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Menangle Pastoral

Report for Menangle Residential Development

Indicative Water and Wastewater Servicing Strategy

April 2012

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

Abbreviations

ANZECC	Australia and New Zealand Environment and Conservation Council
BOO	Build, own and operate
EP	Equivalent person
GHD	GHD Pty Ltd
GLES	Glenfield Liverpool Effluent Scheme
GS	General Security
ha	Hectare
kL	Kilolitre
ML	Megalitre
NWQMS	National Water Quality Management Strategy
RTWP	Recycled water treatment plant
STP	Sewage Treatment Plant
WSAA	Water Services Association of Australia
WFP	Water Filtration Plant

Executive Summary

GHD Pty Ltd (GHD) prepared a 'high level' indicative servicing strategy for the proposed residential and mixed use development at Menangle (herein referred to as the 'study area'). The study area comprises of approximately 27 hectares to be developed for residential and mixed use.

The study area currently comprises of predominantly vacant and agricultural land with scattered rural residential lots. The study area will require a rezoning to allow for the future development of the site. This strategy demonstrates that the land is serviceable for water and wastewater services. The design and sizing of infrastructure will be subject to further engineering, environmental and social assessments.

The proposed development comprises of approximately 27 hectares to be developed for residential and mixed use.

The existing residential Menangle Village is indicatively estimated to accommodate 110 residential houses (as well as the odd non-residential land use). In addition, the Durham Green Retirement Village, located to the south of the village, is forecasted to consist of 168 dwellings.

The Nepean River is situated along the northern and eastern boundary of the site.

Currently there is no centralised sewer infrastructure available for the study area, the closest connection being West Camden Sewage Treatment Plant (STP). The absence of centralised sewer infrastructure suggests that there is an opportunity for a dual reticulation water strategy to both manage wastewater and provide a source of non-potable water to the site. The provision of non-potable water minimises the requirement to manage effluent generated (to management of surplus non potable water).This rationale is subject to cost and other more detailed studies.

The closest centralised sources of potable water include the existing water mains supplying Menangle Village and the trunk water mains from Macarthur Water Filtration Plant. The Nepean River may also serve as a source of potable water once treated.

In addition, the utilisation of non-potable water in place of potable water for non-potable end uses may result in smaller potable water infrastructure footprint.

The provision of recycled water to the study area will ensure that wastewater is managed onsite with only excess recycled water requiring management (either via irrigation or treated discharge to the Nepean River).

GHD considered a range of water and wastewater servicing opportunities for the site, taking into account the apparent inherent opportunities and constraints to determine a short list of servicing strategies for the study area. The resulting short list of servicing strategies was:

> **Servicing Scheme 1**: Supplying potable water to the site via a connection to the existing 200mm water main supplying Menangle Village. This potable water will be stored in a local reservoir potentially located at the southern end of the site.

All sewer flows would be routed to a recycled water treatment plant the location of which is to be determined by further studies. The wastewater would be treated here before being pumped to a local recycled water reservoir which would potentially be located at the southern end of the study area. Surplus recycled water would be managed via discharge to the Nepean River or via irrigation. The indicative irrigation area required to manage the surplus recycled water may be in the order of 6 hectares. The study area is likely to provide ample opportunity to manage surplus water on site.

Servicing Scheme 2: Option 2 is similar to Option 1, with the exception that the potable water demands for the proposed area are supplied from a connection along the 1200mm main from the Macarthur Water Filtration Plant (WT0046), with a new 3 to 14 km main to supply the development.

This provides an alternative option should access to the existing potable water supply main to Menangle Village not be available.

Servicing Scheme 3: Option 3 is similar to Option 1, with the exception that raw water extracted from the Nepean River under the existing 900 ML/y GS extraction license would be treated and provide the primary water supply for the proposed area while the connection to the existing 200mm water supply main for Menangle Village would provide a backup supply only. This provides an alternative option should the capacity of the existing 200mm main not be sufficient to supply the additional demand.

It should be noted that the opportunities and constraints that led to the compilation of the short list of servicing schemes were not conclusive. However they are apparent in the absence of detailed risk assessment, timing, cost, environmental, social and other studies required to determine the most sustainable servicing strategy option.

At this stage, Sydney Water has not prepared a servicing strategy to service any growth within the study area. The wastewater servicing strategy for the Mangle area takes into account existing properties only as part of the Priority Sewage Program (PSP) and not growth.

The preferred option is Servicing Scheme 1. Further detailed analysis and studies are required to determine the required sizing and locations of infrastructure.

It should be noted that the above servicing schemes may be extended to allow Menangle Village to be connected to the proposed infrastructure.

1. Introduction

1.1 Background

GHD Pty Ltd (GHD) prepared a 'high level' indicative servicing strategy for the proposed residential and mixed use development at Menangle (herein referred to as the 'study area'). The proposed study area currently comprises of predominantly vacant and agricultural land with scattered rural residential lots. The study area will require rezoning to allow future development of the site for residential and mixed use. This strategy demonstrates that the land (shown in Figure 1) is serviceable for water and wastewater services.

1.2 Study Area

The study area is situated within the local government area of Wollondilly. It is located to the north and east of Menangle Village. The study area is also situated south of an area to be redeveloped by Landcom/Campbelltown Council referred to as Menangle Park. Sydney Water has prepared a servicing strategy for the whole of the Menangle area. This strategy provides capacity for the existing Menangle Park and Menangle villages to be connected as part of the Priority Sewerage Program. However the proposed Menangle residential infill development has not been included in the servicing strategy for the Menangle Park Release Area and Sydney Water has advised that it does not have funds allocated to service growth in the Menangle area.

The proposed development comprises of approximately 27 hectares to be developed for residential and mixed use (refer to Figure 1).

The existing residential Menangle Village is indicatively estimated to accommodate 110 residential houses (as well as the odd non-residential land use). In addition to this, the Durham Green Retirement Village, located to the south of the village, is forecasted to consist of 168 dwellings.

The Hume Highway lies along the eastern boundary of the site from the north to the south. The main Southern Railway runs close to the western boundary of the site and the Nepean River runs along the northern boundary.

