



CIVIL

Physical Infrastructure Report

For

Development Application

For

Huntlee Stage 2 Urban Release Area

for Huntlee Pty Ltd

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1. INTRODUCTION

Northrop Consulting Engineers have been engaged by Huntlee Pty Ltd to prepare a Physical Infrastructure Report to support an Environmental Impact Statement and State Significant Development Application (SSDA-70748466) that seeks consent for the Huntlee New Town Stage 2 development. The project is seeking NSW Department of Planning Approval pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The intention of this report is to demonstrate consistency with the SEARs issued for the project on the 1st of August 2023. Further to this the intent is to demonstrate that the development can be serviced by essential infrastructure and that it satisfies the general requirements of state and local authorities. This report is not intended to supply detailed design for the Stage 2 infrastructure, including stormwater management and essential services, but rather identify the design principles, techniques and strategies to be adopted for the infrastructure, and where relevant, selection of performance criteria to be met as part of the future detailed infrastructure design. This document will therefore identify the minimum infrastructure and construction management requirements for the development moving forward.

This document is to be read in conjunction with Civil Engineering Plans provided in Appendix A. Included herein is further detail on the following with respect to the proposed development:

- Existing site description.
- Road Network.
- Riparian Corridor Management.
- Stormwater Quality and Quantity Management.
- Flooding.
- Erosion and Sediment Control.
- Essential Service Infrastructure.
- Operation and Maintenance.
- Construction Management Framework.

1.1 Objectives

The following report sections seek to fulfil the below objectives:

- To prepare a Concept Stormwater Management Strategy in accordance with the riparian corridor, flooding and water cycle management controls outlined with the 2013 Huntlee DCP to support the DA.
- To demonstrate the developments' capacity to be connected to essential services.
- To identify the minimum infrastructure and construction management requirements for the development moving forward into the next approval stages.

1.2 Project Background

1.2.1 Regional Context

Huntlee in its regional context, shown in **Figure 1**, is located to the south of the township of Branxton in the Hunter Valley in NSW. The Huntlee site straddles Wine Country Drive, which links Cessnock

with the New England Highway and Hunter Expressway approximately 20km north of Cessnock and 25km southeast of Singleton. The site is generally bound by the Main Northern Rail Line and Hunter Expressway to the north-east, existing North Rothbury township to the south-east and Black Creek to the west. Adjoining land uses include vineyards, rural residential development and general agriculture.



Figure 1 – Huntlee Development Regional Context

1.2.2 Huntlee Urban Release Area (URA)

The Huntlee Project is a major URA in the Hunter region which will provide housing for approximately 20,000 people accommodated within up to 7,500 dwellings. The project will deliver a new town comprising of a commercial centre, residential precincts, open spaces, recreation areas, conservation reserves and supporting employment lands. In its entirety the project will encompass:

- Up to 5,600 dwellings in residential zones of varying sizes covering up to 612 hectares.
- Employment lands totalling up to 200 hectares including a mixed-use town centre with up to 1,700 residential dwellings.
- Rural residential development covering up to 93 hectares to achieve up to 200 lots.
- The provision of associated infrastructure including upgrades to road, sewerage and water infrastructure and the dedication of land for education and health services, community facilities and utilities.

- Dedication of 780 hectares of conservation land within Huntlee.
- Dedication of Persoonia Park (17 hectares).
- Dedication of 4,988 hectares of conservation land elsewhere within the Lower Hunter Region.

In 2013 the Huntlee Development Control Plan (DCP) was adopted by the Director-General of the Department of Planning and Infrastructure pursuant to the provisions of Section 74C of the Environmental Planning and Assessment Act, 1979 (the Act). The DCP applies to all development on the land in Zone R1 General Residential, Zone R2 Low Density Residential and Zone B4 Mixed Use within the Huntlee site and is to be used to assess all development applications.

Figure 2 below shows an extract from the DCP illustrating the extent of the Huntlee Project Area and respective LGA's.

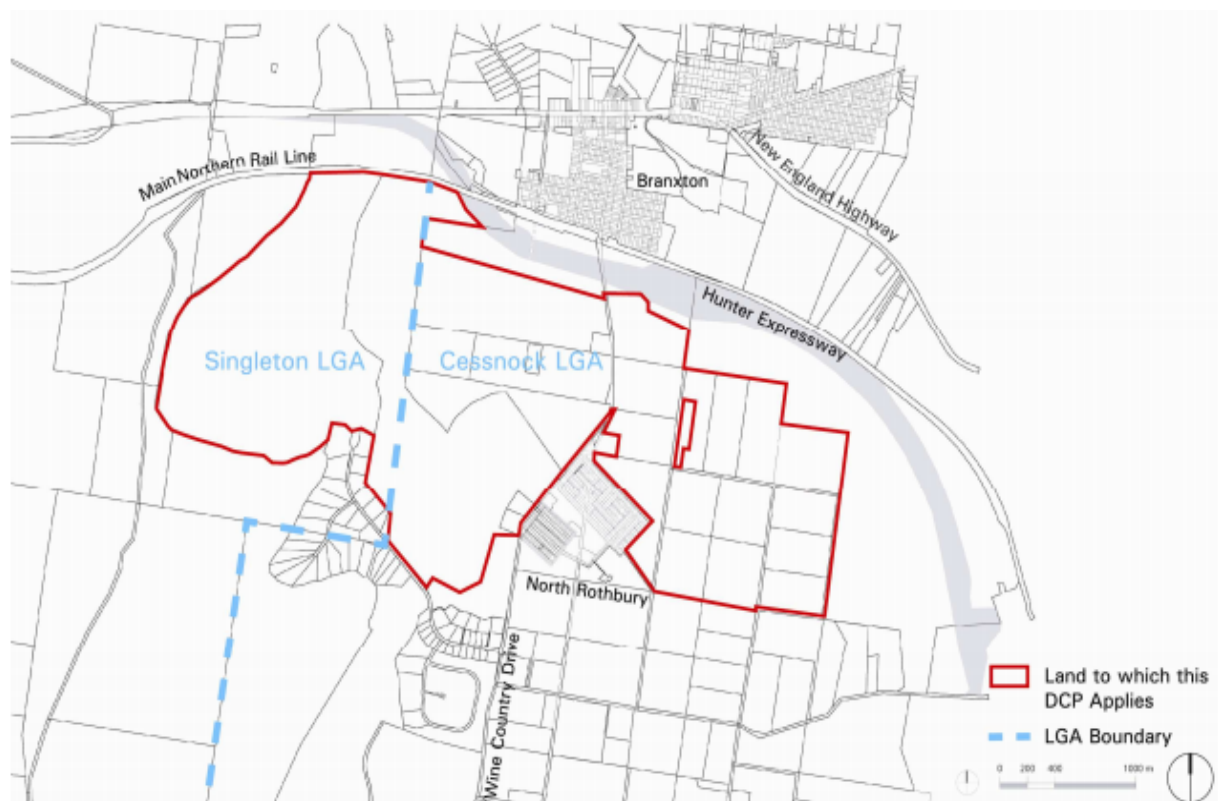


Figure 2 – Extract from Huntlee DCP 2013

The key development objectives for Huntlee as outlined by the DCP are to:

- Facilitate urban development that meets environmental sustainability objectives.
- Promote housing diversity by providing a range of housing types.
- Create walkable neighbourhoods, with good access to public transport.
- Maximise opportunities for local employment and business.
- Create vibrant, successful town and neighbourhood centres.
- Provide social infrastructure that is flexible and adaptable.
- Maximise opportunities for future residents to access and to enjoy the outdoors.
- Protect and enhance riparian corridors, significant trees and vegetation.

1.2.3 Stage 1 Project Area

The Stage 1 Project Area was granted approval in 2013 and covers approximately 360ha of the Huntlee URA, much of which is now well into the construction phase. The Stage 1 Project Area in context of the overall Huntlee development framework is shown below in **Figure 3** in blue.

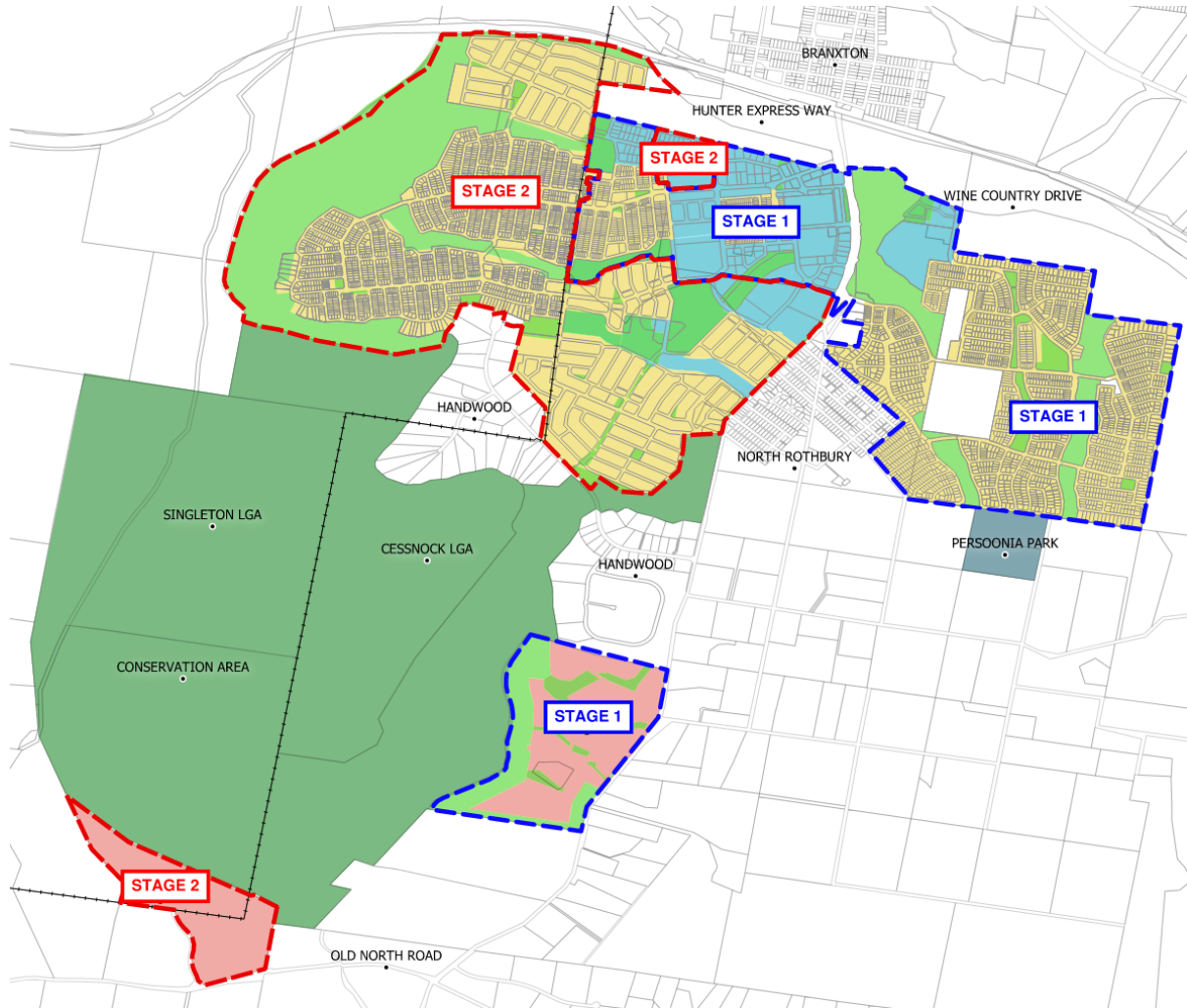


Figure 3 – Stage 1 & 2 Project Areas within Overall Huntlee Development Framework

The Stage 1 Project Area includes the first residential village extending north-east of the existing North Rothbury township, approximately 50ha of the Town Centre and approximately 80ha of large residential lots located off WCD to the south of the Town Centre within the suburb of Rothbury.

1.3 Proposed Development – Stage 2 Project Area

Shown in red in **Figure 3** is the Huntlee New Town Stage 2 Project Area, which covers the remaining development areas, comprising the concept development for the Stage 2 sites including Villages 2 and 3, land off Old North Road and the Town Centre North area, and the detailed development for the central and southern areas of Village 2. The proposal represents the next phase of an extensive planning, assessment and consultation process completed to date for the development of the Huntlee New Town site.

Specifically, this SSDA proposes the following works:

- A Concept Master plan for the Stage 2 site, comprising:

- Overall Stage 2 development footprint, including:
 - The remaining Town Centre North area.
 - Villages 2 and 3.
 - A large lot residential area located to the south of the site on Old North Road.
- Proposed land use and development yield, including the provision for residential subdivision of approximately 5,000 lots.
- Associated new road network and required upgrades to existing network.
- Site-wide open space and riparian areas.
- Detailed development of Village 2 Central and South and eastern connection to the Town Centre, comprising:
 - Demolition and clearing of existing built form structures.
 - Clearing of existing vegetation within proposed development footprints.
 - Open space, recreation, community and riparian areas.
 - Construction of road and access infrastructure.
 - Bulk earthworks.
 - Stormwater and drainage works.
 - Utilities and services, including:
 - Sewer and potable water reticulation.
 - Electricity and communications infrastructure.
 - Subdivision to facilitate approximately 1,750 lots across the Village 2 Central and South areas and Town Centre development lots, comprising approximately 1,730 residential lots, eight (8) medium density superlots, two (2) commercial/mixed use lots and open space areas.
 - Select clearing and grading to establish temporary Asset Protection Zones where development interfaces with the Concept Master plan area.

1.3.1 Stage 2 DA - Detailed & Concept Project Areas

As noted in Section 1.3 above, the proposal has been broken down into two area types for 'Detailed' and 'Concept' submission. This breakdown is depicted in **Figure 4** below, with detailed areas shown in dashed pink outline and concept areas shown in black dashed outline.

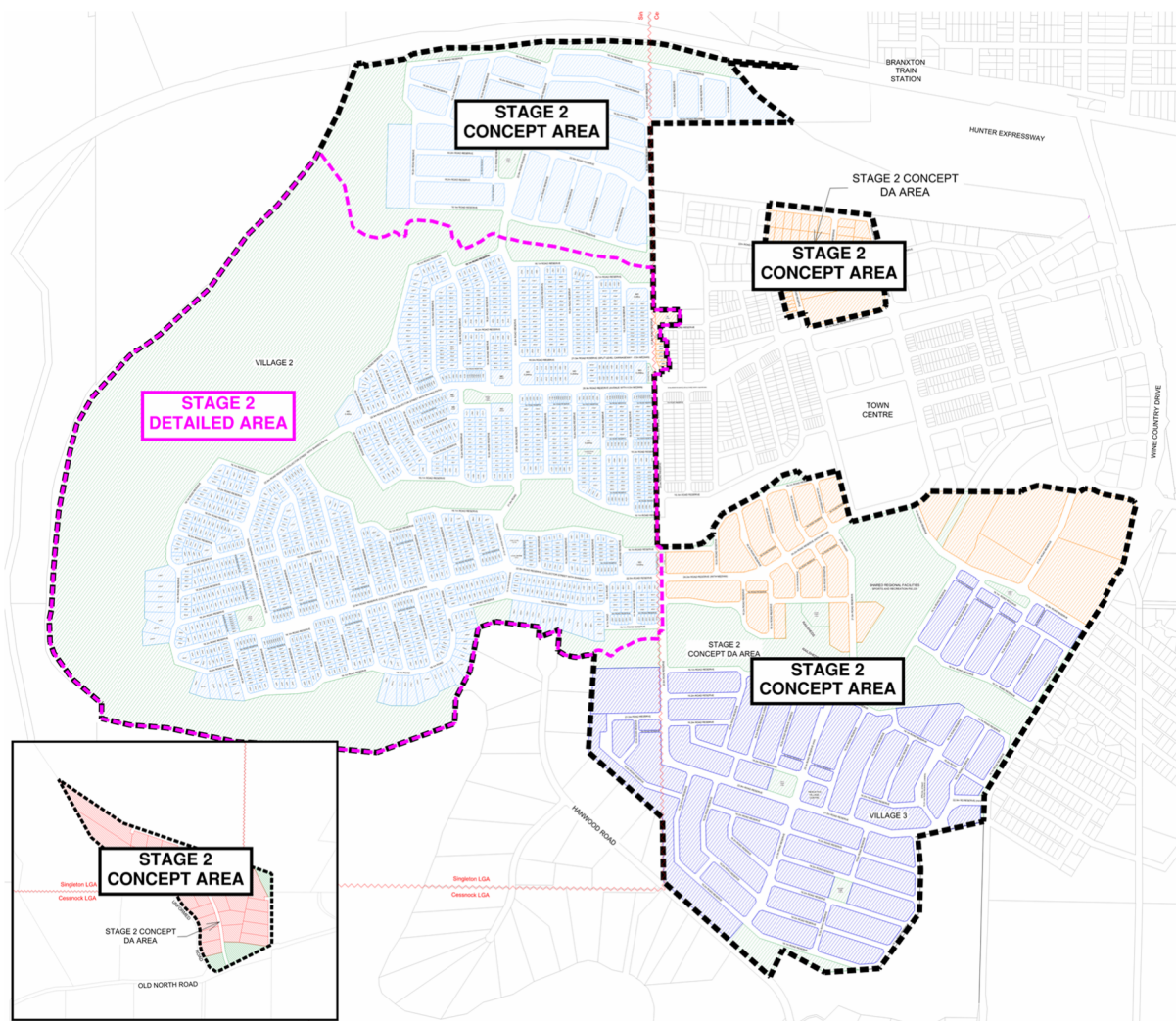


Figure 4 – Huntlee Stage 2 Concept & Detailed Project Areas (Source: Daly Smith)

1.4 Proposed Staging

To enable a logical land release, the subdivision will be undertaken in stages. The Detailed Stage 2 Area will be delivered in 38 stages, comprising a variety of lot types. The proposed staging for the detailed area is illustrated in **Figure 5** below. The Concept Stage 2 Area will adopt a similar staging strategy which will be developed at the detailed design phase.

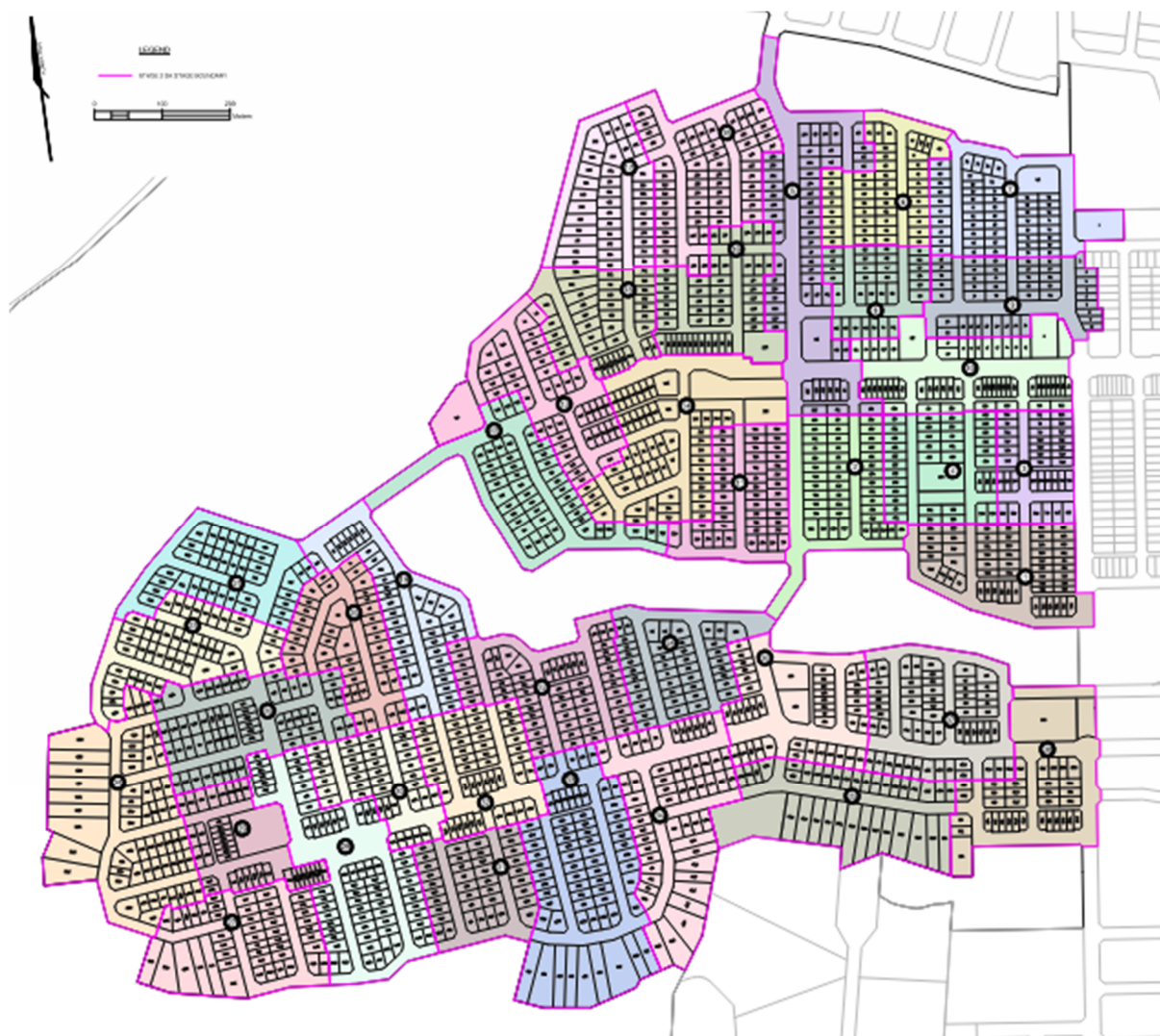


Figure 5 – Huntlee Stage 2 Detailed DA Staging Plan (Source: Daly Smith)

It is intended that there will be flexibility in the staging of the subdivision to meet commercial and market conditions. In scenarios where a development stage crosses or borders an LGA boundary, consultation will be jointly undertaken with Cessnock City Council and Singleton Council to coordinate approval requirements and infrastructure delivery and ownership. There is a site specific DCP for the Huntlee site that has been adopted by both Councils which standardises subdivision design requirements.

1.5 Response to Secretaries Environmental Requirements (SEARS)

In conjunction with the Civil Engineering Plans provided within Appendix A, this report intends to address the relevant Secretaries Environmental Requirements (SEARS). These requirements and area in which they have been addressed have been summarised below in Table 1.

Table 1 - Secretaries Environmental Requirements (SEARS)

Item for Inclusion	Addressed By
3. Subdivision and Civil Design	
Include a concept subdivision layout including. • Urban structure plan identifying the intended land uses • Road network with road hierarchy, including proposed road typologies and typical cross sections • An integrated active transport network • An open space plan identifying the intended uses for each area of open space	Refer following plans prepared by Hatch & MWLA. • Lot Type • Lot Count • Road Hierarchy • Active Transport Network • Public Embellishment Road typologies refer Report Section 9
Detailed subdivision layout for Stage 1 (detailed area) identifying: • Subdivision layout, including lot sizes and dimensions • Road network, with road reserve and carriageway widths • Integrated active transport plan identifying footpath and cycle path locations, detailing how it integrates with Huntlee New Town Stage 1 and the proposed subsequent stages. • Open space plan identifying the use of each open space and proposed embellishments	Refer following plans prepared by Hatch & MWLA. • Base Plan • Allotment Plan • Active Transport Network • Public Embellishment Refer Civil Engineering Drawings provided within Appendix A and Report Section 9 for road network details.
Include a concept bulk earthwork plan for the entire development area, including a bulk earthworks strategy identifying the concept grading.	Refer Civil Engineering Drawings provided within Appendix A for Cut & Fill Plans prepared for the concept project areas.
Include a detailed bulk earthworks plan for the Stage 1 area identifying proposed finished levels and an overall cut/fill analysis.	Refer Civil Engineering Drawings provided within Appendix A for Bulk Earthwork Plans prepared for the detailed project areas.
Include concept civil plans for the development area including typical road cross-sections	Refer Civil Engineering Drawings provided within Appendix A for Concept Civil Plans prepared for the concept project areas. Included also are typical road cross sections.
Include civil plans for the Stage 1 (detailed area) of the development including: • Long sections of all roads • Cross sections of road reserves • Location, size, and type of any retaining walls proposed	Refer Civil Engineering Drawings – Detailed Area provided within Appendix A for typical cross sections, road long sections, retaining wall extents and typical details.
7. Traffic, Transport & Accessibility	
Include a Traffic and Transport Impact Assessment prepared in accordance with the Austroads Guide to Traffic Management Part 12, the complementary TfNSW Supplement and RTA Guide to Traffic Generating Development.	Refer Traffic & Transport Impact Assessment prepared by Arcadis.
Include details of the proposed development, including pedestrian and vehicular access arrangements (including	Refer Traffic & Transport Impact Assessment prepared by Arcadis.

swept path analysis of the largest vehicle and height clearances), parking arrangements and rates (including bicycle and end-of-trip facilities), drop-off/pick-up zone(s) and bus bays (if applicable), and provisions for servicing and loading/ unloading.	Refer to Civil Engineering Drawings for typical intersection arrangement swept paths.
12. Flooding	
Identify and describe any on-site flood impacts and risks associated with the proposed development, having regard to the relevant provisions of the NSW Floodplain Development Manual and other local or State studies and guidance	Refer Flood Impact and Risk Assessment prepared by Northop Consulting Engineers.
Describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	Refer Flood Impact and Risk Assessment prepared by Northop Consulting Engineers.
Assess the impacts of the development, including any changes to flood risk both on-site or off-site, and identify any mitigation and management measures to minimise the impacts of flooding on the proposed development.	Refer Flood Impact and Risk Assessment prepared by Northop Consulting Engineers.
15. Stormwater Drainage & Water Quality	
Provide an Integrated Water Management Plan for the development that is prepared in consultation with both local councils and any other relevant drainage or water authority	This report provides an Integrated Water Management Plan for the proposed development. Refer Appendix C for Council Consultation including provided stormwater summaries & meeting minutes.
Outlines the water-related servicing infrastructure required by the development (informed by the anticipated annual and ultimate increase in servicing demand) and evaluates opportunities to reduce water demand (such as recycled water provision).	Refer Report Section 10 – Essential Infrastructure below.
Details the proposed drainage design (stormwater and wastewater) for the site including any on-site treatment, reuse and detention facilities and their proposed locations, water quality management measures and nominated discharge points.	Refer Report Section 10 below regarding wastewater treatment. For stormwater detention and treatment refer following. • Report Section 6 and 7 below. • Civil Works Engineering Design Drawings • Concept Stormwater Management Plan provided in Appendix B.
Demonstrates compliance with the local council or other drainage or water authority requirements and avoids adverse downstream impacts.	Refer report sections 3-7 below.
Includes the proposed civil design of the stormwater and wastewater networks for Stage 1 (detailed area) including long sections, pipe sizing, inverts, pit sizes and detailed basin or detention design.	Refer to Engineering Design Drawings – Detailed Area Civil Works Plans in Appendix A.
Where drainage infrastructure works are required that would be handed over to the local council, or other drainage or water authority, provide full hydraulic details and detailed	Refer to Engineering Design Drawings – Detailed Area Civil Works Plans and

plans and specification of proposed works that have been prepared in consultation with, and comply with the relevant standards of, the local council or other drainage or water authority	stormwater pipe long sections provided in Appendix A. Refer Appendix C for Council Consultation including provided stormwater summaries & meeting minutes.
16. Ground and Water Conditions	Refer Geotechnical Assessment Report prepared by Stantec. Surface Water Impact also assessed with Report Sections 3-7 below.
17. Geotechnical and Mine Subsidence	Refer Geotechnical Assessment Report prepared by Stantec.
20. Construction	
Include an assessment of any potential impacts of construction on the amenity of the surrounding area (including the public domain and areas within the site that was been completed) with respect to noise and vibration, air quality, dust and particle emissions, water quality, storm water runoff, groundwater seepage, soil pollution and construction waste, having regard to relevant standards and guidelines, and identify required measures to mitigate potential impacts to acceptable levels	Refer Preliminary Construction Management Plan prepared by Northop Consulting Engineers.
Include a Construction and Pedestrian and Traffic Management Plan for Stage 1 addressing: • details of peak hour and daily construction and servicing • vehicle movements and access arrangements and cumulative impact from surrounding development sites, on the local road network, public transport services and parking (including the temporary loss of parking on the site) • road safety at key intersections and locations subject to heavy vehicle movements and high pedestrian activity • details of access arrangements for workers to/from the site, emergency vehicles and service vehicle movements • details of temporary cycling and pedestrian access during construction demonstrating that pedestrian and bicycle rider movements along footways and cycleways are maintained at all times during construction activities. Should the development require closure of either facility, adequate safety measures and diversion measures to limit time delay and detour distances should be detailed. • assessment of traffic and transport impacts during construction and how these impacts will be mitigated for any associated traffic, pedestrians, cyclists and public transport operations.	Refer Preliminary Construction Management Plan prepared by Northop Consulting Engineers.
include a Concept Construction Management Plan for subsequent stages that details the intended construction for subsequent stages of the development, including: • construction timeframes and sequencing • vehicle numbers to be generated by each stage of	Refer Preliminary Construction Management Plan prepared by Northop Consulting Engineers.

• construction • vehicle paths for each stage of construction	
22. Infrastructure and Utilities	
The EIS must, in consultation with the relevant service provider: • assess the impacts of the development on existing utility infrastructure service provider assets surrounding the site. • identify any infrastructure upgrades required on-site and off-site to facilitate the development and any arrangements to ensure that the upgrades will be implemented on time and be maintained. • Consider the environmental and amenity impacts of any infrastructure upgrades including (but not limited to) wastewater services. • Provide an infrastructure delivery and staging plan, including a description of how infrastructure requirements would be coordinated, funded and delivered to facilitate the development. • Provide detailed infrastructure plans for the Stage 1 area detailing the alignment and location of utilities and stormwater services. • Provide concept infrastructure plans for the Concept Plan area outlining the serviceability of these precincts and indicative alignments. • Address any requirements of the Transport and Infrastructure SEPP in relation to development on or adjacent to utilities and infrastructure. • Address the matters raised by NSW EPA in Appendix B	Refer Report Section 10 – Essential Infrastructure below and supporting documentation: • Appendix E – Water Servicing Information • Appendix F - On-site Wastewater Servicing Plan • Appendix G – Electrical and Lighting
23. Staging	
Provide details of how construction and operation would be managed and any impacts mitigated.	Refer Preliminary Construction Management Plan prepared by Northop Consulting Engineers.
Details of the staging and/or sequencing of the proposed development and how development over LGA boundaries would be managed.	Refer to Stage 2 Detailed Staging Plan prepared by Daly Smith and Report Section 1.4.

1.6 Relevant Policies and Guidelines

A number of legislative policies and guidelines relate to the proposed development of the Huntlee Project Area. Notably the following guidelines have been considered in relation to the stormwater and physical infrastructure investigation.

- **Environmental Planning and Assessment Act 1979**

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the statutory framework for environmental assessment and planning approval in NSW. In accordance with Division 4.1 of Part 4 of the EP&A Act, this project is considered to be a 'State Significant Development' (SSD). The Huntlee Development Control Plan 2013 commissioned under the provisions of Section 74C of the Environmental Planning & Assessment Act, 1979 (the Act).

- **‘Guidelines for Riparian Corridors on Waterfront land’ (DPI Water)**

Controlled activities carried out in, on or under waterfront land are regulated by the Water Management Act 2000 (WMA). The Department of Primary Industries – Office of Water Administers the Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to land within 40 meters of a river, lake or estuary as a consequence of carrying out the controlled activity. Previous Stages of the Huntlee project have been assessed under Part 3A, meaning the development proposal was not legally bound to meet the requirements of the WMA. Despite this the WMA was considered best practice and was therefore applied in principle to the previous proposal.

- **Australian Rainfall and Runoff 2019**

Australian Rainfall and Runoff (AR&R) a document originally published in 1987 by the Institution of Engineers, Australia (IEAust) which has recently been revised and re-released in 2019. The document provides designers with the best available information on design stormwater and flood estimation and is widely accepted as a design guideline for all flood and stormwater related design in Australia.

- **Australian Runoff Quality**

Australian Runoff Quality (ARQ) is a document published in 2005 by IEAust which provides design guidelines for all aspect of water sensitive urban design (WSUD), including preventative measures, source controls, conveyance controls and end of line controls. Additionally, it provides guidance for water quality modelling as well as stormwater harvesting and re-use.

- **2013 Huntlee DCP**

The Huntlee site falls under the jurisdiction of both Singleton and Cessnock City Council LGAs. On the 12 June 2013 the integrated Huntlee DCP became effective superseding all previous development controls over the site. The DCP applies to all development on the land in Zone R1 General Residential, Zone R2 Low Density Residential and Zone B4 Mixed Use within the Huntlee site. While Council DCPs are primarily a detailed design guideline, the underlying principles have been adopted to ensure compliance can be achieved at the detailed design stage.

- **Cessnock City Council (CCC) Engineering Requirements for Development**

This specification sets out minimum standards and guidelines for the engineering works required for developments within CCC, covering the design and construction of road, transport, drainage and associated assets.

- **CCC Draft Engineering Guidelines for Design and Construction**

CCC has recently updated the Engineering Guidelines for Design and Construction to reflect a new generation of specifications developed for widespread use by local councils. At the time of writing this report, the Guidelines have been on Public Exhibition and are currently on review.

- **Singleton Council (SC) Development Engineering Specifications**

This guideline details specifications for engineering designs including road and pavement design, stormwater management and site regrading.

- **Draft Singleton Council Engineering Design Guidelines**

SC Draft Engineering Design Guidelines outline Council's requirements for the design, construction and maintenance of public infrastructure assets and subdivisions within the Singleton Local

Government Area. At the time of writing this report, the Guidelines have been on Public Exhibition and are currently on review.

- **Erosion and Sediment Control**

In NSW, the most relevant and comprehensive guideline for the designs of stormwater and sedimentation controls is contained in *Managing Urban Stormwater Volume 1 – Blue Book* (Landcom, 2004). The principles of surface water control, including the design of erosion and sediment control structures, have been adopted where applicable in this stormwater assessment.

2. SITE CHARACTERISTICS

2.1 Existing Site Conditions

Stage 2 encompasses approximately 541.7 hectares within the Huntlee URA. Whilst not currently considered developed, various land uses over time have resulted in significant disturbance across vast areas of the site. Excluding areas of former mine workings, the site is predominately vegetated and can generally be categorised into one of two land types; being either medium to dense bushland or cleared agricultural grazing pasture. Land used for grazing purposes is generally located along the western boundary of the site along the Black Creek floodplain. Notable residential development within close proximity of the site includes the township of North Rothbury to the north and Stage 1 of the Huntlee Urban Release Area to the north east. A portion of the site formally housed the Ayrfield Colliery. Remnant infrastructure from mining and quarry operations including a number of buildings, structures, railway corridor and water storage dams exist onsite. Areas of waste emplacement and land fill resulting from these operations are also evident.

The topography of the site is characterised by gently undulating terrain with elevations ranging between 22m and 121m AHD. With the exception of the old rail corridor, storage dams and ash stockpiles associated with the old Colliery operations, average surface slopes across the vicinity of the catchment do not appear to have been greatly modified from natural conditions. Grades range from 5% to 10% across the majority of the site with channel grades within the tributaries and Black Creek ranging between 0% and 5%.



Figure 6 – Aerial View of Northern Stage 2 Development Extents (Source: Nearmap)



Figure 7 – Aerial View of Southern Stage 2 Development Extents (Source: NSW Six Maps)

Aerial images of the northern and southern portions of the development are shown respectively in **Figure 6** and **Figure 7**. The imagery has been obtained from the NSW Governments Spatial Services web source Six Maps and generally depicts the nature of the land within the catchment at the time of undertaking this study.

2.2 Available Topographic Data

Due to the size of the site, detailed survey has not yet been undertaken for the entirety of the development footprint. To date, detailed survey data has been obtained across the proposed Detailed Stage 2 Project Area. It is understood that detailed survey of the entire development footprint, including Concept Areas and creek bathymetry, will be undertaken on a stage-by-stage basis during the detailed design phase. For the purpose of this assessment, a calibrated surface combining available detailed survey data with Light Detection and Ranging (LiDAR) aerial survey will be adopted. It is noted that the accuracy of the ground information obtained from LiDAR survey can be adversely affected by the nature and density of vegetation, the presence of steeply varying terrain, the vicinity of buildings and/or the presence of water. The accuracy is typically plus or minus 0.15 m for clear terrain. As this assessment has been undertaken to inform the concept planning of the proposal the level of accuracy provided by the LiDAR data has been considered acceptable. It is however recommended that full detailed survey be used to undertake future detailed designs.

2.3 Existing Catchment

Natural drainage within Stage 2 is predominately characterised by unnamed ephemeral tributaries which drain in a westerly direction towards Black Creek, a major branch of the Hunter River. Black Creek runs in a northerly direction marking the Sites' western boundary. Black Creek is a significant feature of the Singleton LGA and the Cessnock LGA, with a large proportion of the Cessnock LGA population living within its catchment. A small portion of the Stage 2 development does drain in a north -easterly direction towards the existing Huntlee Town Centre into an unnamed tributary of the Anvil Creek, also a major arm of the Hunter River. **Figure 8** below illustrates the extent of these sub catchments across the project area, with the blue catchment draining to Black Creek and the purple catchment draining to Anvil Creek.

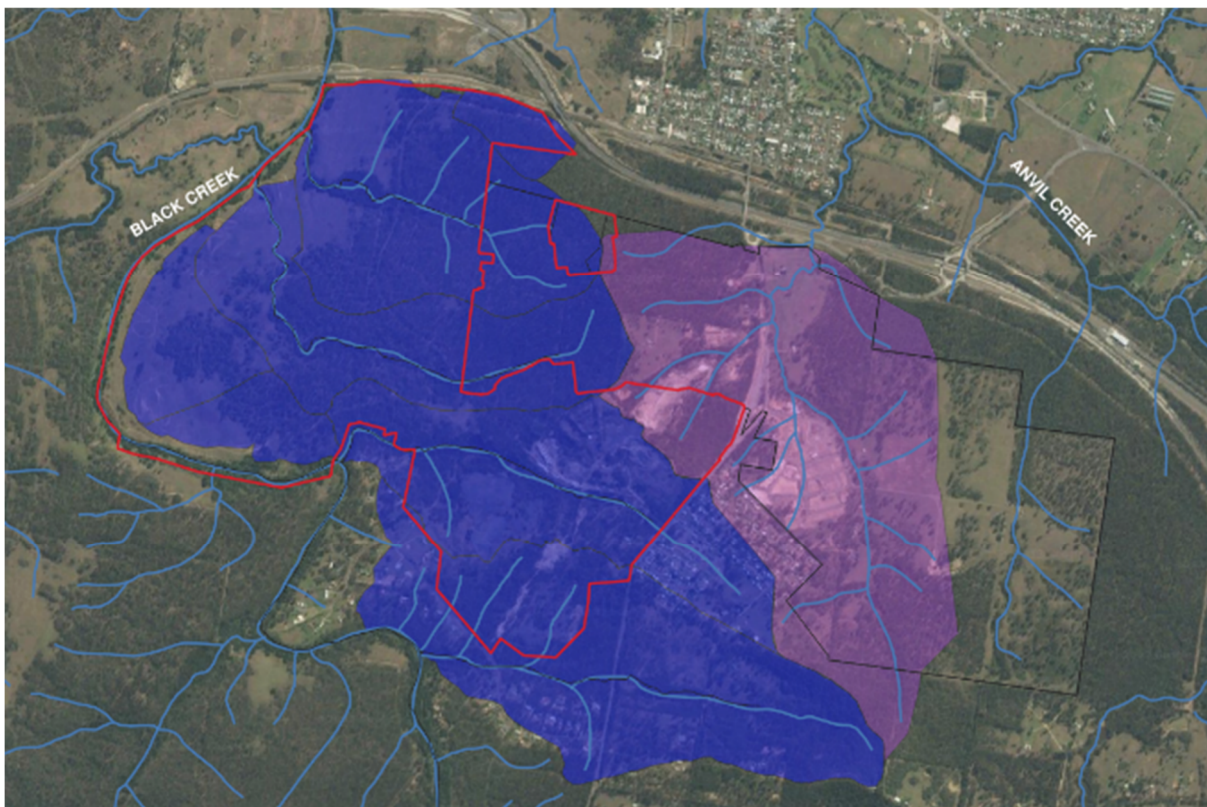


Figure 8 – Black and Anvil Creek Sub-Catchment Extents Across Stage 2 Project Area

In addition to the natural drainage lines, a number of water storage dams of varying sizes, associated with agriculture and former mining operations are also found across the site.

Six main tributaries have been identified within the Huntlee Project Area. Four of the tributaries are predominantly located within Stage 2 of the site and drain to the Black Creek catchment. The remaining two tributaries are in Stage 1 and drain to the Anvil Creek Catchment. The tributaries have been classified in accordance with the Strahler watercourse order method. Excluding Black Creek, the identified watercourses are predominately ephemeral tributaries of first and second order with bed slopes of 1-2%. These tributaries were found to be fed by shorter steeper drainage lines with bed slopes of 3-5%. Condition of the watercourses was found to vary from highly disturbed in areas of former colliery operations to relatively undisturbed in areas of dense bushland. **Figure 9** illustrates the identified watercourses and determined order within the Stage 2 Project Area. It is noted that a defined creek bed was not always evident along the mapped 1st order tributaries.

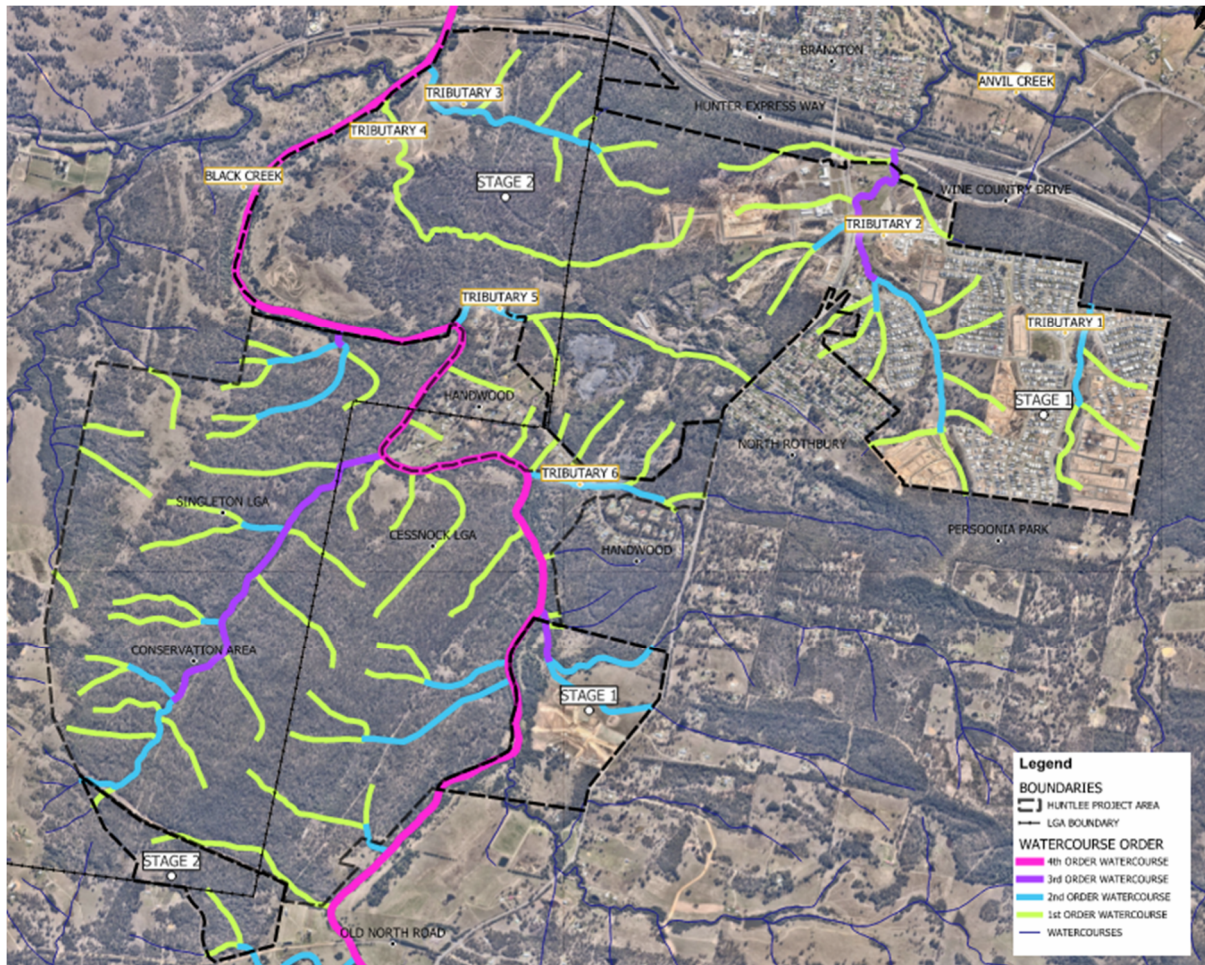


Figure 9 – Existing Watercourses within Stage 2 Project Area

2.4 Black Creek

The entire catchment of Black Creek is approximately 307km² and extends from the Broken Back Range in the west to the Cessnock State Forest in the east. The catchment headwaters are in the Aberdare State Forest to the south of Cessnock. Within the lower reaches the network runs through large areas of agriculture land and is therefore subject to a significant volume of licensed water extraction for irrigation purposes. Within the subject site, Black Creek is characterised by an almost flat bed that maintains permanent flows.

Effluent from the Cessnock wastewater treatment works is discharged to Black Creek approximately 12km upstream of the Huntlee development boundary. Previous studies undertaken by Council have documented the Black Creek catchment as having poor water quality. In particular, the salinity ingress and leachate with low pH from old mine workings including the Ayrfield Colliery have been noted.

The Black Creek catchment has an extensive flooding history with significant flooding events recorded in 1927, 1949, 1974, 1977, 2007 and most recently in 2015. Cessnock City Council commissioned a flood study from Nulkaba to Branxton published in 2015 by WMA Water. Singleton Council have also commissioned a Floodplain Risk Management Study and Plan, which includes flood information on the Black Creek catchment. This flood study was prepared by BMT in 2022 and has now been adopted. It focuses primarily on the impacts of regional Hunter River catchments but also includes a local overland flood assessment on the Stage 2 Project Area and Black Creek. The assessment recommends the outcomes of the flood study be used by Council as a planning tool to mitigate flood

risk to future development in the catchment. In accordance with this recommendation, and in accordance with concurrence received from the Department of Planning, development within the Black Creek catchment across the Huntlee site has been governed by the flood inundation levels obtained from Singleton City Council.

Figure 10 and Figure 11 shown below illustrate the hazard categorisation and corresponding Flood Planning Map for Black Creek adjacent to the Stage 2 development site.

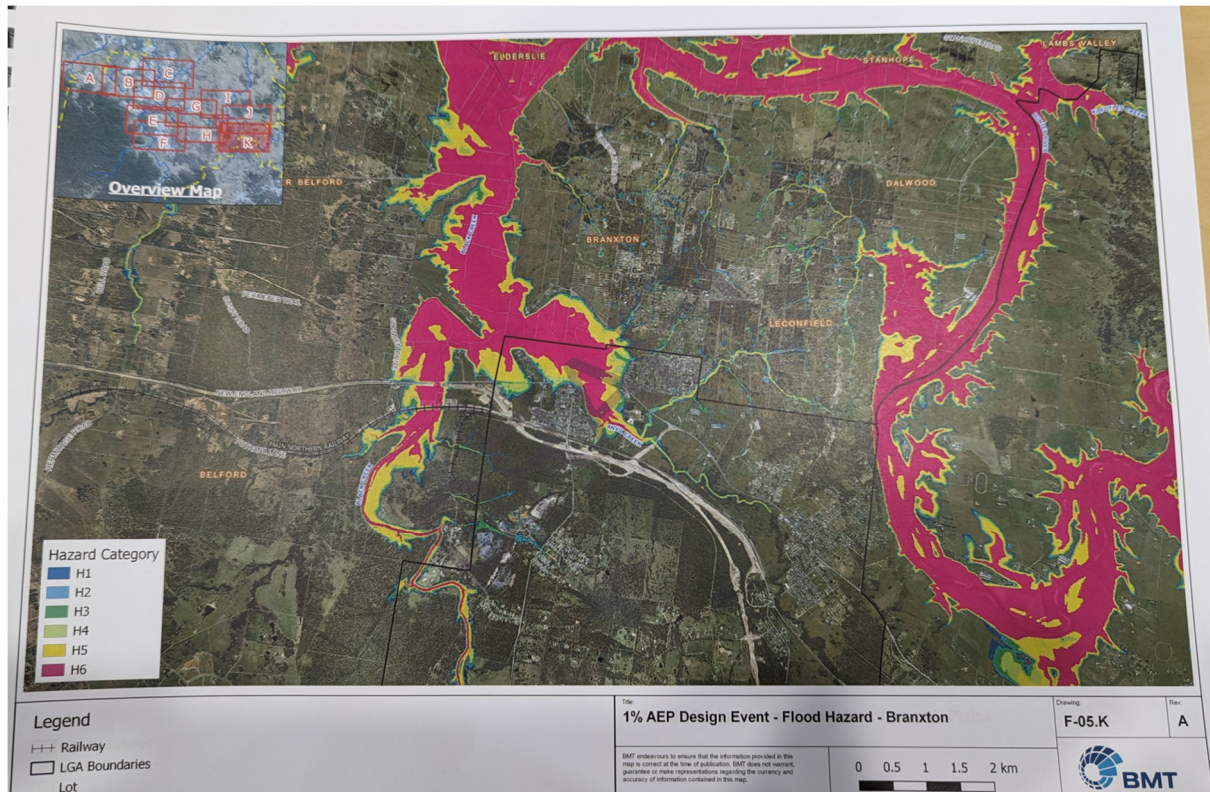


Figure 10 – 1% AEP Design Event – Flood Hazard Brantton (Extract Dwg F-05.K BMT, 2023)

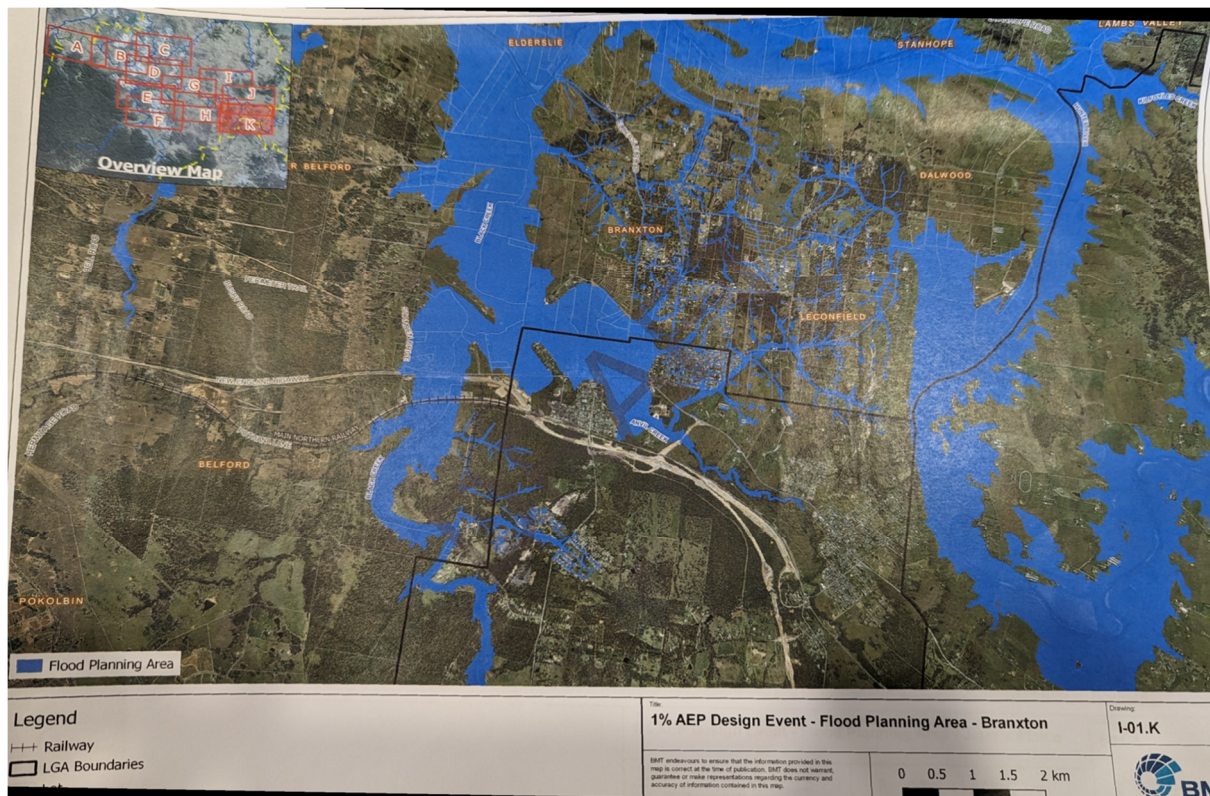


Figure 11 – 1% Design Event – Flood Planning Area Braxton (Extract: Dwg I-01.K BMT, 2023)

The subject site is not expected to be impacted by flood water derived from Black Creek. Flood levels extracted from the Singleton Flood Plan Risk Management Study and Plan (BMT, 2023) suggest at its closest location downstream of the Site, Black Creek reaches a maximum flood elevation of approximately 33.2m AHD, which is approximately a minimum of 2 metres below proposed building envelope surface levels.

3. POTENTIAL SURFACE WATER, STORMWATER AND GROUNDWATER IMPACTS & PROPOSED MANAGEMENT OBJECTIVES

Urbanised development often results in significant modification to soils, topography, impervious percentages and vegetation. Surface water runoff volumes and pollutant concentrations from urban catchments are typically above pre-developed states and without management have the potential to convey increased runoff volumes and pollutant loads to downstream receiving waters. Unmanaged these increases can have detrimental impacts on stream stability, environmental ecology and flooding.

3.1 Potential Surface & Stormwater Impacts

Any development that proposes to change the existing land use has potential to directly impact on the catchment's hydrologic regime and water quality characteristics. The deterioration of water quality, degradation of stream habitats and flooding are the most tangible of the resulting detrimental impacts. These consequences are due to the removal of vegetation, introduction of impervious surfaces and the introduction of pollutants of physical, chemical and biological origin from various anthropogenic activities.

3.2 Potential Groundwater Impacts and Management

Stage 2 of the Huntlee subdivision will involve the construction of roads, lots, drainage infrastructure and services which has the potential to impact the groundwater table.

Numerous field investigations have been completed and are ongoing across the Huntlee site by RCA (2015) and Stantec (2022-23). No groundwater was encountered in the most recent investigation and has previously been measured at depths ranging from 7.9 – 18.5 metres. As noted in Stantec's Geotechnical Assessment Report (2023), groundwater is expected to occur within the weathered rock profile at significant depths below the existing surface level and is therefore unlikely to be impacted by the proposed Stage 2 works.

It is noted that there are no current plans to harvest any existing groundwater resources at the site.

3.3 Common Pollutants Associated with Urbanised Catchments

The most commonly identified surface water pollutants are Total Suspended Solids (TSS), Total Nitrogen (TN), Total Phosphorus (TP) and Gross Pollutants (GP). A summary of the potential environmental effects of these pollutants is provided below in **Table 2**.

Table 2 - Potential Environmental Effects of Stormwater Pollutants

Pollutant	Potential Environmental Effect
TSS	TSS is the total concentration of filterable solids present in a water body in suspension. TSS can reduce light availability and physically coat aquatic life consequently limiting growth. High levels of TSS will increase water temperatures and decrease dissolved oxygen (DO) levels which can cause stratification of a water body. Stratification can lead to the water becoming too hypoxic for organisms to survive. Increased levels of TSS typically result in areas of high impervious percentage or areas clear of vegetation through wash-off and erosion.
TP & TN	Whilst phosphorous and nitrogen exists naturally within the environment excessive levels of either within a waterway will cause accelerated growth of algae and other

	aquatic plants. This condition is termed eutrophication, where the excessive vegetation uses large amounts of oxygen and effectively ‘chokes’ the water body. Dissolved oxygen levels are then further reduced as the plant matter begins to decay often resulting in the death of aquatic life. Elevated levels are typically associated with agricultural and residential areas due to the use of soil and landscape fertilizers.
GP	Gross pollutants are defined as larger visible stormwater pollutants including organic debris, human derived litter and coarse sediment. Gross pollutants in urban waterways disturb physical habitats, attract vermin, impede hydraulic performance, can cause marine animal deaths, can release toxic chemicals, can take long time periods to break down and are visually unattractive. Gross pollutant levels are typically high in commercial, industrial and residential catchments as a result of general littering and illegal dumping.
Heavy Metals	Heavy metals are naturally occurring elements that have a high atomic weight and a density at least 5 times greater than that of water. Their multiple industrial, domestic, agricultural, medical and technological applications have led to their wide distribution in the environment. Even at low concentrations they can be toxic or poisonous to most life forms, including humans, making their presence in receiving environments a major public health concern. Heavy metals predominately enter the environment in developed catchments through wear of vehicle tyres and brake pads, corrosion of metal objects and leaks and spills of various chemicals.
Hydrocarbons	Hydrocarbons are the simplest organic compound containing only carbon and hydrogen and are the major components of oil, natural gas and pesticides. When released into the environment, hydrocarbons can contribute to the greenhouse effect and global warming, deplete the ozone, increase occurrences of cancer and respiratory disorders, reduce the photosynthetic ability of plants and devastate ecosystems. Environmental pollution caused by petroleum is of great concern because petroleum hydrocarbons are toxic to all forms of life. Oils, greases and petroleum hydrocarbons are generally released in urban areas through spills and leaks in motor vehicles.

3.4 Stormwater Management Objectives

To mitigate the potentially detrimental effects of urbanisation upon the catchment a Stormwater Management Plan will be implemented across the site. The principles of the proposed stormwater management strategy have been derived from the riparian, flood and water cycle controls identified under Section 3 of the 2013 Huntlee DCP.

The DCP states that development is to incorporate the principles of Water Sensitive Urban Design (WSUD). WSUD is a philosophy that incorporates urban water cycle management into the urban design process. The philosophy considers options to integrate urban water management infrastructure within the natural environment. It aims to protect the health of aquatic ecosystems and minimise negative impacts on the natural water cycle. Achieving the full benefits of WSUD requires combined consideration of water supply, wastewater, stormwater, groundwater, flooding and riparian zones when planning a development.

To deliver a Stormwater Management Plan which achieves the principles of WSUD the following objectives have been set.

- Identify the riparian corridors within the site through categorisation of the tributaries in accordance with DPI Water’s ‘Guideline for Riparian Corridors on Waterfront Land’ requirements.

- Determine the 1% AEP storm event flood inundation extents along the identified tributaries within the site boundary to inform flood planning for the development.
- Minimise the potential impact of local and downstream flooding by ensuring no net increase in peak flows during events up to the 1% AEP storm in receiving waterways.
- Mitigate the impacts of urban development on stormwater quality through integrated management of land and water resources incorporating best practice stormwater management, reach the nominated pollutant load reduction targets.

3.5 Erosion and Sediment Control

In addition to the long-term impacts of urbanisation, significant impacts on stormwater quality can result during construction. Construction activities involve the removal of vegetation and exposure of large areas of bare soil which increases the risk of erosion. Sediment runoff during construction is considered a significant contributor to high nutrient levels in wet weather conditions.

The site contains numerous tributaries of Black Creek. Therefore, the prevention of sediment and other pollutants into this system will be a paramount consideration during construction. Elevated nutrient levels often promote excessive growth of algae which can release toxic compounds into the water killing aquatic organisms as well as restricting fish migration and recreational activities. The direct build-up of sediment in creeks also has several negative impacts on aquatic plant life, as well as reducing the storage and conveyance properties of the watercourse.

Various best practice guidelines exist to assist in preparing management plans for water quality and erosion control during construction. Landcom's Managing Urban Stormwater: Soils and Construction, Volume 1 is the most relevant and comprehensive guideline in NSW and is expected to form the basis for the preparation of the stage specific erosion and sediment control designs. Key management outcomes for construction have been identified below.

- A Soil and Water Management Plan shall be prepared for the construction works and submitted to the relevant authorities for each stage with the Construction Certificate Application.
- All construction activities will be undertaken in accordance with the Approved Soil and Water Management Plan for each stage.
- Erosion and sediment controls will be implemented prior to the commencement of construction or site disturbance.
- Regular inspections to ensure erosion and sediment controls are maintained throughout construction will be undertaken.
- Design of controls will maximise the retention of riparian and mature native or threatened vegetation.
- Turbidity monitoring downstream of works will be regularly undertaken during the construction phase.
- No-go areas will be established to minimise site disturbance extents for each stage.
- Periods of open soil exposure will be minimised with areas to be re-vegetated as soon as possible.
- Temporary diversion drains will be installed to minimise the flow of clean runoff into the construction site, material stockpiles and open trenches.

4. RIPARIAN CORRIDOR MANAGEMENT

In accordance with outlined stormwater objectives, riparian corridors are to be established over the identified tributaries within the development area. This section of the report seeks to outline methods used to determine the corridor extents and proposed improvement strategies.

4.1 Ecological Value

Riparian corridors play a vital ecological role providing a transition zone between the terrestrial environment on land and the aquatic environment within a waterbody. Environmental functions of riparian corridors include the provision of the following.

- Bed and bank stability reducing bank and channel erosion.
- Water quality treatment through entrapment of sediment, nutrients and other contaminants.
- Diversity of habitat for terrestrial and aquatic flora and fauna.
- Connectivity between wildlife habitats.
- Flood conveyance and directional control of flood water
- A buffer between developments and waterways.
- Passive recreational areas.

4.2 Water Management Act

The Department of Primary Industries – Water (DPI Water) provides guidelines regarding development constraints and riparian setbacks in relation to any controlled activity to be carried out within 40 meters of a river, lake or estuary. The guidelines are regulated under the Water Management Act 2000 (WMA) to ensure minimal harm results as a consequence to any activity. Approval under the WMA will be required for all controlled activities proposed as part of the Stage 2 development.

4.3 Watercourse Assessment

Figure 12 below illustrates the mapped watercourses within the Stage 2 Development Area. Excluding Black Creek the watercourses consist of 1st and 2nd order creek lines. As noted above, a defined creek bed is not evident along a number of the mapped 1st order tributaries. Removal of these ephemeral gully lines is therefore proposed under the Stage 2 works as follows.

- Tributary 3 – four minor ephemeral 1st order watercourses will be removed; 2nd order watercourse to be retained.
- Tributary 4 – first order watercourse to be retained.
- Tributary 5 – main 1st order reach to be retained. 1st order feeder running from the south to be removed. It is noted that Tributary 5 transitions to a 2nd order water course near the site boundary.
- Tributary 6 – three minor ephemeral 1st order watercourses will be removed.

This removal strategy is consistent with the Riparian Corridor Management Plan prepared by Worley Parsons in 2010 which underpins the Major Project Approval. **Figure 13** below shows an excerpt from the 2010 study that depicts the riparian corridors identified for retention and restoration, consistency with this approach is proposed.

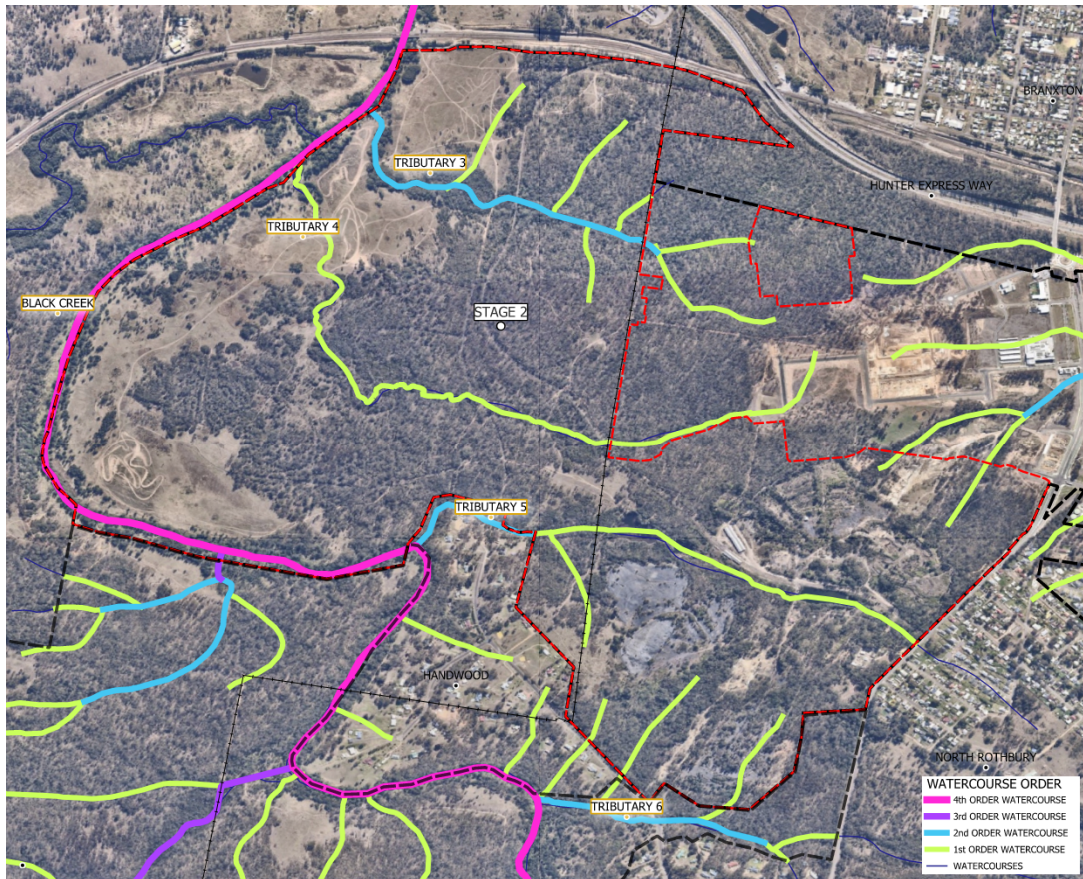


Figure 12 –Stage 2 Project Area Mapped Watercourses and Order

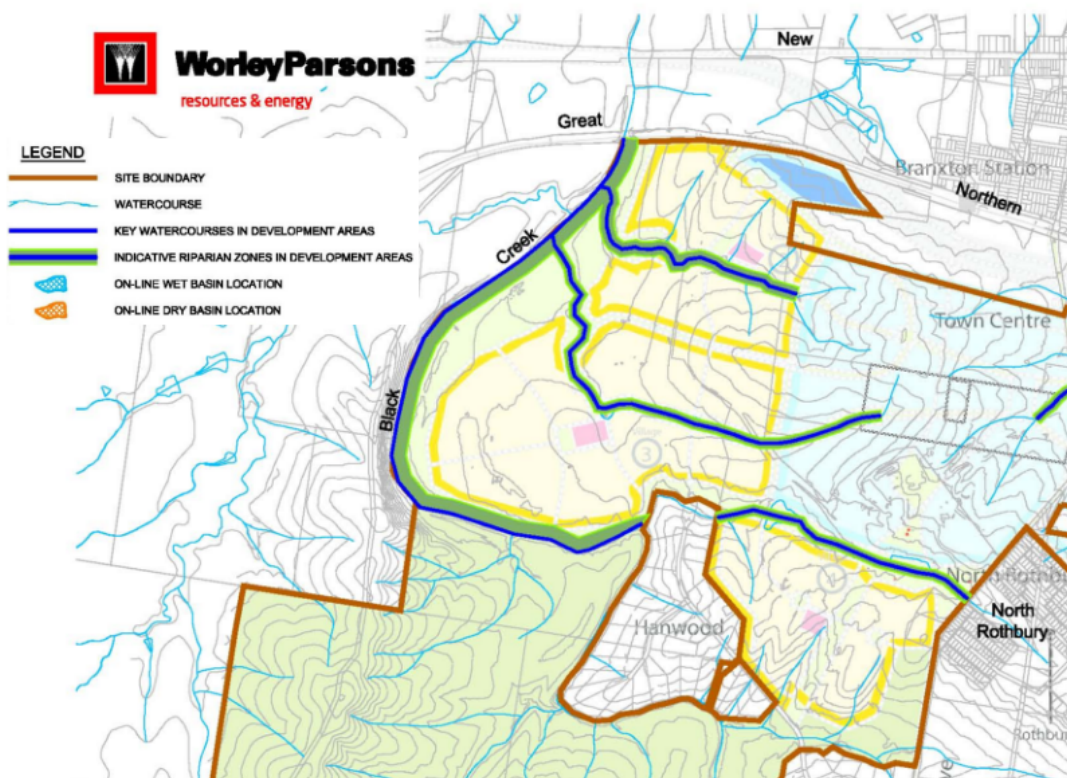


Figure 13 – Worley Parsons 2010 Proposed Riparian Corridors for Retention

4.4 Management Objectives

DPI Water's guidelines for *Riparian Corridors on Waterfront Land* outlines the following water management objectives.

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System.
- For identified watercourses define the riparian corridor width in accordance with the recommended vegetated riparian zone.
- Seek to maintain or rehabilitate the riparian corridor width with fully structured native vegetation.
- Seek to minimise disturbance and harm to the defined riparian corridor.
- Minimise the number of creek crossings and provide perimeter roads separating development from the riparian corridor.
- Locate services and infrastructure outside of the riparian corridor through utilization of road crossings where possible.
- Treat stormwater run-off before discharging into the riparian corridor.

4.5 Corridor Determination

To ensure adequate protection is provided in accordance with the management objectives designated riparian corridors are to be established along each identified tributary.

DPI Water recommends a Vegetated Riparian Zone (VRZ) width based on watercourse order as classified under the Strahler System using current 1:25 000 topographic maps. **Table 3** below summaries the recommended riparian corridor widths.

Table 3 - Recommended Riparian Corridor Widths

Watercourse Order	Vegetated Riparian Zone Width Each Side of Watercourse (m)	Total Riparian Corridor Width (m)
1 st	10	20 + channel width
2 nd	20	40 + channel width
3 rd	30	60 + channel width
4 th	40	80 + channel width

Watercourse order identified under the Strahler System for each tributary in Stage 2 has been adopted in accordance with **Figure 9** within Section 2 above. Adopted riparian corridor widths for the respective water course orders have been summarised in **Table 4** and are illustrated on the Concept Stormwater Management Plan included in Appendix B. It is noted that development offset from Black Creek will be most likely governed by flood inundation levels.

Table 4 - Adopted Riparian Corridor Widths

Tributary	Watercourse Order	Total Riparian Corridor Width (m)
T3	1 st to 2 nd	25 - 45
T4	1 st	25
T5	1 st to 2 nd	25 – 45
T6	2 nd	45
Rothbury Creek Tributary (Old North Road)	1 st	25
Black Creek	4 th	90

4.6 Proposed Works in Riparian Corridors

Online detention basins are proposed to be constructed on tributaries T3, T4 and T5. As noted in **Table 4**, the watercourse order adopted for these tributaries is either 1st or 2nd order. Online detention basins are permissible controlled activities in 1st and 2nd order watercourses under the WMA. Mitigation measures will be incorporated into the design of the basins to minimise any impacts on the riparian function, including utilising the embankments for road crossings, where possible, to limit disturbance to the corridors. With the exception of the natural pools and riffles within the low flow ephemeral creek lines, the online detention basins will be designed to be 'dry' the majority of the time. The basins will become periodically inundated to attenuate post developed flows to pre-developed rates. Inundation events will be relatively short duration and detained stormwater is therefore not expected to adversely impact riparian vegetation or function.

Minor realignment along some sections of the ephemeral watercourses will be required across the development footprint. Wherever possible, natural stream forms will be adopted, including the provision of pool and riffles, a meandering low flow channel and natural erosion protection through the introduction of rock bars at regular intervals to act as bed control structures.

4.7 Proposed Improvement Methods

In accordance with management objectives outlined within the DCP an 'improve or maintain' philosophy for all identified watercourses within the proposed development area has been adopted. It is proposed that such rehabilitation works will occur on a stage by stage basis in accordance with a Vegetation Management Plan undertaken during the detailed design phase. To achieve improvement the following riparian corridor rehabilitation measures are proposed.

- Remove all non-indigenous vegetation from the riparian corridor.
- Where possible retain all existing native riparian vegetation within the core riparian zone.
- Where required, enhance riparian vegetation to consist of a fully structured vegetation corridor, including ground cover, shrubs and trees.
- Remove all existing minor water storage dams that are online to watercourses within the development areas.
- Remove all existing fence and road crossings from within the core riparian zone. All proposed road crossings will be reconstructed in accordance with DPI Water's Guidelines for Controlled Activities: Watercourse Crossings.
- Reconstruct and stabilise sections of the watercourse which are significantly eroded.

5. STORMWATER MANAGEMENT

5.1 Adopted Stormwater Management Strategy – Stage 1 Project Area

The Stormwater Strategy approved under the Stage 1 Development Application was based on the Trunk Stormwater and Flooding Assessment - Stage 1 Project Application prepared by WorleyParsons in 2012 herein referred to as the Worley Report (WorleyParsons, 2012).

The Worley Report provided the following across the Stage 1 project area.

- Existing and developed state hydrology across the two identified tributaries of the Anvil Creek;
- Established an appropriate detention policy to ensure no worsening effect upon up or down stream properties;
- Assessed flood behaviour to map the estimated 1%AEP flood extents across the catchment; and
- Outlined water quality treatment strategies to mitigate increased pollutant loads generated through urbanisation.

The study developed a concept stormwater strategy for Tributaries 1 and 2 which included conceptual modelling for the Town Centre's water management and treatment system. A portion of the Town Centre development proposed under the Stage 2 application falls within the Tributary 2 catchment. Whilst the 2012 assessment was specifically undertaken for Stage 1, the study area encompassed the entire Anvil Creek Catchment and considered the ultimate development footprint. This was done to ensure sufficient allowances were made within the catchment for future stormwater and flooding infrastructure requirements that were proposed as part of overall Huntlee development master plan. No significant changes to the proposed layout or density of development within the Anvil Creek catchment have occurred since the time at which the Stage 1 assessment was undertaken. As such all proposed development under the Stage 2 Application which falls within the Tributary 2 catchment will be mitigated under the approved Stage 1 Strategy.

The approved Tributary 2 stormwater strategy incorporated an online detention basin for the with adjacent offline water quality treatment pond to service Wine Country Drive and the Town Centre. **Figure 14** shows an extract from the Worley Parsons report which depicts the proposed water management strategy.

Detailed design and subsequent construction of residential lots in Sub-Stages 1 to 10 within the Tributary 2 Stormwater Catchment have now been completed. In addition to this detailed design of commercial land release has been undertaken for the first Stage of the Town Centre which has recently commenced construction. These land release strategies utilised end of line stormwater treatment bio-retention basins as recommended within the 'Huntlee Project - Trunk Stormwater and Flooding Assessment' report. These land releases also incorporated detention within the retention basins as an interim measure until such time as the online Tributary 2 basin is constructed. Given the timing of the staged approval of the overall Huntlee Project it has been considered reasonable to assume all infrastructure approved as part of the Stage 1 Application will have been completed prior to construction commencement of Stage 2. Interim measures satisfying the design intent of the approved stormwater strategy will be required until the end of line controls are commissioned if this is not the case.

For full details on the proposed Strategy refer to, *Trunk Stormwater and Flooding Assessment - Stage 1 Project Application* (WorleyParsons in 2012). At this time of writing this report construction of the end of line measures designed for the Tributary 1 strategy had been completed, with construction of the end of lines measures proposed for Tributary 2 expected to commence in early 2024.

FIGURE 3

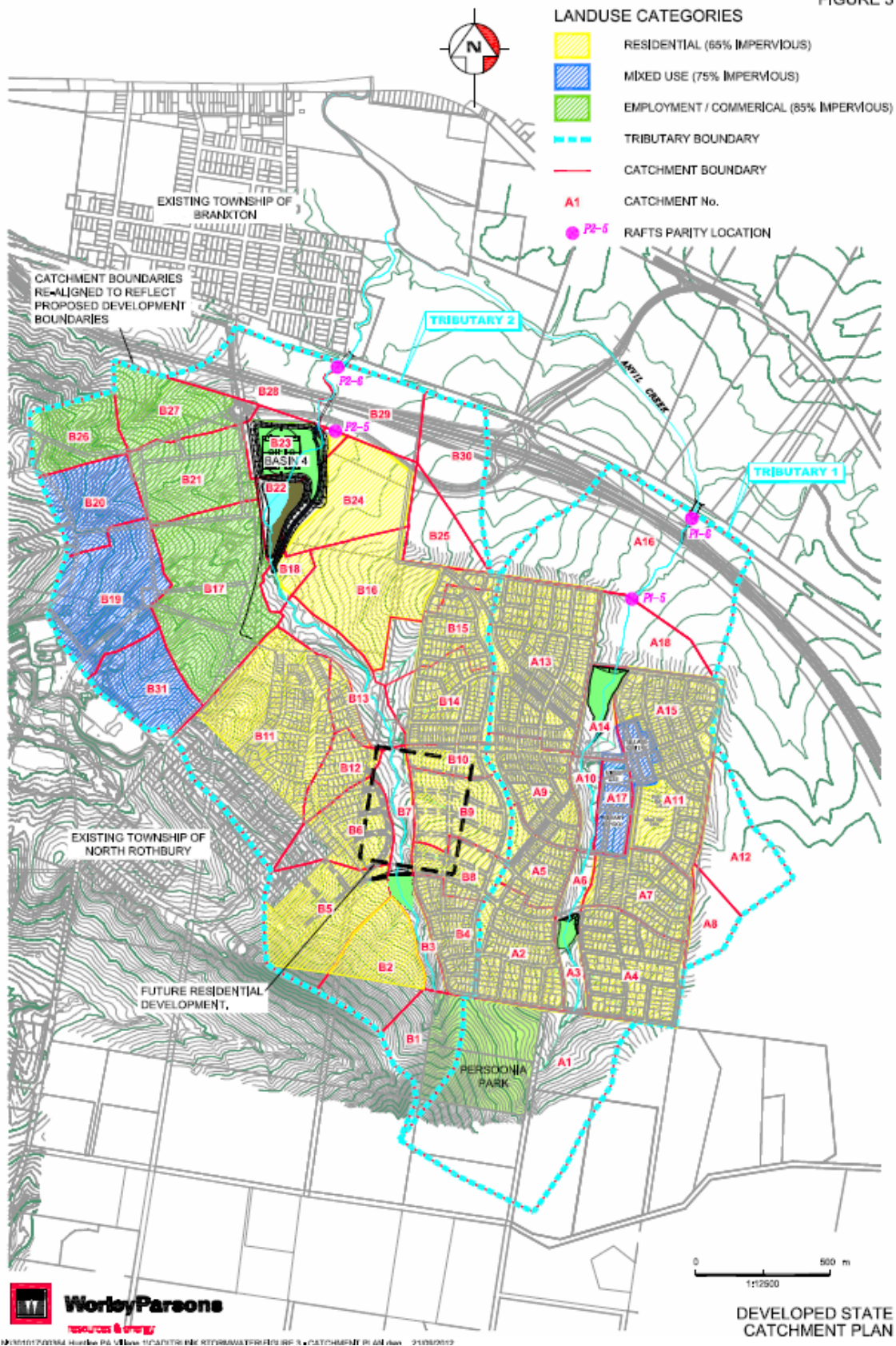


Figure 14 – Stage 1 Project Application Stormwater Proposal (Worley Parsons, 2012)

5.2 Proposed Stormwater Management Strategy – Stage 2 Project Area

The Stage 2 Project Area Stormwater Management Strategy intends to remain consistent with the Stage 1 Strategy by adoption of the following primary principles.

