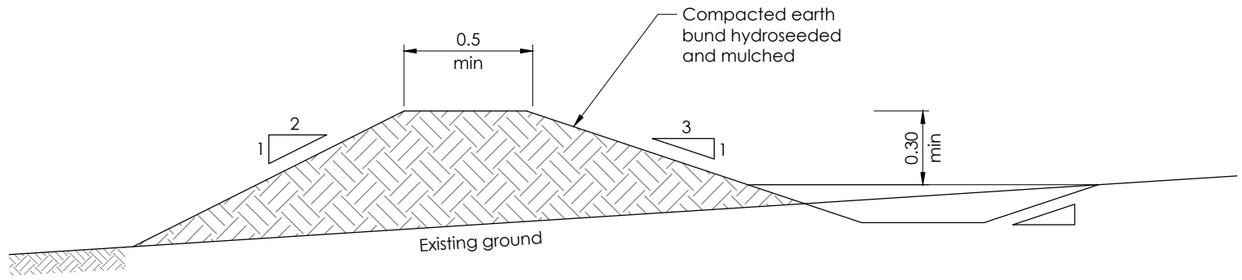
Drawing Number 220528-211 | Rev C

Sediment Retention Pond (SRP)	SRP1
Contributing Area	38000
Actual Contributing Area (m2)	38000
Main Pond, Base Level= 0.0m	
Volume	1140
Depth (primary Spillway Level)	2
Base Width	10.0
Base Length	30.0
Length-Width Ratio	3:1
Pond Batter Slope	3:1
Forebay	
Volume	114
Level Spreader level	2.4
Base Width	10.0
Base Length	6.0
Base Level	1.4
Decant	
Decant Rate (3 litres/second/ha)	11.4
No. of Decants	3
Decant Level No.1	0.42
Decant Level No.2	0.95
Decant Level No.3	1.47
Length of Decant (m)	2
No. of 10mm Holes in Decant	169
6 Rows of Holes Spacing @ mm	54
Outlet Pipe Size	300
Emergency Spillway	
1% AEP Flow Rate (L/s)	488
Width (m)	8
Total Depth (Including 300mm Freeboard)	361
Base Level + (m) (Critical above ground level)	2.3
Pond Outer Bank Level +	2.66



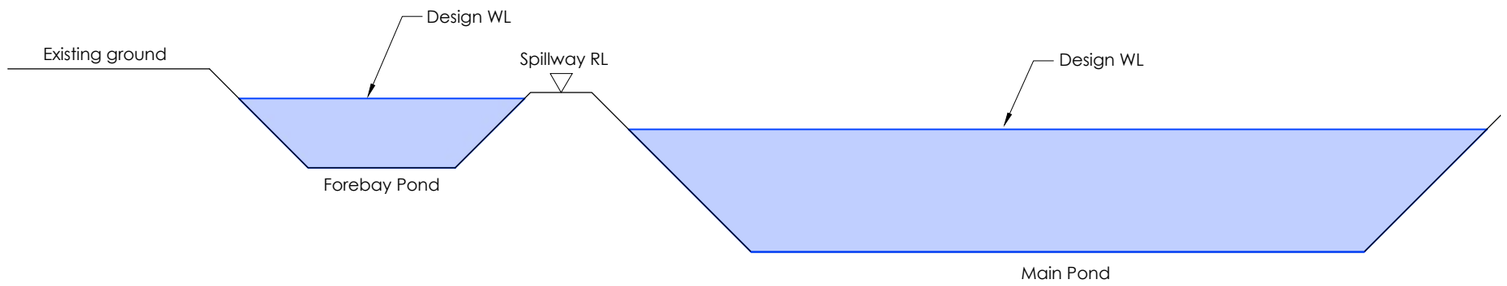
Clean Water Diversion Bund

Scale: NTS



Dirty Water Diversion Bund

Scale: NTS



Sediment Retention Pond Typical Cross Section

Scale: NTS

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NOTES:

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5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.

Rev	Date	Amendment	By	Chk	App
A	23/05/23	Subdivision Consent	JZL	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Sediment & Erosion Control
Diversion Bund and SRP Sections

Surveyed			
Designed			
Drawn	J. Li	30/05/22	JZL
Checked	R. Kilgour	22/05/23	RFK
Approved	S. Prasad	23/05/23	SP

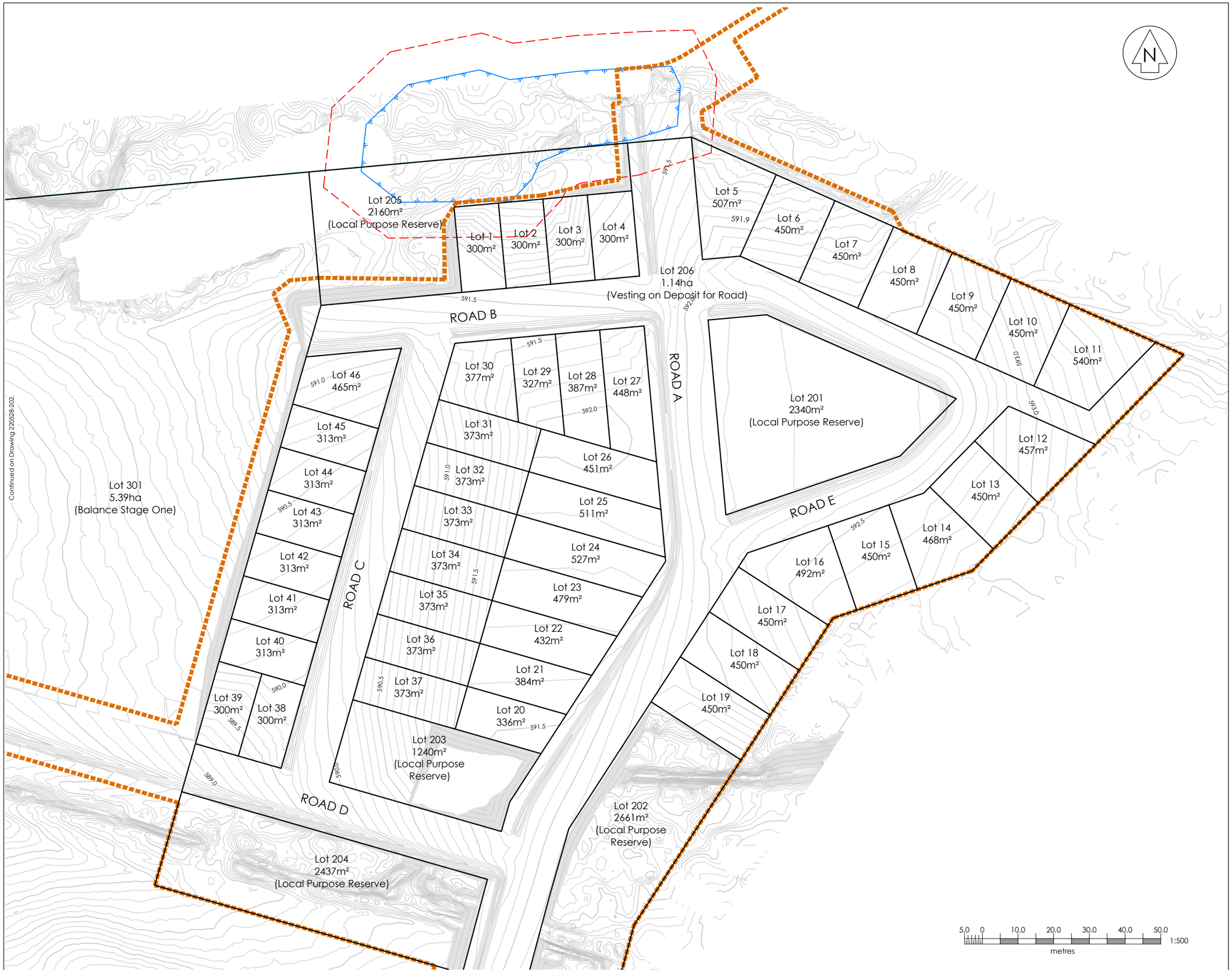
Status **INFORMATION**

Scale A1 AS Shown | A3
A3 As Shown

Drawing Number 220528-212 | Rev A

Appendix 3

Engineering Layout Plans
220528-201 to 204;
401 to 402; 501 to 504
and 601 to 603



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NOTES:

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   Dust control shall be maintained until grassed areas have become established.

Legend:

- Stage 1 (Extent of Works)
- Extent of assessed wetlands
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Proposed Contour Plan
Sheet 1 of 2

Surveyed	G Ripoll	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kilgour	18/05/23	RFK
Approved	S.Prasad	22/05/23	SP

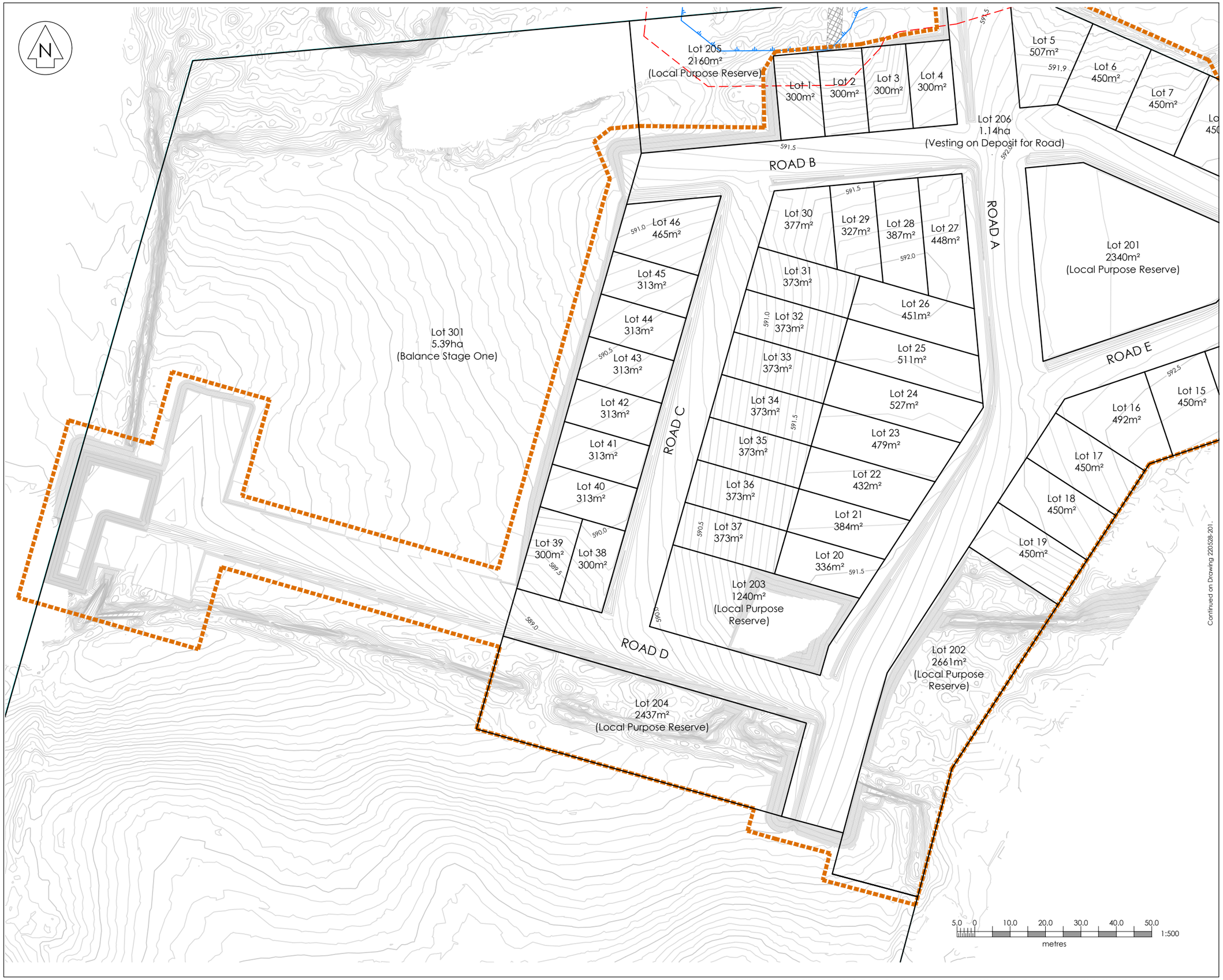
Status **INFORMATION**

Scale A1 1:500
A3 1:1000

A1

Drawing Number 220528-201

Rev C



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NOTES:

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2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
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Legend:

- Stage 1 (Extent of Works)
- Extent of assessed wetlands
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Proposed Contour Plan
Sheet 2 of 2

Surveyed	G. Ripoli	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kigour	18/05/23	RFK
Approved	S.Prasad	22/05/23	SP

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-202 | Rev C

Continued onrawing 220528-204.

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-1.725	-1.500	
2	-1.500	-1.000	
3	-1.000	-0.500	
4	-0.500	0.000	
5	0.000	0.500	
6	0.500	1.000	
7	1.000	1.500	
8	1.500	2.000	
9	2.000	2.279	

Earthworks Volume Summary								
Name	Type	Cut Factor	Fill Factor	Topsoil Area (sq. m)	Cut (Cu. m)	Fill (Cu. m)	Cut Adjusted	Balance
Cut & Fill	Full	0.85	1.00	3920m²	2036m³	16218m³	1731m³	14488m³ fill

5.0 0 10.0 20.0 30.0 40.0 50.0 1:500
metres

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NOTES:

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2. Reduced Levels are in terms of NZ Vertical Datum 2016
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Legend:

- Stage 1 (Extent of Works)
- Extent of assessed wetlands
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Proposed Cut & Fill Plan
Sheet 1 of 2

Surveyed	G. Ripoli	02/11/22	GP
Designed	R.Kilgour	05/23	RK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kilgour	18/05/23	RFK
Approved	S.Prasad	2205/23	SP

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-203 | Rev C

Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-1.725	-1.500	
2	-1.500	-1.000	
3	-1.000	-0.500	
4	-0.500	0.000	
5	0.000	0.500	
6	0.500	1.000	
7	1.000	1.500	
8	1.500	2.000	
9	2.000	2.279	

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NOTES:

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Legend:

- Stage 1 (Extent of Works)
- Extent of assessed wetlands
- 10 m wetland buffer zone

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Earthworks adjusted for wetland	RFK	SP	SP
A	22/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Earthworks
Proposed Cut & Fill Plan
Sheet 2 of 2

Surveyed	G. Ripoli	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P.Harris	18/05/23	PH
Checked	R.Kigour	18/05/23	RFK
Approved	S.Prasad	22/05/23	RFK

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-204 | Rev C

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NOTES:

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   Dust control shall be maintained until grassed areas have become established.
6. All private laterals DN25 MDPE PN12.5.

Legend:

- Water Line Proposed
- Water Line Existing
- Water Valve Proposed
- Fire Hydrant Proposed
- Water Toby Proposed
- Water Line Thrust Block
- Common Services Trench Proposed
- Proposed Road
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, akune

Drawing Title

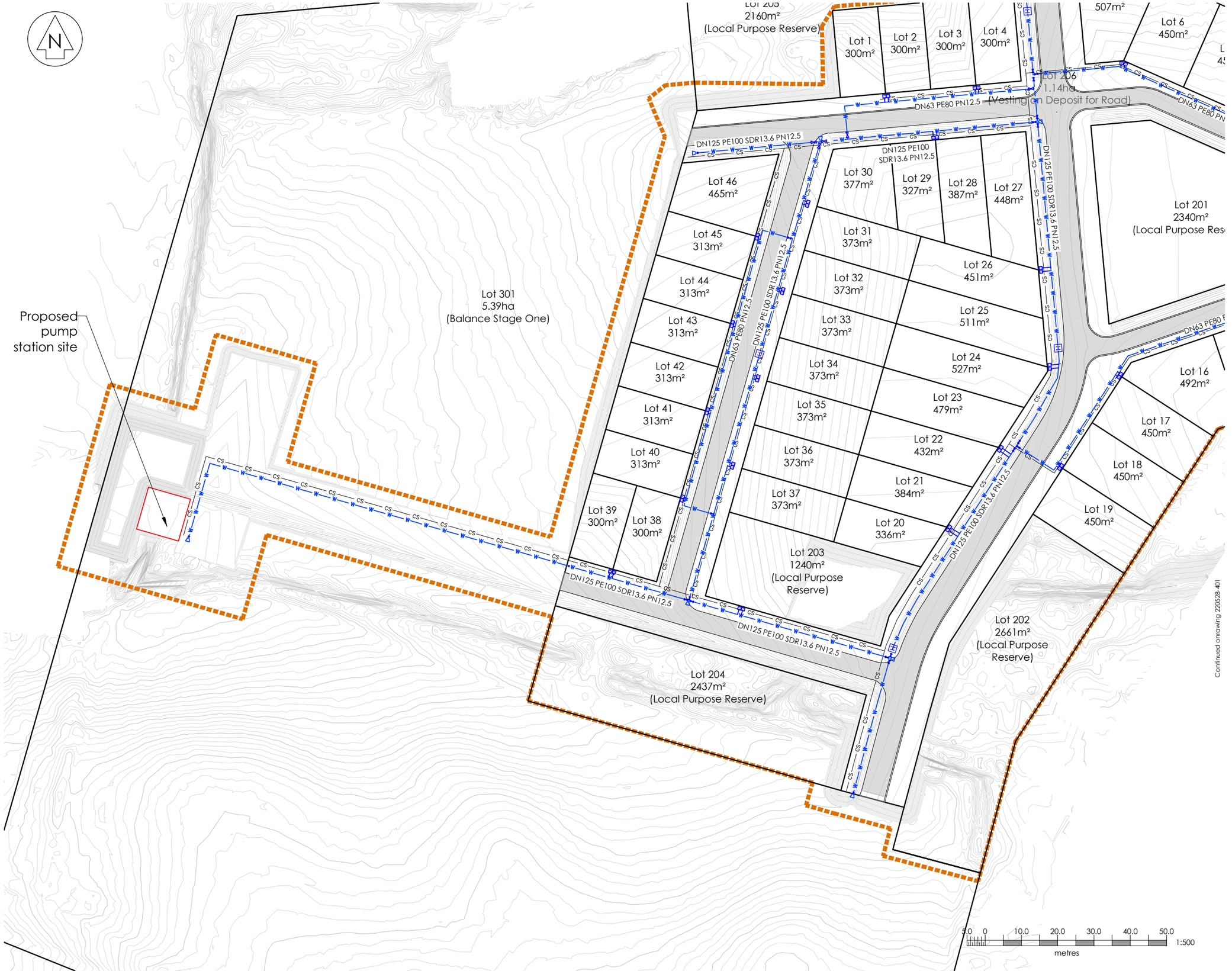
Stage 1 Water & Common Services
Proposed Layout Plan
Sheet 1 of 2

Surveyed	G.Ripoli	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P. Harris	18/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-401 | Rev C



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6. All private laterals DN25 MDPE PN12.5.

Legend:

- Water Line Proposed
- Water Line Existing
- Water Valve Proposed
- Fire Hydrant Proposed
- Water Toby Proposed
- Water Line Thrust Block
- Common Services Trench Proposed
- Proposed Road
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, akune

Drawing Title

Stage 1 Water & Common Services
Proposed Layout Plan
Sheet 2 of 2

Surveyed	G.Ripoli	02/11/22	GR
Designed	R.Kilgour	05/23	RFK
Drawn	P. Harris	18/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

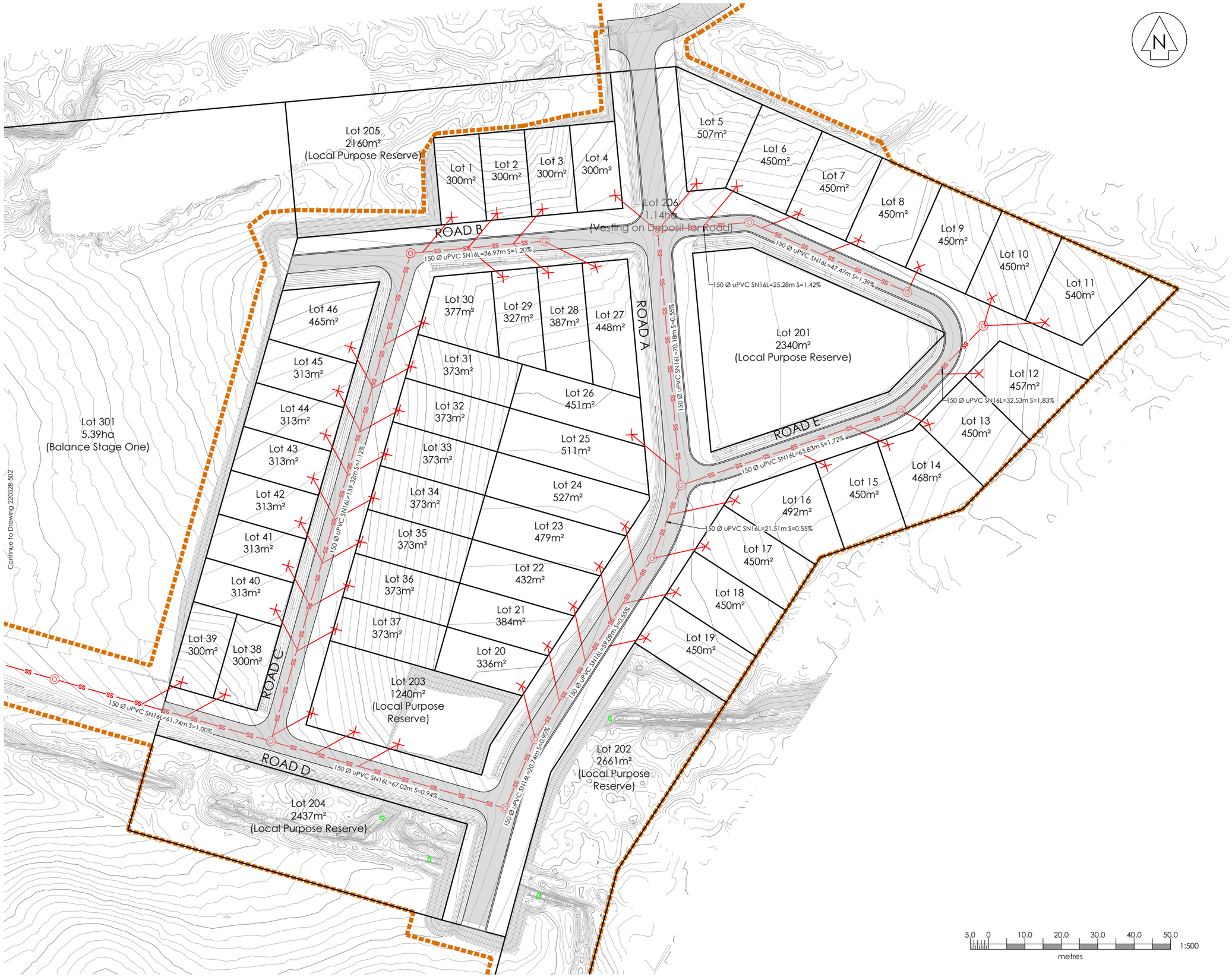
Status **INFORMATION**

Scale A1 1:500
A3 1:1000

A1

Drawing Number 220528-402

Rev C



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NOTES:

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6. All property connection laterals to extend a minimum of 1m inside Lot & marked with 50 x 50 tantalised stakes painted red. Maximum depth from finished ground 1.5m. (use ramp riser if required)
7. All wastewater manholes Ø1050.

Legend:

- SS — Sewer Line Proposed
- SSMH Proposed
- Property Connection Proposed
- Proposed Road
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subddivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

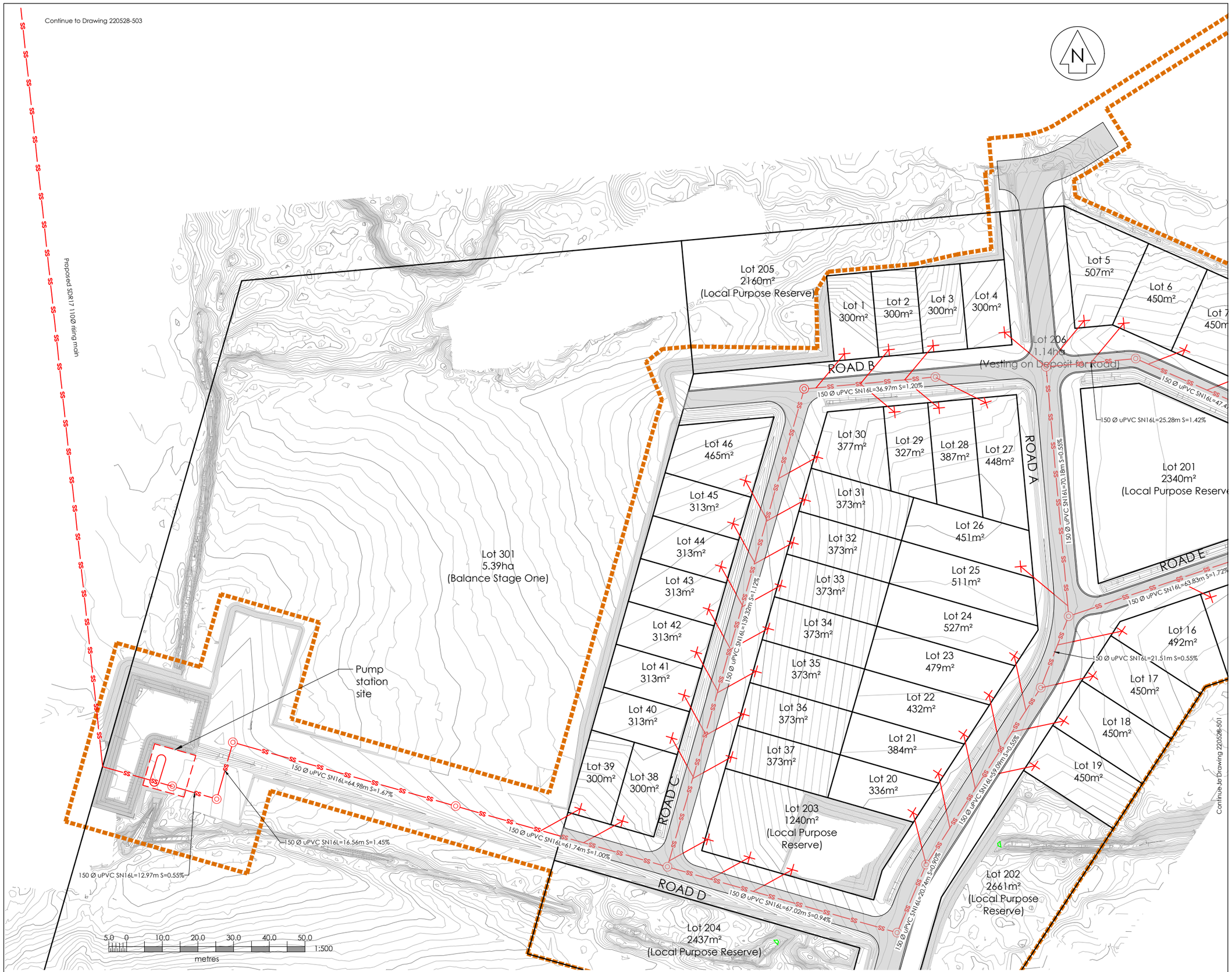
Stage 1 Wastewater
Proposed Layout Plan
Sheet 1 of 3

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:500
A3 1:1000
A1

Drawing Number 220528-501
Rev C



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NOTES:

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7. All wastewater manholes Ø1050.

Legend:

- SS — Sewer Line Proposed
- SSMH Proposed
- Property Connection Proposed
- Proposed Road
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subddivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Wastewater
Proposed Layout Plan
Sheet 2 of 3

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-502 | Rev C

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NOTES:

1. All work shall be done in accordance with the Ruapehu District Council Code of Practice.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
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   RL : 595.70
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7. All wastewater manholes Ø1050.