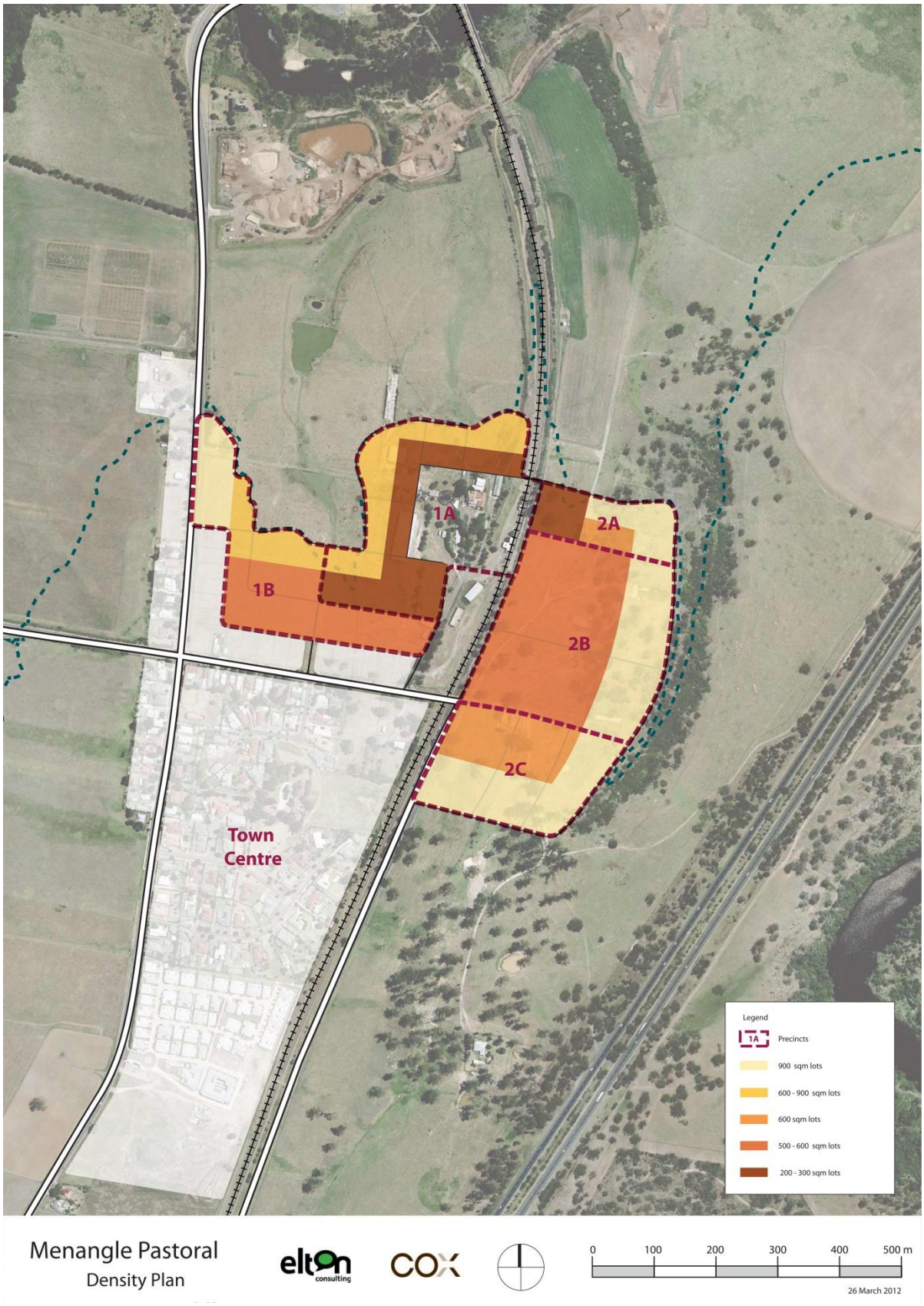


Figure 1 Map Showing Proposed of the Study Area

1.3 Objective

The objective of this report is to demonstrate indicative 'high level' servicing strategy options for the development of the study area, as such GHD has:

- Reviewed the available dwelling/population and open space (requiring watering) areas as supplied by the client.
- Reviewed a range of design standards for water consumption and flows to sewer for the land use requirements in the study area;
- Provided a range of servicing strategy options for water (potable and non-potable) and wastewater, along with associated readily apparent opportunities/constraints of each option;
- Provided 'planning level' indicative sizing for trunk recycled/potable water and sewer mains in addition to reservoir and treatment plant locations and indicative sizes for selected preferred servicing strategies; and
- Provided indicative quality requirements for treatment processes for the specified treatment plants.

The short list of servicing strategies will be illustrated via descriptive text and schematic figures.

It should be noted that opportunities and constraints pertaining to each servicing option within this report are not conclusive. However they are readily apparent in the absence of detailed risk assessment, timing, cost, environmental, social and other studies required to determine the most sustainable servicing strategy option. These apparent opportunities and constraints have been utilised to differentiate between options to proceed to further consideration.

In addition, the sizing of the infrastructure and proposed locations are indicative and subject to more detailed analysis and studies in order to be conclusive. These analyses would occur post gateway determination and prior to exhibition.

2. Development Forecast

The development forecast for the study area, including the proposed development, the existing Menangle Village and the retirement village, is shown in Table 1. Appendix A provides the indicative flows and demands calculated for these areas.

Table 1 Areas and proposed development

Description of Proposed Land Use Type	Gross Hectares	Net Hectares [1]	No. Residential Dwellings	Designated Open Space requiring watering (ha)	Assumptions
Urban infill single detached dwelling (residential)	27	13	450 **	5 *	Assume all residential dwellings are single detached low density (number of residences supplied by the client). Strategy developed for up to 450 dwellings.
Existing urban area (Menangle Village)	14	8	110 (existing)	3 *	Assume all residential dwellings are single detached low density – number of houses estimated from customer SWC info.
Durham Green Retirement Village	10	6	168 *** (existing & proposed)	2 *	Assume all retirement dwellings are single detached low density – number of dwellings sourced from developer website.

*assume 20% of residential land use gross area requires additional watering (parks, open space)

** For the purposes of indicatively sizing assets, our assumptions allow for up to 450 residential dwellings. The current concept plan allows for between 300-400 dwellings.

*** For the purposes of this study, it was assumed that the retirement village would be fully developed.

[1] Net hectares = 0.6 x Gross Hectares for all residential development.

3. Design Criteria

3.1 Use of Dual Reticulation within the Study Area

An existing centralised sewer system currently does not exist within the study area. The existing Menangle Village is serviced by a variety of private on-site sewerage systems which are likely to be prone to operational issues.

The closest centralised wastewater systems within the study area are located a significant distance away (this is further described in Section 4). It is likely that the installation of dual reticulation (and thus the provision of recycled water) would be required in order to sustainably manage the wastewater generated by the development area.

In addition, the utilisation of non-potable water further relieves the existing potable water supply and impost on additional requirements to service the planned development.

Given the costs in transporting wastewater to existing Wastewater Treatment Plants is prohibitive, the alternative would be to collect, treat and discharge into the Nepean River. The utilisation of treated effluent for recycled water purposes therefore makes rational sense and minimises nutrient load based discharges into the river.

As such, the forecasts below are for the implementation of a dual water system (potable and recycled water provision), however single potable water supply options are still considered (albeit, less favourably).

3.2 Potable and Recycled Water Use by End Use

As shown in Section 2, the potential main land use types within the study area are residential. While there is likely to be some business and community water use within the proposed development area, it is likely to be a small proportion of overall water use and therefore the development will be assumed to be residential only for the purposes of this study.

The end uses for which recycled water will be utilised include:

- Residential dwellings: toilet flushing, washing machine and irrigation; and
- Open Space irrigation.

It is assumed that potable water will be utilised for all other end uses within the land use types in the study area.

3.3 Adopted Design Criteria Summary

This section will outline the potable and recycled water, flows to sewer, as well as other design criteria.

The design criteria are conservatively based on a mixture of known latest Sydney Water information relating to peaking factors and Sydney Water WSA 03-2002-2.2

code (WSA). Peaking factors are generally higher when dual reticulations systems are available given historically recycled water has not been governed by restrictions and attitudes to this type of water is different to that of potable water. These higher peaking factors have been used.

Table 2 shows a summary of the adopted potable and recycled demand criteria (for maximum day, maximum hour and average day) by potential major land use, together with other major assumptions that have been adopted to compile the servicing strategy outlined in Section 5.

Table 2 Summary of Adopted Design Criteria

Item	Design Criteria	Units	Potable Water	Recycled Water
Design Demands				
Single Dwelling Residential	Average Day Demand	kL / dwelling / day	0.28	0.46[1]
Single Dwelling Residential	Max Day Demand	kL / dwelling / day	1.0	1.5[1]
Single Dwelling Residential	Max Hr /Max day peak		3.4 x maximum day	4.6 x maximum day[1]
Single Dwelling Residential	Max Hr Demand	kL / dwelling / day	3.4	6.9
Irrigation	Average Day Demand	Ratio	Only permitted off recycled system	1/3 x Max Day demand
Irrigation	Max Day Demand	kL/Ha/Day	Only permitted off recycled system	Where possible assessed on an individual basis OR 7 kl/Ha/day
Minimum Supply Pressure				
Pressures	Minimum Pressure	metres head	20m	15m (minimum) 20m (desirable)
Reservoir Storage				
Surface Reservoir	Operating Storage		Up to one third of max day demand	Up to one third of max day demand
Pumping Capacity Design				
Pumping Stations	Duty pumps supplying surface reservoir		Max day capacity	Max day capacity
Pipeline Design				
Pipe Capacity	Reticulation Mains		Size for Maximum Hour	Size for Maximum Hour
Friction Factor		Hazen-Williams	DICL = 120	DICL = 120
Target Head Losses	Mains <= 150mm	m/km	5	5
Target Head Losses	Mains >=200mm	m/km	3	3
Maximum Velocity		m/s	2.0	2.0
Treatment				
Treatment	Recycled Treatment Plant[7]		N/A	Assess As Required

Notes:

1. Assumes recycled water used for gardens, toilet flushing and washing machines.
2. Average Dry Weather Flow to sewer is assumed to be 180 L/ equivalent person/day. It is assumed that there are 3 equivalent persons per dwelling.
3. Average Dry Weather Flow to sewer is assumed to be 180 L/ equivalent person/day. It is assumed that there are 150 equivalent persons per gross residential hectare (Sydney Water WSA 03-2002-2.2).
4. If recycled network has access to another independent source of supply (e.g. potable back-up), the recycled reservoir can be confined to operational storage subject to a risk assessment and subsequent approval by Sydney Water.
5. Elevated reservoirs should be restricted to a maximum of 4 ML, or 1/3 max day reserve storage plus operational storage, whichever is smaller.