- Regional detention basins will be provided to manage stormwater quantity via attenuation of post developed flows to pre-developed rates. These basins will be positioned both on and off line based on the proposed development layout and existing site topography.
- The quality of stormwater runoff will be managed through Water Sensitive Urban Design (WSUD) elements in the form of local catchment treatment trains consisting of Gross Pollutant Traps (GPTs) and bio-retention basins.

The report sections below aim to identify the Site's existing riparian and onsite flooding constraints, review the sites requirement for onsite detention and outline the proposed stormwater mitigation measures to be adopted under the proposed management strategy.

5.3 Major and Minor Drainage Design

A major/ minor drainage network philosophy will be adopted for local stormwater conveyance. Pit and pipe networks will be designed to convey the 'minor' stormwater event (10% AEP) in accordance with Councils' requirements. Management of the 'major' stormwater flows (1% AEP) will be via dedicated overland flow paths including road corridors, open space areas and tributaries to minimise the impact on proposed lots.

A detailed drainage analysis will be provided as part of the Subdivision Works Certificate documentation for each stage as they are delivered. Standard inlet blockage factors of 50% for sags and 20% for on-grade pits are proposed to be adopted in the major storm event.

5.4 Impervious Area Assumptions

The following impervious percentages listed in **Table 5** are proposed to be adopted for the different land use categories in the Stage 2 Project Area at the detailed design stage. It is considered that they accurately represent the Project Area based on the proposed masterplan and existing development at Huntlee to date.

Table 5 – Proposed Impervious Area Assumptions

Type of Development	Design Impervious Area (%)
Residential Areas (incorporating residential roads and lots typically ranging between 400-800sqm)	75%
Residential Areas (incorporating residential roads and lots typically ranging between 800-1,500sqm)	60%
Rural Residential Areas (incorporating residential roads and lots typically greater than 1,500sqm)	45%
Town Centre/ Mixed Use (incorporating roads, commercial areas, and higher density residential (lots typically less than 400sqm))	85%
Employment/ Commercial (incorporating larger scale commercial/ employment development)	85%
Parkland/ Public Open Spaces	0-15%

For the purposes of the DA design, a typical 85% impervious fraction has been adopted over the developed areas of the catchment. This is expected to be a worst-case impervious percentage and is considered conservative. This assumption is expected to be fine-tuned in accordance with Table 5 at future development phases and the layout is updated.

6. STORMWATER QUANTITY & FLOODING

The effects of catchment urbanisation on stormwater quantity have been investigated via assessment of the pre and post developed runoff rates. Specifically, a Flood Impact and Risk Assessment study has been prepared by Northrop focusing on the following objectives:

- Determination of pre and post developed catchment runoff and peak flow rates for several durations up to and including the 1% Annual Exceedance Probability (AEP) rainfall event.
- Detention design to ensure no additional impact on upstream or downstream landowners.
- Determination of the inundation extent conditions for the 1% AEP, FPL (Flood Planning Level) and PMF (Probable Maximum Flood) events over the catchment, to allow the spatial, servicing, and landscaping requirements across the Stage 2 Project Area to be generally confirmed.

The Flood Impact and Risk Assessment provides a comprehensive summary of the assessment methodologies, detention results and flood behaviour across the Stage 2 Project Area. A copy of this assessment is provided within Appendix K of the Statement of Environmental Effects.

The assessment determines that increased runoff resulting from urbanisation of the catchment is proposed to be managed through the introduction of a series of detention basins. Where layout and site topography permit, basins will be designed to utilise existing storage within the natural gully lines. These basins will be designed to minimise impact on riparian vegetation and function. Where the proposed layout and site topography does not allow, offline detention basins within dedicated drainage reserves have been proposed. These drainage reserves will generally be turfed areas to minimise maintenance requirements.

It is the intent of the detention facilities to limit peak flows from the developed catchment to pre-developed rates for all events from the 0.5EY through to the 1% AEP event, thus managing impacts to the downstream receiving waters and communities. The location of the proposed detention basins have been illustrated on the Concept Stormwater Management Plan prepared by Northrop provided within Appendix B.

The assessment also demonstrates that the proposed development area is located above the necessary Flood Planning Levels. All proposed lots will achieve suitable flood free building envelopes being the 1% AEP flood inundation level plus a minimum 500mm freeboard. All proposed roadways will also remain above the 1% AEP flood inundation level. In addition to this, continuing rising road access will be available across the development for areas affected by flooding during extremely rare events up to and including the PMF.

7. STORMWATER QUALITY

7.1 Methodology

The performance of the proposed stormwater management strategy has been assessed using the conceptual computer software MUSIC (Version 6.3). MUSIC serves as a planning and decision support system that is used to estimate the efficiency of Stormwater Quality Improvement Devices (SQIDs) at capturing common stormwater pollutants including Total Suspended Solids, Total Nitrogen, Total Phosphorous and Gross Pollutants from stormwater runoff. Modelling involves the use of historical or synthesized long-term rainfall data and algorithms that can simulate the performance of stormwater treatment measures to determine stormwater pollution control.

7.2 Stormwater Quality Philosophy and Targets

Stormwater quality is proposed to be managed through a treatment train approach to meet pollutant removal efficiency targets outlined in the Huntlee DCP 2013. These targets have been reproduced in **Table 6** below.

Table 6 – Pollutant Removal Efficiency Targets

Pollutant	Treatment Efficiency Target
Total Suspended Solids (TSS)	85% reduction in pollutant loads
Total Nitrogen (TN)	45% retention of average annual load.
Total Phosphorous (TP)	45% retention of average annual load.

7.3 Treatment Train Assessment

7.3.1 Catchments

The site has been divided into catchments for the purposes of water quality modelling. The catchments are based on the preliminary development layouts and designs, local catchment features and a combination of available detailed survey and LiDAR elevation data. The catchments have been further divided into different land uses, according to the development layout. A total impervious percentage of 85% was adopted for residential areas, commercial areas and the road reserve. The parkland areas were modelled with an impervious percentage of 10%.

The below **Table 7** and **Figure 15** present the MUSIC catchments used for this study.

Table 7 – Water Quality Catchments

Catchment	Total Area (ha)	Residential/Commercial (ha)	Park (ha)
Village 2 – Central (Detailed Area)			
V2-C1	6.798	6.6935	0.1045
V2-C2	8.652	8.652	
V2-C3	12.965	12.965	
V2-C4 Bypass	2.882	2.882	
V2-C5	6.823	6.823	
V2-C6	4.766	4.2897	0.4763
V2-C7	4.697	4.697	
V2-C8	9.018	8.8808	0.1372
Village 2 – Northern (Concept Area)			
V2-N1	5.536	5.536	
V2-N2	10.032	10.032	
V2-V3	7.93	7.5546	0.3754
V2-N4 Bypass	1.982	1.982	
V2-N5	8.924	8.924	
V2-N6	11.357	11.357	
Village 2 – Southern (Concept Area)			
V2-S1	6.525	6.525	
V2-S2	8.17	8.17	
V2-S3	8.604	8.604	
V2-S4	6.539	6.539	
V2-S5	7.436	6.9305	0.5055
V2-S6	9.192	9.192	
V2-S7 Bypass	7.693	7.693	
V2-S8	4.491	4.491	
V2-S9	2.26	2.26	
V2-S10	9.969	9.969	
Village 3 (Concept Area)			
V3-N1	11.529	11.529	
V3-N2	11.666	2.546	9.120
TCW-1	10.538	10.538	
TCW-2	9.634	9.634	

7.3.2 Model Parameters

In order to establish a MUSIC model, rainfall and evaporation records in the vicinity of the Huntlee site were sought. To develop a model that could comprehensively assess the performance of the proposed stormwater management plan the 6-minute pluviograph data from the BoM station 061237, located in Pokolbin (Keira), was used. Rainfall between 1969 and 1973 was used for all MUSIC water quality simulations as this period is reported to represent '5 consecutive years of approximate average rainfall'.

Monthly areal potential evapotranspiration (PET) rates for the site were established from PET data provided by the Climate Atlas of Australia (BoM) from the closest location, Cessnock Airport. The monthly average PET adopted by the MUSIC model are shown in **Table 8**.

Table 8 – Average Evaporation and Potential Evapotranspiration at Huntlee

Month	Average Monthly Evaporation [^] (mm/month)	Areal Potential Evapotranspiration (mm/month)
January	180	186
February	175	142
March	125	120
April	100	90
May	90	66
June	80	48
July	75	60
August	90	85
September	120	117
October	140	142
November	180	156
December	200	180

[^] Evaporation from Class evaporation pan

The source nodes adopted to represent the development were Urban Mixed, and Urban Revegetated Land (for parkland areas).

The Base and Storm Flow concentration parameters for the different land uses have been adopted from the NSW MUSIC Modelling Guidelines, 2015. Parameters for the source node inputs used are summarised in **Table 9** and **Table 10**.

Table 9 – Concentration Parameters for TSS, TN and TP (Tables 5-6 and 5-7 NSW MUSIC Modelling Guidelines)

		Base Flow		Storm Flow	
		Mean (log mg/L)	Std Dev (log mg/L)	Mean (log mg/L)	Std Dev (log mg/L)
Mixed	Total Suspended Solids	1.100	0.170	2.200	0.320
	Total Phosphorus	-0.820	0.190	-0.450	0.250
	Total Nitrogen	0.320	0.120	0.420	0.190
Parkland	Total Suspended Solids	1.150	0.170	1.950	0.320
	Total Phosphorus	-1.220	0.190	-0.660	0.250
	Total Nitrogen	-0.050	0.120	0.300	0.190

Table 10 – Rainfall-Runoff Parameters (Table 5-5 NSW MUSIC Modelling Guidelines)

Property	Rainfall-Runoff Parameter	Residential/ Parkland
Impervious Areas	Rainfall Threshold (mm/day)	1
	Soil Storage Capacity (mm)	88
Pervious Areas	Initial Storage (% of Capacity)	25
	Field Capacity (mm)	70
	Infiltration Capacity Coefficient –a	180
	Infiltration Capacity Exponent –b	3
Ground Water	Initial Depth (mm)	10
	Daily Recharge Rate (%)	25
	Daily Baseflow Rate (%)	25
	Daily Deep Seepage Rate (%)	0

Four MUSIC models were prepared as follows:

- Village 2 – Central
- Village 2 - Southern
- Village 2 – Northern
- Village 3

7.3.3 Adopted Treatment Train

The site was divided into thirty-six stormwater catchments which considered the existing topography, as well as the proposed site layout and grading. The treatment train for each catchment consists of

primary measures in the form of a Gross Pollutant Trap (GPTs) followed by tertiary treatment in offline bio-filtration basins.

In conjunction with the practical constraints of the proposed development layout and riparian corridors, device positions were governed by the provision of access for maintenance.

- Gross Pollutant Traps (GPT):
 - The published removal treatment efficiencies for the proprietary inline GPTs have been utilised within the MUSIC model to simulate the removal of coarse sediment and litter at the GPT locations.
 - A proprietary GPT unit will be required upstream of each biofiltration basin inlet to treat approximately the 3-monthly ARI (Annual Recurrence Interval) peak flow rate approaching each unit.
 - The modelling utilises the GPT treatment node input from the NSW MUSIC Modelling Guidelines (August 2015), with the following reduction efficiency:
 - Total Suspended Solids = 65%
 - Total Phosphorus = 15%
 - Total Nitrogen = 14%
 - Gross Pollutants = 90%
 - Research presented in Australian Runoff Quality (Engineers Australia 2006) suggests that roughly 1m³/ hectare/ year of gross pollutants and sediment could be expected from a typical residential catchment. It is expected that with full development the GPTs will need maintenance on average twice per year. Should a dry weather hydrocarbon spill or any other spill occur, additional maintenance should be carried out to ensure the device operates as intended.
- Bio-filtration Basins:
 - Biofiltration systems are designed with the primary intent of removing suspended pollutants from stormwater before the water is discharged to the local waterway. The stormwater temporarily ponds on the surface within the extended detention zone before slowly filtering through the soil media. The soil media controls the flow rate of water through the system as well as providing a growing media for the plants. Pollutants are retained through fine filtration, absorption and biological uptake. Treated stormwater is collected at the base of the system via a network of perforated pipes located within the gravel drainage layer to be discharged to the outlet pits. Stormwater will enter these basins via a riprap-lined weir designed to dissipate energy.
 - A high flow bypass has been modelled as 50% of the 1EY flows to prevent scour damage in higher intensity rainfall events.
 - The bio-filtration basins have been modelled with a filter depth of 0.5m and an extended detention depth of 0.2m.
 - **Table 11** shows the filter area and surface area for the proposed biofiltration basins for each catchment. Parameters for the bioretention basin were adopted in accordance with the “NSW MUSIC Modelling Guidelines” (BMT WBM, 2015). The proposed location and approximate sizing of these biofiltration basins are depicted on the Concept Stormwater Management Plan included in Appendix B.

Table 11 – Biofiltration basin areas

Catchment	Filter Area (m ²)	Surface Area (m ²)
Village 2 – Central (Detailed Area)		
V2-C1	710	888
V2-C2	868	1085
V2-C3	1000	1250
V2-C4 Bypass	-	-
V2-C5	707	884
V2-C6	478	598
V2-C7	470	588
V2-C8	900	1125
Village 2 – Northern (Concept Area)		
V2-N1	481	602
V2-N2	1000	1250
V2-V3	819	1024
V2-N4 Bypass	-	-
V2-N5	857	1072
V2-N6	881	1102
Village 2 – Southern (Detailed Area)		
V2-S1	665	832
V2-S2	825	1032
V2-S3	858	1073
V2-S4	560	700
V2-S5	830	1038
V2-S6	1000	1250
V2-S7 Bypass	-	-
V2-S8	509	637
V2-S9	260	325
V2-S10	1000	1250
Village 3 (Concept Area)		
V3-N1	979	1224
V3-N2	1000	1250
TCW-1	760	950

TCW-2	1000	1250
V3-S1	1000	1250
V3-S2	1000	1250
V3-S3	979	1224
V3-S4	821	1026
V3-S5	1000	1250
V3-S6	909	1136
V3-S7	873	1091
V3-V8 Bypass	-	-

It is noted that the basin sizes presented in **Table 11** are approximate only, provided at this stage to inform spatial requirements across the site. Basin filtration sizes will need to be confirmed at detailed design stage once site grading has been finalised. The following schematics presented in **Figure 15** to **Figure 18**, presents the nodal representation of the modelled treatment trains in MUSIC.

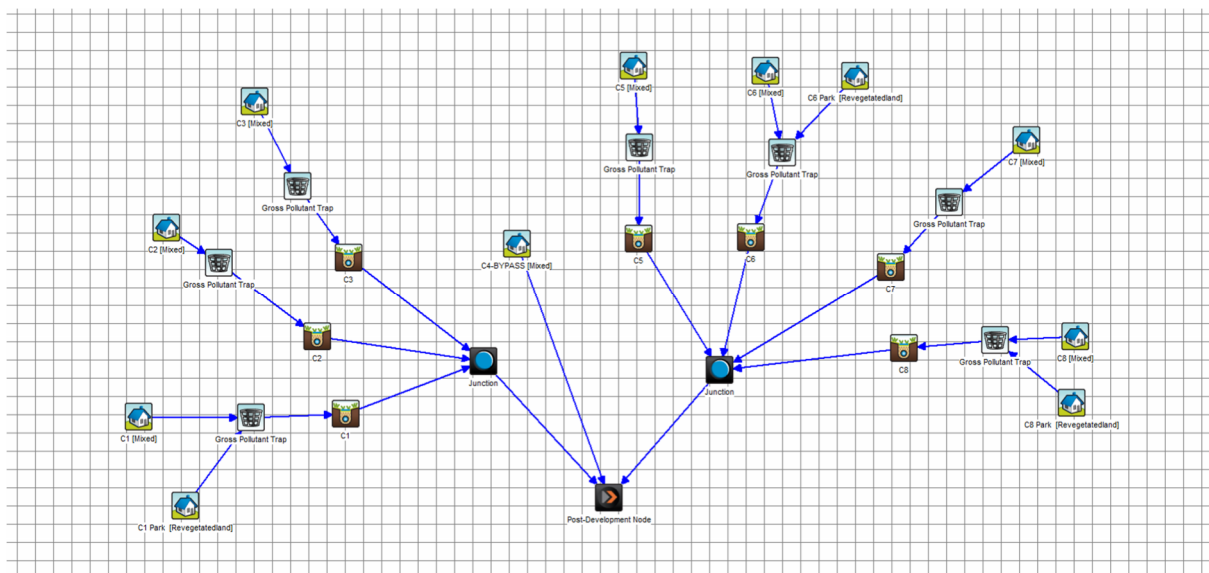


Figure 15 – Schematic of Village 2 Central (Detailed) MUSIC model

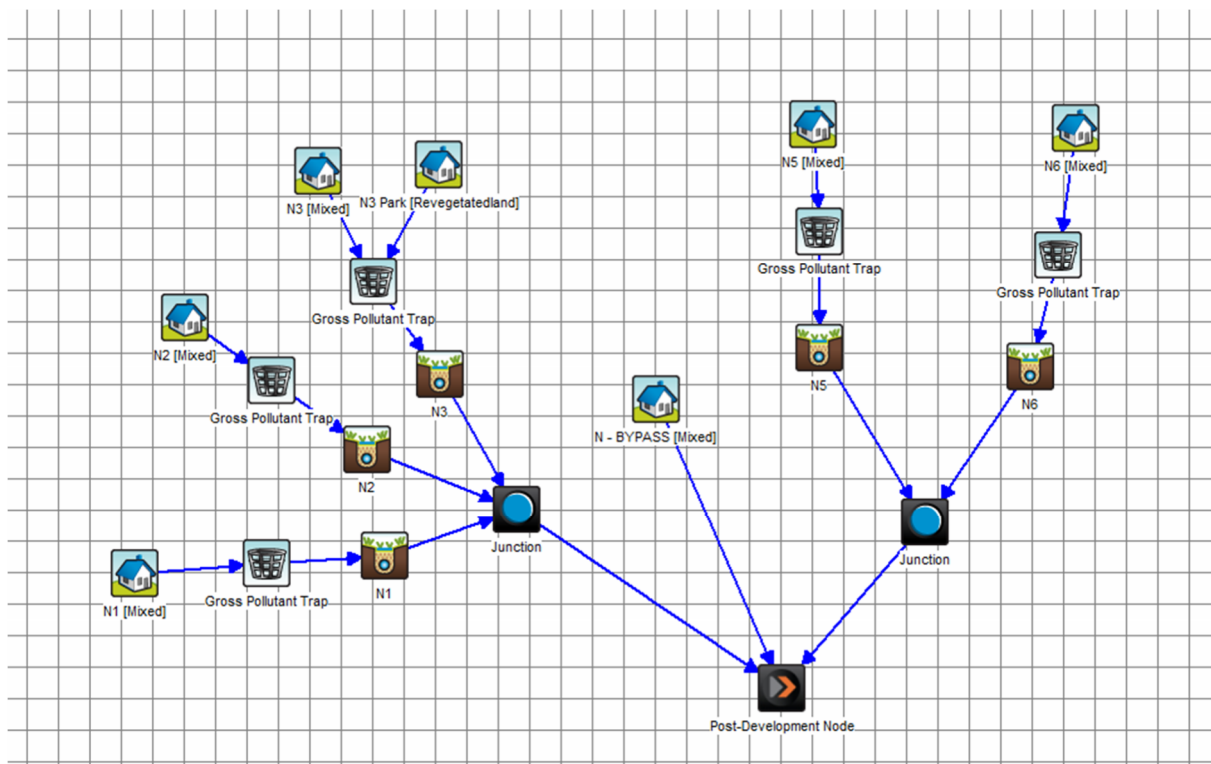


Figure 16 – Schematic of Village 2 Northern (Concept) MUSIC model

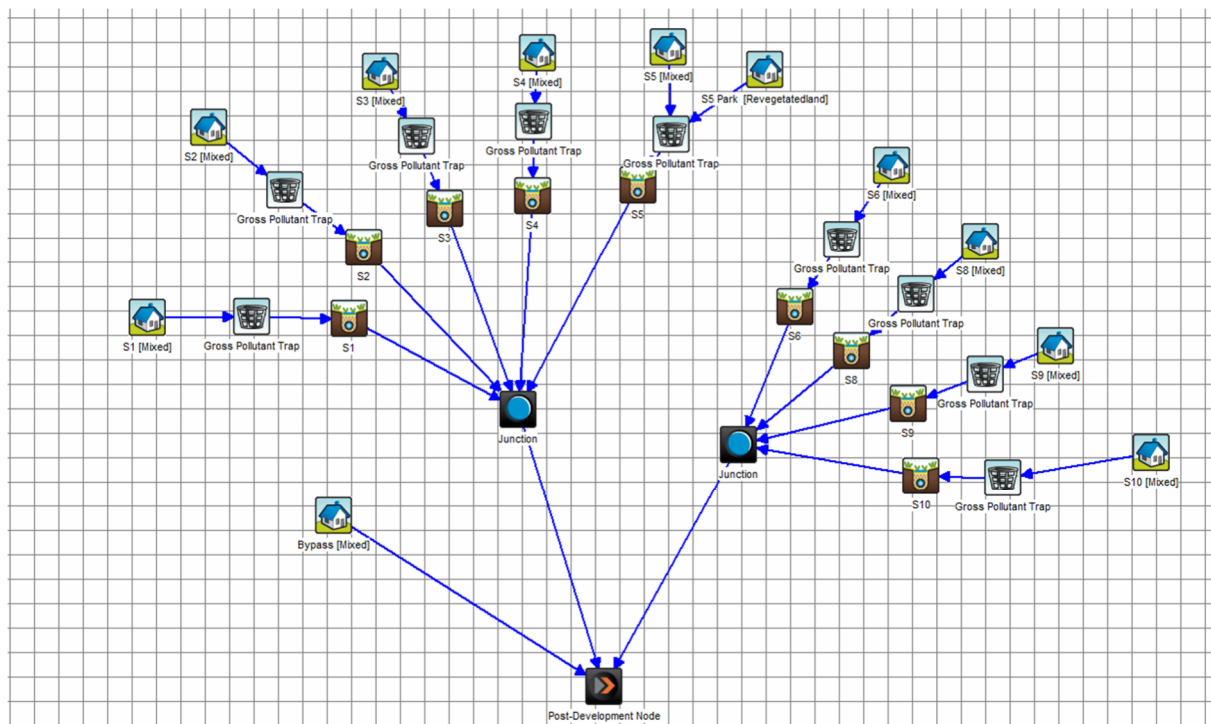


Figure 17 – Schematic of Village 2 Southern (Detailed) MUSIC model

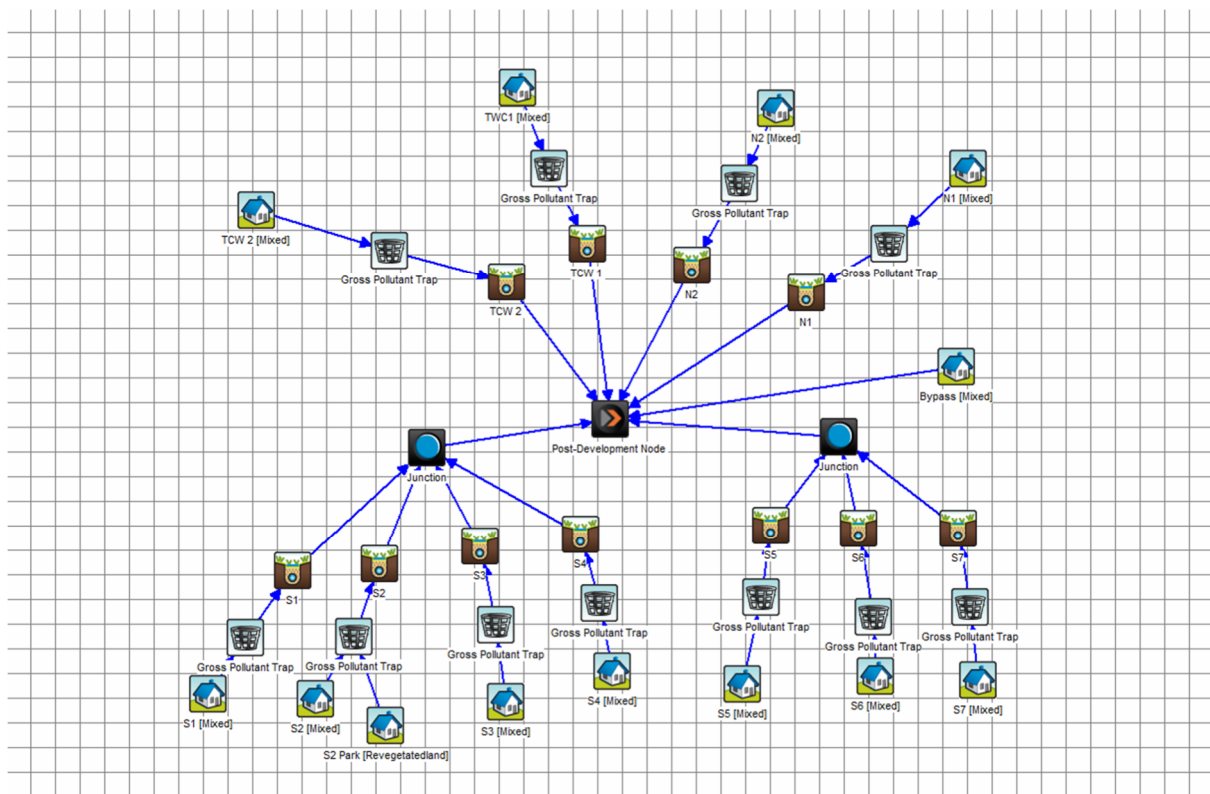


Figure 18 – Schematic of Village 3 Southern (Concept) MUSIC model

7.3.4 MUSIC Model Results

The results calculated by the four MUSIC models are shown below in **Table 12**. The tables show pollutant load and removal efficiencies for the proposed developed exceed the required targets outlined in the Huntlee DCP 2013 (refer to **Table 6**).

Table 12 – Pollutant Removal Efficiency Results

Parameter	Source Load	Residual Load	% Reduction
Village 2 – Central (Detailed Area)			
TSS (kg/yr)	72200	9060	87.4
TP (kg/yr)	146	41.5	71.6
TN (kg/yr)	1010	390	61.5
GP (kg/yr)	11900	707	94.1
Village 2 – Northern (Concept Area)			
TSS (kg/yr)	55900	6020	89.2
TP (kg/yr)	113	30.1	73.3
TN (kg/yr)	777	289	62.8
GP (kg/yr)	9180	404	95.6
Village 2 – Southern (Detailed Area)			
TSS (kg/yr)	89500	13300	85.2
TP (kg/yr)	180	52.9	70.6
TN (kg/yr)	1250	491	60.8
GP (kg/yr)	14800	1430	90.3
Village 3 (Concept Area)			
TSS (kg/yr)	130000	16400	87.4
TP (kg/yr)	264	73.5	72.1
TN (kg/yr)	1840	699	62
GP (kg/yr)	21700	1140	94.7

7.4 Monitoring and Maintenance

Construction methodology along with ongoing maintenance is vital to the long-term success of any water quality management system. This section of the report aims to describe the procedures and processes for maintaining the Stormwater Quality Improvement Devices (SQIDs) to be implemented across the site. It also outlines the procedures for the construction of the SQIDs to avoid damage or significant loss of function due to construction operations.

7.4.1 Bioretention Systems

Bioretention systems are designed with the primary intent of removing pollutants from stormwater before the water is discharged to the downstream waterway. Stormwater will temporarily pond on the surface of the basin before slowly filtering through the soil media. The soil media controls the flow

rate of water through the system as well as providing a growing media for the plants. Treated stormwater is collected at the base of the bioretention system via a network of perforated pipes located within the gravel drainage layer to be discharged to the outlet pit.

The condition of the filter media and health of the vegetation is critical to the performance of a bioretention system:

- The filter media must provide a hydraulic conductivity that ensures sufficient contact time is available for pollutants to be taken up by biofilms.
- Vegetation root systems provide the surfaces for the epiphytic biofilms that take up dissolved pollutants. Vegetation is also critical in maintaining the porosity of the soil media of the bioretention system.

Correct construction procedures and primary treatment measures are fundamental in preserving the life of filter media and health of the vegetation within the basin.

7.4.2 Construction Sequence

To ensure the performance of the bioretention system, it is imperative that the construction of the bioretention system be staged/coordinated with the construction activities in the upstream catchment. Construction activities will generate higher loads of coarse sediment, gross pollutants and other wash off (e.g. cement washing) which will exceed the design capacity of the bioretention system and cause the media to become clogged or blocked. In the event the bioretention media becomes clogged or blocked, the filter media will need to be removed and replaced.

The basins should effectively function as sediment basins during the construction phase. The functional elements of the bioretention system should not be constructed until after 75% of housing development within the catchment has been completed. Once the filter media has been installed, protection should be provided from sediment runoff from the catchment. A sediment fence should be constructed for the full perimeter of the filter media and should remain in place until the entire catchment has been fully developed and revegetated.

7.4.3 Access

Access provision to bioretention basins or swales in accordance with Council requirements is to be met by the design of all proposed devices. Nominated service areas providing suitable access for Council's adductor truck maintenance fleet must also be provided to all gross pollutant traps. Council liaison throughout the detailed design phase will be undertaken to ensure suitable measures are provided.

7.4.4 Ongoing/ Long-term Maintenance Tasks

Regular inspections and maintenance shall be carried out to ensure the system is functioning as designed. It is recommended that these inspections be undertaken at approximately a 3-monthly interval during the initial period of operation. A less frequent schedule may be adopted after the system is fully established depending on the outcomes of the initial inspections.

Routine inspection and maintenance tasks shall generally include:

- Inspection of the bioretention profile to identify any areas of obvious increased sediment deposition, scouring of the basin, rill erosion of the batters and clogging of the bioretention trench.
- Inspection of inlet and outlet points to identify areas of scour, litter build up and blockages.
- Removal of sediment, especially where it is smothering vegetation, and if necessary, re-profiling the system and re-vegetating to the original design specification.

- Removal of all litter and other gross pollutants.
- Inspection of vegetation health, including the invasion of weeds and other unwanted plant species.

Refer **Table 13** for a detailed list of monitoring tasks as well as the appropriate remediation actions.

Table 13 – Monitoring and Maintenance Tasks

Item to be Monitored	Monitoring Task	Purpose of Monitoring	Maintenance Action	Frequency
Inlet and Outlet Pits and Pipes	Ensure inflow areas and grates over pits are clear of litter and are in good/safe condition. Check for dislodged or damaged pit covers and ensure general structural integrity.	If pits or pipes become blocked it is likely to the system will not function correctly and localised flooding will occur. Dislodged or damaged pit covers can also be a safety hazard.	Remove debris and contact the appropriate authority to organise repair of any structural damage. Flush system with water to clear. Camera inspection may be required to identify blockages if flushing is unsuccessful.	3 months / after significant rainfall
Gross Pollutant Traps	Ensure the trash collection chamber or basket is not full. Check for dislodged or damaged covers and ensure general structural integrity.	If the trash collection chamber becomes full, the litter basket will be unable to collect further gross pollutants from the site runoff. Dislodged or damaged pit covers can also be a safety hazard.	Contact the appropriate maintenance authority to organise a vacuum truck to clean the units and repair any structural damage.	In accordance with manufactures specifications / after significant rainfall
Sediment build up	Check for build-up of sediment in pre-treatment devices and on the bioretention media. If sediment build up is noted, identify source of sediment.	If sediment accumulates on the bioretention media surface, percolation of water into the media may be reduced, resulting in poor treatment performance. Sediment can also be the cause of blockage in pit and pipe networks which can significantly reduce capacity.	If sediment is identified across bioretention media remove accumulated sediment and replace top 100mm of filter media from the bioretention system with appropriate filter media and replant. Flush system with water to clear. Camera inspection may be required to identify blockages if flushing is unsuccessful.	3 months / after significant rainfall
Bioretention Underdrains	Ensure that underdrain pipes are not blocked to prevent filter media and plants from becoming waterlogged.	If the underdrain pipes become blocked, percolation of water through the system may be reduced, resulting in poor treatment performance and permanent waterlogging of the plants and filter media.	Flush underdrains with potable water. Inspection of pipelines using a remote camera could be useful to identify blockages if flushing is unsuccessful.	6 months / after significant rainfall

Item to be Monitored	Monitoring Task	Purpose of Monitoring	Maintenance Action	Frequency
Surface Porosity	Inspect for an accumulation of an impermeable layer (such as oily or clayey sediment) that may have formed on the surface of the filter media. A potential symptom is water ponding on the surface of bioretention system for more than a few hours after a rain event.	Percolation into the filter media may be reduced by the build-up of an impermeable layer.	Repair minor accumulations by raking away any mulch on the surface and scarifying the surface of the filter media between plants.	3 months / after significant rainfall
Sediment build up	Check for build-up of sediment in pre-treatment devices and on the bioretention media. If sediment build up is noted, identify source of sediment.	If sediment accumulates on the bioretention media surface, percolation of water into the media may be reduced, resulting in poor treatment performance.	Once sediment source is identified and stabilised, remove accumulated sediment and replace top 100mm of filter media from the bioretention system with appropriate filter media. Lightly spread and compact replaced filter media using hand tools. Replace any damaged plants to meet the design plant schedule.	3 months / after significant rainfall
Erosion or Scour	Check for erosion and scour around all drainage structures. If scour is noted check for source of scour.	Erosion impairs bioretention systems by changing the bed profile and preventing uniform distribution of flow across the media. If left untreated, small concentrations of erosion can quickly spread over large areas becoming costly to repair.	Once source of damage is identified and rectified, infill any holes with appropriate filter media. Lightly spread and compact replaced filter media using hand tools. Provide energy dissipation measures if required. Replace any damaged plants to meet the design plant schedule.	3 months / after significant rainfall
Organic Litter	Check for litter in and around treatment areas.	Organic litter can provide an additional source of nutrients to the bioretention systems, introduce non-native species, which out-compete native plants and block the filter media. Accumulated organic matter can also cause offensive odours and can reduce percolation of water into the filter media.	Address source of organic litter with appropriate action. Remove litter.	3 months

Item to be Monitored	Monitoring Task	Purpose of Monitoring	Maintenance Action	Frequency
Anthropogenic Litter	Check for litter in and around treatment areas and structures.	Litter can potentially block the inlet and outlet structures resulting in flooding, as well as detract from the system's visual amenity.	Address source of litter with appropriate action. Remove litter.	3 months
Weeds and Invasive Plants	Identify the presence of any rapidly spreading weeds or invasive plants.	The growth of weeds can impair a bioretention system's performance by changing flow paths across the media and shading or out-competing plant species that are important for water treatment and filter stability. Weeds can spread to downstream environments, compromising ecosystem health. In addition, weeds can visually compromise the amenity of the bioretention system.	Hand remove weed species or conduct spot spraying with a herbicide. Application of herbicide should be restricted to a minimum.	3 months
Plant condition	Assess plants for; - Disease; Pest infection; Stunted growth; or Senescent plants.	During dry periods plants help maintain structure and porosity of the filter media. During rainfall events above ground vegetation helps to retard and distribute flows and provides scour protection. Below ground, the roots provide an important media for trapping or absorbing pollutants as they percolate through the media. The accumulation of dead plant material can detract from the visual amenity of the bioretention system.	Maintenance action will depend on the cause of die-back or poor plant health. Once the problem is rectified, infill planting may be required particularly if more than 1 square metre of plantings has died. Infill planting must be as per the original planting specification.	3 months / as desired for aesthetics

8. EARTHWORKS

8.1 Proposed Site Earthworks

Earthworks and regrading will be required across Stage 2 for the provision of access, drainage and the creation of residential and commercial lots. Preliminary bulk earthwork and concept cut fill plans have been prepared across the detailed and concept project areas, respectively, to inform the development application. These plans are preliminary in nature and have been provided to indicatively illustrate the extent and scale of proposed works. Preliminary cut and fill quantities have also been included on the Civil Engineering Plans for the detailed project area. Detailed levels for these areas will be determined at Subdivision Works Certificate Stage. Bulk earthwork plans and total cut/fill volumes accounting for detailed earthworks including pavement boxing and lot benching will be undertaken for each sub-stage at detailed design. Earthworks which will change the natural surface topography and the management thereof are further discussed below.

8.1.1 Proposed Cut/ Fill Areas

The main areas of cut/ fill are expected to include the following:

- Most roads will involve some adjustment to existing surface levels, however in general the design principle is to maintain an overall cut/fill balance in the road design. It is expected that the roads will vary from either cut or fill and therefore earthworks batters from the edge of the road reserve will extend into adjacent lots by a distance which will be relative to the height of cut or fill at the road center line.
- Above ground detention and water quality basins will require adjustments to existing surface levels, both cut and fill, to achieve the necessary embankment heights and floor depths/grades within the basins.
- Development areas along watercourses may require filling to ensure building areas are located above the expected 100-year ARI flood level.
- The removal of dams from within the site will require appropriate earthworks, however this will serve to return these areas to a more natural topography.
- Any proposed re-alignments of ephemeral watercourses will require the filling of existing gullies and creation of new watercourses by cut and fill to achieve the desired cross-sectional shape. Wherever possible, natural stream forms will be adopted, including the provision of pool and riffles, a meandering low flow channel, natural erosion protection (e.g. rock rip rap), the introduction of rock bars at regular intervals to act as bed control structures and dense “three storey” indigenous riparian vegetation planting along the core riparian zones.
- Some filling of development lot areas may occur to smooth out any localised surface high or low points which might affect the development lot. This would assist with ensuring that surface runoff occurs in a sheet flow manner rather than concentrating into small gullies which may produce erosion problems and drainage issues for newly constructed buildings.
- Landscaping of open spaces may involve some shaping and regrading of the natural surface; however, it would be expected that this would be minor and not impact on existing vegetation.

8.1.2 Earthworks and Spoil Management

All earthworks required as part of Stage 2 will be detailed at Subdivision Works Certificate stage and go through the appropriate approvals process, including any necessary controlled activity permits for works within defined watercourses.

Management of the earthworks operations for Stage 2 will be as per that currently being undertaken for Stage 1. This will be based on protocols which will respect the relevant authorities' consent conditions and the approved Construction Management Plan (CMP). The CMP for each substage of the development will detail erosion and sediment control requirements, waste management minimisation measures and general requirements for earthworks management.

In relation to specific earthworks and spoil management, the following outlines the minimum expected protocols that would be included in the CMP:

- Only undertake earthworks operations in the areas as defined on the approved plans, i.e. no works to be within designated no-go areas.
- Ensure erosion and sediment controls are in place prior to commencing clearing operations.
- Initial tree/ vegetation clearing to be undertaken in accordance with the environmental requirements of the CMP.
- Re-use of cleared trees and vegetation for protection of disturbed areas or other landscaping purposes (mulching).
- Classify and separate spoil into various groups such as VENM, ASS soils, topsoil and other various waste classifications as may be appropriate including stockpiling as appropriate.
- Maximise the reuse of suitable materials on site in preference to importing fill or disposal to landfill.
- Attempt where possible to maximise the reuse of fill materials unsuitable for engineering purposes for alternative non-structural uses such as landscaping.
- Stockpiles of spoil material awaiting reuse on site or off-site disposal should be located and managed in line with the following;
 - Locate stockpiles within proposed road reserves or areas of future development. These should be identified and approved prior to the commencement of construction and be shown on the sediment and erosion control plans.
 - Locate away from native vegetation and not within the drip line of any trees proposed to be retained.
 - Locate on areas of shallow grade and away from areas of concentrated water flow.
 - Locate away from sensitive areas such as creeks and existing residences.
 - The stockpile should be accessible for the purpose of dust suppression.
 - Provide sediment fences down-slope and earth bank up-slope to divert water from impacting on the stockpile.
 - Long term stockpiles should be protected from wind and rain erosion by covering with geo-textile or stabilised with hydro-seeding or similar.
- Dispose of materials off site in accordance with the approved waste management plan.
- Revegetation and restoration of areas as soon as works are completed in accordance with the approved sediment and erosion control plan.

8.1.3 Former Colliery and Quarry Areas

A former colliery and quarry site is located in the Village 3 project area. Site grading is highly variable, ranging from relatively flat to steep cut faces, resulting from past extractive activities. This area of the site has experienced heavy disturbance and contains uncontrolled fill materials such as coal wash reject stockpiles and landfill cells, as detailed in the Stantec Geotechnical Assessment Report (2023) for the site.

The preliminary design for Village 3 indicates that significant cut and fill will be required in some locations due to the highly disturbed nature of the site. At the detailed design stage, when more comprehensive survey and geotechnical information is available, the Village 3 subdivision design will be refined and optimise.

9. ROAD NETWORK

9.1 Existing Road Network

Wine Country Drive is the main arterial link into the Huntlee Subdivision providing a connection between the New England Highway and the Hunter Expressway. Stage 1 of the development has seen a series of upgrades to Wine Country Drive which now provides 5 intersection access points into the subdivision.

9.1.1 Proposed Interfaces with Existing Road Network

In its completion, Stage 1 will provide access into the Stage 2 project area along the southern and western boundaries of the town centre. This existing network will include collector, avenue, town centre and local street connection points in accordance with the approved road hierarchy.

Two additional intersections onto Wine Country Drive are proposed as part of Stage 2 further south to facilitate direct entry into Village 3. **Figure 19** shown below illustrate this interface and connection points.

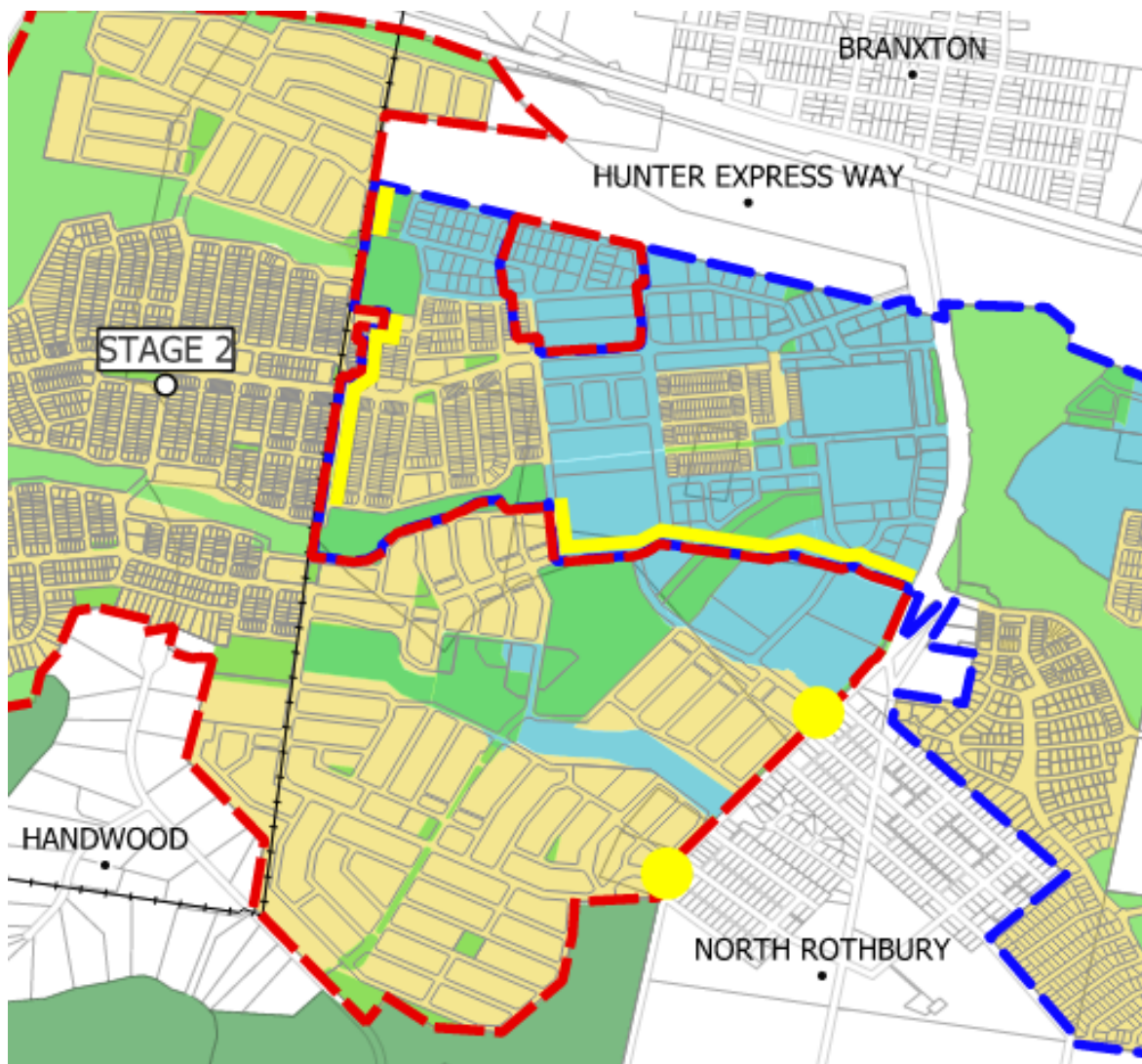


Figure 19 – Proposed Interfaces with Existing Road Network

Access into the southern rural residential segment of the subdivision will be via Old North Road with proposed rural BAR/BAL intersection treatments. **Figure 20** illustrates the location of these proposed intersections. Currently, sealed pavement only extends along Old North Road to the western side of Black Creek from Wine Country Drive. Upgrade works to provide sealed pavement from the proposed rural residential lots to this point will be incorporated as part of the development.

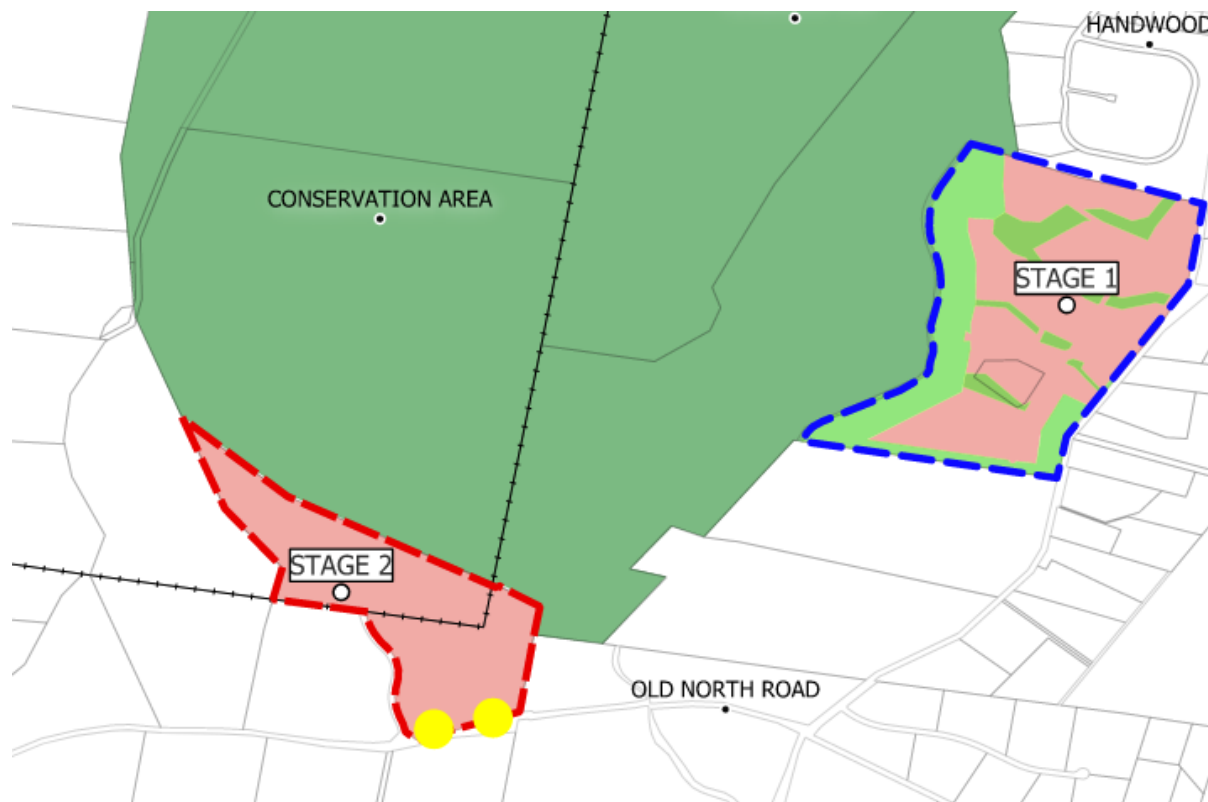


Figure 20 – Proposed Interfaces with Existing Road Network – Southern Area

9.2 Proposed Road Characteristics

The roads within Stage 2 have been designed in accordance with the Huntlee DCP, best practices for traffic management, pedestrian/cyclist safety and amenity as well as the urban design philosophies of the overall development.

Roads have been classified into several types to highlight differences in their vehicle or pedestrian usage, adjacent land uses and general urban design treatment. The road hierarchy depicts how the different road classifications are integrated to form the proposed network, as shown in **Figure 21** below. The different road classifications are described in **Figure 22** to **Figure 27** below.

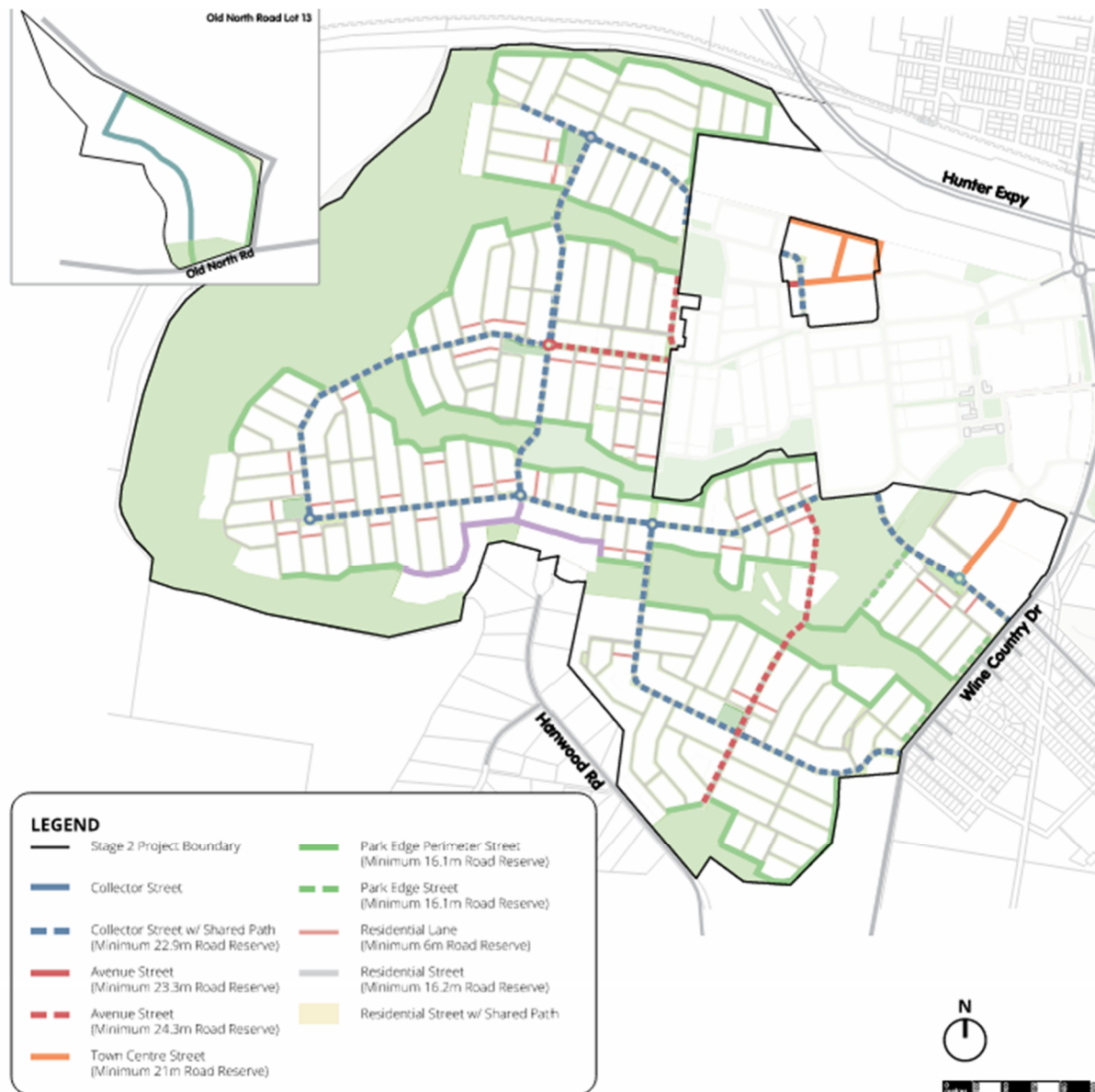


Figure 21 – Proposed Road Hierarchy (Source: Hatch)

Preliminary long sections have been prepared for all roads both in the concept and detailed areas to show the general design intent within Stage 2 of the development; these are also contained in Engineering Drawings provided within Appendix A.

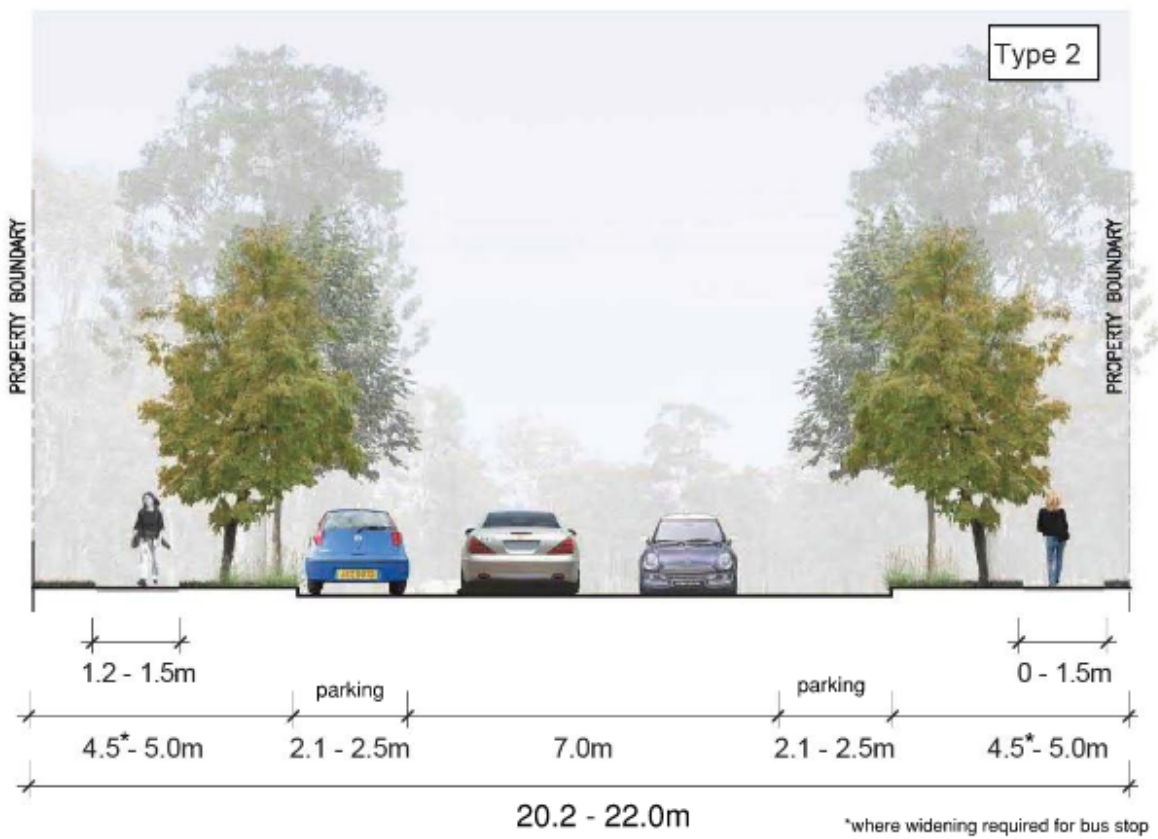
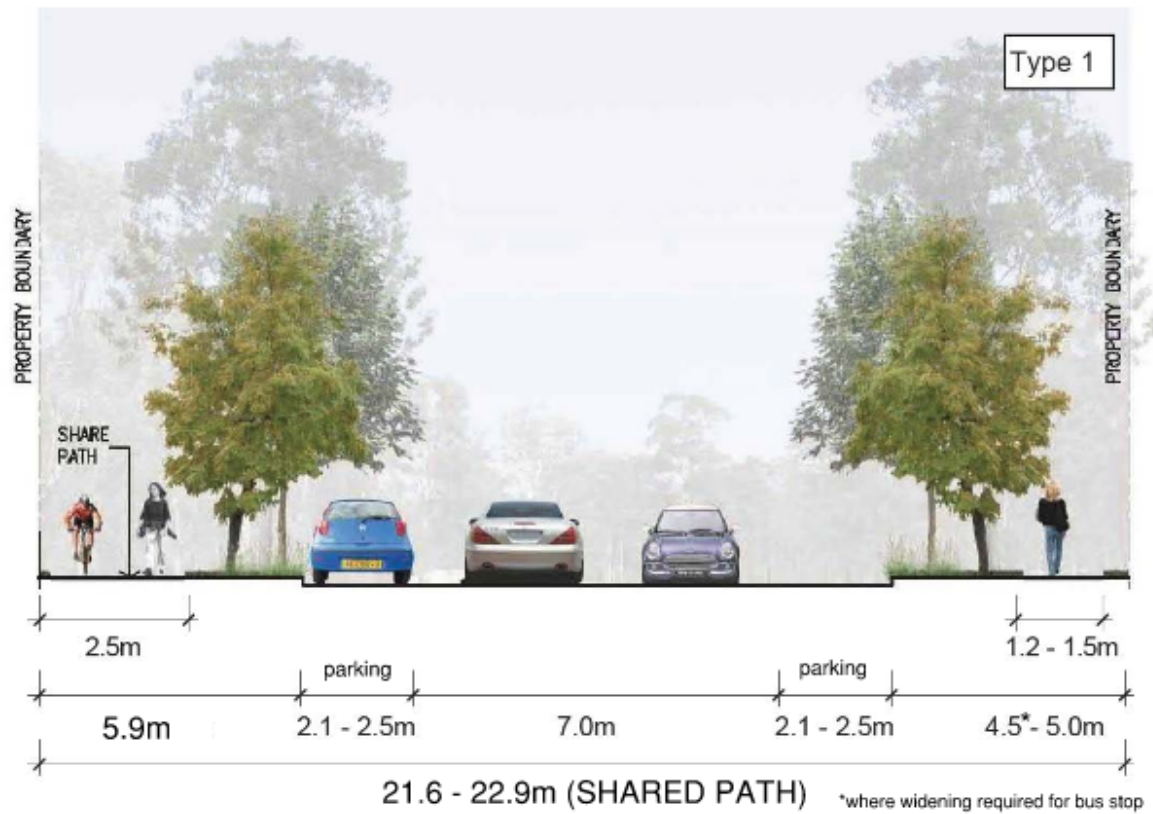


Figure 22 – Collector Streets

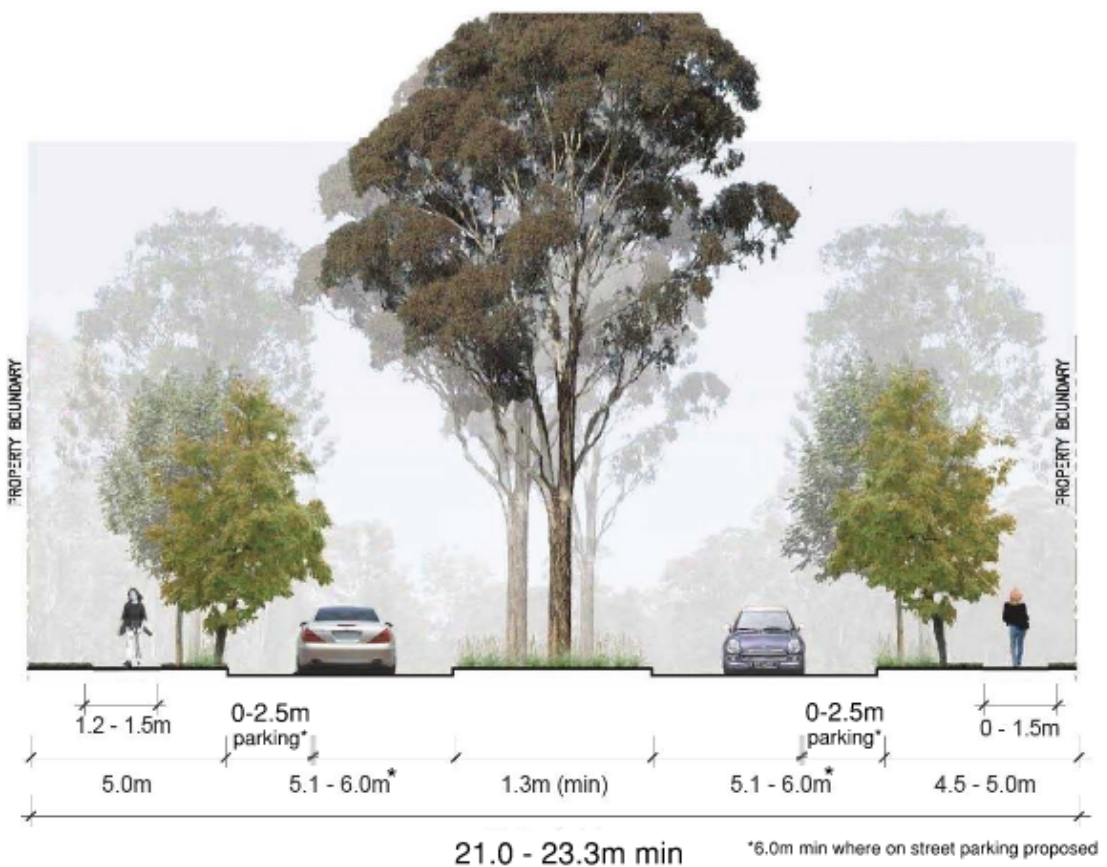
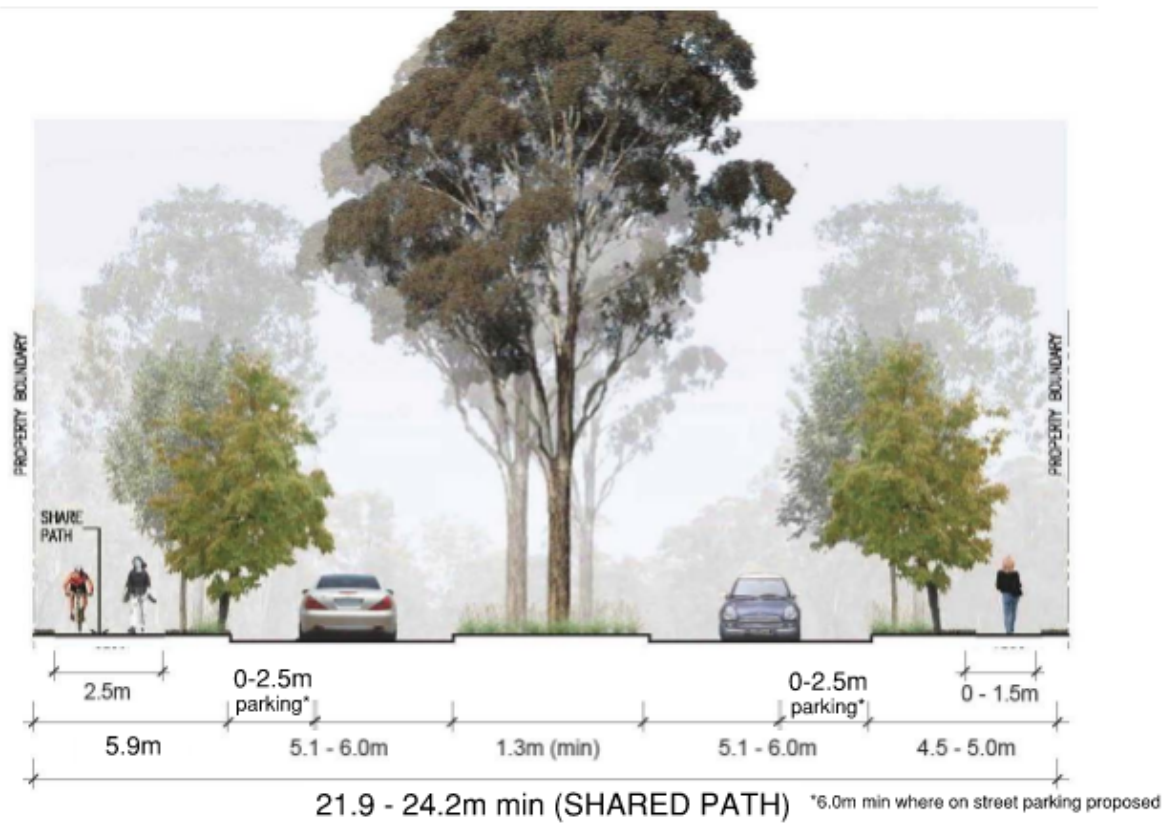


Figure 23 – Avenue Streets

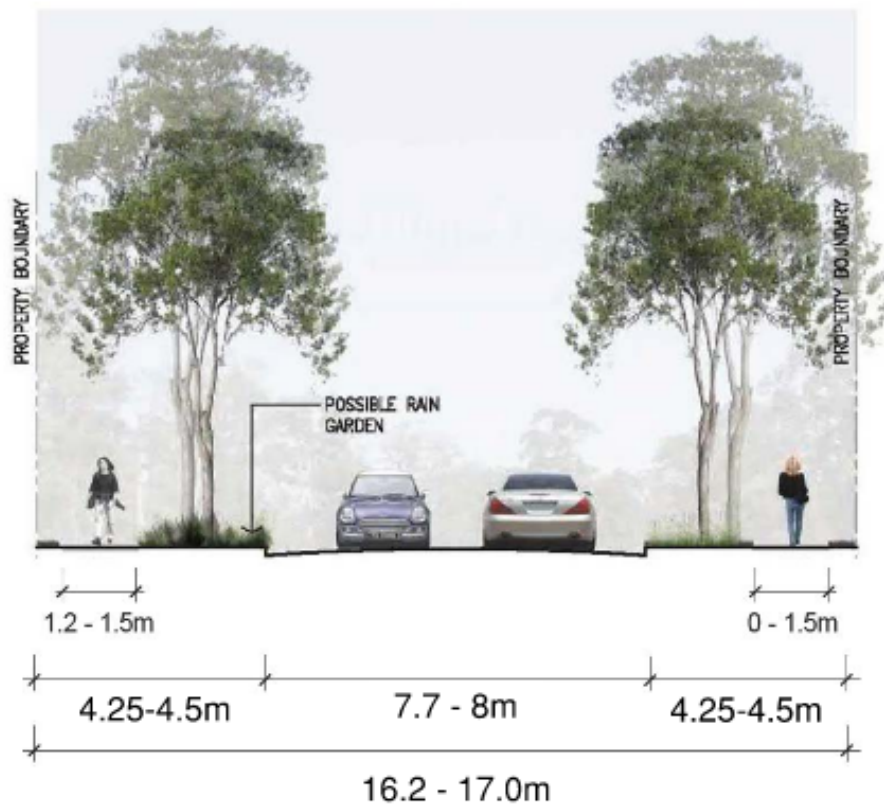
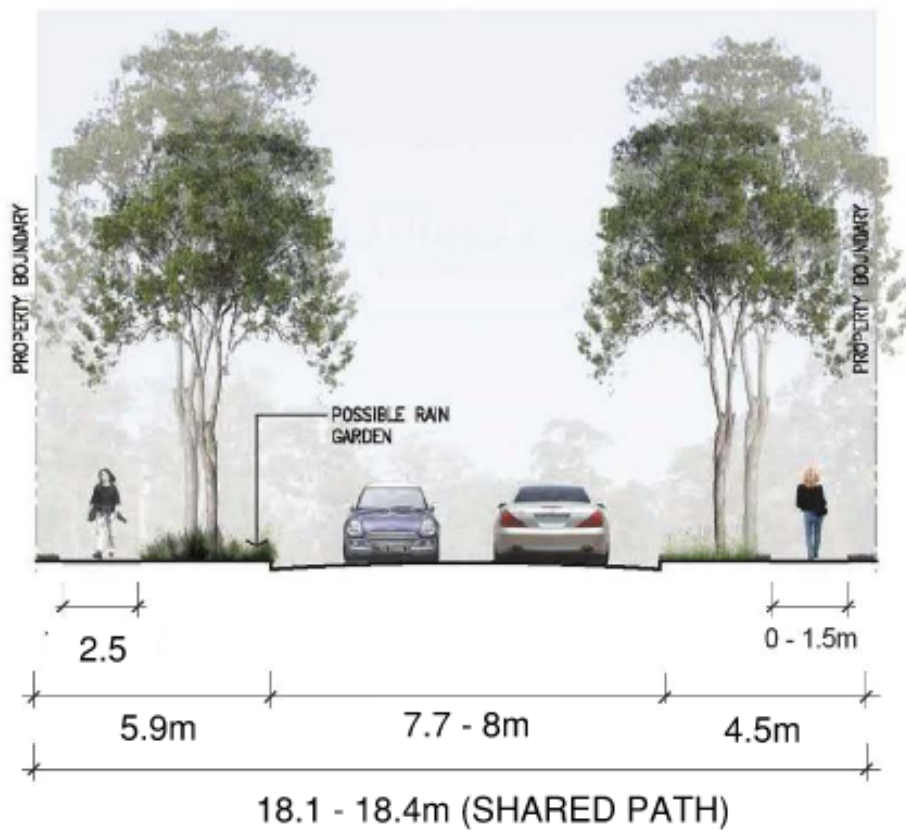


Figure 24 – Local Streets

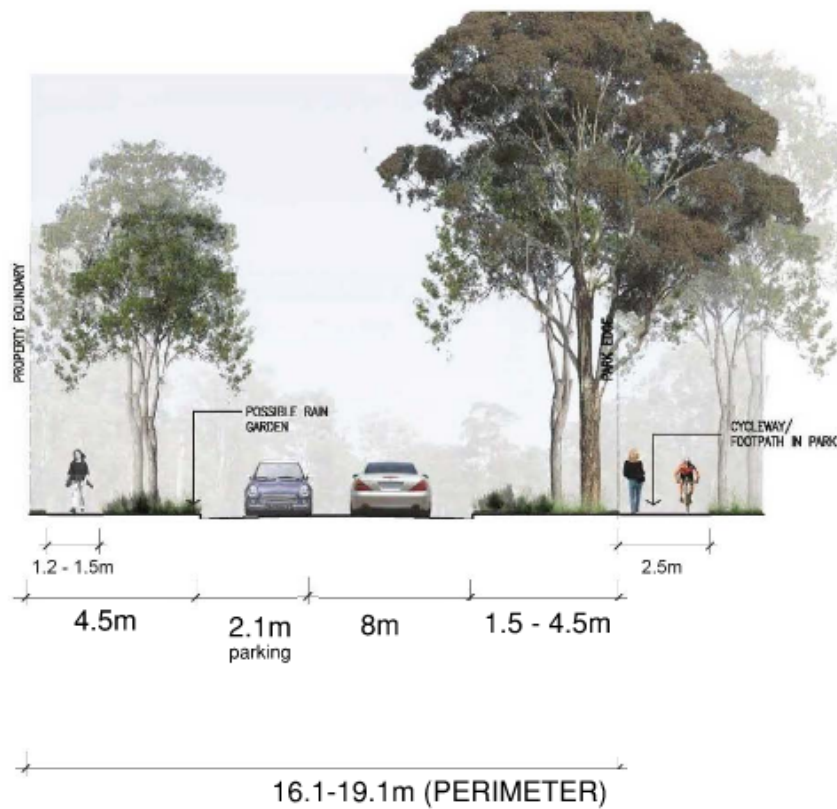


Figure 25 – Park Edge Streets

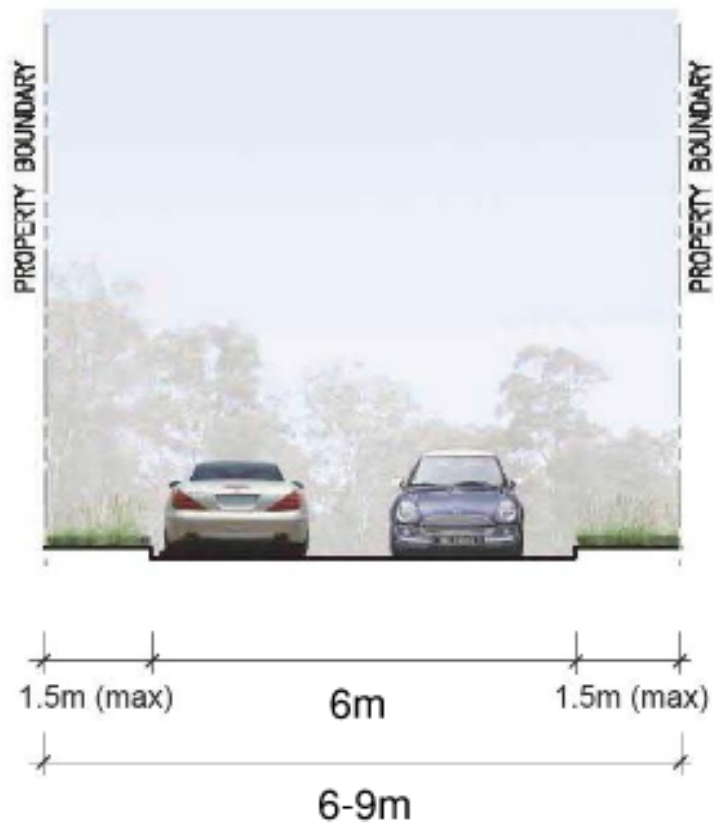


Figure 26 – Residential Laneway

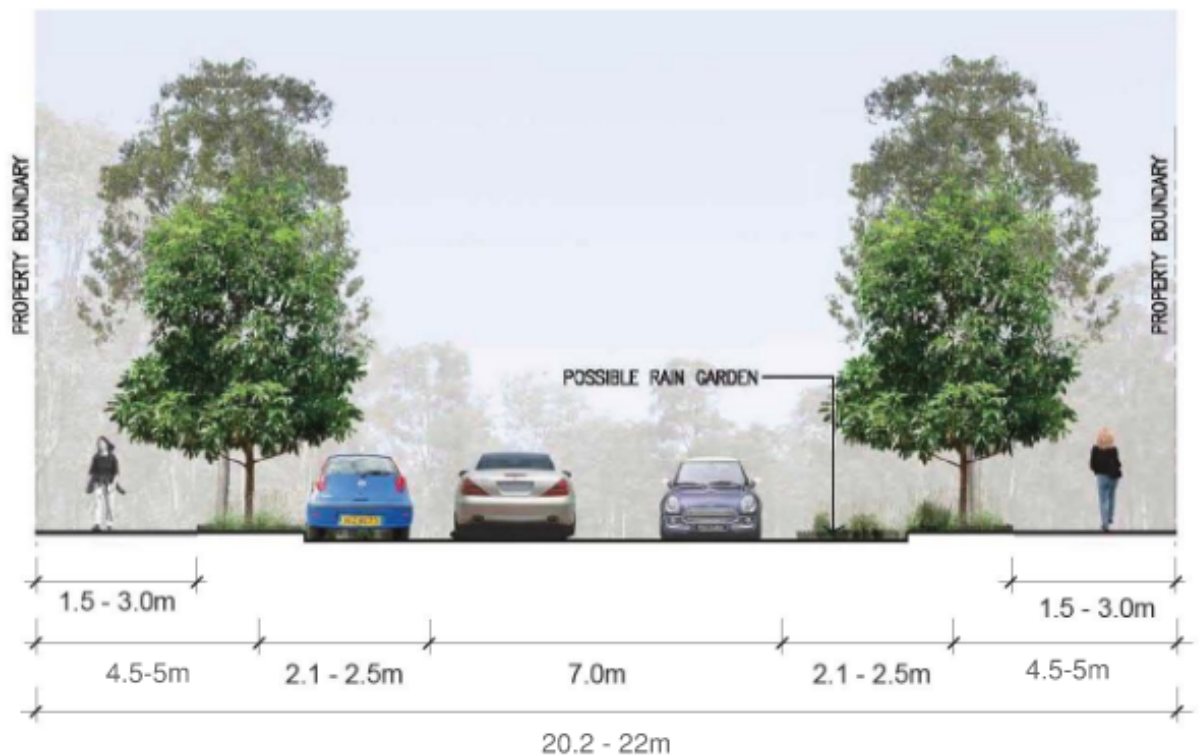


Figure 27 – Town Centre Street

9.3 Engineering Requirements

9.3.1 Design Requirements

The detailed design for new roads within Stage 2 will be carried out based on the relevant guidelines contained within:

- The Huntlee DCP.
- Cessnock City Council's (CCC) "Engineering Requirements for Development" and Singleton Council's (SC) 'Development Engineering Specifications' as required by local Council boundaries.
- AUSTROADS "Guide to Traffic Engineering Practice" for detailed design of intersections and roundabouts, as well as general horizontal and vertical road design.

