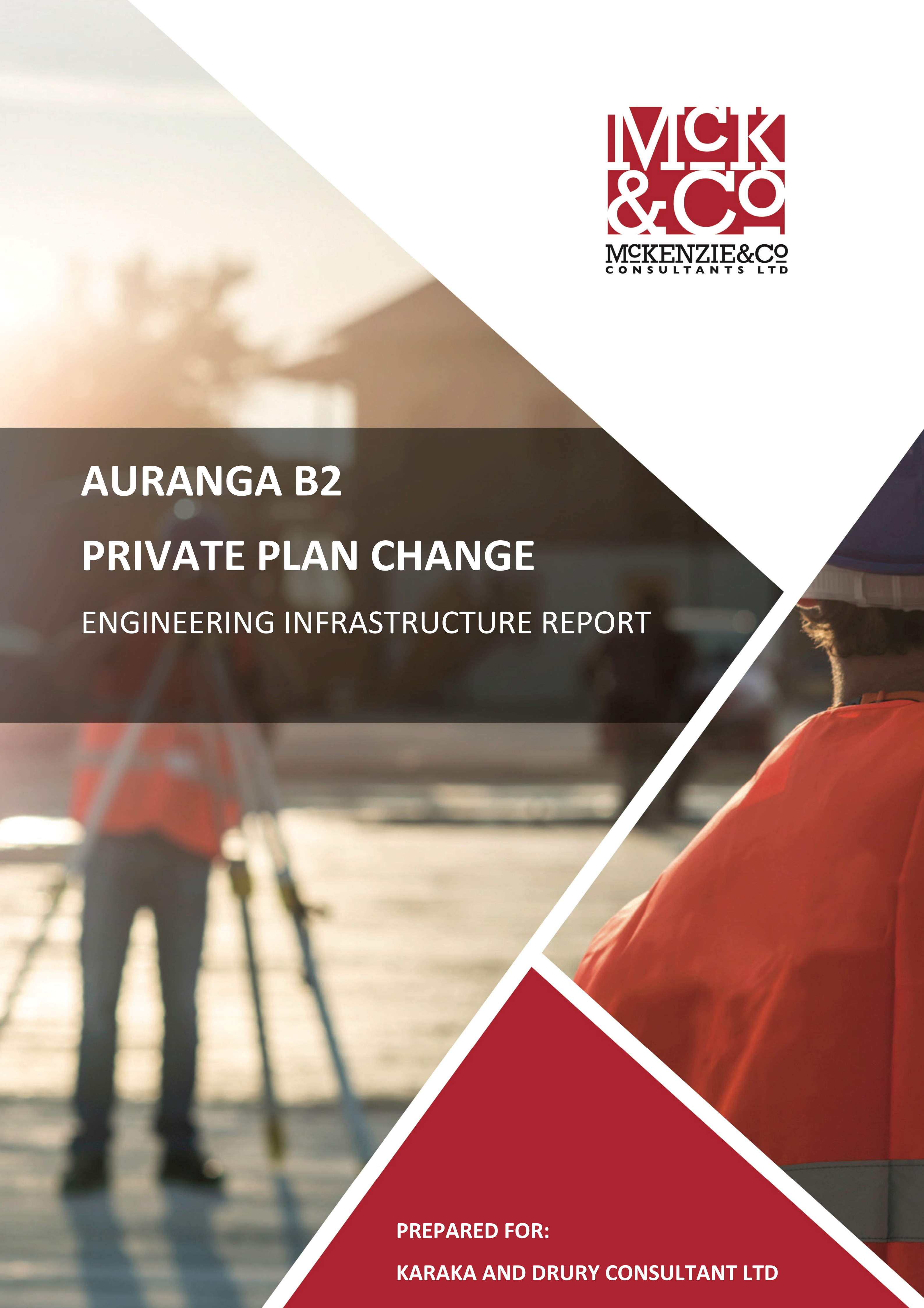


AURANGA B2

PRIVATE PLAN CHANGE

ENGINEERING INFRASTRUCTURE REPORT

PREPARED FOR:

KARAKA AND DRURY CONSULTANT LTD

DOCUMENT CONTROL RECORD

PROJECT: Proposed Private Plan Change – Auranga B2 Engineering Infrastructure Report

CLIENT: Karaka and Drury Consultant Ltd

PROJECT LOCATION: Drury, Auckland 2016

FILE PATH: D:\12dSynergy\Workspace\data\MCKFS01\1823 Auranga B2_553\Documents and Communications\Reports\auranga b2 plan change infrastructure report.docx

Revision	**Date**	**Originat**	**Checker**	**Approve**	**Description**
A	03/2019	MJG	MWM	JDK	Draft
B	04/2020	MJG	MWM	JDK	Draft
C	05/2020	MJG	MWM	JDK	Final

TABLE OF CONTENTS

APPENDICIES

1.0 INTRODUCTION

McKenzie & Co Consultants Limited, has been Engaged by Karaka & Drury Limited (KDL), to prepare this Engineering Infrastructure Report, in support of the proposed Re-Zoning of, approximately, 34-hectares within the Future Urban Zone, to Mixed Housing Urban, Terrace Housing, Apartment Building and Town Centre Zones, as defined in the Auckland Unitary Plan – Operative in Part (AUP). The Zones are located adjacent to Burberry Road and Karaka Road (SH22), Drury.

This Report, summarises the suitability of the existing Infrastructure and any proposed upgrades or extensions, required to service the anticipated development, sought for the Auranga B2 Private Plan Change Area, Figure 1 and as shown in Drawing 1823-PC2B-001, refer to Appendix A. The Plan Change, seeks a new Precinct, to cover the Auranga B2 area, in addition to the current Operative AUP rules.

2.0 SITE DESCRIPTION

The Private Plan Change Area ("PPC") area is, approximately, 40km south of Auckland's Central Business District. The proposed Development, covers the area north of Karaka Road / Great South Road (State Highway 22 (SH22)), either side of Burberry Road. The Plan Change consists of 10 Land Parcel as shown in Drawing 1823-PC2B-001, refer to Appendix A.

FIGURE 1 - Site Location – Extent of affected properties

The affected Land Parcels, are all Burberry Road: 5; 6; 14; 15; 16; 16A; 18; 20; 24; and 25. The topography is undulating, rising from, approximately, RL 5m, on the eastern Boundary, to, approximately, RL 22m, along the western Boundary. The area slopes up-wards, generally, in a north-westerly direction, towards the current Drury 1 Precinct. There is a more significant rise adjacent to SH22 where the gradient is, generally, 5% with some steeper gradients, of 10%. The Land Parcels consist of lifestyle-blocks and pastoral activities.

Auckland Council's GIS, indicates a Stream / Over Land Flow-Path (OLFP), running along the southern / eastern Boundary, flowing north-wards, into the Ngakoroa Stream. However, south of Burberry Road, NZ Transport Agency (NZTA), has confirmed that there are two Storm Water Culverts, providing drainage from north-western side of SH22, south-east, to Council's Ngakoroa Reserve.

An Ecological Study has been undertaken to classify the streams. Approximately half of the streams are intermittent and permanent, and several ponds and located within the site, including a large 1.2ha pond. For further detail on stream ecology refer to RMA's Ecology Report (Ussher, 2019).

3.0 GEOTECHNICAL INVESTIGATION

3.1 Geology

A Geotechnical Investigation Desk Study, has been undertaken by Lander Geotechnical Consultants Limited (2019) for the PPC Area. The Geology of the area, is underlain by the Puketoka Formation of the Tauranga Group Sedimentary Lithology (late Pliocene - early Pleistocene Epoch). These deposits comprise, Terrace Alluvium (Clays, Silts, Sands, Pumiceous Silts and Organic Deposits), overlain in places, by Weathered Volcanic Ash.

The Desktop Study included a review of previous Lander Geotechnical boreholes within the Auranga Development (Bremner Road, Jesmond Road, Burberry Road and Karaka Road) and also, of relevant Geotechnical Records from the New Zealand Geotechnical Database (NZGD - Drillers Logs and Borehole Logs). This review has found that these generally similar ground conditions, are encountered across the site.

Lander Geotechnical recommended that to support Development, (i.e. Resource Consent / Subdivision Design):

- Intrusive Geotechnical Ground Investigations, commensurate with Earthworks / Subdivision Schemes, to be undertaken to substantiate Ground Conditions and address any Geotechnical constraints. Such Investigations, are expected to comprise (but are not limited to) Hand-Auger and Machine Boreholes, Trial Pits and Soil-Sampling; and
- Appropriate Laboratory Testing to be undertaken, to characterise Engineering properties, compressibility, permeability and susceptibility to erosion or dispersion.

At this early stage and provided there is due consideration to prevailing or perceived Geotechnical Constraints during Ground Investigations for Resource Consent, it is considered that Auranga B2, is suitable for the proposed re-Zoning.

4.0 STAGING

Auranga B2 can be developed once infrastructure connections are available from the adjoining Drury 1 Precinct, and/or land within the B2 area provides for the relevant extensions.

5.0 INFRASTRUCTURE REQUIREMENTS

5.1 Introduction

This Section, covers the provision of the following infrastructure necessary to serve the PPC area:

1. Storm Water;
2. Wastewater;
3. Potable Water;
4. Roads;
5. Utilities

5.2 Stormwater

The Stormwater Management Plan (SMP) for the PPC Area, prepared by Mckenzie and Co Consultants Ltd, provides a comprehensive overview of the existing Stormwater System and proposes Infrastructure required, to enable Development.

The requirements for stormwater management are based on the application and implementation of the Auckland Unitary Plan (AUP) SMAF 1 provisions. Final Options, will be decided at the Subdivision Stage for Public and Communal Infrastructure and at Building Consent Stage, for individual Lots.

In general, Development must provide Retention (volume) reduction of, at least, 5mm Run-Off depth, for impervious areas and Detention (temporary storage), for the difference between the Pre-Development and Post-Development, Run-Off volumes, for the 95th percentile, 24-hour, Rainfall Event, minus, the 5mm Retention. The Detention Volume, must drain-down over, at least, 24-hours.

The SMP is supported by a flood hazard assessment, which was carried out using a 2D model with 2013 LiDAR coupled with a 1D component to represent Hingaia Road Bridge. The outcomes are flood hazard maps and proposed approaches for flood and coastal management for Auranga B2 (which align with previous approaches utilised for Auranga A and B1).

All Stormwater Infrastructure within the PPC Area, will be constructed and funded by the Developers.

Auranga B2 is within the Network Discharge Consent (DIS60063613) obtained by Auckland Councils required for the diversion and discharge of Stormwater.

5.3 Wastewater

Currently, the PPC Area, is not serviced by a Wastewater Network, however, provision has been made within the Drury 1 Precinct, to cater for future Urban Development with the construction of the Trunk Wastewater Sewer with an associated connecting Network, which will have capacity to service Auranga B2 and future up-stream Catchments.

Area B2, is planned to be Serviced by Gravity Sewers connecting into the Auranga B1b WW Trunk to the north or flow south, to the proposed Waste Water Pump Station adjacent to SH 22 and then by Gravity, into WW D Trunk. All of the Sewers will, ultimately, flow to the Interim Pump Station in Auranga A, Stage 1. Refer to the GHD's (2017b) Basis of Design Report for the Drury 1 Precinct.

Within the Drury 1 Precinct, a first-stage interim Wastewater Pump Station with an 800 OD PE (680mm ID) inlet, has been installed at 207, Bremner Road. This Pump Station, is Designed with a maximum Pumping Rate, of 188 L/s, (6000 HUE).

GHD, has designed the First-Stage interim Pump Station, to utilise two Rising Mains and Pump / Variable Speed drive combinations, to meet the Design Flow range expected of up to, 188 L/s. To meet the Flow Range, Watercare Services Limited, will be required to install a third pump when Flows exceed ~70 L/s and upgrade the Pump Impellors when flows exceed 126 L/s. GHD recommended that the cost of these upgrades, be included within Infrastructure Funding Agreements between Watercare and contributing Developers. The 6000 HUE capacity of the interim WWPS has capacity for the Auranga B2 PPC catchment (3000 HUE Drury 1 Precinct and Auranga B1 PPC + up to 3000 HUE (or HUE equivalent) for Auranga B2 PPC).

Further to the First stage interim Pump Station, an area of 2,500m² on the neighbouring lot immediately south of the interim Pump Station Site has been allocated for the future ultimate Transmission Pump Station which will service the wider, Drury Area including Auranga, Drury South, Drury West and Opaheke, Future Urban Zones. Associated with the new Pump Station will be an additional DN560 OD PD rising main to provide additional capacity. This transmission pump station and rising main will be provided by Watercare to meet growth as it occurs within the catchment and it is expected that it would be funded through Infrastructure Growth Charges. The 800 OD PE sewer has been sized by GHD for ultimate flow of 571 l/s (14,340 HUE/ 448l/s using adopted WWF of 900 l/p/d from the Drury West Future Urban Zone), including 123 l/s from Drury South.

The wastewater sewer has capacity for up to 750 l/s according to GHD's report (k 0.3mm) (2016b, 2017b) – see Appendix D.

The Water and Wastewater Servicing Plan, Drury – Opaheke Structure Plan report prepared by Watercare Services Ltd (see Appendix C) indicates a Wastewater Pumpstation within Auranga B2 which connects to a Trunk Sewer. This proposed for the central gully (adjacent to the watercourse) of Auranga B1b, refer to drawing 1343-582 (Appendix B) and will connect to the Drury Precinct 1 800 ODPE sewer and WWPS.

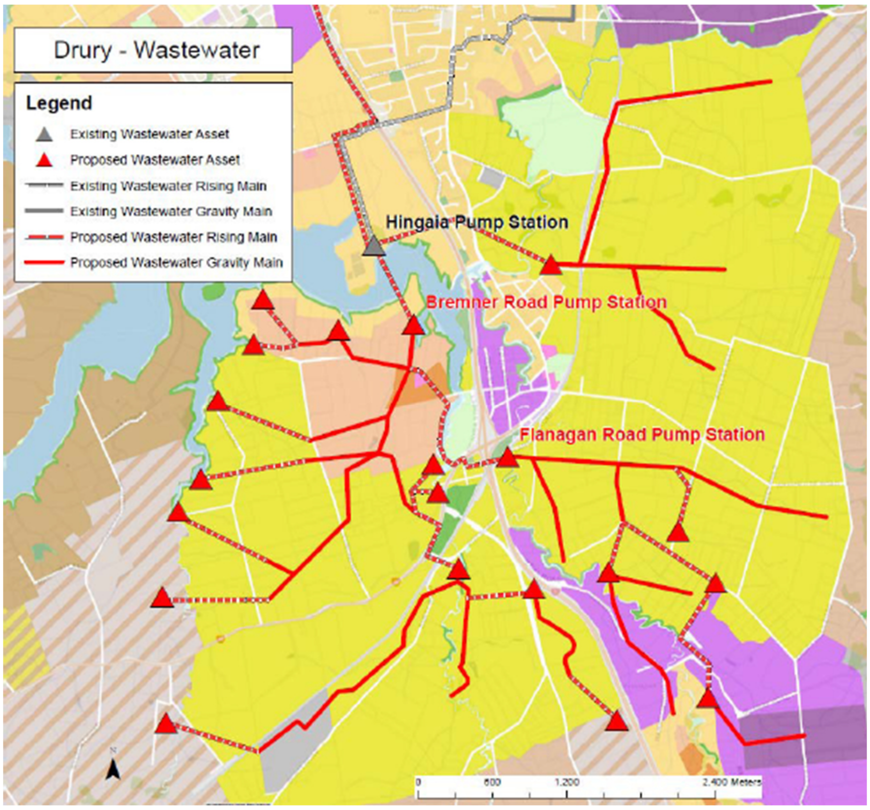


FIGURE 2 - Wastewater Servicing Plan, Drury – Opaheke Structure Plan

Additionally, a WWPS has been constructed at the southern end (Stage 2A) of the Drury 1 Precinct. This WWPS has additional capacity allocated for catchment in the Auranga B2 PPC area. The available capacity is for has spare capacity of 10l/s (231 HUE). This can be connected directly to Burberry Road in Auranga B2 without any dealings across private land. This Pump station and road reserve extension to Burberry Road is expected to be completed mid-2021. The (stage 2A) WWPS pumps to the transmission sewer along Bremner Road which also connects to the first stage WWPS (Bremner Road Pumpstation).

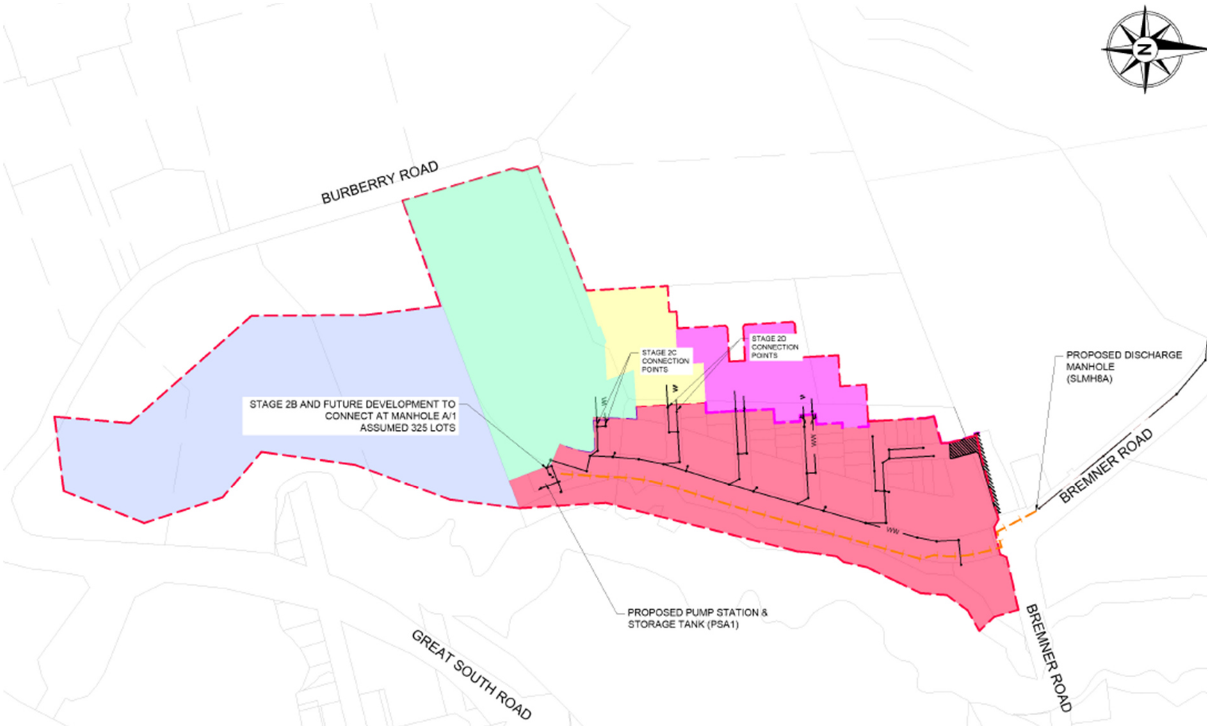


FIGURE 3 - Drury 1 Precinct Stage 2A WWPS Catchment

It is recommended that if Wastewater servicing is to be fast-tracked to Auranga B2, a portion of the PPC area can be connected to the Drury 1 Precinct southern WWPS and/or Cost-Sharing Development Agreements be entered into between Landowners / Developers who wish to have access to the Network sooner than will likely occur, if traditional Land Development processes occur. This is Developer Funded Infrastructure and therefore, Cost-Sharing Development Agreements, as discussed above, would apply.

Internal reticulation will be provided at developer cost at each subdivision stage as per normal practise. Wastewater Network and Pump Station Design, must comply with Watercare Services Limited Code of Practice for Land Development and Subdivision.

Overall, the necessary infrastructure to service the PPC area can be provided to service the area.

5.4 Water

As with Wastewater, the proposed PPC Area, is currently not Serviced by Water and requires the extension of Water Service from the Drury 1 Precinct. Refer to the GHD Water Modelling Reports (2016a, 2017a), Appendix D. The Reports address the servicing of the Drury 1 Precinct and the wider area, including Auranga B2.

Watercare has agreed that the following areas will be Serviced by a 450mm diameter, Bulk Supply Main, connected to the existing 1200mm diameter, CLS Water Main (Bulk Supply Point) at 103, Flanagan Road Drury (GHD Limited, 2016a, 2017a; Mott MacDonald, 2016), refer reports in Appendix D:

- Drury 1 Precinct;
- Auranga / Bremner Road Special Housing Area;

– Initial Drury South Industrial Development;
– Quarry Road Special Housing Area; and
– Future Catchments = Wider Drury Township, Drury West FUZ, Opaheke FUZ.

GHD (2016a) has Designed the Bulk Supply Main to service both Auranga A, B1, B2 and the future development, on Hingaia Peninsula (south of Hingaia Road), from the Bulk Supply Point (BSP) at Flanagan Road.

The Bulk Supply Main (384 ID/450 OD), extends through the Drury 1 Precinct, via Victoria Street on the western side, of SH 1, through to Bremner Road and across the proposed Bremner Road Footbridge. After the cross-connection to Hingaia, the proposed Network will extend south from Bremner Road (through the southern portion of Drury Precinct 1) to Burberry Road, as part of the ultimate Ring Main (339 ID / 400 OD). The ring main through to Burberry Road is expected to be complete mid-2021. Engineering Plan Approval and relevant Consents, have been received with construction due to commence.

Auranga B2, can then be serviced from the southern end of the 400OD ring main down to SH 22 and fully service the area.

Ultimately, it is anticipated that the 339 ID/400 OD Water Main, will be extended west from Burberry Road (Auranga B2 PPC) and connect with the ring main in the Auranga B1b PPC, refer to Drawing 1343-680 in appendix 2 and figure 4 below.

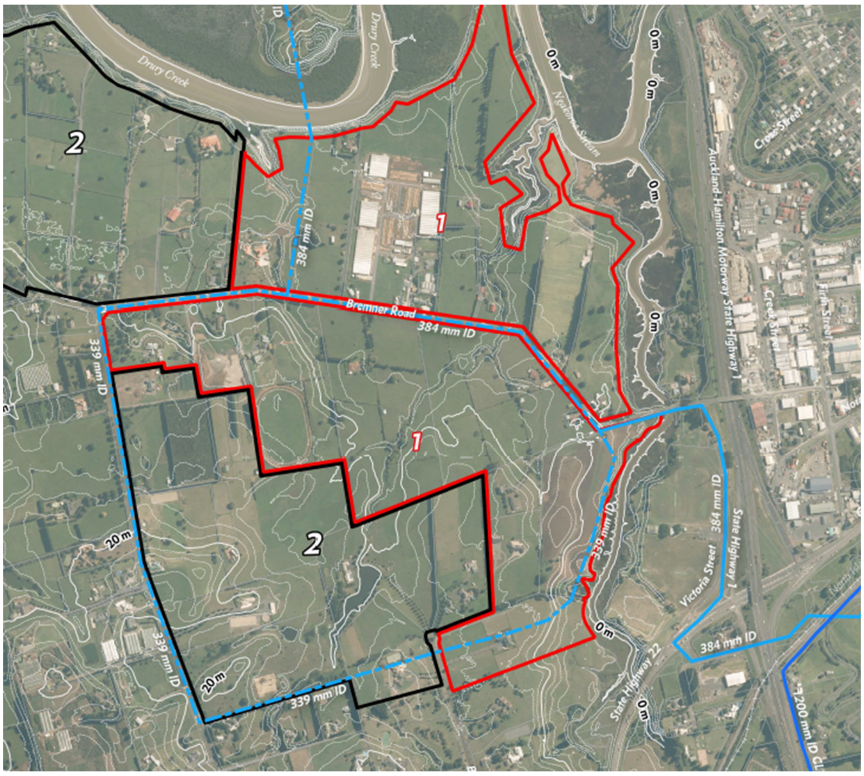


FIGURE 4 - 400 OD PE Ring main through Drury 1 Precinct Auranga B1b and B2

Design for sizing of future reticulation and other required details, must comply with Watercare Services Limited Water and Wastewater Code of Practice for Land Development and Subdivision (2015). Design and testing for firefighting pressure and provision for fire hydrants will located within the road reserves – compliant with the New Zealand Fire Service Fighting Water Supplies Code of Practice SNZ PAS 4509:2008 – will be addressed at future resource consent stage.

Development agreements between Developers / Operators, can address the Cost-Sharing, for the funding of the infrastructure to extent the network as needed.

5.5 Roads

Commute, has undertaken an Integrated Transportation Assessment (ITA) for Auranga B2 that identifies specific transportation improvements required, to support the PPC. The precinct plan for Auranga B2, drawing 1823-PC2B-003 (Appendix A), indicates the concept layout for the key transportation improvement proposed.

Refer to the Commute's ITA for summary or required improvements triggered by existing precinct plans Auranga B2 plan change.

5.6 Utility Services

5.6.1 Gas Reticulation

First Gas, advised for both Auranga A1 and B1 that its current Network is unable to provide Service to the PPC Area without Network Reinforcement, at the Gate Valve on the Major Supply Route. Due to cost implications, Gas, is not proposed to be installed within the Plan Change Area.

The First Gas Transmission Gas Pipeline, passes through properties 6, 16, 16A, 20, and 24 Burberry Road (within Auranga B2) and then into the Drury 1 Precinct. As has been established with the Resource Consents for Auranga A, the protection of the Gas Pipeline, has been addressed at the time of Subdivision, Earthworks and Development through direct engagement, with First Gas.

5.6.2 Telecommunications

Chorus telecommunication networks have been installed in Auranga A and form part of current development occurring in the B1 area. These can be further extended to service the PPC area. This will be confirmed at each subdivision stage once detailed design has been commissioned.

5.6.3 Power

Counties Power underground reticulation networks have been installed in Auranga A and form part of current development occurring in the B1 area. These can be further extended to service the PPC area.

At each Subdivision Stage, the location of above ground infrastructure (transformers and switch gear locations), will be determined, with the mostly likely locations, to be within Lots to avoid cluttering of the Road Reserve. Access to these Assets, will be granted by either Road Set-Back or Easements.

5.6.4 Summary

All Utility operators will enter into Commercial Agreements to Service each Subdivision at the time of Detailed Design.

6.0 INFRASTRUCTURE GROWTH CHARGES

It is anticipated that standard Infrastructure Growth Charges (IGC), will apply to all Development within the Plan Change Area at the time of connection to an existing Network. In matters relating to Water and Waste Water, Veolia requires that IGCs be paid prior to them issuing compliance necessary for 224c certification.

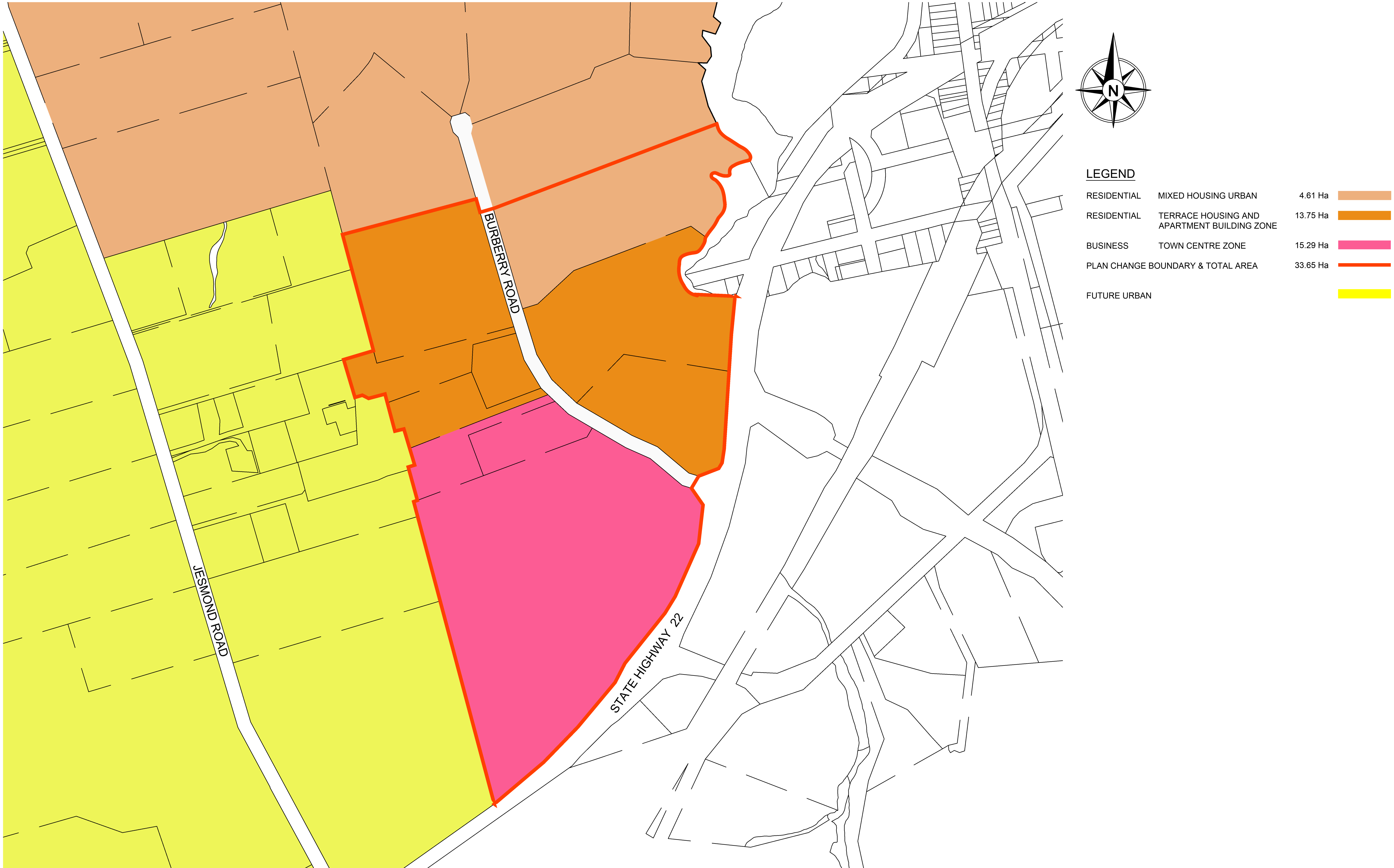
7.0 CONCLUSION

Investigations, meetings and correspondence with the respective Council Authorities, Council Controlled Organisation's and Utility Providers to date, indicate that existing Infrastructure, can be extended and be made available, to Service the Auranga B2 PPC Area.

Future Subdivision and Development associated with Land subject to the PPC area, can provide essential Infrastructure necessary for use and enjoyment of the Developed Lots and is in compliance with the Precinct Rules, the AUP and Council Standards.

APPENDIX A – PRECINCT PLANS

- 1823-PC2B-001 – ZONE MAP
- 1823-PC2B-003 – PRECINCT PLAN



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A	FIRST ISSUE	PC	28/03/19

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DRAWN: PC	DATE: 28/03/19	SIGNED:	PLOT DATE:
CHECKED: MJG	DATE: 28/03/19	SIGNED:	SURVEY BY:
APPROVED: MJG	DATE: 28/03/19	SIGNED:	SURVEY DATE:

ALL DIMENSIONS TO BE CHECKED; DO NOT SCALE FROM DRAWING

PROJECT:
PRIVATE PLAN CHANGE B2
AURANGA B2
DRURY WEST

TITLE:
ZONE MAP

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ISSUE STATUS: FOR INFORMATION ONLY

PROJECT NO: 1823-PC2B

SCALES: 1:2,500 @ A1; 1:5,000 @ A3

A1

DRAWING NO: 001

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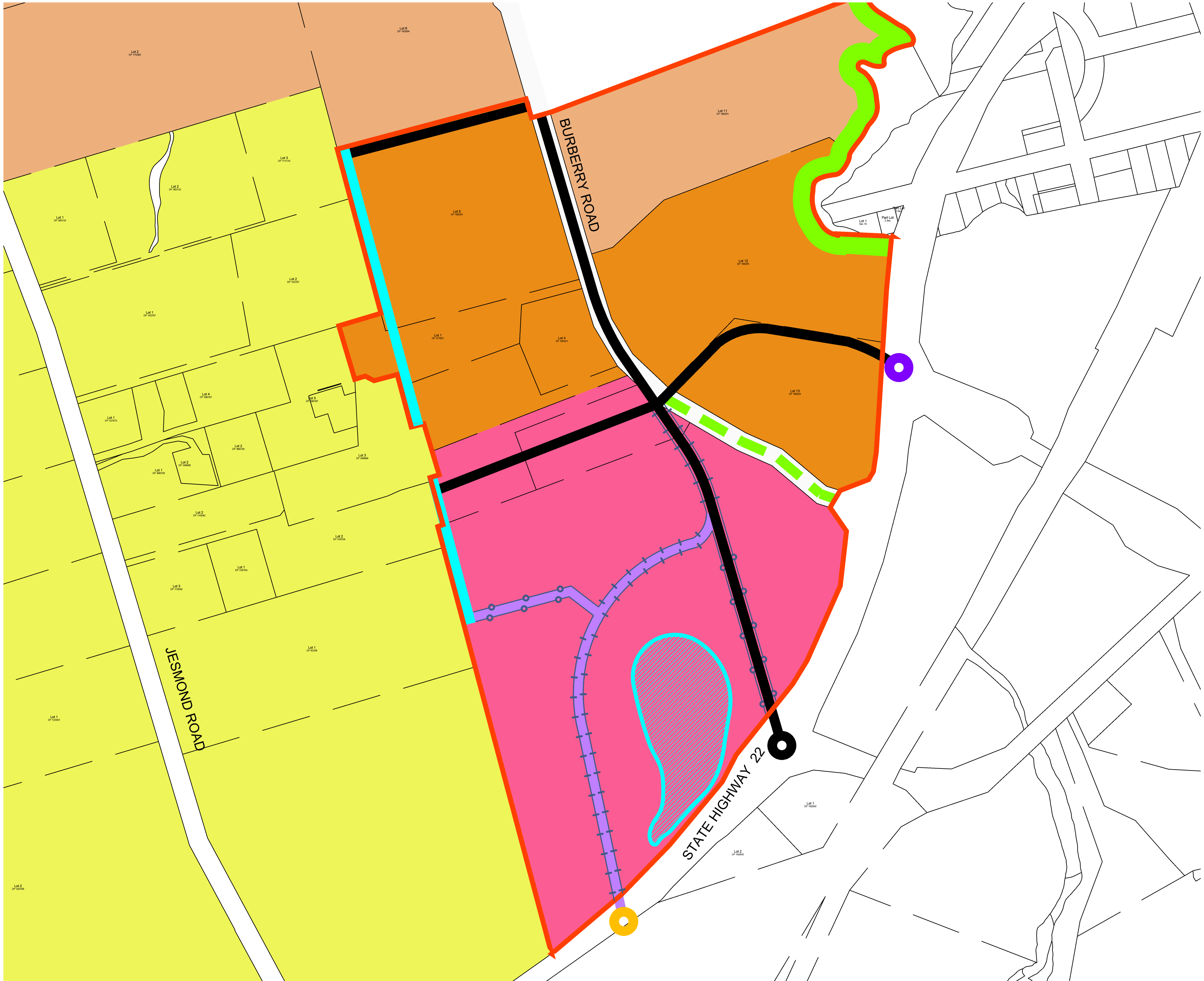

LEGEND

- COLLECTOR ROAD WITH CYCLE AND 3M SHARED PATHS
- LOCAL ROAD WITH CYCLE AND 3M SHARED PATHS
- TOWN CENTRE LOCAL ROAD
- DRURY 2 PRECINCT BOUNDARY
- SIGNALISED INTERSECTION
- POSSIBLE FUTURE SIGNALISED INTERSECTION WITH UPGRADE TO GREAT SOUTH RD BY OTHERS
- LEFT IN AND OUT INTERSECTION - UPGRADE TO A SIGNALISED INTERSECTION BY OTHERS
- FUTURE ESPLANADE RESERVE
- FUTURE ROAD STOPPING
- EXISTING WATER FEATURE
- CONTROLS: BUILDING FRONTAGE CONTROL - KEY RETAIL FRONTAGE
- CONTROLS: BUILDING FRONTAGE CONTROL - GENERAL COMMERCIAL FRONTAGE

REV	DESCRIPTION	BY	DATE
F	REVISED	NC	04/05/20
E	REVISED	NC	07/04/20
D	REVISED	NC	18/03/20
C	REDRAWN	NC	10/03/20
B	BUILDING CONTROLS ADDED	JDK	14/3/19
A	REVISED	JDK	01/03/19

ORIGINATOR: JDK	DATE: 28/02/19	SIGNED:	PLOT BY:
DRAWN: JDK	DATE: 28/02/19	SIGNED:	PLOT DATE:
CHECKED:	DATE:	SIGNED:	SURVEY BY:
APPROVED:	DATE:	SIGNED:	SURVEY DATE:

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PROJECT:
PLAN CHANGE B2
BREMNER ROAD
DRURY

TITLE:
PRECINCT PLAN

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ISSUE STATUS: FOR INFORMATION ONLY

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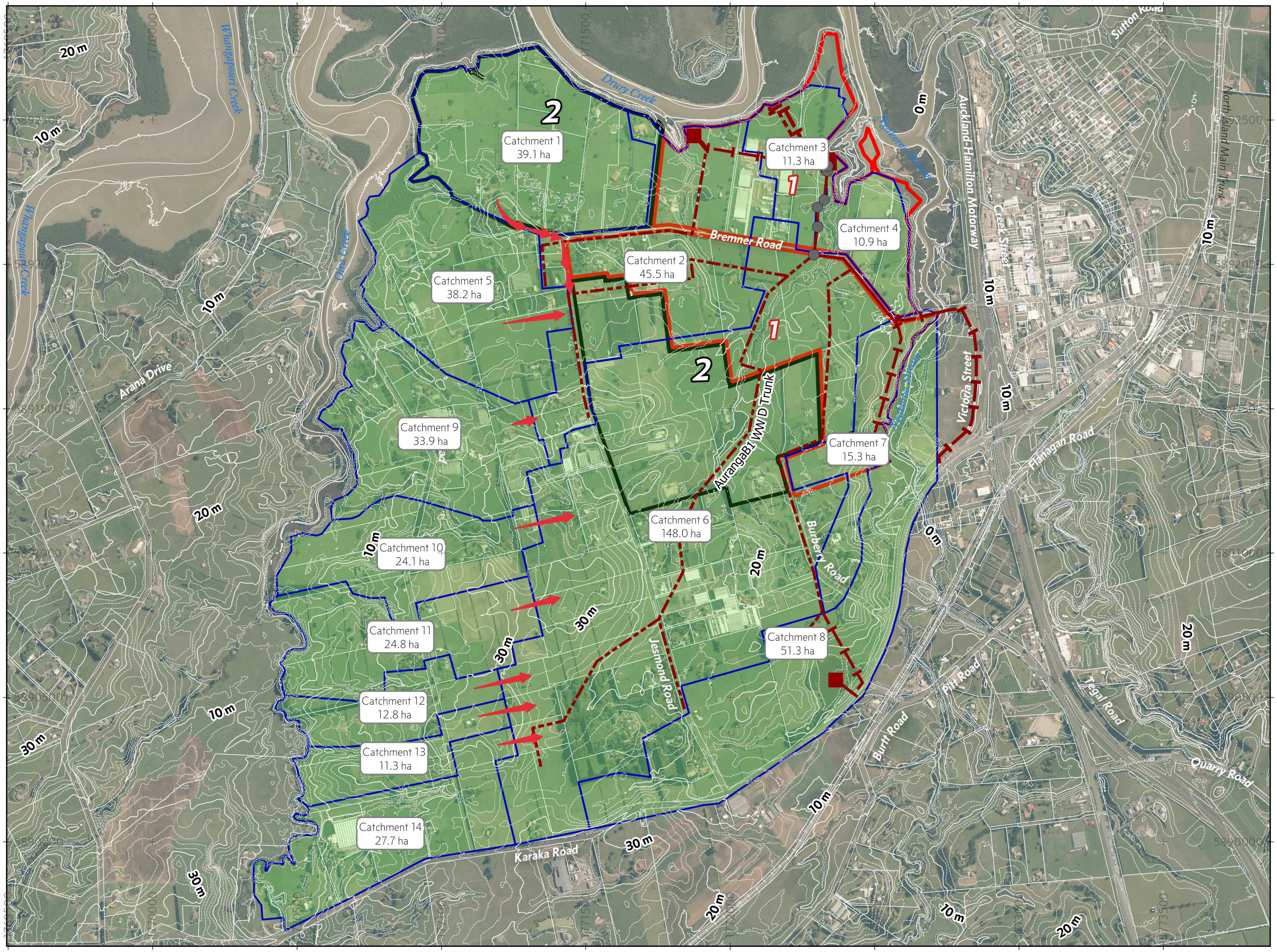
APPENDIX B – CONCEPT PLANS FOR WASTEWATER AND WATER

- 1343-580 – WASTEWATER CATCHMENT PLAN
- 1343-680 – WATER CONCEPT PLAN



N

Notes

1. The catchment areas shown are indicative only and subject to detailed confirmation.
2. The contours shown are from Lidar data and have been used for generating a high level catchment assessment and are subject to confirmation by detailed survey

Areas:
Total area of Catchment (NO.1 - NO.14): 494.0 ha
Total area of Auranga A: 85 ha
Total area of Auranga B: 83 ha
Future area: 326 ha

Legend

- Pump Station
- Auranga A
- Auranga B
- Wastewater Catchments
- Future Trunk Wastewater Line
- Rising Main (Future)
- Rising Main
- Waste Water
- Rising Main Required
- MainHole

Map Projection:
NZGD2000 / Mount Eden 2000 (EPSG: 2105)

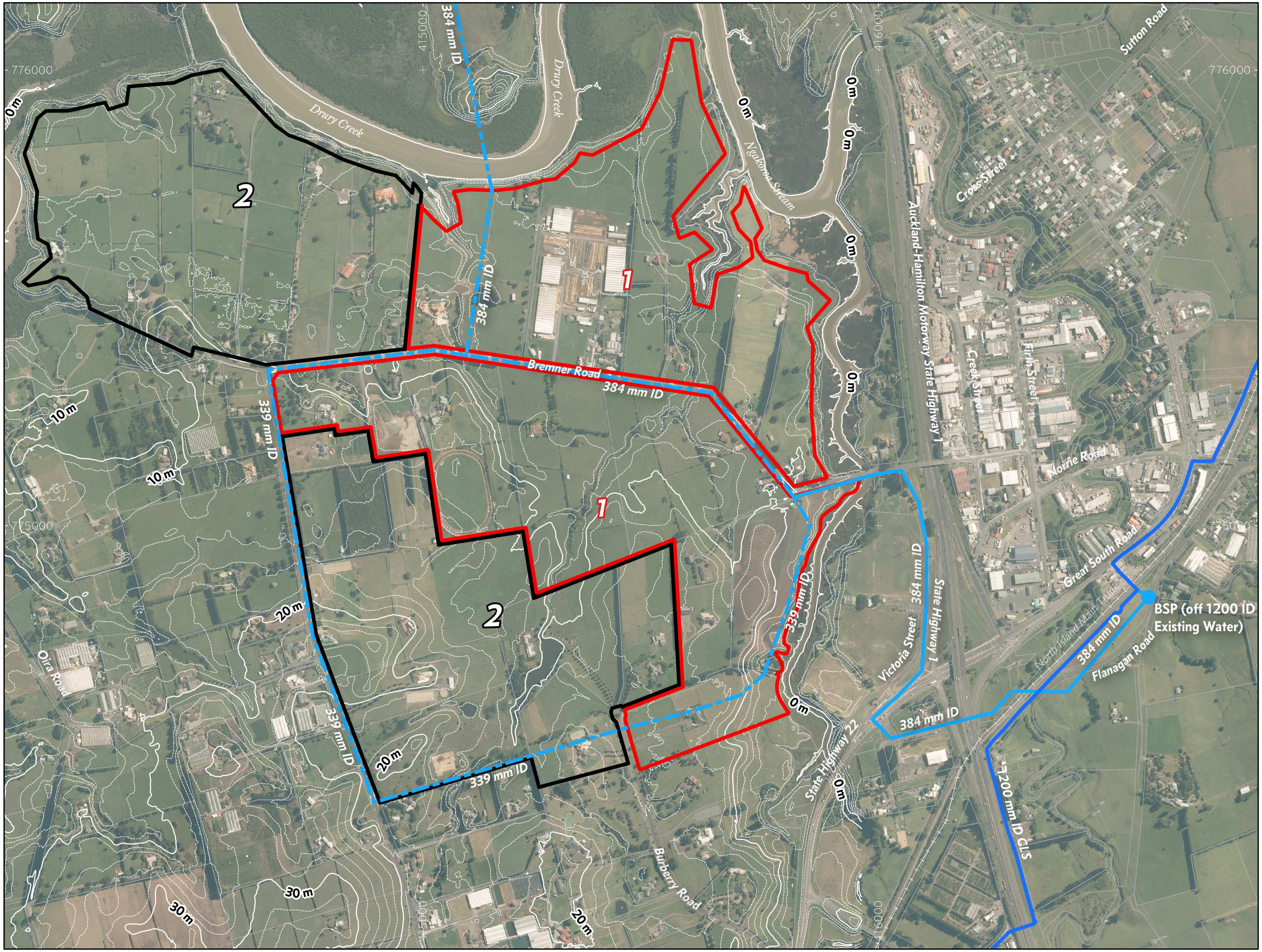
Drawn By:	FW	Date:	09/05/2017	Signed:	
Checked By:		Date:		Signed:	
Approved By:		Date:		Signed:	
Plot Date:	09/05/2017				

Project: Karaka & Drury Ltd.

Title: Wastewater Catchment Plan Auranga B

McKenzie&Co Consultants Ltd

Issue Status:	For Information
Project Number:	1343
Drawing Number:	582
Revision:	A
A3 Scale:	1:12,500



N

Notes

1. The contours shown are from Lidar data and are subject to confirmation by detailed survey.
2. Proposed Trunk Water has been sized by GHD. Internal water connections off the Trunk Water layout is not shown. Location of water pipes are indicative only.
3. Watermain sizes indicative only. Subject to modelling.

Legend

- Auranga A
- Auranga B
- Bulk Supply Point (BSP)
- Existing Water Transmission Network

Proposed Water Retriculation

- Future Water Main
- Water Main (Under Construction)

Map Projection:
NZGD2000 / Mount Eden 2000
(EPSG: 2105)

Drawn By:	FW	Date:	12/03/2018	Signed:	
Checked By:		Date:		Signed:	
Approved By:		Date:		Signed:	
Plot Date:	12/03/2018				

Project: Karaka & Drury Ltd.

Title: Water Network Concept Plan Auranga B

McKenzie&Co Consultants Ltd

Issue Status:	For Information
Project Number:	1343
Drawing Number:	680
Revision:	C
A3 Scale:	1:8,000

APPENDIX C – WATERCARE WASTEWATER AND WATER SERVICING PLAN

Water and Wastewater Servicing Plan

Draft Drury – Opāheke Structure Plan

Prepared by Chris Allen, Watercare Services Limited

Table of Contents

1 Executive Summary

This report confirms that the development yield anticipated by the draft structure plan can be serviced for water and wastewater. Watercare is investing in trunk water and wastewater networks to service the existing live zoned developments underway, allowing to bring forward the structure planning of the future urban zoned land. This report sets out the water and wastewater plan for servicing the structure plan area. It is based on an anticipated yield of around 20,000 dwellings.

1.1.1 Water

Watercare provides bulk water services to the Papakura district. The existing local water services to Drury, Papakura and Takanini are provided by Veolia under a franchise agreement. Some of the trunk assets are reaching the limits of their ability to provide a water service to a growing community. Watercare has planned projects to address future growth.

Water bulk supply points are planned to be constructed on existing trunk assets to provide water beyond the current population.

A new bulk supply point has recently been constructed at Watercare's existing Flanagan Road water pump station with associated infrastructure, to allow the servicing of the bulk of the structure plan area. A new watermain is also planned westward from the existing Hunua bulk supply point to improve resilience and the ability to stage construction, and upgrades to allow for shutdowns during construction. Watercare will work with developers in the Bremner Road and Hingaia Peninsula areas to connect the transmission infrastructure to the two bulk supply points.

Trunk and local network pipelines providing water to the structure plan area will be sized to meet the anticipated yield. All new pipelines will consider the upstream and downstream development potential when being designed and constructed.

1.1.2 Wastewater

The Drury – Opāheke Structure Plan area will be connected to the existing Hingaia pump station, which is planned to be upgraded in a staged manner to meet growth expectations of the area. Augmentation of downstream infrastructure is in the detailed planning stages to allow for this growth. The Mangere wastewater treatment plant future upgrades consider Auckland wide growth, including this area.

The structure plan area will largely be serviced by a new wastewater network connected to the Hingaia pump station. The existing township already connects separately to this pump station. Trunk and local network pipelines collecting and conveying wastewater from the draft structure plan area will be sized to meet the proposed development yield.

2 Introduction

2.1 Purpose and scope of the report

This report sets out the water and wastewater servicing plan for the Drury – Opāheke Structure Plan Area. It is a supporting document that forms part of the draft structure plan information.

2.2 Study Area

The study area for the draft Drury – Opāheke Structure Plan is the Future Urban zone around Drury, including Opaheke, Drury South and Drury West. It comprises around 1921ha of land. The study area is shown coloured yellow Figure 1 below. The anticipated dwelling yield for the structure plan area is around 22,000 dwellings.

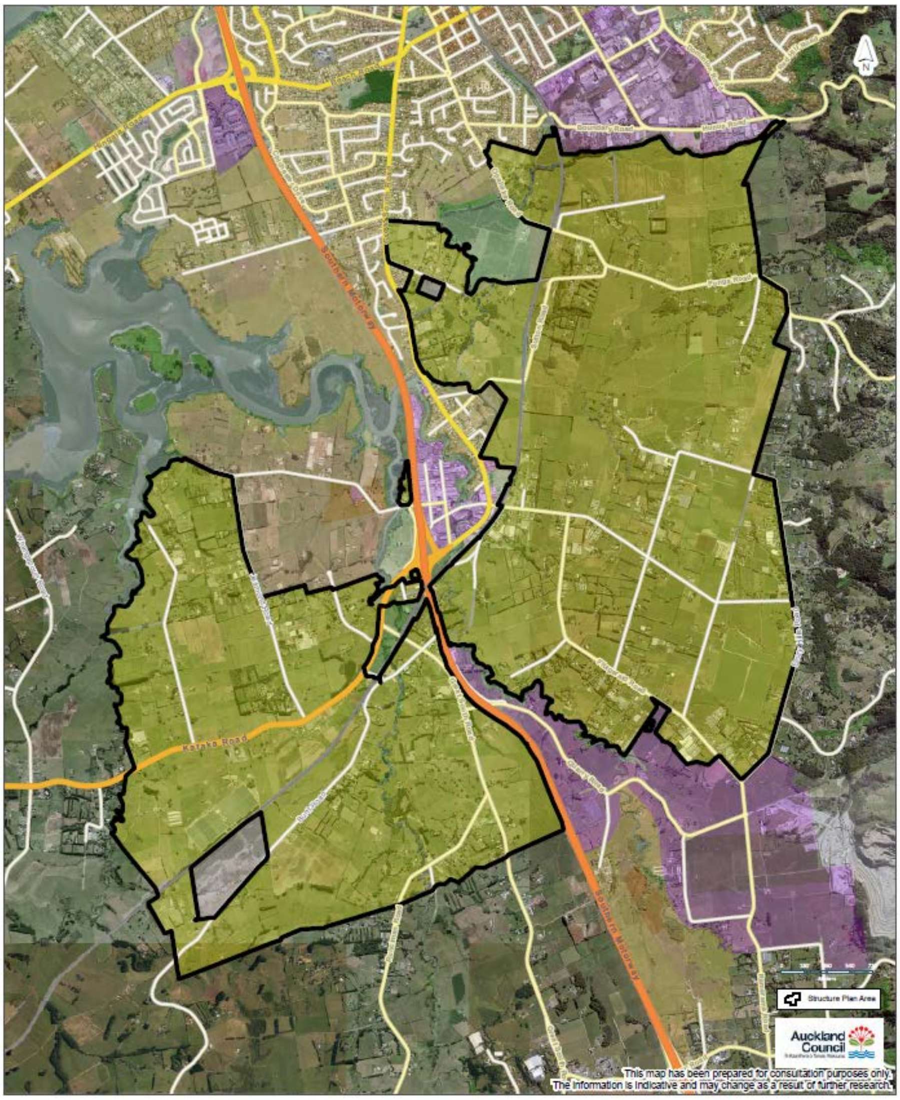


Figure 1: Drury structure plan study area (coloured yellow)

3 Existing environment

3.1 Description of study area

There is existing network infrastructure in place to provide both water and wastewater services to the existing urban area in Drury. There are currently no constructed bulk assets in the draft structure plan area, although services are being constructed by Watercare and developers to service development as it occurs. The existing Bremner Road development is constructing both water and wastewater services, connected to the existing Hingaia pump station, to provide these services. This infrastructure will form a key component of the structure plan servicing plan.