Legend:

- Sewer Line Proposed
- Sewer Line Existing
- SSMH Proposed
- SSMH Existing
- Property Connection Proposed
- Proposed Road
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subddivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

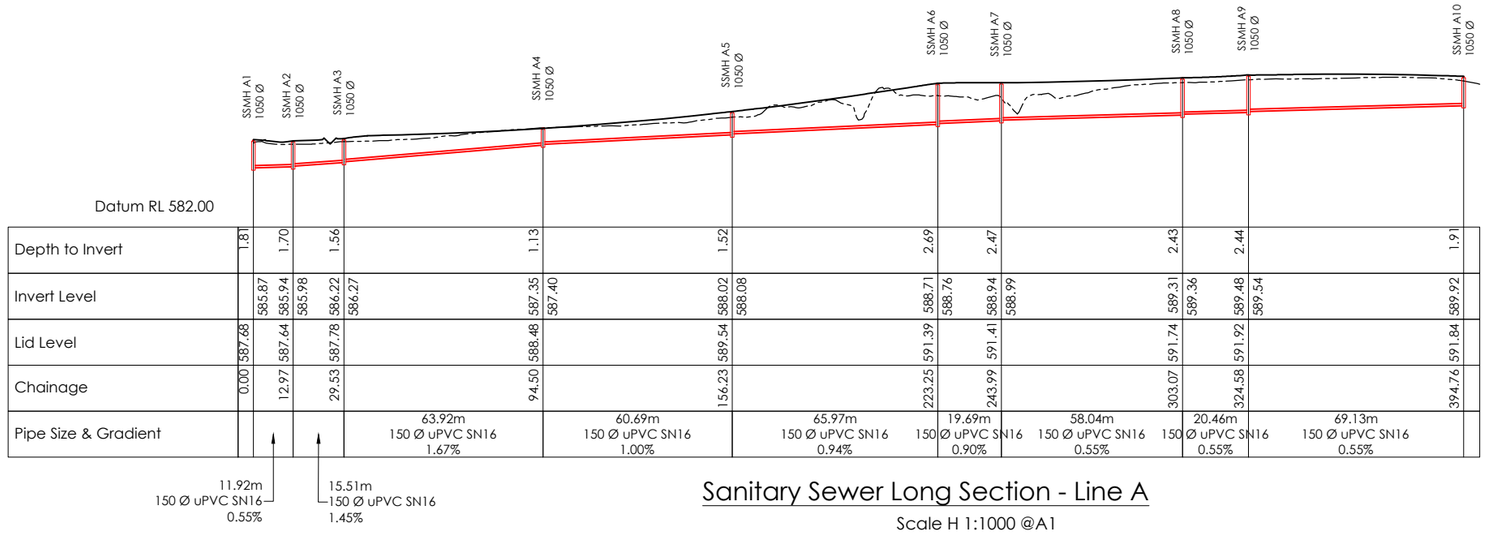
Stage 1 Wastewater
Proposed Layout Plan
Sheet 3 of 3

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

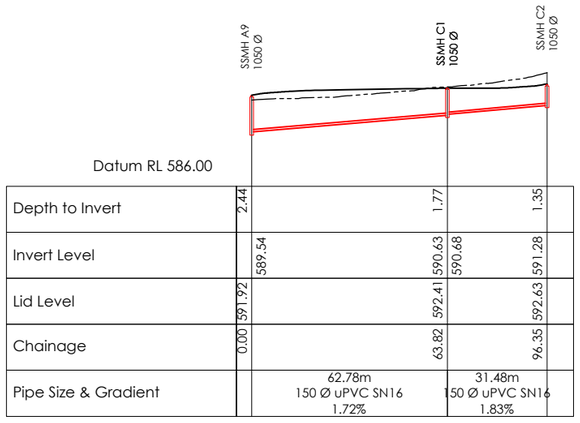
Scale A1 1:500 | A1
A3 1:1000

Drawing Number 220528-503 | Rev C



Sanitary Sewer Long Section - Line A

Scale H 1:1000 @A1
V 1:200 @A1



Sanitary Sewer Long Section - Line C

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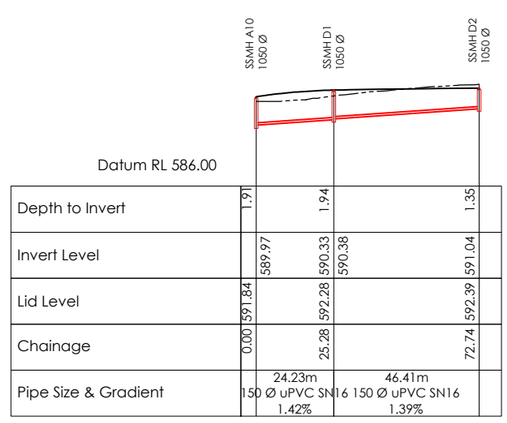
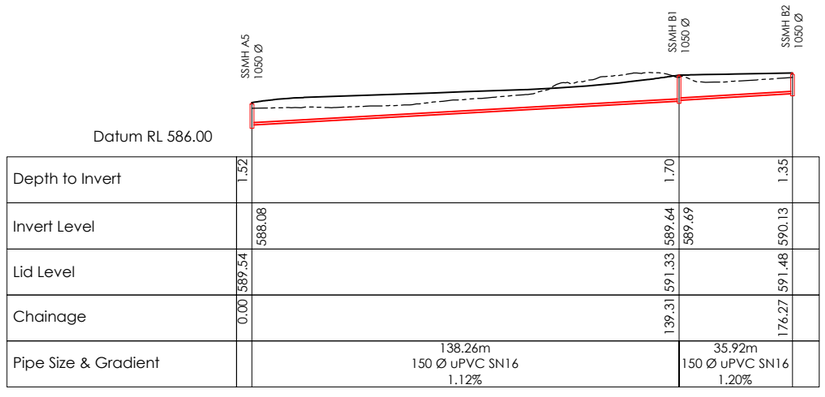
V 1:200 @A1



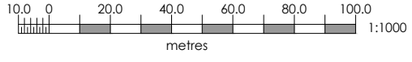
Sanitary Sewer Long Section - Line D

Scale H 1:1000 @A1
V 1:200 @A1



Sanitary Sewer Long Section - Line B

Scale H 1:1000 @A1
V 1:200 @A1



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NOTES:

1. All work shall be done in accordance with the Ruapehu District Council Code of Practice.
2. Reduced Levels are in terms of NZ Vertical Datum 2016
   Level Origin : EBC7 OIT IV DP 44819
   RL : 595.70
   Contour Interval = Major 0.5m
   Minor 0.1m
3. Contractor to locate and identify existing utility location and depths prior to construction. The project engineer shall be informed of any discrepancies to the information depicted on these plans immediately for revised drawings.
4. Contractor shall install and maintain all stormwater, dust and erosion control during construction as per earthworks management plan and the Waikato Regional Council Erosion and Sediment Control - "Guidelines for soil disturbing activities".
5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.
6. All property connection laterals to extend a minimum of 1m inside Lot & marked with 50 x 50 tantalised stakes painted red.
   Maximum depth from finished ground 1.5m.
   (use ramp riser if required)
7. All wastewater manholes Ø1050.

Rev	Date	Amendment	By	Chk	App
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title
Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title
Stage 1 Wastewater
Proposed Long Sections

Surveyed	G. Ripoli	02/11/22	GR
Designed	RFK	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:1000H 1:200V
A3 1:2000H 1:400V
A1

Drawing Number 220528-504
Rev B

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NOTES:

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   RL : 595.70
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5. All disturbed areas shall be re-topsoiled and grassed within 30 days upon completion of contract works.
   Dust control shall be maintained until grassed areas have become established.
6. All manholes to have scruffy dome lids.

Legend:

- SW — Stormwater Line Proposed
- SWMH Proposed
- Proposed Road
- Stormwater Drain Proposed
- Stormwater Drain Existing
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

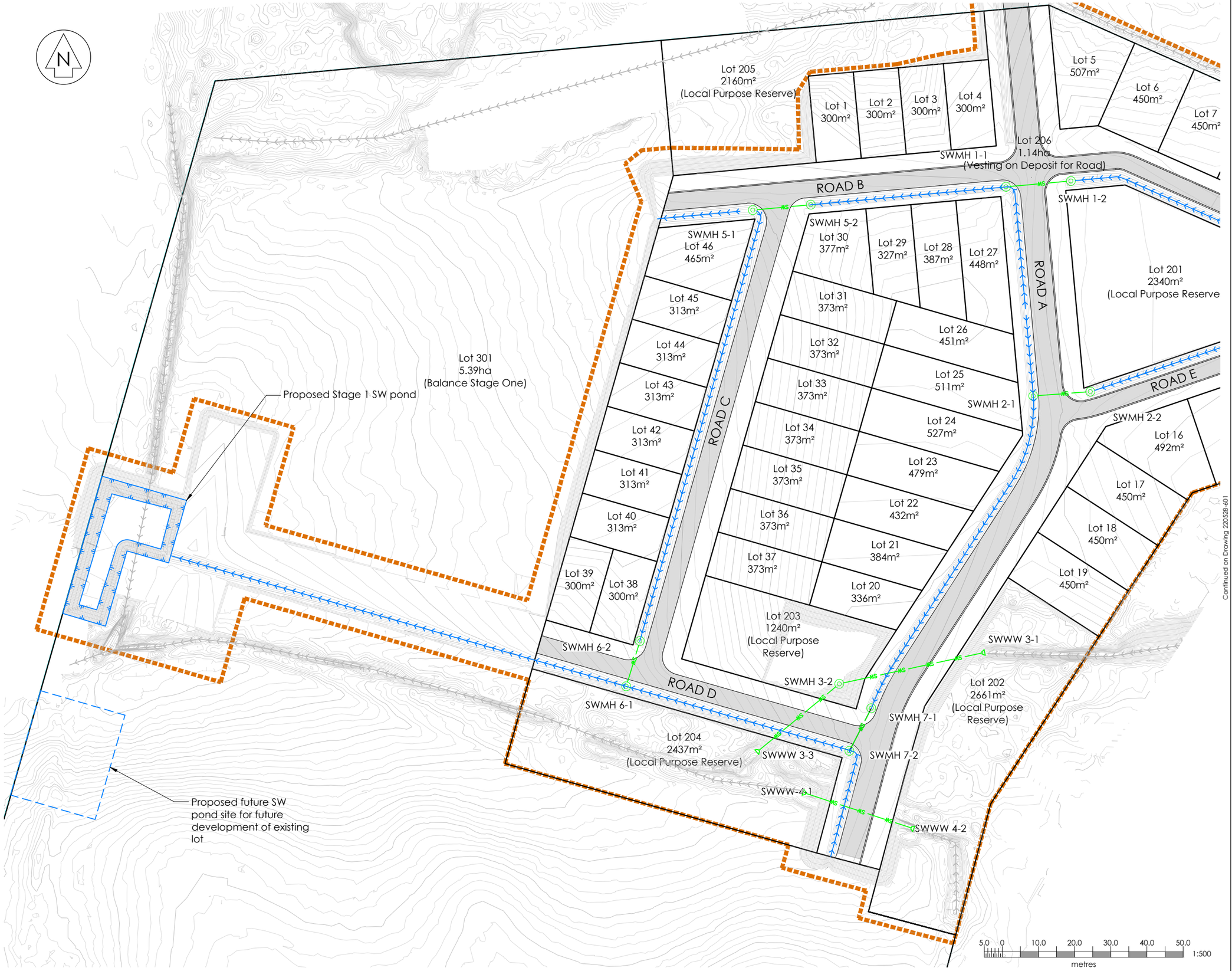
Stage 1 Stormwater
Proposed Layout Plan
Sheet 1 of 2

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:500
A3 1:1000 | A1

Drawing Number 220528-601 | Rev C



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NOTES:

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   Level Origin : EBC7 OIT IV DP 44819
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Legend:

- SW — Stormwater Line Proposed
- SWMH Proposed
- Proposed Road
- Stormwater Drain Proposed
- Stormwater Drain Existing
- Stage 1 (Extent of Works)

Rev	Date	Amendment	By	Chk	App
C	02/06/23	Earthworks Adjusted	SC	AT	SP
B	31/05/23	Adjusted Lots 1-4	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Stormwater
Proposed Layout Plan
Sheet 2 of 2

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

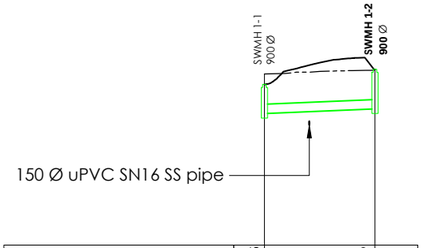
Status **INFORMATION**

Scale A1 1:500
A3 1:1000

A1

Drawing Number 220528-602

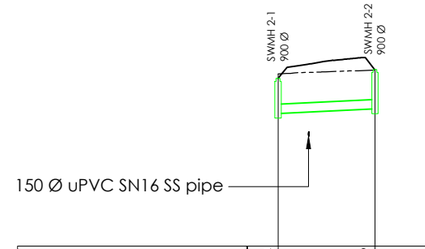
Rev C



Depth to Invert	0.95		1.29
Invert Level		590.29	590.44
Lid Level	591.24		591.73
Chainage	0.00		18.02
Pipe Size & Gradient		17.12m 300 Ø RCRRJ CLASS 4 0.83%	

Stormwater Long Section - Line 1

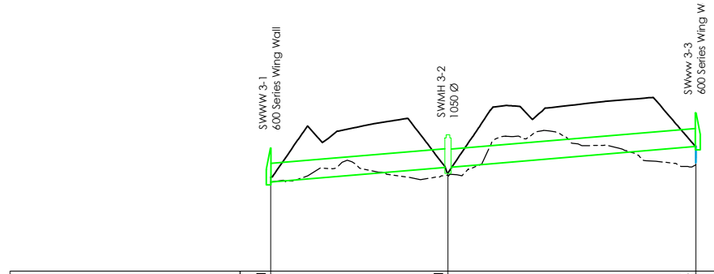
Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	1.14		1.29
Invert Level		590.32	590.47
Lid Level	591.46		591.76
Chainage	0.00		15.81
Pipe Size & Gradient		14.92m 300 Ø RCRRJ CLASS 4 0.95%	

Stormwater Long Section - Line 2

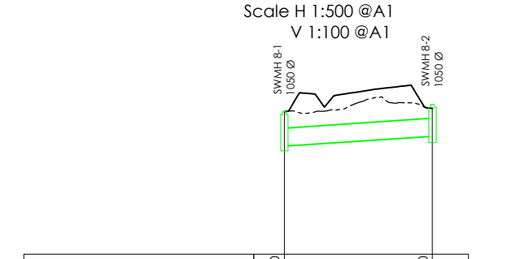
Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	1.11		1.11	1.04
Invert Level		588.90	589.38	590.06
Lid Level	590.01		590.44	591.15
Chainage	0.00		28.92	69.34
Pipe Size & Gradient		28.51m 600 Ø RCRRJ CLASS 4 1.66%		39.94m 300 Ø RCRRJ CLASS 4 1.69%

Stormwater Long Section - Line 3

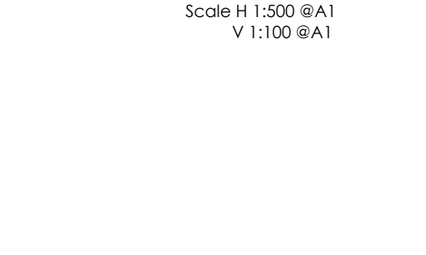
Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	0.94		0.94
Invert Level		589.67	590.00
Lid Level	590.77		591.09
Chainage	0.00		30.82
Pipe Size & Gradient		30.74m 600 Ø RCRRJ CLASS 4 1.06%	

Stormwater Long Section - Line 4

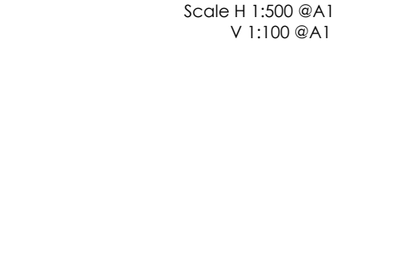
Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	0.74		0.82
Invert Level		589.97	590.08
Lid Level	590.70		590.90
Chainage	0.00		16.09
Pipe Size & Gradient		15.19m 300 Ø RCRRJ CLASS 2 0.72%	

Stormwater Long Section - Line 5

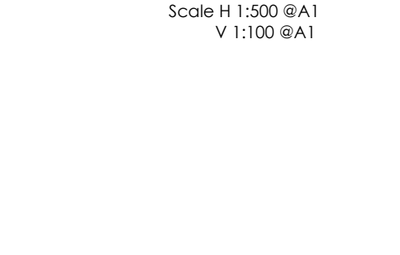
Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	1.89		2.06
Invert Level		587.41	587.54
Lid Level	589.00		589.30
Chainage	0.00		13.10
Pipe Size & Gradient		12.20m 300 Ø RCRRJ CLASS 4 0.97%	

Stormwater Long Section - Line 6

Scale H 1:500 @A1
V 1:100 @A1



Depth to Invert	1.23		1.25
Invert Level		589.52	589.65
Lid Level	590.76		590.90
Chainage	0.00		13.24
Pipe Size & Gradient		12.35m 300 Ø RCRRJ CLASS 4 0.94%	

Stormwater Long Section - Line 7

Scale H 1:500 @A1
V 1:100 @A1

Depth to Invert	0.00		0.00
Invert Level		589.52	589.84
Lid Level	590.65		590.89
Chainage	0.00		24.14
Pipe Size & Gradient		23.10m 600 NB RCRRJ CLASS 4 1.35%	

Stormwater Long Section - Line 8

Scale H 1:500 @A1
V 1:100 @A1

10.0 0 20.0 40.0 60.0 80.0 100.0 1:1000
metres

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6. All manholes to have scruffy dome lids.

Rev	Date	Amendment	By	Chk	App
B	31/05/23	Label Correction	RFK	SP	SP
A	23/05/23	Subdivision Consent	PH	RFK	SP

Project Title

Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title

Stage 1 Stormwater
Proposed Long Sections

Surveyed	G. Ripoli	02/11/22	GR
Designed	R. Kilgour	05/23	RFK
Drawn	P.Harris	11/05/23	PH
Checked	R. Kilgour	18/05/23	RFK
Approved	S. Prasad	23/05/23	SP

Status **INFORMATION**

Scale A1 1:500H 1:100V
A3 1:1000H 1:200V

A1

Drawing Number 220528-603

Rev B

Appendix 4

Stormwater Calculations

Client	Kainga Ora	Date:	24-May-23
Project	6 Teitei Drive, Ohakune	Job Number	220528

On Site detention system — Total Area: 95400

Pre-development

Catchment Area	Description	C (runoff coeff)	Area m²	CA
Roof	Impervious	0.95	0	0
Gravel	Impervious	0.6	0	
Concrete	Impervious	0.9	0	0
Grass	Pervious	0.2	95400	19080
		TOTAL	**95400**	**19080**

Sizing Discharge Outlet Pipe

Total CA 19080
n (surface value) 0.035
L (flow length)= 420 m
s (slope)= 1.95 %

t (Time of Conc.) = 25 minutes

Using Historical HiRDs Data — *ARI* 10 years
I (intensity)= 47.3 mm/hour
Q (runoff) = **250.71** l/s excl climate change
100% **Q** (runoff) = **250.71** l/s excl climate change

Location	Size mm	Gradient (1 in ?)	Manning n	Velocity m/s	Quantity l/s
150mm Conn.	100	125	0.013	0.59	4.62

C value for post development (whole catchment)

Surface	C Value (HCC ITS)	Area **Catchment A** (m^2)	C x Area	Composite C Value	Undetained	Undetained Flow
Grass	0.30	0	0		n	0.00
Permeable paving	0.60	0	0		n	0.00
Concrete	0.90	0	0		n	0.00
Residential	0.55	95400	52470		n	0.00
	Total =	95400	52470	**0.55**		0.00

Calculation of Soakage Rate

A_{sp}= 120.0 m^2 (Area of Base of Soakpit)

S_r= 0 mm/hour

$V_{soak} = A_{sp} S_r$
= **0.00** l/sec

Test Soakage Rate 0
Performance percentage loss 50%

Calculation of Storage Volume

Catchment Area	Description	Area (Ha)	Soakage Q (l/s	Outlet Q (l/s)
A	Whole site	9.5400	0.00	250.7

Area 9.5400
Assume c = 0.55 Composite C Value

Using HirdsRainfall data RCP 8.5 ARI 10 years

Time (min)	Rainfall (mm)	Runoff (m^3)	Discharge to Soakage (m^3)	Discharge to pipe (m^3)	Storage (m^3)
5	8.7	453.9	0.0	75.2	378.7
10	17.3	907.7	0.0	150.4	757.3
20	23.3	1222.6	0.0	300.9	921.7
30	27.7	1453.4	0.0	451.3	1002.1
60	37.0	1941.4	0.0	902.6	1038.8
120	48.7	2555.3	0.0	1805.1	750.2
360	72.4	3798.8	0.0	5415.4	-1616.5
720	91.3	4790.5	0.0	10830.7	-6040.2
1440	113.0	5929.1	0.0	21661.5	-15732.4
2880	140.0	7345.8	0.0	43323.0	-35977.2
4320	157.0	8237.8	0.0	64984.4	-56746.7

Storage required 1038828 litres
1038.8 cu m

Detention Structure

	Diameter (m)	Length (m)	Width (m)	height (m)	Void Constant	Storage Volume (m^3)
Pond		50.00	25.00	1.50	1	1875.0
	Units	1.00	1.00	1.00	50% side wall area	Base area (m^2)
					Total Area	120.0

Client	Kainga Ora	Date:	24-May-23
Project	6 Teitei Drive, Ohakune	Job Number	220528

On Site detention system — Total Area: 95400

Pre-development

Catchment Area	Description	C (runoff coeff)	Area m²	CA
Roof	Impervious	0.95	0	0
Gravel	Impervious	0.6	0	
Concrete	Impervious	0.9	0	0
Grass	Pervious	0.2	95400	19080
		TOTAL	**95400**	**19080**

Sizing Discharge Outlet Pipe

Total CA	19080	
n (surface value)	0.035	
L (flow length)=	420	m
s (slope)=	1.95	%

t (Time of Conc.) = 25 minutes

Using Historical HiRDs Data — *ARI* 200 years

I (intensity)= 117.9 mm/hour

Q (runoff) **=** **624.62** l/s excl climate change

100% **Q** (runoff) = **624.62** l/s excl climate change

Location	Size mm	Gradient (1 in ?)	Manning n	Velocity m/s	Quantity l/s
150mm Conn.	150	125	0.013	0.77	13.62

C value for post development (whole catchment)

Surface	C Value (HCC ITS)	Area **Catchment A** (m^2)	C x Area	Composite C Value	Undetained	Undetained Flow
Grass	0.30	0	0		n	0.00
Permeable paving	0.60	0	0		n	0.00
Concrete	0.90	0	0		n	0.00
Residential	0.55	95400	52470		n	0.00
	Total =	95400	52470	**0.55**		0.00

Calculation of Soakage Rate

A_{sp}= 1150.5 m^2 (Area of Base of Soakpit)

S_r= 0 mm/hour

$V_{soak} = A_{sp} S_r$

= **0.00** l/sec

Test Soakage Rate 0

Performance percentage loss 50%

Calculation of Storage Volume

Catchment Area	Description	Area (Ha)	Soakage Q (l/s	Outlet Q (l/s)
A	Whole site	9.5400	0.00	624.6

Area 9.5400

Assume c = 0.55 Composite C Value

Using HirdsRainfall data RCP Historical ARI 200 years

Time (min)	Rainfall (mm)	Runoff (m^3)	Discharge to Soakage (m^3)	Discharge to pipe (m^3)	Storage (m^3)
5	16.5	864.0	0.0	187.4	676.6
10	32.9	1728.0	0.0	374.8	1353.2
20	43.5	2282.4	0.0	749.5	1532.9
30	51.1	2683.0	0.0	1124.3	1558.7
60	67.2	3524.2	0.0	2248.6	1275.6
120	86.8	4552.6	0.0	4497.3	55.4
360	126.0	6611.2	0.0	13491.8	-6880.6
720	155.7	8167.8	0.0	26983.5	-18815.7
1440	189.7	9951.8	0.0	53967.1	-44015.3
2880	229.3	12033.1	0.0	107934.2	-95901.0
4320	254.3	13344.9	0.0	161901.2	-148556.4

Storage required 1558652 litres

1558.7 cu m

Detention Structure

	Diameter (m)	Length (m)	Width (m)	height (m)	Void Constant	Storage Volume (m^3)
Rain Cells		42.00	25.00	1.50	1	1575.0
	Units	1.00	1.00	1.00	50% side wall area	Base area (m^2)
					100.5	1050.0
					Total Area	1150.5

Appendix 5

Morphum Environmental Memo

Memorandum

Date:	17/05/2023
To:	Katherine Hu, Sunil Prasad, Rachel Griffiths, James Pattullo
From:	Andrew Rossaak
CC:	Fletcher Wilson
Project Number:	P04109
Reviewed and released by:	Stu Farrant

Subject: Teitei Drive wetlands and stormwater

Kaianga Ora engaged Morphum to provide additional assessment on the presence and status of any wetlands on site and potential stormwater options to address potential freshwater impacts at their development site located on Teitei Drive in Ohakune.

Morphum visited site on the 10th May 2023. The nearest rain gauge (Waiharuru, 6 km to the south east) recorded 15mm over the previous 10 days, however, on the day of the site visit, heavy falls were recorded with over 23 mm falling during the day.

Current land use and site history

The site does not appear to have been used for stock grazing, but rather used to cut hay/silage. The site has well established pasture grasses with silage pit areas on the central fence-line running north-south. Areas of the site remain uncut either due to proximity to waterways or for an apparent presence of a plant unpalatable to stock.

Wetlands

Preliminary ecological assessments had identified 4 potential wetland areas on or close to the site[1]. Three of these are along a watercourse/gulley system forming the northern boundary of the site and the fourth is in the south of the site (Figure 1). All potential wetlands were assessed using the NES:F wetland delineation protocols[2].

The potential wetland in the south of the site (labelled wetland 4 in Figure 1) is a roughly triangular shape and is bordered on the southeast and southern extent by a modified stream. The western extent follows a fence-line, and the northern extent follows a farm track. The vegetation comprised of rank

[1] Memo from Rachel Griffiths of Kahu Environmental. Freshwater Ecology Aspects for Proposed Development – Teitei Drive Ohakune. Dated 4 April 2023.

[2] Ministry for the Environment. 2022. Wetland delineation protocols. Wellington: Ministry for the Environment.

pasture grass (tall fescue) with patches of *Ranunculus acris,* an exotic species that is easily spread by stock and machinery and is commonly known as meadow buttercup or giant buttercup. This species often grows in moist areas, but is not a determination of wetland, being noted as a facultative species on the wetland plant indicator status rating 2021[3]. It is also considered to be poisonous to livestock and avoided by dairy cattle[4], which could explain why this area is not included in the hay/silage harvesting conducted on the site. With the *Ranunculus* species being facultative (tall fescue is not on the list), vegetation is inconclusive in determining a wetland at this location and as such further assessment of the vegetation would not add to the wetland determination. The site was assessed using the hydrology and hydric soil tools. The site was slightly downslope, and a stream bordered one side, however there were no indicators of inundation. Soil augers were undertaken in three locations well into the area labelled 4 (Figure 1). The soils were damp near the surface, but dry and friable at a depths of 150 to 300 mm with a colour indicating there was no glaying (Munsel 10YR 5/4) (Figure 2). No matrix or mottles were present. This indicates that this is not a wetland as it lacks wetland hydrology and hydric soils. It is likely that this area is vegetatively different from the reast of the paddock as it has not been mown and allowed to grow rank with resulting increased moisture in the vegetated matter.

Figure 1: Potential wetlands identified by ecology assessment.

[3] Wetland indicator status of plants found in New Zealand wetlands as published in Appendix 1 of Clarkson BR, Fitzgerald NB, Champion PD, Forester L, Rance BD 2021.
[4] https://www.dairynz.co.nz/media/5790938/giant-buttercup-fact-sheet.pdf

Figure 2: Soils in potential wetland area 4 illustrating dry lower horizon and red colours.

Potential wetland 1 is likely a wetland. This is upstream of the site and more than 10 m for expected earthworks. As such it is not considered likely to impact the works and the works are unlikely to affect this wetland. Further assessment was not undertaken to confirm its wetland status or determine whether it is constructed or a natural wetland.

Potential wetland 2 was noted as a flooded gulley area. There was a mix of exotic species here including willows and blackberry. The pasture grasses on the edge of this area were flooded at the time of our site visit. There were areas that indicated sustained inundation and pooling of water, indicating a wetland using the hydrology tool. There is an access track separating wetland areas 2 and 3 which did not appear to have any pipes or culverts installed, but composed of mixed gravel aggregate (road base) placed in the gulley. The wetland may well be induced by this accessway. This does not, however, alter the status of wetland 2 as a natural wetland under the NES:F or under the RMA.

Potential wetland 3 is immediately downstream of wetland 2. It was also flooded into the pasture grass edge at the time of the site visit (Figure 3). Vegetation is similar to wetland 2 and based on the evidence of regular flooding and very wet soils, this too is considered a natural wetland under the NES:F.

Figure 3: Potential wetland area 3.

Wetland 3 was followed downstream where the surface water disappeared. Following the watercourse is limited by the dense vegetation and as such there is uncertainty as to the fate of this water flow. Further assessment may be required. It was noted that there were dry soils in the gulley at the western extent of potential wetland 3. The surface was irregular and it is suggested that this area may be an old waste fill area. Historical imagery from Retrolens shows a railway line existed near this location and that there is likely to have been earthworks at this location.

The assessed wetland extent on the site is presented below in Figure 4 along with the field assessment points.

Figure 4: Assessed wetland area on site and location of assessment points

Stormwater

Based on the site visit and the need to demonstrate the protection of existing and downstream freshwater ecosystems there is a need to manage stormwater appropriately. In particular requirements to demonstrate the intent of Te Mana o Te Wai as per the NPS-FM will be important. Based on discussions with the wider design team it appears that to date the design has been developed with a focus only flood attenuation and limited consideration of management of site generated stormwater to mitigate adverse water quality and post developed hydrology.

Based on our understanding of the site and development aspirations we would recommend that in support of the development proposal and consent application a suite of freshwater objectives be documented to define the overall approach. These could include measures including the following;

- Protect and Enhance freshwater systems on the site and downstream;
- Manage site runoff for a range of urban contaminants including heavy metals, hydrocarbons, sediments, temperature and modified hydrology;
- Manage stormwater volumes and peak flowrates to protect downstream ecosystems and reduce risks of downstream flooding;
- Align development outcomes with both NPS-FW and NPS-UD through managing stormwater to meet Te Mana o Te Wai and creating a well-functioning Urban Environment.

These objectives could be achieved through;

- Providing a standalone stormwater management plan for the development which documents the existing condition, regulatory context, objectives and proposed approach to manage freshwater.
- Providing on lot retention and detention through rainwater tanks with plumbed connection to internal non potable demands including toilet and cold water laundry usage. This will likely require a notice on title to ensure subsequent uptake.
- Convey Road and Private Driveway runoff to a designed constructed wetland in the south west corner integrated with flood detention. The design of this will be critical to ensure the outcomes are achieved in a resilient and efficient manner requiring the following;
    - Design in collaboration with landscape architects;
    - Design to enable staging of development;
    - Design to be offline to peak flows with hydraulics to control detention engagement for large infrequent flood events.
- Develop plan for restoration of existing stream through site including appropriate riparian setbacks, integration of viable habitat and connections with community through pedestrian paths etc.
- Consider relocating proposed wastewater pump station to be within ultimate road corridor rather than stream reserve to provide separation from freshwater and enable ready access and maintenance.

Potential opportunities for a scalable (stage 1 and 2) stormwater treatment wetlands is proposed in the south west of the site (the lighter shaded section would be to address stage 2. There is also potential for a water quality wetland in the north of the site. These are illustrated for concept only and are not to scale.

Figure 5: Potential opportunities for the location of a scalable stormwater treatment wetland in the southwest of the site and a smaller stormwater wetland in the north.

We trust the above assists with the sustainable development of the site. Please feel free to contact me if you have any questions.

Andrew Rossaak
Science Team leader
Morphum Environmental Ltd
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Email: andrew.rossaak@morphum.com

Appendix 6

Hydrology Assessment Report

Kainga Ora – Homes and Communities

6 Teitei Drive, Ohakune

Hydrology Assessment

220528
8 March 2023

Kainga Ora – Homes and Communities

6 Teitei Drive, Ohakune

Hydrology Assessment

Prepared by:

Raymond Kilgour
Chartered Senior Civil Engineer
NZCE(Civil) BE(Hons), CPEng(Civil), CMEngNZ, IntPE

Reviewed and Approved for Release by:

Jake Saathof
Chartered Civil Engineer
BE(Hons)(Forest), CPEng(Civil, Environmental), CMEngNZ

Date: 8 March 2023
Reference: 220528
Status: FINAL

TABLE OF CONTENTS

Enclosures -

1. Topography Plan 220528-TP001 Rev A
2. Kainga Ora Development Options
3. Hydrological & Hydraulic Calculations
4. Horizons District Council 1 in 200-yr Flood Map

1. INTRODUCTION

1.1. Purpose of Report

Cheal Consultants Limited (Cheal) has been engaged by Kainga Ora – Homes and Communities (the client) to carry out a hydrology assessment at 6 Teitei Drive, Ohakune, in support of a proposed multi lot residential development.

This report summarises the hydrology assessment, presents the predicted flows for the mean annual flow (MAF), 50-yr (for access) and 200-yr (for building levels) storm events and determining the flood risk extents for the 50-yr and the 200-yr storm events as per the NZ Building Code and Horizons Regional Council rules for flood risk. The report assesses site suitability for the proposed development and is intended to support a resource consent application.

Figure 1: Site location plan (OpenStreetMap)

1.2. Scope

Cheal Consultants scope in preparing this report included the following tasks:

- Collate District & Regional Council flood information for the site.
- Undertake hydrological modelling of stormwater for the catchment and determine flood extents for the 50-yr and 200-yr ARI storm events.
- Provide recommendations with respect to flood levels and minimum floor levels for the proposed lots.