The documents referred to above will set out the following road design requirements.

- Road cross falls and superelevation.
- Minimum carriageway widths.
- Maximum and minimum longitudinal grades.
- Design speeds.
- Horizontal and vertical curve details.
- Intersection/ roundabout geometry and setout.
- Traffic control devices.
- Footpath.

- Cycleways.
- Signposting and line marking.

9.3.2 Materials and Technical Specifications

Technical specifications for roads and infrastructure will be based on either CCC's "Engineering Requirements for Development" or SC 'Development Engineering Specifications' as dictated by local Council boundaries. Upgrade works to Wine Country Drive may be handled separately and require the use of the TfNSW's standard construction specifications.

9.3.3 Pavement Design

Pavement design will be based on the requirements of the respective Council's Engineering Requirements for all internal development roads except Wine Country Drive. Pavement design will be undertaken by geotechnical engineers as part of the detailed infrastructure design following site investigation and laboratory testing. TfNSW pavement specifications will be utilised for Wine Country Drive upgrades by the geotechnical engineer to design pavements.

9.3.4 Service Vehicle Access

The road layout, particularly junctions and any turning heads, will be designed to ensure access for service vehicles i.e. garbage trucks and emergency vehicles such as fire trucks.

Bus services will be expected within Stage 2. Further to recent advice by Transport for NSW (TfNSW) all Bus routes within the Huntlee development must be designed to cater for the following:

- Transit lanes of 3.5m;
- 3m width reserved for stopping/parking; and
- Turning movements can accommodate 14.5m buses with no centre line crossing.

The collector roads within the development have been specifically developed to cater for these requirements.

9.4 Bus Route Strategy

The Huntlee development has previously been assessed by a number of traffic and public transport accessibility studies. These include the Huntlee Stage 1 Servicing Strategy (2013), completed by Hyder (HBSS). A copy of this report has been provided in Appendix D.

The HBSS considered the Stage 1 and Stage 2 road network to develop internal bus routes throughout the Huntlee development. The intent of the BSS was to ensure bus services were designed and integrated in the overall masterplan for the Huntlee township to enable easy integration of staged services and ensure infrastructure investment in bus stops, shelters, and bus bays will not be wasted in the staged roll out of the development. **Figure 28** shows the layout of Bus routes across the Huntlee township including Stage 2.



Figure 28 – Bus Route Master including Stage 2 (Extract from HBSS)

A bus route strategy has been prepared to service the Stage 2 development and provide connections to the existing Stage 1 network and the surrounding areas. The proposed network has been developed to maximise coverage of the site, link key centres of the development (such as commercial areas, recreational facilities and schools) and with consideration to the road hierarchy.

Consultation has been undertaken with relevant stakeholders, including bus companies that service the area, as part of the development of this strategy.

The ultimate route for the bus strategy is illustrated below in **30**. Indicative bus stop locations are highlighted on the plan that have catchments of approximately 400 metres, consistent with the HBSS.

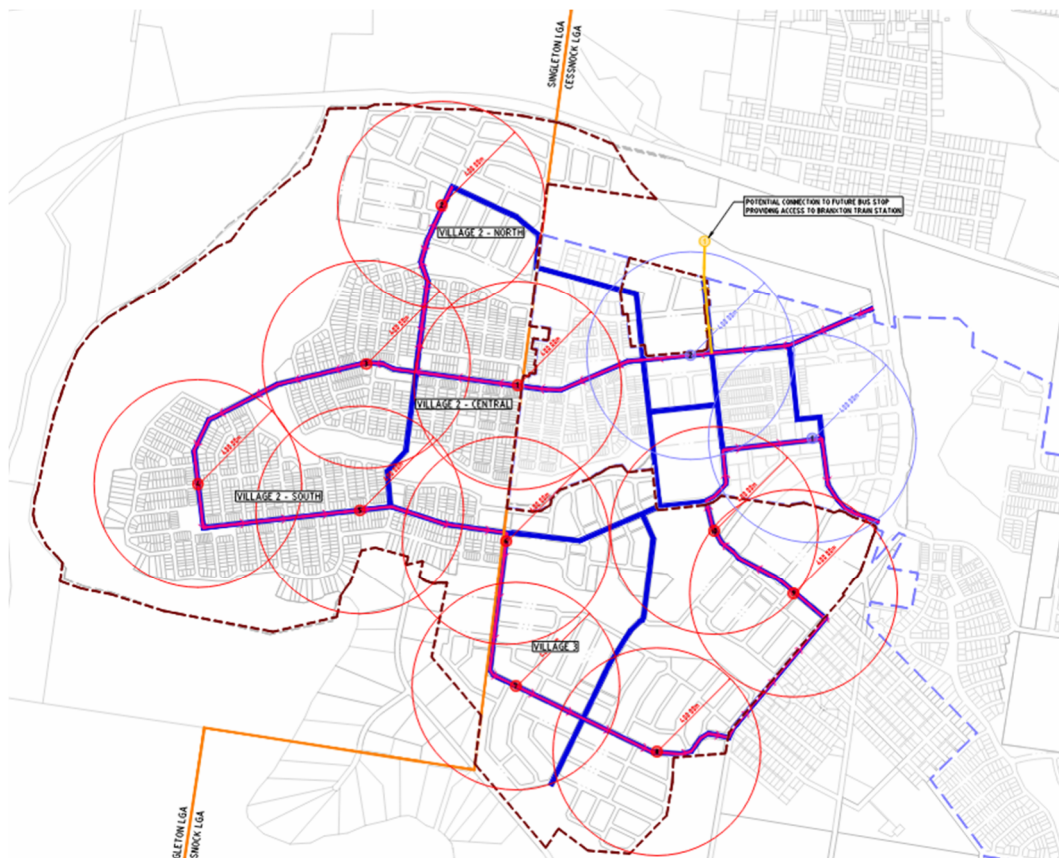


Figure 29 – Bus Route Strategy – Ultimate Scenario

9.4.1 Staging and Short-Term Networks

As Stage 2 of Huntlee will be delivered in stages, short-term bus networks are proposed to service the development during the interim scenarios on a need's basis. How the development is staged will determine the bus access requirements, based on the development yield and land take up. A number of short-term networks have been prepared with consideration to the existing Stage 1 network, as well as the ultimate scenario. Bus stops with 400m catchments are also proposed in the short-term networks. The proposed staging for the Stage 2 bus route network is included in the Huntlee Stage 2 DA Green Travel Plan (2023) prepared by Swan Project Advisory P/ L.

Additionally, a high-level plan for a potential express bus route has been prepared. This plan demonstrates the opportunity for the provision of a central bus stop location that can link different bus services and connect the Town Centre to a potential future bus stop at the Braxton train station. Refer to the Green Travel Plan for details of the proposed network.

10 ESSENTIAL INFRASTRUCTURE

10.1 Potable Water

The water supply authorities responsible for the proposed development area is Altogether Group 'Huntlee Water' and Hunter Water Corporation (HWC). HWC provide bulk drinking water to the front of the Huntlee Development with Altogether having a license (under the Water Industry Competition Act) to provide water and wastewater services within the development site. Currently operating in Stage 1 of the development, this arrangement will continue within Stage 2 development areas.

Extensive engagement with Altogether Group and HWC has been undertaken to date with regard to provision of water services to the Huntlee Development. Numerous developer-funded servicing strategies have been completed for the site with the latest being a revised '*Huntlee Residential Development Bulk Water Servicing Strategy*' provided and approved in July 2015 (contained in Appendix E). This strategy informs the 10 year Utility Services Agreement between Altogether and HWC. Altogether Group have provided written correspondence that they are capable of servicing the extended Stage 2 network. A copy of this correspondence is included in Appendix E.

The Huntlee project requires a number of upgrades to HWC's regional Potable Water Supply network and the building of drinking water reservoirs on the Huntlee site which will be owned and managed by Altogether Group. Stage 2 of the development will be an extension of these services and incorporates the provision of land for future Altogether Group infrastructure requirements, specifically two new Local Water Centre sites within the Stage 2 development area, shown indicatively in **Figure 30** below.

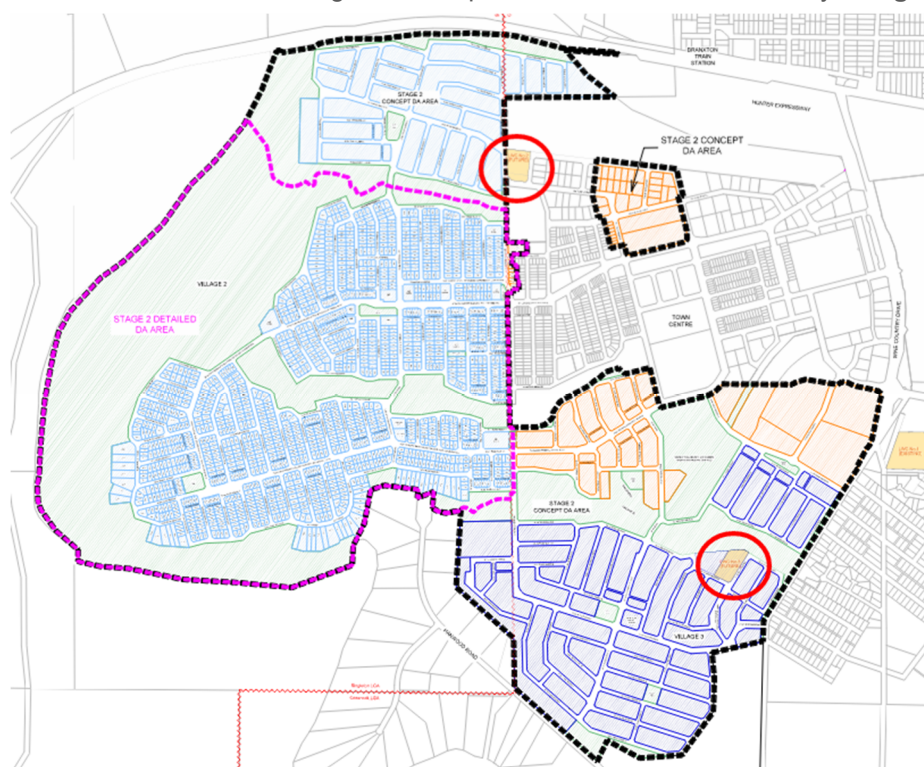


Figure 30 – Additional Local Water Centres to service Stage 2

Altogether Group provides a dual reticulated water system including potable and recycled water to the Huntlee development. The recycled water is a viable water-saving measure for this development, thereby reducing overall potable water demand and assists homeowners to meet BASIX requirements without the need for rainwater tanks. The Recycled water layout essentially follows the potable water network, with the only variation to this being then Old North Road large lot development which will only have drinking water extended.

10.1.1 Regional Infrastructure

The *'Huntlee Residential Development Bulk Water Servicing Strategy'* (Appendix E) provided three options for the upgrade of HWC's regional network to provide bulk potable water services to Huntlee. The preferred option, Option 2, includes servicing from mains within Wine Country Drive. This option requires several upgrades to the HWC network as demand from the site increases.

The first two of these upgrades have already occurred as part of the Stage 1 development, with upgrade 3 proposed in the near future. Refer Appendix E for a full summary of the upgrades required.

The Altogether drinking water network will be extended from the Aria large lot development site (1441 Wine Country Drive) to the Old North Road large lot development site. This extension will occur within the Wine Country Drive and Old North Road corridors.

10.1.2 Internal Infrastructure

For Stage 1 of the development, Altogether completed masterplan studies for the servicing of the Huntlee development with potable water from their Local Water Centre. A copy of this masterplan is also contained in Appendix E. This internal system with major upgrades required for the internal Huntlee infrastructure are also noted in the *'Huntlee Residential Development Bulk Water Servicing Strategy'* for option 2.

Further to advice from Altogether (see Appendix E), Stage 2 of the development will be an extension of this system with trunk mains supplying the new Villages.

10.2 Wastewater

Altogether Group have a license to supply wastewater services to the Huntlee Development. Altogether Group have developed masterplan strategies for the Huntlee development area with the majority of Stage 2 being a natural extension of the Stage 1 release.

Altogether utilise a low-pressure system across the development area to pump wastewater to centrally located 'Local Water Centres'. Wastewater is treated at these sites and then re-supplies to the lots as recycled water or used for irrigation of open spaces. Small amounts of solid waste that remain after the treatment are removed off-site in accordance with Altogether Groups licences conditions.

10.2.1 Internal Infrastructure

An existing Local Water Centre is located at the intersection of Triton Boulevard and Wine Country Drive. Low pressure mains extend throughout Stage 1 of the development to pump wastewater back to this site.

Stage 2 of the development will initially see the extension of this system as the land release expands. It is planned that two additional Local Water Centres will be required to services areas within the remainder of the Huntlee development (refer **Figure 30** above). The first of these additional two sites has been nominated within Stage 1 MOD 21 DA area, this will ensure servicing capability for the majority of the Village 2 and northern Town Centre areas. The third Local Water Centre will be located in Village 3.

The large lot development site located off Old North Road will not be connected to the Altogether sewer network. It is expected that only approximately 35-40 lots will be created on this site, and lots will generally be a minimum of 1.5 to 2 acres. As such, on-site wastewater disposal has been identified as the wastewater solution for this site and an On-Site Wastewater Servicing Plan has been prepared by Whitehead & Associates Environmental Consultants. A copy of the plan is included in Appendix F. A conservative design has been adopted for calculating hydraulic loading for the

development and it is concluded that the site is suitable for sustainable on-site sewer management, provided the site-specific recommendations are implemented.

10.3 Electricity

The energy supply authority responsible for network supply to the proposed development area is Ausgrid.

Ausgrid has carried out preliminary studies to determine a concept plan to supply electricity to the Huntlee development. The required electricity supply upgrade works are to be constructed as needed to service the development and the release of lots. Major electricity upgrades, confirmed by Ausgrid as being required are:

- Augmentation/Extensions are required to existing Branxton and Rothbury Feeder.
- Installation of a new 11kV feeder from the Hunter Expressway corridor to Stage 1 (under construction late 2023).
- 2-3 feeders from Rothbury or Branxton Zone in 2026-2028. Feeder connection from Branxton is currently being investigated. This is the currently preference due to the proximity to the northern edge of Village 2.
- Replacement of an existing transformer at Branxton Zone around 17 to 20 MVA. ‘
- 2-3 feeders from Rothbury Zone in 10-15 years depending on development take up.

Ausgrid have indicated that the large lot residential areas can be serviced from the existing North Rothbury Substation.

The internal electrical reticulation within the development will be designed by the developer and typically handed over to Ausgrid to maintain and operate as the network authority. Liaison with Ausgrid is continuing through the development of the Huntlee project to optimise and provide services on a needs basis.

A HV Feeder Masterplan has been prepared for the Village 2 Detailed Design Area and is included in Appendix G. Also contained in Appendix G are the electrical design specifications for lighting for the different street types.

10.4 Telecommunications

Stage 1 of Huntlee development is serviced by NBN. Huntlee has progressed discussion with NBN Co and signed a new Masterplan Agreement for Village 2 and 3 development areas.

10.5 Natural Gas

Natural gas will not be extended into the Stage 2 residential areas, however, may be provided to commercial development or Education Centres if required by the end users.

10.6 Delivery and Funding of Infrastructure

In general, infrastructure will be delivered in a similar manner to the Stage 1 infrastructure, in line with the roll-out of the development to provide a logical land release. Stage 2 infrastructure and required upgrades will be funded by the developer.

11 LARGE LOT RURAL RESIDENTIAL SUBDIVISION

11.1 Proposed Development

A rural style subdivision forms part of the Concept Project Area, as shown in **Figure 31** below, referred to herein as Old North Road. The proposal incorporates rural residential lots, a single loop road and 2 public open space areas. It is expected that 35-40 lots will be created with areas of approximately 5000-10,000 square metres.

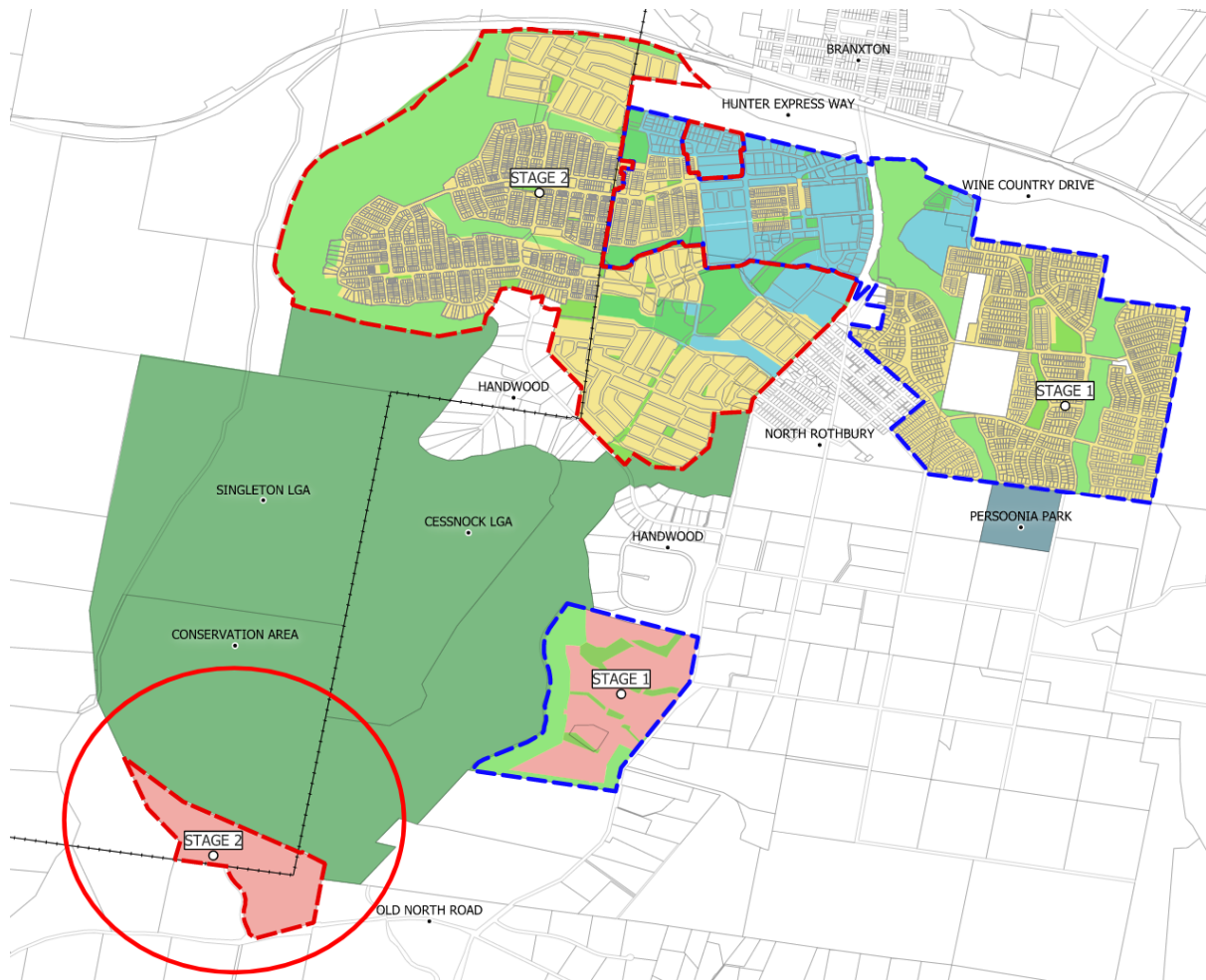


Figure 31– Old North Road Site Context

11.2 Site Description

The Old North Road site is comprised of Lot 13 DP1137569 and has an area of approximately 41.655ha. It is a relatively steep site falling to the northeast and southeast, with an approximate grade of 8-10%. Parts of the site have grades up to approximately 15%. The site is predominantly vegetated and straddles the Singleton Council and Cessnock City Council LGA boundary.

11.2.1 Existing Tributary

An unnamed ephemeral tributary of Rothbury Creek drains in a south easterly direction towards the adjacent Old North Road and ultimately to Black Creek. This tributary has been classified in

accordance with the Strahler method and are summarised in **Table 3** and **Table 4** in Section 4 of this report and is illustrated on the .

11.3 Proposed Stormwater Management Strategy

The stormwater management strategy for the site is to integrate with the existing natural drainage regime and topography, where possible, and seek to enhance the overall environmental and water quality of the catchment.

Rural residential development and large lots provide opportunities for complete on-lot management of stormwater from both a quantity and quality perspective, as discussed further below.

Roadways are proposed to be managed and treated using roadside swales and vegetated buffers.

11.3.1 Stormwater Quality

On-lot management of water quality can be undertaken in a variety of ways. Rainwater tanks can be installed to capture roof water runoff which can be reused within the allotment for non-potable uses such as irrigation for landscaping. Runoff from other impervious areas in the lot, such as driveways and paved areas, can be managed via landscaping features such as soakaway gardens and contour banks, ultimately infiltrating into the groundwater table. It is intended that on-lot stormwater quality controls will be confirmed at the detailed design stage.

To treat the road reserves, roadside swales with distributed lateral inflow will provide treatment, along with grassed buffer areas.

11.3.2 Stormwater Quantity

High level hydrological modelling has been undertaken to assess the site in both the pre and post developed scenarios. A model to predict peak flows for a range of storm durations and frequencies was developed utilising the ILSAX hydrological method in the DRAINS software package. Due to the relatively small increase in impervious percentage in the developed scenario, increases in peak flows in the major events are estimated to be less than 2%. Increases in peak flows in the minor events (approximately 5%) will be accounted for by on-lot measures such as rainwater tanks. Therefore, no detention facilities are proposed for the site at a subdivision scale.

11.3.3 Site Discharge Point

The existing drainage regime for the site will generally be maintained in the post developed scenario. Roadside swales will collect and convey runoff from the roadways to the existing gully and low point in the proposed public open space adjacent to Old North Road, before being discharged from the site. A portion of the site to the north will remain unconcentrated and continue to sheet across the northern boundary, consistent with the undeveloped scenario.

11.4 Proposed Road Characteristics

A 20m wide road corridor is proposed for the site, with a crowned 8m wide pavement and 6m verges and roadside swales, in lieu of kerb and gutter. Typical sections are included in **Figure 32** below. Future property access will be provided via rural driveway crossovers in accordance with Council's standard drawings.

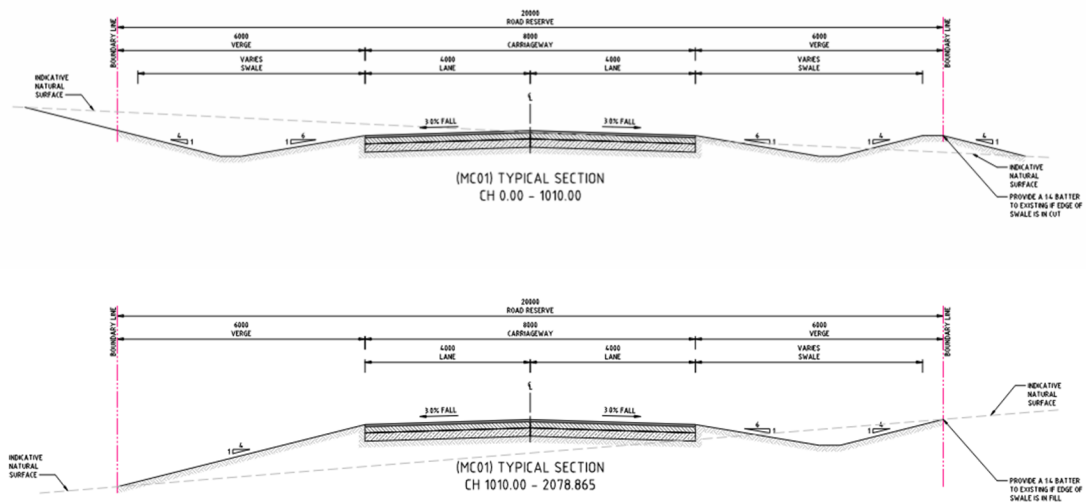


Figure 32– Rural Road Typical Sections

12 CONCLUSION

12.1 Stormwater Management Conclusions

The proposed development has been assessed with respect to the necessary stormwater quantity and quality requirements.

The following recommendations and conclusions are made:

- Riparian corridors are to be established over the proposed natural watercourses which exist across the Site to ensure development buffers are adopted by future on lot development.
- Flood inundation extents for the 1% AEP and PMF across the Site have been provided to inform flood planning of future development.
- All proposed lots are positioned at or above the Flood Planning Level (i.e. the 1% AEP + 500mm).
- Assessment of the pre and post developed flow regimes has been undertaken, concluding that onsite detention will be required to mitigate runoff from the future development, to ensure no significant adverse impact on the existing flood behaviour during the regional flood event.
- The impact of the urban development on stormwater quality is to be mitigated through the incorporation of source and end-of-line treatment controls to reach the nominated pollutant load reduction targets.

12.2 Earthworks

It is expected that reshaping of the existing topography will be required for the provision of access, drainage and the creation of lots. The finished surface level will be designed to:

- Minimise the extent of earthworks.
- Balance the cut and fill to minimise the need for export or import of material to or from site.

Preliminary bulk earthwork and concept cut fill plans have been prepared as part of the Development Application. Detailed levels and bulk earthworks will be prepared at the Subdivision Works Certificate Stage.

12.3 Road Network

The proposed road network has been designed to incorporate major circulation routes for private vehicles, public transport, cyclists, and pedestrians as well as local roads for access to local neighbourhoods and residential lots. Perimeter roads, to facilitate fire fighting access, have also been integrated into the network.

Preliminary long sections have been prepared for all roads both in the concept and detailed areas to show the general design intent within Stage 2 of the development. Road designs will be further developed at the Subdivision Works Certificate Stage.

12.4 Essential Infrastructure

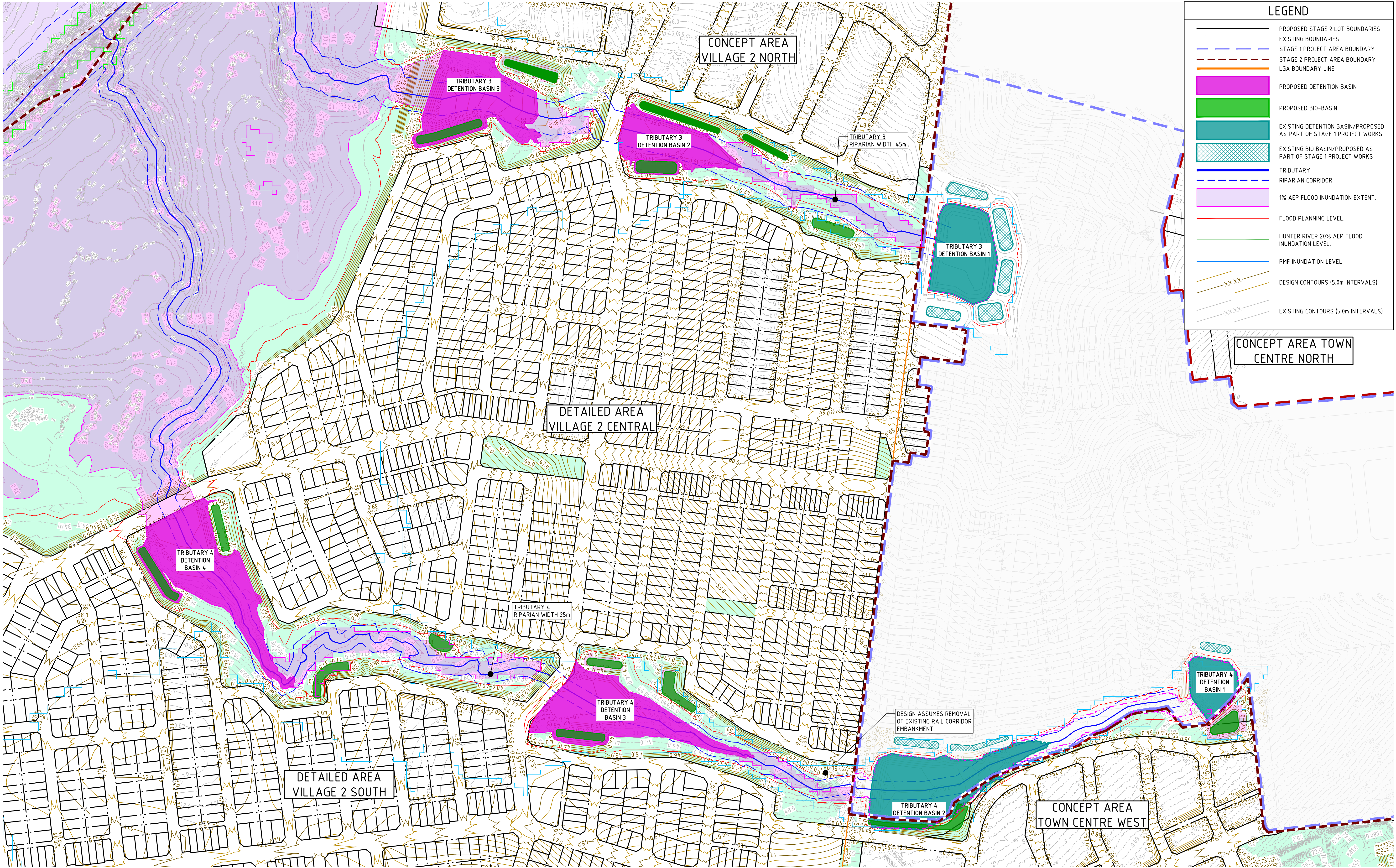
All proposed lots will be serviced with potable water, recycled water, wastewater, electricity and telecommunications infrastructure. Servicing strategies and detailed design in collaboration with the relevant authority will progress in line with the detailed design of each stage.

Appendix A – Civil Engineering Drawings

Drawing No.	Drawing Package
V2-DA-C01.01 – V2-DA-C08.39	Village 2 Detailed Areas (Central & South)
V2-C-C01.01 – V2-C-C05.37	Village 2 Concept Area (North)
V3-C-C01.01 – V3-C-C06.01	Village 3 Concept Area
TCNC-C01.01 – TCNC-C06.01	Town Centre Concept Area
ONRC-C01.01 – ONRC-C05.05	Old North Road Concept Area
WCD-C01.01 – WCD-C09.53	WCD Intersection Concepts

Appendix B – Concept Stormwater Management Plan

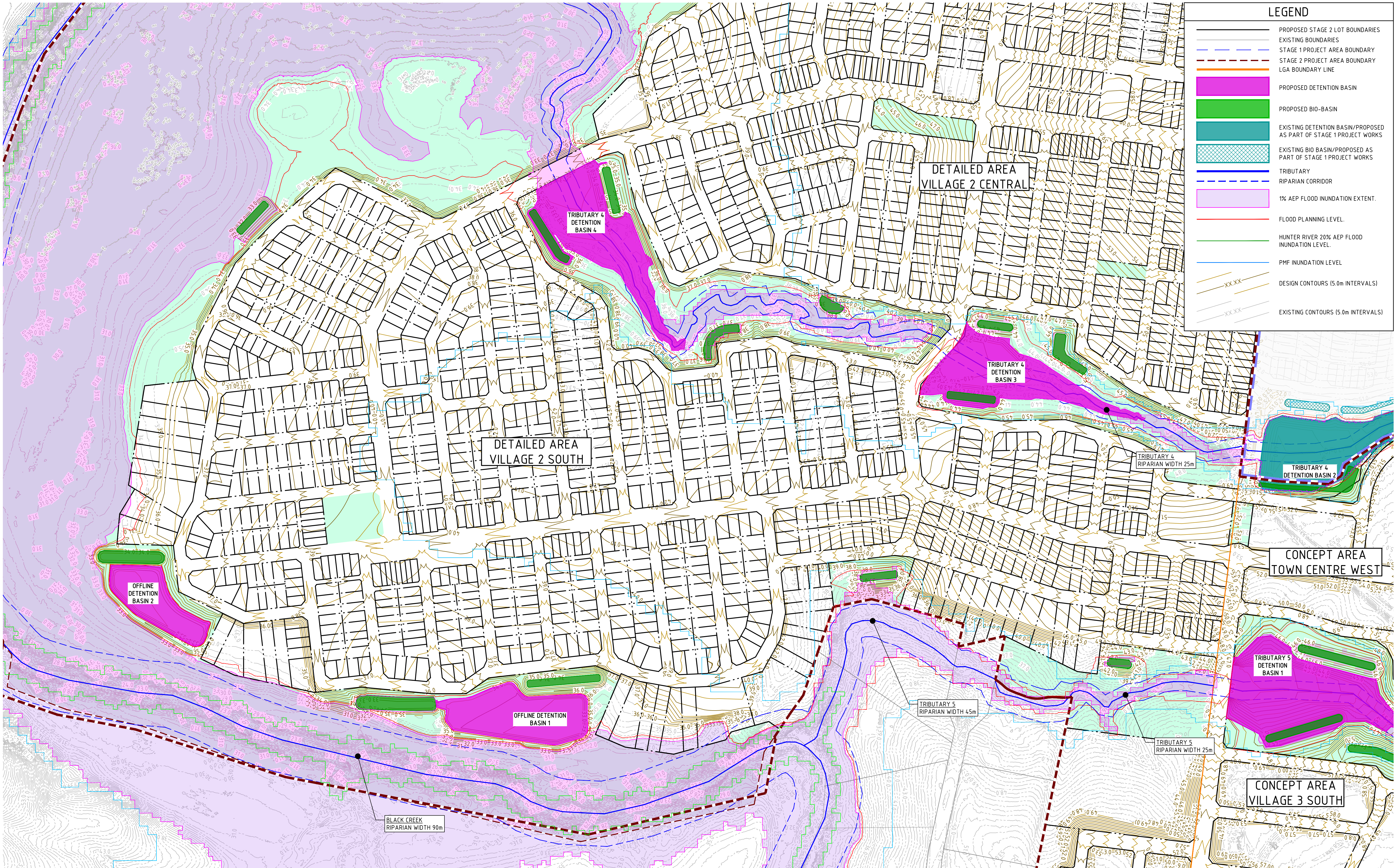
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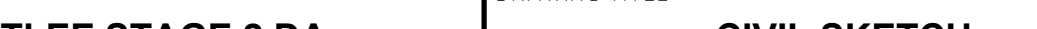
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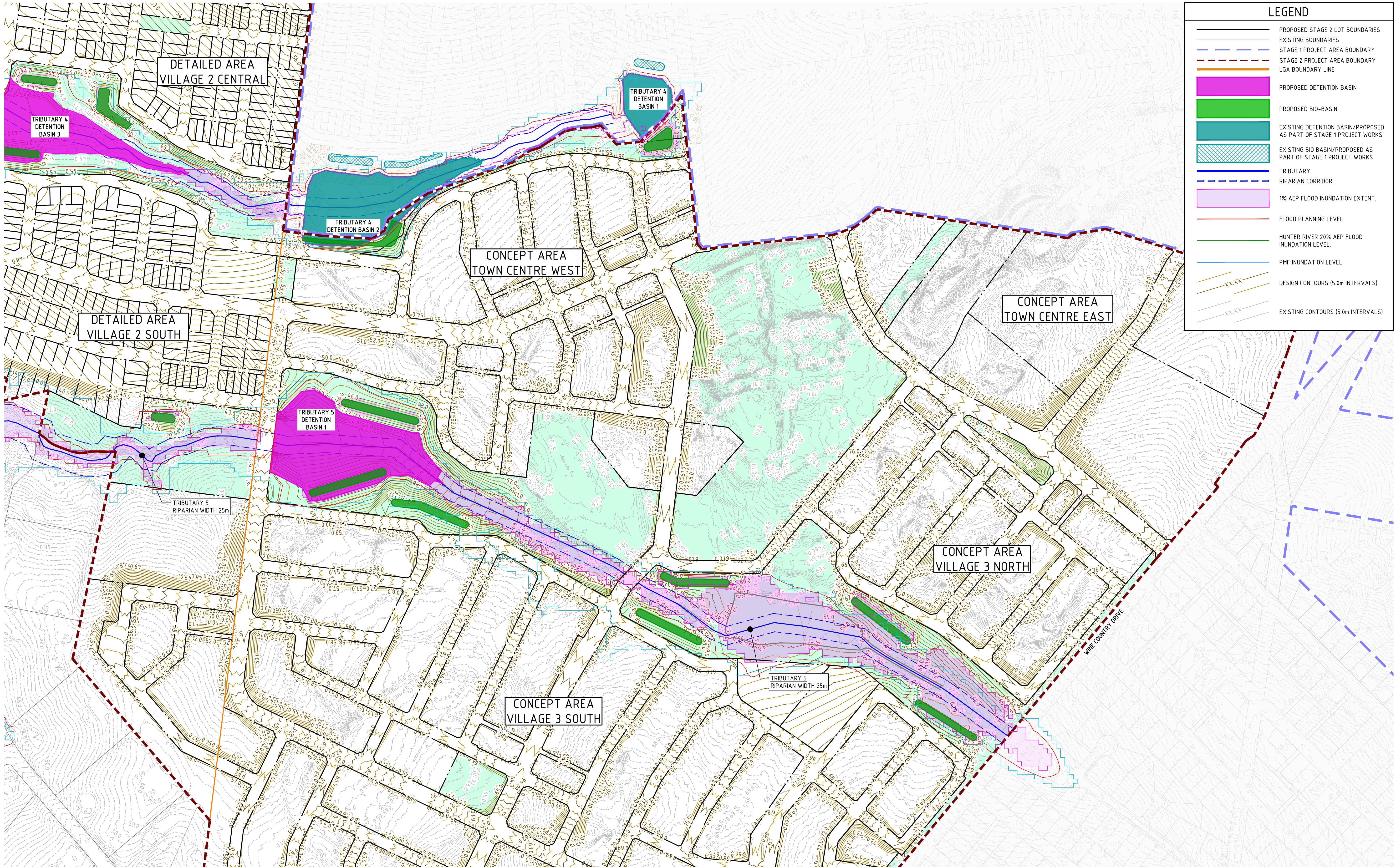
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LEGEND

PROPOSED STAGE 2 LOT BOUNDARIES

EXISTING BOUNDARIES

STAGE 1 PROJECT AREA BOUNDARY

STAGE 2 PROJECT AREA BOUNDARY

LGA BOUNDARY LINE

PROPOSED DETENTION BASIN

PROPOSED BIO-BASIN

EXISTING DETENTION BASIN/PROPOSED AS PART OF STAGE 1 PROJECT WORKS

EXISTING BIO BASIN/PROPOSED AS PART OF STAGE 1 PROJECT WORKS

TRIBUTARY

RIPARIAN CORRIDOR

1% AEP FLOOD INUNDATION EXTENT

FLOOD PLANNING LEVEL

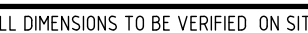
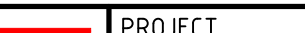
HUNTER RIVER 20% AEP FLOOD INUNDATION LEVEL

PMF INUNDATION LEVEL

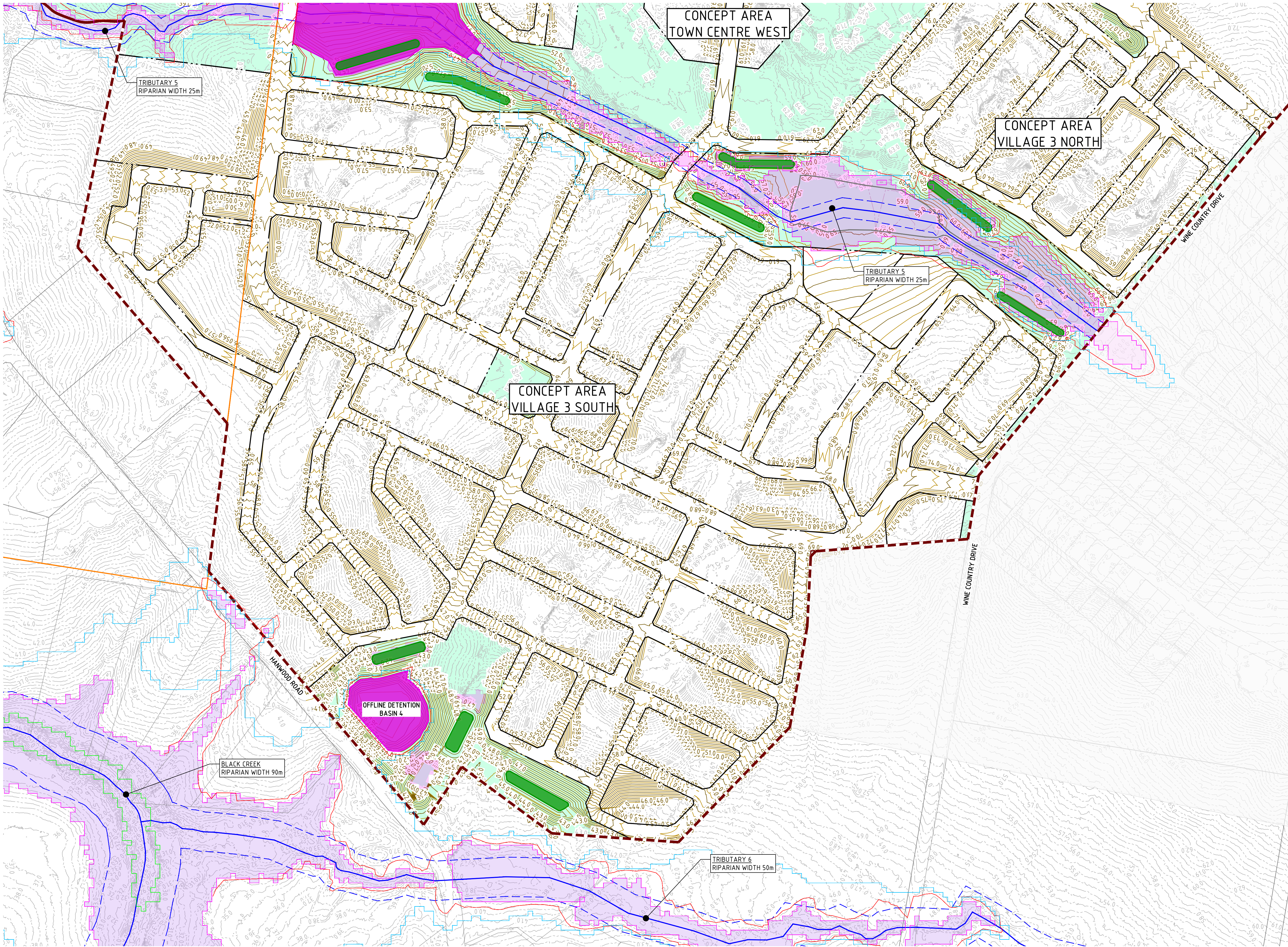
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EXISTING CONTOURS (5.0m INTERVALS)

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CONCEPT STORMWATER MANAGEMENT PLAN - STAGE 2 EAST															

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LEGEND	
	PROPOSED STAGE 2 LOT BOUNDARIES
	EXISTING BOUNDARIES
	STAGE 1 PROJECT AREA BOUNDARY
	STAGE 2 PROJECT AREA BOUNDARY
	LGA BOUNDARY LINE
	PROPOSED DETENTION BASIN
	PROPOSED BIO-BASIN
	EXISTING DETENTION BASIN/PROPOSED AS PART OF STAGE 1 PROJECT WORKS
	EXISTING BIO BASIN/PROPOSED AS PART OF STAGE 1 PROJECT WORKS
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	RIPARIAN CORRIDOR
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	FLOOD PLANNING LEVEL
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Appendix C – Council Consultation

31 August 2023

NL220566

Jules Bosco
Cessnock City Council
PO Box 152
Cessnock NSW 2325

Dear Jules,

Re: Huntlee Stage 2 Project Area – Proposed Concept Engineering / Stormwater Management Strategy

As recently discussed, Northrop Consulting Engineers have been engaged by Huntlee Pty Ltd to prepare a Concept Stormwater Management Strategy for the Huntlee Stage 2 Project Area. The Huntlee Stage 2 Project Area is expected to deliver approximately 5000 new residential lots and will enable completion of the Huntlee Town Centre which comprises of retail and commercial facilities. It is noted that the development footprint spans both Cessnock City Council and Singleton Shire Council LGA's.

The following correspondence has been prepared as an initial summary of the proposed Concept Stormwater Management Strategy for Council's preliminary review feedback. Provided in Attachment 1 is an illustration of possible Stormwater Quantity and Quality management devices across the Project Area. The purpose of this correspondence is to gain concurrence from Council for the general strategy prior to finalisation of the submission to support the Development Application.

The principles of the proposed stormwater management strategy have been derived from the riparian, flood and water cycle controls identified under Section 3 of the 2013 Huntlee DCP. Presented herein is a summary of the Stormwater Quality and Quantity management and Flooding for the proposed development. It is anticipated that the strategy will be further refined through design development prior to Development Application submission and will be subject to change following discussions with relevant stakeholders (e.g the Proponent, Council, and the Department).

Stormwater Quality

Treatment Train

The proposed treatment train for the Stage 2 Project Area will generally comprise of primary treatment via proprietary Gross Pollutant Traps (GPT), followed by tertiary treatment in offline bio-filtration basins, located throughout the catchment as required. This strategy is intended to be consistent with principles of Water Sensitive Urban Design (WSUD) while minimising ongoing maintenance requirements for Council relative to other available treatment options.

It is noted that this strategy is generally consistent with the adopted approach across the Stage 1 Project Area and is considered to be the most efficient and appropriate management system for the ongoing Huntlee Development, future maintenance and compliance with Council's DCP.

Treatment Targets

Stormwater quality for the proposed development is proposed to meet the pollutant removal efficiency targets outlined in the Singleton/ Huntlee Development Control Plan 2013, reproduced in *Table 1* below.

		Date
Prepared by	LG	31/08/2023
Checked by	BB	31/08/2023
Admin	CB	31/08/2023

NL220566 / 31 August 2023 / Revision A

Y:\YEAR 2022 Jobs\NL220566 - Huntlee Stage 2 Project Area\B - Correspondence\B02 - Proposed Stormwater Management Strategy to CCC\B02_Stage 2 Proposed Stormwater Management Strategy_[A].docx

Table 1 - Water Quality Treatment Targets

Pollutant	Treatment Efficiency Target
Total Suspended Solids (TSS)	85% reduction in pollutant loads
Total Nitrogen (TN)	45% retention of average annual load.
Total Phosphorous (TP)	45% retention of average annual load.

It is proposed to assess the treatment targets at a tributary scale rather than at local catchments outlets.

Stormwater Quantity

Major/ Minor Network

A major/ minor drainage network philosophy will be adopted for local stormwater conveyance. Pit and pipe networks will be designed to convey the 'minor' stormwater event (10% AEP) in accordance with Councils' requirements. Management of the 'major' stormwater flows (1% AEP) will be via dedicated overland flow paths including road corridors, open space areas and tributaries.

Standard inlet blockage factors of 50% for sags and 20% for on-grade pits are proposed to be adopted in the major storm event.

Impervious Area Assumptions

The following impervious percentages are proposed to be adopted for the different land use categories in the Stage 2 Project Area. It is noted that the values may differ slightly to the fraction impervious numbers outlined in the Cessnock Council Engineering Design Guidelines, however we believe they will accurately represent the Project Area based on the proposed masterplan and existing development at Huntlee to date.

Table 2 - Design Impervious Percentage Assumptions

Type of Development	Design Impervious Area (%)
Residential Areas (incorporating residential roads and lots typically ranging between 400-800sqm)	75%
Residential Areas (incorporating residential roads and lots typically ranging between 800-1,500sqm)	60%
Rural Residential Areas (incorporating residential roads and lots typically greater than 1,500sqm)	45%
Town Centre/ Mixed Use (incorporating roads, commercial areas, and higher density residential (lots typically less than 400sqm))	85%
Employment/ Commercial (incorporating larger scale commercial/ employment development)	85%
Parkland/ Public Open Spaces	0-15%

It is noted that lumped node models will adopt averages of these percentages where appropriate.

Stormwater Detention

Increased runoff due to the development is proposed to be managed through the introduction of a series of Detention Basins, as shown by the indicative strategy presented in Attachment 1. Where layout and site topography permits, on-site basins will be designed to utilise existing storage within the natural gully lines. These basins will be designed to minimise impact on riparian vegetation and function.

It is the intent of the Detention facilities to limit peak flows from the developed catchment back to pre-developed levels for the 20% AEP – 100% AEP events, thus managing impacts to the downstream receiving water course. In this case the downstream watercourse is Black Creek a very large Tributary of the Hunter River. Preliminary modelling shows that additional runoff from the site will not significantly increase peak flows in Black Creek even without detention in the very less frequent events due to the timing of the respective hydrographs and size of flow already in Black Creek. However, detention is still expected to be provided on site to limit the more frequent events and minimise the likelihood of erosion in watercourses.

As a secondary review of detention performance, it is proposed to compare 1% AEP developed case peak water levels to existing case water levels at the nearest major downstream hydraulic structure. A review of Aerial Imagery and LiDAR elevation data suggests the nearest downstream major hydraulic structure is at the Rail Crossing at Black Creek, approximately 200m north-west of the site.

Review of the detention performance is expected to be performed using the flood model. The proposed flood modelling methodology and model parameters are summarised in the below section.

Flooding

Modelling Methodology

As directed by DPE and Singleton Council, flooding across the site is proposed to be assessed with consideration to the latest **Singleton Floodplain Risk Management Study and Plan (BMT, 2022)**. A site-specific flood model will be developed using data and parameters generally consistent with the Singleton Floodplain Risk Management Study and Plan (BMT, 2022).

XP-RAPIDS is proposed to be used as the hydrological model, capturing the local subject site catchment (i.e. subject site and vicinity). Similarly, TUFLOW is proposed to be used as the hydraulic model.

In comparison, the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) used a combined FFA, WBNM and Rainfall on Grid approach for the hydrology and TUFLOW for hydraulics. XP-RAPIDS is proposed for the local catchment hydrological to enable a more efficient developed case iteration process and is generally consistent with current industry best practice.

The TUFLOW model is expected to include upstream inflows derived by the regional Black Creek catchment which will be extracted from the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) flood model results.

Downstream boundary conditions for the TUFLOW model will also be based on flood levels presented by the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) with the TUFLOW model to extend downstream of the Rail Crossing at Black Creek to enable assessment of flood impacts at this structure and detention performance during the 1% AEP.

The latest HPC GPU TUFLOW model solver is expected to be used for the analysis.

A comparison between the results presented in the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) and the existing case results prepared by the site-specific flood model will be prepared to verify the results of the constructed model.

Design Storm Events

Design storm events are to include the 20% AEP, 10% AEP, 5% AEP, 1% AEP, 0.2% AEP (as a proxy for climate change) and the PMF. These are similar events to what was considered for the Local Overland Flood Assessment presented in the Singleton Floodplain Risk Management Study and Plan (BMT, 2022).

Rainfall Losses

Rainfall losses are proposed to be prepared generally in accordance with the Local Overland Flood Assessment prepared by the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) (refer to Annex B).

This includes the use of the latest NSW Specific Probability Neutral Burst Initial Loss and reduced ARR 2019 data hub continuing loss.

Hydraulic Roughness

TUFLOW hydraulic roughness is proposed to be prepared generally in accordance with the Local Overland Flood Assessment prepared by the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) (refer to Annex B).

Hydraulic Blockage

For the purposes of the detention design, a 0% blockage scenario is proposed for detention basin outlets and proposed creek culvert crossings. This is expected to result in the highest peak flow discharge from the basins and the subject site.

Maximum water levels within the basins and through the creeks will then be assessed using a "Design Blockage" scenario. The Design Blockage scenario will include an envelope of the aforementioned 0% blockage scenario and a standard blockage allowance. The standard blockage allowance will vary depending on a number of factors (culvert/ pipe size, debris availability, debris mobility, debris transportability, etc) and will be based on the latest Australian Rainfall and Runoff Guidelines (2019), in particular Book 6, Chapter 6 – Blockage of Hydraulic Structures.

We trust that the above meets with your expectations however should you have any queries or wish to further discuss please don't hesitate to contact the undersigned on (02) 4943 1777.

Yours sincerely,



Brittany Balcombe

Group Manager | Civil Engineer
BEng (Environmental)

Limitation Statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by LWP Property Group Pty Ltd and Cessnock City Council. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

Except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

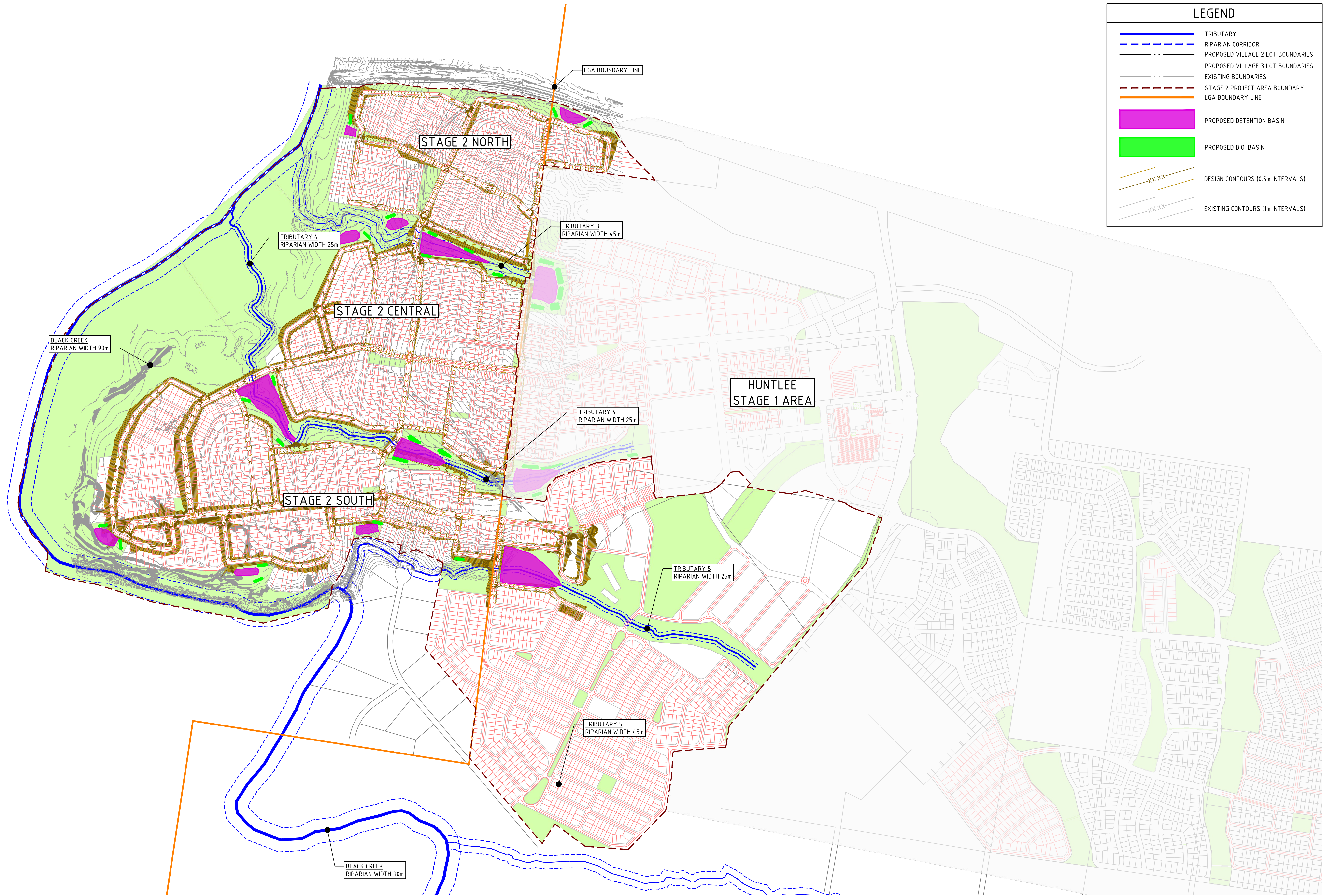
Where this report indicates that information has been provided to Northrop by third parties, Northrop has made no independent verification of this information except as expressly stated in the report. Northrop is not liable for any inaccuracies in or omissions to that information.

The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required.

To the extent permitted by law, Northrop expressly excludes any liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this report.

Attachment 1 – Indicative Stormwater Management Strategy



LEGEND	
	TRIBUTARY
	RIPARIAN CORRIDOR
	PROPOSED VILLAGE 2 LOT BOUNDARIES
	PROPOSED VILLAGE 3 LOT BOUNDARIES
	EXISTING BOUNDARIES
	STAGE 2 PROJECT AREA BOUNDARY
	LGA BOUNDARY LINE
	PROPOSED DETENTION BASIN
	PROPOSED BIO-BASIN
	DESIGN CONTOURS (0.5m INTERVALS)
	EXISTING CONTOURS (1m INTERVALS)

NOT FOR CONSTRUCTION

DRAWN: J.PARKINSON DESIGNED: J.PARKINSON JOB MANAGER: B.BALCOMBE VERIFIER:

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT	ARCHITECT	 ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE COMMENCING WORK. NORTHROP ACCEPTS NO RESPONSIBILITY FOR THE USABILITY, COMPLETENESS OR SCALE OF DRAWINGS TRANSFERRED ELECTRONICALLY. THIS DRAWING MAY HAVE BEEN PREPARED USING COLOUR, AND MAY BE INCOMPLETE IF COPIED TO BLACK & WHITE.  Newcastle Level 1, 215 Pacific Hwy, Charlestown NSW 2290 Ph (02) 4943 1777 Email newcastle@northrop.com.au ABN 81 094 433 100	PROJECT	HUNTLEE STAGE 2 DA	DRAWING TITLE	CIVIL SKETCH	JOB NUMBER	NL220566
1	ISSUED FOR INFORMATION	JP		BB	03.03.23	DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED	 ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE COMMENCING WORK. NORTHROP ACCEPTS NO RESPONSIBILITY FOR THE USABILITY, COMPLETENESS OR SCALE OF DRAWINGS TRANSFERRED ELECTRONICALLY. THIS DRAWING MAY HAVE BEEN PREPARED USING COLOUR, AND MAY BE INCOMPLETE IF COPIED TO BLACK & WHITE.  Newcastle Level 1, 215 Pacific Hwy, Charlestown NSW 2290 Ph (02) 4943 1777 Email newcastle@northrop.com.au ABN 81 094 433 100		CONCEPT STORMWATER MANAGEMENT SITE PLAN	CONCEPT STORMWATER MANAGEMENT SITE PLAN	DRAWING NUMBER	CSK03.01	REVISION	4
2	ISSUED FOR INFORMATION	RH		BB	13.06.23									
3	ISSUED FOR INFORMATION	RH		BB	21.06.23									
4	ISSUED FOR INFORMATION	RH		BB	03.07.23									
							SCALE 1:7000@A1			DRAWING SHEET SIZE = A1				

24 July 2023

NL220566

Sam Masoomi
Singleton Council
PO Box 314
Cessnock NSW 2335

To Sam Masoomi,

Re: Huntlee Stage 2 Project Area – Proposed Concept Masterplan Stormwater Management Strategy

Northrop Consulting Engineers have been engaged by Huntlee Pty Ltd to prepare a Concept Stormwater Management Strategy for the Huntlee Stage 2 Project Area. The Huntlee Stage 2 Project Area is expected to deliver approximately 5000 new residential lots and will enable completion of the Huntlee Town Centre which comprises of retail and commercial facilities.

The following correspondence has been prepared as an initial summary of the proposed Concept Stormwater Management Strategy for Council's preliminary review. Provided in Attachment 1 is an illustration of possible Stormwater Quantity and Quality management devices across the Project Area. The purpose of this correspondence is to gain concurrence from Council for the general strategy and proposed model parameters prior to finalisation of the submission to support the Development Application.

The principles of the proposed stormwater management strategy have been derived from the riparian, flood and water cycle controls identified under Section 3 of the 2013 Huntlee DCP. Presented herein is a summary of the Stormwater Quality and Quantity management and Flooding for the proposed development. It is anticipated that the strategy will be further refined through design development prior to Development Application submission and will be subject to change following discussions with relevant stakeholders (e.g the Proponent, Council, and the Department).

Stormwater Quality

Treatment Train

The proposed treatment train for the Stage 2 Project Area will generally comprise of primary treatment via proprietary Gross Pollutant Traps (GPT), followed by tertiary treatment in offline bio-filtration basins, located throughout the catchment as required. This strategy is intended to be consistent with principles of Water Sensitive Urban Design (WSUD) while minimising ongoing maintenance requirements for Council relative to other available treatment options.

It is noted that this strategy is generally consistent with the adopted approach across the Stage 1 Project Area and is considered to be the most efficient and appropriate management system for the Huntlee Development.

Treatment Targets

Stormwater quality for the proposed development is proposed to meet the pollutant removal efficiency targets outlined in the Singleton/ Huntlee Development Control Plan 2013, reproduced in *Table 1* below.

		Date
Prepared by	LG	24/07/2023
Checked by	BB	24/07/2023
Admin	CB	24/07/2023

NL220566 / 24 July 2023 / Revision A

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We trust that the above meets with your expectations however should you have any queries or wish to further discuss please don't hesitate to contact the undersigned on (02) 4943 1777.

Yours sincerely,



Brittany Balcombe

Group Manager | Civil Engineer
BEng (Environmental)

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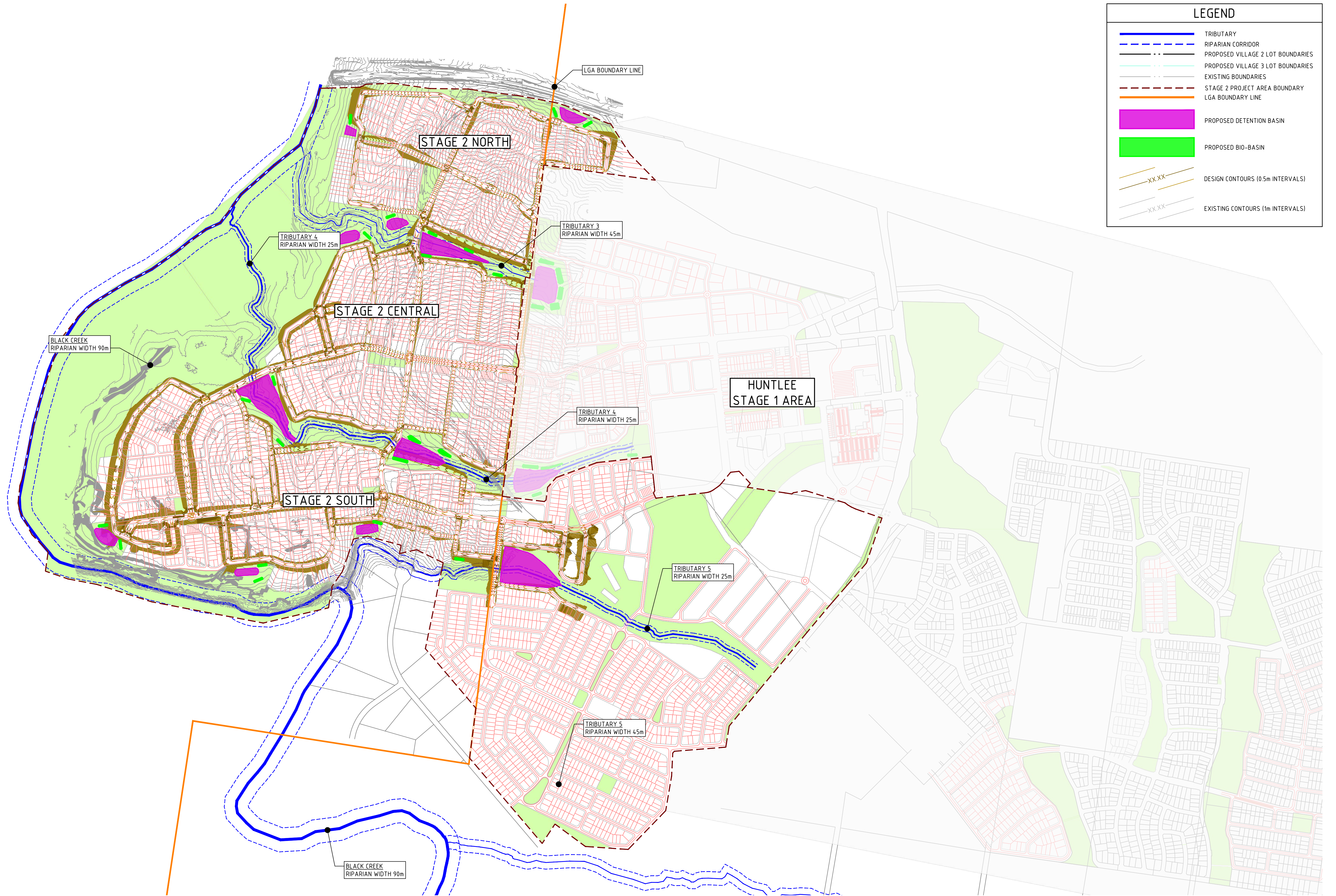
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Attachment 1 – Indicative Stormwater Management Strategy

DRAWN: J.PARKINSON DESIGNED: J.PARKINSON JOB MANAGER: B.BALCOMBE VERIFIER:



LEGEND

TRIBUTARY

RIPARIAN CORRIDOR

PROPOSED VILLAGE 2 LOT BOUNDARIES

PROPOSED VILLAGE 3 LOT BOUNDARIES

EXISTING BOUNDARIES

STAGE 2 PROJECT AREA BOUNDARY

LGA BOUNDARY LINE

PROPOSED DETENTION BASIN

PROPOSED BIO-BASIN

DESIGN CONTOURS (0.5m INTERVALS)

EXISTING CONTOURS (1m INTERVALS)

NOT FOR CONSTRUCTION

REVISION	DESCRIPTION	ISSUED	VER'D	APP'D	DATE	CLIENT	ARCHITECT	 ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE COMMENCING WORK. NORTHROP ACCEPTS NO RESPONSIBILITY FOR THE USABILITY, COMPLETENESS OR SCALE OF DRAWINGS TRANSFERRED ELECTRONICALLY. THIS DRAWING MAY HAVE BEEN PREPARED USING COLOUR AND MAY BE INCOMPLETE IF COPIED TO BLACK & WHITE.  Newcastle Level 1, 215 Pacific Hwy, Charlestown NSW 2290 Ph (02) 4943 1777 Email newcastle@northrop.com.au ABN 81 094 433 100	PROJECT	DRAWING TITLE	JOB NUMBER	
1	ISSUED FOR INFORMATION	JP		BB	03.03.23	DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED	THE COPYRIGHT OF THIS DRAWING REMAINS WITH NORTHROP CONSULTING ENGINEERS PTY LTD		SCALE 1:7000@A1 	HUNTLEE STAGE 2 DA	CIVIL SKETCH	NL220566
2	ISSUED FOR INFORMATION	RH		BB	13.06.23					DRAWING NUMBER	REVISION	
3	ISSUED FOR INFORMATION	RH		BB	21.06.23					CONCEPT STORMWATER MANAGEMENT SITE PLAN	CSK03.01	4
4	ISSUED FOR INFORMATION	RH		BB	03.07.23							
DRAWING SHEET SIZE = A1												

18 September 2023

Meeting Minutes

Date: 13/09/23 **Location:** Online
Job No: NL220566 **Job Name:** Huntlee Stage 2 Project Area

Present:	Jules Bosco	JB	Cessnock Council	Jules.Bosco@cessnock.nsw.gov.au
	Glenn Swan	GS	Swan Project Advisory	glenn@swanprojects.com.au
	Ben Clark	BC	Northrop	bclark@northrop.com.au
	Brittany Balcombe	BB	Northrop	bbalcombe@northrop.com.au

Apologies: _____

Item	Description	Action By
1.0	Project Submission Summary	
1.1	(BC) Further to the Proposed Concept Engineering & Stormwater Management Strategy provided to CCC for information on 31/08/23, refer attachment A, this meeting intends gain advice from Council relating to the proposed strategy prior to submission of the Huntlee Stage 2 subdivision. (BC) Huntlee is a Master planned community with the Stage 1 Project Area now well progressed within the Cessnock LGA. The Stage 2 project area covers the remaining master plan area and falls across both Cessnock & Singleton LGA's.	
1.2	(BC) The Stage 2 Project Area is being segmented into Detailed and Concept areas. It is noted that land within the Cessnock LGA predominately falls within the Concept Design Area. Generally, the civil submission will consist of the following in these areas: ○ Civil Works Plans showing preliminary road and stormwater basin grading and stormwater network layout. ○ Preliminary Road Long Sections ○ Preliminary Cut/Fill Plans for the roads and any areas of significant filling ie gully lines.	



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2.0	Proposed Road Network	
2.1	(BC) The proposed hierarchy aims to generally remain consistent with the existing Stage 1 road network and current DCP typical sections.	
2.2	(JB) Feedback has been received that some of the road widths within the existing subdivision are too narrow which is a concern. Concern predominately relates to provision for on-street parking and waste collection. It is acknowledged that all roads to date have been provided in accordance with current DCP requirements however consultation of AUS-SPEC guidelines is recommended. (JB) No current timeframe in place for Cessnock Council to revise existing typical road sections within DCP.	
2.3	(JB) All road signage & line marking should be reviewed by Cessnock Council and approved by the Local Traffic Committee prior to installation. Concern has been raised that this has not been happening to date. (GS) Confirmed that this has been happening via Nathan Goodburn at detail design for all stages of development since 2020. It was understood that this was now occurring to Council's satisfaction.	
2.4	(JB) Intersections onto WCD will be of most significance to road design. TfNSW comment should be sort. (BC) Confirmed that schematic designs suitable for submission to TfNSW will be provided to support the DA submission. Design, Approval and Construction of these intersections will be undertaken as part of a standard WAD process.	
3.0	Active Transport Network	
3.1	(JB) Provider feedback should be sort on the proposed Bus route / network. (GS) Confirmed this is being sort.	GS
3.2	(JB) No comment on the proposed shared path / recreation trail layout. All concrete paths should however be constructed in accordance with Council's standard detail.	
4.0	Stormwater Management Strategy	
4.1	(BC) The strategy aims to remain consistent to that implemented across the Stage 1 project area. Generally, this comprises of end of line water quality treatment measures at a local catchment scale incorporating Gross Pollutant Traps and Biofiltration Basins. Based on site topography and development layout on and offline regional detention basins have been proposed across the site to attenuate post developed flows to pre-developed rates. (JB) Strategy generally support however noted that number of basins to be minimised were possible. Acknowledge that measures are being designed to meet Council's minimum mitigation / treatment requirements.	
4.2	(JB) Further noted in relation to basin design - Fencing of drainage reserves to be avoided where possible. If fencing is unavoidable, Cessnock Council's Public Open Space team to be consulted on preferences. It is acknowledged that Cessnock Council do not currently have clear guidelines on basin edge treatments, JB to seek clarification on this.	JB



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SUSTAINABILITY

	○ A point of 1 in 6 maximum batter slope to be provided to facilitate safe egress from all unfenced basins to be accommodated at detailed design stage. ○ Retaining walls within drainage reserves to be avoided or at least minimised. ○ Access to all drainage reserves suitable for maintenance vehicles / machinery to be provided at detailed design stage.	
5.0	Flooding	
5.1	• (BC) In accordance with advice from Singleton Council and confirmation from DPE the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) has been adopted for the purposes of this DA. A site-specific flood model will be developed using data and parameters generally consistent with this study. • (JB) Acknowledged, however was not previously aware of this study.	
6.0	Old North Road Project Area	
6.1	• (BC) This part of the development proposes delivery of approximately 35 rural residential lots with minimum ~2 acres allotment size located off Old North Road, south of the existing township. On lot stormwater mitigation measures are being considered for this area. • (JB) Confirm end of line biofiltration / detention basin reserves would preferably be avoided where on-lot mitigation measures can be provided. This is currently being done in other developments in the local area.	
6.2	• (JB) Typical Rural Residential Road cross section to be adopted to be consistent with surrounding suburb. No kerbs and roadside drainage swales would be considered appropriate internally. • (JB) BAR minimum treatment at entrance off Old North Road	
6.3	• (JB) Bushfire constraints should be adequately considered. Planning for fire truck access / turning facilities should be prioritised as often major limiting factor of similar developments.	
6.4	• (GS) Sealed roadway would need to extend approximately 700m from the site boundary to meted existing sealed surface on Old North Road.	
7.0	Operation and Maintenance	
7.1	• (JB) Cessnock Council how have an independent Asset Planning Team. Cameron Martin is appropriate contact for engagement for the Huntlee subdivision. JB will circulate contact details.	JB
7.2	• (JB) Asset Planning Team is currently seeking detail on the existing assets at Huntlee. GS to coordinated as required.	GS
7.3	• (BC) Access into all public reserves to be provided for maintenance vehicles / machinery at detailed design stage across the Stage 2 Project Area.	



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SUSTAINABILITY

25 September 2023

Meeting Minutes

Date: 21/09/23 **Location:** Online
Job No: NL220566 **Job Name:** Huntlee Stage 2 Project Area

Present:	Sam Masoomi	SM	Singleton Council	smasoomi@singleton.nsw.gov.au
	Heinrich Gerber	HG	Singleton Council	hgerber@singleton.nsw.gov.au
	Glenn Swan	GS	Swan Project Advisory	glenn@swanprojects.com.au
	Ben Clark	BC	Northrop	bclark@northrop.com.au
	Brittany Balcombe	BB	Northrop	bbalcombe@northrop.com.au

Apologies: _____

Item	Description	Action By
1.0	Project Submission Summary	
1.1	(BC) Further to the Proposed Concept Engineering & Stormwater Management Strategy provided to SSC for information on 24/07/23, refer attachment A, this meeting intends gain advice from Council relating to the proposed engineering strategy prior to submission of the Huntlee Stage 2 subdivision. (GS) Pre-DA meeting with SSC has recently occurred. Offline discipline specific meetings, such as these are now being undertaken as required to receive further feedback from relevant Council departments. (SM) Confirmed somewhat familiar with project and has been involved in providing high level stormwater and flooding advice to date.	
1.2	(BB) Huntlee is a Master planned community with the Stage 1 Project Area now well progressed within the Cessnock LGA. The Stage 2 project area covers the remaining master plan area and falls across both Cessnock & Singleton LGA's. (BB) The Huntlee Stage 2 Project area is expected to deliver around 5000 additional residential lots of varied size. Stage 2 will enable the completion of the existing Town Centre, with an additional 45ha which will incorporate	



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	further retail and commercial premises. In addition will be the associated public open spaces incorporating drainage and recreational reserves.	
1.3	(BB) The Stage 2 Project Area is being segmented into Detailed and Concept areas. It is noted that land within the Singleton LGA predominately falls within the Detailed Design Area. Generally, the civil submission will consist of the following in these areas: - Civil Works Plans showing preliminary road and stormwater basin grading - Preliminary stormwater network layout and long sections - Preliminary Road Long Sections - Preliminary Cut/Fill Plans for the roads and any areas of significant filling ie gully lines.	
1.4	(GS) Confirmed project is a State Significant Development declared under a SEPP and is seeking NSW State Department of Planning Approval. - Works will be undertaken under a VPA with SSC. - SSC will become asset owners of public infrastructure. - Design will be developed in accordance with adopted 2013 Huntlee Development Control Plan (currently available on Singleton Council's website). (GS) To date staged Subdivision Works Certificates have been assessed by private certifier not Cessnock Council. This is due to limited Council assessment capacity and not at the specific direction of the Department of Planning. It is anticipated that Singleton Council will be able to provide advice relating to their assessment capacity following DA Approval. (HG) Confirmed SCC assessment capacity will be limited.	
2.0	Proposed Road Network	
2.1	(BB) The proposed hierarchy aims to generally remain consistent with the existing Stage 1 road network and current DCP typical sections. - Minor amendments to typical sections have been made to address issues encountered during Stage 1 including. - Increased verge widths where required to accommodate off road cycle ways. - Increased lane widths where required to accommodate Planning for Bushfire Protection perimeter road design guidelines.	
2.2	(SM) Revised Engineering Specifications have just been adopted by Council. These will be available on Council's website shortly however can be provided for information to inform the Huntlee project. HG confirmed copy will be provided. (SM) Recommend these specifications been reviewed and adopted where applicable, acknowledging the area specific Huntlee DCP will take precedence where overlap is present.	HG
2.3	(BC) Typical road cross sections / service allocations may differ from Council's standards due to water servicing strategy. The Huntlee Subdivision is serviced by Huntlee Water which incorporates portable and recycled water connections to each lot and site wide pressure sewer.	
3.0	Active Transport Network	



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3.1	(BB) A staged Bus Route is being developed. A Shared Path Strategy linking the on and off-road cycle ways will also be incorporated as will a Recreation Trail network aiming to link public open spaces.	
4.0	Stormwater Management Strategy	
4.1	(BB) The strategy aims to remain consistent to that implemented across the Stage 1 project area. Stormwater will be collected and conveyed via a minor piped drainage network to end of line local catchment facilities consisting of GPT then biofiltration treatment train. Councils' specified reduction efficiencies will be adopted as project targets. (BB) Based on site topography and development layout on and offline detention basins have been proposed across the site to attenuate post developed flows to pre-developed rates from the 20% AEP through to the 1% AEP.	
4.2	(GH) Council's preferred GPT unit is a HumeGard. (GH) Council do not have any specific fencing / battering safety guidelines however note the revised engineering specifications do include standard details for biofiltration basins. (SM) Councils preference is for retaining walls to be avoided within public open spaces, battering is preferred were spatially achievable. It is noted that Council's updated engineering specifications recommend retaining walls in their entirety (footing, drainage and zone of influence) be maintained wholly within private land.	
5.0	Flooding	
5.1	(BB) As directed by DPE, the Singleton Floodplain Risk Management Study and Plan (BMT, 2022) has been adopted for the site. A site-specific flood model will be developed using data and parameters generally consistent with this study. Review of the detention performance is expected to be performed using the flood mode via review of inundation extents at the downstream Black Creek Rail Crossing. All proposed building envelopes have been proposed above the 1% flood inundation extent.	
6.0	Old North Road Project Area	
6.1	(BB) This part of the development proposes delivery of approximately 35 rural residential lots with minimum ~5000m² allotment size located off Old North Road, south of the existing township. On lot stormwater mitigation measures are being considered for this area. (GH) On-lot mitigation measures would be preferred were suitable lot types permit.	
7.0	Operation and Maintenance	
7.1	(BB) All civil infrastructure is proposed to be designed and constructed generally in accordance with Councils Engineering Guidelines and be generally consistent with that developed as part of the Stage 1 project Area. Access to all public open space and drainage reserves will be designed to ensure adequate maintenance vehicle and machinery access. Infrastructure will be designed were possible to reduce ongoing maintenance burden.	
7.2	(GH) Singleton Council have an independent Asset Planning Team.	