3.1.1 Water

Water is collected at Watercare's southern dams and treated at the Ardmore water treatment plant. Treated water is the transferred to Drury and Papakura through the Papakura 3 transmission main, to the Papakura Kaipara Road storage reservoir. From the reservoir the Papakura 1 transmission main services Drury and Papakura through two existing bulk supply points at Dominion Road and Hunua Road. There is also some ability to feed water south from Takanini into Drury and Papakura. These transmission mains will not have capacity to supply water demand for the structure plan area, without reinforcement.

In addition to the trunk infrastructure there are also hundreds of kilometres of smaller diameter pipes in each suburb and street, servicing individual customers.

3.1.2 Wastewater

The existing Drury and Papakura wastewater network is a predominantly a gravity system, but also includes a number of pump stations, and has limited capacity for population growth. The main trunk wastewater network collects wastewater from Papakura and Drury and transfers it to the Southern Interceptor and to the Manurewa trunk pump station. From Manurewa wastewater is conveyed to the Mangere Wastewater Treatment Plant either by continuing through the Southern Interceptor, or is diverted to the South Western Interceptor. The length of trunk servicing this area main is around 20km overall. Both of these interceptors collect wastewater from all of the southern suburbs between Drury and the treatment plant. In addition to the trunk infrastructure, there are hundreds of kilometres of smaller diameter pipes in each suburb and street, servicing individual customers.

The Southern Interceptor has capacity during dry weather, but is significantly influenced by wet weather events, as rain enters the wastewater network eroding capacity.

4 Draft Drury – Opāheke Structure Plan

4.1 Overview of draft Drury – Opāheke Structure Plan 2019

The Draft Drury – Opāheke Structure Plan 2019 shows the arrangement of various land uses (residential, business, and parks) and infrastructure. It also shows how these areas connect to adjacent urban areas and wider infrastructure networks. Important cultural values, natural features and heritage values are also addressed.

With the development of the draft residential zonings shown on the Draft Drury – Opāheke Structure Plan 2019, the population of the structure plan area could grow by about 60,000 over 30 years. The draft residential zonings would provide for around 22,000 new dwellings in the structure plan area. Live zoned land at Paerata adds a further 4,500 and there will be some intensification within the existing urban area. The draft Drury – Opāheke Structure Plan 2019 is also estimated to provide for about 12, 000 new jobs. These estimates are based on current development feasibility and exclude areas that may not be developable because of constraints.

4.2 Assessment of the Draft Drury – Opāheke Structure Plan

4.2.1 Draft Drury – Opāheke Structure Plan Development Yield

The development yield anticipated from the draft structure plan can be serviced for water and wastewater. The above ground assets are generally minimal. Land requirements for these assets vary depending on the population connected to them and can range from approximately one standard lot size up to four or five standard lots sizes. These lots are created as part of development proposals as required, or located on publicly owned land where appropriate. The land is transferred to Watercare as part of the development, but is not normally designated.

4.2.2 Water

The existing water services to Drury, Papakura and Takanini will remain operational. There is some capacity to accept additional growth, however these assets are reaching the limits of their ability to provide a water service to a growing community.

Water bulk supply points are planned to be constructed on existing trunk assets to provide water beyond the current population. A new bulk supply point has recently been constructed at Watercare's existing Flanagan Road water pump station with associated infrastructure. This will service developments already underway in the short term and will form the basis of the servicing plans for the structure plan area. New watermains will be constructed between this new bulk supply point and the development areas of the draft structure plan, sized to suit future growth expectations. These projects are already underway.

Development in the structure plan area is also dependent on infrastructure servicing areas outside of the area. A new watermain is required westward from the existing Hunua bulk supply point to improve resilience and the ability to stage construction and upgrades to allow for shutdowns.

Trunk and local network pipelines providing water to the draft structure plan area will be sized to meet the forecast yield. As much as practical, water pipelines will follow roading alignments as this is preferred for consenting and access during construction, maintenance and renewal. All new pipelines will consider the upstream and downstream development potential when being designed and constructed. The majority of these assets will be constructed by developers in conjunction with their development proposals.

The map that shows an indicative servicing plan for water infrastructure in the draft structure plan area is below. As noted above, the majority of the water assets will be constructed by developers as part of their development proposals.

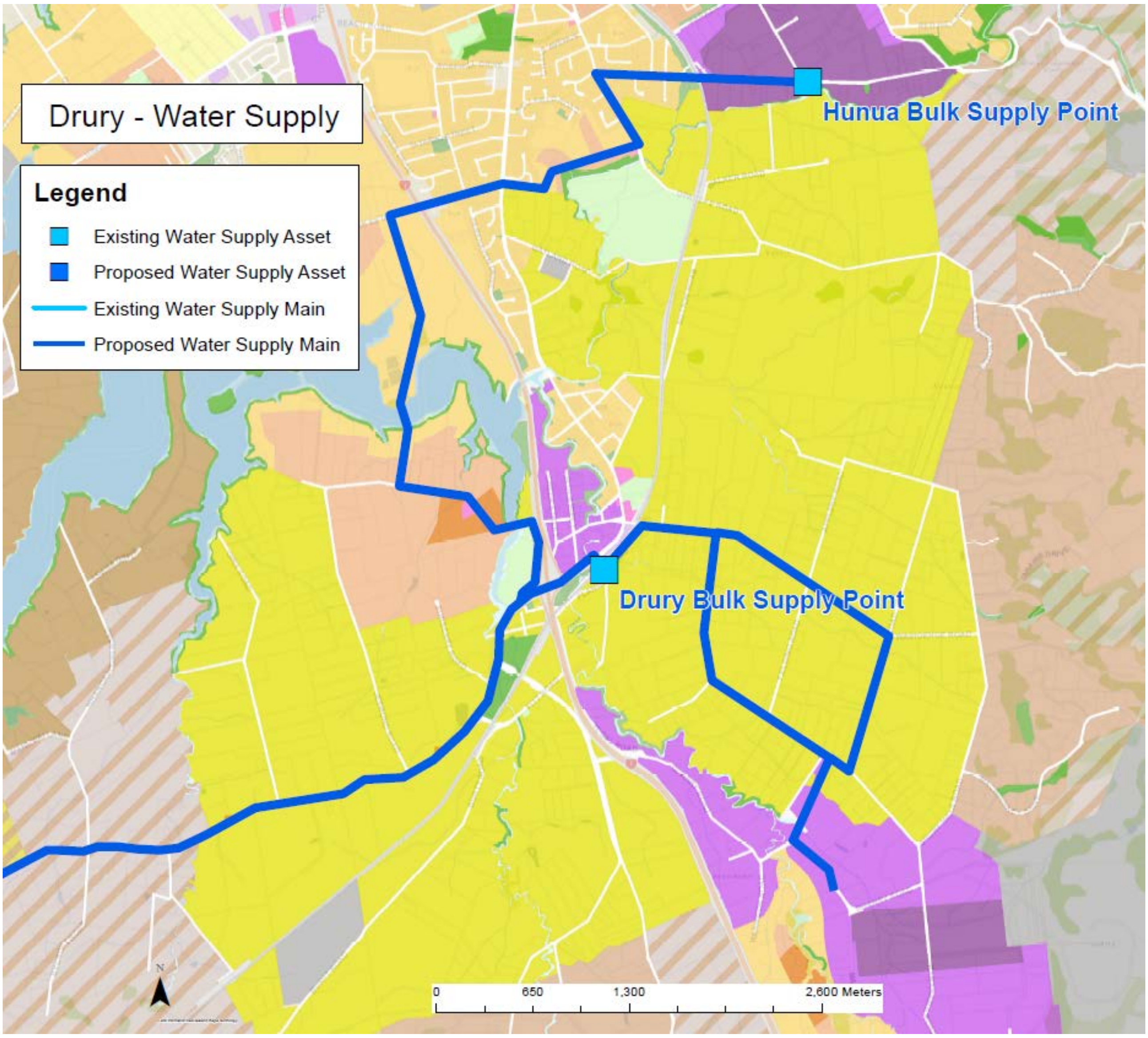


Figure 2: Indicative Drury – Opāheke Water Servicing Plan

4.2.3 Wastewater

The Draft Drury – Opāheke Structure Plan population will largely connect to the existing wastewater network at the existing Hingaia pump station, and to the Southern Interceptor. These assets will be upgraded in a staged manner to meet growth expectations of the area.

Wastewater from the existing Drury township and the structure plan area will be connected to the Hingaia pump station by new wastewater networks, constructed by Watercare and developers as they progress the development proposals. This pump station also services the Hingaia Peninsula. The Southern Interceptor, between Hingaia and Manurewa, will need augmentation to accommodate the expected growth in the structure plan area. The first stage of the augmentation is currently expected to be completed in 2023. Future stages will align with the rate of development. The Mangere wastewater treatment plant future upgrades consider Auckland wide growth, including this area.

The draft structure plan area will have new gravity collector sewers in all catchments, supported by a number of pump stations where required. The key new wastewater pump stations are at Bremner Road and Flanagan Road, which will service current developments underway, as well as developments expected to start in the near term in the southern parts of Opāheke. Watercare is already well advanced in these areas, working with the developers around staging and infrastructure provision.

In addition, there will a number of small drainage catchments that will have local network pump stations that transfer wastewater into the gravity collector or into trunk pump stations.

Trunk and local network pipelines collecting and conveying wastewater from the structure plan areas will be sized to meet the proposed development yield. While gravity wastewater networks are heavily influenced by local topography, as much as practical pipelines will follow roading alignments as this is preferred for consenting and access during construction, maintenance and renewal. All new pipelines will consider the upstream and downstream development potential when being designed and constructed.

The map that shows an indicative servicing plan for wastewater infrastructure in the draft structure plan area is below. This includes assets expected to be constructed by Watercare, as well as assets servicing the local catchments, expected to be constructed by developers.

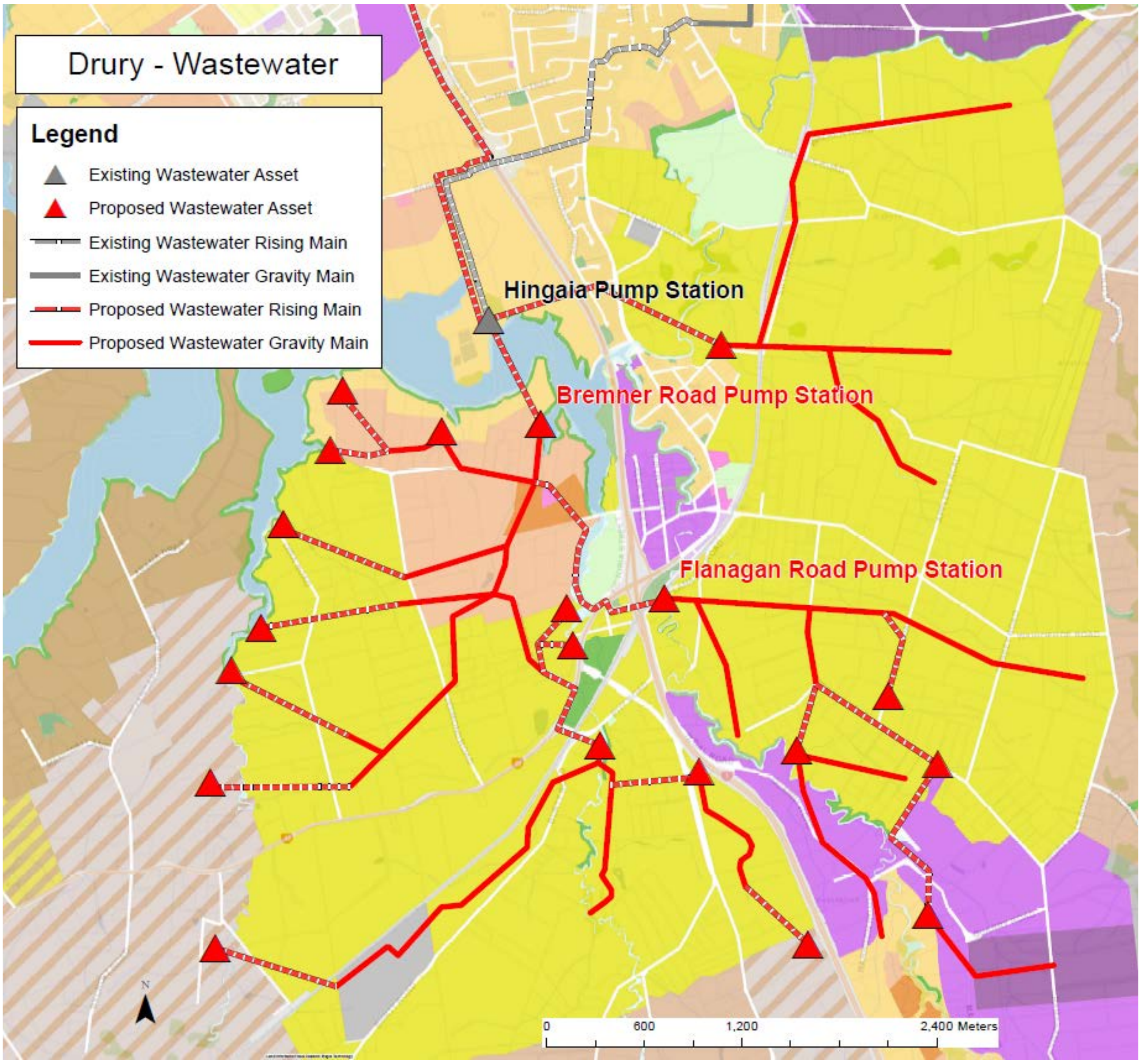


Figure 3: Indicative Drury – Opāheke Wastewater Servicing Plan

4.2.4 National Policy Statement/s

4.2.4.1 National Policy Statement on Urban Development Capacity 2016 (NPS-UDC)

Auckland is defined as high growth area (by MFE guidance), and accordingly there are a number of objectives which must be implemented to give effect to the NPS-UDC. In particular, Objective OD1 of the NPS-UDC requires the integration of urban growth and infrastructure. Objective D1 is delivered in part by Policy A3 which applies to any urban environment that is expected to experience growth.

> *Policy A3: When making planning decisions that affect the way and the rate at which development capacity is provided, decision-makers shall provide for the social, economic, cultural and environmental wellbeing of people and communities and future generations, whilst having particular regard to:*

a) Providing for choices that will meet the needs of people and communities and future generations for a range of dwelling types and locations, working environments and places to locate businesses;

b) Promoting the efficient use of urban land and development infrastructure and other infrastructure; and

c) Limiting as much as possible adverse impacts on the competitive operation of land and development markets.

The key messages from the NPS-UDC is to provide a range of housing choice, efficient use of land and infrastructure and provide for current and future people and communities.

4.2.4.2 National Policy Statement for Freshwater Management 2014

The National Policy Statement for Freshwater Management (Freshwater NPS) provides direction for the council on the management of freshwater. The council must give effect to the Freshwater NPS through the provisions of AUPOP – notably through RPS B7.4 and the Auckland-wide provisions. Some of these provisions are relevant to structure planning.

Wastewater

(10) Manage the adverse effects of wastewater discharges to freshwater and coastal water by all of the following:

(a) ensuring that new development is supported by wastewater infrastructure with sufficient capacity to serve the development;

(b) progressively reducing existing network overflows and associated adverse effects by all of the following:

(i) making receiving environments that are sensitive to the adverse effects of wastewater discharges a priority;

(ii) adopting the best practicable option for preventing or minimising the adverse effects of discharges from wastewater networks including works to reduce overflow frequencies and volumes;

(iii) ensuring plans are in place for the effective operation and maintenance of the wastewater network and to minimise dry weather overflow discharges;

(iv) ensuring processes are in place to mitigate the adverse effects of overflows on public health and safety and the environment where the overflows occur;

(c) adopting the best practicable option for minimising the adverse effects of discharges from wastewater treatment plants; and

(d) ensuring on-site wastewater systems avoid significant adverse effects on freshwater and coastal water.

Freshwater and geothermal water quantity, allocation and use

(11) Promote the efficient allocation of freshwater and geothermal water by all of the following:

(a) establishing clear limits for water allocation;

(b) avoiding over-allocation of water, including phasing out any existing overallocation;

(c) safeguarding spring flows, surface waterbody base flows, ecosystem processes, life-supporting capacity, the recharge of adjacent aquifers, and geothermal temperature and amenity; and

(d) providing for the reasonable requirements of domestic and municipal water supplies.

(12) Promote the efficient use of freshwater and geothermal water.

(13) Promote the taking of groundwater rather than the taking of water from rivers and streams in areas where groundwater is available for allocation.

(14) Enable the harvesting and storage of freshwater and rainwater to meet increasing demand for water and to manage water scarcity conditions, including those made worse by climate change.

4.2.5 Auckland Plan 2050 (2018)

The Auckland Plan 2050 (“Auckland Plan”) is a long-term spatial plan to ensure Auckland grows in a way that will meet the opportunities and challenges of the future.

The Development Strategy in this plan and 30-year Infrastructure Strategy address the prioritisation, sequencing and funding of essential infrastructure. This includes requirements under the National Policy Statement on Urban Development Capacity to provide sufficient feasible development capacity in the medium and long term.

Within the Auckland Plan, Drury – Opāheke structure plan area is a defined as significant urban growth node also functioning as a major rural node in the south of Auckland. It provides a range of services to the surrounding rural areas. Significant future employment growth is anticipated alongside residential growth.

The Auckland Plan is a critical document in future Resource Management Act 1991 processes in Auckland. It will be a key driver of future plan changes to Unitary Plan, including Council-initiated and private plan changes to "live zone" future urban areas. It will also be relevant for the assessment of future resource consent applications. The Auckland Plan has close links with the Future Urban Land Supply Strategy. The strategy informs the greenfield element of the Auckland Plan Development Strategy which makes up a portion of the overall growth anticipated over the next 30 years. The FULSS sets out sequencing for the release of development ready land (large future urban areas).

4.2.6 Future Urban Land Supply Strategy

The purpose of the Future Urban Land Supply Strategy (FULSS 2017) is to identify the sequencing and timing of future urban land for development over a 30-year timeframe. This is to integrate supply of greenfield land for development and provision of infrastructure. The proposed sequencing of development ready future urban zoned land in Drury – Opāheke is as follows:

- Drury South (Planned now)
- Drury West (Decade One 1st half 2018-2022)
- Remaining structure plan area (Decade Two 1st half 2028-2032)

This strategy also addresses the council's obligations under The NPS-UDC which requires the council to ensure there is greater focus on enabling urban development and that there is sufficient capacity for housing and businesses. As noted in section 4.1.1, NPS-UDC requires the integration of urban growth and infrastructure.

4.2.7 The Auckland Unitary Plan (Operative in Part) (2016)

<u>Regional Policy Statement</u>

The Regional Policy Statement (RPS) is part of the AUPOP. It sets out the overall strategic framework for Auckland. Sections B1 to B10 of the RPS all have varying degrees of relevance to structure planning.

Of particular relevance is Section B3 – Infrastructure, which sets outs objectives and policies relating to infrastructure. Policy 5 for example, requires that Infrastructure planning and land use planning are integrated to service growth efficiently. Policy 6 requires that Infrastructure is protected from reverse sensitivity effects caused by incompatible subdivision, use and development.

B3. - Infrastructure, transport and energy

B3.2.1. Objectives

(1) Infrastructure is resilient, efficient and effective.

(2) The benefits of infrastructure are recognised, including:

(a) providing essential services for the functioning of communities, businesses and industries within and beyond Auckland;

(b) enabling economic growth;

(c) contributing to the economy of Auckland and New Zealand;

(d) providing for public health, safety and the well-being of people and communities;

(e) protecting the quality of the natural environment; and

(f) enabling interaction and communication, including national and international links for trade and tourism.

(3) Development, operation, maintenance, and upgrading of infrastructure is enabled, while managing adverse effects on:

(a) the quality of the environment and, in particular, natural and physical resources that have been scheduled in the Unitary Plan in relation to natural heritage, Mana Whenua, natural resources, coastal environment, historic heritage and special character;

(b) the health and safety of communities and amenity values.

(4) The functional and operational needs of infrastructure are recognised.

(5) Infrastructure planning and land use planning are integrated to service growth efficiently.

(6) Infrastructure is protected from reverse sensitivity effects caused by incompatible subdivision, use and development.

(7) The national significance of the National Grid is recognised and provided for and its effective development, operation, maintenance and upgrading are enabled.

(8) The adverse effects of infrastructure are avoided, remedied or mitigated

<u>In terms of RPS relevant objectives, it is noted that:</u>

- The proposed Water and Wastewater Servicing plan generally integrates land use and infrastructure to service future growth of the Drury – Opāheke Structure Plan area efficiently.
- The Plan will provide essential services for the functioning of communities, businesses and industries within and beyond Drury – Opāheke;
- Proposed water and wastewater infrastructure is protected from reverse sensitivity effects caused by incompatible future subdivision, use and development.

<u>District Plan</u>

Chapter E26 of the Auckland-Wide provisions sets out District Level objectives, policies and rules relating to infrastructure. These provisions provide a framework for the development, operation, use, maintenance, repair, upgrading and removal of infrastructure.

The plan recognises that Infrastructure is critical to the social, economic, and cultural well-being of people and communities and the quality of the environment. This means that in some circumstances other activities and development need to be managed in a way that does not impede the operation of infrastructure.

The plan also acknowledges that as well as benefits infrastructure can have a range of adverse effects on the environment, visual amenity of an area, and public health and safety. The sensitivity of adjacent activities, particularly residential, to these effects can lead to complaints and ultimately constraints on the operation of infrastructure. Managing these reverse sensitivity effects is essential.

E26. Infrastructure

E26.2.1. Objectives [rp/dp]

(1) The benefits of infrastructure are recognised.

(2) The value of investment in infrastructure is recognised.

(3) Safe, efficient and secure infrastructure is enabled, to service the needs of existing and authorised proposed subdivision, use and development.

(4) Development, operation, maintenance, repair, replacement, renewal, upgrading and removal of infrastructure is enabled.

(5) The resilience of infrastructure is improved and continuity of service is enabled.

(6) Infrastructure is appropriately protected from incompatible subdivision, use and development, and reverse sensitivity effects.

(9) The adverse effects of infrastructure are avoided, remedied or mitigated

In relation to the relevant District level Infrastructure provisions,:

- The proposed water and wastewater plan will enable the safe, efficient and secure infrastructure to service the needs of existing and authorised proposed subdivision, use and development in Drury – Opāheke.
- The proposed water and wastewater plan will provide for resilient infrastructure in the Structure Plan area as improved and continuity of service is enabled.

5 Conclusion

Overall it is considered that the yield from the structure plan, as well as the live zoned undeveloped land and intensification in the existing urban area, can be serviced for water and wastewater.

Future water connections to existing transmission networks are required to service this structure plan area. Watercare is working with current developers, to consider the shorter-term infrastructure needs, and have planned upgrade paths for the relevant water infrastructure to support longer term growth aspirations. Trunk and local network pipelines providing water to the structure plan area will be sized to meet the anticipated development yield.

Wastewater will be connected to the existing Hingaia pump station, and on to the Mangere wastewater treatment plant. Augmentation is required for the pump station and associated downstream infrastructure, and this process is underway. Trunk and local network pipelines collecting and conveying wastewater from the structure plan area will be sized to meet the proposed development yield.

The majority of the water and wastewater assets for the structure plan area will be constructed by developers, in discussion with Watercare, to service their developments.

APPENDIX D – GHD WATER AND WASTEWATER REPORTS

- GHD Limited. (2016a). Auranga / Bremner Road Basis of Design - Water. Auckland: Water New Zealand.
- GHD Limited. (2016b). Auranga/Bremner Road Basis of Design - Wastewater Infiltration and Inflow Control Manual, Volume 1. Auckland: Water New Zealand.
- GHD Limited. (2017a). Bremner Road Development Trunk Watermain Design. Auckland: Water New Zealand.
- GHD Limited. (2017b). Bremner Road Development Wastewater Design Report. Auckland: Water New Zealand.

Karaka and Drury Consultant Ltd

Auranga / Bremner Road

Basis of design - water

October 2016

Table of contents

Table index

No table of figures entries found.

Figure index

No table of figures entries found.

Appendices

1. Introduction

1.1 Purpose

Karaka and Drury Consultant Ltd, the developer for Bremner Road SHA (and Extension), known as Auranga, have engaged GHD to provide a hydraulic design of the water “trunk” network to service this development and the Drury South Industrial development and Quarry Road SHA. This report will include a high level design for connecting to the existing network and will propose the main pipe sizes and layout. This includes the sizing and phasing of additional pipes to supply the wider ultimate development area, including Hingaia Peninsula and the Drury West FUZ. The design of the local reticulation will be covered separately.

This report has been prepared for the purposes of gaining engineering approval for the proposed bulk wastewater network for the development.

This report has been prepared for the purposes of gaining engineering approval for the proposed bulk water network for the development.

1.2 Location

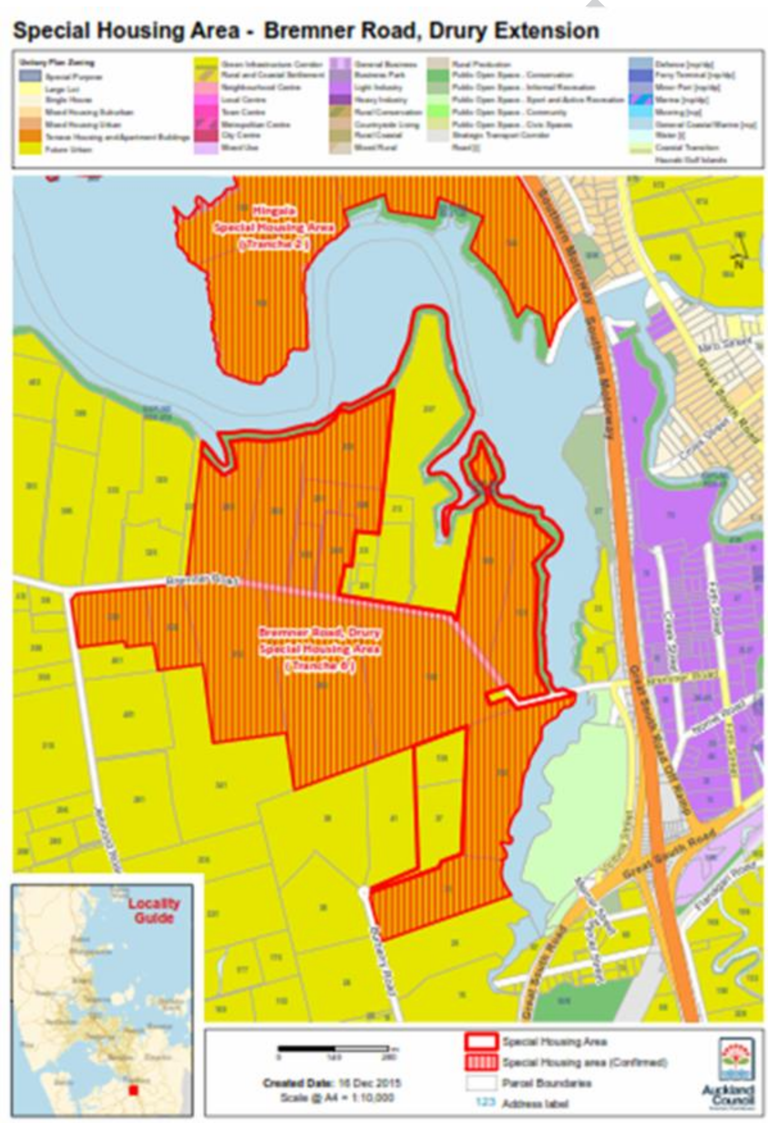


Figure 1 Location plan

The Auranga development is located to the west of Drury township. A location plan of the development area is presented in Figure 1.

The development is predominantly a residential area. The area will be subdivided into approximately 1,350 residential lots, including Apartments, Medium and Lower density residential and a village centre.

1.3 Scope and limitations

This report: has been prepared by GHD for Karaka & Drury Consultant Ltd and may only be used and relied on by Karaka and Drury Consultant Ltd for the purpose agreed between GHD and the Karaka and Drury Consultant Ltd as set out in Section 1 in this report.

GHD otherwise disclaims responsibility to any person other than Karaka and Drury Consultant Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in Section 2 of this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Karaka and Drury Consultant Ltd and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Design standards

The subdivision design is to comply with the water supply reticulation design standards from the Watercare "Water and Wastewater Code for practice for Land Development and Subdivision" (based on Section 6 of NZS 4404:2010).

2.1 Design flows

Design flows have been calculated in accordance with Watercare's "Water Supply Code of Practice for Land Development and Subdivision".

5.3.5.1 Design flow

[ ]

(a) Residential flows

(iv) Number of people per dwelling: 3.0

6.3.5.3 Peak flows

Occupancy rates for properties shall be as stated in Chapter 5 section 5.3.5.1

Peak Day Demand (over a 12-month period) = Average Day Demand x PF

Unless specified otherwise by Watercare:

(a) PF = 1.5 for populations over 10,000;

(b) PF = 2 for populations below 2,000.

(c) Interpolated between 1.5 and 2 for populations between 10,000 and 2,000

Peak Hourly Demand = Average Hourly Demand (on peak day) x PF (over a 24-hour period)

Unless specified otherwise by Watercare:

(a) PF = 2 for populations over 10,000;

(b) PF = 5 for populations below 2,000.

(c) Interpolated between 2 and 5 for populations between 10,000 and 2,000

6.3.5.4 Head losses

The head loss through the local network pipes and fittings at the design flow rate shall be

less than:

(a) 5 m/km for DN ≤150;

(b) 3 m/km for DN >150.

Head loss can be calculated using one of a number of standard hydraulic formulae.

Watercare's preference is for the use of the Hazen-Williams formula.

6.3.5.6 Minimum water demand

The minimum peak domestic demand shall be specified by Watercare, or:

(a) Daily consumption of 250 L/p/day;

(b) Peaking factor of up to 5;

2.2 Housing density

For the purposes of the design, a gross density of 15 houses (or 45 people) per hectare has been assumed. This is marginally higher than typical rates, as detailed in Watercare's guidelines for water / wastewater transmission designs. This is to ensure that sufficient flows are achieved and to provide a factor of safety to allow for future growth.

Watercare's "Guidelines for Design of Water Reticulation and Pumping Stations" states "The values used for residential zones are 25 to 30 persons per hectare based on a gross area including streets, local schools, local reserves etc."

Watercare's "Guidelines for Design of Wastewater Reticulation and Pumping Stations" provides the following table, identifying a population density >40 people per hectare for High Density residential, as shown below:

2.3 Roughness coefficients

The model loss formula is the Hazen-Williams formula with a corresponding roughness coefficient of C = 140 as stated in the Watercare design code.

6.3.5.4.1 Hydraulic roughness values

Hazen Williams Coefficient (C)= 140 (PE Pipe)

2.4 Fire flows

Fire flows are according to SNZ PAS 4509:2008 New Zealand Fire Service Fire Fighting Water Supplies Code of Practice. All residential areas are classified as FW2 with a fire fighting requirement of 25 l/s. The classification covers housing, including single family dwellings, multi-unit dwellings, but excludes multi-storey apartment blocks. The village centre (commercial) is assumed to be classified FW3 with a firefighting requirement of 50 l/s.

2.5 Trunk vs local reticulation

2.5.1 Trunk

The term "trunk" has been used to indicate local, rather than transmission pipe work, but differentiated from local reticulation.

2.5.2 Local reticulation

The local reticulation layout will be covered separately to the trunk water pipework.

A hydraulic model will be developed to demonstrate that the proposed reticulation layout will meet the required design standards.

3. Auranga A and B

3.1 Overview

Under this option, a pipeline would be constructed to solely service the Auranga A & B developments. No allowance would be made for servicing other areas.

3.1.1 Population and flows

The initial subdivision (Auranga A) consists of a total of 1,350 residential lots, including a village centre. The water demand for each residential lot was calculated based on the assumption that average daily demand is 250 l/p/d with three people per dwelling, this equates to 750 L/lot/d.

The proposed Auranga B development brings the total proposed lots to 3,000.

			Peak Day Demand	Peak Hour Demand	
Determine Peak Factors					
	>	10000	1.5	2	**6.3.5.3 Peak flows**
	<	2000	2	5	
		8000	0.5	3	
			0.0000625	0.000375	
Population > 2000		2050	-0.128125	-0.76875	
Factors for Proposed Population		4050	1.87	4.23	
		1,350	dwellings		
		3	people per dwelling		**5.3.5.1 Design flow**
		250	L/p/day		**6.3.5.6 Minimum water demand**
		1.87	Peak Day Factor		
		4.23	Peak Hour Factor		
Peak Flow		92.82	L/s		

Figure 2 Auranga A peak flows

			Peak Day Demand	Peak Hour Demand	
Determine Peak Factors					
	>	10000	1.5	2	**6.3.5.3 Peak flows**
	<	2000	2	5	
		8000	0.5	3	
			0.0000625	0.000375	
Population > 2000		7000	-0.4375	-2.625	
Factors for Proposed Population		9000	1.56	2.38	
		3,000	dwellings		
		3	people per dwelling		**5.3.5.1 Design flow**
		250	L/p/day		**6.3.5.6 Minimum water demand**
		1.56	Peak Day Factor		
		2.38	Peak Hour Factor		
Peak Flow		96.64	L/s		

Figure 3 Auranga A and B peak flows

3.1.2 Initial supply pipe

The required pipe size of the initial 1,350 house development has been determined to be:

- 400mm PE100 SDR13.6 (339.9mm ID).

The pipe has been sized using the criteria, as specified in Watercare's "Water and Wastewater Code of Practice for Land Development and Subdivision" as identified in Section 2 above.

The pipe size required of the ultimate development of Auranga of 3,000 dwellings is also calculated as:

- 400mm PE100 SDR13.6 (339.9mm ID).

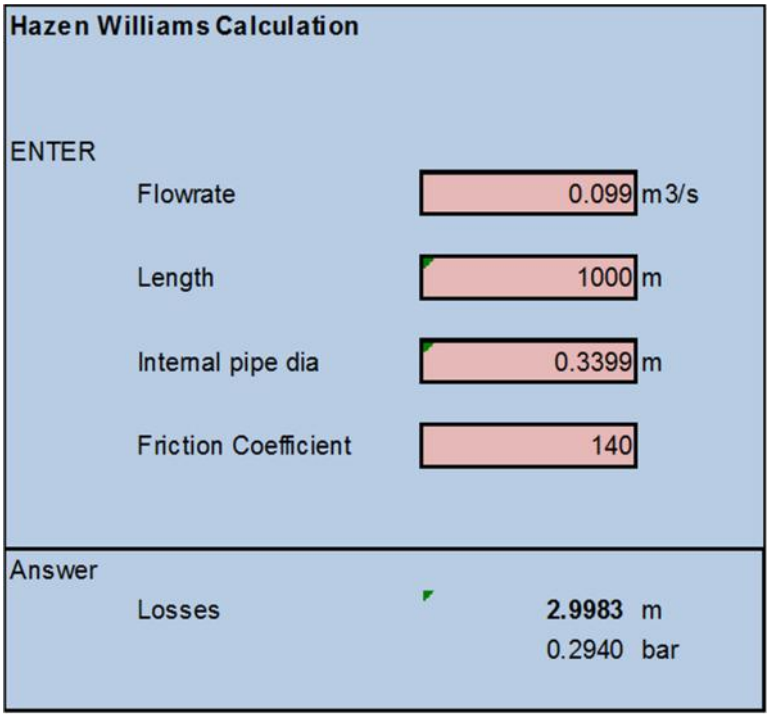


Figure 4 Headloss per km – 400 ND PE100 SDR13.6

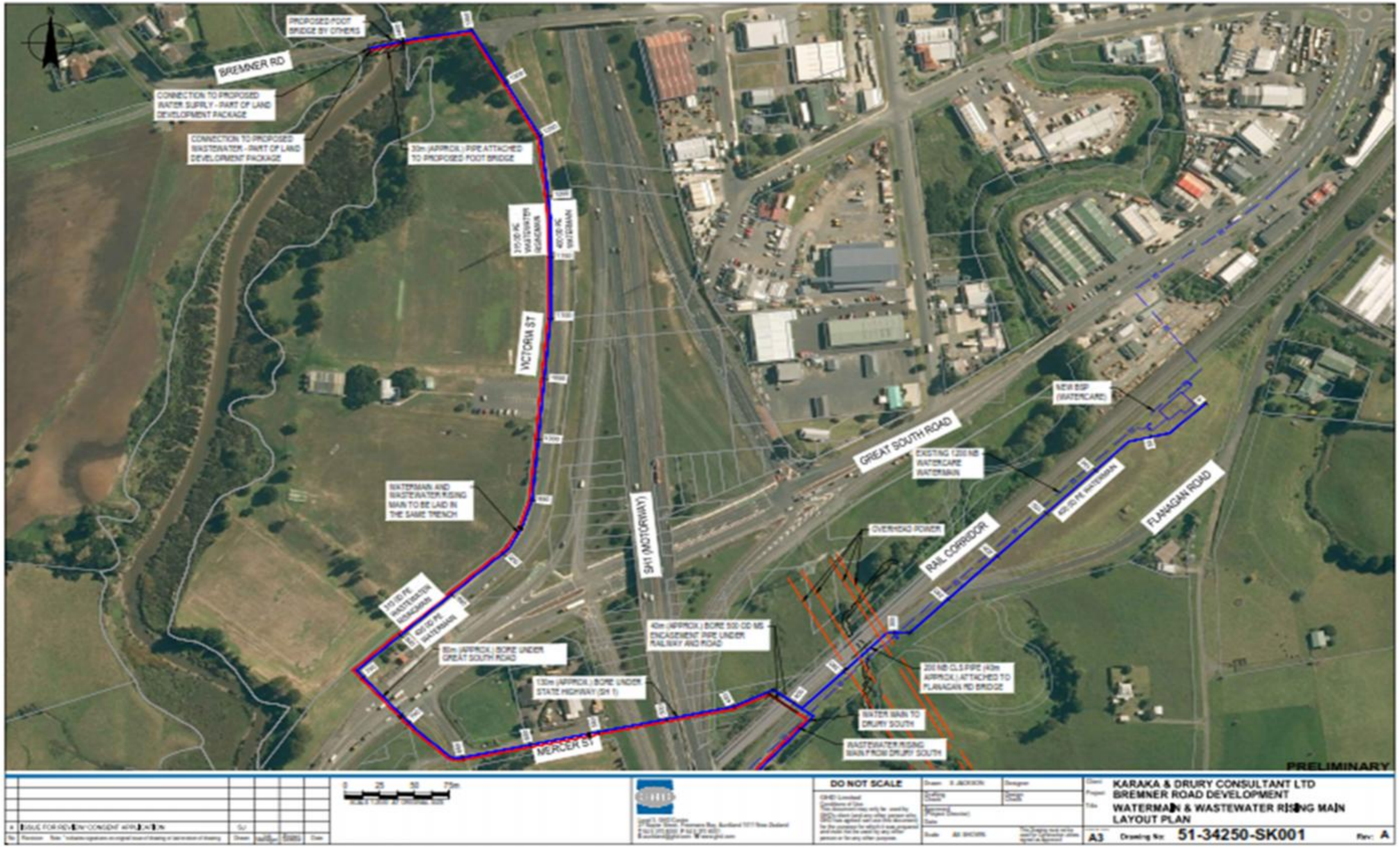


Figure 5 Proposed Pipeline Route – Phase 1

4. Drury South

4.1 Overview

Both Drury South and Auranga (Bremner Road SHA) are to be supplied from the same bulk supply point at 103 Flanagan Road. The first section of pipe, from the BSP to where the Auranga supply pipe crosses the railway line, will be shared between the two development areas.

4.1.1 Drury South and Quarry Road SHA

The Drury South water demand is as specified in the Beca memo included as Appendix A.

The average water demand will be calculated by multiplying the design wastewater flows by 1.2. The 20% allowance is added for drinking water, product water for wet industries etc., which should average out over the site. This results in an average water demand for the total development of 2,120 cubic metres per day.

The peak daily and hourly demand can be calculated as per Watercare’s Code of Practice.

Stated average demand:			
	2,120	m^3/day	
Based on	250	L/person/day	
	8480	people equ.	
	3	people per house	
	2830	Houses / HUE	

Figure 6 Drury South / Quarry Road population equivalent

			Peak Day Demand	Peak Hour Demand	
Determine Peak Factors					
	>	10000	1.5	2	**6.3.5.3 Peak flows**
	<	2000	2	5	
		8000	0.5	3	
			0.0000625	0.000375	
Population > 2000		6490	-0.405625	-2.43375	
Factors for Proposed Population		8490	1.59	2.57	
		2,830	dwellings		
		3	people per dwelling		**5.3.5.1 Design flow**
		250	L/p/day		**6.3.5.6 Minimum water demand**
		1.59	Peak Day Factor		
		2.57	Peak Hour Factor		
Peak Flow		100.51	L/s		

Figure 7 Drury South / Quarry Road peak flows

Hazen Williams Calculation			
ENTER			
	Flowrate	0.099	m3/s
	Length	1000	m
	Internal pipe dia	0.3399	m
	Friction Coefficient	140	
Answer			
	Losses	**2.9983**	m
		0.2940	bar

Figure 8 Headloss per km – 400 ND PE100 SDR13.6

To achieve the design criteria of <3m/km headloss, the combined pipe, supplying both Auranga (A&B) and Drury South, would need to have an ID of greater than 450mm.

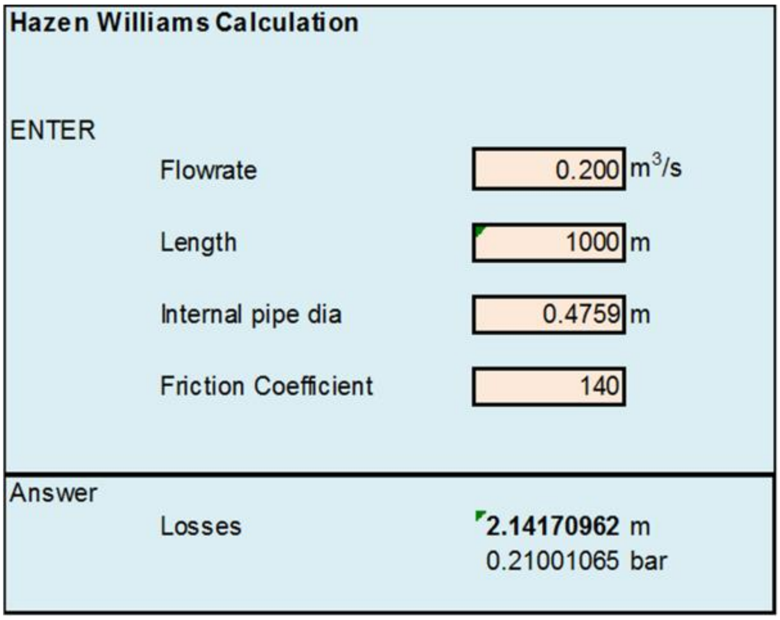


Figure 9 Headloss per km – 560 ND PE100 SDR13.6

5. Hingaia

5.1 Overview

The Hingaia development is located to the north of the Auranga / Bremner Road development with the option to supply the development from the proposed bulk supply point at 103 Flanagan Road via the Auranga / Bremner Road SHA development.

5.1.1 Water demand

The Hingaia Peninsula south of Hingaia Road has a gross area of approximately 306.5 ha. Assuming a density of 15 houses per hectare, this equates to 4,600 houses.

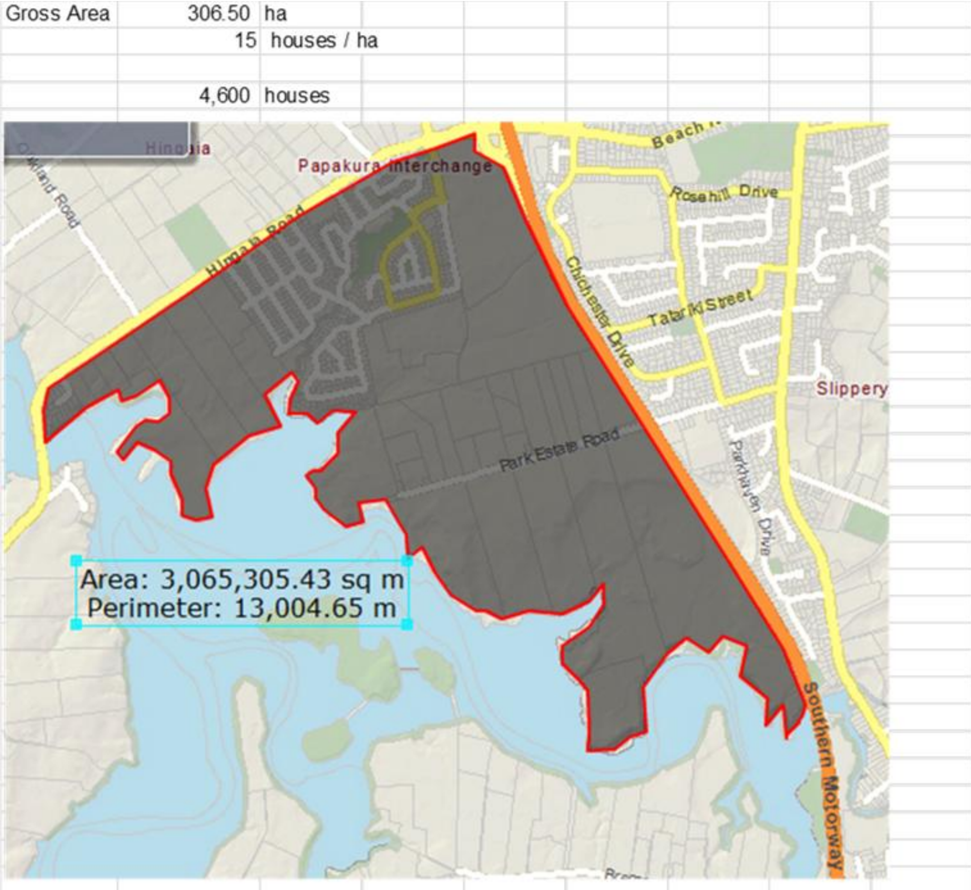


Figure 10 Hingaia population

			Peak Day Demand	Peak Hour Demand	
Determine Peak Factors					
	>	10000	1.5	2	**6.3.5.3 Peak flows**
	<	2000	2	5	
		8000	0.5	3	
			0.0000625	0.000375	
Population > 2000		11800	-0.5	-3	
Factors for Proposed Population		13800	1.50	2.00	
		4,600	dwellings		
		3	people per dwelling		**5.3.5.1 Design flow**
		250	L/p/day		**6.3.5.6 Minimum water demand**
		1.50	Peak Day Factor		
		2.00	Peak Hour Factor		
Peak Flow		119.79	L/s		

Figure 11 Hingaia peak flows

Assuming that the Hingaia Peninsula is to be supplied by twin pipes, the pipes would need to be in the order of 250 or 300mm ID.

Hazen Williams Calculation			
ENTER			
	Flowrate	0.060	m3/s
	Length	1000	m
	Internal pipe dia	0.2676	m
	Friction Coefficient	140	
Answer			
	Losses	**3.8004**	m
		0.3727	bar

Figure 12 Headloss per km – 315 ND PE100 SDR13.6

6. Auranga A & B plus Hingaia

6.1 Overview

This option considers the supply of Auranga A & B, plus the Hingaia Peninsula.

6.2 Proposed layout

6.2.1 Bulk supply

The proposed bulk supply pipe detailed in Section 3 would initially only supply the Auranga / Bremner Road SHA consented development of 1,350 houses, with the ability to service both Auranga A and Auranga B. The proposed pipework is to be seen as the first stage in an incremental network which is grown progressively to meet the demand of the wider area. It is also proposed that bulk pipework within the development area be installed at the same time as the land development takes place, even if not immediately required at the time, to:

- Save disruption to residents within a short timeframe after the initial development work
- Realise cost savings by installing the pipework at the same time as the land development, and
- Ensure that the development allows for the ultimate bulk pipe work.

To this end, it is anticipated that bulk pipework to benefit the development of the Hingaia Peninsula will be constructed at the same time as the land development is undertaken.

The cost appropriation of additional works agreed and undertaken as part of the land development will be covered by a separate Infrastructure Finance Agreement (IFA).

6.2.2 Additional supply pipe(s)

In order to supply additional development areas, including Hingaia, additional pipework would be required to meet peak demands and to provide security of supply.

Phase 2a

It is proposed that a pipe be constructed from the new bulk supply point at 103 Flanagan Road to the bulk pipe at the new Bremner Road Footbridge as a second stage, to provide additional flows and security of supply to allow the supply of the Hingaia Peninsula.

- Take advantage of proposed footbridge / cycleway over SH1 if this is considered beneficial. Construction is proposed to undertaken in 2017-2018
- Augment flows into Drury Township, and
- Increased flows to meet demand from Hingaia.

This pipe is not required to meet the Auranga A and B demand, but to provide sufficient capacity to meet the anticipated demand from the Hingaia Peninsula.

Phase 2b

The proposed phase 2b would be to construct a pipeline southward along Karaka Road and northwards through Burberry Road further to the construction of the Phase 2 pipe and the commencement of the Auranga B development.

Under this option, it is anticipated that the water main along Virginia Street would become redundant, as very low flows would be anticipated within this pipeline.

Rather than this pipe being abandoned, a possible option is to re-use the pipe as a wastewater rising main from Drury South.

6.2.3 Ultimate layout

The "ultimate" layout, further to the completion of Auranga A and commencement of Aurange B would see the construction of a ring main within the Drury West Future Urban Zone, as shown below.

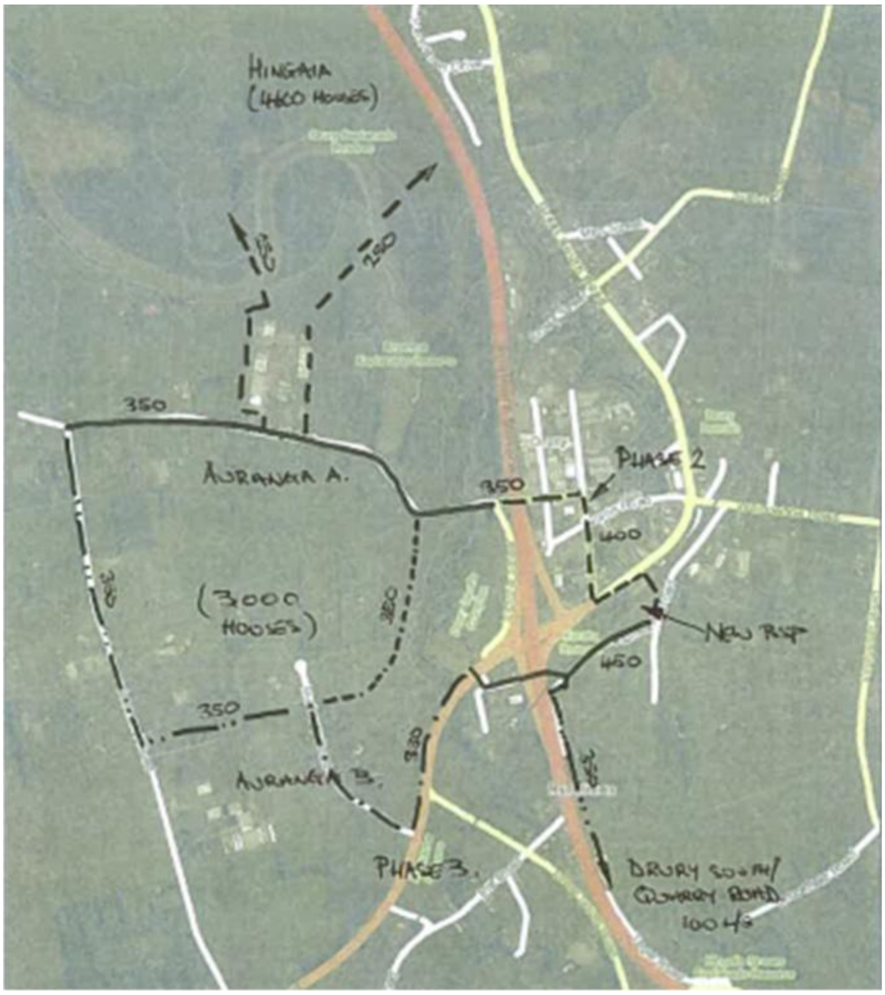


Figure 13 Potential developed trunk pipeline configuration

6.3 Bulk supply - Watercare

A new bulk supply point (BSP) is to be provided by Watercare at 103 Flanagan Road, Drury. This new BSP is to initially supply the Auranga / Bremner Road SHA and the initial Drury South Industrial Development and Quarry Road SHA.

Ultimately, this BSP is anticipated to additionally service the wider Drury Township, Drury West FUZ, Opeheke FUZ,and Hingaia areas.

It is understood that the BSP is to be constructed and commissioned by October 2017.

6.3.1 Security of supply

Watercare have indicated that until the new reservoir has been constructed at Runciman Road, anticipated to be in 2021, areas supplied from the new bulk supply point would need to be able to meet a three-day shutdown.