3.4 Flows to Sewer

It should be noted that the flows to sewer have been estimated using the WSA assumption that 180 L/equivalent person /day in a residential area flows to sewer. GHD have assumed that 3 equivalent people occupy each single residential dwelling (based on the assumption that an equivalent person utilises an average of 250 L/ water/day. As such, the flows to sewer equate to 73% of average water demands or 0.5 kL/dwelling/day (on average).

Further detail pertaining to the water demands and average flows to sewer by area identification within the study area is shown in Appendix A.

4. Water and Sewer Servicing Strategies

4.1 Potable Water Infrastructure

4.1.1 Existing Potable Water Infrastructure

Water Filtration Plant

Macarthur Water Filtration Plant (WFP) provides water to the Macarthur Delivery Area, which includes the Campbelltown local government area from Broughton's Pass Weir. Macarthur WFP is located on Wilton Road, between Brighton's Pass and Appin.

The WFP is built, owned and operated (BOO) by North West Water Australia.

In 2004, the Macarthur maximum day demand was 160 MLD, it is designed for a maximum day capacity of 265 MLD.

Pipelines, supplies and Reservoirs

Filtered water gravitates via a 1200mm BOO to Sugarloaf near Glen Alpine to serve the Narellan and Campbelltown South Water Supply Systems. At Sugarloaf a 750mm pipeline continues on to supply Narellan South Reservoir, located approximately 5 km north west of the study area.

The existing residential Menangle Village is serviced by a 200mm diameter main from the Camden Park Reservoir (which is part of the Campbelltown Supply System).

In addition, the planned Menangle Park development is proposed to be serviced with potable water via a new reservoir at Glenlee Road (to be supplied from Narellan Reservoir), however this development has not yet been constructed and thus incorporation of this option would be dependent on the proposed service proceeding.

The proponent advised GHD that there is a licence to extract up to 900ML per annum from the Nepean River that runs along the northern and eastern boundary of the study area. However these water extraction licenses are General Security (GS) licenses. Water allocations for GS licenses may be reduced during periods of water scarcity and therefore provide a lower security of water allocation than town water supplies.

4.1.2 Potable Water Infrastructure Options

Based on the existing potable water infrastructure on the site, the following potable water opportunities exist:

- Option Potable A: The 200mm diameter main may be extended approximately 1 km into the study area to supply the proposed residential area (in addition to the currently supplied Menangle Village and retirement village). A 300 kL potable water reservoir would also be required. This option provides the opportunity for the portion of proposed development to connect to the main (assuming the existing reservoir has capacity).

Opportunities: growth can be serviced with minimal new potable water infrastructure (assuming the existing reservoir would have sufficient capacity).

Constraints: Any additional development in the area would require an alternative source of potable water.

To be considered further.

- Option Potable B: Connection along the 1200mm main from the Macarthur Water Filtration Plant (WT0046), this is likely to require a new reservoir located within the development area.

  The connection would extend approximately 3.5 km to the location of the reservoir (assuming this portion of the 1200mm pipeline has capacity or an additional main would be laid alongside the 1200mm main).

  Opportunities: independent strategy and scope for growth should development expand and can potentially utilise a portion of the existing 1200mm diameter main from Macathur Water Filtration Plant.

  Constraints: likely to require additional reservoir at the development site.

  To be considered further.

- Option Potable C: Extension by approximately 12km of the pipeline that is proposed to service the Menangle Park development to the north (subject to spare capacity), which includes upgrades including duplication of the inlet main to Narellan reservoir, and a new 8ML reservoir. This is subject to spare capacity at Glenlee Road (to be supplied from Narellan Reservoir) via negotiation with Landcom/ Campbelltown Council under instruction from Sydney Water. However, Sydney Water has advised that growth in the Menangle area has not been included in the servicing strategy for the Menangle Park Release Area and Sydney Water does not have funds allocated to service proposed Menangle infill development.

  Opportunities: utilise a portion of the existing pipeline

  Constraints: new reservoir required, dependent on proposed infrastructure subject to a development application in a separate council area, Sydney Water has advised that growth in Menangle has not been allowed for in the Menangle Park servicing strategy.

  Due to significant constraints, this option will not be considered further.

- Option Potable D: Extraction of raw water from the Nepean River under the existing general security allocation (maximum of 900ML/yr). This extracted raw river water would likely be treated at works located adjacent to the river extraction point and then pumped to a proposed potable water reservoir located at a high point in the vicinity of the study area. Treatment of raw water extracted from the Nepean River would likely consist of chemical dosing (to promote coagulation and / or remove taste and colour) and filtration (to remove solids, algae etc). Following filtration, the water will require disinfection to provide an additional barrier against bacteria and virus as part of the multi barrier approach to drinking water quality.

This can be achieved via either UV or chlorination prior to distribution (further details on these process can be viewed in Appendix B).

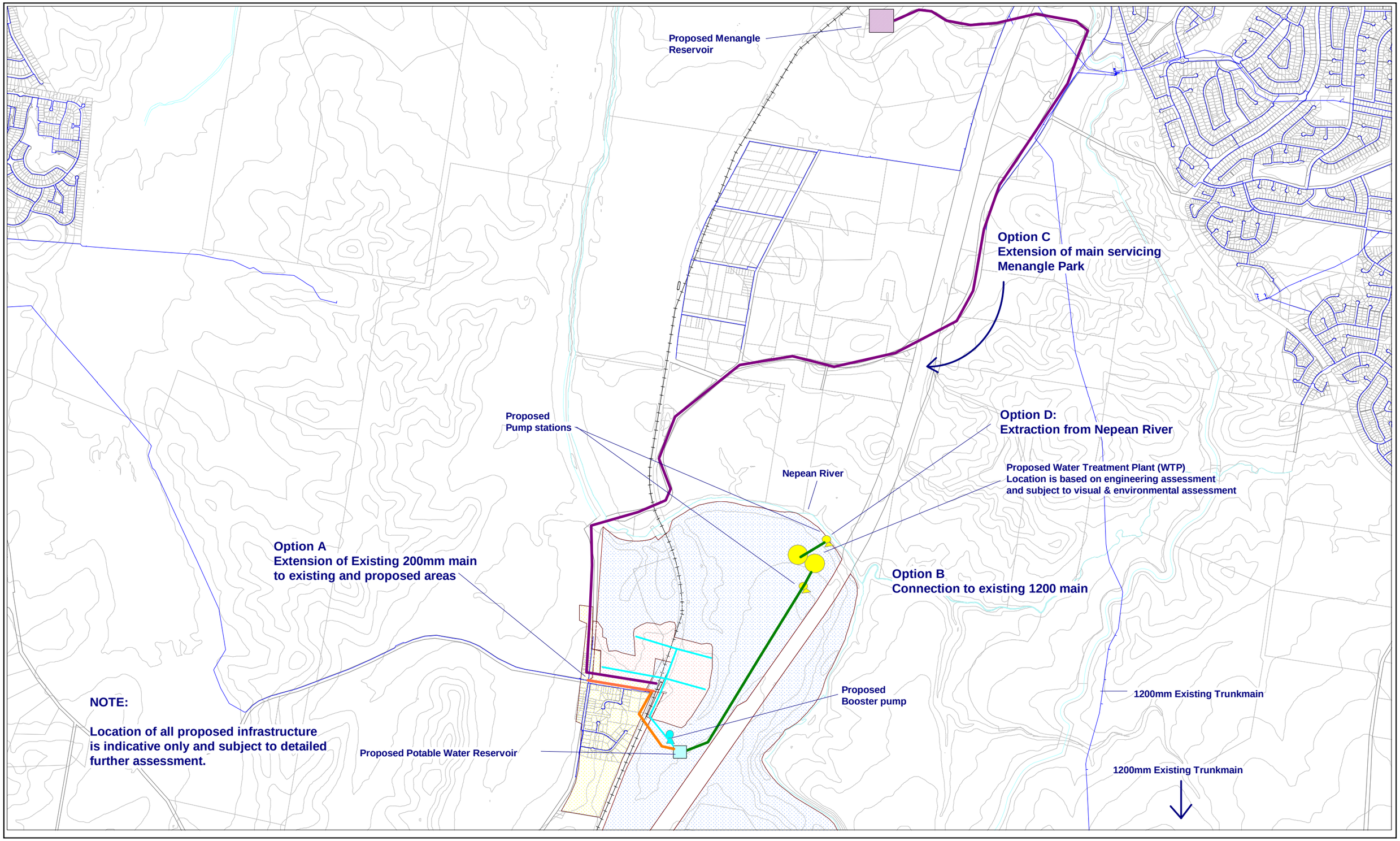
Opportunities: independent strategy for potable water supplied by river.