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Appendix D – Bus Strategy Stage 1



HUNTLEE STAGE 1 BUS SERVICING STRATEGY

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WORLEY PARSONS

HUNTLEE STAGE 1

Bus Servicing Strategy

Author

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A handwritten signature in blue ink, appearing to read "S Manahan", is positioned above a horizontal line.

Report No

AA006181-01_V1.0

Date

18 November 2013

This report has been prepared for Worley Parsons in accordance with the terms and conditions of appointment for Huntlee Stage 1 . Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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EXECUTIVE SUMMARY

This report defines a bus network servicing plan for Stage 1 of the Huntlee Precinct, located to the south of the town of Branxton in the Hunter Valley of NSW. The site straddles Wine Country Drive (MR 220) linking Cessnock with the New England Highway. Within the overall site, the proposed urban area is bounded to the north and east by the Main North Railway and the Hunter Expressway corridor, to the south by the village of North Rothbury and to the west by the Black Creek floodplain.

When fully developed, the Huntlee proposal would provide for up to 7,500 dwellings. Of that the Stage 1 subdivision will include approximately 2,345 dwellings. In conjunction with residential development it is proposed to develop about 200 hectares (ha) of mixed use/employment lands including a mixed use Town Centre. A Town Centre area is proposed to the west of Wine Country Drive and south of the Hunter Expressway Corridor. Land use within the Town Centre would be designed to ensure that a mix of retail, commercial, educational, recreational, entertainment and residential uses will be concentrated in a core retail/mixed use area concentrated along the Main Street. Approximately 55.7 ha of Town Centre are proposed within the Stage 1 development.

The Huntlee is proposed to be planned and developed as a series of staged neighbourhoods over a 20+ year period. Each phase of the staging will determine access requirements and then determines the road and intersection capacity needed to service the demand from residential and employment yields. Huntlee Stage 1 is expected to be fully developed by year 2020. Commencement of subdivision construction is programmed to commence in the second half of 2013 with a development period of approximately 7-8 years.

1 INTRODUCTION AND REPORT CONTEXT

1.1 BACKGROUND

The Huntlee development is a major residential land release at Branxton, NSW. Traffic generating features of the development include:

- up to 5,600 dwellings in residential zones of varying sizes;
- around 200 hectares of employment lands including a mixed use Town Centre with up to 1,700 residential dwellings; and
- up to 200 dwellings on rural residential (large) lots.

Stage 1 of the development comprises up to 1,900 residential lots, 120 rural residential lots, and a 68 hectare town centre with up to 300 dwellings.

The development has been previously assessed in two traffic reports. The first being the "Transport Management and Accessibility Plan" (TMAP) prepared by Better Transport Futures and a "Traffic Modelling Report" prepared by Hyder. The TMAP includes a brief overview of likely bus requirements based on Transport for NSW (TfNSW) Guidelines.

The Bus Servicing Strategy for Huntlee Stage 1 will require an understanding of existing services in the area and the opportunity to extend and provide new services that link into Huntlee. Services will essentially link Huntlee to Branxton at the Railway Station.

Internally, the design of the strategy needs to be able to accommodate the ultimate road network for Stage 2 without significant route changes. It is the objective to conceptualise the bus route services to enable easy integration of the staged services and ensure infrastructure investment in bus stops, shelters, and bus bays will not be wasted. Identification of the routes

also assists in placement of bus stops that future residents can be made aware of when considering purchasing land.

Ultimately bus services are funded through TfNSW and hence their concurrence to any plan is required. This is a core component of the project. We will liaise closely with the department to ensure that this is achieved.

1.2 REPORT PURPOSE AND SCOPE

This report is intended to address the Statement of Commitment relating to the preparation of a Bus Servicing Strategy. The aim of the strategy is to identify an appropriate and affordable strategy that complements the Huntlee development increasing its attractiveness to new residents.

This report documents the key inputs and assumptions considered in the analysis in the development of a long-term and short-term bus network and staging strategy for the Huntlee development area.

2 THE HUNTLEE DEVELOPMENT

2.1 STAGES

The Huntlee New Town is proposed to be planned and developed as a series of staged neighbourhoods over a 20+ year period in accordance with the SSS Study framework. Stage 1 development will involve the initial development of the mixed use Town Centre, including a component of residential development, as well as the development of the first residential village and the first component of the large lot of residential areas. Stage 1 will comprise up to 2,345 dwellings, which includes 300 town residential dwellings. It will contain a range of lot types and sizes which will cater for traditional residential dwellings through to medium density large units and town houses.

It is assumed that Huntlee will be staged over four (4) villages. Figure 1 shows an indicative staging plan for the entire site. Each phase of the staging will determine access requirements and then determines the road and intersection capacity needed to service the demand from residential and employment yields.

Huntlee Stage 1 is expected to be fully developed by year 2020. Commencement of subdivision construction is programmed to commence in the late 2013 with a development period of approximately 7-8 years.

Table 1 presents an indicative time frame for staged development. Key points to note:

- The full Huntlee development is assumed to be completed by 2036. The Huntlee is likely to exceed the Lower Hunter Regional Strategy time frame which is 2031.
- Stage 1 (Village 1) development is expected to be completed by 2020. The Stage 1 subdivision will include approximately 2,345 dwellings. About 21.4 ha GFA of mixed use/employment land is expected to be developed over the same timeframe.
- Stage 2 (Village 2) development is expected to be completed in the following 5-6 years by 2025. The Stage 2 subdivision will include up to 1,895 dwellings. About 9 ha GFA of mixed use/employment land is expected to be developed over the same timeframe.
- Stage 3 (Village 3) development is expected to be completed between 2025 and 2032. The Stage 3 subdivision will include up to 1,935 dwellings. About 9 ha GFA of mixed use/employment land is expected to be developed over the same timeframe.

- Stage 4 (Village 4) development is expected to be completed between 2032 and 2036. The Stage 4 subdivision will include up to 1,325 dwellings. About 9 ha GFA of mixed use/employment land is expected to be developed over the same timeframe.

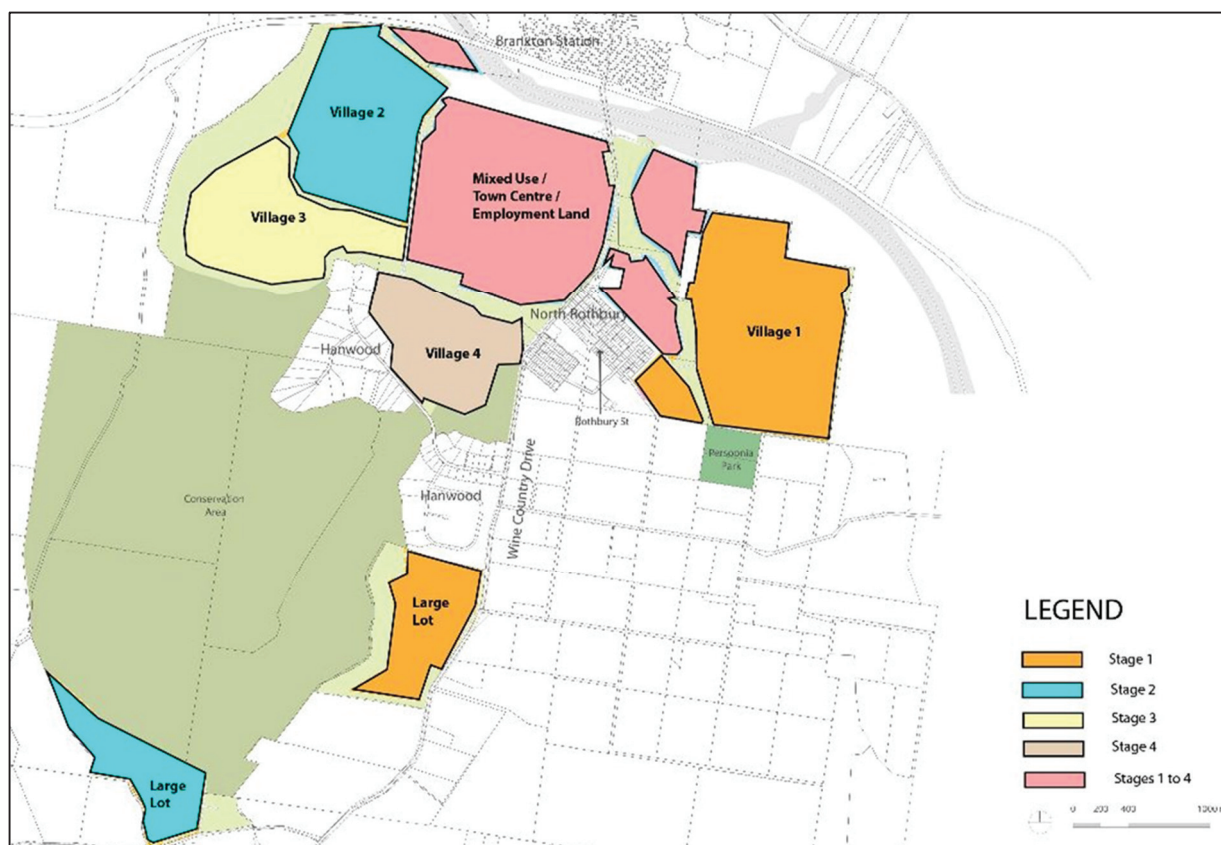


Figure 1 Staging of the Huntlee Development

Table 1 Indicative Staging of Huntlee Development

Item ID	Development Type	SSS Development (Full by 2036)	Stage 1 (Year 2020)	Stage 2 (Year 2025)	Stage 3 (Year 2032)	Stage 4 (Year 2036)
RL	Residential Land					
V1	Village One	1,900 Dwellings	1,900			
VC1	Village Centre (mixed use)	3,000 GFA (m2)	3,000			
V2	Village Two	1,515 Dwellings		1,515		
V3	Village Three	1,435 Dwellings			1,435	
V4	Village Four	700 Dwellings				700
L1	Large Lot 1 (Part of Village 1)	25 Dwellings	25			
L2	Large Lot 2 (Part of Village 4)	25 Dwellings				25
L3	Large Lot Residential 3 (Wine Country Drive)	120 Dwellings	120			

Item ID	Development Type	SSS Development (Full by 2036)	Stage 1 (Year 2020)	Stage 2 (Year 2025)	Stage 3 (Year 2032)	Stage 4 (Year 2036)
L4	Large Lot Residential 4 (Old North Road)	80 Dwellings		80		
EL	Employment Land / Mixed Use(200 ha)					
TCR	Town Centre Residential	1,700 Dwellings	300	300	500	600
TCM	Town Centre Stage 1 (Mixed use 55.7 ha)					
CR	Retail	6.5 GFA (ha)	6.5 ha			
MX	Mixed Use	14.9 GFA (ha)	14.9 ha			
RE	Remaining Employment Land / Mixed Use (118 ha)					
RE1	Mixed Use	27.0 GFA (ha)		9.0	9.0	9.0

2.2 STRUCTURE PLAN

The Structure Plan consists of a series of residential neighbourhoods each connected to the Town Centre via the road network. Each neighbourhood will be distinctive in character, each located within a different landscape.

The Town Centre is the primary commercial centre for the neighbourhood villages. It comprises a mixed use area of approximately 200 hectares catering for a range of uses including retail, service industries, bulky goods, commercial, entertainment, residential, educational and community including open space. The Town Centre will ultimately serve the residents of Huntlee and surrounding areas.

The Village centres will provide for low level retail and community facilities and complement the Town Centre. The village centres will be approximately 5 hectares in area and contain uses including neighbourhood retail premises, community facilities, a primary school and a village centre park. There will be four village centres in the overall Huntlee development.

Table 2 Centre Types and Elements

Centre Type	Radii	Summary
Town Centre	800 metres	Town centres have one or two supermarkets, community facilities, medical centre, schools, etc. Usually a residential origin than an employment destination
Village Centre	600 metres	A strip of shops and adjacent residential area within a 5 to 10 minute walk. Contain between 800 and 2700 dwellings
Neighbourhood Centre	150 metres	One or a small cluster of shops and services. Contain between 150 and 900 dwellings

Figure 2 present the proposed Stage 1 Concept Masterplan showing the location of the Town Centre and the Neighbourhood Centres.



Figure 2 Huntlee Stage 1 Concept Master Plan

2.3 INTERNAL ROAD NETWORK

The internal road network will comprise of a hierarchy of streets. This is shown in Figure 3.

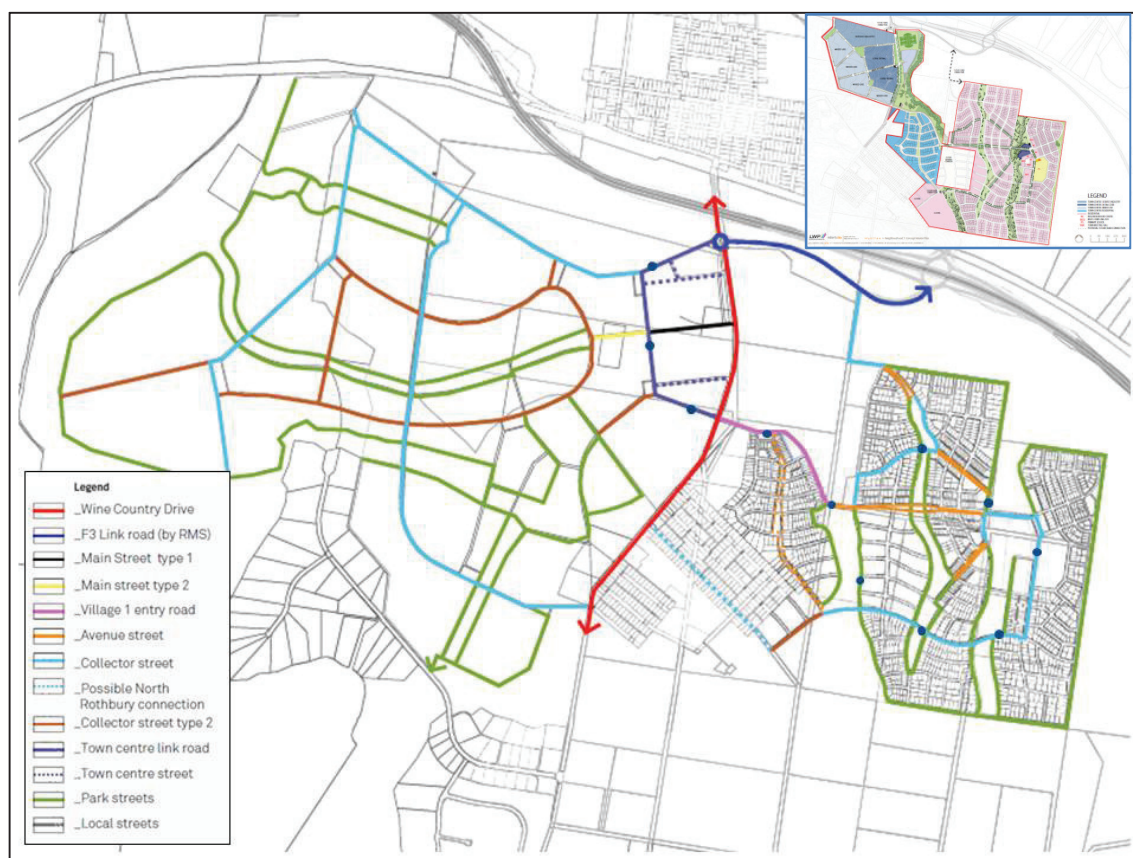


Figure 3 Internal Road Network

3 INPUTS AND ASSUMPTIONS

3.1 CONSULTATION

This Bus Servicing Strategy has been developed in consultation with TfNSW, RMS and Council.

3.2 SUPPORTING INFORMATION

- Huntlee Development Control Plan (Department of Planning and infrastructure, March 2013)
- Outer Metropolitan Bus Service Planning Guidelines 2006 (Transport for New South Wales, November 2009)
- Journey to Work data (Census 2011);
- Household Travel Survey data Summary Report from (Bureau of Transport Statistics, 2011 release)

3.3 DESIGN PRINCIPLES

The following sections describe the design principles as set out in the Outer Metropolitan Bus Service Planning Guidelines (Transport for New South Wales, November 2009). The guidelines provide a framework for the planning and review of bus services for the Outer Metropolitan area so that well-designed bus networks operate at reasonable frequencies with reliable trip times.

3.3.1 DESIGN OF THE NETWORK

The proposed bus network within Huntlee has been designed to:

- Provide an optimal bus network operating at reasonable frequencies and reliable trip times appropriate for the level of development;
- Facilitate integration and inter-connections with the regional, district and local bus routes that link the villages with key centres of activity such as schools, shops, recreational facilities and the Huntlee Town Centre.; and
- Maximise coverage of the development.

The Outer Metropolitan Service Planning Guidelines define a set of principles to be applied to each contract area.

Table 3 Bus Planning Principles

Bus Planning Principle	Criteria
Network (Area Coverage)	Maximum distance of 400 metres to a bus stop or rail line during the daytime and 800 metres to a bus route or rail line during the night time to apply to built-up residential areas with higher population densities. For areas with low population densities, a very low service frequency (primarily provided for shopping purposes, e.g. one trip in mid-morning and one trip in the early afternoon one or two days a week) may be feasible, without unduly reducing service levels elsewhere in the contract region.
Network Legibility	Peak and off-peak services should use the same routes wherever possible to increase passenger awareness of the network and allow for efficiencies in the provision of infrastructure and passenger information.
Service Directness	Routes should be as direct as possible with a major portion of the route using major roads or main collector residential roads.
Accessibility	Accessible buses should be timetabled on the routes and identified as accessible trips in the public timetable.
School Services	Dedicated school services should be kept to a minimum in order to maximise the frequency and availability of normal route services

Source: Service Planning Guidelines, Outer Metropolitan Contract Regions

Furthermore, the Service Planning Guidelines provide a hierarchy of three categories of route types shown in Table 4. The hierarchy defines the required frequencies for the routes

Table 4 Hierarchy of Routes

Hierarchy	Description
Regional Routes	Provides a direct and frequent link for residential areas to their nearest regional centre. Regional routes are designed to pass through patronage generators such as district centres, hospitals, colleges and industrial areas while connecting with other modes serving multiple trip purposes. Bus services operating on regional routes operate from pre peak period through to the evening and provide weekend daytime and evening services, at frequencies generally of 30 minutes or better.
District routes	Links residential areas to either the nearest district centre and a strategic transport corridor; the nearest district centre and other mode operating to the nearest regional centre or to the nearest regional centre. Bus services operating on district routes generally operate during the peak, inter-peak and weekend daytime periods at a frequency of 60 minutes or better.
Local Routes Fixed routes Flexible transport routes Currently un-served communities	Local routes are infrequent routes for communities that lack the density and/or street connectivity to support a 60-minute service. They operate during off-peak periods and are implemented to meet a specific need.

3.3.2 SERVICE TIME PERIODS AND FREQUENCIES

Bus service frequencies and service time periods are defined for each level of route service provision.

Table 5 Service Time Periods and Frequencies

Hierarchy	Service Frequency
Regional Routes	Pre peak – 60 mins Peak – 30 mins Inter peak – 30 mins Night time – 60 mins Saturday daytime – 60 mins Sunday daytime – 60 mins
District routes	Peak – 60 mins Inter peak – 60 mins Saturday daytime – 60 mins Sunday daytime – 120 mins

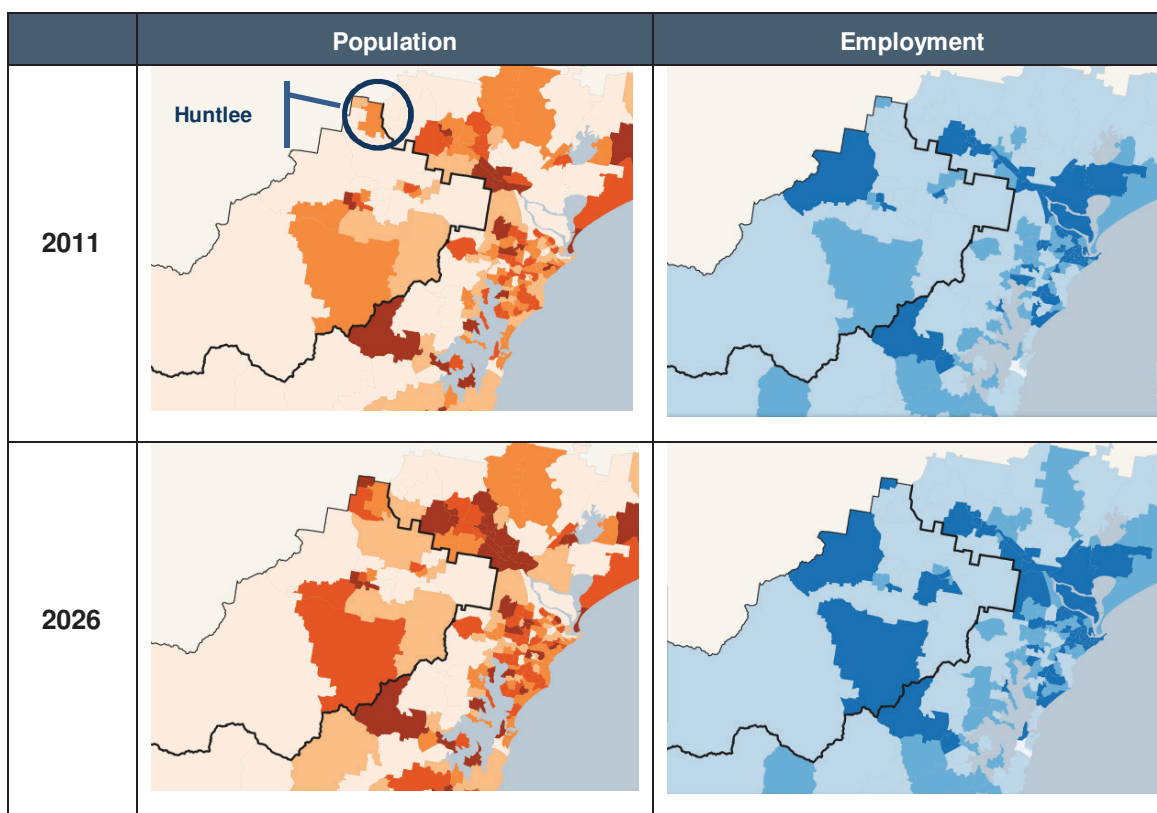
Hierarchy	Service Frequency
Local Routes	Inter peak – 120 mins
Fixed routes	As required (negotiated with the Department)
Flexible transport routes	
Currently un-served communities	

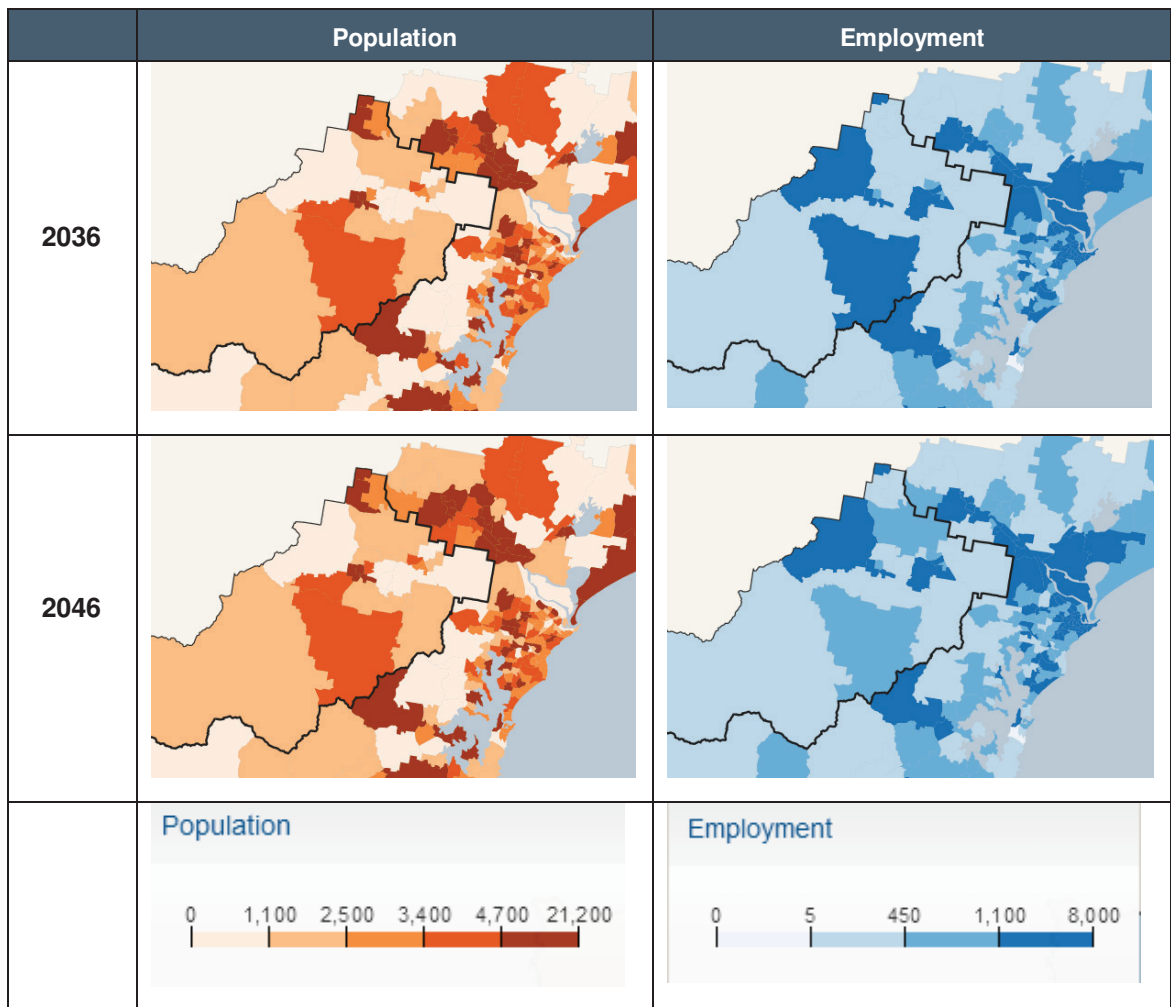
3.4 POPULATION / EMPLOYMENT FORECASTS AND TARGETS

Population and employment forecasts are derived from the Bureau of Transport Statistic (BTS)

In considering the land use and population distribution for Huntlee and the immediate vicinity Figure 4 has been prepared to demonstrate broader land use changes at model travel zones between 2011 and 2046 measured by population in the Lower Hunter. The maps show average population growth for whole travel zones, not at actual locations where residential and development is proposed. For example, population growth from Huntlee would alter the population growth from a range of 2,500-10,000 to a range of 20,000-30,000. However, the actual footprint of the Huntlee development could occur in a small portion of the relevant travel zone.

Figure 4 Population and Employment Forecasts 2026, 2036 and 2046





Source: Bureau of Transport Statistics

Figure 4 shows population and employment changes from 2011 to 2046 mainly for the Cessnock and Maitland areas. A review of the statistics indicates the following:

- Significant population increases at both the eastern and western end of the proposed F3 to Branxton Link. This comprises mainly the Huntlee development at Branxton and the Coal and Allied development near Minmi;
- Significant population increase in Maitland between Branxton and Thornton. This would put additional traffic on the New England Highway, which provides a key access between Maitland and Newcastle;
- Forecast population growth has shifted away from the established major regional centre of Newcastle/Lake Macquarie and has moved west towards the local government areas of Cessnock and Maitland.

3.5 TRAVEL PATTERNS AND DISTRIBUTION

An overview of all types of personal travel is provided by the Journey to Work (2010/11) and Household Travel Surveys. The JTW data for Huntlee study area catchment suggests that car travel is the dominant mode, with 98% of all trips being made by car. Similarly, about 88% of trips by Cessnock residents are made by car. Public transport use in the study area catchment is extremely low (2%). Bus use in Cessnock is relatively high, with 6.4% of trips being made by bus.

3.5.1 2011 HOUSEHOLD TRAVEL SURVEY

An overview of all types of personal travel is provided by the Household Travel Survey (HTS), a continuous survey undertaken by the State Government within the Greater Metropolitan Area. The survey includes the Newcastle Statistical Subdivision which covers the Cessnock and Maitland Local Government Areas.

Trip purpose

Overall residents of Cessnock made 166,000 trips on an average weekday, and those of Maitland made 239,000 trips. This amounted to 3.4 trips per person on a weekday for Cessnock and 3.4 trips per person on a weekday for Maitland. On weekends, the average trip is 3.0 and 2.4, respectively.

Table 6 and Figure 5 identify the number of trips undertaken by residents of Cessnock SLA and Maitland SLA by trip purpose.

Table 6 Number of trips on an average weekday per purpose

Trip purpose	Trips per average weekday	
	Cessnock	Maitland
Commute	27,000	33,000
Work related business	24,000	28,000
Education/childcare	17,000	19,000
Shopping	26,000	42,000
Personal business	15,000	18,000
Social/recreation	32,000	60,000
Serve passenger	20,000	35,000
Other	6,000	3,000
Total	166,000	239,000

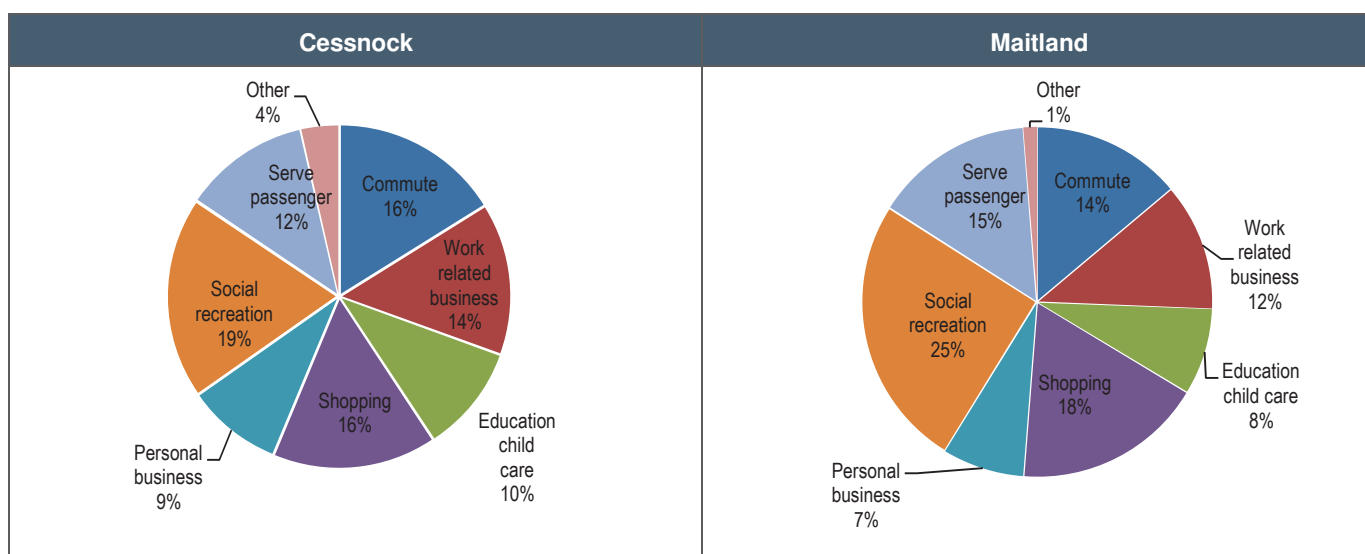


Figure 5 Trip Purpose

Social and recreational trips are the most numerous, about 19% for Cessnock and 25% of the total for Maitland followed by shopping and commute for Cessnock (16%) and shopping for Maitland (18%), then serve passenger or dropping someone else somewhere (12% and 15% respectively).

Trip length

On average, Cessnock residents make longer trips (12.1 km) than those of Maitland (10.3 km), an indication that key activities are located further from the population base. While social/recreational was the most numerous trip purpose, the average trip length was 14.3 km for Cessnock and 11.2 km for Maitland. Work related business and commute trips are relatively longer than most other travel for both Cessnock and Maitland. Table 7 presents the average trip length by trip purpose.

Table 7 Average trip length of weekday trips per purpose

Trip purpose	Average length of weekday trips (km)	
	Cessnock	Maitland
Commute	12.8	15.7
Work related business	18.4	11.9
Education/childcare	7.2	6.8
Shopping	10.1	6.8
Personal business	11.9	10.2
Social/recreation	14.3	11.2
Serve passenger	5.8	8.3
Other	15.8	16.0
All purposes	12.1	10.3

Mode of Travel

Overall, car travel is the dominant mode throughout the Cessnock with 85% of all trips being made by car, either as driver (65%) or passenger (20%), whereas 84% of trips by Maitland residents are made by car. Public transport use is extremely low. Bus accounts for 5.0% and 3.0% of trips respectively. Table 8 gives a breakdown for the percentage share of travel modes.

Table 8 Mode of Travel

Mode	Percentage Share	
	Cessnock	Maitland
Vehicle Driver	65 %	57 %
Vehicle passenger	20 %	27 %
Bus	5 %	3 %
Walk only	9 %	11 %
Other Modes	2 %	2 %

3.5.2 2011 JOURNEY TO WORK

The 2011 Journey to Work (JTW) data enables an understanding of the mode used to travel to work as a degree to which residents travel within or outside their local area of employment. While trips between work and home comprise 12-14% of all trips, the ability to access the workplace is an important component in ensuring economic productivity. The mode share for the Cessnock SLA as an origin and destination is shown in Figure 6.

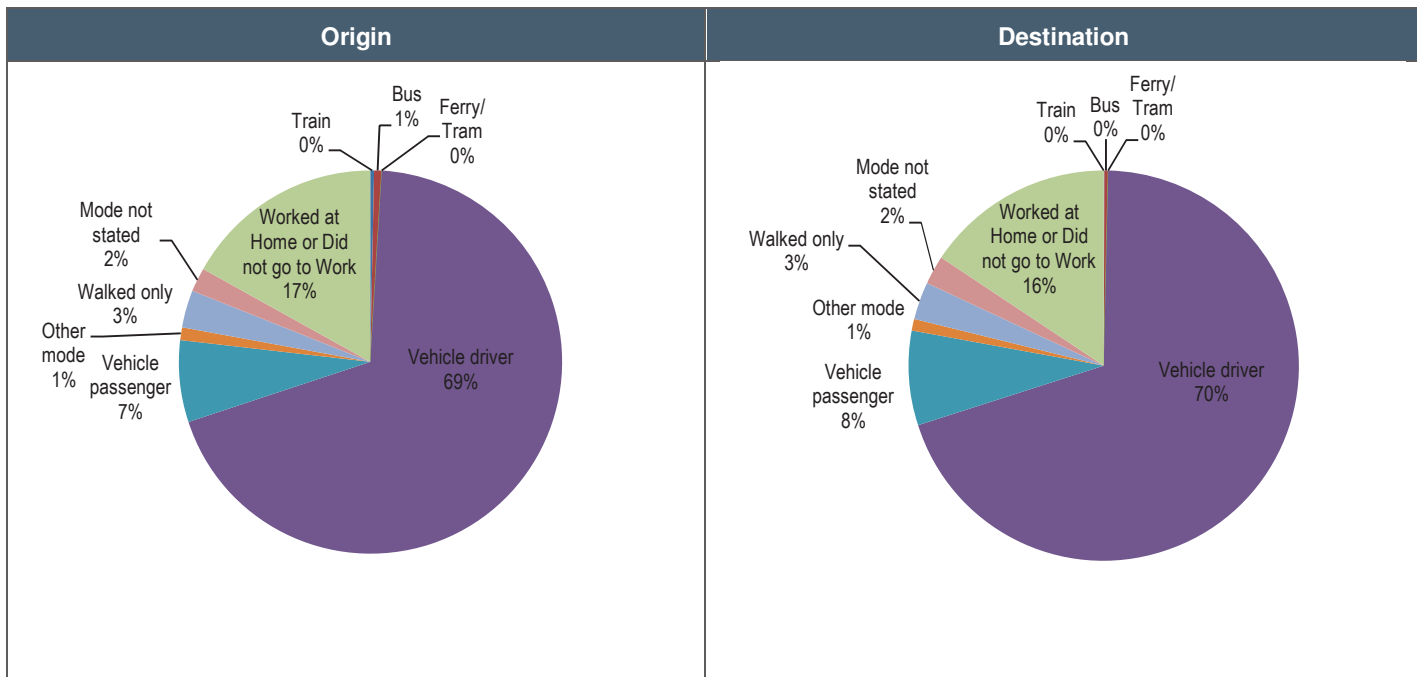


Figure 6 2011 Journey to Work Mode Share, Cessnock

The mode share for the Cessnock SLA as an origin and destination is shown in Figure 7.

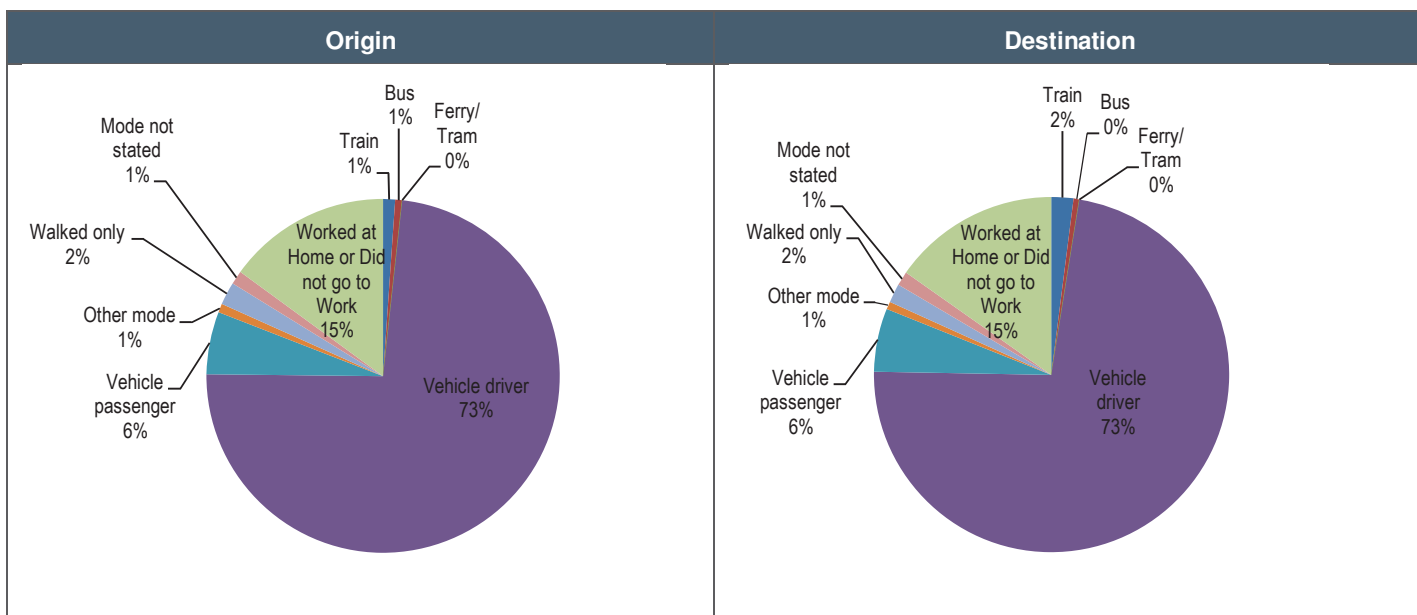


Figure 7 2011 Journey to Work Mode Share, Maitland

For both Cessnock and Maitland, travel to and from work is predominantly done by car mode as a vehicle drive or vehicle passenger (around 79 %).

3.6 EXISTING TRANSPORT ACCESS AND SERVICES

3.6.1 ACCESS

The main access roads to the development are the New England Highway, Wine Country Drive and Hunter Expressway. The Main North Rail Line and Branxton Railway Station are located to the north of the site.

The New England Highway is the main arterial road connecting the Upper Hunter Valley with Newcastle as well as providing regional and interstate connections to the New England, north-west regions of NSW and Brisbane. Wine Country Drive provides the main connection between Branxton and Cessnock and serves the village of North Rothbury. It is generally a two lane road.

The Hunter Expressway is a dual carriageway link between the F3 Freeway at the Newcastle Link Road and the New England Highway approximately 2km west of Branxton. The Branxton Interchange is located just immediately north of the site and connects to New England Highway and Wine Country Drive.

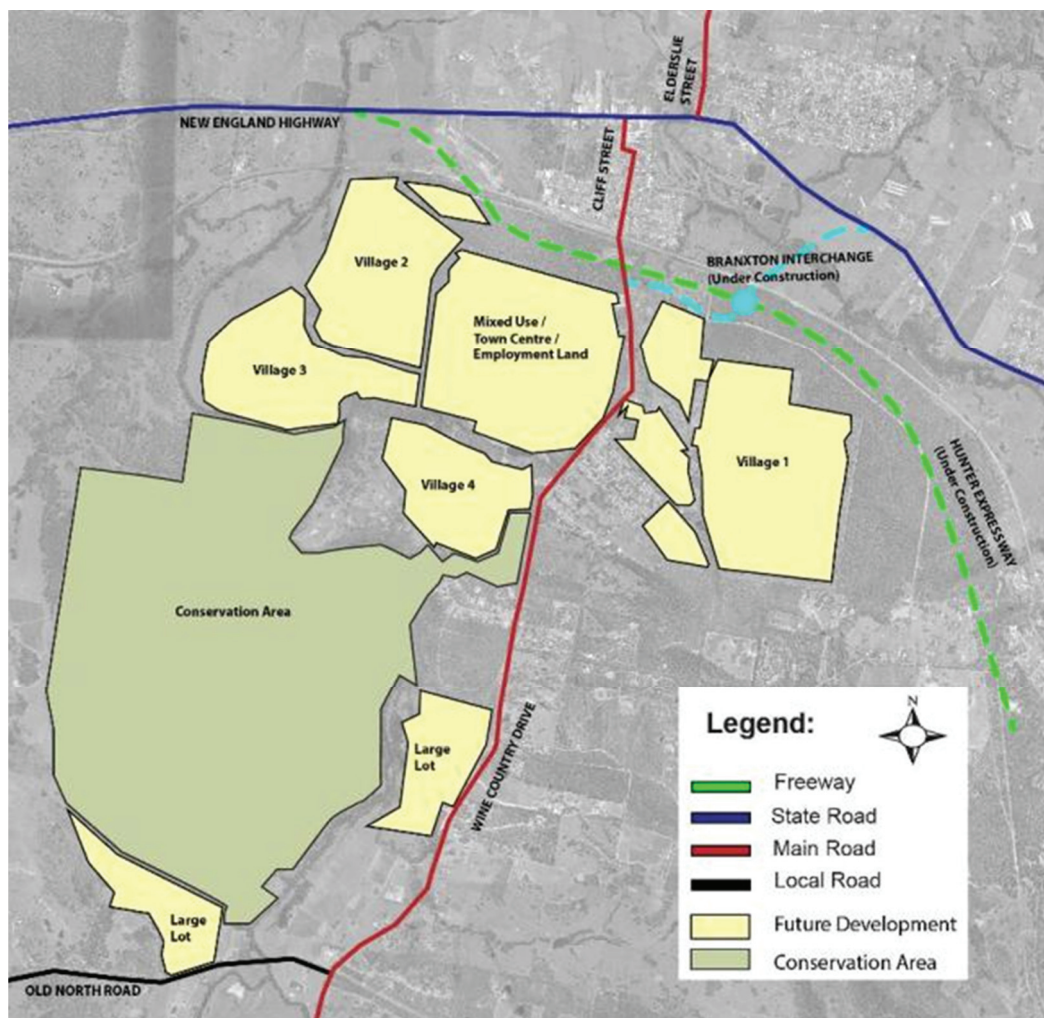


Figure 8 Road Hierarchy for the Huntlee Development

3.6.2 TRANSPORT SERVICES

In general, Cessnock, Maitland and Singleton residents have a high dependence on private car travel. The public transport system serving the area comprises mainly bus services, Hunter Regional passenger rail services, and long-distance country trains from Sydney through Maitland to Armidale and Brisbane. The bus and rail services are generally of low frequency being only several services each day between towns and to Newcastle. Local travel between the towns is by bus.

The current bus route (Route 179) services North Rothbury to Stockland Greenhills via Maitland and operates Monday to Saturday with no services on Sundays and public holidays. The frequency is low at roughly 8-10 trips a day between 6 a.m. and 6 p.m. Only five trips currently have stops at the North Rothbury area.



Figure 9 Existing Bus Route (Hunter Valley Buses)

3.7 IMPLIED MODE SHARE

An overview of all types of personal travel is provided by the Journey to Work (2011) and Household Travel Surveys (2011). The JTW data for Huntlee study area¹ catchment suggests that car travel is the dominant mode, with 95% of all trips being made by car. Similarly, about 85% of trips by Cessnock residents are made by car. Public transport use in the study area catchment is low (3-5%).

It is expected that during initial stages of the development, public transport use will be low. As development progress, there will be an increasing use of the choice of available transport and reducing dependence on cars. This should reduce car trip generation rates currently used.

3.8 IMPLEMENTATION STRATEGY

Public transport is an integral component of Huntlee's urban design and social and economic investment into reduced car dependency. The focus for Huntlee will be the provision of bus services both within Huntlee and connections to other centres. It is proposed that a bus service linking Village One to Huntlee town centre be commenced at Stage 1 phase of development. A bus interchange is proposed to be located within the Huntlee Town Centre which could service the Branxton Train Station in the longer term.

The basic principles of the public transport facilities proposed in the Huntlee TMAP² include the following:

- Priority Internal Routes connecting high intensity centres e.g. town centre, schools. Shops, business park area;
- Bus interchange located centrally within the Huntlee Town Centre, connecting internal Village bus routes with trunk routes to major centres external to the site;
- Cycling and Walking Network as an integral component of the development of Huntlee to supplement and support local public transport initiatives
- Consultation with TfNSW and stakeholders to ensure delivery of adequate services as required.

Huntlee aims to deliver a level of local public transport, walking and cycling in line with NSW Government targets, which are consistent with the long term Huntlee transport principles documented for the project. The following targets have been identified:

- 30% non car mode share for Journey to work
- 50% walk/cycle mode share for education trips
- 30% walk/cycle mode share for town centre travel
- 20% public transport mode share for town centre travel

¹ Study area catchment includes Branxton, East Branxton and North Rothbury (Travel zones 3397, 3398, and 3399).

² Huntlee TMAP, Mark Waugh Pty, Ltd, December 2010

4 DEVELOPMENT OF THE LONG-TERM NETWORK

The proposed development site is currently serviced by one bus route, linking the area to interchanges at Branxton and Maitland Railway Station. New road links are proposed within the development, with major spine roads linking areas to the east and the west of the development through the proposed town centre. The general planning criteria from the Outer Metropolitan Bus Service Planning Guidelines is that 90% of the proposed development should be within 400 metres of a bus route. The Huntlee New Town would be planned and developed as a series of staged neighbourhood over a 20+ year period. The bus routes will be developed in agreement with relevant authorities. The future bus routes will provide connections to regional destinations as development progress. Bus stops will be provided within walking catchment along agreed bus routes. An indicative bus routes are shown in Figure 10.



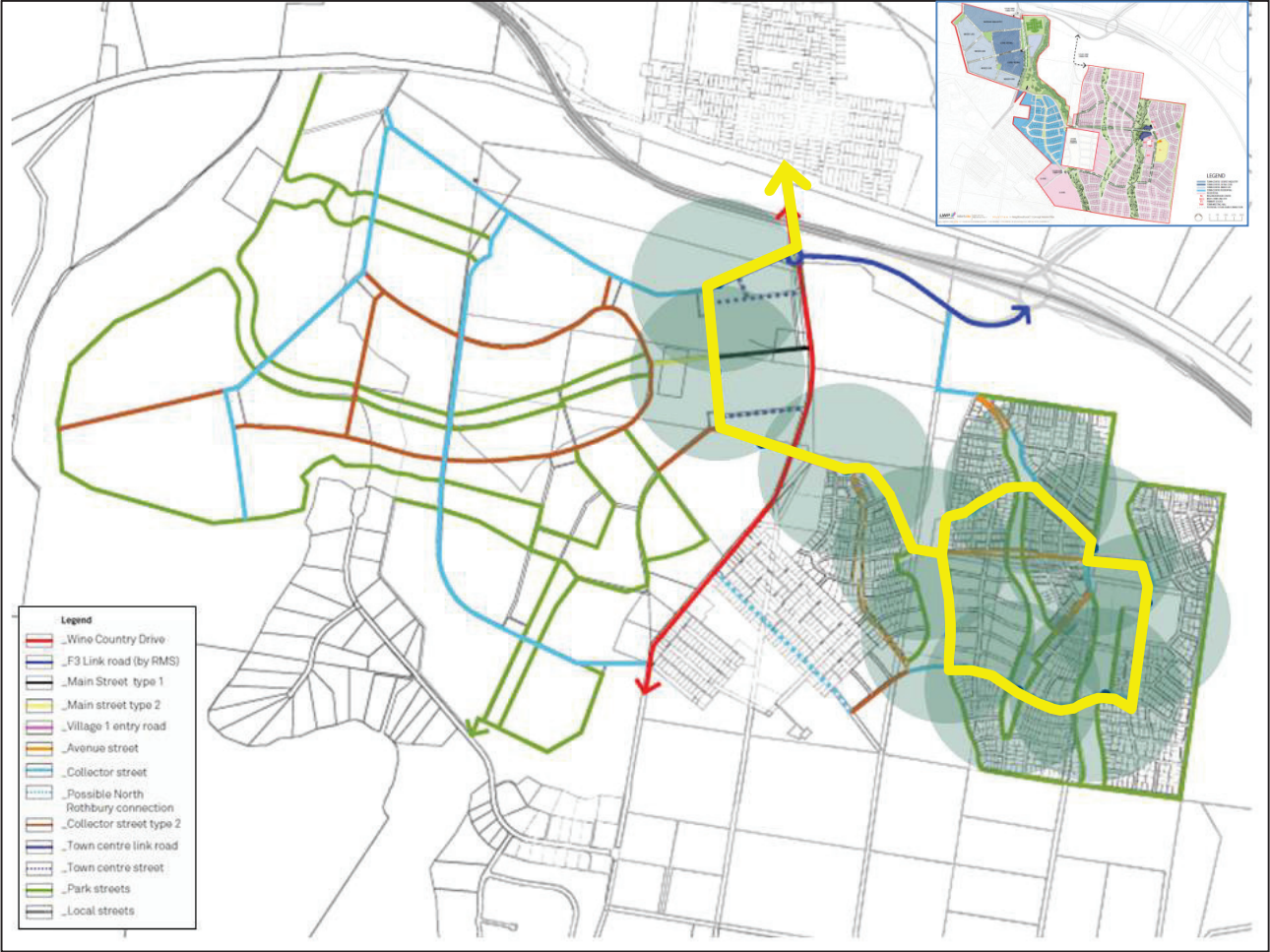
Figure 10 Initial Indicative Bus Route Network Plan

5 DEVELOPMENT OF THE SHORT TERM NETWORK

This section identifies the segments of the recommended network that will be required within the next ten years given that Stage 1 is expected to be completed only after at least seven years. It will be very difficult to predict the exact years for which certain services will be required. However, the current guiding parameter would be the anticipated release of land and the likely take up.

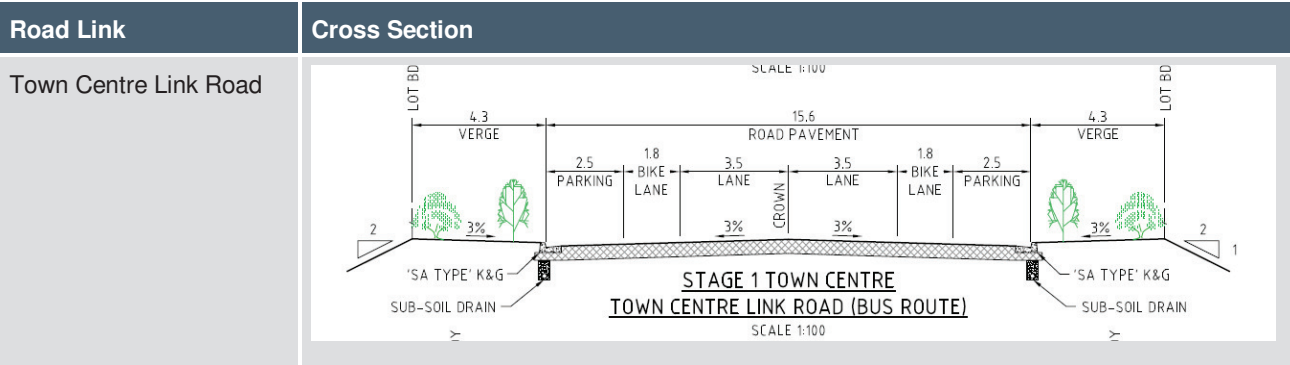
As a starting point, the strategy for the short term bus network considers the existing bus services as the initial route service to be modified to include Stage 1 development of Huntlee. The proposed bus route for Stage 1 is shown in Figure 11. The proposed bus route will the Town Centre Link Road, Village 1 Entry Road, Avenue Street, Collector Road and Park Road. It is intended for the bus route to operate as a one-way loop.

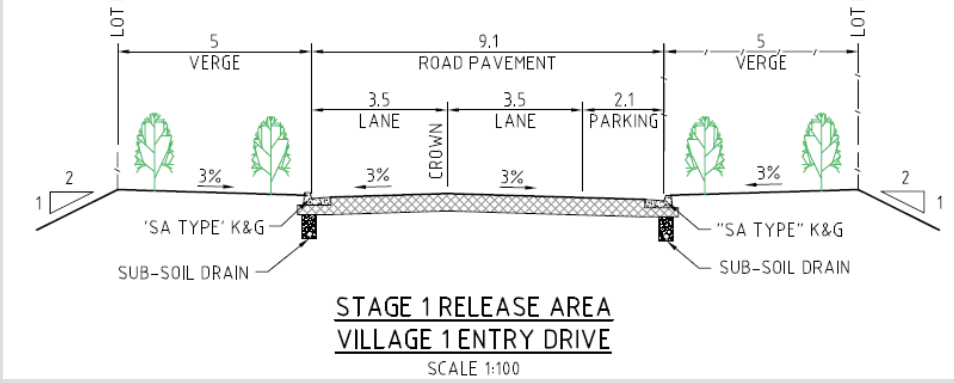
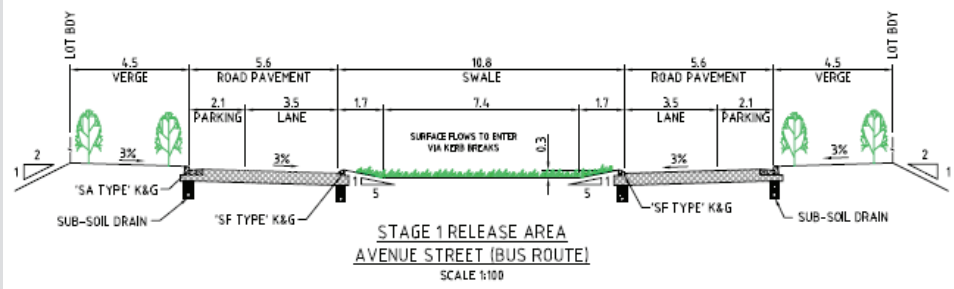
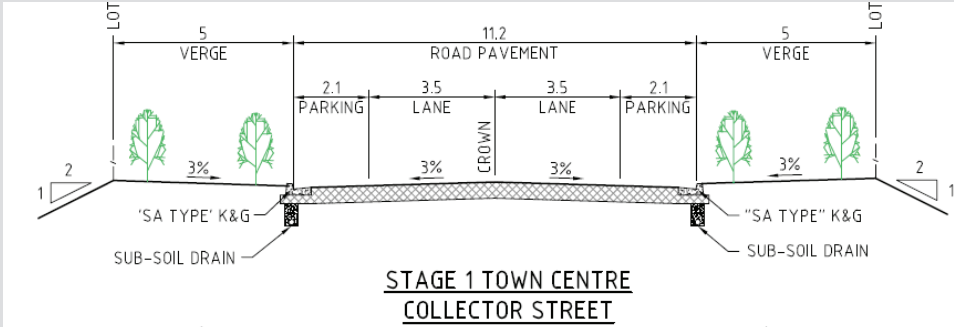
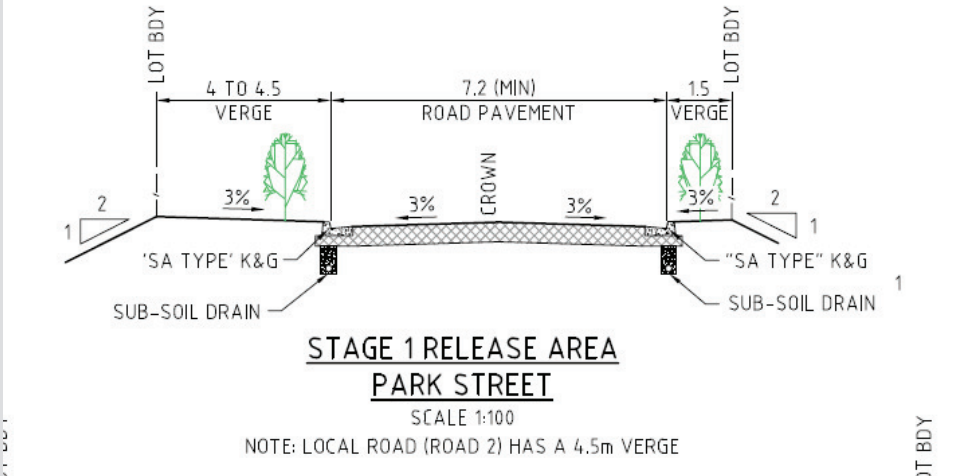
Figure 11 Proposed Stage 1 Bus Route



The road cross sections for the bus route provide a minimum travel lane of 3.5 metres in each direction. The proposed road cross sections are shown in Figure 12. A total of 10 bus stops will be constructed. Each bus stop will have a catchment of 400 metres.

Figure 12 Proposed Road Cross Sections



Road Link	Cross Section
Village 1 Entry Drive	 STAGE 1 RELEASE AREA VILLAGE 1 ENTRY DRIVE SCALE 1:100
Avenue Street	 STAGE 1 RELEASE AREA AVENUE STREET (BUS ROUTE) SCALE 1:100
Collector Street	 STAGE 1 TOWN CENTRE COLLECTOR STREET
Park Street	 STAGE 1 RELEASE AREA PARK STREET SCALE 1:100 NOTE: LOCAL ROAD (ROAD 2) HAS A 4.5m VERGE

The bus stop at the Town Centre is designed to accommodate 2 bus lengths on each side of Town Centre Link Road. The proposed configuration is shown in Figure 13.

Local widening is being proposed at Village 1 Entry Road to accommodate a bus stop. The proposed treatment is shown in Figure 14.

Figure 13 Town Centre Bus Stop Configuration

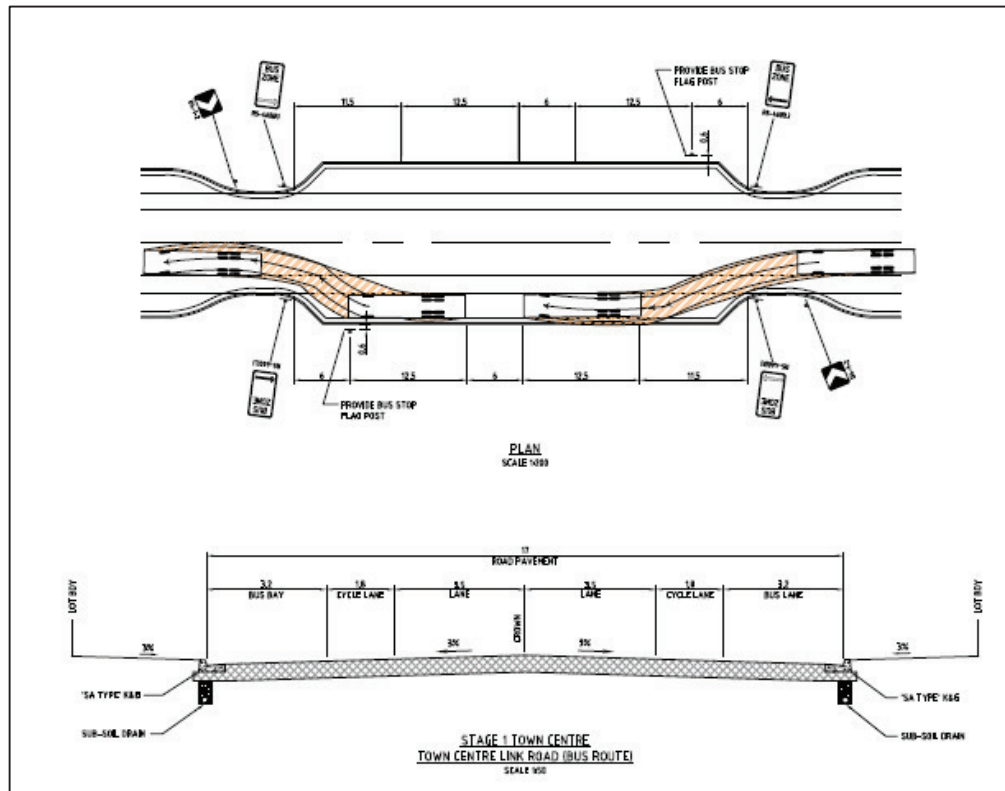
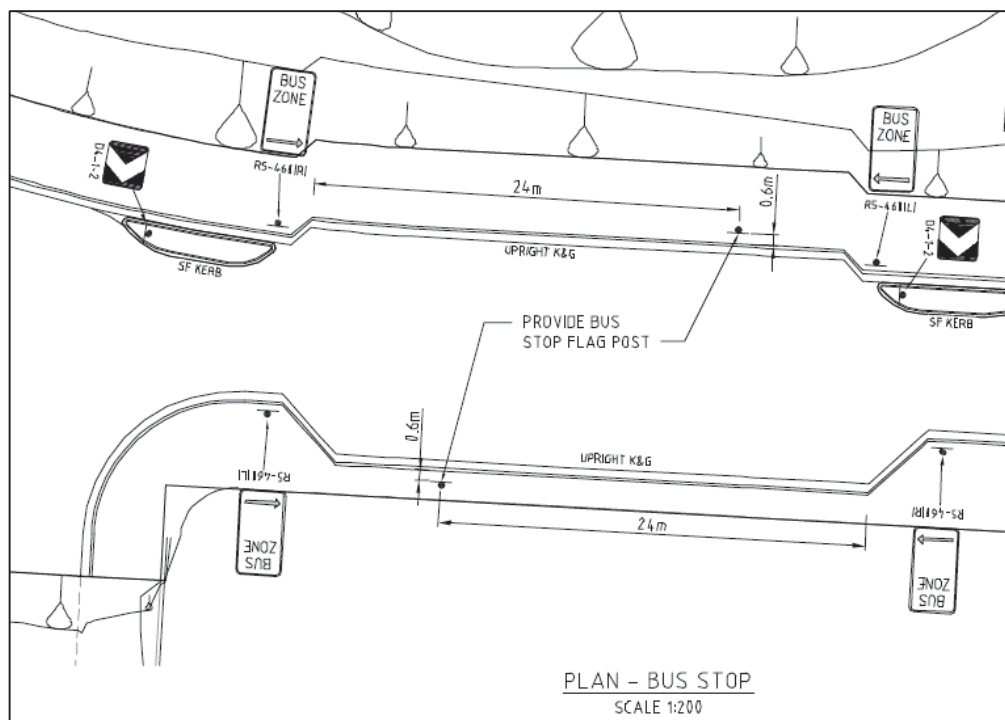


Figure 14 Proposed Local Widening at Village 1 Entry Road



Stage 1 is intended to be released in phases as development progresses from 2014 to 2020, as shown in Figure 15. Bus stops may be deferred in accordance with the proposed phasing of the Stage 1 delivery. Consequently, the bus route coverage will be limited to the released phases where land occupancy has commenced. By such, interim bus route turnarounds are proposed. The proposed turnarounds will utilise bus-capable streets. Restrictions to on street parking may be temporarily imposed where necessary.

Figure 15 Proposing Stage 1 Phasing

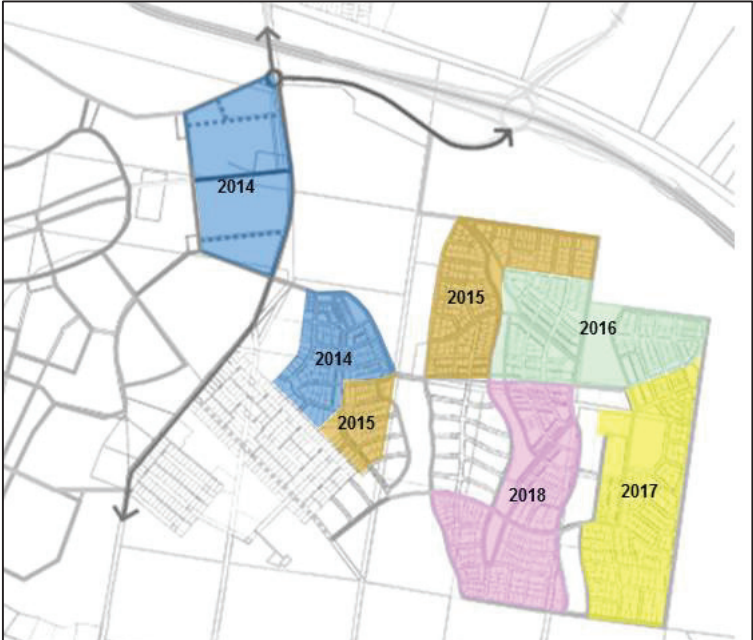
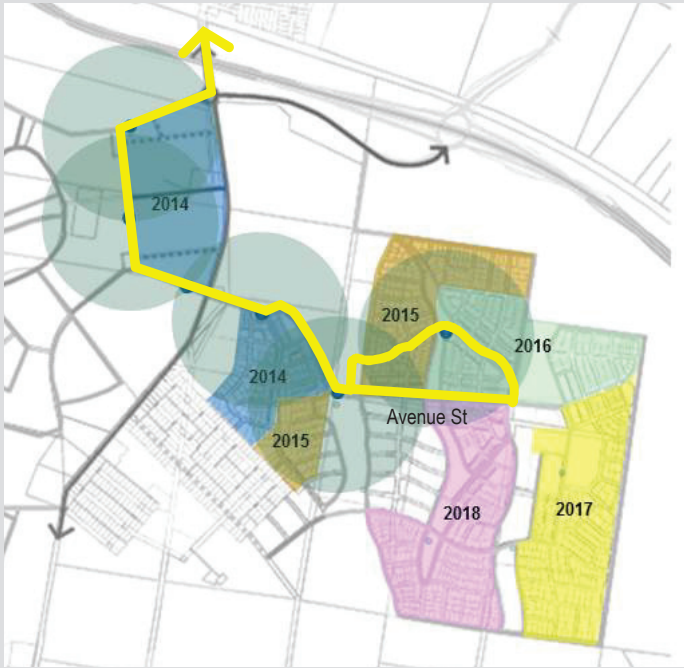
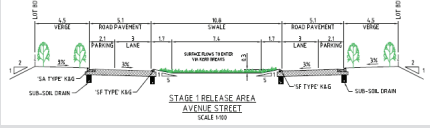
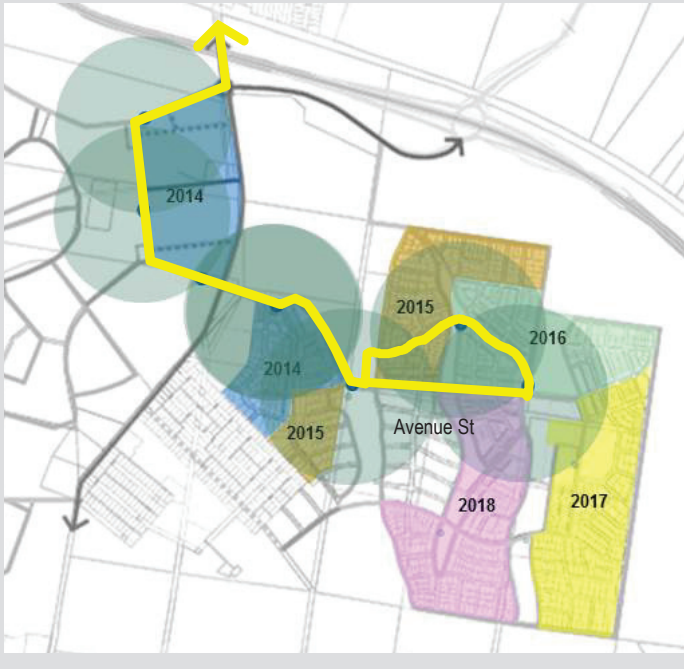
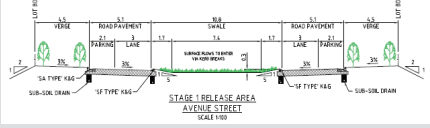
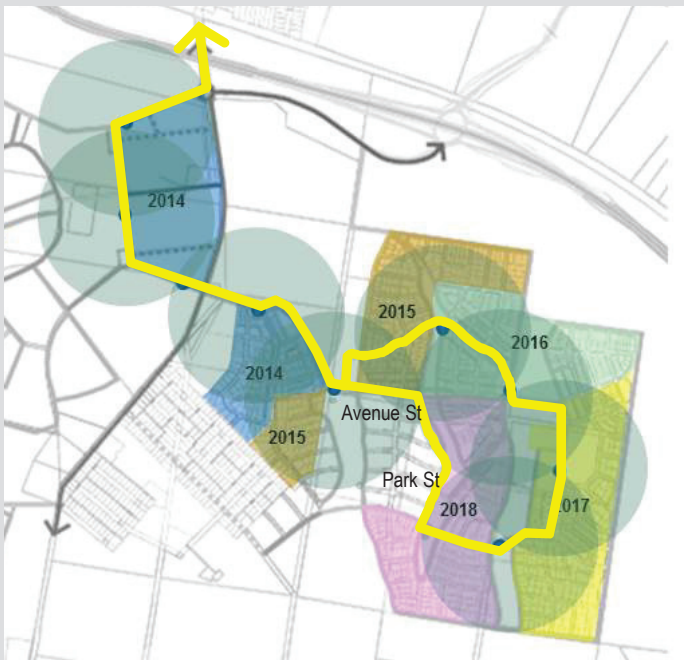
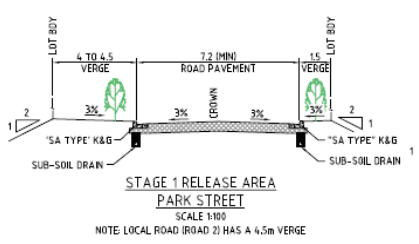


Figure 16 Bus Route Phasing

Phasing	Interim Bus Route	Bus Turnaround
2014		The bus turnaround route will utilise Park Street

Phasing	Interim Bus Route	Bus Turnaround
2015		The bus turnaround route will utilise Avenue Street. The southern section of Avenue Street that is not intended to be part of the final bus route will require temporary no parking restrictions when designated as a bus turnaround route. 
2016		The bus turnaround route will utilise Avenue Street. The southern section of Avenue Street that is not intended to be part of the final bus route will require temporary no parking restrictions when designated as a bus turnaround route. 

Phasing	Interim Bus Route	Bus Turnaround
2017		The bus turnaround route will utilise Park St and Avenue Street.  NOTE: LOCAL ROAD (ROAD 2) HAS A 4.5m VERGE The southern section of Avenue Street that is not intended to be part of the final bus route will require temporary no parking restrictions when designated as a bus turnaround route. 
2018		The Stage 1 Bus route will operate as a one way loop.

Appendix E – Bulk Water Servicing Strategy, Masterplan and Altogether Correspondence



Huntlee Stage 1

Potable and Recycled Water Master Plan

2016-015 – Huntlee Masterplan Update

18 July 2016



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

Disclaimer

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PROJECT 2016-015 - HUNTLEE STAGE 1

REV	DESCRIPTION	ORIG	REVIEW	APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	<u> </u> L.Russell	<u> </u> D.Powell	<u> </u> N/A	7 July 16	<u> </u> N/A	
B	Issued for client review	<u> </u> L.Russell	<u> </u> D.Powell	<u> </u> N/A	7 July 16	<u> </u>	N/A
C	Updated after CLient Comments	<u> </u> L.Russell	<u> </u> D.Powell	<u> </u> N/A	18 July 16	<u> </u>	N/A
		<u> </u>	<u> </u>	<u> </u>		<u> </u>	



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
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FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

1 INTRODUCTION

DGP Water has been commissioned by Huntlee Water (a wholly owned subsidiary of Flow Systems) to prepare a Master Plan for potable and recycled water for Stage 1 of the Huntlee development. The location of the Huntlee development area is shown on Figure 1.

Huntlee Water has been engaged by Huntlee Pty Ltd as an independent operator to provide potable water, wastewater and recycled water services to the Huntlee development. Hunter Water Corporation (HWC) will not own or operate the water, wastewater or recycled water assets within the boundaries of the development area.

This Master Plan has been prepared for potable water and recycled water for Stage 1 of the Huntlee development, based on design demands advised by Huntlee Water. Allowance has also been included in the Master Plan for servicing of future stages (stages 2 and 3) of the development. A Master Plan for wastewater has been prepared by others.

1.1 Scope of Work

Tasks undertaken in preparation of this Master Plan have included the following:

- Review background data.
- Establish design criteria.
- Develop InfoWorks models for potable and recycled water.
- Run InfoWorks models to determine appropriate pipe sizes.
- Prepare Master Plans for potable and recycled water.



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2 DESIGN CRITERIA

2.1 Land Use

Stage 1 of the Huntlee development includes residential lots and medium density dwellings, commercial, retail and light industrial zones, a school, sports grounds and parklands.

Residential lots will be located on the eastern side of Wine Country Drive and within a large lot residential area to the south west of the main Stage 1 release area. Commercial and retail development will be located within the town centre, which will be located to the west of Wine Country Drive. The proposed layout of the Huntlee Stage 1 development is illustrated on Figure 2.

A portion of the residential development area is not currently owned by Huntlee Pty Ltd (refer Figure 2). It has been assumed in preparation of this Master Plan that this land will be developed for residential purposes, with the number of residential lots provided by Huntlee Pty Ltd. Refer to section 2.2 to determine the split between stage 1 and combined stages 2 and 3.

Proposed land uses at ultimate development of Huntlee Stage 1 are included in Table 2-1.

Table 2-1 Huntlee Stage 1 Ultimate Land Use

Land Use	Count
Residential	1,865 lots
Medium Density	230 dwellings
Commercial	4.5 Ha
Retail	3 Ha
Light Industrial Park	10 Ha
School	1 No.
Sports Ground	7 Ha
Parklands	12 Ha



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Stage 2 and 3 development areas will be located to the west of Wine Country Drive. Land use at ultimate development is summarized in Table 2-2.

Table 2-2 Huntlee Ultimate Development Land Use (Stages 1, 2 and 3)

Land Use	Count
Residential	6,355 lots
Medium Density	1,145 dwellings
Commercial	10.5 Ha
Retail	10 Ha
Light Industrial Park	60 Ha
School	3 No.
Sports Ground	21 Ha
Parklands	28 Ha

2.2 Development Split between Stages

As the split between Huntlee stage 1 and the remainder of the development (stages 2 and 3) is unknown at this stage for all areas apart from the residential component (residential and medium density) the development split from the Bulk Water Servicing Strategy has been adopted as outlined in the following Table 2-3. That is, development (for all areas apart from Residential and Medium Density) up to and including year 2022 (closest corresponding year for residential development to hit 1,865 lots) is in stage 1 and the remaining development is in stages 2 and 3. Stage 1 Residential and Medium Density is based on actual lot counts from the information provided by Huntlee.

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Table 2-3 Huntlee Ultimate Development Land Use (Stages 1, 2 and 3 by year)

Year	Huntlee							
	Residential Lots (No.)	Medium Density (No.)	Commercial (Ha)	Retail (Ha)	Light Industrial (Ha)	School (No.)	Sports Ground (Ha)	Parkland (Ha)
2015	155	40	-	-	-	-	-	-
2016	355	65	-	-	-	-	-	1
2017	605	90	-	-	-	-	3.5	3
2018	855	115	2.5	1	2	1	3.5	5
2019	1105	140	2.5	1	4	1	3.5	7
2020	1355	190	2.5	2	6	1	7	9
2021	1605	240	2.5	2	8	1	7	10.5
2022	1855	290	4.5	3	10	1	7	12
2023	2105	340	4.5	3	12	2	10.5	13.5
2024	2355	390	4.5	4	14	2	10.5	15
2025	2605	440	6.5	4	16	2	10.5	16.5
2026	2855	490	6.5	5	18	2	14	18
2027	3105	540	6.5	5	20	2	14	19.5
2028	3355	590	6.5	6	22	3	14	21
2029	3605	640	6.5	7	24	3	17.5	22.5
2030	3855	690	8.5	8	26	3	17.5	24
2035	5105	940	9.5	9	41	3	17.5	26
2040	6355	1145	10.5	10	60	3	21	28
2050	6355	1145	10.5	10	60	3	21	28
2055	6355	1145	10.5	10	60	3	21	28
Ultimate	6355	1145	10.5	10	60	3	21	28

2.3 Average Day Demand

All land use types within the Huntlee Stage 1 development will be provided with both potable and recycled water.