- If the Runciman Road Reservoir is to be taken out of service, and flow from Runciman to Redoubt Road suspended, it is possible to feed the new BSP from Redoubt Road Reservoirs
- If the Redoubt Road Reservoir (or the pipeline from Redoubt Road to 103 Flanagan Road) is to be taken out of service after the construction of the new 50ML reservoir at Runciman Road, there would be sufficient water available to supply the area from the new Runciman Road reservoir(s)
- If the Redoubt Road Reservoir was taken offline prior to the construction of the new Renciman Road Reservoir, it is understood that:
  - Demand from the area directly supplied from the Runciman Road Reservoir is in the order of 30ML/day
  - Minimum turn-down on the Waikato Water Treatment Plant is 40ML/day
- As a result, the Waikato WTP would be shutdown, and the ability to supply would be limited to the capacity of the Runciman Road Reservoir. With this capacity required to supply the existing supply area (Pukekohe), there may not be sufficient capacity to supply any new development areas
  - The option to construct "temporary" storage capacity at Bremner Road has been considered, consisting of "TimberTanks" and a booster pump station. All water would be fed through the tanks to ensure water quality in the tanks was maintained, with the booster pumps required to meet the supply pressure. The provisional capital cost estimate for this is in the order of $1.5M, and
  - An alternative has identified that it would be cheaper to maintain the operation of the Waikato Water Treatment Plant, and "waste" the excess volume of 10 ML/day. This equates to 10,000m^3, at a rate of $1.444 /m^3, resulting in a cost of approximately $45,000 for a three-day shutdown.

7. Conclusions and recommendations

7.1 Conclusions

- Water supply pipework is required to service the immediate development Auranga A (Bremner Road SHA) and Drury South Industrial development / Quarry Road SHA
- Watercare have agreed that the above areas are to be supplied from a new Bulk Supply Point (BSP) to be constructed and commissioned (by Watercare) at 103 Flanagan Road, Drury
- The proposed development on the Hingaia Peninsula, generally south of Hingaia Road can also be supplied from the new BSP along with Drury Township, with the addition of a second pipeline
- It is considered beneficial that infrastructure to service the additional areas be constructed at the same time as the land development is undertaken to minimise costs and future disruption
- Works are to be phased to meet demand whilst minimising costs and technical issues associated with pipes being oversized leading to high retention times.

7.2 Recommendations

It is recommended that:

- The proposed bulk and local reticulation pipework is modelled (using H2OMap).to confirm pipes sizes required, with a brief report prepared
  - Model is to be made available to Veolia for checking / verification
  - Work is constructed in the phases as detailed, and
  - A service agreement / Infrastructure Funding Agreement (IFA) is prepared and agreed between respective parties.

Appendices

Appendix A - Beca memo: Sewer Loads 17 May 2016

GHD

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G:\51\34250\2. Technical\Basis of Design\Water\Auranga Water Basis of Design Report_2016.10.03_DRAFT.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A						03/10/16

www.ghd.com

Karaka & Drury Consultant Ltd

Auranga / Bremner Rd

Basis of Design - Wastewater

October 2016

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Purpose

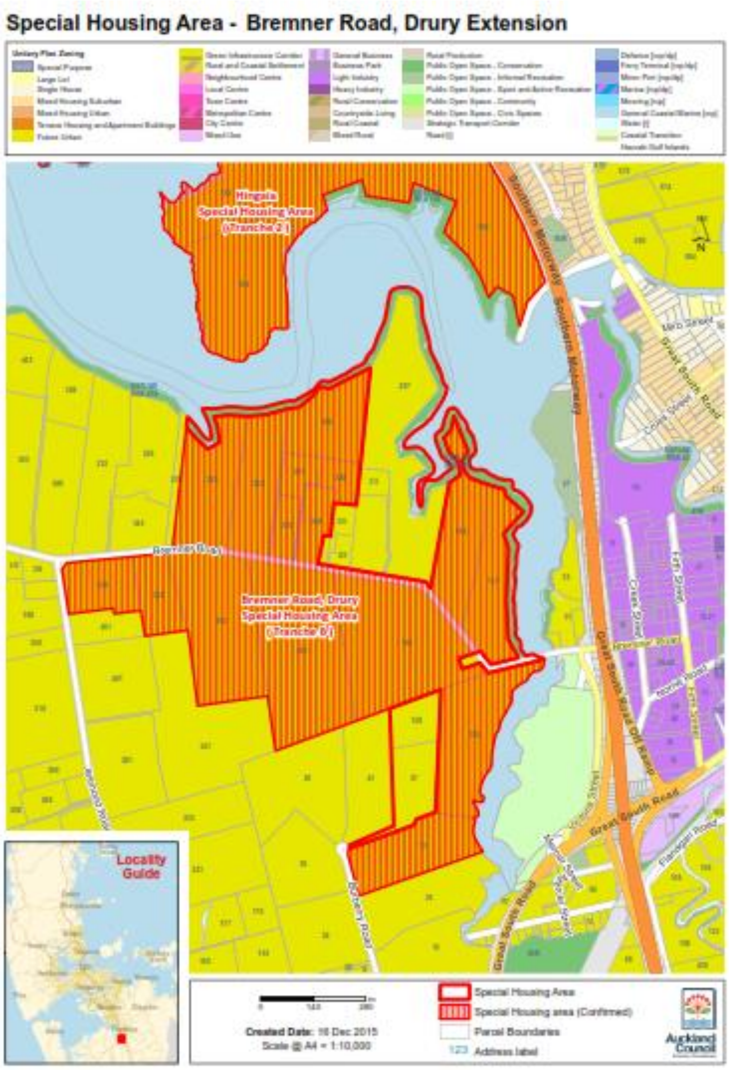
It was recognised early in the planning process that the Bremner Road SHA had the potential to function as a facilitation project for a much larger growth area, south of Drury Creek and also had a potential role to play in the efficient servicing of the wider area.

Karaka and Drury Consultant Ltd, the developer for Bremner Road SHA (and Extension), known as Auranga, have engaged GHD to provide a hydraulic design of the wastewater trunk network to service this development and the Drury South Industrial development and Quarry Road SHA. This report will include a high level design for connecting to the existing network and will propose the main pipe sizes and layout.

The design of the local reticulation will be covered separately.

This report has been prepared for the purposes of gaining engineering approval for the proposed bulk wastewater network for the development.

1.2 Location



The Auranga development is located to the west of Drury township. A location plan of the development area is presented in Figure 1.

The development is predominantly a residential area. The area will be subdivided into approximately 1,350 residential lots, including Apartments, Medium and Lower density residential and a village centre.

Figure 1 Location Plan

1.3 Scope and Limitations

This report: has been prepared by GHD for Karaka & Drury Consultant Ltd and *may only be used and relied on by Karaka & Drury Consultant Ltd for the purpose agreed between GHD and the Karaka & Drury Consultant Ltd as set out in Section 1 in this report.*

GHD otherwise disclaims responsibility to any person other than Karaka & Drury Consultant Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in Section 2 of this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Karaka & Drury Consultant Ltd and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Design Standards

2.1 Transmission and Local Network Reticulation

It is understood that all wastewater infrastructure will be owned by Watercare, with Watercare operating “transmission” infrastructure and Veolia Water “local” or network infrastructure.

2.2 Transmission Infrastructure

Transmission infrastructure is taken to generally be infrastructure that services a population of greater than 10,000 people (3,500 HUE).

It is anticipated that this includes:

- Bremner Road Wastewater pump station and storage (Interim and ultimate)
- Rising mains from the Bremner Road Wastewater Pump Station to Hingaia WWPS
- Gravity pipelines into the Bremner Road WWPS that is 375mm nominal diameter or greater.

Whether the Drury South Pump Station and rising main are to be considered “Transmission” or “Local” is to be confirmed.

Transmission infrastructure is to be designed to Watercare’s “Guidelines for Design of Wastewater Reticulation and Pumping Stations”. Key elements include:

- Thicker concrete pipes and manholes (25mm sacrificial layer to concrete pipes and manholes) (Page 15 of 37).
- Longer distances between manholes (Table, Page 11 of 37).
- Satellite manholes to connect local reticulation to the transmission line (Para 2, Page 11 of 37).

2.3 Local Infrastructure

Local reticulation infrastructure is to be designed in accordance with Watercare “Water and Wastewater Code of Practice for Land Development and Subdivision”. This design is to be undertaken by McKenzie and Co and is separate to this Basis of Design report.

3. Design

3.1 Strategic Intent

It was recognized early in the planning process that the Bremner Road SHA had the potential to function as a facilitation project for a much larger growth area, south of Drury Creek and also had a potential role to play in the efficient servicing of the wider area.

With the high level intention to provide effective and economical infrastructure between the adjacent areas by providing a conduit through the Bremner Road SHA site, a solution was developed which innovatively and cost effectively meets the requirements of all stakeholders to provide servicing for the residential development of the wider area, in the interests of HASHAA.

Through inclusive collaboration and co-operation, this strategy which is endorsed by Veolia and Watercare, represents a solution which supports both the immediate SHA development as well as adds benefit to the servicing of an expanded area along with areas further afield.

3.2 Gravity Mains

An analysis of the wider area has identified a provisional "transmission" network along with catchments and where these catchments would join the transmission network. The proposed transmission mains primarily follow a "stream" from the south west to the proposed pump station location at 207 Bremner Road.

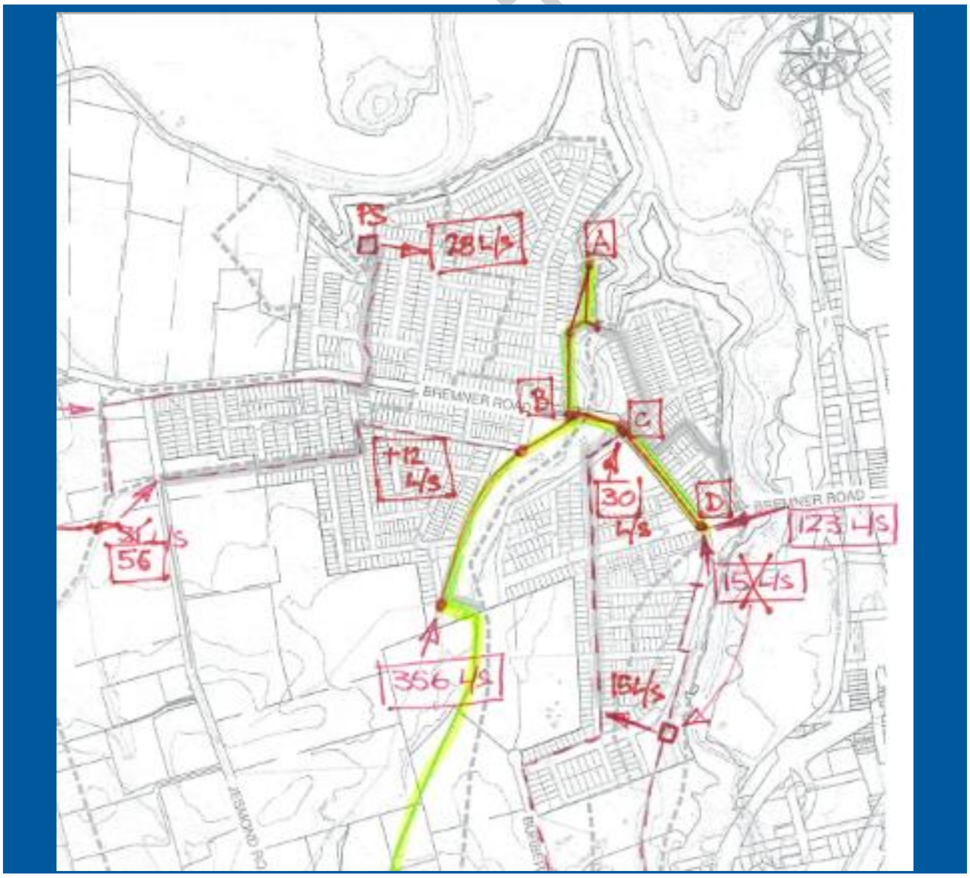


Figure 2 Transmission Main Layout

3.2.1 Bremner Road to Pump Station Site

In order to accommodate the projected ultimate flow, it is proposed that this pipeline is:

- 750mm Concrete
- ~1:225

COLEBROOK-WHITE CALCULATION			
ENTER	Internal pipe dia	712	mm
		0.712	m
		0.398	m^2
	Grade 1 in	225	
	Grade (Decimal)	0.00444444	
		0.44	%
	Pipe roughness	1.5	mm
Assuming	Poly viscosity	0.00000114	m^2/s
	g	9.81	m^2/s
Answer	Flow velocity	1.6109	m/s
	Flow	0.641	m^3/s
		641	l/s

Figure 3 750 ND Concrete Pipe Capacity

Assuming that a pipe one size smaller (675 ND concrete) is adopted, the maximum flow at the same grade is below the calculated ultimate flow.

COLEBROOK-WHITE CALCULATION			
ENTER	Internal pipe dia	636	mm
		0.636	m
		0.318	m^2
	Grade 1 in	225	
	Grade (Decimal)	0.00444444	
		0.44	%
	Pipe roughness	1.5	mm
Assuming	Poly viscosity	0.00000114	m^2/s
	g	9.81	m^2/s
Answer	Flow velocity	1.4991	m/s
	Flow	0.476	m^3/s
		476	l/s

Figure 4 675 ND Concrete Pipe Capacity

A typical issue with the construction of ultimate gravity infrastructure during initial stages of development is the ability to achieve self-cleansing velocities. In order to achieve a self-cleansing velocity of 0.75 m/s in this line, a flow in excess of 16.5 L/s is required.

Bremner Road

Trunk Sewer - 750mm @1:225

Set units: m | mm | ft | inches

Pipe diameter, d_0	.72	m
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0045	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	10	%

Results

Flow, q	0.0165	m^3/s
Velocity, v	0.7799	m/s
Velocity head, h_v	0.0310	m
Flow area	0.0212	m^2
Wetted perimeter	0.4633	m
Hydraulic radius	0.0457	m
Top width, T	0.4320	m
Froude number, F	1.12	
Shear stress (tractive force), tau	3.1771	N/m^2

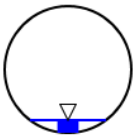


Figure 5 750 ND Concrete Pipe – Self-Cleansing

With this line to service Drury South / Quarry Road, it is possible to set the pump rate for the proposed Drury South WWPS to be greater than 16.5 L/s such that self-cleansing velocity is achieved every time that the Drury South WWPS operates.

3.2.2 Bremner Road

It is proposed that the Drury South rising main will discharge at the high point (~10.0m RL) approximately 150m west of the Ngakoroa Stream and connect to the main gravity line, as detailed above, at 209 Bremner Road.

In order to accommodate the 123 L/s ultimate flow from Drury South / Quarry Road it is proposed that this pipeline is:

- 375mm concrete
- Grade ~1:100

COLEBROOK-WHITE CALCULATION

ENTER	Internal pipe dia	330	mm
		0.33	m
		0.086	m^2
	Grade 1 in	100	
	Grade (Decimal)	0.01	
		1.00	%
	Pipe roughness	1.5	mm
Assuming	Poly viscosity	0.00000114	m^2/s
	g	9.81	m^2/s
Answer	Flow velocity	1.4752	m/s
	Flow	0.126	m^3/s
		126	l/s

Figure 6 375 ND Concrete Pipe Capacity

3.3 Pump Station

The initial development is proposed to service the consented development of Auranga A (1,350 dwelling units) and Auranga B (1,650 proposed dwellings / housing unit equivalents) and the Drury South Industrial development and Quarry Road SHA (stated as having a peak wastewater flow of 123 L/s).

3.3.1 Initial Pump Station

Watercare transmission wastewater pump stations are required to include 4 hours dry weather flow (DWF) storage. This storage is to be based on the area that feeds into the pump station directly by gravity only.

Based on the ultimate flows for the interim pump station of 250 L/s, the pump station would need to be:

Table 1 Pump Station Chamber Volume (Ultimate)

	Qty	Units
Inflow (Q_p)	250	L/s
Starts	8	Per Hour
Sump Volume (900 Q_p / s)	28.125	m^3

Table 2 Pump Station Chamber – Start – Stop

Diameter	Area (m^2)	Depth (m)
2.5	4.91	5.73
3	7.07	3.98
3.5	9.62	2.92

Table 3 Pump Station Chamber Volume (Initial)

	Qty	Units
Inflow (Q_p)	27	L/s
Starts	8	Per Hour
Sump Volume (900 Q_p / s)	3.04	m^3

Table 4 Pump Station Chamber – Start – Stop (Initial)

Diameter	Area (m^2)	Depth (m)
2.5	4.91	0.62
3	7.07	0.43
3.5	9.62	0.32

Local reticulation pump stations are to be constructed with 8 hours DWF storage with telemetry to shut down the pump station(s) on failure of the main / downstream pump station. Under this scenario flows are stored at the local pump station, rather than requiring storage at both the local and main pump station.

3.3.2 Emergency Storage

Watercare transmission wastewater pump stations are required to include 4 hours dry weather flow (DWF) storage. This storage is to be based on the area that feeds into the pump station directly by gravity only. Local reticulation pump stations are to be constructed with 8 hours DWF storage with telemetry to shut down the pump station(s) on failure of the main / downstream pump station. Under this scenario flows are stored at the local pump station, rather than requiring storage at both the local and main pump station.

Based on 1,000 houses feeding directly into the pump station (from Auranga A):

Houses	-	1000
People / House	-	3
Flow	-	250 L/person/day
Storage	-	4 hours
Required Storage	-	125 m^3

The proposed 750mm concrete gravity pipe from the southern edge of Bremner Road to the pump station is approximately 300m long, providing a capacity of 115 m3 (assuming a 700mm ID), which combined with manholes, local reticulation and pump station storage capacity (28m^3), exceeds the required 125 m^3, such that no separate storage would be required for the initial Auranga A development.

3.3.3 Rising Mains

It is proposed to construct twin rising mains, with a third pipe included within the design, but not constructed within the initial stage.

It is proposed to construct twin initial rising mains, as follows:

250 PE100 SDR 13.6

This pipe, with a 212.4mm ID would service the initial development, with a flow of 27L/s achieving a velocity of 0.75m/s. The retention time in the pipeline is minimised with the pipeline volume minimised.

400 PE100 SDR 13.6

On the initial 250mm pipeline operating at 68L/s, the operational pipeline would be switched, with the 250 pipeline flushed and left empty (full of clean water). The flow rate of 68L/s achieved the minimum flush velocity of 0.75m/s in this 400 ND pipe.

Once this pipe is operating at 95 L/s, it is recommended that the option of running both mains together be considered to minimise headloss whilst achieving self-cleansing velocities in both pipes.

In combination the two pipe can achieve a flow of 300 L/s at a friction head of approximately 23m.

560 PE100 SDR 13.6 Future Pipe

Space of the addition of a future 560 PE100 SDR13.6 will be included within the design to allow for the pipeline to be added in the future as the wider development occurs and flows exceed the capacity of the 250 / 400 pipelines.

3.3.4 Pressure Rating

It is proposed that the pipeline is PN12 / SDR13.6. This is for the following reasons:

- Standard Watercare PE100 pipe class to facilitate repair in case of failure
- Whilst initially head will be very low, pumping into Hingaia Wastewater Pump Station, in the future the ultimate Bremner Road Pump Station is anticipated to pump directly to Manurewa, approximately 9,000m away, with pump heads in the region of 70m.

3.3.5 Ultimate Pump Station

Sufficient space would be allocated adjacent to the initial pump station to allow the construction of the ultimate pump station, emergency storage and odour bed. This pump station would feed into the initial 250 and 400mm rising mains along with the additional 560mm rising main, to the Hingaia Pump Station.

The option exists to connect these rising mains to a future single (or twin) main(s) from the Hingaia WWPS to the ultimate discharge point on the Southern Interceptor or the Manurewa WWPS, bypassing the Hingaia WWPS totally.

4. Conclusions and Recommendations

4.1 Conclusions

- The location of Auranga / the Bremner Road SHA links the Drury West Future Urban Zone and Drury South / Quarry Road SHA to existing Wastewater infrastructure on the Hingaia Peninsula.
- It is beneficial to construct ultimate infrastructure at the same time as undertaking the land development works to save costs and disruption associated with returning to undertake upgrade work a short time after the initial development.
- The range of flows from initial to ultimate is difficult to achieve with a single arrangement, with self-cleansing velocities difficult to achieve.

4.2 Recommendations

It is recommended that the following infrastructure is constructed as part of the initial Auranga A development:

- An interim Wastewater Pump Station capable of servicing up to 250 l/s at or about 207 Bremner Road, Drury (capable of serving 6,000 equivalent households) (the New Pump Station), with space allocated for the future construction of the ultimate pump station, emergency storage and odour bed.
- Two rising mains (of nominal diameters of 250mm and 400mm) connecting the New Pump Station to Watercare's Hingaia Pump Station located at 158 Park Estate Rd, Hingaia (known as PS63), with space to add a third (560mm) pipe in the future.
- A gravity main capable of serving the ultimate Drury West Future Urban Zone and Drury South connecting the New Pump Station site to a position immediately south of Bremner Road (750mm concrete at 1:225).
- A gravity main(s) capable of serving the ultimate Drury West Future Urban Zone connecting the position immediately south of Bremner Road to the southern and/or western extent(s) of the development.
- A gravity main capable of servicing Drury South from a location on Bremner Road approximately 150 metres west the Ngakoroa Stream to the main gravity pipe detailed in bullet 3 above (375mm concrete at 1:100).

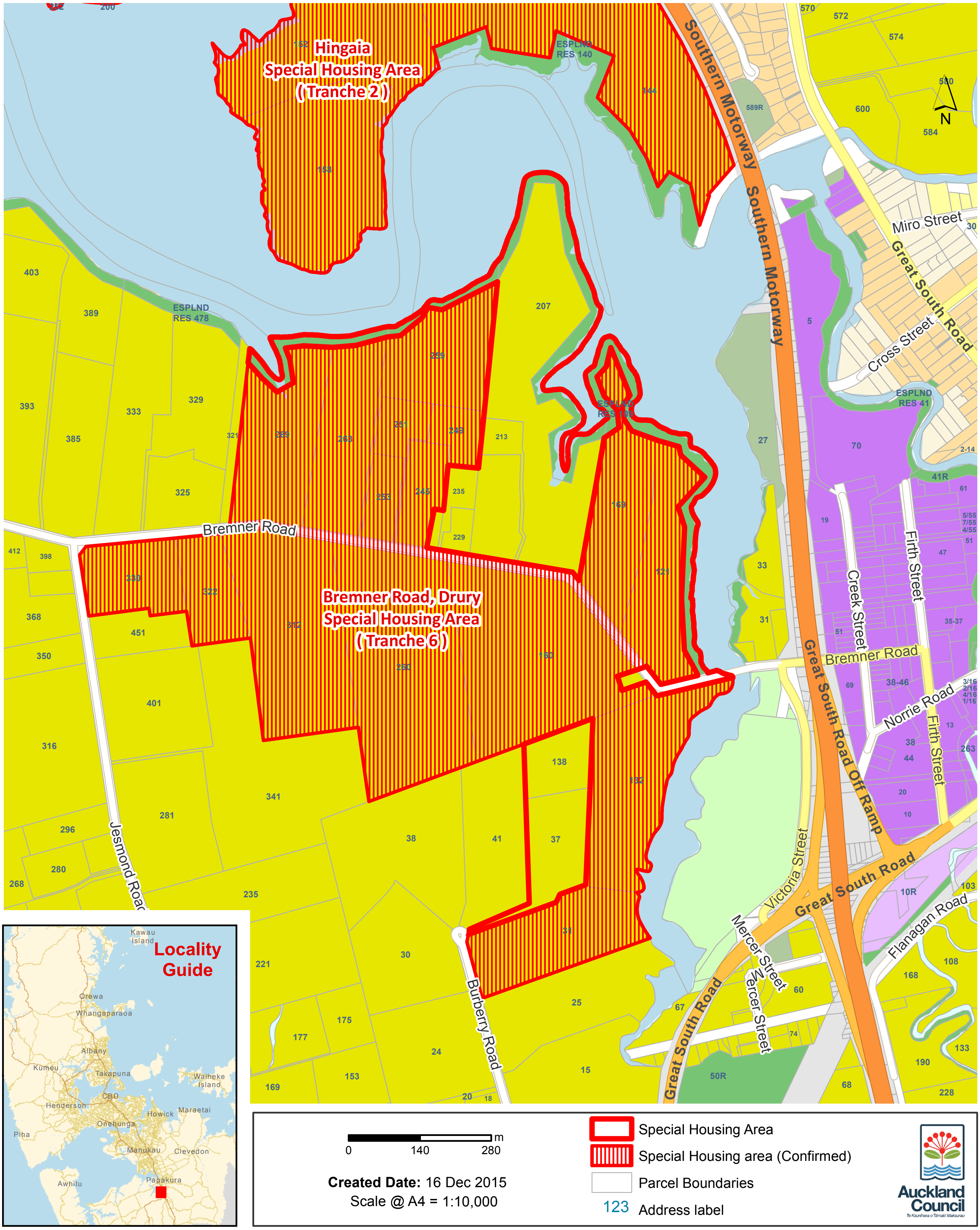
Appendices

Appendix A - Bremner Road SHA - Plans

Special Housing Area - Bremner Road, Drury Extension

Unitary Plan Zoning

- Special Purpose
- Large Lot
- Single House
- Mixed Housing Suburban
- Mixed Housing Urban
- Terrace Housing and Apartment Buildings
- Future Urban
- Green Infrastructure Corridor
- Rural and Coastal Settlement
- Neighbourhood Centre
- Local Centre
- Town Centre
- Metropolitan Centre
- City Centre
- Mixed Use
- General Business
- Business Park
- Light Industry
- Heavy Industry
- Rural Conservation
- Countryside Living
- Rural Coastal
- Mixed Rural
- Rural Production
- Public Open Space - Conservation
- Public Open Space - Informal Recreation
- Public Open Space - Sport and Active Recreation
- Public Open Space - Community
- Public Open Space - Civic Spaces
- Strategic Transport Corridor
- Road [i]
- Defence [rcp/dp]
- Ferry Terminal [rcp/dp]
- Minor Port [rcp/dp]
- Marina [rcp/dp]
- Mooring [rcp]
- General Coastal Marine [rcp]
- Water [i]
- Coastal Transition
- Hauraki Gulf Islands



0 140 280 m

Created Date: 16 Dec 2015

Scale @ A4 = 1:10,000

- Special Housing Area
- Special Housing area (Confirmed)
- Parcel Boundaries
- 123 Address label

Auckland Council

Appendix B - Letter from Watercare, 5 July 2016

Watercare
An Auckland Council Organisation

Watercare Services Limited
73 Remuera Road, Remuera
Auckland 1050, New Zealand
Private Bag 92521 Wellesley Street,
Auckland 1141, New Zealand
Telephone +64 9 539 7300
Facsimile +64 9 539 7334
www.watercare.co.nz

5 July 2016

Charles Ma
Auranga Limited
118c Paratai Drive
Orakei
Auckland 1071

Dear Charles

Wastewater Servicing for the Bremner Road SHA

Thank you for meeting with us regarding your proposed wastewater servicing plan for the Bremner Road SHA. At the meeting, you asked for Watercare's formal confirmation of the proposed approach for wastewater servicing so that you can proceed with preliminary design.

Watercare has reviewed the servicing approach your team outlined in our meeting on 31 May 2015 and considered this approach in light of Watercare's longer term servicing strategy for this area.

This letter is to confirm that the proposed solution is acceptable to Watercare provided that it addresses the matters set out in the attached memo from David Blow, Infrastructure Planning Manager.

We look forward to working through these matters with you as you develop your preliminary design.

Yours faithfully,

Ilze Gotelli
Retail
Watercare Services Limited

Encl: Memorandum to Ilze Gotelli from David Blow, Bremner Road Wasteater Servicing dated 21 June 2016.

Watercare
An Auckland Council Organisation

Memorandum

To: Ilze Gotelli

From: David Blow

Subject: Bremner Road Wastewater Servicing

Date: 21 June 2016

File number:

Further to our recent meeting with the developer and engineering advisors of the Bremner Road SHA and your e-mail of 16 June, please find below Planning's response to the servicing approach proposed by the developer.

The provision of a site by the developer within the Bremner Road development to accommodate both the initial start -up pump station to handle flow from the Bremner Road SHA and the Drury South private plan change developments and an ultimate pump station to handle additional flow from the Opaheke-Drury and Drury West FUZ land is supported.

The site will need to be owned by Watercare and designated for wastewater purposes.

The location and size of the site and the layout of the initial pump station will need to include an appropriate buffer to the residential development and also reflect the need to construct the future ultimate pump station and associated rising main without compromising the operation of the interim pump station. The future pump station will require a bark / earth filter odour treatment facility.

The geotechnical conditions of the chosen site may influence the amount of land required for construction purposes, and hence may have a bearing on the size of the site.

It would be helpful for the route of the future rising main through the SHA to also be protected by a designation or easement.

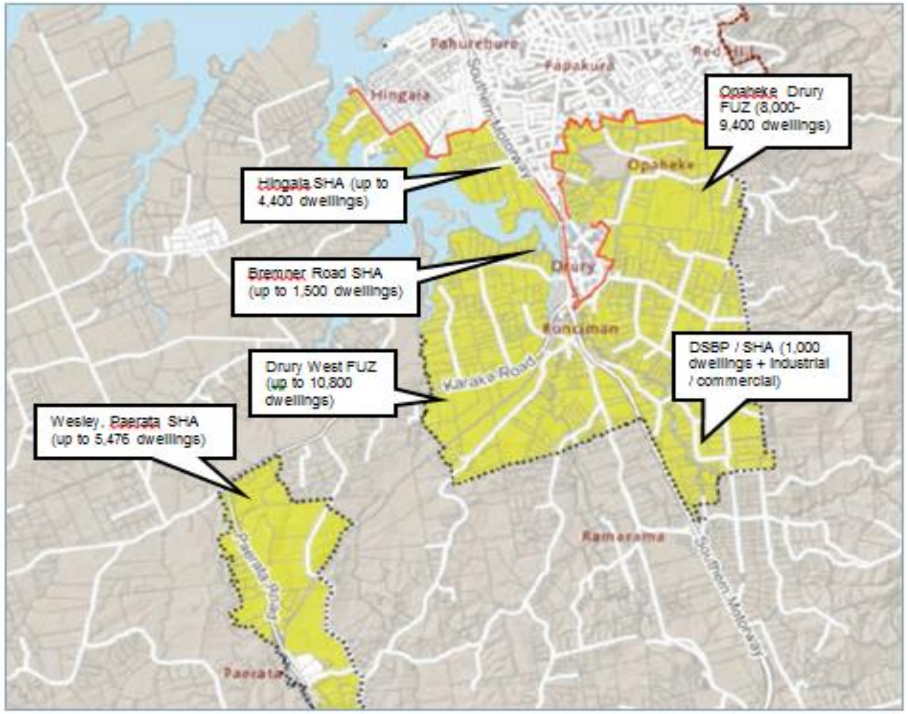
The interim pump station, proposed dual rising mains and connection to the existing Hingaia pump station will need to be constructed in accordance with Watercare's engineering standards and reflect any health and safety and operational requirements specific to the proposed solution.

Subject to a satisfactory resolution to the matters above, the wastewater servicing approach proposed by the developer is, from Planning's perspective, acceptable to Watercare.

D Blow
Infrastructure Planning Manager

Appendix C – Presentation to Watercare – 31 May 2016

Areas to be serviced:



Areas to be serviced:

Development	Development Name	Existing land use	Area (Ha)	Proposed No. of Houses	Timescale
Wesley College	Wesley College	Not stated	Not stated	4,500	2030 - 2035
Drury West FUZ	Drury West	Not stated	1,016	9450	Not stated
Bremner Road SHA		Vacant	Not stated	1350	2017 - 2025
Drury South SHA	Residential	Rural	45	1,000	2018-2022
Drury South Business Project	Industrial	Rural	185	*3000*	2025-2030
				18300	

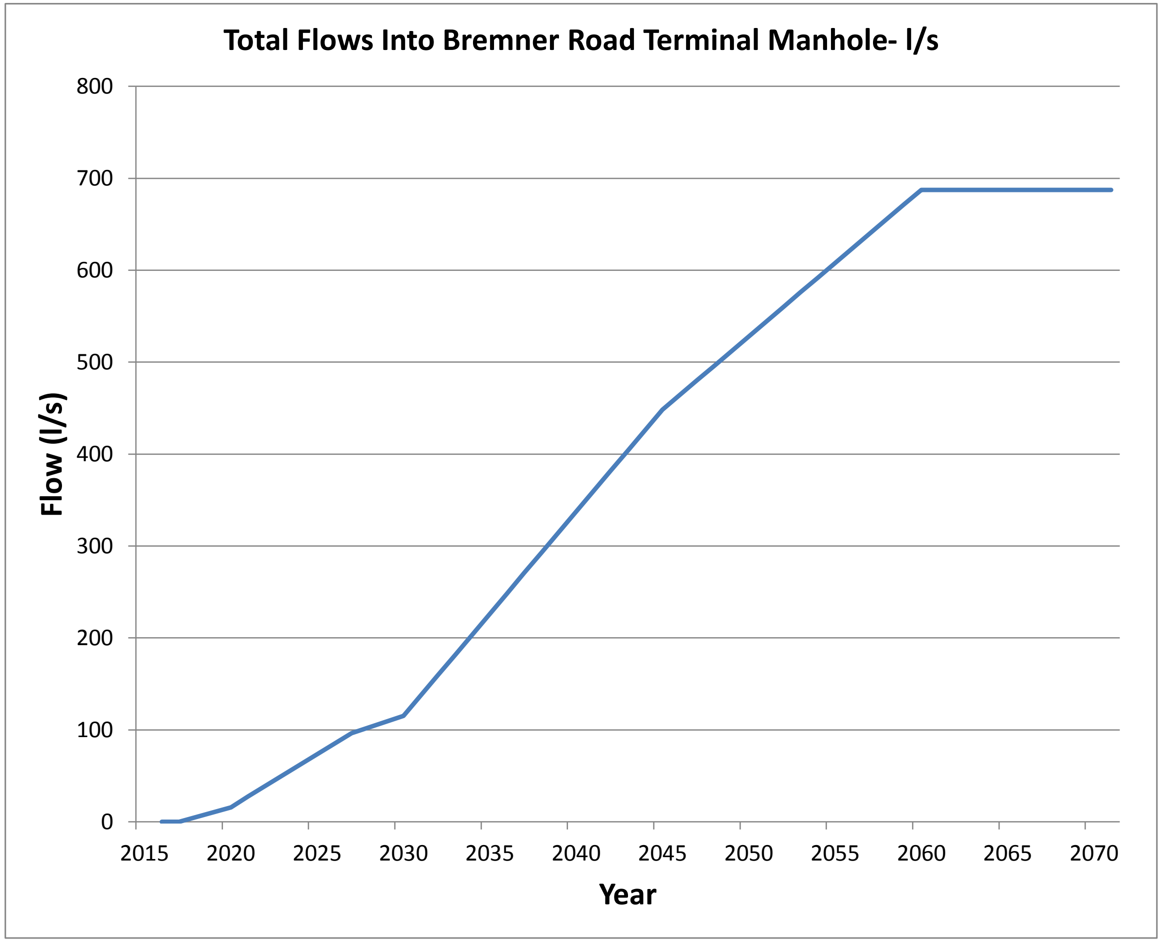
Notes:

3000 HUE assumed for Drury South Industrial
First 1000 houses (Wesley / Paerata) to be serviced by Pukekohe WWTP
Opaheke Drury FUZ to be sewered separately
Hingaia SHA feeds directly to Hingaia PS

Projected Flows

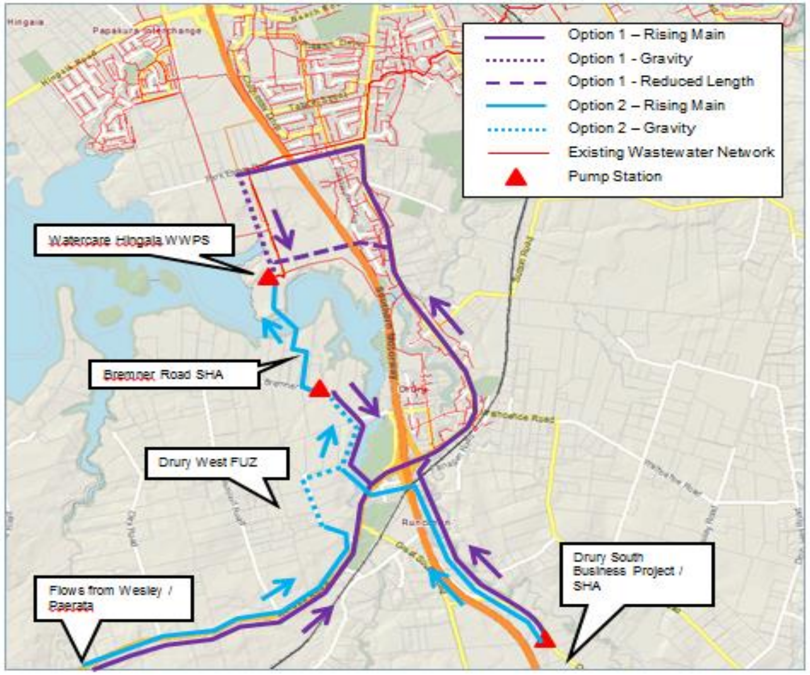
Catchment	Properties (No.)	Years	Start Year	Contributary Flow (%)	Total PWWF (L/s)	Total PDWF (L/s)
Wesley College / Paerata	3500	30	2030	75%	136.7	61.5
Drury South Industrial + SHA (HEU)	4000	25	2020	75%	156.3	70.3
Bremner Road SHA	1350	10	2017	75%	52.7	23.7
Drury West FUZ	9450	30	2030	75%	341.8	153.8
	18300				687.5	309.4

PWWF
Peak Wet Weather Flows reduced to 75%
of design value of 1500L/person/day to 1125 L/person/day



Note:
Boxes shaded pink can be changed in the spreadsheet to change the calculations

Route Options



Option 1 - Great South Road

Advantage / Opportunity	Disadvantage / Risk
■ One less creek crossing than Option 2, lower environmental risk;	■ Approx. 2km of construction will be within Great South Road – significantly more services to avoid / protect, increased traffic management requirements; ■ Longer rising main, increased OPEX for satellite pump stations; ■ Potential land owner issues through Hingaia South development; ■ It is considered that Auckland Transport is less likely to approve option due to disruptions through Great South Road, with alternative viable option available;

Option 2a - Gravity via Bremner Road

Advantage / Opportunity	Disadvantage / Risk
■ Single pump station site (Hingaia)	■ Drury Creek crossing – environmental risk during construction; ■ Pipe jack: deep shafts; silt / sands; high ground water table; ■ Large number of lots required to be occupied to achieve flush flow

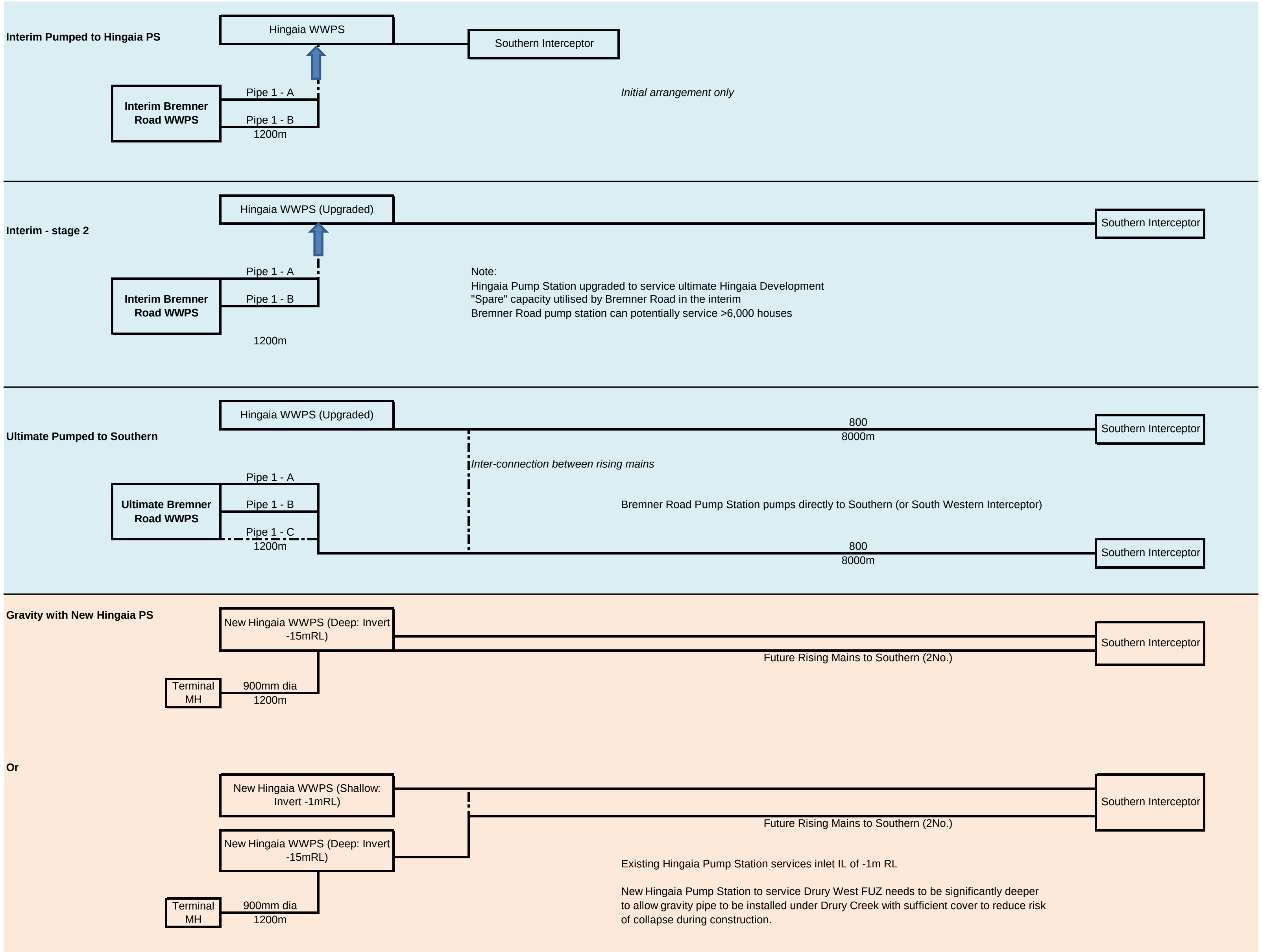
Option 2b - Pumped via Bremner Road

Advantage / Opportunity	Disadvantage / Risk
■ Length of gravity pipe reduces pumping requirements; ■ Gravity pipe can be shared with Bremner Road local reticulation; ■ A Resource Consent has been obtained for a rising main through the Bremner Road development and beneath the Drury Creek; ■ Shorter overall length, less infrastructure for Watercare to maintain; ■ Reduced retention times; ■ Increased length of pipe through open development land – easier construction;	■ Drury Creek crossing – environmental risk during construction; ■ Two seperate pump station sites;

Option 3 - Both options developed

Advantage / Opportunity	Disadvantage / Risk
As above ■ Separate systems for different developers - simpler;	As above ■ Why two when one will do?;

Schematic Layouts - Options / Staging



Pumped Option - Calcualtions

PDWF		
People per house	3	
Flow Per Person	225	L/p/day
Peak Factor	5	
PDWF/HEU	0.0391	L/s

PWWF		
People per house	3	
Flow Per Person	1125	L/p/day
PDWF/HEU	0.0391	L/s

Number of Houses	18300	
People per house	3	
PWWF	1500	L/person/day
Percentage	75%	
Adjusted PWWF	1125	L/person/day
Adj. Peak WWF	**714.84**	L/s

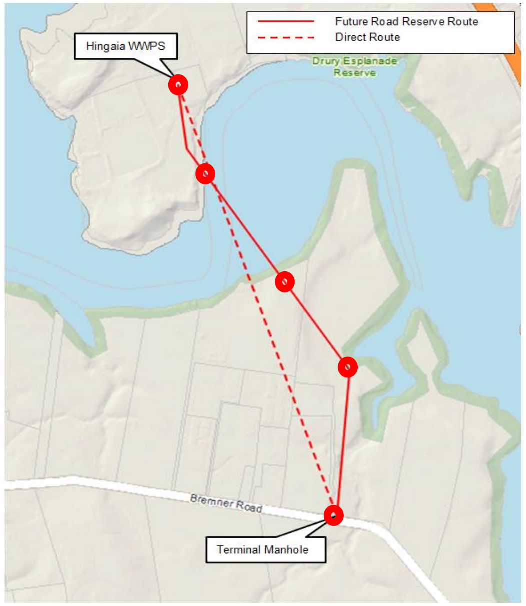
	Nominal Diameter	Internal Diameter	Length	Pipe Volume	Min Velocity	Flow	Max / Design Flow			Design Friction H_L	PDWF Self Cleansing Flow	PDWF HEU (Min Velocity)	PDWF HEU (Design Velocity)	PWWF HEU (Design Velocity)	ADWF HEU (1 day retention in pipe)	Comments:
	mm	mm	m	m^3	m/s	L/s	L/s	L/s	L/s	m	L/s	No.	No.	No.	No.	
Pipe 1 - a	250	212.5	1200	42.56	0.75	26.60	110.00			60.37	27.00	691	2,816	2,816	63	Pumping to Hingaia PS
Pipe 1 - b	400	339.3	1200	108.50	0.75	67.81	250.00			26.83	68.00	1,741	6,400	6,400		No static lift
Pipe 1 - A	250	212.5	1200	42.56	0.75	26.60	52.94			14.25	27.00	691	1,355	1,355		
Pipe 1 - B	400	339.3	1200	108.50	0.75	67.81	181.53	234.48		14.25	68.00	1,741	6,003	6,003		Pumping to Southern Interceptor
Pipe 1 - C	560	475.9	1200	213.45	0.75	133.41	441.25		675.72	14.25	134.00	3,430	17,299	17,299		at Wattle Farm
Pipe 2	800	680	8000	2,905.34	0.75	272.38	675.72		675.72	34.76	273.00	6,989	17,299	17,299		
						Combined Friction				49.01						
						Static				22.00						
						TOTAL				**71.01**						

Gravity Option - Calculations

COLEBROOK-WHITE CALCULATION
(Unverified calc - Please verify before use)

ENTER	Internal pipe dia	900	mm
		0.9	m
		0.636	m^2
	Grade 1 in	600	
	Grade (Decimal)	0.00166667	
		0.17	%
	Pipe roughness	1.5	mm
Assuming	Poly viscosity	0.00000114	m^2/s
	g	9.81	m^2/s
Answer	Flow velocity	1.1421	m/s
	Flow	0.727	m^3/s
		727	l/s

900mm is shown as the minimum diameter, however, pipe is more likely to be 1050, 1350 or 1800 to suit construction methodology



Required Min. flows

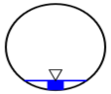
Set units: m | mm | ft | inches

Pipe diameter, d_0	1350	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	11	%

Results

Flow, q	0.0663	m^3/s
Velocity, v	0.7741	m/s
Velocity head, h_v	0.0306	m
Flow area	0.0857	m^2
Wetted perimeter	0.9128	m
Hydraulic radius	0.0939	m
Top width, T	0.8448	m
Froude number, F	0.78	
Shear stress (tractive force), tau	2.4755	N/m^2

67 L/s



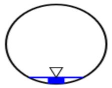
Set units: m | mm | ft | inches

Pipe diameter, d_0	1800	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	8	%

Results

Flow, q	0.0731	m^3/s
Velocity, v	0.7660	m/s
Velocity head, h_v	0.0299	m
Flow area	0.0954	m^2
Wetted perimeter	1.0323	m
Hydraulic radius	0.0924	m
Top width, T	0.9767	m
Froude number, F	0.78	
Shear stress (tractive force), tau	2.4005	N/m^2

73 L/s



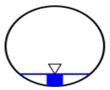
Set units: m | mm | ft | inches

Pipe diameter, d_0	1050	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	15	%

Results

Flow, q	0.0647	m^3/s
Velocity, v	0.7941	m/s
Velocity head, h_v	0.0322	m
Flow area	0.0814	m^2
Wetted perimeter	0.8352	m
Hydraulic radius	0.0975	m
Top width, T	0.7498	m
Froude number, F	0.77	
Shear stress (tractive force), tau	2.6256	N/m^2

65 L/s



Preliminary Costings

Interim Pump Station

			Auranga	Drury South
	HUE	6000	3000	3000
	Percentage		50%	50%
Bremner Road PS	Interim PS	2,400,000	1,200,000	1,200,000
	250mm Rising Main	1,200,000	600,000	600,000
	400mm Rising Main	1,800,000	900,000	900,000
Drury South Extension	200mm Rising Main	600,000		600,000
Gravity Reticulation		600,000	300,000	300,000
		6,600,000	**3,000,000**	**3,600,000**

Separate Routes

Drury South - via Great South Road

	200mm Rising Main	3,600,000		3,600,000
	Risk	800,000		800,000
	Easements	500,000		500,000
		4,900,000		**4,900,000**
Bremner Road PS	Interim PS	2,400,000	2,400,000	
	250mm Rising Main	1,200,000	1,200,000	
		3,600,000	**3,600,000**	
		8,500,000	**3,600,000**	**4,900,000**

Boxes shaded pink can be changed in the spreadsheet to change the calculations

Ultimate Pump Station

			Auranga	Drury South
	HUE	18300	3000	4000
	Percentage		16%	22%
Bremner Road PS	Ultimate PS	6,000,000	983,607	1,311,475
	250mm Rising Main	1,200,000	196,721	262,295
	400mm Rising Main	1,800,000	295,082	393,443
	560mm Rising Main	2,400,000	393,443	524,590
	Land 2,000m^2	1,000,000	163,934	218,579
		12,400,000	**2,032,787**	**2,710,383**

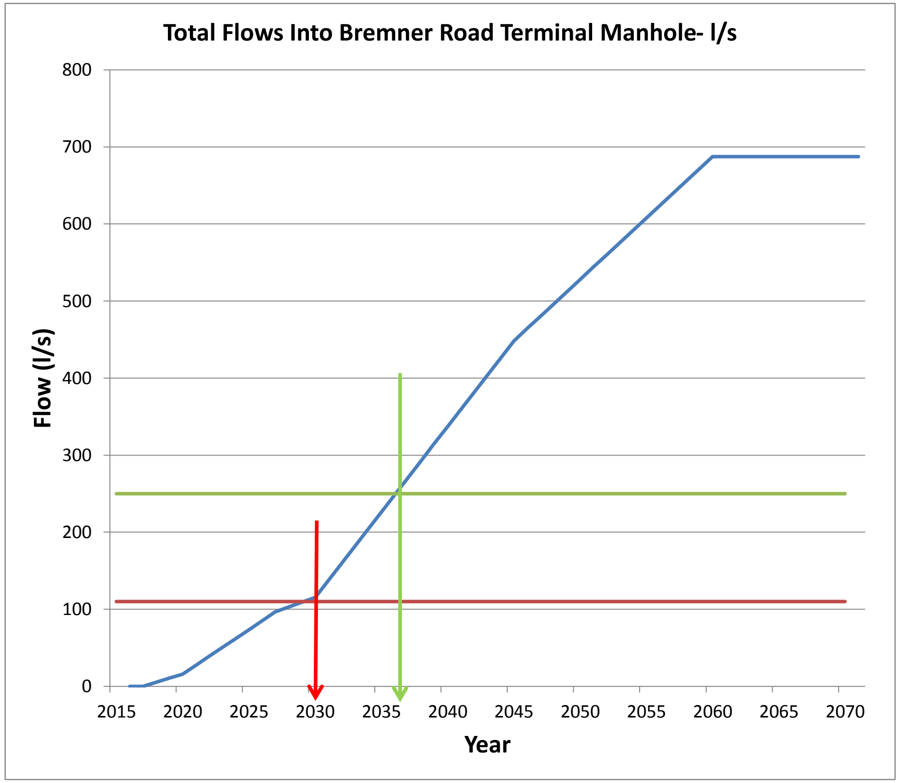
Gravity

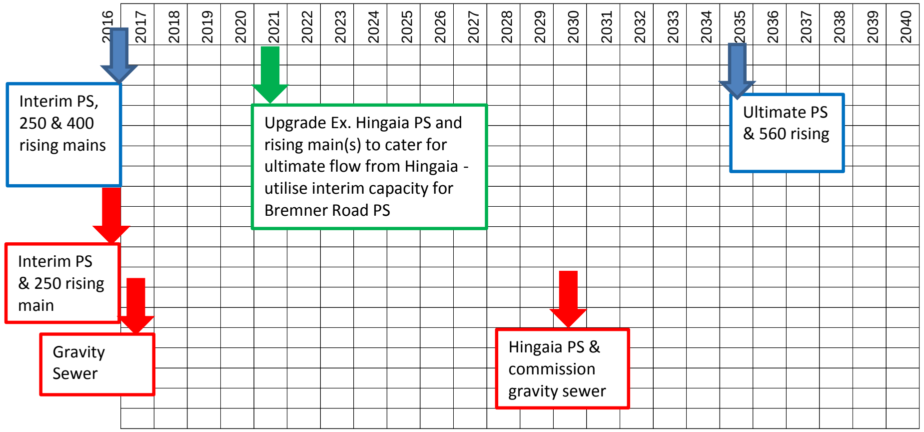
			Auranga	Drury South
	HUE	18300	3000	4000
	Percentage		16%	22%
Hingaia Pump Station	Ultimate PS	12,000,000	1,967,213	2,622,951
	Pipe Jack	19,000,000	3,114,754	4,153,005
		31,000,000	**5,081,967**	**6,775,956**

Boxes shaded pink can be changed in the spreadsheet to change the calculations

Staging Options

Catchment	Properties (No.)	Years	Start Year	Contributary Flow (%)	Total PWWF (L/s)	Total PDWF (L/s)
Wesley College / Paerata	3500	30	2030	75%	136.7	61.5
Drury South Industrial (HEU)	4000	25	2020	75%	156.3	70.3
Bremner Road SHA	1350	10	2017	75%	52.7	23.7
Drury West FUZ	9450	30	2030	75%	341.8	153.8
	18300				687.5	309.4





NPV Comparrison of Pumped and Gravity Option

	Pumped Option		**Gravity Option**	
		4%		4%
2017	Interim PS, 250 and 400 Rising Main	**5,400,000**	Interim PS, 250 Rising Main + Gravity	**22,600,000**
2018	Pump Station Operation	50,000	Pump Station Operation	50,000
2019		50,000		50,000
2020		50,000		50,000
2021		50,000		50,000
2022		50,000		50,000
2023		50,000		50,000
2024		50,000		50,000
2025		50,000		50,000
2026		50,000		50,000
2027		50,000		50,000
2028		50,000		50,000
2029		50,000		50,000
2030		50,000	New Hingaia Pump Station	**12,000,000**
2031		50,000		50,000
2032		50,000		50,000
2033		50,000		50,000
2034		50,000		50,000
2035	Ultimate PS & 560 Rising Main	**8,400,000**		50,000
	Total NPV	**$ 9,800,000.00**	**Total NPV**	**$ 29,200,000.00**

$ 50,000.00 *Assumed annual operating cost of puimp station*

Pumped / Gravity	34%
Cost Saving (Pumped)	**$ 19,400,000.00**

Sensitivity	
Cost Accuracy	30%
Pumped - Max Cost	$ 12,740,000.00
Gravity - Min Cost	$ 20,440,000.00
Pumped / Gravity	62%
Cost Saving (Pumped)	**$ 7,700,000.00**

Appendix D – Beca Memo: Sewer Loads 17 May 2016

Memorandum

To: Richard Pullar - Watercare **Date:** 17 May 2016

From: Ron Melton **Our Ref:** 3910474

Copy: Stephen Hughes, Peter Yendell, Keith Caldwell, Dale Paice

Subject: Ararimu - Flow data update

1 Introduction

The purpose of this memorandum is to update the projected water demand /wastewater generation for Stevenson's Ararimu development.