Constraints: likely to require additional treatment works prior to use. Extraction of water from the river would be subject to environmental investigation and may be subject to reductions in allocations, and any additional development in the area would require an alternative source of potable water

This option will be considered further.

As such, Potable Water Options A, B and D will be considered further.

All the above potable water servicing options are indicatively illustrated in Figure 2.



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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LEGEND

- Option A
- Option B
- Option C
- Option D
- Existing water mains
- Proposed potable water mains
- Proposed potable water reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Potable Water Servicing Options

Figure 2

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4.2 Sewer Infrastructure

A centralised wastewater system does not currently exist within or near the study area. The existing Menangle Village is serviced by a variety of private on-site sewerage systems that have operational problems (and require pump out or disposal by irrigation). As such, servicing the study area with sewer infrastructure provided an opportunity to incorporate the existing Menangle Village.

West Camden Sewage Treatment Plant (STP) and Glenfield STP are the two closest STPs to the development site. West Camden STP is located much closer to the site than Glenfield STP.

Sydney Water advised Maunsell in 2008 that Glenfield STP does not have sufficient capacity to supply additional properties without major upgrades. However Sydney Water has advised that the Glenfield wastewater system will serve the PSP program in addition to additional growth areas and therefore it is assumed that this system will be upgraded. GHD believe capacity is also limited at West Camden STP. In addition, the only likely connection to West Camden STP system is at the headworks of the STP, which is approximately 13 kilometres from the development area.

4.2.1 Potential Sewer Servicing

Based on the lack of existing sewerage infrastructure on the site, the following servicing opportunities exist:

- Option Sewer A: A new package wastewater treatment plant may be located within the study area.

  Note: Council would not be required to operate the proposed wastewater system.

  This option would likely operate independently from Sydney Water's infrastructure developments and would be implemented together with dual reticulation recycled water option 'Option Non Potable A' discussed later. This recycled water treatment plant would be required to treat the wastewater to a quality of water suitable for recycled water use, further details of which are shown in Appendix B. This strategy would require surplus treated effluent to be managed within the study area via either: discharge to the Nepean River or irrigation/watering within, or nearby to, the study area. Storage of the treated effluent would likely be required prior to irrigation or discharge.

  The treatment requirements for surplus recycled water will be dependent on the circumstances of the use and will vary depending on whether the recycled water will be used for controlled municipal irrigation, agricultural irrigation or discharge to the Nepean River. Further details are shown in Appendix B. Alternatively should Sydney Waters PSP strategy prevail then it would also be possible to dispose of any excess effluent into the PSP system.

  The collection system could be either conventional gravity systems or low pressure systems that may complement the existing infrastructure within Menangle Village and the retirement village.

Opportunities: independent strategy for wastewater management. Utilisation of a non-potable water source on site would ensure that the study area is developed in keeping and contributing to the goals of the NSW Governments Metropolitan Water Plan (2010) which includes targets to recycle 70 billion litres of water per year by 2015.

Constraints: land within the study area would be required to locate the STP and recycled water infrastructure, additional dual reticulation network would be required, and excess recycled water requires onsite management.

This option will be considered further.

- Option Sewer B: Wastewater could be pumped to West Camden STP. In 2008, Maunsell were advised that the only likely connection to West Camden STP (due to capacity issues) would be near the headworks, which is approximately 13 km north-west of the site.

  Opportunities: wastewater management occurs outside the development area.

  Constraints: connection to West Camden STP is a significant distance away from the site, requiring significant pumping. West Camden STP would require significant upgrade and timing of the development of the study area would be constrained by West Camden STP upgrades. In addition, this option may or may not be able to provide recycled to the development water (without additional recycled water treatment plant provisions at West Camden) and therefore non-potable demands within the development may need to be supplied by potable water.

  Due to significant constraints this option will not be considered further.

- Option Sewer C: Wastewater could be pumped to Glenfield STP. In 2008, Maunsell were advised that Glenfield STP would require significant capacity upgrade in order to service the proposed Menangle Park development. In addition, Glenfield STP is located approximately 24 km from the site. Assuming that there is sufficient capacity in existing network for half of this distance, the remaining 12 km of transfer pipework to connect to Glenfield STP would require augmentation. In addition, several pump stations would likely be required to transport wastewater.

  Opportunities: wastewater management occurs outside the development area.

  Constraints: connection to Glenfield STP is a significant distance away from the site requiring augmentation and potentially significant pumping for water transfer. Glenfield STP would require significant upgrade and timing of the development of the study area would be constrained by Glenfield STP upgrades. In addition, if Glenfield STP was not able to provide recycled water to the development, increased potable water would be used to meet non-potable demands.

  Due to significant constraints this option will not be considered further.

- Option Sewer D: Each dwelling may have an individual wastewater treatment plant (and thus associated recycled water treatment plant as denoted in Non Potable E below).

Opportunities: each lot or group of lots would be able to be serviced independently of availability of external wastewater infrastructure provisions.

Constraints: excess treated recycled water would require onsite management (which may be difficult) and thus result in a network to manage recycled water in a central location. Option Sewer D requires significant lot scale management and is unlikely to be favoured by the community.

Due to significant constraints this option will not be considered further.

- Option Sewer E: Extension of the existing Menangle Park Servicing Strategy which includes a 'new Menangle Park STP' located approximately 3 kms from the site (on the other side of the Nepean River near the Southwestern Freeway). This STP is proposed to service additional surrounding growth (for example, Glenlee, Jacks Gully amongst others). However, Sydney Water have advised that growth in the Menangle area has not been included in the servicing strategy for the Menangle Park Release Area and Sydney Water does not have funds allocated to service proposed Menangle infill development.

  Opportunities: New proposed STP located a short distance from the site. Wastewater management occurs outside the development area.

  Constraints: Construction of this STP has not yet proceeded. The proposed Menangle Park STP would require upgrading to cater for flows from the study area and the development of the study area would be constrained by the timing and availability of the new STP, Sydney Water have not allowed for growth in the Menangle area in their servicing strategy for Menangle Park.

  Due to significant constraints this option will not be considered further.

As such, Option Sewer A will be developed for further consideration.

All of the above sewer servicing options are indicatively illustrated in Figure 3.

Option E
To Proposed
Menangle STP

Option C
To Proposed
Glenfield STP

Option B
To West Camden STP

Proposed Pump Station to
Recycled Water Reservoir
(For Option A)

Option A
Proposed Wastewater and Recycled Treatment Plant
Effluent to Recycled Water Reservoir;
Surplus effluent to be used for irrigation/watering
within or nearby the study area. Location is based on
engineering assessment and subject to visual and
environmental assessment.

Proposed Wastewater
Pump Station
(For Options B, C & E)

Proposed
Sewer Mains

Proposed Recycled Water Rising Main

Proposed Recycled Water Reservoir

NOTE:

Location of all proposed infrastructure is indicative only and subject to detailed further assessment.

Option E: Lot-scale or cluster-scale onsite wastewater systems.

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Option A
- Option B
- Option C
- Option E
- Proposed Sewer Mains
- Recycled Water Rising Main
- Recycled Water Reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Wastewater Servicing Options

Figure 3

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4.3 Non Potable Water Infrastructure

Non potable water infrastructure is not located within close vicinity to the site.

The closest STP is West Camden STP (approximately 13 km north-west of the site) which after the recent upgrade (proposed to be finished September 2009) will have the capacity to treat an average of 23 ML of wastewater a day.

The recent upgrade of West Camden STP involved the construction of a recycled water pipeline to deliver up to 1 ML per day recycled water to local agricultural and dairy farming at the Elizabeth Macarthur Agricultural Institute (approximately 4 km north east of the study area).