The total average day demands for potable and recycled water for each land use within the Huntlee development are included in Table 2-4.

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Table 2-4 Average Day Demand

Land Use	Unit	Potable Water	Recycled Water	Source
Residential (Huntlee Water)	L/day/lot	275	275	Flow Systems
Medium Density	L/day/lot	275	275	Flow Systems
Commercial	L/day/Ha	5000	12000	Flow Systems- The area represents the net lettable floor space
Retail	L/day/Ha	27000	3000	Flow Systems- The area represents the net lettable floor space
Light Industrial Park	L/day/Ha	5000	12000	Flow Systems- The area represents the net lettable floor space
School	L/day/No.	4450	4450	Flow Systems
Sports Ground	L/day/Ha	1945	1945	WSA 03-2011-3.1 (Sydney Water Edition) Table 2.1 Assume 50% recycled water
Parklands	L/day/Ha	1945	1945	WSA 03-2011-3.1 (Sydney Water Edition) Table 2.1 Assume 50% recycled water
Recycled Water Top Up	L/day	1500000 (Ultimate)	0	Flow Systems. The top up volume was increased each year until it reached 1500 kL/day for the ultimate Huntlee development.
Unaccounted Water	15% of average day demand			WSA 03-2002-2.3 (HWC Version 1.0) Section 2.2.2.4 (Unaccounted Water)

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POTABLE AND RECYCLED WATER MASTER PLAN

2.4 Demand Factors

Demand categories and factors for each land use type were sourced from WSA 03-2002-2.3 (HWC Version 1.0) Table 2.1 (Water Supply Design Demands). The adopted categories and factors are included in Table 2-5.

Table 2-5 Demand Categories and Factors

Land Use	HWC Demand Category	Peak Day Factor	Peak Hour Factor	Extreme Day Factor	95 th %ile Factor
Residential	Residential House – Maitland & Cessnock LGA	2.25	2.02	1.15	1.8
Medium Density	Flats/Units	2.20	2.02	1.15	1.76
Commercial	Commercial	1.20	1.90	1.15	1.14
Retail	Commercial	1.20	1.90	1.15	1.14
Light Industrial Park	Industrial	1.20	1.30	1.15	1.14
Primary School	Schools/ Colleges	1.60	2.50	1.15	1.52
Sports Ground	Parks and Rural	1.60	1.50	1.15	1.52
Parklands	Parks and Rural	1.60	1.50	1.15	1.52
Recycled Water Top Up	N/A	1.00	1.00	1.00	1.00
Unaccounted Water	Unaccounted Water	1.00	1.00	1.00	1.00

It should be noted that the demand factors presented above relate to single supply systems i.e. systems without a recycled water component. The introduction of recycled water may change the traditional demand factors as usage that may typically increase during peak periods such as external watering may be covered by the recycled water system.



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2.5 Diurnal Demand Factors

Diurnal demand factors for each land use type were sourced from WSA 03-2002-2.3 (HWC Version 1.0) Table 2.2 (Diurnal Demand Factors) and are included in Table 2-6.

Table 2-6 Diurnal Demand Categories

Land Use	WSA Demand Category
Residential	Domestic Peak & Extreme Day
Medium Density	Domestic Peak & Extreme Day
Commercial	Commercial
Retail	Commercial
Light Industrial Park	Industrial
Primary School	Schools / Colleges
Sports Ground	Parks / Gardens
Parklands	Parks / Gardens
Recycled Water Top Up	Unaccounted
Unaccounted Water	Unaccounted

2.6 Service Pressure Limits

The service pressure limits from WSA 03-2002-2.3 (Hunter Water Corporation Version 1.0) Table 2.4 (Service Pressure (SP) Limits) were adopted for Huntlee Stage 1 and are summarized in Table 2-7.

Table 2-7 Adopted Service Pressure Limits

Service Pressure Limit	Demand	Pressure (m)
Maximum	All applications	60
Minimum	Peak hour flow on a peak day of a peak week	20/25*
	Peak hour flow on an extreme	12



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Service Pressure Limit	Demand	Pressure (m)
	day of an extreme week	
	Peak hour flow on a 95 th percentile peak day plus fire fighting flow (at location of fire flow)	15**
	Peak hour flow on a 95 th percentile peak day plus fire fighting flow (other than location of a fire flow)	3**

Notes: * Booster pump stations to be designed to deliver a minimum pressure of 25 m.

** Fire fighting flow not applicable to recycled water.

2.7 Reservoirs

The Huntlee potable water reservoirs have been sized based on the following:

- Storage does not fall below 20% capacity during an extreme week demand period.
- Each individual reservoir will have a useable storage volume of 2 ML.



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3 POTABLE WATER DEMANDS

The following sections 3 and 4 outline the potable water and recycled water demands determined based on the modelling completed to date. By way of summary, Tables 3-1 and 3-2 outline the Average Day Demands and Peak Hour Demands at the ultimate Huntlee development for both the potable water and recycled water systems. Refer to section 3 and 4 for a more detailed explanation of how these numbers were derived.

Table 3-1 Ultimate Average Day Demands

Land Use	Average Day Demand (L/s)	
	Potable Water	Recycled Water
Residential	20.23	20.23
Medium Density	3.64	3.64
Commercial	0.61	1.46
Retail	3.13	0.35
Light Industrial Park	3.47	8.33
School	0.15	0.15
Sports Ground	0.47	0.47
Parklands	0.63	0.63
Recycled Water Top Up	17.36	-
Unaccounted Water	4.85	5.29
Total	54.55	40.56

Table 3-2 Ultimate Peak Hour Demands

Land Use	Peak Hour Demand (L/s)	
	Potable Water	Recycled Water
Residential	91.93	91.93
Medium Density	16.20	16.20
Commercial	1.39	3.33
Retail	7.13	0.79
Light Industrial Park	5.42	13.00

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Land Use	Peak Hour Demand (L/s)	
School	0.62	0.62
Sports Ground	1.13	1.13
Parklands	1.51	1.51
Recycled Water Top Up	17.36	-
Unaccounted Water	4.85	5.29
Total	147.53	133.80

3.1 Stage 1 Potable Water Demands

Based on the ultimate Stage 1 development plan presented in Table 2-1, the potable water average, peak and extreme day demands have been calculated and presented in Table 3-3.

Table 3-3 Stage 1 Potable Water Demands

Land Use	No.	ADD (ML)	PDD (ML)	EDD (ML)	AD (L/s)	PHD (L/s)	EHD (L/s)
Residential	1865 Lots	0.51	1.15	1.33	5.94	26.98	31.03
Medium Density	230 Dwellings	0.06	0.14	0.16	0.73	3.25	3.74
Commercial	4.5 Ha	0.02	0.03	0.03	0.26	0.59	0.68
Retail	3 Ha	0.08	0.10	0.11	0.94	2.14	2.46
Light Industrial Park	10 Ha	0.05	0.06	0.07	0.58	0.90	1.04
School	1	0.00	0.01	0.01	0.05	0.21	0.24
Sports Ground	7 Ha	0.01	0.02	0.03	0.16	0.38	0.43
Parklands	12 Ha	0.02	0.04	0.04	0.27	0.65	0.75
Recycled Water Top Up	630000L	0.63	0.63	0.63	7.29	7.29	7.29
Unaccounted Water	15%	0.12	0.12	0.12	1.34	1.34	1.34
Total		1.52	2.29	2.52	17.55	43.73	48.99

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Notes: 1. The totals in Table 3-1 above assume that the peak demands for all land use types occur simultaneously. In reality, the peak demands for each land use type would occur at different times of the day.
 2. The average day demand is represented as a constant flow over 24hrs. The actual flowrate will follow a diurnal pattern.

3.2 Ultimate Potable Water Demands

Based on the ultimate development plan presented in Table 2-2, the potable water average, peak and extreme day demands have been calculated and presented in Table 3-4.

Table 3-4 Ultimate Potable Water Demands

Land Use	No.	ADD (ML)	PDD (ML)	EDD (ML)	AD (L/s)	PHD (L/s)	EHD (L/s)
Residential	6355 lots	1.75	3.93	4.52	20.23	91.93	105.72
Medium Density	1145 dwellings	0.31	0.69	0.80	3.64	16.20	18.63
Commercial	10.5 Ha	0.05	0.06	0.07	0.61	1.39	1.59
Retail	10 Ha	0.27	0.32	0.37	3.13	7.13	8.19
Light Industrial Park	60 Ha	0.30	0.36	0.41	3.47	5.42	6.23
School	3	0.01	0.02	0.02	0.15	0.62	0.71
Sports Ground	21 Ha	0.04	0.07	0.08	0.47	1.13	1.30
Parklands	28 Ha	0.05	0.09	0.10	0.63	1.51	1.74
Recycled Water Top Up	1500000 L	1.50	1.50	1.50	17.36	17.36	17.36
Unaccounted Water	15%	0.42	0.42	0.42	4.85	4.85	4.85
Total		4.71	7.46	8.30	54.55	147.53	166.33

Notes: 1. The totals in Table 3-2 above assume that the peak demands for all land use types occur simultaneously. In reality, the peak demands for each land use type would occur at different times of the day.
 2. The average day demand is represented as a constant flow over 24hrs. The actual flowrate will follow a diurnal pattern.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

4 RECYLED WATER DEMANDS

4.1 Stage 1 Recycled Water Demands

Based on the ultimate Stage 1 development plan presented in Table 2-1, the recycled water average, peak and extreme day demands have been calculated and presented in Table 4-1.

Table 4-1 Stage 1 Recycled Water Demands

Land Use	No.	ADD (ML)	PDD (ML)	EDD (ML)	AD (L/s)	PHD (L/s)	EHD (L/s)
Residential	1865 Lots	0.51	1.15	1.33	5.94	26.98	31.03
Medium Density	230 Dwellings	0.06	0.14	0.16	0.73	3.25	3.74
Commercial	4.5 Ha	0.05	0.06	0.07	0.63	1.43	1.64
Retail	3 Ha	0.01	0.01	0.01	0.10	0.24	0.27
Light Industrial Park	10 Ha	0.12	0.14	0.17	1.39	2.17	2.49
School	1	0.00	0.01	0.01	0.05	0.21	0.24
Sports Ground	7 Ha	0.01	0.02	0.03	0.16	0.38	0.43
Parklands	12 Ha	0.02	0.04	0.04	0.27	0.65	0.75
Unaccounted Water	15%	0.12	0.12	0.12	1.39	1.39	1.39
Total		0.92	1.70	1.94	10.66	36.68	41.98

Notes: 1. The totals in Table 4-1 above assume that the peak demands for all land use types occur simultaneously. In reality, the peak demands for each land use type would occur at different times of the day.

2. The average day demand is represented as a constant flow over 24hrs. The actual flowrate will follow a diurnal pattern.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

4.2 Ultimate Recycled Water Demands

Based on the ultimate development plan presented in Table 2-2, the recycled water average, peak and extreme day demands have been calculated and presented in Table 4-2.

Table 4-2 Ultimate Recycled Water Demands

Land Use	No.	ADD (ML)	PDD (ML)	EDD (ML)	AD (L/s)	PHD (L/s)	EHD (L/s)
Residential	6355 lots	1.75	3.93	4.52	20.23	91.93	105.72
Medium Density	1145 dwellings	0.31	0.69	0.80	3.64	16.20	18.63
Commercial	10.5 Ha	0.13	0.15	0.17	1.46	3.33	3.82
Retail	10 Ha	0.03	0.04	0.04	0.35	0.79	0.91
Light Industrial Park	60 Ha	0.72	0.86	0.99	8.33	13.00	14.95
School	3	0.01	0.02	0.02	0.15	0.62	0.71
Sports Ground	21 Ha	0.04	0.07	0.08	0.47	1.13	1.30
Parklands	28 Ha	0.05	0.09	0.10	0.63	1.51	1.74
Unaccounted Water	15%	0.46	0.46	0.46	5.29	5.29	5.29
Total		3.50	6.31	7.18	40.56	133.80	153.08

- Notes: 1. The totals in Table 4-2 above assume that the peak demands for all land use types occur simultaneously. In reality, the peak demands for each land use type would occur at different times of the day.
2. The average day demand is represented as a constant flow over 24hrs. The actual flowrate will follow a diurnal pattern.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

5 POTABLE WATER MASTERPLAN

5.1 Initial Development

The initial development would be serviced via connection to the existing DN300 and DN150 diameter HWC potable water mains along Wine Country Drive between Branxton and North Rothbury. A bulk water meter and backflow prevention devices would be located at this connection point (refer Figures 3 & 4).

Potable water would initially be used to supply both the potable water and recycled water reticulation systems for the first 180 lots. Once the first 180 lots have been developed, the LWC would be commissioned and recycled water would be provided to the development. Potable water would not be required to service the recycled water reticulation, with the exception of top up of the recycled water system when there is a deficit of recycled water.

HWC will service the new development directly off their system until Huntlee's peak potable water demand reaches 22.5 L/s.

5.2 Ultimate Development

Once the peak potable water demand from the Huntlee Stage 1 development exceeds 22.5 L/s the remainder of the development will be serviced from the future Huntlee reservoirs located to the south of Stage 1 development area (refer to the Bulk Water Servicing Strategy (WP, 2015)). These reservoirs will be filled via a direct draw from the HWC connection point which will provide a constant supply of potable water for 24hrs/day during peak demand periods and 18hrs/day during average demand periods.

A trunk DN300 potable water main runs from the potable water reservoirs, through the development and along the eastern side of WCD heading north until the first road into the commercial area (refer Figures 3 & 4). This pipe then crosses WCD and continues west where it will eventually join with the future stage 2 and 3 reticulation. This trunk water main helps to supply the reticulation with adequate flow and pressure.

5.3 Water Pumping Station and Delivery Main

A transfer WPS would be located at the LWC site. This WPS would receive flows from the HWC connection point and transfer water via a trunk delivery main to the potable water reservoirs located on the southern boundary of the development area (refer Figure 4). The WPS would not pump directly to reticulation mains within the Stage 1 development area.

The ultimate configuration of the WPS would draw approximately 80 L/s out of HWC's potable water system at the connection point. Refer to the Bulk Water Servicing Strategy (WP, 2015) for the staging and sizing of the WPS.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

The trunk main will need to be sized to allow for the delivery of water from the HWC connection point accounting for flows up to the ultimate development. Sizing of this trunk main would be undertaken during detailed design.

5.4 Reservoirs

Four 2ML (8ML total storage) potable water reservoirs would be constructed on a site located to the south of Stage 1 development area (refer Figure 4). This site has been acquired by Huntlee Pty Ltd for the purpose of constructing potable and recycled water reservoirs. The timing of the reservoirs would be staged, to meet the increasing demand of the development.

The reservoirs would have sufficient capacity to service the ultimate Huntlee development and meet the design criteria ensuring that storage does not fall below 20% capacity during an extreme week demand period.

The overall reservoir volume (8ML) was determined during the Bulk Water Servicing Strategy development based on the demand from the Huntlee development, available capacity within the HWC network, proposed upgrades and disaster scenario modelling. FlowSystems have advised that 4 * 2ML reservoirs are proposed to achieve the 8ML required storage however it is unclear if this number of reservoirs (there will be an additional 4 * 2ML recycled water reservoirs as well) will fit on the proposed site hence a detailed assessment of the reservoir site is required. This will allow the determination of the overall reservoir numbers, size and layout.

The overall reservoir configuration including sizing and number of the reservoirs would be undertaken during detailed design to suit the site available land.

5.5 Reticulation

The potable water reticulation was sized as follows (refer Figures 3 & 4):

- DN100 PVC-M reticulation mains throughout the residential and large lot residential areas of Stage 1.
- A DN100 PVC-M main from Wine Country Drive to the large lot residential areas.
- DN150 PVC-M mains throughout the town centre.
- A DN300 PVC-M main from the potable water reservoir to connection into the town centre along Wine Country Drive. This main has been sized to supply Stages 2 and 3 of the Huntlee development.

5.6 Stage 1 Town Centre

As outlined in the last dot point of section 5.6 a DN300 pipeline has been modelled to supply water from the stage 1 residential area to the future commercial zone and the stage 2 and 3 development areas. The location chosen for the DN300 crossing of Wine Country Drive was selected to avoid the



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

main entrance to the commercial area that is currently being constructed as part of the Wine Country Drive stage 2 realignment project. This intersection is very congested and finding an appropriate allocation for this new pipe would be problematic.

To allow initial servicing of the stage 1 commercial zone modelling was undertaken and a DN150 pipeline selected as the most appropriate size to continue along Wine Country Drive and enter the commercial zone at the main intersection. Fitting a DN150 pipeline would be much simpler than a DN300 and hence this would be a better outcome.

As the exact development profile of the commercial zone is unknown as well as the timing of when the larger DN300 trunk main will connect back into the smaller DN150 pipeline taken in for the initial stage 1 area it has been decided to upsize the DN150 pipeline to a DN200 pipeline to build some additional capacity for the future.

5.7 Recycled Water Top Up

Potable water will be required to top up the recycled water system when there is a deficit of recycled water. Huntlee Water has advised that any topping up of the recycled water system with potable water would be managed, such that the ability of the potable water system to meet peak demands would not be compromised (i.e. topping up would occur outside of peak potable water demand periods).

5.8 Potable Water Model

A potable water supply network model of the Huntlee Stage 1 development area has been generated using InfoWorks. The reticulation and trunk mains were positioned within the model along proposed road alignments and sized to meet the peak and extreme hour potable water demands (refer Table 3-2). The model was then run using a range of demand scenarios to verify that adequate service pressure could be maintained during peak and extreme hour flows and to ensure that firefighting conditions could be met (refer Table 2-6).

The following key assumptions were made when developing the model:

- The model was based on the latest lot layout (supplied by LWP 16/6/16).
- It was assumed that the parcel of residential land that is yet to be acquired by Huntlee Pty Ltd (Lot 34 DP 755211) would form part of the development area. The number of residential lots in this area was supplied by Huntlee Pty Ltd.
- Potable water demands Table 2-3 were allocated to each node based on the number of residential lots in the vicinity of the node. Similarly, commercial, retail and other demands were allocated to nodes based on the land uses in the vicinity of each node.
- The demand factors in Table 2-4 were applied to the average daily demands entered at each node.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

- The diurnal factors in Table 2-5 were entered into the model to simulate the distribution of demands over an extreme week.
- All pipework inside of the Huntlee development area was modelled as PVC-M (PN16).
- A minimum pipe size of DN100 was used for the residential reticulation, while a minimum size of DN150 was used for the town centre, in accordance with HWC design criteria.
- The Ultimate Huntlee Potable water reservoir was modelled with 8ML capacity.
- The bottom water level of the Huntlee reservoir was modelled at RL 105 m, while the top water level was modelled at RL 110 m.
- The WPS and trunk delivery main used to fill the reservoir from the HWC connection point have not been modelled as part of the masterplan modelling as this is not required. Refer to the Bulk Water Servicing Strategy to outline the proposed staging for the WPS and trunk main delivery system. The WPS staging is based on the agreed HWC network upgrades and extraction rates from the HWC network. Consultation with HWC would be required to modify the proposed staging. It has been assumed that this delivery system will be sized to adequately fill the reservoir to meet system demands.
- Firefighting flows were modelled as 20 L/s for the town center and 10 L/s for the remainder of the development.
- A single node has been included in the model to account for future development of Huntlee Stages 2 and 3 (the demand due to these stages was included to ensure that the trunk infrastructure is sized to handle future flows). A demand equivalent to 5405 residential lots, 6 Ha of commercial area, 7 Ha of retail area, 50 Ha of light industrial area, 2 schools, 14 Ha of sports grounds and 16 Ha of parkland was applied to this node.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

6 RECYCLED WATER MASTERPLAN

6.1 Initial Development

For development of up to 180 residential lots, wastewater would be tankered off-site to the Branxton WWTW and recycled water would not be available within the Huntlee Stage 1 development area. The recycled water system would be supplied with potable water until a supply of recycled water is available from the on-site LWC.

6.2 Ultimate Development

For development of Huntlee Stage 1 beyond 180 residential lots, recycled water would be sourced from the storage tank at the on-site LWC. A recycled water pumping station located at the LWC site would transfer recycled water from the storage tank to the recycled water reticulation system.

At ultimate development, recycled water would be sourced from recycled water reservoirs, which would be located adjacent to the potable water reservoirs south of the Stage 1 residential area. Recycled water would be pumped from the storage tank at the LWC to the recycled water reservoir via a new recycled water pumping station and trunk delivery main (refer Figure 7).

Timing of construction of the new recycled water pumping station, trunk delivery main and recycled water reservoir would be driven by economic considerations. Matters to be considered in determining timing would include energy costs for continual pumping from the storage tank into the recycled water reticulation system and any capital cost savings that could be realized through construction of the recycled water reservoir concurrently with the potable water reservoir.

A trunk DN375 recycled water main runs from the recycled water reservoirs, through the development and along the eastern side of WCD heading north until the first road into the commercial area (refer Figures 6 & 7). This pipe then crosses WCD and continues west where it will eventually join with the future stage 2 and 3 reticulation. This trunk water main helps to supply the reticulation with adequate flow and pressure.

6.3 Recycled Water Pumping Station and Delivery Main

Recycled water pumps would be located at the LWC site. These pumps would transfer flows from the storage tank at the LWC site to the recycled water reservoir via a trunk delivery main (refer Figure 7). The recycled water pumping would not pump directly to the recycled water reticulation network within the Stage 1 development area.

To cater for ultimate development flows, the recycled water pumps would be sized to deliver approximately 80 L/s at 45 m head however the exact configuration of the recycled water pump station could be based on several considerations and an investigation into available alternatives should be undertaken before a final decision is made on pump station capacity. The trunk main will



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

need to be sized to allow for the delivery of water from the LWC storage tanks accounting for flows up to the ultimate development. Sizing of this trunk main would be undertaken during detailed design.

6.4 Reservoirs

Four 2ML (8ML total storage) Recycled water reservoirs would be constructed adjacent to the potable water reservoirs, on a site that has been acquired by Huntlee Pty Ltd (refer Figure 7). The timing of the reservoirs would be staged, to meet the increasing demand of the development.

The reservoirs would have sufficient capacity to service the ultimate Huntlee development and meet the design criteria ensuring that storage does not fall below 20% capacity during an extreme week demand period.

The overall reservoir volume (8ML) was determined during the Bulk Water Servicing Strategy development based on the demand from the Huntlee development, available capacity within the HWC network, proposed upgrades and disaster scenario modelling. FlowSystems have advised that 4 * 2ML reservoirs are proposed to achieve the 8ML required storage however it is unclear if this number of reservoirs (there will be an additional 4 * 2ML potable water reservoirs as well) will fit on the proposed site hence a detailed assessment of the reservoir site is required. This will allow the determination of the overall reservoir numbers, size and layout.

The overall reservoir configuration including sizing and number of the reservoirs would be undertaken during detailed design to suit the site available land.

6.5 Reticulation

The recycled water reticulation was sized as follows (refer Figures 6 & 7):

- DN100 PVC-M reticulation mains throughout the residential and large lot residential areas of Stage 1
- A DN100 PVC-M main from Wine Country Drive to the large lot residential areas.
- A DN200 PVC-M pipe passing through the centre of the initial Precincts
- DN150 PVC-M mains throughout the town centre.
- A DN375 PVC-M main from the recycled water reservoir to connection into the town centre along Wine Country Drive. This main has been sized to supply Stages 2 and 3 of the Huntlee development.

6.6 Stage 1 Town Centre

As outlined in the last dot point of section 5.6 a DN375 pipeline has been modelled to supply recycled water from the stage 1 residential area to the future commercial zone and the stage 2 and 3 development areas. The location chosen for the DN375 crossing of Wine Country Drive was selected



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

to avoid the main entrance to the commercial area that is currently being constructed as part of the Wine Country Drive stage 2 realignment project. This intersection is very congested and finding an appropriate allocation for this new pipe would be problematic.

To allow initial servicing of the stage 1 commercial zone modelling was undertaken and a DN150 pipeline selected as the most appropriate size to continue along Wine Country Drive and enter the commercial zone at the main intersection. Fitting a DN150 pipeline would be much simpler than a DN375 and hence this would be a better outcome.

As the exact development profile of the commercial zone is unknown as well as the timing of when the larger DN375 trunk main will connect back into the smaller DN150 pipeline taken in for the initial stage 1 area it has been decided to upsize the DN150 pipeline to a DN200 pipeline to build some additional capacity for the future.

6.7 Recycled Water Top Up

When there is a deficit of recycled water, the recycled water system may need to be topped up with potable water (or an alternative source) to enable the recycled water demands to be met. It is anticipated that top up of the recycled water system would occur by topping up the recycled water reservoirs directly from the potable water reservoirs. Huntlee water has also advised that topping up of the recycled water system may occur at the LWC site as well.

Huntlee Water has advised that any topping up of the recycled water system with potable water would be managed, such that the ability of the potable water system to meet peak demands would not be compromised (i.e. topping up would occur outside of peak potable water demand periods).

6.8 Recycled Water Model

A recycled water supply network model of the ultimate Huntlee Stage 1 development area has been generated using InfoWorks. The reticulation and trunk mains were positioned within the model along proposed road alignments and sized to meet the peak and extreme hour recycled water demands (refer Table 4-2). The model was then run using a range of demand scenarios to verify that adequate service pressures could be maintained during peak and extreme hour flows (refer Table 2-6). Note that firefighting conditions are not applicable to recycled water.

The following key assumptions were made when developing the model:

- The model was based on the latest lot layout (supplied by LWP 16/6/16).
- It was assumed that the parcel of residential land that is yet to be acquired by Huntlee Pty Ltd (Lot 34 DP 755211) would form part of the development area. The number of residential lots in this area was supplied by Huntlee Pty Ltd.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

- Potable water demands Table 2-3 were allocated to each node based on the number of residential lots in the vicinity of the node. Similarly, commercial, retail and other demands were allocated to nodes based on the land uses in the vicinity of each node.
- The demand factors in Table 2-4 were applied to the average daily demands entered at each node.
- The diurnal factors in Table 2-5 were entered into the model to simulate the distribution of demands over an extreme week.
- It was assumed that the demand factors and diurnal factors for potable water included in Tables 2-4 and 2-5 are applicable to recycled water.
- All pipework inside of the Huntlee development area was modelled as PVC-M (PN16).
- A minimum pipe size of DN100 was used for the residential reticulation, while a minimum size of DN150 was used for the town centre, in accordance with HWC design criteria.
- The Ultimate Huntlee Recycled water reservoir was modelled with 8ML capacity.
- The bottom water level of the Huntlee reservoir was modelled at RL 105 m, while the top water level was modelled at RL 110 m.
- The recycled WPS and trunk delivery main used to fill the reservoir from the HWC connection point have not been modelled. It has been assumed that this delivery system will be sized to adequately fill the reservoir to meet system demands (see below).
- A single node has been included in the model to account for future development of Huntlee Stages 2 and 3 (the demand due to these stages was included to ensure that the trunk infrastructure is sized to handle future flows). A demand equivalent to 5405 residential lots, 6 Ha of commercial area, 7 Ha of retail area, 50 Ha of light industrial area, 2 schools, 14 Ha of sports grounds and 16 Ha of parkland was applied to this node.

6.9 Recycled Water Transfer Pump Station

A recycled water transfer pump station is required to transfer water from the LWC site up to the storage reservoir site. Unlike the potable water transfer pump station the recycled water transfer pump station is not limited by the HWC network and the pump rate can be determined by FlowSystems based on a number of variables such as;

- Rate of production of recycled water
- System demand
- Size of the storage reservoir (suction tank) at the LWC
- Pumping time preference



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

- Location where potable water top-up occurs

Some high level modelling has been undertaken in order to determine the minimum transfer rates from the LWC up to the main storage reservoirs. The following parameters were used in this modelling;

- Recycled water reservoirs could not fall below 20% in an extreme week
- Recycled water reservoirs at the reservoir site are full at the commencement of the extreme week ie 8ML of existing storage
- Potable water top-up if required occurs at the LWC site.
- Pumping 24 hours a day 7 days a week throughout the extreme week but allowing one 8 hour interruption to pumping during the week.
- Single extreme week modelled for the recycled water system. Note that potable water system has been modelled with two extreme weeks back to back.

On the basis of the above assumptions the minimum transfer rate from the LWC to the recycled water reservoirs needs to be 60l/s. The rate of 60l/s represent the minimum pump rates required. It may be desirable to pump at a higher rate to take advantage of off peak power rates, suit operational reasons or to build additional contingency within the transfer system.

Note that the assumption above is that average demand follows an extreme week which may not be realistic. Once the reservoirs reach 20% at the end of an extreme week it will take approximately 4 days of continuous pumping at 60l/s with only average demands to return the reservoirs to full again. Should a period of above average demands follow an extreme week then the reservoir may not recover pumping at 60l/s and the recycled water system may run out of water.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

7 REFERENCES

SMEC (2013)

Huntlee New Town, Water and Wastewater Servicing Addendum. SMEC. July 2013.

WP (2015)

Bulk Water Servicing Strategy. WorleyParsons. July 2015.



FLOW SYSTEMS / HUNTLEE WATER
HUNTLEE STAGE 1
POTABLE AND RECYCLED WATER MASTER PLAN

Figures

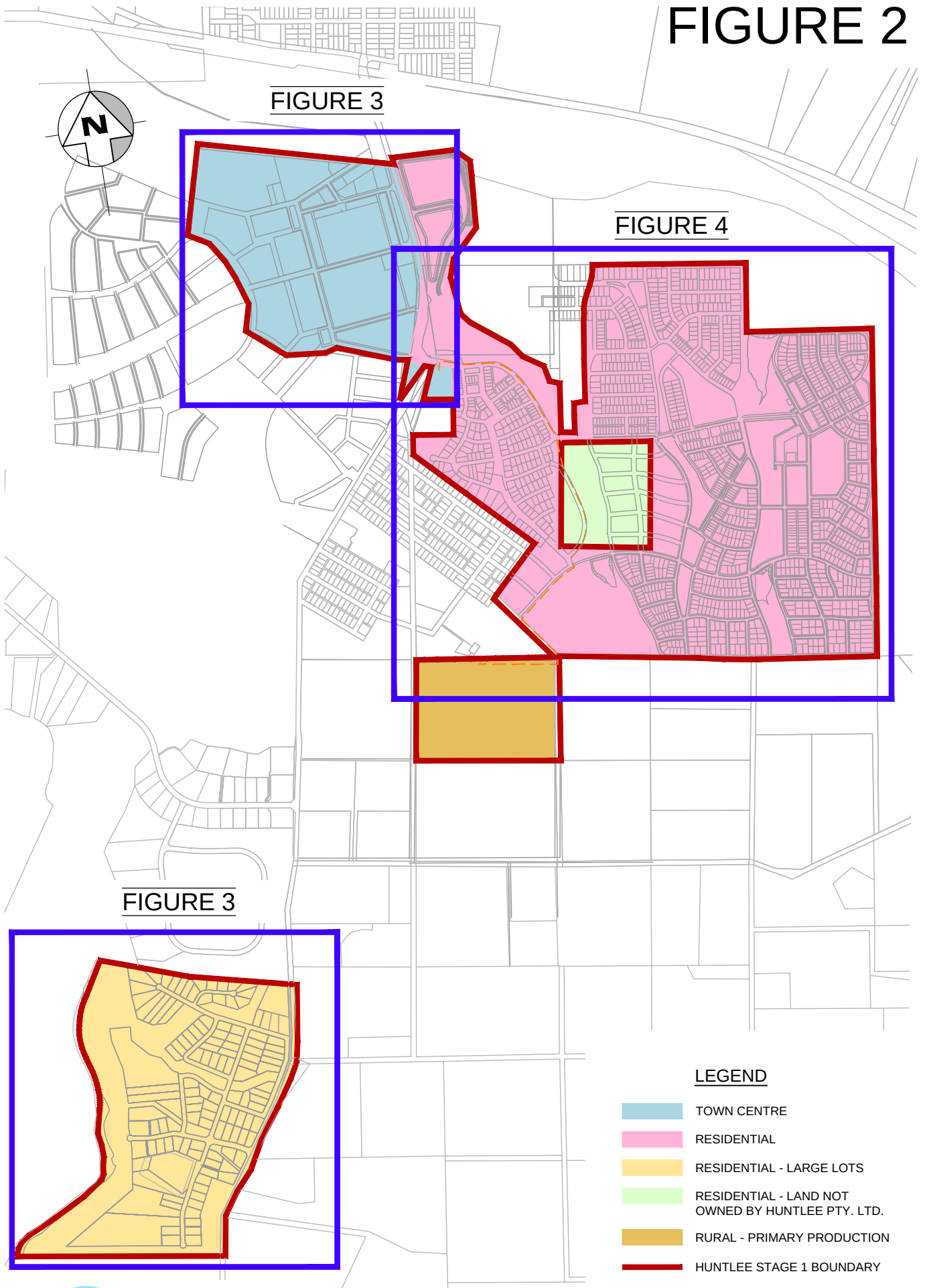
FIGURE 1



HUNTLEE STAGE 1

LOCALITY PLAN

FIGURE 2



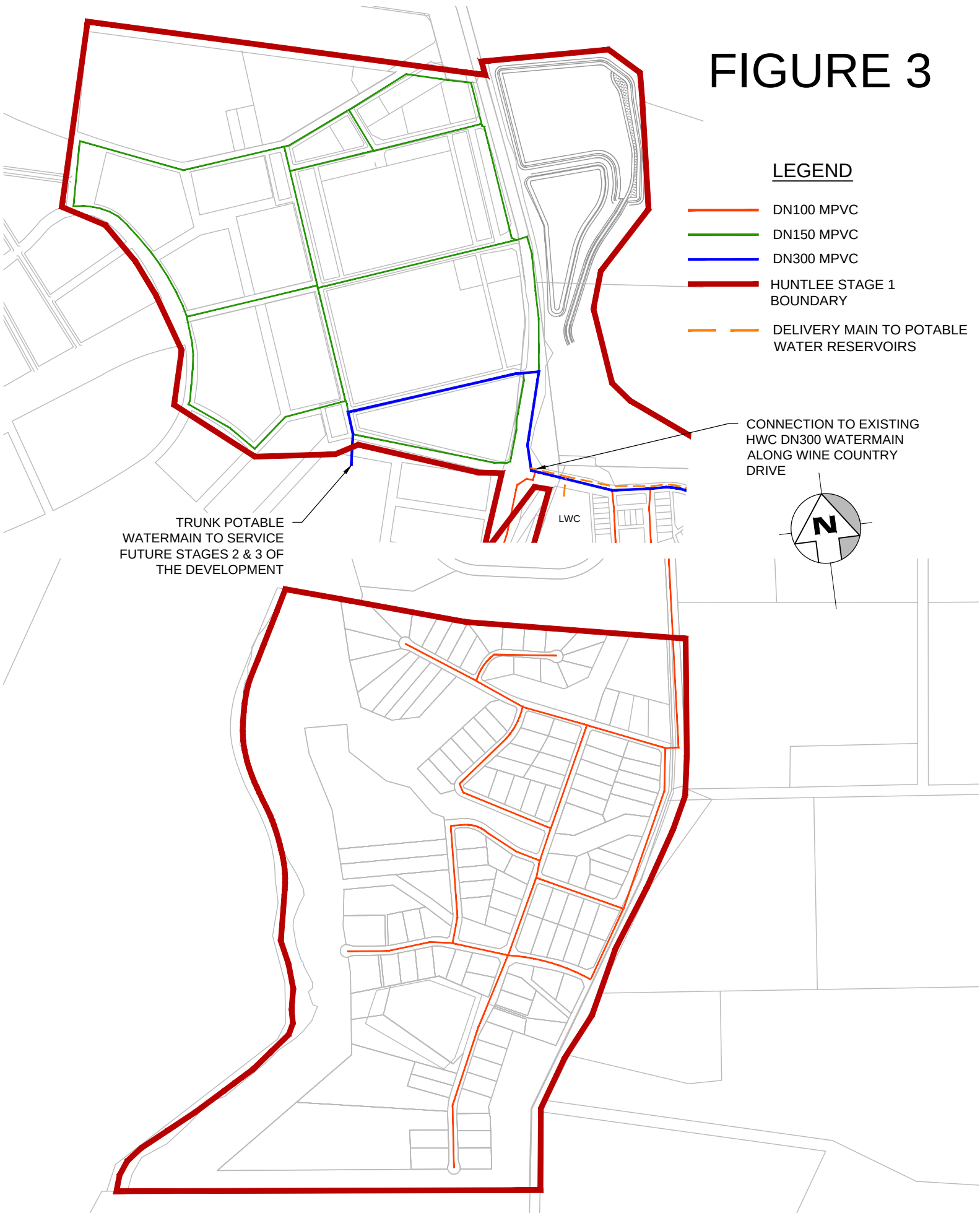
LEGEND

- TOWN CENTRE
- RESIDENTIAL
- RESIDENTIAL - LARGE LOTS
- RESIDENTIAL - LAND NOT OWNED BY HUNTLEE PTY. LTD.
- RURAL - PRIMARY PRODUCTION
- HUNTLEE STAGE 1 BOUNDARY



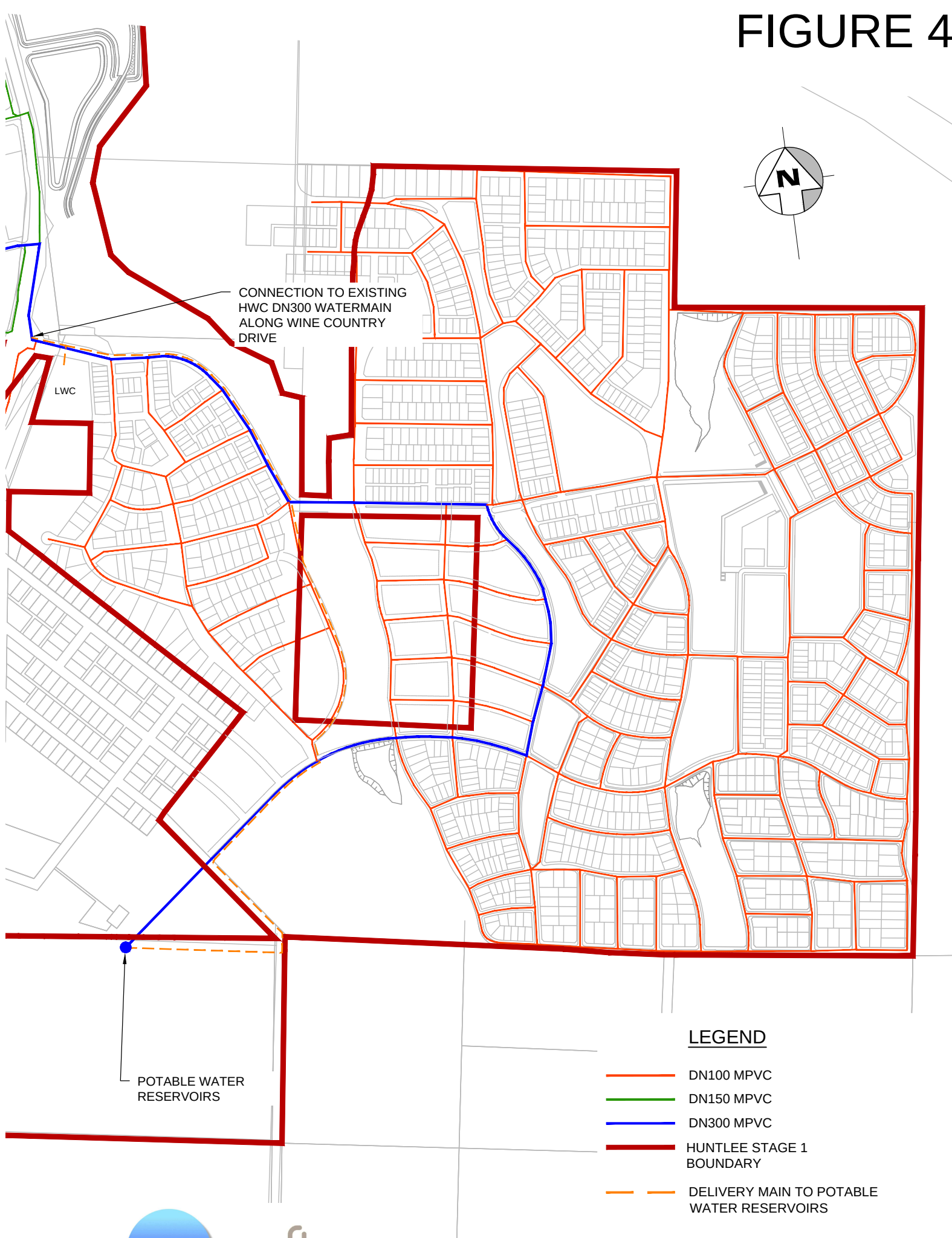
**HUNTLEE STAGE 1
POTABLE WATER
MASTERPLAN**

FIGURE 3



**HUNTLEE STAGE 1
POTABLE WATER
TOWN CENTRE & RURAL LOT**

FIGURE 4



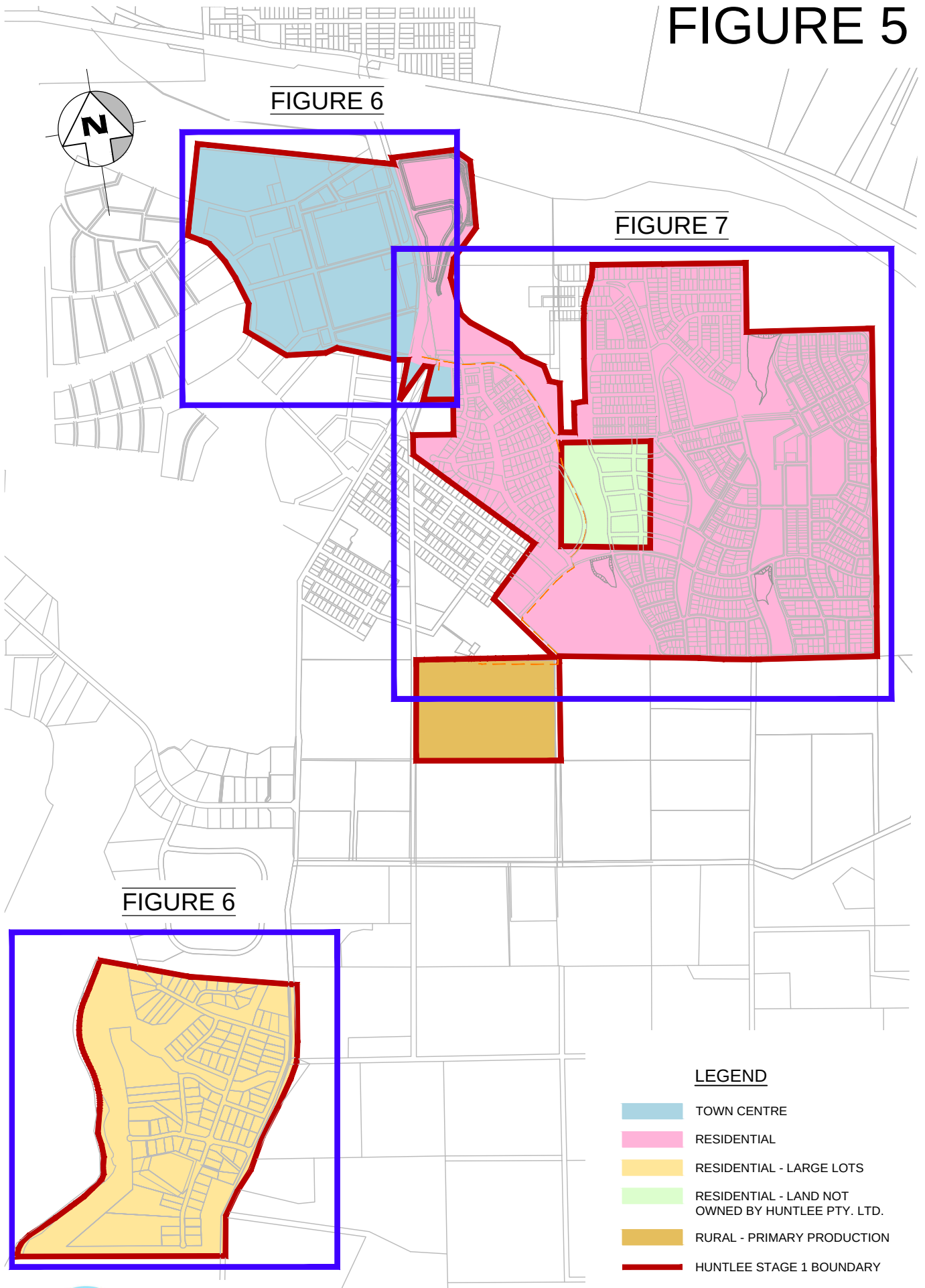
LEGEND

- DN100 MPVC
- DN150 MPVC
- DN300 MPVC
- HUNTLEE STAGE 1 BOUNDARY
- - - DELIVERY MAIN TO POTABLE WATER RESERVOIRS



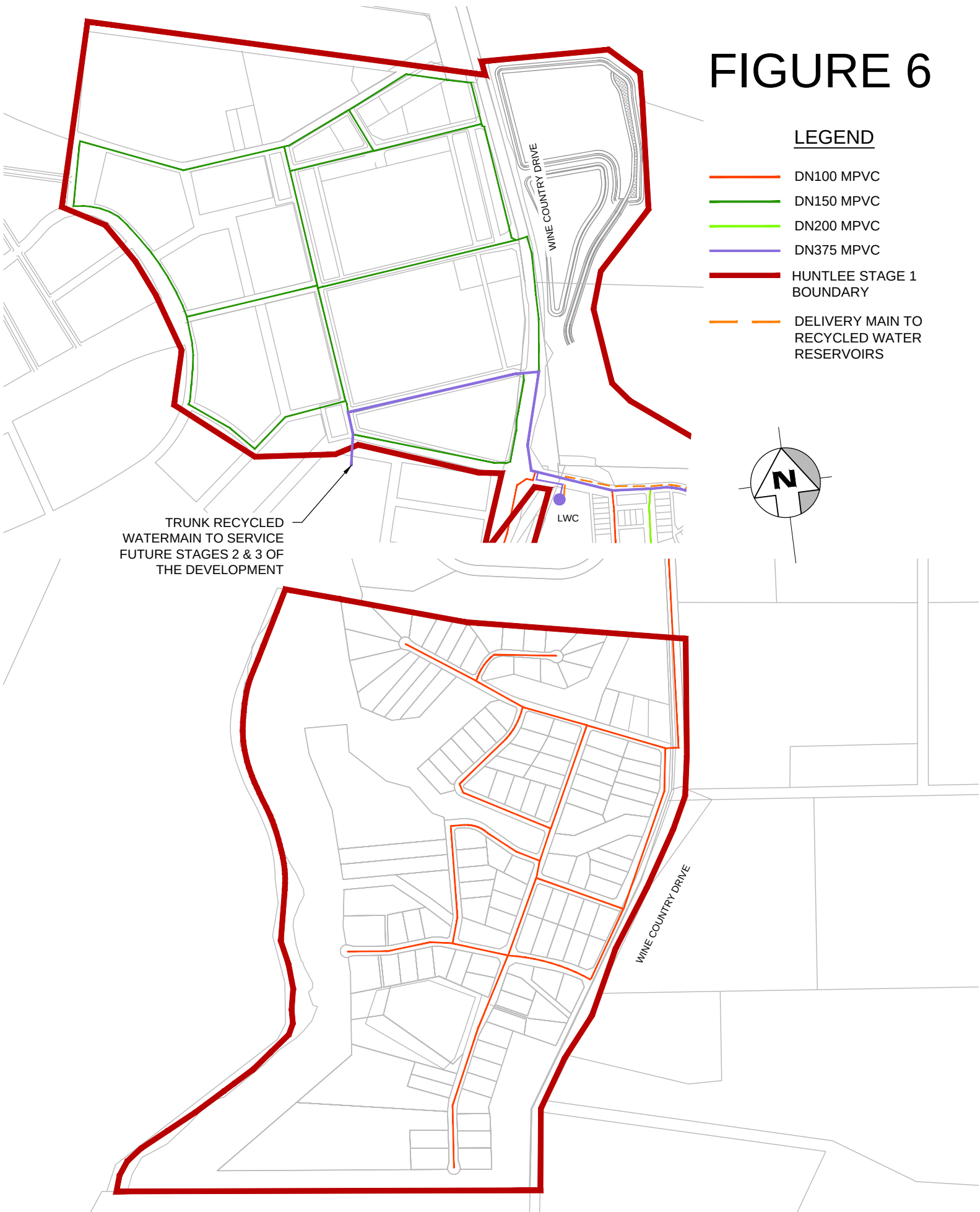
**HUNTLEE STAGE 1
POTABLE WATER
RESIDENTIAL LOTS**

FIGURE 5



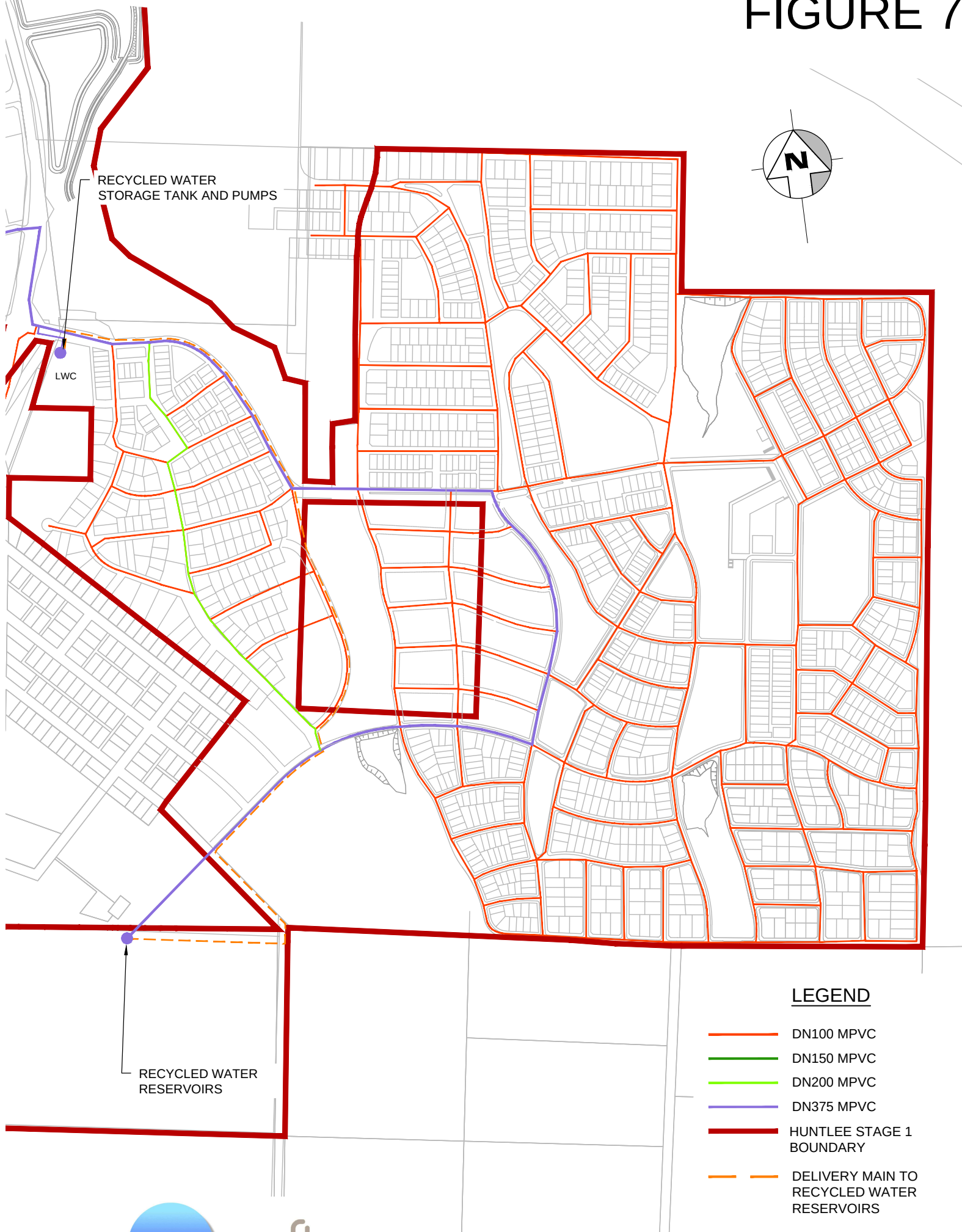
**HUNTLEE STAGE 1
RECYCLED WATER
MASTERPLAN**

FIGURE 6



HUNTLEE STAGE 1
POTABLE WATER
TOWN CENTRE & RURAL LOT

FIGURE 7



**HUNTLEE STAGE 1
RECYCLED WATER
RESIDENTIAL LOTS**



6 October 2023

Glenn Swan
Huntlee Pty Ltd c/o LWP Property Group Pty Ltd
1 Triton Boulevard
NORTH ROTHBURY NSW 2335

By Email

Dear Glenn,

RE: Huntlee Water Overall Servicing Plan: Huntlee Stage 2 – Development Area

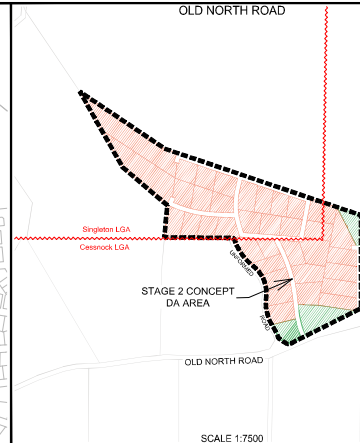
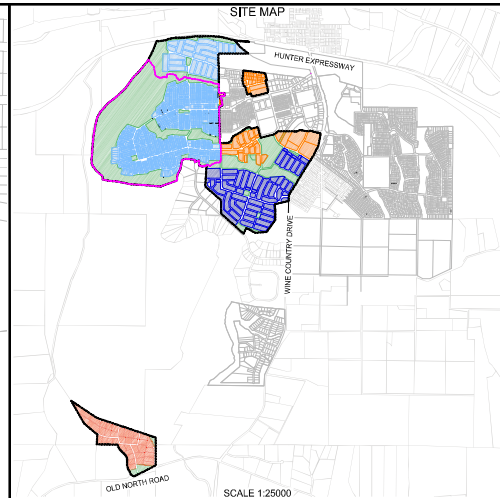
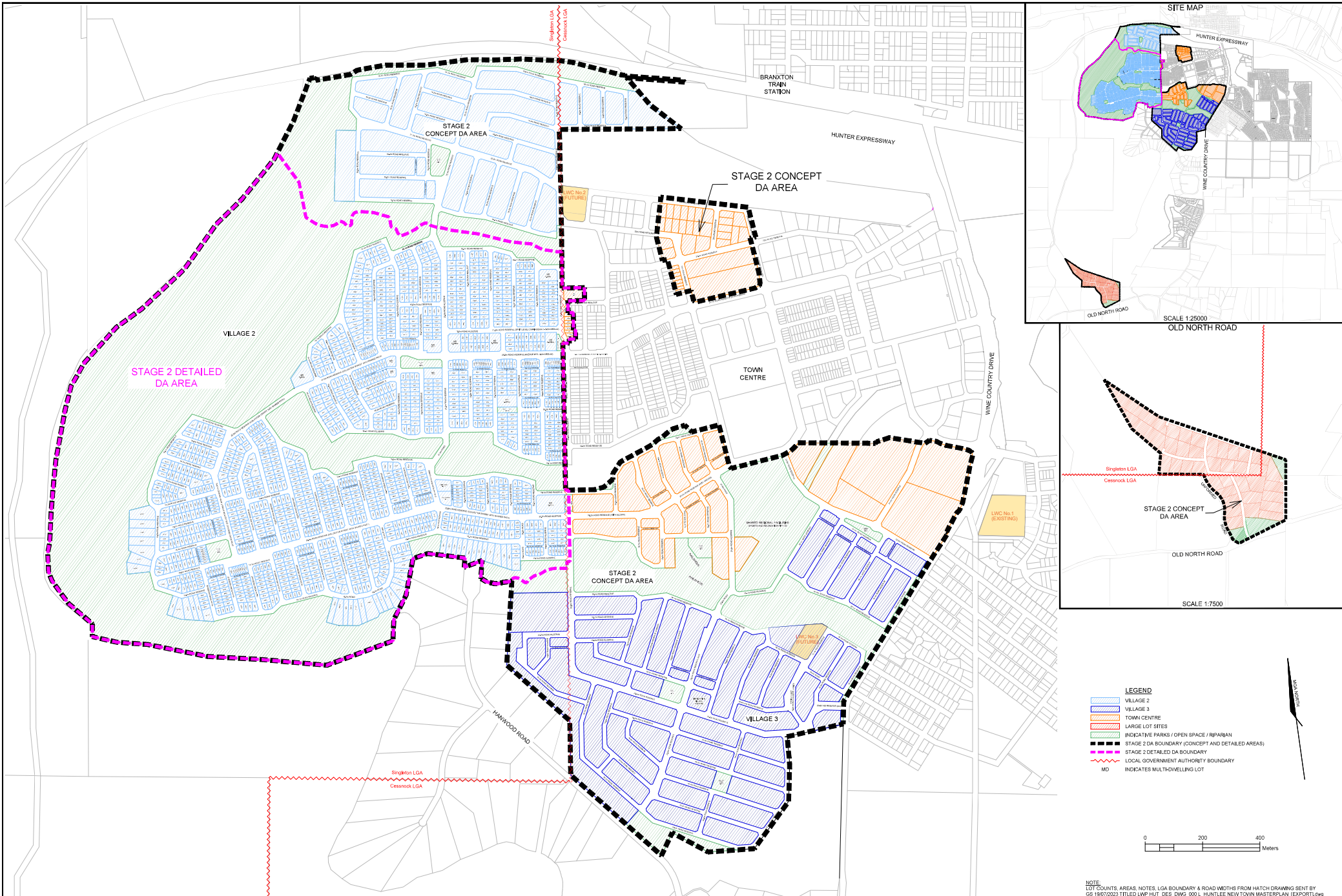
We refer to the Huntlee Stage 2 – Development Area dated 5 September 2023 as recently provided to our office. We confirm that Altogether Huntlee Pty Ltd, a wholly-owned subsidiary of Altogether Group Pty Ltd, a licensed water authority under the NSW Water Industry Competition Act 2006 (Licence No. 15_030) is capable of servicing and maintaining the sewer, recycled water and potable water assets for this extended community.

Altogether Huntlee will need to construct two (2) additional local water centres (LWC) and vary its licence to cater for the additional demand of this overall servicing plan. We note indicative locations for these LWC's have been provided and are generally comfortable with these subject to confirmation of building envelopes and subsequent concept planning of our infrastructure. We also note that associated WICA licence variations and LWC design & approvals processes will need to be closely coordinated between LWP and our office to ensure timely service delivery.

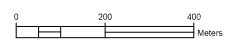
Kind regards

A handwritten signature in blue ink, appearing to read 'D Whitting', is written over a faint, larger signature.

David Whitting
Head of Growth
Altogether Group



- LEGEND**
- VILLAGE 2
 - VILLAGE 3
 - TOWN CENTRE
 - LARGE LOT SITES
 - INDICATIVE PARKS / OPEN SPACE / RIPARIAN
 - STAGE 2 DA BOUNDARY CONCEPT AND DETAILED AREAS
 - STAGE 2 DETAILED DA BOUNDARY
 - LOCAL GOVERNMENT AUTHORITY BOUNDARY
 - MD INDICATES MULTI-DWELLING LOT



NOTE:
LOT COUNTS, AREAS, NOTES, LGA BOUNDARY & ROAD WIDTHS FROM MATCH DRAWING SENT BY
GS 19/07/2023 TITLED LWP HUT_DES_DWG_000_LHUNTLEE NEW TOWN MASTERPLAN_EXPORT.dwg

ISSUE	DATE	PURPOSE	ISSUE	DATE	PURPOSE	ISSUE	DATE	PURPOSE
(0)	24/01/2023	PRELIMINARY REVIEW BY CLIENT	(8)	24/07/2023	AMEND LAYOUT TO LATEST STAGE 1 WOOD ST, VILLAGES 2 & 3 OLD NORTH ROAD LARGE LOTS.	(16)	05/08/2023	LOT AMENDMENTS BY TOWN CENTRE, VILLAGES 2,3.
(1)	15/01/2023	AMEND PER GS DIAL, TO ADD OLD NORTH ROAD, DETAILED CONCEPT DA BOYS.	(9)	25/07/2023	AMEND LAYOUT TO LATEST STAGE 1, ADJUST STAGE 2 DA BOUNDARY NEAR HANWOOD ROAD.	(17)		
(2)	15/01/2023	AMEND DA AREA TITLES PER GS EQUAL.	(10)	28/07/2023	REMOVE STG 1 AMEND STG 1 BOY, ADD ROAD WIDTH, LOT AREAS, DESCRIPTIONS.	(18)		
(3)	16/03/2023	ADD OVERALL STAGE 2 DA BOUNDARY.	(11)	01/08/2023	AMEND PER GS SUPPLYING SERVICES.	(19)		
(4)	01/02/2023	AMEND PER GS DIAL, ADD OLD NORTH ROAD DIAGRAM.	(12)	01/08/2023	AMEND TO INCREASE STG 2 TO PUBLIC OPEN SPACE INCLUDING CLARITY.	(20)		
(5)	01/06/2023	AMEND TO LATEST WOOD ST STAGE 1 BOUNDARIES, AMEND STAGE 2 DA BOUNDARY EXTENTS.	(13)	05/08/2023		(21)		

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A3

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ADM

PROJECT

HUNTLEE STAGE 2 DA

HUNTLEE STAGE 2 - DEVELOPMENT AREA

WINE COUNTRY DRIVE, HUNTLEE

CLIENT

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Bulk Water Servicing Strategy

301020-07149 – WW-REP-0001

20 July 2015

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**HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY**

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PROJECT 301020-07149 - HUNTLEE RESIDENTIAL DEVELOPMENT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY- PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
G	Reissued for HWC review	L.Russell	D.Powell	D.Powell	11.6.15	N/A	
H	Reissued for review	L.Russell	D.Powell	D.Powell	17.6.15		
I	Reissued for HWC review	L.Russell	D.Powell	D.Powell	20.7.15		
J	Reissued for HWC review	L.Russell	D.Powell	D.Powell	24.7.15		

**HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY**

EXECUTIVE SUMMARY

“Huntlee Water” is an independent operator that will provide potable water, wastewater and recycled water services within the Huntlee development. Hunter Water Corporation (HWC) will not own or operate the water, wastewater or recycled water assets servicing the properties within Huntlee Water’s area of operations. HWC will still be providing bulk drinking water supplies to the development through a Utility Services Agreement with Huntlee Water. The key changes to the previous water servicing strategies are a reduction in potable water demands required by Huntlee due to the provision of a recycled water network and new HWC advice indicating that existing drinking water capacity available to the Huntlee Development is only 1/3 of what was advised in 2013.

The Huntlee Development received approval from the Department of Planning in 2013 and the initial stages of development have commenced construction on the basis of infrastructure requirements outlined in the previous approved HWC strategies and HWC advice in relation to available water capacity, which was advised as 22.5 l/s in 2013. HWC have subsequently advised a change to the boundary conditions to be utilised in modelling which has resulted in a reduction of peak hour flow. The result is that the existing Harpers Hill / North Rothbury water supply network can now only service the Huntlee development up until the end of 2016.

It is expected that the first houses for the Huntlee Development will be completed by the end of September 2015 (approximately 8 weeks from now).

This servicing strategy should be treated as an “Engineering Only” assessment and should not be used to infer funding agreements or commitments. It is important to note that there has been a considerable history of previous servicing strategies and past agreements around the provision of infrastructure between HWC and Huntlee. At the request of HWC this previous history has been removed from this strategy on the understanding that this history will not be lost and will be addressed in a separate forum.

An investigation has been undertaken into options to provide water supply from the HWC network to the Huntlee Development. Three options have been considered within this servicing strategy to provide a suitable water supply to the Huntlee Development. These options are as follows;

- Option 1 – Servicing from New England Highway (NEH)
- Option 2 – Servicing from Wine Country Drive (WCD)
- Option 3 – Servicing via Tuckers Lane

The Net Present Value of each option is included in Table S-1.

**HUNTLEE PTY LTD AND HUNTLEE WATER
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BULK WATER SERVICING STRATEGY**

Table S-1 Net Present Value

Option	Net Present Value
Option 1 – Servicing from NEH	\$11.9 M
Option 2 – Servicing from WCD	\$11.6 M
Option 3 – Servicing via Tuckers Lane	\$11.7 M

Option 2 to service the Huntlee development from a connection point along the WCD has the lowest net present value.

For Option 2, the proposed connection off the New England Highway would not be built, leaving Wine Country Drive as the sole source of potable water supply for the Huntlee development. Security of supply for the development will be provided by the emergency storage capacity available in the proposed Huntlee reservoirs. Additionally, the DN150 pipeline in Wine Country Drive could be upsized to a DN300 pipeline leaving two DN300 pipelines in Wine Country Drive to aid in security of supply. This additional upsize in the DN150 for security of supply purposes has been included in the NPV analysis.



**HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
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**HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY**

1 INTRODUCTION

WorleyParsons (WP) has been commissioned by “Huntlee Pty Ltd” and “Huntlee Water” to prepare a Bulk Water Servicing Strategy for the Huntlee development. The location of the development is shown on Figure 1.

Huntlee Water (a wholly owned subsidiary of Flow Systems) has been engaged by Huntlee Pty Ltd as an independent operator to provide potable water, wastewater and recycled water services within the Huntlee development (refer Figure 2). Hunter Water Corporation (HWC) will not own or operate the water, wastewater or recycled water assets servicing the properties within Huntlee Water’s area of operations, however HWC will sell bulk water supplies to the Development under a Utility Services Agreement with Huntlee Water.

A Water Servicing Strategy (WP 2009) and a Water and Wastewater Servicing Addendum (SMEC 2013) have previously been prepared for the Huntlee development and approved by HWC. However, HWC have advised that as Huntlee Pty Ltd have elected to be serviced by a private network (i.e. Huntlee Water), a new Bulk Water Servicing Strategy is required to be prepared.

This servicing strategy should be treated as an “Engineering Only” assessment and should not be used to infer funding agreements or commitments. It is important to note that there has been a considerable history of previous servicing strategies and past agreements around the provision of infrastructure between HWC and Huntlee. At the request of HWC this previous history has been removed from this strategy on the understanding that this history will not be lost and will be addressed in a separate forum.

A Potable and Recycled Water Master Plan for Stage 1 of the Huntlee development (refer Figure 3) was prepared by WP in August 2014. The Master Plan focussed on sizing internal reticulation and other infrastructure for potable and recycled water for Stage 1 of the Huntlee development, based on design demands advised by Huntlee Water.

This Bulk Water Servicing Strategy has been prepared for provision of bulk potable water from HWC’s water supply system to the Huntlee development.

1.1 Scope of Work

Tasks undertaken in preparation of this Bulk Water Servicing Strategy include:

- Review the existing HWC InfoWorks model of the water supply system between the Harpers Hill and North Rothbury reservoirs.
- Run the existing InfoWorks model to check current operating pressures within HWC’s water supply system.

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- Update the InfoWorks model for each year through to the ultimate development to include future HWC demands in the system. This will be used to determine a base case for any upgrades to the HWC network.
- Update the InfoWorks model for each year through to the ultimate development to include future HWC demands and the demands from the Huntlee development.
- Determine the works required and staging options to service through to the ultimate development with potable water, while maintaining sufficient pressure within HWC's existing network.
- Develop strategies for provision of bulk water to the Huntlee development through to the ultimate development.

1.2 Background

In December 2014 HWC provided WorleyParsons with their InfoWorks model for the supply network between the Harpers Hill and North Rothbury reservoirs. The December 2014 model provided by HWC did not include any future growth within the HWC catchment.

In February 2015 WorleyParsons prepared a revised Bulk Water Servicing Strategy for Huntlee Pty Ltd and Huntlee Water which outlined the required upgrades to service the Huntlee development. HWC reviewed this strategy and requested that the HWC growth forecast for the catchment be incorporated into the modelling to ensure the bulk water strategy reflected the ultimate development within the catchment. HWC also introduced a new boundary condition that specified that the North Rothbury Reservoir must not fall below 20% capacity during an extreme week demand period.

When the HWC growth polygons (refer to Section 3) are incorporated into the InfoWorks model, the Huntlee development can only draw peak hour flows up to the end of 2016 before the North Rothbury Reservoir drops below 20% capacity in an extreme week. The result of this modelling has revealed that upgrades to the existing HWC network downstream of Harpers Hill reservoir are required to service the Huntlee development and existing HWC network beyond 2016.

It should be noted as advised in Section 1 the anticipated demand for each lot within the Huntlee development is lower than the HWC standard design. Hence it is not possible to directly compare HWC ET's with Huntlee Water ET's. Therefore caution is made when referring to ET's within this report. To address this issue all ET's have been converted to flows to allow proper comparison.

**HUNTLEE PTY LTD AND HUNTLEE WATER
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2 DESIGN CRITERIA

2.1 Land Use

The Huntlee development includes residential lots and medium density dwellings, commercial, retail and light industrial zones, schools, sports grounds and parklands (refer Figure 3).

Residential lots within Stage 1 will be located on the eastern side of Wine Country Drive and within a large lot residential area to the south west of the main Stage 1 release area. Commercial and retail development will be located within the town centre, which will be located to the west of Wine Country Drive.

A portion of the Stage 1 residential development area is not currently owned by Huntlee Pty Ltd (refer Figure 3). It has been assumed that this land will eventually be developed for residential purposes, and a potable water demand allocated to this lot.

Stage 2 and 3 development areas will be located to the west of Wine Country Drive. Land use at ultimate development is summarized in Table 2-1.

Table 2-1 Huntlee Ultimate Development Land Use

Land Use	Count
Residential	6,355 lots
Medium Density	1,145 dwellings
Commercial	10.5 Ha
Retail	10 Ha
Light Industrial Park	60 Ha
School	3 No.
Sports Ground	21 Ha
Parklands	28 Ha



**HUNTLEE PTY LTD AND HUNTLEE WATER
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BULK WATER SERVICING STRATEGY**

2.2 Average Day Demand

All land use types within the Huntlee development will be provided with both potable and recycled water. The total average day demand (potable water component only) for each land use within the Huntlee development is included in Table 2-2. The average day demand for HWC residential customers is also included in the first row for comparison.

Table 2-2 Average Day Demand

Land Use	Unit	Potable Water	Source
Residential (HWC)	L/day/ET	780	WSA 03-2002-2.3 (HWC Edition Version 1) Table HW 2.1
Residential (Huntlee Water)	L/day/lot	275	Flow Systems
Medium Density	L/day/lot	275	Flow Systems
Commercial	L/day/Ha	5000	Flow Systems- The area represents the net lettable floor space
Retail	L/day/Ha	27000	Flow Systems- The area represents the net lettable floor space
Light Industrial Park	L/day/Ha	5000	Flow Systems- The area represents the net lettable floor space
School	L/day/No.	4450	Flow Systems
Sports Ground	L/day/Ha	1945	WSA 03-2011-3.1 (Sydney Water Edition) Table 2.1 Assume 50% recycled water
Parklands	L/day/Ha	1945	WSA 03-2011-3.1 (Sydney Water Edition) Table 2.1 Assume 50% recycled water
Recycled Water Top Up	L/day	1500000 (Ultimate)	Flow Systems. The top up volume was increased each year until it reached 1500 kL/day for the ultimate Huntlee development.
Unaccounted Water	15% of average day demand		WSA 03-2002-2.3 (HWC Version 1.0) Section 2.2.2.4 (Unaccounted Water)



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Potable water will be required to top up the recycled water system when there is a deficit of recycled water. Huntlee Water has advised that any topping up of the recycled water system with potable water would be managed, such that the ability of the potable water system to meet peak demands would not be compromised (i.e. topping up would occur outside of peak potable water demand periods).

2.3 Demand Factors

Demand categories and factors for each land use type were sourced from WSA 03-2002-2.3 (HWC Version 1.0) Table 2.1 (Water Supply Design Demands). The adopted categories and factors are included in Table 2-3.

Table 2-3 Demand Categories and Factors

Land Use	HWC Demand Category	Peak Day Factor	Peak Hour Factor	Extreme Day Factor	95 th %ile Factor
Residential	Residential House – Maitland & Cessnock LGA	2.25	2.02	1.15	1.8
Medium Density	Flats/Units	2.20	2.02	1.15	1.76
Commercial	Commercial	1.20	1.90	1.15	1.14
Retail	Commercial	1.20	1.90	1.15	1.14
Light Industrial Park	Industrial	1.20	1.30	1.15	1.14
Primary School	Schools/ Colleges	1.60	2.50	1.15	1.52
Sports Ground	Parks and Rural	1.60	1.50	1.15	1.52
Parklands	Parks and Rural	1.60	1.50	1.15	1.52
Recycled Water Top Up	N/A	1.00	1.00	1.00	1.00
Unaccounted Water	Unaccounted Water	1.00	1.00	1.00	1.00

**HUNTLEE PTY LTD AND HUNTLEE WATER
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It should be noted that the demand factors presented above relate to single supply systems i.e. systems without a recycled water component. The introduction of recycled water may change the traditional demand factors as usage that may typically increase during peak periods such as external watering may be covered by the recycled water system.

2.4 Diurnal Demand Factors

Diurnal demand factors for each land use type were sourced from WSA 03-2002-2.3 (HWC Version 1.0) Table 2.2 (Diurnal Demand Factors) and are included in Table 2-4.

Table 2-4 Diurnal Demand Categories

Land Use	WSA Demand Category
Residential	Domestic Peak & Extreme Day
Medium Density	Domestic Peak & Extreme Day
Commercial	Commercial
Retail	Commercial
Light Industrial Park	Industrial
Primary School	Schools / Colleges
Sports Ground	Parks / Gardens
Parklands	Parks / Gardens
Recycled Water Top Up	Unaccounted
Unaccounted Water	Unaccounted

**HUNTLEE PTY LTD AND HUNTLEE WATER
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BULK WATER SERVICING STRATEGY**

2.5 Service Pressure Limits

The service pressure limits from WSA 03-2002-2.3 (HWC Version 1.0) Table 2.4 (Service Pressure (SP) Limits) were adopted for Huntlee Stage 1 and are summarized in Table 2-5.

Table 2-5 Adopted Service Pressure Limits

Service Pressure Limit	Demand	Pressure (m)
Maximum	All applications	60
Minimum	Peak hour flow on a peak day of a peak week	20/25*
	Peak hour flow on an extreme day of an extreme week	12
	Peak hour flow on a 95 th percentile peak day plus firefighting flow (at location of fire flow)	15
	Peak hour flow on a 95 th percentile peak day plus firefighting flow (other than location of a fire flow)	3**

Notes: * Booster pump stations to be designed to deliver a minimum pressure of 25 m.

2.6 Reservoirs

The Huntlee potable water reservoirs have been sized based on the following:

- Storage does not fall below 20% capacity during an extreme week demand period.
- Each individual reservoir will have a useable storage volume of 2 ML.



HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY

3 DEVELOPMENT STAGING

3.1 HWC Growth Profile

HWC has supplied WorleyParsons with their predicted growth polygons for the area downstream of Harpers Hill Reservoir excluding the Huntlee development. The cumulative growth profile at 3 separate load points (refer to Figure 3-1 below) was provided in HWC ET's until ultimate (beyond 2055).

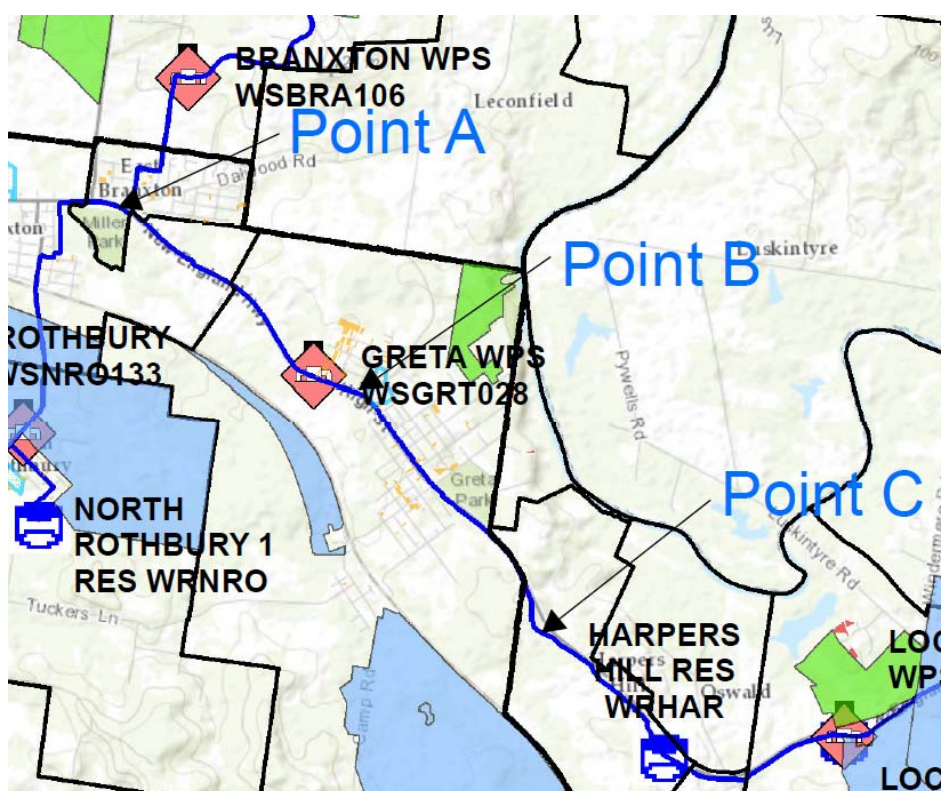


Figure 3-1 HWC predicted growth load points.