Since the Plan Change was approved:

- There has been firm interest from businesses requiring sites for their warehousing and distribution functions. These businesses have significantly different water demand and wastewater generation profile from "industry" in general, and will make up most of the land used in the early stages of the site development
- Consideration has been given to incorporate a residential component to support the industrial area, and an area of 45ha adjacent to the motorway has been identified for this

This memo captures these changes.

2 Land use categories and design Water /Wastewater flows

2.1 2012 Recap

The 2012 Plan Change had four Land Use categories identified as zones for the development of industrial and commercial businesses on the site. The following definitions apply, with the design wastewater values given taken from the guidelines from Watercare's Code of Practice for Land Development and Subdivision (May 2015). The design values include for wet and dry weather peaks and make allowance for potable water use.

- **Industrial 4** – Area for any business including **heavy industry** (significant manufacturing/ processing)
  - Wastewater is made up of sanitary wastewater and trade wastes; the trade waste component is likely to be significant.
  - Wastewater design flow is 1.3 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.
- **Industrial 3** - Area for **light to medium industry**
  - Wastewater is made up of sanitary wastewater and trade wastes
  - Wastewater design flow is 0.7 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.

- **Motorway Edge** - Area envisaged to incorporate **50% Office space and 50% light industrial businesses**
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and minimal requirements for industrial processes;
- **Commercial Precinct** – Area is intended to be a "**Town Centre**" type area providing services to the industrial/motorway edge areas
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for commercial facilities

2.2 2016 Additions

Two additional demand types are now proposed for incorporation:

2.2.1 Warehousing & Distribution Centres

The characteristics of these sites are as follows:

- Likely to be situated in land shown on the existing structure plan as Industrial 3 or 4.
- Size of site between 5 – 10 ha per business
- Potable water supply required for employees on site – typical daily activities (drinking, toilet, shower, kitchen facilities) and fire protection of facilities
- Sanitary wastewater only (zero trade waste)
- As part of the supporting evidence for Plan Change 12, an Economic Impact Assessment was prepared in 2011by Market Economics[1] and relating this to the current business interest:
  - The maximum number of employees on site (Modified Employment Counts) is estimated by the specific business owner, but would typically confirm to the norms noted in the 2011 Economic Impact Assessment prepared by Market Economics (~ 24.6 MEC/ha).[2]
  - For these sites, there may be significantly fewer MECs on site for much of the day or overnight

To reflect this, warehousing/distribution is added as a separate land use category. The design wastewater flow for this type of site is based on the following:

- A typical MEC will work 1x 8 hour shift on site. The wastewater generated by MEC during 1 shift is assumed to be 65 l/MEC/d.
- A typical site of 10 hectares with 25 MEC/ha will therefore have an average wastewater generation (Average Dry Weather Flow) of 0.0188 l/s/ha.
- Applying a peaking factor of 6 gives a Peak Wet Weather Flow (PWWF) of 0.11 l/s/ha

[1] Drury Business Land Economic Impact Assessment, Market Economics, 2011

[2] Initial discussions with one prospective lot holder indicated max 250 people on site over 10 ha

2.2.2 Residential

The residential component envisaged is relatively high density, with up to 1,000 dwellings on the 45ha site. This area includes roads, and in the Plan Change documentation had 42.2ha of saleable land.

The standard Watercare residential flows of 3 persons per dwelling, with daily flows of 225l/p and a PWWF factor of 6.67 have been adopted. This gives loadings of:

- Daily Flow 675m3
- PWWF 52 l/s (1.23 l/s/ha if spread over 42.2ha)

2.3 Site wide land use

For the purposes of estimating water demand/wastewater generation, the site-wide land areas for the different industry types as shown in Table 1 are assumed. The assessment of what industries will establish on site does not have any impact on previous land zoning as the changes relate to the establishment of lighter industries on land zoned for heavy industry, which is permissible.

Table 1 Land Use Estimation 2012 and 2016 for entire Ararimu site

	Land Use estimation 2012 (ha)	Land Use estimation 2016 (ha)	Design wastewater PWWF (l/s/ha)
Heavy Wet Industry	42	20	1.3
Light Industry	96	30	0.7
Motorway Edge	64	20	0.4
Commercial Precinct	22	15	0.4
Warehousing	0	97	0.11
Residential	0	42	1.23
Total Area (ha)	**224**	**224**	

The total wastewater loading for the Ararimu development is estimated in Table 2 below. This information will be used as the basis for the design of the ultimate infrastructure (full development of Ararimu).

Table 2 Wastewater flows for Total Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	30	21
Motorway Edge	0.4	20	8
Commercial	0.4	15	6
Warehousing	0.11	97	10.6
Residential	1.23	42	51.7
Total		**224**	**123**

2.4 Stage 1 Wastewater Flows

Stage 1 is estimated to be completed by 2022 and the projected wastewater flows are shown in Table 3. These reflect the Land Use projections presented above.

This information will be used to inform the design of site Stage 1 infrastructure, so that the pipelines installed will function acceptably in the initial stages of the project.

Table 3 Wastewater flows for Stage 1 Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	13	9.1
Motorway Edge	0.4	0	0
Commercial	0.4	4	1.6
Warehousing	0.11	55	6.1
Residential	1.23	42	52
Total		**134**	**95**

The Peak Wet Weather Flow (PWWF), average flow and daily volumes for stage 1 and the total development are summarised in Table 4. The average flow rates have been calculated as follows:

- For warehousing from the base assumptions made in developing the design flows for this use.
- For all other industrial type land uses we have assumed a peaking factor of 6.0, in accordance with Watercare design practices
- For residential development the average flow is based on a daily demand of 675 l/household

Table 4 Wastewater flows used for concept confirmation

	Stage 1	Total Development
PWWF (l/s)	95	123
Average Flow (l/s)	15.8	20.5
Daily Flow (m3)	1,370	1,770

Note that:

- The trunk infrastructure will be designed with some flexibility to cope with flows above /below those predicted; however:
- As additional land sales are made and development proceeds, a "watching brief" will need to be kept on the nature of the businesses establishing at Ararimu to make sure that the confirmed water demand and wastewater flows are within the tolerance limits of the designed infrastructure.

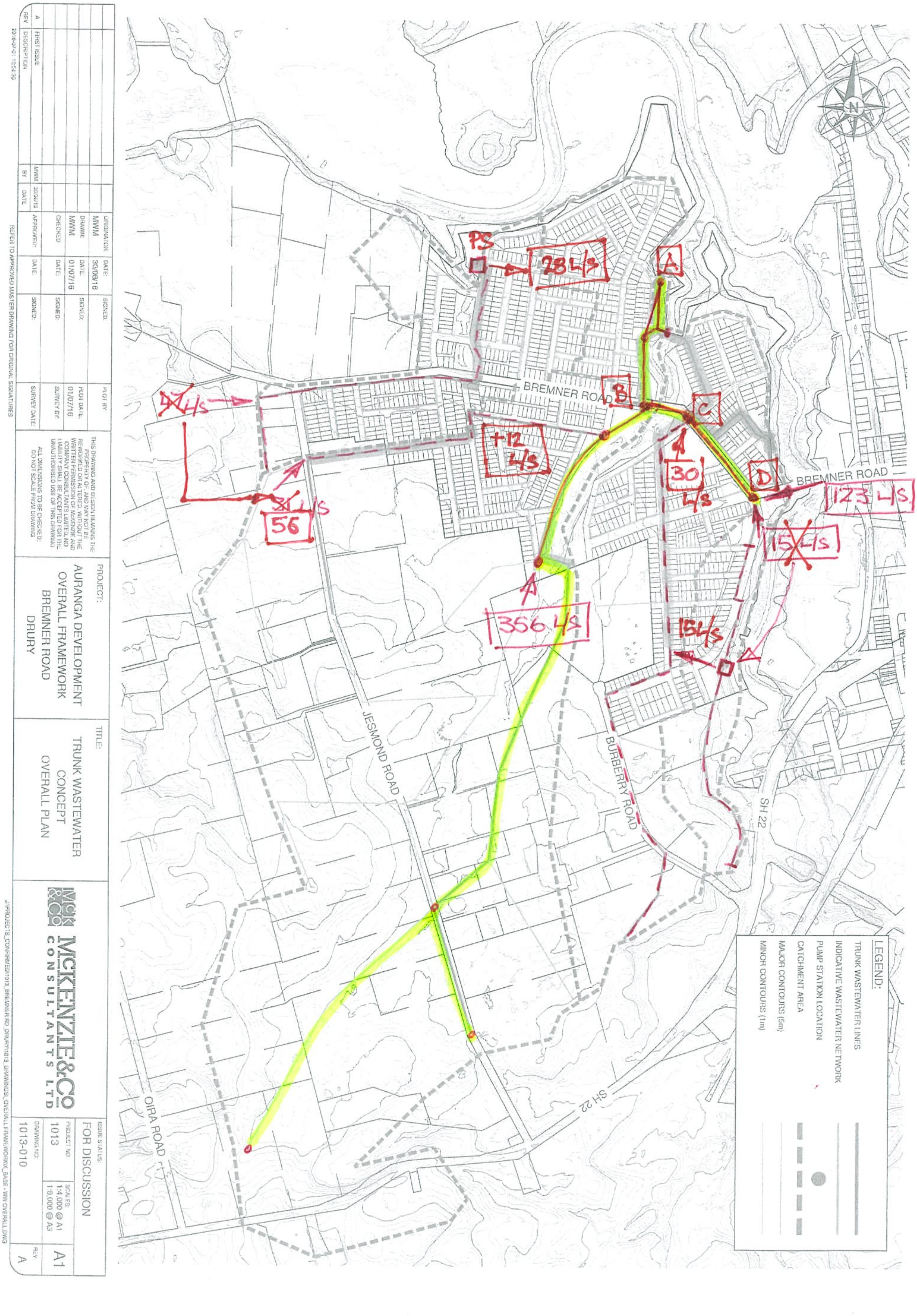
3 Water demand

The average water demand will be calculated by multiplying the Design wastewater flows by 1.2. The 20% allowance is added for drinking water, product water for wet industries etc, which should average out over the site. This results in an average water demand for the total development of 2,120 cubic metres per day.

The peak daily and hourly demand can be calculated as per Watercare's Code of Practice.

Ron Melton
Technical Director – Land Development
Phone Number: +64 9 300 9000
Email: ron.melton@beca.com

Appendix E – Drury West Catchments and Flows



BREMNER ROAD
JESMOND ROAD
BURBERRY ROAD
SH 22
OIRA ROAD
PS
28 L/s
A
B
C
D
+12 L/s
30 L/s
123 L/s
15 L/s
15 L/s
56
356 L/s
LEGEND:
TRUNK WASTEWATER LINES
INDICATIVE WASTEWATER NETWORK
PUMP STATION LOCATION
CATCHMENT AREA
MAJOR CONTOURS (5m)
MINOR CONTOURS (1m)
PROJECT:
AURANGA DEVELOPMENT
OVERALL FRAMEWORK
BREMNER ROAD
DRURY
TITLE:
TRUNK WASTEWATER
CONCEPT
OVERALL PLAN
McKENZIE&CO CONSULTANTS LTD
ISSUE STATUS:
FOR DISCUSSION
PROJECT NO.
1013
SCALES:
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1:8,000 @ A3
DRAWING NO.
1013-010
A1
REV.
A
A FIRST ISSUE MWM 30/06/16
REV DESCRIPTION BY DATE
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DRAWN: MWM DATE: SIGNED:
CHECKED: MWM DATE: 01/07/16 SIGNED:
APPROVED: DATE: SIGNED:
PLOT BY: PLOT DATE: 01/07/16
SURVEY BY: SURVEY DATE:
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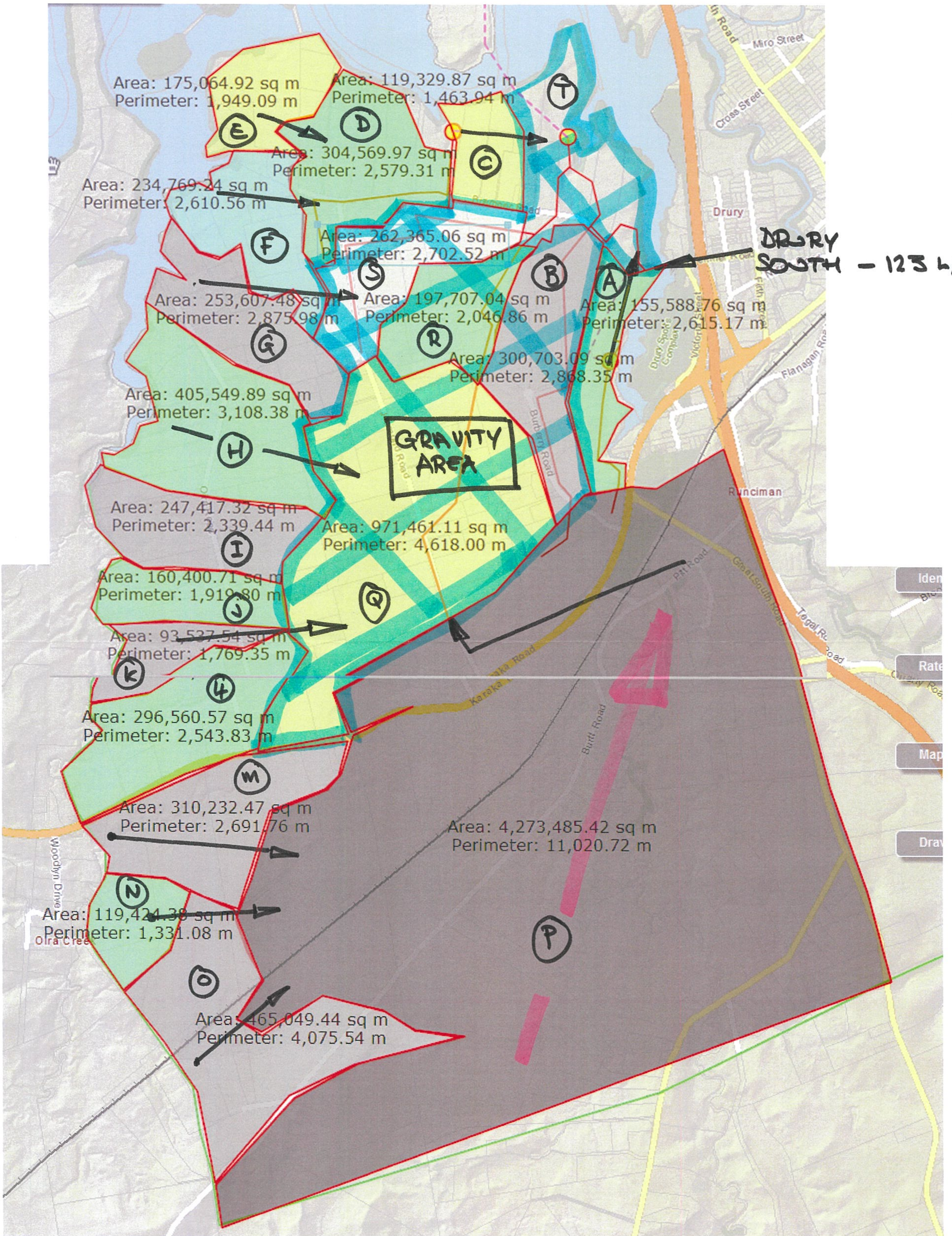

PUMPED / RISING MAIN.

Total Drury West Area + Drury South

	Area m^2	ha	Houses / ha	Houses No.	People per House	People
A	156000	15.60	15	234	3	702
B	301000	30.10	15	452	3	1,355
C	120000	12.00	15	180	3	540
D	305000	30.50	15	458	3	1,373
E	175000	17.50	15	263	3	788
F	235000	23.50	15	353	3	1,058
G	255000	25.50	15	383	3	1,148
H	405,600	40.56	15	608	3	1,825
I	250,000	25.00	15	375	3	1,125
J	160,000	16.00	15	240	3	720
K	95,000	9.50	15	143	3	428
L	300,000	30.00	15	450	3	1,350
M	310,000	31.00	15	465	3	1,395
N	120,000	12.00	15	180	3	540
O	465,000	46.50	15	698	3	2,093
P	4,275,000	427.50	15	6,413	3	19,238
Q	972,000	97.20	15	1,458	3	4,374
R	198,000	19.80	15	297	3	891
S	263,000	26.30	15	395	3	1,184
T	200,000	20.00	15	300	3	900
		956				43,023

	43,023	people
Full PWWF	1500	L/s
	60%	
Adj. PWWF	900	L/s
Design PWWF	448	L/s
+ Drury South	123	L/s
	571	L/s

Gravity Line at Southern Edge of Development

	Area m^2	ha	Houses / ha	Houses No.	People per House	People	
A		-	15	-	3	-	
B		-	15	-	3	-	
C		-	15	-	3	-	
D		-	15	-	3	-	
E		-	15	-	3	-	
F		-	15	-	3	-	
G		-	15	-	3	-	
H	405,600	40.56	15	608	3	1,825	
I	250,000	25.00	15	375	3	1,125	
J	160,000	16.00	15	240	3	720	
K	95,000	9.50	15	143	3	428	
L	300,000	30.00	15	450	3	1,350	
M	310,000	31.00	15	465	3	1,395	
N	120,000	12.00	15	180	3	540	
O	465,000	46.50	15	698	3	2,093	
P	4,275,000	427.50	15	6,413	3	19,238	Watercare
Q	972,000	97.20	15	1,458	3	4,374	
R	198,000	19.80	15	297	3	891	
S		-	15	-	3	-	
T		-	15	-	3	-	
						33,978	

	33,978	people
Full PWWF	1500	L/s
	60%	
Adj. PWWF	900	L/s
Design PWWF	354	L/s

Gravity Line into Pump Station

	Area m^2	ha	Houses / ha	Houses No.	People per House	People	
A	156000	15.60	15	234	3	702	
B	301000	30.10	15	452	3	1,355	
C		-	15	-	3	-	
D		-	15	-	3	-	
E		-	15	-	3	-	
F		-	15	-	3	-	
G	255000	25.50	15	383	3	1,148	
H	405,600	40.56	15	608	3	1,825	
I	250,000	25.00	15	375	3	1,125	
J	160,000	16.00	15	240	3	720	
K	95,000	9.50	15	143	3	428	
L	300,000	30.00	15	450	3	1,350	
M	310,000	31.00	15	465	3	1,395	
N	120,000	12.00	15	180	3	540	
O	465,000	46.50	15	698	3	2,093	
P	4,275,000	427.50	15	6,413	3	19,238	Watercare
Q	972,000	97.20	15	1,458	3	4,374	
R	198,000	19.80	15	297	3	891	
S	263,000	26.30	15	395	3	1,184	
T		-	15	-	3	-	
						38,365	

	38,365	people
Full PWWF	1500	L/s
	60%	
Adj. PWWF	900	L/s
Design PWWF	400	L/s
Drury South	123	L/s
Total	523	L/s

Gravity - Additional Flow into Bremner Road Line

	Area m^2	ha	Houses / ha	Houses No.	People per House	People
A	156000	15.60	15	234	3	702
B	301000	30.10	15	452	3	1,355
C		-	15	-	3	-
D		-	15	-	3	-
E		-	15	-	3	-
F		-	15	-	3	-
G		-	15	-	3	-
H		-	15	-	3	-
I		-	15	-	3	-
J		-	15	-	3	-
K		-	15	-	3	-
L		-	15	-	3	-
M		-	15	-	3	-
N		-	15	-	3	-
O		-	15	-	3	-
P		-	15	-	3	-
Q		-	15	-	3	-
R		-	15	-	3	-
S		-	15	-	3	-
T		-	15	-	3	-
						2,057

	2,057	people
Full PWWF	1500	L/s
	80%	
Adj. PWWF	1200	L/s
Design PWWF	29	L/s
Drury South		L/s
Total	29	L/s

Local Pump Station Flow (West of Main Pump Station)

	Area m^2	ha	Houses / ha	Houses No.	People per House	People
A		-	15	-	3	-
B		-	15	-	3	-
C	120000	12.00	15	180	3	540
D	305000	30.50	15	458	3	1,373
E	175000	17.50	15	263	3	788
F	0	-	15	-	3	-
G		-	15	-	3	-
H		-	15	-	3	-
I		-	15	-	3	-
J		-	15	-	3	-
K		-	15	-	3	-
L		-	15	-	3	-
M		-	15	-	3	-
N		-	15	-	3	-
O		-	15	-	3	-
P		-	15	-	3	-
Q		-	15	-	3	-
R		-	15	-	3	-
S		-	15	-	3	-
T		-	15	-	3	-
						2,700

	2,700	people
Full PWWF	1500	L/s
	60%	
Adj. PWWF	900	L/s
Design PWWF	28	L/s
Drury South		L/s
Total	28	L/s

Western Catchment

	Area m^2	ha	Houses / ha	Houses No.	People per House	People
A		-	15	-	3	-
B		-	15	-	3	-
C		-	15	-	3	-
D		-	15	-	3	-
E		-	15	-	3	-
F	235000	23.50	15	353	3	1,058
G	255000	25.50	15	383	3	1,148
H	405,000	40.50	15	608	3	1,823
I		-	15	-	3	-
J		-	15	-	3	-
K		-	15	-	3	-
L		-	15	-	3	-
M		-	15	-	3	-
N		-	15	-	3	-
O		-	15	-	3	-
P		-	15	-	3	-
Q		-	15	-	3	-
R		-	15	-	3	-
S		-	15	-	3	-
T		-	15	-	3	-
						4,028

	4,028	people
Full PWWF	1500	L/s
	80%	
Adj. PWWF	1200	L/s
Design PWWF	56	L/s
Drury South		L/s
Total	56	L/s

Appendix F – Watercare Infrastructure Finance Agreement Schedule 1 (modified with comments)

SCHEDULE 1 – WASTEWATER NETWORK

~~CHARLES MA~~KARAKA AND DRURY CONSULTANT LIMITED

1. ~~Charles Ma~~Karaka & Drury Consultant Limited will design and build the Primary Wastewater Infrastructure in agreement with Watercare as follows:

1.1 A Wastewater Pump Station capable of servicing up to ~~[XX]~~250 l/s at or about 207 Bremner Road, Drury (capable of serving 6,000 equivalent households) **(the New Pump Station).**

1.2 Two rising mains (of nominal diameters of 250mm and ~~410mm~~400mm) connecting the New Pump Station to Watercare's Hingaia Pump Station located at 158 Park Estate Rd, Hingaia (known as PS63).

1.3 A gravity main capable of serving ~~6,000 equivalent households~~the ultimate Drury West Future Urban Zone and Drury South connecting the New Pump Station site to a position ~~about 207~~immediately south of Bremner Road.

1.4 A gravity main(s) capable of serving the ultimate Drury West Future Urban Zone connecting the position immediately south of Bremner Road to the southern and/or western extent(s) of the development.

~~1.3~~1.5 A gravity main capable of servicing Drury South from a location on Bremner Road approximately 150 metres west the Ngakoroa Stream to the gravity pipe detailed in 1.3 above.

2. The Primary Wastewater Infrastructure including any land rights required to operate the infrastructure will vest to Watercare at no cost to Watercare.

3. Watercare may require additional land to be associated with the New Pump Station to allow for future upgrades. Such land area will be agreed between Watercare and ~~Charles Ma~~Karaka and Drury Consultant Limited.

4. Should Karaka and Drury Consultant Limited ~~Charles Ma~~ fail to meet an agreed schedule of works then Watercare will have rights to step in and complete construction of the Primary Wastewater Infrastructure. Rights to be confirmed including land access rights which at the option of Watercare may be in the form of easements.

BOTH DEVELOPERS

5. Each Developer will be required to fund and build the local reticulation to connect their development to the New Pump Station and/or gravity infrastructure detailed in 1.3 to 1.5 above. Designs are to be agreed with Veolia (and Watercare where it interfaces with the New Pump Station and/or gravity pipework).

6. The cost of design and construction of the Primary Wastewater Infrastructure detailed in Items 1.1 and 1.2 above will be jointly funded by the Developers on a 50/50 cost share basis (or other ratio as agreed between themselves).

7. The cost of design and construction of the Primary Wastewater Infrastructure detailed in Items 1.5 above will be funded by Drury South (or other ratio as agreed between Karaka and Drury Consultant Limited and Drury South).

8. The cost of design and construction of the Primary Wastewater Infrastructure detailed in Item 1.3 above will be jointly funded by the Developers on a 50/50 cost share basis for the infrastructure required to service their respective developments (or other ratio as agreed between themselves), with Watercare to fund the additional cost associated with increasing the pipe capacity to service future growth.

9. The cost of design and construction of the Primary Wastewater Infrastructure detailed in Item 1.4 above will be funded by Karaka and Drury Consultant Limited, with Watercare to fund the additional cost associated with increasing the pipe capacity to service future growth.

~~6.~~10. **The cost of** additional land to be associated with the New Pump Station to allow for future upgrades is to be agreed between Karaka and Drury Consultant Limited and Watercare.

~~7.~~11. Drury South will be required to demonstrate payment of amounts owing to Karaka and Drury Consultant Limited ~~Charles Ma~~ before services are provided.

WATERCARE

~~8.~~12. Watercare will connect the Rising Mains to the Hingaia Pump Station and the reasonable costs of connection will form cost of the Primary Wastewater Infrastructure.

~~9.~~13. Watercare will take responsibility for the Primary Wastewater Infrastructure and all downstream infrastructure once the Primary Wastewater Infrastructure has vested to Watercare, including any subsequent upgrades as required to maintain service to future development.

~~10.~~14. Watercare may require

- Design – criteria, who to do, appointment of consultant, obtain consents
- Preparation of design and specifications for the Works
- Staging of processes, construction, commissioning delivery of stages, works programme
- Certification and Handover
- Watercare will want to approve the designer, the design of the infrastructure and the construction supervisor.
- Watercare will also want to see certification of works by the construction supervisor, and a timeline for build and commissioning will need to be agreed between the three parties.

MATTERS COVERING BOTH SCHEDULE~~S~~ 1 ~~AND 2~~

1. Watercare will guarantee capacity within the Primary Wastewater Infrastructure to service demand by both developments. All subsequent augmentation of the Primary Wastewater Infrastructure and downstream infrastructure will be the responsibility of Watercare.

2. The preliminary routes of the various pipeline alignments are shown on the plan in Attachment 1.

~~3.~~ The Developers allow Watercare the right to complete at the Developers' cost any of the works under this agreement to be carried out by the Developers but not so carried out in accordance with this agreement and to give Watercare access rights to their Lands to enable this work to be done.

GHD

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	Robert White	Bradley Rudsits		Robert White		

www.ghd.com

Karaka and Drury Consultant Limited

Bremner Road Development
Trunk Watermain Design

May 2017

Table of contents

Table index

Figure index

Appendices

This report: has been prepared by GHD for Karaka and Drury Consultant Limited and *may only be used and relied on by Karaka and Drury Consultant Limited for the purpose agreed between GHD and the Karaka and Drury Consultant Limited as set out in Section 1 in this report.*

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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Table 1 List of Acronyms and Abbreviations

Acronym / Abbreviation	Meaning
AMA	Auckland Motorway Alliance
BSP	Bulk Supply Point
CoP	Code of Practice
DN	Nominal dimeter
EPA	Engineering Plan Approval
FW	Fire Water
FUZ	Future Urban Zone
ID	Internal Diameter
IFA	Infrastructure Funding Agreement
KDCL	Karaka and Drury Consultant Ltd
km	kilometre
L/s	Litres per second
L/day	Litres per day
L/p/day	Litres per person per day
m	metre
mm	millimetre
m/km	metre/kilometre
mRL	metres relative level
NIMT	North Island Main Trunk
NZS	New Zealand Standard
PAS	Publicly Available Specification
PE	Polyethylene
PF	Peak Flow
PRV	Pressure Reducing Valve
Rd	Road
SDR	Standard Dimension Ratio
SH	State Highway
SHA	Special Housing Area
SNZ	Standards New Zealand

1. Introduction

1.1 Purpose

Karaka and Drury Consultant Ltd (KDCL), the developer for Bremner Road Special Housing Area (SHA) and Extension, known as Auranga A, have engaged GHD to provide the design of the water supply pipework to service 3,000 houses, (comprising Auranga A and the proposed Aurange B development) and the Drury South Industrial development / Quarry Road SHA, where infrastructure is shared. This report will include the design for connecting to the existing network and will propose the main pipe sizes and layout. The design of the local reticulation within Auranga A will be covered separately by KDCL's local reticulation Consultant.

This report has been prepared for the purposes of gaining Engineering Plan Approval (EPA) for the proposed trunk water network for the Auranga A development.

The design of the water supply pipework for Drury South will be covered by a separate report and EPA submission.

1.2 Location

The Auranga development is located to the west of Drury township. The Drury South industrial development and Quarry Road SHA are located south and east of Drury Township. A location plan of the development areas is presented in Figure 1.

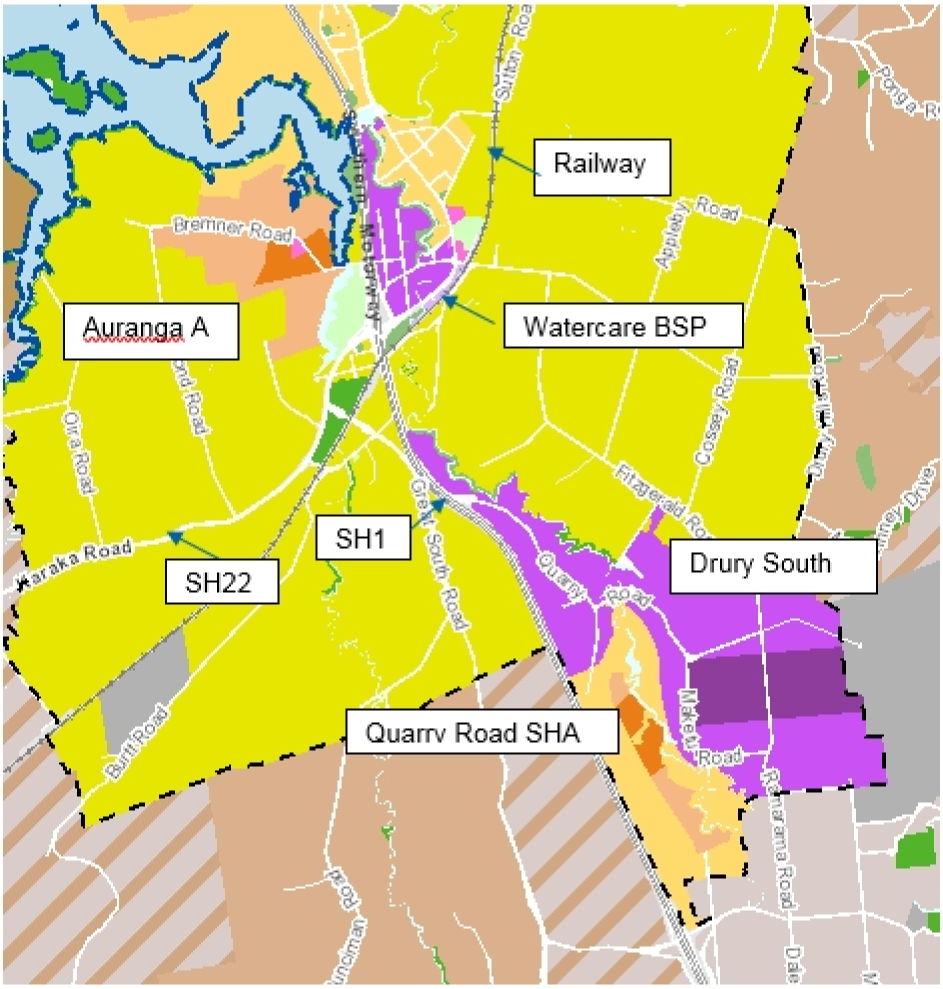


Figure 1 Location Plan

2. Design Standards

The design is to comply with the water supply reticulation design standards from the Watercare "Water and Wastewater Code for Practice (CoP) for Land Development and Subdivision" (based on Section 6 of NZS 4404:2010).

2.1 Design Flows

Design flows were based on the following specific sections from the Water and Wastewater CoP:

CoP Section	Section Heading	Details
5.3.5.1	Design Flow	(a) Residential flows (iv) Number of people per dwelling: 3.0
6.3.5.3	Peak Flows	Occupancy rates for properties shall be as stated in Chapter 5 Section 5.3.5.1 **Peak Day Demand (over a 12-month period) = Average Day Demand x PF** Unless specified otherwise by Watercare: (a) PF = 1.5 for populations over 10,000 (b) PF = 2 for populations below 2,000 (c) Interpolated between 1.5 and 2 for populations between 10,000 and 2,000 **Peak Hourly Demand = Average Hourly Demand (on peak day) x PF (over a 24-hour period)** Unless specified otherwise by Watercare: (a) PF = 2 for populations over 10,000 (b) PF = 5 for populations below 2,000 (c) Interpolated between 2 and 5 for populations between 10,000 and 2,000
6.3.5.4	Head Losses	The head loss through the local network pipes and fittings at the design flow rate shall be less than: (a) 5 m/km for DN ≤150 (b) 3 m/km for DN >150 Head loss can be calculated using one of a number of standard hydraulic formulae. We have used the Hazen-Williams formula and the Colebrook-White formula.
6.3.5.6	Minimum Water Demand	The minimum peak domestic demand shall be specified by Watercare, or; (a) Daily consumption of 250 L/p/day (b) Peaking factor of up to 5

2.2 Roughness Coefficient

The model loss formula used is the Hazen-Williams formula with a corresponding roughness coefficient of C = 140 (for PE pipes) as stated in the Watercare design code (CoP Section 6.3.5.4.1 Hydraulic roughness values).

2.3 Fire Flows

Fire flows are according to Standard New Zealand (SNZ) Publicly Available Specification (PAS) 4509:2008 New Zealand Fire Service Fire Fighting Water Supplies CoP.

All residential areas are classified as FW2 with a fire-fighting requirement of 25 l/s. The classification covers housing, including single family dwellings, multi-unit dwellings, but excludes multi-storey apartment blocks. The village centre (commercial) is assumed to be classified FW3 with a firefighting requirement of 50 l/s.

The Drury South industrial development has been classified as FW4 with a fire-fighting requirement of 100 l/s.

Fire flow scenarios have been calculated on 60% peak domestic water demand and a minimum pressure of 10 m pressure head at the respective fire hydrants.

The Water and Wastewater CoP headloss per kilometre requirements are not considered as part of a pipe failure / fire flow scenario, with the criteria being able to meet the fire flow requirement at a minimum of 10 m pressure at the respective hydrants.

2.4 Pressures and Levels

Available and allowable water pressures and levels are as identified below:

Table 2 Pressure and Levels

Particular	Unit	Value
Available Water pressure at Flanagan Rd Bulk Supply Point (BSP)	mRL	~125
Pressure Reducing Valve (PRV) setting at BSP	mRL	85
Ground Level (@ Auranga)	mRL	5 – 26.5
Ground Level (@ Drury South)	m	15 – 32*
Maximum Pressure (as per CoP)	m	80
Minimum Pressure (as per CoP)	m	25
Minimum Pressure - Fire Flow	m	10

**Note: A supply to Stevensons Drury Quarry (38 mRL) is proposed although this is not considered to include firefighting requirements.*

Based on the above figures, an estimated maximum headloss of 43 m through the whole reticulation system is assumed acceptable under a fire flow scenario to achieve a minimum of 10 m residual head at the highest ground level in the Drury South Industrial development.

As the local reticulation system losses are unknown, the trunk infrastructure has been extended in length to the highest point in the reticulation (for the Drury South Development) to reflect the total system headloss that would affect the water network performance.

2.5 Trunk vs. Local Network Reticulation

The term trunk is used to indicate local, rather than transmission pipework but differentiated from local network reticulation.

The local network reticulation layout which is outside the scope of work of GHD will be covered separately to the trunk water pipework.

3. Development Areas

3.1 Overview

The proposed trunk pipework is to service the Auranga A and B developments, along with the Drury South Industrial and Quarry Road SHA developments.

No allowance has been made to service any other developments, including servicing of the Hingaia Peninsula.

3.2 Population and Flows

3.2.1 Auranga A + B

The initial subdivision (Auranga A) consists of a total of 1,350 residential lots, including a village centre. The proposed Auranga B development brings the total proposed lots to 3,000.

The water demand for Auranga is calculated as follows:

Table 3 Water Demand Calculation – Auranga

Particular	Unit	Value
Average Daily Water Demand	l/p/d	250
Total number of dwellings / residential lots	No.	3,000
No. of persons per dwelling	No.	3
Total Number of persons	No.	9000
Average day demand	L/s	26.04
Peak Day Factor	N/A	1.56
Peak Day Demand	L/s	40.69
Peak Hourly Factor	N/A	2.38
Peak Hourly Demand	L/s	96.64
60% Peak Hour Demand	L/s	57.98

FW3 has been identified as the required fire rating to cover the proposed village centre, with 50 L/s provided above 60% peak hourly demand.

Therefore, the design flow for Auranga (A + B) is 107.98 L/s.

3.2.2 Drury South / Quarry Rd Ultimate

The Drury South industrial development and Quarry Road SHA is a mixture of residential and industrial / commercial areas.

The exact number of HUE for the whole Drury South development cannot be estimated at this time as the exact types of industries within the development is unknown. Some industries may have minimal water demands (dry industries, warehousing etc.) whilst others may be large consumers (wet industries).

The water demand has been calculated previously as per memorandum issued by Beca on 17 May 2016 on the Ararimu Flow (Drury South development) data as attached in Appendix A. The memorandum estimated that the average daily flow for Drury South is 2,120 m^3/d, equivalent to 24.54 L/s (2,827 HUE).

From this assumed water usage and the known number of residential HUE's, the HUE assigned to commercial/industrial areas has been back calculated as follows:

- Total Development 2,827 HUE
- Quarry Road Residential 1,000 houses

- Drury South Industrial 1,827 HUE

The water demand for Drury South is calculated based on HUE and equivalent persons as follows:

Table 4 Water Demand Calculation – Drury South

Particular	Unit	Value
Average Daily Water Demand	l/p/d	250
Total number of dwellings / residential lots (HUE)	No.	2,827
No. of persons per dwelling	No.	3
Total Number of persons	No.	8,481
Average day demand	L/s	24.54
Peak Day Factor		1.59
Peak Day Demand		39.14
Peak Hourly Factor		2.57
Peak Hourly Demand		100.57
60% Peak Hour Demand		60.34

FW4 has been identified as the required fire rating to cover the proposed industrial / warehousing development, with 100 L/s provided above 60% peak hourly demand.

Therefore, the design flow for Drury South Ultimate development during fire flow scenario would be 160.34 L/s.

3.2.3 Drury South / Quarry Rd Interim

The interim flows will be based on only the Quarry Road SHA (1,000 HUE) and an allowance for an extra 1,000 HUE covering different potential industries. The water demand is calculated as follows:

Table 5 Water Demand Calculation – Drury South / Quarry Road Interim

Particular	Unit	Value
Average Daily Water Demand	l/p/d	250
Total number of dwellings / residential lots	No.	2000
No. of persons per dwelling	No.	3
Total Number of persons	No.	6000
Average day demand	L/s	17.36
Peak Day Factor	N/A	1.75
Peak Day Demand	L/s	30.38
Peak Hourly Factor	N/A	3.50
Peak Hourly Demand	L/s	106.34
60% Peak Hour Demand	L/s	63.80

FW4 has been identified as the required fire rating to cover the proposed industrial / warehousing development, with 100 L/s provided above 60% peak hourly demand.

Therefore the design flow for Drury South Interim during fire flow scenario would be 163.80 L/s. While this figure is slightly higher than the ultimate development flows, this is attributable to the higher values for the peaking factors.

3.2.4 Combined Auranga + Drury South

The ultimate combined water demands for Auranga and Drury South have been summarised as per the following table. These values have been used in the design of the common watermains along Flanagan Road and between Flanagan Road and Great South Road.

Table 6 Water Demand Calculation – Combined

Particular	Unit	Value
Average Daily Water Demand	l/p/d	250
Total number of dwellings / residential lots (HUE)	No.	5827
No. of persons per dwelling	No.	3
Total Number of persons	No.	17481
Average day demand	L/s	50.58
Peak Day Factor		1.50
Peak Day Demand		75.87
Peak Hourly Factor		2.00
Peak Hourly Demand		151.74
60% Peak Hour Demand		91.05

FW4 has been identified as the required fire rating to cover the proposed Drury South industrial / warehousing development, with 100 L/s provided above 60% peak hourly demand.

Therefore the design flow for Drury South Interim during fire flow scenario would be 191.05 L/s.

Note that when considering the total HUE, the peaking factors are lower for peak day and hour. These peak factors have been derived for the entire population being serviced, and the design flow can be considered the peak flow required from the BSP.

4. Bulk Supply Point

A new BSP is to be provided by Watercare at 103 Flanagan Road, Drury. This new BSP is to initially supply the Auranga / Bremner Road SHA and the Drury South Industrial Development and Quarry Road SHA.

Ultimately, this BSP is anticipated to additionally service the wider Drury Township, Drury West Future Urban Zone (FUZ), Opaheke FUZ, and Hingaia areas.

It is understood that the BSP is to be constructed and commissioned by October 2017.

The design of the BSP is outside of the scope of work of this commission.

All trunk network downstream of the BSP will be operated by Veolia.

5. Trunk Water Supply Pipes

5.1 Pipework Route to Bremner Road / Auranga

The Auranga development and the proposed BSP are North Island Main Trunk (NIMT) railway line and State Highway 1 (SH1), requiring the pipelines to cross both of these major pieces of infrastructure.

Previous initial discussions with the Auckland Motorway Alliance (AMA) identified that crossing the motorway by directional drilling under the carriageway was preferred to attaching the pipeline to a bridge structure.

5.1.1 Primary Supply

It is proposed that the primary supply for Auranga will be laid from the south of the proposed BSP across the railway line after crossing the creek on Flanagan Rd, followed by crossing the motorway, by directional drilling. The pipe would then run along Mercer Rd before it slightly turns north along Victoria St and then Bremner Rd into the Auranga development.

5.1.2 Secondary Supply

Two route options were identified, as detailed below, so as to provide security of supply:

Option 1 - Northern Route

The northern route would cross the railway line north of the proposed BSP parallel to the Waikato Trunk Main, through a paper road that has been built over, before turning south through Great South Road, crossing a creek, before turning North along Firth Street and West along Bremner Road and crossing the motorway then into the Auranga development.

Option 2 - Southern Route

This option involves laying a second water supply pipe almost of similar length as Option 1 from the Watercare BSP to the development site. The pipe would generally be laid parallel to the proposed primary water supply pipe up to the intersection of Great South Rd and Victoria St. At this point, this secondary pipeline would then continue in a north westerly direction through the Drury Sports Complex and across the stream into the development. In order to make this pipeline fully operational, a link from this pipeline (~400 m long) through Stage 2a to Bremner Road would be required.

The northern and southern routes are shown in Figure 2 and Figure 3, respectively.

Selected Route

The southern route has been adopted for the following reasons:

- SH1 crossing (at location discussed with AMA)
- Pipes service both Auranga and Drury South
- Minimises disruption to already developed areas

The overall layout showing the primary and secondary mains is presented in Figure 4.

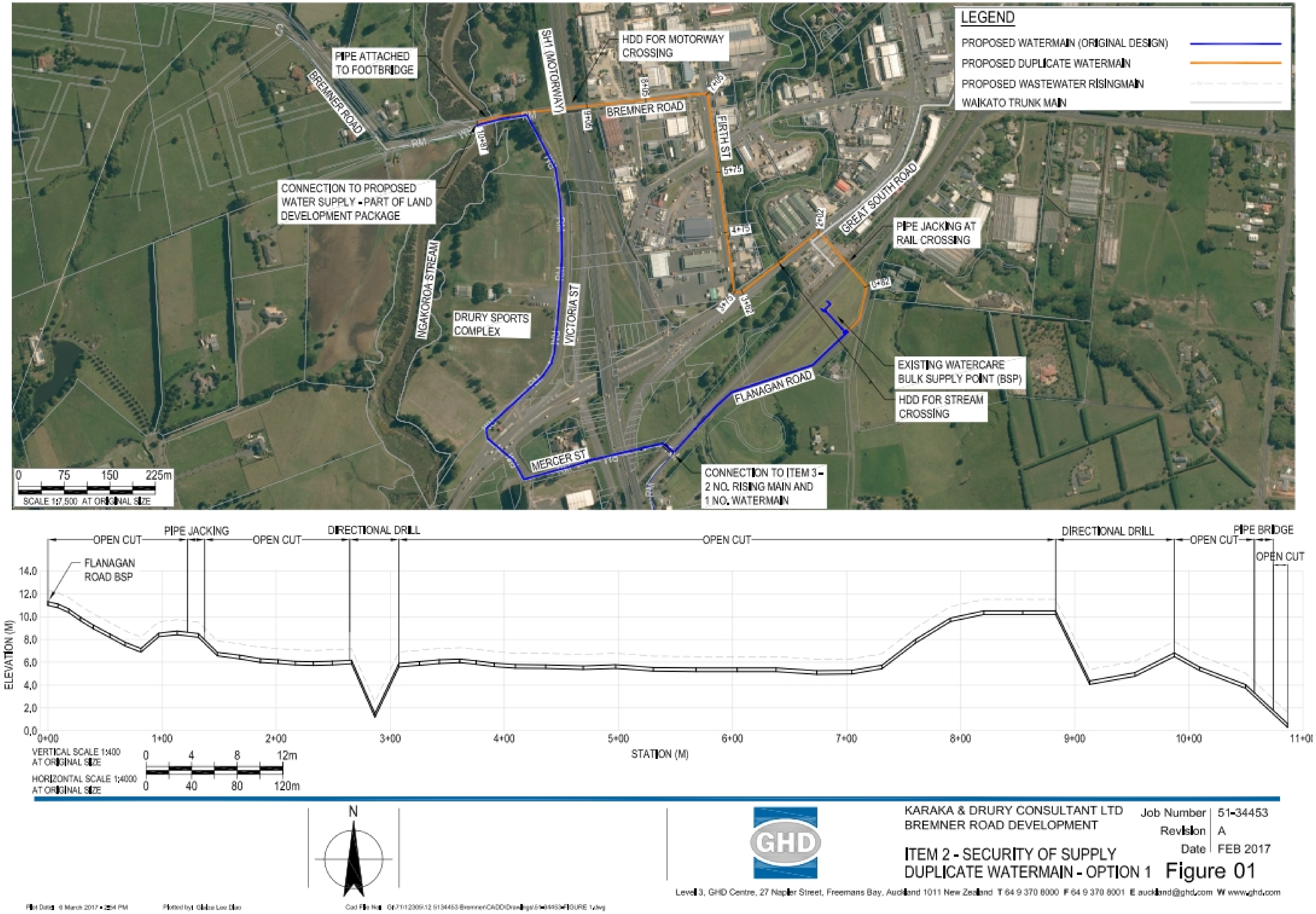


Figure 2 Option 1 – Secondary Supply

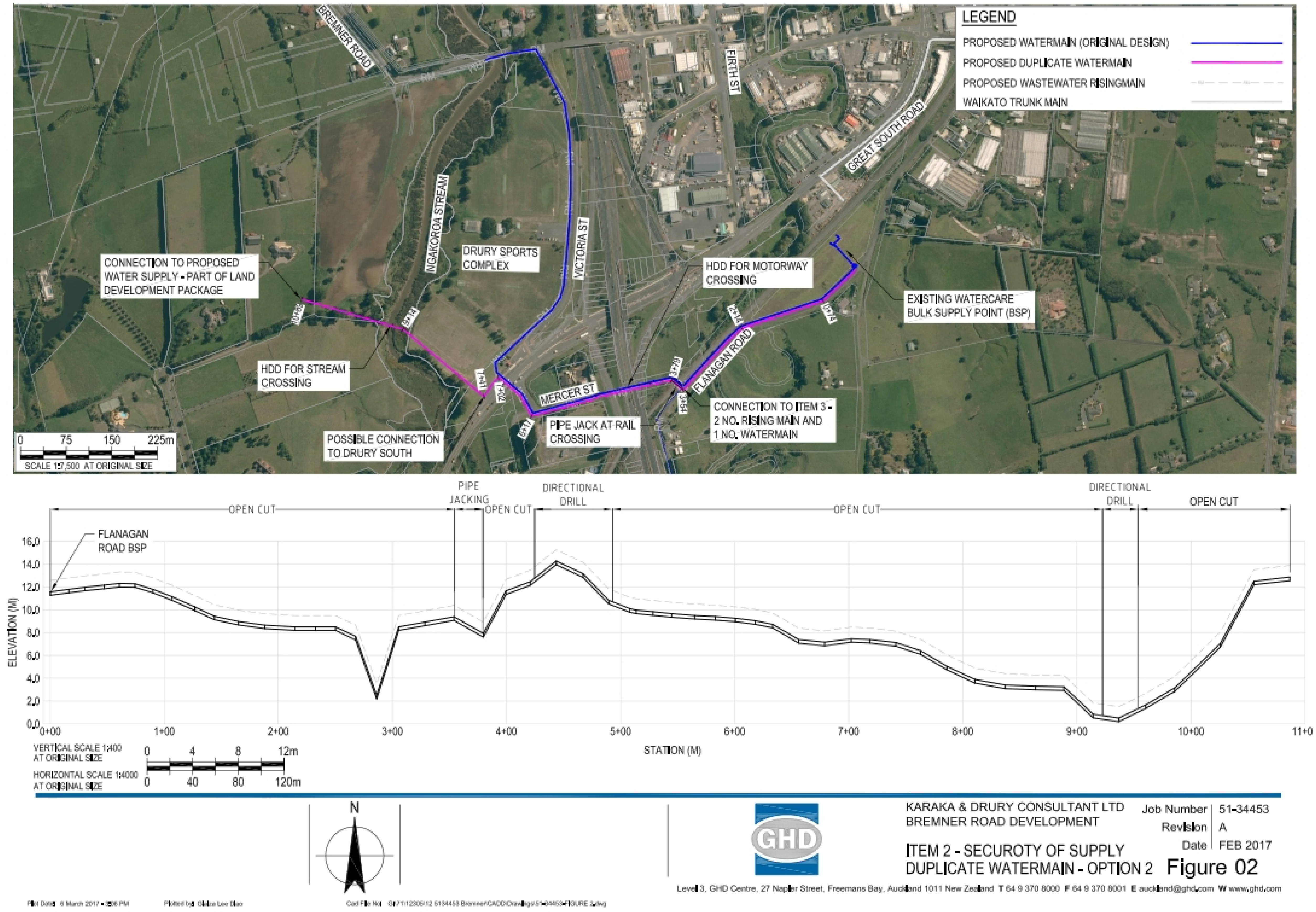


Figure 3 Option 2 – Secondary Supply

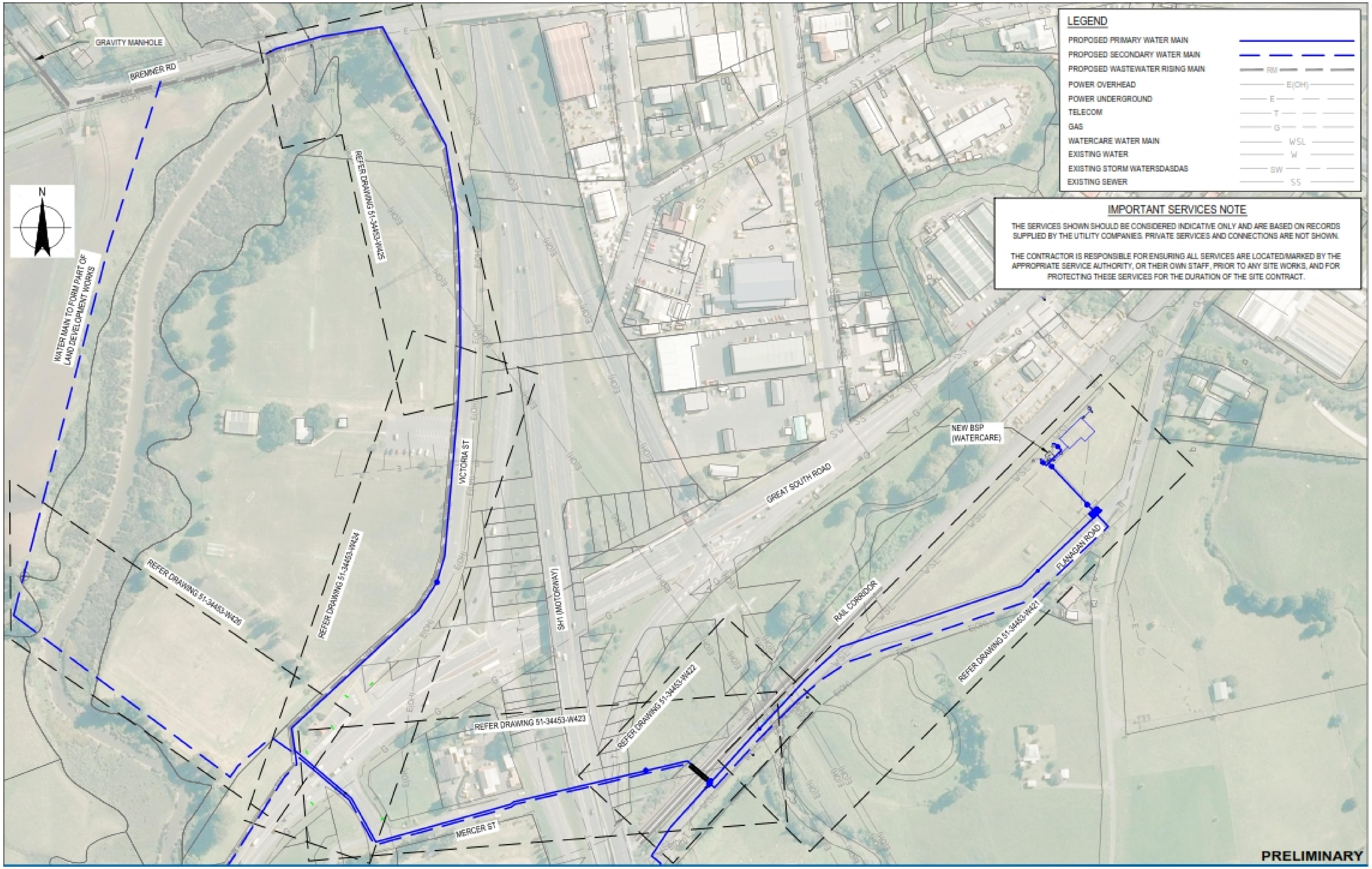


Figure 4 Primary and Secondary Watermain Layout

5.2 Pipework Route to Drury South

Whilst this report is primarily focussed on the pipelines to service Auranga, the pipe sizing is influenced by servicing the Drury South and Quarry Road developments.