The objective of supplying recycled water via a pipeline to the Elizabeth Macarthur Agricultural Institute was to improve the health of the Hawkesbury Nepean River by reducing the volume of water extracted for irrigation.

Glenfield STP is located approximately 20 km northeast of the site. Sydney Water recently completed work on the Glenfield Liverpool Effluent Scheme (GLEDS). The GLEDS transfers treated wastewater from Glenfield and Liverpool Sewage Treatment Plants along the Liverpool to Ashfield Pipeline (LAP) for reuse by industrial customers. Glenfield STP is located far from the study area and is likely to require major amplification to cater for effluent from the study area. As such the option of utilising Glenfield STP was not considered further.

4.3.1 Non Potable Water Infrastructure Opportunities

It seems 'sensible' to utilise non-potable water (particularly recycled water) on site for three main reasons:

- The proponent has indicated that their preference would be to have BOO infrastructure to enable independently serviced development in a timely manner;
- The site is predominantly a green field and no existing wastewater or water infrastructure. As such, the servicing of the site with non-potable water would:
  - reduce dependency on potable water;
  - manage flows to sewer by treating and reuse as non-potable recycled water; and
  - allow the study area to be developed in keeping with, and contributing to, the goals of the NSW Governments Metropolitan Water Plan (2010) which includes targets to recycle 70 billion litres of water per year by 2015.

Based on the lack of existing non potable water infrastructure on the site, the following non potable water opportunities exist:

- Option Non Potable A: Non potable recycled water may be supplied by a recycled water treatment plant located within the study area. This treatment plant would treat effluent from within the study area. This option would operate independently from Sydney Water's infrastructure developments, and thus excess treated effluent

would require management on the study area, either by discharge to the Nepean River, or by storage and irrigation/watering within or nearby the study area.

Opportunities: Independent source of non-potable water with reduced reliance on potable water. Contribution to the recycled water goals of the NSW Governments Metropolitan Water Plan (2010).

Constraints: Excess effluent would require onsite management. A network of dual reticulation pipes would be required within the study area.

This option will be considered further.

- Option Non Potable B: The spare capacity in the recycled water pipeline (300mm diameter) that was commission to supply recycled water to EMAI from West Camden STP would either be used or amplified as a source of recycled water. This would require approximately 4 km of additional pipework.

  Opportunities: potentially able to utilise some spare capacity in existing recycled water pipeline and existing recycled water facilities at West Camden.

  Constraints: Significant extension of the existing recycled water pipeline required, in addition to upgrade of the recycled water facilities at West Camden. The development's recycled water provisions would not be independent. Option Non Potable B would likely be implemented hand-in-hand with diverting all sewer flows to West Camden STP (Option Sewer B).

  Due to significant constraints this option will not be considered further.

- Option Non Potable C: Extension of the existing Menangle Park Servicing Strategy which includes a 'new Menangle Park recycled water treatment (and associated STP)' located approximately 3 km from the site (on the other side of the Nepean River near the Southwestern Freeway).

  Opportunities: New proposed recycled water treatment plant located a short distance from the site.

  Constraints: Construction of the 'Menangle Park' area has not yet proceeded. The proposed development would require upgrading to cater for recycled water demands (and associated sewer flows) from the study area and the development of the study area would be constrained by the timing of the availability of the new recycled water treatment plant.

  Due to significant constraints this option will not be considered further.

- Option Non Potable D: Non potable water may also be supplied by rainwater. The use of rainwater tanks as a source of non-potable water may be most applicable to existing developments via retrofitting the existing residential properties with rainwater tanks as a supply of non-potable water (which is topped up by potable water or recycled water). However the servicing of this would require negotiation with the relevant parties.

  Opportunities: rainwater tanks would provide a source of non-potable water to existing developments within the existing Menangle Village and retirement village. This would reduce demand on potable water from the existing 200 mm pipeline to

enable this spare capacity to be supplied to the proposed development within the study area.

Constraints: Retrofitting of existing properties required and may result in increased pump costs and energy usage. The Menangle Village and retirement village is outside the proposed development.

This option could be considered further incorporated with Option Non Potable A. However it is subject to the involvement of other parties in relation to delivery and cost.

- Option Non Potable E: Non potable recycled water may be supplied by each dwelling having an individual BOO recycled water treatment plant (and thus associated wastewater treatment plant).

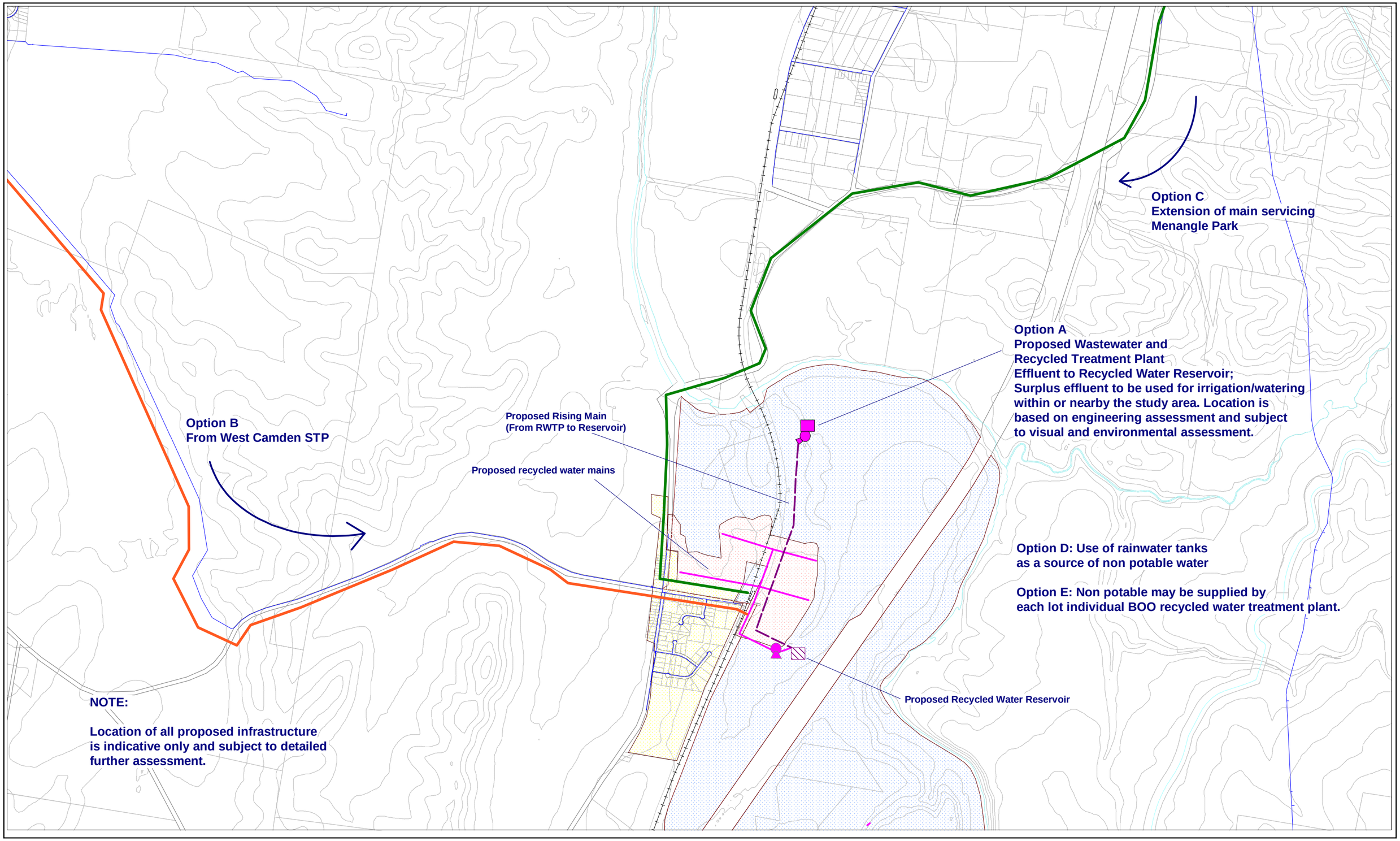
  Opportunities: each lot or group of lots would be able to be serviced independently of external wastewater/recycled infrastructure provisions.