3.2 Huntlee Growth Profile

The timing for the rollout of Huntlee was estimated by LWP from 2015 through to their ultimate development in 2040. This development growth was aligned with the HWC Harpers Hill/ North Rothbury catchment growth profile and presented in Table 3-1.



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Table 3-1 Huntlee and HWC Development Staging Plan

	HWC			Huntlee							
Year	HWC Point A (ET)	HWC Point B (ET)	HWC Point C (ET)	Residential Lots (No.)	Medium Density (No.)	Commercial (Ha)	Retail (Ha)	Light Industrial (Ha)	School (No.)	Sports Ground (Ha)	Parklands (Ha)
2015	-	-	-	155	40	-	-	-	-	-	-
2016	20	45	0	355	65	-	-	-	-	-	1
2017	45	90	0	605	90	-	-	-	-	3.5	3
2018	75	135	0	855	115	2.5	1	2	1	3.5	5
2019	90	180	0	1105	140	2.5	1	4	1	3.5	7
2020	130	185	40	1355	190	2.5	2	6	1	7	9
2021	170	190	80	1605	240	2.5	2	8	1	7	10.5
2022	210	195	120	1855	290	4.5	3	10	1	7	12
2023	250	200	160	2105	340	4.5	3	12	2	10.5	13.5
2024	275	205	200	2355	390	4.5	4	14	2	10.5	15
2025	300	210	240	2605	440	6.5	4	16	2	10.5	16.5
2026	325	215	280	2855	490	6.5	5	18	2	14	18
2027	350	220	320	3105	540	6.5	5	20	2	14	19.5
2028	375	225	360	3355	590	6.5	6	22	3	14	21



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BULK WATER SERVICING STRATEGY**

	HWC			Huntlee							
Year	HWC Point A (ET)	HWC Point B (ET)	HWC Point C (ET)	Residential Lots (No.)	Medium Density (No.)	Commercial (Ha)	Retail (Ha)	Light Industrial (Ha)	School (No.)	Sports Ground (Ha)	Parklands (Ha)
2029	400	230	400	3605	640	6.5	7	24	3	17.5	22.5
2030	425	235	440	3855	690	8.5	8	26	3	17.5	24
2035	550	260	640	5105	940	9.5	9	41	3	17.5	26
2040	675	285	840	6355	1145	10.5	10	60	3	21	28
2050	925	335	1240	6355	1145	10.5	10	60	3	21	28
2055	1050	412	1360	6355	1145	10.5	10	60	3	21	28
Ultimate	1086	412	1360	6355	1145	10.5	10	60	3	21	28



**HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY**

4 HUNTLEE POTABLE WATER DEMANDS

Based on the staging plan presented in Table 3-1, the cumulative potable water demand flowrates and volumes associated with each year of development have been calculated to help determine the required Huntlee reservoir storage volumes and delivery pump stations duty.

Huntlee Water has advised that the Local Water Centre (LWC) for the development would not be operational until the first 180 lots have been developed. Therefore, recycled water would not initially be available for these properties and the recycled water reticulation would be supplied with potable water until a supply of recycled water is available from the LWC. The actual potable water demands for stages developed prior to commissioning of the LWC therefore need to include provision for supplying the recycled water system with potable water.

4.1 Flowrates

Average day, peak hour and extreme hour potable water demand flowrates for the Huntlee and HWC development staging plan have been calculated from the criteria included in Tables 2-2, 2-3 and 2-4 and are presented in Table 4-1. The Huntlee demands presented in Table 4-1 (from 2019 to Ultimate) represent the flowrates delivered from the Huntlee reservoirs and not the demand applied to the HWC network. Refer to Appendix B for detailed calculations.

Table 4-1 Potable Water Demands (Flowrates)

Year	HWC ⁴ ADD (L/s)	HWC ⁴ PHD (L/s)	HWC ⁴ EHD (L/s)	Huntlee ADD (L/s)	Huntlee PHD (L/s)	Huntlee EHD (L/s)
2015	0.00	0.00	0.00	1.43 ¹	5.80 ¹	6.64 ¹
2016	0.59	2.67	3.07	2.60	7.35	8.27
2017	1.22	5.54	6.37	4.80	12.81	14.37
2018	1.90	8.62	9.91	7.61	19.59	21.98
2019	2.44	11.08	12.74	9.85	25.05	28.07
2020	3.20	14.57	16.75	12.62	31.83	35.68
2021	3.97	18.05	20.76	14.93	37.62	42.16
2022	4.74	21.54	24.77	17.74	44.46	49.83
2023	5.51	25.03	28.78	20.20	50.66	56.78
2024	6.14	27.90	32.09	22.87	57.22	64.13



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Year	HWC ⁴ ADD (L/s)	HWC ⁴ PHD (L/s)	HWC ⁴ EHD (L/s)	Huntlee ADD (L/s)	Huntlee PHD (L/s)	Huntlee EHD (L/s)
2025	6.77	30.77	35.39	25.31	63.29	70.93
2026	7.40	33.65	38.69	28.08	70.04	78.51
2027	8.03	36.52	42.00	30.39	75.84	84.99
2028	8.67	39.39	45.30	33.12	82.60	92.58
2029	9.30	42.26	48.60	35.88	89.36	100.15
2030	9.93	45.13	51.90	38.68	96.19	107.82
2035	13.09	59.50	68.42	46.69	122.06	137.29
2040	16.25	73.86	84.93	54.55	147.53	166.33
2050	22.57	102.58	117.96	54.55	147.53	166.33
2055	25.48	115.79	133.16	54.55	147.53	166.33
Ultimate	25.80	117.27	134.86	54.55	147.53	166.33

- Notes: 1. The potable water demand flowrates for the first 180 lots take into account servicing the recycled water system with potable water.
2. The totals in Table 4-1 above assume that the peak demands for all land use types occur simultaneously. In reality, the peak demands for each land use type would occur at different times of the day.
3. The average day demand is represented as a constant flow over 24hrs. The actual flowrate will follow a diurnal pattern.
4. The HWC flowrates in Table 4-1 only represent the demand from future growth and does not incorporate the potable water demand of any existing development in the area.
5. The Huntlee development is forecast to be complete in 2040 hence there is no change in figures beyond 2040. Entries beyond 2040 have been included only to be consistent with HWC growth forecasts.

4.2 Storage Volume

The average day, peak day and extreme day potable water demand volumes for the Huntlee and HWC development staging plan have been calculated from the criteria included in Tables 2-2, 2-3 and 2-4 and are presented in Table 4-2. Refer to Appendix B for detailed calculations.



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Table 4-2 Potable Water Demands (Volume)

Year	HWC ³ ADD (ML)	HWC ³ PDD (ML)	HWC ³ EDD (ML)	Huntlee ADD (ML)	Huntlee PDD (ML)	Huntlee EDD (ML)
2015	0	0	0	0.12 ¹	0.26 ¹	0.29 ¹
2016	0.05	0.11	0.13	0.23	0.37	0.41
2017	0.11	0.24	0.27	0.41	0.66	0.73
2018	0.16	0.37	0.42	0.66	1.01	1.12
2019	0.21	0.47	0.54	0.85	1.30	1.44
2020	0.28	0.62	0.72	1.09	1.66	1.83
2021	0.34	0.77	0.89	1.29	1.97	2.16
2022	0.41	0.92	1.06	1.53	2.32	2.56
2023	0.48	1.07	1.23	1.75	2.65	2.92
2024	0.53	1.19	1.37	1.98	2.99	3.29
2025	0.59	1.32	1.51	2.19	3.31	3.64
2026	0.64	1.44	1.65	2.43	3.66	4.04
2027	0.69	1.56	1.80	2.63	3.97	4.37
2028	0.75	1.68	1.94	2.86	4.32	4.76
2029	0.80	1.81	2.08	3.10	4.67	5.15
2030	0.86	1.93	2.22	3.34	5.03	5.54
2035	1.13	2.54	2.93	4.03	6.26	6.93
2040	1.40	3.16	3.63	4.71	7.46	8.30
2050	1.95	4.39	5.05	4.71	7.46	8.30
2055	2.20	4.49	5.70	4.71	7.46	8.30
Ultimate	2.23	5.02	5.77	4.71	7.46	8.30

Notes: 1. The potable water demand volumes for the first 180 lots take into account servicing the recycled water system with potable water.

2. The Huntlee development is forecast to be complete in 2040 hence there is no change in figures beyond 2040. Entries beyond 2040 have been included only to be consistent with HWC growth forecasts.

3. The HWC volumes in Table 4-2 only represent the demand from future growth and does not incorporate the potable water demand of any existing development in the area.



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5 BULK WATER STRATEGY

5.1 Bulk Water Model

The bulk water servicing strategy has been developed by modelling HWC's existing water supply system in the vicinity of the Huntlee development using InfoWorks.

The HWC and Huntlee average day demand flowrates for each year of the development (refer to Table 4-1) were progressively included in the model to determine the bulk water strategy for the Huntlee development including the staging of HWC upgrades.

Four separate scenarios were investigated:

- HWC Demands Only – Base Case.
- HWC & Huntlee Demands Option 1 – Servicing from NEH.
- HWC & Huntlee Demands Option 2 – Servicing from WCD.
- HWC & Huntlee Demands Option 3 – Servicing via Tuckers Lane.

The servicing strategy for each option is detailed in Sections 6, 7, 8 and 9.

5.2 Operational Assumptions

The following assumptions were made in relation to upgrade requirements and operation of the Huntlee water system;

- Upgrade works have been progressively inputted into the InfoWorks model to ensure that the Huntlee Development is not creating new operational issues in the existing HWC System.
- As the Huntlee and HWC demand increases upgrade works are required to ensure that the North Rothbury Reservoir does not fall below 20% capacity during an extreme week.
- During an extreme week it is assumed that the Huntlee delivery pump station taking water from the HWC system and pumping to the Huntlee reservoirs would be operating continuously.
- During an average week it is assumed that the Huntlee delivery pump station taking water from the HWC system and pumping to the Huntlee reservoirs would operate over an 18 hour period avoiding peak electrical demand periods.
- Transfer rates from the HWC system to the Huntlee reservoirs have been determined to ensure the Huntlee reservoirs do not fall below 20% capacity during an extreme week when pumping 24hrs/day.

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6 HWC DEMANDS ONLY - BASE CASE

The base case used for the modelling was HWC's existing water supply network between the Harpers Hill and North Rothbury reservoirs (HWC 2014).

The predicted HWC growth at Points A, B and C (refer to Figure 3-1 and Table 3-1) were progressively included in the model to determine when HWC upgrades to the Harpers Hill / North Rothbury system are required. This modelling assumed zero demand from the Huntlee development.

Where a reference to a year is included against an upgrade this date refers to the upgrade being completed and capacity available at the start of that year.

6.1 Upgrade 1 (Must be implemented by the start of 2023)

- Upgrade 1 will service additional HWC development up until an additional peak hour demand of approximately 45 L/s (2030)

In order to meet this demand whilst ensuring that the North Rothbury Reservoir does not fall below 20% capacity during an extreme week the following additional works would need to be undertaken (refer Figure 4):

- Approximately 2200 m of DICL DN 300 water main along the New England Highway from Greta towards Branxton.

6.2 Upgrade 2 (Must be implemented by the start of 2035)

- Upgrade 2 will service additional HWC development up until an additional peak hour demand of approximately 117 L/s (Ultimate)

In order to meet this demand whilst ensuring that the North Rothbury Reservoir does not fall below 20% capacity during an extreme week the following additional works would need to be undertaken (refer Figure 4):

- Approximately 3750 m of DICL DN 300 water main from the Harpers Hill reservoir to Greta
- An upgrade to the Harpers Hill reservoir – either an increase in capacity or an increase in the capacity of the pumps pumping into the reservoir. Options for upgrading the reservoir would need to be investigated at a later date.

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7 HWC & HUNTLEE DEMANDS OPTION 1 – SERVICING FROM NEW ENGLAND HIGHWAY

The initial servicing option investigated involves providing a direct connection from the New England Highway towards Greta into the Huntlee development. The exact location of the connection between the New England Highway and Huntlee does not have a great impact on the option however a location closer to Greta is preferable. The connection would need to traverse under the New England Highway, Railway line, Anvil Creek and the Hunter Expressway. The outcomes of the InfoWorks modelling have been used to determine the required upgrades and timing of infrastructure for this option.

Where a reference to a year is included against an upgrade this date refers to the upgrade being completed and capacity available at the start of that year.

7.1 Initial Wine Country Drive Connection

7.1.1 Initial Connection (2015)

An initial potable water connection will be made to provide water to the Huntlee development along Wine Country Drive in the vicinity of the main intersection into the Huntlee Development. The connection will be to the DN300 and DN150 water mains in Wine Country Drive between Branxton and North Rothbury. This initial connection will service the Huntlee development up until a peak hour demand at the end of 2016.

The initial development would be serviced via connection to the existing DN300 and DN150 diameter HWC potable water mains along Wine Country Drive (refer Figure 5). A bulk water meter and check valve would be located at this connection point.

A booster pump station would also be required to meet the minimum service pressure of 25 metres during peak demand periods to all of the properties highlighted in Figure 6. This pump station will not be required during average demand periods. This pump station would be located at the LWC site and would be designed to boost the residual pressure by 15-20 metres.

As discussed in Section 4, potable water would initially be used to supply both the potable water and recycled water reticulation systems for the first 180 lots. Once the first 180 lots have been developed, the LWC would be commissioned and recycled water would be provided to the development. Potable water would not be required to service the recycled water reticulation, with the exception of top up of the recycled water system when there is a deficit of recycled water.

The Wine Country Drive connection to HWC's potable water system would have sufficient capacity to supply up to a peak hour demand to the end of 2016 without the need for upgrades to the existing HWC potable water system.

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7.1.2 Upgrade 1 (Must be implemented by the start of 2017)

Due to the timing for the roll out of the Huntlee Development after the end of 2016 (i.e. approximately 17 months from now) capacity within the initial connection to the Huntlee Development in Wine Country Drive will be exhausted (based on the HWC operating restrictions) and hence additional capacity will be required. Upgrade 1 will service the Huntlee development up until a peak hour demand of 22.5 L/s

Upgrade 1 involves the construction of approximately 2,200 m of D1CL DN 375 water main from Greta to the future NEH connection point (see 7.2 below).

This initial upgrade would be required as part of the connection to the New England Highway upgrade outlined in section 7.2 anyway however based on the available timing it will not be possible to have the full upgrade outlined in section 7.2 completed by the end of 2016. Construction of this section of pipeline allows the work outlined in section 7.2 to be delayed till the end of 2018 giving sufficient time to implement the remaining component of upgrade 2 outlined in section 7.2.

7.2 Connection to New England Highway

Before the peak hour potable water demand from the Huntlee development reaches 22.5 L/s (capacity available based on upgrade 1), a connection along the New England Highway would be made into the new HWC pipeline constructed in Upgrade 1. At this time the initial connection to the potable water mains in Wine Country Drive would be shut off and the connection maintained for security of supply purposes only. The booster pumping station located at the LWC site would not be required once the connection was made to the New England Highway; however could be maintained for security of supply purposes.

Construction of a potable water pumping station and potable water reservoirs within the Huntlee development area would be required to enable the New England Highway connection point to deliver water to the Huntlee development area. Potable water mains between the connection point and the potable water pumping station and from the pumping station to the reservoirs would also be required. Proposed works are detailed in the sections below.

To minimize the impact on the HWC network and effectively make the best use of both the HWC and Huntlee Water network it is proposed to draw water from the HWC network at a constant rate and pump to the proposed Huntlee Reservoirs for later distribution to the Huntlee development. Water could then be fed from the Huntlee Reservoirs into the Huntlee development based on actual demands in the Huntlee development and the Huntlee reservoirs used to buffer the difference between the flow rate extracted from the HWC system and the flow rate delivered by the Huntlee Reservoirs. This way the impact from the Huntlee development on the HWC system can be averaged out rather than imposing diurnal peaks on the HWC system.

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7.2.1 Upgrade 2 (Must be implemented by the start of 2019)

Upgrade 2 will draw a continuous demand of up to 20L/s from the HWC network (24hrs/day during peak demand periods and 18hrs/day during average demand periods). Upgrade 2 will service the Huntlee development up until a peak hour demand of approximately 38 L/s (end of 2021)

By drawing up to 20 L/s from the connection point on the New England Highway, a peak hour potable water demand of up to approximately 38 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following works were undertaken (refer Figure 8):

- Based on the criteria in Section 2.6, potable water storage of approximately 4 ML would be required. This could be achieved by providing 2 x 2 ML reservoirs to the south of the Huntlee Stage 1 development area.
- A potable water pumping station in the north eastern corner of the Huntlee Stage 1 development area drawing up to 20 L/s at approximately 45 metres head out of HWC's potable water system at the connection point. This could be achieved installing 2 x 20 L/s pumps in a duty/standby arrangement.
- Approximately 2,000 m of DICL DN 375 water main between the connection point and the potable water pumping station
- Approximately 2,700 m of PVC-M DN375 water main between the Huntlee potable water pumping station and the Huntlee potable water reservoirs.

The timing of the reservoirs could also be staged, with one 2 ML reservoir constructed initially and the second reservoir constructed to meet the increasing demand. However this option reduces the redundancy in the reservoir.

7.2.2 Upgrade 3 (Must be implemented by the start of 2022)

Upgrade 3 will draw a continuous demand of up to 75L/s from the HWC network (24hrs/day during peak demand periods and 18hrs/day during average demand periods). Upgrade 3 will service the Huntlee development up until a peak hour demand of approximately 148 L/s (end of 2040)

By drawing up to 75 L/s from the connection point on the New England Highway, a peak hour potable water demand of up to 148 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following additional works were undertaken (refer Figure 9):

- Approximately 3,750 m of DICL DN 375 water main from the Harpers Hill reservoir to Greta
- An upgrade to the Harpers Hill reservoir – either an increase in capacity or an increase in the capacity of the pumps pumping into the reservoir. Options for upgrading the reservoir would need to be investigated at a later date.



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- Based on the criteria in Section 2.6, potable water storage on the Huntlee site of approximately 8 ML would be required. This could be achieved by providing two additional 2 ML reservoirs to the south of the Huntlee Stage 1 development area for a total of 4 x 2ML reservoirs.
- A upgrade to the potable water pumping station in the north eastern corner of the Huntlee Stage 1 development area to enable the WPS to draw 75 L/s at approximately 45 metres head out of HWC's potable water system at the connection point. This could be achieved by retrofitting the existing station with two new 75L/s pumps in a duty/standby arrangement.

It is likely that the sizing of the pumps within the potable water pumping station would be staged in line with the potable water demands of the development. This could be achieved over several interim upgrades. Initially the existing WPS could be retrofitted with a further two 20 L/s pumps (staged as required) for an arrangement of duty/duty/duty/standby. Once an ultimate flowrate of approximately 60 L/s is achieved by around 2035 the entire station would be retrofitting with two new 75L/s pumps described above.

Similarly, the timing of the reservoirs could also be staged to meet the increasing demand. However this option reduces the redundancy in the reservoirs.

7.2.3 Upgrade 4 (Must be implemented by the start of 2050)

The ultimate Huntlee development has an estimated completion date of 2040 which means that the upgrade 3 detailed in the previous section will satisfy the bulk water requirements to service this development. However, future HWC growth in the Harpers Hill/ North Rothbury catchment will require a further section of the New England Highway trunk water system to be upgraded to meet the operational requirements outlined in Section 5.2 (refer Figure 8).

- Approximately 1,800 m of DI CL DN 375 water main from the connection point on the New England Highway to Branxton.



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7.3 Option 1 - Upgrade Summary

A summary of the required upgrades is provided in Table 7-1.

Table 7-1 Infrastructure Upgrade Summary

Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
Initial Connection (2015)	Average Demand of 2.60 L/s	7.35 L/s	• Connection to WCD • Booster pump station		• Connection to WCD • Booster pump station
Upgrade 1 (Start of 2017)	Average Demand of 8.32 L/s	22.5 L/s		• 2200m of DICL DN375 water main from Greta to the future NEH connection point.	• Connection to WCD • Booster pump station • 2200m of DICL DN375 water main from Greta to the future NEH connection point. (HWC)
Upgrade 2 (Start of 2019)	20 L/s (Continuous)	38 L/s	• Connection to NEH • 2 x 2ML reservoirs • Potable water pumping station (20L/s @ 45m) with VSD's. • 2000m of DICL DN375 water main between the connection point and the potable water pumping		• 2200m of DICL DN375 water main from Greta to the future NEH connection point. (HWC) • Connection to NEH • 2 x 2ML reservoirs • Potable water pumping station (20L/s @ 45m) with VSD's. • 2000m of DICL DN375 water main between the connection point and the potable water pumping station • 2700m of PVC-M DN375 water main between the



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Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
			station 2700m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs		potable water pumping station and the potable water reservoirs
Upgrade 3 (Start of 2022)	75 L/s (Continuous)	148 L/s	2 x 2ML reservoirs - Upgrade potable water pumping station with new pumps (75 L/s @ 45m)	3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta - Upgrade to the Harpers Hill reservoir	2200m of DICL DN375 water main from Greta to the future NEH connection point. (HWC) - Connection to NEH 4 x 2ML reservoirs - Potable water pumping station (75L/s @ 45m) 2000m of DICL DN375 water main between the connection point and the potable water pumping station 2700m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs 3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta (HWC) - Upgrade to the Harpers Hill reservoir (HWC)
Upgrade 4 (Start of	75 L/s (Continuous)	148 L/s		1800m of DICL DN375 water main	2200m of DICL DN375 water main from Greta to the future NEH connection point. (HWC)



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Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
2050)				from the connection point on the New England Highway to Branxton	• Connection to NEH • 4 x 2ML reservoirs • Potable water pumping station (75L/s @ 45m) • 2000m of DICL DN375 water main between the connection point and the potable water pumping station • 2700m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs • 3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta (HWC) • Upgrade to the Harpers Hill reservoir (HWC) • 1800m of DICL DN375 water main from the connection point on the New England Highway to Branxton (HWC)

7.4 Security of Supply

The initial bulk water connection to the DN300 and DN150 water main along Wine Country Drive could be maintained as a secondary water supply source in the event that the primary supply source was taken offline. However feeding directly off this line may cause some service pressure issues in the south of Stage 1.

Huntlee Water can utilize the storage within the Huntlee reservoirs for security of supply for the potable water system. On the basis of the total reservoir storage of 8ML (ultimate development) and the reservoirs being full at the commencement of the service interruption the reservoirs could provide

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full potable water supply to the Huntlee development for approximately 40 hours based on average day demands.

Some other options to consider include:

- Provide dual mains out of the reservoirs to provide redundancy in case one of the mains is damaged and needs to be repaired.
- Provide a backup diesel pump in case the water pump station loses power
- Provide a cross connection between the reservoirs so that supply can be maintained in case of one reservoir needs to be taken offline.
- Provide a security of supply connection to Stages 2 & 3 of the Huntlee development off the New England Highway to the west of Branxton. HWC's supply mains do not currently extend this far but there are plans to develop this area in the future.

7.5 Existing HWC Customer Pressure Constraints

HWC provided their InfoWorks model which was based on peak hour flows. Due to the operational constraint applied by HWC i.e. North Rothbury Reservoir does not fall below 20% in an extreme week, all subsequent modelling has been based on extreme week conditions. The model provided is also a trunk main model only that does not contain the full reticulation network. Therefore it is not possible to see individual properties external to the Huntlee Development.

Earlier investigations indicated that a number of properties may experience low pressure issues in the township of Greta. Based on the items outlined above it is not possible based on the modelling completed to date to determine exactly if this low pressure problem has been addressed by the upgrades proposed however we understand the following;

- Just prior to upgrade 1 the available pressure in Greta experiences a drop of around 3% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2017). It is not possible to determine if this is due to increase in demand on the system or just the difference between peak to extreme week.
- Just prior to upgrade 2 the available pressure in Greta experiences a drop of around 7% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2019). It is not possible to determine if this is due to increase in demand on the system or just the difference between peak to extreme week.
- Just after upgrade 2 the available pressure in Greta experiences an increase of around 4% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2019). Therefore by 2019 the proposed upgrades have resulted in an increase in the available pressure in Greta.

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8 HWC & HUNTLEE DEMANDS OPTION 2 – SERVICING FROM WCD

Option 2 involves providing potable water for the entire Huntlee Development from a connection to the HWC network in Wine Country Drive. This option has been modelled in InfoWorks. The outcomes of this modelling have been used to determine the required upgrades and timing of infrastructure for this option.

Where a reference to a year is included against an upgrade this date refers to the upgrade being completed and capacity available at the start of that year.

8.1 Wine Country Drive Connection

8.1.1 Initial Connection (2015)

An initial potable water connection will be made to provide water to the Huntlee development along Wine Country Drive in the vicinity of the main intersection into the Huntlee Development. The connection will be to the DN300 and DN150 watermains in Wine Country Drive between Branxton and North Rothbury. This initial connection will service the Huntlee development up until peak hour demands at the end of 2016.

The initial development would be serviced via connection to the existing DN300 and DN150 diameter HWC potable water mains along Wine Country Drive (refer Figure 5). A bulk water meter and check valve would be located at this connection point.

A booster pump station would also be required to meet the minimum service pressure of 25 metres during peak demand periods to all of the properties highlighted in Figure 6. This pump station will not be required during average demand periods. This pump station would be located at the LWC site and would be designed to boost the residual pressure by 15-20 metres.

As discussed in Section 4, potable water would initially be used to supply both the potable water and recycled water reticulation systems for the first 180 lots. Once the first 180 lots have been developed, the LWC would be commissioned and recycled water would be provided to the development. Potable water would not be required to service the recycled water reticulation, with the exception of top up of the recycled water system when there is a deficit of recycled water.

The Wine Country Drive connection to HWC's potable water system would have sufficient capacity to supply up to a peak hour demand up to the end of 2016 without the need for upgrades to the existing HWC potable water system.

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8.1.2 Upgrade 1 (Must be implemented by the start of 2017)

Upgrade 1 will service the Huntlee development up until a peak hour demand of 22.5 L/s. Upgrade 1 is the same upgrade as Upgrade 1 for option number 1. The location for Upgrade 1 has been chosen as this represents the most hydraulically constrained section of the HWC network and hence where the greatest impact is achieved. This upgrade also represents the only reasonable upgrade that could be completed before the end of 2016 (ie approximately 17 months from now) when the capacity within the initial connection to the Huntlee Development in Wine Country Drive will be exhausted (based on the HWC operating restrictions) and hence additional capacity will be required.

The exact length of the upgrade proposed for upgrade 1 is subjective and can be changed with associated reductions or increases in available capacity. Constructing a shorter section of this pipeline will make less additional capacity available and bring upgrade 2 further forward and constructing more of upgrade 1 will provide additional capacity. The current strategy is based on the following initial upgrade;

- Upgrade 1 involves the construction of approximately 2,200 m of DICL DN 375 water main along the New England Highway from Greta towards Branxton.

8.1.3 Upgrade 2 (Must be implemented by the start of 2019)

- Upgrade 2 will draw a continuous demand of up to 27 L/s from the HWC network (24hrs/day during peak demand periods and 18hrs/day during average demand periods).
- Upgrade 2 will service the Huntlee development up until a peak hour demand of approximately 51 L/s (end of 2023)

By drawing up to 27 L/s from the WCD connection point, a peak hour potable water demand of up to approximately 51 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following works were undertaken (refer Figure 13):

- Approximately 3,750 m of DICL DN 375 water main from the Harpers Hill reservoir to Greta (required by 2020)
- An upgrade to the Harpers Hill reservoir – either an increase in capacity or an increase in the capacity of the pumps pumping into the reservoir (required by 2022). Options for upgrading the reservoir would need to be investigated at a later date.
- Based on the criteria in Section 2.6, potable water storage of approximately 4 ML would be required. This could be achieved by providing 2 x 2 ML reservoirs to the south of the Huntlee Stage 1 development area.
- The booster pump station would need to be reconfigured to pump directly to the potable water reservoirs with new pumps drawing up to 27 L/s at approximately 45 metres head out of

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HWC's potable water system at the connection point. This could be achieved by retrofitting the existing station with two new 27 L/s pumps in a duty/standby arrangement.

- Approximately 1,760 m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs.

The timing of the reservoirs could also be staged, with one 2 ML reservoir constructed initially and the second reservoir constructed to meet the increasing demand. However this option reduces the redundancy in the reservoir.

8.1.4 Upgrade 3 (Must be implemented by the start of 2024)

- Upgrade 3 will draw a continuous demand of up to 51.5 L/s from the HWC network (24hrs/day during peak demand periods and 18hrs/day during average demand periods).
- Upgrade 3 will service the Huntlee development up until a peak hour demand of approximately 96 L/s (end of 2030)

By drawing up to 51.5 L/s from the WCD connection point, a peak hour potable water demand of up to 96 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following additional works were undertaken (refer Figure 14):

- Approximately 1,800 m extension of the DICL DN375 water main along the New England Highway from Greta to Branxton.
- Based on the criteria in Section 2.6, potable water storage of approximately 6 ML would be required. This could be achieved by providing an additional 2 ML reservoir to the south of the Huntlee Stage 1 development area for a total of 3 x 2ML reservoirs.
- A upgrade to the potable water pumping station to enable the WPS to draw up to 51.5 L/s at approximately 45 metres head out of HWC's potable water system at the connection point. This could be achieved by installing a further 27L/s pump with a VSD so that the station operates at a combined flowrate of approximately 51.5L/s in a duty/duty/standby arrangement.

8.1.5 Upgrade 4 (Must be implemented by the start of 2035)

- Upgrade 4 will draw a continuous demand of up to 75L/s from the HWC network (24hrs/day during peak demand periods and 18hrs/day during average demand periods).
- Upgrade 4 will service the Huntlee development up until a peak hour demand of approximately 148 L/s (Ultimate)

By drawing up to 75 L/s from the WCD connection point, a peak hour potable water demand of up to 148 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following additional works were undertaken (refer Figure 15):



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- Approximately 1,260 m of DICL DN 375 water main from the east side of Branxton to connect into the DN300 main in Wine Country Drive i.e. through Branxton.
- Based on the criteria in Section 2.6, potable water storage of approximately 8 ML would be required. This could be achieved by providing an additional 2 ML reservoir to the south of the Huntlee Stage 1 development area for a total of 4 x 2ML reservoirs.
- A upgrade to the potable water pumping station to enable the WPS to draw up to 75 L/s at approximately 45 metres head out of HWC's potable water system at the connection point. This could be achieved by installing a further 27L/s pump with a VSD so that the station operates at a combined flowrate of approximately 75L/s in a duty/duty/duty/standby arrangement. Alternatively the existing pumps could be upgraded and have two 75 L/s pumps installed so that the station operates at a combined flowrate of 75L/s in a duty/standby arrangement.

8.2 Option 2 - Upgrade Summary

A summary of the required upgrades is provided in Table 8-1.

Table 8-1 Infrastructure Upgrade Summary

Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
Initial Connection (2015)	Average Demand of 2.60 L/s	7.35 L/s	• Connection to WCD • Booster pump station		• Connection to WCD • Booster pump station
Upgrade 1 (Start of 2017)	Average Demand of 8.32 L/s	22.5 L/s		• 2200m of DICL DN375 water main from Greta towards Branxton.	• Connection to WCD • Booster pump station • 2200m of DICL DN375 water main from Greta towards Branxton. (HWC)
Upgrade 2 (Start of 2019)	27 L/s (Continuous)	51 L/s	• 2 x 2ML reservoirs • Upgrade potable water pumping station	• 3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta (required	• Connection to WCD • 2200m of DICL DN375 water main from Greta towards Branxton. (HWC) • 3750m of DICL DN375 water



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Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
			(27L/s @ 45m). 1760m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs.	by 2020) Upgrade to the Harpers Hill reservoir (required by 2022)	main from the Harpers Hill reservoir to Greta (HWC) - Upgrade to the Harpers Hill reservoir (HWC) 2 x 2ML reservoirs - Potable water pumping station (27L/s @ 45m) 1760m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs.
Upgrade 3 (Start of 2024)	51.5 L/s (Continuous)	96 L/s	1 x 2ML reservoirs - Upgrade potable water pumping station with new pumps (51.5 L/s @ 45m)	1800m extension of DICL DN375 water main from Greta to Branxton	- Connection to WCD 2200m of DICL DN375 water main from Greta towards Branxton. (HWC) 3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta (HWC) - Upgrade to the Harpers Hill reservoir (HWC) 3 x 2ML reservoirs - Potable water pumping station (51.5L/s @ 45m) with VSD's. 1760m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs. 1800m extension of DICL DN375 water main from Greta



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Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
					to Branxton (HWC)
Upgrade 4 (Start of 2035)	75 L/s (Continuous)	148 L/s	• 1 x 2ML reservoirs • Upgrade potable water pumping station with new pumps (75 L/s @ 45m) • 1260m of DICL DN375 water main through Branxton		• Connection to WCD • 2200m of DICL DN375 water main from Greta towards Branxton. (HWC) • 3750m of DICL DN375 water main from the Harpers Hill reservoir to Greta (HWC) • Upgrade to the Harpers Hill reservoir (HWC) • 4 x 2ML reservoirs • Potable water pumping station (75L/s @ 45m) • 1760m of PVC-M DN375 water main between the potable water pumping station and the potable water reservoirs. • 1800m extension of DICL DN375 water main from Greta to Branxton (HWC) • 1260m of DICL DN375 water main through Branxton (HWC)

8.3 Security of Supply

For this option another proposed connection into the Huntlee Development would not be built leaving Wine Country Drive as the sole source of potable water supply for the Huntlee development.

Huntlee Water can utilize the storage within the Huntlee reservoirs for security of supply for the potable water system. On the basis of the total reservoir storage of 8ML (ultimate development) and the reservoirs being full at the commencement of the service interruption the reservoirs could provide

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full potable water supply to the Huntlee development for approximately 40 hours based on average day demands.

Supply within the HWC network to the Huntlee connection under this arrangement would be provided by the DN300 and DN150 pipelines within Wine Country Drive supplying flow from Harpers Hill from the North and the North Rothbury Reservoir from the South. One option to provide additional security of supply is to upsize the DN150 pipeline in Wine Country Drive to a DN300 pipeline to match the other DN300 pipeline. The DN150 pipeline from the Huntlee connection point to the Hunter Expressway will be replaced as part of the Wine Country Drive relocation and hence the additional costs associated with this option involve the cost of the pipe upsize only.

Some other options to consider include:

- Provide dual mains out of the reservoirs to provide redundancy in case one of the mains is damaged and needs to be repaired.
- Provide a backup diesel pump in case the water pump station loses power.
- Provide individual outlets from each reservoir so that supply can be maintained in case of one reservoir needs to be taken offline.
- Provide a security of supply connection to Stages 2 & 3 of the Huntlee development off the New England Highway to the west of Branxton. HWC's supply mains do not currently extend this far but there are plans to develop this area in the future.

8.4 Pipeline through Branxton

Upgrade 4 proposes that approximately 1,260 m of DICL DN 375 water main be constructed between Branxton and the DN300 main located in the north of Wine Country Drive. This pipeline would be an addition to the existing DN250 water main that runs through Branxton.

The pipeline would connect on the east side of Branxton into the DN375 water main proposed in Upgrade 3 and run along the golf course parallel to the existing DN250 water main. The pipeline would then continue along Cessnock Road and Railway Street until it reaches the bridge that crosses the rail line between Bridge St Branxton and Wine Country Drive. There are a number of options for the route of this pipeline and the final route would be determined during concept design phase. Refer to Figure 15 for an outline of this proposed route.

A site inspection of this bridge uncovered several services, including the DN250 water main, located in a service cavity underneath the east side of the bridge footpath. The west side of this service cavity appeared to be free of services except for a small orange conduit. There was plenty of horizontal space available for a DN375 pipe to be allocated in the west side of this service cavity. Thus it appears that ample space exists to accommodate this pipeline beneath the footpath of this bridge. John Holland Rail manage this bridge and WorleyParsons has submitted an 'Approval in Principle' request to determine whether this service allocation is available for this proposed pipeline.

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8.5 Existing HWC Customer Pressure Constraints

HWC provided their InfoWorks model which was based on peak hour flows. Due to the operational constraint applied by HWC i.e. North Rothbury Reservoir does not fall below 20% in an extreme week, all subsequent modelling has been based on extreme week conditions. The model provided is also a trunk main model only that does not contain the full reticulation network. Therefore it is not possible to see individual properties external to the Huntlee Development.

Earlier investigations indicated that a number of properties may experience low pressure issues in the township of Greta. Based on the items outlined above it is not possible based on the modelling completed to date to determine exactly if this low pressure problem has been addressed by the upgrades proposed however we understand the following;

- Just prior to upgrade 1 the available pressure in Greta experiences a drop of around 3% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2017). It is not possible to determine if this is due to increase in demand on the system or just the difference between peak to extreme week.
- Just prior to upgrade 2 the available pressure in Greta experiences a drop of around 7% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2019). It is not possible to determine if this is due to increase in demand on the system or just the difference between peak to extreme week.
- Just after upgrade 2 the available pressure in Greta experiences an increase of around 5% when comparing HWC model peak week (2015) to Huntlee model in extreme week (2019). Therefore by 2019 the proposed upgrades have resulted in an increase in the available pressure in Greta.

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9 HWC & HUNTLEE DEMANDS OPTION 3 – SERVICING VIA TUCKERS LANE

HWC requested that an alternative connection route along Tuckers Lane be investigated after they identified a potential reduction in construction costs and timing of this option compared to upgrading pipework along the New England Highway between Greta and Branxton. This option was modelled using InfoWorks and the results of this modelling have been used to determine the required upgrades and timing of infrastructure.

Where a reference to a year is included against an upgrade this date refers to the upgrade being completed at the start of that year.

9.1 Wine Country Drive Connection

9.1.1 Initial Connection (2015)

An initial potable water connection will be made to provide water to the Huntlee development along Wine Country Drive in the vicinity of the main intersection into the Huntlee Development. The connection will be to the DN300 and DN150 water mains in Wine Country Drive between Branxton and North Rothbury. This initial connection will service the Huntlee development up until a peak hour demand at the end of 2016.

The initial development would be serviced via connection to the existing DN300 and DN150 diameter HWC potable water mains along Wine Country Drive (refer Figure 5). A bulk water meter and check valve would be located at this connection point.

A booster pump station would also be required to meet the minimum service pressure of 25 metres during peak demand periods to all of the properties highlighted in Figure 6. This pump station will not be required during average demand periods. This pump station would be located at the LWC site and would be designed to boost the residual pressure by 15-20 metres.

As discussed in Section 4, potable water would initially be used to supply both the potable water and recycled water reticulation systems for the first 180 lots. Once the first 180 lots have been developed, the LWC would be commissioned and recycled water would be provided to the development. Potable water would not be required to service the recycled water reticulation, with the exception of top up of the recycled water system when there is a deficit of recycled water.

The Wine Country Drive connection to HWC's potable water system would have sufficient capacity to supply up to a peak hour demand to the end of 2016 without the need for upgrades to the existing HWC potable water system.

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9.1.2 Upgrade 1 (Must be implemented by the start of 2017)

Due to the timing for the roll out of the Huntlee Development after the end of 2016 (i.e. approximately 17 months from now) capacity within the initial connection to the Huntlee Development in Wine Country Drive will be exhausted (based on the HWC operating restrictions) and hence additional capacity will be required. Upgrade 1 will service the Huntlee development up until a peak hour demand of 31.8 L/s

The main issue with the Tuckers Lane option is that there is currently minimal infrastructure in the vicinity and hence the initial upgrade requires a substantial investment and requires a considerable construction of large diameter pipeline to transfer water from Greta through to North Rothbury. Based on the available timing of when this pipeline would be required there may not be sufficient time available. Hence an alternative option would be to construct the initial upgrade outlined in section 7.1.2 and 8.1.2. Construction of this section of pipeline allows the work outlined in section 9.1.2 to be delayed till the end of 2018 giving sufficient time to implement the full scope of works outlined in section 9.1.2. The cost of the additional stage outlined in 7.1.2 and 8.1.2 has not been included in the cost estimates and makes the NPV higher making this option less preferable:

- Approximately 6,400 m of DICL DN 375 water main along Tuckers Lane from Greta to the North Rothbury Reservoir.

9.2 Connection to North Rothbury Reservoir

Before the peak hour potable water demand from the Huntlee development reaches 31.8 L/s, construction of a potable water pumping station and potable water reservoirs within the Huntlee development area would be required to deliver water to the Huntlee development area. A potable water main between the North Rothbury Reservoir and the Huntlee Reservoirs would also be required.

At this time the initial connection to the potable water mains in Wine Country Drive would be shut off and the connection maintained for security of supply purposes only. The booster pumping station located at the LWC site would not be required once the Huntlee reservoirs are constructed; however could be maintained for security of supply purposes.

9.2.1 Upgrade 2 (Must be implemented by the start of 2021)

- Upgrade 2 will draw a continuous demand of up to 75 L/s from the North Rothbury Reservoir (24hrs/day during peak demand periods and 18hrs/day during average demand periods).
- Upgrade 2 will service the Huntlee development up until a peak hour demand of approximately 148 L/s (Ultimate)

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By drawing up to 75 L/s from the North Rothbury Reservoir site, a peak hour potable water demand of up to approximately 148 L/s (refer to Table 4-1) could be met from the Huntlee reservoirs if the following works were undertaken (refer Figure 18):

- Approximately 3,750 m of DICL DN 375 water main from the Harpers Hill reservoir to Greta (required by 2022)
- An upgrade to the Harpers Hill reservoir – either an increase in capacity or an increase in the capacity of the pumps pumping into the reservoir (required by 2022). Options for upgrading the reservoir would need to be investigated at a later date.
- Based on the criteria in Section 2.6, potable water storage up to approximately 8 ML would be required. This could be achieved by providing 4 x 2 ML reservoirs to the south of the Huntlee Stage 1 development area.
- A WPS located at the North Rothbury Reservoir which delivers up to 75 L/s at approximately 25 metres head into the Huntlee Reservoirs. This could be achieved by installing two 75 L/s pumps in a duty/standby arrangement.
- Approximately 80 m of PVC-M DN375 water main between the North Rothbury Reservoir and the Huntlee potable water reservoirs.

The sizing of the pumps within the potable water pumping station would be staged in line with the potable water demands of the development. This could be achieved over several upgrades. Similarly, the timing of the reservoirs would also be staged to meet the increasing demand. However this option reduces the redundancy in the reservoir.

There are a number of options for the location of the transfer WPS as well as operational scenarios for this option that would need to be resolved in the concept and detailed design of this option.

9.3 Option 3 - Upgrade Summary

A summary of the required upgrades is provided in Table 9-1.

Table 9-1 Infrastructure Upgrade Summary

Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
Initial Connection (2015)	Average Demand of 2.60 L/s	7.35 L/s	• Connection to WCD • Booster pump station		• Connection to WCD • Booster pump station



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Upgrade	Demand from HWC System	Peak Hour Demand	New Huntlee Infrastructure Required	New HWC Infrastructure Required	Cumulative Infrastructure Required
Upgrade 1 (Start of 2017)	Average Demand of 12.6 L/s	31.8 L/s		6400m of D1CL DN 375 water main along Tuckers Lane from Greta to the North Rothbury Reservoir.	- Connection to WCD - Booster pump station 6400m of D1CL DN 375 water main along Tuckers Lane from Greta to the North Rothbury Reservoir. (HWC)
Upgrade 2 (Start of 2021)	75 L/s (Continuous)	148 L/s	4 x 2ML reservoirs - Potable water pumping station (75L/s @ 25m). 80m of PVC-M DN375 water main between the North Rothbury Reservoir and the Huntlee potable water reservoirs.	3750m of D1CL DN375 water main from the Harpers Hill reservoir to Greta (required by 2022) - Upgrade to the Harpers Hill reservoir (required by 2022)	- Connection to North Rothbury Reservoir 6400m of D1CL DN 375 water main along Tuckers Lane from Greta to the North Rothbury Reservoir. (HWC) 4 x 2ML reservoirs - Potable water pumping station (75L/s @ 25m). 80m of PVC-M DN375 water main between the North Rothbury Reservoir and the Huntlee potable water reservoirs. 3750m of D1CL DN375 water main from the Harpers Hill reservoir to Greta (HWC) - Upgrade to the Harpers Hill reservoir (HWC)

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10 LIFECYCLE COST ANALYSIS

A high level lifecycle cost analysis has been prepared for each of the investigated options.

Version 2.03 of the HWC Estimating Guidelines Tool has been used to estimate the capital cost of the proposed works and the HWC Lifecycle Cost Analysis template has been used to determine the net present value for each option (refer to Appendix C).

The net present value for the various scenarios are summarised in Table 10-1.

Table 10-1 Net Present Value

Option	Net Present Value
Option 1 – Servicing from NEH	\$11.9 M
Option 2 – Servicing from WCD	\$11.6 M
Option 3 – Servicing via Tuckers Lane	\$11.7 M

Table 10-1 indicates that the option 2 to service the Huntlee development from a connection point along the WCD has the lowest net present value.

To compile the capital cost estimates, the following assumptions have been made:

- No allowance has been made for acquiring easements.
- HWC pipe work is assumed to be DICL where pipework within the Huntlee Water area of operations is assumed to be PVC-M.
- Area classification A has been used for Connection 1 and PVC-M pipework from the connection points to the Huntlee reservoirs, as per HWC Estimating Guidelines.
- Area classification B1 has been used for the remaining pipework, as per HWC Estimating Guidelines.
- Terrain classification A has been used, as per HWC Estimating Guidelines.
- Road, bridge, rail and creek crossings have been included, as per HWC Estimating Guidelines or advice from contractors where available.
- For the portions where the main will be installed using an open trench a cost for the restoration of the ground surface is included.
- An allowance for pipelines being constructed close to several other existing services has been included.



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- An allowance for tree removal and trimming has been included for various sections of pipework.
- An allowance for traffic management during construction has been included.
- A default allowance for valves and fittings has been generated by the HWC Estimating Tool.
- The estimate assumes no filling or major reshaping of the site.
- The estimate excludes dewatering of the open cut excavation.
- The estimate excludes HWC Fees/Charges.
- The estimate assumes no excavation through rock.
- The estimate excludes relocation of any existing services.
- The estimate does not include the Huntlee initial booster pumping station as it has not been determined if this will be constructed.
- The estimate includes the Huntlee reservoirs. To determine a cost for the Huntlee reservoirs an estimate for the purchase and erection for the reservoir along with an allowance for the site works has been included. It is assumed that the site preparation and access costs for the Huntlee reservoirs are shared equally between the potable water and recycled water systems. The cost for the reservoirs has been estimates as \$380,000 for purchase and erection and \$120,000 for site preparation per reservoir.
- The estimate for the Harpers Hill reservoir upgrade in the amount of \$6,275,000 has been provided by HWC.

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11 RESERVOIR SITE

The proposed reservoir site would contain eight separate 2ML reservoirs (4 potable water and 4 recycled water). The use of a larger number of smaller reservoirs introduces some cost savings however it could result in a larger overall footprint. It is unclear if the proposed reservoir site can accommodate these reservoirs in this configuration at this time.

If additional potable water reservoirs were included at the reservoir site, the size of the ultimate potable water pumping station could be reduced slightly. The effect of additional reservoir capacity on pumping station size for the ultimate development is included in Table 11-1.

Table 11-1 Ultimate Potable Water Reservoir Capacity vs Pumping Station Size

Ultimate Potable Water Reservoir Capacity (ML)	Pumping Station Size (L/s)
8	75
10	70
12	68
16	62

Increasing the reservoir capacity is unlikely to have an impact on the sizing of the lead in infrastructure, other than the pump capacity. As mentioned previously, the proposed reservoir site may not have sufficient space to accommodate a large number of small reservoirs. Based on Table 11-1 the reduction in pump station size by increasing the reservoir storage is not sufficient enough to warrant increasing reservoir storage on the Huntlee site.



12 CONNECTION TO CESSNOCK WATER SUPPLY SYSTEM

Connecting the Harpers Hill/ North Rothbury network to the nearby Cessnock water supply system was investigated to determine if this would reduce the required upgrades (outlined in Option 1) along the New England Highway.

HWC provided WorleyParsons with their InfoWorks model of the Cessnock system. This water supply system was connected to the North Rothbury reservoir with approximately 8km of DN250 DICL pipe. The model was then run with ultimate demands to determine the required upgrades to the system.

The results of this modelling determined that the required upgrades along the New England Highway between Harpers Hill reservoir and Branxton were not reduced at all by connecting to the Cessnock system. Since this option did not offer any benefits for the ultimate development it was not investigated any further.

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13 SUMMARY

As outlined within this bulk water servicing strategy, the preferred upgrade option is option 2, that is, servicing the entire Huntlee development via a connection in WCD. Based on the current timing for the Huntlee Development and increase in demand within the HWC network the initial upgrade works along the New England Highway are required to be fully completed within the next 17 months to ensure that available capacity in the HWC water supply system west of Harpers Hill does not become a constraint to the Huntlee development progress. Based on the time taken to complete design, tendering and construction of the initial upgrade it is critical that design works commence on the initial upgrade immediately to ensure that sufficient water supply is available west of Harpers Hill.

The current MNR stage 4 upgrade works proposed by HWC includes (amongst other works) a DN375 pipeline from Harpers Hill to Greta and from Greta to Branxton. Based on the modelling undertaken as part of this investigation it has been confirmed that this proposed component of the MNR stage 4 upgrade by HWC (i.e. additional DN375 from Harpers Hill to Branxton) would cater for the entire growth within the MNR system west of Harpers Hill including both HWC and Huntlee growth and hence this current component of the HWC proposed MNR stage 4 upgrade is appropriate.

Table 13-1 and 13-2 outlines the upgrades that would be required to the HWC system should Huntlee not proceed (i.e. HWC growth only) as well as the upgrade to the HWC system that would be required if both HWC and Huntlee growth is considered.

13.1 Option 1 – Servicing from NEH

Based on the analysis completed to date for Option 1 column 3 shows the required upgrade should only the HWC growth be analysed. Column 4 shows the required upgrades considering both the HWC and Huntlee growth:

Table 13-1 Required upgrades (Option 1)

Upgrade	Section	Base Case (HWC Demands Only)	Option 1 (Both HWC & Huntlee Demands)
1	2200m along NEH from Greta to the future NEH connection point	DN300 (2023)	DN375 (2017)
3	3750m along NEH from Harpers Hill Reservoir to Greta	DN300 (2035)	DN375 (2022)
4	1800m along NEH from the connection point to Branxton	Not Required*	DN375 (2050)*

* Note that the 1800m section between the NEH connection point and Branxton is required after the completion of the Huntlee development.



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13.2 Option 2 – Servicing from WCD

Based on the analysis completed to date for Option 2 column 3 shows the required upgrade should only the HWC growth be analysed. Column 4 shows the required upgrades considering both the HWC and Huntlee growth:

Table 13-2 Required upgrades (Option 2)

Upgrade	Section	Base Case (HWC Demands Only)	Option 2 (Both HWC & Huntlee Demands)
1	2200m water main along NEH from Greta towards Branxton	DN300 (2023)	DN375 (2017)
2	3750m water main along NEH from Harpers Hill Reservoir to Greta	DN300 (2035)	DN375 (2019)
3	1800m extension of water main along NEH from Greta to Branxton	Not Required	DN375 (2024)
4	1260m of water main through Branxton	Not Required	DN375 (2035)

13.3 Option 3 – Servicing via Tuckers Lane

Based on the analysis completed to date for Option 3 column 3 shows the required upgrade should only the HWC growth be analysed. Column 4 shows the required upgrades considering both the HWC and Huntlee growth:

Table 13-3 Required upgrades (Option 3)

Upgrade	Section	Base Case (HWC Demands Only)	Option 3 (Both HWC & Huntlee Demands)
1	6400m of water main along Tuckers Lane from Greta to the North Rothbury Reservoir	DN300 (2023)	DN375 (2017)
2	3750m water main along NEH from Harpers Hill Reservoir to Greta	DN300 (2035)	DN375 (2022)
3	2200m water main along NEH from Greta towards Branxton	Not Required	Not Required

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14 MODEL ASSUMPTIONS

HWC supplied WorleyParsons with a section of their InfoWorks supply network model between the Harpers Hill and North Rothbury reservoirs. The model was edited and run using a range of scenarios to verify that adequate service pressure could be maintained and the reservoirs did not fall below 20% capacity during an extreme week demand period.

The following key assumptions were made when editing the model:

- For (2015 – 2018) the average potable water demands for Huntlee were allocated to a single node connected to the DN300 pipe at the WCD connection point. Demands were based on the staging plan presented in Table 3-1.
- For (2019 – ultimate) the average potable water demands for Huntlee were allocated to a single node connected to the Huntlee reservoir. Demands were based on the staging plan presented in Table 3-1.
- For (2015 – ultimate) the average potable water demands for HWC growth was allocated to the three nodes illustrated in Figure 3-1. Demands were based on the staging plan presented in Table 3-1.
- The demand factors in Table 2-3 were applied to the average daily demands entered at each node.
- The diurnal factors in Table 2-4 were entered into the model to simulate the distribution of demands over an extreme week.
- All internal pipework inside of the Huntlee development area was modelled as PVC-M (PN16).
- All pipes outside of the Huntlee development area were modelled as DICL (PN35).
- The bottom water level of the Huntlee reservoirs was modelled at RL 105 m, while the top water level was modelled at RL 115 m.
- Reservoirs were modelled in 2 ML increments.
- The Greta Pump Station has been turned on in the model in 2016 so that it operates 24/7. The pump station is turned off in the model after Upgrade 1 (2017).
- Pump capacities are indicative only until pipe routes are better understood.
- The results presented in this report are based on the current HWC model and growth predictions presented in Table 3-1.
- A table of model inputs is provided in Appendix D



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15 REFERENCES

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bringing communities to life

HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY

Figures

FIGURE 1



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flow
systems

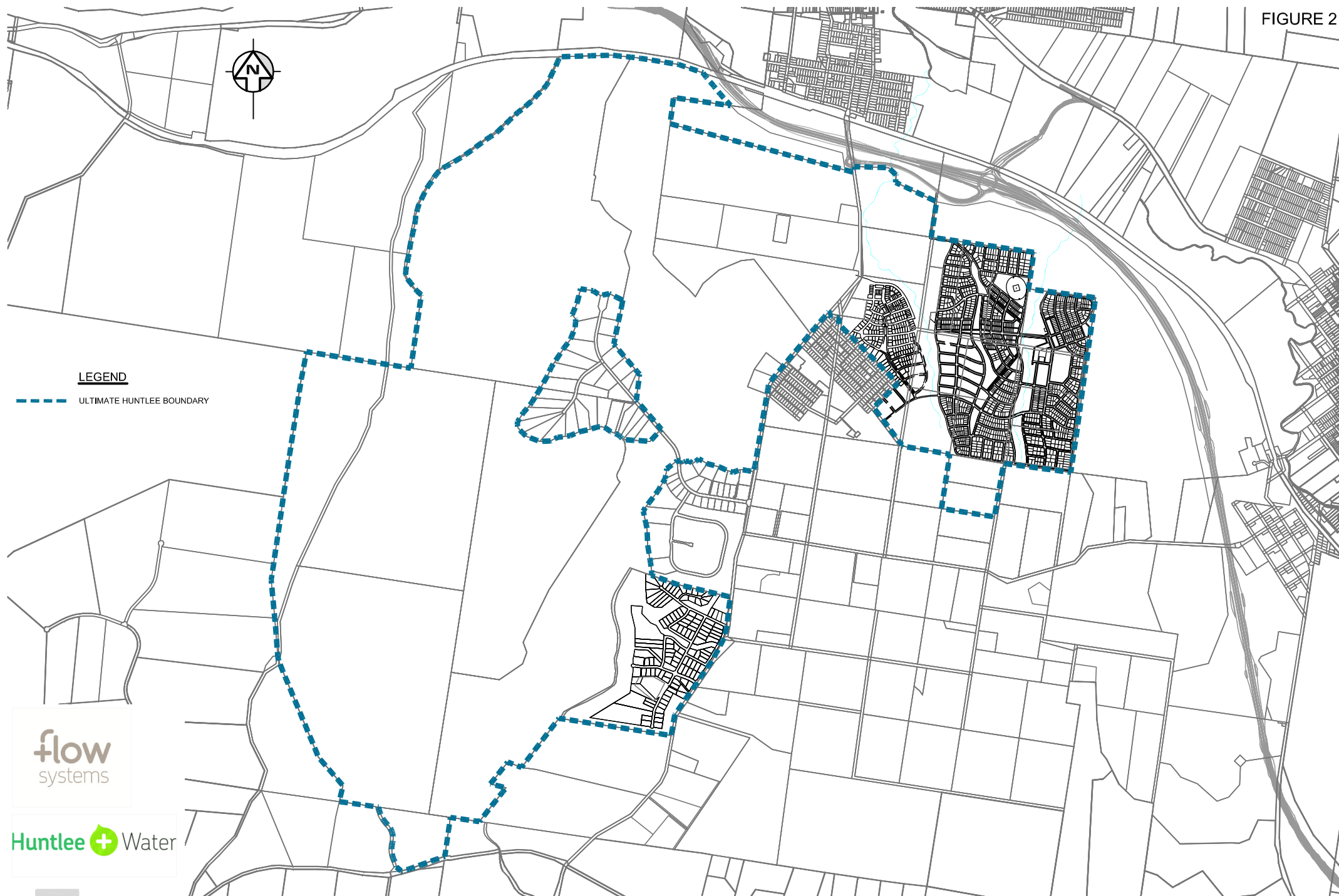
Huntlee+ Water



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**HUNTLEE DEVELOPMENT AREA
LOCALITY PLAN**



flow
systems

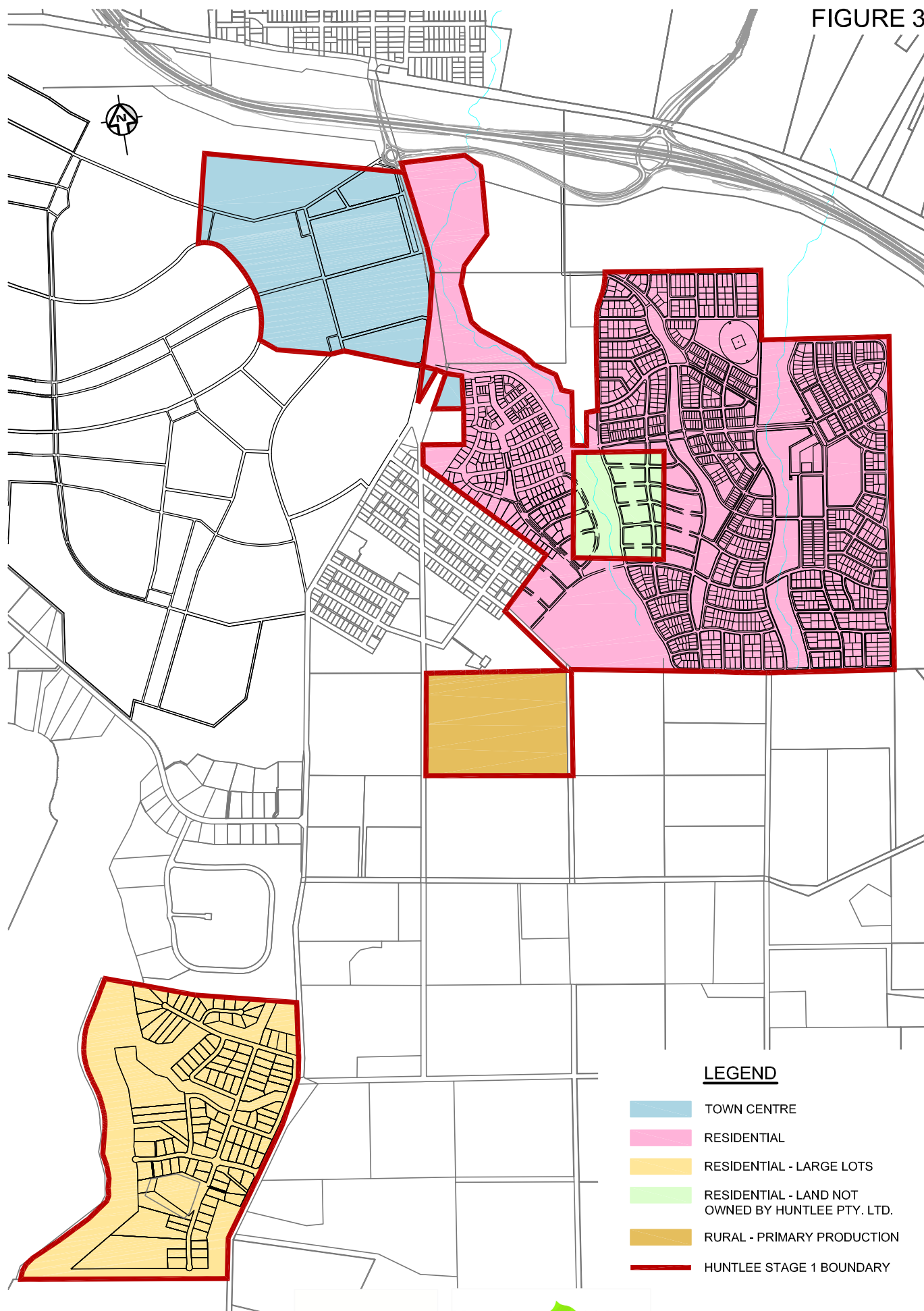
Huntlee + Water



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FIGURE 3



LEGEND

- TOWN CENTRE
- RESIDENTIAL
- RESIDENTIAL - LARGE LOTS
- RESIDENTIAL - LAND NOT OWNED BY HUNTLEE PTY. LTD.
- RURAL - PRIMARY PRODUCTION
- HUNTLEE STAGE 1 BOUNDARY



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resources & energy

flow
systems

Huntlee + Water

**HUNTLEE DEVELOPMENT AREA
STAGE 1 DEVELOPMENT BOUNDARY**

FIGURE 4

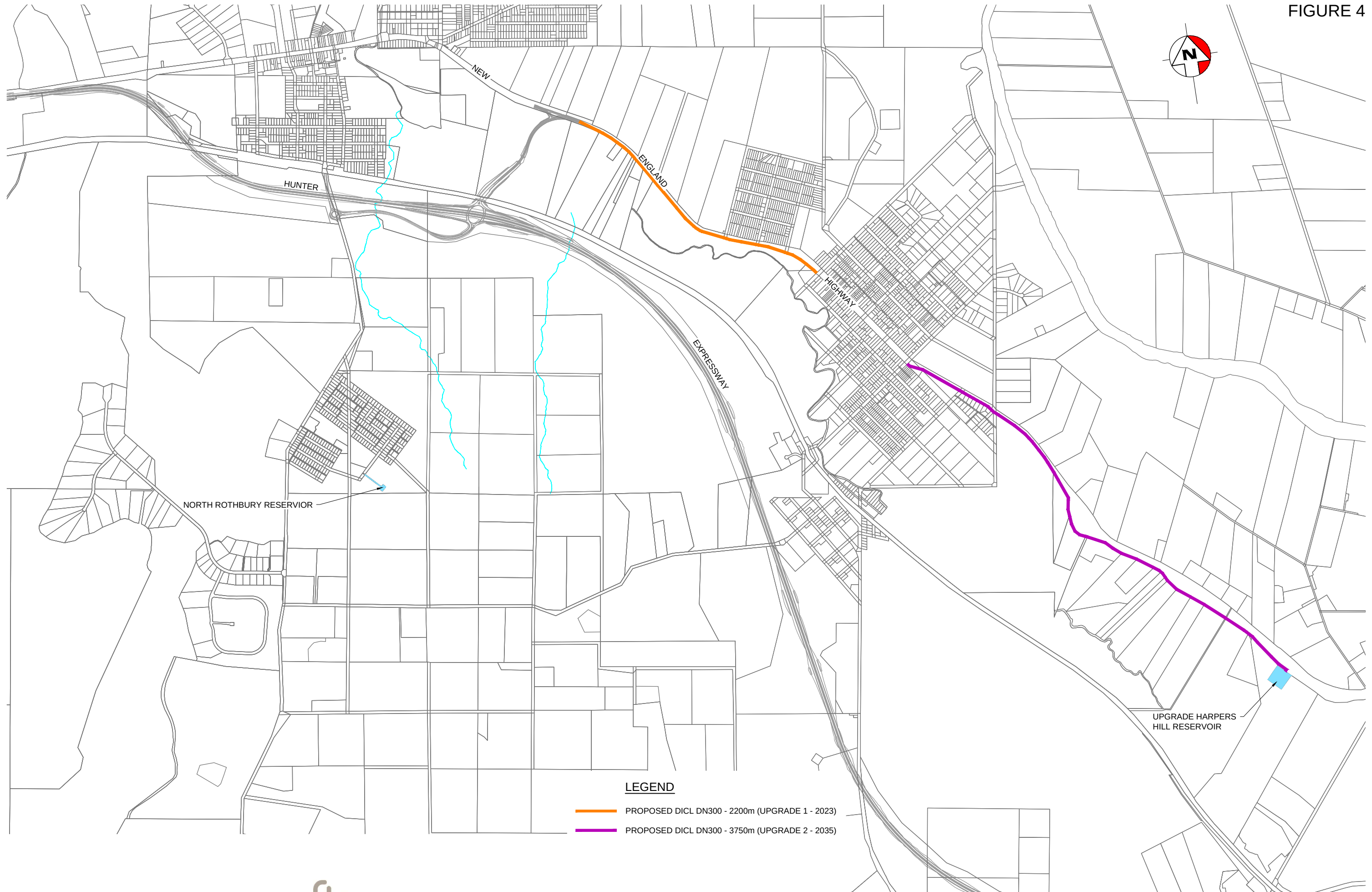


FIGURE 5



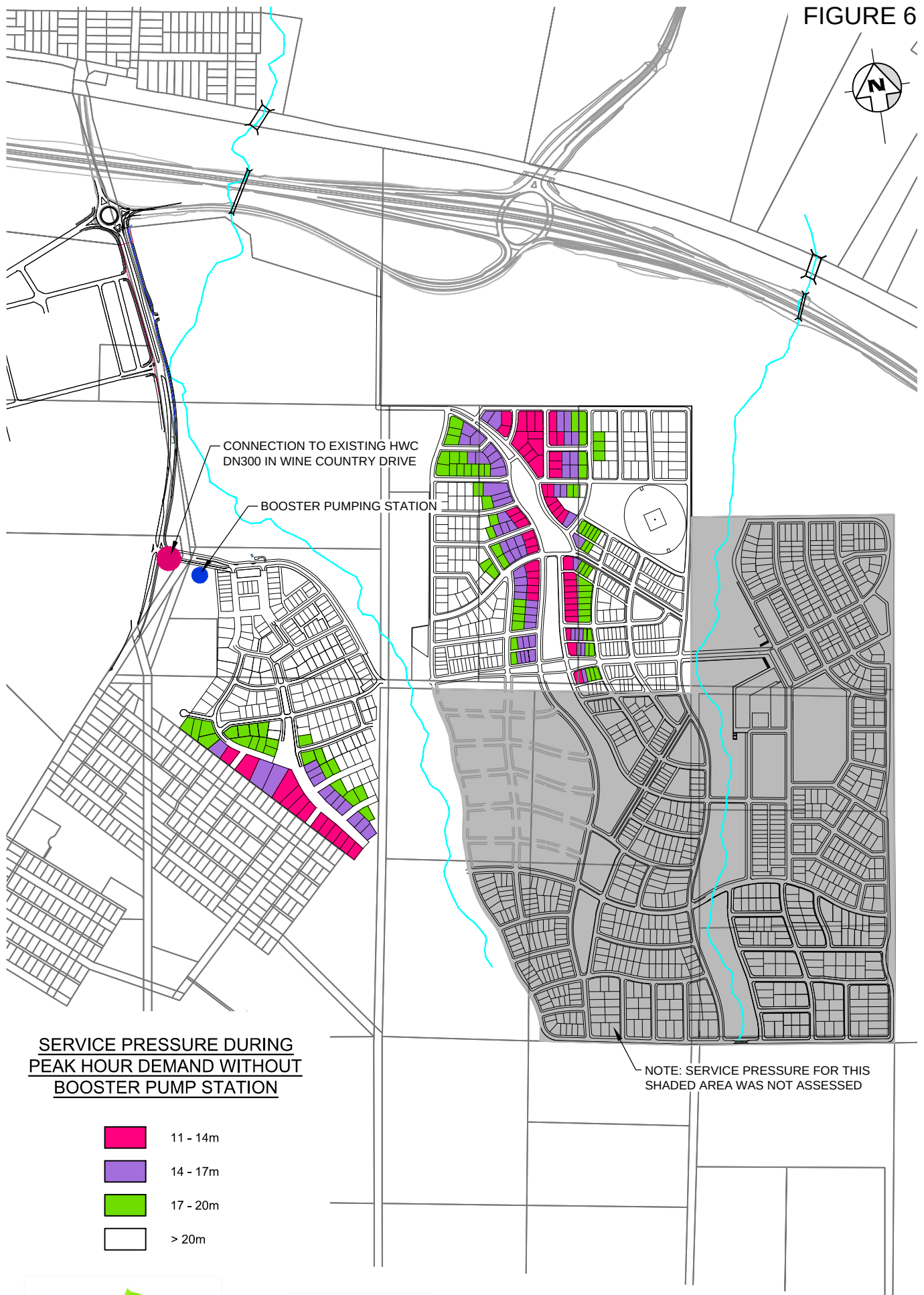
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flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 1: SERVICING FROM NEH
INITIAL CONNECTION (2015)

FIGURE 6



Huntlee + Water



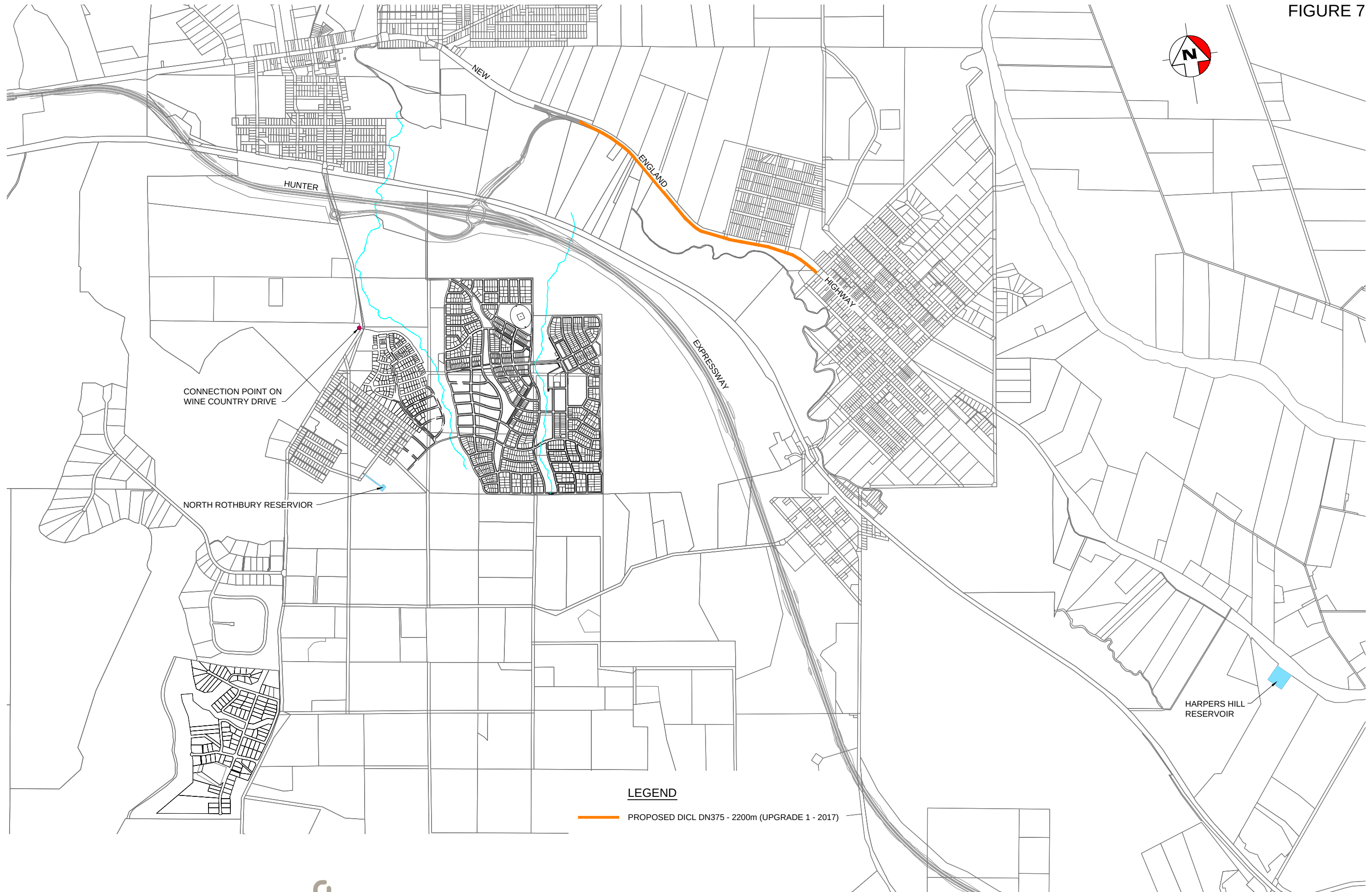
WorleyParsons

resources & energy

flow
systems

**HUNTLEE DEVELOPMENT AREA
INITIAL CONNECTION POINT
(DEVELOPMENT UP TO PEAK HOUR
DEMAND OF 22.5 L/S)**

FIGURE 7



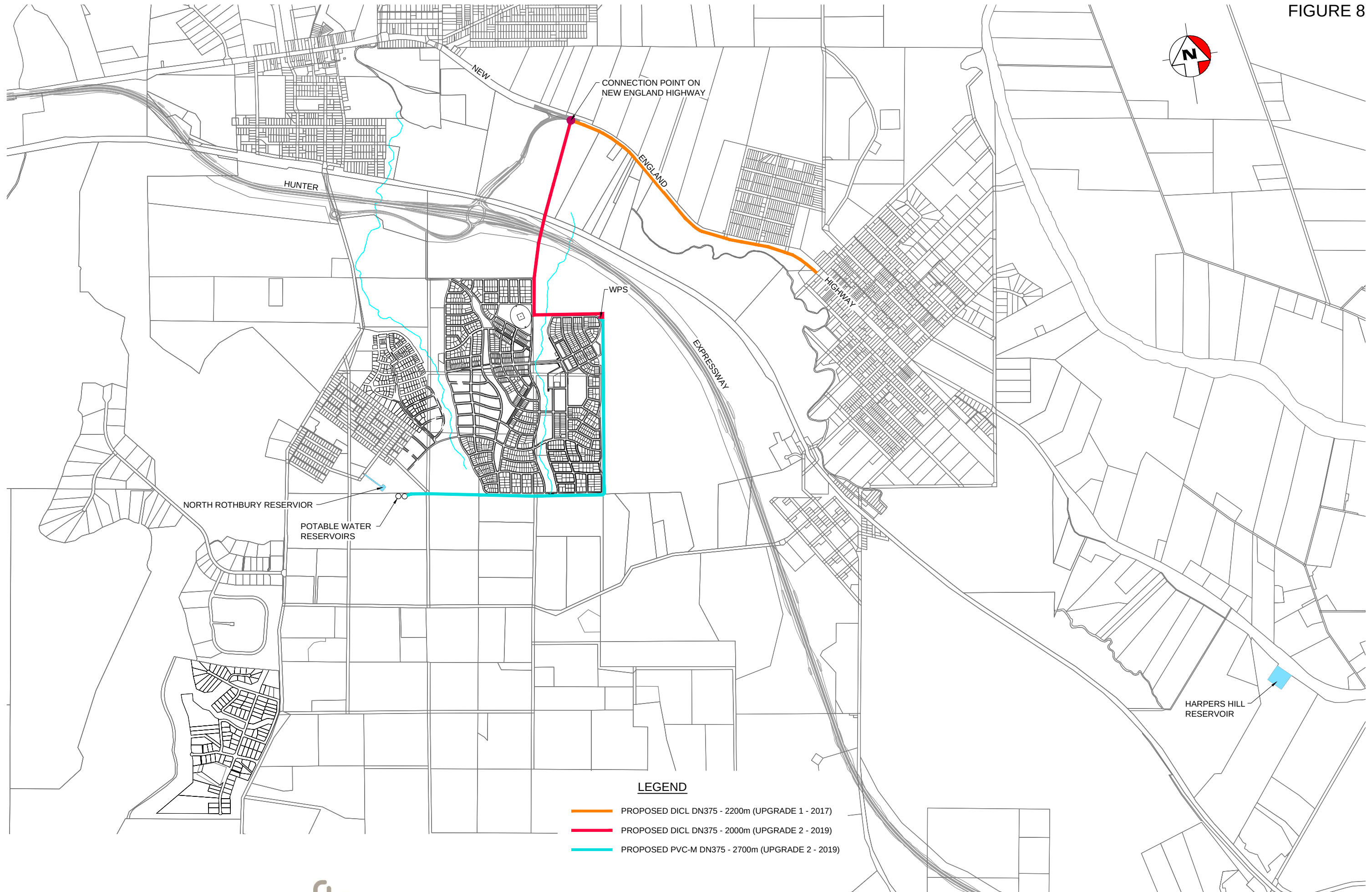
WorleyParsons
resources & energy

flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 1: SERVICING FROM NEH
UPGRADE 1 (2017)