Detailed engineering design is excluded from the scope of this report and can be provided at engineering approval stage.

1.3. Site Description

As shown in Figure 1, the site is located approximately 500m to the southeast of the Ohakune town centre and 400m west to the centre of Turoa Village. The Mangateitei Stream is located approximately 230m to the north of the site.

In general, the site comprises flat to undulating topography and is currently used for farming. Access to the site and existing farming infrastructure is off Teitei drive to the north.

The site is bounded to the west by Rochfort Park, to the east by residential development of Turoa Village, to the north by a park reserve area and to the south by farmland. The ground levels are shown in drawing 220528-TP001 Rev. A in Enclosure 1.

The Mangateitei Stream runs east to west until it joins the Mangawhero River which is generally flowing northeast to southwest and is located to the northwest of the site.

As part of the Mangawhero River catchment, the site is located within two hydrology sub catchments. The northern catchment has an area of 17.5ha and the southern catchment has an area of 25.7ha, with the flows from both catchments meeting at the western boundary of the proposed development.

1.3.1. Existing Drainage

Sometime between the years 1967 and 2000, the flow from the northern catchment has been diverted from flowing to the Mangateitei Stream to the north and is now directed to a constructed open channel flowing along the western boundary between the site and Rochford Park.

The southern catchment flow is directed through two open channels that enter the site mid-way along the eastern boundary and the southern end of the eastern boundary. They meet within the site and then traverse from east to west across the site.

These open channels appear to have been constructed with the southern catchment channel being formalised into an overland flow path. Existing channels and flow paths are shown in Figure 2 below.

Within the neighbouring development these channels have been modified, landscaped and planted. Within the site, the channels appear to be minimally maintained and are overgrown with weeds and brush.

The channels have very flat gradients and along with the thick vegetation pooling occurs in the channels which was observed during Cheal site visits. This pooling appears to be temporary and soaks into the ground or evaporates over extended dry periods.

Historic aerial imagery (obtained from Retrolens - https://retrolens.co.nz and Google Earth Pro) identify overland flow paths and lower lying areas to retain water in wetter periods but it appears over time that these areas while still existing have been modified by cultivation and the differing vegetation appears to be based on land usage and maintenance.

Figure 2: Drainage Sketch

1.4. Proposed Development

The proposed subdivision is for a residential subdivision to create approximately 150 lots over three stages of the lot designated as Lot 2 DP 54909. Conceptual options can be found in Enclosure 2.

1.5. Current Stormwater Data

1.5.1. NIWA Flow Data

Flow gauge data for the Mangawhero River has been sourced from NIWAs' New Zealand River Flood Statistics website (https://www.arcgis.com/apps/webappviewer/index.html?id=933e8f24fe9140f99dfb57173087f27d).

NIWA has three river flow gauge sites on the Mangawhero River. One at Hagleys by the Ohakune Oxidation Ponds, one at Pakihi Road Bridge and one at Ore Ore. The data sets were collected for 7, 8 and 52 years, respectively.

Table 2 – NIWA flood frequency flows – gauging sites

	Area (km^2)	2.33-yr	5-yr	10-yr	20-yr	50-yr	100-yr	250-yr	500-yr	1000-yr
Hagleys	70	37.6	46.05	52.93	59.52	68.06	74.45			74.45
Pakiri Road Bridge	138		89.32	108.46	126.81	150.57	168.38	191.82	209.52	227.21
Ore Ore	506	252.57	333.67	399.7	463.57	545.89	607.58	688.80	750.13	811.41

1.6. Recent Flood Events

A high-level search did not yield any information with regard to specific extensive flooding within the site area. There has been extensive flooding around the Ohakune township and to the north of State Highway 49.

2. STORMWATER MODELLING

2.1. Methodology

2.1.1. Existing Drainage Capacity

Autodesk's' Hydraflow Express was used to determine the existing capacities of the northern and southern channels.

Given the overgrown vegetative nature of the unmaintained channels, a Manning's of 0.1 was assumed.

Cross- sections were taken through each channel and a longitudinal gradient of 0.1 % used to make an estimation each channel flow.

It was determined that the northern and southern channels had an existing capacity of 0.2 and 0.85 $m^3 s^{-1}$, respectively.

Calculations can be found in Enclosure 3.

2.1.2. Determining Model Flood Flows

The gauging sites providing calculated flows catchment runoff, from the Mangawhero River adjacent to the site, has been estimated using the method proposed in Flood Frequency in New Zealand (McKerchar & Pearson, 1989) and the gauge sites as a comparative catchment (see Figure 3 for flow measurement locations).

Flow data for the smallest available catchment was obtained from New Zealand River Flood Statistics website (see Figure 3 for locations) and are presented in Tables 3 and 4. Discharge return period curves are presented below in Figures 4 and 5.

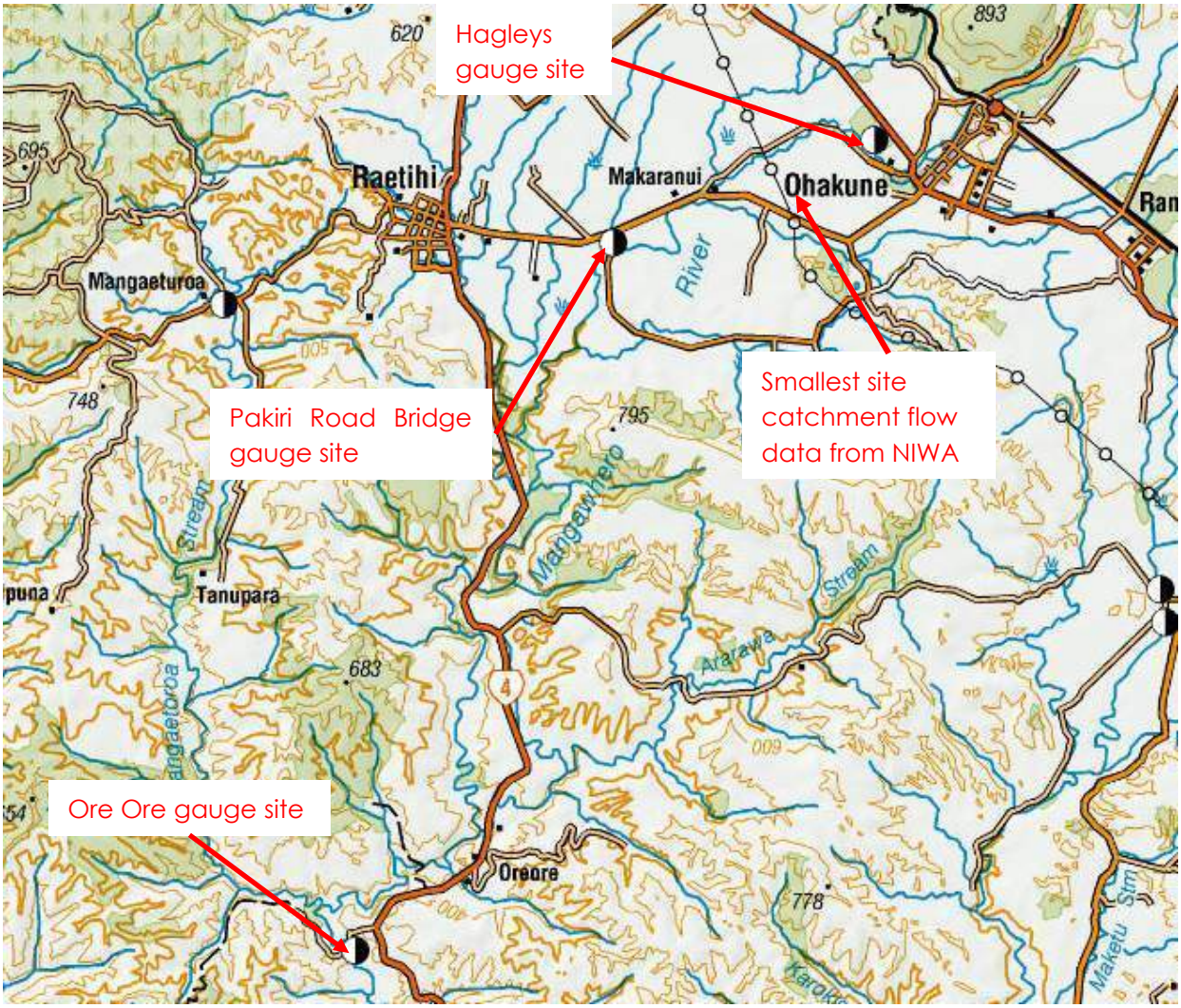

Figure 3 – New Zealand River Statistics flood frequency flow locations

Table 3 – New Zealand River Statistics flood frequency flows (m^3s^{-1}) – Smallest Catchment flow incorporating the site.

Area (km2)	MAF	5-yr	10-yr	20-yr	50-yr	100-yr	1000-yr
1.46	0.70	0.85	0.98	1.10	1.26	1.38	1.77

Table 4 – Calculated model flows (m^3s^{-1}) for the catchments of the northern and southern open channels.

Channel	Area (km2)	2.33-yr	5-yr	10-yr	20-yr	50-yr	100-yr	1000-yr
Northern	0.175	0.13	0.16	0.18	0.21	0.24	0.26	0.33
Southern	0.257	0.17	0.21	0.24	0.27	0.31	0.34	0.44

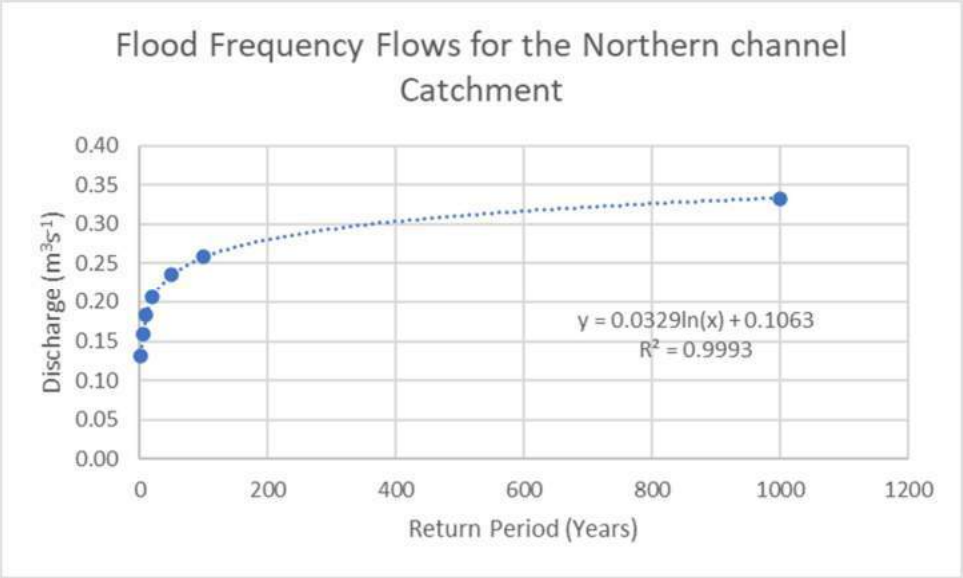

Figure 4 – flood frequency flows and return periods for catchment at site.

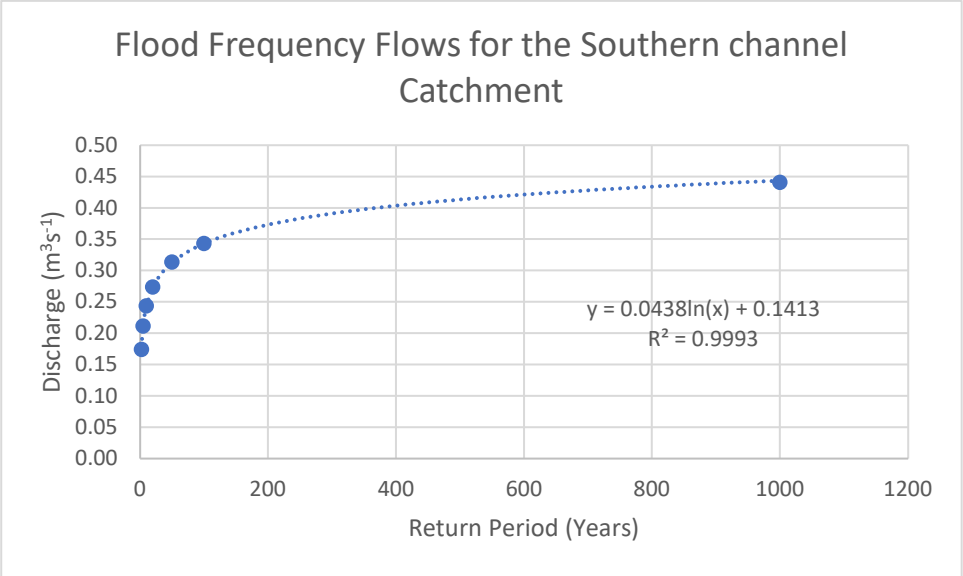

Figure 5 – flood frequency flows and return periods for catchment at site.

2.1.3. Climate Change

In the Ministry for the Environments' Tools for Estimating the Effects of Climate Change on Flood Flow May 2010, it states:

> 'It is possible to use results from McKerchar and Pearson (1989) to suggest that over much of New Zealand (places where the 100-year ARI flood is between two and three times the mean annual flood), the average recurrence interval would approximately halve if flood peaks all increased by a hypothetical 10 per cent.'

This means that for every 10 % increase due to climate change a 100-yr AR storm in the present would be equivalent to a 50-yr storm in the future.

With this in mind, there has been an allowance for a 20 % increase and the flows to be used in the modelling are presented in Table 5 below.

Table 5 – Future flows at the site due to climate change.

	Current	20% increase equated return period	Future flood flow	
			Northern Channel	Southern Channel
Return period	50-yr	200-yr	0.281 m^3s^{-1}	0.303 $m3s^{-1}$
	100-yr	400-yr	0.373 m^3s^{-1}	0.404 m^3s^{-1}

2.1.4. Modelling in HEC RAS and Hydraflow Express

The software used to model the stream flow was HEC RAS v6.0 and Autodesk Hydroflow Express. The following inputs/assumptions were used:

- Terrain has been input by creating a TIFF surface in Autodesk Civil 3D 2022 from Cheal's Drone data. This data was verified by Cheal by surveying spot heights around the site.
- HEC RAS models the open channels as they run through or adjacent to the proposed development site.
- Critical flow boundary conditions were used.
- Flows were modelled as sub-critical and as a steady state flow.
- Due to the thick vegetation with the open channels, Manning's n was assumed to be 0.1.
- Future 1 in 100-yr storm flows, accounting for climate change, were modelled in Hydraflow Express to determine the typical cross section that had the capacity to contain the modelled flood discharges, these are found in Enclosure 4.

3. RESULTS

3.1. Flood Extents

3.1.1. 50-year Flood

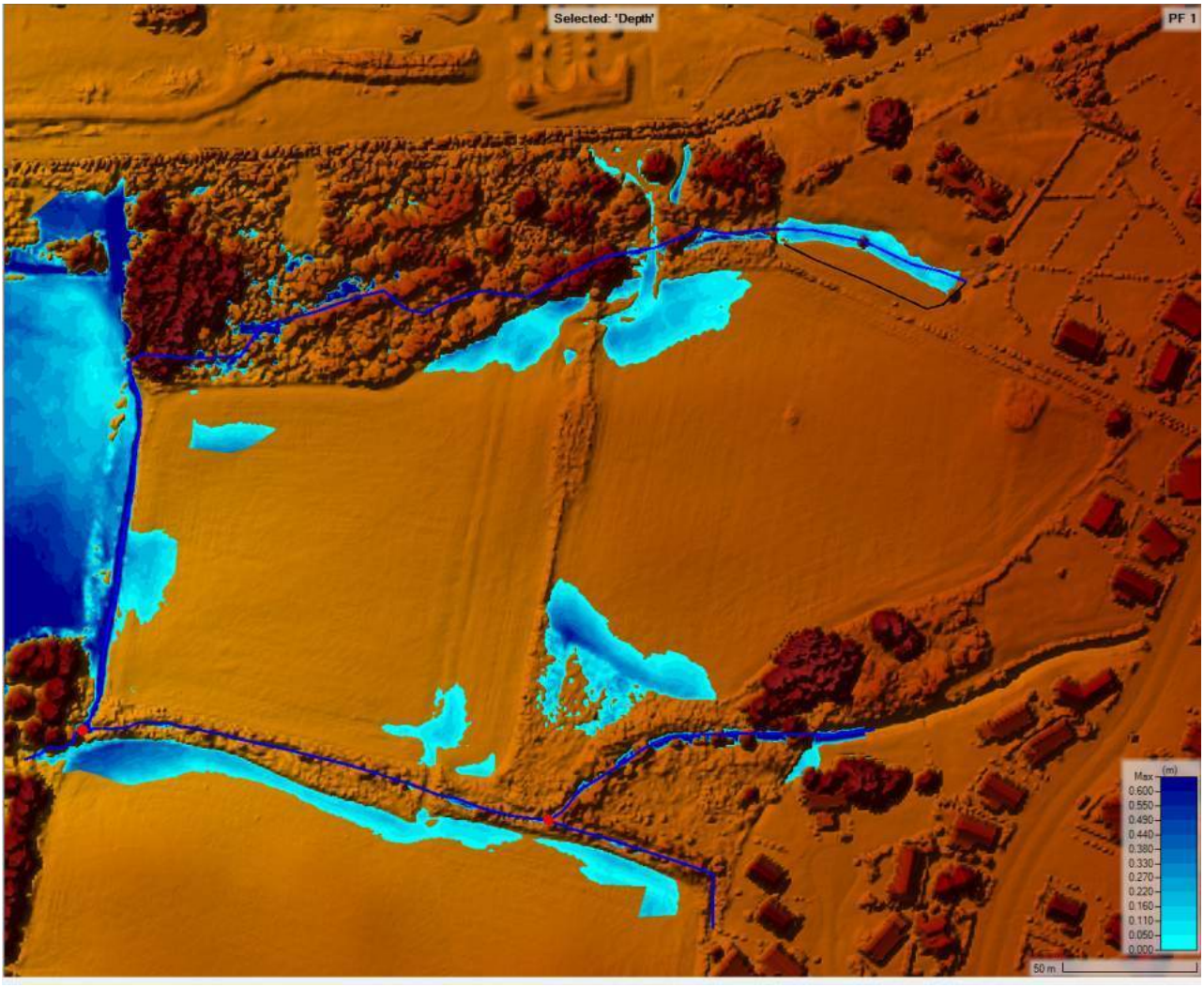

Figure 6 – Modelled 50-year flood extents.

3.1.2. 100-year Flood

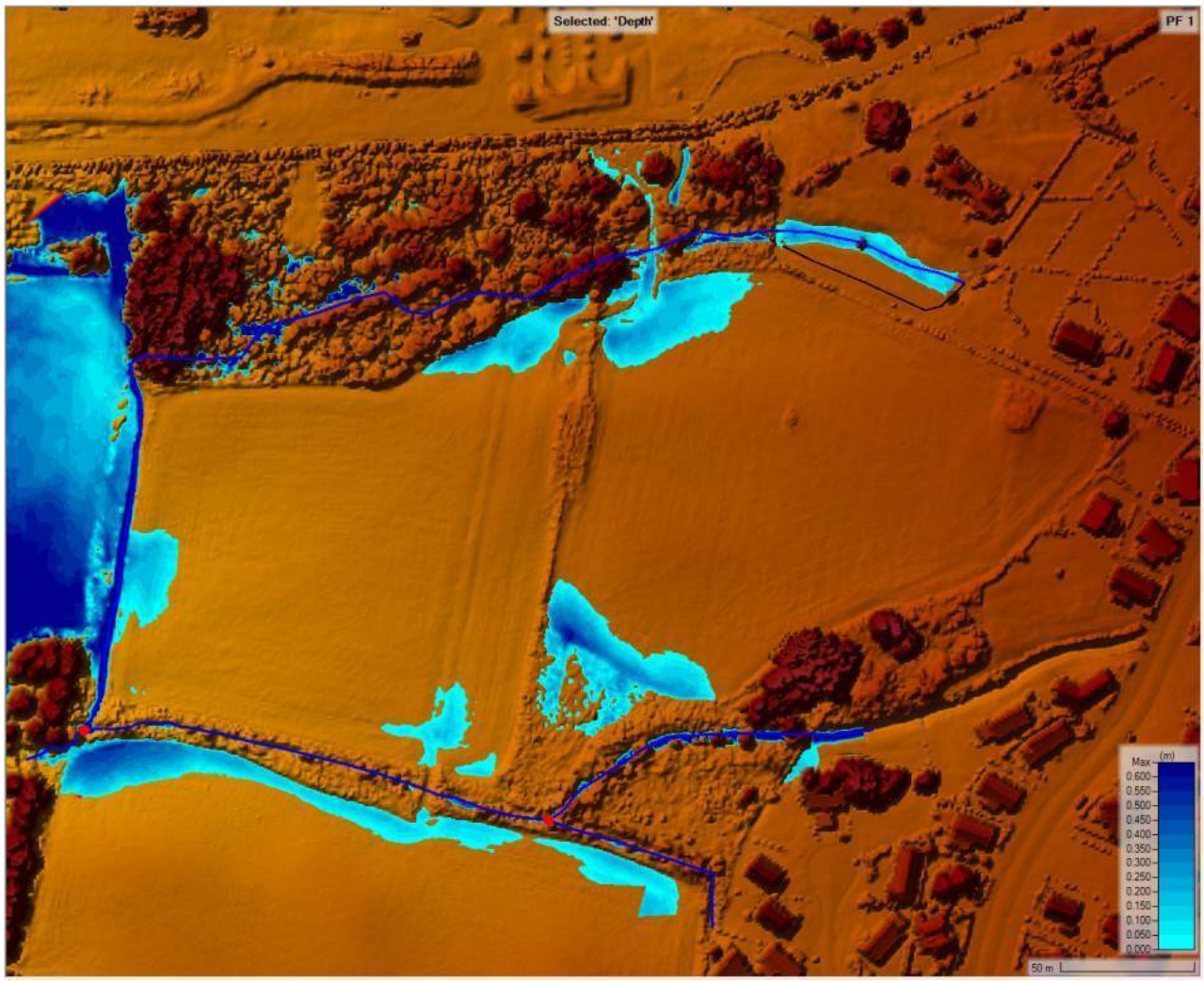

Figure 7 – Modelled 100-year flood extents.

3.1.3. Model Summary

Figures 6 and 7 show that:

- Flooding will occur in localised low-lying areas to a maximum depth of 0.6 m with most of the flooding less than of 0.1 m.
- No water velocities are greater than 0.5 ms^{-1} with the majority being less than 0.2ms^{-1}.
- Hydroflow Express shows that an open channel with a base width of 0.5m with 1:1 side slopes and a depth of 0.8m could contain the current 1:400 ARI storm event for both channels (Calculation found in Appendix 2).

Model results are attached in Enclosure 3.

3.2. Minimum Floor Level

To further mitigate possible inundation risk:

- Drains should be constructed as per the development to the east with two stages to accommodate the MAF (up to 0.15m^3s^{-1}) and the 100-yr storm event (up to 0.4 m^3s^{-1}). An expected channel section can be found in enclosure 3 with a total depth of 0.8 m and a Total width of 7m.

- These channels, once constructed, will determine the ground levels for earthworks within the development which should not be subjected to flooding.

- The current flood level has an approximate RL of 590.2 m. Therefore, **if earthworks filling of low-lying areas was not to occur,** then by local and regional authority rules the minimum **finished floor level should be an RL of 590.7 m**.

- **It is expected with drainage modification and earthworks that the minimum floor level shall be set at 0.3 m above the finished ground level within future lots.**

4. DISCUSSION

- The flooding from the Horizons 1:200 flood model appears to be caused by banks preventing water from entering the current channels (mounds have built up with drain maintenance creating levees either side of the southern open channel), and culvert crossings. The Horizons District Council flood map can be found in Enclosure 4.

- The concept drawings may allow for the possibility of bringing the northern catchment flows to the southern channel through the property.

- The fence line and the western boundary open channel drain are not on the boundary. Relocation will need to be considered during detailed design.

5. SUMMARY

Cheal Consultants Ltd (Cheal) has been engaged by Kainga Ora – Homes and Communities (Client) to undertake a stormwater assessment for a subdivision at 6 Teitei Drive, Ohakune.

The site is largely flat and has been identified by HDC as located in an area at risk of inundation from the 1 in 200-yr flood event.

The Mangateitei Stream is located to the north of the site. The future 50-year and 100-year (equated as the current 200-yr and 400-yr events) flows of the catchments affecting the site have been calculated to be 0.281 m^3s^{-1} and 0.373 m^3s^{-1} , for the northern channel and be 0.303 m^3s^{-1} and 0.404 m^3s^{-1}, for the southern channel, using the method developed by McKercher and Pearson (1989)

utilising the stream gauges found along the Mangawhero River and the New Zealand River Statistics website.

These are the recommendations to mitigate any stormwater flooding hazard onsite:

- The minimum floor level shall be:
  - 590.7 m RL (NZVD 2016 Datum) if no earthworks and drainage modification is undertaken at the site.
  - 0.3 m above finished ground level, if drainage modification was to occur to accommodate larger storm events and earthworks, filling of up to 0.5 m was undertaken to fill in the low-lying areas adjacent to the drains to be modified.

6. DISCLAIMER

This Report has been prepared solely for the use of our client with respect to the particular brief given to Cheal Consultants Limited (Cheal).

No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this Report are the result from the application of accepted industry methods.

CHEAL CONSULTANTS LIMITED
8 March 2023

Enclosure 1

Topography Plan
220528-TP001 Rev A

Survey Control Marks			
Description	RL	Northing	Easting
IS 1	591.71	810099.84	379582.84
M64/A(AGJF)	592.56	810258.48	379596.27
BM XII DP 363875 (EBC5)	592.24	809823.24	379644.71
IS 2	593.47	810007.21	379683.28

AutoCAD

cheal

www.cheal.co.nz

NOTES:

Asbuilt utilities may have other services in close proximity which are not shown for the purposes of this plan. Please identify existing utility locations and depths with the Ruapehu District Council GIS before any field investigation or construction.

Underground services shown here are indicative only. It is the Contractors responsibility to identify existing utility locations and depths prior to construction.

Coordinates are in terms of New Zealand Geodetic Datum 2000, Tuhirangi Circuit.
Reduced Levels are in terms of New Zealand Vertical Datum 2016.
Origin: BM XII DP 363875
809823.24 mN
379644.71 mE
RL: 592.24m
Source: Land Information New Zealand Geodetic Database
Authorised date: 30/11/2018
Calculation Date: 30/11/2018
Contours Interval 0.25 m

Aerial Imagery has been captured with a DJI Matrice M300. Topographic information has been captured with a DJI Matrice M300, a DJI Zenmuse P1 Camera and a DJI Zenmuse L1 LiDAR unit, and a Leica GNSS System.

Areas of dense vegetation may not accurately reflect true ground levels due to obstructing a clear view of the ground beneath.

Aerial Imagery outside the extent of the UAV imagery has been obtained from the Land Information New Zealand and is provided under a Creative Commons Public License. It has been provided as a guide to where other features are positioned, or proposed on the ground, but may not be absolute.

Boundary information has been sourced from DP54909.