  Constraints: excess treated recycled water would require onsite management (which may be difficult) and thus result in a network to manage recycled water in a central location by irrigation or other. This would require significant lot scale management and is unlikely to be favoured by the community.

  Due to significant constraints this option will not be considered further.

As such, Options Non Potable A and D will be developed for further consideration.

All the above non-potable water servicing options are indicatively illustrated in Figure 4.



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

LEGEND

- Option A
- Option B
- Option C
- Existing water mains
- Proposed recycled water mains
- Proposed recycled water reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Pastoral
Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Recycled Water Servicing Options

Figure 4

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4.4 Summary of Servicing Opportunities

Section 4 provides a range of options for servicing the proposed residential development with potable water, recycled water and sewerage services. These are summarised in Table 3.

Table 3 Summary of proposed servicing options

Option Type	Label	Description	Short-listed
Potable	A	Extension of existing 200 mm potable water supply main approximately 0.5 km to service the proposed development.	✓
Potable	B	Connection along the 1200mm main from the Macarthur Water Filtration Plant (WT0046), with a new 3 to 14 km main to supply the development.	✓
Potable	C	Extension by approximately 12km of the pipeline that is proposed to service the Menangle Park development to the north.	
Potable	D	Extraction of raw water from the Nepean River, treatment and storage in a proposed potable water reservoir before use.	✓
Sewer	A	A new package wastewater treatment plant located within the study area and management of surplus effluent on site.	✓
Sewer	B	Transfer of wastewater to the headworks of West Camden STP, approximately 13 km north-west of the site.	
Sewer	C	Transfer of wastewater approximately 24 km to Glenfield STP, includes upgrading of the STP and augmentation of the existing trunk system.	
Sewer	D	Individual lot scale wastewater capture and treatment.	
Sewer	E	Extension of the existing Menangle Park Servicing Strategy which includes a new STP located approximately 3 kms from the site	
Non-potable	A	Non potable recycled water supplied by a recycled water treatment plant located within the study area. Effluent would be managed on site by irrigation or discharge to the Nepean River.	✓
Non-potable	B	Source recycled water from the 300 mm recycled water pipeline that supplies recycled water to EMAI from West Camden STP including approximately 4 km of additional transfer mains.	

Option Type	Label	Description	Short-listed
Non-potable	C	Supply of recycled water from the proposed Menangle Park recycled water treatment located approximately 3 km from the site.	
Non-potable	D	Use of rainwater tanks as a source of non-potable water in existing properties.	✓
Non-potable	E	Lot scale water recycling at each dwelling utilising individual BOO recycled water treatment plants.	

5. Short List of Proposed Servicing Schemes

At this stage, the client has not been able to secure a meeting with Sydney Water to discuss the proposed servicing scheme options.

However, the above proposed water, non-potable and sewer servicing options for the study area have been selected as preferable for further consideration and the associated pipework, treatment and reservoir infrastructure has been indicatively sized.

It should be noted that the size of proposed new infrastructure and capacity of existing infrastructure should be verified by detailed assessment.

In addition, the proposed short list of servicing schemes and the suggested location of infrastructure is subject to detailed sustainability assessments, to incorporate quadruple bottom line considerations.

5.1 Servicing Scheme Option 1- Combination of Option Potable A, with Option Non Potable A and Non Potable D, and Sewer A

This option involves the development of an independent servicing strategy for the study area. It also provides the opportunity for Council to connect Menangle Village and the retirement village to a sewerage scheme.

The existing 200 mm water main supplying Menangle Village would be extended by approximately 1 km to a potable water reservoir to supply the proposed development in addition to existing demands. The proposed potable water reservoir will also supply potable water for substitution of non-potable water during times of deficit. Preliminary assessments of the capacity of the 200 mm water main suggest there is sufficient capacity to supply the additional potable demand associated with the new development, however this would need to be confirmed via detailed planning. This option also assumes there is sufficient capacity within the existing Camden Park Reservoir.

Water from the proposed reservoir would be supplied to properties via a 200mm diameter reticulation network and, due to the relatively flat topography of the area, it is assumed that a booster pump will be required to meet the required supply pressure.

The above potable water trunk pipeline to the reservoir from the existing 200mm main has been sized for maximum day potable water demand for the proposed development.

The potable water reservoir has been indicatively sized for 2/3 maximum day potable water demands for the proposed development. The size of the potable water reservoir proposed will be approximately 300 kL.

The indicative potable water assets required are:

- 1km extension of existing water supply main (150mm)
- 300 kL potable water reservoir
- Booster pump station
- Approximately 1.8km of 200mm potable water distribution mains

Recycled Water and Wastewater

A new recycled water treatment plant could be constructed at the site, currently GHD have placed this in the northern end of the site to ensure that the opportunity for wastewater to gravitate to the treatment plant is maximised (and for infrastructure sizing purposes). This area is on a flood plain (below the 1/100 year ARI flood level) and therefore may require additional protection from flooding.

This recycled water treatment plant is sized to treat up to three times average dry weather flow (3 x ADWF) for both the existing and proposed areas (allowing for the existing Menangle Village and retirement village to connect) being approximately 1.3 ML/day.

Note: Council would not be required to operate the proposed wastewater system.

The recycled water reservoir has been sized for 2/3 maximum day recycled water demands for the proposed residential area. The capacity of the recycled water reservoir will be approximately 500 kL. The recycled water reservoir will be located to the east of the study area (adjacent to the potable water reservoir). The treated recycled water will be pumped via a pump station to the recycled water reservoir to the east of the site. A pipeline of 200 mm for 1.3 km will connect the recycled water system with the recycled water reservoir (this has been sized for maximum day demands).

Due to the relatively flat topography of the area, it is assumed that a booster pump will be required to meet the required supply pressure.

The 250mm recycled water pipeline to feed the area will be laid as close as possible to the same location as the potable water pipelines (to save time and cost). The recycled water pipelines were sized for maximum hour. A network of sewerage pipes ranging from 200 to 300 mm diameter will be required to collect sewage and deliver to the wastewater treatment plant.

The indicative recycled water assets required are:

- 1.3 ML/day recycled water treatment plant
- 500 kL recycled water reservoir
- 2 booster pump stations
- 1.3 km of 200mm recycled water rising main
- Approximately 1.8km of 250mm diameter recycled water distribution mains
- Approximately 2.3 km of sewage collection mains ranging from 200 mm to 300 mm in diameter

A connection from the recycled water reservoir to either irrigable land (indicatively assumed to be 14 hectares, assuming adequate storage and a soil percolation rate of 10mm/week) or the Nepean River would be required to manage surplus recycled water (this is envisaged to be an average of approximately 174 kL/day).

Existing areas may use rainwater tanks as a source of non-potable water in existing properties.

It should be noted that the location and sizes of all infrastructure is subject to further detailed assessments.

In addition, storages to manage the wastewater and surplus recycled water would be required, this has not been sized as part of the scope of works. Servicing Scheme Option 1 is shown illustrated in Figure 5.

5.2 Servicing Scheme Option 2- Combination of Option Potable B, with Option Non Potable A and Non Potable D, and Sewer A

Option 2 is similar to Option 1, with the following exception. This exception is that the potable water demands for the proposed area are supplied from a connection along the 1200mm main from the Macarthur Water Filtration Plant (WT0046), with a new 3 to 14 km main to supply the development.

This provides an alternative option should access to the existing potable water supply main to Menangle Village not be available.

Servicing Scheme Option 2 is shown illustrated in Figure 6.

5.3 Servicing Scheme Option 3- Combination of Option Potable D backed up with Option Potable A, with Option Non Potable A and Non Potable D, and Sewer A

Option 3 is similar to Option 1, with the following exception. This exception is that raw water extracted from the Nepean River under the existing 900 ML/y GS extraction license would provide the primary water supply for the proposed area while the connection to the existing 200mm water supply main for Menangle Village would provide a backup supply only. This provides an alternative option should the capacity of the existing 200mm main not be sufficient to supply the additional demand.

Raw water would be extracted from the Nepean River by a pump station and would be treated at a water treatment plant to potable water standards and delivered to the potable water reservoir via another booster pump.

In addition to the infrastructure requirements required for Option 1, this option would require the following:

- 700 kL/day water treatment plant
- 2 pumping stations
- Approximately 1.7km of 150mm rising main

Servicing Scheme Option 3 as described above is shown illustrated in Figure 7.