FIGURE 8



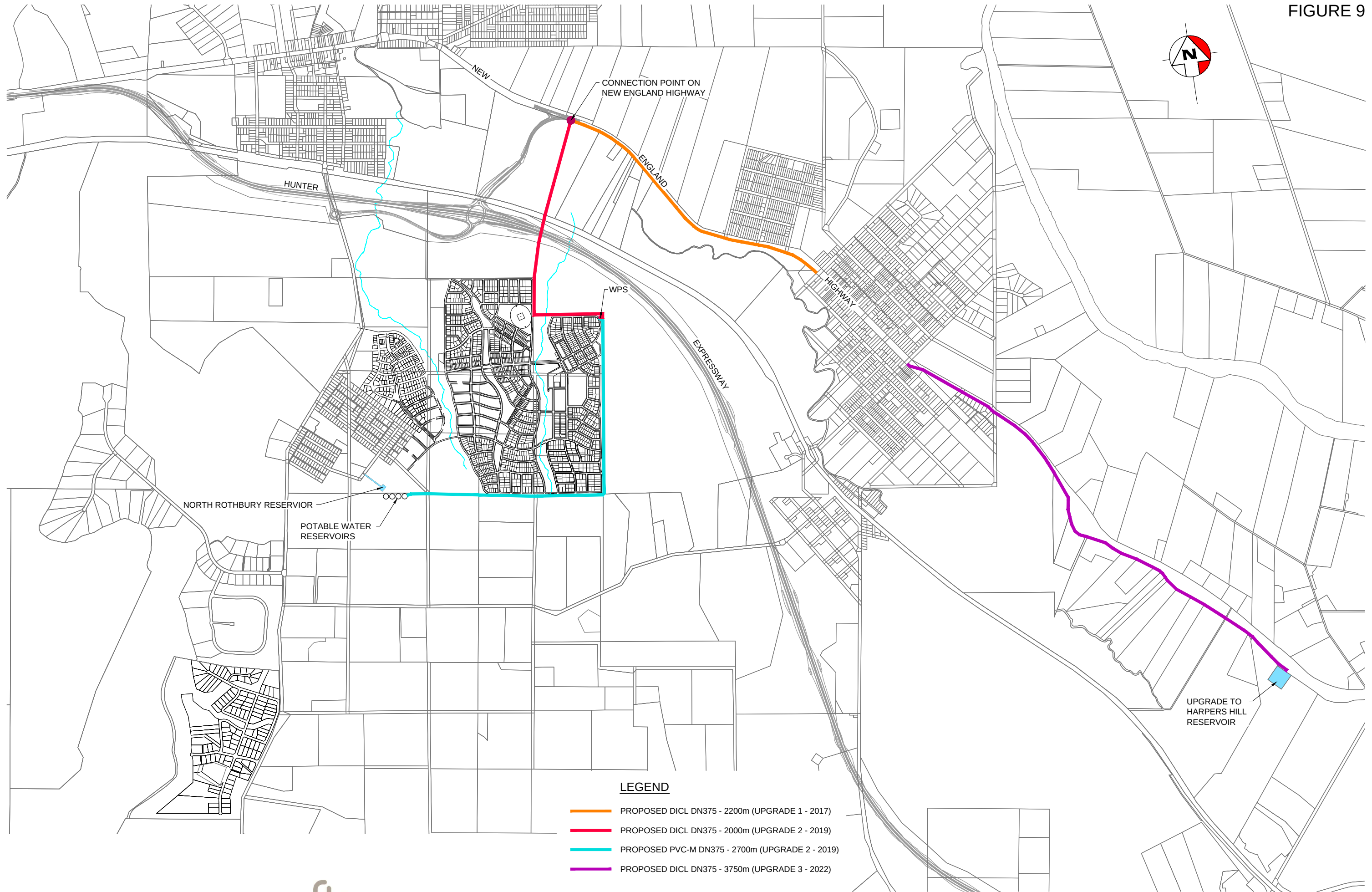
WorleyParsons
resources & energy

flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 1: SERVICING FROM NEH
UPGRADE 2 (2019)

FIGURE 9



WorleyParsons
resources & energy

flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 1: SERVICING FROM NEH
UPGRADE 3 (2022)

FIGURE 10

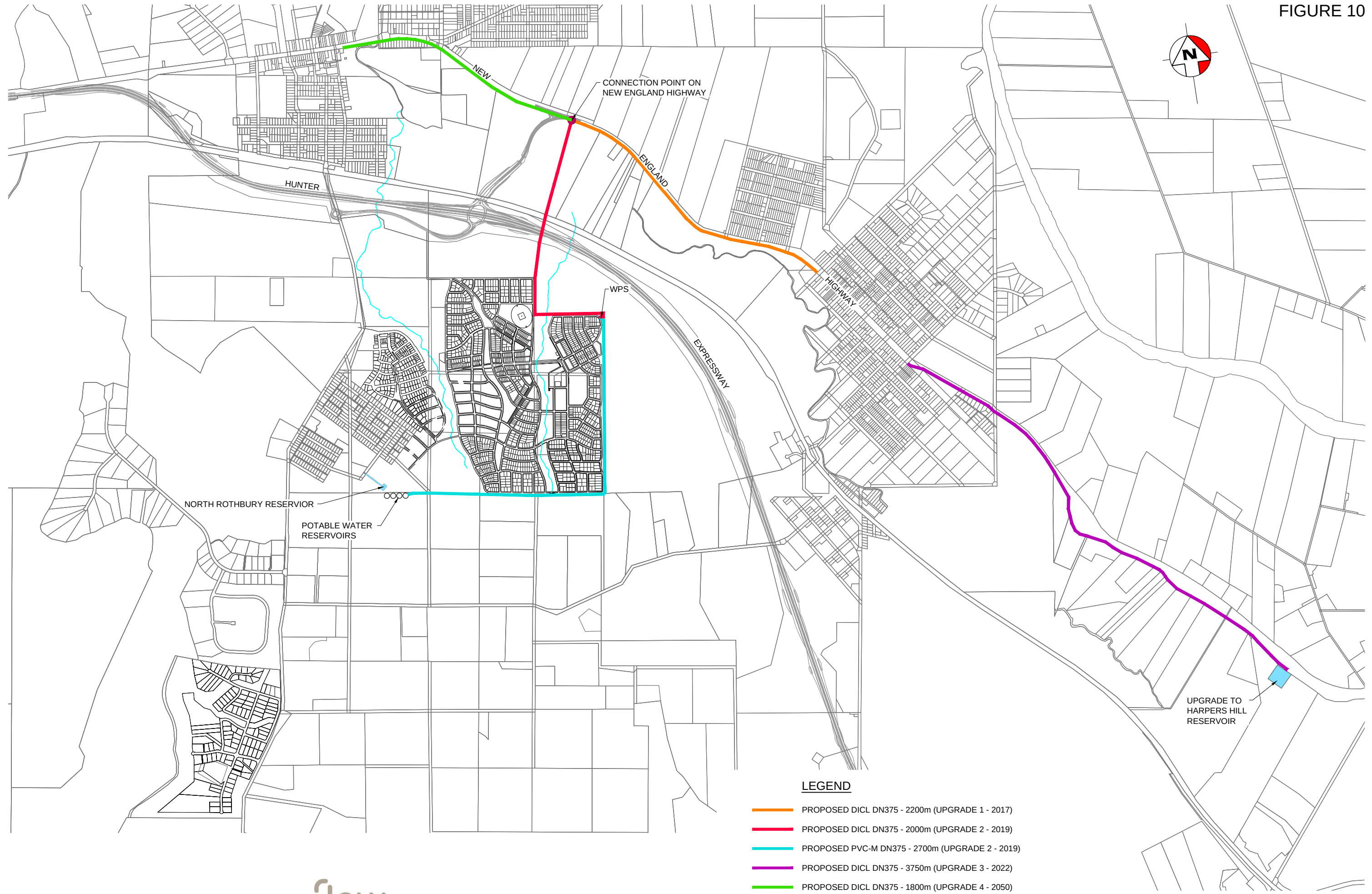


FIGURE 11



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flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 2: SERVICING FROM WCD
INITIAL CONNECTION (2015)

FIGURE 12

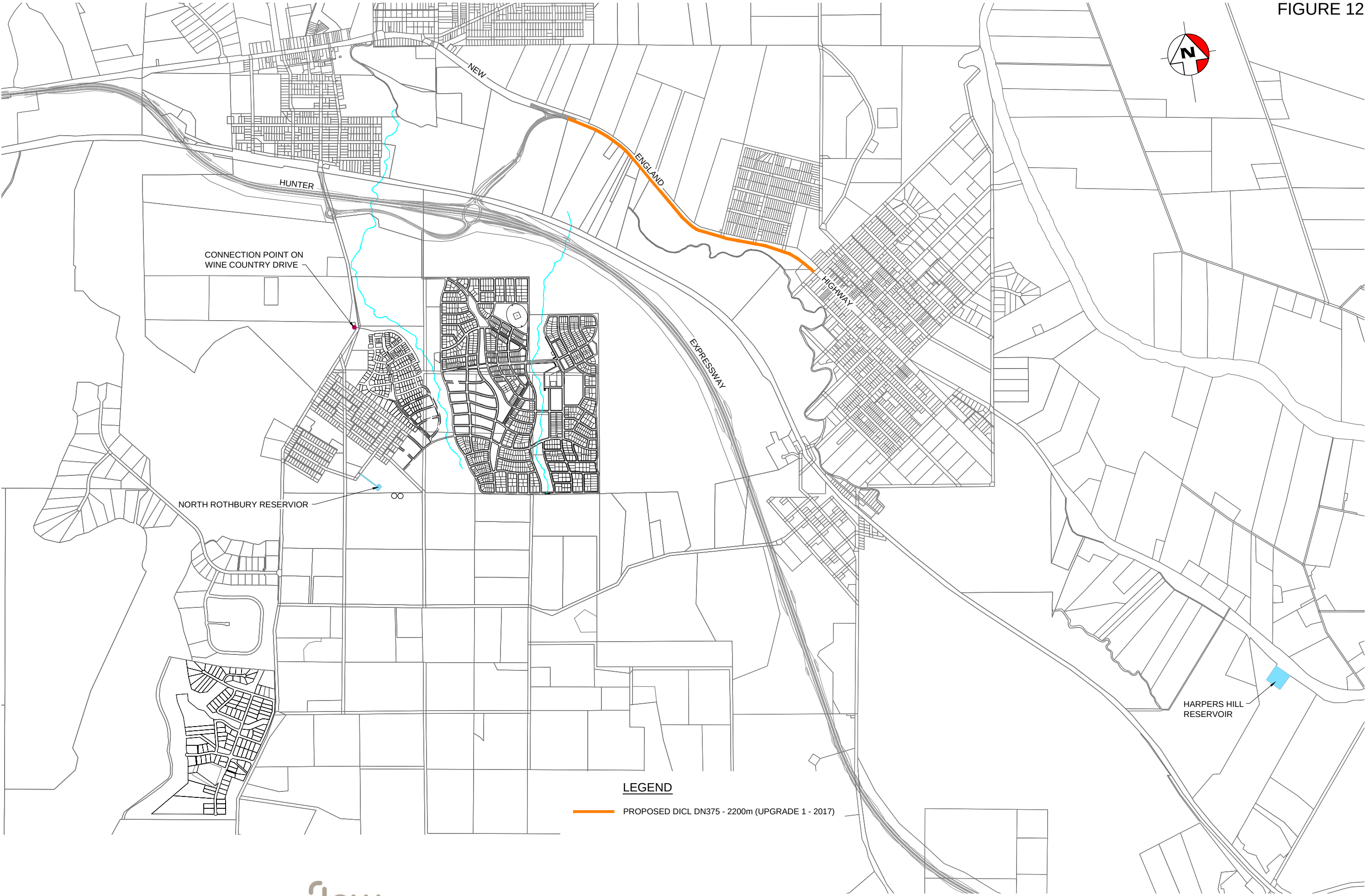


FIGURE 13

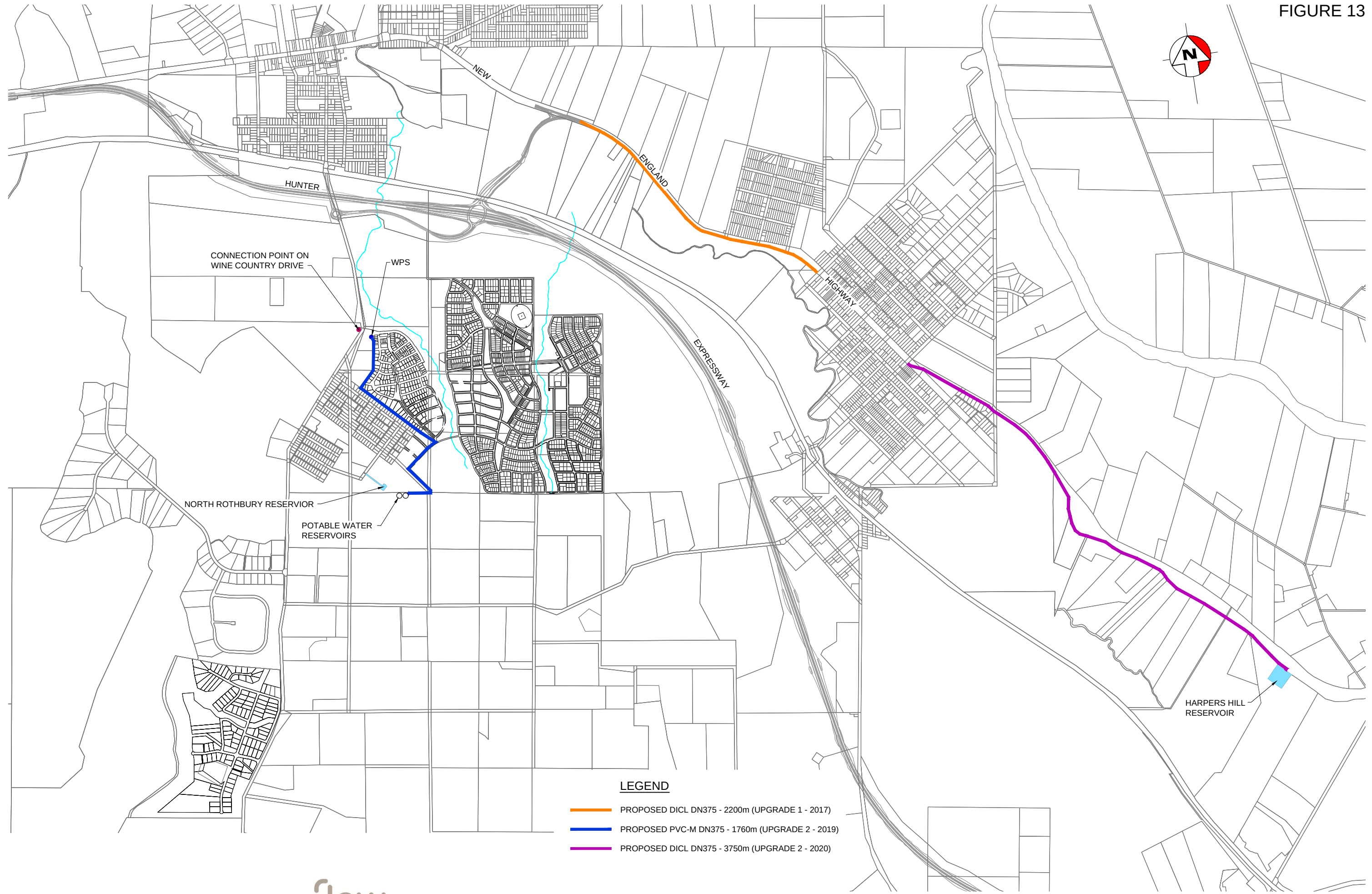


FIGURE 14

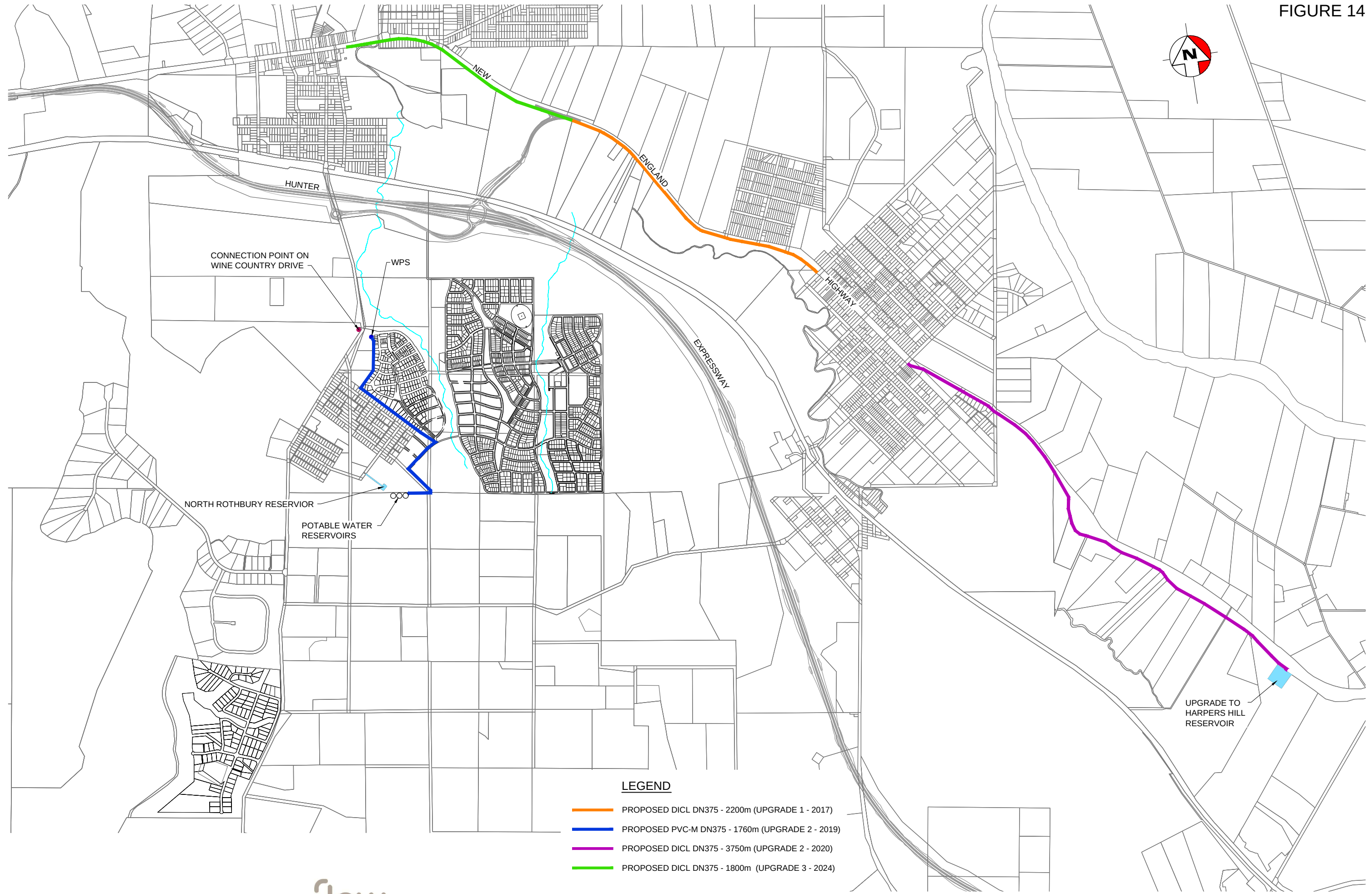


FIGURE 15

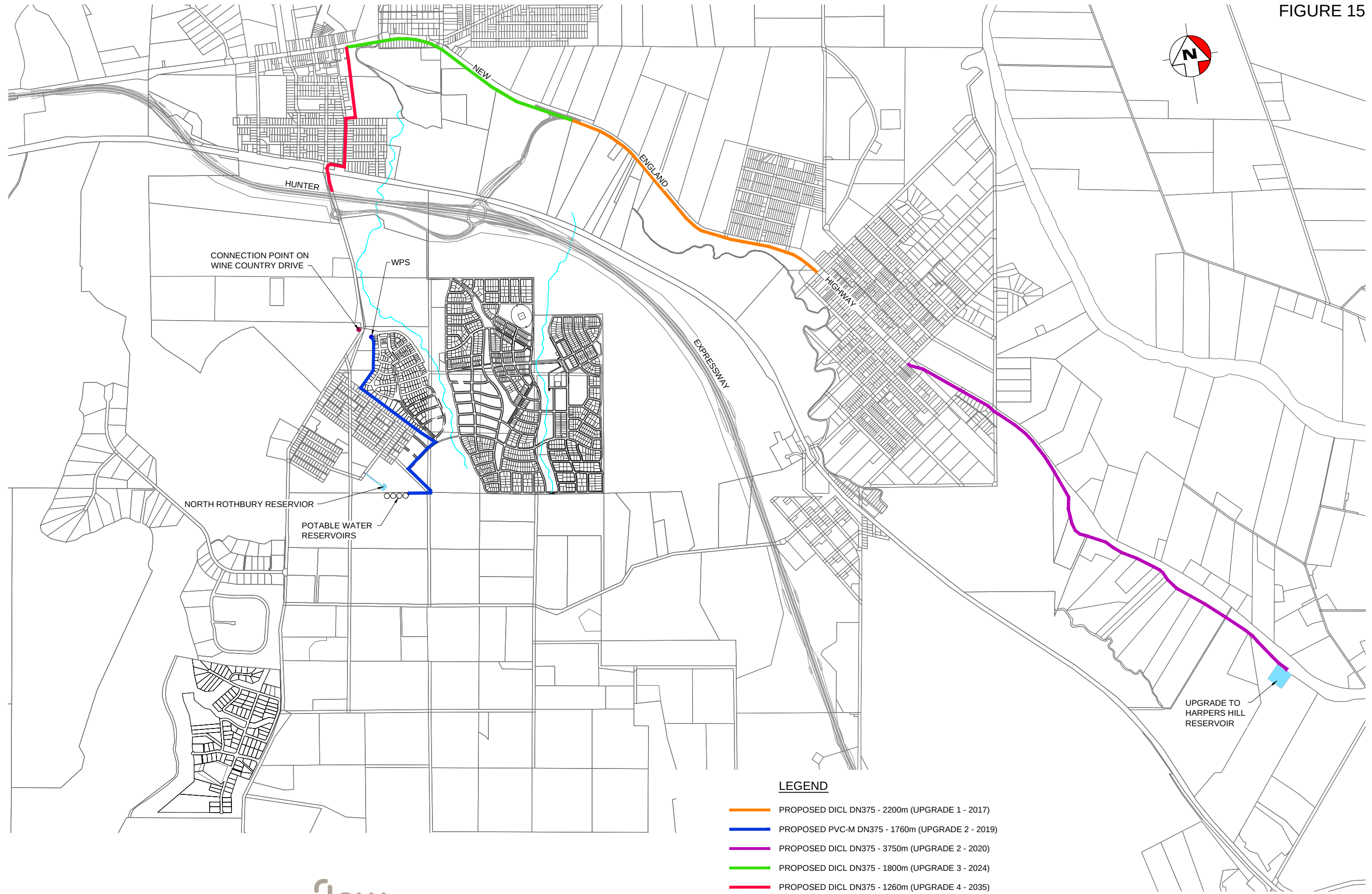


FIGURE 16



WorleyParsons
resources & energy

flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 3: SERVICING FROM TUCKERS LANE
INITIAL CONNECTION (2015)

FIGURE 17

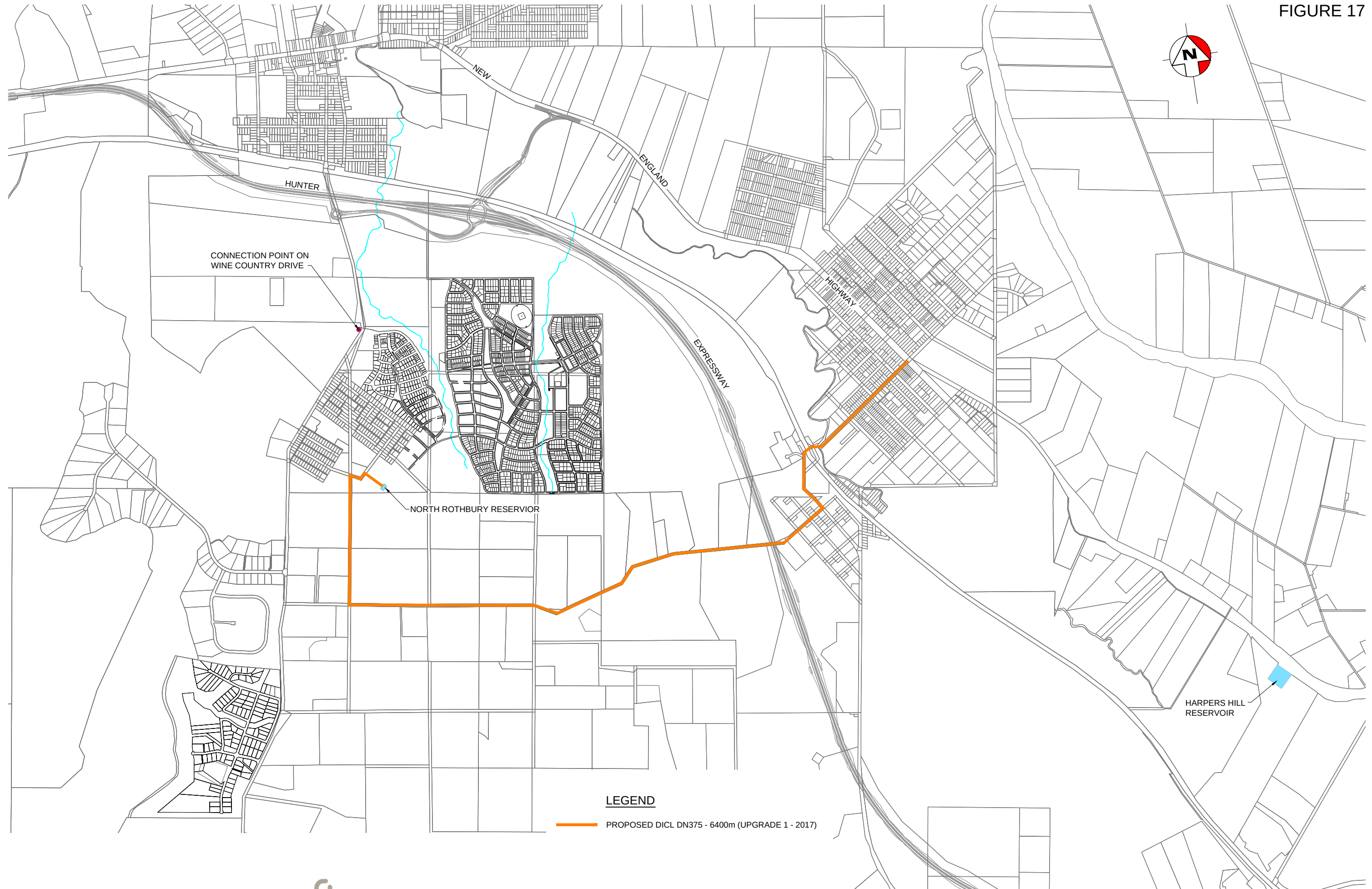
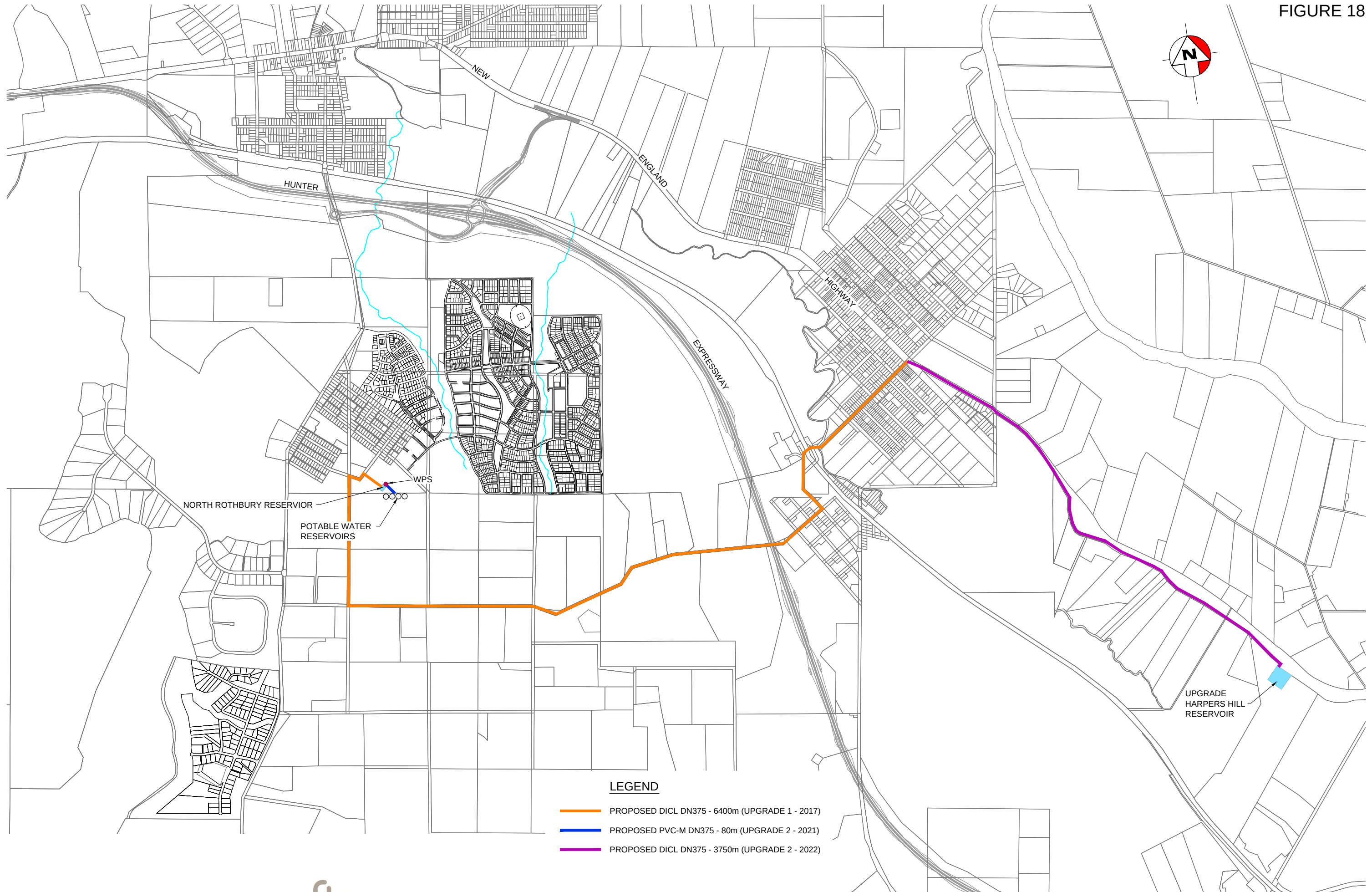


FIGURE 18



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flow
systems

Huntlee + Water

HUNTLEE DEVELOPMENT AREA
OPTION 3: SERVICING FROM TUCKERS LANE
UPGRADE 2 (2021)



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HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY

Appendix A – Approval of SMEC Servicing Strategy



Hunter Water Corporation
ABN 46 228 513 446

PO Box 5171
HRMC NSW 2310
36 Honeysuckle Drive
NEWCASTLE NSW 2300
1300 657 657
(02) 4979 9625 (F)
enquiries@hunterwater.com.au

26 June 2013

Ref: XXXX-XXXX

SMEC Australia
PO Box 1346
Newcastle NSW 2300

Attention: Kate Beard

Dear Kate

**APPROVAL OF HUNTLEE NEW TOWN WATER AND WASTEWATER SERVICING STRATEGY
ADDENDUMS REVISION C**

Thank you for your submission of the Huntlee New Town Water and Wastewater Servicing Strategy Addendums Revision C – July 2013. Hunter Water is satisfied from your responses that the strategy has been suitably modified to take into account the recommendations made following our most recent review. Approval of the strategy is therefore given.

In offering this approval, Hunter Water notes that the strategy proposes to serve initial development at Huntlee by a single pressure zone. This servicing arrangement will be able to serve up to a maximum of 550 lots prior to construction of "Connection 1" to connect the site to Greta, in conjunction with a portion of the Stage 4 Maitland to North Rothbury upgrades. Accordingly, this approval is **conditional** on the developer investigating and designing the optimal solution for low pressure customers at Greta, and implementing the preferred solution within sufficient lead time prior to this threshold being reached.

The approval of this strategy is valid for a maximum five year period from the date of this letter, however, Hunter Water reserves the right to require a revision to the strategy should any of the following circumstances arise:

- The development does not substantially proceed within this five year timeframe; or
- Significant changes in development profile (ie yield, timing, staging or additional development potential); or
- Significant changes in development yield within the contributing catchment(s); or
- Hunter Water Design Standards or criteria are revised impacting the loading / demand derived from the development; or
- Operation circumstances change; or
- Legislative or regulatory changes are imposed on Hunter Water.

Should any of the above circumstances arise within the five-year approval period, the strategy will require revision by the developer and approval by Hunter Water. Should the maximum 5 year period elapse it is a mandatory requirement that the strategy be reviewed by the developer and approved by Hunter Water prior to proceeding with the works related to water, wastewater or recycled water supply. This process should commence with submission of a new Development Assessment application, Preliminary Servicing application or feasibility analysis to ensure that the most current information, system modelling and performance, and design standards are used in the analysis.

Should the strategy need to be reviewed, the revised servicing strategies shall apply only to those development stages not already completed, or for which detail designs have not yet been approved. The revision of servicing strategies shall be completed by the developer and again be reviewed and approved by Hunter Water. Any costs associated with these reviews shall be borne by the developer.

Please note that approval of a strategy is not a commitment by Hunter Water to fund infrastructure, or an approval to connect the development to Hunter Water's water and sewerage systems. Furthermore, a strategy approval is not a commitment for capacity being allocated to a particular development in existing water and sewerage systems, nor is it an approval to connect to these systems. Connection and/or capacity availability will only be confirmed by submission and determination of a Development Assessment application and development consent being issued by the relevant consent authority. Please also note the legal disclaimer attached at Appendix A with respect to the use of Hunter Water's Servicing Strategy Template for the development of this strategy.

Please also note that all intellectual property in a servicing strategy as submitted to Hunter Water vests in Hunter Water on submission and Hunter Water can distribute the strategy, as submitted, and as may be approved by Hunter Water, to third parties (including developer/consultants and members of the public under freedom of information laws). Hunter Water will use reasonable endeavours not to disclose private personal information or information which is commercial in confidence when providing a servicing strategy to third parties.

Please submit three hard copies and one electronic copy of the final strategy (in PDF format). Please ensure that the version history in the document and the front cover of the strategy are clearly notated as "final".

If you have any questions, please do not hesitate to contact me on 4979 9545.

Yours faithfully



Malcolm Withers
Senior Developer Services Engineer

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Legal Disclaimer

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BULK WATER SERVICING STRATEGY

Appendix B – Demand Calculations

Calculation Cover Sheet

Customer	Flowsystems	Proj No	301020-07149
Project Title	Huntlee Bulk Water SS	Calc No	WW-CAL-0001
Calculation Title	Potable Water Demands	Phase/CTI	Servicing Strategy
Elec File Location	O:\301020\07149 - Huntlee Bulk Water Servicing Strategy\11.0 Engineering\11.14 Water\Latest Demand Calculations- 7.5.15\301020-07149-WW-CAL-0001.xlsx\Potable Water Demands		
		Page	1 of 3

Calculation Objective

The objective of this calculation is to determine the potable water demands for each year of the staging plan so that this data can be inputted into InfoWorks.

Calculation Method

The average daily demands provided by Flowsystems have been multiplied by the number of lots or the area of commercial, retail etc.

Average demands were multiplied by WSA demand factors to determine the total peak and extreme demands.

Assumptions

Residential (HWC): 550 L/day/lot

Residential: 275 L/day/lot

Medium Density: 275 L/day/lot

Commercial: 5000 L/day/Ha

Retail: 27000 L/day/Ha

Light Industrial Park: 5000 L/day/Ha

School: 4450 L/day/No.

Sports Ground: 1945 L/day/Ha

Parkslands: 1945 L/day/Ha

Recycled Water Top Up: 1500000 L/day (ultimate)

Unaccounted for water: 15% of average day demand

Software Used

Title	Version	Validation (Y / N / N/A)
Microsoft Excel	2010	Y

References

WSA 03-2002-2.3 (Hunter Water Corporation Version 1.0) Table 2.1 (Water Supply Design Demands)

WSA 03-2011-3.1 (Sydney Water Edition)

WSA 03-2002-2.3 (Hunter Water Corporation Version 1.0) Section 2.2.2.4 (Unaccounted Water)

Conclusions

-	-	-	-	-	-
-	-	-	-	-	-
A	08-May-15	SS	LR	DP	DP
Rev	Date	Description	By	Checked	Approved

This Calculation represents the work of WorleyParsons performed to recognized engineering principles and practices appropriate for the terms of reference provided by WorleyParsons contractual Customer. This Calculation is confidential and prepared solely for the use of the Customer. The contents of this Calculation may not be disclosed to or relied upon by any party other than the Customer, and neither WorleyParsons, its subconsultants nor their respective employees assume any liability for any reason, including, but not limited to, negligence, to any other party for any information or representation herein.

Calculation Checklist

Customer	Flowsystems	Proj No	301020-07149
Project Title	Huntlee Bulk Water SS	Calc No	WW-CAL-0001
Calculation Title	Potable Water Demands	Phase/CTF	Servicing Strategy
Elec File Location	Demand Calculations- 7.5.15\301020-07149-WW-CAL-0001.xlsx]Potable Water Demands		
		Page	2 of 3

Please check boxes for all applicable items checked or mark as "N/A" if not appropriate:

Calculations:

- ☒ Calculation number assigned and registered (refer to project numbering system or Document Numbering System EPP-0040 for format).
- ☒ Project title shown.
- ☒ Calculation title shown.
- ☒ Revision history box complete and signed.
- ☐ Table of Contents.
- ☒ Appropriate stamp for preliminary issues.
- ☒ Calculation objectives (aims) stated.
- ☒ Calculation method defined or described (including formulae if relevant).
- ☒ Reference made to text, standard or code. Check version/edition with that required for project.
- ☒ Source of input data stated (with revision number and date if relevant).
- ☒ Customer's requirements included/addressed.
- ☒ Assumptions stated.
- ☒ Summary of results or conclusions if appropriate.
- ☒ For software based calculations, reference to software verification if available.
- ☒ Approach used is appropriate for problem being solved.
- ☒ Method clear and easy to follow.
- ☒ Input data correct.
- ☒ Calculation arithmetically correct OR software previously verified and reference to verification checked.
- ☒ Calculation result within expected limits.
- ☒ Calculation tolerances stated if significant.
- ☒ Units used as required by customer. Unit conversions correctly performed.
- ☒ Abbreviations correct.
- ☒ Appropriate cross-references.
- ☒ Sketches included and clearly labelled, where required.
- ☒ Appendices included and referenced, as required.
- ☐ Considered design reviews, Hazop actions, client input, safety and environmental issues, etc.
- ☒ Document Sign-offs (typed full names of Originator, Checker, Approver; to be initialed beside at sign-off)
- ☒ Dates in standard format (DD-MMM-YY)

Checking Records:

- ☒ Checked and annotated copy of calculation filed (use "Check Print" stamp).
- ☒ Corrections made as required and calculation dated and signed on cover sheet by checker.
- ☒ Alternative method calculation and/or representative check performed and filed, as required.

Revisions:

- ☐ Changes clouded.
- ☒ Revision history block updated.
- ☒ Calculation re-checked if required.

-	-	-	-	-	-
-	-	-	-	-	-
A	08-May-15	SS	LR	DP	DP
Rev	Date	Description	By	Checked	Approved

Customer: Flowsystems												Project Number: 301020-07149				
Project Title: Huntlee Bulk Water SS												Calc No: WW-CAL-0001				
Calculation Title: Potable Water Demands												Phase/CTR: Servicing Strategy				
Elec File Location: O:\301020\07149 - Huntlee Bulk Water Servicing Strategy\11.0 Engineering\11.14 Water\Latest Demand Calculations- 7.5.15\301020-07149-WW-CAL-0001.xlsx\Potable Water Demands																
Rev	Date	By	Checked		Rev	Date		By	Checked			Rev	Date	By	Checked	Page
A	08-May-15	LR	DP		-	-		-	-			-	-	-	-	3 of 3

Potable Water Demand

2015												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extrem Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
HWC Point B	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
HWC Point C	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
Residential	155	Lots	550	0.09	2.25	0.19	1.15	0.22	2.02	0.99	4.48	5.16
Medium Density	40	Dwellings	550	0.02	2.2	0.05	1.15	0.06	2.02	0.25	1.13	1.30
Commercial	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Retail	0	Ha	27000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Light Industrial Park	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.30	0.00	0.00	0.00
School	0	No.	4450	0.00	1.6	0.00	1.15	0.00	2.50	0.00	0.00	0.00
Sports Ground	0	Ha	1945	0.00	1.6	0.00	1.15	0.00	1.50	0.00	0.00	0.00
Parklands	0	Ha	1945	0.00	1.6	0.00	1.15	0.00	1.50	0.00	0.00	0.00
Recycled Water Top Up	1	No.	0	0.00	1	0.00	1	0.00	1.00	0.00	0.00	0.00
Unaccounted Water	15%			0.02	1	0.02	1	0.02	1.00	0.19	0.19	0.19
Total				0.12		0.26		0.29		1.43	5.80	6.64

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.00	0.00
1.8	0.00	0.00
1.8	0.00	0.00
1.8	0.15	3.59
1.76	0.04	0.91
1.14	0.00	0.00
1.14	0.00	0.00
1.14	0.00	0.00
1.52	0.00	0.00
1.52	0.00	0.00
1.52	0.00	0.00
1	0.00	0.00
1	0.02	0.19
	0.21	4.68

2016												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extrem Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	20	Lots	780	0.02	2.25	0.04	1.15	0.04	2.02	0.18	0.82	0.94
HWC Point B	45	Lots	780	0.04	2.25	0.08	1.15	0.09	2.02	0.41	1.85	2.12
HWC Point C	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
Residential	355	Lots	275	0.10	2.25	0.22	1.15	0.25	2.02	1.13	5.14	5.91
Medium Density	65	Dwellings	275	0.02	2.2	0.04	1.15	0.05	2.02	0.21	0.92	1.06
Commercial	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Retail	0	Ha	27000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Light Industrial Park	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.30	0.00	0.00	0.00
School	0	No.	4450	0.00	1.6	0.00	1.15	0.00	2.50	0.00	0.00	0.00
Sports Ground	0	Ha	1945	0.00	1.6	0.00	1.15	0.00	1.50	0.00	0.00	0.00
Parklands	1	Ha	1945	0.00	1.6	0.00	1.15	0.00	1.50	0.02	0.05	0.06
Recycled Water Top Up	1	No.	90000	0.09	1	0.09	1	0.09	1.00	1.04	1.04	1.04
Unaccounted Water	15%			0.02	1	0.02	1	0.02	1.00	0.20	0.20	0.20
Total				0.23		0.37		0.41		2.60	7.35	8.27

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.03	0.66
1.8	0.06	1.48
1.8	0.00	0.00
1.8	0.18	4.11
1.76	0.03	0.74
1.14	0.00	0.00
1.14	0.00	0.00
1.14	0.00	0.00
1.52	0.00	0.00
1.52	0.00	0.00
1.52	0.00	0.00
1	0.09	1.04
1	0.02	0.20
	0.32	6.14

2017												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extrem Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	45	Lots	780	0.04	2.25	0.08	1.15	0.09	2.02	0.41	1.85	2.12
HWC Point B	90	Lots	780	0.07	2.25	0.16	1.15	0.18	2.02	0.81	3.69	4.25
HWC Point C	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
Residential	605	Lots	275	0.17	2.25	0.37	1.15	0.43	2.02	1.93	8.75	10.06
Medium Density	90	Dwellings	275	0.02	2.2	0.05	1.15	0.06	2.02	0.29	1.27	1.46
Commercial	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Retail	0	Ha	27000	0.00	1.2	0.00	1.15	0.00	1.90	0.00	0.00	0.00
Light Industrial Park	0	Ha	5000	0.00	1.2	0.00	1.15	0.00	1.30	0.00	0.00	0.00
School	0	No.	4450	0.00	1.6	0.00	1.15	0.00	2.50	0.00	0.00	0.00
Sports Ground	3.5	Ha	1945	0.01	1.6	0.01	1.15	0.01	1.50	0.08	0.19	0.22
Parklands	3	Ha	1945	0.01	1.6	0.01	1.15	0.01	1.50	0.07	0.16	0.19
Recycled Water Top Up	1	No.	180000	0.18	1	0.18	1	0.18	1.00	2.08	2.08	2.08
Unaccounted Water	15%			0.03	1	0.03	1	0.03	1.00	0.35	0.35	0.35
Total				0.41		0.66		0.73		4.80	12.81	14.37

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.06	1.48
1.8	0.13	2.95
1.8	0.00	0.00
1.8	0.30	7.00
1.76	0.04	1.02
1.14	0.00	0.00
1.14	0.00	0.00
1.14	0.00	0.00
1.52	0.00	0.00
1.52	0.01	0.18
1.52	0.01	0.15
1	0.18	2.08
1	0.03	0.35
	0.57	10.79

2018												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extrem Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	75	Lots	780	0.06	2.25	0.13	1.15	0.15	2.02	0.68	3.08	3.54
HWC Point B	135	Lots	780	0.11	2.25	0.24	1.15	0.27	2.02	1.22	5.54	6.37
HWC Point C	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
Residential	855	Lots	275	0.24	2.25	0.53	1.15	0.61	2.02	2.72	12.37	14.22
Medium Density	115	Dwellings	275	0.03	2.2	0.07	1.15	0.08	2.02	0.37	1.63	1.87
Commercial	2.5	Ha	5000	0.01	1.2	0.02	1.15	0.02	1.90	0.14	0.33	0.38
Retail	1	Ha	27000	0.03	1.2	0.03	1.15	0.04	1.90	0.31	0.71	0.82
Light Industrial Park	2	Ha	5000	0.01	1.2	0.01	1.15	0.01	1.30	0.12	0.18	0.21
School	1	No.	4450	0.00	1.6	0.01	1.15	0.01	2.50	0.05	0.21	0.24
Sports Ground	3.5	Ha	1945	0.01	1.6	0.01	1.15	0.01	1.50	0.08	0.19	0.22
Parklands	5	Ha	1945	0.01	1.6	0.02	1.15	0.02	1.50	0.11	0.27	0.31
Recycled Water Top Up	1	No.	270000	0.27	1	0.27	1	0.27	1.00	3.13	3.13	3.13
Unaccounted Water	15%			0.05	1	0.05	1	0.05	1.00	0.59	0.59	0.59
Total				0.66		1.01		1.12		7.61	19.59	21.98

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.11	2.46
1.8	0.19	4.43
1.8	0.00	0.00
1.8	0.42	9.89
1.76	0.06	1.30
1.14	0.01	0.31
1.14	0.03	0.68
1.14	0.01	0.17
1.52	0.01	0.20
1.52	0.01	0.18
1.52	0.01	0.26
1	0.27	3.13
1	0.05	0.59
	0.89	16.70

2019												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	90	Lots	780	0.07	2.25	0.16	1.15	0.18	2.02	0.81	3.69	4.25
HWC Point B	180	Lots	780	0.14	2.25	0.32	1.15	0.36	2.02	1.63	7.39	8.49
HWC Point C	0	Lots	780	0.00	2.25	0.00	1.15	0.00	2.02	0.00	0.00	0.00
Residential	1105	Lots	275	0.30	2.25	0.68	1.15	0.79	2.02	3.52	15.99	18.38
Medium Density	140	Dwellings	275	0.04	2.2	0.08	1.15	0.10	2.02	0.45	1.98	2.28
Commercial	2.5	Ha	5000	0.01	1.2	0.02	1.15	0.02	1.90	0.14	0.33	0.38
Retail	1	Ha	27000	0.03	1.2	0.03	1.15	0.04	1.90	0.31	0.71	0.82
Light Industrial Park	4	Ha	5000	0.02	1.2	0.02	1.15	0.03	1.30	0.23	0.36	0.42
School	1	No.	4450	0.00	1.6	0.01	1.15	0.01	2.50	0.05	0.21	0.24
Sports Ground	3.5	Ha	1945	0.01	1.6	0.01	1.15	0.01	1.50	0.08	0.19	0.22
Parklands	7	Ha	1945	0.01	1.6	0.02	1.15	0.03	1.50	0.16	0.38	0.43
Recycled Water Top Up	1	No.	360000	0.36	1	0.36	1	0.36	1.00	4.17	4.17	4.17
Unaccounted Water	15%			0.06	1	0.06	1	0.06	1.00	0.74	0.74	0.74
Total				0.85		1.30		1.44		9.85	25.05	28.07

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.13	2.95
1.8	0.25	5.91
1.8	0.00	0.00
1.8	0.55	12.79
1.76	0.07	1.58
1.14	0.01	0.31
1.14	0.03	0.68
1.14	0.02	0.34
1.52	0.01	0.20
1.52	0.01	0.18
1.52	0.02	0.36
1	0.36	4.17
1	0.06	0.74
	1.14	21.35

2020												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	130	Lots	780	0.10	2.25	0.23	1.15	0.26	2.02	1.17	5.33	6.13
HWC Point B	185	Lots	780	0.14	2.25	0.32	1.15	0.37	2.02	1.67	7.59	8.73
HWC Point C	40	Lots	780	0.03	2.25	0.07	1.15	0.08	2.02	0.36	1.64	1.89
Residential	1355	Lots	275	0.37	2.25	0.84	1.15	0.96	2.02	4.31	19.60	22.54
Medium Density	190	Dwellings	275	0.05	2.2	0.11	1.15	0.13	2.02	0.60	2.69	3.09
Commercial	2.5	Ha	5000	0.01	1.2	0.02	1.15	0.02	1.90	0.14	0.33	0.38
Retail	2	Ha	27000	0.05	1.2	0.06	1.15	0.07	1.90	0.63	1.43	1.64
Light Industrial Park	6	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.30	0.35	0.54	0.62
School	1	No.	4450	0.00	1.6	0.01	1.15	0.01	2.50	0.05	0.21	0.24
Sports Ground	7	Ha	1945	0.01	1.6	0.02	1.15	0.03	1.50	0.16	0.38	0.43
Parklands	9	Ha	1945	0.02	1.6	0.03	1.15	0.03	1.50	0.20	0.49	0.56
Recycled Water Top Up	1	No.	450000	0.45	1	0.45	1	0.45	1.00	5.21	5.21	5.21
Unaccounted Water	15%			0.08	1	0.08	1	0.08	1.00	0.97	0.97	0.97
Total				1.09		1.66		1.83		12.62	31.83	35.68

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.18	4.27
1.8	0.26	6.07
1.8	0.06	1.31
1.8	0.67	15.68
1.76	0.09	2.15
1.14	0.01	0.31
1.14	0.06	1.35
1.14	0.03	0.51
1.52	0.01	0.20
1.52	0.02	0.36
1.52	0.03	0.46
1	0.45	5.21
1	0.08	0.97
	1.46	27.21

2021												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	170	Lots	780	0.13	2.25	0.30	1.15	0.34	2.02	1.53	6.98	8.02
HWC Point B	190	Lots	780	0.15	2.25	0.33	1.15	0.38	2.02	1.72	7.80	8.97
HWC Point C	80	Lots	780	0.06	2.25	0.14	1.15	0.16	2.02	0.72	3.28	3.77
Residential	1605	Lots	275	0.44	2.25	0.99	1.15	1.14	2.02	5.11	23.22	26.70
Medium Density	240	Dwellings	275	0.07	2.2	0.15	1.15	0.17	2.02	0.76	3.39	3.90
Commercial	2.5	Ha	5000	0.01	1.2	0.02	1.15	0.02	1.90	0.14	0.33	0.38
Retail	2	Ha	27000	0.05	1.2	0.06	1.15	0.07	1.90	0.63	1.43	1.64
Light Industrial Park	8	Ha	5000	0.04	1.2	0.05	1.15	0.06	1.30	0.46	0.72	0.83
School	1	No.	4450	0.00	1.6	0.01	1.15	0.01	2.50	0.05	0.21	0.24
Sports Ground	7	Ha	1945	0.01	1.6	0.02	1.15	0.03	1.50	0.16	0.38	0.43
Parklands	10.5	Ha	1945	0.02	1.6	0.03	1.15	0.04	1.50	0.24	0.57	0.65
Recycled Water Top Up	1	No.	540000	0.54	1	0.54	1	0.54	1.00	6.25	6.25	6.25
Unaccounted Water	15%			0.10	1	0.10	1	0.10	1.00	1.13	1.13	1.13
Total				1.29		1.97		2.16		14.93	37.62	42.16

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.24	5.58
1.8	0.27	6.24
1.8	0.11	2.63
1.8	0.79	18.57
1.76	0.12	2.72
1.14	0.01	0.31
1.14	0.06	1.35
1.14	0.05	0.69
1.52	0.01	0.20
1.52	0.02	0.36
1.52	0.03	0.54
1	0.54	6.25
1	0.10	1.13
	1.73	32.12

2022												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	210	Lots	780	0.16	2.25	0.37	1.15	0.42	2.02	1.90	8.62	9.91
HWC Point B	195	Lots	780	0.15	2.25	0.34	1.15	0.39	2.02	1.76	8.00	9.20
HWC Point C	120	Lots	780	0.09	2.25	0.21	1.15	0.24	2.02	1.08	4.92	5.66
Residential	1855	Lots	275	0.51	2.25	1.15	1.15	1.32	2.02	5.90	26.83	30.86
Medium Density	290	Dwellings	275	0.08	2.2	0.18	1.15	0.20	2.02	0.92	4.10	4.72
Commercial	4.5	Ha	5000	0.02	1.2	0.03	1.15	0.03	1.90	0.26	0.59	0.68
Retail	3	Ha	27000	0.08	1.2	0.10	1.15	0.11	1.90	0.94	2.14	2.46
Light Industrial Park	10	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.30	0.58	0.90	1.04
School	1	No.	4450	0.00	1.6	0.01	1.15	0.01	2.50	0.05	0.21	0.24
Sports Ground	7	Ha	1945	0.01	1.6	0.02	1.15	0.03	1.50	0.16	0.38	0.43
Parklands	12	Ha	1945	0.02	1.6	0.04	1.15	0.04	1.50	0.27	0.65	0.75
Recycled Water Top Up	1	No.	630000	0.63	1	0.63	1	0.63	1.00	7.29	7.29	7.29
Unaccounted Water	15%			0.12	1	0.12	1	0.12	1.00	1.36	1.36	1.36
Total				1.53		2.32		2.56		17.74	44.46	49.83

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.29	6.89
1.8	0.27	6.40
1.8	0.17	3.94
1.8	0.92	21.47
1.76	0.14	3.28
1.14	0.03	0.56
1.14	0.09	2.03
1.14	0.06	0.86
1.52	0.01	0.20
1.52	0.02	0.36
1.52	0.04	0.62
1	0.63	7.29
1	0.12	1.36
	2.04	38.03

2023												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	250	Lots	780	0.20	2.25	0.44	1.15	0.50	2.02	2.26	10.26	11.80
HWC Point B	200	Lots	780	0.16	2.25	0.35	1.15	0.40	2.02	1.81	8.21	9.44
HWC Point C	160	Lots	780	0.12	2.25	0.28	1.15	0.32	2.02	1.44	6.57	7.55
Residential	2105	Lots	275	0.58	2.25	1.30	1.15	1.50	2.02	6.70	30.45	35.02
Medium Density	340	Dwellings	275	0.09	2.2	0.21	1.15	0.24	2.02	1.08	4.81	5.53
Commercial	4.5	Ha	5000	0.02	1.2	0.03	1.15	0.03	1.90	0.26	0.59	0.68
Retail	3	Ha	27000	0.08	1.2	0.10	1.15	0.11	1.90	0.94	2.14	2.46
Light Industrial Park	12	Ha	5000	0.06	1.2	0.07	1.15	0.08	1.30	0.69	1.08	1.25
School	2	No.	4450	0.01	1.6	0.01	1.15	0.02	2.50	0.10	0.41	0.47
Sports Ground	10.5	Ha	1945	0.02	1.6	0.03	1.15	0.04	1.50	0.24	0.57	0.65
Parklands	13.5	Ha	1945	0.03	1.6	0.04	1.15	0.05	1.50	0.30	0.73	0.84
Recycled Water Top Up	1	No.	720000	0.72	1	0.72	1	0.72	1.00	8.33	8.33	8.33
Unaccounted Water	15%			0.13	1	0.13	1	0.13	1.00	1.55	1.55	1.55
Total				1.75		2.65		2.92		20.20	50.66	56.78

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.35	8.21
1.8	0.28	6.57
1.8	0.22	5.25
1.8	1.04	24.36
1.76	0.16	3.85
1.14	0.03	0.56
1.14	0.09	2.03
1.14	0.07	1.03
1.52	0.01	0.39
1.52	0.03	0.54
1.52	0.04	0.69
1	0.72	8.33
1	0.13	1.55
	2.33	43.34

2024												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	275	Lots	780	0.21	2.25	0.48	1.15	0.56	2.02	2.48	11.28	12.98
HWC Point B	205	Lots	780	0.16	2.25	0.36	1.15	0.41	2.02	1.85	8.41	9.67
HWC Point C	200	Lots	780	0.16	2.25	0.35	1.15	0.40	2.02	1.81	8.21	9.44
Residential	2355	Lots	275	0.65	2.25	1.46	1.15	1.68	2.02	7.50	34.07	39.18
Medium Density	390	Dwellings	275	0.11	2.2	0.24	1.15	0.27	2.02	1.24	5.52	6.34
Commercial	4.5	Ha	5000	0.02	1.2	0.03	1.15	0.03	1.90	0.26	0.59	0.68
Retail	4	Ha	27000	0.11	1.2	0.13	1.15	0.15	1.90	1.25	2.85	3.28
Light Industrial Park	14	Ha	5000	0.07	1.2	0.08	1.15	0.10	1.30	0.81	1.26	1.45
School	2	No.	4450	0.01	1.6	0.01	1.15	0.02	2.50	0.10	0.41	0.47
Sports Ground	10.5	Ha	1945	0.02	1.6	0.03	1.15	0.04	1.50	0.24	0.57	0.65
Parklands	15	Ha	1945	0.03	1.6	0.05	1.15	0.05	1.50	0.34	0.81	0.93
Recycled Water Top Up	1	No.	810000	0.81	1	0.81	1	0.81	1.00	9.38	9.38	9.38
Unaccounted Water	15%			0.15	1	0.15	1	0.15	1.00	1.76	1.76	1.76
Total				1.98		2.99		3.29		22.87	57.22	64.13

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.39	9.03
1.8	0.29	6.73
1.8	0.28	6.57
1.8	1.17	27.25
1.76	0.19	4.41
1.14	0.03	0.56
1.14	0.12	2.71
1.14	0.08	1.20
1.52	0.01	0.39
1.52	0.03	0.54
1.52	0.04	0.77
1	0.81	9.38
1	0.15	1.76
	2.63	48.98

2025												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	300	Lots	780	0.23	2.25	0.53	1.15	0.61	2.02	2.71	12.31	14.16
HWC Point B	210	Lots	780	0.16	2.25	0.37	1.15	0.42	2.02	1.90	8.62	9.91
HWC Point C	240	Lots	780	0.19	2.25	0.42	1.15	0.48	2.02	2.17	9.85	11.32
Residential	2605	Lots	275	0.72	2.25	1.61	1.15	1.85	2.02	8.29	37.68	43.34
Medium Density	440	Dwellings	275	0.12	2.2	0.27	1.15	0.31	2.02	1.40	6.22	7.16
Commercial	6.5	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.90	0.38	0.86	0.99
Retail	4	Ha	27000	0.11	1.2	0.13	1.15	0.15	1.90	1.25	2.85	3.28
Light Industrial Park	16	Ha	5000	0.08	1.2	0.10	1.15	0.11	1.30	0.93	1.44	1.66
School	2	No.	4450	0.01	1.6	0.01	1.15	0.02	2.50	0.10	0.41	0.47
Sports Ground	10.5	Ha	1945	0.02	1.6	0.03	1.15	0.04	1.50	0.24	0.57	0.65
Parklands	16.5	Ha	1945	0.03	1.6	0.05	1.15	0.06	1.50	0.37	0.89	1.03
Recycled Water Top Up	1	No.	900000	0.90	1	0.90	1	0.90	1.00	10.42	10.42	10.42
Unaccounted Water	15%			0.17	1	0.17	1	0.17	1.00	1.94	1.94	1.94
Total				2.19		3.31		3.64		25.31	63.29	70.93

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.42	9.85
1.8	0.29	6.89
1.8	0.34	7.88
1.8	1.29	30.15
1.76	0.21	4.98
1.14	0.04	0.81
1.14	0.12	2.71
1.14	0.09	1.37
1.52	0.01	0.39
1.52	0.03	0.54
1.52	0.05	0.85
1	0.90	10.42
1	0.17	1.94
	2.92	54.16

2026												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	325	Lots	780	0.25	2.25	0.57	1.15	0.66	2.02	2.93	13.34	15.34
HWC Point B	215	Lots	780	0.17	2.25	0.38	1.15	0.43	2.02	1.94	8.82	10.14
HWC Point C	280	Lots	780	0.22	2.25	0.49	1.15	0.57	2.02	2.53	11.49	13.21
Residential	2855	Lots	275	0.79	2.25	1.77	1.15	2.03	2.02	9.09	41.30	47.50
Medium Density	490	Dwellings	275	0.13	2.2	0.30	1.15	0.34	2.02	1.56	6.93	7.97
Commercial	6.5	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.90	0.38	0.86	0.99
Retail	5	Ha	27000	0.14	1.2	0.16	1.15	0.19	1.90	1.56	3.56	4.10
Light Industrial Park	18	Ha	5000	0.09	1.2	0.11	1.15	0.12	1.30	1.04	1.63	1.87
School	2	No.	4450	0.01	1.6	0.01	1.15	0.02	2.50	0.10	0.41	0.47
Sports Ground	14	Ha	1945	0.03	1.6	0.04	1.15	0.05	1.50	0.32	0.76	0.87
Parklands	18	Ha	1945	0.04	1.6	0.06	1.15	0.06	1.50	0.41	0.97	1.12
Recycled Water Top Up	1	No.	990000	0.99	1	0.99	1	0.99	1.00	11.46	11.46	11.46
Unaccounted Water	15%			0.19	1	0.19	1	0.19	1.00	2.17	2.17	2.17
Total				2.43		3.66		4.04		28.08	70.04	78.51

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.46	10.67
1.8	0.30	7.06
1.8	0.39	9.19
1.8	1.41	33.04
1.76	0.24	5.54
1.14	0.04	0.81
1.14	0.15	3.38
1.14	0.10	1.54
1.52	0.01	0.39
1.52	0.04	0.72
1.52	0.05	0.92
1	0.99	11.46
1	0.19	2.17
	3.23	59.99

2027												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	350	Lots	780	0.27	2.25	0.61	1.15	0.71	2.02	3.16	14.36	16.52
HWC Point B	220	Lots	780	0.17	2.25	0.39	1.15	0.44	2.02	1.99	9.03	10.38
HWC Point C	320	Lots	780	0.25	2.25	0.56	1.15	0.65	2.02	2.89	13.13	15.10
Residential	3105	Lots	275	0.85	2.25	1.92	1.15	2.21	2.02	9.88	44.92	51.65
Medium Density	540	Dwellings	275	0.15	2.2	0.33	1.15	0.38	2.02	1.72	7.64	8.78
Commercial	6.5	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.90	0.38	0.86	0.99
Retail	5	Ha	27000	0.14	1.2	0.16	1.15	0.19	1.90	1.56	3.56	4.10
Light Industrial Park	20	Ha	5000	0.10	1.2	0.12	1.15	0.14	1.30	1.16	1.81	2.08
School	2	No.	4450	0.01	1.6	0.01	1.15	0.02	2.50	0.10	0.41	0.47
Sports Ground	14	Ha	1945	0.03	1.6	0.04	1.15	0.05	1.50	0.32	0.76	0.87
Parklands	19.5	Ha	1945	0.04	1.6	0.06	1.15	0.07	1.50	0.44	1.05	1.21
Recycled Water Top Up	1	No.	1080000	1.08	1	1.08	1	1.08	1.00	12.50	12.50	12.50
Unaccounted Water	15%			0.20	1	0.20	1	0.20	1.00	2.33	2.33	2.33
Total				2.63		3.97		4.37		30.39	75.84	84.99

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.49	11.49
1.8	0.31	7.22
1.8	0.45	10.50
1.8	1.54	35.93
1.76	0.26	6.11
1.14	0.04	0.81
1.14	0.15	3.38
1.14	0.11	1.72
1.52	0.01	0.39
1.52	0.04	0.72
1.52	0.06	1.00
1	1.08	12.50
1	0.20	2.33
	3.50	64.90

2028												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	375	Lots	780	0.29	2.25	0.66	1.15	0.76	2.02	3.39	15.39	17.69
HWC Point B	225	Lots	780	0.18	2.25	0.39	1.15	0.45	2.02	2.03	9.23	10.62
HWC Point C	360	Lots	780	0.28	2.25	0.63	1.15	0.73	2.02	3.25	14.77	16.99
Residential	3355	Lots	275	0.92	2.25	2.08	1.15	2.39	2.02	10.68	48.53	55.81
Medium Density	590	Dwellings	275	0.16	2.2	0.36	1.15	0.41	2.02	1.88	8.35	9.60
Commercial	6.5	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.90	0.38	0.86	0.99
Retail	6	Ha	27000	0.16	1.2	0.19	1.15	0.22	1.90	1.88	4.28	4.92
Light Industrial Park	22	Ha	5000	0.11	1.2	0.13	1.15	0.15	1.30	1.27	1.99	2.28
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	14	Ha	1945	0.03	1.6	0.04	1.15	0.05	1.50	0.32	0.76	0.87
Parklands	21	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.47	1.13	1.30
Recycled Water Top Up	1	No.	1170000	1.17	1	1.17	1	1.17	1.00	13.54	13.54	13.54
Unaccounted Water	15%			0.22	1	0.22	1	0.22	1.00	2.55	2.55	2.55
Total				2.86		4.32		4.76		33.12	82.60	92.58

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.53	12.31
1.8	0.32	7.39
1.8	0.51	11.82
1.8	1.66	38.83
1.76	0.29	6.68
1.14	0.04	0.81
1.14	0.18	4.06
1.14	0.13	1.89
1.52	0.02	0.59
1.52	0.04	0.72
1.52	0.06	1.08
1	1.17	13.54
1	0.22	2.55
	3.81	70.74

2029												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	400	Lots	780	0.31	2.25	0.70	1.15	0.81	2.02	3.61	16.41	18.87
HWC Point B	230	Lots	780	0.18	2.25	0.40	1.15	0.46	2.02	2.08	9.44	10.85
HWC Point C	400	Lots	780	0.31	2.25	0.70	1.15	0.81	2.02	3.61	16.41	18.87
Residential	3605	Lots	275	0.99	2.25	2.23	1.15	2.57	2.02	11.47	52.15	59.97
Medium Density	640	Dwellings	275	0.18	2.2	0.39	1.15	0.45	2.02	2.04	9.05	10.41
Commercial	6.5	Ha	5000	0.03	1.2	0.04	1.15	0.04	1.90	0.38	0.86	0.99
Retail	7	Ha	27000	0.19	1.2	0.23	1.15	0.26	1.90	2.19	4.99	5.74
Light Industrial Park	24	Ha	5000	0.12	1.2	0.14	1.15	0.17	1.30	1.39	2.17	2.49
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	17.5	Ha	1945	0.03	1.6	0.05	1.15	0.06	1.50	0.39	0.95	1.09
Parklands	22.5	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.51	1.22	1.40
Recycled Water Top Up	1	No.	1260000	1.26	1	1.26	1	1.26	1.00	14.58	14.58	14.58
Unaccounted Water	15%			0.24	1	0.24	1	0.24	1.00	2.78	2.78	2.78
Total				3.10		4.67		5.15		35.88	89.36	100.15

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.56	13.13
1.8	0.32	7.55
1.8	0.56	13.13
1.8	1.78	41.72
1.76	0.31	7.24
1.14	0.04	0.81
1.14	0.22	4.74
1.14	0.14	2.06
1.52	0.02	0.59
1.52	0.05	0.90
1.52	0.07	1.15
1	1.26	14.58
1	0.24	2.78
	4.12	76.58

2030												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	425	Lots	780	0.33	2.25	0.75	1.15	0.86	2.02	3.84	17.44	20.05
HWC Point B	235	Lots	780	0.18	2.25	0.41	1.15	0.47	2.02	2.12	9.64	11.09
HWC Point C	440	Lots	780	0.34	2.25	0.77	1.15	0.89	2.02	3.97	18.05	20.76
Residential	3855	Lots	275	1.06	2.25	2.39	1.15	2.74	2.02	12.27	55.77	64.13
Medium Density	690	Dwellings	275	0.19	2.2	0.42	1.15	0.48	2.02	2.20	9.76	11.22
Commercial	8.5	Ha	5000	0.04	1.2	0.05	1.15	0.06	1.90	0.49	1.12	1.29
Retail	8	Ha	27000	0.22	1.2	0.26	1.15	0.30	1.90	2.50	5.70	6.56
Light Industrial Park	26	Ha	5000	0.13	1.2	0.16	1.15	0.18	1.30	1.50	2.35	2.70
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	17.5	Ha	1945	0.03	1.6	0.05	1.15	0.06	1.50	0.39	0.95	1.09
Parklands	24	Ha	1945	0.05	1.6	0.07	1.15	0.09	1.50	0.54	1.30	1.49
Recycled Water Top Up	1	No.	1350000	1.35	1	1.35	1	1.35	1.00	15.63	15.63	15.63
Unaccounted Water	15%			0.26	1	0.26	1	0.26	1.00	3.01	3.01	3.01
Total				3.34		5.03		5.54		38.68	96.19	107.82

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.60	13.95
1.8	0.33	7.71
1.8	0.62	14.44
1.8	1.91	44.61
1.76	0.33	7.81
1.14	0.05	1.07
1.14	0.25	5.42
1.14	0.15	2.23
1.52	0.02	0.59
1.52	0.05	0.90
1.52	0.07	1.23
1	1.35	15.63
1	0.26	3.01
	4.44	82.48

2035												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	550	Lots	780	0.43	2.25	0.97	1.15	1.11	2.02	4.97	22.57	25.95
HWC Point B	260	Lots	780	0.20	2.25	0.46	1.15	0.52	2.02	2.35	10.67	12.27
HWC Point C	640	Lots	780	0.50	2.25	1.12	1.15	1.29	2.02	5.78	26.26	30.20
Residential	5105	Lots	275	1.40	2.25	3.16	1.15	3.63	2.02	16.25	73.85	84.93
Medium Density	940	Dwellings	275	0.26	2.2	0.57	1.15	0.65	2.02	2.99	13.30	15.29
Commercial	9.5	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.90	0.55	1.25	1.44
Retail	9	Ha	27000	0.24	1.2	0.29	1.15	0.34	1.90	2.81	6.41	7.37
Light Industrial Park	41	Ha	5000	0.21	1.2	0.25	1.15	0.28	1.30	2.37	3.70	4.26
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	17.5	Ha	1945	0.03	1.6	0.05	1.15	0.06	1.50	0.39	0.95	1.09
Parklands	26	Ha	1945	0.05	1.6	0.08	1.15	0.09	1.50	0.59	1.40	1.62
Recycled Water Top Up	1	No.	1440000	1.44	1	1.44	1	1.44	1.00	16.67	16.67	16.67
Unaccounted Water	15%			0.34	1	0.34	1	0.34	1.00	3.92	3.92	3.92
Total				4.03		6.26		6.93		46.69	122.06	137.29

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.77	18.05
1.8	0.37	8.53
1.8	0.90	21.01
1.8	2.53	59.08
1.76	0.45	10.64
1.14	0.05	1.19
1.14	0.28	6.09
1.14	0.23	3.52
1.52	0.02	0.59
1.52	0.05	0.90
1.52	0.08	1.33
1	1.44	16.67
1	0.34	3.92
	5.47	103.92

2040												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	675	Lots	780	0.53	2.25	1.18	1.15	1.36	2.02	6.09	27.70	31.85
HWC Point B	285	Lots	780	0.22	2.25	0.50	1.15	0.58	2.02	2.57	11.69	13.45
HWC Point C	840	Lots	780	0.66	2.25	1.47	1.15	1.70	2.02	7.58	34.47	39.64
Residential	6355	Lots	275	1.75	2.25	3.93	1.15	4.52	2.02	20.23	91.93	105.72
Medium Density	1145	Dwellings	275	0.31	2.2	0.69	1.15	0.80	2.02	3.64	16.20	18.63
Commercial	10.5	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.90	0.61	1.39	1.59
Retail	10	Ha	27000	0.27	1.2	0.32	1.15	0.37	1.90	3.13	7.13	8.19
Light Industrial Park	60	Ha	5000	0.30	1.2	0.36	1.15	0.41	1.30	3.47	5.42	6.23
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	21	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.47	1.13	1.30
Parklands	28	Ha	1945	0.05	1.6	0.09	1.15	0.10	1.50	0.63	1.51	1.74
Recycled Water Top Up	1	No.	1500000	1.50	1	1.50	1	1.50	1.00	17.36	17.36	17.36
Unaccounted Water	15%			0.42	1	0.42	1	0.42	1.00	4.85	4.85	4.85
Total				4.71		7.46		8.30		54.55	147.53	166.33

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	0.95	22.16
1.8	0.40	9.36
1.8	1.18	27.57
1.8	3.15	73.55
1.76	0.55	12.96
1.14	0.06	1.32
1.14	0.31	6.77
1.14	0.34	5.15
1.52	0.02	0.59
1.52	0.06	1.08
1.52	0.08	1.44
1	1.50	17.36
1	0.42	4.85
	6.49	125.05

2050												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	925	Lots	780	0.72	2.25	1.62	1.15	1.87	2.02	8.35	37.95	43.65
HWC Point B	335	Lots	780	0.26	2.25	0.59	1.15	0.68	2.02	3.02	13.75	15.81
HWC Point C	1240	Lots	780	0.97	2.25	2.18	1.15	2.50	2.02	11.19	50.88	58.51
Residential	6355	Lots	275	1.75	2.25	3.93	1.15	4.52	2.02	20.23	91.93	105.72
Medium Density	1145	Dwellings	275	0.31	2.2	0.69	1.15	0.80	2.02	3.64	16.20	18.63
Commercial	10.5	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.90	0.61	1.39	1.59
Retail	10	Ha	27000	0.27	1.2	0.32	1.15	0.37	1.90	3.13	7.13	8.19
Light Industrial Park	60	Ha	5000	0.30	1.2	0.36	1.15	0.41	1.30	3.47	5.42	6.23
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	21	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.47	1.13	1.30
Parklands	28	Ha	1945	0.05	1.6	0.09	1.15	0.10	1.50	0.63	1.51	1.74
Recycled Water Top Up	1	No.	1500000	1.50	1	1.50	1	1.50	1.00	17.36	17.36	17.36
Unaccounted Water	15%			0.42	1	0.42	1	0.42	1.00	4.85	4.85	4.85
Total				4.71		7.46		8.30		54.55	147.53	166.33

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	1.30	30.36
1.8	0.47	11.00
1.8	1.74	40.70
1.8	3.15	73.55
1.76	0.55	12.96
1.14	0.06	1.32
1.14	0.31	6.77
1.14	0.34	5.15
1.52	0.02	0.59
1.52	0.06	1.08
1.52	0.08	1.44
1	1.50	17.36
1	0.42	4.85
	6.49	125.05

2055												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	1050	Lots	780	0.82	2.25	1.84	1.15	2.12	2.02	9.48	43.08	49.55
HWC Point B	412	Lots	780	0.32	2.25	0.72	1.15	0.83	2.02	3.72	16.90	19.44
HWC Point C	1360	Lots	780	1.06	2.25	2.39	1.15	2.74	2.02	12.28	55.80	64.17
Residential	6355	Lots	275	1.75	2.25	3.93	1.15	4.52	2.02	20.23	91.93	105.72
Medium Density	1145	Dwellings	275	0.31	2.2	0.69	1.15	0.80	2.02	3.64	16.20	18.63
Commercial	10.5	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.90	0.61	1.39	1.59
Retail	10	Ha	27000	0.27	1.2	0.32	1.15	0.37	1.90	3.13	7.13	8.19
Light Industrial Park	60	Ha	5000	0.30	1.2	0.36	1.15	0.41	1.30	3.47	5.42	6.23
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	21	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.47	1.13	1.30
Parklands	28	Ha	1945	0.05	1.6	0.09	1.15	0.10	1.50	0.63	1.51	1.74
Recycled Water Top Up	1	No.	1500000	1.50	1	1.50	1	1.50	1.00	17.36	17.36	17.36
Unaccounted Water	15%			0.42	1	0.42	1	0.42	1.00	4.85	4.85	4.85
Total				4.71		7.46		8.30		54.55	147.53	166.33

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	1.47	34.47
1.8	0.58	13.52
1.8	1.91	44.64
1.8	3.15	73.55
1.76	0.55	12.96
1.14	0.06	1.32
1.14	0.31	6.77
1.14	0.34	5.15
1.52	0.02	0.59
1.52	0.06	1.08
1.52	0.08	1.44
1	1.50	17.36
1	0.42	4.85
	6.49	125.05

Ultimate												
	No.	Units	Unit Demand (L)	Average Day Demand (ML)	Peak Day Factor	Peak Day Demand (ML)	Extreme Day Factor	Extreme Day Demand (ML)	Peak/Extreme Hour Factor	Average Demand (L/s)	Peak Hour Demand (L/s)	Extreme Hour Demand (L/s)
HWC Point A	1086	Lots	780	0.85	2.25	1.91	1.15	2.19	2.02	9.80	44.56	51.24
HWC Point B	412	Lots	780	0.32	2.25	0.72	1.15	0.83	2.02	3.72	16.90	19.44
HWC Point C	1360	Lots	780	1.06	2.25	2.39	1.15	2.74	2.02	12.28	55.80	64.17
Residential	6355	Lots	275	1.75	2.25	3.93	1.15	4.52	2.02	20.23	91.93	105.72
Medium Density	1145	Dwellings	275	0.31	2.2	0.69	1.15	0.80	2.02	3.64	16.20	18.63
Commercial	10.5	Ha	5000	0.05	1.2	0.06	1.15	0.07	1.90	0.61	1.39	1.59
Retail	10	Ha	27000	0.27	1.2	0.32	1.15	0.37	1.90	3.13	7.13	8.19
Light Industrial Park	60	Ha	5000	0.30	1.2	0.36	1.15	0.41	1.30	3.47	5.42	6.23
School	3	No.	4450	0.01	1.6	0.02	1.15	0.02	2.50	0.15	0.62	0.71
Sports Ground	21	Ha	1945	0.04	1.6	0.07	1.15	0.08	1.50	0.47	1.13	1.30
Parklands	28	Ha	1945	0.05	1.6	0.09	1.15	0.10	1.50	0.63	1.51	1.74
Recycled Water Top Up	1	No.	1500000	1.50	1	1.50	1	1.50	1.00	17.36	17.36	17.36
Unaccounted Water	15%			0.42	1	0.42	1	0.42	1.00	4.85	4.85	4.85
Total				4.71		7.46		8.30		54.55	147.53	166.33

Fire		
95th % Factor	95% Peak Day Demand (ML)	95% Peak Hour Demand (L/s)
1.8	1.52	35.65
1.8	0.58	13.52
1.8	1.91	44.64
1.8	3.15	73.55
1.76	0.55	12.96
1.14	0.06	1.32
1.14	0.31	6.77
1.14	0.34	5.15
1.52	0.02	0.59
1.52	0.06	1.08
1.52	0.08	1.44
1	1.50	17.36
1	0.42	4.85
	6.49	125.05



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HUNTLEE PTY LTD AND HUNTLEE WATER
HUNTLEE RESIDENTIAL DEVELOPMENT
BULK WATER SERVICING STRATEGY

Appendix C – Lifecycle Cost Analysis

[illegible][illegible][illegible][illegible]

Costs	
2010/2011 Energy Cost	0.157 / kWh
Annual Real Energy Increase	2.18%
2010/2011 GHG Cost	25.00 / tonnes CO ₂ -e
Real GHG Increase	3.52%

[illegible]



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Appendix D – Model Inputs

MODEL INPUTS

Item	Value
Nodes	
Point A	33m AD
Point B	42m AD
Point C	85m AD
WCD Connection Point	55m AD
NEH Connection Point	47m AD
Reservoirs	
BWL	105m AD
TWL	115m AD
Initial Reservoir Level	115m AD
2015	N/A
2016	N/A
2017	2ML
2018	2ML
2019	2ML
2020	2ML
2021	4ML
2022	4ML
2023	4ML
2024	4ML
2025	4ML
2026	6ML
2027	6ML
2028	6ML
2029	6ML
2030	6ML
2035	8ML
2040	8ML
2050	8ML
2055	8ML
Ultimate	8ML
Pipelines	
DICL (PN35)	Dia = 401mm, k = 0.3
PVC-M (PN16)	Dia = 387mm, k = 0.06
Pumps	
<u>HWC Greta WPS</u>	Turned off (2015) Turned on (2016) Turned off (2017- Ultimate)
<u>Huntlee Reservoir Delivery WPS</u>	
2015	N/A
2016	N/A
2017	N/A
2018	N/A
2019	13.5 L/s
2020	17 L/s
2021	20 L/s
2022	24 L/s

2023	27 L/s
2024	30.5 L/s
2025	34 L/s
2026	37.5 L/s
2027	40.5 L/s
2028	44.5 L/s
2029	48 L/s
2030	51.5 L/s
2035	65 L/s
2040	75 L/s
2050	75 L/s
2055	75 L/s
Ultimate	75 L/s

Appendix F – On-Site Wastewater Servicing Plan



Whitehead & Associates
Environmental Consultants

Mr Glenn Swan
Swan Project Advisory Pty Ltd
Ref: 3579_WSP_001
Email: glenn@swanprojects.com.au

14 November 2023

On-Site Wastewater Servicing Plan for proposed rural residential subdivision at Hanwood Road, North Rothbury, NSW

Whitehead & Associates Environmental Consultants Pty Ltd ("W&A") was engaged by Mr Glenn Swan from Swan Project Advisory Pty Ltd to prepare an On-Site Wastewater Servicing Plan (WSP) for a proposed large-lot residential subdivision development at Hanwood Road, North Rothbury (the "Site") as shown in Figure 1, Appendix A.