Rev	Date	Amendment	By	Chk	App
A	24/11/22	First Issue	GR	BG	GR

Project Title
Kainga Ora
Homes and Communities
6 Teitei Drive, Ohakune

Drawing Title
Topographic Survey of
Lot 2 DP 54909

Surveyed	G.Ripoll	02/11/22	GR
Designed			
Drawn	G.Ripoll	04/11/22	GR
Checked	B.Greer	24/11/22	BG
Approved	G.Ripoll	24/11/22	GR

Status **INFORMATION**

Scale A1
A3 1:1500 | A3

Drawing Number
220528-TP001

Rev
A

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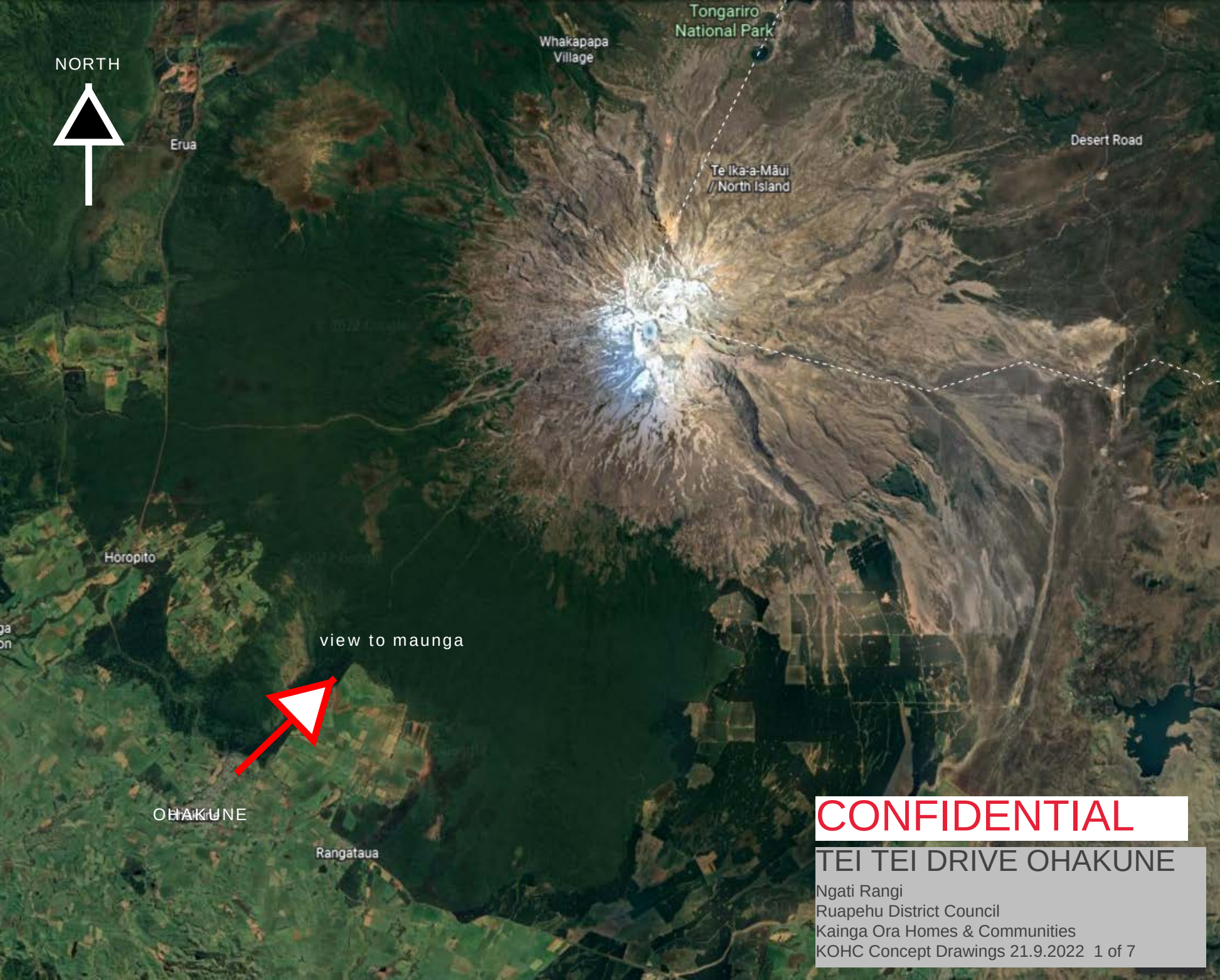
Enclosure 2

Kainga Ora Development Options



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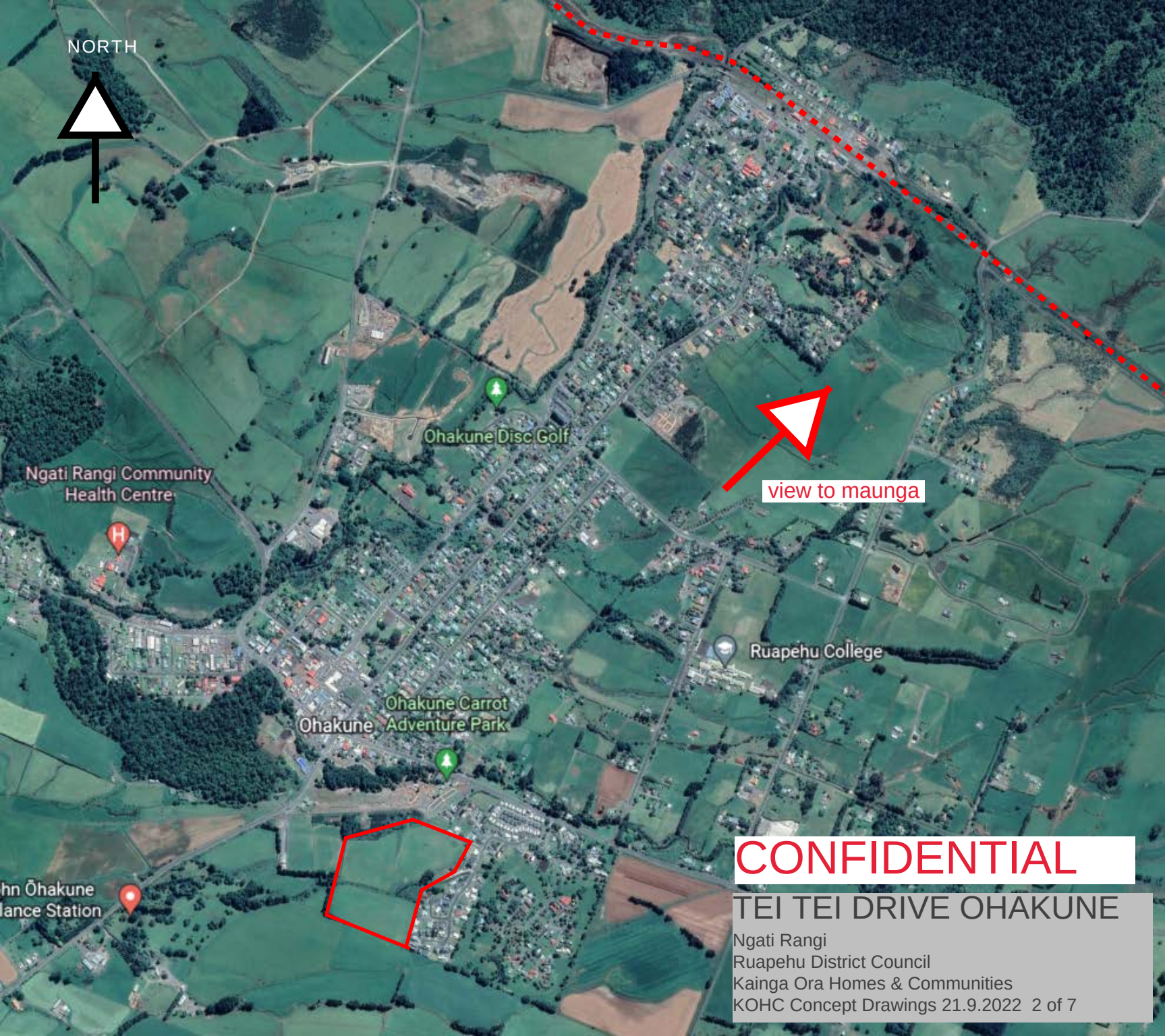
TEI TEI DRIVE OHAKUNE

Ngati Rangi
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022



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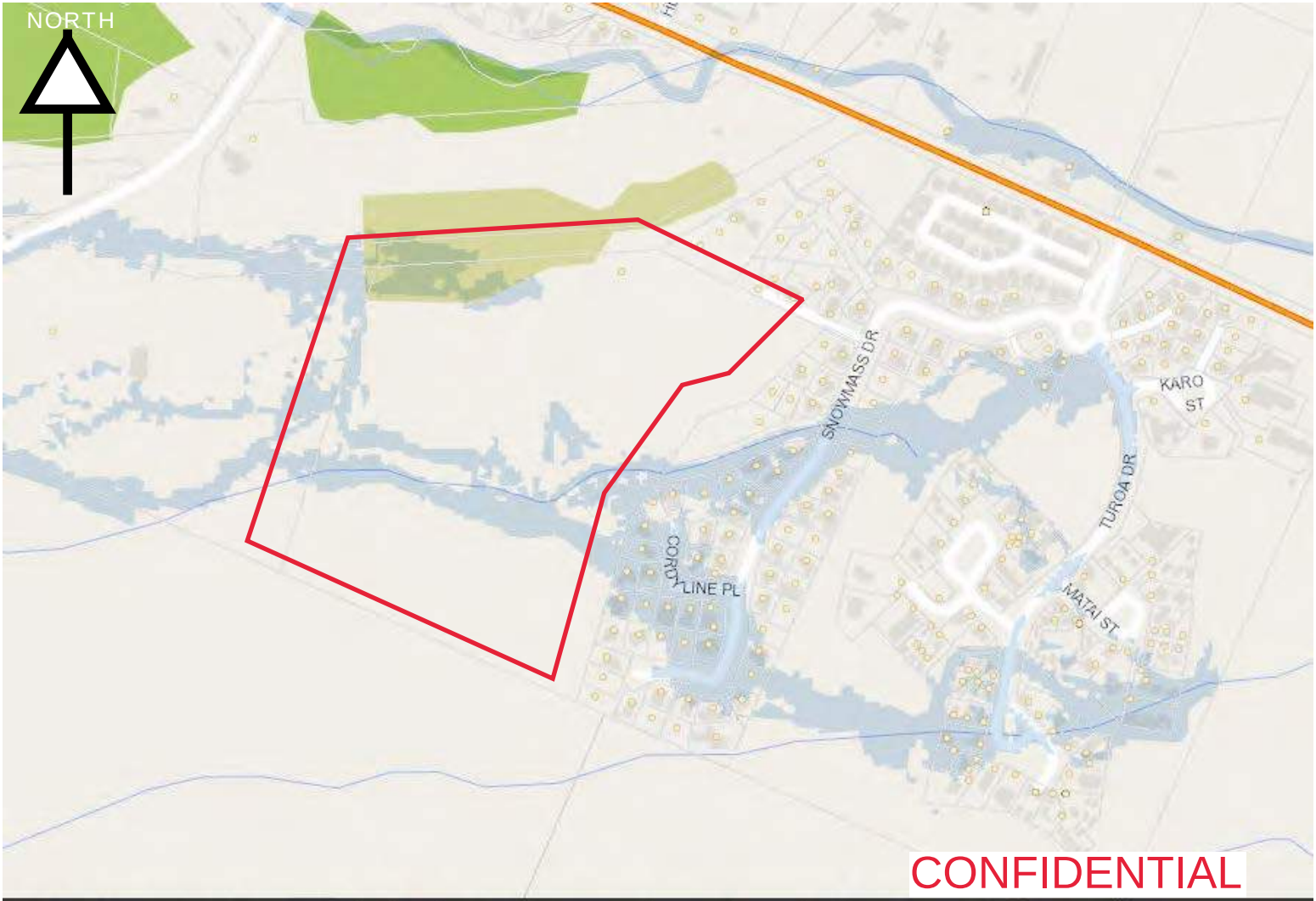
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022 2 of 7



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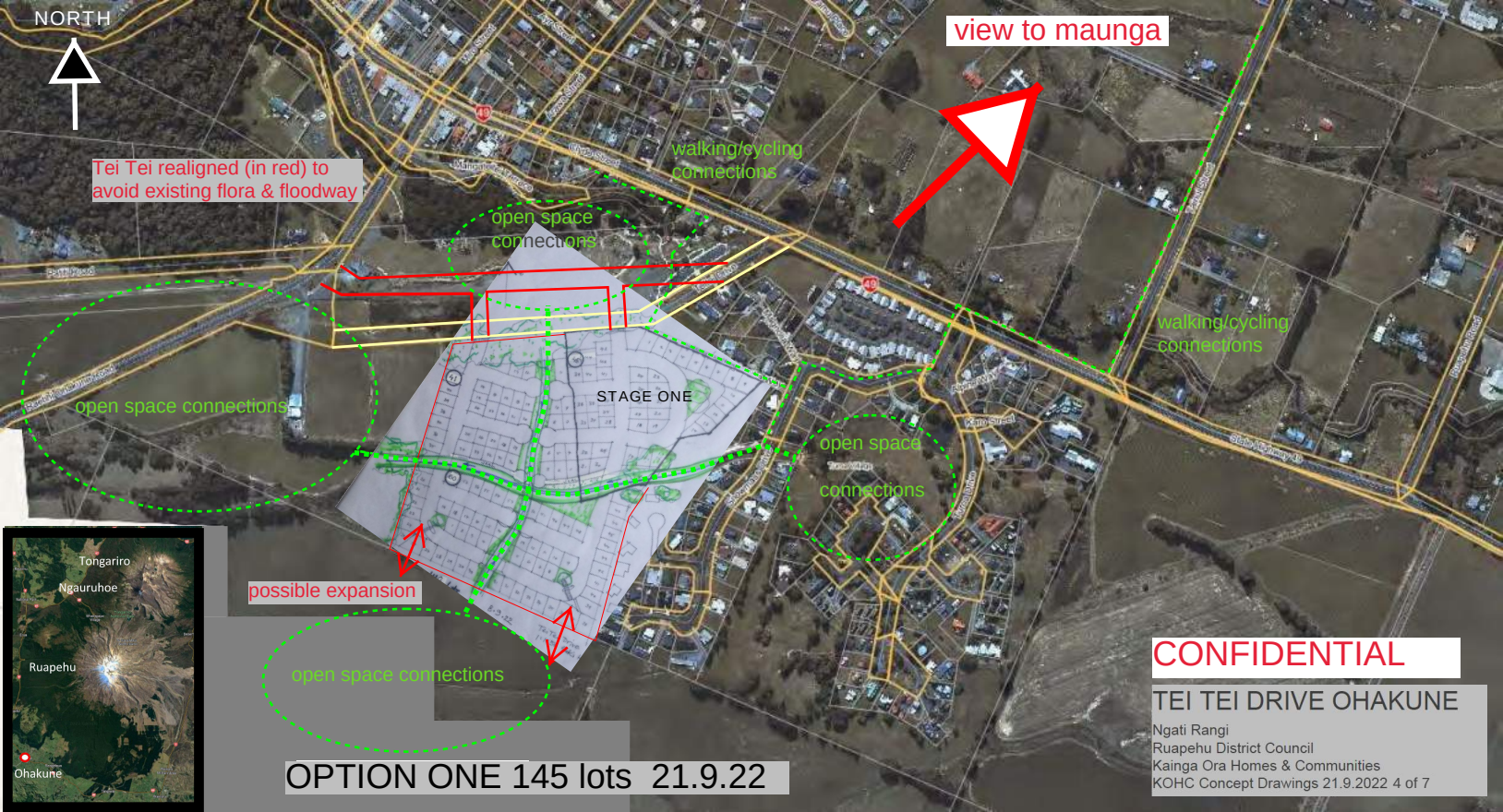
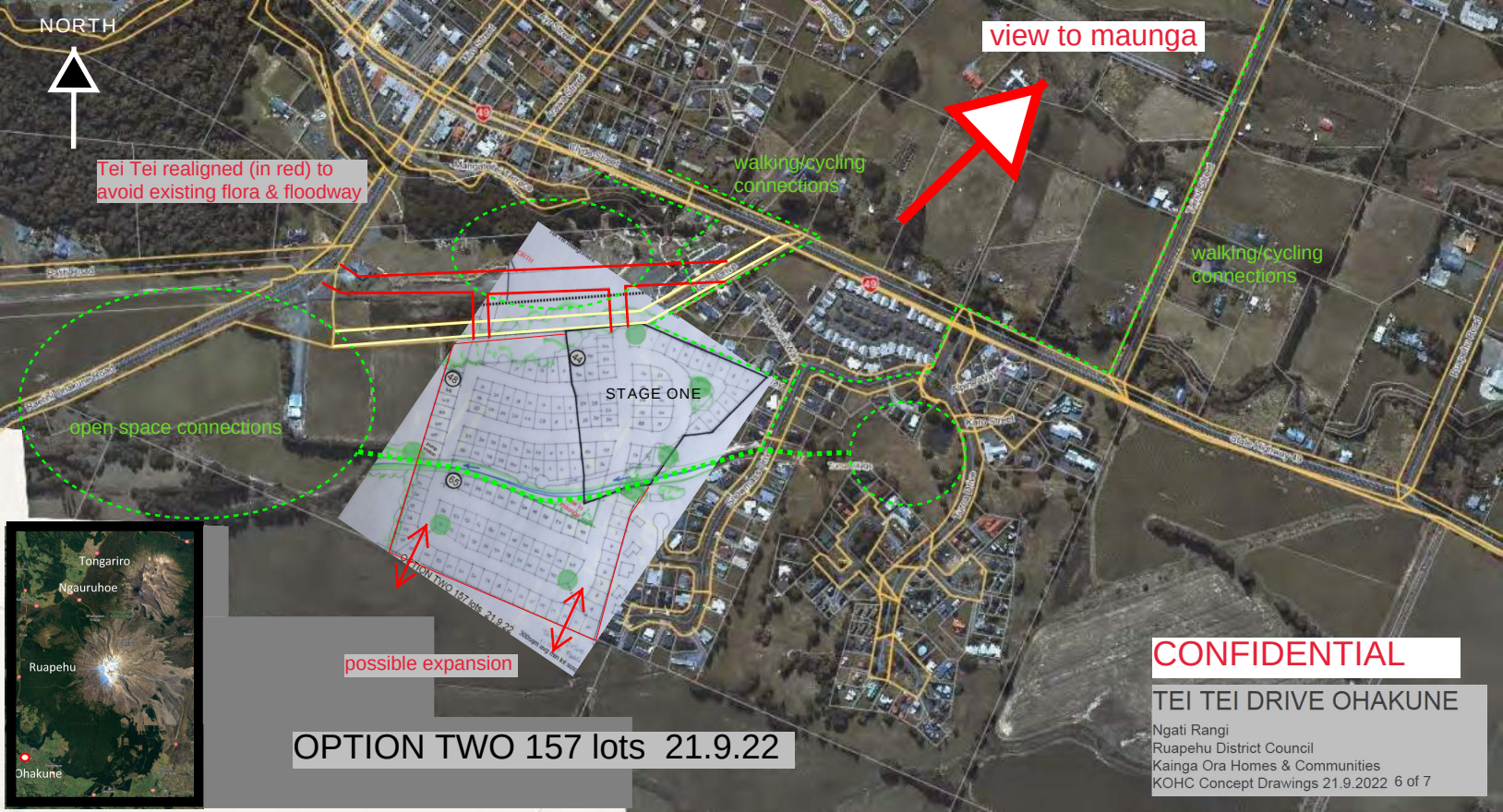
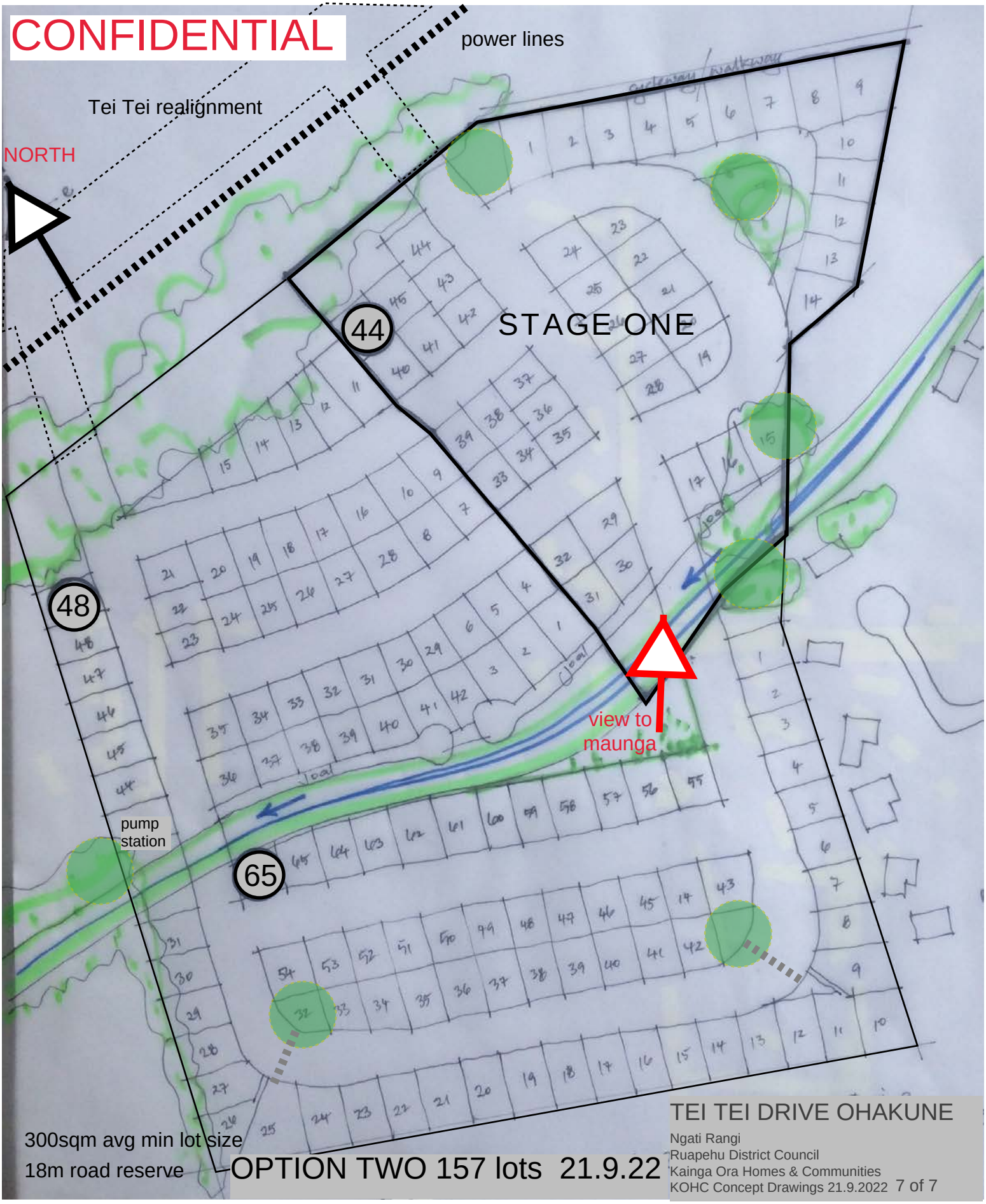
KOHC Concept Drawings 21.9.2022 3 of 7


NORTH
view to maunga
Tei Tei realigned (in red) to avoid existing flora & floodway
walking/cycling connections
open space connections
open space connections
STAGE ONE
walking/cycling connections
open space connections
open space connections
possible expansion
open space connections
Tongariro
Ngauruhoe
Ruapehu
Ohakune
CONFIDENTIAL
TEI TEI DRIVE OHAKUNE
Ngati Rangi
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022 4 of 7
OPTION ONE 145 lots 21.9.22


CONFIDENTIAL
power lines
Tei Tei realignment
NORTH
STAGE ONE
45
40
60
SW run-off into swale
& pedestrian landscape
view to
maunga
pump
station
300sqm avg min lot size
18m road reserve
OPTION ONE 145 lots 21.9.22
TEI TEI DRIVE OHAKUNE
Ngati Rangi
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022


NORTH
Tei Tei realigned (in red) to avoid existing flora & floodway
walking/cycling connections
view to maunga
walking/cycling connections
open space connections
STAGE ONE
possible expansion
OPTION TWO 157 lots 21.9.22
Tongariro
Ngauruhoe
Ruapehu
Ohakune
CONFIDENTIAL
TEI TEI DRIVE OHAKUNE
Ngati Rangi
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022 6 of 7


CONFIDENTIAL
power lines
Tei Tei realignment
NORTH
STAGE ONE
44
48
65
pump station
view to maunga
300sqm avg min lot size
18m road reserve
OPTION TWO 157 lots 21.9.22
TEI TEI DRIVE OHAKUNE
Ngati Rangi
Ruapehu District Council
Kainga Ora Homes & Communities
KOHC Concept Drawings 21.9.2022

Appendix 3

Hydrological & Hydraulic Calculations

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Feb 27 2023

Southern channel existing capacity scection

User-defined

Invert Elev (m)	= 89.0000
Slope (%)	= 0.1000
N-Value	= Composite

Calculations

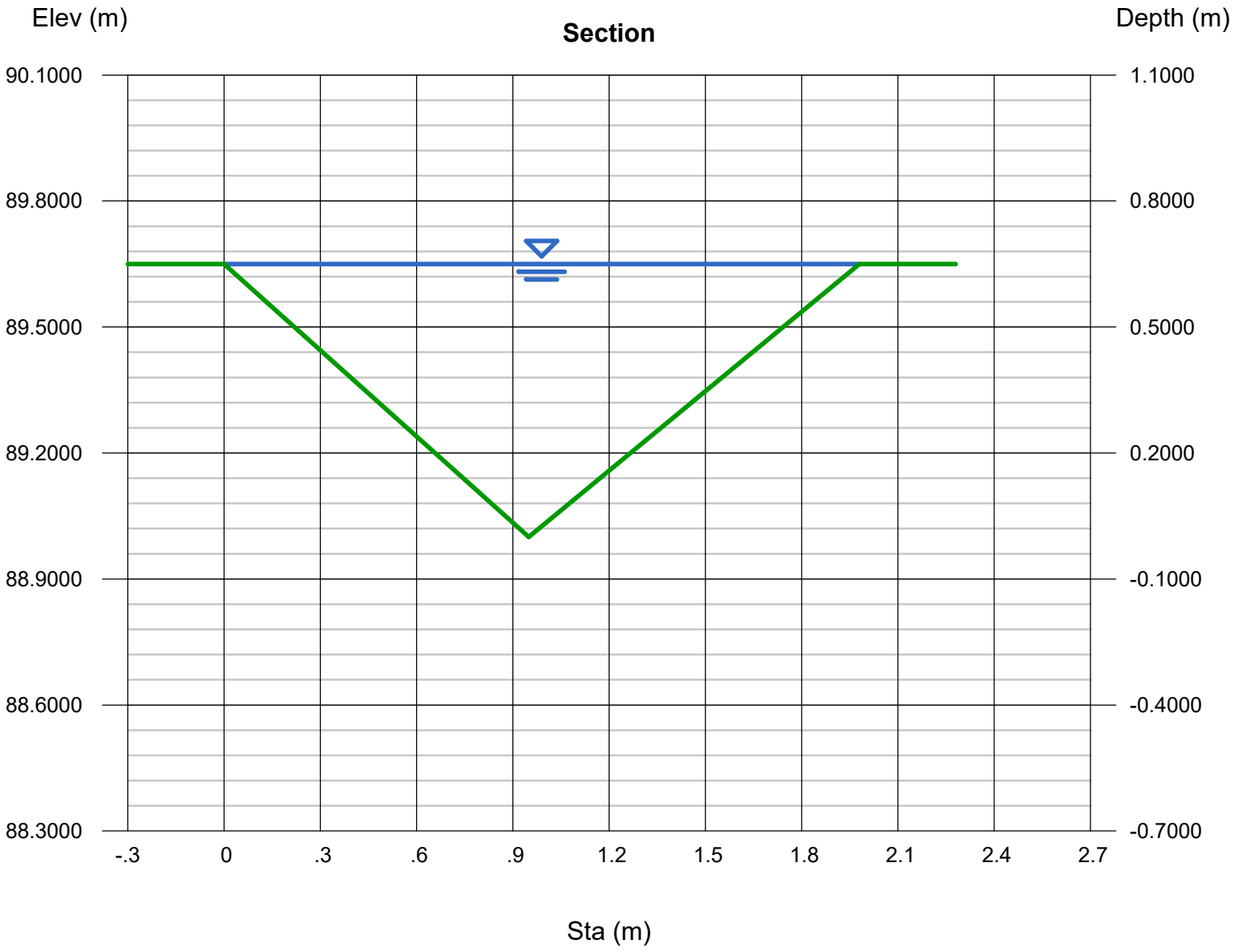
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (m)	= 0.6500
Q (cms)	= 0.085
Area (sqm)	= 0.6435
Velocity (m/s)	= 0.1328
Wetted Perim (m)	= 2.3690
Crit Depth, Yc (m)	= 0.2316
Top Width (m)	= 1.9800
EGL (m)	= 0.6509

(Sta, El, n)-(Sta, El, n)...

(0.0000, 89.6500)-(0.9500, 89.0000, 0.100)-(1.9800, 89.6500, 0.100)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Feb 27 2023

Northern Channel Existing Capacity Section

User-defined

Invert Elev (m)	= 89.0000
Slope (%)	= 0.1000
N-Value	= Composite

Calculations

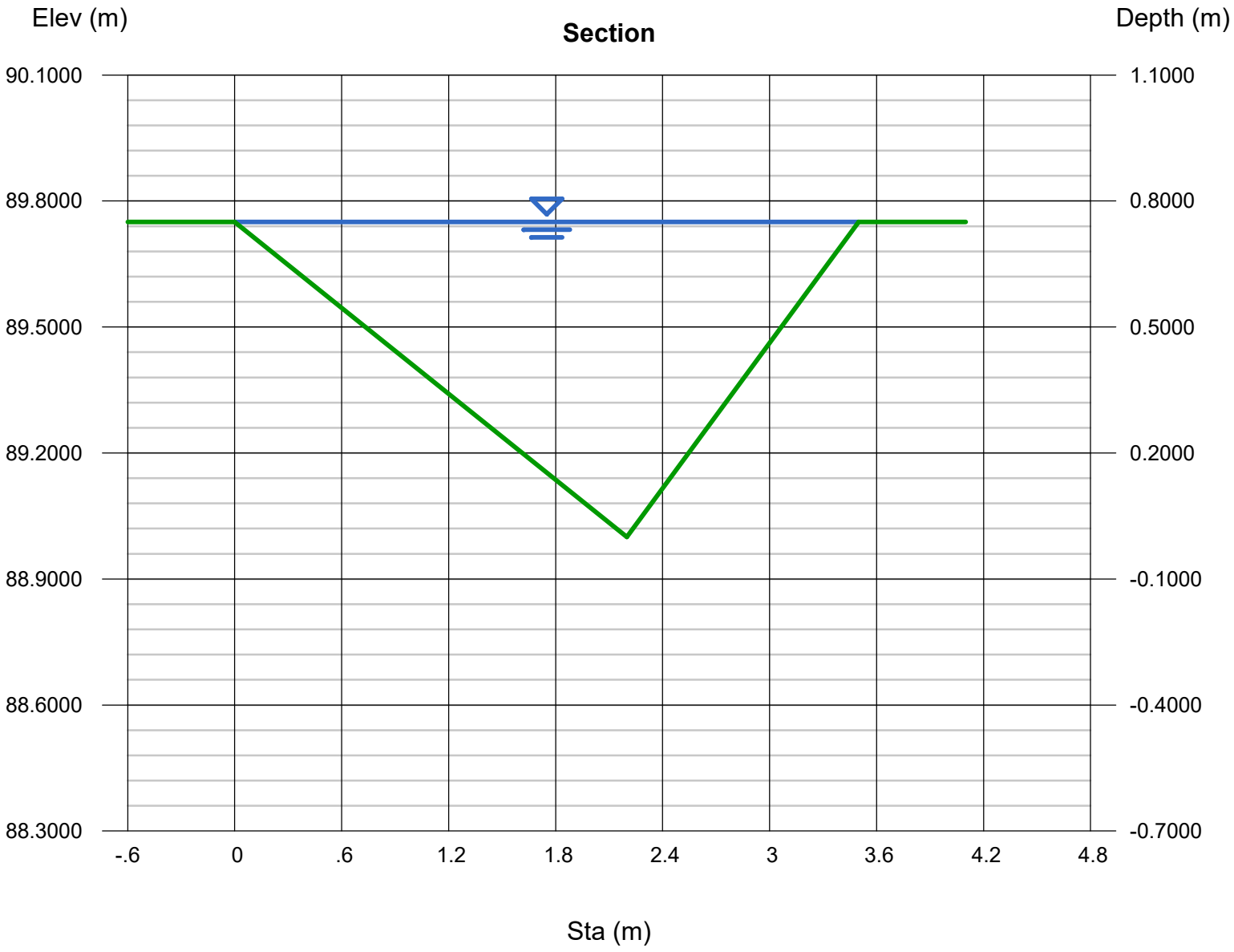
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (m)	= 0.7500
Q (cms)	= 0.204
Area (sqm)	= 1.3125
Velocity (m/s)	= 0.1552
Wetted Perim (m)	= 3.8252
Crit Depth, Yc (m)	= 0.2774
Top Width (m)	= 3.5000
EGL (m)	= 0.7512

(Sta, El, n)-(Sta, El, n)...