Nepean River

Proposed pump station
(to Recycled Water Reservoir)

Proposed Wastewater/Recycled Water Treatment Plant & Pump Station (1.3 MLD). Location is based on engineering assessment ans subject to visual and environmental assessment.

300mm

200mm rising main

150mm extension of existing main to potable water reservoir

250mm

200mm

Proposed Booster pumps

250mm

Proposed Recycled Water Reservoir (500 kL)

Proposed Potable Water Reservoir (300 kL)

200mm

NOTES:

Location and size of all proposed infrastructure is indicative only and subject to detailed further assessment.

Excess treated effluent (i.e. above the reservoir supply) would require management on the study area by storage and/or irrigation/watering within or nearby the study area.

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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LEGEND

- Proposed Offtake
- Recycled rising main
- Potable water main
- Recycled water main
- Sewer main
- Proposed recycled water reservoir
- Proposed potable water reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Pastoral
Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Servicing Option 1

Figure 5

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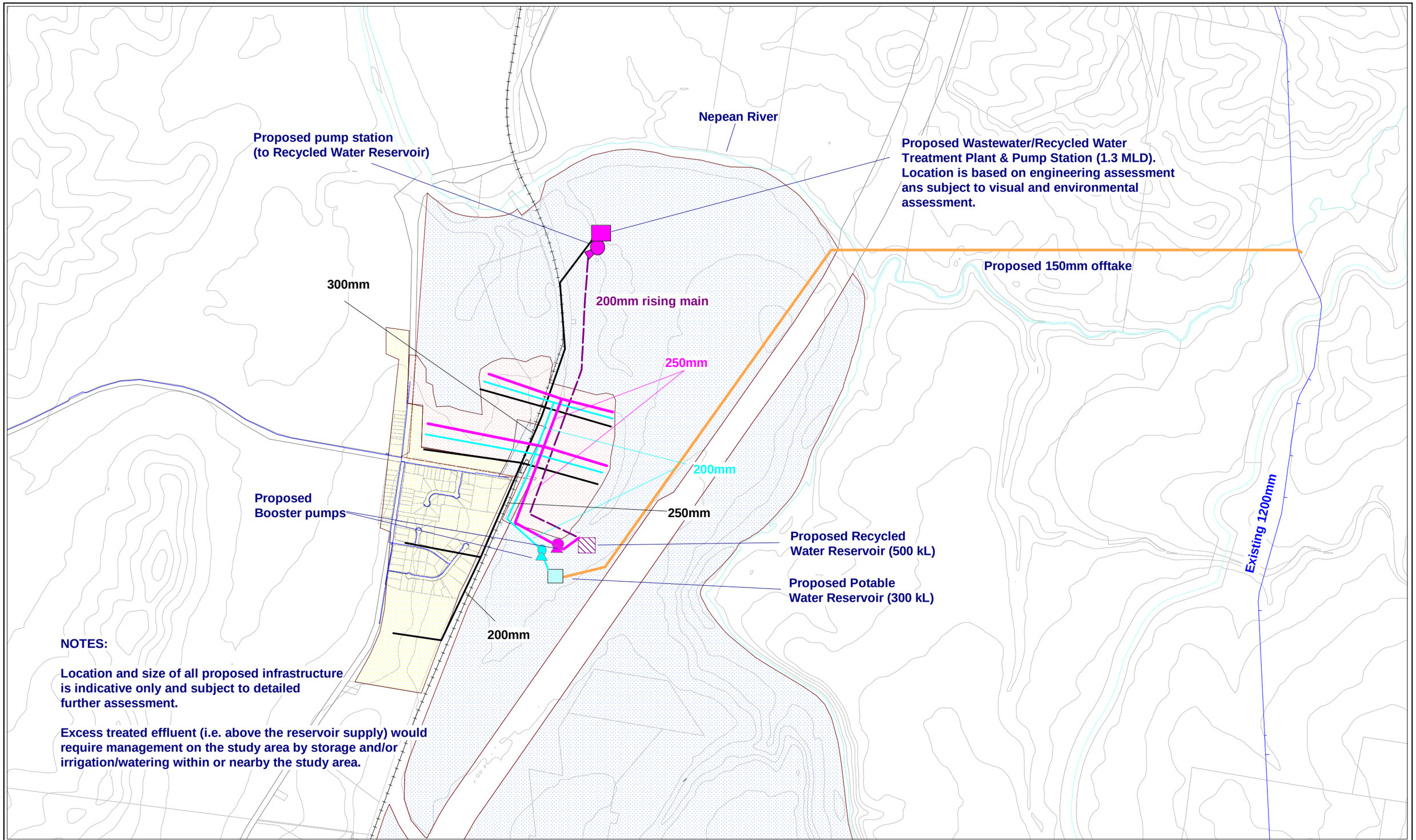

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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LEGEND

- Proposed Offtake
- Recycled rising main
- Potable water main
- Recycled water main
- Sewer main
- Proposed recycled water reservoir
- Proposed potable water reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Pastoral
Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Servicing Option 2

Figure 6

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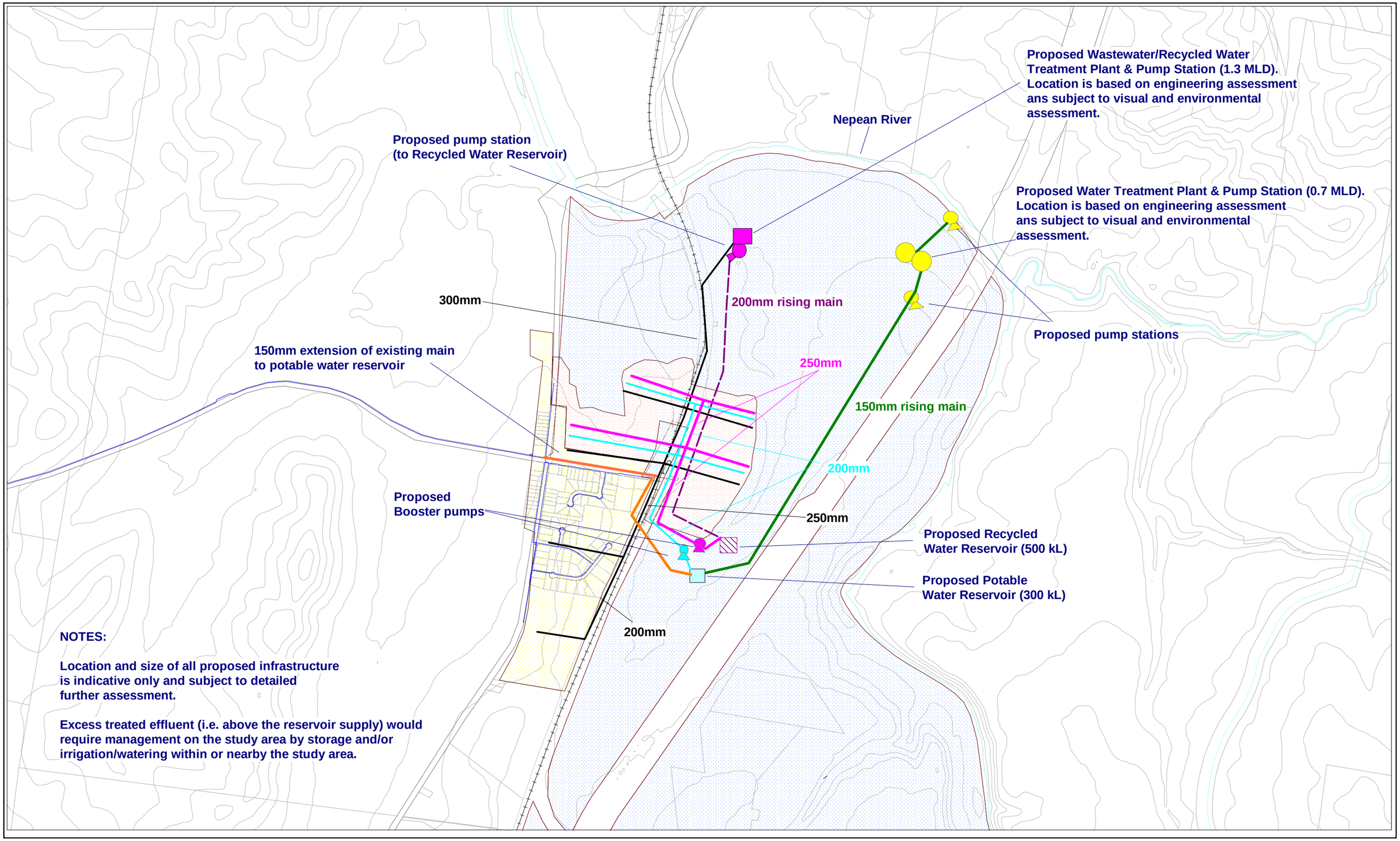