The Site, identified as Lot 13, DP 1137569, is approximately 43.01ha in area and is zoned R5 (Large Lot Residential) by both Cessnock Local Environmental Plan (LEP) (2011) and Singleton LEP (2013). The lot straddles and forms part of the greater 'Huntlee' Masterplan development area. It is understood that the owner intends to submit a Development Application (DA) for subdivision of the Site into 36 residential lots ranging from 0.55 to 1.7ha in size. The proposal also includes 3 lots for drainage and open space recreation purposes. Access to the Site will be provided by two (2) new access entries from Old North Road. The proposed subdivision layout is attached on the Site Plan (Figure 2, Appendix A).

The Site is largely forested, with smaller clearings for pasture/grazing along the eastern and southern boundaries. The Site contains a small dam in the south-east and includes intermittent waterways (dry creeks). The Site is identified as moderate-high bushfire risk and includes Biodiversity Values.

Councils will require the preparation of a detailed Wastewater Management Report (WMR) for submission with the DA to demonstrate that sustainable wastewater management is achievable following the proposed subdivision at the Site.

This WSP assesses the suitability and sustainability of unsewered On-site Sewage Management (OSSM) for the proposed subdivision lots. Special consideration will be given to performance, environmental outcomes and cost effectiveness of the recommended OSSM servicing approaches.

This WMR presents the results of a detailed site and soil assessment that considers the inherent conditions and constraints of the Site with regard to 'domestic' OSSM. Where appropriate, recommendations are provided for OSSM system design and management measures necessary to ensure compliance with the relevant standards and guidelines currently enforced by Council.

1 Author Statement

This WMR was prepared by Prabin Raut. Prabin is an Environmental Consultant with W&A, holding a Graduate Diploma Degree in Water, Wastewater and Waste Engineering from University of New South Wales in 2020.

2 Introduction

For the preparation of this report, the assessment and design principles outlined in the following standards and reports have been referred to:

- *AS/NZS 1547:2012 On-Site Domestic Wastewater Management* (Standards Australia/Standards New Zealand, 2012);
- *Environment & Health Protection Guidelines: On-Site Sewage Management for Single Households* (Department of Local Government, 1998);
- Cessnock City Council's Local Environment Plan (2011);
- Cessnock City Council's Development Control Plan – Specific areas E17 - Huntlee (2010);
- Cessnock City Council's On-Site Sewage Management Strategy (2010-2012);
- Singleton Local Environmental Plan (2013);
- Singleton Development Control Plan (2014).

The following table presents salient information about the property investigated:

Feature	Description
Site Address	Hanwood Road, North Rothbury, NSW
Lot/ DP	Lot 13 / DP 1137569
Local Government Area	Cessnock City Council & Singleton Council
Land Zoning	R 5 - Large Lot Residential (pub. 16-6-2023) R 5 - Large Lot Residential (pub. 21-4-2023)
Proposed Lots	39 (36 residential and 3 open spaces)
Total Lot Size (ha)	43.01
Individual Lot Range (ha)	0.55-1.7
Dwelling size (per lot)	5 Bedroom (conservative assumption)
Sewer Connection Available	No
Potable Water Supply	Reticulated Water Supply (Hunter Water)

3 Site and Soil Assessment

A site and soil investigation was taken by Prabin Raut and Ben Colautti of Whitehead & Associates Environmental Consultants Pty Ltd. ("W & A") on the 4th of October 2023. The site investigation results are presented in the following tables and include descriptions of the site constraints and the degree of limitation they pose to OSSM within the available Effluent Management Area (EMA). Reference is made to the rating scale in Table 4 of NSW DLG (1998).

SITE ASSESSMENT				
Parameter	Data/Observation	Reference		Classification /Outcome
Climate	Temperate climate with median annual rainfall of 580mm. Monthly minimum rainfall is 23.7mm in July and maximum in February at 77.7mm. Average Annual evaporation is 1468.6mm. Average evaporation exceeds median rainfall for all months.	Data Drill for Lat, Long: - 32.70 151.30. Elevation of 73m For the years 1/1/1960 to 18/9/2023 (63 years)		Minor Limitation
Land Application Area (LAA) sizing Hydraulic Balance (monthly) attached: Nutrient Balance (annual) attached: LAA sizing attached:		Yes Yes Yes		As per NSW DLG (1998) and AS/NZS 1547:2012 procedures
Flooding Land application area above 5% AEP flood level: Land application area above 1% AEP flood level:		Yes Yes	Cessnock City Council: Black Creek Flood Study - Stage two: Nulkaba to Branxton - final report, 2015	Moderate Limitation
Electrical components above 1% AEP flood level:		Yes		
Exposure	At present, the site is forested with native trees and shrubs with medium exposure. After vegetation clearing for development of the lots, the exposure to sun and prevailing wind is expected to be good.	Minor Limitation		
Slope	The land altitude varies considerably from an elevation of 42m at the main gate at Old North Road to a summit at an elevation of 102m. Slopes vary across the Site with slopes in some small areas greater than 20%.	Minor Limitation		
Landform	Undulating and rolling low hills. Landforms vary across the site with available EMAs exhibiting waning, waxing, divergent and a few convergent slope configurations.	Minor Limitation		
Run-on and Seepage	No run – on or up slope seepage observed during site investigation.	Minor Limitation		

SITE ASSESSMENT			
Parameter	Data/Observation	Reference	Classification /Outcome
	Stormwater from up-slope and roof run-off must be directed away from the LAAs. Mitigation measures for seepage and run-off recommended (refer section 8.3)		
Erosion Potential	Some rill and gully erosion noticed. Due to topography and steep slope at some lots, potential for erosion is high, especially where groundcover is limited or absent. Vegetation should be established on those particular LAAs to protect against erosion.	Minor Limitation	
Site Drainage	Well drained within the available EMAs due to slope and landform. Gully erosion was observed near bore holes 1 and 2. Some individual lots will require stormwater management to divert stormwater away from LAAs.	Minor Limitation	
Fill	None observed or apparent.	Minor Limitation	
Flood Potential	Black creek lies toward the east Site boundary within a distance of 300m and Rothbury Creek lies within 200m toward the South. Intermittent waterways flow from the Site into these creeks.	Minor Limitation	
Groundwater Bores	NSW Office of Water GW bore registry indicates that there are no domestic groundwater bores located within 250m of the Site.	Minor Limitation	
Applicable Buffers			
Permanent rivers and creeks (100m):		Yes	Achievable (shown on site plan)
Intermittent watercourses, drainage channels and dams (40m):		Yes	Achievable (shown on site Plan)
Domestic groundwater bores (250m):		N/A	
Other sensitive receptors:		N/A	
Lot boundaries (3m if EMA downslope - 6m if EMA upslope): for irrigation systems		Yes	Achievable (shown on Site Plan)

SITE ASSESSMENT				
Parameter	Data/Observation	Reference		Classification /Outcome
Lot boundaries (6m if EMA downslope - 12m if EMA upslope): for trenches and beds		Yes	Achievable (shown on Site Plan)	
Buildings, driveways and swimming pools (3m if EMA downslope - 6m if EMA upslope): for irrigation systems		Yes	Achievable (shown on Site Plan)	
Buildings, driveways and swimming pools (6m if EMA downslope - 12m if EMA upslope): for trenches and beds		Yes	Achievable (shown on Site Plan)	
Limiting horizon (groundwater, bedrock etc.) (0.6m):		Yes	Achievable	
Surface Rock / Outcrop	Though compacted soil layers were quite common during soil sampling, no surface rock or outcrop was noticed.		Minor Limitation	
Effluent Management Area (EMA)	All the lots within the subdivision have ample area for land application of effluent except lot 26 which has significantly reduced area due to setback for the dam and intermittent waterway / gully. However, decommissioning and backfilling of the dam will be included as part of the subdivision development. Also, clearing as well as extensive landscaping of both proposed lots 2, 26 and 27 will be required to accommodate residential development and mitigate stormwater run on. This will alter the drainage characteristics within the subject lots and increase the available EMA. The smallest available EMA on any of the proposed lots is 623m ² , which is located within Lot 26.		Minor Limitation	
Concluding Remarks				
No major constraints to OSSM exist at the Site. There is surplus to required LAA of 580 m ² in each parcel meeting the standard buffer requirements.				

SOIL ASSESSMENT (physical)			
Parameter	Data/Observation	Reference	Classification /Outcome
Soil Depth	450-800mm BH refusal was encountered on highly compacted and dry clay and sandstone bedrock.		Moderate Limitation

SOIL ASSESSMENT (physical)		
Soil Profile	<u>BH 1</u> A: 0-250mm, Single grained, Brown, Clay Loam (CL) (Cat. 4) B: 250-700mm, Weak, Yellow, Medium Clay (MC) (Cat. 6)	Moderate to Major Limitation
	<u>BH 2</u> B: 0-450mm, Single grained, Black, Sandy Clay Loam (SCL) (Cat. 4)	
	<u>BH 3</u> A₁: 0-50mm, Single grained, Black, Loam (L) (Cat. 3) A₂: 50-550mm, Single grained, Very Dark Gray, Silty Loam (SiL) (Cat. 3) B₁: 550-680mm, Weak, Brownish Yellow, Medium Clay (MC) (Cat. 6) B₂: 680-750mm, Single grained, Black, Light Clay (LC) (Cat. 5)	
	<u>BH 4</u> A₁: 0-150mm, Single grained, Dark Brown, Loam (L) (Cat. 3) A₂: 150-350mm, Single grained, Yellowish Brown, Sandy Clay Loam (SCL) (Cat. 4) B₁: 350-500mm, Single grained, Very Dark Gray, Clay Loam (CL) (Cat. 4) B₂: 500-700mm, Moderate, Reddish Yellow, Heavy Clay (HC) (Cat. 6)	
	<u>BH 5</u> A: 0-100mm, Weak, Very Dark Gray, Sandy Clay (SC) (Cat. 5) B: 100-450mm, Weak, Brownish Yellow, Medium Clay (MC) (Cat. 6)	
	<u>BH 6</u> A: 0-350mm, Single grained, Dark Brown, Fine Sandy Loam (FSL) (Cat. 3) B₁: 350-650mm, Weak, Yellow, Medium Clay (MC) (Cat. 6) B₂: 650-800mm, Weak, Brownish Yellow, Light Clay (LC) (Cat. 5)	
	<u>BH 7</u> B: 0-650mm, Single grained, Brown, Loam (L) (Cat. 3)	

SOIL ASSESSMENT (physical)			
Depth to Water Table	Shallow water table not encountered.	Minor Limitation	
Coarse Fragments (%)	2 – 10% of varying size in the range of 2-20mm.	Minor Limitation	
Indicative Soil Permeability (K_{sat}) (m/d)	<0.06	for indicative Massive Light – Medium Clay (Cat. 5 and Cat. 6) AS/NZS 1547:2012	Major Limitation
Modified Emerson Aggregate Class (EAT)	Topsoil: majority of the topsoil non-dispersive, non-slaking (Class 7/8) Subsoil: majority of subsoils are slaking with some dispersion (Class 2)	Moderate Limitation	
Soil Landscape	The Site is located within the Rothbury Soil Landscape (ro) which comprises Red Podzolic Soils (Dr3.21, Dr5.21) on upper slopes with Yellow Podzolic Soils (Dy 2.41) on midslopes. Yellow Sodic Soils (Dy 3.42) and Brown Soloths (Db3.40) lies on lower slopes. Topography consists of undulating and rolling hills and rises. Limitations include sheet and gully erosion on the lower slopes. Soils have generally moderate flood hazard, low fertility, and moderate to high structural degradation hazard.	1:250,000 Sheet Survey, Profile 174, by John Lawrie, 1988 (MGA Grid reference: Zone 56, 342605 E, 6379390 N, Cessnock)	
Concluding Remarks The majority of top soils are Loams with Clay sub soils beneath. Most of the soil structure is massive or weak. Based on the limiting Category 6 soil (Medium to Heavy clay), secondary treatment is required. A maximum Design Irrigation Rate (DIR) of 2.0 mm/day is recommended for irrigation systems. Some of the limitations of soil e.g. dispersion can be ameliorated through appropriate soil improvement measures (refer to section 8.1).			

SOIL ASSESSMENT (Chemical)				
Parameter	Data/Observation		Reference	Classification /Outcome
pH	Topsoil: 4.45-6.26 Subsoil : 4.71-5.70	Extremely acidic to slightly acidic	Moderate to minor limitation	
Electrical Conductivity (EC _e)	Topsoil: 0.28-0.76 Subsoil: 0.34-2.82	Non saline to slightly saline	Minor limitation	
ESP (%)	22.6	Strongly sodic	Average values from prior soil sampling at nearby site by “W&A” on pre-dominantly Rothbury Soil Landscape (“Huntlee-Stage 1”)	Major limitation
CEC (meq/100g)	7.74	Low fertility		Moderate Limitation
P-sorption (mg/kg)	471 (5300 kg/ha)	Medium-High		Moderate limitation
Concluding Remarks Exchangeable Sodium Percentage (ESP) in soil poses a major constraint for OSSM, however, it can be ameliorated by soil improvement techniques (refer 8.1.1). Explanatory notes on soil chemistry parameters are presented in Appendix D.				

4 Wastewater Generation

4.1 Wastewater Quantity

Wastewater generation associated with proposed residential subdivision is expected to include sources such as kitchen, bath / shower, laundry and toilet facilities. A maximum design load based on conservative assumption of 5 bedroom dwellings for reticulated water supply was taken as guidance and presented in the following table:

	Value	Description
Number of bedrooms	5	A conservative assumption
Population Equivalent (persons)	8	Table J1: all waste septic tank operational capacities; AS/NZS 1547:2012
Wastewater generation (L/person/day)	150	Appendix H, value for reticulated water supply; AS/NZS 1547:2012
Design hydraulic load from dwelling (L/day)	1,200	{Persons in dwelling (8)* wastewater generation (150)}

4.2 Wastewater Quality

The contaminants in wastewater have the potential to create undesirable public health concerns and pollute waterways unless managed appropriately. As a result, domestic wastewater must

be treated to remove the majority of pollutants and enable the attenuation of the remaining pollutants through soil processes and plant uptake.

Wastewater generated by the proposed lot dwellings are expected to be of 'typical' domestic nature, with combined wastewater; blackwater (toilet) and greywater (kitchen, laundry and shower) streams.

As such, untreated wastewater is expected to have characteristics similar to that described in the table below; which incorporates information taken from the NSW DLG (1998).

Parameter	Loading	Greywater %	Blackwater %
Biochemical Oxygen Demand	200-300mg/L	35	65
Suspended Solids	200-300mg/L	40	60
Total Nitrogen	20-100mg/L	20-40	60-80
Total Phosphorus	10-25mg/L	50-70	30-50
Faecal Coliforms	10 ³ – 10 ¹⁰ cfu/100ml	Medium – High	High

5 Onsite Effluent Management Options

W&A have considered the suitability of various land application systems in relation to the identified site and soil limitations. In determining the suitability of the various options we have assessed the site constraints and the relative environmental and public health risks associated with each.

The table below provides a summary analysis of the range of effluent land application options considered, and presents recommendation for the preferred land application method to be used in conjunction with secondary treatment systems.

Land Application Option	Suitable	Reasoning
Absorption Trenches/Beds	No	Considered unsuitable as conventional subsoil absorption systems are generally not supported by Category 5 and 6 soil (Large trench systems per unit volume) (Table K1, AS/NZS 1547:2012).
Evapo-Transpiration and Absorption (ETA) Beds	Possible	Slope and climatic conditions are the possible constraints (high rainfall months coinciding with high evapotranspiration months causing probability of system failure. Suitability and sizing of ETA beds to be confirmed by water balance.
Mounds	Possible	Considered suitable, but have been discounted due to their substantial cost and the availability of more suitable options.
Surface Irrigation (SI)	No	Surface spray irrigation not considered suitable due to aesthetics, potential of aerosol carry-over and setback distances.

Land Application Option	Suitable	Reasoning
Subsurface Irrigation (SSI)	Yes	Considered suitable as effluent is able to be applied high in the soil profile, maximising evapotranspiration and vegetation uptake while minimising the human contact risk. Treated effluent <u>must</u> be disinfected.

Based on the analysis, pressure-compensating subsurface drip irrigation is considered the most suitable effluent land application option for each of the proposed lots. A description of the preferred effluent management method and (nominal) sizing are presented in chapters that follow.

5.1 Wastewater Treatment System

Given the site and soil constraints, primary treatment (e.g. by septic tanks) of generated sewage is not appropriate. A minimum effluent quality standard of secondary treatment, with disinfection, is recommended for the proposed development. Secondary treatment is aimed at the removal of dissolved and suspended organic material by a combination of physical and biological methods, usually incorporating both aerobic and anaerobic phases. Secondary treatment presents a significantly lower risk to human health and the environment, when compared to conventional primary (septic tank) systems.

The NSW Ministry of Health (“NSW Health”) provides accreditation for domestic secondary treatment systems in NSW. The systems selected for use at the Site must hold such an accreditation. Appropriate secondary treatment technologies include (but are not limited to) the following:

- Aerated wastewater treatment systems (AWTS);
- Media filter systems;
- Membrane filter systems; and
- Recirculating sand filters.

A detailed list of NSW Health accredited secondary treatment systems can be found at:

<https://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx>

Disinfection units are typically installed as a standard component of proprietary secondary treatment systems, or can be installed as an add-on by the system supplier. An appropriate disinfection system is required to be installed with the chosen system. Domestic systems typically use one or a combination of the following disinfection methods:

- Chlorination; and/or
- Ultra Violet (UV) Irradiation.

Final system selection is the responsibility of the lot owner; however, selection and installation of the system must follow Council requirements.

5.1.1 Treated Effluent Quality

The expected effluent quality of all NSW Health accredited OSSM systems are provided in their associated accreditation certificates. Secondary treatment systems are expected to consistently

achieve the prescribed minimum effluent quality standard as detailed in Table 14 of the NSW DLG (1998) and reproduced in the table below.

Parameter	Loading
Biochemical Oxygen Demand	≤20mg/L
Suspended Solids	≤30mg/L
Faecal Coliforms	≤30cfu/100mL
Total Nitrogen	35mg/L
Total Phosphorus	11mg/L

The listed phosphorus and nitrogen concentration values are targets (only) and have been adopted for nutrient balance modelling purposes.

5.1.2 System Siting

The exact positioning of the each treatment system will depend on local gradient and level controls and can be determined in consultation with a licensed plumber and Council prior to obtaining consent for the installation.

5.1.3 System Operation and Management

Successful performance of wastewater treatment systems relies on periodic monitoring and maintenance, which will be the responsibility of the owner of each lot. The treatment systems should be serviced by a suitably qualified technician at the prescribed intervals.

6 Proposed Effluent Management

This section describes the Site's capability for effluent management and provides design details, including sizing of the required LAAs for each of the proposed lots to demonstrate that effluent management is conceptually feasible to sustainably service a conservatively sized dwelling. As detailed above, secondary treatment is considered the most appropriate wastewater treatment option for the proposed lots. The details of preferred SSI is described on following subheadings.

6.1.1 Subsurface Irrigation

Subsurface irrigation (SSI) is the preferred method of effluent disposal for each of the proposed lots within the subdivision. SSI is suitable within lawn and landscaped areas and applies effluent within the root-zone of plants for optimum irrigation efficiency. It is an ideal option for ensuring even, widespread coverage of the proposed irrigation area. SSI installation does not require any bulk materials or heavy machinery; irrigation lines can be simply installed with a small trench digger or "ditch-witch".

Proprietary, pressure-compensating subsurface drip (PCSD) irrigation pipe designed for use with treated effluent should be used that will ensure distribution of effluent at uniform, controlled application rates. These products have been specifically designed for use with effluent and allow for the higher BOD₅, suspended solids, nutrient and biological loads usually present in effluent compared to potable water. They contain specially designed emitters that reduce the risk of blockage, typically incorporating chemicals that provide protection against root intrusion and biofilm development (e.g. Trifluralin or copper). The dripper lines are coloured lilac to clearly identify that they are irrigating treated effluent.

6.1.2 LAA Sizing

Water and nutrient balance modelling was undertaken to determine the sustainable application rate for Site soils and to determine the necessary size of the LAA required to manage the anticipated hydraulic and nutrient loads from each proposed lot. The procedures for this generally follow the NSW DLG (1998) guidelines.

The water balance used is a monthly model adapted from the “Nominated Area Method” described in the NSW DLG (1998). These calculations determined the minimum LAA size for the given effluent load for each month of the year. The water balance can be expressed by the following equation:

$\text{Precipitation} + \text{Effluent Applied} = \text{Evapotranspiration} + \text{Percolation} + \text{Storage}$
--

A conservative (annual) nutrient balance was also undertaken, which calculates the minimum application area requirements to enable nutrients to be assimilated by the soils and vegetation. The nutrient balance used here is based on the simplistic NSW DLG (1998) methodology but improves this by more accurately accounting for natural nutrient cycles and processes.

The inputs and results of the analyses are presented in the table below. Full water and nutrient balance results are presented in Appendix C.

Parameter	Units	Value	Comments
Design (daily) hydraulic load	L/day	1200	Section 4.1
Precipitation	mm/month	median	Data Drill for Lat, Long: -32.70 151.30 (DECIMAL DEGREES), or 32° 42'S 151° 18'E, Elevation of 73m For the years 1/1/1960 to 18/9/2023
Pan Evaporation	mm/month	mean	Same as above
Retained Rainfall	Unitless	0.8	Proportion of incident rainfall that percolates into subsoil
Crop Factor	Unitless	0.5-0.8	Seasonal variation in hydraulic uptake capability of managed lawn groundcover as per reference from Connellan
Design Loading Rate	mm/day	2.0	Table M1 , AS/NZS 1547:2012 for Category 6 soil
Effluent total nitrogen concentration	mg/L	35	Target effluent quality following secondary treatment
Nitrogen lost to soil processes	Annual percentage	20	Geary & Gardner (1996)

Parameter	Units	Value	Comments
Effluent total phosphorus concentration	mg/L	11	Target effluent quality following secondary treatment
Soil phosphorus sorption capacity	mg/kg	471	Laboratory result for soil samples from similar soil landscape (average value)
Nitrogen uptake rate by plants	kg/ha/yr	260	Conservative estimate based on 50% of the published nutrient uptake rate in DEC (2004) for kikuyu grass (September-March)
Phosphorus uptake rate by plants	kg/ha/yr	30	Conservative estimate based on 50% of the published nutrient uptake rates in DEC (2004) for kikuyu grass (September-March)
Design life of system (for nutrient management)	Years	50	NSW DLG (1998) , recommended design life
Results			
LAA required based on Hydraulic Balance for zero storage (m²)		544	
Effluent Nitrogen Balance (m²)		472	
Effluent Phosphorous Balance (m²)		581	

Based on the hydraulic and nutrient modelling outcomes, the phosphorus assimilation is the limiting factor for sizing the required SSI LAA. W&A recommend a conservative **580m²** LAA to ensure complete assimilation of effluent within each lot.

6.1.3 LAA Design and Construction

A Linear Loading rate (LLR) of <30L/m/day for each one (1) meter width of slope is suitable. For the DIR of 2mm/day, the maximum downslope length of an irrigation zone should not exceed 15m (i.e. 30/2). So, for a subsurface drip irrigation area of 580 m², the length across the slope should be ~ 39 (580/15) meters. This can be achieved by setting up 2 (two) dosing zones of 290 square meters area each.

Specifically for the Lots 26 and 27 which are constrained due to intermittent waterways and existing dam, it is suggested that after the lots are cleared, the client would decommission and backfill the dam. Alternatively, a drainage line could be established for stormwater flow. Landscaping to construct the dwelling and alter the stormwater flow path using a stormwater diversion drain that discharges to the access road is recommended. The dam and associated drainage must be removed or remodelled as part of the development for the suitability of dwelling and OSSM construction.

A critical element of the design process is hydraulic design including selection of appropriate dripline, dosing and flush manifold pipe, lateral and emitter spacing and pump performance.

Dripline typically needs an operating pressure at the emitter of 10-40m (head) to maintain pressure compensation. As such, higher head, low flow pumps are required to service drip irrigation systems that differ from pumps traditionally used in OSSM.

Lateral pipes should be spaced to provide good and even coverage of the area they service. They should be no more than 1m apart, roughly parallel and along the contour as close as possible. SSI shall be installed at a depth of 100 – 150mm into the topsoil as per AS/NZS 1547:2012.

General specifications for SSI land application systems are as follows:

- Effluent must be applied evenly across the LAA. (If necessary), it is recommended that the LAA be split evenly into separate zones using hydraulic indexing valves (or similar);
- PCSD line specifically designed for effluent irrigation (e.g. Toro Drip-in, Netafim Dripnet PC AS XR or Safe-T-Flo) shall be installed. 1.6 – 2.1 litres per hour emitters should be used;
- An in-line 120µm disc filter may be installed to minimise the amount of solids entering the pipelines and emitters. This must be removed and cleaned regularly (at least at 3-monthly intervals). Alternately, a flush main may be installed to periodically clean-out the irrigation lines to provide effective long term performance. Either manual or automatic flush valves may be installed, with flush water directed back to the treatment system;
- Air release valves will be installed at the high points in individual irrigation areas to prevent soil particles being sucked into the lines at the end of pump cycles as pipelines depressurise; and
- An 'as-built' layout of the OSSM system (treatment and LAA) shall be provided to Council and the system Owner upon completion.

Figure 3 in Appendix A provides a schematic representation of a generic SSI system. Specialist advice must be obtained for designing and installing the irrigation systems.

7 Buffers

Buffer distances from LAAs are recommended to minimise risk to public health, maintain public amenity and protect sensitive environments. Buffer or setback distances are recommended to provide a form of mitigation against unidentified hazards and reduce potential pathways of human and environmental exposure.

The prescribed setback distances are conservative to take into consideration a diverse range of site and soil conditions. The potential of soils to assimilate nutrients and attenuate pathogens is highly variable due to a broad range of interdependent physical and chemical properties.

The following environmental buffers are recommended, based on Table 5 of NSW DLG (1998):

- 250m from domestic GW bores;
- 100m from permanent watercourses;
- 40m from intermittent watercourses and dams; and
- 6m if area up-gradient and 3m if area down-gradient of property boundaries, driveways, swimming pools and buildings.

All of the recommended buffer distances are achievable on-site, as shown on the Site Plan (Figure 2; Appendix A). All proposed lots achieve >620m² available EMA, adequately providing for a LAA of 580m² to service a 'typical' five (5) bedroom dwelling.

8 Mitigation Measures

8.1 Soil Improvement

8.1.1 Soil Chemistry

Given that Site soils are sodic, dispersive and are identified as moderately acidic, vegetative growth and stability may be impacted within the LAA. These properties can combine to reduce the soils' capacity to support healthy vegetation and sustainably manage wastewater.

Prolonged application of sodium rich wastewater can exacerbate the situation. Application of calcium mineral is a recognised way of reducing the effects of soil instability. It does this by supplying calcium to the affected soil and thereby elevating calcium concentrations with respect to sodium. Added calcium will improve the soil CEC and Ca/Mg ratio, improving fertility, while reducing the potential for soil structural degradation.

Typically, gypsum would be the preferred soil amendment; however, given the identified acidity concern a 50:50 application of gypsum and lime may be more suitable for the Site. Both gypsum and lime are only slowly soluble in water, so simply broadcasting at the surface can be of limited benefit as it can take a long time for the calcium to penetrate the soil and reach the deeper soil layers.

Therefore, it is recommended to incorporate the amendment into the soil during construction of the land application systems. Prepare the soil by deep ripping (~200mm), shallow cultivation and applying the amendment. A suitable gypsum/lime application rate of approximately 0.5kg/m² should be applied.

8.1.2 Coarse Fragments

Due to the presence of coarse fragments from the surface to ~300mm within some elevated areas of the Site, further deep ripping of the soil profile to a depth of ~300mm is recommended if these areas are proposed for effluent application. Large coarse fragments should be removed before LAA installation.

8.2 Vegetation Establishment

Vegetation that is suited to the application of effluent, preferably with high water and nutrient requirements (such as turf) should be established over the LAA following construction. A complete vegetation cover is important to reduce the erosion hazard and optimise water and nutrient uptake.

It is recommended to establish and maintain a vegetated buffer around the LAA. It should be planted with moisture-tolerant vegetation and remain well maintained to maximise moisture uptake. Plants must be selected that will not be so large as to shade the LAA once fully grown. It is important that the LAA receives maximum exposure to sun and wind to maximise evapotranspiration.

To maximise assimilation of effluent-borne nutrients within the LAA, vegetation clippings should be removed from the LAA and mulched elsewhere on-site for use on other landscaped areas that are not used for wastewater application. Mulching clippings back onto the area from which

they were cut is not recommended. An alternative is to dispose clippings in the general waste bin, or green waste bin collection service, if provided.

8.3 Stormwater Management

The performance of LAAs (and potentially treatment systems) can be adversely affected if stormwater is allowed to run onto these areas. Stormwater diversion devices should be designed and constructed to collect, divert and dissipate collected run-on away from the LAA. The structure(s) should be designed and installed by a suitably qualified professional and be compliant with relevant guidelines and standards.

A diagram of a 'typical' stormwater diversion, which would be appropriate for this purpose, is provided in Figure 4, Appendix A. The outlet must be stabilised and must discharge water in a safe location where it will not create an erosion hazard or impact on structures or neighbouring properties.

8.4 Water Saving Measures

To minimise wastewater generation, it is recommended that all domestic water use fixtures in new dwellings be installed in accordance with BASIX requirements, including installation of 'standard water reduction fittings'.

Standard water reduction fixtures for internal and external water use include:

- Taps – WELS 4-star (or better) rated;
- Toilets – 4.5/3.0 litre dual flush pan and cistern;
- Showers – WELS 3-star (or better) rated; and
- Dishwashers (if used) – AAA rated using as little as 18 litres per wash.

Implementation of these measures is expected to reduce water use, and thereby wastewater generation, by as much as 10-15%.

9 Conclusions and Recommendations

This completes our assessment of the Site's capability for sustainable OSSM in relation to the proposed rural residential development at Hanwood Road, North Rothbury. A conservative design based on 5 bedroom dwelling with 8 persons equivalent occupancy is used for calculating hydraulic load and LAA sizing. Specifically, we recommend the following:

- The small dam located within proposed Lot 26 must be decommissioned, backfilled and the surrounding area landscaped to accommodate a feasible LAA;
- The wastewater from each dwelling will be treated to a minimum secondary standard with disinfection;
- Each selected secondary treatment system must be NSW Health accredited and should be installed by an experienced professional, taking into account the expected flows and other recommendations contained within this report;
- Treated effluent will be reused on each lot via pressure-compensating SSI;
- A minimum LAA of **580m²** will be utilized based on limiting Phosphorous balance requirement;

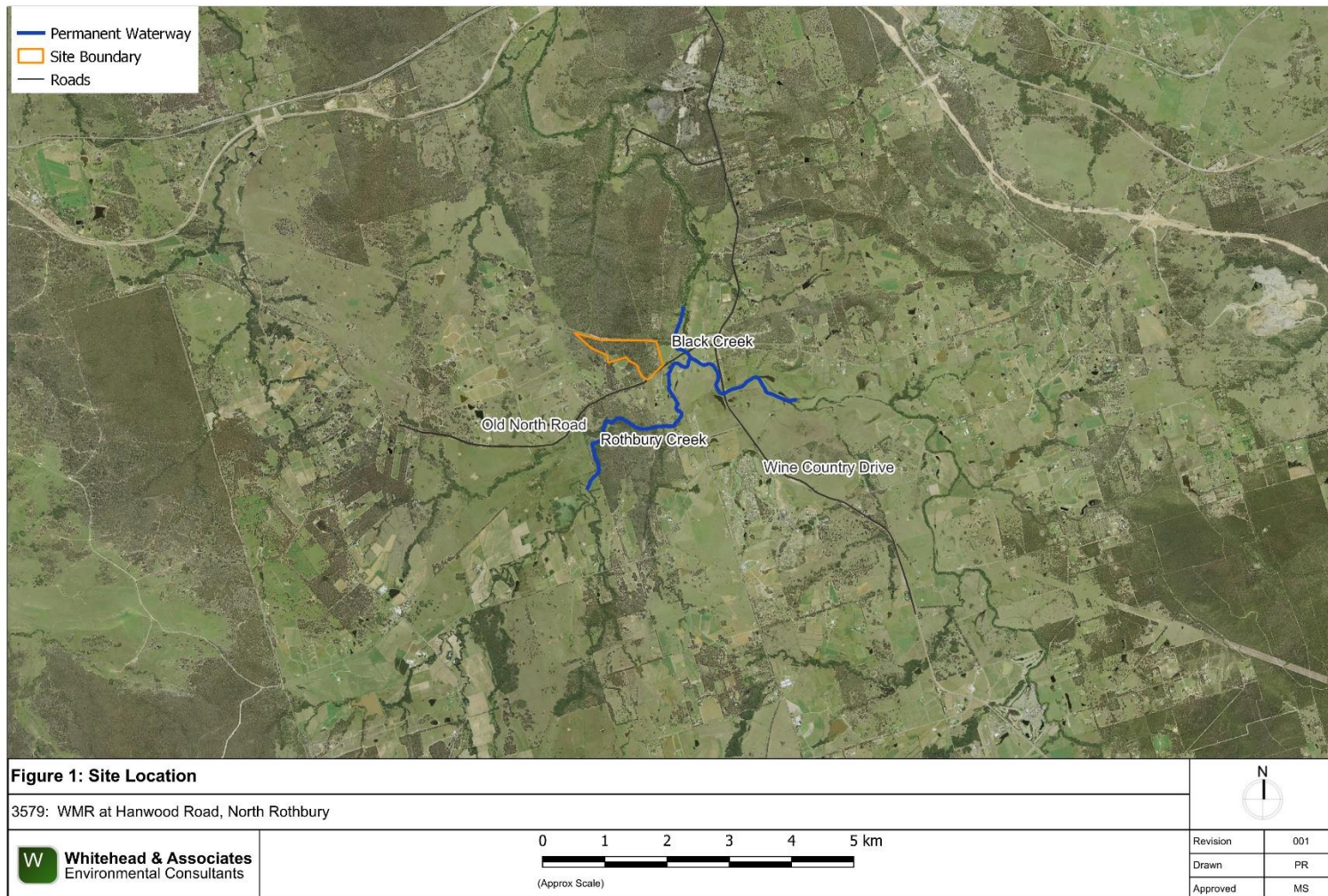
- The SSI area shall be designed and installed by experienced professional taking into consideration the design calculations of this report;
- LAAs must be located within the available EMA specified to comply with adopted setbacks from surface waters, property boundaries and other improvements (NSW DLG, 1998);
- SSI lines should not be located within the drip line of trees (minimum 3m from trunk);
- A suitable gypsum/lime application rate of approximately 0.5kg/m² should be applied at the base of each LAA prior to installation;
- Within lots at higher elevation such as 1, 2, 14, 15, 16 and 17 it is recommended that the surface profile of LAAs be deep ripped to ~300mm with large cobbles removed;
- Immediately after the installation of SSI system, the LAA shall be covered with suitable vegetation e.g. lawn grass/turf.
- Stormwater run-on must be directed away from the proposed LAAs; and
- Vehicles and grazing animals must be prevented from entering the designated LAAs.

Yours Sincerely

Prabin Raut
Environmental Consultant
Whitehead & Associates Environmental Consultants Pty Ltd

Appendix A

Figures





NOTES

Design for long lateral runs on relatively uniform slope.

An earth bank diversion drain must be constructed upslope of each zone to divert stormwater run-on.

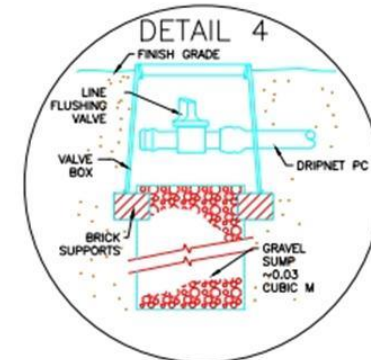
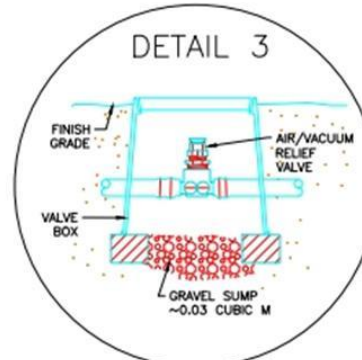
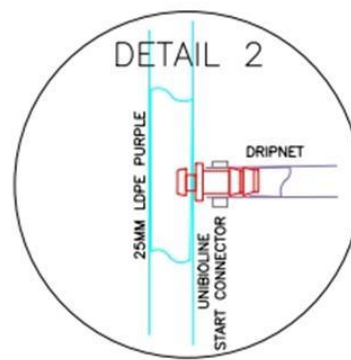
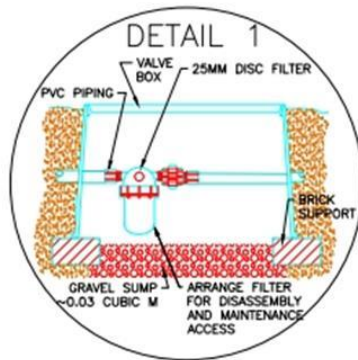
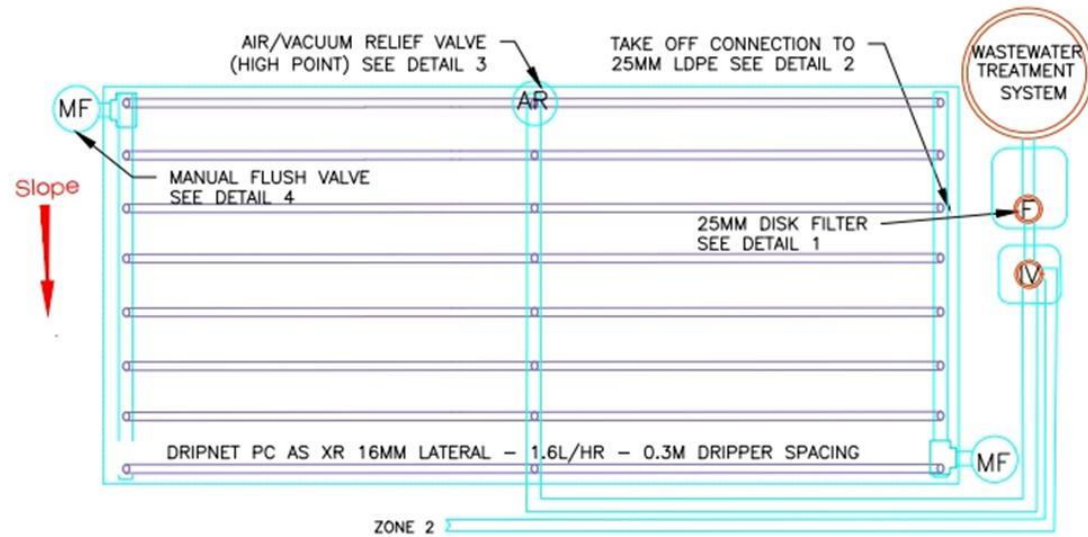
A Total application area = 852m². Four zones of 213m² each.

B Each zone is fed by a central distribution manifold with return flushing manifolds on the outer ends, each with a flush valve. An air/vacuum relief valve is located at the high point in each zone.

C Distribution and flushing return manifolds should be buried minimum 150mm below the ground surface.

D Pressure Compensating (PC) subsurface drip line with emitters at 0.3m spacing, with output 1.6L/hr, and laterals at 1000mm spacing and buried to a depth 150-200mm.

E Non-return valves to be installed on distribution and return flushing manifolds where fall is greater than 2m over the zone.



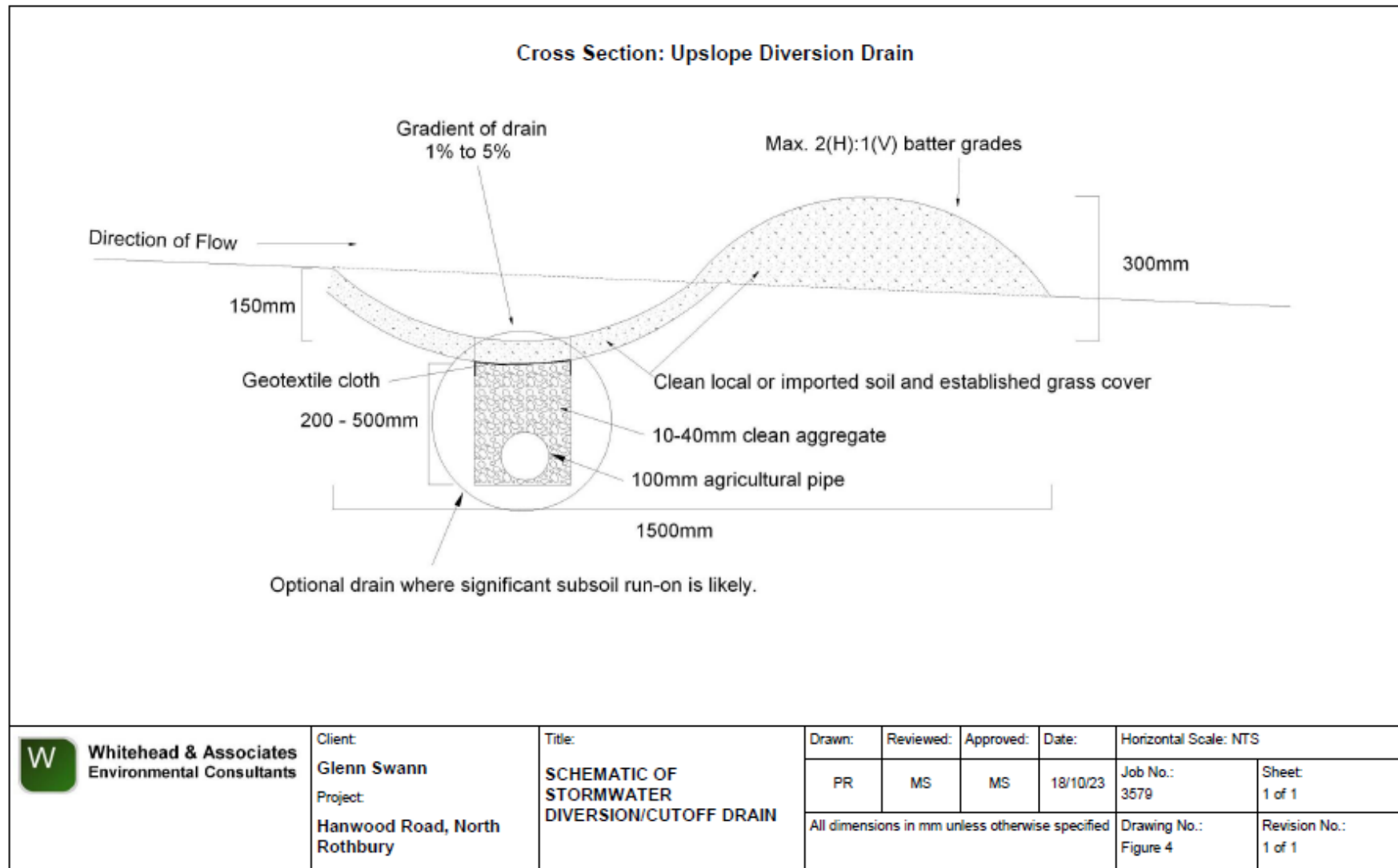
Courtesy: Netafim Australia Pty Ltd



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This standard design has been based on a generic area for irrigation based on typical conditions. It does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only.

Figure 3:
Standard Drawing
Subsurface Irrigation



Appendix B
Soil Borelogs & Chemical Analyses



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Key to Soil Borelogs

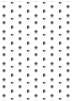
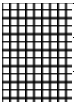
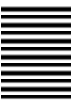
Symbols

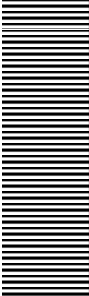
W Watertable depth ● Sample collected
X Depth of refusal

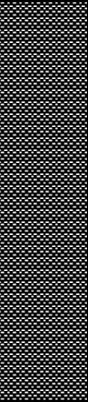
Moisture condition

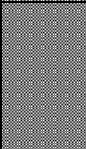
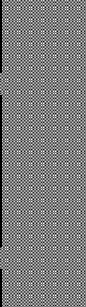
D Dry
SM Slightly moist
M Moist
VM Very moist
W Wet / saturated

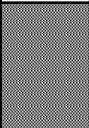
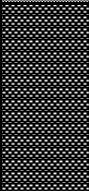
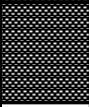
Graphic Log and Textures

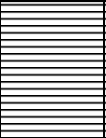
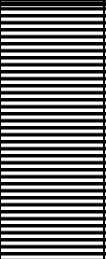
	S - Sand LS - Loamy sand CS - Clayey sand		CL - Clay loam SCL - Sandy clay loam SiCL - Silty clay loam		Gravel (G)
	SL - Sandy loam		LC - Light clay SC - Sandy clay		Parent material (stiff)
	L - Loam LFS - Loam fine sandy SiL - Silty loam		MC - Medium clay HC - Heavy clay		Parent material (weathered)

SOIL BORE LOG				 Whitehead & Associates Environmental Consultants Pty Ltd						
Client:	Glenn Swann for Huntlee Pty. Ltd.			Borehole No:	BH 1					
Site:	Hanwood Road, North Rothbury, NSW			Excavated/logged by:	P.Raut & Ben.C					
Date:	04/10/2023			Excavation type:	Auger and Crowbar					
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.25		BH 1/1	A	Clay Loam (LC)	Single grained	Brown	None	2- 10% (6-20 mm) Medium gravel	Dry	Fine roots to 100 mm
0.7		BH 1/2	B	Medium Clay	Weak	Yellow	None	<2 % (2-6 mm) fine gravel	Dry	Terminated due to compacted and dry clay

SOIL BORE LOG				 Whitehead & Associates Environmental Consultants Pty Ltd						
Client:	Glenn Swann for Huntlee Pty. Ltd.			Borehole No:	BH 2					
Site:	Hanwood Road, North Rothbury, NSW			Excavated/logged by:	P.Raut & Ben.C					
Date:	04/10//2023			Excavation type:	Auger and Crowbar					
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/nam ^e	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.45		BH 2	B	Sandy Clay Loam (SCL)	Single grained	Black	None	< 2% (2-6mm) Fine gravel	Dry	A thin layer of top soil , nearly 50 mm Refusal at sandstone stype layer

SOIL BORE LOGC2:M24							 Whitehead & Associates Environmental Consultants Pty Ltd			
Client:	Glenn Swann for Huntlee Pty. Ltd.					Borehole No:	BH3			
Site:	Hanwood Road, North Rothbury, NSW					Excavated/logged by:	P.Raut & Ben.C			
Date:	04/10//2023					Excavation type:	Auger and Crowbar			
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.05		BH 3/1	A1	Loam(L)	Single grained	Black	None	<2 % (2-6 mm, fine gravel)	Dry	Few roots of grass and shrubs seen
0.55		BH 3/2	A2	Silty Loam(SiL)	Single grained	Very Dark Gray	None	2-10% (6-20 mm, medium gravel)	Dry	
0.68		BH 3/3	B1	Medium Clay (HC)	Weak	Brownish Yellow	None	2-10 % (6-20 mm, medium gravel)	Dry	Thin layer of loam observed from 680 mm
0.75		BH 3/4	B2	Light Clay (LC)	Weak	Black	None	<2 % (2-6 mm, fine gravel)	Dry	Terminated due to dry and compacted clay

SOIL BORE LOG  Whitehead & Associates Environmental Consultants Pty Ltd										
Client:	Glenn Swann for Huntlee Pty. Ltd.					Borehole No:	BH4			
Site:	Hanwood Road, North Rothbury, NSW					Excavated/logged by:	P. Raut & Ben. C			
Date:	04/10/2023					Excavation type:	Auger and Crowbar			
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.15		BH 4/1	A1	Loam	Massive	Dark Brown	None	2-10 % (6-20 mm)	Dry	Fine roots to 100 mm
0.35		BH 4/2	A2	Silty Clay Loam (SiCL)	Massive	Yellowish Brown	None	<2 % (6-20 mm)	Dry	Big tree roots seen
0.50		BH 4/3	B1	Clay Loam (CL)	Massive	Very Dark Gray	None	<2% (6-20 mm)	Dry	Big tree roots seen
0.70		BH 4/4	B2	Heavy Clay (HC)	Moderate	Reddish Yellow	None	2-10 % (6-20 mm)	Dry	Terminated due to dry and compacted clay

SOIL BORE LOG						 Whitehead & Associates Environmental Consultants Pty Ltd				
Client:	Glenn Swann for Huntlee Pty. Ltd.				Borehole No:	BH 5				
Site:	Hanwood Road, North Rothbury, NSW				Excavated/logged by:	P.Raut & Ben.C				
Date:	04/10/2023				Excavation type:	Auger and Crowbar				
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.1		5\1	A	Sandy Clay (SC)	Weak	Very Dark Gray	None	2- 10% (6-20 mm)	Dry	Shrubs and grass roots
0.45		5\2	B	Medium Clay	Weak	Brownish Yellow	None	<2% (2-6 mm)	Dry	Terminated due to compacted and dry clay

SOIL BORE LOG								Whitehead & Associates Environmental Consultants Pty Ltd		
Client:	Glenn Swann for Huntlee Pty. Ltd.				Borehole No:	BH 6				
Site:	Hanwood Road, North Rothbury, NSW				Excavated/logged by:	P. Raut & Ben. C				
Date:	04/10/2023				Excavation type:	Auger and Crowbar				
Notes:	Refer to site plan for position of Borehole									
PROFILE DESCRIPTION										
Depth (m)	Graphic Log	Sampling depth/name	Horizon	Texture	Structure	Colour	Mottles/Gley	Coarse Fragments	Moisture Condition	Comments
0.35		BH 6/1	A	Fine Sandy Loam (FSL)	Single grained	Dark Brown	None	2-10 % (2-6mm)	Dry	Few roots of shrubs and grass
0.65		BH 6/2	B1	Medium Clay (MC)	Moderate	Yellow	None	<2 % (2-6 mm)	Dry	Profile change from loam to clay at 350 mm
0.80		BH 6/3	B2	Light Clay (LC)	Moderate	Brownish Yellow	None	<2 % (2-6 mm)	Dry	Refusal due to sandstone type layer

Soil sampling schedule and results of pH, EC and Modified Emerson Test

Site	Sample Name	Sample Depth (mm)	Texture Class	EAT [1]	Rating [2]	pH _f [3]	pH _{1:5} [4]	Rating	EC _{1:5} (μS/cm)	Ece (dS/m) [5]	Rating	Other analysis [6]
TP 1	BH 1/1	250	CL	2	Mod	n/a	6.26	Slightly acid	39.00	0.35	Non-saline	
	BH 1/2	700	MC	2	Mod	n/a	5.29	Strongly acid	306.00	2.14	Slightly saline	
TP 2	BH 2	450	SL	2	Mod	n/a	4.71	Very strongly acid	51.00	0.56	Non-saline	
TP 3	BH 3/1	50	L	8	Low	n/a	4.45	Extremely acid	31.00	0.31	Non-saline	
	BH 3/2	550	L	2	Mod	n/a	5.05	Strongly acid	28.00	0.28	Non-saline	
	BH 3/3	680	MC	4	Low	n/a	5.30	Strongly acid	160.00	1.12	Non-saline	
	BH 3/4	750	LC	2	Mod	n/a	5.25	Strongly acid	92.00	0.74	Non-saline	
TP 4	BH 4/1	150	L	8	Low	n/a	5.22	Strongly acid	41.00	0.41	Non-saline	
	BH 4/2	350	SL	2	Mod	n/a	5.32	Strongly acid	69.00	0.76	Non-saline	
	BH 4/3	500	CL	2	Mod	n/a	5.13	Strongly acid	313.00	2.82	Slightly saline	
	BH 4/4	700	HC	2	Mod	n/a	5.70	Moderately acid	313.00	1.88	Non-saline	
TP 5	BH 5/1	100	LC	8	Low	n/a	4.73	Very strongly acid	65.00	0.52	Non-saline	
	BH 5/2	450	MC	4	Low	n/a	4.92	Very strongly acid	232.00	1.62	Non-saline	
TP 6	BH 6/1	350	SL	7	Low	n/a	4.93	Very strongly acid	36.00	0.40	Non-saline	
	BH 6/2	650	MC	2	Mod	n/a	5.14	Strongly acid	73.00	0.51	Non-saline	
	BH 6/3	800	LC	2	Mod	n/a	4.78	Very strongly acid	104.00	0.83	Non-saline	
TP 7	BH7	650	L	2	Mod	n/a	4.99	Very strongly acid	34.00	0.34	Non-saline	

Notes:- (also refer Interpretation Sheet 1)

- [1] The modified Emerson Aggregate Test (EAT) provides an indication of soil susceptibility to dispersion.
- [2] Ratings describe the likely hazard associated with land application of treated wastewater.
- [3] pH measured in the field using Raupac Indicator.
- [4] pH measured on 1:5 soil:water suspensions using a *Hanna Combo* hand-held pH/EC/temp meter.
- [5] Electrical conductivity of the saturated extract (Ece) = $EC_{1:5}(\mu S/cm) \times MF / 1000$. Units are dS/m. MF is a soil texture multiplication factor.
- [6] External laboratories used for the following analyses, if indicated:
 - CEC (Cation exchange capacity)
 - Psorb (Phosphorus sorption capacity)
 - Bray Phosphorus
 - Organic carbon
 - Total nitrogen

Phone Office/Lab (02) 6775 1157
 Fax (02) 6775 1043
 email: lanfaxlabs@bigpond.com.au
 Website: <http://www.lanfaxlabs.com.au>
 Lab address: 493 Old Inverell Road
 Postal address: PO Box 4690 Armidale NSW 2350
 Director: Dr Robert Patterson FIEAust, CPSS, CPAg
 Soil Scientists and Environmental Engineers



2nd March 2014

Whitehead & Associates
 197 Main Road
 Cardiff NSW 2285

Soil Report: Project 1209, ten samples
 Samples received 26th February 2014
 Samples dried to 50°C, crushed and sieved to minus 2 mm prior to analysis

Whitehead & Assoc. Project 1209 - FEB14													
Exc. Al+ H	Ca		K		Mg		Na		Base Sat.	ESP	CEC	Ca/Mg	Site Location
cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	mg/kg	cmol+/kg	%	%	cmol+/kg	ratio	Sample ID
1.60	381	1.90	97	0.25	278	2.29	120	0.52	75.6	8.0	6.6	0.8	Project 1209, sample 1
1.52	67	0.33	92	0.24	250	2.06	249	1.08	70.9	20.7	5.2	0.2	Project 1209, sample 2
0.40	221	1.10	119	0.30	334	2.75	428	1.86	93.8	29.0	6.4	0.4	Project 1209, sample 3
0.16	269	1.34	39	0.10	380	3.13	363	1.58	97.5	25.0	6.3	0.4	Project 1209, sample 4
1.92	29	0.14	77	0.20	815	6.70	530	2.30	83.0	20.4	11.3	0.0	Project 1209, sample 5
0.16	211	1.05	75	0.19	762	6.27	840	3.66	98.6	32.3	11.3	0.2	Project 1209, sample 6
0.72	17	0.09	64	0.16	747	6.15	643	2.80	92.7	28.2	9.9	0.0	Project 1209, sample 7
0.96	89	0.44	122	0.31	627	5.16	573	2.49	89.8	26.6	9.4	0.1	Project 1209, sample 8
1.52	152	0.76	71	0.18	410	3.37	92	0.40	75.6	6.4	6.2	0.2	Project 1209, sample 9
0.16	178	0.89	65	0.17	267	2.20	326	1.42	96.7	29.4	4.8	0.4	Project 1209, sample 10

Methods: Rayment & Lyons 2011
 P sorption modified method 9J1 - elevated equilibrating solutions, ICP determination of P

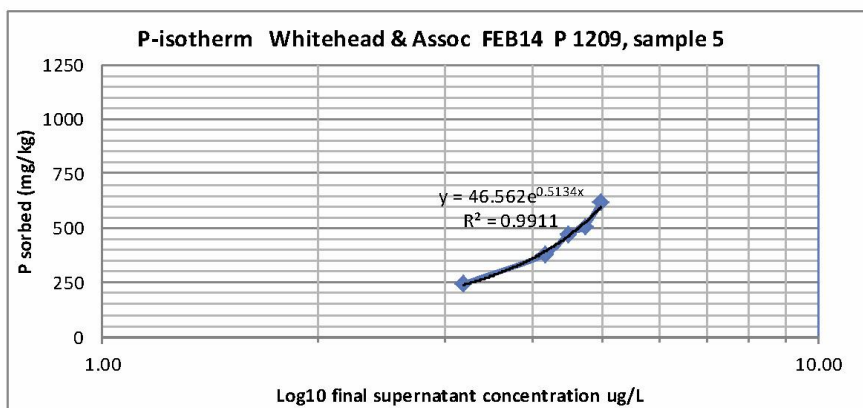
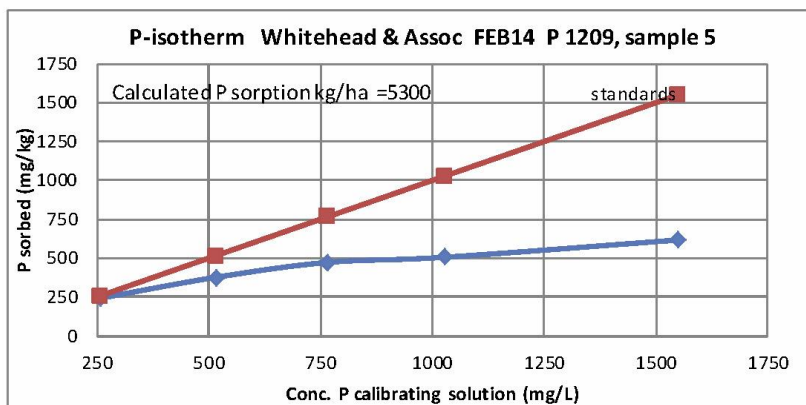
Dr Robert Patterson



Commercial and research laboratory for soil, water and plant analysis.
 Soil survey and analytical assessments, landscape analysis and plant nutrient relationships,
 Wastewater and effluent reuse specialists - on-site and decentralised

Lanfax Labs. Armidale

Soil Results



Percent sorbed is the proportion of the initial P sorbed during equilibration					P-isotherm Whitehead & Assoc FEB14 P 1			
Initial P	filtrate	sorbed P	Sample	Percent	Std line	filtrate	Y axis	X axis
mgP/L	P	mg/kg	I.D.	sorbed		C	Log C	
	mg/L			(%)		ugP/L		
25.8	1.54	242.9	Whitehead & Assoc FEB14	94.0	258	1543	3.19	242.9
51.6	13.90	376.7	P 1209, sample 5	73.0	516	13900	4.14	376.7
76.5	29.26	472.7		61.8	765	29260	4.47	472.7
102.9	52.27	506.3		49.2	1029	52270	4.72	506.3
154.9	93.22	616.8		39.8	1549	93220	4.97	616.8
Calculated P sorption kg/ha = 5300								

Appendix C
Water & Nutrient Balance

[illegible]

Nutrient Balance- Individual Lots

Whitehead & Associates
Environmental Consultants

Project 3579: Hanwood Road, North Rothbury

Please read the attached notes before using this spreadsheet.

SUMMARY - LAND APPLICATION AREA REQUIRED BASED ON THE MOST LIMITING BALANCE =

581 m²

INPUT DATA ^[1]

Wastewater Loading		Nutrient Crop Uptake			
Hydraulic Load	1,200 L/day	Crop N Uptake	260 kg/ha/yr	which equals	71.23 mg/m ² /day
Effluent N Concentration	35 mg/L	Crop P Uptake	30 kg/ha/yr	which equals	8.22 mg/m ² /day
% Lost to Soil Processes (Geary & Gardner 1996)	0.2 Decimal	Phosphorus Sorption			
Total N Loss to Soil	8,400 mg/day	P-sorption result	471 mg/kg	which equals	5,299 kg/ha
Remaining N Load after soil loss	33,600 mg/day	Bulk Density	1.5 g/cm ³		
Effluent P Concentration	11 mg/L	Depth of Soil	0.75 m		
Design Life of System	50 yrs	% of Predicted P-sorp. ^[2]	0.5 Decimal		

METHOD 1: NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer		Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)	
Nitrogen	472 m ²	Nominated LAA Size	580 m ²
Phosphorus	581 m ²	Predicted N Export from LAA	-2.82 kg/year
		Predicted P Export from LAA	0.00 kg/year
		Phosphorus Longevity for LAA	50 Years
		Minimum Buffer Required for excess nutrient	1 m ²

PHOSPHORUS BALANCE**STEP 1: Using the nominated LAA Size**

Nominated LAA Size	580 m ²			
Daily P Load	0.0132 kg/day	→ Phosphorus generated over life of system	240.9 kg	
Daily Uptake	0.0047671 kg/day	→ Phosphorus vegetative uptake for life of system	0.150 kg/m ²	
Measured p-sorption capacity	0.529875 kg/m ²			
Assumed p-sorption capacity	0.265 kg/m ²	→ Phosphorus adsorbed in 50 years	0.265 kg/m ²	
Site P-sorption capacity	153.66 kg	→ Desired Annual P Application Rate	4.813 kg/year	
		which equals	0.01319 kg/day	
P-load to be sorbed	3.08 kg/year			

NOTES

[1]. Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as,

- Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households
- Appropriate Peer Reviewed Papers
- EPA Guidelines for Effluent Irrigation
- USEPA Onsite Systems Manual.

[2]. A multiplier, normally between 0.25 and 0.75, is used to estimate actual P-sorption under field conditions which is assumed to be less than laboratory estimates.

Appendix D

General Notes

DRAFT

Soil Physical Properties/Chemistry

pH

This test is used to determine the acidity or alkalinity of native soils. pH is measured on a scale of 0 to 14, with 7 being neutral. Results below 7 are considered acid, while those above 7 are alkaline. For land application of effluent, soil with a pH of 4.5 to 8.5 should typically pose no constraints. Soil pH affects the solubility and fixation of some nutrients; this in turn reduces soil fertility and plant growth. By correcting soil pH beneficial plant growth is improved, assisting in the assimilation of nutrient and improving evapotranspiration of effluent. Most Australian soils are naturally acidic.

Electrical Conductivity

Electrical conductivity (EC) is a measure of a soil or soil/water extracts ability to conduct an electrical current. It is used as an indirect measure of a soils accumulation of water soluble salts, mainly of sodium, with minor potassium, calcium and magnesium. High EC within a LAA reflects general soil salinity and is undesirable for vegetation growth. The tolerance of vegetation species to soil salinity varies among plant types. Typically EC readings of <4dS/m pose no constraints. There are a number of measures available to counter high soil EC values for land application of effluent; however, the most important measure relates to the conservative selection of application rates and appropriate application area sizing.

Emerson Aggregate Test

The Emerson Aggregate Test (EAT) is a measure of soil dispersibility and susceptibility to erosion and structural degradation. It assesses the physical changes that occur in a single ped of soil when immersed in water, specifically whether the soil slakes and falls apart or disperses and clouds the water. Dispersive soils pose limitations to on-site sewage management because of the potential loss of soil structure when effluent is applied. Soil pores can become smaller or completely blocked, causing a decrease in soil permeability, which can lead to system failure.

Cation Exchange Capacity

The cation exchange capacity (CEC) is the capacity of the soil to hold and exchange cations (positively charged molecules). Because some soils have a dominant negative charge, they can adsorb cations. Soils bind cations such as calcium, magnesium, potassium and sodium, preventing them from being leached from the soil profile and making them available as plant nutrients. CEC is a major controlling agent for soil structural stability, nutrient availability for plants and the soils' reaction to fertilisers and other ameliorants. A CEC of greater than 15 cmol+/kg or me/100g is recommended for land application systems. Adding organic matter (compost/humus) to soil can greatly increase its CEC.

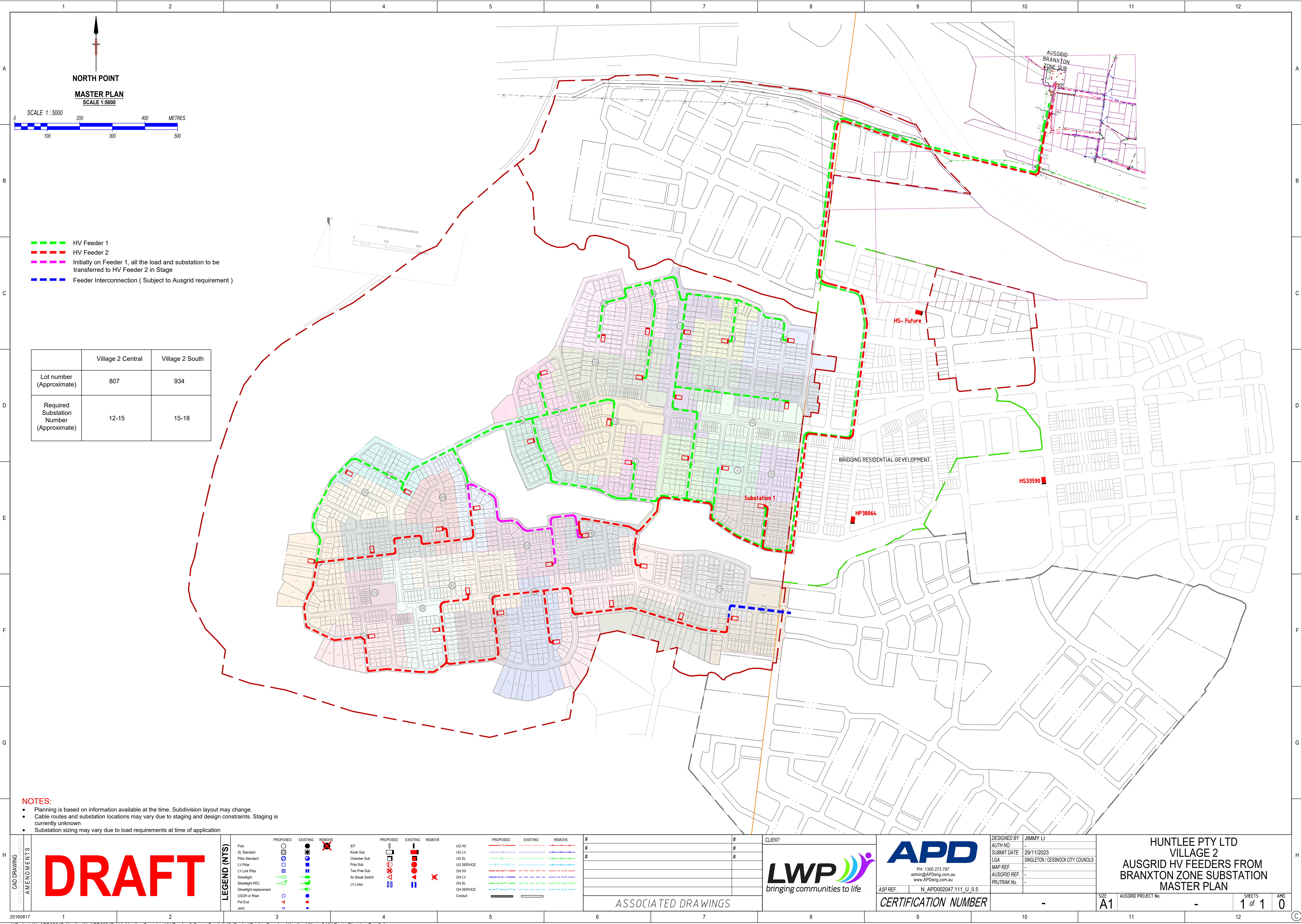
Exchangeable Sodium Percentage

The exchangeable sodium percentage (ESP) is an important indicator of soil sodicity, which affects soil structural stability and overall susceptibility to dispersion. Sodic soils tend to have a low infiltration capability, low hydraulic conductivity, and a high susceptibility to erosion. When sodium dominates the exchangeable cation complex, soil structural stability declines significantly. Soil ESP is considered acceptable for effluent application areas when it is below 5%, marginal between 5% – 10% and limiting >10%. The ESP of application area soils can be improved by the measured application of calcium (lime/gypsum).

Phosphorus Sorption Capacity

Phosphorus sorption (P-sorption) capacity is a direct measure of a soils ability to adsorb phosphorus. Phosphorus is an important plant nutrient and is the limiting available nutrient in many aquatic environments. Excess phosphorus can increase the production of nuisance vegetative growth such as algae. The P-sorption capacity of the soil in an effluent application area relates to its ability to assimilate the phosphorus in the wastewater for the design life of the application area. P-sorption values greater than 400mg/kg is considered acceptable for land application of effluent, while values below 150mg/kg present a constraint.

Appendix G – Electrical and Lighting



- HV Feeder 1
- HV Feeder 2
- Initially on Feeder 1, all the load and substation to be transferred to HV Feeder 2 in Stage
- Feeder Interconnection (Subject to Ausgrid requirement)

	Village 2 Central	Village 2 South
Lot number (Approximate)	807	934
Required Substation Number (Approximate)	12-15	15-18

- NOTES:**
- Planning is based on information available at the time. Subdivision layout may change.
 - Cable routes and substation locations may vary due to staging and design constraints. Staging is currently unknown
 - Substation sizing may vary due to load requirements at time of application

CAD DRAWING
DO NOT MANUALLY AMEND
AMENDMENTS

DRAFT

LEGEND (NTS)

- | PROPOSED | EXISTING | REMOVE |
|-------------------------|----------|--------|
| Pole | ○ | ⊗ |
| SL Standard | ○ | ⊗ |
| Pillar Standard | ○ | ⊗ |
| LV Link Pillar | ○ | ⊗ |
| Streetlight | ○ | ⊗ |
| Streetlight+PEC | ○ | ⊗ |
| Streetlight+replacement | ○ | ⊗ |
| UGOH or Riser | ○ | ⊗ |
| Pot End | ○ | ⊗ |
| Joint | ○ | ⊗ |
- | PROPOSED | EXISTING | REMOVE |
|------------------|----------|--------|
| IDT | ○ | ⊗ |
| Kiosk Sub | ○ | ⊗ |
| Chamber Sub | ○ | ⊗ |
| Pole Sub | ○ | ⊗ |
| Two Pole Sub | ○ | ⊗ |
| Air Break Switch | ○ | ⊗ |
| LV Links | ○ | ⊗ |
- | PROPOSED | EXISTING | REMOVE |
|------------|----------|--------|
| UG HV | ○ | ⊗ |
| UG LV | ○ | ⊗ |
| UG SL | ○ | ⊗ |
| UG SERVICE | ○ | ⊗ |
| OH HV | ○ | ⊗ |
| OH LV | ○ | ⊗ |
| OH SL | ○ | ⊗ |
| OH SERVICE | ○ | ⊗ |
| Conduit | ○ | ⊗ |

PROPOSED	EXISTING	REMOVE
UG HV	○	⊗
UG LV	○	⊗
UG SL	○	⊗
UG SERVICE	○	⊗
OH HV	○	⊗
OH LV	○	⊗
OH SL	○	⊗
OH SERVICE	○	⊗
Conduit	○	⊗

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ASP REF: N_APD002047.111_U_0.5

CERTIFICATION NUMBER

DESIGNED BY: JIMMY LI
AUTH NO: 29/11/2023
SUBMIT DATE: SINGLETON / CESSNOCK CITY COUNCILS
LGA: MAP REF: -
AUSGRID REF: -
PRJ/TRAJ No: -

HUNTLEE PTY LTD
VILLAGE 2
AUSGRID HV FEEDERS FROM
BRANXTON ZONE SUBSTATION
MASTER PLAN

SIZE: A1
AUSGRID PROJECT No: -
SHEETS: 1 of 1
AMD: 0

HUNTLEE STAGE 2 – Electrical Design Specifications



LOCAL STREET ROAD TYPE

- Relevant AS standards
AS/NZS 1158
- Lighting category
PR5 – To be determined by Cessnock City Council or Singleton Shire Council as relevant.
- Column sizes / styles / outreach
Galvanised steel, 6.5m high and with 2.0m outreach arms
Galvanised steel, and are likely to be 10.5m high and with 2.0m outreach
- Luminaire type
Aldridge P14W.N7PAG LEDs (residential Area)
Or
Philips BRP391 LED36/WW 25W DWP3 PSD P7 LM6 (commercial Area)
- Light pole location
Located 1.8m from kerb within Council footways and generally placed on shared property boundaries or splays except where utility clearances and civil works prevent this. Where a column cannot achieve this placement, it will be placed in an appropriate location considering clearances and civil works.

HUNTLEE STAGE 2 – Electrical Design Specifications



COLLECTOR STREET ROAD TYPE

- Relevant AS standards
AS/NZS 1158
- Lighting category
PR3 – To be determined by Cessnock City Council or Singleton Shire Council
- Column sizes / styles / outreach
Galvanised steel, and are likely to be 10.5m high and with 2.0m outreach
- Luminaire type
Aldridge P14W.N7PAG LEDs (residential Area)
Or
Philips BRP391 LED36/WW 25W DWP3 PSD P7 LM6 (commercial Area)
- Light pole location from kerb
Located 1.8m from kerb within Council footways and generally placed on shared property boundaries or splays except where utility clearances and civil works prevent this. Where a column cannot achieve this placement, it will be placed in an appropriate location considering clearances and civil works.

HUNTLEE STAGE 2 – Electrical Design Specifications



AVENUE STREET ROAD TYPE

- Relevant AS standards
AS/NZS 1158
- Lighting category
Avenue type road lighting category will be determined on a case by case basis.
- Column sizes / styles / outreach
Galvanised steel, and are likely to be 10.5m high and with 2.0m outreach
- Luminaire type
Likely to be Philips BRP391 LED36/WW 25W DWP3 PSD P7 LM6
- Light pole location from kerb
Located 1.8m from kerb within Council footways and generally placed on shared property boundaries. This may vary where roundabout and other traffic management devices are present or where there is reduced road width.

Avenue type roads with a raised median will have each side designed individually. This will consider the street light category, land usage and will be consistent with the above descriptions for residential and commercial uses.