(0.0000, 89.7500)-(2.2000, 89.0000, 0.100)-(3.5000, 89.7500, 0.100)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Feb 27 2023

Concept section for future flows

User-defined

Invert Elev (m)	= 89.0000
Slope (%)	= 0.1000
N-Value	= Composite

Calculations

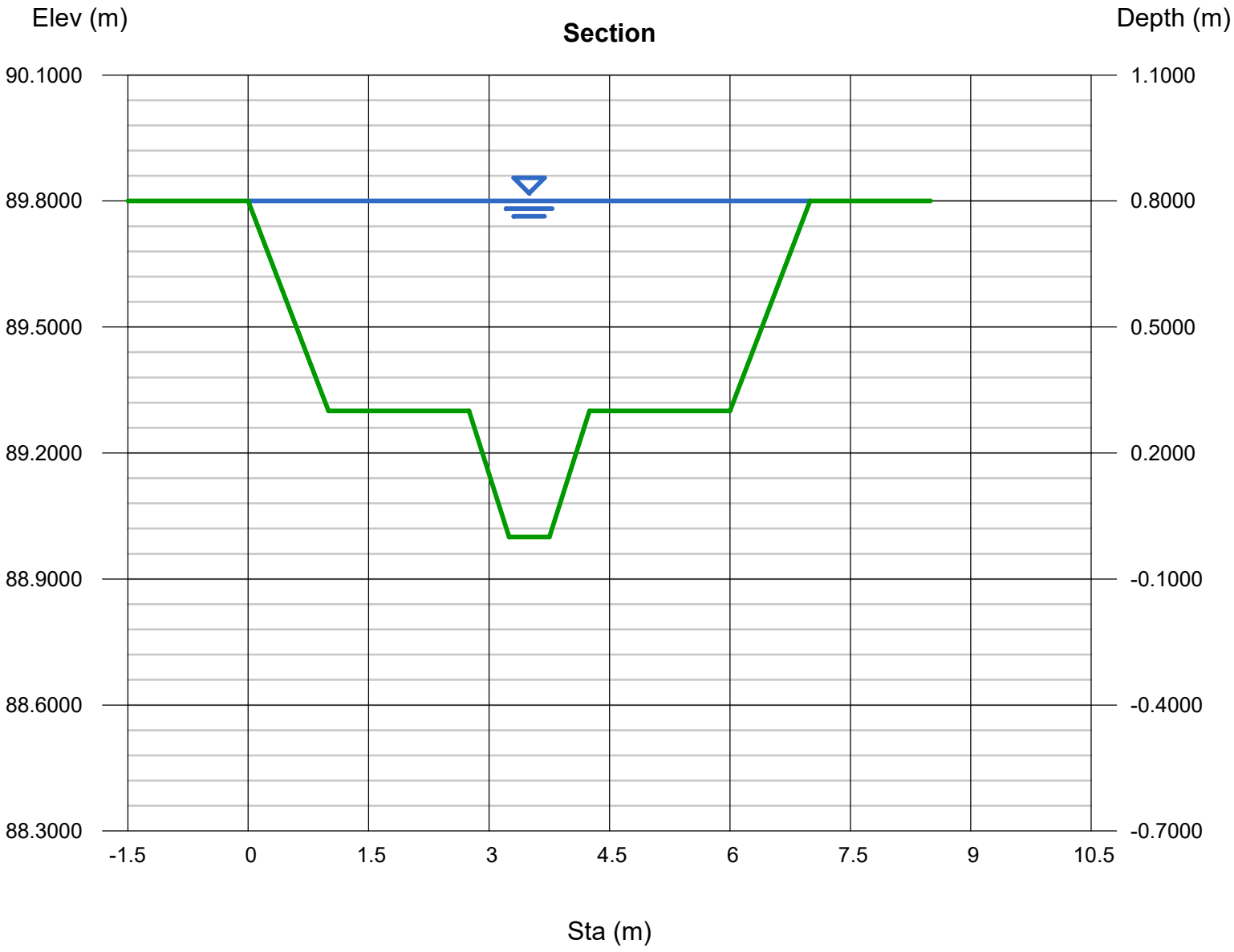
Compute by:	Q vs Depth
No. Increments	= 15

Highlighted

Depth (m)	= 0.8000
Q (cms)	= 0.6098
Area (sqm)	= 3.3000
Velocity (m/s)	= 0.1848
Wetted Perim (m)	= 7.4023
Crit Depth, Yc (m)	= 0.3566
Top Width (m)	= 7.0000
EGL (m)	= 0.8017

(Sta, El, n)-(Sta, El, n)...

(0.0000, 89.8000)-(1.0000, 89.3000, 0.100)-(2.7500, 89.3000, 0.100)-(3.2500, 89.0000, 0.100)-(3.7500, 89.0000, 0.100)-(4.2500, 89.3000, 0.100)-(6.0000, 89.3
-(7.0000, 89.8000, 0.100)



Depth	Q	Area	Veloc	Wp
(m)	(cms)	(sqm)	(m/s)	(m)
0.0533	0.001	0.031	0.0397	0.7073
0.1067	0.004	0.072	0.0583	0.9146
0.1600	0.009	0.123	0.0724	1.1220
0.2133	0.015	0.183	0.0842	1.3293
0.2667	0.024	0.252	0.0948	1.5366
0.3200	0.023	0.401	0.0569	5.2556
0.3733	0.053	0.677	0.0784	5.4942
0.4267	0.093	0.965	0.0965	5.7326
0.4800	0.142	1.265	0.1125	5.9712
0.5333	0.200	1.576	0.1269	6.2097
0.5867	0.266	1.898	0.1401	6.4482
0.6400	0.340	2.231	0.1523	6.6867
0.6933	0.422	2.576	0.1638	6.9252
0.7467	0.512	2.932	0.1746	7.1637
0.8000	0.610	3.300	0.1848	7.4023

Yc	TopWidth	Energy
(m)	(m)	(m)
0.0091	0.6778	0.0534
0.0213	0.8555	0.1068
0.0335	1.0333	0.1603
0.0457	1.2111	0.2137
0.0579	1.3889	0.2671
0.0579	5.0800	0.3202
0.0945	5.2933	0.3736
0.1311	5.5067	0.4271
0.1676	5.7200	0.4806
0.2042	5.9333	0.5342
0.2377	6.1467	0.5877
0.2713	6.3600	0.6412
0.3322	6.5733	0.6947
0.3444	6.7867	0.7482
0.3566	7.0000	0.8017

HEC-RAS Plan: 100 yr plan Profile: PF 1

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Southern Stream	1	257	PF 1	0.20	590.29	590.45	590.36	590.46	0.003280	0.13	1.54	13.92	0.13
Southern Stream	1	225	PF 1	0.20	590.07	590.20		590.21	0.035881	0.36	0.56	6.83	0.40
Southern Stream	1	209	PF 1	0.20	589.80	590.03		590.03	0.005124	0.16	1.29	12.51	0.16
Southern Stream	1	192	PF 1	0.20	589.65	589.73	589.73	589.76	0.269393	0.78	0.26	4.46	1.03
Southern Stream	2	152	PF 1	0.40	589.13	589.25	589.24	589.26	0.014398	0.45	0.89	18.55	0.66
Southern Stream	2	130	PF 1	0.40	588.84	588.98	588.95	588.98	0.010920	0.42	0.96	18.21	0.58
Southern Stream	2	98	PF 1	0.40	588.34	588.47	588.47	588.50	0.021902	0.80	0.50	6.08	0.89
Southern Stream	2	73	PF 1	0.40	587.70	587.83	587.83	587.87	0.028846	0.90	0.45	5.56	1.01
Southern Stream	2	49	PF 1	0.40	587.23	587.43	587.35	587.43	0.004335	0.42	0.97	9.30	0.41
Southern Stream	2	28	PF 1	0.40	587.01	587.43		587.43	0.000050	0.08	4.88	18.56	0.05
Northern Stream	1	496	PF 1	0.30	591.80	592.07	591.95	592.08	0.008171	0.26	1.15	7.16	0.21
Northern Stream	1	485	PF 1	0.30	591.75	591.92		591.93	0.028366	0.40	0.76	6.54	0.37
Northern Stream	1	474	PF 1	0.30	591.48	591.70		591.71	0.014514	0.30	1.01	8.20	0.27
Northern Stream	1	463	PF 1	0.30	591.32	591.48		591.49	0.025467	0.35	0.86	8.30	0.35
Northern Stream	1	449	PF 1	0.30	591.08	591.29		591.30	0.008615	0.26	1.14	7.47	0.22
Northern Stream	1	437	PF 1	0.30	592.00	591.20		591.20	0.008125		1.17	7.51	0.00
Northern Stream	1	420	PF 1	0.30	591.18	591.06		591.07	0.007236		0.82	2.63	0.00
Northern Stream	1	409	PF 1	0.30	591.55	590.91		590.92	0.032721		0.80	12.58	0.00
Northern Stream	1	397	PF 1	0.30	590.84	590.82		590.82	0.003659		1.90	14.77	0.00
Northern Stream	1	384	PF 1	0.30	590.70	590.78		590.78	0.002268	0.05	2.03	13.81	0.09
Northern Stream	1	366	PF 1	0.30	590.67	590.74		590.74	0.002279	0.05	2.49	21.40	0.09
Northern Stream	1	349	PF 1	0.30	590.99	590.61	590.56	590.63	0.055260		0.48	3.27	0.00
Northern Stream	1	330	PF 1	0.30	589.96	590.10		590.11	0.016262	0.28	1.18	13.38	0.28
Northern Stream	1	312	PF 1	0.30	589.58	589.83		589.83	0.013993	0.30	1.07	10.65	0.27
Northern Stream	1	291	PF 1	0.30	589.59	589.62		589.63	0.007022	0.05	1.15	6.47	0.12
Northern Stream	1	265	PF 1	0.30	588.91	589.27		589.29	0.032026	0.57	0.53	2.57	0.40
Northern Stream	1	248	PF 1	0.30	588.20	588.83		588.84	0.021511	0.47	0.64	2.78	0.31
Northern Stream	1	227	PF 1	0.30	587.74	588.81		588.81	0.000368	0.10	3.17	7.88	0.05
Northern Stream	1	206	PF 1	0.30	587.92	588.80		588.80	0.001061	0.13	2.34	8.63	0.08
Northern Stream	1	189	PF 1	0.30	587.99	588.70	588.70	588.74	0.315990	0.82	0.37	5.52	1.01
Northern Stream	1	169	PF 1	0.30	587.12	587.44	587.27	587.44	0.000550	0.07	4.47	28.31	0.05
Northern Stream	1	141	PF 1	0.30	586.19	587.44		587.44	0.000048	0.03	12.02	53.66	0.02
Northern Stream	1	132	PF 1	0.30	586.11	587.44		587.44	0.000019	0.02	15.63	52.21	0.01
Northern Stream	1	112	PF 1	0.30	585.95	587.44		587.44	0.000008	0.02	19.81	47.52	0.01
Northern Stream	1	90	PF 1	0.30	585.79	587.44		587.44	0.000004	0.01	26.17	62.72	0.01
Northern Stream	1	72	PF 1	0.30	586.00	587.44		587.44	0.000004	0.01	25.00	50.93	0.01
Northern Stream	1	53	PF 1	0.30	586.17	587.44		587.44	0.000003	0.01	22.19	30.81	0.01
Northern Stream	1	43	PF 1	0.30	586.14	587.44		587.44	0.000108	0.07	4.55	6.94	0.03

HEC-RAS Plan: 100 yr plan Profile: PF 1 (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Northern Stream	1	36	PF 1	0.30	585.91	587.43		587.44	0.000422	0.12	2.51	4.35	0.05
Northern Stream	2	16	PF 1	0.71	593.39	587.42		587.42	0.000738		2.27	8.51	0.00
Northern Stream	2	7	PF 1	0.71	587.19	587.33	587.33	587.40	0.020954	0.71	0.64	4.87	0.83
Northern Stream	2	1	PF 1	0.71	586.39	586.55	586.68	587.06	0.226182	3.14	0.23	1.96	2.95
Central Stream	1	127	PF 1	0.20	589.60	590.76	589.88	590.76	0.000140	0.08	2.58	4.14	0.03
Central Stream	1	111	PF 1	0.20	589.41	590.75		590.75	0.000076	0.06	3.30	4.88	0.02
Central Stream	1	92	PF 1	0.20	589.58	590.75		590.75	0.000119	0.07	2.73	4.25	0.03
Central Stream	1	74	PF 1	0.20	590.67	590.73	590.73	590.74	0.218406	0.49	0.42	12.33	0.85
Central Stream	1	55	PF 1	0.20	589.42	590.19	589.64	590.19	0.000349	0.06	3.22	15.94	0.04
Central Stream	1	43	PF 1	0.20	589.72	590.18		590.18	0.000027	0.02	11.19	55.08	0.01
Central Stream	1	33	PF 1	0.20	590.00	590.17		590.18	0.126106	0.46	0.44	9.04	0.67
Central Stream	1	18	PF 1	0.20	589.38	589.82		589.83	0.009763	0.38	0.53	1.95	0.23

Hydrological Catchment Analysis

Stream Name: **Northern Channel**
Reference: 220528 Kainga Ora Ohakune
Location: 6 Teitei Drive Northern Catchment
Calculated: R Kilgour **Date:** 8-Mar-23

FFINZ

Area: A = 0.2 km²

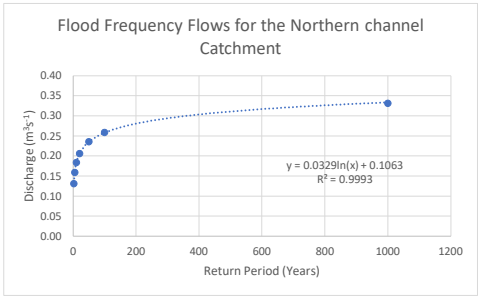
Comparative Catchment Area: NZREACH 7017262, A2 = 1.46 km²

		2.33 year	5 year	10 year	20 year	50 year	100 year	1000 year
Comparison flow	Q2	0.7	0.9	1.0	1.1	1.3	1.4	1.8
Subject flow rate	Q1	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**

Design Method Selected:

	2.33 year	5 year	10 year	20 year	50 year	100 year	1000 year	
FFINZ	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	m^3/s

2.33	5	10	20	50	100	1000
0.13	0.16	0.18	0.21	0.24	0.26	0.33



Hydrological Catchment Analysis

Stream Name: **Southern Channel**
Reference: 220528 Kainga Ora Ohakune
Location: 6 Teitei Drive Southern Catchment
Calculated: R Kilgour **Date:** 20-Oct-21

FFINZ

Area: A = 0.26 km²

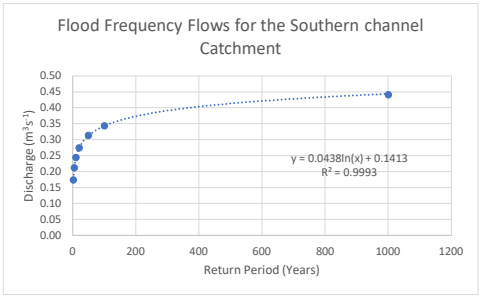
Comparative Catchment Area: NZREACH 7017262, A2 = 1.46 km²

		2.33 year	5 year	10 year	20 year	50 year	100 year	1000 year
Comparison flow	Q2	0.7	0.9	1.0	1.1	1.3	1.4	1.8
Subject flow rate	Q1	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.4**

Design Method Selected:

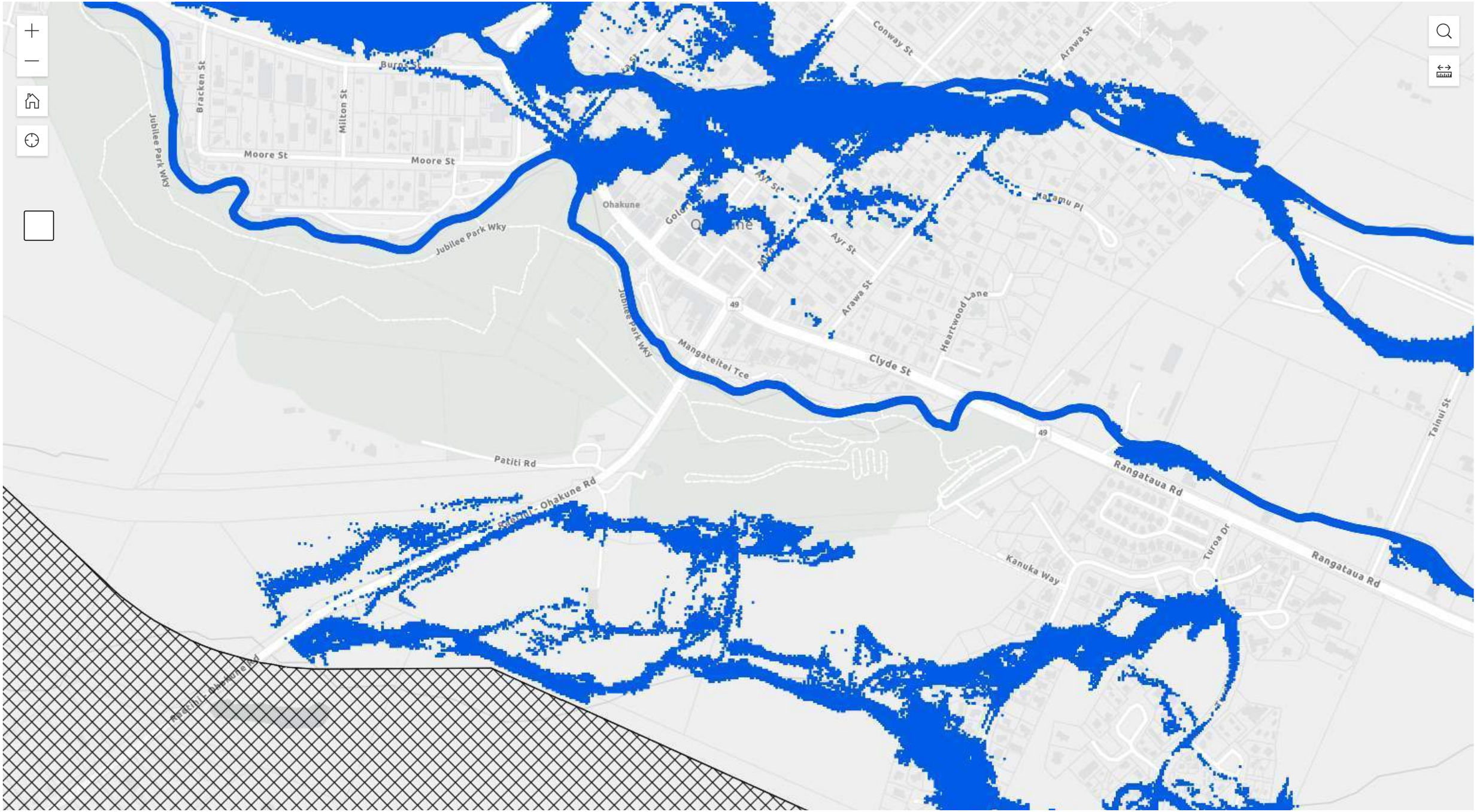
	2.33 year	5 year	10 year	20 year	50 year	100 year	1000 year	
FFINZ	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.4**	m^3/s

2.33	5	10	20	50	100	1000
0.17	0.21	0.24	0.27	0.31	0.34	0.44



Appendix 4

Horizons District Council 1
in 200-yr Flood Map



Horizons region modelled wet extents from flood plain mapping analysis

Map navigation tools are at top-left.
Search and **measurement** tools are at top-right.

Appendix 7

Mott McDonald - Ohakune Wastewater Network Modelling – Static Capacity Assessment

MOTT MACDONALD

Ohakune Wastewater Network Modelling

Static Capacity Assessment

Project:	Ohakune Wastewater Network Modelling		
Our reference:	424652	**Your reference:**	P.O. 7300139267
Prepared by:	Catherine Dagan	**Date:**	March 2022
Approved by:	Sarah Davies	**Checked by:**	Tom Lecomte
Subject:	Static Capacity assessment		

1 Introduction

As an alternative to the model calibration and system performance assessment, the development of a static model is commonly used and often preferred to evaluate the impact of new developments on the existing wastewater system.

Static models have the advantage of being rapidly set up and are still considered as the most reliable approach to assess the capacity of the extremities of a network. This approach is however proven to be conservative for the most downstream parts of the network.

In this assessment, the static model of Ohakune wastewater network is to be used to determine the theoretical ability of the network to accept future growth and development, which is particularly relevant for Ruapehu District Council to respond to resource consents.

The analysis will highlight and prioritise the parts of the system predicted to be impacted the most by the forecasted population growth. However, the approach is not suitable to accurately assess the pipe surcharge, or the volume spilled at the uncontrolled overflows. This assessment will be achieved once the system performance of the calibrated model is undertaken.

2 Model update

The existing (2021) scenario of the static model was developed from the Ohakune model used for the on-going calibration.

Two additional scenarios were implemented to represent the 2026 and 2031 population growth.

2.1 Wastewater network

The model is built based on the GIS asset data provided in April 2021, with the amendments implemented during the model build and the on-going calibration on the missing or unreliable data.

No committed projects have been modelled as part of this capacity assessment.

2.2 Population growth

The population projection, presented in Table 2.1, was extracted from the 'Ruapehu District Council Growth Projections 2020-2031 dated January 2021 (Ohakune)' with the amendment provided in December 2021. The assumptions and distribution methodology are consistent with the approach used in the water supply network model study completed in 2021, see '*Okahune Township Water Supply Network Model, Mott MacDonald, Version C, December 2021*'.

Table 2.1: Ohakune peak population 10-year forecast

	2021	2026	2031
Peak Population[1]	9,544	10,773	12,010

1: Peak population includes 1) Usually resident population, 2) Holiday home, 3) Overnight visitors, and 4) Other visitors.

The new growth areas and connection points to the existing wastewater network are shown in Figure 2.1.

2.3 Design flows

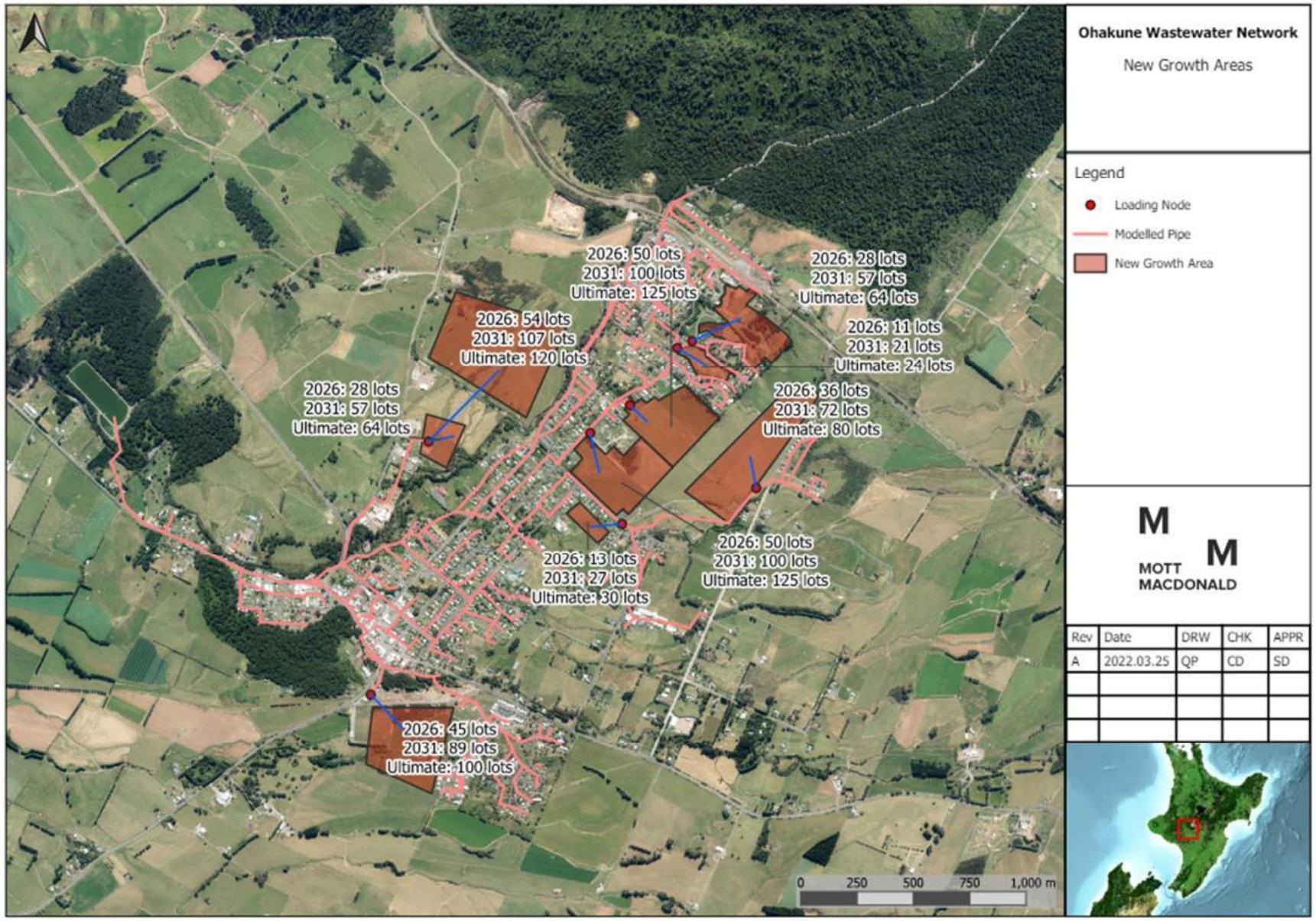
Static model uses design flows, which parameters were taken from the '*NZS 4404:2010 Land Development and Subdivision Infrastructures, October 2010'* section 5.3.5.1:

- Average dry weather flow (ADWF) of 180 litres per day per person (NZS 4404:2010 recommends an ADWF of 180 to 250 l/d/person).
- Dry weather diurnal peak factor of 2.5.
- Dilution/infiltration factor of 2 for peak wet weather.

Two design flows were utilised in this capacity assessment:

1. Peak Dry Weather Flow (PDWF), implemented in the model as constant flows of 360l/d/pers. and associated to the distributed residential population, and
2. Peak Wet Weather Flow (PWWF), implemented in the model as constant flows of 900l/d/pers. and associated to the distributed residential population.

Figure 2.1: Ohakune new growth areas



3 Peak dry weather flow capacity assessment

The static capacity assessment for the PDWF is shown in Figure 3.1 to Figure 3.3.

No overflow is predicted during static peak dry weather flow.

Three areas are showing pipe surcharge in PWDF conditions for the existing (2021) and/or future (2026 & 2031) peak population scenarios – see Figure 3.3 for the location of the issue areas:

- PDWF1: Vicinity of Snowmass Rd pump station:
  - The pipeline upstream of Snowmass Rd pump station is expected to be surcharged. However, the surcharge is due to a limitation of the static models as flows are represented as constant peak flows over the day while in reality the peak would only last a few hours. This surcharge can be disregarded.
  - The pipeline downstream of the pump station is also shown as surcharged; the pump rate implemented in the model comes from the rates provided by the manufacturer and might be overestimated.
- PDWF2: 150mm diameter pipe ID 20210420102443 connected to the Ø375mm main branch on Burns Rd close to the wastewater treatment plant (WWTP) is also predicted to be surcharged. However, no levels were available for that branch in the GIS asset data; the simulation results need therefore to be considered with reservation.
- PDWF3: A third area is predicted to be surcharged in the 2031 peak population scenario, between Ayr St and Rata St due to a particularly slack gradient (0.00027m/m) of pipe ID 1000697. Please note the levels provided in GIS asset data were unreliable and had to be interpolated, which means that the predicted surcharge is to be considered with caution.

The Ohakune wastewater system is predicted to have sufficient capacity to convey the peak dry weather design flows. No overflows are expected, and only a few areas appear to be surcharged. However, the uncertainties around the pipe gradients, the Snowmass Rd pump station capacity as well as the conservative nature of the approach are likely to overpredict the peak dry weather flows and the pipe surcharge.