The following options are as identified in the memo “Drury South Development Provision of Water Supply for Drury South”, dated 21 March 2017, included as Appendix A.

5.2.1 Primary Supply

Three options were considered for the principal supply line as follows:

- Option 1– This option involved laying a 3,600 m-length watermain from the Bulk Supply Point (BSP) at 103 Flanagan Rd to 88 Quarry Rd via Tegal Road. This route has been identified as not acceptable to Watercare / Veolia as it passes through private property.
- Option 2–This option involves laying a 3,920m- length watermain from the proposed BSP to Quarry Road via Flanagan Road, Pitt Road, and Great South Road, crossing the SH1 twice.
- Option 3–This option involves laying a 4,500m-length watermain from the Great South Road / Victoria Street Intersection to Quarry Road via Great South Road. This option will require the proposed watermain servicing Auranga to be upsized from the BSP through to Great South Road (including NIMT and SH1 crossings).

The alignment options are as shown on the attached plan in Figure 5.

5.2.2 Secondary Supply

A solution for the security of supply is potentially to lay a watermain about 4,200 m in length from the existing BSP through to the northeast of Flanagan Rd. From here, the watermain would turn east at Waihoehoe Rd and then south at Fitzgerald Rd up to the intersection at Brookfield Rd. The watermain would then turn southwest but still following Fitzgerald Rd up to the intersection at Cossey Rd where the alignment would link to Quarry Rd.

This route has the potential to service the Opaheke FUZ. However, this area is not zoned to be developed until the 1st half, Decade Two (2028 – 2032).

Delaying the construction of this pipe potentially allows the infrastructure to be constructed in conjunction with Opaheke FUZ development, allowing the pipeline to be suitably sized and the costs to shared amongst other developers.

5.2.3 Initial Route(s)

It is proposed initially that the Drury South / Quarry Road development will be supplied via the routes identified as Option 2 and Option 3.

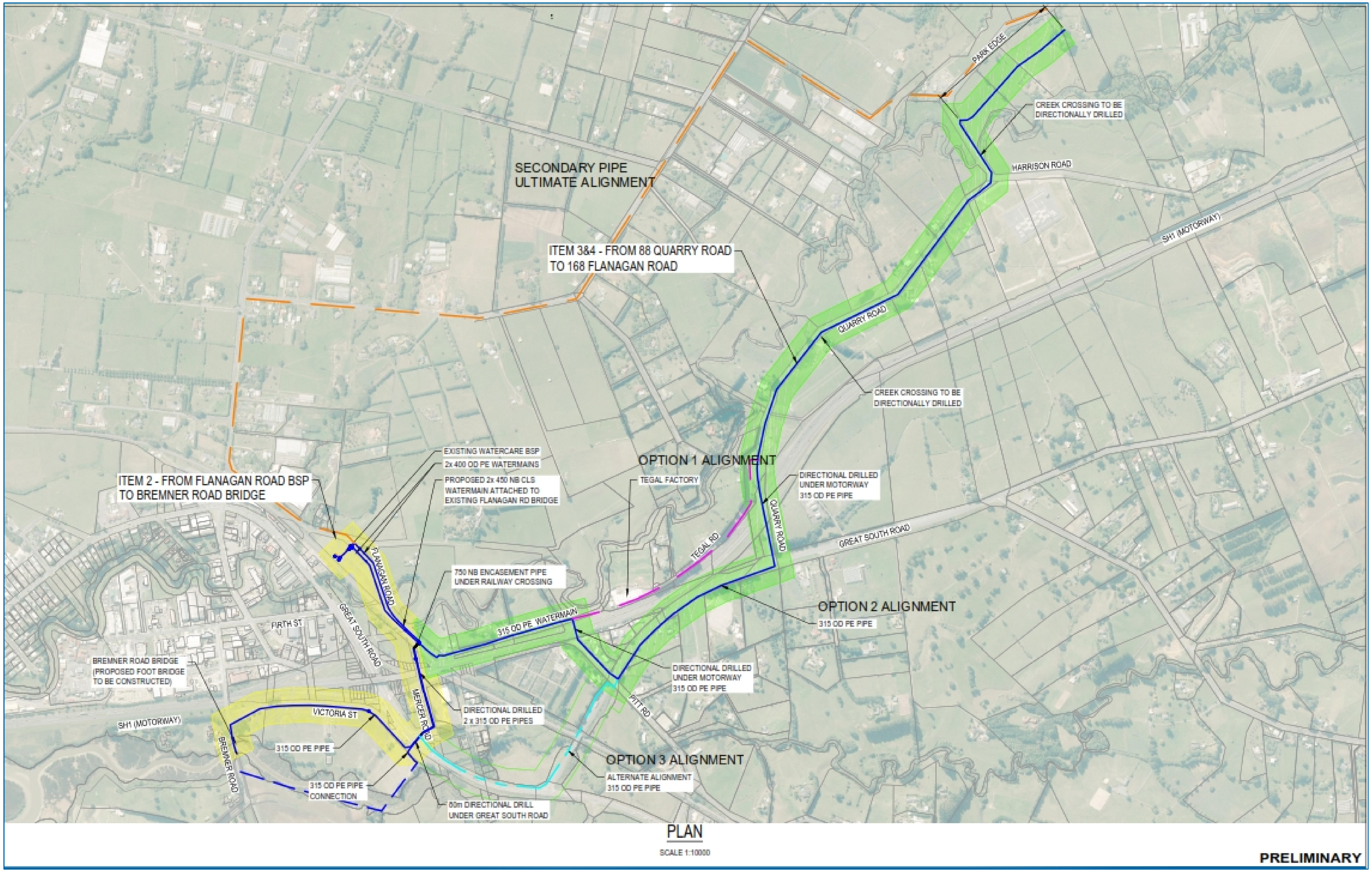


Figure 5 Drury South – Pipe Routes

5.3 Design Scenarios

A hydraulic model of the trunk water network has been constructed to determine the required pipe sizing to meet the design requirements. The scenarios have been based on the pressure at the BSP being 85 m RL.

The BSP pressure has been based on a lowest ground level of 5.7 m (providing a maximum water pressure of less than 80 m in line with the CoP)

The watermain sections have been analysed based on the following design scenarios.

- PHD – Peak hourly demand, on peak day.
  - Ultimate
  - Interim
- Fire flow @ Auranga (FW3) and Fire flow @ Drury South (FW4) – when coincident with 60% PHD for both developments
- Fire flow @ Drury South + Mains Break - when coincident with 60% PHD for both developments
  - Ultimate
  - Interim

The input data of the model is attached in Appendix C.

Figure 6 and Figure 77 show the pipe sizes (internal diameter) adopted in the model for the ultimate and the interim scenarios, respectively.

The headloss (in km/m) in the pipe and minimum pressures in the nodes at the ultimate scenario using global and local peaking factors are shown in Figure 8 and Figure 9, respectively.

The headloss (in km/m) in the pipe and minimum pressures in the nodes at the interim scenario using global and local peaking factors are shown in Figure 10 and Figure 11, respectively.

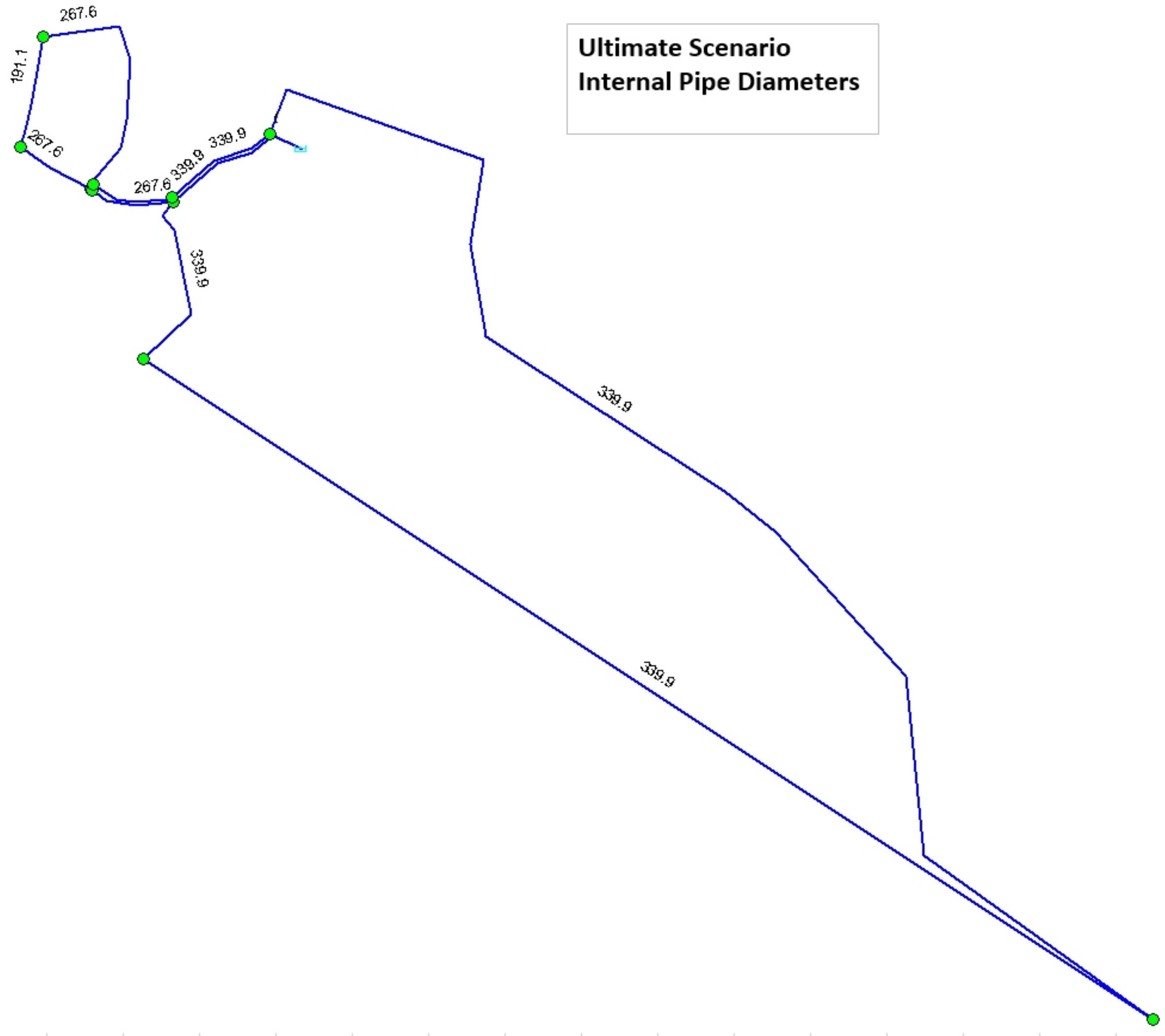


Figure 6 Auranga A & B and Drury South Supply Pipe(s) – Sizes (Ultimate Layout)

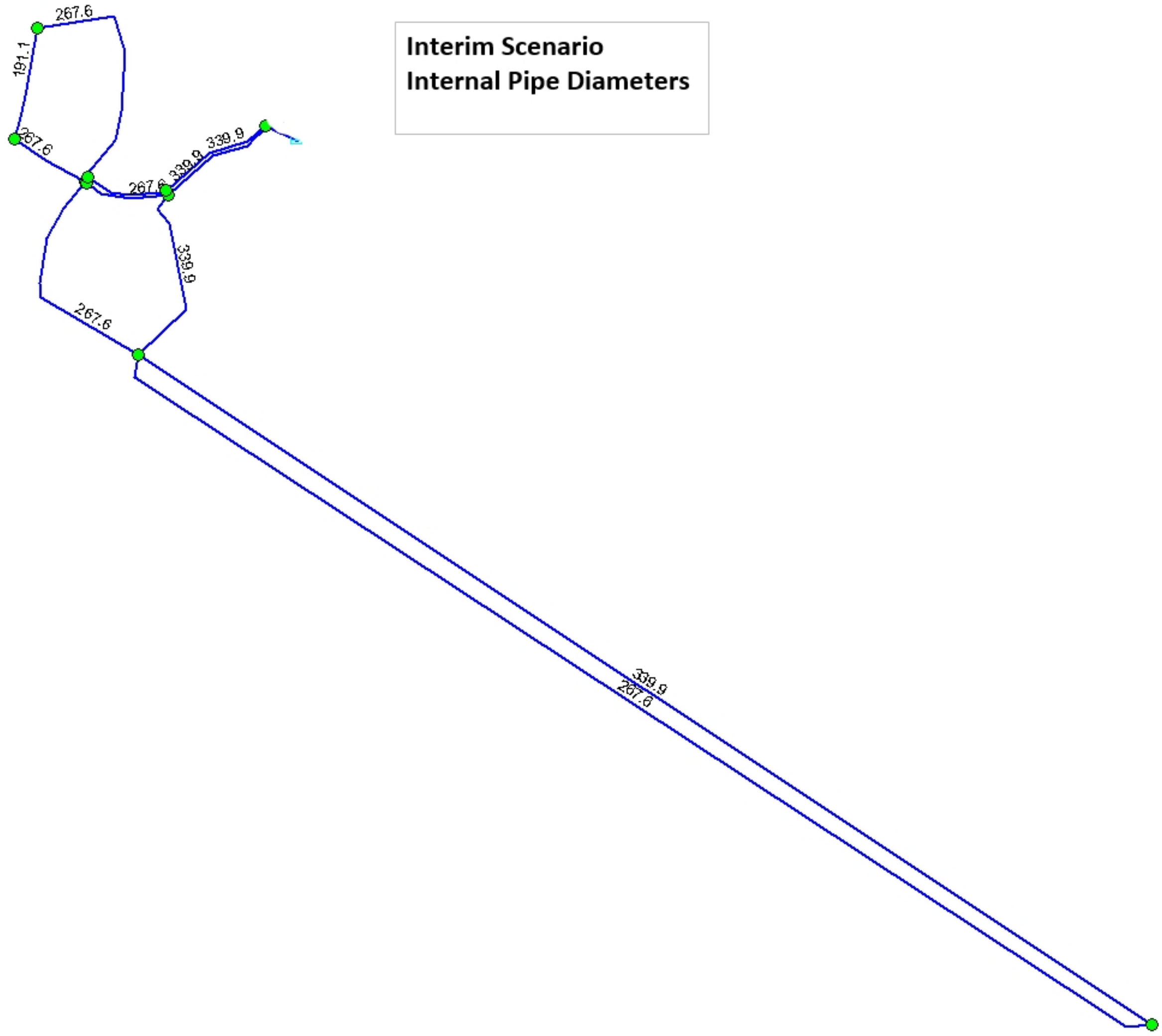


Figure 7 Auranga A & B and Drury South Supply Pipe(s) – Sizes (Interim Layout)

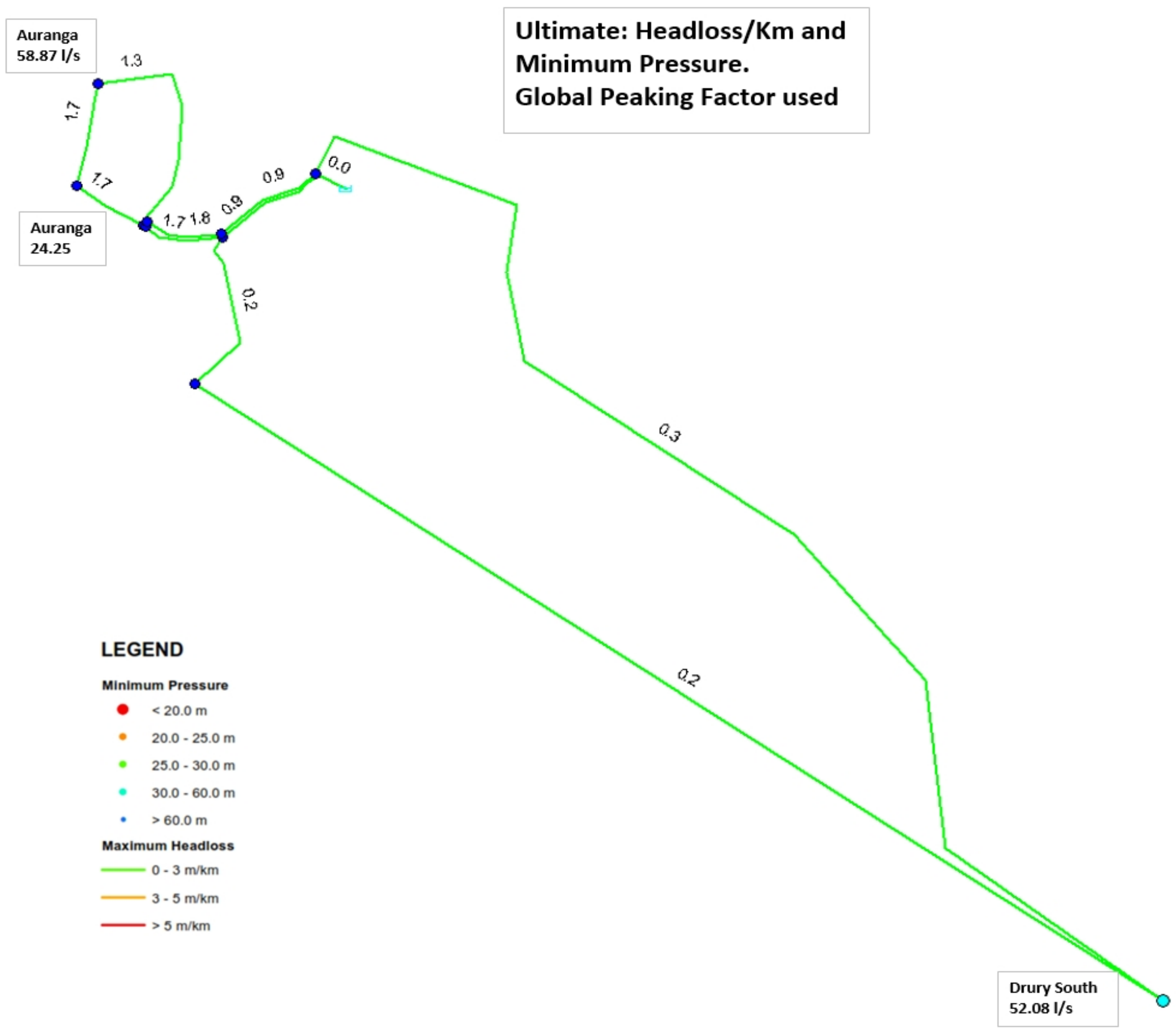


Figure 8 Auranga A & B and Drury South – Peak Hourly Demand, on Peak Day (Ultimate) – Global Peaking Factor

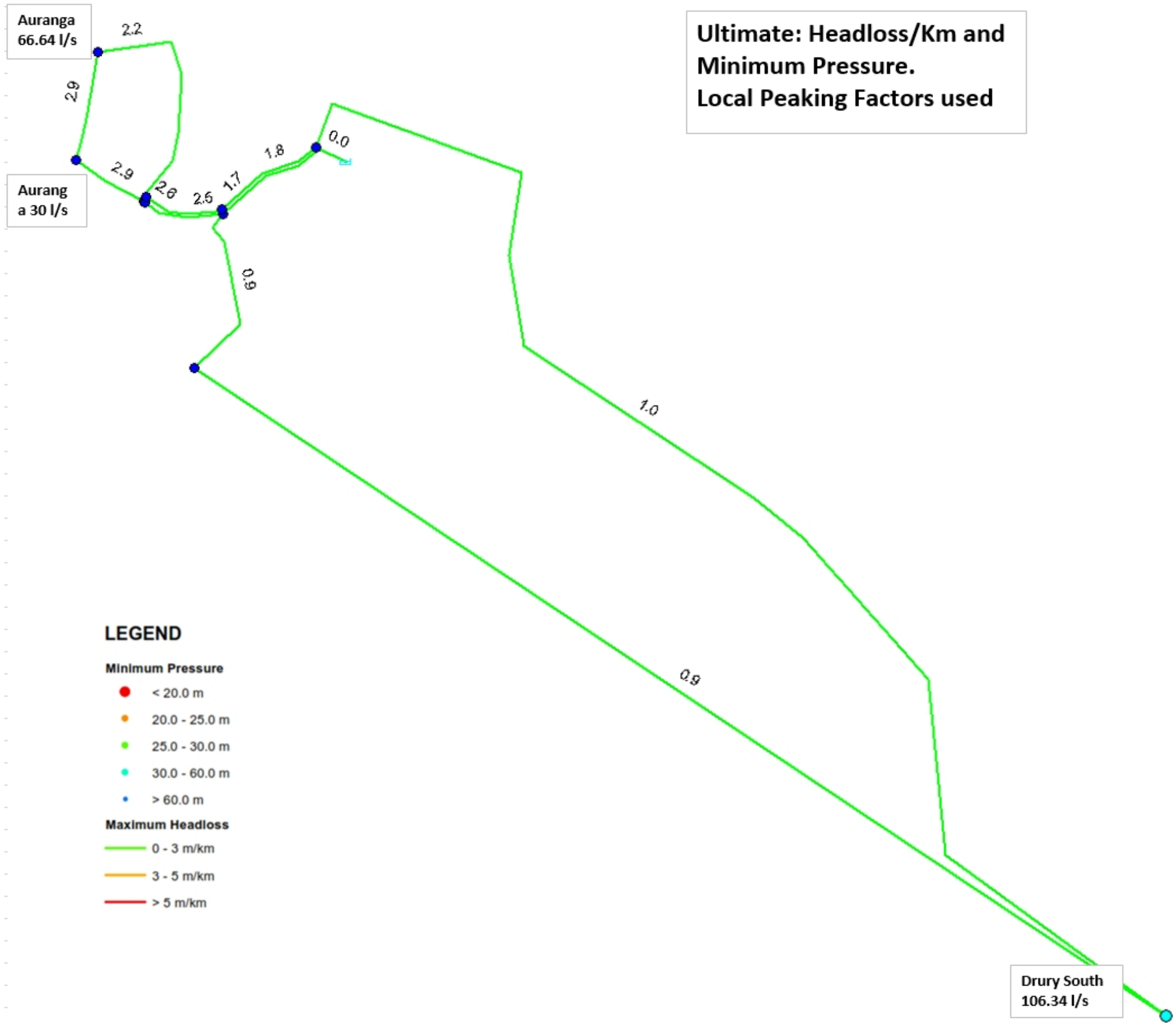


Figure 9 Auranga A & B and Drury South – Peak Hourly Demand, on Peak Day (Ultimate) – Local Peaking Factor

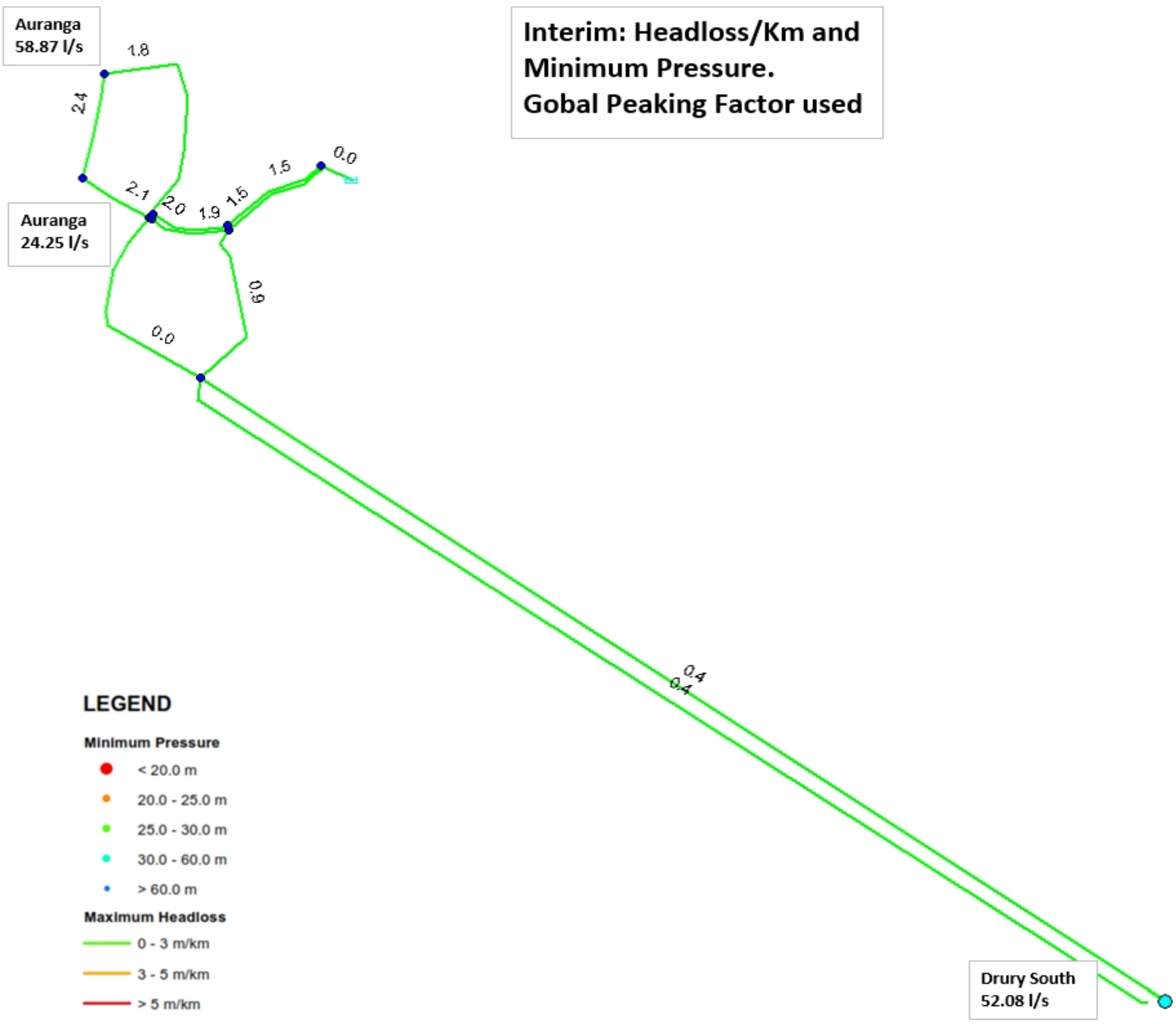


Figure 10 Auranga A & B and Drury South – Peak Hourly Demand, on Peak Day (Interim) – Global Peaking Factor

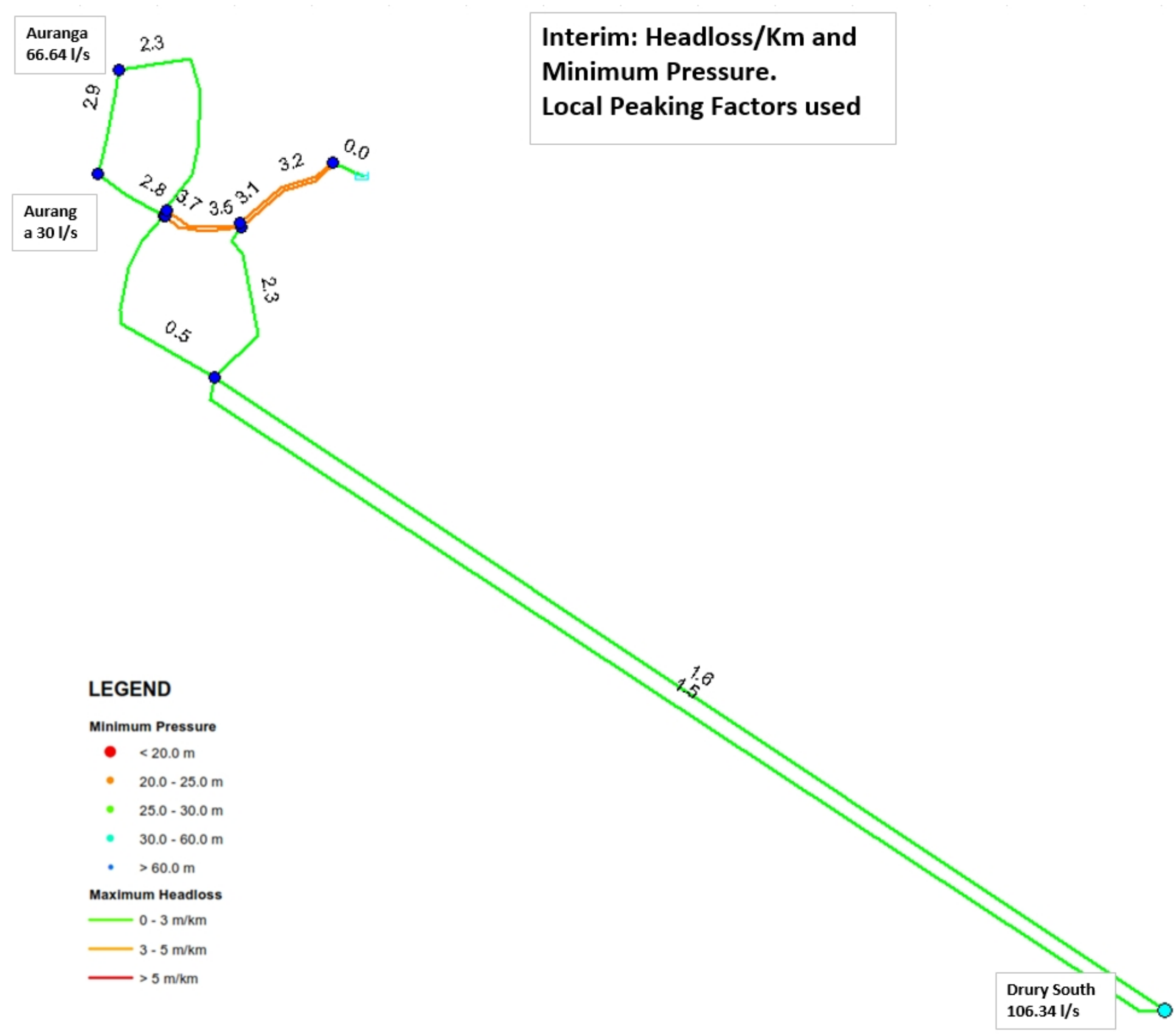


Figure 11 Auranga A & B and Drury South – Peak Hourly Demand, on Peak Day (Interim) – Local Peaking Factor

Figure 12 shows the result of the fire flow analysis, for the ultimate layout, with a closed line (shown in red) on which the highlighted node at Auranga and Drury South development were tested. The analysis indicates that the minimum pressure requirement is exceeded in both development areas.

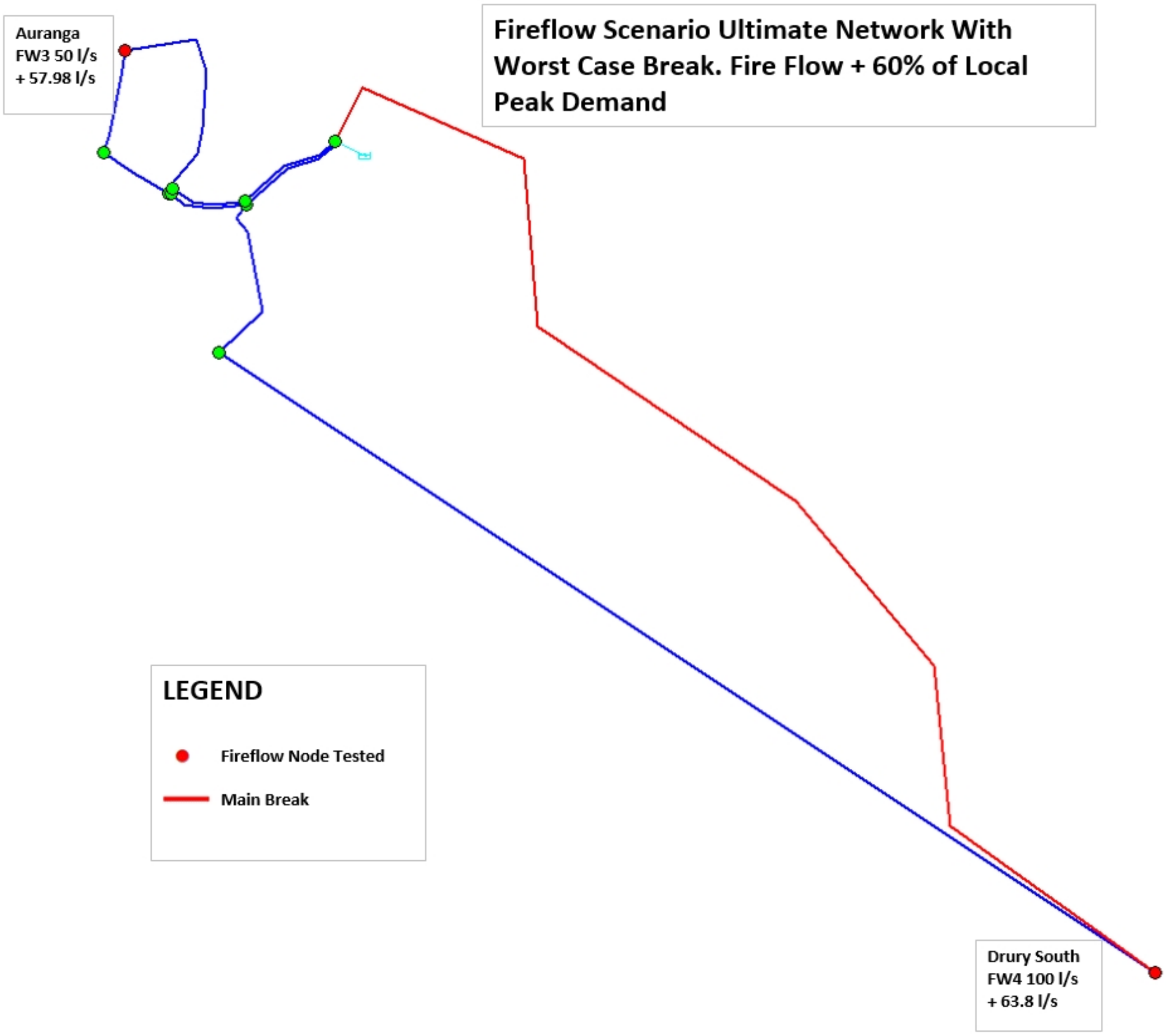


Figure 12 Model Output – Fire Flow (Ultimate) with Mains Break

Table 7 shows the residual pressure at the highest point in the developments. These residual pressures are greater than the minimum pressure of 10 m, as required by the code.

Table 7 Fireflow Scenario Ultimate Network with Worst Case Break

ID	Static Demand (L/s)	Static Pressure (m)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (m)*	Available Flow at Hydrant (L/s)	Available Flow Pressure (m)
Drury South	63.8	46.37	78.37	100	16.29	178.57	10
Auranga (A+B)	57.98	75.48	82.98	50	71.72	423.93	10

**Residual Pressure at development high point.*

Figure 13 shows the result of the fire flow analysis, for the interim layout, with a closed line (shown in red) on which the highlighted node at Auranga and Drury South development were tested. The analysis indicates that the minimum pressure requirement is exceeded in both development areas.

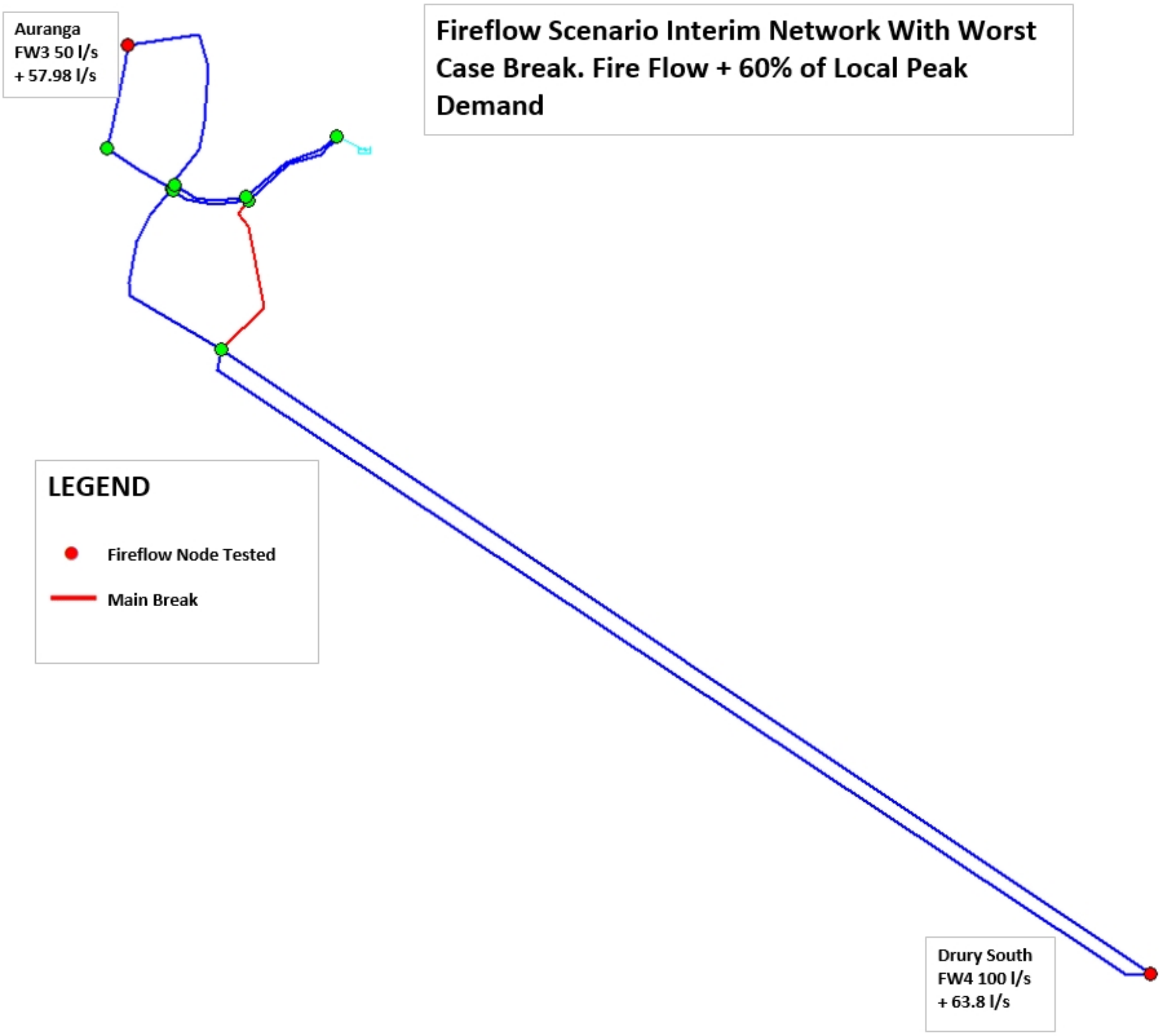


Figure 13 Model Output – Fire Flow (Interim) with Mains Break

Table 8 shows the residual pressure at the highest point in the developments. These residual pressures are greater than the minimum pressure of 10 m, as required by the code.

Table 8 Fireflow Scenario Interim Network with Worst Case Break

ID	Static Demand (L/s)	Static Pressure (m)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (m)*	Available Flow at Hydrant (L/s)	Available Flow Pressure (m)
Drury South	63.8	45.59	77.59	100	14.82	175.04	10
Auranga (A+B)	57.98	74.76	82.26	50	70.87	427.8	10

**Residual Pressure at development high point.*

5.4 General Pipe Sizing

5.4.1 Auranga and Drury South Supply Pipe(s)

This trunk pipe covers the connection from the BSP along Flanagan Road to the Kiwirail crossing. The trunk pipe size required for the ultimate development of Auranga of 3,000 dwellings (FW3) and Drury South 2,000 HUE (FW4) is calculated as **2 No. 400 mm PE 100 SDR 13.6 (339.9 mm ID).** This pipe is approximately 360 m long.

It is noted that the headloss per kilometre in the interim scenario with local peak demand (Figure 11) exceeds 3 m/km in the “shared” sections of pipeline. However, the headloss per kilometre requirement are met under the combined peak demand (Figure 10).

5.4.2 Railway to Gt South Road – Ultimate (and Interim)

Based on dual supply pipe to ensure security of supply, the required bulk pipe size for the ultimate 3,000 houses Auranga development and the 2,000 HUE interim Drury South are proposed to be **2 No. 315 mm PE 100 SDR 13.6 (267.8 mm ID)**. The alignment of the two watermains from the Kiwirail crossing is discussed in Section 5.1. These pipes are approximately 350 m long.

As above, it is noted that the headloss per kilometre in the interim scenario with local peak demand (Figure 11) exceeds 3 m/km in the “shared” sections of pipeline. However, the headloss per kilometre requirement are met under the combined peak demand (Figure 10).

5.4.3 Auranga Supply Pipe - Ultimate

Based on dual supply pipe to ensure security of supply, the required bulk pipe size for the ultimate 3,000 houses development has been determined to be **2 No. 315 mm PE 100 SDR 13.6 (267.8 mm ID) pipes**. The alignment of the two watermains from Great South Road crossing is discussed in Section 5.1. **These pipes are approximately 675 m long.**

The pipe has been sized using the criteria, as specified in Watercare’s “Water and Wastewater CoP for Land Development and Subdivision” and as identified in Section 2 of this report.

The trunk pipe size required of the initial development of Auranga A of 1,350 dwellings is also calculated as be **2 No. 315 mm PE 100 SDR 13.6 (267.8 mm ID) pipes**.

5.4.4 Drury South Supply Pipe(s) - Ultimate

The pipe size required of the ultimate development of Drury South of 2,827 HUE (FW4) calculated as **2 No. 400 mm PE 100 SDR 13.6 (339.9 mm ID).**

The size is based on the two pipes following separate routes (Ultimate) with no interconnections along an approximately 3,500-m length. Under normal peak demand the pipes operate within the requirements of the CoP, with a headloss less than 3 m/km.

Under a failure scenario, with one of the two pipes out of service, the total flow would need to pass through the single pipe. The proposed pipe sizes of **400 mm PE 100 SDR 13.6 (339.9 mm ID)** will provide the minimum pressure under fire flow requirements of a minimum 10 m pressure head.

5.4.5 Drury South Supply Pipe(s) - Interim

The pipe sizes required for the initial development of Drury South of 2,000 HUE (FW4), assuming that the two pipe will run in parallel in Great South Road / Quarry Road (and interconnected at intervals of less than 850 m) is calculated as:

- **1 No. 400 mm PE 100 SDR 13.6 (339.9 mm ID)**
- **1 No. 315 mm PE 100 SDR 13.6 (267.8 mm ID)**

Under a failure scenario, with one of these two pipes out of service, the total flow would need to pass through the single pipe. Based on interconnections at 850 m intervals, the headloss along the smaller 315 is minimised, allowing the minimum of 10 m residual head to be achieved.

6. Conclusions and Recommendations

6.1 Conclusions

6.1.1 Overview

- Trunk water supply pipework is required to service the consented Auranga A (Bremner Road SHA), Drury South Industrial and Quarry Road SHA developments, with the provision to meet the future demand from the development of Auranga B.
- No allowance has been made to service developments other than those listed above.
- Watercare have agreed that the above areas are to be supplied from a new BSP to be constructed and commissioned (by Watercare) at 103 Flanagan Road, Drury.

6.1.2 Pipeline Routes

It has been identified by Veolia that twin pipes are required to provide security of supply; with the following routes identified:

- Auranga: Twin pipes from the BSP, south westerly along Flanagan Road; crossing the railway line and SH1; and running along Mercer Street, before splitting, with one pipe following Victoria Street and Bremner Road; and the second entering the development site via the southern end of the Drury Sports Field. These pipes would then be inter-connected via the development site's reticulation.
- Drury South: It is proposed that Drury South would ultimately be serviced by twin pipes, one generally following the Motorway (Flanagan Rd; Pitt Road; and Great South Road) to Quarry Road and the second pipe to the north following Fitzgerald Road, joining together within the Drury South development site.
- However, initially, it is proposed that Drury South be serviced by two pipes generally following the motorway to Quarry Road:
  - BSP, Flanagan Road, SH1 crossing; Pitt Road, Gt South Road; SH1 crossing and Quarry Road;
  - BSP to Victoria Street, as per the Auranga supply, Karaka Road (SH22), Great South Road, SH1 crossing and Quarry Road. This initial secondary main, would ultimately be decommissioned and re-used as a wastewater rising main.
  - This potentially allows the ultimate water main proposed in Fitzgerald Road to be sized and constructed to service the development land between the BSP and the Drury South development, rather than solely the Drury South development. Additional time is required for the developers to work together / agree to the financing of this pipe.

6.1.3 Pipe sizing

Analysis has determined that the following pipe sizes are required:

- Combined:
  - Twin 400 PE100 SDR 13.6 pipes are required within Flanagan Road
  - Twin 315 PE100 SDR 13.6 pipes are required between Flanagan Road and Victoria Street

- Auranga:
  - Single 315 PE100 SDR 13.6 pipe is required between along Victoria Street and Bremner Road
  - Single 315 PE100 SDR 13.6 pipe is required between Great South Road (SH22)/ Victoria Street and the development site, via Drury Sports Field.
- Drury South:
  - Ultimately twin 400 PE100 SDR 13.6 pipes are required to meet the fire flow(FW4) requirements with one pipe out of service, on the assumption that the two pipes are not interconnected along their length (approx. 3,500m).
  - Therefore the pipe installed initially that will remain under the ultimate scenario, is required to be a 400 PE100 SDR13.6 pipe.
  - The initial secondary main, which will ultimately be decommissioned and re-used as a wastewater rising main, is required to be a 315 PE100 SDR13.6 pipe to meet fire flow requirements with the adjacent section of 400 PE100 SDR13.6 pipe out of service, on the assumption that the pipes are interconnected at less than 850 m intervals.

6.2 Recommendation

It is recommended that the proposed routes, staging and pipe sizes, as detailed within the report be adopted.

Appendices

Appendix A – Beca Memorandum: Sewer Loads 17 May 2016

Memorandum

To:	Richard Pullar - Watercare	**Date:**	17 May 2016
From:	Ron Melton	**Our Ref:**	3910474
Copy:	Stephen Hughes, Peter Yendell, Keith Caldwell, Dale Paice		
Subject:	Ararimu - Flow data update		

1 Introduction

The purpose of this memorandum is to update the projected water demand /wastewater generation for Stevenson's Ararimu development.

Since the Plan Change was approved:

- There has been firm interest from businesses requiring sites for their warehousing and distribution functions. These businesses have significantly different water demand and wastewater generation profile from "industry" in general, and will make up most of the land used in the early stages of the site development
- Consideration has been given to incorporate a residential component to support the industrial area, and an area of 45ha adjacent to the motorway has been identified for this

This memo captures these changes.

2 Land use categories and design Water /Wastewater flows

2.1 2012 Recap

The 2012 Plan Change had four Land Use categories identified as zones for the development of industrial and commercial businesses on the site. The following definitions apply, with the design wastewater values given taken from the guidelines from Watercare's Code of Practice for Land Development and Subdivision (May 2015). The design values include for wet and dry weather peaks and make allowance for potable water use.

- **Industrial 4** – Area for any business including **heavy industry** (significant manufacturing/ processing)
  - Wastewater is made up of sanitary wastewater and trade wastes; the trade waste component is likely to be significant.
  - Wastewater design flow is 1.3 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.
- **Industrial 3** - Area for **light to medium industry**
  - Wastewater is made up of sanitary wastewater and trade wastes
  - Wastewater design flow is 0.7 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.

- **Motorway Edge** - Area envisaged to incorporate **50% Office space and 50% light industrial businesses**
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and minimal requirements for industrial processes;
- **Commercial Precinct** – Area is intended to be a "**Town Centre**" type area providing services to the industrial/motorway edge areas
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for commercial facilities

2.2 2016 Additions

Two additional demand types are now proposed for incorporation:

2.2.1 Warehousing & Distribution Centres

The characteristics of these sites are as follows:

- Likely to be situated in land shown on the existing structure plan as Industrial 3 or 4.
- Size of site between 5 – 10 ha per business
- Potable water supply required for employees on site – typical daily activities (drinking, toilet, shower, kitchen facilities) and fire protection of facilities
- Sanitary wastewater only (zero trade waste)
- As part of the supporting evidence for Plan Change 12, an Economic Impact Assessment was prepared in 2011by Market Economics[1] and relating this to the current business interest:
  - The maximum number of employees on site (Modified Employment Counts) is estimated by the specific business owner, but would typically confirm to the norms noted in the 2011 Economic Impact Assessment prepared by Market Economics (~ 24.6 MEC/ha).[2]
  - For these sites, there may be significantly fewer MECs on site for much of the day or overnight

To reflect this, warehousing/distribution is added as a separate land use category. The design wastewater flow for this type of site is based on the following:

- A typical MEC will work 1x 8 hour shift on site. The wastewater generated by MEC during 1 shift is assumed to be 65 l/MEC/d.
- A typical site of 10 hectares with 25 MEC/ha will therefore have an average wastewater generation (Average Dry Weather Flow) of 0.0188 l/s/ha.
- Applying a peaking factor of 6 gives a Peak Wet Weather Flow (PWWF) of 0.11 l/s/ha

[1] Drury Business Land Economic Impact Assessment, Market Economics, 2011

[2] Initial discussions with one prospective lot holder indicated max 250 people on site over 10 ha

2.2.2 Residential

The residential component envisaged is relatively high density, with up to 1,000 dwellings on the 45ha site. This area includes roads, and in the Plan Change documentation had 42.2ha of saleable land.