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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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LEGEND

- Proposed Offtake
- Recycled rising main
- Potable water main
- Recycled water main
- Raw water rising main
- Sewer main
- Proposed recycled water reservoir
- Proposed potable water reservoir
- Study Area
- Existing Menangle Village
- Available land

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Menangle Pastoral
Menangle Residential Development
Water and Wastewater Servicing Strategy

Job Number 21-21416
Revision 1
Date 02 April 2012

Servicing Option 3

Figure 7

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Appendix A

Demands and Flows to Sewer within Study Area

Water Demands and Sewer Flows within the Study Area

Area	Potable and Non Potable Water Demand Max Day (kL/day)				Design Flows									
	Res Dwellings	Watering area (ha)	Per Residential Single Dwelling	Watering area (per hectare)	Average Potable kL/day (Dual)	Max Day Potable kL/day (Dual)	Max Hr Potable kL/day (Dual)	Average Recyc kL/day (Dual)	Max Day Recyc kL/day (Dual)	Max Hr Recycl kL/day (Dual)	Average Potable kL/day (Single)	Max Day Potable kL/day (Single)	Max Hr Potable kL/day (Single)	To Sewer (kL/ave day)
Urban Infill Housing	450	5.4	3	7	126	450	1530	220	713	3143	-	-	-	243
Existing urban area	110	2.8	3	7	-	-	-	-	-	-	109	240	527	59
Retirement village	168	2.0	3	7	-	-	-	-	-	-	157	344	780	91
Totals	728	10.2			126	450	1530	220	713	3143	266	622	1308	393

Appendix B

Indicative Water / Wastewater Treatment Quality

Indicative Water and Wastewater Treatment Quality

(i) Wastewater Treatment Plant Requirements for Recycled Water – Municipal and Commercial/Industrial Reuse

National Guidelines for Water Recycling: Managing Health and Environmental Risks, NWQMS, November 2006 require that the risk in the use of recycled water has to be such that it is reduced to below acceptable levels or to a tolerable level. The tolerance risk can be achieved via two main ways being treatment of the source water; and altering exposure levels.

For the dual reticulation of recycled water (involving toilet flushing, washing machines, garden use and air conditioning), advanced water treatment is required which may incorporate:

- Secondary treatment, coagulation, filtration and disinfection
- Secondary treatment , membrane filtration and UV light (disinfection)

Hence a typical recycled water treatment plant may involve the following process units to achieve the required quality:

1. Primary treatment incorporating screening and grit removal
2. Biological treatment (typically an aerobic bioreactor of an attached or suspended growth type) for removal of organics and nutrients
3. Tertiary treatment incorporating filtration, membrane filtration etc.
4. Disinfection through chlorination or UV

The second and third stages can potentially be incorporated jointly in an MBR (membrane bioreactor) type unit.

(ii) Wastewater Treatment Plant Requirements for Recycled Water – Surplus Effluent

The treatment requirements for surplus recycled water will be dependent on the circumstances of the use and will vary depending on whether the recycled water will be used for controlled municipal irrigation, agricultural irrigation or discharge to the Nepean River. Should discharge to the Nepean River be adopted the water quality may potentially be negotiated with the discharge authority although higher fees may be applicable to a poorer quality discharge.

However, it is likely that for discharge to the Nepean River it is likely that a similar level of treatment to that described above will be applicable (i.e. advanced wastewater treatment incorporating secondary treatment, coagulation, filtration and disinfection or similar will be required).

For discharge to agricultural or municipal use type applications the discharge location, application and likely exposure levels (e.g. whether there will be restricted or unrestricted access) will determine the required treatment level / effluent requirements. However, as a minimum it is likely that secondary treatment plus disinfection would be required. This would typically involve the following process units:

1. Primary treatment incorporating screening and grit removal
2. Biological treatment (typically an aerobic bioreactor of an attached or suspended growth type) for removal of organics and nutrients
3. Disinfection through chlorination or UV

Should there be unrestricted access and application then a similar process train as for river discharge and recycled water use for domestic/commercial/industrial purposes would be applicable (i.e. advanced wastewater treatment involving tertiary treatment).

Applicable guidelines include

- NWQMS, Australian Guidelines for Water Recycling: Managing Health and Environmental Risks, NWQMS, November 2006
- NSW Recycled Water Coordination Committee (1993) NSW Guidelines for Urban and Residential Use of Reclaimed Water. These guidelines are for urban and residential use of reclaimed water (such as car washing) and require tertiary filtration, disinfection and pH adjustment.
- Interim NSW Guidelines For Management of Private Recycled Water Schemes, Department of Water and Energy, October 2007
- National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) for discharge of effluent to waterways. While these guidelines do not provide discharge limits, they provide an indication of the required water quality in the receiving waterway (i.e. dilution effects would need to be considered).
- National Water Quality Management Strategy (2000) Guidelines for Sewerage Systems
- Environmental Guidelines for the Use of Effluent by Irrigation, Department of Environment and Conservation, 2004.

(iii) Potable Water Treatment Plant Requirements for Water Extracted from the Nepean River for Potable Purposes

The requirements for a potable water treatment plant will be dependent on the water quality of the raw water source. Water should be treated to a level where it meets the requirements of the Australian Drinking Water Guidelines (ADWG). Without water quality data it is considered likely that possible risks to water quality may include the following:

- Cryptosporidium – a chlorine resistant pathogen that originates from cattle and human activity but can be controlled through the drinking water treatment process (e.g. Coagulation, filtration, followed by UV disinfection).
- Algae toxins, taste and odour which also originate from agricultural and human activities. Algae toxins can be harmful to humans which taste and odour are aesthetic issues
- pH and alkalinity can significantly impact on water treatability and treatment plant performance
- other parameters such as metals (e.g. Iron and manganese) and salinity would also need to be considered.

Various treatment plant options could be adopted to meet the general requirements outlined above. But might include a plant such as:

1. Dual/multi media pressure filtration. Typically involves pressure filtration through a media such as silica sand, anthracite, GAC for organics adsorption, gravel, garnet and zeolite. These can be arranged in a mono, dual, and multimedia form. Backwash of the filters can be manual or automatic and with or without air scour. The filters are usually preceded by a clarifier and chemicals are added to promote coagulation needed to ensure success of the filtration process. Optimisation of the chemical dosing and clarification steps is required for successful treatment.
2. DAFF – Dissolved Air Flotation/Filtration removes particles through flotation as fine bubbles of air pass upwards through the unit carrying solids to the surface. The water then passes through multimedia filters located in the same tank. It is conventional technology for algal cell removal

and also reduces turbidity and colour (with PAC dosing). Optimisation of the fine bubbles and chemical dosing is required for successful treatment.

3. Microfiltration. This unit involves filtration through a microfiltration unit. Microfiltration is a membrane process that removes particles of greater size than the pore size, typically around 0.2µm. Microfiltration will remove algae (although large quantity of algae will block the membranes rapidly), reduce turbidity and colour and remove Giardia and Cryptosporidium (PAC dosing may also be required to remove tastes and odours). MF is an automated process that is easy to operate when raw water quality is variable as the filtrate turbidity is always low. Due to the physical barrier provided by the membrane, the process has a high level of robustness.

Essentially all systems should generally comprise a chemical dosing stage (to promote coagulation and / or remove taste and colour) and a filtration stage (to remove solids, algae etc.). Following filtration, all systems will require final disinfection to provide an additional barrier against bacteria and virus as part of the multi barrier approach to drinking water quality. This can be achieved via either UV or chlorination

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133 Castlereagh St Sydney NSW 2000

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T: 2 9239 7100 F: 2 9239 7199 E: sydmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	S Tyrrell	M Healey		M Healey		
0	S Tyrrell	M Healey		M Healey		16/04/12.