Figure 3.1: Static capacity assessment – Current (2021) peak population – PDWF

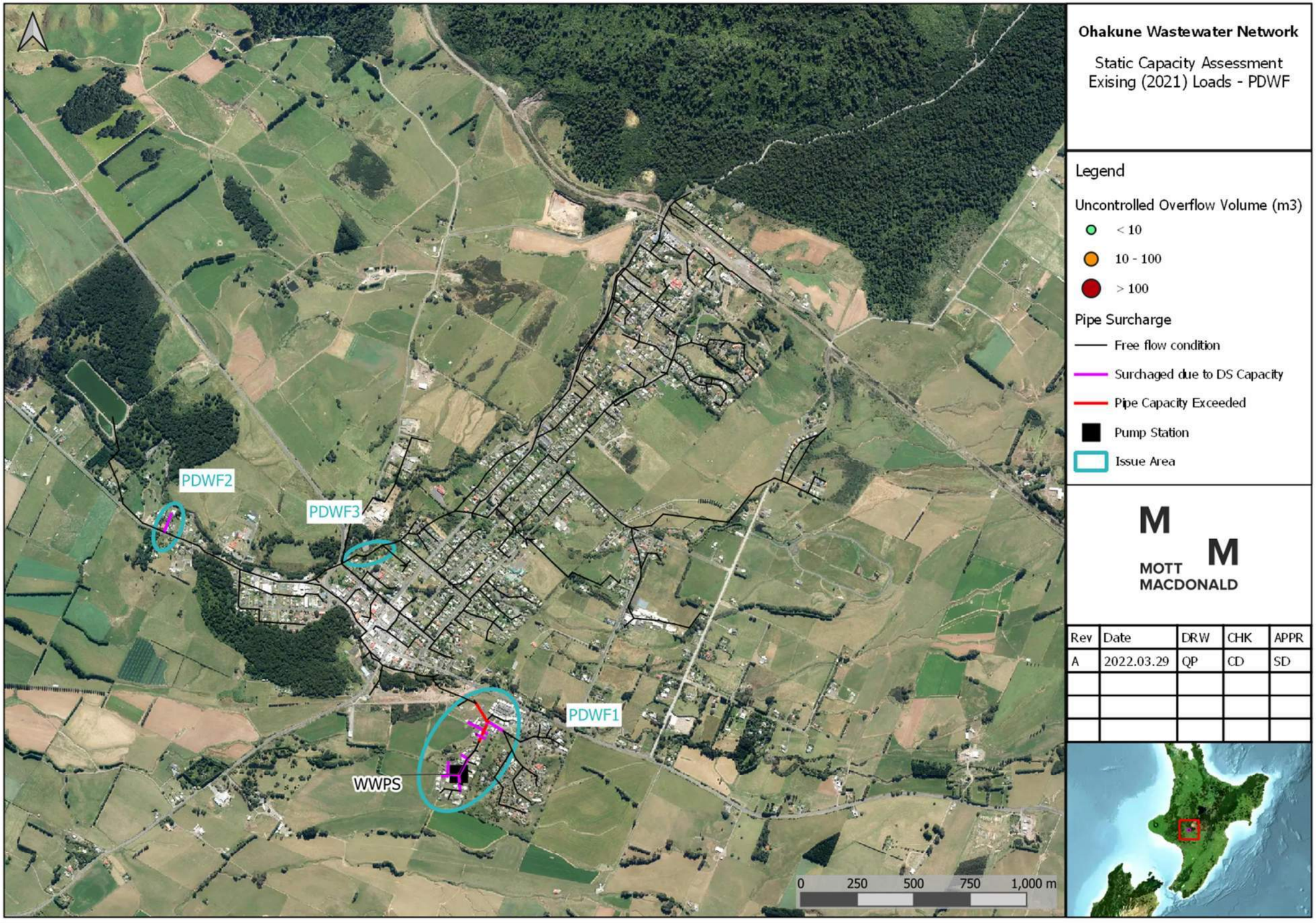


Figure 3.2: Static capacity assessment –2026 peak population – PDWF

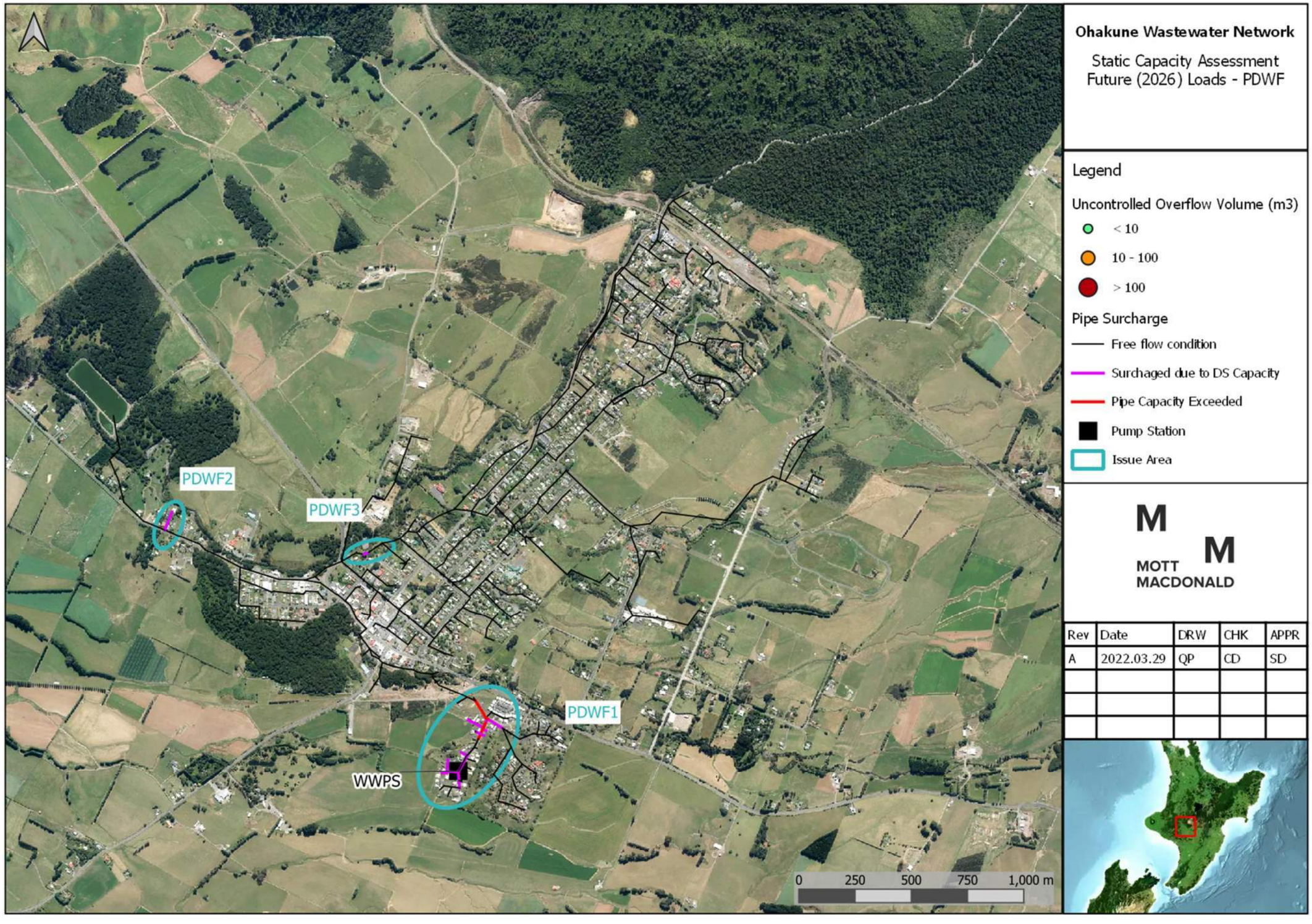
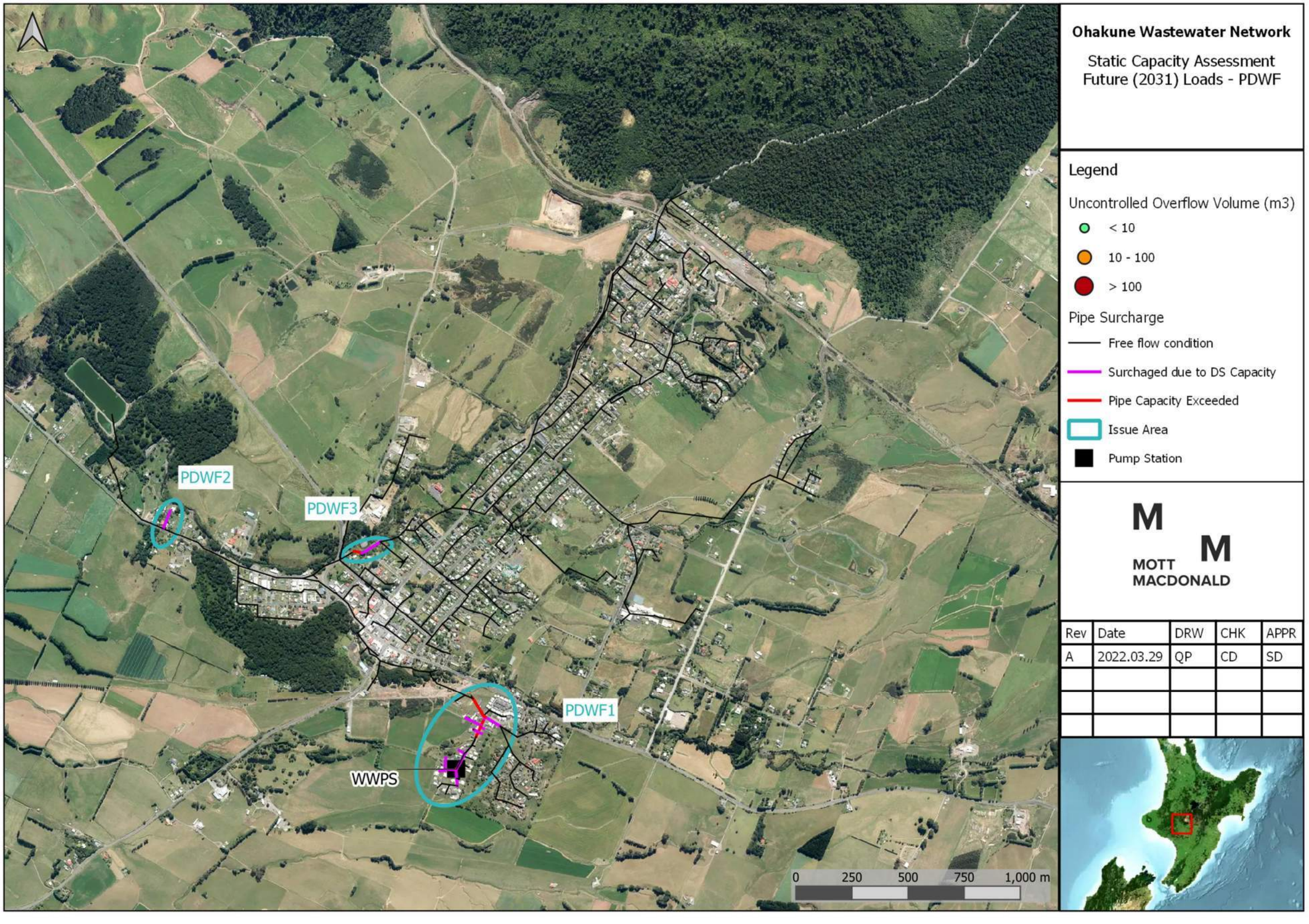


Figure 3.3: Static capacity assessment –2031 peak population – PDWF



4 Peak wet weather flow capacity assessment

The static capacity assessment for the PWWF is shown in Figure 4.1 to Figure 4.3.

One uncontrolled overflow is predicted in the current (2021) and future (2026 & 2031) scenarios, on the Ø150mm on Southridge Dr upstream of its intersection with Miro St, at manhole ID2001180. The overflow is due to the shallow ground cover of 0.77m observed at the manhole. However, Veolia Operational team mentioned that no overflows were observed on the Ohakune wastewater system, which implies that the peak wet weather factor of 2 used in this analysis is probably too conservative compared to the actual intrusion of Inflow and Infiltration (I&I) in the Ohakune wastewater system.

The table below summarises the uncontrolled overflows predicted in PWWF conditions.

Table 4.1: Ohakune predicted uncontrolled overflow daily volume.

Manhole ID	Daily volume spilled (m^3)		
	2021	2026	2031
2001180	5	135	190
2000757	-	8	93
2001867	-	-	430

Despite the conservative aspect of this assessment, it is most likely that the following parts of the network will not have sufficient capacity to convey the additional flows from the population growth, see Figure 4.3 for the location of the issue areas.

- PWWF1: ~300m of the Ø150mm pipeline along Miro St, upstream of its change of diameter to Ø225mm.
- PWWF2: ~300m of the Ø250mm pipeline and ~300m of the Ø300mm pipeline at the bottom of Tikouka Pl and Tay St.
- PWWF3: The Ø375mm pipeline along Burns St. This branch is predicted to be surcharged at a couple of low-gradient conduits but presents sufficient ground cover to prevent any overflow to occur.

The Ohakune wastewater system is predicted to show insufficient capacity to convey the peak wet weather design flows, with multiple pipes surcharged, as well as a few uncontrolled overflows. The situation will worsen with the additional flows from the future (2026 and 2031) peak population. The main areas of concern are along Park Avenue, along Burns St (close to the WWTP) and at the bottom of Tikouka Pl. However, it is important to put the results into perspective noting the conservative nature of the static approach, especially for the further downstream of the pipe network.

Figure 4.1: Static capacity assessment – Current (2021) peak population – PWWF

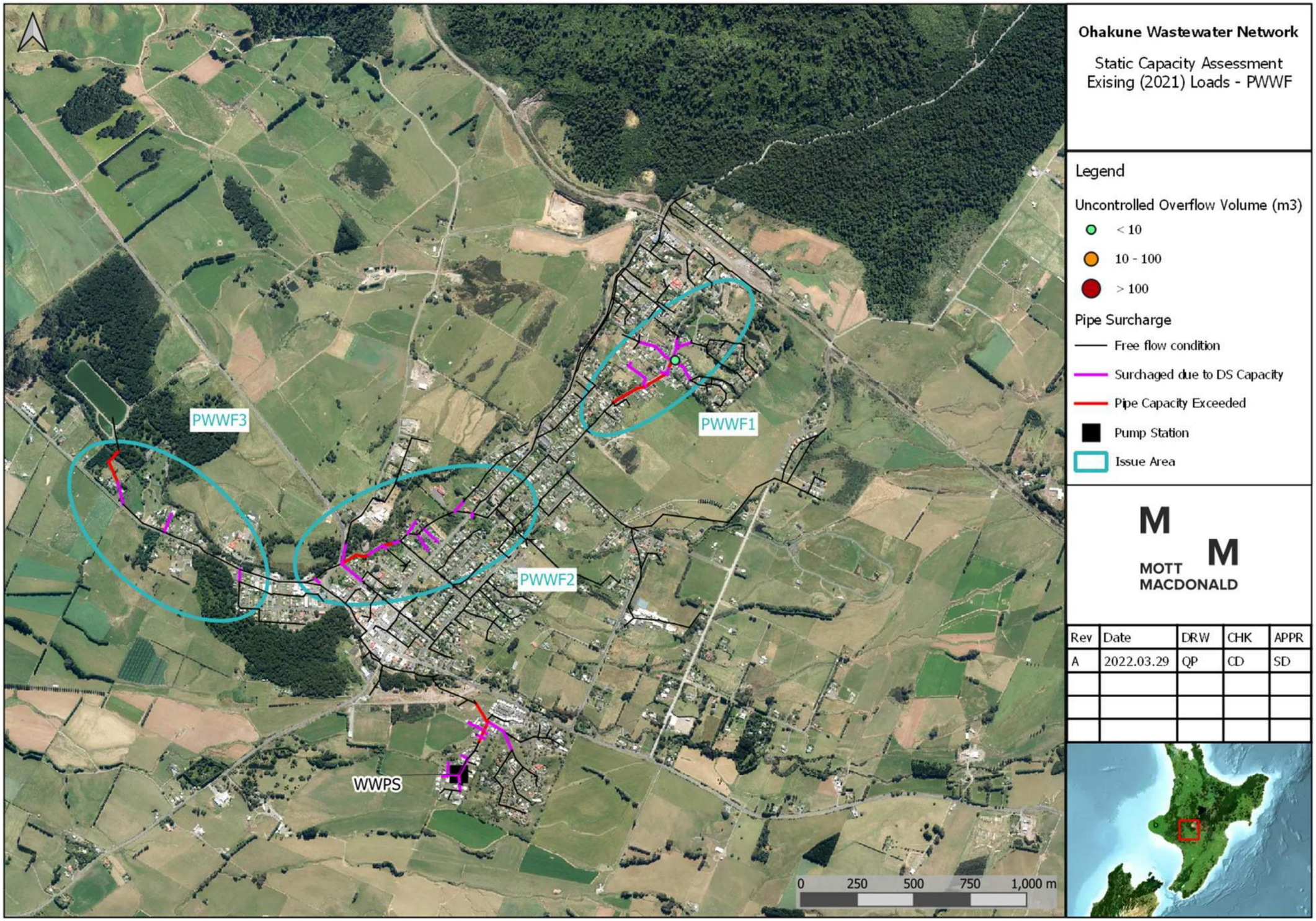


Figure 4.2: Static capacity assessment –2026 peak population – PWWF

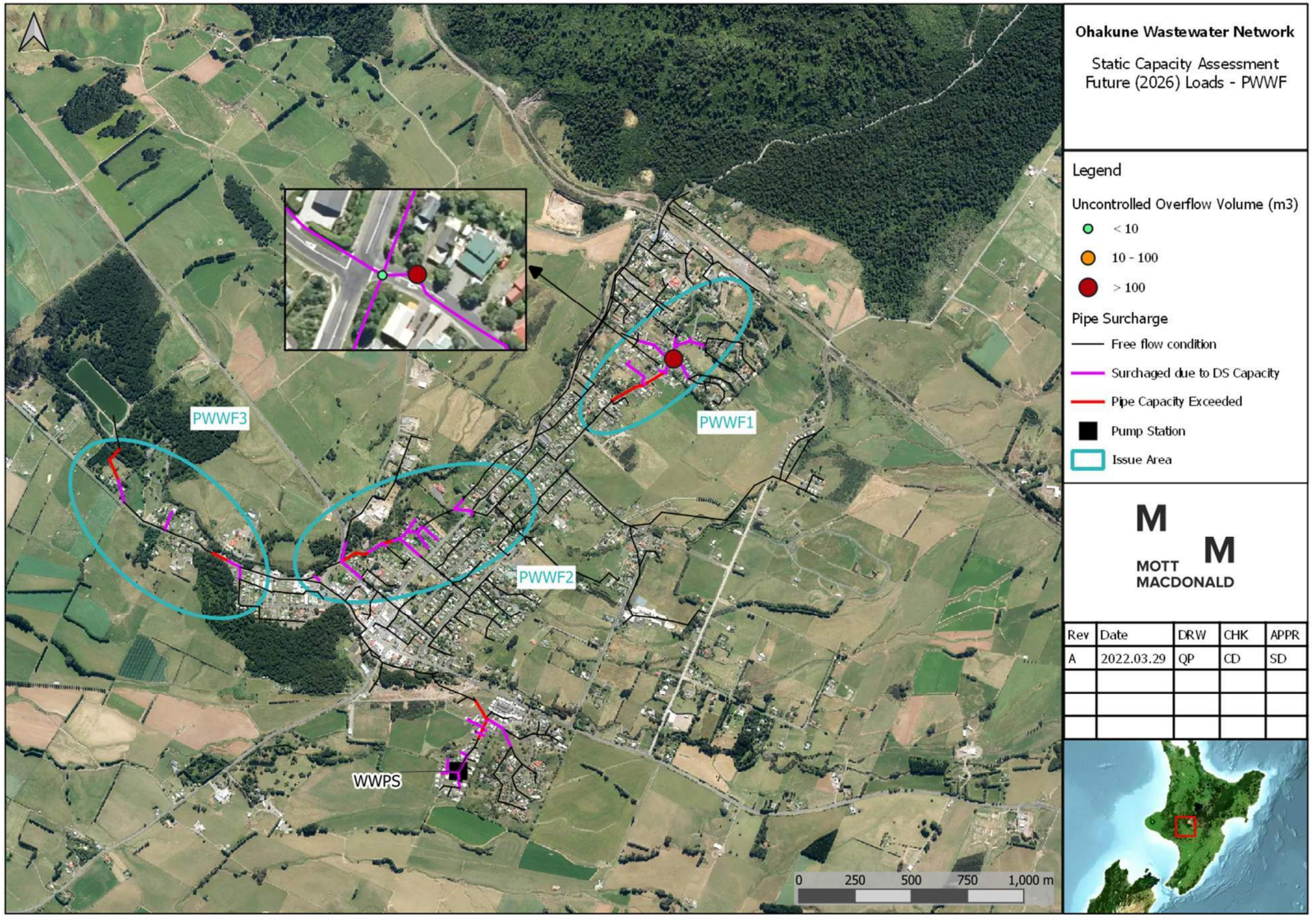
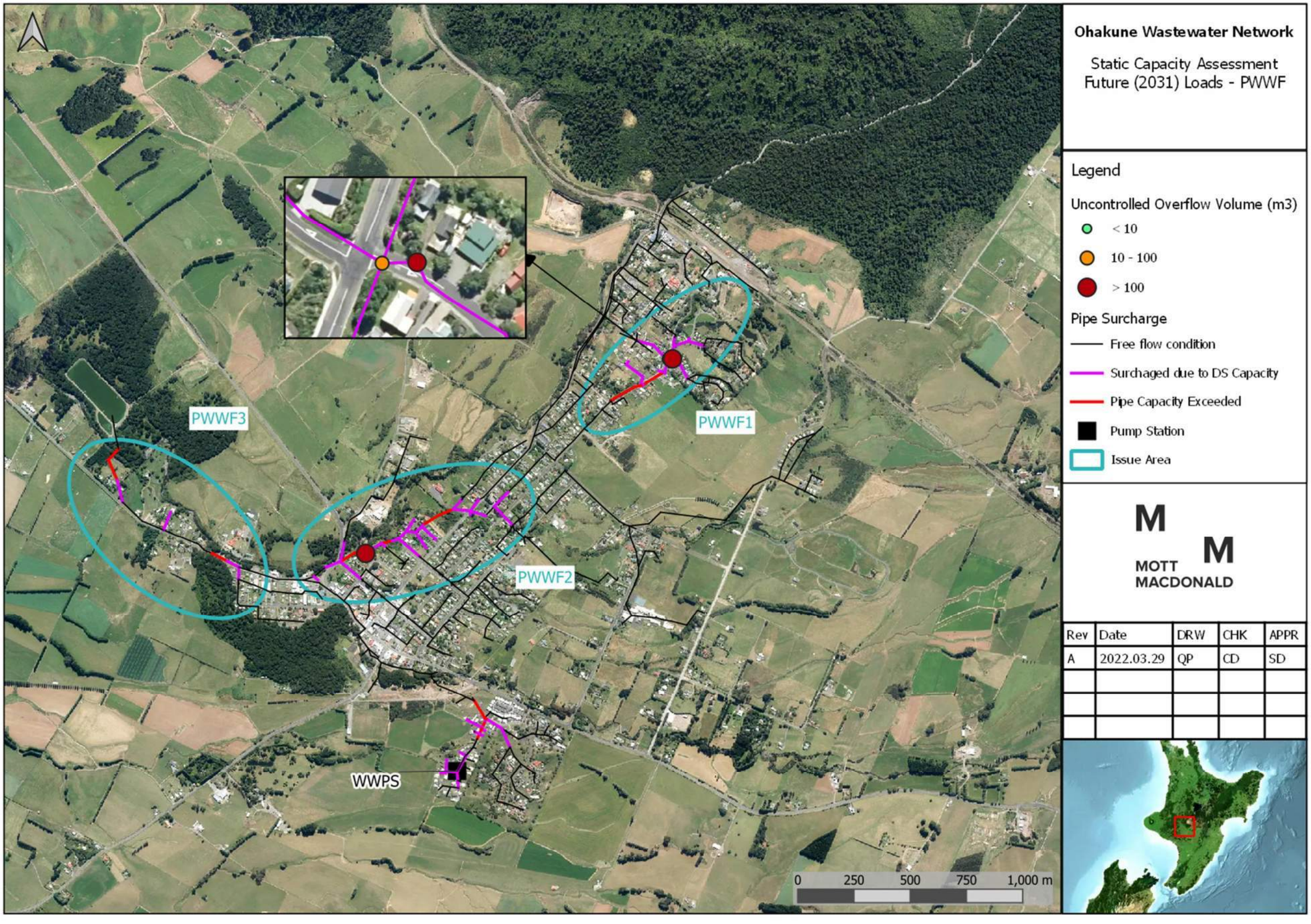


Figure 4.3: Static capacity assessment –2031 peak population – PWWF



5 Findings and recommendations

5.1 Peak dry weather flow capacity

The simulated peak dry weather performance for the existing and future horizons shows the modelled sewers generally operate with sufficient capacity and no overflows are predicted. The main areas of concern are summarised in Table 5.1 below and shown in Figure 3.1 to Figure 3.3.

Table 5.1: PDWF static capacity assessment

Issue area ID	Location	2021	2026	2031	Comments
PDWF1	Upstream of Snowmass Rd PS	√	√	√	Surcharge due to a limitation of the static models as flows are represented as constant peak flows over the day while in reality the peak would only last a few hours. This surcharge can therefore be disregarded.
PDWF1	Downstream of Snowmass Rd PS	√	√	√	Surcharge due to the pump rate implemented, which might be overestimated.
PDWF2	Ø150mm secondary branch connected to Ø375mm on Burns Rd close to the WWTP	√	√	√	Invert levels of the conduit were not available and were inferred.
PDWF3	Ø300mm between Ayr St and Rata St	-	-	√	Invert levels of the conduit were not unreliable and inferred. A diameter of 288mm was modelled as per the flow gauge installation report.

5.2 Peak wet weather flow capacity

The existing (2021) scenario simulates one uncontrolled overflow at the intersection of Park Av, Willow Ln and Southridge Dr, at manhole ID 2001180. This increases to two and three overflows in the future 2026 and 2031 scenarios respectively.

The table below summarises the uncontrolled overflows predicted in PWWF conditions.

Table 5.2: Ohakune predicted uncontrolled overflow daily volume.

Issue area ID	Manhole ID	Daily volume spilled (m^3)		
		2021	2026	2031
PWWF1	2001180	5	135	190
PWWF1	2000757	-	8	93
PWWF2	2001867	-	-	430
	Comments	No overflow observed by Veolia; the PWWF is likely to be overly conservative.		

Several pipelines are also unable to pass the peak wet weather design flow without surcharging and three locations have been identified with insufficient capacity, as summarised in Table 5.3 below. However, please note the issue areas mentioned are only indicative and need to be confirmed with the system performance of the calibrated model.

Table 5.3: PWWF static capacity assessment – pipelines with insufficient capacity

Issue area ID	Location	2021	2026	2031	Comments
PWWF1	Miro St	√	√	√	Surcharge creating overflow(s) within a secondary branch on Southridge Dr. ~300m of Ø150mm pipe to upgrade.
PDWF1	Downstream of Snowmass Rd PS	√	√	√	Surcharge due to the pump rate implemented, which might be overestimated.
PWWF2	Bottom of Tikouka Pl and Tay St	√	√	√	300m of the Ø250mm pipeline and ~300m of the Ø300mm pipeline for the 2031 scenario.
PWWF3	Burns St	Only DS[1]	Only DS	√	Main surcharge just upstream of the WWTP – to be confirmed by the system performance of the calibrated model as the static approach is conservative for the downstream parts of the system.

[1] DS: Downstream

5.3 Recommendations

The key recommendations are summarised below.

- Confirm Snowmass Rd pump station capacity with a drawdown test.
- Confirm the depth of manhole ID 2001180 and the gradients of the upstream and downstream pipes.
- Survey the pipelines predicted to be surcharged during PDWF conditions to confirm the gradient and capacity.

The upgrades mentioned in the PWWF capacity assessment are only indicative and need to be confirmed with the system performance of the calibrated model.

Appendices

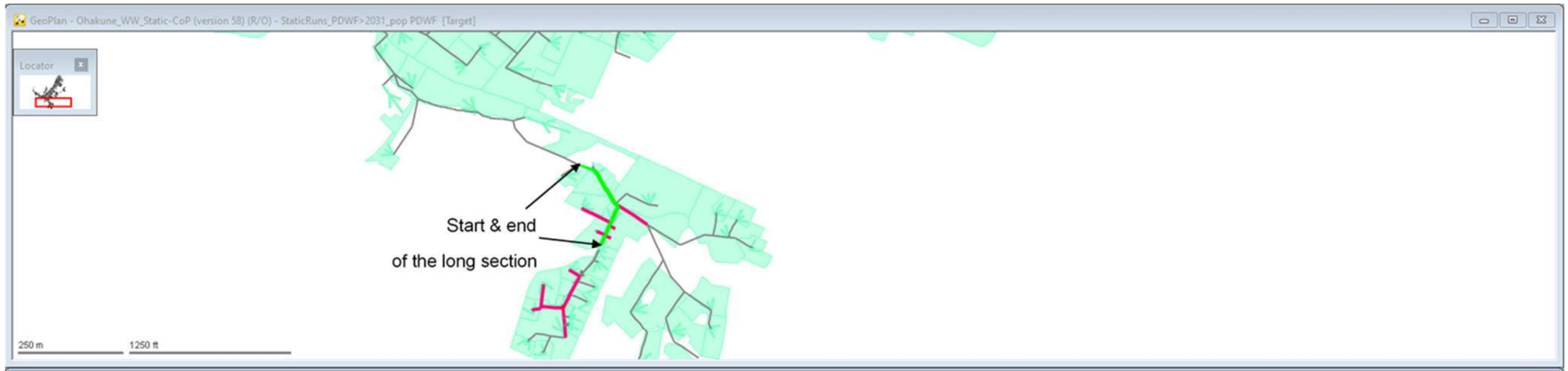
A. Long sections – 2031 peak population – PDWF results

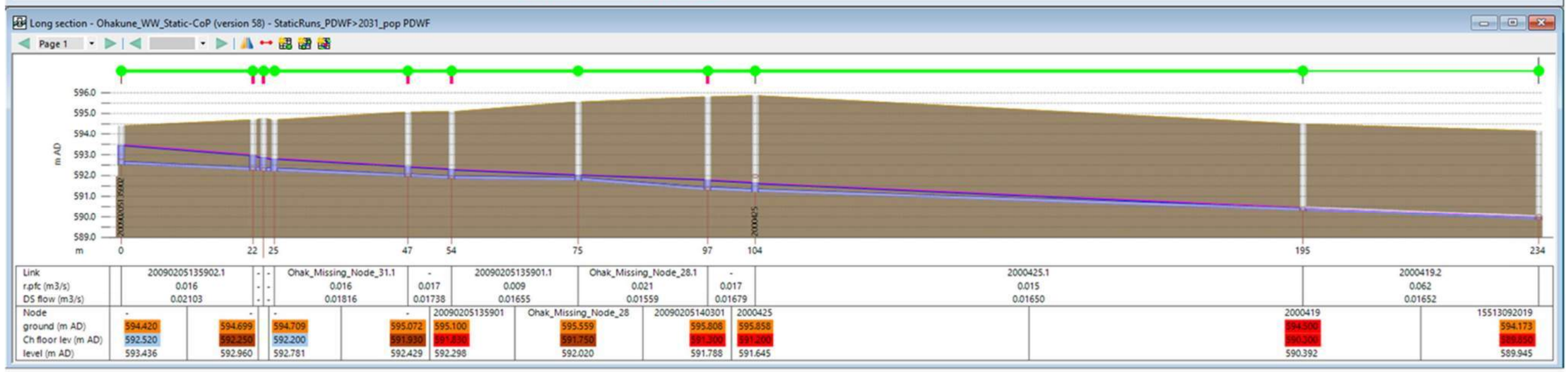
A.1 Upstream of Snowmass Rd PS

Link	20090205135913.1	20090205135911.1	20090205135909.1	20090205135910.1	-	Ohak_Missing_Node_49.1	-	Ohak_Missing_Node_47.1	-
r.pfc (m3/s)	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.009
DS flow (m3/s)	0.00003	0.00003	0.00011	0.00209	-	0.00475	-	0.00767	0.01880

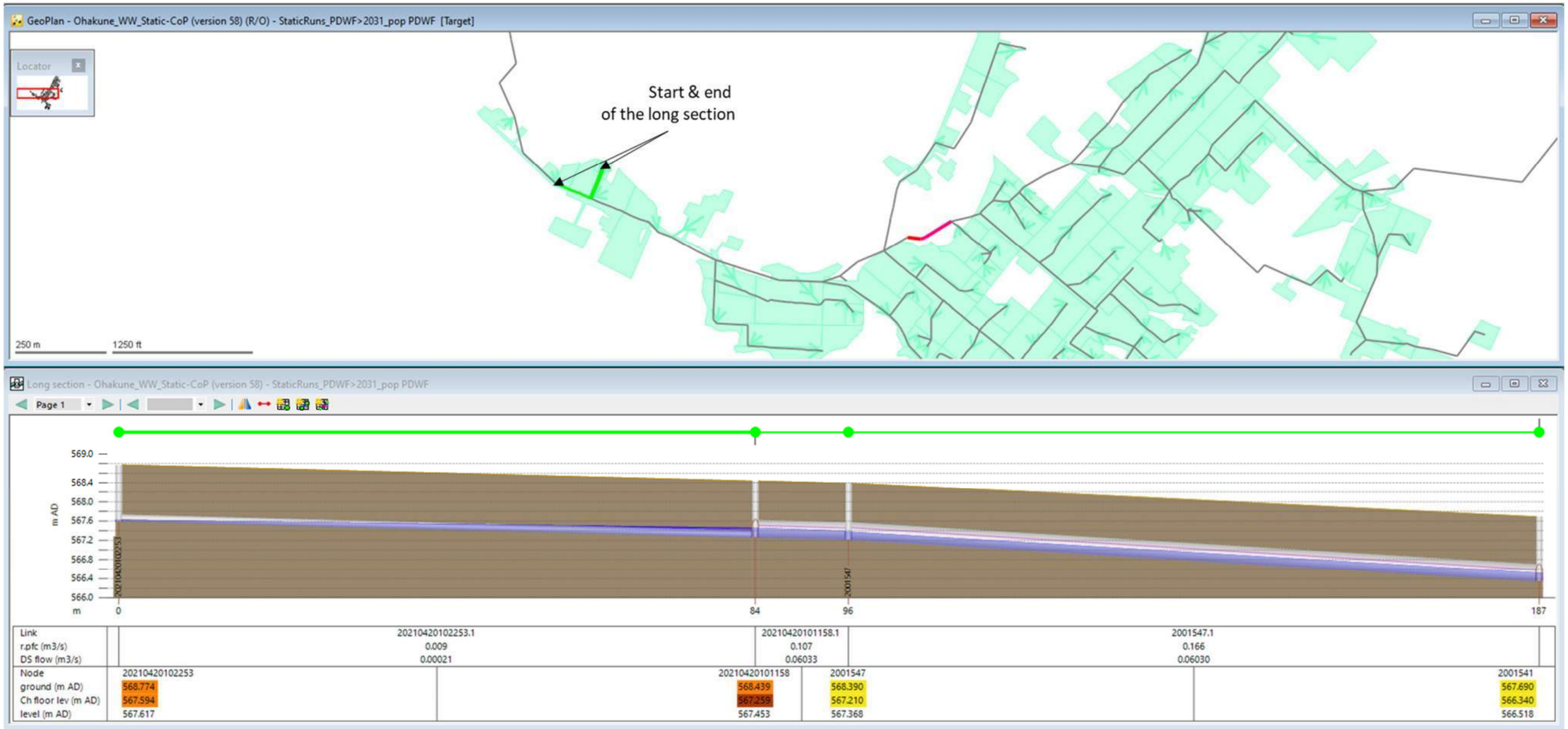
Node	20090205135913	20090205135911	20090205135909	20090205135910	Ohak_Missing_Node_51	-	-	-	20090205135906	-
ground (m AD)	595.100	594.900	594.800	594.800	594.492	594.397	594.126	593.995	593.500	-
Ch floor lev (m AD)	593.800	593.519	593.143	592.760	592.451	592.407	592.252	592.215	592.000	-
level (m AD)	593.820	593.540	593.165	592.794	592.782	592.781	592.781	592.781	592.780	-