The standard Watercare residential flows of 3 persons per dwelling, with daily flows of 225l/p and a PWWF factor of 6.67 have been adopted. This gives loadings of:

- Daily Flow 675m3
- PWWF 52 l/s (1.23 l/s/ha if spread over 42.2ha)

2.3 Site wide land use

For the purposes of estimating water demand/wastewater generation, the site-wide land areas for the different industry types as shown in Table 1 are assumed. The assessment of what industries will establish on site does not have any impact on previous land zoning as the changes relate to the establishment of lighter industries on land zoned for heavy industry, which is permissible.

Table 1 Land Use Estimation 2012 and 2016 for entire Ararimu site

	Land Use estimation 2012 (ha)	Land Use estimation 2016 (ha)	Design wastewater PWWF (l/s/ha)
Heavy Wet Industry	42	20	1.3
Light Industry	96	30	0.7
Motorway Edge	64	20	0.4
Commercial Precinct	22	15	0.4
Warehousing	0	97	0.11
Residential	0	42	1.23
Total Area (ha)	**224**	**224**	

The total wastewater loading for the Ararimu development is estimated in Table 2 below. This information will be used as the basis for the design of the ultimate infrastructure (full development of Ararimu).

Table 2 Wastewater flows for Total Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	30	21
Motorway Edge	0.4	20	8
Commercial	0.4	15	6
Warehousing	0.11	97	10.6
Residential	1.23	42	51.7
Total		**224**	**123**

2.4 Stage 1 Wastewater Flows

Stage 1 is estimated to be completed by 2022 and the projected wastewater flows are shown in Table 3. These reflect the Land Use projections presented above.

This information will be used to inform the design of site Stage 1 infrastructure, so that the pipelines installed will function acceptably in the initial stages of the project.

Table 3 Wastewater flows for Stage 1 Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	13	9.1
Motorway Edge	0.4	0	0
Commercial	0.4	4	1.6
Warehousing	0.11	55	6.1
Residential	1.23	42	52
Total		**134**	**95**

The Peak Wet Weather Flow (PWWF), average flow and daily volumes for stage 1 and the total development are summarised in Table 4. The average flow rates have been calculated as follows:

- For warehousing from the base assumptions made in developing the design flows for this use.
- For all other industrial type land uses we have assumed a peaking factor of 6.0, in accordance with Watercare design practices
- For residential development the average flow is based on a daily demand of 675 l/household

Table 4 Wastewater flows used for concept confirmation

	Stage 1	Total Development
PWWF (l/s)	95	123
Average Flow (l/s)	15.8	20.5
Daily Flow (m3)	1,370	1,770

Note that:

- The trunk infrastructure will be designed with some flexibility to cope with flows above /below those predicted; however:
- As additional land sales are made and development proceeds, a “watching brief” will need to be kept on the nature of the businesses establishing at Ararimu to make sure that the confirmed water demand and wastewater flows are within the tolerance limits of the designed infrastructure.

3 Water demand

The average water demand will be calculated by multiplying the Design wastewater flows by 1.2. The 20% allowance is added for drinking water, product water for wet industries etc, which should average out over the site. This results in an average water demand for the total development of 2,120 cubic metres per day.

The peak daily and hourly demand can be calculated as per Watercare's Code of Practice.

Ron Melton
Technical Director – Land Development
Phone Number: +64 9 300 9000
Email: ron.melton@beca.com

Appendix B - Memorandum - Drury South Development Provision of Water Supply for Drury South

21 March 2017

Michael Paschke
Strategic Projects Manager
Veolia Water
61-63 O'Shannessey Street
Papakura 2110

Our ref: 51/34453/
Your ref:

Dear Michael,

Drury South Development
Provision of Water Supply for Drury South

This is in connection to the provision of water supply to Quarry Road and Drury South developments. Discussed below are the concept options that we have examined including our recommended option moving forward. We would like to seek your official acceptance or non-acceptance of the recommended option before we proceed further with the design.

1 Background

The 45-hectare development at Quarry Road is for approximately 1,000 new homes over six years. The development will provide a mix of housing types. It will be associated with a major business park development of some 185 ha and approximately 95 ha of public parks and reserves, including restored waterways.

The Drury South site is located in the Drury basin in South Auckland, east of the southern motorway (SH1), between the Drury interchange to the north and the Ramarama interchange to the south. The Drury Quarry, which is located at the base of the Hunua foothills, forms the eastern edge of the Drury South site. Industry will be graduated through the project. Lower impact activities will be located around the edges with more intensive uses being located adjacent to the Drury Quarry.

Similar to other developments, water supply is an essential component of these developments.

2 Concept Design

2.1 General Design Consideration

The design of the watermain shall consider all requirements as specified in the Water and Wastewater Code of Practice (CoP) for Land Development and Subdivision of Watercare. This includes addressing security of supply which are presented in the following sections of the CoP:

- Section 6.3.5.9, Bullet "o" - The outputs of water main hydraulic design shall include - *Reticulation layout that provides security of supply to end users.*
- Section 6.3.8.3, Bullet "e" - In determining the general layout of mains, the following factors shall be considered - *Provision of dual or alternate feeds to minimise service risk*

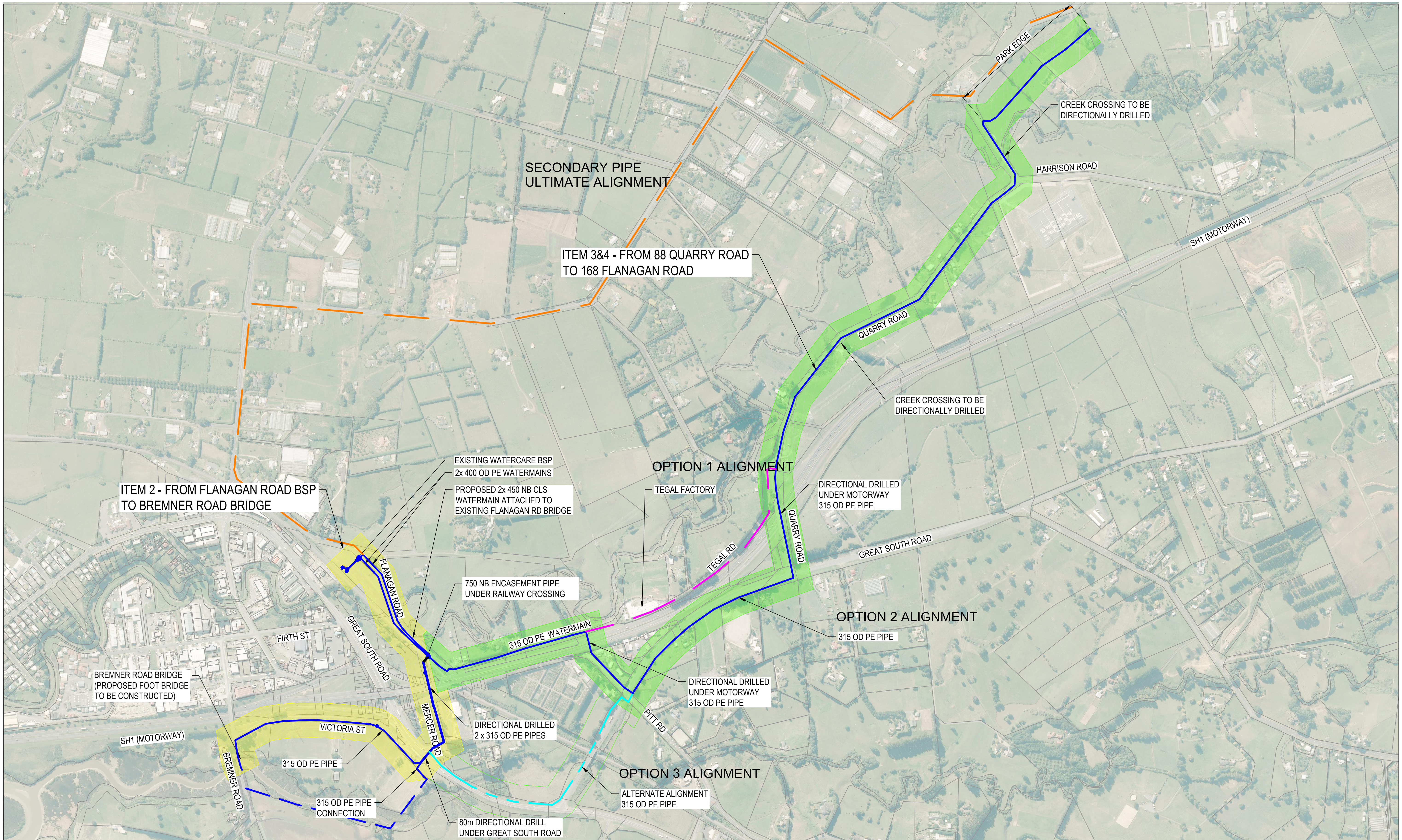
To satisfy the *security of supply* requirement, we understand based on the initial discussions with Minesh Patel on 01 February 2017 that dual pipes should be laid from Day 1 of the development. Because of the associated cost of having two pipes at the early stage of the development, we would like to present an interim solution to address security of supply. This is discussed in detail in Section 2.3.

2.2 Principal Supply Line Route Options

There are three options considered for the principal supply line and these are discussed in general terms as follows:

- Option 1 – This option involves laying a 3,600 m-length watermain from the Bulk Supply Point (BSP) at 103 Flanagan Rd down to 88 Quarry Rd. The alignment starts at 103 Flanagan Rd, running west then south along Flanagan Road. The alignment continues parallel with SH1 through private property to the Tegal property. The alignment runs south along Tegal Rd up to the intersection of Tegal and Quarry Rds. From this intersection, the watermain continues along the rear of private properties on Quarry Rd, past the proposed park edge up to 88 Quarry Rd. This route has been identified as not acceptable to Watercare / Veolia as it passes through private property.
- Option 2 – This option involves laying a 3,920 m-length watermain. Similar to option 1, this option involves laying the watermain from 103 Flanagan Rd in a westerly then southern direction. At the end of Flanagan Rd (“paper road end”) the alignment will cross State Highway 1 (SH1) through to Pitt Rd. The watermain then turns southeast along the Great South Rd, turns east along Quarry Rd, crosses SH1 again and continues through Quarry Rd past the proposed park edge up to 88 Quarry Rd.
- Option 3 – This option involves laying a 4,500 m-length watermain. The watermain will connect to the watermain installed to service the residential development at Bremner Rd (Auranga), at the intersection of Great South and Mercer Rds. The alignment will run south west along Great South Road to the intersection of Karaka Rd. From the intersection, the alignment continues in south easterly direction along Great South Road. The watermain will then turn east along Quarry Rd, crosses SH1 and continues through Quarry Rd past the proposed park edge up to 88 Quarry Rd. This option will require the proposed watermain servicing Auranga to be upsized from the BSP through to Mercer Road (including NIMT and SH1 crossings). The alignment options have been shown on the attached plan.

These options are shown in the figure that follows.



PLAN

SCALE 1:10000

PRELIMINARY

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B	REVISED ALIGNMENT	SJ			
A	ISSUE FOR ENGINEERING PLANNNING APPROVAL	NC	EM	BR	20.01.17

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 100 200 300m
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Client: KARAKA & DRURY CONSULTANT LTD & DRURY SOUTH LTD
Project: BREMNER ROAD AND DRURY SOUTH DEVELOPMENTS
Title: WATERMAIN GENERAL LAYOUT PLAN

Original Size A3 | Drawing No: 51-34453-G000_W | Rev: B

Plot Date: 22 March 2017 - 11:44 a.m. Plotted By: Shane Jackson Cad File No: G:\51\34453\CADD\Drawings\51-34453-G000_W.dwg

The table below provides a comparison of Options 1, 2 and 3.

Table 1 Comparison between Route Options

Parameter	Option 1	Option 2	Option 3
Pipe Design	315 ND, PE 100, SDR 13.6	315 ND, PE 100, SDR 13.6	315 ND, PE 100, SDR 13.6
Length, m	3,600	3,920	4,500
Preliminary Construction Method	• Open cut in most sections • 1 No. creek crossing	• Open cut in most sections • 2 No. additional SH1 crossing • 1 No. creek crossing	• Open cut in most sections • 1 No. additional SH1 crossing • 1 No. creek crossing
Risk / challenges	• Laying of pipe within the private property (Tegal)	• 2 No. SH1 crossings • Works over permit to be obtained from Watercare– 2 No. pipe crossing and work in parallel with Waikato Trunk Main	• Bridge over railway and stream • 2 No. SH1 crossings in total, 1No requiring financial contribution to Auranga developer for upsizing. • Works over permit to be obtained from Watercare – 1 No. pipe crossing of Waikato Trunk Main

Note that 2 No. 315 PE100 SDR13.6 pipes are required to meet ultimate demand for the Drury South Development (in accordance with the Code of Practice for Land Development and Sub-division).

2.3 Secondary Pipe to Ensure Security of Supply

Regardless of the final alignment option for the principal supply line, a need for a second pipe to address *security of supply* is inevitable. An interim solution and an ultimate solution will be provided and are discussed as follows:

Interim Solution

As an interim solution, one of the wastewater rising mains would be utilised as the dual pipe providing for *security of supply* into the development. The route of this wastewater rising main follows the same route as Option 3 of the principal supply line with the following:

- Initial consent obtained on the basis that the second pipe is a water main, with a limit on the number of HUE that can be built (based on capacity of initial sewage rising main)
- **A future consent will be required for a new water main and should include for the interim "secondary" watermain pipe to be converted into sewage rising main.**

The Interim Secondary Water Supply Pipe will be:

- 280 PE100 SDR 13.6
- Designed and constructed along the wastewater agreed route
- Designed to the requirements as specified in the Water and Wastewater CoP for Land Development and Subdivision of Watercare specifically it will be designed with minimum vertical grades (as per a sewer rising main), with equal tees for Air Valve Locations and sufficient height to allow installation of Wastewater Air Valves in the future.

Note: It is proposed that the pipe would be constructed with Black PE pipe, with twin warning tapes – Water / Wastewater.

EPA submission to be made on the basis of a defined number of HUE, able to be serviced by this Interim Watermain (~1,500 – i.e. less than the ultimate development of an estimated 3,200 HUE).

Ultimate Solution

An ultimate solution for the security of supply is potentially to lay a watermain about 4,200 m in length from the existing BSP through to the northeast of Flanagan Rd. From here, the watermain turns east at Waihoehoe Rd and then south at Fitzgerald Rd up to the intersection at Brookfield Rd. The watermain then turns southwest but still following Fitzgerald Rd up to the intersection at Cossey Rd where the alignment goes south until it reaches Quarry Rd.

Delaying the construction of this pipe potentially allows it to be constructed in conjunction with Opaheke Future Urban Zone (FUZ) developers, allowing costs to be shared.

This Ultimate Secondary Water Supply Pipe to service Drury South will be:

- 315 PE100 SDR 13.6 (or such larger size to service a wider population)
- Designed and constructed along this proposed route
- Designed to the requirements as specified in the Water and Wastewater CoP for Land Development and Subdivision of Watercare

Note that at this stage, the Interim Secondary Water Supply Pipe will need to be decommissioned. The pipeline will be physically disconnected at each end of the watermain and converted to a second wastewater rising main.

- Air valves to be removed and replaced with suitable wastewater air valves
- Pipeline to be modified to connect to pump station / gravity network etc.

- Any warning signs to be updated to show wastewater, not water assets buried nearby

2.4 Second BSP at Great South Rd / Quarry Rd. Intersection

Another option to service Drury South is through a second BSP to be constructed at Great South Rd / Quarry Rd intersection. However, based on initial discussions with Watercare and Veolia they have confirmed that option would not be preferred and should not be considered further. As such we have not considered this option as viable.

3 Recommendation

For the principal supply line, we recommend Option 1 because of the inherent simplicity of the alignment. There are no motorway crossings which may be tricky both in terms of approval and construction. We recognize that there may be a challenge laying pipe within the Tegal Property but we believe that there is a technical solution to make this work.

For the secondary supply line, we recommend the option of an Interim Watermain that would become a future wastewater rising main. The Interim Watermain would service a maximum of 1,500 HUE in the Drury South Development. The ultimate solution for a secondary pipeline would need to be in place for >1,500 HUE.

We are happy to discuss the above with you in more detail, if necessary. Contact detail is provided below.

Regards,

Robert White
Technical Lead - Bremner Rd and Drury South Development Projects
021 402 975

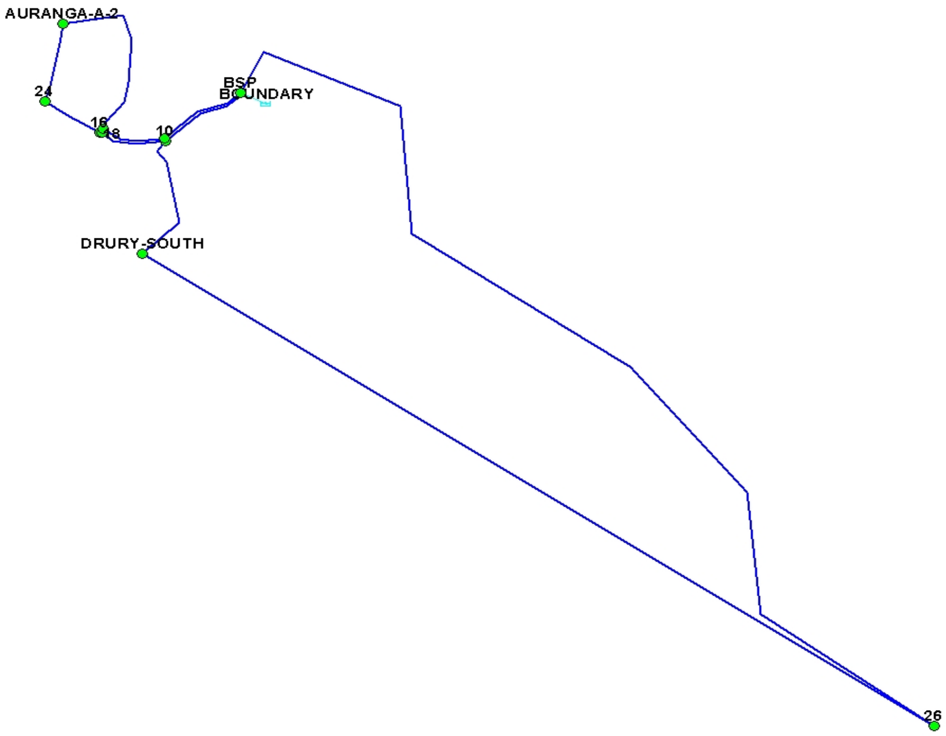
Noted:

Brad Rudsits
Project Director – Bremner Rd and Drury South Development Projects

Appendix C – Model Input Data

ID (Char)	DESCRIPT (Char)	YR_INST (Num)	YR_RETIRE (Num)	ZONE (Char)	ELEVATION (Num)	PHASE (Num)
BSP	103 Flanagan road	0	0		13	0
10	node drury south	0	0		0	0
DRURY-SOUTH		0	0		20	0
AURANGA-A-2		0	0		7.5	0
16	New Junction	0	0		0	0
18	New Junction	0	0		0	0
20	New Junction	0	0		0	0
22	New Junction	0	0		0	0
24	New Junction	0	0		0	0
26	New Junction	0	0		32	0

ID (Char)	TYPE (Num)	ELEVATION (Num)	MIN_LEVEL (Num)	MAX_LEVEL (Num)	INIT_LEVEL (Num)	DIAMETER (Num)	MIN_VOLUME (Num)	PATTERN (Char)	CURVE (Char)
BOUNDARY	0: Fixed Head Reservoir	85	0	0	0	0	0		



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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Robert White	Eva Matammu/ Brad Rudsits		Brad Rudsits		10/05/17

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Karaka and Drury Consultant Limited

Bremner Road Development
Wastewater Design Report

MARCH 2017

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Table of Contents

Table Index

Figure Index

Appendices

Table 1 List of Acronyms / Abbreviations

Acronym / Abbreviation	Meaning
DWF	Dry Weather Flow
EPA	Engineering Planning Approval
FUZ	Future Urban Zone
GRP	Glass-reinforced Plastic
ha	hectare
HAASHAA	Housing Accords and Special Housing Areas Act
HUE	Housing Unit Equivalent
ID	Internal diameter
KDCL	Karaka and Drury Consultant Ltd.
km	Kilometre
l	litres
l/p/day	litres per person per day
l/s	litres per second
I/I	Infiltration and Inflow
m	metre
m^2	square metre
m^3	cubic metre
m/s	m/s
MH	Manhole
mm	millimetre
No.	number
PE	Polyethylene
Rd	Road
RL	Reduced level
SDR	Standard Dimension Ratio
SHA	Special Housing Area
St	Street
Watercare	Watercare Services Ltd.
WWF	Wastewater Flow
WWPS	Wastewater Pump Station

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1. Introduction

1.1 Purpose

It was recognised early in the planning process that the Bremner Rd Special Housing Area (SHA) had the potential to function as a facilitation project for a much larger growth area, south of Drury Creek, and also had a potential role to play in the efficient servicing of the wider area.

Karaka and Drury Consultant Ltd, the developer for Bremner Road SHA (and Extension), known as Auranga, have engaged GHD to provide a hydraulic design of the wastewater trunk network to service Auranga, the Drury South Industrial development and also the Quarry Road SHA. This report includes a high level design for connecting to the existing network which includes a pump station as well as gravity and rising mains.

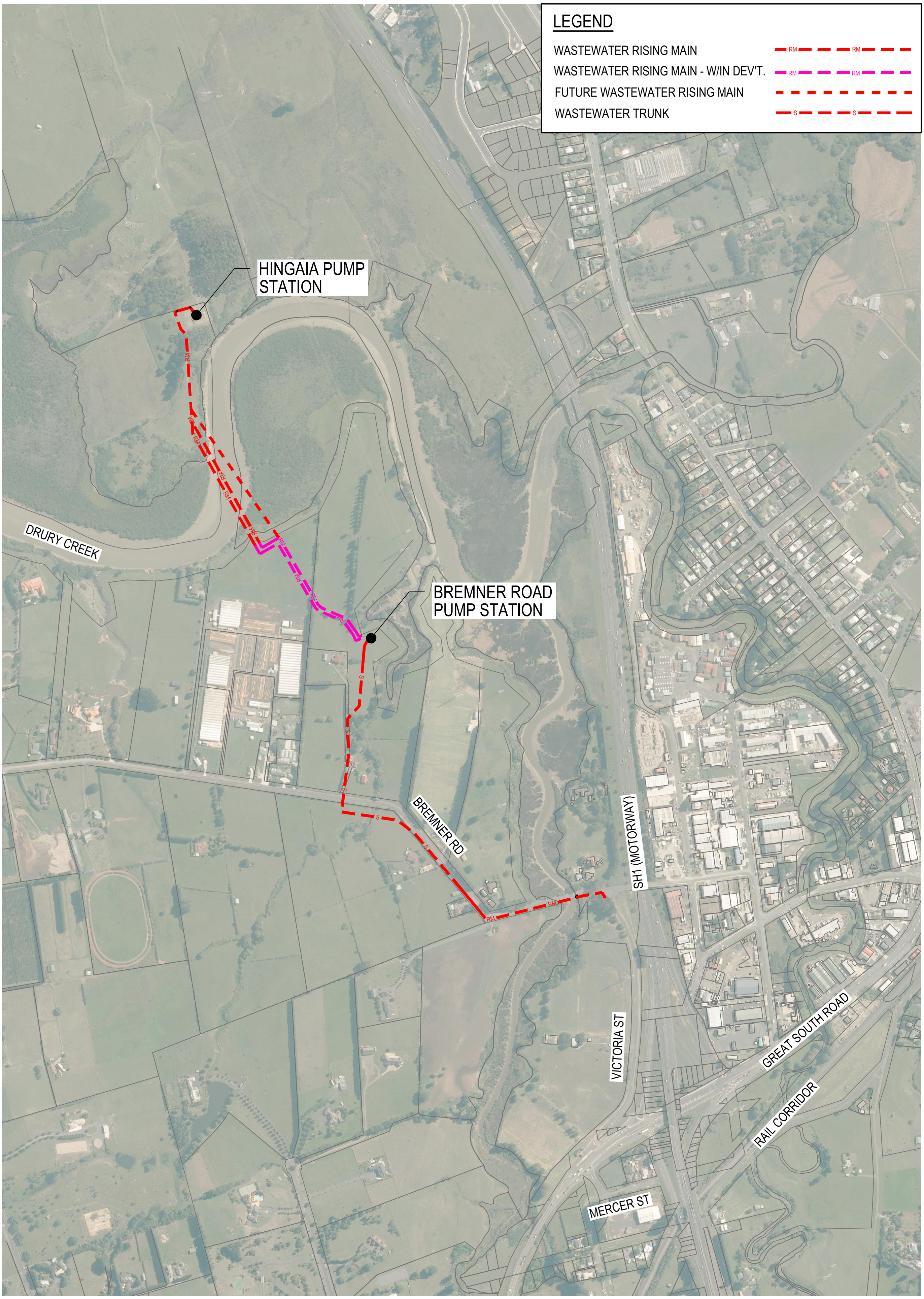
The design of the local network reticulation is covered separately and is not included in this report.

This report has been prepared for the purposes of gaining Engineering Planning Approval (EPA) for the proposed bulk wastewater network for the development. Specifically, approval is sought for the following main works

- Bremner Rd WWPS and Drury Creek Crossing
- Wastewater Trunk Main

Figure 1 shows the location and extent of the works.

The EPA drawings are attached as Appendix A.



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KARAKA & DRURY CONSULTANT LTD
BREMNER ROAD DEVELOPMENT

LOCATION PLAN

Job Number	51-34453
Revision	A
Date	FEB 2017

Figure 01

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1.2 Location

The Auranga development is located to the west of Drury township. The Bremner Rd SHA plan is presented in

Figure 2, identifying the Auranga A development.

The Auranga A development is predominantly a residential area which will be subdivided into approximately 1,350 residential lots, including apartments, medium and lower density residential areas and a village centre.

The Auranga B development area is generally adjacent to the Auranga A development. It will predominantly be a residential area, which will be subdivided into approximately 1,650 residential lots, including apartments, medium and lower density residential areas. This area is yet to be consented.

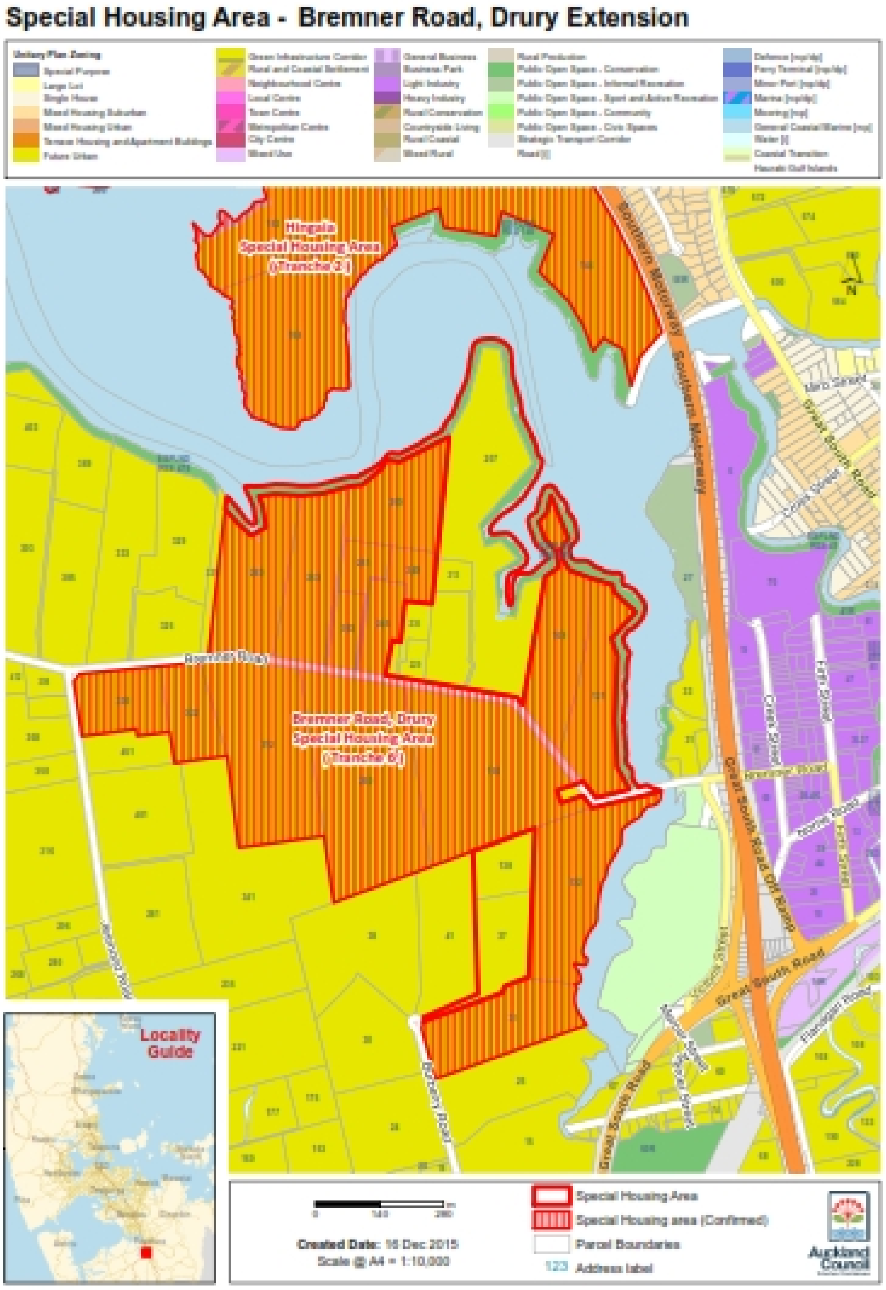


Figure 2 Bremner Road SHA Plan

The 45-hectare development at Quarry Rd is for approximately 1,000 new homes over six years.

The development will provide a mix of housing types. It will be associated with a major business park development of some 185 ha and approximately 95 ha of public parks and reserves, including restored waterways, as shown in Figure 3.

Figure 3 Quarry Road Location Plan

The Drury South (Figure 4) site is located in the Drury basin in South Auckland, east of the southern motorway (SH1), between the Drury interchange to the north and the Ramarama interchange to the south. The Drury Quarry, which is located at the base of the Hunua foothills, forms the eastern edge of the Drury South site.

Industry will be graduated through the project. Lower impact activities will be located around the edges with more intensive uses being located adjacent to the Drury Quarry.

Figure 4 Drury South Industrial Location Plan

Note that the wastewater pipeline within the Quarry Rd and Drury South Industrial development areas are not included as part of this report.

2. Design Standards

2.1 Transmission and Local Network Reticulation

It is understood that all wastewater infrastructure will be owned by Watercare, with Watercare operating "transmission" infrastructure and Veolia Water operating the "local" or network infrastructure.

2.2 Transmission Infrastructure

It has been identified that the following infrastructure will be Transmission infrastructure, operated by Watercare:

- Bremner Road wastewater pump station (WWPS) and storage (interim and ultimate)
- Rising mains from the Bremner Road WWPS to Hingaia WWPS
- 800 Gravity pipeline into the Bremner Road WWPS from Bremner Road

Transmission infrastructure is designed to Watercare's "Guidelines for Design of Wastewater Reticulation and Pumping Stations". Key elements include:

- Thicker concrete pipes - 25 mm sacrificial layer to concrete pipes and manholes (Guidelines for Design of Wastewater Reticulation and Pumping Stations, Page 15 of 37)
- Longer distances between manholes (Guidelines for Design of Wastewater Reticulation and Pumping Stations, Table, Page 11 of 37)
- Satellite manholes to connect local reticulation to the transmission line (Guidelines for Design of Wastewater Reticulation and Pumping Stations, Para 2, Page 11 of 37)

It is proposed that the interim WWPS at Bremner Road is to be designed to the network standard, due to low initial development flows. It is proposed that the WWPS be supplied and installed as a 'package' pump station (pre-fabricated Glass-Reinforced Plastic (GRP)).

3. Design

3.1 Strategic Intent

With regard to the Housing Accords and Special Housing Areas Act (HASHAA), the Bremner Road wastewater transmission strategy was based on providing effective and economic infrastructure for the adjacent development areas.

Through inclusive collaboration and co-operation, this strategy, which is endorsed by Veolia and Watercare, represents a solution which supports both the immediate SHA development as well as adds benefit to the servicing of an expanded area along with areas further afield.

A copy of the presentation to Watercare on 31 May 2015 in light of the longer-term servicing strategy is provided as Appendix B.

Watercare's confirmation of the concept as presented in 31 May 2015 is attached as Appendix C.

3.2 Flow Projections

As a reference, a memorandum issued by Beca on 17 May 2016 on the Ararimu Flow (Drury South development) data is attached as Appendix D. The stated peak flow from Drury South has been estimated as 123 l/s.

3.2.1 Ultimate Flow

The ultimate area serviced is taken to be the Drury West Future Urban Zone (FUZ) and the Drury South / Quarry Road development. The following assumptions have been made to determine the ultimate peak flow:

Table 2 Ultimate Peak Wastewater Flow

Parameter	Unit	Value
Drury West FUZ		
Area	ha	956
Number of houses per ha	No/ha	15
Total number of houses	No	14,340
Persons per house	No/house	3
Wastewater Flow (WWF)	l/p/day	1,500
Flow adjustment	%	60
Adopted WWF	l/p/day	900
Adopted WWF	m^3/day	38,718
Calculated Peak Ultimate Flow for Drury West FUZ	l/s	448
Drury South		
Stated Peak Ultimate Flow	l/s	123
TOTAL CALCULATED PEAK ULTIMATE FLOW	l/s	571

Note that the calculated ultimate peak flow is used to design the pipelines.

A Peak flow of 900 L/person/day has been adopted in accordance with the Watercare "Wastewater Reticulation Design Guide" rather than the 1,500 L/p/day as stated in the "Water and Wastewater Code of Practice for Land Development and Subdivision" due to the size of the development.

It is however, noted that the Drury South flows are calculated on the "Water and Wastewater Code of Practice for Land Development and Subdivision".

3.2.2 Ultimate Flow - MWH

In comparison to the calculated flows, as above, flows identified in the "Southern Growth Area Wastewater Servicing Strategy" (MWH Stantec) are as follows:

- Table 4.3 - Summary of Information identifies a Peak Wet Weather Flow for Bremner Road as 747 L/s.
- Section 4.3.1.2 Servicing Requirements for Option A Stage 3 states "The pump station would need to be designed to cater for an ultimate flow of 800 L/s"

3.2.3 Interim Flow – Preliminary Watercare Advice

Watercare have previously advised that they expect the WWPS at Bremner Road to cater for an interim flow of 188 l/s, based on servicing 6000 HUE.

For flows in excess of 188 l/s, Watercare will construct a new WWPS, refer Section 3.8.6.

3.2.4 Interim Flow - Auranga

The initial development for the Auranga A and B development has been based on 3,000 HUE. The following assumptions have been made to determine the interim peak flow:

Table 3 Interim Peak Wastewater Flow for the Pump Station

Parameter	Unit	Value	Remarks
Total No. of houses / HUE	No.	3,000	1,350 for Auranga A and 1,650 for Auranga B
Persons per house	No.	3	
Adopted WWF	l/p/day	900	
Calculated Interim Peak Flow	l/s	94	

3.2.5 Interim Flow – Drury South

The Drury South development includes the Quarry Road SHA and the surrounding proposed Industrial/Commercial development, expected to produce an ultimate peak flow of 123 l/s. The interim peak flow from the Quarry Rd SHA has been estimated in Table 4.

Table 4 Interim Peak Wastewater Flow From Quarry Rd SHA

Parameter	Unit	Value	Remarks
Total No. of houses / HUE	No.	1,000	1,000 for the Quarry Rd. SHA development
Persons per house	No.	3	
Adopted WWF	l/p/day	1,500	
Calculated Interim Peak Flow	l/s	52	

The difference in peak flow of 71 L/s (123 – 52 L/s) will be attributable to the flows from the Industrial/Commercial part of the development. The flow range from the Industrial/Commercial area has been calculated as HUE for two wet weather scenarios:

- Transmission = 900 l/p/d as per Wastewater Reticulation Design Guide;
- Network = 1500 l/p/d as per Wastewater Code of Practice for Land Development and Subdivision

Table 5 Drury South Ind/Com Area HUE Range

Scenario	Peak Flow (l/s)	Adopted WWF (l/p/d)	Persons per house	HUE
Transmission	71	900	3	2,272
Network		1,500	3	1,363

With consideration of the HUE's from the Quarry Road SHA, the Drury South Development would be expected to have a range of HUE's from 2,363 to 3,272.

The exact number of HUE for the whole Drury South development cannot be estimated at this time as the exact types of industries within the development is unknown. Some industries may have minimal trade waste discharges (only sanitary flows) while others maybe large trade waste customers. Further, the different design standards have a large effect on the estimation of peak flows and the back calculation to HUE's.

The peak interim flow from Drury South development for has been based on the following values:

- Gravity Transmission and Network Pipelines = 123 l/s as per Beca Memorandum, with HUE's potentially ranging from 2363 to 3272.
- Bremner Rd WWPS = 94 L/s based on servicing 3000 HUE, comprising half of the capacity requested by Watercare, and the remaining capacity after allocating HUE's from Auranga A and B.

3.2.6 Interim Flow – Design Values

The design flows used for the gravity mains, rising mains and pump station have been summarised based on Table 6. Refer to Figure 5 for the network section references.

Table 6 Interim Flow Design Values

Design Element	Flow from Auranga (l/s)	Flow from Drury South (l/s)	Total Design Flow (l/s)
Gravity Main – Transmission (A-B)	448	123	571
Gravity Main – Network (B-C)	30	123	153
Gravity Main – Network (B-C)	7	123	130
Rising Mains	94	94	188
Bremner Rd WWPS	94	94	188

The gravity main design flow values are based on the ultimate flows, while the interim peak flows for the rising mains and WWPS are based on sections 3.2.4 and 3.2.5.

3.3 Provisional Transmission Network

3.3.1 Layout and Ultimate Flows

An analysis of the wider area has identified a provisional “transmission” network (Figure 5) servicing surrounding catchments. The proposed transmission mains primarily follow a “stream” from the southwest to the proposed pump station location at 207 Bremner Road.

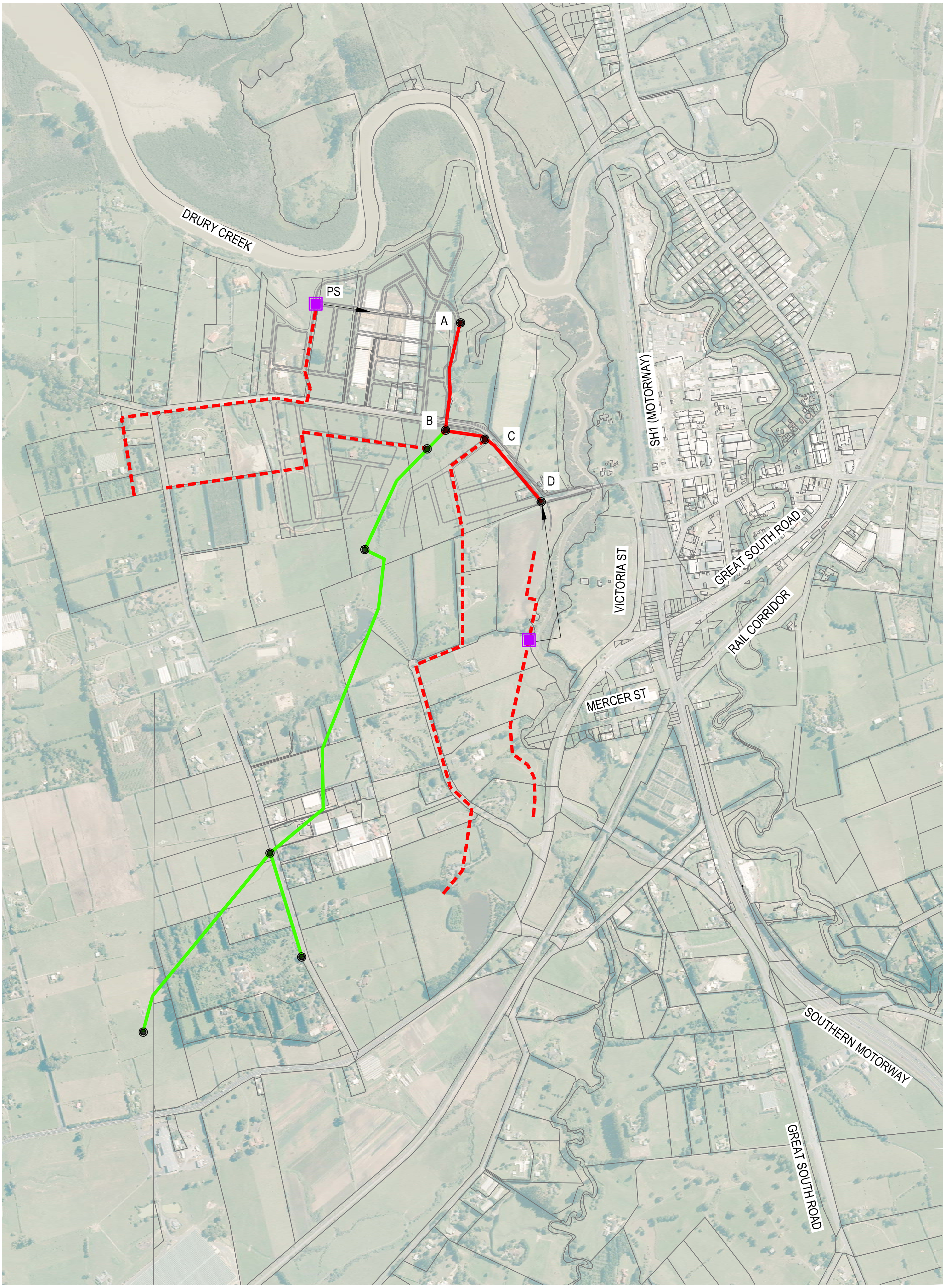
The calculation of provisional / anticipated ultimate flows are detailed in section 3.2.

3.3.2 Future Transmission Gravity Pipe

It is anticipated that the transmission gravity pipe will be extended south of Bremner Road at a future date to service the wider Drury West Future Urban Zone.

As this pipeline will not be constructed as part of the Auranga A development space should be allocated within the park / esplanade reserve for future construction.

The provisionally proposed extended transmission gravity pipe layout is as shown in Appendix E.



LEGEND:

- PROPOSED
- NETWORK
- FUTURE

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KARAKA & DRURY CONSULTANT LTD
BREMNER ROAD DEVELOPMENT

TRUNK SEWER LAYOUT

Job Number	51-34453
Revision	A
Date	FEB 2017

Figure 05

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Plot Date: 17 March 2017 - 9:12 AM Plotted by: Glaiza Lee Diao Cad File No: G:\51\34453\CADD\Drawings\sketches\51-34453-FIG5.dwg

3.4 Gravity Main (Bremner Road A-B)

3.4.1 Nominated Pipe Sizes

The gravity main along Bremner Rd to the WWPS site is shown as line A-B in Figure 5.

In order to accommodate the calculated ultimate flow (571 l/s), this gravity pipeline was designed as:

- 800 mm diameter (680 ID) PE100 SDR13.6 pipe
- Grade of 0.5% (1:200)

Table 7 below shows the hydraulic results assessed using Colebrook White equation with pipe roughness of 0.3 mm.

Table 7 Gravity Pipeline Design (A-B)

Design Diameter =	800 mm	700 mm
Internal Diameter (ID)	680	603
Design Gradient (%)	0.5	0.5
Pipe Full Capacity (l/s)	725	531
Pipe Full Velocity (m/s)	2.0	1.9
Ultimate Peak Design Flow (l/s)	571	
Depth of Flow @ Ultimate Peak Design Flow (mm)	457	-
% Pipe Utilisation (Depth of Flow / Pipe ID)	67	-

As shown above, a smaller diameter pipe (700 mm) at the design gradient would not have sufficient capacity for the ultimate peak design flow. The 800 mm pipe has sufficient capacity for the calculated ultimate peak flows, and was thus adopted for the design.

As previously noted, the stated / required capacity of the gravity main was identified as being in the order of 750 to 800 L/s in the “Southern Growth Area Wastewater Servicing Strategy” (MWH Stantec).

Adopting a less conservative friction factor of ks=0.15mm, (Assuming a Mean Velocity 1.5m/s) the theoretical design flow equals 773 L/s. Additionally, as the pipeline is deep, a small amount of surcharge could be allowed without negative affect to customers, to increase the flows to the stated 800 L/s.

Based on the above, it is proposed that the 800 mm PE100 SDR13.6 pipe is selected as the proposed gravity transmission pipe.

3.4.2 Self-Cleansing Velocities

A typical issue with the construction of ultimate gravity infrastructure during initial stages of development is the ability to achieve self-cleansing velocities. In order to achieve a self-cleansing velocity of greater than 0.75 m/s in this line, and 10% full ratio, a flow in excess of 16.5 l/s is required. A snapshot of the calculation showing this ratio is shown in Figure 6.

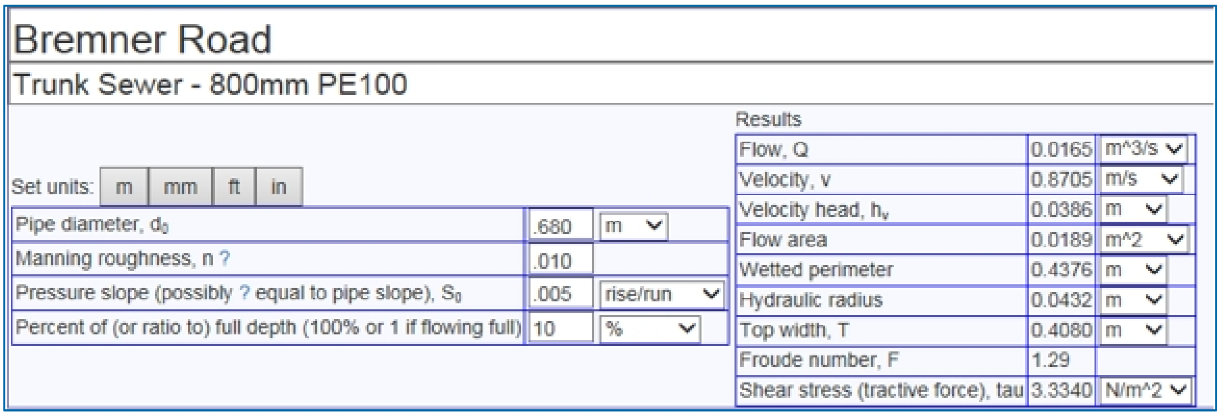


Figure 6 800 PE Pipe – Self-Cleansing

As this line will service Drury South / Quarry Road, it is possible to set the pump rate for the proposed Drury South WWPS to be greater than 16.5 l/s. Therefore the Bremner Road gravity will regularly receive flows such that self-cleansing velocity is achieved when Drury South (Quarry) WWPS operates.

3.4.3 Pipe Material

PE pipe have been proposed further to Watercare confirming their preference for PE pipes. The use of PE over concrete reduces the number of pipeline joints and the associated risk of infiltration and inflow (I/I).

PE is also considered advantageous from a construction perspective and with regard to resisting corrosivity due to issues associated with septicity in the earlier stages of the development (low flows and high retention times).

3.4.4 Pipe Class

SDR13.6 pipe has been specified based on AS / NZS 2566.1:1998 - Buried flexible pipelines - Structural Design. Detailed calculations are included in Appendix F.

3.4.5 Pipe Jointing

It is confirmed that the pipe can be jointed by butt-fusion or electrofusion welding.

3.4.6 Gravity Invert Level – Bremner Road

It is proposed that the invert of the gravity pipeline immediately south of Bremner Road be set to allow:

- The maximum (practicable) area of the Drury West Future Urban Zone to be serviced via gravity, whilst keeping “sensible” pipeline depths
- Allow the gravity pipeline between B and C to be constructed under the Ngakoroa stream

As a result of the above items, the pipeline would be constructed at an increased depth, over and above that required to service the Auranga A development.

The provisionally proposed extended transmission gravity pipe layout is as shown in Appendix E.

3.5 Gravity Main (Bremner Road B-C)

This section of the gravity alignment refers to the line between B and C on Figure 5.

The peak design flow for this section was 123 l/s from Drury South and 30 l/s from the contributing Auranga catchment, and would be conveyed through:

- 450 mm diameter (383 ID) PE100 SDR13.6 pipe
- Grade 0.6% (1:185)

Subsequent discussions with Watercare has confirmed that Watercare have requested the pipe diameter be increased to an outside diameter of 560 mm.

Table 8 below shows the hydraulic results assessed using Colebrook White equation with pipe roughness of 0.3 mm.

Table 8 Gravity Pipeline Design (B-C)

Design Diameter =	560	450	400
Internal Diameter	478	384	341
Design Gradient (%)	0.6	0.6	0.6
Pipe Full Capacity (l/s)	300	176	130
Pipe Full Velocity (m/s)	1.7	1.5	1.4
Velocity at 10% Pipe Capacity (m/s)	1.1	1.0	0.9
Ultimate Peak Design Flow (l/s)	153		
Depth of Flow @ Ultimate Peak Design Flow (mm)	242	276	-
% Pipe Utilisation (Depth of Flow / Pipe ID)	51	72	-

Based on the pipe full capacities, the 560 mm PE pipe can convey ultimate peak flow and allows for increased future flows as requested by Watercare.

3.6 Gravity Main (Bremner Road C-D)

The majority of flow for this section of the pipeline is the 123 L/s ultimate flow from Drury South / Quarry Road, with input of 7 L/s at point D from Auranga A (Stage 2A). The hydraulic calculations determined that the required pipe diameter between points C and D would be:

- 355 mm diameter (303 ID) PE100 SDR13.6 pipe
- Grade 2.0% (1:50)

Subsequent discussions with Watercare has confirmed that Watercare have requested the pipe diameter be increased to an outside diameter of 450 mm.

Table 9 below shows the hydraulic results assessed using Colebrook White equation with pipe roughness of 0.3 mm.

Table 9 Gravity Pipeline Design (C-D)

Design Diameter =	450	355	315
Internal Diameter	384	303	269
Design Gradient (%)	2.0	2.0	2.0
Pipe Full Capacity (l/s)	327	176	128
Pipe Full Velocity (m/s)	2.8	2.4	2.3
Velocity at 10% Pipe Capacity (m/s)	1.8	1.6	1.5
Ultimate Peak Design Flow (l/s)	130		

Design Diameter =	450	355	315
Depth of Flow @ Ultimate Peak Design Flow (mm)	168	195	-
% Pipe Utilisation (Depth of Flow / Pipe ID)	44	64	-

Based on the pipe full capacities, the 450 mm PE pipe can convey the ultimate peak flow, and has been included in the design of the gravity sewer.

This pipe diameter allows for increased future flows from upstream catchment areas, as requested by Watercare.

3.6.1 Pipe Material

PE pipe have been proposed further to Watercare confirming their preference for PE pipes. The use of PE over concrete reduces the number of pipeline joints and the associated risk of infiltration and inflow (I/I).

PE is also considered advantageous from a construction perspective and with regard to resisting corrosivity due to issues associated with septicity in the earlier stages of the development (low flows and high retention times).

3.6.2 Pipe Class

SDR13.6 pipe has been specified based on AS / NZS 2566.1:1998 - Buried flexible pipelines - Structural design. Detailed calculations are included in Appendix F.

3.6.3 Pipe Jointing

It is confirmed that the pipe can be jointed by butt-fusion or electrofusion welding.

3.7 Bremner Road Rising Mains

The initial development is proposed to service the consented development of Auranga A (1,350 dwelling units), Auranga B (1,650 proposed dwellings / housing unit equivalents), the Drury South Industrial development and the Quarry Road SHA (with an initial 3,000 HUE).

3.7.1 Rising Main Sizing

It is proposed to construct twin rising mains, with a third pipe included within the design, but not constructed within the initial stage.

The twin rising mains will be as follows:

- 250 PE100 SDR 13.6 - This pipe with a 212.4 mm ID would service the initial development, with a minimum flow of 27 l/s achieving a velocity of 0.75 m/s. The retention time in the pipeline is minimised as the pipeline volume has been minimised.
- 400 PE100 SDR 13.6 – The 400 mm pipeline would be used when the WWPS inflow and matching required pump rate exceeds 68 l/s, as the 250 mm pipeline would be too small. The flow rate of 68 L/s would achieve minimum flush velocity of 0.75 m/s in this 400 mm pipe. The 250 mm pipeline would be flushed and temporarily removed from service.
- Combined Operation – When the required pump rate through the 400 mm pipeline exceeds 121 L/s, it is recommended that the 250 and 400 mm pipelines operate together to minimise head-loss whilst achieving self-cleansing velocities in both pipes. In combination the two pipe can achieve a flow of 300 l/s at a friction head of approximately 20 m, pumping to Hingaia WWPS.