A.2 Downstream of Snowmass Rd PS

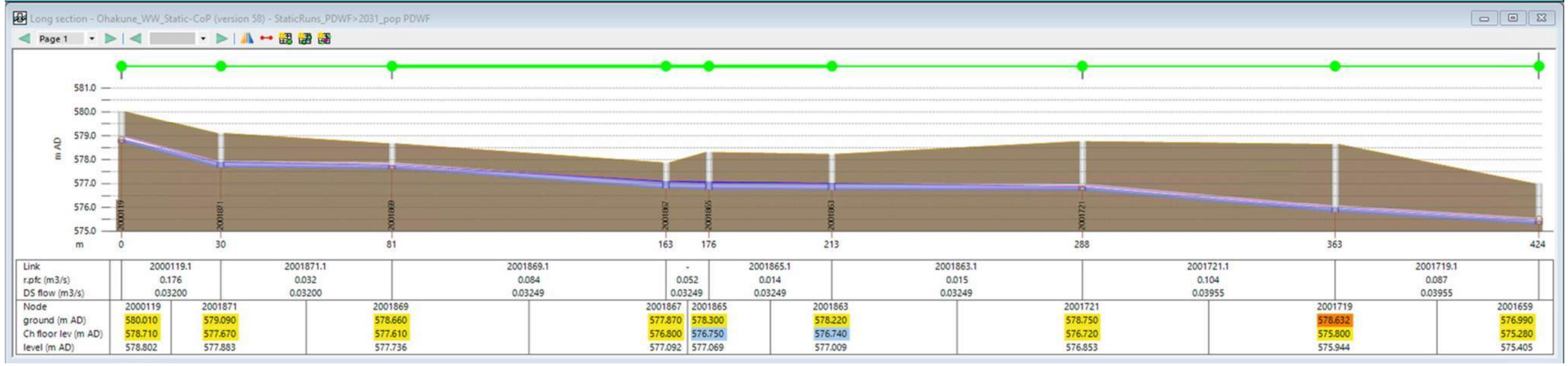




A.3 Burns St


GeoPlan - Ohakune_WW_Static-CoP (version 58) (R/O) - StaticRuns_PDWF>2031_pop PDWF [Target]
Locator
Start & end
of the long section
250 m
1250 ft
Long section - Ohakune_WW_Static-CoP (version 58) - StaticRuns_PDWF>2031_pop PDWF
Page 1
m AD
569.0
568.4
568.0
567.6
567.2
566.8
566.4
566.0
m
0
84
96
187
20210420102253
2001547
Link
r.pfc (m3/s)
DS flow (m3/s)
20210420102253.1
0.009
0.00021
20210420101158.1
0.107
0.06033
2001547.1
0.166
0.06030
Node
ground (m AD)
Ch floor lev (m AD)
level (m AD)
20210420102253
568.774
567.594
567.617
20210420101158
568.439
567.259
567.453
2001547
568.390
567.210
567.368
2001541
567.690
566.340
566.518

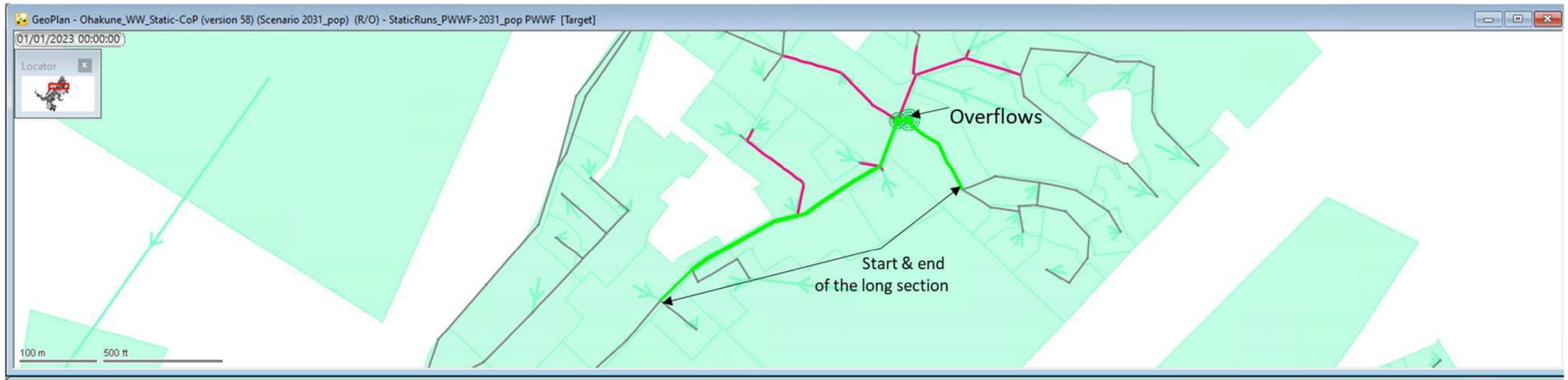
A.4 Vicinity of Ayr St and Rata St

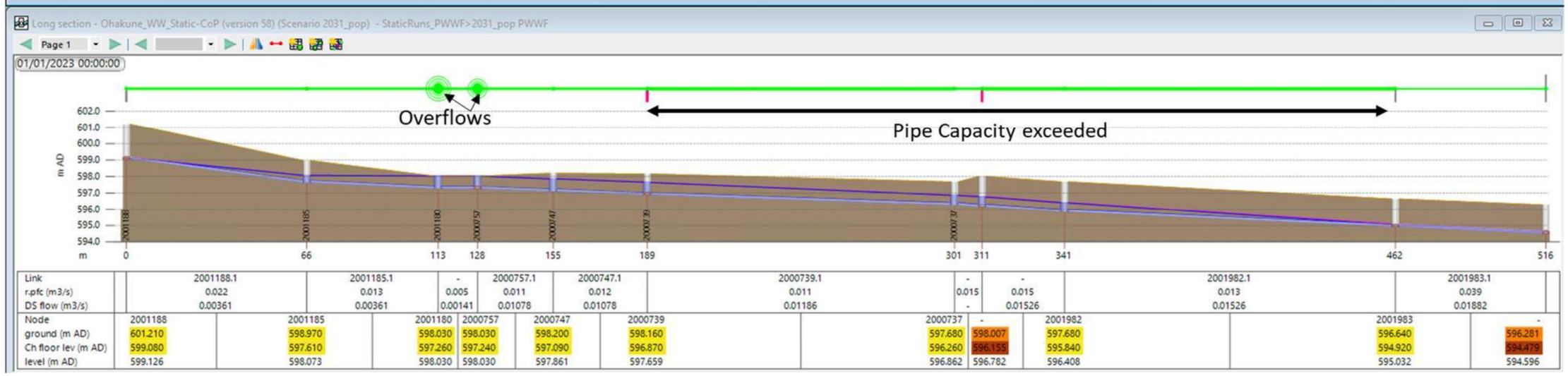


Link	2000119.1	2001871.1	2001869.1	-	2001865.1	2001863.1	2001721.1	2001719.1	
r.pfc (m3/s)	0.176	0.032	0.084	0.052	0.014	0.015	0.104	0.087	
DS flow (m3/s)	0.03200	0.03200	0.03249	0.03249	0.03249	0.03249	0.03955	0.03955	
Node	2000119	2001871	2001869	2001867	2001865	2001863	2001721	2001719	2001659
ground (m AD)	580.010	579.090	578.660	577.870	578.300	578.220	578.750	578.632	576.990
Ch floor lev (m AD)	578.710	577.670	577.610	576.800	576.750	576.740	576.720	575.800	575.280
level (m AD)	578.802	577.883	577.736	577.092	577.069	577.009	576.853	575.944	575.405

B. Long sections – 2031 peak population – PWWF results

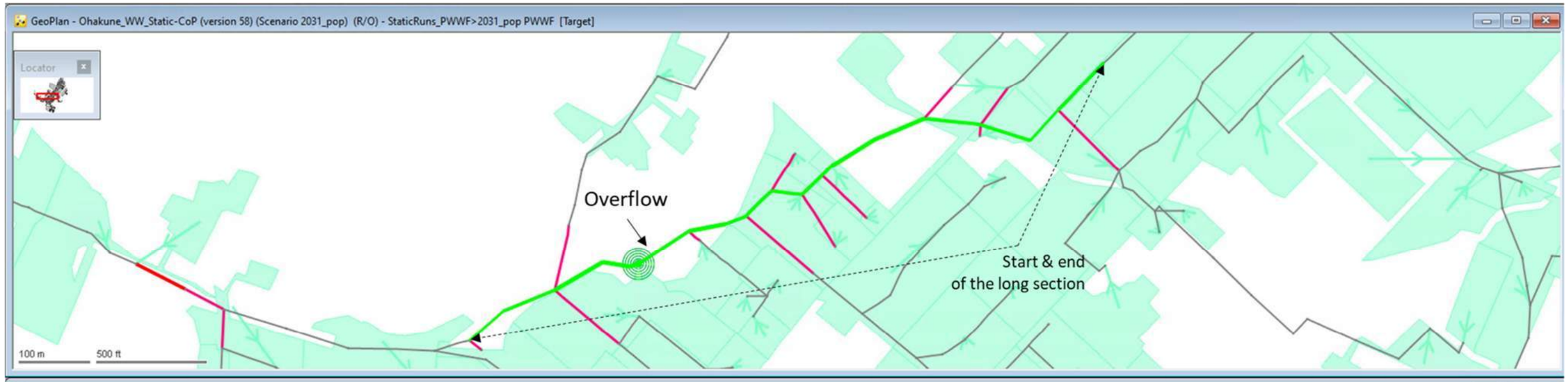
B.1 Miro St

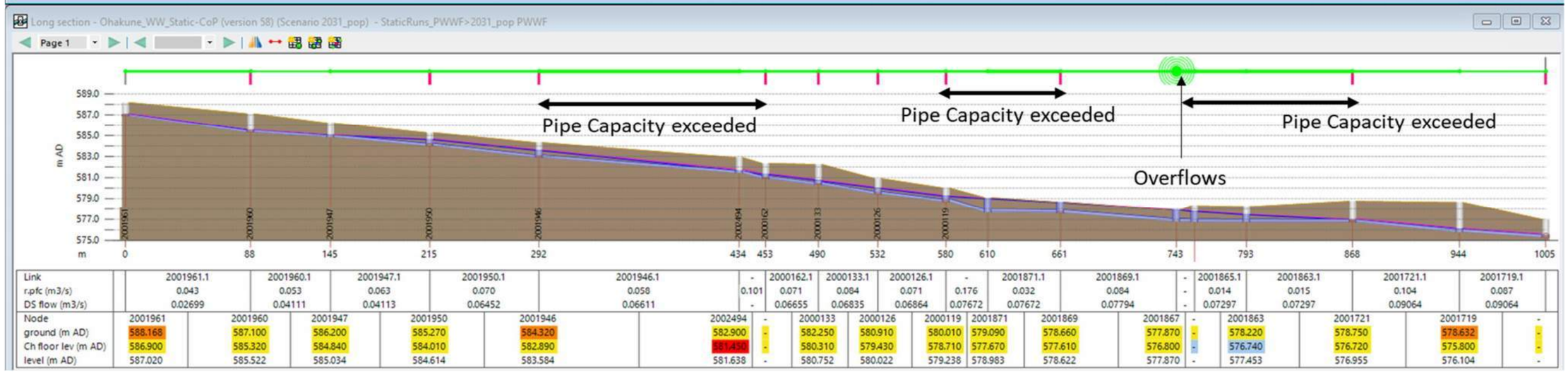




Link	2001188.1		2001185.1	-	2000757.1	2000747.1	2000739.1	-	-	2001982.1		2001983.1	
r.pfc (m3/s)	0.022		0.013	0.005	0.011	0.012	0.011	0.015	0.015	0.013		0.039	
DS flow (m3/s)	0.00361		0.00361	0.00141	0.01078	0.01078	0.01186	-	0.01526	0.01526		0.01882	
Node	2001188		2001185	2001180	2000757	2000747	2000739	2000737	-	2001982		2001983	-
ground (m AD)	601.210		598.970	598.030	598.030	598.200	598.160	597.680	598.007	597.680		596.640	596.281
Ch floor lev (m AD)	599.080		597.610	597.260	597.240	597.090	596.870	596.260	596.155	595.840		594.920	594.479
level (m AD)	599.126		598.073	598.030	598.030	597.861	597.659	596.862	596.782	596.408		595.032	594.596

B.2 Bottom of Tikouka Pl and Tay St

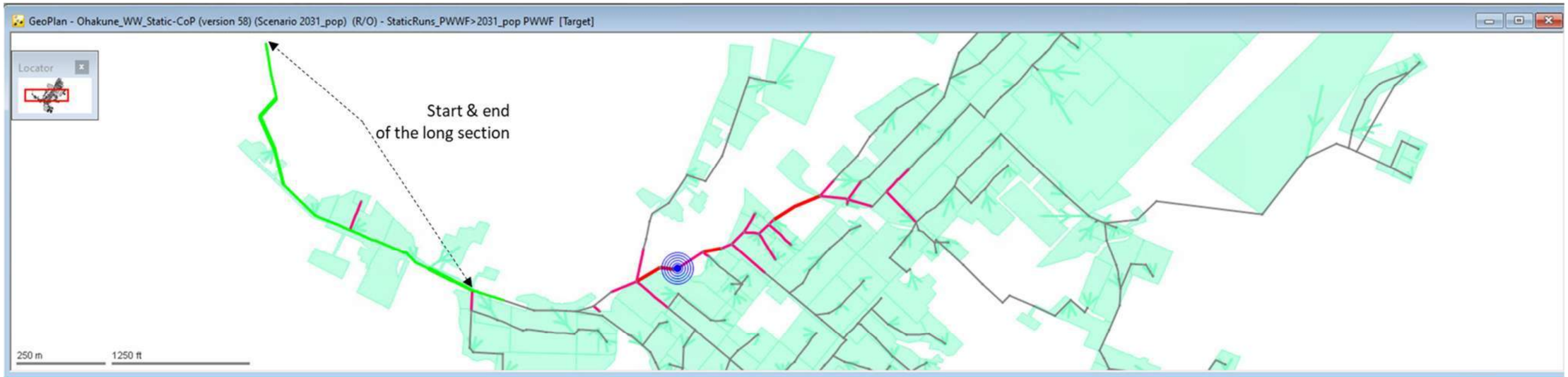


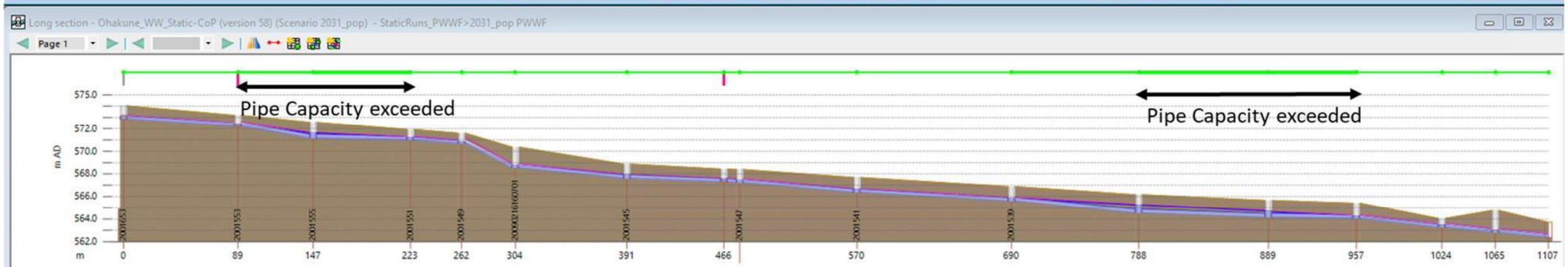


Link	2001961.1	2001960.1	2001947.1	2001950.1	2001946.1	-	2000162.1	2000133.1	2000126.1	-	2001871.1	2001869.1	-	2001865.1	2001863.1	2001721.1	2001719.1
r.pfc (m3/s)	0.043	0.053	0.063	0.070	0.058	0.101	0.071	0.084	0.071	0.176	0.032	0.084	-	0.014	0.015	0.104	0.087
DS flow (m3/s)	0.02699	0.04111	0.04113	0.06452	0.06611	-	0.06655	0.06835	0.06864	0.07672	0.07672	0.07794	-	0.07297	0.07297	0.09064	0.09064

Node	2001961	2001960	2001947	2001950	2001946	2002494	-	2000133	2000126	2000119	2001871	2001869	2001867	-	2001863	2001721	2001719	-
ground (m AD)	588.168	587.100	586.200	585.270	584.320	582.900	-	582.250	580.910	580.010	579.090	578.660	577.870	-	578.220	578.750	578.632	-
Ch floor lev (m AD)	586.900	585.320	584.840	584.010	582.890	581.450	-	580.310	579.430	578.710	577.670	577.610	576.800	-	576.740	576.720	575.800	-
level (m AD)	587.020	585.522	585.034	584.614	583.584	581.638	-	580.752	580.022	579.238	578.983	578.622	577.870	-	577.453	576.955	576.104	-

B.3 Burns St





Link	2001653.1	2001553.1	2001555.1	2001551.1	2001549.1	20090216160701.1	2001545.1	-	2001547.1	2001541.1	2001539.1	2001537.1	2001535.1	2001533.1	-	-
r.pfc (m3/s)	0.144	0.232	0.080	0.143	0.383	0.180	0.107	-	0.166	0.134	0.178	0.104	0.077	0.178	0.178	0.178
DS flow (m3/s)	0.11427	0.11908	0.11907	0.11914	0.11993	0.11990	0.11987	-	0.12123	0.12131	0.12105	0.12126	0.12125	0.12124	0.12124	0.12124

Node	2001653	2001553	2001555	2001551	2001549	-	2001545	-	2001547	2001541	2001539	2001537	2001535	2001533	-	-	-
ground (m AD)	574.030	573.200	572.580	571.920	571.600	570.370	568.870	568.439	568.390	567.690	566.890	566.170	565.670	565.420	564.058	564.756	-
Ch floor lev (m AD)	572.840	572.200	571.110	570.940	570.660	568.530	567.560	567.259	567.210	566.340	565.590	564.510	564.130	563.990	563.257	562.800	-
level (m AD)	573.098	572.397	571.609	571.208	570.810	568.763	567.920	567.555	567.454	566.636	565.850	565.257	564.708	564.256	563.495	563.036	

Appendix 8

Wastewater Calculations
- Pipe Capacity

cheal

Client:	Kainga Ora - Homes and Communities
Job No:	220528
Site Address:	6 Teitei Drive, Ohakune
Description:	Wastewater Calculations - Pipe Capacity Checks
Computed By:	AT
Checked:	RFK

Date: 25 May 2023

	Stage 1	Stages 2 and 3	
Lots	47	114	
Maximum Flow:			
Maximum Flow Per Lot(MF)	**4375**	**4375**	L/d
Diurinal Peaking Factor	2.5	2.5	
Infiltration Factor	2	2	New development
Average Dry Weather Flow Person	250	250	L/day/p
People per Lot	3.5	3.5	p
MF for Stage 1	205625	498750	L/d
	2.4	**5.8**	L/s

MF=Infiltration rate x Diurinal Peaking Factor x ADWF x People Per Lot

Have used maximum flows per person and persons per lot for winter season

Total Flow 8.2

Pipe Grad (%)	Dia (mm)	Velocity (m/s)	Q_c (L/s)
0.550%	150	0.65	11.5

The maximum flow 150 mm pipe can allow is 11.5 l/s > 2.4 L/s . Thus capacity of a 150 mm pipe will be sufficient for Stage 1 maximum flow.

Appendix 9

Mott McDonald - Ohakune Township Water Supply Network Model

MOTT MACDONALD

Technical Memo

Ohakune Township Water Supply Network Model

Project:	Ruapehu (District Wide) Water Supply Network Hydraulic Modelling		
Our reference:	411000 | OKN-2 | B	**Revision:**	Final - B
Prepared by:	Qihang Pan	**Date:**	February 2022
Approved by:	Paul Haddon	**Checked by:**	Tom Lecomte
Subject:	Demand and Option Update and Hydrant Testing Scope		

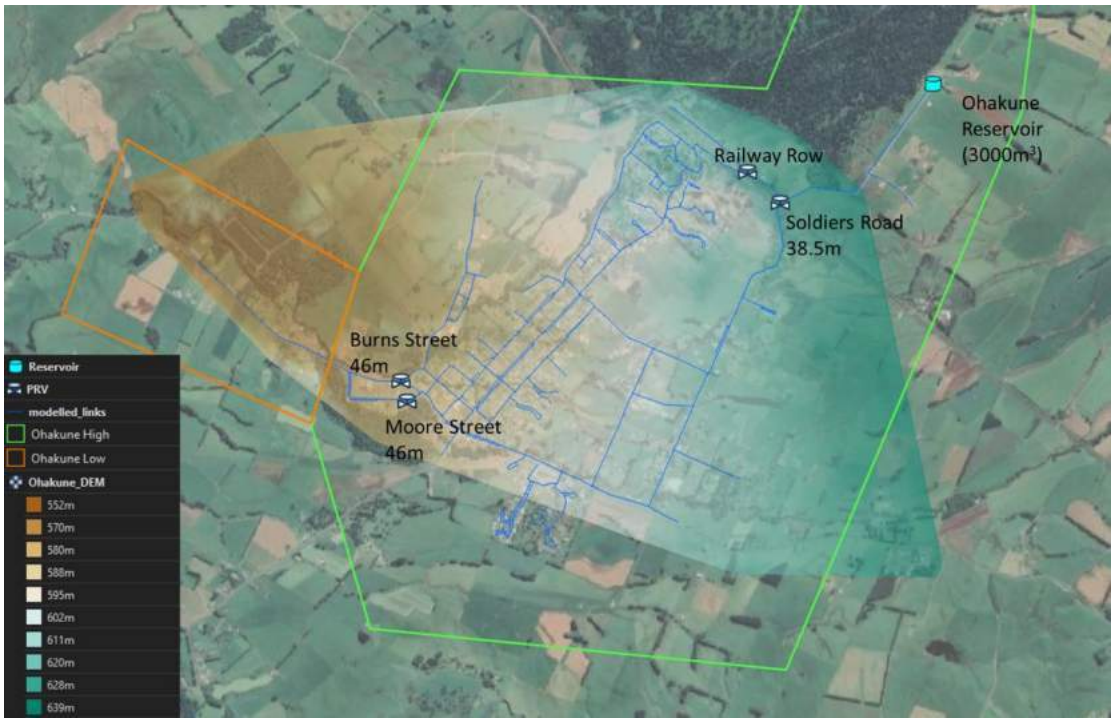
In January 2022, Mott MacDonald was commissioned by Veolia to model an additional scenario for the Ohakune water supply model based on the existing 2031 peak day Scenario. The new model scenario allows for demand for 110 proposed lots in addition to the demand included in the previous 2031 peak day scenario. The system performance of this scenario was assessed, and the previously proposed network upgrades and fire upgrades were revised. In addition, a hydrant testing scope, actionable by the operations team of Veolia, is provided, to verify the hydrant flow as recommended in the previous report. This memo is to be read in conjunction with the previously delivered modelling report (Reference: 411000 | OKN-1 | C).

1 Background

Mott MacDonald has carried out model build, field testing, calibration, system performance assessment (SPA) and options investigation for Ohakune township in Ruapehu District (Ohakune Township Water Supply Network Model, 411000 | OKN-1 | C, November 2021). An overview of the network is shown in Figure 1.1.

This memo presents the updated SPA results, updated options and a hydrant testing methodology, actionable by Veolia operators, to address the recommendation on verifying the hydrant flow, as included in the modelling report.

Figure 1.1: Ohakune Network, Zones and Terrain (Elevation in mRL)



2 Demand Update

There was an update to the proposed development with 110 additional lots expected by 2031 in Ohakune, as shown in Figure 2.1. An updated map of all proposed developments in Ohakune included in this model is available in Appendix A.1.

The demand from the 110 additional lots is applied to the network as follows, as agreed with Veolia:

- 100 lots connected to a new connection point, node MM3469 at 134B Miro Street, as noted in the Ohakune Proposed Subdivision drawing provided by Veolia
- 5 lots added to the existing connection point (node 20180615104727) on Miro Street
- 5 lots added to the existing connection point (node 6002030) on Shannon Street

Occupancy is assumed to be 3 persons/lot. Demand from the 110 lots was calculated assuming a daily demand of 250 l/p/day and a peak day factor of 1.5 as per NZS 4404:2010. These assumptions are identical to the assumptions used in the previous model scenarios. The existing demand and updated demand at the three connection points with additional demand is summarised in Table 2.1. A map showing these three connection points is available in Appendix A.2.

All other connection points and associated demand in the network remain the same.

Figure 2.1: Proposed Development Update

Table 2.1: Demand Summary

Connection Point	Previous 2031 Peak Day Demand (l/s)	Additional Demand (l/s)	Total Demand in New Model Scenario(l/s)
MM3469	0	1.30	1.30
20180615104727	0.59	0.07	0.65
6002030	0.59	0.07	0.65

3 System Performance

3.1 System Performance Criteria

The system performance was assessed against the levels of service agreed with Veolia and detailed in Table 3.1.

Table 3.1: Level of Service

Parameter	Criteria
Minimum pressure	> 250kPa (25m)
Maximum pressure	< 800kPa (80m)
Pressure fluctuation	< 300kPa (30m)
Maximum Pipe Head Loss	< 5m/km for DN < 150mm < 3m/km for DN > 200mm
Pipe Velocity Range	0.5m/s to 2.0m/s

The fire flow is assessed against the standards in the New Zealand Fire Service Firefighting Water Supplies Code of Practice (SNZ PAS 4509:2008). The criteria are listed in Table 3.2.

Table 3.2: Fire Flow Classifications

Fire Water Classification	Required Flow Within 135 m	Additional Flow within 270 m	Maximum # of hydrants to provide Flow	Minimum Residual Pressure
FW2	12.5 l/s	12.5 l/s	2	100 kPa (10m)
FW3	25 l/s	25 l/s	3	100 kPa (10m)
FW4	50 l/s	50 l/s	4	100 kPa (10m)
FW5	75 l/s	75 l/s	6	100 kPa (10m)
FW6	100 l/s	100 l/s	8	100 kPa (10m)

In addition, hydrants were assessed on whether they could provide a flow of 12.5 l/s (FW2-1) if they fail to meet the requirements for any of the classifications listed in the standard.

3.2 System Performance Results

The system performance of the new model scenario is summarised below. Detailed breakdown and maps of the SPA results are presented in Appendix A.3.

Storage

The current storage of Ohakune Reservoir is 3,000 m^3.
The WTP maximum capacity from 2026 will be 2,500 m^3, aligning with the raw water consent of 2,500 m^3.

With a design flow of 250 l/p/d and a peak day factor of 1.5, the 110 new proposed lots have a total peak day demand of 124 m^3/day. This gives a total peak day demand of 2,879 m^3/day in the model. The total demand exceeds the 2026 onward WTP maximum capacity of 2,500 m^3/day and the raw water extraction consent of 2500 m^3/day.

Using current Ohakune customer consumptions with a flow rate of 214 l/p/d (calculated 2021 peak day flow rate) for all proposed lots, the total 2031 peak day demand is 2,576 m^3/day. While this still exceeds the 2026 WTP maximum capacity, it is much lower compared to the volume calculated using the design flow.

There is sufficient storage in the network under both of the flow rates considered.

Pressure

9% of customers in Ohakune High have a minimum pressure under 25m. These customers are located in the north-eastern part of the town near the reservoir where the elevation is high. All remaining customers have a minimum pressure of at least 25m.

17% customers in Ohakune High and all customers in Ohakune Low experience a maximum pressure over 80m. These customers are located on the eastern side of the town where the elevation is much lower than the reservoir. Some customers have a pressure as high as 98m.

64% customers in Ohakune High and all customers in Ohakune Low have a daily pressure fluctuation of 30m or greater. Prior to the addition of the 110 proposed lots, only 9% customers experience a pressure fluctuation of 30m or higher. This additional demand results in higher head losses in the network, and the customers connected to the network downstream of the proposed connection points experience a higher pressure fluctuation.

Head Loss

High head losses over 10 m/km are seen along Shannon Street and Railway Row, Ruapehu Road south of Shannon Street, Rangataua Road between Tainui Street and Turoa Drive, Kowhai Crescent and Bruns Street west of Bracken Street. Head losses between 5m/km and 10m/km are seen on Mangawhero Terrace, Ruapehu Road, Tainui Street, Turoa Drive and Burns Street. The 110 additional lots lead to an increase in head loss, mostly on Shannon Street and Railway Row.

Velocity

The maximum velocity with the additional demand is similar to the maximum velocity before the addition. 0.1% of the pipes by length have a maximum velocity over 2m/km. This is caused by either pipe diameter being adjusted during model calibration to replicate constrictions in the model, or the pipes being undersized with a diameter lower than the downstream pipes.

Over 99% of the pipes in the network have a minimum velocity under 0.5m/s at night when the demand is low.