Space for the addition of a future 560 PE100 SDR13.6 will be included within the land development civil design to allow for the pipeline to be added in the future as the wider development occurs and flows exceed the capacity of the 250 / 400 pipelines.

The pressure rating of the pipeline is proposed to be PN12.5 / SDR13.6. This is for the following reasons:

- Standard Watercare PE100 pipe class to facilitate repair in case of failure
- Whilst initially head will be very low pumping into Hingaia WWPS, in the future the ultimate Bremner Road WWPS is anticipated to pump directly to Manurewa (PS84), approximately 9 km away, with pump heads in the region of 70 m.

3.7.2 Air Valves

Bermad air valves have been proposed due to their low operating head, with operating pressure heads within the pipeline less than the required operating pressure for Vent-o-Mat air valves.

Technical details are included in Appendix G.

3.7.3 Scour Valves

No scour valves have been proposed on the pipeline. The pipeline is relatively flat between the pump station and the creek, and then from the northern bank of Hingaia Creek to Hingaia WWPS, with the relatively steep section beneath Drury Creek which is not accessible. The Bremner Road WWPS does include pipework arrangement for the rising mains to scour/drain back to the wet well.

Additionally, the system has been designed to achieve minimum velocities greater than 0.75 m/s within the pipeline to minimise the risk of settlement / sedimentation in the pipe.

It may be considered beneficial to have grit trap located within the Bremner Road WWPS inlet chamber to capture grit, etc. to prevent it entering the pump chamber and being pumped into the pipe. This, however, will increase the operational costs, with the grit chamber requiring regular cleaning. It is recommended that the interim Bremner Road WWPS wet well be regularly inspected to assess the level of grit entering. Thereafter Watercare can determine if the ultimate WWPS will require an inlet grit trap.

3.8 Bremner Road Pump Station

3.8.1 Initial Pump Station

As an interim WWPS, it is proposed that the Bremner Rd WWPS will be a pre-fabricated GRP type WWPS (packaged WWPS, designed to Watercare Network standards.

There are numerous pre-fabricated GRP type Wastewater Pumping Station in operation within Watercare catchments, including:

- Oruarangi 4.0 m diameter x 8.05 m deep - 140 L/s; (Stage 1 = 60 l/sec)
- Beachlands 3.0 m diameter x 7.0 m deep – Ultimate 88 L/s
- AUT South 3.0 m diameter x 8.5 m deep
- Grove Rd 2.5 m diameter x 7.58 m deep
- Lynley Park 3.0 m diameter x 5.0 m deep
- Scott Rd 2.5 m diameter x 6.1 m deep
- Taupo Heights 2.5 m diameter x 5.0 m deep

- Rowles Rd 2.5 m diameter x 5.8 m deep
- Wallaceville 2.5 m diameter x 7.0 m deep

3.8.2 Initial Pump Station Capacity

Flows will be expected to progressively increase as development occurs within Auranga, and after commissioning of the Quarry Road WWPS (servicing the Quarry Rd SHA). Initial flows discharging to the WWPS will initially be minimal and rate of increase will be dependent on the growth within the development. Estimating the rate of increase to wastewater flows to the WWPS is outside the scope of this report, however the WWPS has been designed for flexibility in regards to the increasing flows.

Based on the interim peak flows for the interim WWPS of 188 l/s (refer Table 6), the pump station operating volume would need to be:

Table 10 Bremner Road Pump Station Chamber Volume (Interim - ultimate)

Parameter	Units	Value
Inflow (Qp)	l/s	188
Starts (s)	Per hour	8
Volume (900 Qp / s)	m^3	21.2

A range of WWPS wet well diameters was assessed to determine the operating depth required to meet the 8 starts per hour volume value of 21.2 m^3.

Table 11 Bremner Road WWPS – Operating Depth (Interim - ultimate)

Diameter, m	Area, m^2	Operating Depth, m
2.5	4.9	4.3
3.0	7.1	3.0
3.5	9.6	2.2

The initial flows at the WWPS will increase to the interim - ultimate flow rates as development progressively occurs across Auranga and Drury South. The initial peak flows will be considerably less than the interim - ultimate flows.

The initial pump operating rate has been set at 27 l/s to achieve a minimum velocity of 0.75 m/s in a 250 PE pipe. The actual incoming flows to the WWPS wet well are expected to be less than this initially, however an inflow rate of 27 l/s corresponds to 518 HUE (at WWF of 1500 l/p/d). The HUE’s would be comparable with the provisional first two years’ growth estimates as advised by KDCL (~500 HUE).

Table 12 Bremner Road Pump Station Chamber Volume (Initial)

Parameter	Units	Value
Inflow (Qp)	l/s	27
Starts (s)	Per hour	8
Volume (900 Qp / s)	m^3	3.0

The range of pump station wet well diameters were assessed to determine the operating depth required to meet the 8 starts per hour volume value of 3.0 m^3.

Table 13 Bremner Road WWPS – Operating Depth (Initial)

Diameter, m	Area, m^2	Operating Depth, m
2.5	4.9	0.62
3.0	7.1	0.43
3.5	9.6	0.32

Based on the range of operating depths for initial and interim-ultimate scenarios, and the pump sizes recommended (refer Section 3.8.3), a minimum diameter of 3.5 m was adopted.

3.8.3 Pumps

It is proposed that the WWPS is (ideally) initially equipped with pumps (duty / standby) that operate at the initial flow rate of 27 l/s (to achieve the velocity of 0.75 m/s in the initial 250 mm rising main), with the ability to upgrade the pumps to achieve a flow of 188 l/s in the future (duty / duty assist / standby).

The "ideal" pump rate ranges shown in Table 14 will achieve self-cleansing velocity in the respective pipes.

Table 14 "Ideal" Pump Rate Ranges vs Rising Main Sizes

Rising Main Size, mm	"Ideal" Pump Rates Ranges, l/s
250	27 up to 68
400	68 up to 121
Combined (250 + 400)	121 up to 188

The minimum flows stated above are required to achieve a self-cleansing velocity of 0.75 m/s in the respective pipes.

Pump selection was undertaken in order to identify pump options that minimises upgrade work in the future in order to meet increased flows: Key factors include:

- Installing riser pipes and duckfoot bends that service the proposed pumps across the entire flow range such that no work is required within the wet well to increase pump sizes;
- Three pumps: Duty / standby pumps for initial operation, with the addition of a third duty assist pump to increase flows in the future;
- Minimise any upgrade work associated with incremental increases in flows

The identified pump was:

- Xylem (Flygt) NP 3153 MT3 – 435

The identified pump can service the entire range from 27 L/s (217 impellor / 35 Hz) as a single duty pump servicing the 250 mm rising main to ~190 L/s (261 impellor / 50 Hz) in a duty / duty assist arrangement via both the 400 and 250 mm rising mains.

The proposed staging is as detailed below:

Table 15 Pump Staging

Phase	Pipe ND mm	Pumps	L/s	Hz	Impellor
1a	250	Duty	27.7	38	217
1b	250	Duty / Assist	74	50	217
2a	400	Duty	69	46	217
2b	400	Duty / Assist	126	50	217
3a	250+400	Duty	110	50	261
3b	250+400	Duty / Assist	190	50	261

All three pumps can be installed initially, or two pumps installed with one held in store (by Watercare) until required, with a variable frequency drive operating the initial duty and standby pumps at 38 Hz.

In order to change the operating regime, control settings will need to be adjusted (i.e. start and stop levels; duty only or duty/assist operation; etc.) and the operational rising main will need to be switched and ultimately the impellors changed. The Phases 1a through to 2b inclusive can be undertaken as operational changes without having to physically change any pump station components.

It is understood that the developer would be responsible for the cost of upgrading the system to service the growth. It is suggested that this cost is covered within an Infrastructure Finance Agreement, whereby Watercare will be responsible for the upgrading the controls and impellors in the future, along with switching the operational rising main, when required.

Pump curves are included in Appendix H.

3.8.4 Electrical Cabinet

It is proposed that the electrical elements will be housed in free-standing cabinet(s). The pumps will be controlled by variable frequency drives to adjust impellor speeds and meet the flow rates as nominated in Table 15. Pumps will cycle duty/assist/standby status each pump run.

3.8.5 Emergency Storage

Watercare transmission WWPS are required to include 4 hours dry weather flow (DWF) storage. This storage is to be based on the gravity catchment area that feeds into the WWPS.

It is proposed that any upstream local reticulation (network) pump stations will be linked by telemetry such that when the downstream pump station fails, this is conveyed to all upstream pump stations such that they shut down and their local storage is utilised.

It is noted that as the upstream Quarry Road Pump Station will be operated by Veolia, appropriate controls will need to be put into place to ensure that the two systems “talk” to each other.

It is also proposed that the system will operate such that it requires a positive signal to indicate that the downstream pump station is operating, with the upstream pump station shutting down if the signal from the downstream pump station is lost / fails.

Under this scenario, flows are stored at the local pump station rather than requiring storage at both the local and main WWPS.

Based on 970 houses feeding directly into the WWPS (from Auranga A), the required emergency storage would be 87 m^3, based on the Transmission requirements. For completeness the required volume if adopting the Network requirements of 225 l/p/d would be 109 m^3.

Table 16 Auranga A - WWPS Emergency Storage

Parameter	Unit	Transmission Scenario	Network Scenario
Houses	No.	970	970
People / House		3	3
Flow	l/person/day	180	225
Storage	hrs	4	4
Required Storage	m^3	87	109

180 L/p/day DWF from Watercare “Wastewater Reticulation Guidelines”

While the future extent of Auranga B is currently unknown, there may be areas due to topography that would need to be serviced by local pump stations. As this extents and final topography are unknown, it has been conservatively estimated that all properties will be serviced by gravity with the exception of 100 houses in the Stage 2A area. The future impact of additional flows from Auranga B has been considered, with the additional 1550 houses assumed to be serviced by a gravity network, and emergency storage required at the WWPS.

Table 17 Auranga A & B - WWPS Emergency Storage

Parameter	Unit	Transmission Scenario	Network Scenario
Houses	No.	2520	2520
People / House		3	3
Flow	l/person/day	180	225
Storage	hrs	4	4
Required Storage	m^3	227	284

Auranga A - Transmission Storage

It is proposed that the incoming DN800 gravity sewer is utilised as emergency storage during the operation of the initial / interim pump station.

Assuming a maximum level within the gravity sewer, to a depth of 2 m (RL= 4.42 m) below the lowest manhole cover level, then pipe section between MH5 and MH1 would provide a storage greater than 190 m^3, including the manholes and pump station wet well (above the operating level). Calculations are included within Appendix I.

As the storage volume is greater than the required 4 hours emergency storage for Auranga A (refer Table 16), it is proposed that no separate emergency storage is constructed as part of the initial development, with all emergency storage provided within the transmission gravity pipework.

Auranga B – Storage Tanks

The addition of Auranga B, which has been identified as predominantly serviced by gravity (although the area has not been defined) would require additional storage, over and above that in the section of pipe between MH5 and MH1. As no additional gravity transmission main is proposed south of Bremner Road, emergency storage tank(s) would be required to provide the required 4 hours emergency storage for this area (227 m^3, as per Table 17).

The addition of a single tank 2.5 m diameter by 8 m long would be required to provide additional storage capacity of 39 m^3, which combined with the 190 m^3 in the transmission network exceeds the 227 m^3 volume required.

Auranga A+B – Tanks Only

As an alternative to storage within the transmission main, separate emergency storage can be provided at the WWPS site. It is proposed that this would comprise two individual 3 m diameter x 15 m long GRP storage tanks. Two tanks would be required to provide the required storage, in conjunction with the storage provided within the pump station wet well, assuming no reticulation storage.

3.8.6 Ultimate WWPS

Sufficient space has been allocated adjacent to the initial pump station to allow the construction of the ultimate pump station, emergency storage and odour bed. This ultimate pump station would feed into the initial 250 and 400 mm rising mains along with the proposed additional 560 mm rising main, to the Hingaia WWPS.

The option exists to connect these rising mains to a future single (or twin) main(s) from the Hingaia WWPS to the ultimate discharge point on the Southern Interceptor or Wattle Downs WWPS (PS84 in Manurewa), bypassing the Hingaia WWPS totally.

A total area of 2,500 m^2 has been allocated for the interim and ultimate WWPS sites.

Additionally, it is proposed that an easement or designation is put in place over the adjacent reserve area, to be vested in Auckland Council, to allow the land to be used as a temporary construction site for the future construction of the ultimate WWPS.

4. Conclusions and Recommendations

4.1 Conclusions

- The location of Auranga / the Bremner Road SHA links the Drury West Future Urban Zone and Drury South / Quarry Road SHA to existing Wastewater infrastructure on the Hingaia Peninsula.
- It is beneficial to construct ultimate gravity pipeline infrastructure at the same time as undertaking the land development works to save costs and disruption associated with returning to undertake upgrade work a short time after the initial development. This includes installing large diameter pipework, at increased depths, to allow wider areas to be serviced in the future.
- The range of flows in rising mains, from initial to ultimate, is difficult to achieve with a single arrangement, specifically self-cleansing velocities.

4.2 Recommendations

It is recommended that the following infrastructure be constructed as part of the initial Auranga A development:

- An interim WWPS capable of servicing up to 188 l/s at or about 207 Bremner Rd, Drury (capable of serving 6,000 equivalent households), with space allocated for the future construction of the ultimate pump station, emergency storage and odour bed. The interim WWPS would be a pre-constructed concrete or pre-fabricated GRP type pump station.
- The pump station be equipped with three variable speed (duty / duty assist / standby) Xylem (Flygt) NP 3153 MT3-435 wastewater pumps, with the impellors upgraded in the future, from 217 to 261 mm to match flow requirements. The Infrastructure Finance Agreement should identify and allocate the cost of the upgrade.
- Emergency storage be provided within the gravity transmission reticulation for Auranga A with a single 2.5 m diameter by 8 m long GRP storage tank added to future proof for managing emergency situations when Auranga B comes online.
- Twin rising mains (of nominal diameters of 250 mm and 400 mm) connecting the Bremner Road WWPS to Watercare's Hingaia WWPS located at 158 Park Estate Rd, Hingaia (known as PS63), with space to add a third (560 mm) pipe in the future. The pipelines are to be pressure rated to allow them to be used for pumping directly to the Wattle Downs Pump Station (PS84, Manurewa) in the future, with pump head of up to 70 m.
- A gravity main capable of serving the ultimate Drury West Future Urban Zone and Drury South connecting the New WWPS site to a position immediately south of Bremner Rd (800 mm ND PE at a minimum grade of 1:200), with a capacity in the order of 750 L/s.
- A gravity main capable of servicing Drury South from a location on Bremner Rd approximately 150 m west the Ngakoroa Stream to the main gravity pipe detailed in bullet 3 above (355 mm / 450 mm ND PE at 1:50 / 1:185), servicing the Drury South development along with minor inflows from adjacent Auranga A developments.

The following will not form part of the Auranga development, but would be required in the future:

- A gravity main(s) capable of serving the ultimate Drury West Future Urban Zone connecting the position immediately south of Bremner Rd to the south.
- Ultimate Pump Station (dry / wet well and control building, emergency storage and odour bed)

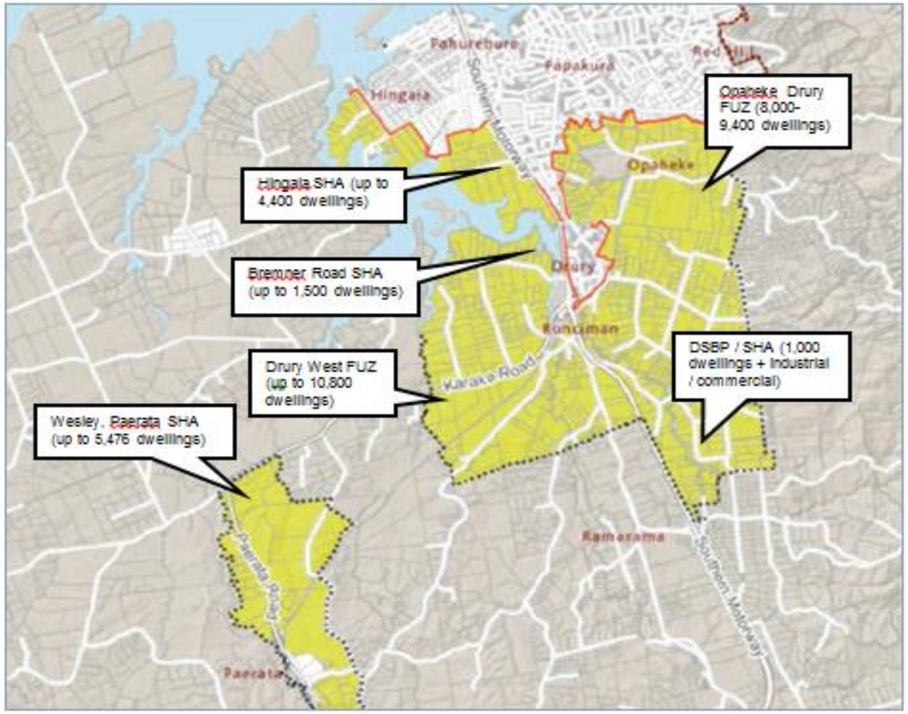
- Third rising main (potentially 560 PE) to service the ultimate flow, from the ultimate pump station to Hingaia / Wattle Downs Pump Station (PS84, Manurewa)

Appendices

Appendix A – EPA Drawings

Appendix B – Presentation to Watercare – 31 May 2016

Areas to be serviced:



Areas to be serviced:

Development	Development Name	Existing land use	Area (Ha)	Proposed No. of Houses	Timescale
Wesley College	Wesley College	Not stated	Not stated	4,500	2030 - 2035
Drury West FUZ	Drury West	Not stated	1,016	9450	Not stated
Bremner Road SHA		Vacant	Not stated	1350	2017 - 2025
Drury South SHA	Residential	Rural	45	1,000	2018-2022
Drury South Business Project	Industrial	Rural	185	*3000*	2025-2030
				18300	

Notes:

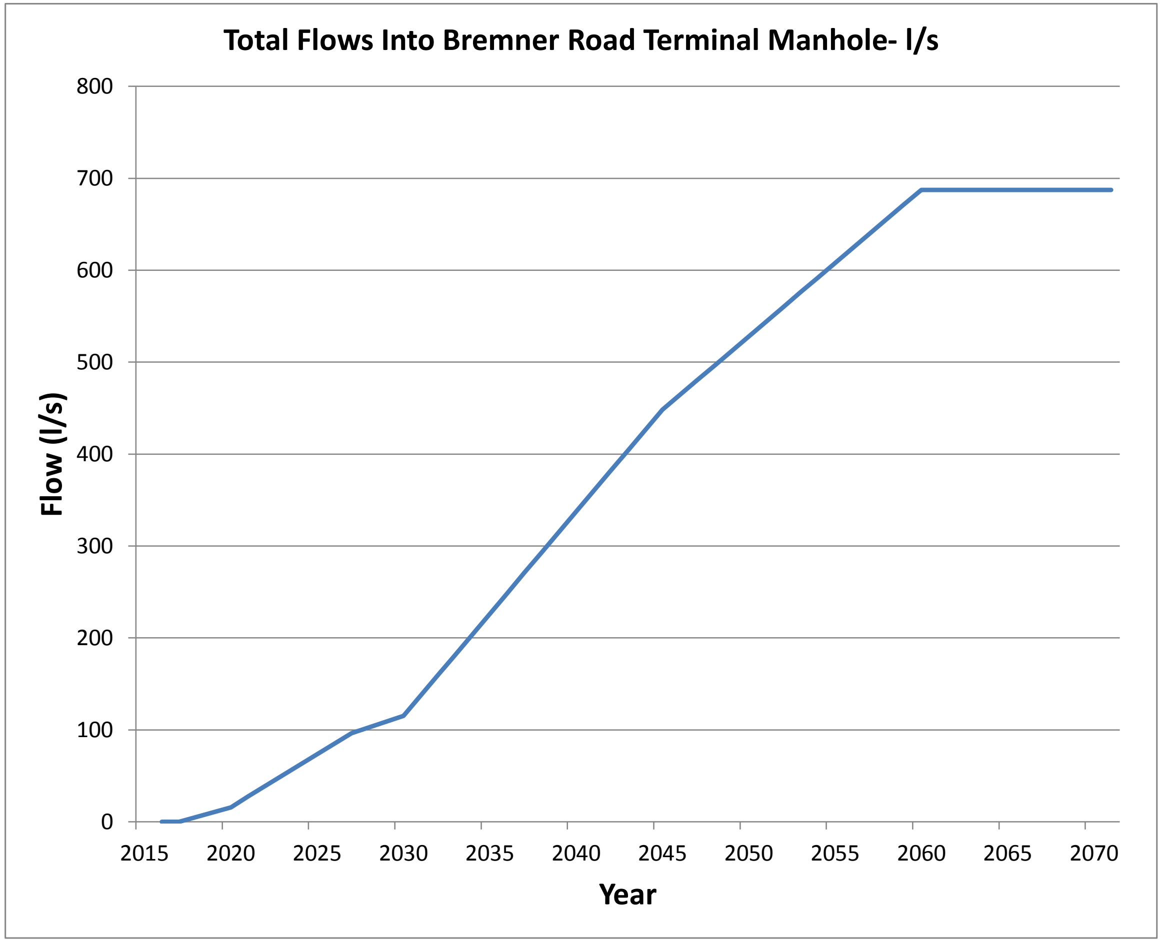
3000 HUE assumed for Drury South Industrial
First 1000 houses (Wesley / Paerata) to be serviced by Pukekohe WWTP
Opaheke Drury FUZ to be sewered separately
Hingaia SHA feeds directly to Hingaia PS

Projected Flows

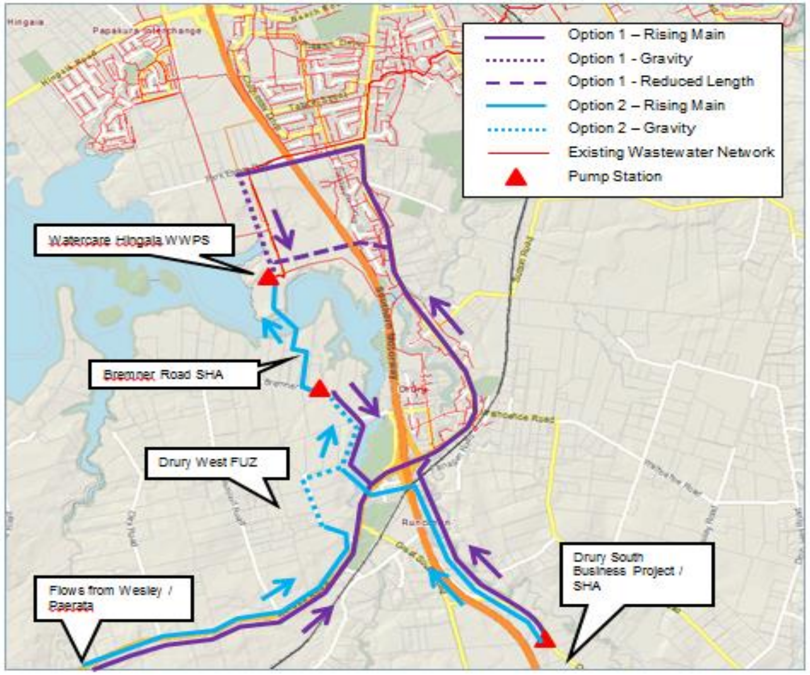
Catchment	Properties (No.)	Years	Start Year	Contributary Flow (%)	Total PWWF (L/s)	Total PDWF (L/s)
Wesley College / Paerata	3500	30	2030	75%	136.7	61.5
Drury South Industrial + SHA (HEU)	4000	25	2020	75%	156.3	70.3
Bremner Road SHA	1350	10	2017	75%	52.7	23.7
Drury West FUZ	9450	30	2030	75%	341.8	153.8
	18300				687.5	309.4

PWWF
Peak Wet Weather Flows reduced to 75%
of design value of 1500L/person/day to 1125 L/person/day

Note:
Boxes shaded pink can be changed in the spreadsheet to change the calculations



Route Options



Option 1 - Great South Road

Advantage / Opportunity	Disadvantage / Risk
▪ One less creek crossing than Option 2, lower environmental risk;	▪ Approx. 2km of construction will be within Great South Road – significantly more services to avoid / protect, increased traffic management requirements; ▪ Longer rising main, increased OPEX for satellite pump stations; ▪ Potential land owner issues through Hingaia South development; ▪ It is considered that Auckland Transport is less likely to approve option due to disruptions through Great South Road, with alternative viable option available;

Option 2a - Gravity via Bremner Road

Advantage / Opportunity	Disadvantage / Risk
▪ Single pump station site (Hingaia)	▪ Drury Creek crossing – environmental risk during construction; ▪ Pipe jack: deep shafts; silt / sands; high ground water table; ▪ Large number of lots required to be occupied to achieve flush flow

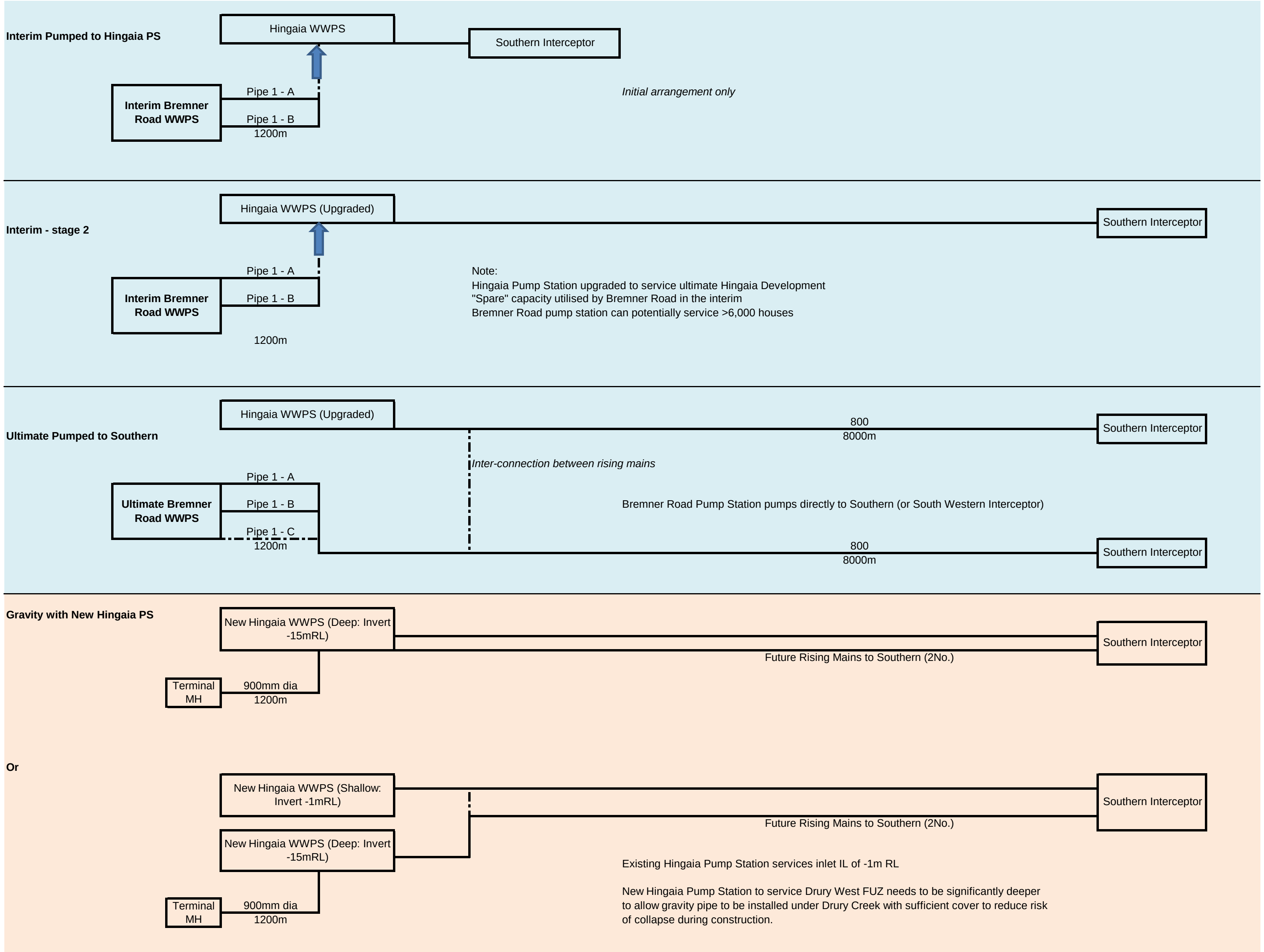
Option 2b - Pumped via Bremner Road

Advantage / Opportunity	Disadvantage / Risk
▪ Length of gravity pipe reduces pumping requirements; ▪ Gravity pipe can be shared with Bremner Road local reticulation; ▪ A Resource Consent has been obtained for a rising main through the Bremner Road development and beneath the Drury Creek; ▪ Shorter overall length, less infrastructure for Watercare to maintain; ▪ Reduced retention times; ▪ Increased length of pipe through open development land – easier construction;	▪ Drury Creek crossing – environmental risk during construction; ▪ Two seperate pump station sites;

Option 3 - Both options developed

Advantage / Opportunity	Disadvantage / Risk
As above ▪ Separate systems for different developers - simpler;	As above ▪ Why two when one will do?;

Schematic Layouts - Options / Staging



Pumped Option - Calcualtions

PDWF		
People per house	3	
Flow Per Person	225	L/p/day
Peak Factor	5	
PDWF/HEU	0.0391	L/s

PWWF		
People per house	3	
Flow Per Person	1125	L/p/day
PDWF/HEU	0.0391	L/s

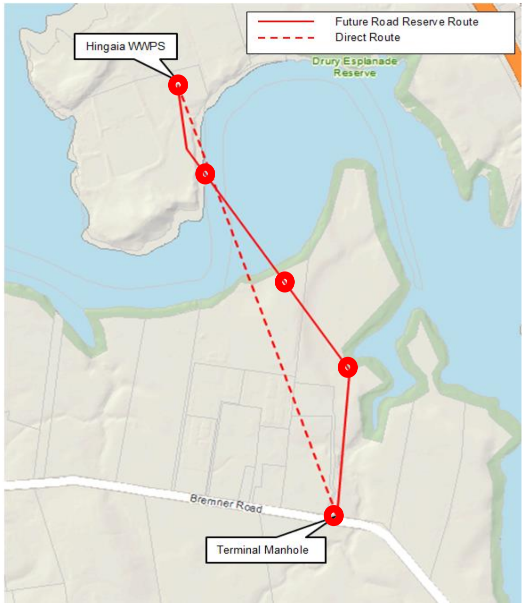
Number of Houses	18300	
People per house	3	
PWWF	1500	L/person/day
Percentage	75%	
Adjusted PWWF	1125	L/person/day
Adj. Peak WWF	**714.84**	L/s

											PDWF			PWWF	ADWF	
	Nominal Diameter	Internal Diameter	Length	Pipe Volume	Min Velocity	Flow	Max / Design Flow			Design Friction H_L	Self Cleansing Flow	HEU (Min Velocity)	HEU (Design Velocity)	HEU (Design Velocity)	HEU (1 day retention in pipe)	Comments:
	mm	mm	m	m^3	m/s	L/s	L/s	L/s	L/s	m	L/s	No.	No.	No.	No.	
Pipe 1 - a	250	212.5	1200	42.56	0.75	26.60	110.00			60.37	27.00	691	2,816	2,816	63	Pumping to Hingaia PS
Pipe 1 - b	400	339.3	1200	108.50	0.75	67.81	250.00			26.83	68.00	1,741	6,400	6,400		No static lift
Pipe 1 - A	250	212.5	1200	42.56	0.75	26.60	52.94			14.25	27.00	691	1,355	1,355		
Pipe 1 - B	400	339.3	1200	108.50	0.75	67.81	181.53	234.48		14.25	68.00	1,741	6,003	6,003		Pumping to Southern Interceptor at Wattle Farm
Pipe 1 - C	560	475.9	1200	213.45	0.75	133.41	441.25		675.72	14.25	134.00	3,430	17,299	17,299		
Pipe 2	800	680	8000	2,905.34	0.75	272.38	675.72		675.72	34.76	273.00	6,989	17,299	17,299		
						Combined Friction				49.01						
						Static				22.00						
						TOTAL				**71.01**						

Gravity Option - Calculations

COLEBROOK-WHITE CALCULATION			
(Unverified calc - Please verify before use)			
ENTER	Internal pipe dia	900	mm
		0.9	m
		0.636	m^2
	Grade 1 in	600	
	Grade (Decimal)	0.00166667	
		0.17	%
	Pipe roughness	1.5	mm
Assuming	Poly viscosity	0.00000114	m^2/s
	g	9.81	m^2/s
Answer	Flow velocity	1.1421	m/s
	Flow	0.727	m^3/s
		727	l/s

900mm is shown as the minimum diameter, however, pipe is more likely to be 1050, 1350 or 1800 to suit construction methodology



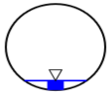
Required Min. flows

Set units: m | mm | ft | inches

Pipe diameter, d_0	1350	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	11	%

Results		
Flow, q	0.0663	m^3/s
Velocity, v	0.7741	m/s
Velocity head, h_v	0.0306	m
Flow area	0.0857	m^2
Wetted perimeter	0.9128	m
Hydraulic radius	0.0939	m
Top width, T	0.8448	m
Froude number, F	0.78	
Shear stress (tractive force), tau	2.4755	N/m^2

67 L/s

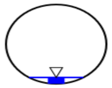


Set units: m | mm | ft | inches

Pipe diameter, d_0	1800	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	8	%

Results		
Flow, q	0.0731	m^3/s
Velocity, v	0.7660	m/s
Velocity head, h_v	0.0299	m
Flow area	0.0954	m^2
Wetted perimeter	1.0323	m
Hydraulic radius	0.0924	m
Top width, T	0.9767	m
Froude number, F	0.78	
Shear stress (tractive force), tau	2.4005	N/m^2

73 L/s

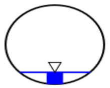


Set units: m | mm | ft | inches

Pipe diameter, d_0	1050	mm
Manning roughness, n ?	.011	
Pressure slope (possibly ? equal to pipe slope), S_0	.0017	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	15	%

Results		
Flow, q	0.0647	m^3/s
Velocity, v	0.7941	m/s
Velocity head, h_v	0.0322	m
Flow area	0.0814	m^2
Wetted perimeter	0.8352	m
Hydraulic radius	0.0975	m
Top width, T	0.7498	m
Froude number, F	0.77	
Shear stress (tractive force), tau	2.6256	N/m^2

65 L/s



Preliminary Costings

Interim Pump Station

			Auranga	Drury South
	HUE	6000	3000	3000
	Percentage		50%	50%
Bremner Road PS	Interim PS	2,400,000	1,200,000	1,200,000
	250mm Rising Main	1,200,000	600,000	600,000
	400mm Rising Main	1,800,000	900,000	900,000
Drury South Extension	200mm Rising Main	600,000		600,000
Gravity Reticulation		600,000	300,000	300,000
		6,600,000	**3,000,000**	**3,600,000**

Separate Routes

Drury South - via Great South Road

	200mm Rising Main	3,600,000		3,600,000
	Risk	800,000		800,000
	Easements	500,000		500,000
		4,900,000		**4,900,000**
Bremner Road PS	Interim PS	2,400,000	2,400,000	
	250mm Rising Main	1,200,000	1,200,000	
		3,600,000	**3,600,000**	
		8,500,000	**3,600,000**	**4,900,000**

Boxes shaded pink can be changed in the spreadsheet to change the calculations

Ultimate Pump Station

			Auranga	Drury South
	HUE	18300	3000	4000
	Percentage		16%	22%
Bremner Road PS	Ultimate PS	6,000,000	983,607	1,311,475
	250mm Rising Main	1,200,000	196,721	262,295
	400mm Rising Main	1,800,000	295,082	393,443
	560mm Rising Main	2,400,000	393,443	524,590
	Land 2,000m^2	1,000,000	163,934	218,579
		12,400,000	**2,032,787**	**2,710,383**

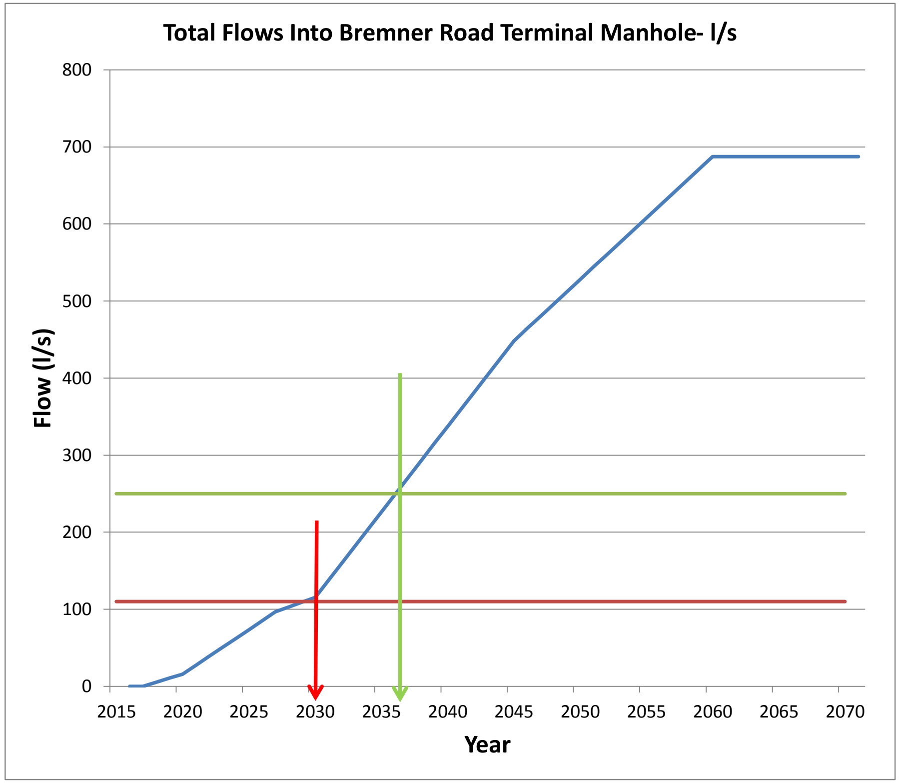
Gravity

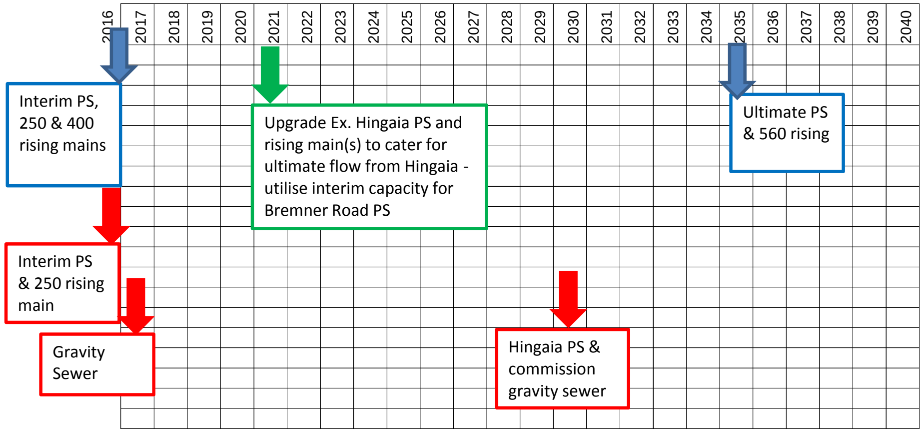
			Auranga	Drury South
	HUE	18300	3000	4000
	Percentage		16%	22%
Hingaia Pump Station	Ultimate PS	12,000,000	1,967,213	2,622,951
	Pipe Jack	19,000,000	3,114,754	4,153,005
		31,000,000	**5,081,967**	**6,775,956**

Boxes shaded pink can be changed in the spreadsheet to change the calculations

Staging Options

Catchment	Properties (No.)	Years	Start Year	Contributary Flow (%)	Total PWWF (L/s)	Total PDWF (L/s)
Wesley College / Paerata	3500	30	2030	75%	136.7	61.5
Drury South Industrial (HEU)	4000	25	2020	75%	156.3	70.3
Bremner Road SHA	1350	10	2017	75%	52.7	23.7
Drury West FUZ	9450	30	2030	75%	341.8	153.8
	18300				687.5	309.4





NPV Comparrison of Pumped and Gravity Option

	Pumped Option			**Gravity Option**	
		4%			4%
2017	Interim PS, 250 and 400 Rising Main	**5,400,000**		Interim PS, 250 Rising Main + Gravity	**22,600,000**
2018	Pump Station Operation	50,000		Pump Station Operation	50,000
2019		50,000			50,000
2020		50,000			50,000
2021		50,000			50,000
2022		50,000			50,000
2023		50,000			50,000
2024		50,000			50,000
2025		50,000			50,000
2026		50,000			50,000
2027		50,000			50,000
2028		50,000			50,000
2029		50,000			50,000
2030		50,000		New Hingaia Pump Station	**12,000,000**
2031		50,000			50,000
2032		50,000			50,000
2033		50,000			50,000
2034		50,000			50,000
2035	Ultimate PS & 560 Rising Main	**8,400,000**			50,000
	Total NPV	**$ 9,800,000.00**		**Total NPV**	**$ 29,200,000.00**

$ 50,000.00 *Assumed annual operating cost of puimp station*

Pumped / Gravity	34%
Cost Saving (Pumped)	**$ 19,400,000.00**

Sensitivity	
Cost Accuracy	30%
Pumped - Max Cost	$ 12,740,000.00
Gravity - Min Cost	$ 20,440,000.00
Pumped / Gravity	62%
Cost Saving (Pumped)	**$ 7,700,000.00**

Appendix C – Letter from Watercare (5 July 2016) confirming Concept Design

Watercare
An Auckland Council Organisation

Watercare Services Limited
73 Remuera Road, Remuera
Auckland 1050, New Zealand
Private Bag 92521 Wellesley Street,
Auckland 1141, New Zealand
Telephone +64 9 539 7300
Facsimile +64 9 539 7334
www.watercare.co.nz

5 July 2016

Charles Ma
Auranga Limited
118c Paratai Drive
Orakei
Auckland 1071

Dear Charles

Wastewater Servicing for the Bremner Road SHA

Thank you for meeting with us regarding your proposed wastewater servicing plan for the Bremner Road SHA. At the meeting, you asked for Watercare's formal confirmation of the proposed approach for wastewater servicing so that you can proceed with preliminary design.

Watercare has reviewed the servicing approach your team outlined in our meeting on 31 May 2015 and considered this approach in light of Watercare's longer term servicing strategy for this area.

This letter is to confirm that the proposed solution is acceptable to Watercare provided that it addresses the matters set out in the attached memo from David Blow, Infrastructure Planning Manager.

We look forward to working through these matters with you as you develop your preliminary design.

Yours faithfully,

Ilze Gotelli
Retail
Watercare Services Limited

Encl: Memorandum to Ilze Gotelli from David Blow, Bremner Road Wasteater Servicing dated 21 June 2016.

Watercare
An Auckland Council Organisation

Memorandum

To: Ilze Gotelli

From: David Blow

Subject: Bremner Road Wastewater Servicing

Date: 21 June 2016

File number:

Further to our recent meeting with the developer and engineering advisors of the Bremner Road SHA and your e-mail of 16 June, please find below Planning's response to the servicing approach proposed by the developer.

The provision of a site by the developer within the Bremner Road development to accommodate both the initial start -up pump station to handle flow from the Bremner Road SHA and the Drury South private plan change developments and an ultimate pump station to handle additional flow from the Opaheke-Drury and Drury West FUZ land is supported.

The site will need to be owned by Watercare and designated for wastewater purposes.

The location and size of the site and the layout of the initial pump station will need to include an appropriate buffer to the residential development and also reflect the need to construct the future ultimate pump station and associated rising main without compromising the operation of the interim pump station. The future pump station will require a bark / earth filter odour treatment facility.

The geotechnical conditions of the chosen site may influence the amount of land required for construction purposes, and hence may have a bearing on the size of the site.

It would be helpful for the route of the future rising main through the SHA to also be protected by a designation or easement.

The interim pump station, proposed dual rising mains and connection to the existing Hingaia pump station will need to be constructed in accordance with Watercare's engineering standards and reflect any health and safety and operational requirements specific to the proposed solution.

Subject to a satisfactory resolution to the matters above, the wastewater servicing approach proposed by the developer is, from Planning's perspective, acceptable to Watercare.

D Blow
Infrastructure Planning Manager

Appendix D – Beca Memo: Sewer Loads 17 May 2016

Memorandum

To:	Richard Pullar - Watercare	**Date:**	17 May 2016
From:	Ron Melton	**Our Ref:**	3910474
Copy:	Stephen Hughes, Peter Yendell, Keith Caldwell, Dale Paice		
Subject:	Ararimu - Flow data update		

1 Introduction

The purpose of this memorandum is to update the projected water demand /wastewater generation for Stevenson's Ararimu development.

Since the Plan Change was approved:

- There has been firm interest from businesses requiring sites for their warehousing and distribution functions. These businesses have significantly different water demand and wastewater generation profile from "industry" in general, and will make up most of the land used in the early stages of the site development
- Consideration has been given to incorporate a residential component to support the industrial area, and an area of 45ha adjacent to the motorway has been identified for this

This memo captures these changes.

2 Land use categories and design Water /Wastewater flows

2.1 2012 Recap

The 2012 Plan Change had four Land Use categories identified as zones for the development of industrial and commercial businesses on the site. The following definitions apply, with the design wastewater values given taken from the guidelines from Watercare's Code of Practice for Land Development and Subdivision (May 2015). The design values include for wet and dry weather peaks and make allowance for potable water use.

- **Industrial 4** – Area for any business including **heavy industry** (significant manufacturing/ processing)
  - Wastewater is made up of sanitary wastewater and trade wastes; the trade waste component is likely to be significant.
  - Wastewater design flow is 1.3 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.
- **Industrial 3** - Area for **light to medium industry**
  - Wastewater is made up of sanitary wastewater and trade wastes
  - Wastewater design flow is 0.7 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for industrial processes; industrial process requirements are likely to be significant.

- **Motorway Edge** - Area envisaged to incorporate **50% Office space and 50% light industrial businesses**
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and minimal requirements for industrial processes;
- **Commercial Precinct** – Area is intended to be a "**Town Centre**" type area providing services to the industrial/motorway edge areas
  - Wastewater is made up of sanitary wastewater and minimal trade wastes
  - Wastewater design flow is 0.4 l/s/ha unless information on actual industries is known.
  - Water demand is made up of potable requirements for employees and requirements for commercial facilities

2.2 2016 Additions

Two additional demand types are now proposed for incorporation:

2.2.1 Warehousing & Distribution Centres

The characteristics of these sites are as follows:

- Likely to be situated in land shown on the existing structure plan as Industrial 3 or 4.
- Size of site between 5 – 10 ha per business
- Potable water supply required for employees on site – typical daily activities (drinking, toilet, shower, kitchen facilities) and fire protection of facilities
- Sanitary wastewater only (zero trade waste)
- As part of the supporting evidence for Plan Change 12, an Economic Impact Assessment was prepared in 2011by Market Economics[1] and relating this to the current business interest:
  - The maximum number of employees on site (Modified Employment Counts) is estimated by the specific business owner, but would typically confirm to the norms noted in the 2011 Economic Impact Assessment prepared by Market Economics (~ 24.6 MEC/ha).[2]
  - For these sites, there may be significantly fewer MECs on site for much of the day or overnight

To reflect this, warehousing/distribution is added as a separate land use category. The design wastewater flow for this type of site is based on the following:

- A typical MEC will work 1x 8 hour shift on site. The wastewater generated by MEC during 1 shift is assumed to be 65 l/MEC/d.
- A typical site of 10 hectares with 25 MEC/ha will therefore have an average wastewater generation (Average Dry Weather Flow) of 0.0188 l/s/ha.
- Applying a peaking factor of 6 gives a Peak Wet Weather Flow (PWWF) of 0.11 l/s/ha

---

[1] Drury Business Land Economic Impact Assessment, Market Economics, 2011

[2] Initial discussions with one prospective lot holder indicated max 250 people on site over 10 ha

2.2.2 Residential

The residential component envisaged is relatively high density, with up to 1,000 dwellings on the 45ha site. This area includes roads, and in the Plan Change documentation had 42.2ha of saleable land.

The standard Watercare residential flows of 3 persons per dwelling, with daily flows of 225l/p and a PWWF factor of 6.67 have been adopted. This gives loadings of:

- Daily Flow 675m3
- PWWF 52 l/s (1.23 l/s/ha if spread over 42.2ha)

2.3 Site wide land use

For the purposes of estimating water demand/wastewater generation, the site-wide land areas for the different industry types as shown in Table 1 are assumed. The assessment of what industries will establish on site does not have any impact on previous land zoning as the changes relate to the establishment of lighter industries on land zoned for heavy industry, which is permissible.

Table 1 Land Use Estimation 2012 and 2016 for entire Ararimu site

	Land Use estimation 2012 (ha)	Land Use estimation 2016 (ha)	Design wastewater PWWF (l/s/ha)
Heavy Wet Industry	42	20	1.3
Light Industry	96	30	0.7
Motorway Edge	64	20	0.4
Commercial Precinct	22	15	0.4
Warehousing	0	97	0.11
Residential	0	42	1.23
Total Area (ha)	**224**	**224**	

The total wastewater loading for the Ararimu development is estimated in Table 2 below. This information will be used as the basis for the design of the ultimate infrastructure (full development of Ararimu).

Table 2 Wastewater flows for Total Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	30	21
Motorway Edge	0.4	20	8
Commercial	0.4	15	6
Warehousing	0.11	97	10.6
Residential	1.23	42	51.7
Total		**224**	**123**

2.4 Stage 1 Wastewater Flows

Stage 1 is estimated to be completed by 2022 and the projected wastewater flows are shown in Table 3. These reflect the Land Use projections presented above.

This information will be used to inform the design of site Stage 1 infrastructure, so that the pipelines installed will function acceptably in the initial stages of the project.

Table 3 Wastewater flows for Stage 1 Development

	Design Sewage Flows (l/s/ha)	Area (ha)	PWWF (l/s)
Heavy Wet	1.3	20	26
Light Industrial	0.7	13	9.1
Motorway Edge	0.4	0	0
Commercial	0.4	4	1.6
Warehousing	0.11	55	6.1
Residential	1.23	42	52
Total		**134**	**95**

The Peak Wet Weather Flow (PWWF), average flow and daily volumes for stage 1 and the total development are summarised in Table 4. The average flow rates have been calculated as follows:

- For warehousing from the base assumptions made in developing the design flows for this use.
- For all other industrial type land uses we have assumed a peaking factor of 6.0, in accordance with Watercare design practices
- For residential development the average flow is based on a daily demand of 675 l/household

Table 4 Wastewater flows used for concept confirmation

	Stage 1	Total Development
PWWF (l/s)	95	123
Average Flow (l/s)	15.8	20.5
Daily Flow (m3)	1,370	1,770

Note that:

- The trunk infrastructure will be designed with some flexibility to cope with flows above /below those predicted; however:
- As additional land sales are made and development proceeds, a “watching brief” will need to be kept on the nature of the businesses establishing at Ararimu to make sure that the confirmed water demand and wastewater flows are within the tolerance limits of the designed infrastructure.

3 Water demand

The average water demand will be calculated by multiplying the Design wastewater flows by 1.2. The 20% allowance is added for drinking water, product water for wet industries etc, which should average out over the site. This results in an average water demand for the total development of 2,120 cubic metres per day.

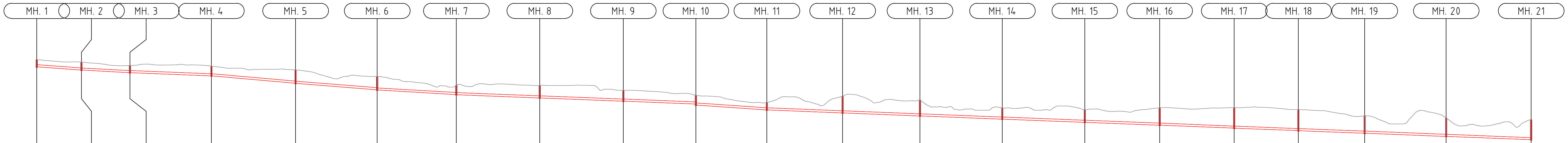
The peak daily and hourly demand can be calculated as per Watercare's Code of Practice.

Ron Melton
Technical Director – Land Development
Phone Number: +64 9 300 9000
Email: ron.melton@beca.com

Appendix E – Proposed Extended Transmission Gravity Pipe Layout

LAYOUT PLAN

SCALE 1:5000



DATUM R.L. -23.00

	PIPE GRADE (%) / PIPE SLOPE (1 IN X)	PIPE SIZE (mm)	DEPTH TO INVERT FROM EXISTNG SURFACE (start)	DEPTH TO INVERT FROM EXISTNG SURFACE (end)	INVERT LEVEL (start)	INVERT LEVEL (end)	EXISTING SURFACE LEVEL (start)	CHAINAGE (start)	CHAINAGE (length)
MH. 1 – MH. 2	1.4%	500OD PE SDR 17	1.67	1.87	21.58	20.84	23.25	0.00	53.15
MH. 2 – MH. 3	1.1%	500OD PE SDR 17	1.89	1.71	20.82	20.20	22.71	53.15	57.58
MH. 3 – MH. 4	0.8%	500OD PE SDR 17	1.72	2.30	20.19	19.45	21.91	110.73	96.67
MH. 4 – MH. 5	1.7%	500OD PE SDR 17	2.31	3.17	19.44	17.71	21.75	207.40	99.94
MH. 5 – MH. 6	1.6%	500OD PE SDR 17	3.22	3.18	17.66	16.12	20.87	307.34	97.00
MH. 6 – MH. 7	1.2%	500OD PE SDR 17	3.23	2.21	16.07	14.98	19.30	404.34	93.99
MH. 7 – MH. 8	0.8%	500OD PE SDR 17	2.22	2.96	14.97	14.21	17.19	498.33	99.01
MH. 8 – MH. 9	0.8%	500OD PE SDR 17	2.97	2.56	14.20	13.43	17.17	597.34	99.24
MH. 9 – MH. 10	0.8%	500OD PE SDR 17	2.57	2.07	13.42	12.76	15.99	696.58	86.14
MH. 10 – MH. 11	1.3%	500OD PE SDR 17	2.34	1.76	12.49	11.36	14.83	782.72	84.29
MH. 11 – MH. 12	0.8%	500OD PE SDR 17	1.78	3.98	11.34	10.65	13.12	867.00	89.99
MH. 12 – MH. 13	0.8%	500OD PE SDR 17	3.99	3.77	10.64	9.93	14.63	956.99	91.83
MH. 13 – MH. 14	0.8%	500OD PE SDR 17	3.78	2.68	9.92	9.17	13.70	1048.82	97.88
MH. 14 – MH. 15	0.8%	500OD PE SDR 17	2.69	2.98	9.16	8.40	11.85	1146.70	97.86
MH. 15 – MH. 16	0.8%	500OD PE SDR 17	2.99	4.16	8.39	7.71	11.39	1244.56	88.93
MH. 16 – MH. 17	0.8%	500OD PE SDR 17	4.17	4.90	7.70	7.02	11.87	1333.49	88.49
MH. 17 – MH. 18	0.8%	500OD PE SDR 17	4.91	5.01	7.01	6.42	11.92	1421.98	76.27
MH. 18 – MH. 19	0.8%	500OD PE SDR 17	5.02	4.14	6.41	5.81	11.43	1498.24	78.72
MH. 19 – MH. 20	0.8%	500OD PE SDR 17	4.15	4.38	5.80	5.05	9.95	1576.96	96.82
MH. 20 – MH. 21	0.8%	500OD PE SDR 17	4.39	4.76	5.04	4.27	9.43	1673.78	100.83
MH. 21							9.02	1774.61	

FUTURE WW LONGITUDINAL SECTION

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE
HORI SCALE

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE
VERT SCALE

GHD

Level 3, GHD Centre
27 Napier Street, Freemans Bay, Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E auckland@ghd.com W www.ghd.com

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Drawn	S JACKSON	Designer	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

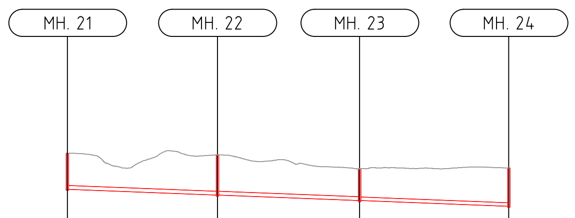
Client **KARAKA & DRURY CONSULTANT LTD**
Project **BREMNER ROAD DEVELOPMENT**
Title **FUTURE WASTEWATER PIPE**
PLAN AND LONGITUDINAL SECTION - SHT 1 OF 2

Original Size **A3** Drawing No: **51-34453-SK017** Rev: **A**

Plot Date: 22 March 2017 - 9:43 a.m. Plotted By: Shane Jackson Cad File No: G:\51\34453\CADD\Drawings\51-34453-SK017.dwg

LAYOUT PLAN

SCALE 1:5000



	MH. 21		MH. 22		MH. 23		MH. 24
PIPE GRADE (%) / PIPE SLOPE (1 IN X)		0.8%		0.8%		0.8%	
PIPE SIZE (mm)		500OD PE SDR 17		500OD PE SDR 17		500OD PE SDR 17	
DATUM R.L.	-31.00						
DEPTH TO INVERT FROM EXISTNG SURFACE	4.76 / 4.77		5.33 / 5.34		4.22 / 4.23		5.08 / 5.08
INVERT LEVEL	4.27 / 4.26		3.49 / 3.48		2.76 / 2.75		1.99 / 1.99
DESIGN SURFACE LEVEL	9.02 / (9.02)		8.82 / (8.82)		6.99 / (6.99)		7.07 / (7.07)
EXISTING SURFACE LEVEL	9.02		8.82		6.99		7.07
CHAINAGE	1774.61	99.26	1873.86	94.03	1967.89	98.64	2066.53

FUTURE WW LONGITUDINAL SECTION

PRELIMINARY

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Job Manager	Project Director	Date

0 50 100 150m
SCALE 1:5000 AT ORIGINAL SIZE — HORI SCALE

0 10 20 30m
SCALE 1:1000 AT ORIGINAL SIZE — VERT SCALE

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E auckland@ghd.com **W** www.ghd.com

DO NOT SCALE

Drawn	S JACKSON	Designer	
Drafting Check		Design Check	
Approved (Project Director)			
Date			
Scale	AS SHOWN	This Drawing must not be used for Construction unless signed as Approved	

Client **KARAKA & DRURY CONSULTANT LTD**
Project **BREMNER ROAD DEVELOPMENT**
Title **FUTURE WASTEWATER PIPE PLAN AND LONGITUDINAL SECTION - SHT 2 OF 2**

Original Size **A3** Drawing No: **51-34453-SK018** Rev: **A**

Plot Date: 22 March 2017 - 9:57 a.m. Plotted By: Shane Jackson Cad File No: G:\51\34453\CADD\Drawings\51-34453-SK018.dwg

Appendix F – Buried Flexible Pipeline – Structural Design

GHD
Bremner Road Development 5134453
Design to AS / NZS 2566.1:1998
Bremner Road Transmission Gravity Sewer

Item	Description	Symbol	Maximum depth				Minimum depth				Unit	Reference to AS 2566.1
			HO	HO	52T	52T	HO	HO	52T	52T		
Pipe Specification and Properties of pipe wall			HDPE	HDPE	HDPE	HDPE	HDPE	HDPE	HDPE	HDPE		
1	DN		800	800	800	800	800	800	800	800		
2	Profile Number		SDR13.6	SDR17	SDR13.6	SDR17	SDR13.6	SDR17	SDR13.6	SDR17		
	SDR		13.6	17	13.6	17	13.6	17	13.6	17		
3	Internal Diameter	Di	0.6824	0.7059	0.6824	0.7059	0.6824	0.7059	0.6824	0.7059	m	
4	External Diameter	D_e	0.8000	0.8000	0.8000	0.8000	0.8000	0.8000	0.8000	0.8000	m	
5	Profile Thickness	t	0.0588	0.0471	0.0588	0.0471	0.0588	0.0471	0.0588	0.0471	m	
	Cement Lining Thickness	T	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	m	
	Overall Thickness - t + 0.1T	t	0.0588	0.0471	0.0588	0.0471	0.0588	0.0471	0.0588	0.0471		
6	Moment of Inertia for ring bending	I	1.69618E-05	8.68444E-06	1.69618E-05	8.68444E-06	1.69618E-05	8.68444E-06	1.69618E-05	8.68444E-06	m^4/m	
7	Distance from neutral axis to internal surface	c_2	0.0294	0.0235	0.0294	0.0235	0.0294	0.0235	0.0294	0.0235	m	For PP assume 1/3 of Profile Pitc,manually change
8	Initial ring-bending modulus of elasticity (3 Minute)	E_b	950	950	950	950	950	950	950	950	MPa	Table 2.1
9	Long term ring-bending modulus of elasticity (50 Year)	E_{bL}	260	260	260	260	260	260	260	260	MPa	Table 2.1
10	Diameter of neutral axis	D	0.712	0.729	0.712	0.729	0.712	0.729	0.712	0.729	m	
11	Ring Bending Stiffness	S_{DI}	44688	21259	44688	21259	44688	21259	44688	21259	N/m/m	Eq. 2.2.1.1(1)
11a	50yr Long term RB Stiffness	$S_{DI50} = S_{DL}$	12230	5818	12230	5818	12230	5818	12230	5818		
12	Ratio Long term(2 year)/Initial(3 min) Ring Bending Stiffness	S_{DL2}/S_{DI}	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36		Eq 2.2.3, check for Thermoplastic pipes
13	Long Term(2 Year) R B Stiffness	S_{DL2}	15875	7552	15875	7552	15875	7552	15875	7552		
14	Allowable long term internal pressure	Pall	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	MPa	Manufacturer's Data
15	Poisson's Ratio	ν	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		Table 2.1
Limiting Parameters for the pipe												
16	Allowable long term vertical deflection	Δ_{yall}/D	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	%	Table 2.1
17	Allowable long term Ring bending strain	$\varepsilon_b$all	4	4	4	4	4	4	4	4		Table 2.1; if N/R enter as 0
18	Design factor for buckling	F_s	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5		Clause 5.4
19	Factor of safety for: long term internal pressure	η_p	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25		Table 2.1
	-long term ring bending strain	η_b	2	2	2	2	2	2	2	2		Table 2.1
	-long term combined loading	η	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25		Table 2.1
Site Conditions												
20	Cover	H	6.0600	6.0600	6.0600	6.0600	4.9800	4.9800	4.9800	4.9800	m	
21	Native Soil:											
	- classification		Fine Grained Soil	ne Grained Soil	ne Grained Soil	ne Grained Soil	ne Grained Soil	ne Grained Soil	ne Grained Soil	ne Grained Soil		Table 3.2
	- standard penetration test										No. of blows	Table 3.2
	- soil modulus	E'n	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	Mpa	Table 3.2; if N/R enter as 0.001
22	Embedment:											
	- classification		GAP7	GAP7	GAP7	GAP7	GAP7	GAP7	GAP7	GAP7		Table 3.2
	- density Index / Compaction %	I_D / R_D	Uncompacted	Uncompacted	Uncompacted	Uncompacted	Uncompacted	Uncompacted	Uncompacted	Uncompacted	%	Table 3.2
	- soil modulus	E'_e	3	3	3	3	3	3	3	3	Mpa	Table 3.2
23	Width of trench at springline	B	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	m	
	Height of water surface above pipe	H_W	5.96	5.96	5.96	5.96	4.83	4.83	4.83	4.83	m	Water level = 2m above pipe
25	Internal working pressure	P_W	0	0	0	0	0	0	0	0	MPa	
26	Internal vacuum	q_V	0	0	0	0	0	0	0	0	kPa	
27	Unit weight of trench fill	γ	18	18	18	18	18	18	18	18	kN/m^3	Clause C4.2.2
	Unit Weight of water	γ_L	10	10	10	10	10	10	10	10		
		γ_{sub}	11.20754717	11.20754717	11.20754717	11.20754717	11.20754717	11.20754717	11.20754717	11.20754717		
28	Specific gravity of soil particles	ρ_s	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65		Equation 5.4(2)
Design Dead Load and Live Loads Determination												
29	Design load due to external dead loads	w_g	109.08	109.08	109.08	109.08	89.64	89.64	89.64	89.64	kPa	Equation 4.3
	Super Imposed Dead load	w_{gs}	3.5	3.5	0	0	3.5	3.5	0	0	kPa	
30	Design loads due to external live loads:											
	- wheel loads	P	120	120	0	0	120	120	0	0	kN	Figure C4.5
	- sum of wheel loads	Σ P	240	240	525	525	240	240	525	525	kN	
	- wheel load, contact area	a	0.9	0.9	4.47	4.47	0.9	0.9	4.47	4.47	m	Figure C4.6
		b	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	m	Figure C4.6
		a*b	0.54	0.54	2.682	2.682	0.54	0.54	2.682	2.682	m^2	Figure 4.2
	- dist. between wheel centres	G	1.8	1.8	2.38	2.38	1.8	1.8	2.38	2.38	m	Figure 4.2
	- length of base of load prism											
	- perpendicular	L_1	11.2	11.2	11.8	11.8	9.6	9.6	10.2	10.2	m	Fig. 4.2, Fig.C4.7
	- parallel	L_2	9.7	9.7	13.3	13.3	8.1	8.1	11.7	11.7	m	Figure 4.2
	Check on load prism overlap		Load prisms overlap	Load prisms overlap	Load prisms overlap	Load prisms overlap	Load prisms overlap	Load prisms overlap	Load prisms overlap	Load prisms overlap		
	- live load impact factor	α	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1		Equation 4.7.2(2)
	- ave intensity of des. live loads	w_q	2	2	4	4	3	3	5	5	kPa	Equation 4.7.2(1)
Determine Effective Soil Modulus												
31	E'_e/E'_n		1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50		
32	B/D_e		1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88		
		Δf	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57		
33	Leonhardt Correction Factor	ζ	0.767	0.767	0.767	0.767	0.767	0.767	0.767	0.767		Eq. 3.4.3(2) or Fig. 3.2
34	Effective Soil Modulus	E'	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	MPa	Equation 3.4.3(1)
Determine Deflection												
35	Predicted long term vertical deflection	Δ_y/D	4.30	5.73	2.26	5.61	3.61	4.81	1.90	4.70	%	Equation 5.2(2)
	COMPARE WITH 16 (Δ_{yall}/D)		ok	ok	ok	ok	ok	ok	ok	ok		
Determine Strain												
36	Shape Factor	D_f	3.14	3.27	3.07	3.27	3.14	3.27	3.07	3.27		Eq. 5.3.1(3) or Fig.5.1
37	Effective wall thickness of pipe	t_{es}	0.059	0.047	0.059	0.047	0.059	0.047	0.059	0.047	m	Clause 1.5
38	Predicted long term ring bending strain	ε_b	1.12	1.21	0.57	1.18	0.94	1.01	0.48	0.99		Equation 5.3.1(2)
	COMPARE WITH 17 (ε_b must be < $\varepsilon_b$all)		ok	ok	ok	ok	ok	ok	ok	ok		
Determine Effects of External Hydrostatic pressure and Internal Vacuum												
39	Buckling pressure on pipe for:											
	- H < 0.5m		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	kPa	
	- H > or = Hw		143	143	140	140	120	120	118	118	kPa	Equation 5.4(1)
	- H < Hw		142	142	140	140	119	119	117	117	kPa	Equation 5.4(3)
40	Allowable Buckling Pressure:											
	- H < 0.5m		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	kPa	Equation 5.4(4)
	- H > or = 0.5m - q_{all}1		181	86	511	86	181	86	511	86	kPa	Equation 5.4(4)
	- q_{all}2		176	137	248	137	176	137	248	137	kPa	Equation 5.4(5)
	COMPARE ITEM 39 WITH ITEM 40 (Item 40 m		Ok	Check Pipe Class	Ok	Check Pipe Class	Ok	Ok	Ok	Ok		
Determine Effects of Combined Loading												
41	Re-rounding Coeff	r_c	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		Equation 5.3.3
42	$P_w/\eta_p P_{all}$		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		Equation 5.3.3
43	$r_c \varepsilon_b/\eta_b \varepsilon_{ball}$		0.14	0.15	0.07	0.15	0.12	0.13	0.06	0.12		Equation 5.3.3
44	Item 42 + Item 43		0.14	0.15	0.07	0.15	0.12	0.13	0.06	0.12		Equation 5.3.3
	ITEM 44 MUST BE < OR =		Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok		

Therefore SDR 13.6 is sufficient.

Appendix G – Air Valve Details

Stainless Steel Sewage & Wastewater Combination Air Valve

Models C50-G, C50-N

BERMAD C50 is a high quality combination air valve for a variety of sewage and wastewater networks and operating conditions. It evacuates air during pipeline filling, allows efficient release of air and gas pockets from pressurized pipes, and enables large volume air intake in the event of network draining.

With its advanced aerodynamic design and double orifice, this valve provides excellent protection against air and gas accumulation and vacuum formation with improved sealing under low pressure conditions.

C50-G

C50-N

Typical Applications

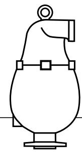
- Sewage and wastewater pumping stations – Air relief and vacuum prevention.
- Sewage and wastewater pipelines – Protection against air and gas accumulation and vacuum formation at elevations, slope change points and at road / river crossings.
- Wastewater treatment plants – Air relief, protection against air and gas accumulation and vacuum formation.

Features & Benefits

- Straight flow body with large diameter automatic orifice – Higher than usual flow rates.
- Aerodynamic, full-body kinetic shield – Prevents premature closing without disturbing air intake or discharge.
- Dynamic Sealing – Prevents leakage under low pressure conditions (0.05 bar).
- Elongated body design – Prevents solids from making contact with valve's operating parts.
- Compact, simple and reliable structure with fully corrosion-resistant parts – Lower maintenance and increased life span.
- Two inlets – Enabling back flushing and drainage.
- Threaded Side outlet (DN50/2") for connection of Surge Protection (SP) or Inflow prevention (IP) devices.
- Factory approval and Quality Control – Performance and specification tested and measured with specialized test bench, including vacuum pressure conditions.

Additional Features

- Surge Protection (anti-slam) – Smoother operation, preventing damage to the valve and the system (C50-SP).
- Inflow Prevention – Prevents intake of atmospheric air in cases where this could lead to damaged pumps, required re-priming, or disruption of siphons (C50-IP).
- Drainage Valve.
- Stainless Steel lower float.



Principles of Operation

Pipeline filling:

During the filling process of a pipeline, high air flow is forced out through the kinetic orifice of the air valve. Once water enters the valve's chamber, the float buoyed upwards causes the kinetic orifice to close. The unique aerodynamic structure of the valve body and float ensures that the float cannot be closed before water reaches the valve.

Pressurized Operation:

During pressurized operation of the pipeline, air accumulates in the upper part of the air valve chamber, causing the float to gravitate downwards. This in turn causes the automatic orifice to open, releasing the accumulated air. Once the air is discharged, the water level and float rise, causing the automatic orifice to close.

Pipeline Draining:

When a pipeline is drained, a negative differential pressure is created causing atmospheric air to push the float down. The kinetic orifice stays open and air enters the valve chamber, preventing vacuum formation in the pipe.

Surge Protection (anti-slam):

The Surge Protection device is fitted to the air valve outlet. In the event of a pressure surge it partially closes the valve's outlet. The approaching water column decelerates due to the resistance of the rising air pressure in the valve. This is typically used on pump stations and at specific pipeline locations to minimise pressure surges during pipe filling or power failure conditions at the pump station.

Inflow Prevention:

The inflow prevention mechanism is a Normally Closed check device fitted on the valve's outlet and preventing flow of atmospheric air into the valve. Typically used to prime pump suction lines or on pipelines requiring only air discharge and no air re-entry such as siphons.

Valve Selection

- Body Material – All Stainless Steel (C50-N), with Glass Reinforced Nylon neck and cover (C50-G)
- Inlet sizes – DN50, DN80, DN100 (2" 3" 4")
- Connections:
  - Threaded Male BSPT
  - Flanged
- Outlets – Sideways
- Additional features:
  - Surge Protection, connected to DN50/2" threaded side outlet (C50-SP).
  - Inflow Prevention, connected to DN50/2" threaded side outlet (C50-IP)

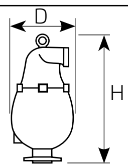
Operational Data

- Maximum test pressure - 16 bar
- Operating pressure range: 0.05 - 10 bar
- Operating temperature: up to 60°C

Orifice Specifications

Size		Kinetic		Automatic
DN	Inch	D [mm]	Ad [mm²]	Ad [mm²]
50	2"	45.0	1,590	12.2
80	3"	45.0	1,590	12.2
100	4"	45.0	1,590	12.2

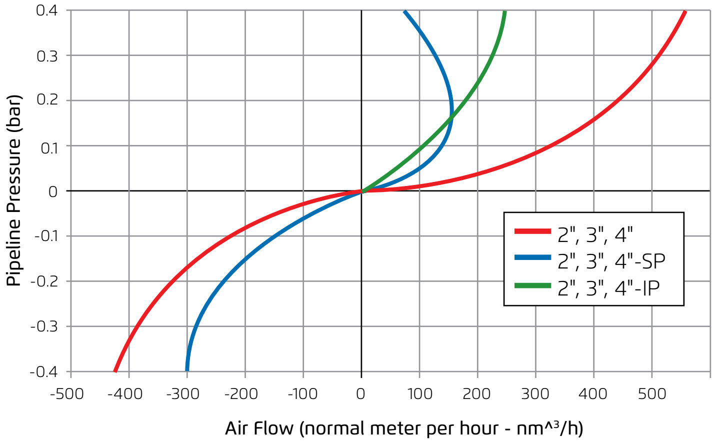
Dimensions & Weights



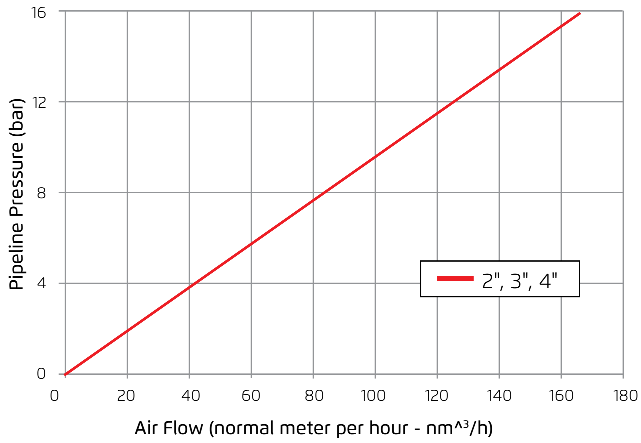
Size			C50-G			C50-N		
DN	Inch	Connection	D (mm)	H (mm)	Weight (kg)	D (mm)	H (mm)	Weight (kg)
50	2"	Threaded	349	489	10.6	296	489	16.8
50	2"	Flanged	349	486	13.2	296	492	18.9
80	3"	Flanged	349	501	16.2	349	504	21.9
100	4"	Flanged	349	501	18.7	296	504	22.9

Air Flow Performance Charts

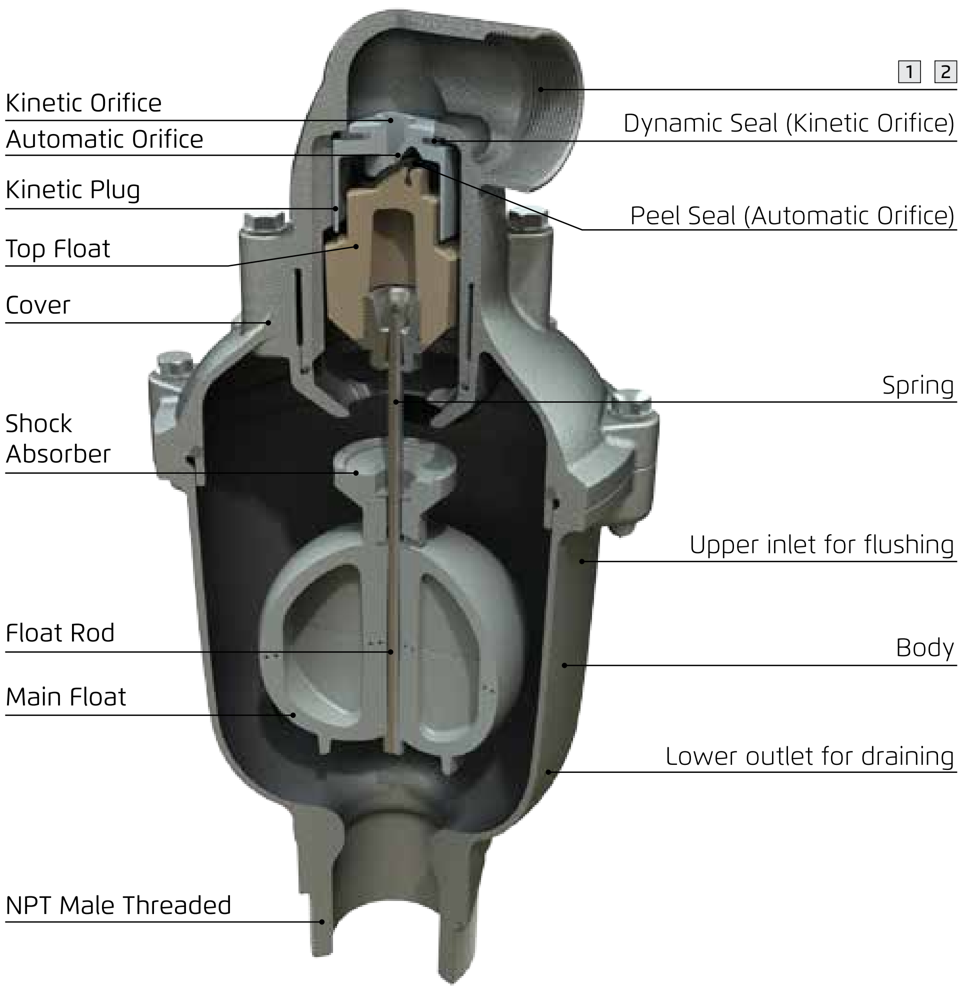
Air Relief and Intake
(Pipeline Filling, Draining and Vacuum Conditions)

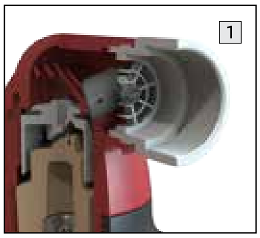


Air Release
(Pressurized Operation)

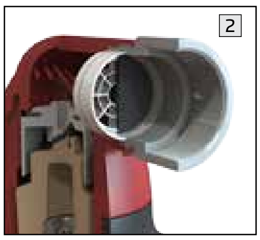


Air relief and intake charts are based on actual measurements, made during 2014-2015 in Bermad Air Flow test bench, according to EN-1074/4 standard and certified to AS-4598 (2008) standard. For Side outlet air flow performance, please consult with BERMAD. Use Bermad Air software (www.bermad-air.com) for optimized Sizing & Positioning of Air Valves.





Surge Protection
(anti slam) – (C50-SP)



Inflow Prevention
(C50-IP)

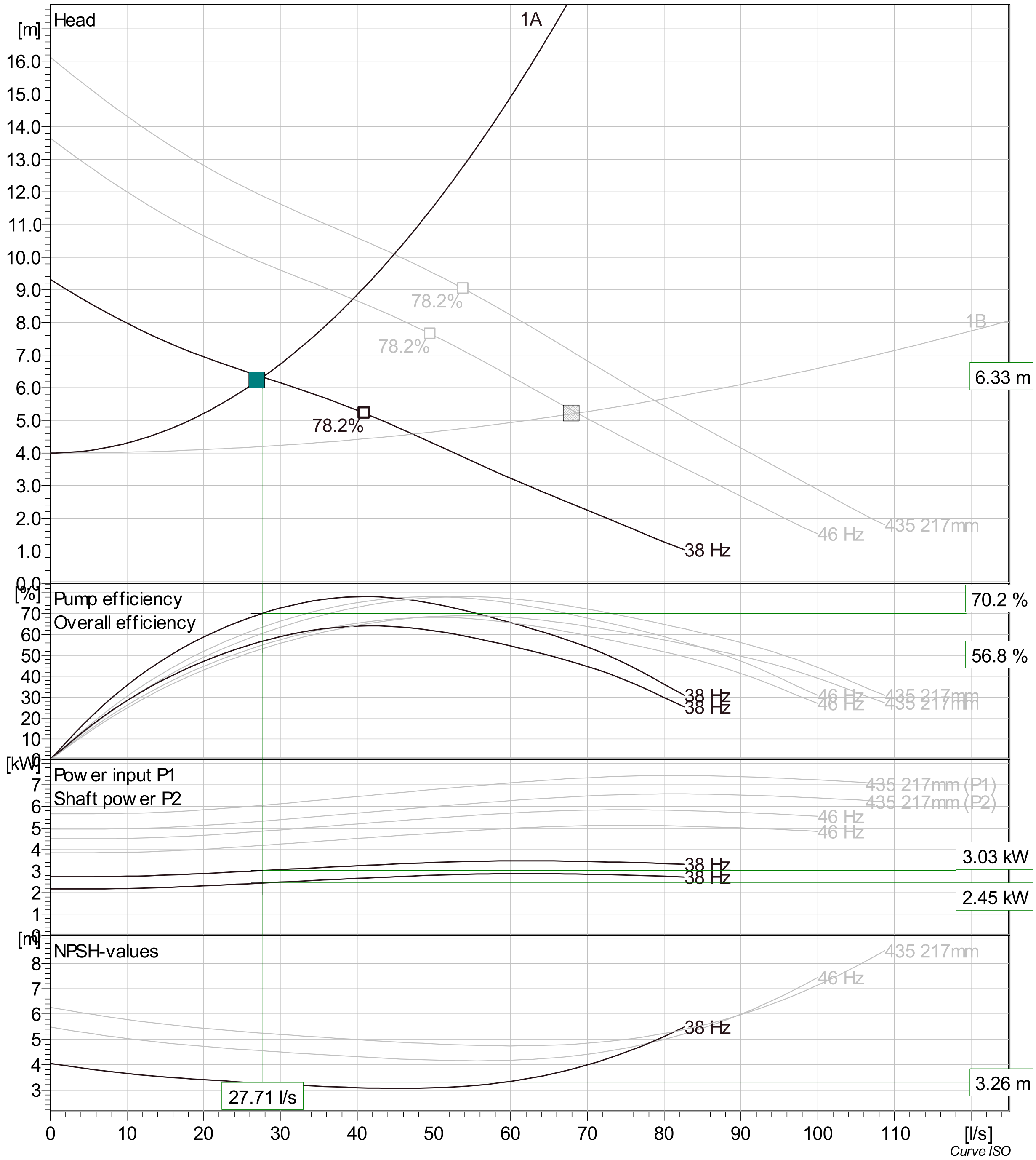
Parts List and Materials

	Description	Material	Standards / Remarks
1	Body BSP / NPT Male	Stainless steel	SS 316 ASTM A744 GR. CF8M
2	Neck	Glass Reinforced Nylon (C50-G) or Stainless Steel (C50-N)	SS 316 ASTM A744 GR. CF8M
3	Cover	Glass Reinforced Nylon (C50-G) or Stainless Steel (C50-N)	SS 316 ASTM A744 GR. CF8M
4	Shock Absorber	Polypropylene	
5	Top Float	Polypropylene	
6	Main Float	Polypropylene	Optional - Stainless Steel
7	Kinetic Plug	Nylon	
8	Peel Seal	EPDM	Optional - Viton
9	Kinetic Seal	EPDM	Optional - Viton
10	Hex domed nut	Stainless Steel	SS316 A4
11	Washer	Stainless Steel	SS316 A4
12	Float Rod	Stainless Steel	SS316 A4
13	Top Float Nut	Nylon	
14	Spring	Stainless Steel	SS316 A4
15	Washer	Stainless Steel	SS316 A4
16	Nut	Stainless Steel	SS316 A4
17	Insert M12	Stainless Steel	SS316
18	O-Ring	EPDM	Optional - Viton
19	Bolt	Stainless Steel	SS316 A4
20	Washer	Stainless Steel	SS316 A4
21	Surge Protection (Optional)	Glass Reinforced Nylon, PP, EPDM	
22	Inflow Prevention (Optional)	Glass Reinforced Nylon, PP, EPDM	

Appendix H – Pump Curves

NP 3153 MT 3~ 435

VFD Analysis



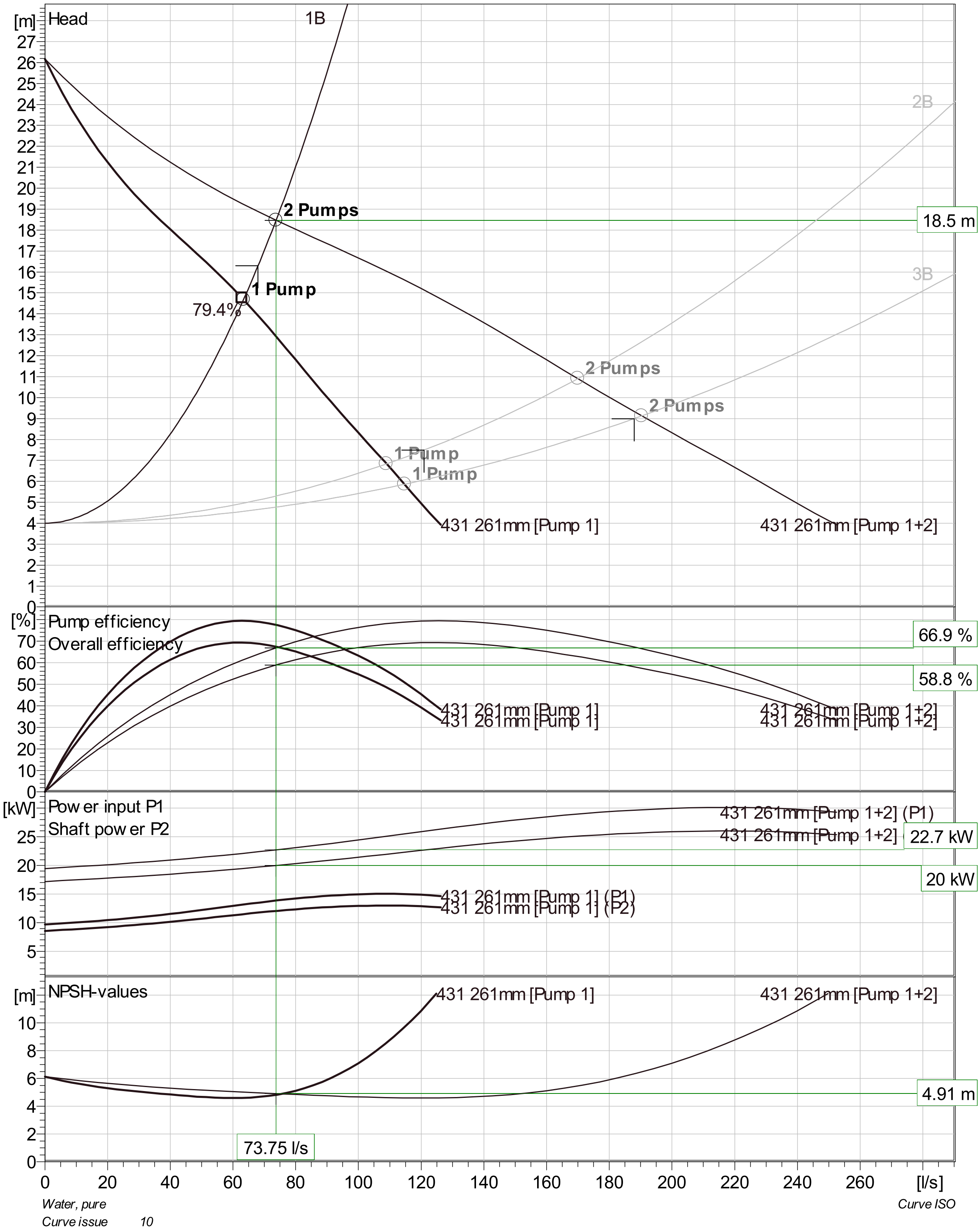
Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
1A	50 Hz	44.8 l/s	10.1 m	5.84 kW	44.8 l/s	10.1 m	5.84 kW	76 %	4.1E-5 kWh/l	4.9 m
1A	46 Hz	39.4 l/s	8.72 m	4.5 kW	39.4 l/s	8.72 m	4.5 kW	75 %	3.64E-5 kWh/l	4.32 m
1A	38 Hz	27.7 l/s	6.33 m	2.45 kW	27.7 l/s	6.33 m	2.45 kW	70.2 %	3.03E-5 kWh/l	3.26 m
1B	50 Hz	78.7 l/s	5.61 m	6.58 kW	78.7 l/s	5.61 m	6.58 kW	65.9 %	2.62E-5 kWh/l	5.16 m
1B	46 Hz	68.7 l/s	5.22 m	5.1 kW	68.7 l/s	5.22 m	5.1 kW	69 %	2.35E-5 kWh/l	4.36 m
1B	38 Hz	47.2 l/s	4.58 m	2.78 kW	47.2 l/s	4.58 m	2.78 kW	76.5 %	1.98E-5 kWh/l	3.06 m

xylem

NP 3153 MT 3~ 431

Duty Analysis

FLYGT

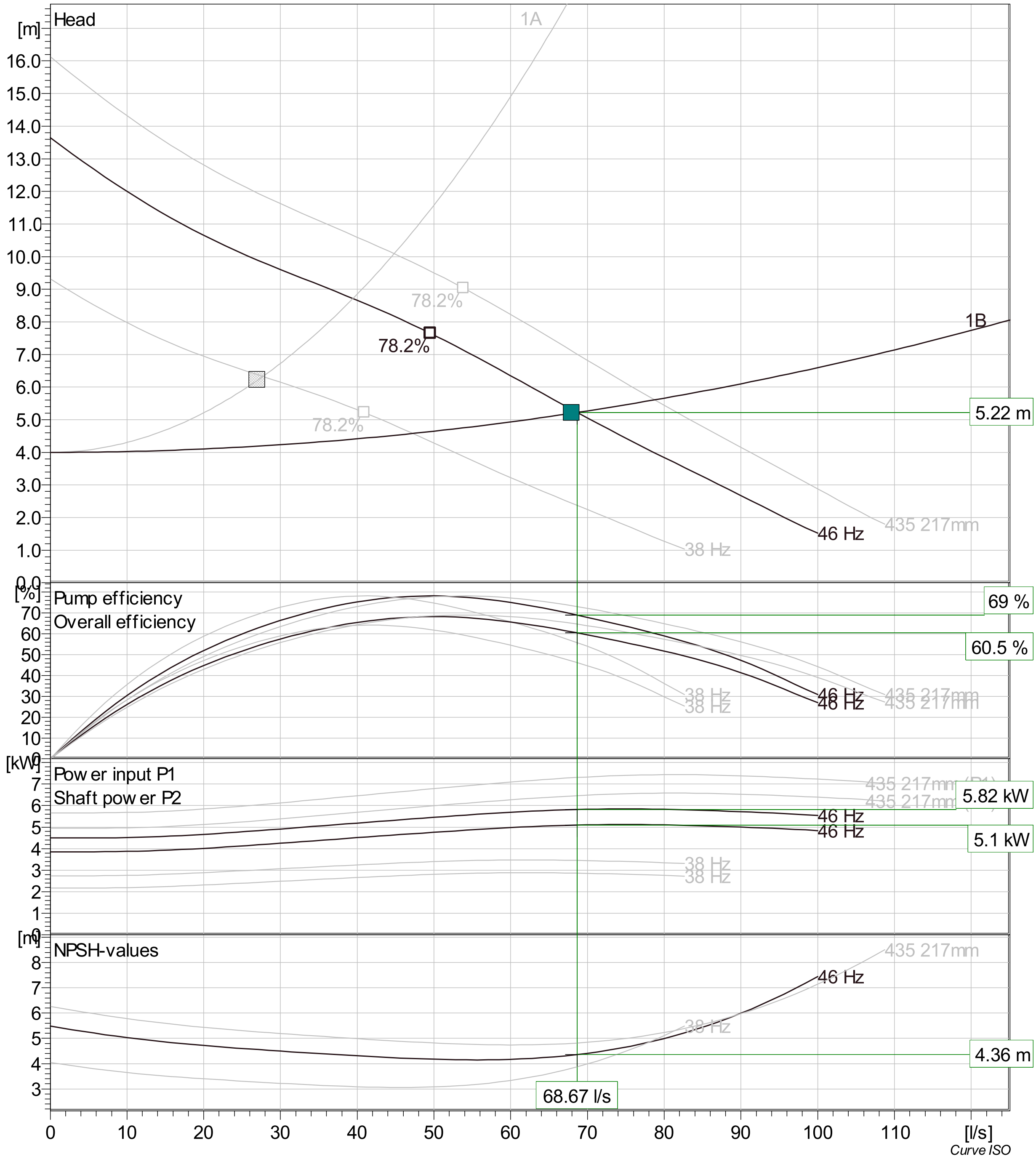


Pumps running /System	Individual pump			Total					
	Flow	Head	Shaft power	Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
2 / 2B	85 l/s	10.9 m	12.5 kW	170 l/s	10.9 m	25.1 kW	72.5 %	4.73E-5 kWh/l	5.45 m
1 / 2B	109 l/s	6.84 m	13 kW	109 l/s	6.84 m	13 kW	56.2 %	3.79E-5 kWh/l	8.56 m
2 / 1B	36.9 l/s	18.5 m	9.99 kW	73.8 l/s	18.5 m	20 kW	66.9 %	8.55E-5 kWh/l	4.91 m
1 / 1B	63.4 l/s	14.7 m	11.5 kW	63.4 l/s	14.7 m	11.5 kW	79.4 %	5.72E-5 kWh/l	4.61 m

Project	Project ID	Created by	Created on	Last update
			2016-12-13	

NP 3153 MT 3~ 435

VFD Analysis

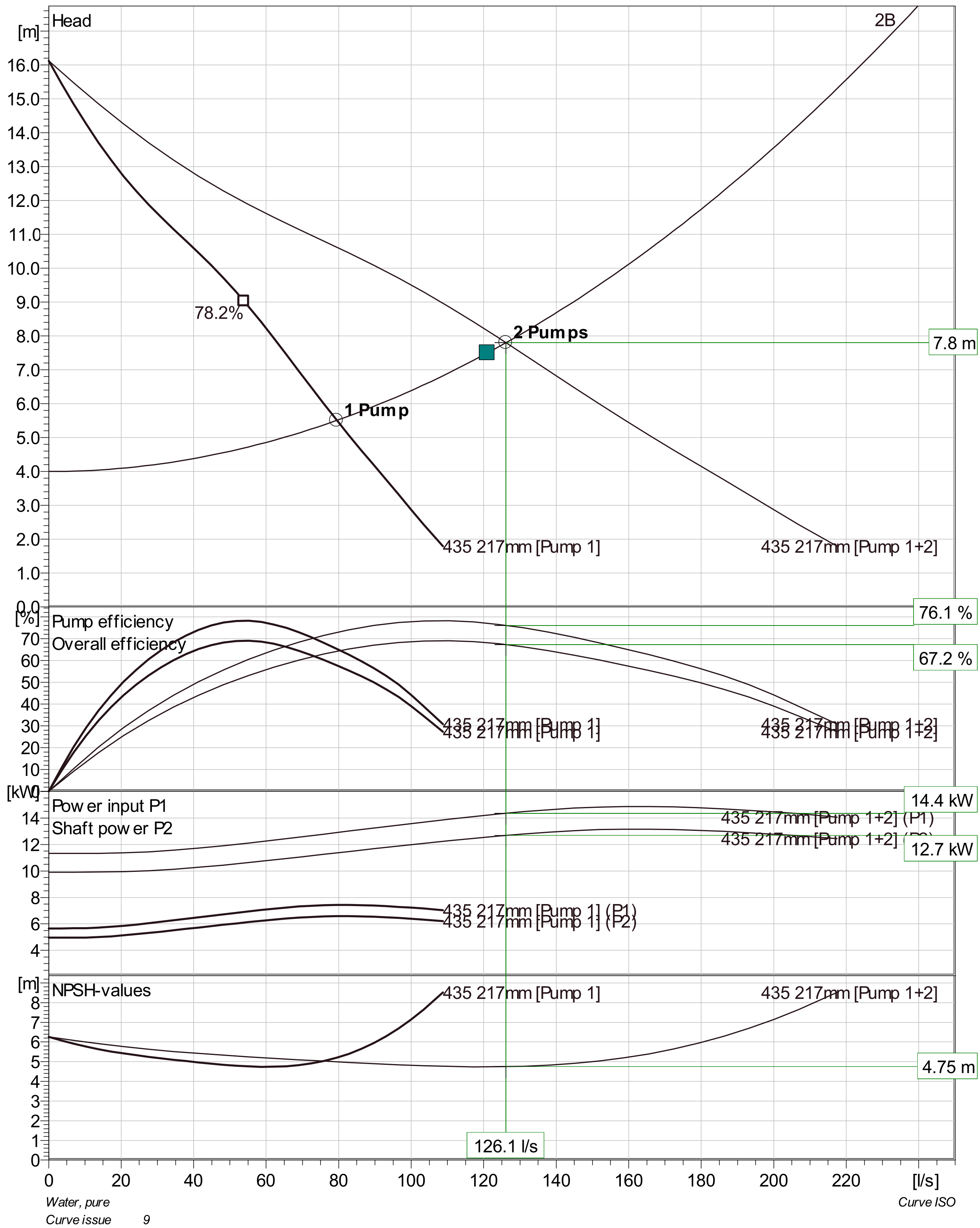


Pumps running /System	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
1A	50 Hz	44.8 l/s	10.1 m	5.84 kW	44.8 l/s	10.1 m	5.84 kW	76 %	4.1E-5 kWh/l	4.9 m
1A	46 Hz	39.4 l/s	8.72 m	4.5 kW	39.4 l/s	8.72 m	4.5 kW	75 %	3.64E-5 kWh/l	4.32 m
1A	38 Hz	27.7 l/s	6.33 m	2.45 kW	27.7 l/s	6.33 m	2.45 kW	70.2 %	3.03E-5 kWh/l	3.26 m
1B	50 Hz	78.7 l/s	5.61 m	6.58 kW	78.7 l/s	5.61 m	6.58 kW	65.9 %	2.62E-5 kWh/l	5.16 m
1B	46 Hz	68.7 l/s	5.22 m	5.1 kW	68.7 l/s	5.22 m	5.1 kW	69 %	2.35E-5 kWh/l	4.36 m
1B	38 Hz	47.2 l/s	4.58 m	2.78 kW	47.2 l/s	4.58 m	2.78 kW	76.5 %	1.98E-5 kWh/l	3.06 m

Project	Project ID	Created by	Created on	Last update
			2016-12-13	

NP 3153 MT 3~ 435

Duty Analysis



Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
2 / 2B	63.1 l/s	7.8 m	6.35 kW	126 l/s	7.8 m	12.7 kW	76.1 %	3.16E-5 kWh/l	4.75 m
1 / 2B	79.5 l/s	5.51 m	6.58 kW	79.5 l/s	5.51 m	6.58 kW	65.3 %	2.61E-5 kWh/l	5.2 m

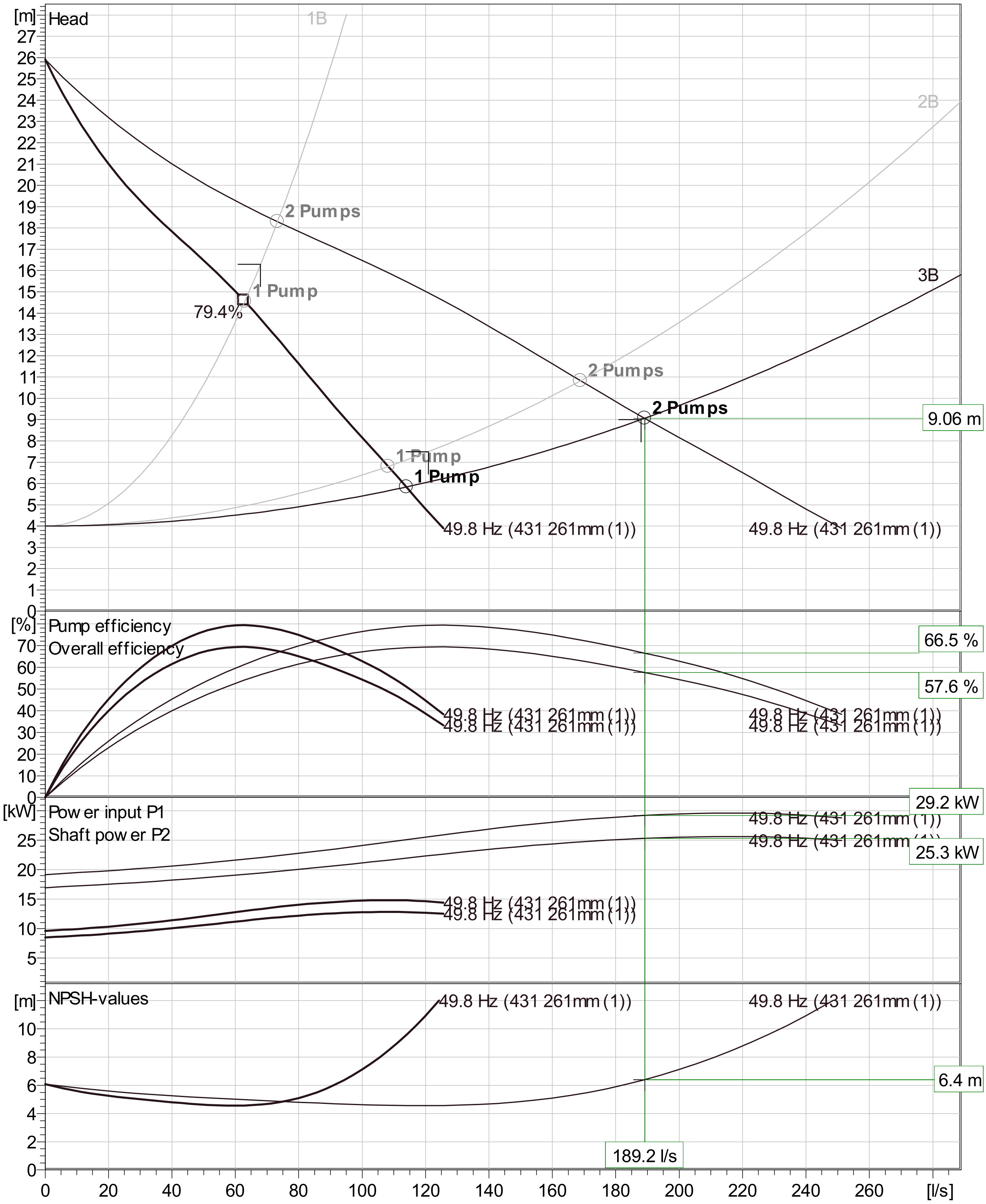
Project	Project ID	Created by	Created on	Last update
			2016-12-13	

xylem

NP 3153 MT 3~ 431

Duty Analysis

FLYGT



Water, pure *Curve ISO*

Curve issue *10*

Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Pump eff.	Specific energy	NPSHre
2 / 2B	84.5 l/s	10.8 m	12.4 kW	169 l/s	10.8 m	24.7 kW	72.5 %	4.68E-5 kWh/l	5.4 m
1 / 2B	108 l/s	6.8 m	12.8 kW	108 l/s	6.8 m	12.8 kW	56.3 %	3.75E-5 kWh/l	8.47 m
2 / 1B	36.7 l/s	18.3 m	9.84 kW	73.3 l/s	18.3 m	19.7 kW	66.8 %	8.47E-5 kWh/l	4.87 m
1 / 1B	63 l/s	14.6 m	11.3 kW	63 l/s	14.6 m	11.3 kW	79.4 %	5.67E-5 kWh/l	4.57 m

Project	Project ID	Created by	Created on	Last update
			2016-12-13	

Appendix I – Storage Calculations

Gravity Storage Calculation

	Storage level	SSMH1	SSMH2	SSMH3	SSMH4	SSMH5
Reduced Level	4.42					
Invert level (lower bound)	-0.121	-0.121	0.467	0.694	1.085	1.71
Invert level (higher bound)		-0.121	0.517	0.744	1.135	2.058
Top of pipe (highest of the 2 pipes)		0.559	1.197	1.424	1.815	2.39
Diameter of the manhole		1.54	1.54	1.54	1.54	1.54
Volume in the manhole	27.41	7.191693	6.003322	5.5805	4.852204	3.78118

BREMNER ROAD GRAVITY

Grade of pipe (%)		0.005	0.005	0.005	0.005
Angle of pipe (degrees)		0.286477	0.286477	0.286477	0.286477
Pipe length on long section (m) - horizontal		117.64	35.28	68.28	115.09
Pipe sections (m)		116.87	33.74	66.74	113.55
Pipe length at grade (m)		116.8715	33.74042	66.74083	113.5514
Pipe diameter (ID) (m)		0.68	0.68	0.68	0.68
Horizontal length to height ratio (m)		200	200	200	200
Horizontal length of pipe @ storage level (m)		pipe full	pipe full	pipe full	pipe full
Check if horizontal length of pipe @ storage level is less than actual pipe length		ok	ok	ok	ok
Pipe length @ grade and storage level (m)		pipe full	pipe full	pipe full	pipe full
Partial full volume (m3)		pipe full	pipe full	pipe full	pipe full
Volume in pipe (m3)	120.17	42.44399	12.25345	24.23814	41.23825
Full pipe volumes (for reference)		42.44399	12.25345	24.23814	41.23825

Pump Station Wet well diameter	3.05
Volume in the wet well above the invert level (m3)	35.95
Volume in the wet well below the invert level (m3)	3.65

Total volume of storage (m^3) **187.18**

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https://projects.ghd.com/oc/NewZealand/bremnerroaddevelopme2/Delivery/Documents/5134453-RPT_Item 1_Auranga Wastewater Design Report.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
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