Fire Flow

All 10 hydrants in Ohakune Low fail to provide 12.5l/s of flow. 167 of the total 196 hydrants in Ohakune High fail to meet the FW2 requirements, including 4 failing to provide 12.5 l/s of flow. While the firefighting capacity at some hydrants is limited by local pipe capacity, hydrants on Miro Street, Mangawhero Terrace and Goldfinch Street fail the meet the FW2 requirements because the pressure in low lying parts of the network, on Railway Row and Utuhia Place, fall below 10m when the fire flow is applied to the network. The FW2 or above hydrants are mostly located on Tainui Street, Ruapehu Road, and Shannon Street between Tainui Street and Ruapehu Road.

Criticality

The pipe criticality simulation results are similar to the results without the 110 new lots, with 16% of the pipes by length in Ohakune High and 9% of the pipes in Ohakune Low impacting over 50 customers. The critical pipes in Ohakune High are located on Soldiers Rd, Railway Row, Ruapehu Road and Shannon Street. Pipes on Turoa Drive and Snowmass Drive also affect over 50 customers as they supply a large number of customers in Turoa Village. Approximately 200m pipes on Burns Street west of Bracken Street affect over 50 customers due to the lack of an alternative line of supply.

Water Age

The age of water is under 24 hours in all pipes in Ohakune Low. This favourable condition is similar in Ohakune High except for dead ends where the water age is over 3 days.

4 Options Assessment

The network upgrades are refined to account for the additional demand. Similar network limitations to the previous 2031 peak day scenario, including extreme pressure, high head losses and limited firefighting capacity, are seen in this model scenario.

4.1 Proposed options

Recommended PRV Setting

Adjusting the settings of the 4 PRVs in the network is sufficient to limit the pressure to between 25m and 80m. The recommended PRV settings are as follows:

- Railway Row – 29m
- Ruapehu Road – 31m
- Burns street – 52m
- Moore street – 48m

Network Upgrades

All network upgrades are sized assuming that the recommended PRV settings are already implemented in the network. Pipes are sized assuming a material of HDPE unless specified otherwise and a PN rating of 12.5. The proposed upgrades include upgrades for reducing head losses in the network and upgrades for improving the firefighting capacity of the network. The firefighting upgrades are proposed in areas where the combined hydrant firefighting capacity is unlikely to meet FW2 requirements.

The location of the proposed network upgrades is shown in Figure 4.2 and detailed in Appendix A.4.

Network Schematic

The schematic of the network with the proposed upgrade is shown in Figure 4.1.

Figure 4.1: Ohakune Proposed Network Schematic

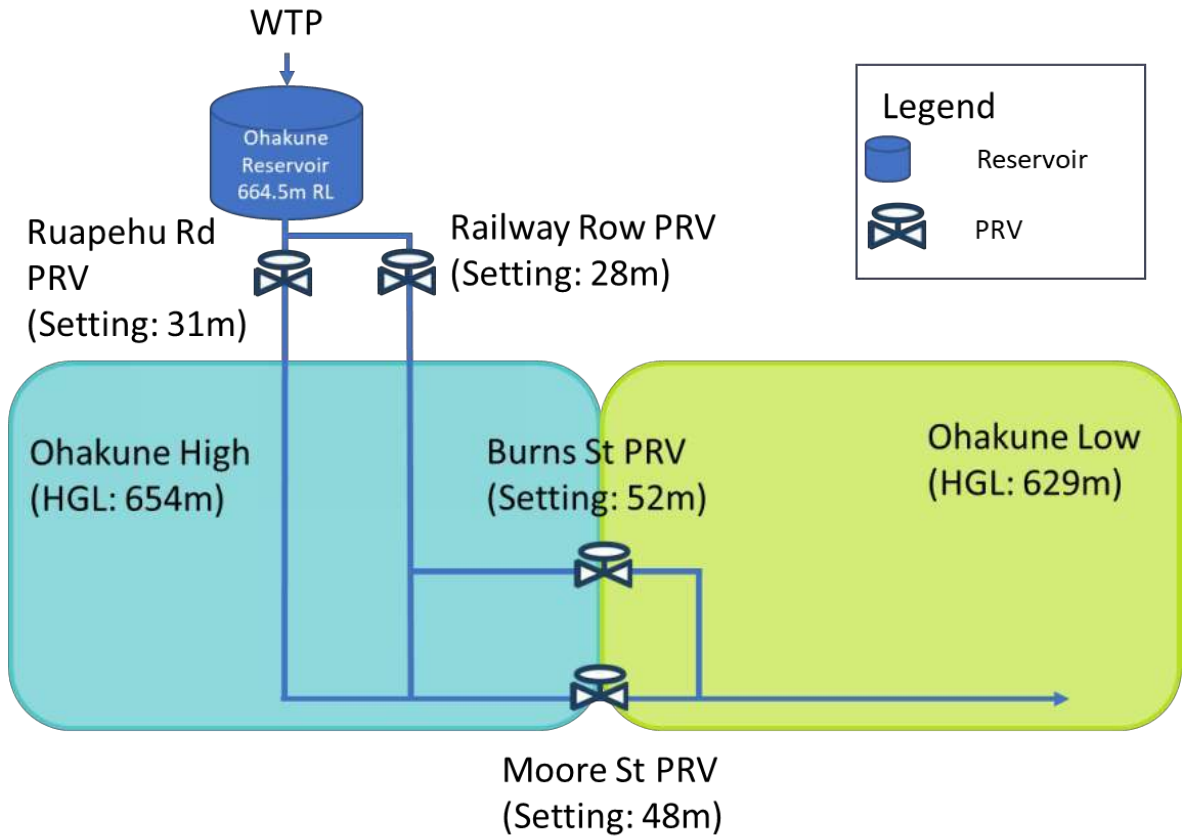
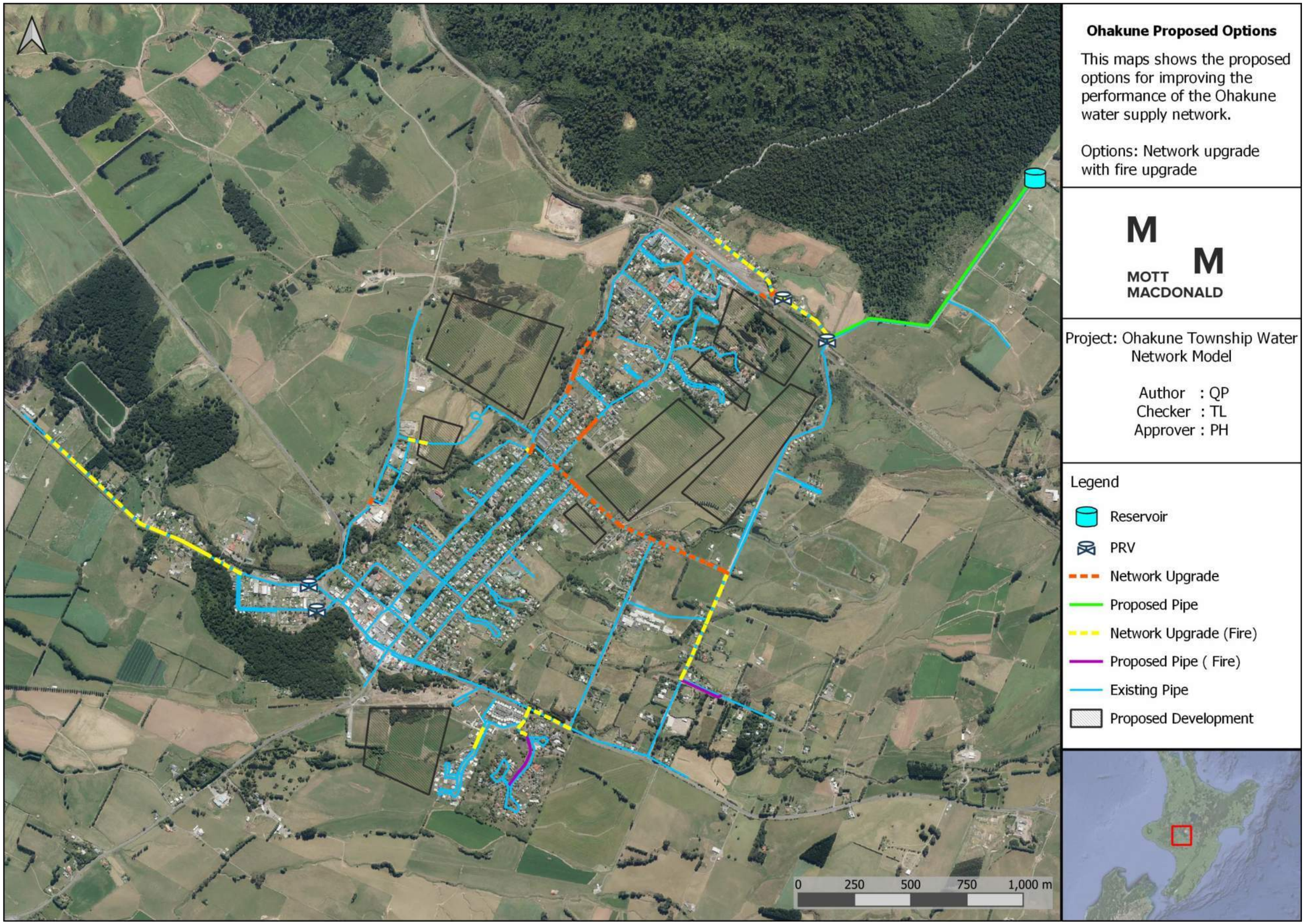


Figure 4.2: Proposed Upgrades



4.2 System Performance with Proposed Options

The proposed upgrades were implemented in the model such that the performance of the model network with the proposed options can be assessed. The detailed SPA results can be found in Appendix A.3.

Pressure

The pressure in the network is between 25m and 80 except two nodes on Soldiers Road and two nodes on Taylors Road due to their high elevation, as shown in Figure 4.3. The minimum pressure is 20m at the node with the highest elevation. While this is lower than the minimum pressure requirement in the LoS, this pressure is still considered acceptable. The pressure in this area should be monitored and individual house pumps can be considered if the pressure drops further. All customers experience a daily pressure fluctuation under 10m.

Head Loss

The maximum head loss is under 5m/km in all modelled pipes and under 3 m/km in all modelled pipes with a diameter of 150mm or higher except pipe 20081002121401 on Ruapehu Road. This pipe is 16m in length has a model predicted unit head loss of 3.4 m/km and this head loss does not have any significant impact on the pressure in the network.

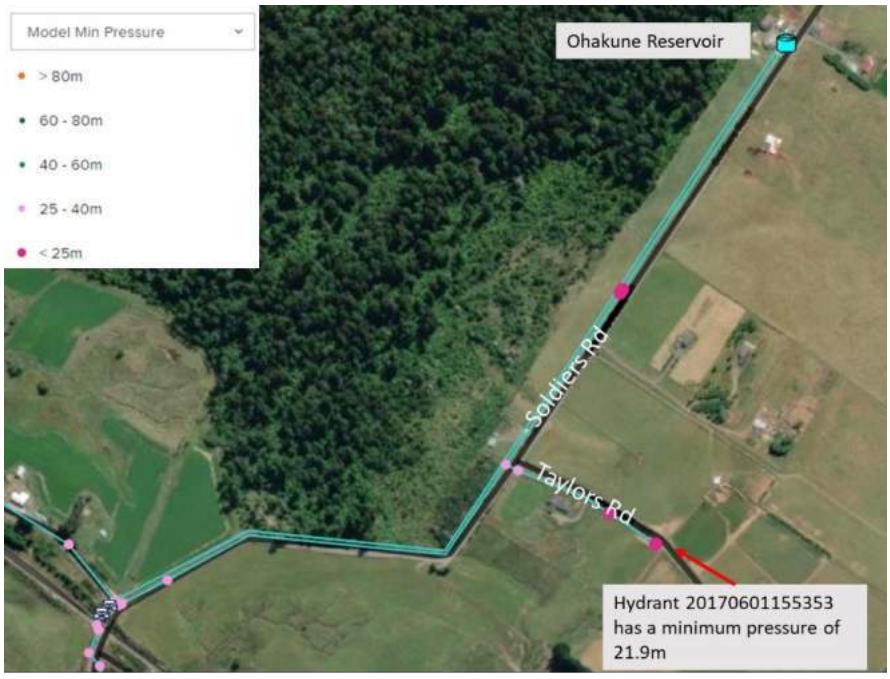
Velocity

The maximum velocity in all modelled pipes is under 2 m/s.

Fire Flow

195 of the 196 hydrants in Ohakune High and all 10 hydrants in Ohakune Low can meet the requirements of FW2. The only hydrant failing to meet FW2 requirements is hydrant 20170601155353 on Taylors Road on a 63mm main. The location of the hydrant is shown in Figure 4.3. The pressure is low at this hydrant due to its elevation, without the fire demand. Properties in this area are over 270m away from other hydrants in Ohakune. Static storage, and an emergency pump if needed, can be installed at this location to provide the required firefighting capacity. Alternatively, a hydrant can be installed on the 300mm main on Soldiers Rd to provide the fire flow.

Figure 4.3: Remaining Issues



5 Hydrant Testing Scope

The previously delivered modelling report highlighted the low hydrant flow observed during the hydrant flow test, with all six tested hydrants having a flow of 10 l/s or less. While multiple hydrants can be opened at the same time to provide the flow required for firefighting, each hydrant is required to be able to provide at least 12.5 l/s of flow. The six hydrants are recommended to be re-tested to verify the maximum flow that they can provide, with the following methodology actionable by the Veolia operations team:

- Slowly open the hydrant to be tested fully
- Record the meter reading and time after the hydrant is fully open
- Flow the hydrant for 5 minutes
- Record meter reading and time before closing the hydrant
- Close the hydrant
- Test the hydrants between 12pm (midday) and 2pm.

It is important to ensure that:

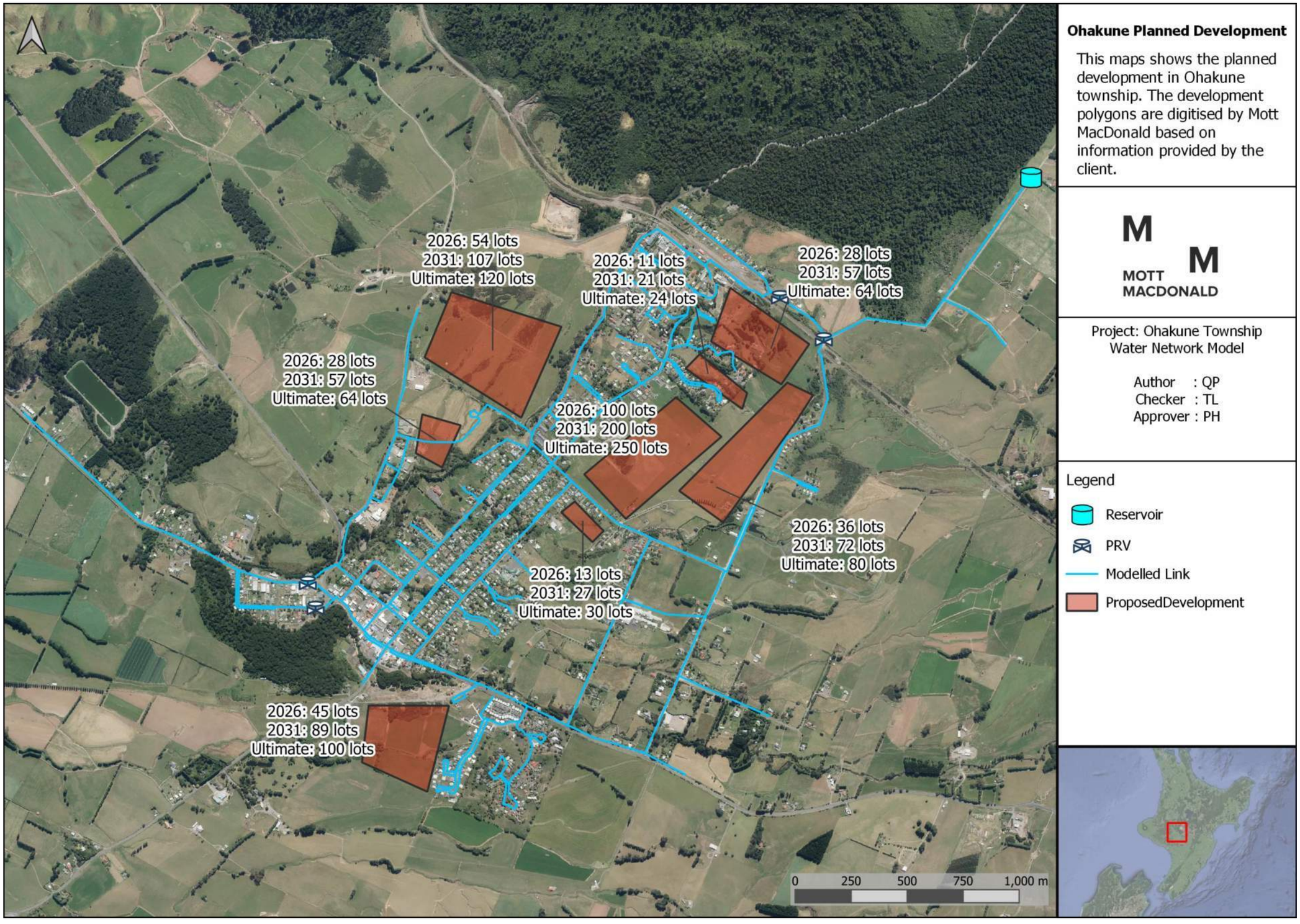
- The hydrant being tested is fully open
- The hydrant is tested for a minimum duration of 5 minutes, though it is not necessary for the hydrant to be flowed for more than 5 minutes
- The hydrants are tested one at a time

The original Ohakune hydrant test plan is attached with this memo to provide information on the asset ID and location of the hydrants to be tested.

A. Appendix

A.1 Ohakune Planned Development

Figure 5.1: Ohakune Planned Development - Updated



A.2 Connection Point of Amended Development

Figure 5.2: Proposed Connection points

A.3 SPA Results

Pressure

Table 5.1: Pressure SPA Results – 2031 Peak Day

Criteria	Area	< 25 m	25 - 40 m	40 - 60 m	60 – 80 m	> 80 m
Minimum Pressure	Ohakune High	9%	39%	52%	0%	0%
	Ohakune Low	0%	0%	74%	26%	0%
Maximum Pressure	Ohakune High	0%	0%	22%	62%	17%
	Ohakune Low	0%	0%	0%	0%	100%
		< 10 m	**10 – 20 m**	**20 – 30 m**	**> 30 m**	
Daily Pressure Fluctuation	Ohakune High	0%	2%	34%	64%	
	Ohakune Low	0%	0%	0%	100%	

Figure 5.3: Minimum Pressure – 2031 Peak Day

Figure 5.4: Maximum Pressure – 2031 Peak Day

Figure 5.5: Pressure Fluctuation – 2031 Peak Day

Head loss

Table 5.2: Head Loss SPA Results – 2031 Peak Day

Area	< 2 m/km	2 - 3 m/km	3 - 5 m/km	5 - 10 m/km	> 10 m/km
Ohakune High	97%	2%	0.3%	1%	0.1%
Ohakune Low	85%	15%	0%	0%	0%

Figure 5.6: Maximum Head Loss – 2031 Peak Day

Velocity

Table 5.3: Pipe Velocity SPA Results – 2031 Peak Day

Criteria	Area	< 0.5m/s	0.5 – 1 m/s	1 – 2 m/s	2 – 3 m/s	> 3m/s
Minimum Velocity	Ohakune High	99.9%	0.0%	0.1%	0%	0%
	Ohakune Low	100%	0%	0%	0%	0%
Maximum Velocity	Ohakune High	71%	19%	9%	0	0.1%
	Ohakune Low	75%	25%	0%	0%	0%

Figure 5.7: Minimum Velocity – 2031 Peak Day

Figure 5.8: Maximum Velocity – 2031 Peak Day

Fire Flow

Table 5.4: Fire Flow SPA Results – 2031 Peak Day

Area	Cannot provide 12.5l/s	FW2-1	FW2	FW3	FW4	FW5	FW6
Ohakune High	4	163	28	1	0	0	0
Ohakune Low	10	0	0	0	0	0	0

Figure 5.9: Hydrant Maximum Fire Class – 2031 Peak Day

Pipe Criticality

Table 5.5: Pipe Criticality SPA Results – 2031 Peak Day

	Customers affected				
Area	< 5	5 – 25	25 – 50	50 – 100	> 100
Ohakune High	70%	12%	3%	2%	13%
Ohakune Low	13%	61%	17%	9%	0%

Figure 5.10: Pipe Criticality – 2031 Peak Day

Water Age

Table 5.6: Water Age SPA Results – 2031 Peak Day

Area	< 24 hrs	24 – 48 hrs	48 – 72 hrs	> 72 hrs
Ohakune High	98%	0%	0%	2%
Ohakune Low	100%	0%	0%	0%

Figure 5.11: Maximum Water Age – 2031 Peak Day

A.4 Proposed Pipe Sizes

Table 5.7: Proposed Network Upgrade

Assetid	Length (m)	Diameter- existing (mm)	Diameter- Proposed (mm)	Location
20090226164502	1	20	50	Kowhai Heights
20140702155615	8	63	125	Old Station Road
20140702155545_1	7	63	125	Old Station Road
20140702155545_2	4	63	125	Old Station Road
20130515144400us	13	100	140	Miro Street
20160513142819	88	150	250	Shannon St
20160513150852_3	14	250	250	Ruapehu Rd
20160513151217	13	150	250	Shannon St
20090107130201_1	1	200	280	Rimu /Thames Street Intersection
20090107131301	27	200	250	Rimu Street
20090107130701	6	200	250	Rimu Street
20090107144401	2	200	280	Rimu Street
20090107130501	24	200	250	Rimu Street
20090107130201_2	1	200	250	Rimu /Thames Street Intersection
20101105161001	6	100	280	Railway Row
20081205001354_1	2	200	280	Thames Street
20081205001354_2	80	200	280	Thames Street
5001562	2	100	140	Mangawhero Terrace
5001561	32	100	140	Mangawhero Terrace
5001785_2	28	100	140	Mangawhero Terrace
5001784	91	100	140	Mangawhero Terrace
5001786	8	100	140	Mangawhero Terrace
5001785_1	78	100	140	Mangawhero Terrace
5001453	36	100	140	Mangawhero Terrace
5001450	9	100	140	Mangawhero Terrace
5001449	61	100	140	Mangawhero Terrace
5001222_3	33	150	250	Shannon Street
5001222_2	32	150	250	Shannon Street
5001222_1	10	150	250	Shannon Street
5001221	100	150	250	Shannon Street
5001208	96	150	250	Shannon Street
5001209	49	150	250	Shannon Street
5001219_1	95	150	250	Shannon Street
5001220	5	150	250	Shannon Street
5001218	50	150	250	Shannon Street
5001219_2	3	150	250	Shannon Street
5001224	4	150	250	Shannon Street
5001215	100	150	250	Shannon Street
5001223_2	94	150	250	Shannon Street
5001223_1	6	150	250	Shannon Street
5001253_2	12	100	140	Miro Street
5001253_1	1	100	140	Miro Street
5001253_9	3	100	140	Miro Street
5001232	70	150	225	Shannon Street
5001253_8	2	100	140	Miro Street
5001253_7	34	100	140	Miro Street
5001253_6	9	100	140	Miro Street
5001253_5	8	100	140	Miro Street
5001253_4	19	100	140	Miro Street
5001253_3	14	100	140	Miro Street
5001219_3	11	150	250	Shannon Street
5001231	5	150	225	Shannon Street
5001233	44	150	225	Shannon Street
MM31New_2	1272		180	Soldiers Road

Table 5.8: Proposed Firefighting Upgrade

Assetid	Length (m)	Diameter- existing (mm)	Diameter- Proposed (mm)	Location
5001491	2	100	140	Burns Street
5001492	9	100	140	Burns Street
20160513143318ds	77	100	160	Ruapehu Road
20160513151318_1	11	100	160	Ruapehu Rd
20160513151318_2	2	100	160	Ruapehu Rd
20081222163072	28	100	160	Snowmass Drive
20091211162502_2	9	63	180	Kowhai Crescent
20091211162502_1	63	63	180	Kowhai Crescent
20081222161737_3	4	100	160	Snowmass Drive
20081222161737_2	1	100	160	Snowmass Drive
20081222161743	20	100	160	Snowmass Drive
20081222161737_1	22	100	160	Snowmass Drive
20081222161736_2	25	100	160	Snowmass Drive
20080724165001	55	100	160	Burns Street
5001486	8	100	160	Burns Street
5001485_3	9	100	160	Burns Street
5001485_2	52	100	160	Burns Street
5001485_1	32	100	160	Burns Street
5001484_3	11	100	160	Burns Street
5001484_2	56	100	160	Burns Street
5001484_1	29	100	160	Burns Street
5001483_5	31	100	160	Burns Street
5001572	24	50	100	Mangawhero Terrace
5001500	93	100	160	Burns Street
5001483_4	18	100	160	Burns Street
5001483_3	20	100	160	Burns Street
5001483_2	26	100	160	Burns Street
5001483_1	15	100	160	Burns Street
5001482	94	100	160	Burns Street
5001497_2	78	100	160	Burns Street
5001499_2	48	100	160	Burns Street
5001496_2	49	100	160	Burns Street
5001498	67	100	160	Burns Street
5001495	118	100	160	Burns Street
5001497_1	14	100	160	Burns Street
5001496_1	39	100	160	Burns Street
5001499_1	63	100	160	Burns Street
20080723104762	19	100	160	Burns Street
20080724165002	11	100	160	Burns Street
5001926_2	8	150	315	Railway Row
5001926_1	96	150	280	Railway Row
5001924	175	150	280	Railway Row
5001917	10	150	280	Railway Row
5001920	23	150	280	Railway Row
5000681	141	100	200	Railway Row
5000688	50	100	200	Railway Row
5000695	86	100	200	Railway Row
5000705_2	84	100	160	Turoa Drive
5000707	18	100	160	Rangataua Road
5000706	45	100	160	Turoa Drive
5000705_1	15	100	160	Turoa Drive
5001341_2	9	100	200	Railway Row
5001341_1	93	100	200	Railway Row
5000958_1	4	100	160	Ruapehu Road
5000974	94	100	160	Rangataua Road
5000975	99	100	160	Rangataua Road
5001690_2	12	100	160	Ruapehu Road
5001679	15	100	160	Ruapehu Road
5001689_2	64	100	160	Ruapehu Road
5001691	81	100	160	Ruapehu Road
5001689_1	37	100	160	Ruapehu Road
5001690_1	93	100	160	Ruapehu Road
5001680	116	100	160	Ruapehu Road
5001150	6	100	160	Rangataua Road

Assetid	Length (m)	Diameter- existing (mm)	Diameter- Proposed (mm)	Location
MM31New_ff	198		160	Tawhero Road
MM31New_1	242		160	Turoa Drive

A.5 SPA Results with Options

Pressure

Table 5.9: Pressure SPA Results – 2031 Peak Day with Options

Criteria	Area	< 25 m	25 - 40 m	40 - 60 m	60 – 80 m	> 80 m
Minimum Pressure	Ohakune High	0%	11%	57%	32%	0%
	Ohakune Low	0%	0%	70%	30%	0%
Maximum Pressure	Ohakune High	0%	8%	42%	50%	0%
	Ohakune Low	0%	0%	30%	70%	0%
		< 10 m	**10 – 20 m**	**20 – 30 m**	**> 30 m**	
Daily Pressure Fluctuation	Ohakune High	100%	0%	0%	0%	
	Ohakune Low	100%	0%	0%	0%	

Figure 5.12: Minimum Pressure – 2031 Peak Day with Options

Figure 5.13: Maximum Pressure – 2031 Peak Day with Options

Figure 5.14: Pressure Fluctuation – 2031 Peak Day with Options

Head Loss

Table 5.10: Head Loss SPA Results – 2031 Peak Day with Options

Area	< 2 m/km	2 - 3 m/km	3 - 5 m/km	5 - 10 m/km	> 10 m/km
Ohakune High	78%	15%	7%	0%	0%
Ohakune Low	100%	0%	0%	0%	0%

Figure 5.15: Maximum Head Loss – 2031 Peak Day with Options

Velocity

Table 5.11: Velocity SPA Results – 2031 Peak Day with Options

Criteria	Area	< 0.5m/s	0.5 – 1 m/s	1 – 2 m/s	2 – 3 m/s	> 3m/s
Minimum Velocity	Ohakune High	100%	0%	0%	0%	0%
	Ohakune Low	100%	0%	0%	0%	0%
Maximum Velocity	Ohakune High	82%	18%	0%	0%	0%
	Ohakune Low	100%	0%	0%	0%	0%

Figure 5.16: Minimum Velocity – 2031 Peak Day with Options

Figure 5.17: Maximum Velocity – 2031 Peak Day with Options

Fire Flow

Table 5.12: Fire Flow SPA Results – 2031 Peak Day with Options

Area	Cannot provide 12.5l/s	FW2-1	FW2	FW3	FW4	FW5	FW6
Ohakune High	1	0	67	76	50	2	0
Ohakune Low	0	0	10	0	0	0	0

Figure 5.18: Fire Flow – 2031 Peak Day with Options

Appendix 10

Chorus and
The Lines Company
Connection Applications

Chorus New Zealand Limited

03 April 2023

Chorus reference: 10408120

Attention: Amala Thomas

Quote: New Property Development

44 connections at 6 Teitei Drive, Ohakune, Ruapehu District, 4625

Thank you for your enquiry about having Chorus network provided for the above development.

Chorus is pleased to advise that, as at the date of this letter, we are able to provide reticulation for this property development based upon the information that has been provided:

Fibre network	$52,800.00

The total contribution we would require from you is **$60,720.00 (including GST)**. This fee is a contribution towards the overall cost that Chorus incurs to link your development to our network. This quote is valid for 90 days from 03 April 2023. This quote is conditional on you accepting a New Property Development Contract with us for the above development.

If you choose to have Chorus provide reticulation for your property development, please log back into your account and finalise your details. If there are any changes to the information you have supplied, please amend them online and a new quote will be generated. This quote is based on information given by you and any errors or omissions are your responsibility. We reserve the right to withdraw this quote and requote should we become aware of additional information that would impact the scope of this letter.

Once you would like to proceed with this quote and have confirmed all your details, we will provide you with the full New Property Development Contract, and upon confirmation you have accepted the terms and paid the required contribution, we will start on the design and then build.

For more information on what's involved in getting your development connected, visit our website www.chorus.co.nz/develop-with-chorus

Kind Regards

Chorus New Property Development Team

Mary Chappel

From: Connections@thelines.co.nz
Sent: Thursday, 6 April 2023 11:04 am
To: Amala Thomas
Subject: [#220528] Automatic reply: Connections to 6 Teitei Drive, Ohakune

Thank you, we acknowledge your email and will be in touch within 5 working days.
If you would like to get in touch with our Connections team during office hours Monday-Friday 8.30am-4.30pm on 0800 367 546, option 2, then option 2

Ngā mihi,

PO Box 281, Te Kuiti 3941
8 King St East, Te Kuiti
0800 367 546
thelinescompany.co.nz